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Bulletin of The Korean Space Science Society

제25권 2호

2016년 10월



사단법인 한국우주과학회
The Korean Space Science Society

한국우주과학회

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<사단법인 한국우주과학회 입회 안내>

사단법인 한국우주과학회는 천문·우주과학 및 관련분야에 종사하는 여러분의 입회를 환영합니다. 우리 학회에 입회를 희망하시는 분은 입회원서 양식에 인적사항을 기재하시어 학회로 보내 주시거나 홈페이지에서 가입하시고 입회비와 년회비는 학회 은행계좌로 송금하시기 바랍니다.

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■ 은행계좌:
 국민은행 012-01-0603-888
 우리은행 126-435843-01-001
 예 금 주 한국우주과학회

■ 회비납부안내

회원구분	입회비	연회비
학생회원(학부생)	10,000원	-
정회원	10,000원	50,000원
회장, 부회장	-	100,000원
이사, 감사	-	100,000원

※ 회원의 구분은 정관 제6조에 의거하며, 변경된 연회비는 학회운영에 대한 규정 제2조에 의거한 사항입니다.

※ 뒷면의 입회원서를 복사하여 사용해 주십시오.

[표지사진 설명]

OWL-Net은 국가과학기술연구회의 국가현안문제해결형 사업(NAP)으로 한국천문연구원에서 수행하였으며, 전세계5개소에 광학관측 네트워크를 구축하여 전자동무인으로 인공위성 등 우주물체를 관측하고 이에 대한 궤도정보를 독자적으로 획득하는 것을 목표로 하고 있다.

한국우주과학회

2016년 가을 학술대회 일정표

일 시 : 2016. 10. 26.(수) 14:00 - 28.(금) 12:00

장 소 : 제주 해비치호텔@리조트

발표논문 : 초청강연 3편, 구두발표 80편, 포스터발표 125편 총 208편

발표시간 : 초청강연(30분), 연구발표(15분~20분) 3세션 동시 진행

포스터 발표 : 2016. 10. 26.(수) 14:00 - 28.(금) 10:00

사단법인 한국우주과학회

등록 및 교통 안내

1. 등록

회원의 등록비는 200,000원이며, 학생회원과 정회원 중 석.박사 과정(전일제) 학생은 100,000원입니다. 사전등록을 하신 회원은 등록자 명부에 서명 후 학회보, 명찰, 등록비 영수증(계산서)을 수령하시기 바랍니다.

2. 회원 가입

회원가입을 원하시는 분은 학회 홈페이지에서 회원가입신청 후 입회원서를 인쇄하여 추천인(2인) 서명을 받아 학회 사무국으로 송부하여 주시고 입회비와 연회비는 학회계좌로 송금하여 주시기 바랍니다.

입회비: 10,000원, 연회비: 50,000원

(학부학생회원은 입회비 10,000원, 연회비 면제)입니다.

학회계좌: 국민은행 012-01-0603-888

우리은행 126-435843-01-001

예금주 한국우주과학회

3. 발표자료 준비

구두발표: 발표자료는 파워포인트 파일로 준비하시기 바랍니다.

포스터발표: 포스터 발표 1부 세션은 10월 26일(수) 14시까지 지정된 장소에 게시하고, 27일(목) 10시에 수거하여 주시고, 2부 세션은 27일(목) 10시까지 게시하고, 28일(금) 10시에 수거하여 주시기 바랍니다. 집중발표 시간에 발표자는 자신의 포스터 앞에서 회원들의 질문에 답할 수 있도록 준비해 주시기 바랍니다. 포스터를 부착하지 않거나 학회 종료 후 수거하지 않은 회원은 추후 학회발표가 제한될 수 있습니다(2006년 3차 이사회 결정).

4. 발표장(크리스탈홀)

발표형식	구분	분과명
구두발표	1발표장 (크리스탈홀1)	초청강연 Historical Astronomy Sun/Space Environment I,II,III,IV
	2발표장 (크리스탈홀2)	Solar System Exploration I, II Space Astronomy I, II Special Session: Multi-satellite Mission and Observations
	3발표장 (크리스탈홀3)	Space Technology&Application I, II Special Session: Space Situational Awareness 6 th Space Weather Conference
포스터 발표	로비	

5. 교통

가. 주소 : 제주특별자치도 서귀포시 표선면 민속해안로 537
제주 해비치호텔&리조트 (Tel: 064-780-8100)

나. 찾아오시는 길

▶공항무료셔틀버스 이용(선착순 탑승)

-예약 : 064-780-8100

-탑승장소: 제주공항 B구역 대형버스 주차장

구분	공항 → 해비치	해비치 → 공항
	공항출발	해비치출발
1회차	09:00~10:30	08:30~09:30
2회차	10:00~11:30	11:00~12:00
3회차	12:30~13:30	12:00~13:00
4회차	14:00~15:00	14:00~15:30
5회차	17:00~18:00	15:10~16:40
6회차	20:30~21:30	18:10~19:40

▶자세한 내용은 해비치 홈페이지를 참조

<https://www.haevichi.com/hr/jeju/kr/about/location.hvc>

2016년 가을학술대회 일정표

세션별 발표장

발표일	구분	시간	제1발표장 (크리스탈홀1)	제2발표장 (크리스탈홀2)	제3발표장 (크리스탈홀3)	포스터발표장 (로비)
10월 26일 (수)	초청강연 I	14:10~14:50	IS-1			1부 : 집중발표 16:20~17:20
	세션 I	14:50~16:20	Historical Astronomy	Solar System Exploration I	Space Technology & Application I	
10월 27일 (목)	세션 II	09:30~11:00	Sun/Space Environment I	Space Astronomy I	Special Session: Space Situational Awareness	2부 : 집중발표 11:00~12:00
	세션 III	13:30~15:00	Sun/Space Environment II	Solar System Exploration II	Space Technology & Application II	
	초청강연 II	15:10~15:40	IS-2			
	세션 IV	15:45~17:15	Sun/Space Environment III	Space Astronomy II	6 th Space Weather Conference	
10월 28일 (금)	초청강연 III	09:30~10:00	IS-3			
	세션 V	10:15~11:45	Sun/Space Environment IV	Special Session: Multi-satellite Mission and Observations		

구두발표

첫째 날 10월 26일 (수요일)

시간	구분	내용					
12:00~	등록	해비치 호텔 지하1층 크리스탈홀 로비					
14:00~14:10	개회식	제1발표장 (크리스탈홀1)					
14:10~14:40	초청강연 I	장소 : 제1발표장(크리스탈홀1) 좌장 : 최영준(천문연) 박상영(연세대) / Cubesat Mission for Virtual Space Telescope in Formation Flying					
14:40~14:50		휴식					
		제1발표장 (크리스탈홀1)		제2발표장 (크리스탈홀2)		제3발표장 (크리스탈홀3)	
		Historical Astronomy 좌장: 김천휘(충북대)		Solar System Exploration I 좌장: 김주현(항우연)		Space Technology & Application I 좌장: 천용식(항우연)	
14:50~15:05	I-1-1	민병희	I-2-1	최영준	I-3-1	김경원	
15:05~15:20	I-1-2	김상혁	I-2-2	이효정	I-3-2	김창호	
15:20~15:35	I-1-3	최고은	I-2-3	김경자1	I-3-3	윤재철	
15:35~15:50	I-1-4	신기철	I-2-4	김경자2	I-3-4	황혜원	
15:50~16:05	I-1-5	서윤경	I-2-5	심채경	I-3-5	임조령	
16:05~16:20			I-2-6	정민섭	I-3-6	강수연	
16:20~17:20		1부 포스터발표 (No.1 - No.62)					

둘째날 10월 27일 (목요일)

시간	제1발표장 (크리스탈홀1)	제2발표장 (크리스탈홀2)	제3발표장 (크리스탈홀3)
	Sun/Space Environment I 좌장: 박재흥(천문연)	Space Astronomy I 좌장: 강영운(세종대)	Special Session: Space Situational Awareness 좌장 : 박장현(천문연)
09:30~09:45	II-1-1 신재혁	II-2-1 김혜영	II-3-1 초청강연: 조중현
09:45~10:00	II-1-2 감호식	II-2-2 정민지	II-3-2 최은정
10:00~10:15	II-1-3 김은솔	II-2-3 Samyaday Choudhury	II-3-3 이덕진
10:15~10:30	II-1-4 독고경환	II-2-4 문상만	II-3-4 이은지
10:30~10:45	II-1-5 박진혜	II-2-5 정선영	II-3-5 이정아
10:45~11:00		II-2-6 이성환	II-3-6 박영재
11:00~12:00	2부 포스터발표 (No.63-No.125)		
12:00~13:30	점심식사		
	Sun/Space Environment II 좌장: 이우경(천문연)	Solar System Exploration II 좌장: 심채경(경희대)	Space Technology&Application II 좌장: 송영주(항우연)
13:30~13:45	III-1-1 이영숙	III-2-1 서행자	III-3-1 양지모
13:45~14:00	III-1-2 이대영	III-2-2 김영록	III-3-2 신근웅
14:00~14:15	III-1-3 이상윤	III-2-3 조은진	III-3-3 김유광
14:15~14:30	III-1-4 이우경	III-2-4 김형래	III-3-4 박성제
14:30~14:45	III-1-5 이원석	III-2-5 홍익선	III-3-5 이종원
14:45~15:00		III-2-6 선창완	III-3-6 최흥택
15:00~15:10	휴식		
15:10~15:40	초청강연 II 장소 : 제1발표장(크리스탈홀1) 좌장 : 유광선(과기원) Tiger Liu (National Central University, Taiwan) / Ionospheric Climate and Weather Probed by GNSS Radio Occultation Soundings		
16:40~16:45	이동		
	Sun/Space Environment III 좌장: 김정환(극지연)	Space Astronomy II 좌장: 김영수(천문연)	6 th Space Weather Conference 좌장: 이재진(천문연)
15:45~16:00	IV-1-1 이창섭	IV-2-1 이대희	IV-3-1 문준철
16:00~16:15	IV-1-2 이준현	IV-2-2 고경연	IV-3-2 최경은
16:15~16:30	IV-1-3 홍준석	IV-2-3 이덕행	IV-3-3 김수진
16:30~16:45	IV-1-4 우창호	IV-2-4 Gaikov Georgii	IV-3-4 광영실
16:45~17:00	IV-1-5 조은별	IV-2-5 이용선	IV-3-5 황정아
17:00~17:15	IV-1-6 유광선		IV-3-6 김태영
17:15~17:30	사진촬영		
17:30~18:30	제34차 정기총회 장소 : 제1발표장(크리스탈홀1)		
18:30~20:00	만찬		

세째날 10월 28일 (금요일)

시간	제1발표장 (크리스탈홀1)	제2발표장 (크리스탈홀2)	제3발표장 (크리스탈홀3)
09:30~10:00	초청강연 Ⅲ 장소 : 제1발표장(크리스탈홀1) 좌장 : 이대영(충북대) Mario M. Bisi (Rutherford Appleton Laboratory, UK) / Living with a Star: The Need to Defend Earth from Space Weather		
10:00~10:15	휴식, 이동		
시간	Sun/Space Environment IV 좌장: 지건화(극지연)	Special Session: Multi-satellite Mission and Observations 좌장: 박영득(천문연)	
10:15~10:30	V-1-1 Mengist Chalachew Kindie	V-2-1 이재진	
10:30~10:45	V-1-2 장수정	V-2-2 송영범	
10:45~11:00	V-1-3 김희은	V-2-3 김해동	
11:00~11:15	V-1-4 김관혁	V-2-4 박재홍	
11:15~11:30	V-1-5 김진현	V-2-5 이은상	
11:30~11:45	V-1-6 신대규	V-2-6 이중기	

1부 포스터 발표
게시기간 : 2016. 10. 26(수) 14:00 ~ 27(목) 10:00

번호	분야	발표자	소속	번호	분야	발표자	소속
P-1	우주기술	강금실1	항우연	P-32	우주기술	이상택	항우연
P-2	우주기술	강금실2	항우연	P-33	우주기술	이승헌	항우연
P-3	우주기술	공종필	항우연	P-34	우주기술	이원범	항우연
P-4	우주기술	김형완	항우연	P-35	우주기술	이재승1	항우연
P-5	우주기술	박근영	항우연	P-36	우주기술	이재승2	항우연
P-6	우주기술	박봉규	항우연	P-37	우주기술	이종태	항우연
P-7	우주기술	박성욱	항우연	P-38	우주기술	이주훈	항우연
P-8	우주기술	박수현	항우연	P-39	우주기술	이춘우	항우연
P-9	우주기술	박응식	항우연	P-40	우주기술	임성진	항우연
P-10	우주기술	박종석	항우연	P-41	우주기술	임정흠1	항우연
P-11	우주기술	박종오1	항우연	P-42	우주기술	임정흠2	항우연
P-12	우주기술	박종오2	항우연	P-43	우주기술	임조령	항우연
P-13	우주기술	박주호	항우연	P-44	우주기술	임현수	항우연
P-14	우주기술	박진형	항우연	P-45	우주기술	장경덕	항우연
P-15	우주기술	방수완	항우연	P-46	우주기술	장성수1	항우연
P-16	우주기술	백선기1	(주)한양ENG	P-47	우주기술	장성수2	항우연
P-17	우주기술	백선기2	(주)한양ENG	P-48	우주기술	전현진	항우연
P-18	우주기술	서석배1	항우연	P-49	우주기술	조승원	항우연
P-19	우주기술	서석배2	항우연	P-50	우주기술	조창권	항우연
P-20	우주기술	신현규	항우연	P-51	우주기술	천이진	항우연
P-21	우주기술	양정환1	항우연	P-52	우주기술	최정수	항우연
P-22	우주기술	양정환2	항우연	P-53	우주기술	한조영	항우연
P-23	우주기술	연정흠1	항우연	P-54	우주기술	허윤구	항우연
P-24	우주기술	연정흠2	항우연	P-55	태양계 및 우주탐사	오영석	경희대
P-25	우주기술	오시환	항우연	P-56	기타	강 철	항우연
P-26	우주기술	유재남1	항우연	P-57	기타	이은석	항우연
P-27	우주기술	유재남2	항우연	P-58	기타	이창은	항우연
P-28	우주기술	윤석택	항우연	P-59	기타	이혜영	성균관대
P-29	우주기술	윤영수	항우연	P-60	기타	정태검1	항우연
P-30	우주기술	이도경	항우연	P-61	기타	정태검2	항우연
P-31	우주기술	이상록	항우연	P-62	기타	권순호	항우연

2부 포스터 발표
게시기간 : 2016. 10. 27(목) 10:00 ~ 28(금) 10:00

번호	분야	발표자	소속	번호	분야	발표자	소속
P-63	우주응용	김성희	항우연	P-95	태양 및 우주환경	장재진	경희대
P-64	우주응용	김영선	항우연	P-96	태양 및 우주환경	정종일	충남대
P-65	우주응용	명환춘	항우연	P-97	태양 및 우주환경	최규철	SELab
P-66	우주응용	박종역	항우연	P-98	태양 및 우주환경	최지원	경희대
P-67	우주응용	최범규	NMSC	P-99	태양 및 우주환경	최화진	극지연
P-68	우주응용	허행팔1	항우연	P-100	태양 및 우주환경	홍진희	경희대
P-69	우주응용	허행팔2	항우연	P-101	태양계 및 우주탐사	고대호	항우연
P-70	우주천문	Tumarina Mariia	성균관대	P-102	태양계 및 우주탐사	김명진	천문연
P-71	우주천문	강용우	천문연	P-103	태양계 및 우주탐사	김연규	항우연
P-72	우주천문	김영수	천문연	P-104	태양계 및 우주탐사	김주현	항우연
P-73	우주천문	김일중	천문연	P-105	태양계 및 우주탐사	민승용	항우연
P-74	우주천문	송민규	천문연	P-106	태양계 및 우주탐사	손승희	항우연
P-75	우주천문	이충욱	천문연	P-107	태양계 및 우주탐사	송영주	항우연
P-76	우주천문	정두석	연세대	P-108	태양계 및 우주탐사	송용준	경희대
P-77	우주천문	정의정	천문연	P-109	태양계 및 우주탐사	이만규	경희대
P-78	우주천문	한정열	천문연	P-110	태양계 및 우주탐사	이정규	경희대
P-79	우주천문	함선영	천문연	P-111	태양계 및 우주탐사	이주희	항우연
P-80	태양 및 우주환경	고대호	항우연	P-112	태양계 및 우주탐사	이희재	천문연
P-81	태양 및 우주환경	김명준	충북대	P-113	태양계 및 우주탐사	정다운	항우연
P-82	태양 및 우주환경	김보경	충남대	P-114	태양계 및 우주탐사	조경복	충남대
P-83	태양 및 우주환경	나고운	경희대	P-115	태양계 및 우주탐사	최수진	항우연
P-84	태양 및 우주환경	노성준	충북대	P-116	태양계 및 우주탐사	권재욱	항우연
P-85	태양 및 우주환경	박근찬	충남대	P-117	우주기술	김희경	항우연
P-86	태양 및 우주환경	박우연	충남대	P-118	기타	강상욱	항우연
P-87	태양 및 우주환경	손종대	천문연	P-119	기타	강선일	항우연
P-88	태양 및 우주환경	신유라	경희대	P-120	기타	김동현	항우연
P-89	태양 및 우주환경	오수연	전남대	P-121	기타	김춘원	항우연
P-90	태양 및 우주환경	윤종연	SELab	P-122	기타	박성제	기계연
P-91	태양 및 우주환경	이동희	NMSC	P-123	기타	육영춘	항우연
P-92	태양 및 우주환경	이상택	항우연	P-124	기타	윤원주	항우연
P-93	태양 및 우주환경	이시백	경희대	P-125	기타	한정우	항우연
P-94	태양 및 우주환경	이원형	NMSC				

구두발표 논문제목 및 시간표

10월 26일 (수)

제1발표장 (크리스탈홀1)

■ 초청강연 I

좌장: 최영준 (천문연)

14:10 [IS-I]

Cubesat Mission for Virtual Space Telescope in Formation Flying

Sang-Young Park

Department of Astronomy, Yonsei University, Seoul, Korea

제1발표장 (크리스탈홀1)

■ I-1 Historical Astronomy

좌장: 김천휘 (충북대)

14:50 [I-1-1]

Structure of Hong Dae-Yong's Mechanical Armillary Sphere

Byeong-Hee Mihn^{1,2}, Min-Soo Lee³, Sang Hyuk Kim^{1,2},
Ki-Won Lee⁴

¹*Korea Astronomy and Space Science Institute*

²*Korea University of Science and Technology*

³*Chungbuk National University*

⁴*Catholic University of Daegu*

15:05 [I-1-2]

Artefacts of the Simplified Sundial (So-ilyeong) in the Early Joseon Dynasty

Sang Hyuk Kim^{1,2}, Byeong-Hee Mihn^{1,2}, Yong Sam Lee³

¹*Korea Astronomy and Space Science Institute*

²*Korea University of Science and Technology*

³*Chungbuk National University*

15:20 [I-1-3]

Calculation of Solar Eclipse Times Using the Zhongxiu-Daming Calendar

Go Eun Choi^{1,2}, Ki-Won Lee³, Byeong-Hee Mihn^{1,2}, Young Sook Ahn¹

¹*Korea Astronomy and Space Science Institute*

²*Korea University of Science and Technology*

³*Catholic University of Daegu*

15:35 [I-1-4]

A Study on the Calendrical Calculation System and the Calendrical Exegesis of Joseon Dynasty, through Jakryeoksiks.

Ki-Chul Shin

Chungbuk National University

15:50 [I-1-5]

Study on the Application of the CBD Methodology for the Operational Type Software in Real Time Observation System

Yoon Kyung Seo, Byeong-Hee, Mihn^{1,2}, Soo-Yeon Kang

¹*Korea Astronomy and Space Science Institute*

²*Korea University of Science and Technology*

³*Korea Aerospace Research Institute*

제2발표장 (크리스탈홀2)

■ I-2 Solar System Exploration I

좌장: 김주현 (항우연)

14:50 [I-2-1]

Wide-Angle Polarimetric Camera for the Lunar Surface

Young-Jun Choi, Sungsoo S. Kim, Kyung-In Kang, Minsup Jeong^{1,2}, Chae Kyung Sim, Il-Hoon Kim², Haingja Seo¹, Ik-Seon Hong^{1,4}, Eunjin^{1,4}, Kilho Baek², Jingyu Kim³, Bonjoo Koo, Chulwoo Lim³, Seyeon Kim³,

¹*Korea Astronomy and Space Science Institute*

²*Kyung Hee University*

³*Korea Advanced Institute of Science and Technology*

⁴*Chungnam National University*

15:05 [I-2-2]

KMAG: Multi-Magnetometer Observation Method

Hyojeong Lee, Ho Jin, Jung-Kyu Lee, Seongwhan Lee, Jehyuck Shin, Seonyeong Jeong, Mangyu Lee, Khan-Hyuk Kim

Kyung Hee University

15:20 [I-2-3]

Introduction to the Gamma-Ray Spectrometer for the Korea Pathfinder Lunar Orbiter

Kyeong Ja Kim^{1,2}, Junghun Park, Yire Choi^{1,2}, Sungsoon Lee¹, Young-Kwang Yeon, Eung Seok Yi^{1,3}, Meeyoung Jeong, Chang Wan Sun^{1,2}, K. B. Lee⁴, Yongkwon Kim⁵, Kyoung-Wook Min⁶, Kyungin Kang⁶, Jin Yeon Cho⁷, Kook Jin Park⁷, Nobuyuki Hasebe⁸, Richard Elphic⁹, Peter

Englert¹⁰, Olivier Gasnault¹¹, Lucy Lim¹², Eido Shibamura and KGRS science Team

¹Korea Institute of Geoscience and Mineral Resources

²University of Science and Technology

³Chungnam National University

⁴Korea Research Institute of Standards and Science

⁵NuCare

Korea Advanced Institute of Science and Technology

Inha University

Waseda University

NASA Ames Research Center

¹⁰Quest University

¹¹The Research Institute in Astrophysics and Planetology

¹²NASA Goddard Space Flight Center

15:35 [I-2-4]

Development of a gamma-ray and neutron spectrometer suite for Prospective Korean Lunar Explorer

Kyeong Ja Kim^{1,2}, Junghun Park, Yire Choi^{1,2}, Eung Seok Yi^{1,3}, Chang Wan Sun^{1,2}, Sungsoon Lee, Young-Kwang Yeon, K. B. Lee, Nobuyuki Hasebe, Won-Kee Park⁶, Bongkon Moon⁶, Kyungin Kang, Young-Jun Choi

¹Korea Institute of Geoscience and Mineral Resources

²University of Science and Technology

³Chungnam National University

⁵Waseda University

Korea Astronomy and Space Science Institute

Korea Advanced Institute of Science and Technology

15:50 [I-2-5]

Optical Maturity on the Walls of Lunar Craters

Chae Kyung Sim¹, Sungsoo S. Kim, Paul G. Lucey², Ian Garrick-Bethell^{1,3}, Gilho Baek¹, Young-Jun Choi

¹Kyung Hee University

²University of Hawaii at Manoa, USA

³University of California Santa Cruz, USA

⁴Korea Astronomy and Space Science Institute

16:05 [I-2-6]

Microstructure of Regolith on Reiner Gamma Swirl

Minsup Jeong^{1,2}, Sungsoo S. Kim², Young-Jun Choi¹, Ian Garrick-Bethell

¹Korea Astronomy and Space Science Institute

²Kyung Hee University

³University of California, Santa Cruz

14:50 [I-3-1]

Trade-Off Study of Spacecraft Adapter Design for Medium-size Satellite

Kyung-Won Kim¹, Ji-Hwan Seo, Sun-Won Kim, Chang-Ho Kim¹, Hyoung-Yoll Jun¹, Won-Young You², Kwon-Tae Hwang

¹Korea Aerospace Research Institute

²Korea Aerospace Industry

15:05 [I-3-2]

Qualification of Structure Design with Quasi-static Test of STM (Structure Thermal Model)

Chang-Ho Kim, Kyung-Won Kim, Sun-Won Kim, Hyoung-Yoll Jun

Korea Aerospace Research Institute

15:20 [I-3-3]

Development of Flight Dynamic Total Solutions for Orbit Design and On-Orbit Operation of LEO SAR Satellite

Jae-Cheol Yoon, Ok-Chul Jung, Jin-Hee Kim

Korea Aerospace Research Institute

15:35 [I-3-4]

Angles-only Initial Orbit Determination of Low Earth Orbit Satellites using Optical data

Hyewon Hwang, Sang-Young Park, Eunji Lee

Astrodynamics and Control lab., Department of Astronomy, Yonsei University, Seoul, Korea

15:50 [I-3-5]

Fault Management and Performance Verification of an On-Board Orbit Generation Algorithm for a GEO Satellite

Jo Ryeong Yim, Bong Kyu Park, Hyun-Ho Seo

Korea Aerospace Research Institute

16:05 [I-3-6]

An Introduction of FDIR Mechanism for MI Mission in COMS On-Board Software

Soo-Yeon Kang

Korea Aerospace Research Institute

제3발표장 (크리스탈홀3)

■ I-3 Space Technology & Application I
좌장: 천용식 (항우연)

16:20~17:20 1부 포스터발표
(No.1 - No.62)

10월 27일 (목)

제1발표장 (크리스탈홀1)

■ II-1 Sun/Space Environment I 좌장: 박재홍 (천문연)

09:30 [II-1-1]

Development of the Ground-Based Search-Coil Magnetometer at the Jang Bogo Station in the Antarctica

Jehyuck Shin¹, Khan-Hyuck Kim^{1,2}, Ho Jin^{1,2}, Hyomin Kim³, Jongwoo Kwon, Seungah Lee², Jung-Kyu Lee¹, Seongwhan Lee, Geonhwa Jee⁴, Marc R. Lessard⁵

¹School of Space Research, Kyung Hee University, Korea,
²Department of Astronomy and Space Science, Kyung Hee University, Korea,
³Center for Solar-Terrestrial Research, New Jersey Institute of Technology, USA
⁴Korea Polar Research Institute, Korea
⁵Space Science Center, University of New Hampshire, USA

09:45 [II-1-2]

Northern High-latitude Mesospheric Temperature Trends Derived from Esrange Meteor Radar, Kiruna, Sweden (67° 57'N, 20°13'E).

Hosik Kam¹, Yong Ha Kim, Won Seok Lee¹, Nicholas Mitchell², Jeong-Han Kim³

¹Chungnam National University
²University of Bath
³Korea Polar Research Institute

10:00 [II-1-3]

Reconstruction of Plasmaspheric Density Distributions by Applying a Tomography Technique to Jason-1 Plasmaspheric TEC Measurements

Eunsol Kim¹, Yong Ha Kim, Geonhwa Jee²

¹Chungnam National University, Daejeon
²Korea Polar Research Institute, Incheon

10:15 [II-1-4]

PIC Simulation of Multiband Whistler Wave Generation by Lower Band Cascade

Kyunghwan Dokgo¹, Kyoung-Wook Min¹, Cheong-Rim Choi², Peter H. Yoon³

¹Korea Advanced Institute of Science and Technology
²Chungbuk National University
³University of Maryland

10:30 [II-1-5]

Characteristics of Solar Energetic Protons Based

on Stereoscopic Observations

Jinhye Park¹, Yong-Jae Moon^{1,2}, Harim Lee

¹The department of Astronomy & Space Science, Kyung Hee University
²School of Space Research, Kyung Hee University

제2발표장 (크리스탈홀2)

■ II-2 Space Astronomy I 좌장: 강영운 (세종대)

09:30 [II-2-1]

The First Photometric Studies of Five Kepler Contact Binaries with Extremely Low Mass Ratio: Discovery of Small Peculiar Structures in the Light Residuals from the Light-curve Synthesis

Hye-Young Kim, Chun-Hwey Kim, Min-Ji Jeong¹, Mi-Hwa Song, Hyoun-Woo Kim^{1,2}

¹Chungbuk National University
²Korea Astronomy and Space Science Institute

09:45 [II-2-2]

KIC02159783: A Very Active, Low Mass Ratio Contact Binary System

Min-Ji Jeong¹, Chun-Hwey Kim^{1,2}

¹Chungbuk National University in Korea
²Chungbuk National University Observatory in Jincheon, Korea

10:00 [II-2-3]

The First of Its Kind Metallicity Map of the Large Magellanic Cloud

Samyaday Choudhury¹, Annapurni Subramaniam², Andrew A. Cole

¹Yonsei University Observatory, Republic of Korea
²Indian Institute of Astrophysics, India
³School of Physical Sciences, Australia

10:15 [II-2-4]

Korean VLBI Availability Analysis Using the LRO Ka-band HGA

¹Sangman Moon, ¹Eunhyeuk Kim, ¹Su-Jin Choi, ²Taehyun Jung

¹Korea Aerospace Research Institute, Daejeon
²Korea Astronomy and Space Science Institute

10:30 [II-2-5]

Verification Test of CubeSat Ground Station

Seonyeong Jeong, Hyojeong Lee, Seongwhan Lee, Jehyuck Shin¹, Jung-kyu Lee¹, Ho Jin^{1,2}

¹School of Space Research, Kyung Hee University

²Department of Astronomy and Space Science, Kyung Hee University

10:45 [II-2-6]

Final Check and Initial Operation Concept of the SIGMA(KHUSAT-03) CubeSat

Seongwhan Lee, Jung-Kyu Lee, Hyojeong Lee, Jehyuck Shin, Seonyeong Jeong, Ho Jin

School of Space Research, Kyung Hee University

제3발표장 (크리스탈홀3)

■ II-3 Special Session:

Space Situational Awareness

좌장: 박장현 (천문연)

09:30 [II-3-1]

Korean Space Surveillance Technology Status and International Collaboration

Junghyun Jo

Korea Astronomy and Space Science Institute, Korea

09:45 [II-3-2]

Space Objects Database for National Space Situational Awareness System

Eun-Jung Choi, Sungki Cho, Junghyun Jo, Jang-Hyun Park

Space Situational Awareness Center, Korea Astronomy and Space Science Institute

10:00 [II-3-3]

Computational Methods for Ground Risk Assessment due to Space Debris Re-entries

Deok-Jin Lee, Tae-Soo No, Eun-Jung Choi, Junghyun Jo, Sungki Cho³, Jang-Hyun Park³

¹Kunsan National University

²Chonbuk National University

³Korea Astronomy and Space Science Institute

10:15 [II-3-4]

Precise Orbit Determination of Cryosat-2 and KOMPSAT-1 Satellites using Optical Wide-field Patrol Network (OWL-Net) Data with Batch Least Squares Filter

Eunji Lee¹, Sang-Young Park¹, Sungki Cho, Eun-Jung Choi², Junghyun Jo, Jang-Hyun Park

¹Astrodynamic and Control Lab., Department of Astronomy, Yonsei University

²Korea Astronomy and Space Science Institute

10:30 [II-3-5]

Collision Estimation and Collision Avoidance Control for Multiple Cubesat Mission

Jeong-Ah Lee, Sang-Young Park

Astrodynamic and Control Lab., Dept. of Astronomy, Yonsei University

10:45 [II-3-6]

A Survey of Space Debris Re-entries and Analysis Tools

Young-Jae Park¹, Deok-Jin Lee, Tae-Soo No¹, Eun-Jung Choi³, Jung-Hyun Jo³, Sung-ki Cho³, Jang-Hyun Park³

¹Chonbuk National University

²Kunsan National University

³Korea Astronomy and Space Science Institute

11:00 ~ 12:00 2부 포스터발표
(No.63 - No.125)

제1발표장 (크리스탈홀1)

■ III-1 Sun/Space Environment II

좌장: 이우경 (천문연)

13:30 [III-1-1]

Intense Turbulence Induced by Large Plasma Velocities in Association with High-Energy Solar Electron Precipitation During High-Speed Solar Wind Stream Events in the Polar Summer Mesosphere

Young-Sook Lee^{1,2}, Young-Sil Kwak^{1,3}, Kyung-Chan Kim and Jaejin Lee^{1,3}

¹Korea Astronomy and Space Science Institute, Daejeon, Korea

²Department of Earth and Space and Engineering, Lassonde School of Engineering, York University, Toronto, Canada

³Department of Astronomy and Space Science, University of Science and Technology, Korea

⁴Division of Science Education, College of Education, Daegu University, Korea

13:45 [III-1-2]

Effect of Hot Anisotropic He+ Ions on Ion Cyclotron Instabilities and Its Implication on EMIC Waves in the Inner Magnetosphere

Dae-Young Lee, Sung-Jun Noh¹, C.R. Choi, Jaejin Lee, Junga Hwang

¹Department of Astronomy and Space Science, Chungbuk National University

²Korea Astronomy and Space Science Institute

14:00 [III-1-3]

Simulation Study of Whistler Instability with Magnetic Inhomogeneity Perpendicular to the Background Magnetic Field

Sang-Yun Lee, Ensang Lee, Khan-Hyuk Kim, Dong-Hun Lee, Jongho Seon

School of Space Research, Kyung-Hee University, Korea

14:15 [III-1-4]

Ionospheric Disturbances in Low-and Middle-Latitudes Induced by Neutral Winds and Vertical E×B Drift During the 2015 St. Patrick’s Day Storm

Woo Kyoung Lee¹, Hyosub Kil

¹*Korea Astronomy and Space Science Institute*

²*Johns Hopkins University Applied Physics Laboratory*

14:30 [III-1-5]

An Analysis of Meteor Altitude Distributions Observed by a Meteor Radar at King Sejong Station, Antarctica

Wonseok Lee , Yong Ha Kim , Changsup Lee², Jeong-Han Kim²

¹*Chungnam National University*

²*Korea Polar Research Institute*

제2발표장 (크리스탈홀2)

III-2 Solar System Exploration II
좌장: 심채경 (경희대)

13:30 [III-2-1]

Infrared Spectrometer for Lunar Water Ice

Haingja Seo , Young-Jun Choi , Minsup Jeong , Eunjin Cho^{1,2}, Ikseon Hong^{1,2}, Woong-Seob Jeong , Bongkon Moon¹, Sung-Joon Park¹, Dae-Hee Lee , Jeonghyun Pyo , Il-joong Kim¹, Seung Kwan Kim , Seong Je Park , Geon-Hee Kim , Kyungin Kang⁶

¹*Korea Astronomy and Space Science Institute*

²*Chungnam National University*

³*Korea Research institute of Standards and Science*

⁴*Korea Institute of Machinery and Materials*

⁵*Korea Basic Science Institute*

⁶*Satellite Technology Research Center, KAIST*

13:45 [III-2-2]

Effect of Lunar Gravity Model on Orbit Determination of Lunar Orbiter

Young-Rok Kim, Young-Joo Song, Jonghee Bae, Bang-Yeop Kim, Gi-Hyuk Choi

Korea Aerospace Research Institute

14:00 [III-2-3]

Shielding Effect of Geomagnetic Field on Hydroxyl formation on Lunar Surface

Eunjin Cho^{1,2}, Jaehyung Yu¹, Young-Jun Choi², Yu Yi

¹*Chungnam National University*

²*Korea Astronomy and Space Science Institute*

14:15 [III-2-4]

Lunar paleomagnetic pole analysis using central Magnetic Anomaly Signatures of Nectarian Basins

Hyung Rae Kim , Hyung-Gyu Kim¹, Ralph von Frese , Lon Hood

¹*Kongju National University*

²*Ohio State University, USA*

³*Lunar & Planetary Laboratory, Arizona, USA*

14:30 [III-2-5]

Lunar subsurface void exploration using GRAIL gravimetry data

Ik-Seon Hong^{1,2}, Seung-Sep Kim¹, Jaehyung Yu¹, Young-Jun Choi², Yu Yi¹

¹*Chungnam National University*

²*Korea Astronomy and Space Science Institute*

14:45 [III-2-6]

Analysis of Kaguya Lunar Radar Sounder (LRS) Surface Range Data for Detection of Possible Lunar Lava Tube

Changwan Sun^{1,2}, Takao Kobayashi¹, Kyeong-Ja Kim^{1,2}, Young-Jun Choi³

¹*Korea Institute of Geoscience & Mineral Resources (KIGAM)*

²*University Science & Technologies(UST)*

³*Korea Astronomy and Space Science Institute(KASI)*

제3발표장 (크리스탈홀3)

III-3 Space Technology & Application II
좌장: 송영주 (항우연)

13:30 [III-3-1]

An Overview of the Korean Satellites Development History and Status Based on the Compact Advanced Satellite 500(CAS-500) Program

Ji-Mo Yang, Keunwoong Shin, Myung-Jin Baek

Korea Aerospace Research Institute

13:45 [III-3-2]

Introduction to the Procedure of Securing of the Next Year R&D Budget for CAS500-1

Keun-Woong Shin, Ji-Mo Yang, Chul-Kang, Myung-Jin Baek

Korea Aerospace Research Institute

14:00 [III-3-3]

Considerations of Bonding Material Selection & Process Evaluation for Composite Structured Satellite

You-Gwang Kim, Sang-Teak Lee, Chang-Ho Lee

Korea Aerospace Research Institute

14:15 [III-3-4]

Preliminary Study of the Stirling Cryocooler for the Thermal Vacuum Environmental Test

Seong-je Park¹, Yong-Ju Hong, Jun-Seok Ko¹,
Hyo-Bong Kim, Han-kil Yeom, Se-hwan In,
Young-Jun Choi, Seung Kwan Kim, Geon-Hee Kim,
Kyungin Kang

¹*Korea Institute of Machinery and Materials*

²*Korea Astronomy and Space Science Institute*

³*Korea Research Institute of Standards and Science*

⁴*Korea Basic Science Institute*

⁵*Satellite Technology Research Center, KAIST*

14:30 [III-3-5]

A Study on Design and Statistical Analysis of the Droplet Combustion Apparatus in Micro-gravity Environment

Jong-Won Lee, Joo-Hee Lee, Youn-Kyu Kim

Korea Aerospace Research Institute

14:45 [III-3-6]

Thruster Loop Controller Design of Sun Mode for LEO Satellite

Hong-Taek Choi¹, Hyung-Joo Yoon, Young-Woong Park, Bong-Un Lee

¹*Korea Aerospace Research Institute*

²*Korea Aerospace Industries, Ltd*

제1발표장 (크리스탈홀1)

초청강연 II

좌장: 유광선 (과기원)

15:10 [IS-II]

Ionospheric Climate and Weather Probed by GNSS Radio Occultation Soundings

Tiger J.Y. Liu^{1,2}

¹*Institute of Space Science, National Central University, Taiwan*

²*Center for Space and Remote Sensing Research, National Central University, Taiwan*

제1발표장 (크리스탈홀1)

IV-1 Sun/Space Environment III

좌장: 김정환 (극지연)

15:45 [IV-1-1]

A New Method for Temperature Estimation Near the Mesopause Region Using Meteor Radar

Changsup Lee, Jeong-Han Kim¹, Geonhwa Jee,
Wonseok Lee, In-Sun Song, Yong Ha Kim²

¹*Korea Polar Research Institute, Korea*

²*Chungnam National University, Korea*

16:00 [IV-1-2]

Variation of Particle Fluxes Across Plasmapause Under Quiet Geomagnetic Condition

Junhyun Lee^{1,2}, Ensang Lee, Khan-Hyuk Kim,
Dong-Hun Lee, Junga Hwang²

¹*School of Space Research, Kyung Hee University, Korea*

²*Korea Astronomy and Space Science Institute, Korea*

16:15 [IV-1-3]

Detection of GPS Phase Scintillation During St. Patrick's day Geomagnetic Storm in 2015 over King Sejong Station, Antarctica

Junseok Hong, Yong Ha Kim¹, Jeong-Han Kim

¹*Chungnam National University*

²*Korea Polar Research Institute*

16:30 [IV-1-4]

Kinetic Temperature Analysis of the Charged Particles' Stochastic Motion by Magnetosonic Waves

Chang-Ho Woo¹, Kyoung-Wook Min, Kyunghwan Dokgo,
Cheongrim Choi²

¹*Department of Physics, KAIST, Daejeon, Korea*

²*Chungbuk National University*

16:45 [IV-1-5]

An Analysis of Ionospheric E-region Profiles from Ionosondes at Icheon and Jeju, South Korea

Eunbyeol Jo¹, Yong Ha Kim¹, Junseok Hong, Juncheol Moon²

¹*Chungnam National University, Daejeon*

²*Korea Space Weather Center*

17:00 [IV-1-6]

Characterization of the Plasma Generated in the SaTReC Space Plasma Chamber Facility

Kwangsun Ryu, Goo-Hwan Shin, Junchan Lee,

Kyoung-Wook Min², Koh-Ichiro Oyama³

¹Satellite Technology Research Center, KAIST

²Department of Physics, KAIST

³Kyushu University, Japan

제2발표장 (크리스탈홀2)

■ IV-2 Space Astronomy II

좌장: 김영수 (천문연)

15:45 [IV-2-1]

Feasibility Study of a Future Korean Space Telescope

Dae-Hee Lee^{1,2}, Chang Hee Ree, Yong-Seon Song, Woong-Seob Jeong^{1,2}, Hong-Kyu Moon, Min Gyu Kim^{1,3}, Jeonghyun Pyo¹, Bongkon Moon, and Won-Keek Park

¹Korea Astronomy and Space Science Institute

²University of Science and Technology

³Seoul National University

16:00 [IV-2-2]

FM Dewar Design for NISS Onboard NEXTSat-1

Kyeongyeon Ko^{1,2}, Bongkon Moon¹, Woong-Seob Jeong^{1,2}, Dukhang Lee^{1,2}, Sung-Joon Park¹, Dae-Hee Lee^{1,2}, Won-Keek Park¹, Mingyu Kim^{1,3}, Youngsik Park¹, Jeonghyun Pyo¹, Il-Joong Kim¹, Goo-Whan Shin⁴, Jangsoo Chae⁴

¹Korea Astronomy and Space Science Institute

²University of Science and Technology

³Seoul National University

⁴Satellite Technology Research Center, KAIST

16:15 [IV-2-3]

Thermal Analysis of NISS onboard NEXTSat-1 for Verification of Passive and Active Cooling Performances

Dukhang Lee^{1,2}, Bongkon Moon, Kyeongyeon Ko^{1,2}, Woong-Seob Jeong^{1,2}, Sung-Joon Park, Dae-Hee Lee^{1,2}, Won-Keek Park, Mingyu Kim^{1,3}, Youngsik Park¹, Jeonghyun Pyo¹, Il-Joong Kim, Goo-Whan Shin, Jangsoo Chae⁴

¹Korea Astronomy and Space Science Institute

²University of Science of Technology

³Seoul National University

⁴Satellite Technology Research Center, KAIST

16:30 [IV-2-4]

First space tests of Slewing Mirror Telescope

G. Gaykov

Department of physics, Sungkyunkwan University

16:45 [IV-2-5]

Korean Network for the monitoring of Night Sky

Brightness Measurement

YongSun Lee^{1,4}, JeHoon Park^{1,3}, Yonggi Kim^{1,2}, Yoh Na Yoon^{1,2}, HyungBin Choi⁴

¹Chungbuk National University Department of Astronomy and Space Science

²Chungbuk National University Astronomical Observatory

³Yeongyang Firefly Astronomical Observatory

⁴Daejeon Astronomical Observatory

제3발표장 (크리스탈홀3)

■ 6th Space Weather Conference

좌장: 이재진 (천문연)

15:45 [IV-3-1]

Space Weather Services of Korean Space Weather Center

Junchul Mun, KiChang Yoon, Yun Kong, Gwan-Sik Wi
Korean Space Weather Center, RRA

16:00 [IV-3-2]

Statistics and Physical Properties of Interplanetary Magnetic Fields Measured Near the Earth

Kyung-Eun Choi, Dae-Young Lee¹, Kyu-Cheol Choi², Jae-Hun Kim

¹Chungbuk National University

²SELab

³Korean Space Weather Center

16:15 [IV-3-3]

Solar Cycle Variation of Microwave Emission observed by Nobeyama Radioheliograph from July 1992 to August 2016

Sujin Kim¹, Yeon-Han Kim^{1,2}, Jae-Hyung Lee³

¹Korea Astronomy and Space Science Institute

²University of Science and Technology

³Korea Space Weather Center/National Radio Research Agency

16:30 [IV-3-4]

Ionospheric Oblique Incident Sounding Observations Between Korea and Japan: Preliminary Results

Young-Sil Kwak^{1,2}, Jaeheung Park^{1,2}, Jae-Woo Park³, Ho-Cheol Jeon³, Tae Young Kim³, Jun-Chul Mun⁴, Hyun-Jun Jin⁵, Jong-Hyeon Kim⁵, Terry Bullett⁶

¹Korea Astronomy and Space Science Institute, Korea

²University of Science and Technology, Korea

³Radar and Space Inc., Korea

⁴National Radio Research Agency, Korea

⁵SELab Inc., Korea

⁶University of Colorado, USA

16:45 [IV-3-5]

Relativistic Electron Flux Forecast at Geostationary Orbit Using Multiple Linear Regression Model and DREAM

Junga Hwang^{1,2}, Daekyu Shin^{1,3}, Kijeong Kim^{1,4}, Junhyun Lee^{1,4}, Kichang Yoon⁵

¹Korea Astronomy and Space Science Institute

²University of Science and Technology

³Chungbuk National University

⁴Kyunghee University

⁵Korean Space Weather Center

17:00 [IV-3-6]

Advanced SAFE(Safety during Aviation Flight Environment from radiation) System Connected to Aviation System

Tae-Young Kim¹, Yun-Hee Oh¹, Ki-Chang Yoon², Seok-Hyeon Byeon¹, Seoung-Bum Yang¹, Eun-Seok Kang, Myung-Jin Choi¹

¹InSpace.co., ltd

²Korea Space Weather Center (KSWC) Radio Research Agency

10:30 [V-1-2]

Statistical Comparison of Halo CME 3D Parameters and Its Associated Flare Ones for Two Different Groups of CME Kinematics

Soojeong Jang¹, Yong-Jae Moon, Rok-Soon Kim²

¹Kyung Hee University

²Korea Astronomy and Space Science Institute

10:45 [V-1-3]

Heating of Ions in the Downstream Region of a Quasi-perpendicular Bow Shock

Hee-Eun Kim, Ensang Lee¹, George K. Parks, Naiguo Lin, Khan-Hyuk Kim¹, Dong-Hun Lee¹

¹School of Space Research, Kyung Hee University, Korea

²Space Sciences Laboratory, University of California, USA

11:00 [V-1-4]

Occurrence of EMIC waves and plasmaspheric plasmas derived from THEMIS observations in the outer magnetosphere: Revisit

Khan-Hyuk Kim¹, Gi-Jeong Kim¹, Dong-Hun Lee¹, Hyuck-Jin Kwon²

¹School of Space Research, Kyung Hee University

²Korea Polar Research Institute

11:15 [V-1-5]

Contribution of Solar/Geomagnetic Activities and CO₂ Variation to Global Temperature Anomaly

Jinhyun Kim^{1,2}, Yong-Jae Moon¹, Roksoon Kim, Junga Hwang²

¹Kyung Hee University

²Korea Astronomy and Space Science Institute

11:30 [V-1-6]

Determining the statistical significance of inner magnetosphere particle precipitation related to EMIC waves

Dae-Kyu Shin^{1,2}, Dae-Young Lee², Sung-Jun Noh², Junga Hwang¹, Jaejin Lee¹

¹Korea Astronomy and Space Science Institute

²Department of Astronomy and Space Science Chungbuk National University

10월 28일(금)

제1발표장 (크리스탈홀1)

초청강연 III

좌장: 이대영 (충북대)

09:30 [IS-III]

Living with a Star: The Need to Defend Earth from Space Weather

Mario M. Bisi

RAL Space, Science & Technology Facilities Council (STFC) - Rutherford Appleton Laboratory (RAL), UK

제1발표장 (크리스탈홀1)

V-1 Sun/Space Environment IV

좌장: 지건화 (극지연)

10:15 [V-1-1]

Korean Three Dimensional Ionosphere Electron Density Modeling Using Data Assimilation

Chalachew Kindie Mengist^{1,2}, Yong Ha Kim¹, Nicholas Ssessanga

¹Chungnam National University

²Adama Science and Technology University, Ethiopia

제2발표장 (크리스탈홀2)

■ V-2 Special Session:

Multi-satellite Mission and Observation

좌장: 박영득 (천문연)

10:15 [V-2-1]

Electron Microburst Observation with Formation Flying Nonosats

Jaejin Lee, Young-Sil Kwak, Jaeheung Park, Jung-A Hwang, Young-Sook Lee

Korea Astronomy and Space Science Institute

10:30 [V-2-2]

A Prior Study on Space Mission Analysis of Cubesat Formation Flying for Geomagnetic Field Observation

Youngbum Song, Dae-Eun Kang, Seokju Kang, Ho-Chul Kang, Sang-Young Park

Department of Astronomy, Yonsei University, Seoul, Korea

10:45 [V-2-3]

Current Status of Developments of Nanosatellites for Government Space Agencies

Hae-Dong Kim^{1,2}, Won-Sub Choi, Dong-Hyun Cho¹, Min-Ki Kim, Jin-Hyung Kim¹, and Eun-Sup Sim¹

¹*Korea Aerospace Research Institute,*

²*Korea University of Science and Technology*

11:00 [V-2-4]

Geometry of High-latitude Plasma Density Irregularities as Deduced from GNSS Observations Onboard LEO Satellites

Jaeheung Park^{1,2}, Young-Sil Kwak^{1,2}

¹*Korea Astronomy and Space Science Institute*

²*University of Science and Technology*

11:15 [V-2-5]

Growth of Large Amplitude Magnetic Pulsations Upstream of Earth's Bow Shock

Ensang Lee¹, George K. Parks, Naiguo Lin, Jinhy Hong

¹*School of Space Research, Kyung Hee University*

²*Space Sciences Laboratory, University of California, Berkeley*

11:30 [V-2-6]

Prospects for Solving Mysteries of Magnetic Reconnection by Multi-spacecraft Missions

Junggi Lee^{1,2}, Jaejin Lee¹, G. S. Choe²

¹*Korea Astronomy and Space Science Institute*

²*Kyung Hee University*

1부 포스터발표 논문제목 및 시간표

10. 26(수) 14:00 ~ 27(목) 10:00

■ 우주기술

[P-1] Analysis of In-orbit Radiometric Gain Variation of Geostationary Ocean Color Imager

Gmsil Kang¹, Sang-Soon Yong, Sang-Gyu Lee¹, Seung-Hun Lee

¹KARI Payload Electronics Team

²KARI Satellite Payload Research Office

[P-2] Study of In-orbit PRNU Variation of Geostationary Ocean Color Imager

Gmsil Kang¹, Sang-Soon Yong, Sang-Gyu Lee¹, Seung-Hun Lee²

¹KARI Payload Electronics Team

²KARI Satellite Payload Research Office

[P-3] Channel Link for Image Data Communication

Jong-Pil Kong, Youngsun Kim, Jong-Euk Park, Seok-Bae Seo, Sang-Gyu Lee

Korea Aerospace Research Institute,

[P-4] Process Modeling Concepts for a Spacecraft Development

Hyung-Wan Kim, Jeong-Su Choi, Jong-Seok Park

Korea Aerospace Research Institute

[P-5] Utilization of Payloads in Korea Communication and Broadcasting Satellite Development

Guen-Young Park, Myung-Jin Baek¹, Seong-Bong Choi¹, In-Bok Yom², Manseok Uhm

¹Korea Aerospace Research Institute

²Electronics and Telecommunications Research Institute

[P-6] GEO-KOMPSAT-2 Launch Window Analysis considering Eclipse by the Moon

Bong-Kyu Park, Jae-Dong Choi

Korea Aerospace Research Institute

[P-7] Design and Manufacture of Black Body for Infrared Temperature Sensor

Sung-wook Park, Hyokjin Cho, Hee-Jun Seo, Guee-Won Moon

Korea Aerospace Research Institute

[P-8] On-Board Control Procedure Language Design for Satellite Operation

Su-Hyun Park, Hyun-Kyu Shin

Korea Aerospace Research Institute

[P-9] Residual Propellant Accuracy Prediction of Geostationary Satellite

Eungsik Park

Korea Aerospace Research Institute,

[P-10] Mechanical Accommodation of a Meteorological Payload in GEO-KOMPSAT-2A

Jong-Seok Park, Jung-Su Choi, Jae-Dong Choi, Sang-Ryool Lee

Korea Aerospace Research Institute

[P-11] Preliminary Electric System Design of Standard Platform's for 500kg medium-sized Satellite

Jong-Oh Park¹ Hyeon-Jin Jeon, Kyoung-Soo Kim, Jin-Kon Bae

¹Korea Aerospace Research Institute

²Korea Aerospace Industry

[P-12] Power Bus Design of Standard Platform for 500kg Satellite

Jong-Oh Park¹ Hyeon-Jin Jeon, Kyoung-Soo Kim, Jin-Kon Bae

¹Korea Aerospace Research Institute

²Korea Aerospace Industry

[P-13] Power EGSE Design for Both AIT and Launch Pad Operation

Joo-Ho Park, Dong-Chul Chae, Yun-Goo Huh, Young-Yun Kim, Seung-Won Cho, Su-Wan Bang, Guee-Won Moon

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Jeong-Woo Han, Dae-Oh Kim

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[P-122] Vibration Characteristics of the Stirling Cryocooler with the Input Voltage

Seong-Je Park¹, Yong-Ju Hong¹, Jun-Seok Ko¹,
Hyo-Bong Kim¹, Han-kil Yeom¹, Se-Hwan In ,
Young-Jun Choi , Seung Kwan Kim , Geon-Hee Kim ,
Kyungin Kang

¹Korea Institute of Machinery and Materials

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[P-123] Optical Alignment Techniques for the Optical Telescope Development

Younghcun Youk¹, Seonghui Kim¹, Daejun Jung¹, Dai Ho
Ko , Wonbeom Lee¹, Eung Shik Lee¹, Suyoung Chang ,
Jungheum Yeon , Deoggyu Lee , Seunghoon Lee

¹Payload Optics Team, Korea Aerospace Research Institute

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[P-124] Development of the RS422-to-Ethernet Telemetry PCM Decoder

Won-Ju Yoon

Korea Aerospace Research Institute

[P-125] A Study on the Bispectrum-based Communication Technique for Telemetry

Jeong-Woo Han, Dong-Hyun Kim, Sun-Ho Kwon,
Chun-won Kim, Dea-O Kim

Korea Aerospace Research Institute

구두발표논문 초록

10월 26일 (수)

제1발표장 (크리스탈홀1)

■ 초청강연 I

좌장: 최영준 (천문연)

14:10 [IS-I]

Cubesat Mission for Virtual Space Telescope in Formation Flying

Sang-Young Park

Department of Astronomy, Yonsei University, Seoul, Korea

Many space telescopes have a single structure that may have limitations in improvement of the resolution of science images. Telescopes using single spacecraft also have strict mechanical alignment and stability requirements for large metering structures. Yonsei University and NASA Goddard Space Flight Center have collaborated in a study to resolve these limitations of existing space telescopes. A potential solution uses two spacecraft instead, one with a refractive lens system and the other with a detector system. The separation between the two spacecraft can be used for an increased focal length of telescope in space. By using formation flying, the two spacecraft can be simplified as a virtual telescope system. Some proposed missions seek to advance the state of the art in spacecraft science imaging by utilizing a virtual space telescope. The most challenging aspects of these missions are the relative navigation and control of spacecraft in formation flying. Orders of magnitude improvement in science imaging over conventional single spacecraft instruments is possible with advances in precision formation flying. This study presents an overview of the mission and the configuration systems of the CANYVAL-X (CubeSat Astronomy by NASA and Yonsei using Virtual telescope ALignment-eXperiment). Two cubesats have been developed by Yonsei University for demonstrating basic technologies of virtual telescope alignment system. Precision formation flying can be achieved by use of separate control laws for formation maintenance and precision astrometric alignment. For performing inertial alignment, many advanced technologies are required for a vision alignment system, a relative position control system with fine thrusters, a relative orbit determination system, an inter-satellite link system, and a satellite separation system. The CANYVAL-X mission will demonstrate the core technologies of a virtual telescope in space. The experimental results can be used for subsequent science demonstration missions.

제1발표장 (크리스탈홀1)

■ I-1 Historical Astronomy

좌장: 김천휘 (충북대)

14:50 [I-1-1]

Structure of Hong Dae-Yong's Mechanical Armillary Sphere

Byeong-Hee Mihn^{1,2}, Min-Soo Lee³, Sang Hyuk Kim^{1,2}, Ki-Won Lee⁴¹Korea Astronomy and Space Science Institute²Korea University of Science and Technology³Chungbuk National University⁴Catholic University of Daegu

We study the Tongcheon-ui (通天儀, uranographic armillary sphere) developed by Hong Dae-Yong (洪大容, 1731-1783), a Neo-Confucian of the later Joseon dynasty. He constructed the Longsu-gak (籠水閣, a private observatory) and built several instruments such as a star globe, a simple planisphere, and an inclinometer, including the Tongcheon-ui. To the best of our knowledge, the Tongcheon-ui is the only mechanical-type armillary sphere developed by Neo-Confucian scholars of the Joseon dynasty. The power of the Tongcheon-ui was driven by a heavy weight and controlled by a crown wheel escapement, in a manner similar to the Jamyeongjong (自鳴鐘, astronomical alarm or armillary clock) developed by Song I-Yeong (宋以穎, 1619-1692), a royal astronomer who served during the reign of King Hyeonjong. Unlike Song Yi-Yeong's clock, the rings in Hong Dae-Yong's armillary sphere were operated by the Cheonunhwan (天運環, a heaven-moving ring) using a crown gear that is directly connected to the main arbor. This study discusses the structure of the Tongcheon-ui, with a focus on the number of cogs used in the wheels.

15:05 [I-1-2]

Artefacts of the Simplified Sundial (So-ilyeong) in the Early Joseon Dynasty

Sang Hyuk Kim^{1,2}, Byeong-Hee Mihn^{1,2}, Yong Sam Lee³¹Korea Astronomy and Space Science Institute²Korea University of Science and Technology³Chungbuk National University

We study on two kind of the Simplified Sundial (So-ilyeong) in the early Joseon dynasty. It is difficult to grasp those reality because it is not recorded in detail except one sentence in the Sejong sillok (Veritable Record of King Sejong) and the Seongjong sillok (Veritable Record of King Seongjong) respectively. However we find the clue of the Small Sundial by analyzing the Sun-and-star Time-determining Instrument and Simplified Time-determining Instrument. When our extended analysis is applied to Hundred-interval sundials existing in Korea, we are convinced that the Simplified Sundial made in the reign of Sejong and Seongjong is different to each other. We can conclude that the Simplified Sundial of King Sejong has a alidade to create a triangle thread gnomon but those of King Seongjong has not so.

15:20 [I-1-3]

Calculation of Solar Eclipse Times Using the Zhongxiu-Daming Calendar

Go Eun Choi^{1,2}, Ki-Won Lee³, Byeong-Hee Mihn^{1,2}, Young Sook Ahn¹

¹Korea Astronomy and Space Science Institute

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³Catholic University of Daegu

We study a method for the calculation of solar eclipse times using the Zhongxiu-Daming (重修大明) calendar developed by Zhao Zhi-Wei (趙知微, 1156-1189), a Chinese astronomer from the Jin dynasty (A.D. 1115 - 1234) in 1171. This calendar was developed to improve the Daming (大明) calendar developed by Yang Ji (楊級, A.D. ? - ?), an astronomer from the same dynasty, in 1127, and was used in China before the introduction of the Shoushi (授時) calendar of the Yuan dynasty (A.D. 1279 - 1368) in 1281. In Korea, however, the Zhongxiu-Daming calendar was used as a supplementary calendar with the Chiljeongsan-Oepyeonwas for determining astronomical events, particularly solar and lunar eclipses, since the reign of King Sejong (A.D. 1418 - 1450) of the Joseon dynasty (A.D. 1392 - 1910). In this study, we analyze the method of calculation of the solar eclipse times using the Jeongmyoyeon-Gyeosik-Garyeong (Example Supplement for the Calculations of Solar and Lunar Eclipses Occurred in 1447) of the Zhongxiu-Daming calendar and compare them with the results of modern calculation. In addition, we estimate the observer's location of the sunrise and sunset times utilized in the calculations of the eclipse times.

15:35 [I-1-4]

A Study on the Calendrical Calculation System and the Calendrical Exegesis of Joseon Dynasty, through Jakryeoksiks.

Ki-Chul Shin

Chungbuk National University

Jakryeoksiks were published to make the calendar during the late Joseon Dynasty. These books were used to make the annual astronomical almanac of Siheonryeok system. Currently, Jakryeoksiks that are well known for is five. Some of Jakryeoksik are an name of independent one book and the others are an name of certain chapter on relative books. Because of unique similarities and differences, These are very interesting. Jakryeoksik is an basic reference data. These books are used in various ways for the annual astronomical almanac research. the differences of Jakryeoksiks are utilized in the study of the sambok and other calendrical exegesis. Despite this variety of research, We just don't understand what are the exact contents of Jakryeoksiks and the specific goals for publication. In addition, We don't know how to apply Jakryeoksiks to the annual astronomical almanac. A comprehensive study about the Jakryeoksiks is still not made. So this study includes the entire contents of the five Jakryeoksiks and a comparative analysis of one another. Furthermore I will find out not only the relevance of Jakryeoksiks and the annual astronomical almanac, but also the relevance of the calendrical calculation system and exegesis.

15:50 [I-1-5]

Study on the Application of the CBD Methodology for the Operational Type Software in Real Time Observation System

Yoon Kyung Seo, Byeong-Hee, Mihn^{1,2}, Soo-Yeon Kang

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Component Based Development is one of the commonly used methodologies in software engineering fields. Operational type software development for astronomical observation systems features various communication interfaces and arithmetic algorithms. Their development has greater impact on systems, that is they determine overall performances of entire systems. Therefore, the CBD methodology has been selected in previous studies and applied for more stable and effective software development. In this presentation, we will explain the background and aims of the current research, as well as what has been found by previous studies. Moreover, the procedure, method and results of the research focused on the differentiation will be presented in terms of software engineering. The process and results of this study is expected to contribute to the investigation for a more appropriate methodology in the area of similar system development.

제2발표장 (크리스탈홀2)

I-2 Solar System Exploration I

좌장: 김주현 (항우연)

14:50 [I-2-1]

Wide-Angle Polarimetric Camera for the Lunar Surface

Young-Jun Choi, Sungsoo S. Kim, Kyung-In Kang, Minsup Jeong^{1,2}, Chae Kyung Sim, Il-Hoon Kim², Haingja Seo¹, Ik-Seon Hong^{1,4}, Eunjin^{1,4}, Kilho Baek², Jingyu Kim³, Bonjoo Koo, Chulwoo Lim³, Seyeon Kim³,

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Polarimetry of lunar surface gives us a useful information about regolith such as a grain size and porosity, but unfortunately it was never performed from the lunar orbit. Recently, we started to develop Wide-Angle Polarimetric Camera (PolCam) for Korea Pathfinder Lunar Orbiter (KPLRO), to construct a map of polarization for the lunar surface. The purpose of the PolCam are; 1) obtaining the polarization data of the whole lunar surface at wavelengths of 430 nm and 750 nm for a phase angle range from 0° to 120° with a spatial resolution of ~ 80 m. 2) obtaining the albedo ratios at 320 nm and 430 nm for the whole lunar surface with a spatial resolution of ~ 80 m. In order to design PolCam, we calculated the surface brightness and thermal condition using the data

from Solar and Heliospheric Observatory (SOHO) and Moon Mineralogy Mapper (M³). In addition, we simulated the phase angle coverage distribution for each altitude/latitude location on the Moon during 1-year mission using the telemetry data of SELENE (KAGUYA). We will introduce current progress, in particularly, analysis results of science requirements of PolCam.

15:05 [I-2-2]

KMAG: Multi-Magnetometer Observation Method

Hyojeong Lee, Ho Jin, Jung-Kyu Lee, Seongwhan Lee, Jehyuck Shin, Seonyeong Jeong, Mangyu Lee, Khan-Hyuk Kim

Kyung Hee University

KMAG (Kplo MAGnetometer) is one of the scientific instruments in KPLO (Korea Pathfinder Lunar Orbiter) to carry out the lunar scientific observation. The main purpose of KMAG is a magnetic field observation on the lunar surface. Its primary requirement is the reliable magnetic field measurement in common with other space mission. For the accurate measurement, one of the most difficulties is estimation of the magnetic field induced by the spacecraft. KMAG has a 1.2 meter short length of the boom because the KPLO spacecraft has physical constraints. Therefore we chose the multi-magnetometer sensor method as other previous space science missions. KMAG will observe the magnetic field by total three sensors. Two sensors are in the boom and the other one is on a spacecraft wall near boom hinge. The boom hinge is located at the edge of spacecraft wall and a deployment angle between the spacecraft wall and the boom is considered 90 degree and 135 degree. In this paper, we present the preliminary results in order to use the multi-sensor method: the allowable magnetic field range induced from the spacecraft in sensor position and a proper position of two sensors in the boom.

15:20 [I-2-3]

Introduction to the Gamma-Ray Spectrometer for the Korea Pathfinder Lunar Orbiter

Kyeong Ja Kim^{1,2}, Junghun Park, Yire Choi^{1,2}, Sungsoo Lee¹, Young-Kwang Yeon¹, Eung Seok Yi^{1,3}, Meeyoung Jeong, Chang Wan Sun^{1,2}, K. B. Lee⁴, Yongkwon Kim, Kyoung-Wook Min, Kyungin Kang, Jin Yeon Cho⁷, Kook Jin Park, Nobuyuki Hasebe, Richard Elphic⁹, Peter Englert¹⁰, Olivier Gasnault¹¹, Lucy Lim¹², Eido Shibamura and KGRS science Team

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³Chungnam National University

⁴Korea Research Institute of Standards and Science

⁵NuCare

Korea Advanced Institute of Science and Technology

Inha University

Waseda University

NASA Ames Research Center

¹⁰Quest University

¹¹The Research Institute in Astrophysics and Planetology

¹²NASA Goddard Space Flight Center

Korea is preparing for its first lunar orbiter which is called the Korea Pathfinder Lunar Orbiter (KPLO). This orbiter is to be developed in 2018. A gamma-ray spectrometer onboard the spacecraft is called as KPLO GRS (KGRS) allowing to collect low energy gamma-ray signals in order to detect elements by either X-ray fluorescence or by natural radioactive decay in the low as well as higher energy regions of up to 10 MeV. Scientific objectives include lunar resources investigation of the lunar geology and studies of the lunar environment.

The KGRS system is a compact low-weight instrument for the chemical analysis of lunar surface materials within a gamma-ray energy range from 10s keV to 10 MeV. The main LaBr₃ detector is surrounded by an anti-coincidence counting module scintillators to reduce both low gamma-ray backgrounds from the spacecraft and housing materials and high energy gamma-ray background from cosmic rays. The KGRS system will determine the elemental compositions of the near surface of the Moon. The KGRS system is a recently developed gamma-ray scintillation based detector which can be used as a replacement for the HPGe gamma-ray detector with the advantage of being able to operate at a wide range of temperatures with remarkable energy resolution. LaBr₃ also has a high photoelectron yield, fast scintillation response, good linearity and thermal stability. With these major advantages, the LaBr₃ GRS system will allow us to investigate scientific objectives and assess important research questions on lunar geology and resource exploration. The KGRS investigation will help to assess open questions related to the spatial distribution and origin of the elements on the lunar surface and will contribute to unravel geological surface evolution and elemental distributions of potential lunar resources.

15:35 [I-2-4]

Development of a gamma-ray and neutron spectrometer suite for Prospective Korean Lunar Explorer

Kyeong Ja Kim^{1,2}, Junghun Park, Yire Choi^{1,2}, Eung Seok Yi^{1,3}, Chang Wan Sun^{1,2}, Sungsoo Lee, Young-Kwang Yeon, K. B. Lee⁴, Nobuyuki Hasebe⁵, Won-Kee Park⁶, Bongkon Moon⁶, Kyungin Kang⁷, Young-Jun Choi

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⁵Waseda University

Korea Astronomy and Space Science Institute

Korea Advanced Institute of Science and Technology

Korea is planning a series of lunar space programs. The first one is called the Korea Pathfinder Lunar Orbiter (KPLO) and the second one is to be launched with a Korean rocket. For these missions, lunar geological investigation and resources exploration will be few of major important tasks for current and future interest with a conjunction with prospective permanent lunar activities by human. Results of a Gamma-ray spectrometer (GRS) on the lunar surface will contribute to unravel geological surface evolution and elemental distributions of potential lunar resources. For the second lunar orbiter both a Gamma-ray spectrometer and neutron spectrometer as a suite is currently being developed. The Gamma-ray Spectrometer (GRS) measures the elemental abundance of major constituents of the lunar surface and natural

radioactive elements as well as any minor elements that can be measurable such as volatiles and rare earth elements. The Neutron Spectrometer (NS) measures the water presence of lunar surface soils using epithermal neutron flux variations. This presentation includes the development status of the GRS/NS suite for prospective Korean lunar and planetary explorations.

15:50 [I-2-5]

Optical Maturity on the Walls of Lunar Craters

Chae Kyung Sim¹, Sungsoo S. Kim, Paul G. Lucey², Ian Garrick-Bethell^{1,3}, Gilho Baek¹, Young-Jun Choi

¹Kyung Hee University

²University of Hawaii at Manoa, USA

³University of California Santa Cruz, USA

⁴Korea Astronomy and Space Science Institute

Recent studies have found that the optical maturity (OMAT) and mean grain size $\langle d \rangle$ of the lunar regolith have latitude dependences, probably because of the reduced flux of space-weathering agents at high latitudes. Here we extend our previous work (Jeong et al.) to the inner walls of lunar impact craters, dividing the wall into four quadrants. We consider the 1,872 craters whose diameter is between 5 km and 120 km in the Lunar Impact Crater Database 2015 from the LPI. We adopt the topography-corrected OMAT data from the Kaguya/MI observations. We find that at high latitudes, the equator-facing walls have generally smaller (more mature) OMAT values than the pole-facing walls. This is consistent with the global latitudinal dependence of the OMAT and $\langle d \rangle$ values previously found. The overall mean value curve of [OMAT(E) OMAT(W)] has a minimum and maximum near longitudes 60° and $+60^\circ$, respectively. This is thought to be due to the shielding of solar wind particles during the Moon's passage through the Earth's magneto-tail. Because micrometeoroids are not affected by the magnetosphere passage, the longitudinal effect unambiguously discriminates between micrometeoroid and solar wind effects.

16:05 [I-2-6]

Microstructure of Regolith on Reiner Gamma Swirl

Minsup Jeong^{1,2}, Sungsoo S. Kim², Young-Jun Choi¹, Ian Garrick-Bethell

¹Korea Astronomy and Space Science Institute

²Kyung Hee University

³University of California, Santa Cruz

Regolith characteristics, such as grain size and porosity, are important to understand lunar swirl's nature. We analyze Stokes parameters that are the linear polarization flux Q and Intensity I for Reiner Gamma swirl, one of the well-known lunar swirls. In addition, we compare between the phase function (phase angle dependency of I) of the swirl and that of its neighbors using polarimetric method. We find that the swirl is located at the unique position on $Q-I$ space. We also find that the swirl has a unusually shallow phase function compared to its neighbors. As a result of our analyses, we suggest that the regolith of the swirl has unusually low porosity because the microstructure of the regolith has been

disrupted.

제3발표장 (크리스탈홀3)

I-3 Space Technology & Application I

좌장: 천용식 (항우연)

14:50 [I-3-1]

Trade-Off Study of Spacecraft Adapter Design for Medium-size Satellite

Kyung-Won Kim¹, Ji-Hwan Seo, Sun-Won Kim, Chang-Ho Kim¹, Hyoung-Yoll Jun¹, Won-Young You², Kwon-Tae Hwang

¹Korea Aerospace Research Institute

²Korea Aerospace Industry

Spacecraft adapter transfers main structural loads of the spacecraft to launch vehicle. Therefore, it should be designed to have enough strength and stiffness. To meet these requirements, spacecraft mass is inevitably increased. However, as the launch mass is limited, trade-off study of spacecraft adapter design for high strength, stiffness and lightweight is required. Using the design trade-off study, the detail shape and dimensions of spacecraft adapter is defined. In addition, light fitting structure is added in order to improve load path effectively. From this study, the lightweight spacecraft adapter is designed without degradation of strength and stiffness.

15:05 [I-3-2]

Qualification of Structure Design with Quasi-static Test of STM (Structure Thermal Model)

Chang-Ho Kim, Kyung-Won Kim, Sun-Won Kim, Hyoung-Yoll Jun

Korea Aerospace Research Institute

Satellite structure should be designed to accommodate and support safely the payload and equipments necessary for its own missions and to secure satellite and payloads from severe launch environments. The launch environments imposed on satellites are quasi-static accelerations, aerodynamic loads, acoustic loads and shock loads. Currently KARI(Korea Aerospace Research Institute) is developing Geo-KOMPSAT-2 (Geostationary Earth Orbit Korea Multi-Purpose Satellite). To qualify the design of structure, the Qualification tests were performed with Qualification Ground Model named by STM(Structural Thermal Model). This paper deals the qualification of structure design against quasi-static launch environment with STM test.

15:20 [I-3-3]

Development of Flight Dynamic Total Solutions for Orbit Design and On-Orbit Operation of LEO SAR Satellite

Jae-Cheol Yoon, Ok-Chul Jung, Jin-Hee Kim

Korea Aerospace Research Institute

The interferometry is one of the significant missions for Synthetic Aperture Radar(SAR) Satellite. Two operation functions are essential to meet the mission requirement. First, the precise repeat ground track of satellite shall be designed and be maintained within narrow baseline limitation after launch. Second, the precision orbit ephemeris shall be expeditiously provided to interferometric processing entity. The Flight Dynamic Total Solutions, which are able to guarantee coherent accuracy from orbit design to the actual on-orbit operation phase, were successfully developed for low Earth orbit(LEO) SAR satellite. The solutions, which consist of orbit propagation, orbit optimization, orbit control, and orbit determination, applied new technologies to meet unprecedented high accuracy requirements from the next generation SAR mission. The accuracy of precision orbit determination was verified using actual dual frequency GPS data from the KOMPSAT-5. The accuracies of precise orbit optimization and control were tested using real F10.7cm Solar Flux and KP8 Geomagnetic data during past one year. The results of verification show that the Flight Dynamic Total Solutions can be used for almost the whole low Earth orbit satellites.

15:35 [I-3-4]

Angles-only Initial Orbit Determination of Low Earth Orbit Satellites using Optical data

Hyewon Hwang, Sang-Young Park, Eunji Lee

Astrodynamic and Control lab., Department of Astronomy, Yonsei University, Seoul, Korea

By angles-only initial orbit determination (IOD) methods, the orbit of satellites could be determined with only angular data such as topocentric right ascension and declination. In this study, four IOD methods (Laplace, Gauss, Double-r, and Gooding method) are analyzed for various artificial data in low earth orbits. The characteristics of the four methods are also analyzed for different measurement data in noise, bias or classical orbital elements. Then IOD methods are applied to real measurements data of Cryosat-2 and KOMPSAT-1 satellites from Optical Wide-field Patrol Network (OWL-Net). The accuracy of IOD methods is verified by comparing the results of IOD with Two Line Elements (TLE) data of each satellite.

15:50 [I-3-5]

Fault Management and Performance Verification of an On-Board Orbit Generation Algorithm for a GEO Satellite

Jo Ryeong Yim, Bong Kyu Park, Hyun-Ho Seo

Korea Aerospace Research Institute

This paper deals with the performance and fault management verification results of an on-board orbit generation algorithm by using software based verification tool. The configuration of verification tool and some nominal performance results were provided in previous presentations. After the performance verifications were performed, the on-board orbit generation code was extended and upgraded to cope with possible error cases caused by ground systems or ground operators. Main

objectives of orbit generation fault management are to avoid abrupt changes in on-board orbit position and velocity values to cause the satellite control unstable and to minimize any impact to nominal earth observing missions. In order to achieve the objectives, the main possible error cases are itemized and the on-board orbit generation code is manipulated to provide for users the error occurrence and promptly to upload new orbit information within about 30 minutes when it is a possible case. In this paper, the final on-ground verification results are presented including some refined performance and fault management cases.

16:05 [I-3-6]

An Introduction of FDIR Mechanism for MI Mission in COMS On-Board Software

Soo-Yeon Kang

Korea Aerospace Research Institute

Fault Detection, Isolation and Recovery (FDIR) mechanism is indispensable to the successful satellite operation. As space missions become increasingly more complicated, the design and implementation of FDIR is gradually reflected from hardware functionalities into OBSW (On-Board Software) for higher reliability. COMS is the first Korea geostationary multi-purpose satellite that should continuously conduct Meteorological Imaging (MI), ocean color monitoring, and Ka-band communication service. The COMS spacecraft bus is Eurostar 3000 (E3000) spacecraft bus platform, which is a generic satellite model widely used for commercial and military satellites manufactured by EADS Astrium. Requirements of FDIR for newly developed and adapted MI mission had been allocated to OBSW. This paper introduce FDIR mechanism for MI mission in COMS OBSW. Also we explain how to cope with actual happened errors during mission operation.

16:20 ~ 17:20 1부 포스터발표
(No.1 - No.62)

10월 27일 (목)

제1발표장 (크리스탈홀1)

■ II-1 Sun/Space Environment I

좌장: 박재홍 (천문연)

09:30 [II-1-1]

Development of the Ground-Based Search-Coil Magnetometer at the Jang Bogo Station in the Antarctica

Jehyuck Shin¹, Khan-Hyuck Kim^{1,2}, Ho Jin^{1,2}, Hyomin Kim³, Jongwoo Kwon, Seungah Lee², Jung-Kyu Lee¹, Seongwhan Lee, Geonhwa Jee⁴, Marc R. Lessard⁵

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⁴Korea Polar Research Institute, Korea

⁵Space Science Center, University of New Hampshire, USA

The Search-Coil Magnetometer (SCM), designed to observe time-varying magnetic fields associated with magnetosphere-ionosphere coupling, has been developed for ground-based instrument. It measures the Ultra Low Frequency (ULF) wave activity and provides two-axis magnetic field waves vector data. The SCM consists of two orthogonal search-coil magnetic sensors (920 × 130 mm, 10.5 kg, each), amplifier circuit boards and data acquisition system which carries out 10 Hz sampling rate with 16-bit resolution. The SCM has been calibrated to verify performance and detected Pi2 wave during field test on the Bohyeonsan Optical Astronomy Observatory (BOAO). Sensor sensitivity and system resolution of the SCM are $364 \mu V/(nT \cdot Hz)$, $0.11 pT/\sqrt{Hz}$ at 1 Hz respectively. In this austral summer, we have a plan to install the SCM at the Korean Antarctic station (Jang Bogo). In this paper, we discuss primary test results of system specification and installation plan on the Jang Bogo.

09:45 [II-1-2]

Northern High-latitude Mesospheric Temperature Trends Derived from Esrange Meteor Radar, Kiruna, Sweden (67° 57'N, 20°13'E).

Hosik Kam¹, Yong Ha Kim, Won Seok Lee¹, Nicholas Mitchell², Jeong-Han Kim³

¹Chungnam National University

²University of Bath

³Korea Polar Research Institute

Meteor echoes detected by a meteor radar (MR) can provide information on winds and temperatures in the mesosphere and lower thermosphere (MLT) region. In this study, mesospheric temperatures are derived from the data of Esrange MR at Kiruna by two methods. The first method utilizes the slope from a height profile of meteor decay times that were measured for about 20000 meteor

echoes per day. The second method uses the full width half maximum (FWHM) of a daily meteor height distribution. We will compare the two temperatures from these methods with OH airglow temperatures independently measured by FTS (Fourier Transform Spectrograph) at the same site. The comparison will allow to evaluate the credibility of MR temperatures from two methods, leading to improvement in the monitoring ability of MR. We will also discuss about the long term trend of derived mesospheric temperatures during a period of 2003 - 2015, which is related to global warmings in the lower atmosphere.

10:00 [II-1-3]

Reconstruction of Plasmaspheric Density Distributions by Applying a Tomography Technique to Jason-1 Plasmaspheric TEC Measurements

Eunsol Kim¹, Yong Ha Kim¹, Geonhwa Jee

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GPS receiver onboard Jason-1 satellite provided a dataset of plasmaspheric total electron content (pTEC) between altitudes of Jason-1 and GPS satellites (1,336 and 20,200 km). We developed a tomography algorithm applying to the Jason-1 pTEC dataset. To invert the measured pTEC into vertical distribution of electron density, we adopted a multiplicative algebraic reconstruction technique (MART) with an initial guess profile from Huang et al. (2004). The reconstruction of the plasmaspheric density distribution was performed on Indian (70°E - 90°E), Pacific (200°E - 220°E), and Atlantic (320°E - 340°E) longitudinal planes during the periods of high solar activity ($F107 > 100$) and low geomagnetic activity ($A_p < 12$) from 2002 to 2005. The reconstructed density distribution displays general climatological characteristics of the plasmasphere. For all three longitudinal sectors, the reconstructed distribution shows a weak diurnal variation being greater during daytime (09 - 15 LT) than nighttime (21 - 03 LT). In Atlantic sector, the reconstructed plasmaspheric density exhibits an annual anomaly (higher density in December than in June), while the annual anomaly was not apparent in other longitude sectors. By fitting the reconstructed density profiles, we derived empirical functions of equatorial plasmaspheric profiles for four seasons (March, June, September, and December) and for the three longitude sectors. We will discuss about variations of plasmaspheric structure over local times, seasons and longitudes in terms of the empirical functions.

10:15 [II-1-4]

PIC Simulation of Multiband Whistler Wave Generation by Lower Band Cascade

Kyunghwan Dokgo¹, Kyoung-Wook Min¹, Cheong-Rim Choi², Peter H. Yoon³

¹Korea Advanced Institute of Science and Technology

²Chungbuk National University

³University of Maryland

Recently, a new potential generation mechanism for multiband chorus, called lower band cascade, was

proposed. (Gao et al., 2016, GRL) In the mechanism, upper band chorus is generated by the wave-wave coupling between lower band chorus and a density mode. Using 1D Particle-In-Cell (PIC) simulation, we studied lower band cascade process. Initially, we launched oblique whistler wave of $0.2\omega_{ce}$ according to the linear whistler dispersion relation with plasma parameter based on Gao et al., 2016. We clearly observed 2nd harmonic upper band whistler generation from $\omega_{ce}t=200$. Moreover, its power is $10^{-3}\sim 10^{-4}$ of 1st harmonic whistler waves and that is consistent with the satellite observation. ω -k power spectrum of Bz field and bicoherence analysis of Bz-Ex-Bz show that 2nd harmonic whistler propagate with the same phase speed with 1st harmonic whistler waves and there is no three wave interaction. Therefore, we conclude that harmonic oscillation of electrons trapped in the longitudinal electric field could play important role in lower band cascade process.

10:30 [II-1-5]

Characteristics of Solar Energetic Protons Based on Stereoscopic Observations

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In the present study, we examine characteristics of 18 solar energetic protons (SEPs) based on stereoscopic observations (SOHO, STEREO-A and B). To obtain 3D CME speed and angular width, we reconstruct CMEs used by STEREO CME Analysis Tool (StereoCAT) from 2010 August to 2013 June. Longitudinal angular separations between SEP source regions and magnetic footpoints of the spacecraft are also considered. The main results are as follows. 1) We find that the dependence of SEPs on 3D CME speed are similar to that of 2 dimensional (2D) CME speed. 2) There is a weak tendency that the SEP peak flux increases with 3D angular width, while the 2D angular widths of all CMEs except for three events are 360°. 3) There is a noticeable anti-correlation ($r=-0.62$) between SEP peak flux and angular separation for 40 measurements. 4) All 17 measurements whose magnetic footpoints are located inside the CME angular widths, have SEP enhancements but about 40% of the measurements (14/37) whose footpoints are located outside, have no SEP enhancement. 5) Multiple spacecraft observations show that most strong SEP events are associated with very fast CMEs whose angular separations are closer to zero within the 3D angular widths.

제2발표장 (크리스탈홀2)

■ II-2 Space Astronomy I

좌장: 강영운 (세종대)

09:30 [II-2-1]

The First Photometric Studies of Five Kepler Contact Binaries with Extremely Low Mass Ratio: Discovery of Small Peculiar Structures in

the Light Residuals from the Light-curve Synthesis

Hye-Young Kim, Chun-Hwey Kim, Min-Ji Jeong¹, Mi-Hwa Song, Hyoun-Woo Kim^{1,2}

¹Chungbuk National University

²Korea Astronomy and Space Science Institute

The ultra-high precision photometric data of five Kepler contact binary stars are analyzed with the latest version of the Wilson-Devinney (WD) code to investigate with unprecedented detail the light-residuals from the WD binary model. The five contact binary stars chosen are KIC 5290305, KIC 8804824, KIC 9350889, KIC 10229723, and KIC 12055014. They have very symmetric light curves with flat bottom at secondary eclipse, which would indicate no noticeable stellar surface activities and allow reliable photometric solutions. Their first photometric solutions show that all of them belong to the A sub-group of W UMa-type binary stars with extremely low mass ratios less than $q=0.2$ and their inclinations being nearly close to 90 deg. Above all, it is found that there exist un-modeled peculiar-structures over all phases, commonly appearing in light residuals from the photometric solutions of five systems, which are mostly remarkable in the phase interval of 0.35-0.60. It is also interesting to note that these phenomena are common over all quarters for all five systems with different periods. We discuss potential causes of the peculiar structures as well as the possible evolution of the studied contact binary stars with extremely low mass ratios.

09:45 [II-2-2]

KIC02159783: A Very Active, Low Mass Ratio Contact Binary System

Min-Ji Jeong¹, Chun-Hwey Kim^{1,2}

¹Chungbuk National University in Korea

²Chungbuk National University Observatory in Jincheon, Korea

The ultra-accurate light curves of KIC02159783 ($m_k=14.^m97$, $P=0.^d3738842$), which are continuously secured over all quarters, are analyzed with the latest version of the wilson-devinney(hereafter WD) binary code to investigate the time variation of the possible spots on the system which have been suggested as the causes of the anti-correlation between primary and secondary minima (Tran et al. 2013; Balaji et al. 2015). Stellar activities are quantized to see time-behaviors of the O'Connell effect in a series of defined light curves and to select the most stable and symmetric light curve. A Monte Carlo simulation technique is applied to the WD code with the selected light curve to yield the best photometric solution of the system. After fixing the solution, only spot parameters for a series of light curves are continuously obtained. It is found that the system has an extremely low mass ratio of $q\approx 0.17$ and the time variation of the obtained spot parameters is quasi-cyclical. Its implications are discussed with the possible evolution state of the system.

10:00 [II-2-3]

The First of Its Kind Metallicity Map of the Large Magellanic Cloud

Samyaday Choudhury , Annapurni Subramaniam², Andrew A. Cole³

¹*Yonsei University Observatory, Republic of Korea*

²*Indian Institute of Astrophysics, India*

³*School of Physical Sciences, Australia*

We have estimated a metallicity map of the Large Magellanic Cloud (LMC) using the Magellanic Cloud Photometric Survey (MCPS) and Optical Gravitational Lensing Experiment (OGLE III) photometric data. This is a first of its kind, high-spatial resolution map of metallicity up to a radius of 4°-5°, derived using large area photometric data and calibrated using spectroscopic data of Red Giant Branch (RGB) stars. The RGB is identified in the V, (V - I) colour- magnitude diagrams of small subregions of varying sizes in both data sets. The slope of the RGB is used as an indicator of the mean metallicity of a subregion, and it is calibrated to metallicity using spectroscopic data for field and cluster red giants in selected subregions. The mean metallicity of the LMC is found to be [Fe/H] = -0.37 dex (σ [Fe/H] = 0.12) from MCPS data, and [Fe/H] = -0.39 dex (σ [Fe/H] = 0.10) from OGLE III data. The bar is found to have a uniform and higher metallicity compared to the disk, and is indicative of an active bar in the past. Both the data sets suggest a shallow radial metallicity gradient up to a radius of 4 kpc (-0.049 ± 0.002 dex kpc⁻¹ to -0.066 ± 0.006 dex kpc⁻¹). This metallicity gradient of the LMC disk, though shallow, resembles the gradient seen in spiral galaxies, and similar to that found in our Galaxy.

10:15 [II-2-4]

Korean VLBI Availability Analysis Using the LRO Ka-band HGA

¹Sangman Moon, ¹Eunhyeuk Kim, ¹Su-Jin Choi, ²Taehyun Jung

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This paper utilizes the LRO(Lunar Reconnaissance Orbiter) Ka-band with a HGA(High Gain Antenna), in an effort to confirm the availability of the Korean VLBI(Very Long Baseline Interferometry) for the spacecraft tracking. The LRO carries out downloading to ground station(White Sands Test Facility in New Mexico, USA) four times per day on average using the Ka-band HGA. In this paper to verify the feasibility of communication identification of the LOS(Line-of-sight) of the ground station according to the radiation pattern of the HGA in an arbitrary LRO Moon orbit was carried out. When the LRO communicates with the ground station (White Sands) in the United States for a certain period of time during the lunar orbit, the LRO by the HGA, the LOS is identified at a Korean ground station. Although ground stations in the USA and South Korea are geographically distant, the results indicate that some of the Ka-band signal reception is possible in Korea. In other words, this result is shown that it can not receive all of four times and it can not use the main lobe gain(44 dBi). However, when using the first side lobe gain(29 dBi), the communication time according to a trajectory simulation tool could be

confirmed to last approximately two hours. Moreover, when utilizing the first side lobe, if utilizing the 27m ground station as VLBI receive antenna, the received signal is calculated to be approximately -110 dBm (without filter). In conclusion, the weak signal using the first side lobe of the LRO Ka-band HGA indicates that reception is possible for more than 56 minutes(Communication duration during on one lunar orbit) via Korean VLBI.

10:30 [II-2-5]

Verification Test of CubeSat Ground Station

Seonyeong Jeong , Hyejeong Lee , Seongwhan Lee , Jehyuck Shin¹, Jung-kyu Lee¹, Ho Jin^{1,2}

¹*School of Space Research, Kyung Hee University*

²*Department of Astronomy and Space Science, Kyung Hee University*

SIGMA (Scientific CubeSat with Instrument for Global Magnetic field and rAdiation) is a standard 3 U CubeSat developed by Kyung Hee University. For the reliability of radio telecommunication of the CubeSat, we had been carried out far-field test on the ground. However, the ground far field test has some dependencies according to the ground test conditions. Therefore, the ground station was tested by OSCAR satellites to verify a RF chain. In this satellite communication test, we transmitted and received our voice signals at SIGMA ground station through the transponder of OSCAR. The satellites were FO-29 and SO-50 which had same frequency bands with SIGMA. From this satellite communication test, we were able to verify reliability of the ground station. In this paper, we present the satellite communication test procedures and results of the CubeSat ground station including ground far field test.

10:45 [II-2-6]

Final Check and Initial Operation Concept of the SIGMA(KHUSAT-03) CubeSat

Seongwhan Lee, Jung-Kyu Lee, Hyejeong Lee, Jehyuck Shin, Seonyeong Jeong, Ho Jin

School of Space Research, Kyung Hee University

The Scientific cubesat with Instrument for Global Magnetic field and rAdiation (SIGMA) 3U CubeSat, a installation of Tissue Equivalent Proportional Counter (TEPC) and a fluxgate MAGnetometer (MAG), is scheduled to launch on 1Q of 2017. Before the launch, the SIGMA CubeSat has uploaded a final Flight SoftWare (FSW) and has verified stability of fully long-term operation test for a period of 1 week. In the integration campaign, we carried out confirmation of CubeSat status and health check. The SIGMA CubeSat operates initial mode after SIGMA is deployed from dispenser. During the initial mode, the antennae and MAG boom will be deployed and beacon will be sent to ground station at Kyung Hee University. Then, SIGMA enters Attitude Control System (ACS) mode to de-tumble and nadir pointing. In the operation mode, TEPC and MAG payload are operated and science data are sent. The SIGMA send science data automatically if the command is not received from ground station within 3 days. In this paper, we present the result of final check and initial operation plan of the SIGMA.

제3발표장 (크리스탈홀3)

■ II-3 Special Session:

Space Situational Awareness

좌장: 박장현 (천문연)

09:30 [II-3-1]

Korean Space Surveillance Technology Status and International Collaboration

Junghyun Jo

Korea Astronomy and Space Science Institute, Korea

Current number of active satellites and space debris is near the saturation level of the space surveillance capability. Korea has seen the development of a 'Electro-Optical Space Object Monitoring System' to improve the space surveillance capability since 2010 and has tried to upgrade its coverage. The international collaboration is necessary for the space surveillance due to its nature. Every sector of international space surveillance is ambitiously looking for hard coupled collaboration now. In this presentation, current status of Korean space surveillance technology and international collaboration will be discussed.

09:45 [II-3-2]

Space Objects Database for National Space Situational Awareness System

Eun-Jung Choi, Sungki Cho, Junghyun Jo, Jang-Hyun Park

Space Situational Awareness Center, Korea Astronomy and Space Science Institute

This paper presents the design of space objects database for developing national space situational awareness(SSA) system. The space objects database is carried out as part of the integrated analysis system for space risk. In order to study and design a data policy for the national SSA system, an overview of existing space object databases is described. An efficient and systematic management is required to deal with the space objects data collected by various routes, such as space object surveillance information of foreign partners, calculated data and information of space surveillance observation equipment and data provided by domestic space observation system. This system includes main functions about acquisition data, implementation, statistical analysis and data visualization. Also, in this paper, the standard structure and interfaces are proposed.

10:00 [II-3-3]

Computational Methods for Ground Risk Assessment due to Space Debris Re-entriesDeok-Jin Lee, Tae-Soo No, Eun-Jung Choi, Junghyun Jo, Sungki Cho, Jang-Hyun Park³¹*Kunsan National University*²*Chonbuk National University*³*Korea Astronomy and Space Science Institute*

The trajectory prediction and risk analysis of uncontrolled reentries of space objects is still challenging research issues. The difficulties come from the facts that tracking data from sensors may be sparse and not particularly accurate, and complicate object shape and unknown attitude evolution may make the aerodynamic computations difficult, etc. In this paper, a overview of the relevance of the risk assessment related to space debris reentries and debris survival down to the ground is given first, and then the analytic techniques developed in support of the analysis of ground impact risk including human casualty risk are investigated in detail. The risk due to reentries can be determined through analysis of surviving fragments, their dispersion across a ground swath and the resulting human casualty risk can be obtained for the underlying ground population distribution. The on-ground risk comprises a population density prediction model based on the Grided Population of the World scaled with the UN World Population Prospect. Special attentions are paid to the evaluation of the ground risk computation by making various simulation studies.

10:15 [II-3-4]

Precise Orbit Determination of Cryosat-2 and KOMPSAT-1 Satellites using Optical Wide-field Patrol Network (OWL-Net) Data with Batch Least Squares FilterEunji Lee¹, Sang-Young Park, Sungki Cho, Eun-Jung Choi², Junghyun Jo², Jang-Hyun Park²¹*Astrodynamics and Control Lab., Department of Astronomy, Yonsei University*²*Korea Astronomy and Space Science Institute*

Optical Wide-field Patrol Network (OWL-Net) is Korean optical system for the surveillance of space objects. The measurements are used to track and monitor domestic satellites. In this research, the effects of bias and noise on precise orbit determination are analyzed and precise orbit determinations of Cryosat-2 and KOMPSAT-1 are conducted using OWL-Net data and batch least squares algorithm. The algorithm is verified by Monte-Carlo simulation and covariance analysis. The estimation accuracy significantly depends on the declination bias in case of polar orbit. The noise linearly affects the estimation accuracy and the level of residuals after convergence is the same order of the level of noise. Therefore the residual can be used as a criterion to determine the noise level of measurement data. The accuracy of the orbit determination is about 10 km, same order of TLE (Two Line Elements), when the bias estimation is included. The estimated bias are sub-degree level for each, and the precision of OWL-Net data is figured out as tens of arc-seconds.

10:30 [II-3-5]

Collision Estimation and Collision Avoidance Control for Multiple Cubesat Mission

Jeong-Ah Lee, Sang-Young Park

Astrodynamics and Control Lab., Dept. of Astronomy, Yonsei University

The cubesat missions have been rapidly on an upward

tendency because of its cost saving effect. Especially, formation flying of multiple cubesats is used for various science and technology validation missions. The cubesat needs to maneuver in order to prevent any collision when another satellite gets close in their formation flying. This study presents the method to estimate the collision probability and to perform the orbit control for collision avoidance. Firstly, the covariance analysis is conducted. The positions and the covariance matrices over time are propagated with the dynamic model including the perturbation effects such as differential gravity, eccentricity of a reference orbit, J_2 effects. Then, the mahalanobis distance and the real-time collision probability for each time are calculated. The orbit control methods to mitigate the collision risk are classified into grade according to the probability. As a result of this study, an algorithm for the estimation of autonomous collision probability and the optimal control is designed. The algorithm developed in the current study can be applicable to the orbit control of a subsequent cubesat that has collision risk with other cubesat or conjunctive object.

10:45 [II-3-6]

A Survey of Space Debris Re-entries and Analysis Tools

Young-Jae Park, Deok-Jin Lee, Tae-Soo No
Eun-Jung Choi, Jung-Hyun Jo³, Sung-ki Cho
Jang-Hyun Park³

¹Chonbuk National University

²Kunsan National University

³Korea Astronomy and Space Science Institute

Space debris re-entry events are distinct from natural object such as a meteorite, asteroid and artificial structure such as satellite, booster. For decades, in order to avoid the disasters caused by uncontrolled space debris re-entries, international space agencies and other organizations made efforts on designing space debris reentry analysis methods and tools. One of the typical and representative tools include ORSAT and DAS designed by NASA, SCARAB from ESA for re-entry analysis and prediction. In this paper, we present detailed investigation results of space debris re-entries as long as the analysis tools for space debris re-entry analysis. We investigate advantages, disadvantages and performances, of the analysis tools (ORSAT, DAS and SCARAB). In addition, recently produced tools, DAS2.0 by NASA and STELA from CNES(French Space Agency) are also investigated in detail for re-entry prediction accuracy and life-time analysis. In this work, we are also tried to suggest key research trends and topics for space debris re-entry risk analysis. In turn, it is trusted that the suggested data and results in this work could be the basis for developing a Korean Re-entry Analysis (KRA) tool.

**11:00 ~ 12:00 2부 포스터발표
(No.63 - No.125)**

제1발표장 (크리스탈홀1)

**III-1 Sun/Space Environment II
좌장: 이우경 (천문연)**

13:30 [III-1-1]

Intense Turbulence Induced by Large Plasma Velocities in Association with High-Energy Electron Precipitation During High-Speed Solar Wind Stream Events in the Polar Summer Mesosphere

Young-Sook Lee^{1,2}, Young-Sil Kwak^{1,3}, Kyung-Chan Kim and Jaejin Lee^{1,3}

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⁴Division of Science Education, College of Education, Daegu University, Korea

This study reports that significant portion of intense turbulences in the polar summer mesosphere (82-90 km) occur in association with large velocity ($\geq 150 \text{ m s}^{-1}$) including the supersonic ($\geq 300 \text{ m s}^{-1}$), in turn linked to corotating interaction region (CIR) formation and the passage of high speed solar wind streams (HSS) over the Earth's magnetosphere. The turbulence and the velocity are retrieved from 52 MHz VHF radar, Kiruna, Sweden for 2006 summer. The turbulence at 82-86 km in 24 hour running mean is well correlated ($R=0.52$) with AE index. This implies that turbulence at those altitudes are to a significant extent linked to solar wind energy input during geomagnetic disturbance. Especially turbulence peaks (or intense turbulence) at 82-86 km in the majority precedes to peaks of polar mesospheric summer echoes (PMSE), which is well correlated with recurrent HSS. In the meanwhile, at 86-90 km turbulence is not well correlated with AE index, and PMSE occurrence and reflectivity are generally lower than that of 82-86 km. The occurrence rate of extreme horizontal plasma velocities $\geq 300 \text{ m s}^{-1}$ can be accelerated in electric field as induced by high-energy electron precipitation during geomagnetic disturbance. The extreme neutral speed is identified with supersonic at temperature $< 150 \text{ K}$ in the polar summer mesosphere. In this study, the turbulence is also observed for vortex occurrence likely created by the upward propagating winds confronting with the existing wind field at the higher altitude. However, the vortex-produced turbulence is much weaker than that produced by large velocities $\geq 150 \text{ m s}^{-1}$ including supersonic velocity over 300 m s^{-1} . As a result, this study suggests that as a new aspect, in the summer polar mesosphere intense turbulence can be significantly induced by large plasma/neutral velocities as sourced from above driven by the fast solar-wind streams interacting with the magnetosphere.

13:45 [III-1-2]

Effect of Hot Anisotropic He+ Ions on Ion Cyclotron Instabilities and Its Implication on EMIC Waves in the Inner Magnetosphere

Dae-Young Lee, Sung-Jun Noh¹, C.R. Choi¹, Jaejin Lee², Junga Hwang²

¹Department of Astronomy and Space Science, Chungbuk National University

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Electromagnetic waves below but near proton cyclotron frequency plays an important role in the magnetosphere and magnetosheath. A conventional linear theory suggests ion cyclotron instability to explain such wave amplification when hot ions are characterized by anisotropic distributions. In the magnetosheath, both warm protons and He⁺⁺ ions were considered to be anisotropic and its effect has been investigated since long ago. In the inner magnetosphere, the majority of the related research has focused on proton temperature anisotropy effect, and no serious attention has been given to hot He⁺ ion anisotropy. Motivated by observations showing hot anisotropic He⁺ ion distribution, in this work, we solve the kinetic dispersion relation to identify the effect by such ions. We find that hot anisotropic He⁺ ions can increase He band wave growth and reduce H band wave growth (damping). This effect is most prominent for high enough He⁺ temperature. It is also more significant for cold plasma dominant condition such as inside the plasmasphere or plume than for hot proton dominant plasma condition.

14:00 [III-1-3]

Simulation Study of Whistler Instability with Magnetic Inhomogeneity Perpendicular to the Background Magnetic Field

Sang-Yun Lee, Ensang Lee, Khan-Hyuk Kim, Dong-Hun Lee, Jongho Seon

School of Space Research, Kyung-Hee University, Korea

We investigate some effects of magnetic inhomogeneity of whistler instability using two-dimensional relativistic electromagnetic particle-in-cell (PIC) code. Whistler instability is generated from electron temperature anisotropy, $T_{\perp p}/T_{\parallel p} > 1$. We apply a gradient of magnetic field intensity perpendicular to the background magnetic field. The thermal velocity of electrons is constant in this simulation so that the electron plasma beta only depends on the perpendicular magnetic inhomogeneity. The broad range of beta yields a broad frequency range of whistler waves. We focus on the wave propagation in the inhomogeneous region. Generally, anisotropic temperature of electrons in homogeneous magnetic field generates oblique whistler only when the beta is small enough ($\beta < 0.025$). However, the whistler waves in the gradient region propagate oblique to the magnetic field regardless of electron beta.

14:15 [III-1-4]

Ionospheric Disturbances in Low-and Middle-Latitudes Induced by Neutral Winds and Vertical E×B Drift During the 2015 St. Patrick's Day Storm

Woo Kyoung Lee¹, Hyosub Kil

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Significant longitudinal and latitudinal modulations in plasma density were observed by satellites during the 17 March 2015 storm. Pronounced equatorial ionization anomaly (EIA) and ionization trough developed in the Indian sector (60°-90°E), whereas those features did not appear in the African sector (20°-40°E). Significant ionospheric uplift was observed in the Indian sector, but the uplift was ignorable in the African sector. The vertical E×B drift is an important factor for the longitudinal variation of the ionospheric morphology, but the observed latitudinal density profiles are not fully explained by the effect of the vertical E×B drift alone. In this study, we investigate the combined effect of vertical E×B drift and meridional winds by conducting SAM2 (Sam2 is Another Model of the Ionosphere) model simulations. By comparing the model results with satellite observations, we will assess the ionospheric conditions in the Indian and African sectors. The observations of Defense Meteorological Satellite Program, Swarm, and Communication/Navigation Outage Forecasting System satellites will be analyzed for this purpose.

14:30 [III-1-5]

An Analysis of Meteor Altitude Distributions Observed by a Meteor Radar at King Sejong Station, Antarctica

Wonseok Lee, Yong Ha Kim, Changsup Lee², Jeong-Han Kim²

¹Chungnam National University

²Korea Polar Research Institute

The meteor radar at King Sejong Station (KSS), Antarctica (62.22°S, 58.78°W) observes more than 20000 meteors a day, providing physical parameters, such as speeds, plasma line densities and altitudes of meteor trails. Utilizing a meteoroid ablation model, we determined initial mass and velocity of incoming meteoroids from the observed parameters, assuming an atmospheric model and entry angles. According to the ablation model simulation, a meteoroid would be observed at an altitude of 3.9 km lower and 1.6 km higher if its initial mass and velocity increase by 10 times and by 5 km/s, respectively. The meteor altitude would also appear 1.2 km lower if the entry angle becomes 15° steeper. Applying the ablation model to KSS meteor radar data we derived the initial mass distribution whose logarithmic distribution is close to a Gaussian shape with a full width of half maximum (FWHM) in a range of 1.9 ~ 2.2. The FWHMs of mass distributions cause FWHMs of meteor altitude distributions to be 5.2 ~ 6.1 km in December and 8.0 ~ 9.2 km in June. This indicates that meteor altitude distributions are affected by seasonal atmospheric density variation (~3 km) more sensitively than by variation in the incoming meteoroid mass distributions (~1 km). Therefore, we conclude that observed meteor altitude distributions are mainly dependent on the atmospheric density, and thus can be used as a mesospheric temperature indicator with an appropriate calibration method.

제2발표장 (크리스탈홀2)

III-2 Solar System Exploration II

좌장: 심채경 (경희대)

13:30 [III-2-1]

Infrared Spectrometer for Lunar Water Ice

Haingja Seo, Young-Jun Choi, Minsup Jeong, Eunjin Cho^{1,2}, Ikseon Hong^{1,2}, Woong-Seob Jeong, Bongkon Moon¹, Sung-Joon Park¹, Dae-Hee Lee, Jeonghyun Pyo, Il-joong Kim¹, Seung Kwan Kim, Seong Je Park, Geon-Hee Kim, Kyungin Kang⁶

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⁵Korea Basic Science Institute

⁶Satellite Technology Research Center, KAIST

The existence of hydroxyl and water ice is important to understand lunar environment, tectonic processing, and origin. We are developing an engineering model of Lunar Infrared Spectrometer (LIRS) to detect temporal variation of hydroxyl/water ice on the lunar surface, and to construct the global map of hydroxyl/water ice distribution. Infrared spectrometers of planetary exploration mission in a fly-by of the Moon, such as VIMS/Cassini and HRI-IR/Deep Impact, indeed, detected hydroxyl at 2.8 micron. Recently M3/Chandrayaan-1 reported a global distribution of hydroxyl on lunar surface, but, unfortunately, the wavelength had been cut off by 3.0 micron. The central wavelengths of hydroxyl and water ice are 2.8 and 3.1 micron, respectively, and LIRS is designed to have the wavelength coverage of 2.0 ~ 4.0 micron. We will discuss science requirements, such as spectral resolution, spatial resolution and sensitivity.

13:45 [III-2-2]

Effect of Lunar Gravity Model on Orbit Determination of Lunar Orbiter

Young-Rok Kim, Young-Joo Song, Jonghee Bae, Bang-Yeop Kim, Gi-Hyuk Choi

Korea Aerospace Research Institute

The lunar gravity field plays an important role in spacecraft orbit propagation and orbit determination (OD) around the Moon. For better orbit accuracy and effective mission operation, selection of lunar gravity model is a key issue of lunar orbiter OD problem. In this study, OD simulation for lunar orbiter locating at 100 km altitude is performed by using various lunar gravity models. First, measurements of Lunar Prospector, which has 100 km altitude lunar polar orbit are simulated for Korea Pathfinder Lunar Orbiter (KPLO) mission operation. DSN Doppler and DSN sequential range measurements by 3 Deep Space Network (DSN) and 1 Korea Deep Space Antenna (KDSA) are generated. Next, OD results during one month are investigated and assessed by covariance analysis using position uncertainty. For measurement simulation and OD, Orbit Determination Tool Kit (ODTK) version 6 is utilized. GLGM2, LP100K, LP150Q, and

GRAIL660B are used for demonstration of lunar gravity model effect. Consequently, significant improvement of OD precision is observed by applying recent lunar gravity model. However, it is also discovered that applying full order and degree gravity modeling is not always best strategy. This study gives useful guideline for KPLO OD during nominal mission operation.

14:00 [III-2-3]

Shielding Effect of Geomagnetic Field on Hydroxyl formation on Lunar Surface

Eunjin Cho^{1,2}, Jaehyung Yu¹, Young-Jun Choi², Yu Yi

¹Chungnam National University

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The moon is located in the Earth magnetosphere during about 25% of each lunar orbital period. During the period, the lunar surface is supposed to get less amount of solar proton flux because of the shielding effect of geomagnetic field. Although some previous studies made models explaining how the distribution of solar wind flux is changed by shielding effect on lunar surface, there is not a case of direct observation showing whether the flux of solar wind particles implanted on the surface indeed decrease according to the shielding effect. This study tested its evidence by analyzing the amount of hydroxyl. In order to confirm this hypothesis, comparative analyses of absorption features of hydroxyl was conducted for the periods when the moon is inside and outside of geomagnetosphere employing M3(Moon Mineralogy Mapper)/chandrayaan-1 data. The results reveal that while the moon is inside of geomagnetosphere, it has about 5-7 % less amount of hydroxyl than outside. It implies that the shielding effect of geomagnetic field affects the formation of hydroxyl on lunar surface. If a new infrared spectrometer covering the wavelength range near 3 μm performs a mission and gets additional data of hydroxyl, this studies will be able to be conducted further in detail.

14:15 [III-2-4]

Lunar paleomagnetic pole analysis using central Magnetic Anomaly Signatures of Nectarian Basins

Hyung Rae Kim, Hyung-Gyu Kim¹, Ralph von Frese, Lon Hood

¹Kongju National University

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The Nectarian age (3.8 - 4.2 Gyr) impact basins are investigated for finding a prominent central crustal magnetic anomaly features from Kaguya and Lunar Prospector satellite magnetometer observations. Comparable central basin magnetic anomalies observed for several other Nectarian basins (e.g., Mendel-Rydberg, Nectaris, Bailly, Moscoviense, Crisium, Humboltianum) have been attributed to thermoremanent magnetization, and thus may provide important constraints on the Nectarian properties of the of the lunar core dynamo. Accordingly, the three-component central basin magnetic anomaly features are modeled in selenographic coordinates for its possible magnetization attributes. Specifically, the central basin anomaly components were

related to spherical cylinder-type magnetic sources in the subsurface. We suggested that the resulting magnetization orientation imply a Nectarian north paleomagnetic pole (dynamo field lines radially outward) and compare with another results by the other researchers.

14:30 [III-2-5]

Lunar subsurface void exploration using GRAIL gravimetry data

Ik-Seon Hong^{1,2}, Seung-Sep Kim¹, Jaehyung Yu¹, Young-Jun Choi², Yu Yi¹

¹Chungnam National University

²Korea Astronomy and Space Science Institute

In the Moon, a subsurface void as a lunar lava tube is of importance for the possibility of habitable shelters in the future. A lunar pit feature could be a candidate of a subsurface void because a lunar pit might be an entrance for a subsurface void. However, existence of the void below a pit is hardly to be confirmed because observation of a pit solely depends on the optical image so far. Therefore, it is highly encouraged to explore the information on the lunar interior. In this study, we introduce the attempts to detect a subsurface void by analyzing gravity anomaly of the surrounding areas of lunar pits with Gravity Recovery And Interior Laboratory (GRAIL) data.

14:45 [III-2-6]

Analysis of Kaguya Lunar Radar Sounder (LRS) Surface Range Data for Detection of Possible Lunar Lava Tube

Changwan Sun², Takao Kobayashi¹, Kyeong-Ja Kim², Young-Jun Choi³

¹Korea Institute of Geoscience & Mineral Resources (KIGAM)

²University Science & Technologies (UST)

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Lunar Radar Sounder (LRS) on board Japanese lunar orbiter, KAGUYA, was a High Frequency (HF) radar and successfully performed global lunar observation. LRS observation results provide its surface range data. On the other hand, the surface range can be calculated using Digital Terrain Map (DTM) data of KAGUYA Terrain Camera (TC) and the orbit data. These surface ranges are expected to be identical to each other. If not, the discrepancy should be made by the influence of the shallow subsurface structure of the Moon, e.g. a lava tube. In this work, we make an attempt to find such surface range discrepancies that imply possible lunar lava tube. The results will be presented in this fall meeting.

제3발표장 (크리스탈홀3)

III-3 Space Technology & Application II

좌장: 송영주 (항우연)

13:30 [III-3-1]

An Overview of the Korean Satellites

Development History and Status Based on the Compact Advanced Satellite 500(CAS-500) Program

Ji-Mo Yang, Keunwoong Shin, Myung-Jin Baek

Korea Aerospace Research Institute

The development of Satellite in Korea was started KSISAT-1 which is the small satellite, and it has expanded development area from the 'Arirang' series (low-orbit satellites) to the 'Chunrian' series (geostationary satellites). In recent, the Compact Advanced Satellite 500(CAS-500) development program has started with the goal of the industrialization of space technology as well as the independence of domestic satellite development. In this paper, I will consider the history and status of development programs of Korean satellites and focus on the significance of the CAS500 program.

13:45 [III-3-2]

Introduction to the Procedure of Securing of the Next Year R&D Budget for CAS500-1

Keun-Woong Shin, Ji-Mo Yang, Chul-Kang, Myung-Jin Baek

Korea Aerospace Research Institute

This article introduce the procedure of securing of the next year R&D budget for CAS-500 series. For the stable R&D, ensuring stable R&D budget is essential. So, it is needed to understand the R&D budget securing procedure. In the case of national R&D budget, due to the nature of which is composed of national tax, related institutions(research institutes, government ministries, parliament, etc) are involved. in addition, National R&D budget is part of the national budget, for that reason, it is affected such as the financial situation of the national budget, related law, and enforcement decrees. In this article, we overview the procedure of securing of the next year R&D budget in basis of related laws as sample for CAS500-1.

14:00 [III-3-3]

Considerations of Bonding Material Selection & Process Evaluation for Composite Structured Satellite

You-Gwang Kim, Sang-Teak Lee, Chang-Ho Lee

Korea Aerospace Research Institute

Most of main structures of the KOMPSAT Series satellites had been manufactured of aluminum alloys and the bonding materials have been evaluated the compatibilities with aluminum alloy substrates also. However, Composite materials based on high modulus carbon fibers dispersed in polymer matrix resins have become a common construction material for satellite in these days. Therefore, the M&P(material and process) evaluation issues faced in implementing integrated bonding of electrical heaters, tie mounts, studs of MLI(Multi layer Insulator) and others which are bonded on the laminated composite structures of the recent KOMPSAT satellite have emerged as a major interest. In this talk, I will present considerations of M&P evaluation issues for composite structured satellite through the bonding adhesion test after the thermal

cycling test based on KPR specifications which have been applied for manufacturing KOMPSAT series satellites. Selected bonding materials and processes will be applied in K6 Structural Thermal Model first, and then those materials and processes will be re-evaluated on the full qualification approaches before the start of integrating the K6 flight model.

14:15 [III-3-4]

Preliminary Study of the Stirling Cryocooler for the Thermal Vacuum Environmental Test

Seong-je Park¹, Yong-Ju Hong, Jun-Seok Ko¹, Hyo-Bong Kim, Han-kil Yeom, Se-hwan In, Young-Jun Choi, Seung Kwan Kim, Geon-Hee Kim, Kyungin Kang

¹Korea Institute of Machinery and Materials

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³Korea Research Institute of Standards and Science

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⁵Satellite Technology Research Center, KAIST

In spite of the growing use of uncooled night vision technologies, cooled systems are still known to be superior in terms of working range, resolution, and ability to recognize/track fast moving objects in dynamic infrared scenes. The Stirling cryocoolers have been widely used for the cooling of the infrared detectors (InSb, HgCdTe and etc.) and HTS (high Temperature Superconductor) to the cryogenic temperature. The integral Stirling cryocoolers with the rotary compressor are applicable to the cooling device for the compact mobile thermal imaging system, because the cryocoolers have the compact structure and light weight. In this study, preliminary tests of the Stirling cryocooler for the thermal vacuum environmental test are investigated. The results show the need for the thermal dissipation of the high temperature region in the Stirling cryocooler for the thermal vacuum environmental test.

14:30 [III-3-5]

A Study on Design and Statistical Analysis of the Droplet Combustion Apparatus in Micro-gravity Environment

Jong-Won Lee, Joo-Hee Lee, Youn-Kyu Kim

Korea Aerospace Research Institute

We are developing a droplet combustion apparatus to study a combustion phenomena in micro-gravity environment. This apparatus consists of a combustion module, a chamber and a controller. The goal is to build and test a chamber which can sustain a pressure condition from a vacuum of 1 mTorr to a maximum pressure of 9 atm with a mixture of inert gases (Ar, He, N₂) and varying oxygen concentration (5~95%) accordingly. Given pressure conditions, we estimated a thickness of a chamber wall and ran a simulation of structural analysis to verify its design. In the following step, we are going to build a prototype chamber based on simulation results and carry out a performance test. With a possibility of collaboration with NASA, this study will lead us to secure a technology development of a space experiment equipment at International Space Station (ISS) and provide a understanding of the scientific

mechanism of combustion phenomena in micro-gravity environment.

14:45 [III-3-6]

Thruster Loop Controller Design of Sun Mode for LEO Satellite

Hong-Taek Choi, Hyung-Joo Yoon, Young-Woong¹ Park, Bong-Un Lee²

¹Korea Aerospace Research Institute

²Korea Aerospace Industries, Ltd

Attitude control subsystem for the LEO satellite usually consists of standby mode, sun mode, maneuver mode and mission mode to perform the mission. The mission mode uses reaction wheels as an actuator and the sun mode and the maneuver mode uses thrusters as an actuator. The sun mode is divided into safe hold submode and sun pointing submode while the maneuver mode is divided into attitude hold submode and ΔV submode. In this paper, we describe the controller design process and the performance of the design results with respect to the sun mode.

제1 발표장 (크리스탈홀1)

■ 초청강연 II

좌장: 유광선 (과기원)

15:10 [IS-II]

Ionospheric Climate and Weather Probed by GNSS Radio Occultation Soundings

Tiger J.Y. Liu ²

¹Institute of Space Science, National Central University, Taiwan

²Center for Space and Remote Sensing Research, National Central University, Taiwan

The FORMOSAT-3 Project is also named Constellation Observing System for Meteorology, Ionosphere and Climate, or FORMOSAT-3/COSMIC (F3/C) for short. The project is targeted to place six micro-satellites into six different orbits with 72-deg inclination at 700~800 kilometer above the earth ground. These satellites orbit around the earth to form a low-earth-orbit constellation that conduct radio occultation (RO) by receiving signals transmitted by the 24 US GPS satellites. The satellite observation covers the entire global atmosphere and ionosphere, providing over 2,500 global RO sounding data (electron density and S4 scintillation profiles) per day since 15 April 2006. This for the first time allows scientists observing the 3D ionospheric electron density structure and dynamics. Ionospheric weathers response to solar wind, solar eclipse, magnetic storm, earthquake/tsunami, etc. are presented. Following the F3/C, FORMOSAT-7/COSMIC (F7/C2) consists of six small-satellites with 24-deg inclination and about 500 km altitude and six small-satellites with 72-deg inclination and about 800 km altitude will be launched in 2016 and 2018, respectively. Currently, NCU (National Central University) has been collaborating with NCAR (National Center for Atmospheric Research) and NOAA to develop ionospheric weather models by assimilating F3/C data into

existing ionospheric models. The developed models with F3/C and F7/C2 data shall be open to the space weather and its related communities in the near future.

제1발표장 (크리스탈홀1)

■ IV-1 Sun/Space Environment III

좌장: 김정환 (극지연)

15:45 [IV-1-1]

A New Method for Temperature Estimation Near the Mesopause Region Using Meteor Radar

Changsup Lee , Jeong-Han Kim¹, Geonhwa Jee ,
Wonseok Lee , In-Sun Song¹, Yong Ha Kim²

¹Korea Polar Research Institute, Korea

²Chungnam National University, Korea

We present a novel method for estimating temperature near the mesopause region using VHF meteor radar observations. The method utilizes a linear relation between a full width at half maximum (FWHM) of meteor height distribution and the atmospheric temperature around the meteor peak height, instead of meteor decay times and its dependence of temperature as in the existing method. Once the proportionality constant of the linear relation is determined from the independent temperature measurements from the Microwave Limb Sounder (MLS) instrument aboard the Aura satellite for a certain period of time, the temperature can readily be estimated from the measurements of FWHM alone without any additional information. The temperatures estimated from FWHM are consistent with the MLS temperatures within 3.0 % throughout the period of this study. While the previous method is subject to an assumed temperature gradient or pressure, the new method does not require such assumptions, which allows us to estimate the atmospheric temperature at around 90 km with a better precision.

16:00 [IV-1-2]

Variation of Particle Fluxes Across Plasmopause Under Quiet Geomagnetic Condition

Junhyun Lee^{1,2}, Ensang Lee , Khan-Hyuk Kim ,
Dong-Hun Lee , Junga Hwang²

¹School of Space Research, Kyung Hee University, Korea

²Korea Astronomy and Space Science Institute, Korea

Plasmopause is the outer boundary of the plasmasphere where cold plasma density sharply decreases from 100~1000 to 1~10 . In this work, we investigate the variation of low-energy particle fluxes across the plasmopause using the measurement from the Helium Oxygen Proton Electron mass spectrometer (HOPE) onboard the Van Allen Probes satellites. From 0400 UT to 0800 UT on 23 April 2013, the satellites moved outward from the plasmasphere to the magnetosphere in the midnight region. From 12 hours prior to this event, the geomagnetic conditions were very quiet, $K_p < 1+$. Within the plasmopause boundary layer, they observed enhancement of proton fluxes with energies between ~8

eV and ~500 eV. The energy of the protons with enhanced fluxes increased as the satellites approach the magnetosphere. The enhanced proton fluxes rapidly dropped after entering the magnetosphere. We also examine velocity space distribution of the low-energy protons. Inside the plasmasphere, the velocity space distribution was almost isotropic. However, within the plasmopause boundary layer, the distribution shows strong anisotropy in the azimuthal directions. These results suggest that the plasmopause boundary layer has unique kinetic properties distinguished from the plasmasphere and magnetosphere.

16:15 [IV-1-3]

Detection of GPS Phase Scintillation During St. Patrick's day Geomagnetic Storm in 2015 over King Sejong Station, Antarctica

Junseok Hong , Yong Ha Kim¹, Jeong-Han Kim

¹Chungnam National University

²Korea Polar Research Institute

It is well known that ionospheric irregularities can affect satellite communication system especially by signal scintillations. Previous studies found that phase scintillations commonly detected at high latitudes may be related to ionospheric irregularities produced by various processes including geomagnetic storm. The largest geomagnetic storm in solar cycle 24 occurred on 17 March 2015, known as St. Patrick's day storm. During this storm negative IMF B lasted about 18 hours, along with dramatic increase in AE index. Despite being at mid-latitudes (52°S) geomagnetically, the GPS/TEC scintillation monitor at King Sejong Station (KSS) detected three events of apparent phase scintillation. During the first event, when KSS was located in day-time sector, Tongue Of Ionization (TOI) and polar cap patch features appeared on Total Electron Contents (TEC) map over the Antarctic region. We found that the GPS signal path from satellite to KSS penetrated TOI and polar cap patch region during the first event. During the second and third events, KSS was located in night-time sector, and the auroral oval expanded to near KSS, according to the Ovation model. An auroral feature in 630 nm emission was in fact observed by All Sky Camera (ASC) over KSS during the third event. Particle precipitation in the expanded auroral oval may have causes phase scintillations. This paper reports that phase scintillation can occur even at geomagnetically sub-high latitude during the strong storm period.

16:30 [IV-1-4]

Kinetic Temperature Analysis of the Charged Particles' Stochastic Motion by Magnetosonic Waves

Chang-Ho Woo¹, Kyoung-Wook Min , Kyunghwan
Dokgo , Cheongrim Choi²

¹Department of Physics, KAIST, Daejeon, Korea

²Chungbuk National University

The interaction between magnetosonic waves and the charged particles is one of the most important mechanisms in space plasma physics. We present the result of our study on the charged particles interacting

with the magnetosonic waves. Using Lie perturbation theory, we analyzed the Hamiltonian of the particles, resonances and stochasticity conditions. Test particle simulations are presented to compare with those theoretical results. The kinetic temperature is also calculated numerically to confirm the relation between stochastic motion and heating of the particles.

16:45 [IV-1-5]

An analysis of ionospheric E-region profiles from ionosondes at Icheon and Jeju, South Korea

Eunbyeol Jo¹, Yong Ha Kim, Junseok Hong¹, Juncheol Moon²

¹Chungnam National University, Daejeon

²Korea Space Weather Center

We analyze ionospheric E-region profiles that were measured by ionosondes at Icheon and Jeju during a period of 2010 - 2015. The data sets of ionosonde profiles were obtained with an auto scaling program (ARTIST-5) from ionograms measured every 7.5 min, thus containing 203,383 and 201,621 profiles in total from Icheon and Jeju ionosondes, respectively. Each profile usually covers from an altitude of 89 km to the F2 peak with various altitude bins of 1~5 km, and thus were interpolated in a 0.5 km bin for the empirical orthogonal function (EOF) analysis. By carrying out singular value decomposition of a data matrix that consists of the interpolated profiles between 95 and 150 km, we found that about 7 components of EOFs can represent the ionospheric E-region profile at every hour with an accuracy of more than 97%. The largest difference between the EOF profiles and mean measured profiles occurs mostly during dawn and dusk periods. We analyze the seasonal variation of the EOF profiles at each hour for the cases of low, mid, and strong geomagnetic activities. By combining the E-region EOF profiles with the F-region profiles one can reduce errors in tomographic reconstruction from GPS total electron content (TEC) that utilizes only the F-region profiles.

17:00 [IV-1-6]

Characterization of the Plasma Generated in the SaTReC Space Plasma Chamber Facility

Kwangsun Ryu¹, Goo-Hwan Shin¹, Junchan Lee, Kyoung-Wook Min², Koh-Ichiro Oyama³

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³Kyushu University, Japan

We developed a space plasma facility by adding a back diffusion plasma source unit to a mid-sized vacuum chamber with a diameter of ~1 m located in SaTReC (Satellite Technology Research Center), KAIST. To generate plasma with a temperature and density similar to the ionospheric plasma, nickel wires coated with carbonate solution were used as filaments which emit thermal electrons. The accelerated thermal electrons emitted from the heated wires collide with the neutral gas to form plasma inside the chamber. The vacuum chamber filled with nitrogen gas through a precision flow controller to maintain the vacuum level stable at ~10-4 Torr to

prevent unintended plasma discharge. By using a Langmuir probe, RPA (Retarding Potential Analyzer), and IDM (Ion Drift Meter) installed inside the vacuum chamber, the generation of the plasma similar to the space environment was validated and the characteristics of the plasma generated by the back diffusion plasma chamber were investigated. The characteristics of the plasma according to the grid voltage and anode voltage, and neutral density were investigated and a simple physical model based on the electron-nitrogen collision cross-section values was established and dedicated to help understand the plasma generation mechanism and the plasma condition inside the space plasma chamber.

제2발표장 (크리스탈홀2)

■ IV-2 Space Astronomy II

좌장: 김영수 (천문연)

15:45 [IV-2-1]

Feasibility Study of a Future Korean Space Telescope

Dae-Hee Lee^{1,2}, Chang Hee Ree, Yong-Seon Song, Woong-Seob Jeong^{1,2}, Hong-Kyu Moon, Min Gyu Kim^{1,3}, Jeonghyun Pyo¹, Bongkon Moon, and Won-Kee Park¹

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According to the Korean government's Long-term Space Development Plan 2040, "Creative space science research" is included in a statement to investigate the origin and evolution of the universe by conducting a series of Korean space telescope missions: launch of space telescopes on a small satellite and an international collaboration explorer by 2020, a mid-size domestic space telescope by 2030, and a large size Korea leading international space telescope by 2040. We studied the feasibility of the future Korean Space Telescope (KST) for a mid-size domestic satellite platform. In order to pursue the uniqueness of the science program, we consider a wide range of observing wavelength (0.2um ~ 2.5um) with a spectral resolution of R~6 in the NUV and optical bands, and R~30 for NIR, utilizing an off-axis TMS(Three Mirror System) optics with a wide field of view (2x4 degrees) which is optimized for ultra-low surface brightness sources. The main science goals of the mission include investigations of the galaxy formation, cosmic web, and the cosmic background radiation in the NUV-NIR regions. In this paper, we present the science cases and several technical challenges to be resolved along with the future milestones for the success of the KST mission.

16:00 [IV-2-2]

FM Dewar Design for NISS Onboard NEXTSat-1

Kyeongyeon Ko^{1,2}, Bongkon Moon¹, Woong-Seob Jeong^{1,2}, Dukhang Lee^{1,2}, Sung-Joon Park¹, Dae-Hee Lee^{1,2}, Won-Kee Park¹, Mingyu Kim^{1,3}, Youngsik Park¹, Jeonghyun Pyo¹, Il-Joong Kim¹, Goo-Whan Shin⁴, Jangsoo Chae⁴

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⁴Satellite Technology Research Center, KAIST

The Dewar is a cryogenic unit to operate an infrared (IR) detector for the Near-infrared Imaging Spectroscopy for Star formation history (NISS) onboard NEXTSat-1 satellite. Based upon the design and test of Engineering Qualification Model (EQM) of the dewar, we have completed the flight model (FM) recently. The dewar consists of two components to meet the requirements from space environments. One is the cold box at 80K stage including an oxygen-free high conductivity copper (OFHC) heat path, three G10 supports and the filter modules for two Linear Variable Filters (LVF) and the window filter. The other component is the exterior box at 200K stage to interface between a lens barrel and a micro cooler. In order to reduce the thermal load to the cold box, we have designed to isolate the cold box from the outside dewar. Test results showed the cold box could be cooled down to the target temperature of 80 K after about 10 hours. After the EQM test, the OFHC heat path has been re-designed to resist damages from the shock and vibration. The heat path have been divided into two parts, a head and a body, which were connected with the copper braid wires. Modal analysis for the copper braid model showed that the wire length should be longer than 30mm to endure random vibration. Here, we report the design and test of NISS FM dewar.

16:15 [IV-2-3]

Thermal Analysis of NISS onboard NEXTSat-1 for Verification of Passive and Active Cooling Performances

Dukhang Lee^{1,2}, Bongkon Moon, Kyeongyeon Ko^{1,2}, Woong-Seob Jeong^{1,2}, Sung-Joon Park, Dae-Hee Lee^{1,2}, Won-Kee Park, Mingyu Kim^{1,3}, Youngsik Park¹, Jeonghyun Pyo¹, Il-Joong Kim, Goo-Whan Shin, Jangsoo Chae⁴

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The flight model (FM) of the Near-infrared Imaging Spectrometer for Star formation history (NISS) onboard NEXTSat-1 satellite is being developed by Korea Astronomy and Space Science Institute (KASI). The ultimate goal of the NISS thermal design is to reduce dark current and thermal noise to negligible levels by using an active cooling technique that cools the infrared (IR) detector down to ~80K with a micro Stirling cooler. In order to achieve the active cooling with the limited cooling power of the cooler (~ 0.6—0.7 W), successful passive cooling (also called radiative cooling) is firstly required. Therefore, the NISS main body which encloses the dewar and the detector module has been optimally designed to be cooled to ~200K by passive cooling, despite the small volume allocated to NISS. We have conducted thermal analyses to verify the passive and active cooling performances. We find that the NISS main body and the IR detector are successfully cooled to ~200K and ~80K, respectively. In this paper, we present

details of the NISS thermal design and the results of the thermal analysis.

16:30 [IV-2-4]

First space tests of Slewing Mirror Telescope

G. Gaykov

Department of physics, Sungkyunkwan University

The Slewing Mirror Telescope(SMT) of Ultra-Fast Flash Observatory(UFFO)/Lomonosov is aimed to detect optical prompt emissions from Gamma-Ray Bursts(GRBs), which allows UFFO to pioneer an unexplored time domain, first seconds, in the observation of GRBs at the wavelength of UV and visible. The observatory was successfully launched on Apr 28 from a new Russian cosmodrome Vostochny. A series of tests have been performed to operate the SMT in space after launch and to check its sensitivity in the orbit. Optical background has been measured as well. We report results of SMT space tests and their correlation with our pre-flight calculations.

16:45 [IV-2-5]

Korean Network for the monitoring of Night Sky Brightness Measurement

YongSun Lee^{1,4}, JeHoon Park^{1,3}, Yonggi Kim^{1,2}, Yoh Na Yoon^{1,2}, HyungBin Choi⁴

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GaN-MN(Globe at Night-Sky Brightness Monitoring Network), started in the International Year of Astronomy 2009, is progressing active this year. Hong Kong University contributed to this project as a main conductor with help of IAU. This project uses SQM(Sky Quality Meter), commercial instrument for the Night-Sky Brightness which is distributed by Unihedron company. The measured data are collected in GaN-MN page (<http://globeatnight-network.org/>) and distributed for further analysis by every users. Chungbuk National university and Yeong-yang firefly astronomical observatory started the monitoring the night sky brightness measurement in January 2015. The Korean Space Science Society has purchased 14 units of SQM for the Korea Astronomy and Space Science Museum Association, now the korean network for the monitoring of night sky brightness measurement has been established this year. We will report the present status of this network and further plan.

제3발표장 (크리스탈홀3)

6th Space Weather Conference

좌장: 이재진 (천문연)

15:45 [IV-3-1]

Space Weather Services of Korean Space Weather Center

Junchul Mun, KiChang Yoon, Yun Kong, Gwan-Sik Wi
Korean Space Weather Center, RRA

The Korean Space Weather Center (KSWC) of the National Radio Research Agency (RRA) is a government agency which is the official source of space weather information for Korean Government and the primary action agency of emergency measure to severe space weather condition. KSWC's main role is providing alerts, watches, and forecasts in order to minimize the space weather impacts on both of public and commercial sectors of satellites, aviation, communications, navigations, power grids, and etc. KSWC is also in charge of monitoring the space weather condition and conducting research and development for its main role of space weather operation in Korea. In this study, we will present KSWC's recent efforts on development of application-oriented space weather research products and services on user needs, and introduce new international collaborative projects, such as IPS-Driven Enlil model, DREAM model estimating electron in satellite orbit, global network of DSCOVR and STEREO satellites tracking, and ARMAS (Automated Radiation Measurement for Aviation Safety).

16:00 [IV-3-2]

Statistics and Physical Properties of Interplanetary Magnetic Fields Measured Near the Earth

Kyung-Eun Choi¹, Dae-Young Lee¹, Kyu-Cheol Choi², Jae-Hun Kim

¹*Chungbuk National University*

²*SELab*

³*Korean Space Weather Center*

Space weather creates geomagnetic disturbance that can impact our life. There are many reasons that cause space weather changes, and the interplanetary magnetic field(IMF) is the most important one. Compared with other components, IMF Bz is an immediate cause as it is a parallel component to the geomagnetic field. Intense geomagnetic disturbance can be made by magnetic reconnection which can occur more strongly when the magnitude of southward IMF Bz is stronger. Nevertheless, until to date, it has not been trivial to predict IMF Bz. In this work we analyze the statistic properties of IMF Bz measured at L1 point using the data from 1996 to 2015 corresponding to a solar cycle and a half. In this study, we classify the IMF data into three groups. They are IMF conditions associated with CME, those with CIR+HSS (high speed stream) and the remaining ordinary conditions. we find that a majority(84%) of the IMF data are duration the ordinary conditions, only 5% are related to CME structure and ~11% are associated with CIR+HSS. In order to study geoeffectiveness, we have examined relativistic electron(>2MeV) flux response at geosynchronous orbit and compared them among the three groups. We have also investigated AL index. We find that the geomagnetic response in terms of AL and geosynchronous electron flux is non-negligible during the ordinary solar wind condition of IMF Bz with various solar wind parameters to determine the most responsible factors for southward IMF Bz.

16:15 [IV-3-3]

Solar Cycle Variation of Microwave Emission observed by Nobeyama Radioheliograph from July 1992 to August 2016

Sujin Kim¹, Yeon-Han Kim^{1,2}, Jae-Hyung Lee³

¹*Korea Astronomy and Space Science Institute*

²*University of Science and Technology*

³*Korean Space Weather Center/National Radio Research Agency*

We have investigated the variation of the brightness temperature in latitude using the microwave butterfly diagram which is constructed by 17 GHz synoptic maps. For this study, we used 17 GHz daily images obtained by Nobeyama Radioheliograph(NoRH) from July 1992 to August 2016. NoRH is an unique instrument that have provided 17 GHz full disk image of the sun consistently over solar cycle 23 and 24. In this talk, we present the comparison of the variation on the brightness temperature in the polar and middle region and their correlation in the solar cycle. Based on the results, we discuss the application of the polar brightness variation to the prediction parameter for the next solar cycle.

16:30 [IV-3-4]

Ionospheric Oblique Incident Sounding Observations Between Korea and Japan: Preliminary Results

Young-Sil Kwak^{1,2}, Jaeheung Park^{1,2}, Jae-Woo Park³, Ho-Cheol Jeon³, Tae Young Kim³, Jun-Chul Mun⁴, Hyun-Jun Jin⁵, Jong-Hyeon Kim⁵, Terry Bullett⁶

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⁶*University of Colorado, USA*

Ionospheric changes have a strong influence on GPS communication, geodetic, traffic information, shortwave communication, and inshore fishing in modern society. Therefore, the importance of constant monitoring ionospheric environment is increasing. Ionosonde oblique incident sounding observation can diagnose the ionosphere over the ocean which is difficult to install the vertical incident sounder on, and a wide range of local ionosphere can be diagnosed by a small number of oblique sounder compared to the diagnostic sounder of the vertical incident manner. Korea-Japan long distance (~2,000 km) ionospheric oblique sounding observations can create the effect of extending regular surveillance systems for space radio disturbance into the ocean around the Korean Peninsula. In our talk, we introduce the ionospheric oblique sounding observations between Korea and Japan and also present preliminary results.

16:45 [IV-3-5]

Relativistic Electron Flux Forecast at Geostationary Orbit Using Multiple Linear Regression Model and DREAM

Junga Hwang^{1,2}, Daekyu Shin^{1,3}, Kijeong Kim^{1,4}, Junhyun Lee^{1,4}, Kichang Yoon⁵

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⁴Kyunghee University

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The relativistic electron population at MeV energy in the Van Allen radiation belts at geostationary orbit largely varies in association with solar wind disturbances. To provide alerts of possible satellite malfunctions due to deep-dielectric charging during relativistic electron enhancements, we developed an algorithm to forecast daily > 2 MeV electron flux variations at geostationary orbit using a multiple linear regression model. We tested the various combinations of input parameters such as Kp, Dst, solar wind speed, and electron flux of 40 keV, 75 keV, 150 keV, 275 keV, 450 keV, > 0.8 MeV and > 2 MeV obtained from GOES observation. We calculated the model coefficients based on the period from January 2013 to July 2015 and examined the prediction efficiency (PE) for the period from August 2015 to July 2016. The results showed that some combinations of those parameters were most effective in reducing the prediction error. The prediction efficiencies for +1 day, +2 day, and +3 day forecast are about 0.72, 0.52 and 0.34 each. Our model exhibits the best performance of conventional forecast models particularly for the solar declining phase. We also developed a 3D visualization system by using real-time DREAM model for satellite space weather customers. Real-time Dynamic Radiation Environment Assimilation Model (rtDREAM) was developed by Los Alamos National Laboratory (LANL) for nowcast of energetic electrons' flux at the radiation belt to quantify potential risk from radiation damage at the geosynchronous orbit's satellites.

17:00 [IV-3-6]

Advanced SAFE(Safety during Aviation Flight Environment from radiation) System Connected to Aviation System

Tae-Young Kim¹, Yun-Hee Oh¹, Ki-Chang Yoon², Seok-Hyeon Byeon¹, Seung-Bum Yang¹, Eun-Seok Kang, Myung-Jin Choi¹

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In this paper, The development and role of Advanced System comprised of Open API, mobile application, desktop application will be discussed. The system, SAFE(Safety during Aviation Flight Environment from radiation) is built to manage/analyze the effect of cosmic radiation. We extended the existing system that users can lookup/manage radiation dose by in the limited environment to mobile application, Open API and desktop application according to system to system so that we can allow SAFE for the public use. Therefore, we're able to provide cosmic radiation data to not only the domestic air carriers but also researchers. More details of development of Advanced SAFE System will be introduced.

10월 28일(금)

제1발표장 (크리스탈홀1)

■ 초청강연 III

좌장: 이대영 (충북대)

09:30 [IS-III]

Living with a Star: The Need to Defend Earth from Space Weather

Mario M. Bisi

RAL Space, Science & Technology Facilities Council (STFC) - Rutherford Appleton Laboratory (RAL), UK

The term "space weather" can apply to the effects the Sun has on Earth and is seen to have two main strands: (i) scientific research, and (ii) applications (including operations). The former being self-explanatory, however, the latter includes forecasting and operational needs which can be very different from pure research. Understanding and forecasting space weather is essential to ensuring the resilience of critical infrastructures, including power grids, aviation/rail/maritime transportation networks, satellite applications (most notably the precision timing and location services acquired from GNSS) and also terrestrial communication networks as well as for enabling safe human exploration and habitation of space. As a result, space weather has been situated high on the UK's National Risk Register since 2012. Space weather is the driver of the Auroras which result from particles carried directly out from our star, the Sun, transported/propelled out through interplanetary space, which then intersect and interact with the Earth's own magnetically-confined space environment (the magnetosphere-ionosphere-troposphere system), and thus can have deleterious effects in the various infrastructures/areas described above. Here I plan to provide a brief overview of space weather and its impacts, I will very briefly describe the current UK position on space-weather forecasting, and time permitting, I will highlight a few of the scientific areas where STFC RAL Space (often in partnership with the UK Met Office) is working on developing deeper scientific understanding of space weather in order to potentially improve/increase the armoury by which we can conduct and improve space-weather forecasting.

제1발표장 (크리스탈홀1)

■ V-1 Sun/Space Environment IV

좌장: 지건화 (극지연)

10:15 [V-1-1]

Korean Three Dimensional Ionosphere Electron Density Modeling Using Data Assimilation

Chalachew Kindie Mengist^{1,2}, Yong Ha Kim¹, Nicholas Ssessanga

¹Chungnam National University

²Adama Science and Technology University, Ethiopia

In this study, we develop Korean three dimensional ionosphere data assimilation system based on Kalman filter. Slant total electron content observed from ground based Global Positioning System (GPS) receiver network over South Korea is assimilated into International Reference Ionosphere (IRI) 2016 empirical background model. The results show that the data assimilation technique can improve the electron density retrieval in comparison with IRI. The assimilated results are validated with independent ground based ionosonde observations confirms the improvement of background model. It illustrates that our algorithm predicted well and can be able to use for real time application.

10:30 [V-1-2]

Statistical Comparison of Halo CME 3D Parameters and Its Associated Flare Ones for Two Different Groups of CME Kinematics

Soojeong Jang , Yong-Jae Moon , Rok-Soon Kim²

¹Kyung Hee University

²Korea Astronomy and Space Science Institute

We investigate the statistical relationship between the CME 3D parameters (radial speed and width) and its associated flare ones (fluence and duration). For this we consider 105 flare-associated halo CMEs from 2010 to 2013. We calculate the time difference (ΔT = flare peak time - CME first appearance time at STEREO COR1 field of view) of these events. Then we divide the CMEs into two groups: 42 events in group A ($\Delta T < 0$) which first appear after the flare peak times and 63 events in group B ($\Delta T \geq 0$). Our main results are as follows: (1) a correlation coefficient between flare fluence and CME 3D speed ($CC=0.65$) in group B is higher than that ($CC=0.36$) of the group A; (2) there is a possible correlation between flare fluence and CME 3D width for group B ($CC=0.53$); and (3) events in group A show short flare durations less than 1 hours, while events in group B have long durations up to about 4 hours. Based on our results, we infer that CMEs observed before flare peak times may be closely related with flares. Furthermore we will discuss the relationship between flare fluence with CME acceleration.

10:45 [V-1-3]

Heating of Ions in the Downstream Region of a Quasi-perpendicular Bow Shock

Hee-Eun Kim , Ensang Lee , George K. Parks², Naiguo Lin , Khan-Hyuk Kim¹, Dong-Hun Lee¹

¹School of Space Research, Kyung Hee University, Korea

²Space Sciences Laboratory, University of California, USA

We have investigated heating process of the solar wind ions in the downstream region of the supercritical quasi-perpendicular bow shock observed on 27 January 2003. Examination of the velocity space distribution in the particle frame of reference shows that the solar wind ions consist of two different components in the downstream region. One of them is the directly transmitted solar wind ion beam and the other is the component hotter than the directly transmitted ions. We find that the core component is slightly heated crossing the shock to the downstream, while the hot component mainly contributes to the

temperature in the Cluster HIA moment data. In the far downstream region, the temperature of the core component increases about four times from the upstream region and the magnetic moment of the core component does not change much compared to the upstream region, which implies that the heating of the core component in the downstream region is mainly adiabatic. Therefore, this observation suggests that the solar wind ion beam does not instantly thermalize and the hot component plays a substantial role on heating of the ions at the transition region of the supercritical quasi-perpendicular bow shock.

11:00 [V-1-4]

Occurrence of EMIC waves and plasmaspheric plasmas derived from THEMIS observations in the outer magnetosphere: Revisit

Khan-Hyuk Kim¹, Gi-Jeong Kim¹, Dong-Hun Lee¹, Hyuck-Jin Kwon²

¹School of Space Research, Kyung Hee University

²Korea Polar Research Institute

We have statistically studied the relationship between electromagnetic ion cyclotron (EMIC) waves and cold plasmaspheric plasma (Nsp) in the L range of 6-12 using the Time History of Events and Macroscale Interactions during Substorms (THEMIS) data for 2008-2011. We found that the cold plasma density plays a significant role in determining the spectral properties of EMIC waves. We discuss whether a morning-afternoon asymmetry of the EMIC wave properties can be explained by the spatial distribution of cold plasmaspheric plasma.

11:15 [V-1-5]

Contribution of Solar/Geomagnetic Activities and CO₂ Variation to Global Temperature Anomaly

Jinhyun Kim^{1,2}, Yong-Jae Moon¹, Roksoon Kim , Junga Hwang²

¹Kyung Hee University

²Korea Astronomy and Space Science Institute

We have investigated the correlation analysis between global temperature anomaly(TA) and two type factors: greenhouse gas (CO₂) and solar/geomagnetic activities (sunspot number, total solar irradiance, aa, kp, and Dst). From the comparison between TA and these parameters, we find that only aa index from 1859 to 2015 has a meaning correlation ($r=0.61$) with TA. For the same period, CO₂ index has a much stronger correlation ($r=0.94$) with TA, suggesting that the heating by greenhouse gas such as CO₂ is a main factor of global warming. In order to minimize the effect of solar 11 year cycle, we use 11 years running average data. Then we examine the correlations of these parameters as a function of year. It is interesting to note that all correlations except for CO₂ continually increase until around 1990 and then decrease. In the case of aa index, the correlation from 1864 to 1993 is 0.90 and the correlation from 1994 to 2010 is -0.96. This tendency may be due to the fact that solar activity from 22 to 24 solar cycle continually decreases with time. We will discuss the contribution of CO₂ and solar/geomagnetic activities to global warming.

11:30 [V-1-6]**Determining the statistical significance of inner magnetosphere particle precipitation related to EMIC waves**

Dae-Kyu Shin^{1,2}, Dae-Young Lee², Sung-Jun Noh², Junga Hwang¹, Jaejin Lee¹

¹Korea Astronomy and Space Science Institute

²Department of Astronomy and Space Science Chungbuk National University

One of the particle loss process in the inner magnetosphere is precipitation into the Earth's atmosphere caused by electromagnetic ion cyclotron (EMIC) waves through pitch angle scattering. These EMIC wave related particle precipitation can affect the dynamics of ring current protons (~tens of keV) and radiation belt electrons (~ MeV) in the inner magnetosphere. But their statistical effectiveness is poorly understood and is not fully quantified. Here we survey the particle precipitation events observed with MEPED P1, P6 telescope onboard low altitude NOAA POES/MetOp satellites while Van Allen Probes observe the EMIC waves over 3 years. We calculate precipitation rate of ring current and radiation belt particle and their MLT distributions. Proton precipitation rate is much higher than electron precipitation rate a few times and their MLT distribution is different. The main group location of proton precipitation is around noon and the case of electron precipitation is dusk to midnight sector. Each main group location of electron and proton precipitation rate is slightly shifted relative to EMIC waves maximum occurrence rate location. Finally we determine the relationship between precipitations of electrons and protons and dependence of EMIC waves and precipitations on the solar phase years.

■ V-2 Special Session:**Multi-satellite Mission and Observation****좌장: 박영득 (천문연)****10:15 [V-2-1]****Electron Microburst Observation with Formation Flying Nonosats**

Jaejin Lee, Young-Sil Kwak, Jaeheung Park, Jung-A Hwang, Young-Sook Lee

Korea Astronomy and Space Science Institute

Electron microbursts are the short duration (less than one second) energetic electron precipitation into the Earth's atmosphere, mainly observed in the recovery phase of geomagnetic storms. Microbursts are thought to be caused by chorus waves that is generated by equatorial plasma instability. Measuring spatial scale of electron microbursts imply estimating chorus wave's spatial structures and eventually plasma irregularities in equatorial region. In addition, wave-particle interaction, one of hot topics in magnetospheric physics, could be investigated by observing energy dispersion of microbursts. Korea Astronomy and Space Science Institute(KASI) has plan to launch four nanosats to investigate the microburst

structures. These four nanosats will be separated on orbit and slowly move away each other to reach the distance of 100 km one year later. The nanosats have simple particle detectors, Langmuir probes and magnetometers. With this mission, we can study multi-scale structures of Ionosphere/ Magnetosphere in low earth orbit. Now this mission is under planning phase and will be launched around 2020.

10:30 [V-2-2]**A Prior Study on Space Mission Analysis of Cubesat Formation Flying for Geomagnetic Field Observation**

Youngbum Song, Dae-Eun Kang, Seokju Kang, Ho-Chul Kang, Sang-Young Park

Department of Astronomy, Yonsei University, Seoul, Korea

This study presents a space mission analysis of cubesat formation flying for geomagnetic field observation. The geomagnetic field observation is necessary to analyze near Earth space environments. There are many space missions to observe the geomagnetic field in the world. In Korea, KASI has a research plan to make observations of the geomagnetic field by using four cubesats in formation flying in low Earth orbit. Through the research, we can understand the micro-structure of non-uniform phenomena in the ionosphere. The relative orbits of four cubesats should be determined and controlled to keep a proper formation flying to observe the geomagnetic field. This study shows mission constraints and requirements for the space mission. These results can be utilized to develop formation flying GNC (guidance navigation and control) algorithm of cubesats.

10:45 [V-2-3]**Current Status of Developments of Nanosatellites for Government Space Agencies**

Hae-Dong Kim^{1,2}, Won-Sub Choi, Dong-Hyun Cho¹, Min-Ki Kim, Jin-Hyung Kim¹, and Eun-Sup Sim¹

¹Korea Aerospace Research Institute,

²Korea University of Science and Technology

Recently nanoSatellite including CubeSat are very actively being developed. The missions of nanosatellites are also diversifying from technology verification at college level to specified mission for government level. This situation has spurred a wave of innovation through nanosatellites worldwide. In accordance with this trend, government space agencies such as NASA and ESA have been developing nanosatellite missions in order to explore deep space including Moon, Asteroid, and Mars. In this paper, we present current status of developments of nanosatellites for foreign government space agencies. And then, the nanosatellite program at KARI is addressed, which is the 6U CubeSat development program in Korea for the first time. The main purpose of the nanosatellite program at KARI is to develop core technologies for deep space exploration using low-cost testbed. The results of detailed design for first nanosatellite, HiREV(High

Resolution Image and Video cubesat), are presented. Finally, the future prospects of nanosatellites are addressed.

11:00 [V-2-4]

Geometry of High-latitude Plasma Density Irregularities as Deduced from GNSS Observations Onboard LEO Satellites

Jaeheung Park^{1,2}, Young-Sil Kwak^{1,2}

¹*Korea Astronomy and Space Science Institute*

²*University of Science and Technology*

Using Global Navigation Satellite System (GNSS) antennas onboard Low-Earth-Orbit (LEO) satellites, we can estimate Total Electron Content (TEC) along the Line-Of-Sight (LOS) direction between the GNSS and LEO satellites. In general, the TEC values as well as their along-track gradients show dependence on LOS directions. In this presentation we demonstrate (1) how the along-track gradients of high-latitude TEC can be sorted as a function of angles between the LOS directions and background magnetic field, and (2) how geometry of high-latitude ionospheric irregularities can be inferred from the results.

11:15 [V-2-5]

Growth of Large Amplitude Magnetic Pulsations Upstream of Earth's Bow Shock

Ensang Lee¹, George K. Parks, Naiguo Lin, Jinhy Hong

¹*School of Space Research, Kyung Hee University*

²*Space Sciences Laboratory, University of California, Berkeley*

Low frequency waves are excited by the back-streaming ions in the foreshock region of Earth's bow shock. Some of the waves grow to large amplitude pulsations. It is not yet fully understood how a particular wave selectively grow nonlinearly while the adjacent waves remain unchanged. In this study, we investigated the structure of large amplitude magnetic pulsations in the foreshock region using multi-point observations by the Cluster spacecraft. The growth of low frequency waves is associated with the slowdown and scattering of the back-streaming ions, which makes the back-streaming ions diffuse in velocity space. After the waves grow nonlinearly, some particular pulsations further grow to the amplitude a few times larger than the adjacent waves. The growth of the magnetic pulsations is related to a large field-aligned current, which flows in a very narrow, localized region.

11:30 [V-2-6]

Prospects for Solving Mysteries of Magnetic Reconnection by Multi-spacecraft Missions

Junggi Lee^{1,2}, Jaejin Lee¹, G. S. Choe²

¹*Korea Astronomy and Space Science Institute*

²*Kyung Hee University*

Magnetic reconnection is a physical process, which converts magnetic energy of a plasma system into kinetic

and thermal energies of plasma by changing field line connectivity. Although the effect of magnetic reconnection is global, the cutting and "re-connection" of field lines takes place in a small electron diffusion region of the order of the electron inertial length. Therefore, we need microscopic observations and theories to unravel the structure and physical processes of the electron diffusion region. However, the small size and the fast relocation of the electron diffusion region greatly reduce the chance of one observing spacecraft being located in it long enough to collect a useful sequence of information. With a multi-spacecraft mission, one can not only increase the chance of meeting an electron diffusion region, but also make simultaneous measurements in the electron and ion diffusion regions and in the outside regions (inflow and out flow regions) affected by magnetic reconnection. The Magnetospheric Multiscale (MMS) is a NASA four-spacecraft constellation mission purposed to investigate microphysics of magnetic reconnection in the Earth's magnetopause and in the magnetotail. Four identical MMS spacecraft flying in a pyramid-like formation are to generate a meaningful time sequence of measurements in multi-locations in and around the electron and ion diffusion regions. Owing to the unprecedentedly high time resolutions of its instruments, MMS is also able to observe the kinetic processes of very short time scales. We expect that MMS and future multi-spacecraft missions will enable us to understand controversial and unresolved issues of magnetic reconnection.

1부 포스터발표논문 초록

10. 26(수) 14:00 ~ 27(목) 10:00

■ 우주기술

[P-1] Analysis of In-orbit Radiometric Gain Variation of Geostationary Ocean Color Imager

Gmsil Kang¹, Sang-Soon Yong, Sang-Gyu Lee¹, Seung-Hun Lee

¹KARI Payload Electronics Team

²KARI Satellite Payload Research Office

The Geostationary Ocean Color Imager (GOCI) developed for the first time to provide multi-spectral data which is useful to detect, monitor, and predict short term changes of coastal ocean environment around the Korean Peninsula from a geostationary platform has been performing observation mission since successful launch of COMS on 27th of June 2010. The GOCI has equipped with two on-board calibration devices to perform in-orbit solar calibration. For six years operation, its radiometric gain has been periodically measured using the on-board calibration devices. In this paper, radiometric gain variation for each channel and channel to channel variation over six years are analyzed. For this analysis, solar calibration data achieved by the SD (Solar Diffuser) and the DAMD (Diffuser Aging Monitoring Device) are examined. In-orbit radiometric gain shows very stable performance except channel B1. Also, periodic variation of radiometric gain has been shown and it does not mean the real change of instrument. This artificial periodic trend is understood due to on-ground characterization error of on-board calibration devices along solar azimuth angle. In this paper, the actual amount of degradation of radiometric gain is assessed for each spectral channel. Relative gain variation between bands could have some influence on application which uses multi-spectral bands. Channel to channel variation over six years is examined. Also, aging characteristics of SD is analyzed for all spectral bands.

[P-2] Study of In-orbit PRNU Variation of Geostationary Ocean Color Imager

Gmsil Kang¹, Sang-Soon Yong, Sang-Gyu Lee¹, Seung-Hun Lee²

¹KARI Payload Electronics Team

²KARI Satellite Payload Research Office

The Geostationary Ocean Color Imager (GOCI) was developed for the first time to observe ocean around the Korean Peninsula from a geostationary platform. After successful launch of COMS on 27th of June 2010, the GOCI has been performing in-orbit mission during six years. The GOCI is equipped with 2-D pointing mirror to cover the observation area (2500km x 2500km) with 2-D CMOS detector. Also the filter wheel is implemented in order to provide multi-spectral observation with single 2D

CMOS detector. There is intrinsic Pixel Response Non-Uniformity (PRNU) over pixels which is mainly caused by PRNU of CMOS detector and gain deviation of video electronics. Due to this PRNU, there is distortion in raw images. But, this distortion is corrected by the radiometric gain matrix which is characterized through in-orbit solar calibration by on-board calibration devices. Through in-orbit solar calibration over six years, it is noticed that mean gain over matrix is gradually degraded. In this paper, PRNU variation during its mission is analyzed. In order to avoid any artificial impact due to on-ground characterization error, the in-orbit solar calibration data performed at the same solar incident angle have been used for this analysis. The PRNU variation over mission time and over channel to channel. Also, residual PRNU is examined by using the gain matrix calculated by in-orbit calibration. Based on analysis results, in-orbit calibration method to reduce the residual PRNU is recommended.

[P-3] Channel Link for Image Data Communication

Jong-Pil Kong, Youngsun Kim, Jong-Euk Park, Seok-Bae Seo, Sang-Gyu Lee

Korea Aerospace Research Institute,

With the request of smaller ground sampling distance in a electro-optical system development for satellite payload, the line rate increase of the camera electronic has been inevitable and resulted in higher data rate. It normally means that the communication for image data is designed at a nearly maximum speed that the communication device allows, and it suggests more probability of the communication failure due to narrower margin of the timing design. This paper describes what we have done for fixing the communication error in transferring the image data using Channel Link, for which we improved grounding, jitter and skew performance by changing the clocking path to the communication device.

[P-4] Process Modeling Concepts for a Spacecraft Development

Hyung-Wan Kim, Jeong-Su Choi, Jong-Seok Park

Korea Aerospace Research Institute

This paper provides some key concepts of process modeling for a spacecraft development program. A spacecraft developing program is a kind of complex systems that involves multi-disciplinary organizations and activities. We have studied how those activities are structured and represented as a integrated process model. It presents motivations, objectives, and a formal definition of the process modeling. A process is treated as a system. The product system is built for developing a complex system. However, the process systems which can be reused by workers have to be observed and

established. We examine generalized frameworks for the process modeling. Those frameworks can be supported to build a integrated model for project planning and control such as scheduling, budget management, resource control, and risk management.

[P-5] Utilization of Payloads in Korea Communication and Broadcasting Satellite Development

Guen-Young Park, Myung-Jin Baek¹, Seong-Bong Choi¹, In-Bok Yom², Manseok Uhm

¹Korea Aerospace Research Institute

²Electronics and Telecommunications Research Institute

Feasibility Study for the Korea Communication and Broadcasting Satellite Development and Domestic Satellite Communication and Broadcasting Service Industry Promotion Plan is recently in progress. The proposed satellite program will develop satellite bus based on the GEO-KOMPSAT Program (GK2) platform, which can be used as standard platform for future application on domestic communication and broadcasting satellites. The satellite will incorporate several payloads such as Ka-band telecommunication payload, Ka-band broadcasting payload, Satellite Based Augmentation System (SBAS) payload, river/ocean data collection systems (DCS) payload. In this paper, we will present predicted configuration of satellite bus to accommodate several payloads and present development method as well as utilization method for each satellite payloads to meet the demand on the service of government and/or commercial sector.

[P-6] GEO-KOMPSAT-2 Launch Window Analysis considering Eclipse by the Moon

Bong-Kyu Park, Jae-Dong Choi

Korea Aerospace Research Institute

GEO-KOMPSAT-2A and GEO-KOMPSAT-2B which are under development by KARI to replace the COMS mission will be launched by Arian V launch vehicle in 2018 and 2019 respectively. Ariane V will inject GEO-KOMPSAT-2 into transfer orbit whose apogee and perigee altitude is 35,786km and 250km respectively. After injection to GTO, the satellites are transferred to drift orbit by applying a series of apogee burns. GEO-KOMPSAT-2 will stay in transfer orbit for about ten days until it is injected into drift orbit. For the safe transfer orbit operation of satellite, there exist several constraints, especially for satellite attitude with respect to the sun vector which forms the launch window. Launch window is the daily time span during which launch is allowed. GEO-KOMPSAT-2 launch window has been computed and presented in Korea Space Science Society 2015 fall conference considering two constraints: avoidance of eclipse at separation and a constraint of solar aspect angle during apogee burn. The first constraint comes from the necessity to minimize the time duration till the completion of sun acquisition. The second constraint is to meet the solar array thermal condition requirement. In this paper, the launch window has been updated considering third constraint: avoidance of eclipses induced by the moon during transfer orbit operation. The occurrence of an eclipse by the moon might induce problem of power supply during transfer orbit operation as the full charge is requested before start of next apogee burn. Iterative transfer orbit simulation with reduced time interval between two launch times has been performed to define launch

window. The analysis has been done for 3 months of time period starting from 31 of May, 2018.

[P-7] Design and Manufacture of Black Body for Infrared Temperature Sensor

Sung-wook Park, Hyokjin Cho, Hee-Jun Seo, Guee-Won Moon

Korea Aerospace Research Institute

The KOMPSAT-3A is equipped with an infrared payload, and the health care is possible using mobile phone equipped with a infrared sensor.

The daily application of the infrared temperature sensors has been made rapidly. Therefore, the technology of infrared temperature sensor will be accelerated

and also the need for the black body that is used for the infrared temperature sensor calibration will be increased. However, there is no domestic commercial black body product, only specific development for limited field cases have been reported. This paper summarizes the design and manufacture of high precision black body with a wide temperature range and uniformity.

[P-8] On-Board Control Procedure Language Design for Satellite Operation

Su-Hyun Park, Hyun-Kyu Shin

Korea Aerospace Research Institute

For the satellite operation, a ground station carries out the operational procedures which send telecommands to the satellite and check telemetries from the satellite in sequence. If the flight software is able to execute the operational procedures on-board, the satellite will achieve a higher degree of autonomy to recover from the failure more promptly and to survive longer without the ground intervention. This paper proposes the On-Board Control Procedure (OBCP) language design for the autonomous satellite operation. The language is compiled to the intermediate code by the rule defined in this paper. For the future work, the intermediate code shall be to be translated to the target code and finally loaded to the flight software. The flight software shall provide the OBCP execution environment independently from the other parts of the flight software.

[P-9] Residual Propellant Accuracy Prediction of Geostationary Satellite

Eungsik Park

Korea Aerospace Research Institute,

The bookkeeping method for estimating residual propellant of the general geostationary satellites evaluates the propellant consumption through flow rates evaluation. The overall accuracy of the bookkeeping method results from the uncertainty in the flow rates during both LAE and RCT firings. The accuracy of this method directly relies on the predicted accuracy of the flow rate consumptions. The flow rate uncertainty is nominally derived from errors in inlet pressure, temperature, Mission parameters, standard thruster influence coefficients, and PS(Propellant System) piping and equipment modeling. In this paper, we introduce the accuracy model of bookkeeping method and show the result of residual propellant accuracy of

COMS.

[P-10] Mechanical Accommodation of a Meteorological Payload in GEO-KOMPSAT-2A

Jong-Seok Park, Jung-Su Choi, Jae-Dong Choi,
Sang - Ryool Lee

Korea Aerospace Research Institute

In order to maintain the continuity of the meteorological mission of the COMS, the GEO-KOMPSAT-2A carries an advanced instrument, AMI(Advanced Meteorological Imager). It features improved performance over the current MI in COMS so that more stringent interface design have been imposed. Various requirements have been achieved through the spacecraft mechanical design to secure the stable geometrical interface and clean environment required for its sensor unit. This paper presents design requirements to accommodate the AMI into the GK2A and describes how mechanical design implemented in its interface.

[P-11] Preliminary Electric System Design of Standard Platform's for 500kg medium-sized Satellite

Jong-Oh Park Hyeon-Jin Jeon¹, Kyoung-Soo Kim ,
Jin-Kon Bae²

¹*Korea Aerospace Research Institute*

²*Korea Aerospace Industry*

KARI is now developing the 500kg medium-sized Satellite for acquisition of high resolution images of the Korean peninsula to meet the public requirements such as national territory management, agriculture and forestry management, disaster monitoring, etc. This satellite will have the standard platform to accommodate the various payloads system in the future. The standard platform means the reproducible platform without any change in the design as well as configuration predefined. In this paper, we want to introduce the electric system of standard platform for 500kg medium-sized satellite.

[P-12] Power Bus Design of Standard Platform for 500kg Satellite

Jong-Oh Park Hyeon-Jin Jeon¹, Kyoung-Soo Kim ,
Jin-Kon Bae²

¹*Korea Aerospace Research Institute*

²*Korea Aerospace Industry*

The CAS500 is standard platform for 500kg-class satellite. This satellite's standard platform is designed to support a variety of payloads with minimal design changes. The power bus of small-size satellite (less than 1kW) is usually unregulated 28V bus, and medium-size satellite (over 1kW) is unregulated 50V and regulated 28VDC bus. The CAS500 is 1kW class mid-size satellite, and studied to appreciate power bus structure for supplying power to the various payloads

[P-13] Power EGSE Design for Both AIT and Launch Pad Operation

Joo-Ho Park, Dong-Chul Chae, Yun-Goo Huh,
Young-Yun Kim, Seung-Won Cho, Su-Wan Bang,
Guee-Won Moon

Korea Aerospace Research Institute

Korea's space programme has begun since 1990s. During several decades, a lot of achievements are recorded. Korea is no longer just follower but starts a new challenge. Based on the previous sufficient experience, Korea applies new strategy to next satellite development, especially power EGSE. It is called Power and Load Test Set (PLTS) and Control and Monitoring Test Set (CMTS). The main purpose is not much different from other power EGSE. It literally provides electrical power for satellite and monitor the many signals during AIT. However, there is pronounced advantage of this design. In previous power EGSE system, there is an additional equipment just for launch pad operation called Launch Support Test Set (LSTS). It is simply designed so that only necessary components are included. Even though the number is not many, it is unavoidable to overlapped some equipment of power EGSE for AIT. To remove this point and increase the efficiency, PLTS and CMTS are under developing. PLTS and CMTS will be used in whole AIT period, and CMTS can support the launch pad operation as well. This paper will introduce the new design concept and its developing status.

[P-14] Image Reconstruction Prototype System for GEO-KOMPSAT-2B GEMS

Jinhyung Park, Daewon Chung

Korea Aerospace Research Institute

Korea Aerospace Research Institute(KARI) has planned to launch GEO-KOMPSAT-2B(GK-2B) in 2019. The GEMS (Geostationary Environmental Monitoring Spectrometer) is instrument on GK-2B for environmental imaging Korean peninsular and Northern-east asia. GEMS is the first geostationary hyper spectral payload in the world. Hyper spectral sensor produces spectral domain images, not only spatial domain one. Due to difference from conventional payload, new ground image processing system is required for GEMS. We are developing ground system for GEMS and its prototype program. This paper introduces architecture of prototype system for GEMS image reconstruction. The test was performed using synthetic simulated image data.

[P-15] Design of ITOS(Integrated Test and Operation System) for Low Orbit Satellite

Su-wan Bang, Yungoo Huh, Jin-Yeong Ryu, Joo-Ho Park, Guee-Won Moon

Korea Aerospace Research Institute

ITOS(Integrated Test and Operation System) is the most important device for integration and test for low orbit satellite. ITOS is similar with MCE(Mission Control Element), it means ITOS can be developed with common function of MCE. It can have advantages for saving money and changeover AIT(Assembly, integration & Test) to satellite operation phase easily. There are two advantages develop with ITOS for AIT and operating phase. First, AIT processor and satellite database can be

verified before operating satellite. Second, satellite development hazard can be low. When developing low orbit satellite, ITOS have many functions that automatically operating scenario and sending command and receiving telemetry and saving all of data at AIT and operating phase for low orbit satellite. Main function of operating and testing low orbit satellite is that user can make satellite DB and special user can design command structure and telemetry parsing process. In this paper, there are concept and design of ITOS for low orbit satellite.

[P-16] Walking Platform Design Results for Satellite Access Fixture Support inside Space Simulation Chamber

SunKi Baek, KeunShik Kim¹, Jung-Gyu Seo¹, HeeSu Yang¹, Hyokjin Cho, Sung-Jin Lim, Hee-Jun Seo, Sung-Wook Park², Guee-Won Moon

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The walking platform was designed for supporting and operating the 1.6 ton-heavy satellite access fixture. In order to avoid structural deformation detected on the previous platforms, the structural reinforcement distributing the load efficiently was applied on the design. The structural analysis was done in consideration of the safety factor of 1.5. The maximum displacement was 0.25 mm and the maximum stress was 197.87 MPa at the rotating wheel axis point. The analysis results satisfied the structural requirements derived from the composing material properties. Moreover, the separate mounting carts were applied to secure the reliability of the installation.

[P-17] Making and Verification Test of a Large Heat Control Panel for Thermal Vacuum Test

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The large radiating panel was designed, manufactured, and performance-verified for the satellite thermal balance test under the pressure condition of 10^{-3} Pa or less and the temperature environment of -180 °C or lower inside a thermal vacuum chamber. Copper-tube-brazed copper plates were utilized in order to secure a high thermal conductivity. Path of copper tubes on the copper plate was designed based on the thermal/flow analysis results to improve the temperature uniformity of the copper plate surface. The dimensions of the copper plate were 2.2 m by 2.6 m and 2.9 m by 2.9 m respectively with same thickness of 3 mm. Three copper plates for the 2.2 m by 2.6 m plate and four copper plates for the 2.9 m by 2.9 m plate were assembled by brazing because of the dimensional constraints for the material supply and the heat treatment. Helium leak tests, pressure tests, and chill-down tests were performed successfully, and then the performance tests were conducted with satisfying the recruitments in the temperature control range from -180 °C to 100 °C.

[P-18] Introductions of COSMOS for a GEMS EEM Test

Seok-Bae Seo, Jong-Pil Kong, Youngsun Kim, Jong-Euk Park, Sang-gyu Lee, Seung-Hoon Lee

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COSMOS (COMprehensive Space Mission Operations Suite) is a latest technology of the payload test developed for a payload joint development between KARI (Korea Aerospace Research Institute) and BATC (Ball Aerospace Technologies Corp.). The COSMOS has simplified configurations with common interfaces for test systemizing and automation: command sending, telemetry receiving, status and data analysis. This paper explains the COSMOS for a GEMS EEM (Geostationary Environment Monitoring Spectrometer Electrical Engineering Model).

[P-19] Connector Drawings of an EEM Test between GEMS and GK2B

Seok-bae Seo, Jong-Pil Kong, Youngsun Kim, Jong-Euk Park, Sang-gyu Lee, Seung-Hoon Lee

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Before the flight model integration tests of GEMS (Geostationary Environment Monitoring Spectrometer), EEM (Electrical Engineering Model) tests will be conducted for the verification of the interface between GEMS and GK2B (Geo-KOMPSAT-2B). The GEMS EEM is connected to its EGSE (Electrical Ground Support Equipment) by COTS connectors, and this connector interfaces are same with the flight model one. This paper explains the design results of connector drawings for the EEM test of them.

[P-20] Design and Implementation of Satellite Data Logger

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Satellite on-board flight software provides several ways to transfer the information about the status of system. Basically, telemetry packet contains various data of satellite. However, the space for telemetry packet is limited due to the down-link rate. So each item of telemetry packets is selected with a careful consideration. Memory dump is a very useful functionality of telemetry. Also MCS (Minor Cycle Sampling) enables high frequency data gathering while normal telemetry functions work every second. Satellite Data Logger (SDL) facilitates more flexible data collection for the operation of satellite. SDL has a similarity with MCS on data gathering but SDL support more flexible operation. The result of SDL remains in the memory and it can be downloaded to the ground by memory dump while MCS replaces the data area every second. This paper introduces the design and implementation of Satellite Data Logger.

[P-21] The Effect of Temperature Variation on the Circuit that Contains BJT in Spacecraft Application

Jeong-Hwan Yang, Jeong-Eon Park, Hee-Sung Park,
Sung-Woo Park, Jin-Baek Jang
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The low-earth-orbit spacecraft passes through sunlight and eclipse period, therefore the temperature of the low-earth-orbit spacecraft increases and decreases abruptly. So, the electronics in the low-earth orbit spacecraft should endure this abrupt temperature variation to accomplish its mission. Meanwhile, the Bipolar Junction Transistor (BJT) is sensitive to temperature variation when it is working in the active region. In the active region, the BJT operates as amplifier and its amplifier ratio increases as its temperature increases. Therefore, The electronics circuit which contains BJT may not work properly as intended if it is not designed to endure the temperature variation. In this paper, the electronics circuit that consists of BJT is introduced. And the operation of this circuit is analyzed when its temperature increases. And in the end, the relationship between the circuit operation and its temperature is analyzed based on test result.

[P-22] Study on the Structural Stiffness Improvement of Converter Module for LEO Satellite Applications

Jeong-Hwan Yang, Hee-Sung Park, Sung-Woo Park,
Jeong-Eon Park, Jin-Baek Jang
Korea Aerospace Research Institute

Most electronic units installed in satellites are exposed to various environmental conditions such as mechanical shock, vibrations, thermal, radiation and vacuum during launch and on-orbit operation. To verify their robustness against these kinds of severe external operational conditions, normally EQM (Engineering Qualification Model) is built and used to perform the ground level qualification tests. During ground verification tests, the electronics are qualified under much higher environmental stress levels than those of they actually meet. In this paper, root cause analysis on the converter failure occurred during vibration test of the power converter and distribution unit for LEO satellite is carried out and a new structural improvement for the converter module is also proposed. Finally, verification on all environmental tests with proposed converter structure is performed.

[P-23] Development of Medium Size Monolithic Silicon Carbide Mirror for Space Application

Jeoung-Heum Yeon, Won-Beom Lee, Sang-Soon Yong,
Deog-Gye Lee, Seunghoon Lee
Korea Aerospace Research Institute

Prototype model of medium size monolithic Silicon Carbide (SiC) mirror is on the developing for space application. SiC has high dimensional stability with respect to temperature and has high specific stiffness. Its thermal conductivity is also good and therefore thermal control can be easily implemented. SiC is outstanding material for the space application. In this research, developing of monolithic mirror with rear-tail is presented. Monolithic structure has the advantage of control and handling. Rear-tail structure has a function of flexure to minimize

deformation of mirror surface by interface defects. Back side of mirror surface is light-weighted to minimize mass. Mirror design and analysis results with manufacturing status will be presented.

[P-24] Development of Silicon Carbide Telescope Structure for Space Application

Jeoung-Heum Yeon, Won-Beom Lee, Sang-Soon Yong,
Deog-Gye Lee, Seunghoon Lee
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Prototype model of Silicon Carbide (SiC) telescope structure is on the developing for space application. SiC has many advantages for space application, such as, stiffness, strength and thermal point of views. SiC telescope structure with SiC mirror can provide athermalization of telescope system. SiC telescope consists of mirror bracket, tube, and leg parts. Each parts are glued or screwed to be assembled. Mirror bracket and tube are made of SiC for the athermal property. Legs are made of Invar and Titanium for the interface with other structure. Bonding strengths of SiC/SiC, SiC/Invar, and SiC/Titanium are tested for the design of SiC telescope. Assembly jigs are developed for the precise control of bonding gap. Telescope design and analysis results with manufacturing status will be presented. After completion of manufacturing and integration, telescope will be sent to the vibration test for the verification of integrity and mechanical performances.

[P-25] Prediction of Antenna Surface Deformation due to the Excitation of Rotor Disturbance

Shi-Hwan Oh
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For earth-observation camera, a high frequency jitter which affects the pointing stability of line-of-sight of payload can reduce the image quality of the payload product. Actuators or sensors which have vibration source such as angular / linear motor can be a disturbance source for high frequency jitter. Whereas for the radar payload, disturbance forces and torques from the vibration source distort the pointing stability of surface normal vector of beam radiation surface at the high frequency range and finally it degrades the product image quality. Thus, in this paper, the amount of radiation surface distortion is estimated by using the best-straight-fit approach. The representative surface normal vector under the existence of disturbance source is perpendicular to the best-straight-fit line of the outer radiation surface, so the performance degradation of product can be estimated by calculating the maximum rotational angle of the best-straight-fit line of antenna when the disturbance exists. As a result, it is checked that the antenna surface deformation due to actuator disturbance is within the allowable range and the performance degradation is not critical to the overall image quality.

[P-26] Characteristics of the 1/f Noise Depending on resistor width and on whether silicide of n+ poly and p+ poly Resistors on Processors of Satellite Application

Jae-Nam Yu, Na-Young Lee, Sung-Su Jang

Korea Aerospace Research Institute

In this work, dependence of resistor width of flicker noise(1/f noise) characteristics in 0.24 μ m, 0.36 μ m, 1.2 μ m of resistor width of n+ poly resistors and p+ poly resistors is investigated. Also, we investigated of 1/f noise characteristics according to application of silicide or not of n+ poly resistors and p+ poly resistors. Because poly resistor is a basic structure of diodes, BJTs, and FETs in processors of satellite application, study of poly resistor is very important. For high resistance, shrinking resistor width or enlarging resistor length are required. However, enlarging resistor length is not suit for integrating chip size. So, shrinking resistor width is needed. For lower resistance, silicide technology is required, on the other hand, NONSAL(without silicide) is also important for high resistance. In our work, p+ poly resistor with silicide has higher 1/f noise characteristic than n+ poly resistor with silicide, but p+ poly resistor without silicide(NONSAL) has lower 1/f noise characteristic than n+ poly resistor without silicide.

[P-27] Characteristics of 1/f Noise of n+ p+ poly Resistors with Silicide in Accordance with Resistance Variation as a Function of Temperature Changes of Processors in Satellite Application

Jae-Nam Yu, Na-Young Lee, Sung-Su Jang

Korea Aerospace Research Institute

In this work, we investigate the resistance variation with temperature change and also 1/f noise according to the variation of processors in Satellite application. Satellite is in a harsh temperature condition during operation. For estimating 1/f noise of processors in satellite, n+/p+ poly silicide/NONSAL(non-silicide) resistors, which is basic structure of diodes, BJTs, and FETS, are used. Width of resistors are 0.24 μ m and 0.36 μ m, length is 100 μ m, thickness is 0.8 μ m. We analyze the resistors in three temperatures, 25 $^{\circ}$ C, 50 $^{\circ}$ C, and 75 $^{\circ}$ C. In our work, n+ poly resistors has different 1/f noise characteristics with temperature changes than p+ poly resistors. Power spectrum density of n+ p+ silicide resistors and p+ NONSAL resistors is increased with increasing temperature, but n+ poly NONSAL resistor is decreased with increasing temperature. We will show resistance, 1/f noise with changing temperature and will explain the reason of the difference of resistance change with changing temperature.

[P-28] Design of Power Failure Gradual Isolation for LEO Satellite

Seok-Teak Yun, Jung-Un Park, Jeong-Hwan Yang

Korea Aerospace Research Institute

The power protection design is usually considered as critical item. And, even though survival mode, satellite can manage power and thermal stability by it's own function. Because of limited ground contact, low-earth orbiting(LEO) satellite power protection design is more important and critical. The LEO satellite power protection design deal with emergency failure isolation operation and

normal operation management. Due to ground recovery cost and time, this kind of protection must be designed gradually. And, it also guarantee satellite survival at least. So, this kind of design is connected to unit and subsystem failure mode and effect analysis(FMEA). Therefore, this paper propose guide line for design of power gradual isolation connected with FMEA for low-earth orbiting satellite.

[P-29] System Engineering Management for Satellite

Young-Su Youn

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The systems engineering management is the foundation for the technical and engineering activities conducted during the development program. The systems engineering management describes the planning and control of the engineering efforts for the design, development, test and verification of the satellite system and it also includes the system engineering processes. The systems engineering management conveys information on the technical integration methodologies and activities for the program within the scope of the program plan to all of the personnel. The systems engineering management includes the two major parts such as technical program planning and control, and system engineering processes. The technical program planning and control describes roles and responsibilities, integrated product teams and working groups, work breakdown structure, program reviews, technical reviews, and risk management. The system engineering processes describe system engineering process and requirement analysis and allocation. The systems engineering is defined as a methodical and disciplined approach to the design, creation, and operation of systems. The systems engineering consists of identification and quantification of system goals, creation of alternative system design concepts, performance of design trades, selection and implementation of the best design, verification that the design is actually built and properly integrated in accordance with specifications, and assessment of how well the system meets the goals.

[P-30] Reliability Assessment for Engineering Qualification Model of MCS

Do-Kyoung Lee, Hyeon-Cheol Lee, Jong-Tae Lee, Sang Burm-Ryu, Eun-Soo Kang, Sang-Gyu Lee

Korea Aerospace Research Institute

MCS(Multi-Channel Synthetic Aperture Radar) has been developed as EQM (Engineering Qualification Model) for small Radar satellite and critical radar payload technology development. The system of MCS is to provide SAR images from reflected waves of the transmitter and information of Scatteration, Altitude, and Radiation. MCS Hardware constituent is CTA (Controller Assembly), TCA (Transceiver Assembly), RAD (Radiometer), TRP (Tranceiver/Receiver Package) and ATA (Antenna Assembly). The operation of MCS is quite complex than other satellites. MCS functions consist of three band (C, X, Ku) SAR and Scatterometer, Altimeter, and Radiometer. The Mission of MCS are composed of Land, Ocean, and Altimetry mission. Each mission has been decided how to operate several function of MCS in the

point of Hardware. And Each hardware duty cycle is variable dependant on mission operation. The complexity of System has made separation of several mission. This paper show how much impact on reliability due to the mission operation of MCS.

[P-31] Energy Balance Analysis of Low Earth Orbit Satellite from Operation Result

Sang-Rok Lee, Changkyoon Kim, Moon-Jin Jeon,
Seong-Bin Lim

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During daylight period of every orbit, Low Earth Orbit (LEO) satellite generates power by utilizing solar array. And surplus power is stored at battery for eclipse and high power consuming mission operation. In order to have power supply stability, energy balance between generation and consumption should be achieved. In this aspect, through energy balance analysis is performed during design phase. But it assumes worst case to have design margin and cover unexpected effect. So it is possible to different from in orbit operation result. Since analysis from actual operation result is excellent indicator for design maturity evaluation and helpful for next generation satellite design, it should be performed. In this context, energy balance analysis by utilizing actual operation result will be discussed.

[P-32] Development of RF Signal Simulation Device for Verifying RF Signal of Satellite Communication System

Sang-Taek Lee, Change-Ho Lee, Hae-Sun Lee,
Myung-Jin Baek

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Mission data which is acquired by payload is modulated in the data transmission system of satellite and it is transmitted to receiving system of ground station. Transmitting signal from satellite to ground is affected by many kind of loss and noise such like space loss, multi-path loss, polarization loss and noise. For these reason, transmitting RF signal have to be tested and verified during development of satellite communication system. In this paper, the development of hardware will be introduced which is implemented to simulate transmission path effect such like loss and noise between satellite and ground for test and verification.

[P-33] Simplification of Satellite Dynamic Simulator for Attitude Control System Verification

Seung-Hun Lee, Jun-Won Son, Hyun-Ho Seo,
Dae-Kwan Kim

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The attitude control system (ACS) of satellite should be designed to orientate the main structure of a spacecraft correctly and satisfy the required accuracy and to manage angular momentum. Attitude determination logic with precise sensors and attitude control algorithm for actuators are designed to meet the goal of the attitude control system. In this presentation, we present the verification procedure of attitude control system of

satellite. It starts from the creation of requirements for attitude control system and ends with Flight Model test for electrical signal connection and terminal test. The performance of control algorithm for the attitude control system is demonstrated by Satellite Dynamic Simulator (SDS) which runs at real-time computing machine and ACS Performance Analysis Simulator (APAS) which runs at PC. Also we propose the abridged model for SDS and APAS for shortening development phase.

[P-34] Despace Measurement of Compacted High Stability Telescope Structure

WonBeom Lee, JeongHeum Yeon, SuYoung Cang,
EungShik Lee, DeogGyu Lee, SeungHoon Lee

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High stability telescope structure supporting optical components and focal plane assembly is one of the most important parts of compact high resolution electro-optical camera. The despace tolerance of HSTS should be kept within the scope of optical performance under the vibration transferred during launch and the space environment. The despace tolerance of HSTS within operating temperature range has been measured using high precision measurement device and meets the performance within requirement specification.

[P-35] Study on the Usage of Database for the Generation of Telemetry Frame

Jae-Seung Lee, Hyun-Kyu Shin

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The satellite generates and transmits telemetry frames to the ground station for monitoring of satellite's status and analyzing the mission results. In order to analyze the satellite's status more precisely and perform satellite operation more easily, it is required to transmit as many telemetry data as possible. However, the downlink rate is limited by hardware performance. Especially in LEO(Low Earth Orbit)-Satellites, there is a limit to the amount of data to be transmitted to the ground during the contact time in the specified downlink rate. Under this constraint, 'Bit-Packing' method is used to raise the efficiency of downlink. The flight software is modularized to functionalities such as task scheduling, thermal control, electrical power control, attitude and orbit control, command processing, telemetry processing, etc.. For each module has its own telemetry items and function to gather bit-information. Thus, each module cannot be independent to others, and 'Coupling' exists between telemetry module and other modules. Because of this kind of 'Coupling', a change of telemetry data may affect one or more other modules. In this paper, the method of telemetry frame generation using database to minimize 'Coupling' effect among modules and to avoid effect on flight software code itself from telemetry change is introduced.

[P-36] Development of Verification Environments for Efficient Test of Flight Software

Jae-Seung Lee, Hyun-Kyu Shin

Korea Aerospace Research Institute

The flight software monitors the satellite's status, and performs attitude and orbit control and its own mission. Due to the mission objective and its uniqueness, the high level reliability is required for the flight software. To this end, a variety of activities to meet the given requirements and improve the safety and reliability are made during the development of flight software. For example, initial requirement analysis, code test using a static analysis tool, unit test which demands the level of statement coverage using satellite simulator, verification test which checks if the flight software is satisfied with the functional requirements are performed in the development period. A variety of development environments should be provided to support execution of flight software on STBM(Software Test Bed Model) or satellite simulator and dynamic verification of flight software through command/telemetry interface. Satellite flight software team has developed verification environments specialized in software to be applied to various satellite projects more efficiently and improve the reliability of flight software. The verification environment supports the whole test process, test scripts familiar with software developers, and specialized features dedicated to the specific satellite. Also, it provides interfaces with both the on-board target computer and flight simulator, and can be applied to the future satellite project effectively by adopting agent-based as the interface with satellite subsystem and payloads. In this paper, the design and configuration method of the software verification environments for the effective verification of flight software will be introduced.

[P-37] The Operational Concept of Multi-band Microwave On-board Data Recorder

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Recently the development and utilization of payloads using electromagnetic waves such as SAR(Synthetic Aperture Radar), Scaterrometer, Radiometer and Altimeter has been significantly increased. In Korea new satellite program called CAS500 (Compact Advanced Satellite 500) has been started for providing a compact and lightweight platform and for supporting different kind of payloads in total weight around 500 Kg. Also plans are underway to develop an imaging radar and meteorological radar using this platform. In response to future demands, the KARI is developing core technologies of microwave payloads and operational concept of multi-band payload. On this paper it suggests operational concept of on-board data recorder.

[P-38] Installing Study of Flexible Solar Array

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KARI (Korea Aerospace Research Institute) was developed the Korean LEO (Low Earth Orbit) earth observation optical satellite, KOMPSAT(Korea Multi-Purpose Satellite)-2. The KOMPSAT-2 was successfully launched on July 2006 and was operated, with success, for 9 years. The S/A (solar array) structure of the KOMPSAT-2 consists of the yoke (supporting structure of the S/A), tape hinges of the strain energy

type and S/A substrates/panels. In the folded configuration of the S/A, the S/A occupies two closure panels of the bus. This causes the difficulties in installing the electronic devices due to the insufficient space. This paper describes the study results for using one closure panel of the bus in the folded configuration of the S/A. The location of the Hold-down/Release mechanism, yoke design and hinge type are modified.

[P-39] Review on Multi-Layer Insulator(MLI) Erosion by Atomic Oxygen Collision in Low Earth Orbit

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A good knowledge of gas constituents in the low-Earth orbit(LEO) below 1000km altitude can be important for many space missions. At these orbital altitudes atmosphere is composed primarily of oxygen in an atomic state and the density of AO is drastically increased, depending on solar cyclic activity condition. In that, the satellites in LEO collide continuously with the atomic oxygen (AO) at a velocity of about 7~8.0 km/sec during the whole life and the AO total flux collided with satellite surface is in a highly reactive state and can produce serious erosion of LEO satellite surfaces through oxidation. In particular, MLI(Multi-Layer Insulator) used for Low Earth Orbit Satellite is rapidly degraded and eroded by AO(atomic oxygen) during the mission life. Therefore, satellite MLI design requirements shall be established, based on the prediction of MLI erosion depth by AO collision expected during the mission life. Therefore, atomic oxygen fluence prediction and analysis for LEO satellite are required to verify the AO durability and suitability of MLI materials. The purposes of this study are to review the AO effect to satellite and to present how to estimate AO erosion depth by using several analysis models.

[P-40] Compliance verification for the use of heat exchange coolant according to aluminum surface treatment inside a space environment simulator

Sungjin Lim, Hyokjin Cho, Hee-Jun Seo, Sung-Wook Park, Guee-Won Moon

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Cooling-water-compatibility of the aluminum surfaces were analyzed composing heat exchangers of the cryogenic blowers in space environment simulators. Two samples were taken for the tests of Teflon coated aluminum plate and anodized aluminum plate. The reference was the bare aluminum plate with no surface treatment. Two sample plates and one reference plate were soaked in the cooling water for 180 days, and surface oxidation level was measured by using a scanning electron microscope (SEM) before and after the tests. In case of the reference bare aluminum plate, the oxidation level was 1 % before being soaked in the cooling water, and the value was increased into 13 % after the test. However, there were less than 2 % changes of the oxidation level for the Teflon coated plate and anodized plate. It was verified that Teflon coating or anodizing

surface treatment is mandatory for the aluminum surfaces being exposed to the cooling water continuously.

[P-41] Spacecraft Bus Operation Concept Design for Low Earth Orbit Satellite

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KARI (Korea Aerospace Research Institute) is developing a medium sized low earth orbit satellite.

This paper describes the spacecraft bus operation concepts for the satellite. In general, the spacecraft bus operation concept will follow the heritage one. It will adopt internal and external redundancy with cross-strap. For the case which full redundancy is not applicable, K of N active redundancy will be applied (with $K < N$). Key difference from the heritage design is software based RU (reconfiguration unit). Fault management will be centralized in this RU with help of hardware and software. The operation phase can be divided into pre-launch phase, LEOP (launch and early operation) phase and Mission Operation Phase. The satellite operation mode consists of ground test mode, launch mode, safe hold mode, standby mode, mission mode and orbit maintenance mode. Subsystem modes are identified and mapped into the system mode. And mode transition flow was preliminary designed.

[P-42] Modular Transfer Function Degradation Analysis by Spacecraft Bus Roll Tilt

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MTF (Modular Transfer Function) is one of key index to evaluate the performance of satellite images. It can be degraded by various factors such as optical characteristics of the camera payload, spacecraft motion, and other parameters like signal processing and atmospheric effect. This paper described the MTF degradation by spacecraft motion. The motion includes not only spacecraft linear motion drift and high frequency jitter but satellite maneuver for taking images also. The satellite takes earth ground images from high orbit and due to the characteristics of earth curvature, the more the spacecraft tilts, the greater the image performance degradation. Another key factor influencing the MTF is the number of time delay integration. The satellite moves quite a fast on orbit and to get a still image the satellite gets image within a very short time duration and it results in a dark image. To overcome this disadvantage, time-delay integration method is implemented but it results in another MTF degradation. This paper suggests what can be done to maintain image quality.

[P-43] An Introduction to Design Concept of Attitude and Orbit Control for Korea Pathfinder Lunar Orbiter

Jo Ryeong Yim, Donghun Lee

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This paper introduces a preliminary design concept of attitude and orbit control subsystem(AOCS) for Korea Pathfinder Lunar Orbiter(KPLO). KPLO is the first Korean deep space satellite not for rotating the Earth but for the Moon. Even though it has been a lot of experience in developing low earth orbit satellites including a few geo synchronous orbit satellites until now for AOCS, it is a kind of totally new design concepts and therefore very technically huge challenging mission for AOCS even with very limited development time. In this paper, the first step AOCS design concept from scratch is presented. It includes the AOCS operation modes along with the combinations of AOCS sensors and actuators, and some hardware candidates with their characteristics based on the simple trade-off study results. This preliminary design concept will be matured with more critical analysis and to meet the system requirements.

[P-44] LRIT/HRIT Broadcasting Services Migration Issues with the COMS-GK2A Satellite Transition

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The COMS (Communication, Ocean and Metrological Satellite) has been providing its broadcasting service of on-ground processed meteorological data to end-users in the East Asia area since 2011. The next satellite of COMS, Geostationary KOMPSAT-2A(GK2A) is being developed for launch in 2018 to continue the current COMS' LRIT/HRIT(Low Rate Information Transmission/High Rate Information Transmission) broadcasting service. The GK2A satellite will take over the COMS' LRIT/HRIT services when the GK2A's in-orbit testing will be successfully closed. In order to help mitigate issues associated with COMS-GK2A satellites transition, GK2A will be designed to transmit LRIT/HRIT signals to LRIT/HRIT users station via the identical RF characteristics to the COMS. The GK2A ground system will provide selected GK2A meteorological payload data with reduced-resolution approximating the legacy COMS' meteorological payload data. Since the GK2A meteorological payload will have different observation areas comparing to COMS, existing COMS ENH (Extended Northern Hemisphere) image data will not be included in GK2A broadcasting services. But its format will comply with the legacy COMS LRIT/HRIT mission specification available at <http://nmssc.kma.go.kr>.

[P-45] Analysis of Compatibility Between Radiated Emission of Satellite System and Receiver Sensitivity

Kyung-Duk Jang, Tae-Youn Kim, Jae-Woong Jang, Chang-Eun Lee, Guee-Won Moon

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Analysis of compatibility between radiated emission of satellite system and receiver sensitivity can be performed by calculating the electric field reached to receivers from noise generated by each unit. We don't know the noise radiated from each unit before testing, so the noise is

assumed by the level specified at requirement. There are several receivers in satellite such as for communication with ground station(S-band) and transmission of image data(X-band). If the noise level received at each receiver is less than the receiver sensitivity, then the compatibility are established. The analysis results shows that the receiver has at least 15 dB safety margin.

[P-46] The Development of Single-Point-Ground-Assembly for GEO-KOMPSAT-2

Sung-Soo Jang, Jong-Seok Park, Jung-Su Choi,
Jae-Dong Choi, Sang-Ryool Lee

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This paper summarizes the main functions and test results of the Single-Point-Ground-Assembly (SPGA) in GEO-KOMPSAT-2. The spacecraft structure in COMS (Communication, Ocean and Meteorological Satellite) is used to provide an electrical ground plane reference (EGRP). The EGRP will carry the primary power return current. For each units, the secondary voltage reference and housing of units is connected to the EGRP via bonding stud and a bonding strap. The structure-electrical-return of primary power source has been designed in COMS to return the power source through structure. In the GEO-KOMPSAT-2 (GK2), the wire-return is design baseline based on the judgement that it will improve the EMI/EMC properties than structure-electrical-return. As a result, all wire-return of harness shall be connected one grounding point in the Power Control Unit (PCU). But the PCU can't accommodate the all wire-return harness from satellite loads due to limited hardware resource. Therefore the Single-Point-Ground- Assembly (SPGA) is developed to accommodate all wire-return harness from the power load of the satellite, battery and ground equipments. The SPGA is single point grounding of satellite power system, and it consists of five 8W8 D-sub connectors on the busbar plate with high conductive series of aluminum. It is able to resist to the space environment conditions.

[P-47] The Study of Preliminary Power Budget Analysis for New Communication Satellite in GEO

Sung-Soo Jang, Na-Young Lee, Jae-Nam Yu, Jae-Dong Choi, Sang-Ryool Lee

Korea Aerospace Research Institute

This paper summarizes the study of preliminary power budget analysis for new Communication Satellite in GEO (Geostationary Earth Orbit). The results of study will be described the electrical power budget in Transfer Orbit after launch and on Orbit at EOL(End of Life). The electrical architecture of new Communication Satellite is identical with GEO-KOMPSAT-2, excepting Observation Data Communication Subsystem. And the power consumption of the electrical components and units is estimated based on the units in GEO-KOMPSAT-2 with contingency margin according to design maturity. The DOD(Depth of Discharge) of battery is designed to keep not to exceed 70% and the SA(Solar Array) power margin also is considered to keep greater than 7.5% power margin at equinox under worst conditions at EOL. Generally, the purpose of power budget demonstrate the adequacy-between the DC power needs of the embedded

users and capacities of the power source of the satellite all along the transfer and throughout the spacecraft on station lifetime. During the transfer orbit, power budget will be characterized by many mission events which induce changes in either the bus power consumption or the power source availability and performances. The solar array and battery will generate electrical power and store energy to provide users' demand for the satellite operation. They will be conditioned by the Power Regulator in order to provide fully regulated power bus. The electrical performances of the solar array depend obviously on its design but also on its mechanical configuration, on the solar flux received by its cells and on the temperatures of these last ones. The solar array wing is stowed for the launch, then fully deployed during transfer orbit. The performances of the battery depend firstly on its design and then on its State Of Charge, its temperatures, and on the current that cross it. The study of these profiles allows checking that the power sources can face the user needs and thus that the power budget is well sized to pass the transfer phases and on station lifetime.

[P-48] A Study on Required Minimum Solar Array Capacity Determination

Hyeon-Jin Jeon and Jong-Oh Park

Korea Aerospace Research Institute

Solar array on a satellite shall be designed to generate sufficient power to perform any typical missions at the end of life of the satellite. Energy balance analysis can be an appropriate method to decide if solar array is well designed. To obtain required minimum solar array output power to satisfy energy balance, first of all, satellite power consumption shall be calculated based on a typical mission profile. Then, using the calculated value, required minimum solar array output power can be obtained with further transformations. For satellites having solar array drive electronics and assembly (SADE&A), required minimum solar array output power is easily obtained by using sunlight duration. But, for satellites with fixed solar array, tilting angle while mission conduction in sunlight period shall be additionally considered. Because the solar array output power has functional relationship between solar array temperature and solar array tilting angle, it is good to use average tilting angle with some margin to decide required minimum solar array output power. In this paper, guideline to determine required minimum solar array capacity for two types of solar array was presented. This can be a good guideline for optimal satellite design.

[P-49] Design and Fabrication of Validation Unit for Power EGSE Verification

Seung-Won Cho, Dong-Chul Chae, Guee-Won Moon

Korea Aerospace Research Institute

Power Electrical Ground Supporting Equipment (EGSE) is developed in order to provide electrical power to low earth orbit and geostationary satellite during Assembly Integration & Test (AI&T). Prior to being connected to a satellite, Power EGSE should be validated. To validated the power EGSE, the special equipment which simulates the satellite interface and measure the output signal from the power EGSE is required. The validation unit for the

power EGSE should be able to measure power supply voltage at the end of the power EGSE harness which is connected to a satellite. Analog telemetries should be simulated in the validation unit. The power EGSE should control the interface between a satellite and battery during AI&T. The validation unit can measure the high pulse signal from the power EGSE and provide the relay status for battery interface control. Additionally, the validation unit can verify launch vehicle breakwire simulation function which is established in the power EGSE. In this paper, the detailed design of the validation unit for the power EGSE is presented and finally it is shown that the validation unit is manufactured according to the design.

[P-50] Application of a Model-Based Approach for Initial Operational Concept Definition of GK2

Chang-Kwon Cho

Korea Aerospace Research Institute

As a Satellite system is more complex and bigger, Development Methods using modeling are applied much. The system should be considered both hardware development and software development simultaneously. In other words, To be consistency of development method, It helps to utilize the modeling. This paper describes in defining the initial operational concepts by using Model-based Functional Architecture (FAS, hereafter) from use cases. The functions of system is well-structured by grouping functions and allocating them by using FA Method. The operational concepts of satellite should define early at development phase. In defining system requirements from user requirements, Developers can share the concept of operation and system architectures with stakeholder by using the system modeling. In other words, Developers are able to increase understanding by employing the modeling of system operational concepts. So Functional Architecture method in variety of modeling techniques is applied in this paper. This paper intends to define initial operational concepts of GEO-Kompsat-2 in using some diagram of SysML in a system modeling language

[P-51] A Power Fault Tolerant Architecture for Dual Active On-Board Computers in Satellite System

Yee-Jin Cheon

Korea Aerospace Research Institute

Generally, a satellite system has k-out-of-n redundancy at system level, or subsystem level, or unit/module level to prevent fault/failure propagation, to minimize operational interruption, and to secure the satellite system. There are several operational schemes available for k-out-of-n redundancy depending on operational needs or system reliability or stability. One of them is cold redundancy where a redundant part is powered off while a primary part is powered on and operational (i.e., active). Second one is hot redundancy where both primary/redundant parts are powered on but only a primary part is operational. The last one is active redundancy where both primary/redundant parts are powered on and operational. Some parts of satellite system requires active redundancy to ensure the system operation in case of fault/failure. Satellite system may experience harsh condition during

the satellite launch. This harsh condition may cause some faults such as relay pole flips, resulting in catastrophic impacts on the whole satellite system. In this work, a power fault tolerant architecture is presented and studied to make satellite system, especially on-board computers, tolerate any fault/failure on power supply paths.

[P-52] Field of View Analysis of Geo-Kompsat-2B Satellite

JungSu Choi, JongSeok Park¹, InGul Kim

¹*Korea Aerospace Research Institute*

²*Chungnam National University*

The GEO-KOMPSAT-2 program is a national program of Korean government to develop two geostationary orbit observation satellites for multi-purpose applications. GEO-KOMPSAT-2A is for the meteorological and the space environment monitoring mission satellite and GEO-KOMPSAT-2B is for the ocean monitoring and environment monitoring spectrometer mission satellite. To get the best performance, the FoV(Field of View) from the satellite sensors shall not be obstructed along the sensors specific directions and angle of view. Not only sensors but also radiators, antennas and spacecraft shadow should be considered for spacecraft design. In this study, GEO-KOMPSAT-2B satellite main sensor units such as GOCI-II(Global Ocean Color Imager-ii), GEMS (Geostationary Environment Monitoring Spectrometer) 3D FoV CAD models are generated to verification of the requirement completion. And also based on the 3D CAD data, solar array shadow, attitude orbit control sensors and data communication antennas FoV interferences are considered not to have spacecraft performance degradation.

[P-53] Mechanical Design of CAS500 Satellite using Standard Bus

Cho-Young Han, Seok-Soo Kim, Junseong Kim²,

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Currently a standard bus is being developed in Korea so that the Compact Advanced Satellite 500 (CAS500) is composed of this standard bus and a high-resolution camera in order to meet national need. The standard bus is able to fulfill the design requirement by minor adjustment in connection with various payload accommodation. It can, moreover, drastically reduce development expenses as well as period required for successive satellites. In this study the mechanical design concept of the CAS500 applying the standard bus is explained. Illustrative examples for the standard bus and its mechanical characteristics are displayed in the first place. The mechanical design of the CAS500, then, is presented in detail, in terms of versatility of the standard bus.

[P-54] The Electrical Integration and Test at the Satellite Launch Site

Yungoo Huh, Su-Wan Bang, Jin-Yeong Ryu, Joo-Ho Park, Guee-Won Moon

Korea Aerospace Research Institute

The satellites designed and made by KARI (Korea Aerospace Research Institute) are transported to the foreign launch site. When satellite arrives at the launch site, SOH (Status Of Health) test is firstly conducted to ensure that it is operational after the transport from remote locations. EGSE (Electrical Ground Support Equipment) is connected to the satellite for ISO valve open before fueling and ISO valve is closed after fueling. The electrical interface test is also performed to verify interface signals between satellite and EGSE through Launch Vehicle. At launch day, satellite is set to the launch configuration using the EGSE. Afterwards, satellite status checks is performed to monitor satellite launch configuration until launch countdown. EGSE must be required to accomplish all activities mentioned above. In this paper, the activities regarding the electrical integration and test at the satellite launch site will be introduced.

■ 태양계 및 우주탐사

[P-55] DEEP-South: Inspection of Moving Object Detection Program

Young-Seok Oh¹, Yeong-Ho Bae², Myung-Jin Kim², Dong-Goo Roh², Ho Jin¹, Hong-Kyu Moon², Jintae Park², Hee-Jae Lee^{2,3}, Hong-Suh Yim², Young-Jun Choi², and the DEEP-South Team

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³*Chungbuk National University*

The Moving Object Detection Program (MODP) is being developed for the Deep Ecliptic Patrol of the Southern Sky (DEEP-South). This dedicated software package utilizes multiple mosaic CCD images that are taken for the same target fields at different epochs at the three Korea Microlensing Telescope Network (KMTNet) sites in the southern hemisphere. MODP employs existing software packages such as SExtractor (Source-Extractor) and SCAMP (Software for Calibrating Astrometry and Photometry); SExtractor generates object catalogs, while SCAMP conducts precision astrometric calibration, and then MODP determines if a point source is moving. In this paper, we present our test results for MODP with two different algorithms: MODP-c extracts x and y pixel positions at specific epochs in each image using catalog matching, while MODP-i extracts pixel positions employing the image subtraction method. Then we evaluate the efficiency of the two different MODP algorithms; present our near-term plan for fine-tuning of the codes, test of Minor Planet Center (MPC) reporting, and implementation of a software platform for visual confirmation.

■ 기타

[P-56] Introduction to GEO-KOMPSAT-2 Configuration Change Control

Chul Kang, Keun-Woong Shin

Korea Aerospace Research Institute

This article introduces the Configuration Change Control of GEO-KOMPSAT-2(GK2) Program. As one of four major Configuration Management(CM) activities, the Configuration Change Control is the process for establishing and maintaining a consist record of a product's functional and physical characteristics compared to its design and operational requirements. In case of GK2, the existing off-line documentation management was partially changed to the on-line documentation management through the developed GK2 Configuration Change Control Management System. The R&D cost such as man power and development time was saved by the reduced number of meeting and related wasting time.

[P-57] Development of Multigrid Algorithm for Fast Convergence Rate in Transonic Flow Calculation

Eun-Seok Lee

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In recent fluid mechanics, the computational fluid dynamics becomes essential to predict the fluid flow in aerospace. However in transonic flow, the convergence rate becomes slow due to the appearance of shock. To get a better convergence rate, the multigrid and preconditioning algorithms are widely often used. The multigrid method effectively reduced the low-frequency system error, which determines the system convergence and the precondition method changed the low system condition number to unity in order to alleviate the stiffness the corresponding governing equation system.

[P-58] Satellite Communication Using Hyperbolic Frequency Modulation

Chang-Eun Lee, Jae-Woong Jang, Kyung-Duk Jang, Tae-Youn Kim, Guee-Won Moon

Korea Aerospace Research Institute

Recently, satellite communication has been used in a variety of areas such as mobile communications, GPS and any terrestrial communication systems. Therefore, studies have been conducted to maintain the stability of satellite communications since these kinds of technologies are getting more important. When the relative velocity between a source and a receiver is huge and not negligible, received signals will be distorted by Doppler effects. In this paper, the hyperbolic frequency modulated signal is used because it is robust in the Doppler channel. The proposed method is one of the spread spectrum technologies. It has a great orthogonality and structures of its transmitters and receivers can be simply and cheaply implemented. In addition, this method uses same bandwidth between up-sweep and down-sweep. Because of this, it can much more reduce waste of bandwidth than other spread spectrum technologies can.

[P-59] Development of 64-channel silicon photomultiplier sensor

H. Y. Lee, Jin-A Jeon, Il H. Park, Jik Lee

Sungkyunkwan University, Korea.

Silicon photomultiplier (SiPM) is a photo sensor consists

of multi micro-pixels which are operated with Geiger mode. SiPM has various preferable characteristics such as operating with low voltage, small size and light-weighted shape, robust and insensitive to magnetic fields as well as enables counting single photons thanks to the high gain of $10^5 \sim 10^6$ like conventional Photomultiplier tubes (PMT). In this study, we have simulated and designed the PN junction with high electric field into epitaxial layer on p type substrate for working at low operating voltage. Finally we have fabricated the 64 channels of SiPMs as a first step to use multichannel sensors. We will present also the result of it.

[P-60] Design and Test of 75Tonf Liquid Rocket Engine's Main Pipes for Feeding Propellants to Combustor

Taegeum Chung, Seongmin Jeon, Eunhwan Jung,

Korea Aerospace Research Institute

75Tonf liquid rocket engine's main pipes for feeding propellants to combustor were designed, manufactured and tested. Main pipes' role is feeding propellants from turbopump's exit to combustor's inlet. Main pipes are composed with each pipe for liquid oxygen and fuel propellants. The environment of pipes' operation is in the condition of high pressure and LOx pipe is in the condition of extremely low temperature. The pipes are designed in the consideration of those operation conditions. The pipes' structural analyses were performed and ascertained structural safety. Spherical joint flanges are applied for assembly in the engine. Machining and welding processes were applied for pipes' manufacturing. After manufacturing pipes, strength test and leakage test were performed for confirmation of structural safety and manufacturing regularity.

[P-61] Design and Test of 7Tonf Liquid Rocket Engine's Main Pipes for Feeding Propellants to Combustor

Taegeum Chung, Seongmin Jeon, Eunhwan Jung

Korea Aerospace Research Institute

Main pipes of 7Tonf liquid rocket engine for feeding propellants to combustor were designed, manufactured and tested. Main pipes feed propellants from turbopump's exit to combustor's inlet. Main pipes are composed with each pipe for liquid oxygen and fuel propellants. The environment of pipes' operation is in the condition of high pressure and LOx pipe is in the condition of extremely low temperature. The pipes are designed in the consideration of those operation conditions. The ports for feeding tube lines of gas-generator and combustor ignition device were designed. The pipes' structural analyses were performed and ascertained structural safety. Machining and welding processes were applied for pipes' manufacturing. After manufacturing pipes, strength test and leakage test were performed for confirmation of structural safety and manufacturing regularity.

[P-62] An Estimation 3-D Position of Launch Vehicle using Multiple RF Angles of Arrival

Soon-Ho Kwon, Ha-Ryong Song, Dae-Oh Kim

Korea Aerospace Research Institute

Telemetry station is a receiving and processing system for RF signals from a launch vehicle in NARO Space Center. It's tracking antenna system can extract signal angle of arrival in azimuth and elevation. But there is no method to measure distance between launch vehicle and the ground station. In this paper, we propose an estimation method which extract 3 dimensional position of launch vehicle. The estimation algorithm use multiple Angles of Arrival(AOA) which are measured in different station. Using AOA information we can make unit vector which is Range=1, Elevation and Azimuth in spherical coordinates on each station. And converting it in cartesian coordinates we can make plane and line equation which include the unit vector. Finally using geometrical analysis, we can find intersect points which is 3-D position of launch vehicle. Also using Kalman filter and position combiner we can obtain optimal 3-D position.

2부 포스터발표논문 초록

10. 27(목) 10:00 ~ 28(금) 10:00

■ 우주응용

[P-63] Studies on High-resolution Earth Observation Optical System from Geostationary Satellites

Seonghui Kim, Deog-Gyu Lee, Youngchun Youk, Seunghoon Lee

Korea Aerospace Research Institute

In geostationary orbit we can obtain the earth image with very short revisit time and long-time exposure at any time. Whereas this lots of advantages, the distance to the earth surface is about 36,000 km, this is 45 times the typical low earth orbit so it is very hard to get a high-resolution image. Currently best resolution at the GEO is about 500 m. It is need to improve the resolution to tens of meters to meet the requirement of disaster, fire, water monitoring. The required optical aperture is more than 5 m, extremely over 10 meters. Due to the limitation of launch vehicles, the volume and mass should be minimized using new technologies and materials. The Membrane can be a good solution with ultra light-weighted and deformable for surface shape control and accommodate to a small size during launch. We will introduce the Membrane and diffraction lens for initial study of high-resolution geostationary optical system.

[P-64] Real-time Correction Method of Dark Current by Temperature Change for Satellite Camera

Youngsun Kim, Jong-Pil Kong, Seokbae Seo, Sang-Gyu Lee, Seunghoon Lee

Korea Aerospace Research Institute

The higher temperature in CCD or CMOS detector generates the higher dark current which is integrated along with the photocurrent. Dark current is unnecessary signal to be removed in order to improve system performance such as the dynamic range and the fixed pattern noise. The paper proposes the method to correct the dark current in real time for the satellite camera. The method uses the pre-pixel and dark pixel which are usually provided by the detector for the science mission. The controller or processor gets these pixel values in real-time and uses them in the correction algorithm to compensate temperature and its change. The correction algorithm can be implanted in the software in the on-board controller. Simulations are carried out to verify the method in the satellite electro-optical system and the results are shown in the paper.

[P-65] Development Status of Optical Payload

Hwan-chun Myung, Koon-ho Yang

Korea Aerospace Research Institute

Recently, the new approaches to the size/mass-reduction of the payload have been studied in many ways. In particular, such cutting-edge technologies are very beneficial to the GEO satellite development, in which the increased size/mass of the payload has been supposed to be inevitable for the LEO-like high resolution. The first one is to constitute an optical system by a set of smaller apertures(sub-aperture). The mechanical features of the sub-aperture mainly comes from the transformational launch-configuration as well as the reduced mass of the primary mirror in comparison with the single aperture. Secondly, the planar photonic payload features the minimal use of the optical elements, which is to replace them by the electrical processing. Its principle is largely based upon the electrical implementation of the spatial interferometry. The fact results in 'no large optics' and 'no precision gimbals for LOS steering'. As the third technology, the membrane optic payload shows some outstanding advantages in terms of weight and cost. Due to the diffractive optic theory, its primary optical part is composed of the membrane etched transmissive phase diffractive elements. Such feature delivers much lighter weight and lower cost as well as less sensitive to the primary surface figure.

[P-66] The Design Concept Analysis of the Lunar Exploration Electro-Optic Payload Control Module

Jong-Euk Park , Kijun Lee

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²*Chungnam National University, Department of Electronics Engineering*

The Satellite Electro-Optic Payload System development technology shall be improved according to the high resolution satellite payload camera growth. This technology will be used as the foundation of the lunar or planet exploration payload unit development. The high resolution camera which acquires the high quality image from lunar orbit requires the high reliability superior to the low earth orbit satellite payload. The lunar exploration payload system has the limited environment conditions which are the power consumption, the proper temperature condition of the reliable mission operation, and the various radiation condition of the lunar. The weight lightening and miniaturization are the essential top requirement. The payload consists of the mirror module, mechanical module, and the electronic module same as the normal payload camera. The payload camera has the design concept of the preventing interference from the outside condition because the exploration orbiter has several payloads for the various mission. In this paper, the design concept of the lunar exploration electro-optic payload system should be described for development of the engineering model. Also, the preparation of the flight model design might be suggested.

[P-67] Analysis Zenith Total Delay variability from reference station determination

Beom-Kyu Choi, Sung-Chul Jung, Hyun-Jong Oh, Hyuk-Jin Yun

Satellite Operation Division, National Meteorological Satellite Center, Korea Meteorological Administration

There are big three types to define the geodetic datum, free network solution, minimum constraint solution and constraining reference coordinates. If the geodetic datum is defined by constraining reference coordinates, final results like Zenith Total Delay (ZTD) are influenced by reference stations. For this reason, we calculate ZTDs with various initial reference stations and compared with IGS ZTD data to find suitable reference stations for Korean GNSS stations. As a results, in case of only one reference station selected, DAEJ referenced results are most close to the IGS results. However CHAN referenced results are the most different result with IGS results. Also we test multiple reference stations conditions. As a consequence, the more reference stations are involved, the more different with the IGS ZTD. These results show that the IGS stations is not always suit for reference station. Also if the low accuracy reference station is involved, it makes negative effect on GNSS network although other referenced stations have high accuracy. Our analysis provides that DAEJ, SUWN and IRKM are suitable for the referenced stations of Korean GNSS network.

[P-68] Requirements of the Image Sensor for Lunar Terrain Imager

HaengPal Heo, GmSil Kang, YoungSun Kim, SangSoon Yong, SangGyu Lee, SeungHoon Lee

Korea Aerospace Research Institute,

High performance electro-optical camera system to be used for collecting the terrain information of the lunar surface from the lunar orbiter needs to be developed with special care because the operating environments are much different from the earth orbit. Most of the remote sensing electro-optical camera systems in the earth orbit are being operated in the sun synchronous orbit and the brightness of a specific target is not being changed depending on the various sun angle. However, the material on the lunar surface is much different from the earth and the range of the input radiance tends to be much dynamic. The image sensor to be user for the terrain imager in the lunar orbit should have big dynamic range to increase the duty cycle in the orbit. Wider temperature variation should also be considered. In this presentation, the requirements of the image sensor for moon observation are to be summarized and described.

[P-69] Design of the Spaceborne Camera System with High Dynamic Range

HaengPal Heo, GmSil Kang, YoungSun Kim, SangSoon Yong, SangGyu Lee, SeungHoon Lee

Korea Aerospace Research Institute,

Dynamic range in a camera system is defined as the ratio of the maximum signal to the average noise. In

order to provide delicate images of the targets which contain various level of the brightness, the camera system should have the capability to collect pixels with much different brightness. Therefore, in that case, high dynamic range of the camera system is the most important performance parameter. Image sensors such as the CCD and the CMOS should have big full well capacity and the total noise needs to be controlled as minimum. Driving electronics should be designed to utilize the full performance of the sensor and should not add any additional readout noise. Electronic shutter control can also be utilized for big radiance target. In this presentation, methodologies to be used for the development of the space borne camera system with high dynamic range are to be introduced.

■ 우주천문

[P-70] Adjustment and testing the ultra-compact high-resolution space telescope for earth and astronomical observations

Mariia Tumarina, GiHan Hong, Mikhail Ryazanskiy², Il. H. Park¹, Soomin Jeong¹, Alexander Milov²

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²*SatByul Co., Ltd*

The opto-mechanical prototype was produced and adjusted for ultra-compact telescope with 3° flat FOV, resolution better than 0.9 arcsec, F/# 3.5, 241 mm equivalent aperture, 230*230*330 mm in size, 6kg in mass, and operational temperature of -50 to +50 °C (suitable for 16U CubeSat). This resolution corresponds to GSD of 2.5m with 25km wide Earth images from 600km orbit, or 14 star magnitude with 2.5x2.5° FOV for astronomical observation. The centering and tip-tilt adjustment was done using special rotating stand with laser and microscope, and axial adjustment was done using autocollimation schema with multi-laser stand. Performance check was done using several different sensors (including real sensor for target satellite) and with collimators and USAF 1951 target, and show the resolution 1.25 arcsec, found satisfactory for prototype. Thermal-vacuum tests and vibration tests was also performed, and the improvements for Engineering/Flight Model design presented.

[P-71]

Current Status of Development of 10Gbps Data Output Module in High Speed Sampler System for Radio Observational Data Analysis

Yong-Woo Kang, Min-Gyu Song, Jae-Hwan Yeom, Do-Heung Je

Korea Astronomy & Space Science Institute

KVN Digital Sampler(KDS) was developed for radio observational data analysis. The sampler has a dual sampling frequencies of 1024MHz, 2048MHz with 2bits per sample. And we are developing 4GHz sampler with 2bits per sample. In this sampler system, data output speed is 8Gbps at 2bit samples. It needs high speed data output module. We are developing 10Gbps data output module for this sampler system. I will introduce

some progress of the 10Gbps data output module in high speed sampler system and also the sampler development.

[P-72] Development Status of Light-weight CFRP Mirror

Young-Soo Kim, Jeong Gyun Jang, Jihun Kim, Jakyoungh Nah, Jeong-Yeol Han, Uk Won Nam

Korea Astronomy and Space Science Institute

Carbon fiber reinforced polymer (CFRP) has been utilized in airplane, rocket, satellites, telescope structure, etc., as it is stiffer than steel but light-weight. Additional merit of low thermal expansion attracts it to be applied to telescope mirror. However, complicate surface refinements need to be improved. In this paper, current status of CFRP mirror development is presented.

[P-73] Data Status of MIRIS Paschen- α Observations

Il-Joong Kim, Jeonghyun Pyo, Woong-Seob Jeong, Won-Kee Park, Min Gyu Kim^{1,2} Dukhang Lee, Bongkon Moon, Sung-Joon Park¹, Youngsik Park, Dae-Hee Lee, Wonyong Han

¹*Korea Astronomy and Space Science Institute*

²*Seoul National University*

One of main goals of the MIRIS, the primary payload of the Korea science and technology satellite 3 (STSAT-3), is Paschen- α ($Pa\alpha$) Galactic Plane Survey. The survey was completed and we obtained the first whole Galactic plane map of the $Pa\alpha$ emission line. Additionally, we performed $Pa\alpha$ pointing observations for 19 targets located away from the plane. In this contribution, we present the full list of MIRIS $Pa\alpha$ observation data and some $Pa\alpha$ images of them. To obtain the $Pa\alpha$ emission line image, we have to perform flux calibration for two filter (line and continuum) data and point spread function (PSF) matching on both filter images. We show the results of these works and a few issues that should be considered when using the data.

[P-74] Introduction to e-KVN Network Status & Future Plan for the Real Time Broadband Observation

Min-Gyu Song, Hyo-Ryung Kim, Jong-Soo Kim¹, Jan Wagner¹, Do-Young Byun¹, Tae-Hyun Jung, Yong-Woo Kang, Duk-Gyoo Roh¹, Jae-Hwan Yeom¹, Se-Jin Oh, Bu-Seung Cho², Min-Ki Noh²

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In the field of VLBI, the capacity of observation data is now growing bigger rapidly and broadband VLBI observation becomes increasingly crucial. For instance, more than ten terabytes of data is created during each KVN station's VLBI observation already, which makes it very difficult for the transfer of data to correlation center by transportation. To solve this, high-speed advanced network is widely used and KVN also has a plan to upgrade network bandwidth of e-KVN up to 100GbE with

the support of KREONET(Korea Research Environment Open Network). In this poster, we first introduce system architecture and network status of KVN, and also discuss the network based of e-VLBI system for the efficient processing of massive data.

[P-75] A comparison of the common mode rejection ratio of various CCD cameras

Chung-Uk Lee^{1,2}, Dong-Joo Lee¹, Beom-Du Lim¹, Myung-Jin Kim, Joh-Na Yoon

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²*University of Science and Technology*

³*Chungbuk National University Observatory*

Korea Astronomy and space Science Institute (KASI) operate various optical CCD cameras in the astronomical observatories at domestic and abroad. One of the state-of-the-art CCD cameras in the KASI facilities is the 18k Mosaic CCD camera for Korea Microlesing Telescope Network (KMTNet). It consists of four $9k \times 9k \times 10\mu m$ CCD chips, and eight amps read each chip at the same time for fast readout. The relative variation of amp-to-amp sensitivity in the multi-readout system should be carefully considered, especially for stacking multiple Mosaic images. Hence, understanding the characteristics of various readout systems of CCD cameras is worthy for better science result. To approach it in a practical way, we present and compare plots of overscan level as a function of flat-field level that characterize the common mode rejection ratio of readout system.

[P-76] Near-infrared Photometric Properties of Red-supergiant Stars in Nearby Galaxies: NGC 4214, NGC 4736 and NGC 5194 / NGC 5195

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We study the near-infrared photometric properties of red-supergiant stars (RSGs) in three nearby galaxies located within 15 Mpc: NGC 4214, NGC 4736 and NGC 5194 / NGC 5195. The near-infrared (JHK) imaging data were obtained using the WFCAM detector mounted on UKIRT telescope in Hawaii. We used the DAOPHOT/ALLSTAR package to carry out the photometry. We applied MARCS synthetic fluxes to estimate the effective temperatures and luminosities of the RSGs in all the three galaxies. The results were plotted in the Hertzsprung-Russell(H-R) diagram along with the theoretical evolutionary tracks with different masses. We explore the spatial correlation between the RSGs and H II regions by examining the H-R diagram of the RSGs in the dominant H II regions for each of these three galaxies.

[P-77] Development Plan for the GMT Fast-steering Secondary Mirror

Ueejeong Jeong¹, Sugnho Lee¹, Jeong-Yeol Han¹, Chan Park¹, Ueejeong Jeong¹, Yang-noh Yoon¹, Je Heon Song¹, Bongkon Moon¹, Byeong-Gon Park¹, Sanghyuk Kim¹, Myung K. Cho², Christoph Dribusch², Won Hyun Park², Youra Jun², Ho-Soon Yang³, Il-Kwon Moon³, Chang Jin Oh⁴, Ho-Sang Kim⁵, Kyoung-Don Lee⁵, Robert Bernier⁶, Paul Gardner⁶, Chris Alongi⁶, Andrew Rakich⁶, Lee Dettmann⁶, Wylie Rosenthal⁶

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GMTO Corporation

The Giant Magellan Telescope (GMT) will feature two interchangeable Gregorian secondary mirrors, an adaptive secondary mirror (ASM) and a fast-steering secondary mirror (FSM). The FSM has an effective diameter of 3.2 m and built as seven 1.1 m diameter circular segments, which are conjugated 1:1 to the seven 8.4m segments of the primary. Each FSM segment contains a tip-tilt capability for fine co-alignment of the telescope subapertures and fast guiding to attenuate telescope wind shake and mount control jitter. This tip-tilt capability thus enhances performance of the telescope in the seeing limited observation mode. As the first stage of the FSM development, KASI conducted a Phase 0 study to develop a program plan detailing the design and manufacturing process for the seven FSM segments. The GMTO-KASI team matured this plan via an internal review in May 2016 and the revised plan was further assessed by an external review in June 2016. In this poster, we present the technical aspects of the FSM development plan.

[P-78] Tool Influence Function (TIF) Characteristics of SiC Mirrors

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TIF (Tool Influence Function) has been a representative parameter to quantify the material removal characteristics for polished surfaces. We generated a pseudo Gaussian-like TIF on Silicon Carbide (SiC) mirrors with different machine input parameters using Orthogonal Velocity Tool (OVT). Material differences due to distinctive manufacturing processes for optical polishing can be classified by obtained TIF pattern. In this paper, we present technical details of experiments and results.

[P-79] A Study on the Internal Composition of Heumgyeonggaknu

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Heumgyeonggaknu is water-hammering type astronomical clock, made by Jang yeong-sil in 1438. According to Sejong Sillok, machines of *Heumgyeonggaknu* were installed in *Gasan* (imitation mountain), made with paper and its height was 7 *Cheok* (unit of length). We analyzed literatures of *Heumgyeonggaknu* and divided machines as nine operation structures (Water Supply System, Water Wheel Control System, Power Transmission System, Solar Movement Apparatus, and so on). In this study, we composed space, placing nine operation structures in *Gasan* to work systematically.

■ 태양 및 우주환경

[P-80] Phase Angle and Duty Cycle Analysis of the LUnar Terrain Imager (LUTI) during One Year Mission Life Time of the Korea Pathfinder Lunar Orbiter (KPLO)

Dai Ho Ko, Youngchun Youk, Haeng-Pal Heo

Korea Aerospace Research Institute

The Korea Pathfinder Lunar Orbiter (KPLO) is under developing according to the Korean Lunar Exploration Project. It is the Korea's first lunar orbiter and will be launched on the Korean launch vehicle which is also under developing. Among many other payloads on board the KPLO, LUnar Terrain Imager (LUTI) is high resolution camera with more or less than 2m ground sampling distance. Its' main mission is to observe and take image data of the candidate landing sites for the next lunar landing mission. One of the operation constraints that allows the LUTI to take image data is its phase angle with respect to a nadir point. As lunar surface radiance is highly dependent on the observing phase angle, phase angle requirement which shall be between 30 degree to 60 degree, keeps the LUTI from low signal or saturated level image data. In this study, we analysed observable points or area on the lunar surface as well as its duty cycle with the phase angle restriction applied. In addition, we also present required swath width of the LUTI in order for the LUTI to cover the entire lunar surface in low latitude area.

[P-81] Global MHD Simulation of Response of The Magnetospheric Phenomena to Interplanetary Small Magnetic Flux Rope (ISMFR)

Myeong-Joon Kim, Kyung Sun Park, Dae-Young Lee

Department of Astronomy and Space Science, Chungbuk National University

Recently, another category of the magnetic flux rope was observed by various satellites, which is called the Interplanetary Small Magnetic Flux Rope (ISMFR). In

comparison with the usual magnetic clouds, the geometric size and the magnetic field of ISMFR are small and their duration is short. Furthermore, there are differences in plasma properties such as proton temperature behavior. In this study, we performed the global MHD simulations to examine the response of the Earth's magnetosphere when ISMFR impacts the Earth's magnetosphere. We used the ISMFR list of Feng et al. 2008 to select two cases ISMFR events for their geometry. Global MHD simulations were performed in order to examine the effects that the two ISMFR events induce in the magnetosphere and the ionosphere.

[P-82] Correlation Between Variations of GONG p-mode and Solar Magnetic Multipoles Since 1995

Bogyeong Kim, Yu Yi

Chungnam National University

The Schwabe sunspot number cycle and the associated activities are the results of dynamic processes occurring in the solar interior. The basic parameters responsible for most of the solar activities might be the internal magnetic and velocity fields. The p-mode, acoustic wave in radial direction on the solar surface observed by GONG project since 1995, could be influenced by the solar activities. Thus, the solar magnetic field may affect p-mode. Hence a relationship between the p-mode and the solar activity indices may be able to provide the clues for the underlying mechanisms of the solar cycle activities. The multiple components of the open solar magnetic field could complement the study of the geomagnetic activity based on the solar photospheric magnetic field observations. Therefore, we investigate a correlation of GONG p-mode frequency shift within the range of 2920-3450 (μHz) with solar magnetic field multipoles of dipole, quadrupole and high-order multipole components. The preliminary results are to be presented.

[P-83] Development of the Electrical Interface Unit (EIU) for the Operation of the Instruments for the Study of Space Storms (ISSS)

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The Instruments for the Study of Space Storms (ISSS) onboard next generation small satellite-1 (NEXTSat-1) has scientific goals to observe and to study precipitation of radiation belt particles, ionospheric irregularities and their effects on GPS signals. The ISSS has two kinds of radiation particle detectors classified according to the measuring energy range: a Medium Energy Particle Detector (MEPD) and a High Energy Particle Detector (HEPD). It also has three kinds of plasma detectors such as a Langmuir Probe (LP), a Retarding Potential Analyzer (RPA), and an Ion Drift Meter (IDM). It is important to operate detectors flexibly according to the space environment or the orbit and the attitude of NEXTSat-1. To satisfy this condition, the ISSS is prepared the Electrical Interface Unit (EIU) to undertake the interface

between the on-board computer of the satellite and the ISSS detectors, and the scheduling of the ISSS detectors. The EIU keeps the flexibility of the operation for each detector with parameters determining the detector selection, operating time, data transferring frequency, and so on. On the basis of the EIU, the ISSS is able to handle the unexpected situations. In this paper, we present the development and the role of the EIU, and the operation concept of the ISSS and the technical operation method using the EIU.

[P-84] An Observational Estimation of the EMIC Wave Generation Conditions with Linear Instability Theory

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In the earth magnetosphere, many waves interact with charged particles, which is responsible for a number of magnetospheric activities. Electromagnetic ion cyclotron (EMIC) waves have been considered as an important wave to precipitate the energetic charged particles of the radiation belt and ring current region into the Earth's atmosphere. According to linear theory, EMIC wave is triggered by anisotropic distribution of energetic protons ($T_{\perp} > T_{\parallel}$) and propagates along the Earth's magnetic field with pure left-hand polarization. However, observations have not supported these theoretical characteristics. Most of the waves are not of perfectly left-hand polarization and some waves propagate even with large normal angle ($> 30^{\circ}$) to the magnetic field. In this study, we identify the EMIC waves in the inner magnetosphere ($L < 7$) with Van Allen Probes observations, and check particle distributions at the wave onsets. The characteristics of proton such as anisotropy and flux variation are investigated, and we report implications that they provide about wave generation mechanism.

[P-85] The Results of Electron Flux Prediction at Geostationary Orbit Using Two Methods

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The electron flux at geostationary orbit is changed rapidly by solar wind condition and these particles affect on satellites. To protect the various risk, researches of the electron flux prediction have been progressed constantly. We designed the electron flux prediction algorithm as the one of 5 space weather algorithm utilizing data from Korea Space Environment Monitors (KSEM) on GEO-KOMPSAT-2A (GK-2A) satellite. We used solar wind parameters (speed, density, IMF Bz) obtained from ACE

satellite, geomagnetic indices at Kyoto and gfz potsdam (Dst, Kp) and electron flux at GOES satellite as inputs and predicted electron flux from 1 hour ahead to 24 hour ahead. The each algorithm using neural network (NN) and multiple linear regression (MLR) is trained from 1998 to 2003 and the test period is 2004. It is known that the problem called overfitting and time shift occurred in prediction algorithm. To solve this problem, we confirm the prediction results as changing the number of hidden layer neuron, values of weight and bias in NN and finding the optimum equation in MLR. Finally, we show simply the results of prediction algorithm combined with two methods.

[P-86] Development of Hybrid Algorithms for Dst Index and Kp Index

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An artificial neural network and a multiple linear regression are useful to predict geomagnetic indices such as Dst index and Kp index, because there is no confident physical theory for geomagnetic field yet. Two techniques above well predicted 1 hour later geomagnetic indices. However the hybrid algorithm of two techniques is not often in space science field. We try to combine two techniques, there was the improvement of predictions. Also we try to use geomagnetic field strength at geosynchronous orbit, GOES data. We use solarwind and geomagnetic field strength data during 1999~2015 for training the algorithms to predict 1~24 hours later geomagnetic field indices. In the future, we are going to employ geomagnetic field strength data of GEO-KOMPSAT 2A (GK-2A) satellite to improve prediction efficiency.

[P-87] Development of Flight Model for Instruments for the Study of Space Storms (ISSS) to Understand Space Storms and Ionospheric Storms

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The next generation small satellite-1 (NEXTSat-1) will be launched into sun-synchronous Low Earth Orbit (LEO) at an altitude in the range of 500 ~ 600 km between the

fourth quarter of 2017 and the first quarter of 2018. Scientific goals of the Instruments for the Study of Space Storms (ISSS) onboard NEXTSat-1 is to study precipitation of radiation belt particles and ionospheric irregularities. The ISSS payload consists of five instruments; Medium Energy Particle Detector (MEPD), High Energy Particle Detector (HEPD), Langmuir Probe (LP), Retarding Potential Analyzer (RPA), and Ion Drift Meter (IDM). MEPD measure the electrons and ions spectrum with energy of ~100 keV with pitch angle information. HEPD measure electron spectrum with energy of ~ 1 MeV and protons with energy above 10 MeV with pitch angle information. MEPD and HEPD measure electrons and protons in parallel and perpendicular directions to the geomagnetic field in the sub-auroral region for the particle interactions with whistler mode waves and electromagnetic ion cyclotron (EMIC) waves. LP measure the density in the range of $10^4/\text{cm}^3 - 2 \times 10^6/\text{cm}^3$ and the temperature in the range of 600 K - 3000 K for ionospheric thermal electrons. RPA measure the density in the range of $10^4/\text{cm}^3 - 2 \times 10^6/\text{cm}^3$ and the temperature in the range of 1000 K - 3000 K for ionospheric thermal ions. IDM measure about 1 km/s cross track for RAM direction and about 1 km/s drift velocities for ionospheric thermal ions. LP, RPA, and IDM observe plasma irregularities in the low altitude ionosphere. In this time, we report development of Flight Model (FM) for the ISSS to understand space storms and ionospheric storms.

[P-88] Magnetospheric source regions of the auroral precipitating particles

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It is well known that global auroral images are associated with the precipitating particles from the magnetosphere. In this study, we examined the source regions of auroras observed by the WIC instrument onboard the Magnetopause-to-Aurora Global Exploration (IMAGE) satellite. The mapping was achieved by tracing electrons backward in time using the TS05 and Weimer 2K models, which provide magnetic and electric field models, respectively. During the event occurred on 14 Feb. 2001 double auroral arcs were formed. The mapped region consistent with the expansion of the equatorward arc broadened tailward and duskward in the inner magnetosphere. On the other hand, the source region of the poleward arc extended into the mid-tail region along the x-direction in the GSM coordinates. This indicates the source regions for the different arcs can be significantly different from each other.

[P-89] Solar Polar Magnetic Field Dependency of Geomagnetic Activity Semiannual Variation Analyzed by Aa Index

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The semiannual variation of geomagnetic activity, maxima

at equinoxes and minima at solstices, is a well-known phenomenon. This study examined whether the seasonal variation of equinoctial geomagnetic activity is different in periods of opposite solar magnetic polarity in order to understand deeply the contribution of the interplanetary magnetic field (IMF) in the Sun-Earth connection. Solar magnetic polarity is parallel with Earth's polarity in solar minimum years of odd/even cycles and antiparallel in solar minimum years of even/odd cycles. The daily mean of aa, Aa index, during each solar minimum was compared for periods when the solar magnetic polarity remained in opposite dipole conditions. The Aa index values were used for each of the three years surrounding the solar minimum years of 14 solar cycles since 1844. As the results, the geomagnetic activities indicated in Aa index are presented in this study.

[P-90] Determine the Best Performing Parameter Sets for IPS-driven ENLIL

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IPS-driven ENLIL model was jointly developed by UCSD(University of California, San Diego) and GMU(George Mason University), it has been operated since 2014 in KSWC(Korea Space Weather Center). IPS-driven ENLIL model has a number of ambient solar wind parameters and the results of the model depends on the combination of these parameters. We have done research to determine the best combination of parameters to improve the performance of the IPS-driven ENLIL. Selection of the four quiet period and compared to the model results about 1440 combination of parameters. Compare the ACE observation data with model results using RMSE(Root-Mean-Square Error) and determine the top 10 parameter sets. Finally, analyze the characteristics of the determined parameter sets, and reviewed the result by applied to IPS-driven ENLIL model.

[P-91] Relationship Between Space Weather and Lightning: A Review

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Jiyoung Kim

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Solar influences on the terrestrial atmosphere and electrified storms have been studied for many years. Above all, there has been renewed activity in the study of interaction between lightning (or thunder) rate and various space weather effects on many time scales. Understanding of the relationship between space weather and lightning is important, because it may improve adverse weather forecasting skill and therefore save the lives of people and reduce socioeconomic impacts due to lightning. In this presentation, we briefly review statistical and theoretical studies about the relationship between space weather and lightning. The times scales of space

weather effect about lightning (thunder day) can be roughly divided into long-term and short-term. The long-term effect depends on solar activity along the 11-year sunspot cycle. Many conflicting opinions have been expressed on the long-term effect about thunder day. Some studies have found a correlation between sunspot number and day on which thunder while other studies have found an anti-correlation between solar cycle variations and thunder days. Meanwhile, short-term effect has various phenomena such as galactic cosmic ray (GCR), high speed solar wind streams (HSS). In South Korea, we investigated how the response of lightning rate is statistically correlated with HSS. The result shows that the lightning rates are changed after HSS onset depending on velocity of coronal mass ejection (CME), season, and magnetic local time (MLT). The less HSS events are related to CME, the more lightnings are triggered. The dominant enhancements of lightning were found in spring among 4 seasons, in the midnight sector among 4 sectors of a day. The reasons why the enhancements were found in spring and midnight will be discussed with other studies.

[P-92] Verification and Software Development for Post-processing of Remote-sensing Payload Data

Sang-Taek Lee, Gun-Young Park, Woo-Jun Lee,
Myung-Jin Baek

Korea Aerospace Research Institute

Data acquired by remote-sensing payload is processed such like compression, encryption, formatting and modulation via data chain hardware including communication system. The integrity of data during development of satellite payload system should be verified and it also have to check for transmission path effect. In this paper, verification and software development for post-processing software will be introduced.

[P-93] A New Method for Coronal Magnetic Field Reconstruction and Its Application to AR 11974

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Reconstruction of coronal magnetic fields is an essential part in understanding the conditions and evolving sequences of solar dynamic activities. For decades, many reconstruction methods have been developed in force-free approximation with vector magnetogram data given, but most of them have some shortcomings. In this paper, we present a new method for coronal magnetic field reconstruction with a vector potential description of magnetic field, which ensures the divergence-free condition. The source surface condition is implemented in the top boundary for the first time to resolve the flux imbalance problem. An accelerated solver based on the gradient method is employed, which achieves a much faster convergence than conventional frictional or viscous methods. Our method is tested for accuracy using the analytic model by Low & Lou (1990) as the reference solution. When the

solution is given only at the bottom boundary, our method surpasses all competitors in most figures of merits devised by Schrijver et al. (2006). We have applied our method to Active Region (AR) 11974, in which two M-class flares and a halo CME took place. Here we have found two interwound flux tubes, which later separate from each other by magnetic reconnection to form large erupting loops. We suspect that the erupting loops are the major constituent of the observed CME. From the comparison based on the metrics employed by DeRosa et al. (2015), we have also found that our reconstructed field is much more force-free and (naturally) divergence-free than that generated by an optimization method.

[P-94] Preliminary result of a Local K-index Estimation

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K index is one of indicators to represent geomagnetic disturbance. But it is not useful for near real-time monitoring due to their calculation method. So some operational organizations such as Space Weather Prediction Center (SWPC) of National Oceanic and Atmospheric Administration (NOAA) are using estimated K index. In this regard, estimating method of local K index needs to be developed. Cheongyang (CYG) magnetometer was installed in Cheongyang in April 2009 by Korea Meteorological Administration (KMA) with Korea Research Institute of Standards and Science (KRISS) and joined to International Real-time Magnetic Observatory Network (INTERMAGNET) in December 2013. So it can be regarded as a reference geomagnetic data in South Korea. To estimate automated near real-time local K-index at CYG observatory, algorithm that is introduced by Takahashi et al. 2001 is tested by calculating geomagnetic disturbance of Fredricburg and Jeju geomagnetic observatory. And we compared these disturbances with definitive (or official) planetary K index from GeoForschungsZentrum (GFZ) and estimated K index of Jeju from RRA. And also estimated Kakioka K index in this study is compared with that of Japan Meteorological Agency (JMA). Our result shows good correlation of 0.809 between Fredericksburg' geomagnetic difference and planetary K (Kp) index in each of the 3-hour bin and similar coefficient of 0.808 between JEJU' geomagnetic difference and estimated Jeju K index. In the presentation, we will describe that how we calculate geomagnetic difference and compare it with K index from other organizations. We are also developing a prototype process and have a plan to test it in order to produce near real-time local K-index at CYG observatory in near future.

[P-95] Effect of Conductivity Asymmetry Between the Northern and Southern Latitudes on Quarter Waves

Jae-Jin Jang, Jiwon Choi, Dong-Hun Lee

Kyung Hee University

Quarter-wave modes are standing shear Alfvén waves in the magnetosphere, which are excited when conductivities between the northern and southern ionosphere become

significantly different. Quarter-wave modes tend to have strong damping and energy dissipation, which indicates that we should pay attention to time-dependent feature of such transient modes. By using a three-dimensional dipole model, we numerically study how quarter waves are affected by such asymmetry. Unlike the previous studies mainly showing peak frequency variations, we examine the effect of dipolar geometry on time histories of electric and magnetic fields for various conditions and locations. It is presented how the quarter modes depend on various conditions of ionospheric conductivities.

[P-96] A Study on Diurnal Variation of Cosmic Ray Flux at Jang Bogo and McMurdo Neutron Monitors

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Recently, we have installed a neutron monitor at the Jang Bogo station of the Antarctica. The Jang Bogo neutron monitor is one of three units moved from McMurdo neutron monitor. The rest units will be transferred in December 2017. Now, Jang Bogo neutron monitor has been stabilized in comparison with McMurdo neutron monitor. Since two neutron monitors are close to each other, they show the similar profiles of cosmic ray counts. In order to confirm the similarity between two neutron monitors, the diurnal variations of cosmic ray flux have to be analyzed from the data at two neutron monitors. The diurnal variation of cosmic ray flux to be measured by neutron monitor on ground has the sinusoidal pattern with 1-2% amplitude. In this study, we analyze and compare the diurnal variation at two neutron monitors. We present the results of diurnal variation in two neutron monitors in this study.

[P-97] Automatic Detection of Halo CME in LASCO C3 images

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Several researchers have found that front-side halo CMEs are the major cause for large geomagnetic storms. Halo CMEs can result in damage to satellites, electrical transmission lines and power systems. Thus automated techniques for detecting and analysis Halo CMEs in coronagraph data are of ever increasing importance for space weather monitoring and forecasting. In this study, we developed the algorithm and image processing techniques that automatically detects Halo CMEs in images by the LASCO C3 coronagraph on board the SOHO spacecraft. As the result of the detection, we derived the geometric and kinematical parameters of halo CMEs, such as source location, width, actual CME speed and arrival time at 21.5 solar radius.

[P-98]**Characteristics of Poloidal Mode Waves in Dipolar Geometry**

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Ensang Lee

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Standing poloidal Alfvén waves with high azimuthal wave number ($m \sim 100$) in the Earth's magnetosphere can be generated by interacting with high-energy ring current particles. Poloidal waves are one-dimensional modes that propagate along the magnetic field line, similar to toroidal modes, field line resonances (FLR). Unlike FLR, poloidal mode waves have transient nature, thus understanding their dynamic properties is important to examine wave-particle interaction. We have performed two-dimensional MHD simulations to investigate how the dipole geometry affects the characteristics of the high- m poloidal Alfvén waves. Simulations are conducted with the fundamental or 2nd harmonic standing poloidal mode imposed at the beginning of each run. Our numerical results show that initial poloidal wave energy rotates into toroidal in time for both fundamental and 2nd harmonic modes. Poloidal lifetime linearly increases as the wave number becomes higher for both harmonics, consistent with previous study in a box model. However, lifetime is much shorter in dipolar geometry than that from a box model, indicating that it is essential to incorporate the curved geometry to examine such transient phenomena. Our results suggest that the poloidal mode waves are likely to have mixed signature for short time period before the polarization becomes dominantly toroidal.

[P-99] Effects of the Refraction of Gravity Waves on Polar Mesospheric Warming After Sudden Stratospheric Warming

Hwajin Choi, In-sun Song, Changsup Lee, Jeong-Han Kim, Geonhwa Jee

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Two Fourier Transform Spectrometers at ESRANGE (67°53'N) and Dasan arctic station (78°55'N) have been operated for mesospheric temperature measurements. During sudden stratospheric warming (SSW) event, WACCM simulation severely underestimates mesospheric temperature near the Dasan while it is in a good agreement with FTS measurement at ESRANGE. WACCM assumes that gravity waves only propagate in a vertical direction and this may lead to significant discrepancy in polar mesospheric wind and temperature structure. In this study, we try to investigate the effects of gravity wave propagation on mesospheric warming during SSW by using ray-tracing model and to provide better understanding on polar mesospheric response to SSW.

[P-100] Numerical Study of Propagation of Interplanetary Shocks in front of ICMEs

Jinhy Hong, Ensang Lee, Kyung-Im Kim, Dong-Hun Lee

School of Space Research, Kyung Hee University

Interplanetary shocks can produce large disturbances in Earth's magnetosphere as they impact on the

magnetosphere. Thus, it is important for the prediction of magnetospheric disturbances to accurately determine the temporal profile and arrival time of interplanetary shocks. In this study, we investigated the structure and propagation of interplanetary shocks formed in front of ICMEs using a one-dimensional MHD model. We used for the initial conditions the observed quantities of ICMEs by the ACE spacecraft at the L1 point and the Cluster spacecraft around Earth, which are simplified for the 1D model. Simulations show that an interplanetary shock is formed in front of an ICME and the macroscopic properties are similar to the observations. The profile of the interplanetary shock is affected by the spatial grid size, which suggests that it is important to use high spatial resolution to obtain simulation results comparable to actual observations.

■ 태양계 및 우주탐사**[P-101] Total Ionizing Dose (TID) Calculation of the Image Data Handling Unit (IDHU) on the Advanced Earth Imaging Sensor System-Compact(AEISS-C) through the GEOMETRY AND TRACKING4(GEANT4) Simulation Tool Kit**

Dai Ho Ko, Deog Gyu Lee

Korea Aerospace Research Institute

The Advanced Earth Imaging Sensor System-Compact (AEISS-C) is the main payload of the Compact Advanced Satellite 500 (CAS500). Its main mission is to acquire high resolution images of the Korean peninsula for national territory management, agriculture and forestry management, disaster monitoring & control, Korean peninsula observation. In addition, technical maturity to accomplish independent in-country developing of medium-sized satellite is also expected. One of the key electronic subsystem which store, compress, and encode the image data is Image Data Handling Unit (IDHU). Since Total Ionizing Dose (TID) effect can significantly impact the performance of the IDHU, the importance of the TID analysis cannot be underestimated. Rather than shield-thickness analysis that can calculate TID on the IDHU boards, we present more accurate and detailed TID analysis by using the GEOMETRY AND TRACKING4 (GEANT4) monte carlo simulation tool kit and compare the data with the previous method.

[P-102] Photometric Observations of PHA 162173 Ryugu (1999 JU3) During the 2016 Apparition

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Potentially Hazardous Asteroid (PHA) 162173 Ryugu (1999 JU3) is the target of the JAXA's Hayabusa 2 spacecraft which is the first sample return mission to a C-type asteroid. The optical properties of Ryugu were investigated from vigorous ground-based observations carried out during the previous observational opportunities in the 2007 – 2008 and 2011 – 2012 apparitions. However, the spin axis and shape model that are essential for the safety and fuel efficiency of landing and sampling on the asteroid was not precisely constrained due to large uncertainties in photometric data and small variations in the lightcurve amplitude. We conducted the network observations for Ryugu between European and American Continents, and also in Hawaii and Australia, during the end of July to the beginning of the August 2016 nearly simultaneously. We employed several 1-2 m class telescopes: CA 1.2 m in Spain, RTT 1.5 m in Turkey, Terksol 2 m in Russia, Rozhen 2 m in Bulgaria, LCOGT 2 m Faulkes Telescopes in US and Australia, McDonald 2.1 m in USA, ZTSh 2.6 m in Crimea, Ukraine. Based on our dataset, we will present the rotational period and the amplitude using the dense lightcurve data.

[P-103] Study on Rover Electric Power System Architecture Considering the Lunar Environment

Younkyu Kim, Joohee Lee, Jong-Won Lee, Ik-Hyeon Choi

Korea Aerospace Research Institute

In this study, Considering the extreme environments on the moon, optimization study for the electric power system (EPS) and other subsystems of lunar exploration rover conducted. The lunar day and night lasts approximately each 14.5 Earth days with high temperature in daytime and with an extremely low temperature at night. To survive in this extreme environment, lunar rover systems should be optimized in the mission conditions. First of all, the important conditions of lunar environment were matched to rover's subsystem design variables and the effect of those to rover design and performance were analyzed. Especially the EPS's performances of lunar rover which is performed and planning in other countries such as Yutu, Apollo, Lunokhod, Chandrayaan, Selene and of Mars rover of Sojourner, MER, MSL were reviewed, and then main EPS candidates like solar array, RTG (Radioisotope Thermoelectric Generator), fuel cell and were conducted through comparative analysis, and the secondary power storage system and other electric devices for power regulation and distribution were also analyzed by performance. With the results of these analysis, the mass budget and electric power efficiency were deducted according to the EPS architecture. Therefore the results of this study will be applied to optimal EPS design of lunar rover to maximize the mission performance and the survivability on lunar environment.

[P-104] Conceptual design of a science data management system for the Korea Pathfinder Lunar Orbiter

Joo Hyeon Kim

Korea Aerospace Research Institute

Korea Aerospace Research Institute is carrying out the development of science data management system for the Korea Pathfinder Lunar Orbiter. The goals of the system are to efficiently manage the science data processing and archiving from science instruments onboard the orbiter in order to promote international collaboration in lunar science researches and enhance scientific achievements. The system will provide similar functions to data management system for other Korean satellites except the functions for verifying processed science data in the PDS4 standards. The main functions are to extract the raw data from telemetry data, to distribute the data for science instrument developers for higher level data processing, to verify the science data based on the PDS4 standards and to permanently store the data. I present the conceptual design of the science data management system for KPLO.

[P-105] An Introduction to Mission Concept of Operations of KPLO

Seung Yong Min, Byong-Suk Suk

Korea Aerospace Research Institute

KPLO is the first mission of the Korean lunar exploration program. The mission objectives of the KPLO are 1) development of key technologies for lunar exploration, 2) scientific investigation of the Moon and lunar environment, and 3) realization and validation of new space technology. The mission concept of operations of KPLO is the key system-level design to provide various mission concepts, spacecraft description, instruments overview, and preliminary operations concepts for the KPLO mission. In this research, the operation concepts of recent foreign lunar orbiters are explained briefly. And then, System architecture, instruments overview, trajectory overview, and mission phases overview of KPLO are described compared to the foreign lunar missions. Each mission phase include operational concepts of KPLO. Mission concept of operations of KPLO is not defined yet, but it will be updated and matured concurrently with the system design.

[P-106] Introduction and Usage of LRO Instrument SPICE Information

Seunghee Son, Dawoon Jung

Korea Aerospace Research Institute

The SPICE toolkit is an information system developed by NASA to support planetary exploration and provides ancillary data such as the relative position, attitude and time of a spacecraft and celestial objects. SPICE kernels are composed of navigation and other ancillary information. We acquired the NASA LRO mission SPICE kernels and present a visualization of LRO ephemerides and extract instrument specific information. We explore their applicability to the Korea Pathfinder Lunar Orbiter (KPLO) mission.

[P-107] Effect of Applying Improved Version of Selenopotential Model on Predicting Lunar Orbiter's State

Young-Joo Song, Young-Rok Kim, Jonghee Bae,
Bang-Yeop Kim, Gi-Hyouk Choi

Korea Aerospace Research Institute

Precise knowledge of selenopotential model is remarkably important not only for the aspects of scientific research of the Moon but also for the spacecraft applications around the Moon. For engineering-oriented aspects, knowledge of gravity field of the Moon directly affects to the performance of spacecraft orbit propagation (OP) and orbit determination (OD) knowledge. Since the first dynamical proof of the Moon's oblateness, made in 1966, the lunar gravity field model has been continuously updated and improved. While preparing Korea Pathfinder Lunar Orbiter's (KPLLO) flight dynamics operation, selecting one of the appropriate selenopotential model that meets its mission requirement is very important. Therefore, the effect of adapting improved version of selenopotential model on predicting lunar orbiter's state is analyzed. Mission operation orbit around the Moon is assumed as a circular orbit having 100 km altitude with 90 deg inclination. Orbiter's state is propagated during 4 days as to regard up-loading operation schedules during weekends, and four different selenopotential models, including GLGM2, LP150Q, GRAIL660B and the most recent version GRAIL1500E, are adapted. For each lunar gravity model, full order and degree is used during simulations. As a result, it is discovered that significant OP errors are expected by just solely applying the different lunar gravity model. Regarding GRAIL1500E model as a reference, GRAIL660B model showed maximum up to about 280 m errors in transverse direction, LP150Q maximum up to about 4.9 km, also in transverse, and GLGM2 maximum up to about 28.2 km errors in normal direction. Current findings again confirm the importance of appropriate selection of lunar gravity model in predicting lunar orbiter's state. In addition, discovered error ratio in OP performance may significantly affect to the accuracy of mission planning (i.e., imaging and contact scheduling) and OD during the nominal operation of the KPLLO.

[P-108] Launch Opportunities for the Moon Orbiting Small Satellite Utilizing Lunar Fly-by en Route to Mars

Yongjun Song¹, Young-Joo Song, Ho Jin¹

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In planning the deep space mission, the flight trajectory analysis and mission design that minimizes a overall mission budget is one of the important tasks. In this study, we analyzed the launch opportunities for the conceptual Mars mission which utilize lunar fly-by en route to Mars. It is assumed that proposed conceptual mission is performed with the mother-ship, the main Mars orbiter and the daughter-ship which will be separated from the mother-ship to orbit around the Moon during the lunar fly-by phase. Simulations were performed to investigate launch opportunities between year of 2018 and 2022, and showing that utilizing the lunar fly-by en route to Mars is possible during the periods of Apr. 2018, Jul.

2020, and Sep. 2022, respectively. In addition, the required minimum delta-Vs for the mother-ship is found to be about 7~8 km/s. These results indicate that the launch opportunities for the proposed conceptual Mars mission are very similar to those of launch opportunities with the typical Mars direct transfer mission. However, a slight amount of additional delta-Vs required which is found to be about 1 km/s. To make the daughter-ship orbit around the moon, it is also discovered that about 0.2~0.9 km/s of delta-V is required to separate during the lunar fly-by phase. From only delta-V budget point of views, proposed conceptual mission may not be efficient than the missions with Mars direct transfer. Nevertheless, an enabling of multiple planet explorations with a single launch by adapting the proposed concept will not only be the great interest of engineers world-wide but also the scientist who wishes to have more chances to explore planets.

[P-109] The mechanical concept design of the KMAG in KPLLO mission

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Hyojeong Lee, Jehyuck Shin, Seonyeong Jeong

School of Space Research, Kyung Hee University

KPLLO (Korean Pathfinder Lunar Orbiter) is a first Korean lunar explorer mission. The KMAG (Kplo MAGnetometer), a study of lunar magnetism and magnetic fields, is one of the scientific payload of KPLLO. It consists of three fluxgate magnetometer sensors, boom structure, and FCE (Fluxgate magnetometer Control Electronics). Two out-board sensors are positioned at the boom-tip, and in-wards, of a boom which is deployed in-orbit and extends 1.5 m away from the spacecraft. Although the length of boom is short, we use that because the dual sensing methods can compensate and calibrate the magnetic interference from spacecraft. The boom structure is composed of boom tube, Boom actuator and boom hinge. The boom tube consists of CFRP (Carbon Fiber Reinforced Plastic) that has a high strength to weight ratio and an outstanding rigidity. Boom hinge is able to deploy until 135 degrees and not to fold back again after deployment. SMA (Shape Memory alloy), a transfer thermal energy to nonelastic energy, is used boom actuator to release the fastener of the boom. The dimensions of FCE are 130 x 130 x 95 mm and it contains four electronic boards and the in-board sensor. In this paper, we discuss about the mechanical concept design and its specific mechanism of the KMAG.

[P-110] Study of Magnetic Anomalies and Optical Properties for Small Regions of Octopus Swirls

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Subsatellite of the Apollo 15 has discovered that magnetic fields are existed at the Moon. These magnetic fields are localized and magnetized. Some crustal magnetic anomalies coincide with surface albedo anomalies known as swirls, where exhibit no distinct

topography on the surface. The Octopus region (1.0 °S, 61.3 °W) is located south-west rim of Oceanus Procellarum. Previous studies have not been reported the feature as a swirl and a thorough study has not yet been performed. We study magnetic anomalies related with surface albedo markings which look like a omega symbol (Ω) at Octopus swirls. We use Lunar Prospector (LP) of low altitude magnetometer (MAG) data and crustal magnetic strength of Electron Reflectometer (ER) data. The magnetic field contour data are illustrated in Lunar Reconnaissance Orbiter (LRO) Wide Angle Camera (WAC) imagery and ER matrix. We also use Clementine UV/VIR data for Optical Maturity (OMAT) may be consistent with space weathering. We found evidences of a relation of optical properties and magnetic fields at Octopus region. The swirls processes can describe these features. In this study, we explain about the first report of a swirls at Octopus region.

[P-111] A Conceptual Study on Lunar Rover Mission

Joo Hee Lee, Joo Hyeon Kim, Youn Kyu Kim, Jong Won Lee, Ik Hyeon Choi

Korea Aerospace Research Institute

A Korean Lunar Exploration Program (KLEP) based on the national space promotion plan is consisted of two phases. The first phase for lunar observation is to develop the Korea Pathfinder Lunar Orbiter (KPLO) from 2016 to 2018. After a KPLO mission in 2018, the Korea Aerospace Research Institute (KARI) has a plan to send a lunar orbiter, lander and rover through the second phase for lunar surface exploration mission around 2020. From this year, KARI is conducting a preliminary study for the rover mission concept for the purpose of successful mission completion of the second lunar surface exploration mission (lunar lander and rover mission) around 2020. In this presentation, we suggest the rover science mission and candidate payloads for the successful lunar surface mission on the basis of foreign lunar surface rover mission.

[P-112] The Distributed Processing System for Parameter Study on Asteroid Lightcurve Analysis

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The time-series photometry of asteroids is one of the important methods for obtaining their physical properties. In order to characterize the objects from their lightcurves, we are able to conduct a parameter study of the input variables with the inversion method developed by Kaasalainen et al. (2001). However, this process takes a very long time because the inversion method searches a huge number of combinations of various parameters in multi-dimensional phase space in order to find the most probable solution. Hence, it usually takes several months or even almost a year until we have a physically

plausible model of the Non-Principal Axis (NPA) rotator if we manually take different sets of parameters and run the code in such a semi-automatic way. This is why we have developed a dedicated software for multi-core distributed computing system for asteroid lightcurve analysis. In this paper, we present the structure and functions of the distributed processing system (hardware) and the analysis result of the asteroid lightcurve inversion method (software).

[P-113] The Lunar Opposition Effect as Measured from Lunar Orbiter Laser Altimeter (LOLA) Data

Dawoon Jung, Seunghee Son

Korea Aerospace Research Institute

The lunar surface is known to exhibit strong backscatter in optical wavelengths, in a phenomenon known as the opposition effect. Accurate understanding of the opposition effect is important for calibrating lunar imagery, but so far the phenomenon has been poorly understood. We use recently-published Lunar Orbiter Laser Altimeter (LOLA) active, calibrated laser reflectance data from the Lunar Reconnaissance Orbiter to measure the lunar opposition effect. The phase angle of LOLA laser pulses is nearly zero, allowing us to probe the opposition effect at smaller phase angles than previously possible. Additional passive reflectance data from LOLA provides a fuller picture at larger phase angles. We present preliminary results that show the relative magnitude of the opposition effect at zero phase angle.

[P-114] Martian ionospheric response to ICME as detected by Mars Atmosphere and Volatile Evolution (MAVEN) Mission

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Because the Mars has weak magnetic fields, the Mars has been strongly affected by the solar activities and the space weather. Especially, if the Interplanetary Coronal Mass Ejection (ICME) accompany the solar energetic particles, ICME have stronger influence on the atmosphere/ionosphere/magnetosphere of Mars. The Mars Atmosphere and Volatile Evolution (MAVEN) spacecraft made comprehensive measurements of the Martian upper atmospheric and ionospheric response to solar activity to solve those historical questions on the relationship between the Mars and the solar activities. The MAVEN has observed 23 ICME event since its arriving at the Mars in September 2014. In this paper, we report the results of the analysis on the effects of these ICME to the Martian ionospheric particles, both ions and electrons, by using data from Solar Wind Electron Analyzer (SWEA), Solar Wind Ion Analyzer (SWIA), SupraThermal and Thermal Ion Composition (STATIC) and Neutral Gas and Ion Mass Spectrometer (NGIMS) instruments onboard MAVEN spacecraft.

[P-115] Visibility Study of the Lunar Orbiter Considering Constraint of Antenna

Su-Jin Choi, Dong-Hun Lee, Seong-Yong Min,
Dong-young Rew

Korea Aerospace Research Institute

Korean government has a plan to develop an Korean Pathfinder Lunar Orbiter(KPLO) until 2018 to get the key technologies for planetary mission and verify the technologies for future lunar orbiter and lunar lander that will be launched by 2020. Science data from several instrument of the KPLO will be sent to the ground station by using X-band antenna, major command and telemetry will be sent to and received from the ground station by using S-band antenna. X-band antenna has gimbal type of 2 axis so there is some limitation to point toward into the ground station. Although visibility between KPLO and ground station is available, X-band antenna is not visible due to the constraints of gimbal. This paper describes the visibility study of KPLO between ground station and S-band/X-band antenna.

[P-116] The Derived Mission Main Requirements for the Lunar Exploration Orbiter

Jae-Wook Kwon, Byong-Suk Suk, Dong-Young Rew

Korea Aerospace Research Institute

The mission of the spacecraft that needs to achieve is defined to the user's goal. The spacecrafts for the lunar exploration particularly have the more scientific mission. The KPLO (Korea Pathfinder Lunar Orbiter) has been being designed with five instruments as payload. This manuscript describes how the mission requirements are derived from the concept of operation for the payloads. Moreover, for spacecraft to get to the moon, the capabilities of the launch vehicle are considered for the derived factors to the mission requirement. Mission parameters mentioned in the mission requirements are the launch mass, the transfer trajectory to the moon, lunar orbit requirements, level of orbit determination, the coordinate systems, and so on.

■ 우주기술

[P-117] Thermal Environment Conditions Applied to Lunar Orbiter

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Most lunar orbiters developed recently have performed various missions in a polar orbit of 100 km altitude. These lunar orbiters should be exposed to more severe thermal environments than earth-orbiting satellites are. The thermal environments of a lunar orbit are composed of a direct solar heating, its Albedo (reflected from the lunar surface), and a lunar IR radiation. Of these, a Albedo is very low due to black-body like lunar surface optical properties, that is, the incident solar heat rate is nearly absorbed on the lunar surface; also, because the moon have no atmosphere and relatively a long rotation

of 27-day period, its surface temperature rises up to about 120 degree C and drops to nearly -170 degree C. Therefore, the lunar orbiter of a 100 km polar orbit is affected directly by such severe thermal environments. This study investigated the thermal environment characteristics of previous lunar orbiters and then, proposed the proper thermal conditions for the lunar orbiter thermal analysis.

■ 기타

[P-118] Optimal Guidance Algorithm for Planetary Landing via Convex Optimization

Sang-Wook Kang, Sang-Ryool Lee

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Recently, pinpoint landing accuracy is required for a successful planetary landing. In this study, optimal guidance algorithm for planetary landing via convex optimization is invested to obtain the global optimal solution and implementation on real time. Generally, equations of motion of a lander can be expressed by the nonlinear differential equations. Therefore, it takes a long time to solve the nonlinear differential equations numerically and also, local optimal solution is achieved in most cases. As a results, non-convex terms should be transformed to convex terms by various convexification methods such as relaxation, successive linearization. By numerical simulations, we confirmed that convex optimization can be used for pinpoint landing of planetary exploration to be performed in near future.

[P-119] Study of Technical Trend of Russia and China Launch Complexes

Sunil Kang, Hwayoung Oh

Korea Aerospace research Institute

The Russia has maintained the status of two giants in outer space exploration with Unites States and China also established the emerging powerful position. They has developed various launch vehicles and launch complexes since 1950s and well maintained all of them. The basics of China's space technology was inherited from Russia and their technical trends are very similar. Therefore, it is very useful to comparative analysis of technical trend of two country together. Korea Aerospace Research Institute has constructed a new launch complex in accordance with KSLV-2 development program at NARO Space Center. And design concept of the new launch complex has inherited the basic operation policy of KSLV-1 which originated from Russian launch vehicle. It is expected to helpful in construction of KSLV-2 launch complex and planning of next generation launch vehicle also that understand the technical trend of Russia's and China's launch complexes.

[P-120] The Design of Downrange Telemetry Station in Palau for KSLV-II Launch Mission

Dong-Hyun Kim, Jeong-Woo Han, Chun-won Kim,
Sun-Ho Kwon, Dea-O Kim

Korea Aerospace Research Institute

The total range of SSO launch mission for KSLV-II is over 3,000km, so it's hard to cover and get the flight telemetry data stably for whole range with domestic tracking system itself. NARO Space Center is currently under developing new downrange station in Republic of Palau, and it is expected to be completed by mid-2019. The station has transportable 7.3m antenna with G/T 19dB/K in S-Band, and also be capable to receive, process and store 3 RF streams simultaneously.

[P-121] The Calculation Method of Reflector Antenna Performance by Using Feed Horn Pattern

Chun-Won Kim, Dong-Hyun Kim, Soon-Ho Kwon, Jeong-Woo Han, Dae-Oh Kim

Korea Aerospace Research Institute

The Reflector antenna performance is dependant on an size, radiation pattern, beamwidth, return loss of Feed Horn. Therefore Feed horn performance is using for easily predicting reflector antenna performance. Reflector antenna sidelobe and pattern are very similar with feed's and reflector antenna gain decrease by blockage area and reflector projection level of feed. In this paper, the calculation method of reflector antenna performance is represented according to feed horn size, pattern, beamwidth and verified whether or not this method is appropriate.

[P-122] Vibration Characteristics of the Stirling Cryocooler with the Input Voltage

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Stirling cryocoolers have been widely used for the cooling of infrared sensors and high temperature superconducting filters to the temperature of the liquid nitrogen. The Stirling cryocooler with the rotary compressor is applicable to the cooling device for the compact mobile thermal imaging system, because the cryocoolers have the compact structure and light weight. Spaceborne infrared instrumentation is known to be inherently susceptible to cryocooler induced vibration. The vibration is a series of force harmonics because the cooler motion is periodic. We record the vibration on a spectrum analyzer while the cooler is running at full power and at low temperature with input voltage. The vibrations of the Stirling cryocooler depend on the mode structure in the cryocooler, and are sensitive to the operating frequency and stroke amplitude.

[P-123] Optical Alignment Techniques for the Optical Telescope Development

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We introduce two optical alignment techniques for the optical telescope development. One is to use laser tracker and metrology software to establish structure coordinate system using the cones on the GSE lifting fittings built into the structure. The other is to use coordinate system having the capacity to measure large objects in size and mass without affecting the metrology performances. We present the experimental results by using those methods.

[P-124] Development of the RS422-to-Ethernet Telemetry PCM Decoder

Won-Ju Yoon

Korea Aerospace Research Institute

The onboard telemetry system of the Korea Space Launch Vehicle (KSLV-II) generates the PCM frame data by acquiring the data from variable sensors and onboard electronic units and transmits them to the ground telemetry station via the RS-422 interface before flight or the RF link during flight. This paper presents the development of the telemetry PCM decoder which has the following features: it 1) receives a serial bit stream of the PCM frame data from the onboard telemetry system via the RS-422 interface, 2) extracts each PCM minor frame data by decoding the received bit stream of the PCM frame data and detecting the SYNC word within the data, 3) generates multicast UDP/IP packets per PCM minor frame data, and 4) transmits the packets via Ethernet interface. The developed telemetry PCM decoder with a laptop makes possible to build the mobile ground telemetry station which checks the telemetry PCM frame data via the RS-422 interface.

[P-125] A Study on the Bispectrum-based Communication Technique for Telemetry

Jeong-Woo Han, Dong-Hyun Kim, Sun-Ho Kwon, Chun-won Kim, Dea-O Kim

Korea Aerospace Research Institute

Recently, telemetry systems are designed to provide high data rate network that supports the full complement of communications needs such as video, various sensor data and digital bus data. The traditional modulation techniques employed on telemetry systems are based on PCM-FM. However, telemetry channels are vulnerable to multi-path, fading, jamming, bandwidth etc, in particular when a high data rate is required. In this study, we have explored the utility and performance of a bispectrum-based communication technique that exploit the properties of the higher-order spectrum of the modulation waveform.

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■ 사단법인 한국우주과학회 정관 ■

1995년 5월 3일 제정
1996년 5월 4일 개정
2014년 10월 30일 개정

제1장 총칙

제1조 (목적) 이 법인은 사회일반의 이익에 공여하기 위하여 공익법인의 설립운영에 관한 법률의 규정에 따라 우주과학의 발전과 그 응용 및 보급에 기여하고 나아가 과학의 발전에 이바지함을 목적으로 한다.

제2조 (명칭) 이 법인은 사단법인 한국우주과학회(이하 학회)라 칭하고, 영어명칭은 The Korean Space Science Society로 한다.

제3조 (사무소의 소재지) 학회의 사무소는 대전광역시 유성구 대덕대로 776 한국천문연구원 내에 둔다.

제4조 (사업) 학회는 제1조의 목적을 달성하기 위하여 다음 각 호의 목적사업을 행한다.

1. 학술적 회합의 개최
2. 학술간행물의 발행 및 배포
3. 학술자료의 조사, 수집, 교환
4. 학술의 국제교류
5. 과학기술진흥에 관한 지원 및 건의
6. 기타 본 학회 목적에 적합한 사업

제5조 (법인 공여이익의 수혜자)

1. 학회가 목적사업을 수행함에 있어서 그 수혜자에게 제공하는 이익은 이를 무상으로 한다. 다만, 부득이한 경우에는 미리 감독청의 승인을 받아 그 대가의 일부를 수혜자에게 부담시킬 수 있다.
2. 학회의 목적 사업의 수행으로 인하여 제공되는 이익은 수혜자의 출생지, 출신학교, 근무처, 직업 또는 기타 사회적 지위 등에 의하여 차별을 두지 않는다.

제2장 회원

제6조 (회원의 종류 및 자격) 학회 회원의 종류와 자격은 다음과 같다.

1. 정회원: 정회원은 우주과학에 관심을 갖는 개인으로서 대학에서 우주과학 또는 그에 관련된 과정을 수학한 자 또는 이사회에서 동등한 자격을 가진 자라고 인정된 자
2. 학생회원: 학생회원은 대학 학부 과정에서 우주과학 또는 그에 관련된 과정을 수학하고 있는 자 또는 이사회에서 동등한 자격을 가진 자라고 인정한 자
3. 준회원: 준회원은 정회원 중 과거 3년간 회원의 의무를 이행하지 아니한 자
4. 명예회원: 명예회원은 우주과학 발전에 공적이 현저하거나 학회의 목적달성에 큰 공적이 있는 자

5. 특별회원: 특별회원은 학회에 찬조 및 기부행위 또는 동등한 기여를 한 개인 또는 단체
6. 기관회원: 기관회원은 학회의 목적에 뜻을 같이하고 사업에 기여하는 학술 및 연구단체

제7조 (입회) 학회의 회원은 다음 각 호에 따라 그 자격을 얻을 수 있다.

1. 본 학회의 정회원 혹은 학생회원이 되고자 하는 자는 정회원 2인의 추천을 얻어 입회를 신청하고 이사회의 승인 후 입회금과 회비를 납부함으로써 회원이 된다.
2. 명예회원은 회장의 제청에 의하여 이사회에서 의결하여 총회에서 추대한다.
3. 특별회원 및 기관회원은 이사 2인의 추천에 의하여 이사회의 승인을 받아야 한다.

제8조 (의무와 권리) 학회 회원은 다음 각 호의 의무와 권리를 갖는다.

1. 정관 및 의결사항의 준수와 회비납부의 의무
2. 회원은 연구발표, 논문 기고 및 학술 활동에 참여할 수 있다.
3. 회원은 학회 운영에 참여 할 수 있으며, 별도 규정이 정한 바에 따라 선거권과 피선거권을 갖는다.

제9조 (회원의 탈퇴 및 권리의 정지)

1. 회원은 임의로 탈퇴할 수 있다.
2. 회원으로서 의무를 다하지 아니한 경우나 학회의 목적에 배치되는 행위 또는 명예나 위신에 손상을 가져오는 행위를 하였을 때에는 이사회의 의결로서 권리를 정지하거나 제명할 수 있다.

제3장 임원

제10조 (임원) 학회에 다음 임원을 둔다.

1. 회 장 1인
2. 부회장 1인 이상 3인 이내
3. 감사 2인
4. 이사 15인 이상 25인 이내 (회장, 부회장 포함)

제11조 (임원의 임기)

1. 임원의 임기는 2년으로 하며 연임할 수 있다. 다만, 회장은 연임할 수 없다.
2. 임원의 임기 중 결원이 생긴 때에는 2개월 이내에 이사회에서 보선하고, 보선에 의해 취임한 임원의 임기는 전임자의 잔여기간으로 한다.
3. 임원은 임기가 끝난 후일지라도 후임자가 선출 확정될 때까지는 그 직무를 담당한다.

제12조 (임원의 선임방법)

1. 회장과 감사는 총회에서 직접선거로 선출하며, 부회장은 회장이 지명하고 이사의 절반은 투표로 선출하고 나머지 절반은 회장이 지명한다.
2. 상기 임원 선출을 위하여 임원선출방법을 별도로 정

하여야 하며, 선출된 임원은 감독관청의 취임 승인을 받아야 한다.

- 3. 임기전의 임원의 해임은 총회의 의결을 거쳐 감독관청의 승인을 받아야 한다.

제13조 (회장 및 부회장의 직무)

- 1. 회장은 학회를 대표하고 학회 업무를 총괄하며, 총회 및 이사회의 의장이 된다.
- 2. 부회장은 회장의 직무를 보좌하며 회장 유고시 부회장 중 연장자가 회장의 직무를 대행한다.

제14조 (이사의 직무)

- 1. 이사는 이사회에 출석하여 학회의 업무에 관한 사항을 의결하며 회장으로 부터 위임받은 사항을 처리한다.
- 2. 필요에 따라 이사 중에서 총무, 재무, 학술 이사 등을 둘 수 있다.

제15조 (감사의 직무) 감사는 다음 각 호의 직무를 행한다.

- 1. 학회의 재산상황을 감사하는 일
- 2. 이사회의 운영과 그 업무에 관한 사항을 감사하는 일
- 3. 제1호 및 제2호의 감사결과 부정 또는 불법한 점이 있음을 발견할 때에는 이를 이사회, 총회에 그 시정을 요구하고 그래도 시정치 않을 때에는 감독관청에 보고하는 일
- 4. 제3호의 보고를 하기 위하여 필요한 때에는 총회 또는 이사회의 소집을 요구하는 일
- 5. 학회의 재산상황, 또는 총회, 이사회의 운영과 업무에 관한 사항에 대하여 회장 또는 총회, 이사회에서 의견을 진술하는 일
- 6. 총회 및 이사회의 회의록에 기명 날인하는 일

제4장 총회

제16조 (총회의 구성 및 기능) 총회는 정회원으로 구성하고 다음 각 호의 사항을 의결한다.

- 1. 임원 선출에 관한 사항
- 2. 정관 변경에 관한 사항
- 3. 예산 및 결산의 승인
- 4. 사업계획의 승인
- 5. 기타 중요한 사항

제17조 (총회 소집)

- 1. 총회는 정기총회와 임시총회로 나누며 회장이 소집한다. 정기총회는 년 1회, 임시총회는 필요에 따라 소집할 수 있다.
- 2. 회장은 회의안건을 명기하여 회의 7일전에 각 회원에게 통보하여야 한다.
- 3. 총회는 제2항의 통지사항에 한하여서만 의결할 수 있다.

제18조 (총회의결과 정족수)

- 1. 총회는 국내에 있는 정회원 10분의 1 이상의 출석으로 개최한다.
- 2. 총회의 의사는 출석한 정회원의 과반수의 찬성으로 의결한다. 다만, 가부동수인 경우에는 의장이 결정한

다.

제19조 (총회소집의 특례)

- 1. 회장은 다음 각 호의 하나에 해당하는 소집요구가 있을 때에는 그 소집 요구일로부터 20일 이내에 총회를 소집하여야 한다.
 - ① 재적이사 과반수가 회의의 목적을 제시하고 소집을 요구한때
 - ② 제15조 제4호 규정에 따라 감사가 소집을 요구한 때
 - ③ 국내에 있는 정회원의 10분의 1 이상이 회의의 목적을 제시하여 소집을 요구한때
- 2. 총회 소집권자가 궐위되거나 또는 이를 기피함으로써 총회소집이 불가능할 때에는 재적이사 과반수 또는 국내에 있는 정회원 10분의 1 이상의 찬성으로 감독관청의 승인을 받아 총회를 소집할 수 있다.
- 3. 제2항에 의한 총회는 출석 이사 중 연장자의 사회아래 그 의장을 지명한다.

제20조 (총회의결 제적사유) 의장 또는 정회원이 다음 각 호의 하나에 해당하는 때에는 그 의결에 참여하지 못한다.

- 1. 임원 취임 및 해임에 있어 자신에 관한 사항
- 2. 금리 또는 재산의 접수를 수반하는 사항으로서 의장 또는 정회원 자신과 학회의 이해가 상반되는 사항

제5장 평의위원회 (삭제)

제21조 (평의원의 자격 취득과 상실)

삭제

제22조 (평의원회의 직무)

삭제

제6장 이사회

제23조 (이사회 구성 및 기능) 이사회는 회장, 부회장 및 이사들로 구성되며 다음 각 호의 사항을 심의 의결한다.

- 1. 업무집행에 관한 사항
- 2. 사업계획 운영에 관한 사항
- 3. 예산 결산서 작성에 관한 사항
- 4. 총회에서 위임받은 사항
- 5. 정관에 의하여 그 권한에 속하는 사항
- 6. 기타 중요한 사항

제24조 (의결 정족수)

- 1. 이사회는 이사 정원수의 과반수가 출석하지 아니하면 개최하지 못한다.
- 2. 이사회의 의사는 출석이사 과반수의 찬성으로 의결한다. 다만 가부동수인 경우에는 의장이 결정한다.
- 3. 감사는 이사회에 출석하여 의견을 진술할 수 있다.

제25조 (이사회 소집)

1. 이사회는 회장이 소집한다.
2. 이사회를 소집하고자 할 때에는 적어도 회의 7일전에 목적을 제시하여 각 이사에게 통지하여야 한다.
3. 이사회는 제2항의 통지사항에 한하여서만 의결할 수 있다. 다만 재적이사 전원이 출석하고 출석이사 전원의 찬성이 있을 때에는 통지하지 아니한 사항이라도 이를 안건으로 채택하여 의결할 수 있다.

제26조 (이사회 소집의 특례)

1. 회장은 다음 각 호의 하나에 해당하는 소집요구가 있을 때에는 그 소집요구일로부터 20일 이내에 이사회를 소집하여야 한다.
 - ① 재적이사 과반수로부터 회의의 목적을 제시하여 소집을 요구한때
 - ② 제15조 제4호에 의하여 소집을 요구한때
2. 이사회 소집권자가 궐위되거나 또는 이를 기피함으로써 7일 이상 이사회 소집이 불가능할 때에는 재적이사 과반수의 찬성으로 감독관청의 승인을 받아 소집할 수 있다.
3. 제2항에 의한 이사회는 출석이사 중 연장자의 사회 아래 그 의장을 지명한다.

제27조 (서면의결 금지) 이사회 의사는 서면의결에 의할 수 없다.

제7장 재산 및 회계

제28조 (재정) 학회의 재정은 다음의 수입금으로 충당한다.

1. 회원의 회비
2. 재산의 과실
3. 사업 수익금
4. 기부금 및 기타 수익금

제29조 (회계연도) 학회의 회계연도는 정부 회계연도에 따른다.

제30조 (세입, 세출, 예산) 학회의 세입, 세출, 예산은 매 회계연도 개시 1개월 전까지 사업계획서와 함께 이사회 의 의결과 총회의 승인을 얻어 감독관청에 제출한다

제31조 (예산외의 채무부담 등) 학회의 예산외의 채무의 부담이나 채권의 포기는 총회의 의결을 거쳐 감독관청의 승인을 받아야 한다.

제8장 보칙

제32조 (해산) 학회를 해산하고자 할 때에는 총회에서 국내에 있는 재적 정회원 3분의 2 이상의 찬동으로 의결하여 감독관청의 허가를 받아야 한다.

제33조 (해산법인의 재산 귀속) 학회가 해산할 때의 잔여 재산은 감독관청의 허가를 받아 국가 또는 지방자치단체에 귀속된다.

제34조 (정관 개정) 학회의 정관을 개정하고자 할 때에는 재적이사 3분의 2 이상의 찬성과 총회의 승인을 얻어야 한다.

제35조 (시행 세칙) 정관의 시행에 필요한 세부적인 사항은 이사회에서 정하여 총회의 승인을 얻어야 한다.

제36조 (공고사항 및 방법) 법령의 규정에 의한 사항과 다음 각 호의 사항은 이를 일간신문에 공고함을 원칙으로 한다.

1. 법인의 명칭
2. 학회의 해산
3. 학회 운영과 관련하여 이사회에서 공고하기로 의결한 사항

제37조 (설립당초의 임원 및 임기) 학회의 설립당초의 임원 및 임기는 다음과 같다.

성명	현직	전화번호	임기
회장 오규동	전남대학교 교수	062-520-6965	94.5-96.5
부회장 정장해	충북대학교 교수	0431-61-2313	94.5-96.5
이사 강영운	세종대학교 교수	02-460-0234	94.5-96.5
이사 김천휘	충북대학교 교수	0431-61-3139	94.5-96.5
이사 김철희	전북대학교 교수	0652-70-2807	94.5-96.5
이사 김호일	천문대 연구원	042-865-3217	94.5-96.5
이사 민경욱	한국과학기술원 교수	042-869-2525	94.5-96.5
이사 박경윤	시스템공학센터 연구원	042-869-1571	94.5-96.5
이사 서경원	충북대학교 교수	0431-61-2315	94.5-96.5
이사 이영욱	연세대학교 교수	02-361-2689	94.5-96.5
이사 이용복	서울교육대학교 교수	02-580-5456	94.5-96.5
이사 이우백	표준연구원 천문대장	042-865-3215	94.5-96.5
이사 조경철	한국우주환경 연구소장	02-761-0031	94.5-96.5
이사 천문석	연세대학교 교수	02-361-2685	94.5-96.5
이사 최규홍	연세대학교 교수	02-361-2686	94.5-96.5
이사 한원웅	천문대 연구원	042-865-3217	94.5-96.5
감사 나일성	연세대학교 교수	02-361-2681	94.5-96.5
감사 이용삼	충북대학교 교수	0431-61-2314	94.5-96.5

부칙

제1조 (시행일) 이 정관은 감독관청의 허가를 받은 날부터 시행한다.

1. 1995년 12월 26일 과학기술처장관 허가
2. 1996년 7월 24일 과학기술처장관 허가
3. 2014년 12월 03일 미래창조과학부장관 허가

■ 학회운영에 대한 규정 ■

2014년 10월 30일 제정
2016년 2월 18일 개정

제1조(목적) 한국우주과학회(이하 "학회") 정관 제35조에 근거하여 학회 운영에 필요한 사항을 규정함을 목적으로 한다.

제1장 회비

제2조(회비) 학회 정관 제7조, 제8조 및 제28조의 각 1호에 근거하여 회원이 납부해야 할 연회비는 다음과 같다.

- ① 임원: 10만원
- ② 정회원: 5만원
- ③ 학생회원: 1만원
- ④ 명예회원: 면제
- ⑤ 특별회원: 면제
- ⑥ 기관회원 : 이사회에서 결정

제3조(회비의 면제) 2년 이상 해외 체류하는 자에 한하여 연회비를 면제할 수 있다.

제2장 위원회 및 분과 활동

제4조(구분)

- ① 학회 정관 제4조의 학회 활동에 관련하여 아래 각호와 같이 위원회, 분과회, 그리고 연구회를 둘 수 있다.
 - 1. (위원회) 위원회는 학회원의 학술활동에 대한 지원을 목적으로 한다.
 - 2. (분과회) 분과회는 학회원의 전문분야별 자율적 학술 활동을 목적으로 한다.
 - 3. (연구회) 연구회는 학회원의 특정 목적 학술 활동을 목적으로 한다.
- ② 상설위원회로는 편집위원회, 포상위원회, 학술대회준비위원회를 둔다.
- ③ 특별 위원회는 학회의 필요에 따라 수시로 구성 및 해산할 수 있다.
- ④ 분과회의 전문 분야는 학회원들의 자율적 논의와 참여를 통하여 정하고 회칙을 정하여 이사회에 승인을 얻어야 한다.
- ⑤ 연구회의 특정 학술 활동 분야는 대내외적 요구에 따라 수시로 정할 수 있다.

제5조(편집위원회)

- ① 편집위원회는 학회에서 발간하는 정기 학술지에 게재되는 논문의 심사, 편집 및 출판을 관장한다.
- ② 학술이사가 위원장을 맡고, 국내위원은 15인 이내로 하며 정회원 중에서 이사회의 동의를 얻어 회장이 임명한다. 국외위원은 20인 이내로 하며 이사회의 동의를 얻어 회장이 임명한다. 임기는 모두 2년으로 한다.
- ③ 학술지 논문 투고규정 및 세부사항은 편집위원회에서 논의한 후 이사회의 의결을 거쳐 시행한다.

제6조(포상위원회)

- ① 포상위원회는 학회를 통한 대내외 수상 관련 수상자 추천 및 선발을 관장한다.
- ② 포상위원회의 구성은 위원장을 포함하여 5인 이내로 하되 위원은 정회원 중에서 이사회의 동의를 얻어 회장이 임명하며, 임기는 2년으로 한다.
- ③ 포상자의 추천 및 수상 관련 세부 규정을 둘 수 있으며, 이사회의 의결을 거쳐 시행한다.

제7조(학술대회준비위원회)

- ① 학술대회준비위원회는 학회가 개최하는 정기 및 비정기 학술대회와 관련된 모든 것을 관장한다.
- ② 위원회는 위원장을 포함한 8인 이내로 하며 위원은 정회원 중에서 이사회의 동의를 얻어 회장이 임명하며, 임기는 2년으로 한다.

제8조 (활동)

- ① 세부 사업계획은 자체적으로 결정하여 수립한다.
- ② 세부 규정 및 세부 사업계획은 이사회에 보고하여야 한다.
- ③ 필요시 학회에서 예산 및 행정 지원을 할 수 있다.

제3장 간행물

제9조(간행물) 학회의 간행물에 대해서는 다음과 같이 정한다.

- ① 정기 학술대회의 발표순서가 담긴 회보는 총무이사가 담당한다.
- ② 논문집 우주과학회지는 편집위원회에서 담당한다.
- ③ 기타 우주과학전반에 걸친 간행물에 관한 토의 및 규정은 필요에 따라 위원회를 두어 담당한다.

제4장 이사회 운영

제10조(이사회 운영)

- ① 이사회 직무를 수행하기 어려운 이사는 휴직할 수 있다.
- ② 휴직한 이사는 본 학회의 정관 24조 1항의 정원수에서 제외 한다.

제5장 규정의 개폐 및 시행세칙

제11조 (세칙) 이 규정의 시행을 위해 필요한 세부사항은 이사회의 승인을 받아 별도로 정할 수 있다.

제12조 (규정 개폐) 이 규정을 개정하거나 폐지할 때는 이사회 재적이사 과반수의 찬성과 총회의 승인을 받아야 한다.

부칙

제1조(시행일) 이 규정은 총회의 승인을 받은 2014년 10월 30일부터 시행한다.

이 규정은 이사회의 승인을 받은 2016년 2월 18일부터 시행한다.

제2조(경과조치) 이 규정이 제정되기 이전에 시행된 모든 사항은 이 규정을 따른 것으로 본다.

■ 사단법인 한국우주과학회 사무국 규정 ■

2008년 4월 24일 제정
2014년 2월 6일 개정
2014년 9월 30일 개정

제1조 (사무국) 학회 업무를 원활하게 수행하기 위하여 사무국을 설치, 운영하며, 약간 명의 직원을 고용할 수 있다.

- ① 사무국에는 국장, 과장 및 일반 직원의 직제를 둘 수 있으며, 이는 회장이 정한다.
- ② 사무국은 문서접수 및 발송, 회원관리, 회비징수와, 총회, 이사회에 대한 회의 준비, 진행 및 기록, 직인관리, 법인 관련업무, 자산관리, 회계, 서무 일반과 아울러 학회 홈페이지와 서버 관리업무를 담당한다.

제2조 (결재)

- ① 사무국의 모든 업무는 회장과 총무이사의 결재를 통하여 집행된다. 단 업무처리 효율을 위하여 회장이 지정한 일상 업무에 대해서는 총무이사 전결로 사후 결재할 수 있다.
- ② 사무국의 모든 재정 지출은 재무이사가 승인하며 회장이 정한 일정 금액 이상의 지출에 대해서는 회장의 승인을 받는다. 단 업무처리의 효율을 위하여 재무이사와 회장이 정한 일정 금액 이하의 일상적 경비는 재무이사 전결로 사후 결재할 수 있다.

제3조 (보수 및 용어의 정의)

- ① 국장, 과장, 일반직원은 능력과 경력을 감안하여 적절한 보수를 지급한다.
- ② 연봉이라 함은 매년 1월 1일부터 12월 31일까지 직원에게 지급되는 급여를 말한다. 연봉 책정은 회계연도 개시 1개월 전까지 이루어져야 한다. 단, 이사회 의결에 따라 체결시점을 변경할 수 있다.
- ③ 연봉은 담당 업무를 기초로 하여 책정하며 직원과 연봉계약을 통하여 확정한다. 연봉계약은 매년 체결하며, 학회대표와 해당 직원이 연봉계약서에 서명날인 함으로써 효력이 발생한다.
- ④ 월급은 연봉의 1/13로 매월 말일 지급하며, 지급일이 휴일인 경우 그 전 날 지급한다. 발령 월에는 근무일을 기준으로 일할 계산하여 지급하고, 1년 이상 근속한 직원에 대해서는 해당 월의 14일 이후 퇴직하는 경우 봉급 전액을 지급하며 14일 이내인 경우에는 일할 계산하여 지급한다.
- ⑤ 퇴직금은 1년 이상 근속한 직원에게 지급하고, 근무연수에 월급을 곱한 금액으로 한다. 근무연수가 1년 미만인 경우에는 퇴직금을 지급하지 않는다.

제4조 (직원의 채용) 직원의 신규임용은 공개채용을 원칙으로 하며 채용에 결격이 있는 자는 채용하지 않는다.

제5조 (수습기간 및 처우) 신규직원은 3개월의 수습기간을 두며, 정규 급여의 70%를 지급한다. 다만, 수습기간도 근무연수에 포함된다.

제6조 (건강검진) 사무국 직원은 기본검진에 준하는 범위에서 매년 정기 건강검진을 받을 수 있다.

제7조 (휴가 및 용어의 정의) 유급휴가는 일반휴가, 특별휴가, 출산휴가를 지칭하며, 사무국 직원은 근로기준법에 따라 이를 사용할 수 있다.

제8조 (직원의 정년) 직원의 정년은 57세로 정한다

제9조 (규정개폐) 이 규정을 개정하거나 폐지할 때는 이사회 의 승인을 받아야 한다.

제10조 (기타) 이 규정에 명시되지 않은 사항은 한국과학기술단체총연합회의 관례에 따른다.

■ 사단법인 한국우주과학회 편집국 규정 ■

2014년 9월 30일 제정

제1조 (편집국) 학회는 학회간행물 및 학회편집위원회 관련업무의 원활한 수행을 위하여 편집국을 설치·운영하며, 이를 위하여 편집전담 직원을 고용할 수 있다.

제2조 (담당업무) 편집전담 직원은 아래의 각 호에 해당하는 업무를 담당한다.

- ① 학회지; Journal of Astronomy and Space Sciences (이하 JASS)의 발행을 위한 저자교신 및 게재 논문의 편집
- ② 학회보 발행 시 게재논문의 편집
- ③ 학회논문집(Monograph)의 편집, 발행
- ④ 학회지 JASS 게재 논문과 관련된 자료관리 및 대외 온라인 논문등록 업무(ADS, KCI, KISTI, KOFST; eNEST 등)
- ⑤ 학회지 온라인 투고시스템(<http://janss.kr>)의 운영지원 및 관리
- ⑥ (기타업무) 편집국의 책임자인 편집위원장의 협의 하에 업무를 지원할 수 있다.

제3조 (경비결재)

- ① 편집국의 모든 재정지출은 재무이사가 승인하며 회장이 정한 일정 금액 이상의 지출에 대해서는 회장의 승인을 받는다.
- ② 업무처리의 효율을 위하여 재무이사와 회장이 정한 일정 금액 이하의 일상적 경비는 재무이사 전결로 사후 결재할 수 있다. 단, 편집국의 재정 지출과 관련된 모든 행정·회계 업무는 학회사무국에서 지원한다.

제4조 (직원의 채용) 직원의 신규임용은 공개채용을 원칙으로 하며 채용에 결격이 있는 자는 채용하지 않는다.

제5조 (수습기간 및 처우) 신규직원은 3개월의 수습기간을 두며, 정규 급여의 70%를 지급한다. 다만, 수습기간도 근무연수에 포함된다.

제6조 (보수 및 용어의 정의)

- ① 편집전담 직원에게는 업무능력과 경력을 감안하여 적절한 보수를 지급한다.
- ② 연봉이라 함은 매년 1월 1일부터 12월 31일까지 직원에게 지급되는 급여를 말한다. 연봉 책정은 회계연도 개시 1개월 전까지 이루어져야 한다. 단, 이사회 의결에 따라 체결시점을 변경할 수 있다.
- ③ 연봉은 담당 업무를 기초로 하여 책정하며 직원과 연봉계약을 통하여 확정한다. 연봉계약은 매년 체결하며, 학회대표와 해당 직원이 연봉계약서에 서명날인함으로써 효력이 발생한다.
- ④ 월급은 연봉의 1/13로 매월 말일 지급하며, 지급일이 휴일인 경우 그 전 날 지급한다. 발령 월에는 근무일을 기준으로 일할 계산하여 지급하고, 1년 이상 근속한 직원에 대해서는 해당 월의 14일 이후 퇴직하는 경우 봉급 전액을 지급하며 14일 이내인 경우에는 일할 계산하여 지급한다.
- ⑤ 퇴직금은 1년 이상 근속한 직원에게 지급하고, 근무연수에 월급을 곱한 금액으로 한다. 근무연수가 1년 미만인 경우에는 퇴직금을 지급하지 않는다.

제7조 (건강검진) 편집국 직원은 기본검진에 준하는 범위에서 매년 정기 건강검진을 받을 수 있다.

제8조 (휴가 및 용어의 정의) 유급휴가는 일반휴가, 특별휴가, 출산휴가를 지칭하며 편집국 직원은 근로기준법에 따라 이를 사용할 수 있다.

제9조 (직원의 정년) 직원의 정년은 57세로 정한다.

제10조 (규정개폐) 이 규정을 개정하거나 폐지할 때는 이사회 의 승인을 받아야 한다.

제11조 (기타) 이 규정에 명시되지 않은 사항은 한국과학기술단체총연합회의 관례에 따른다.

■ 연구윤리위원회의 설치·운영에 관한 규정 ■

제정 2008년 1월 2일

제1장 총칙

제1조 (목적) 이 규정은 사단법인 한국우주과학회(이하 “학회”라 한다) 회원으로서 연구를 수행하는 자의 연구윤리를 확립하고 연구부정행위를 사전에 예방하며, 연구부정행위 발생시 공정하고 체계적인 진실성 검증과 처리를 위한 비상설 연구윤리위원회(이하 “위원회”라 한다)의 설치 및 운영 등에 관한 사항을 규정함을 목적으로 한다.

제2조 (정의) ① 연구부정행위(이하 “부정행위”라 한다)라 함은 다음 각 호가 정의하는 바와 같이 연구의 제안, 연구의 수행, 연구결과의 보고 및 발표 등에서 행하여진 위조·변조·표절·부당한 논문저자 표시·자료의 중복사용 등

을 말한다. 다만, 경미한 과실에 의한 것이거나 데이터 또는 연구결과에 대한 해석 또는 판단에 대한 차이의 경우는 제외한다.

1. “위조”는 존재하지 않는 데이터 또는 연구결과 등을 허위로 만들어 내는 행위를 말한다.
 2. “변조”는 연구 재료·장비·과정 등을 인위적으로 조작하거나 데이터를 임의로 변형·삭제함으로써 연구 내용 또는 결과를 왜곡하는 행위를 말한다.
 3. “표절”이라 함은 타인의 아이디어, 연구내용결과 등을 정당한 승인 또는 인용 없이 도용하는 행위를 말한다.
 4. “부당한 논문저자 표시”는 연구내용 또는 결과에 대하여 과학적·기술적 공헌 또는 기여를 한 사람에게 정당한 이유 없이 논문저자 자격을 부여하지 않거나, 과학적·기술적 공헌 또는 기여를 하지 않은 자에게 감사의 표시 또는 예우 등을 이유로 논문저자 자격을 부여하는 행위를 말한다.
 5. “자료의 중복사용”은 본인이 이미 출판한 자료를 정당한 승인 또는 인용없이 다시 출판하거나 게재하는 행위를 말한다.
 6. 타인에게 위 제1호 내지 제4호의 행위를 제안·강요하거나 협박하는 행위
 7. 기타 학계 또는 과학기술계에서 통상적으로 용인되는 범위를 현저하게 벗어난 행위
- ② “제보자”라 함은 부정행위를 인지한 사실 또는 관련 증거를 해당 연구기관 또는 연구지원기관에 알린 자를 말한다.
- ③ “피조사자”라 함은 제보 또는 연구기관의 인지에 의하여 부정행위의 조사 대상이 된 자 또는 조사 수행 과정에서 부정행위에 가담한 것으로 추정되어 조사의 대상이 된 자를 말하며, 조사과정에서의 참고인이나 증인은 이에 포함되지 아니한다.
- ④ “예비조사”라 함은 부정행위의 혐의에 대하여 공식적으로 조사할 필요가 있는지 여부를 결정하기 위하여 필요한 절차를 말한다.
- ⑤ “본조사”라 함은 부정행위의 혐의에 대한 사실 여부를 검증하기 위한 절차를 말한다.
- ⑥ “판정”이라 함은 조사결과를 확정하고 이를 제보자와 피조사자에게 문서로써 통보하는 절차를 말한다.

제3조 (적용범위) 이 규정은 학회 회원의 연구활동과 직·간접적으로 관련 있는 자에 대하여 적용한다.

제4조 (다른 규정과의 관계) 연구윤리 확립 및 연구진실성 검증과 관련하여 다른 특별한 규정이 있는 경우를 제외하고는 이 규정에 의한다.

제2장 연구윤리위원회의 설치 및 운영

제5조 (소속등) ① 위원회는 학회내에 비상설위원회로 둔다.

제6조 (구성) ① 위원회는 위원장 1인을 포함한 3인의 당연직 위원과 3인의 추천직위원으로 구성한다.

② 당연직위원은 학회 부회장 2인과 학술이사로 하며, 추천직위원은 학회장이 임명한다.

- ③위원장은 학술이사로 한다.
- ④위원회는 특정한 안건의 심사를 위하여, 특별위원회를 둘 수 있다.

제7조 (위원장) ①위원장은 위원회를 대표하고, 회의를 주재한다.

- ②위원장이 부득이한 사유로 직무를 수행할 수 없는 때에는 위원장이 미리 지명한 위원이 그 직무를 대행한다.

제8조 (위원의 임기) ①위원의 임기는 위원회의 활동기한으로 제한한다.

제9조 (간사등) ①위원회의 원활한 업무수행을 위하여 간사 1인을 둘 수 있다.

- ②위원회의 각종 업무를 지원하기 위하여 전문위원을 둘 수 있다.

제10조 (업무) 위원회는 다음 각 호의 사항을 심의·의결한다.

1. 연구윤리 관련 제도의 수립 및 운영에 관한 사항
2. 부정행위 제보 접수 및 처리에 관한 사항
3. 예비조사와 본조사의 착수 및 조사결과의 승인에 관한 사항
4. 제보자 보호 및 피조사자 명예회복 조치에 관한 사항
5. 연구윤리 검증결과의 처리 및 후속조치에 관한 사항
6. 기타 위원장이 부의하는 사항

제11조 (회의) ①위원장은 위원회의 회의를 소집하고 그 의장이 된다.

- ②회의는 재적위원 과반수이상의 출석과 출석위원 3분의 2 이상의 찬성으로 의결한다.
- ③위원장은 심의안건이 경미하다고 인정할 때에는 서면심의로 대체할 수 있다.
- ④위원회에서 필요하다고 인정될 때에는 위원이 아닌 자를 출석케 하여 의견을 청취할 수 있다.

제12조 (경비) 위원회의 운영에 필요한 경비를 학회예산의 범위 내에서 지급할 수 있다.

제3장 연구진실성 검증

제13조 (부정행위 제보 및 접수)

- ①제보자는 학회에 구술서면·전화전자우편 등 가능한 모든 방법으로 제보할 수 있으며 실명으로 제보함을 원칙으로 한다. 다만, 익명으로 제보하고자 할 경우 서면 또는 전자우편으로 연구과제명 또는 논문명 및 구체적인 부정행위의 내용과 증거를 제출하여야 한다.
- ②제보 내용이 허위인 줄 알았거나 알 수 있었음에도 불구하고 이를 신고한 제보자는 보호 대상에 포함되지 않는다.

제14조 (예비조사의 기간 및 방법)

- ①예비조사는 신고접수일로부터 15일 이내에 착수하고, 조사시작일로부터 30일 이내에 완료하여 학회장의 승인을 받도록 한다.
- ②예비조사에서는 다음 각 호의 사항에 대한 검토를 실시한

다.

1. 제보내용이 제2조제1항의 부정행위에 해당하는지 여부
2. 제보내용이 구체성과 명확성을 갖추어 본조사를 실시할 필요성과 실익이 있는지 여부
3. 제보일이 시효기산일로부터 5년을 경과하였는지 여부

제15조 (예비조사 결과의 보고)

- ①예비조사 결과는 위원회의 의결을 거친 후 10일 이내에 학회장과 제보자에게 문서로써 통보하도록 한다. 다만 제보자가 익명인 경우에는 그렇지 아니하다.

- ②예비조사 결과보고서에는 다음 각 호의 내용이 포함되어야 한다.

1. 제보의 구체적인 내용 및 제보자 신원정보
2. 조사의 대상이 된 부정행위 혐의 및 관련 연구과제
3. 본조사 실시 여부 및 판단의 근거
4. 기타 관련 증거 자료

제16조 (본조사 착수 및 기간)

- ①본조사는 위원회의 예비조사결과에 대한 학회장의 승인 후 30일 이내에 착수되어야 한다.

- ②본조사는 판정을 포함하여 조사시작일로부터 90일 이내에 완료하도록 한다.

- ③위원회가 제2항의 기간 내에 조사를 완료할 수 없다고 판단될 경우 학회장에게 그 사유를 설명하고 조사기간의 연장을 요청할 수 있다.

- ④본조사 착수 이전에 제보자에게 위원회 명단을 알려야 하며, 제보자가 위원 기피에 관한 정당한 이의를 제기할 경우 이를 수용하여야 한다.

제17조 (출석 및 자료제출 요구)

- ①위원회는 제보자·피조사자·증인 및 참고인에 대하여 진술을 위한 출석을 요구할 수 있다.

- ②위원회는 피조사자에게 자료의 제출을 요구할 수 있으며, 증거자료의 보전을 위하여 소속 기관장의 승인을 얻어 부정행위 관련자에 대한 실험실 출입제한, 해당 연구자료의 압수보관 등의 조치를 취할 수 있다.

- ③제1항 및 제2항의 출석요구와 자료제출요구를 받은 피조사자는 반드시 이에 응하여야 한다.

제18조 (제보자와 피조사자의 권리 보호 및 비밀엄수)

- ①어떠한 경우에도 제보자의 신원을 직·간접적으로 노출시켜서는 아니되며, 제보자의 성명은 반드시 필요한 경우가 아니면 제보자 보호 차원에서 조사결과 보고서에 포함하지 아니 한다.

- ②제보자가 부정행위 제보를 이유로 징계 등 신분상 불이익, 근무조건상의 차별, 부당한 압력 또는 위해 등을 받은 경우 피해를 원상회복하거나 제보자가 필요로 하는 조치 등을 취하여야 한다.

- ③부정행위 여부에 대한 검증이 완료될 때까지 피조사자의 명예나 권리가 침해되지 않도록 주의하여야 하며, 무혐의로 판명된 피조사자의 명예회복을 위해 노력하여야 한다.

- ④제보·조사·심의·의결 및 권의조치 등 조사와 관련된 일체의 사항은 비밀로 하며, 조사에 직·간접적으로 참여한 자는 조사 및 직무수행 과정에서 취득한 모든 정보에 대하여 누설하여서는 아니 된다. 다만, 정당한 사유에 따른 공개

의 필요성이 있는 경우에는 위원회의 의결을 거쳐 공개할 수 있다.

제19조 (제척·기피 및 회피)

- ①위원이 해당 안건과 직접적인 이해관계가 있는 경우에는 그 직무집행에서 제척된다.
- ②위원회는 직권 또는 당사자의 신청에 의하여 제척의 결정을 한다.
- ③위원에게 직무수행의 공정을 기대하기 어려운 사정이 있는 경우에는 제보자와 피조사자는 기피신청을 할 수 있다.
- ④위원은 제1항 또는 제3항의 사유가 있는 때에는 위원장의 허가를 얻어 회피할 수 있다.

제20조 (이의제기 및 변론의 권리 보장) 위원회는 제보자와 피조사자에게 의견진술, 이의제기 및 변론의 권리와 기회를 동등하게 보장하여야 한다.

제21조 (본조사결과보고서의 제출)

- ①위원회는 의견진술, 이의제기 및 변론내용 등을 토대로 본조사결과보고서(이하 "최종보고서"라 한다)를 작성하여 학회장에게 제출한다.
- ②최종 보고서에는 다음 각 호의 사항이 포함되어야 한다.
 1. 제보 내용
 2. 조사의 대상이 된 부정행위 혐의 및 관련 연구과제
 3. 해당 연구과제에서의 피조사자의 역할과 혐의의 사실 여부
 4. 관련 증거 및 증인
 5. 조사결과에 대한 제보자와 피조사자의 이의제기 또는 변론 내용과 그에 대한 처리결과
 6. 위원 명단

제22조 (판정) 위원회는 학회장의 승인을 받은 후 최종 보고서의 조사내용 및 결과를 확정하고 이를 제보자와 피조사자에게 통보한다.

제4장 검증 이후의 조치

제23조 (결과에 대한 조치)

- ①위원회는 학회장에게 다음 각 호에 해당하는 행위를 한 자에 대하여 징계조치를 권고할 수 있다.
 1. 부정행위
 2. 본인 또는 타인의 부정행위 혐의에 대한 조사를 고의로 방해하거나 제보자에게 위해를 가하는 행위
- ②징계조치에 관한 사항은 별도로 정할 수 있다.

제24조 (기록의 보관 및 공개)

- ①예비조사 및 본조사와 관련된 기록은 학회에서 보관하며, 조사 종료 이후 5년간 보관하여야 한다.
- ②최종보고서는 판정이 끝난 이후에 공개할 수 있으나, 제보자·위원·증인·참고인·자문에 참여한 자의 명단 등 신원과 관련된 정보에 대해서는 당사자에게 불이익을 줄 가능성이 있을 경우 공개대상에서 제외할 수 있다.

제5장 기 타

제25조 (시행세칙) 위원회는 이 규정의 시행을 위하여 필요한 세부사항을 별도로 정할 수 있다.

부 칙 1. (시행일) 이 규정은 2008년 1월 2일부터 시행한다.

■ 포상위원회 운영에 관한 규정 ■

2011년 10월 27일 제정
 2011년 12월 7일 개정
 2015년 1월 16일 개정

제1조 (목적) 본 학회 운영규정 제2장 위원회 및 분과활동, 제6조 포상위원회 규정에 따라 포상에 관련된 추천 및 수상관련 세부규정을 정함을 목적으로 한다.

제2조 (포상위원장의 역할) 포상위원장은 위원들을 회장에게 추천하고 위원회 소집, 회의 주재, 수상자 추천 등 제반 업무를 총괄하며 정기총회에서 위원회 활동 사항을 보고한다. (신설, 2015.1.16)

제3조 (포상의 종류) 본 학회와 관련된 학술활동 및 대외활동에 있어서 뚜렷한 업적이 있는 경우 이에 대한 포상을 하며 그 종류는 다음과 같다. 세부적인 기준은 별도 포상위원회 내부기준으로 정한다.

- 가. 학술상: 학문적 업적이 뚜렷한 회원에게 매년 정기총회에 수여한다.
- 나. 두진 젊은 우주과학자상: 학문적인 업적이 뛰어난 40세 이하 또는 박사학위 후 5년 이내의 회원에게 매년 정기총회에서 수여한다. (신설 2015.1.16)
- 다. 에스이랩 상: 학회 발전에 기여한 학위과정 회원들에게 수여한다. (명칭변경)
- 라. 공로상: 학회의 발전에 커다란 공헌을 한 회원에게 수여한다.
- 마. 특별상: 학회가 주관하는 활동에 대하여 그 업적이 뛰어난 자 또는 단체에게 수여한다.

제4조 (대외 추천요령) 대외에서 요청받는 포상에 대한 후보자 선정의 경우는, 적절한 기간을 설정하여 전체 회원에게 이 내용을 공지하며, 적절한 형태의 추천형식에 따라 추천을 받는다. 포상위원회에서 별도의 추천을 할 수 있다. 포상위원회에서는 이들 후보자 중에서 해당자를 선정하며, 회장이 결정한다.

제5조 (기타 사항) 선정 기준이 정해지지 않은 포상의 경우는 그 특성에 따라 수상자 혹은 후보자 선정기준을 별도로 적용할 수 있으며, 회장이 포상위원회와 협의하여 선정한다.

제6조 (내부기준) 포상위원회 세부규정 시행을 위해 필요한 세부사항을 내부기준 또는 지침으로 정할 수 있다 (신설, 2015.1.16)

제7조 (운영규정 개폐) 이 규정을 개정하거나 폐지할 때는 이 사회의 승인을 받아야 하며 총회에 보고하여야 한다 (신설, 2015.1.16)

부 칙 (시행일)

1. 이 규정은 2011년 10월 27일부터 시행한다.
2. 이 규정은 2012년 1월 1일부터 시행한다.
3. 이 규정은 2015년 1월 16일부터 시행한다.

■ 편집위원회 운영에 관한 규정 ■

2014년 4월 24일 제정

제1장 총 칙

제1조 (목적) 본 한국우주과학회 (이하 본 학회) 정관 제4조 (사업) 2항 학술간행물의 발행 및 배포와 학회 운영에 대한 규정 제5조 (편집위원회) 임무와 위원 구성 조항과 관련된 제반 사항을 규정함을 목적으로 한다.

제 2조 (임무)

1. 본 위원회의 주임무는 학술간행물의 발간과 배포 관련하여 논문의 기획, 접수, 심사, 편집, 관리 등을 주관한다.
2. 기획 논문집, 자료의 발굴 및 수집 등 본 학회에서 발간하는 모든 도서의 기획 및 편집 등을 주관한다.
3. 학회지 발간과 관련된 제반 규정을 정한다.

제 2장 편집위원회의 구성

제3조 (위원회의 구성) 위원회의 위원은 학회 운영에 대한 규정 제5조에 의거하여 내국인 15인 내외 외국인 20인 내외로 한다.

제4조 (위원의 선임)

1. 위원은 학회 운영에 대한 규정 제5조에 따라 지역과 전공 등을 고려하여 편집위원장이 추천하고 본 학회 이사회의 동의를 받아 회장이 임명한다.
2. 위원이 개인사정으로 인하여 사임하는 경우, 그 후임자를 즉시 새로 위촉한다.

제5조 (위원의 임기)

1. 위원의 임기는 학회 운영에 대한 규정 제5조에 의거하여 2년으로 한다.
2. 위원의 사임으로 인하여 새로 보임된 자의 임기는 전임자의 잔여임기로 한다.
3. 위원은 필요한 경우 연임할 수 있다.

제6조 (위원의 자격) 편집위원의 자격은 다음과 같다.

1. 학회 활동에 적극적이고 학술 활동을 활발히 하는 자.
2. 연구 업적이 국내외의 학계에서 현저한 자.

제7조 (위원의 의무) 편집위원은 다음의 의무를 가진다.

1. 위원은 위원회 개최시에 특별한 사유가 없는 한 출석하여야 한다.
2. 위원은 공정해야 하고, 항상 학회와 학문 발전을 위하여 부단히 노력하여야 한다.

제8조 (위원장 및 부위원장의 선임)

1. 위원회의 위원장은 학회 운영에 대한 규정 제5조에 의거하여 학술이사가 당연직으로 맡는다.
2. 위원장은 위원회를 소집하고, 그 의장이 된다.
3. 위원장의 업무를 보조하기 위해 부위원장을 둘 수 있으며 부위원장은 위원장이 임명한다.
4. 위원장과 부위원장의 임기는 2년으로 하고 연임할 수 있다.

제9조 (회의 소집)

1. 회의 소집은 개최일 1주일 이전에 연락하여 위원장이 행한다.
2. 위원장이 임무를 수행하기 곤란할 때는 부위원장이 소집한다.

제10조 (의결)

1. 위원회는 재적위원 과반수 출석으로 성립하고, 출석위원 과반수의 찬성으로 결정한다.
2. 출석하지 못한 위원이 위임장을 제출한 경우, 출석인원에는 포함하되, 의결시에는 포함하지 않는다.
3. 시간이 촉박한 중대한 사항에 대하여는 위원장이 직접 전화나 전자우편 등으로 위원의 의견을 들어 결정할 수 있다.
4. 특정 사안에 대하여 위원장이 위원회의 위임을 받은 경우 위원장이 처리할 수 있다.

제11조 (문서 관리)

1. 위원회의 회의록은 반드시 작성하고, 작성일로부터 3년간 보관한다.
2. 위원회의 원고 접수, 관리, 심사위원 위촉, 심사결과 보고서 취합, 심사결과통보 등은 모두 문서로 하며, 그 문서는 3년간 보관한다.

제3장 학회지 Journal of Astronomy and Space Sciences (이하 JASS)의 발간

제12조 (분야) JASS는 천문학 및 우주과학 전반에 관한 주제의 영문논문을 출판한다.

제13조 (발행 횟수) JASS는 년 4회 발행하는 것을 원칙으로 한다.

제14조 (발행일) 발행일은 매년 3, 6, 9, 12월의 15일로 한다.

제15조 (발행 부수) 현재 회원수와 보관용 등을 감안하여 위원회에서 정한다.

제16조 (편집 체제) 한국우주과학회 학술지 투고 규정에 따른다.

제17조 (학회지 배포)

1. 회비를 납부한 회원에게 발행일로부터 15일 이내에 학회지를 우송하는 것을 원칙으로한다.
2. 발행일 이후에 회비를 납부한 회원에게는 당해연도 발

- 행부를 일괄 우송한다.
- 3. 학술대회 등 다수 회원이 참석하는 회의 일정이 30일 이내에 계획되어 있는 경우, 우송을 연기할 수 있다.
- 4. 외국에 거주하는 회원의 우송료는 별도로 징수할 수도 있다.

제18조 (논문 접수 및 투고 논문의 관리) 논문은 연중 수시로 접수하며 투고논문은 반드시 접수 대장을 작성하여 관리한다.

제19조 (심사 의무)

- 1. 학회지에 게재할 논문은 반드시 심사를 거쳐야 한다.
- 2. 기획 논문 및 특별히 청탁한 원고나 외국인의 원고와 학술대회 발표논문 등은 위원장의 결정으로 심사를 면제할 수 있다.

제20조 (심사위원 위촉)

- 1. 심사위원의 위촉은 위원회의 결의로 편집위원장이 행한다.
- 2. 심사위원은 논문 1편 당 2인을 위촉한다. 단 위원회는 만일의 경우를 대비하여 후보위원 1인을 추가로 선정하여 둔다.
- 3. 심사위원의 위촉은 가급적 전공, 연령, 지역 등이 편중되지 않도록 위촉한다.
- 4. 논문 투고자와 근무지가 같거나 학연 등 특별한 관계가 있는 자를 심사위원으로 선정하지 않는 것을 원칙으로 한다.
- 5. 심사위원에게는 소정의 심사료를 지불한다.
- 6. 심사위원의 위촉에 관한 사항은 공개하지 않는다.

제21조 (심사위원 수칙)

- 1. 공평한 기준을 정하여 공정하게 평가하여야 한다.
- 2. 논문 심사결과 등을 타인에게 발설하여서는 안 된다.

제22조 (심사기준)

- 1. 심사위원은 심사대상 논문이 JASS가 추구하는 주제를 다루고 있고 기존에 발표되지 않은 새로운 결과임을 확인하여야 한다.
- 2. 심사위원은 심사대상 논문이 국제적 수준의 결과를 포함하고 있는지 판단하여야 한다.
- 3. 심사위원은 심사대상 논문이 JASS의 편집체제에 맞추어 작성되었는지 확인하여야 한다.
- 4. 심사위원은 심사대상 논문의 영문 교열을 확인하여야 한다.

제23조 (심사결과 보고) 심사위원은 심사 대상 논문을 접수한 날로부터 10일 이내에 소정의 심사결과 보고서를 위원회에 제출하여야 한다.

제24조 (심사결과 통보) 심사위원이 심사결과 보고서를 제출하면, 위원장은 심사위원의 성명이나 소속 등을 삭제하고, 즉시 그 결과를 투고자에게 전자우편으로 통보한다.

제25조 (수정보완)

- 1. 심사결과 통보를 받은 투고자는 심사위원의 수정의견

을 최대한 반영하여 논문의 질적 향상을 도모하여야 한다.

- 2. 심사의 종합결과 ‘게재 가’ 혹은 ‘수정 후 게재’ 등급을 받은 투고자는 학회에서 정한 기일내에 수정논문을 학회에 제출해야 한다.
- 3. 심사의 종합결과 ‘수정 후 재심’ 등급을 받은 논문 투고자는 충분히 연구보완 수정 후에 다음 호에 게재될 수 있도록 완벽하게 수정한 논문을 학회에 제출해야 한다.

제26조 (논문 투고자의 자격) 논문의 교신저자는 한국우주과학회 회원으로 한정한다.

제27조 (논문 게재료 납부)

- 1. 심사완료 게재된 논문의 투고자는 학회에서 지정한 기일까지 소정의 게재료를 납부하여야 한다.
- 2. 국제 학술회의, Symposium, Workshop 등의 Proceeding 논문을 JASS에서 출판하는 경우, 편집위원장의 청원으로 이사회의 동의를 받아 논문 게재료를 면제할 수 있다.
- 3. 위원회에서 요청한 논문이나 기타 본 학회의 국제성을 위한 특별한 원고에 대해서는 게재료를 징수하지 않는다.

제28조 (원고료) 위원회에서 요청한 논문이나 기타 본 학회의 국제성을 위한 특별한 원고에 대해서는 원고료를 지급할 수 있다.

제 4장 규정의 개정

제29조 (개정절차) 이 규정의 개정은 이사회의 승인을 요한다.

제30조 (개정발표) 개정된 편집규정은 다음 호의 학회지에 게재하여 발표한다.

- 1. (효력발생) 이 규정은 2014년 1월 1일부터 시행한다.
- 2. (시행규칙) 이 규정의 시행에 필요한 세부사항은 편집위원회에서 별도로 정하여 이사회의 승인을 받는다.

■ 임원 선출에 관한 규정 ■

2011년 8월 26일 제정
 2011년 12월 7일 개정
 2014년 10월 30일 개정

제1조 (목적) 한국우주과학회 정관 제12조 1항에 따라 임원 선출에 관한 사항을 규정함을 목적으로 한다.

제2조 (선거권) 정회원 자격을 취득한지 만 1년이 경과된 회원은 선거권을 갖는다.

제3조 (임원 자격)

- ① 회장은 최근 10년간 학회의 정회원으로 활동하고 있으

며, 이사로 봉사한 경험이 있는 회원이어야 한다.

- ② 이사는 최근 5년간 본 학회의 정회원으로 활동하고 있는 회원이어야 한다.
- ③ 감사는 10년간 본 학회의 정회원으로 활동한 회원이어야 한다.

제4조 (회장후보 선출)

- ① 회장 후보는 선거권자 온라인 추천 투표에서 최소 10명 이상의 추천을 받은 자로 한다.
- ② 제①항을 충족하는 후보자가 없을 경우, 이사회에서 2명의 후보를 지명할 수 있다.
- ③ 회장은 회장 후보를 총회 개최 최소 1주일 전에 회원에게 알려야 한다.
- ④ 회장 후보 선출 온라인 추천 투표에서 선거권자 1인은 1명의 후보를 추천할 수 있다.
- ⑤ 회장 후보 선출 온라인 추천 투표는 임원선출 정기 총회 개최 30일 전에 실시하고 그 기간은 2주로 한다.

제5조 (회장 선출)

- ① 회장은 총회에서 회장 후보를 대상으로 하여 선거권자의 무기명 비밀선거로 선출한다.
- ② 무기명 투표에서 과반수의 득표를 한 후보자가 없을 경우 상위 득표자 2인을 대상으로 재투표하여 다수 득표자를 차기회장으로 한다.

제6조 (부회장 선출) 부회장은 회장이 지명한다.

제7조 (이사선출)

- ① 전체 이사 수의 1/2을 선거권자 온라인 투표로 선출하며, 나머지 1/2은 차기 회장이 지명한다.
- ② 이사 선출 온라인 투표는 선거권자 1인이 3명을 추천한다.
- ③ 투표 결과 상위 다득점자로 수락 여부를 거쳐 이사의 1/2을 확정한다.
- ④ 선출된 이사 중에서 총회 당일 회장 또는 감사로 선출되어 결원이 생긴 경우 차득점 순으로 수락 여부를 거쳐 이사로 확정한다.
- ⑤ 부회장, 총무, 재무, 학술이사는 회장이 지명하며, 당연직 이사가 된다.

제8조 (감사선출) 감사는 총회에서 직접선거로 선출한다.

제9조 (세칙) 이 규정의 시행을 위해 필요한 세부사항은 이사회 승인을 받아 별도의 세칙으로 정할 수 있다.

제10조 (규정 개폐) 이 규정을 개정하거나 폐지할 때는 이사회 재적이사 과반수의 찬성과 총회의 승인을 받아야 한다.

부칙 1. 이 규정은 2014년 10월 30일부터 시행한다.

■ 사단법인 한국우주과학회 용역사업 규정 ■

2011년 12월 7일 제정

제1조 (목적) 이 규정은 용역사업의 시행에 대하여 필요한 사항을 규정함을 그 목적으로 한다.

제2조 (적용범위) 이 규정은 외부로부터 수탁하거나 학회 예산으로 직접 수행하는 용역사업에 적용한다.

제3조 (사업구분) 학회에서 수행하는 용역사업은 정관 제4조의 사업 중 다음 각 호의 사업에 한한다.

- ① 우주과학 및 그와 관련된 분야의 기초 및 응용 연구, 연구지원, 기술교육
- ② 우주과학 및 그와 관련된 분야의 자료의 발행과 보급
- ③ 국내외 관련 학회와의 기술 교류
- ④ 우주과학 및 그와 관련된 분야의 기준 및 규정의 제안
- ⑤ 정부, 공공단체, 기타 기관에 대한 자문 및 건의
- ⑥ 기타 학회의 목적을 달성하기 위한 사업

제4조 (연구진의 구성과 자격)

- ① 연구진은 연구책임자, 연구원, 보조연구원으로 구성하며, 사업의 규모, 기간 및 사업비 등을 고려하여 필요한 경우에는 총괄 연구책임자를 둘 수 있다.
- ② 연구진은 학회 회원으로 구성함을 원칙으로 한다. 다만, 학회에 해당분야 전공자가 없거나 보조연구원인 경우에는 예외로 할 수 있다.

제5조 (연구책임자의 자격과 선임)

- ① 총괄 연구책임자 또는 연구책임자(이하 “연구책임자”라고 칭함)는 학계의 지식과 경험이 풍부한 전문가로서, 특히 연구분야별로 연구진을 통솔하고 연구기획, 조정능력을 갖춘 자이어야 한다.
- ② 연구책임자는 학회 분과위원회, 전문성, 지역성을 최대한으로 고려하여 회장이 선임한다. 단, 의뢰자가 연구책임자를 지명할 경우 의뢰자의 뜻에 따라 선임함을 원칙으로 하되, 지명된 회원이 연구책임자로 부적합하다고 판단되는 경우에 회장은 의뢰자와 협의하여 연구책임자를 변경할 수 있다.

제6조 (연구책임자의 역할과 책임)

- ① 연구책임자는 연구진의 구성과 변경에 관하여 책임을 져야 한다.
- ② 연구책임자는 연구사업의 진행, 성과의 신뢰성, 연구기간의 엄수 등 계약서의 모든 사항을 책임져야 한다.
- ③ 연구책임자는 수탁용역사업 종료 후 1년 이내에 사업수행성과에 대한 개요를 학회지 혹은 학회논문집에 게재하여야 한다.

제7조 (비용징수와 비용의 산정) 개인 또는 단체가 3조의 용역사업을 학회로 위탁하는 경우에는 필요한 비용을 징수한다. 용역비용 산정은 다음 각 호에 따른다.

- ① 용역비용은 교육과학부 장관이 고시하는 연구개발사업 처리규정의 제20조의 연구개발비 사용(이하 정부기준)의 범위 내에서 학회와 의뢰자가 협의하여 정한다.
- ② 전항에 규정되지 아니한 용역사업은 당해 사업 수행에

필요한 직접경비의 범위 내에서 학회와 의뢰자가 협의하여 정한다.

제8조 (정부기준 적용원칙) 정부기준의 적용은 다음에 따른다.

- ① 직접인건비: 당해 사업에 참여하는 회원 및 외부전문가의 인건비로서 정부기준을 적용한다.
- ② 직접경비: 당해 사업 수행에 직접 필요한 여비, 재료비, 인쇄비, 복사비, 시험비, 외부전문가 자문비 등을 포함한 실비를 계산 산출한다.
- ③ 간접경비: 간접경비의 계상은 의뢰자가 학회에 직접 의뢰한 경우는 전체 용역 금액의 20%로 하고, 의뢰자가 학회의 회원에게 직접 의뢰하였으나 그 회원이 학회를 통하여 수수하는 경우는 전체 용역 금액의 5%로 한다.

제9조 (용역비용의 수령 및 지출) 용역의뢰자가 용역기간 중에 용역비용의 일부만을 학회에 지급하고, 용역계약 만료 시 그 나머지 비용을 지급하는 경우, 학회는 원활한 연구 진행을 위해 필요한 비용을 연구책임자에게 선 지급할 수 있다.

제10조 (용역비용의 관리) 학회는 용역사업의 용역비용의 지출을 연구책임자와 협의 하에 관리할 수 있다.

제11조 자세한 운영내용은 운영세칙에 정한다.

부 칙 1. (시행일) 본 규정은 2012년 1월 1일부터 시행한다.

■ 한국우주과학회 학술지 투고 규정 ■

1. PUBLICATION TYPES, QUALIFICATION FOR AUTHORSHIP

Five types of manuscripts are published in this journal: Editorials, Review Papers, Research Papers, Technical Papers, and Letters to the Editor.

Editorials:

Editorials are submitted by invitation only and will be on topics considered to be essential by the Editorial Board of the journal.

Review Papers:

Review papers will be published by direct submission as well as from invited experts. In both cases, the work will be subject to editorial review. Review papers should critically review topics not only to inform the reader of the background, but also to communicate the state of the art and outstanding research problems.

Research Papers:

Following a peer review, original findings within the scope of the journal will be published. Critical and new results of

experiments or theories should be described in full-length research papers.

Technical Papers:

Articles in this category introduce scientific work on novel skills dealing with new methods and techniques.

Letters to the Editor:

Any issues of interests to the journal readership may be contained in letters to the editor. Letters concerning articles published

earlier will generally be sent to the author of the previous research for possible response before publication.

2. RESEARCH AND PUBLICATION ETHICS

Research published in JASS must follow institutional, national, and international guidelines. For the policies on the research and publication ethics that are not stated in this instructions, International standards for editors and authors (<http://publicationethics.org/international-standards-editors-and-authors>) can be applied.

Authorship

An author is defined as one who has made a significant contribution to the overall design and execution of the experiment; the Korean Space Science Society thus deems all authors responsible for the entire paper.

Originality and Duplicate Publication

All submitted manuscripts should be original and should not be submitted to other scientific journals for consideration while under JASS review. No part of an accepted manuscript should be duplicated in other scientific journals without the permission of the Editorial Board. If duplicate publication related to papers in this journal is detected, the names of the authors will be announced in this journal, the authors' institutes will be informed, and the authors will be subject to restrictions on future publications in JASS.

CrossCheck is a multi-publisher initiative to screen published and submitted content for originality. JASS uses iThenticate software to detect instances of overlapping and reproduced text in submitted manuscripts. Detailed information about CrossCheck can be found at <http://www.crossref.org>.

Conflict of Interest Statement

Authors should disclose any conflicts of interest in their manuscripts.

3. PEER REVIEW PROCESS

Once manuscripts are submitted, they will be reviewed by two or more experts in the corresponding field. The Editorial Board may request that authors revise the manuscripts in light of the reviewers' suggestions. The authors should upload the revised files with a reply to each item in the reviewers'

comments after revision of the manuscript. The authors should complete the revisions within 60 days of request. If the authors want to extend the revision period to more than 60 days, they should contact the Editorial Board. The manuscript review process should be completed after the second review. If the authors wish to engage in further revision, the Editorial Board may consider it. The Editorial Board will make a final decision on the approval for publication of submitted manuscripts and can request further corrections of the article text if necessary.

Review and publication processes that are not described in the Instructions for Authors will be incorporated from the Editorial Policy Statements, approved by the Council of Science Editors Board of Directors (http://www.councilscienceeditors.org/services/draft_approved.cfm).

4. COPYRIGHTS

The Korean Space Science Society requires a corresponding author to sign a copyright transfer agreement on behalf of all the authors in order to maintain and protect the ownership and the rights of the Society, as well as to protect the original authors from misappropriation of their work. If this agreement is not assented to, the Korean Space Science Society will not publish the manuscript. This agreement is sent with the proofs to the corresponding author.

5. PAGE CHARGES

Manuscripts accepted for publication in JASS will be charged a base fee of ₩400,000 (US \$400). An additional charge of ₩20,000 (US \$20) per page will be added to this. Authors must pay additional page charges for each color illustration. Charges may be changed without notice by the board.

6. SUBMISSION OF MANUSCRIPT

Authors must submit manuscript files to the Editorial Office of the Korean Space Science Society using the online submission system of the Journal at <http://janss.kr>. We do not accept direct email submission to the Editor-in-Chief or Editors. Incomplete manuscripts will be returned to the author without review. Manuscripts submitted to the journal must represent reports of original research and must be written in English. Manuscripts are accepted for review under the condition that important parts of the study have not been published and are not being considered for publication. Also, no submission can be published without approval of the institution and all the authors. The usual prerequisites for publication will be originality, clarity, and significance as relevant to a better understanding of space science and technology.

7. MANUSCRIPT PREPARATION

Word Processors and Format of Manuscript:

Word Processors and Format of Manuscript:

Manuscripts should be submitted in the file format of Microsoft Word 2007 or a later version. Manuscripts should be double-spaced, using a font size of 11. Pages should be numbered consecutively, beginning with the title page. Page numbers should be placed at the middle of the bottom of each page. There is no fixed maximum length for full-length papers, but they rarely exceed 30 double-spaced, typewritten pages on 210×297 mm (A4 size) paper, including figures and tables.

Research and Technical Papers

The manuscript for a research or technical paper should be organized in the following sequence: title page, abstract and keywords, introduction, methods, results, conclusion, acknowledgements, references, tables, and figure captions.

Title page:

The title page should include the full title of the article, authors' names, affiliations, footnotes, and a short title. The title should emphasize the principal objectives covered by the paper. Authors' names should be consistent and preferably be written in a standard form for all publications to facilitate indexing and to avoid ambiguity. If some of the authors have different affiliations, use superscript numbers (1, 2, 3...) after the surnames of authors and before the names of their affiliations. Use a dagger (†) after the name of one designated corresponding author. The contact information for correspondence should include the mailing address, e-mail address, fax number, telephone number, and the ORCID iD.

Abstract & Keywords:

The abstract should state the objectives and present salient conclusions in no more than 200 words. This should be a clear, concise summary describing the scope and purpose, methods or procedures, significant new results, and conclusions. The abstract should be written as one paragraph. At the end of the abstract, the keywords should be given in 3 to 6 words or phrases.

Introduction:

The paper should begin with an introduction that is written for the general reader of the journal as well as for the specialist. This section should include the background and objectives, together with significant prior works.

Methods:

The methods section should include sufficient information to allow the results to be repeated. Refer to published procedures by citing both the original description and pertinent published modifications. Do not include extensive details unless they present a substantial modification. For commonly used methods, a simple reference is sufficient. If several alternative methodologies are employed, it is useful to

identify the methods briefly as well as to cite the references.

Results:

The results should be described in logical order using text, tables, and illustrations, to make clear the protocol of the study. Where appropriate, tests should be described and supported by a reference to the original citation of the test.

Conclusions:

The conclusions section should highlight key findings and compare the results of the work to appropriate findings of other studies. The conclusions should be based on the evidence presented in the paper.

Acknowledgements:

The acknowledgements section is placed at the end of body. It can cite financial and any other support.

References:

References must be obviously related to the manuscript. In the text, references should be cited with the author's surname and year of publication. When reference is made to a work by two authors, both names should be given using "&" (e.g., Kim & Lee 1996); for three or more author names, give the first author followed by "et al." and the year (e.g., Park et al. 2010). Multiple references must be arranged in chronological order (e.g., Sohn 1982; Choi & Kang 1991; Ahn et al. 2003). If more than two papers with the same authors and publication years are cited, list a, b, c... after the year to clarify (e.g., Jung & Han 2011a, b). Only cite articles or books already published or in press, not unpublished work "in preparation."

In the references section, the references should be listed in alphabetical order by letter of the first author's surname. List the first five authors followed by "et al." if there are more than five authors. If more than two papers with the same authors and publication years are cited, list a, b, c... after the year in publication order. Abstracts of conferences should not be included in the references. Lines after the first line of a reference are indented by one tab space ("hanging indent" in MS Word). The style for citing papers in periodicals is surname and initials of authors, title, journal name, volume, first and last page numbers, year, and digital object identifier (DOI) if available. The styles to be used for references are as follows:

Journal articles:

1. Takahashi K, McPherron RL, Hughes WJ, Multispacecraft observations of the harmonic structure of Pc3-4 magnetic pulsations, *J. Geophys. Res.* 89, 6758-6774 (1984). <http://dx.doi.org/10.1029/JA089iA08p06758>
2. Hwang KJ, Kuznetsova MM, Sahraoui F, Goldstein ML, Lee E, et al., Kelvin-Helmholtz waves under southward interplanetary magnetic field, *J. Geophys. Res.* 116, A08210 (2011). <http://dx.doi.org/10.1029/2011JA016596>

Book, Book in series:

3. Kelley MC, *The Earth's Ionosphere* (Academic Press, San

Diego, 1989).

Articles from book, conference or symposium proceedings:

4. Holmberg E, Magnitudes, colors, surface brightness, intensity distributions, absolute luminosities, and diameters of galaxies, in stars and stellar systems, vol. 9, *Galaxies and the Universe*, eds. Sandage A, Sandage M, Kristian J (Univ. Chicago Press, Chicago, 1975), 123-157.
5. Capitaine N, Gambis D, McCarthy DD, Petit G, Pay J, et al., Proceedings of the IERS Workshop on the Implementation of the New IAU Resolutions, Observatoire de Paris, Paris, France, 18-19 April 2002.
6. Kim K, Hwang J, Sung S, Geosynchronous magnetic field variations associated with the passage of interplanetary shocks or solar wind discontinuities, in 2007 AGU Fall Meeting, San Francisco, CA, 10-14 Dec 2007.

Technical report:

7. Mazanek DD, Roithmayr CM, Antol J, Park SY, Koons RH, et al., Comet/asteroid protection system (CAPS): preliminary space-based system concept and study results, NASA Langley Research Center Technical Report, NASA/TM-2005-213758 (2005).

Dissertation:

8. Park SY, Optimization and guidance of ascent trajectories with inequality constraints, PhD Dissertation, Texas A&M University (1996).

Website:

9. National Radio Astronomy Observatory, Very long baseline array [Internet], cited 2011 Feb 20, available from: <http://www.vlba.nrao.edu>.

Tables:

Each table should be prepared on a separate page and numbered with an Arabic numeral in the order of its appearance in the text. When it is difficult to present data that cannot be synthesized conveniently in the text, tables should be used. Authors should avoid extensively repeating in the text data that appear in tables. Abbreviated names should be defined when they are used for the first time in each table. Tables should have a concise and informative title with the table content between horizontal lines. Vertical lines should not be used. The structure should be clear, with simple column headings giving all units. A table should not exceed one page when printed. Use lower case letters in superscripts (a, b, c...) for special remarks. Unaltered computer output and notation are generally unacceptable.

Figures:

Each figure or figure plate must have a caption written in one paragraph. For figure plates, a summary statement should precede the specific explanation of each figure. Abbreviated names are not allowed when they are used for the first time in each figure. The explanatory caption of each

illustration should be understandable without reference to the text. Number figures in order of citation. Authors should place the figure number in the lower-left corner of each figure, and the numbering order must be from left to right, and from top to bottom. Citations of figures in the text or parentheses are abbreviated, e.g., Fig. 1, Figs. 1 and 2, Figs. 1–3, (Fig. 1), (Figs. 1 and 2), (Figs. 1–3). When the text refers to both figures and tables, they may be mentioned in parentheses, e.g., (Table 1; Fig. 2) and (Tables 1–3; Figs. 4–6). Line drawings should be prepared in high quality using India ink on tracing paper.

Computer-generated graphics must be produced with high tones and resolution. Photographs must be of sufficient contrast to withstand the inevitable loss of contrast and detail during the printing process. Authors should double check whether the text withstands reduction and remains legible if a figure or a figure plate is reduced. Electron and light microscopic figures must be original or scanned copies from the original.

Review papers

General points on text style

Verb tense:

Generally, authors should use the past tense or present perfect tense to delineate specific events in the past, including the procedures, observations, and data of the study that authors are reporting. Use the present tense for the authors' own general conclusions, firm conclusions of previous researchers, and generally accepted facts and phenomena. The Abstract, Methods, and Results should generally be in the past tense or present perfect tense, whereas most of the Introduction and some of the Conclusions can be in the present tense. However, the tense may be different in a single sentence.

Units:

If authors describe length, height, weight, and volume, they should use standard metric units. Temperature should be given in degrees Celsius. All other units should follow the International System of Units (SI). All units must be preceded by a space.

Numbers:

Except when beginning a sentence in the text, numbers should be Arabic numerals. Authors should use commas if numbers are greater than 999, e.g., 1,984,826. The 24-hour system is used to indicate time, e.g., 20:00 hr.

Abbreviations:

Abbreviations must be used as an aid to the reader, rather than as a convenience of the author, and therefore their use should be limited. Generally, avoid abbreviations that are used less than three times in the text, including tables and figure legends. Standard SI abbreviations and

Review papers may be solicited or submitted. A comprehensive presentation of a topic should discuss previously published material. Topics of scientific consensus as well as topics that remain controversial may be dealt with in reviews. A review is organized as follows: title page including abstract and keywords, introduction, body text, conclusions or summary, acknowledgments, and references. Text that exceeds 5,000 words, excluding references, will not be accepted.

Letters to the editor

Brief constructive comments about previously published articles and interesting new ideas should be submitted as Letters to the Editor. The body text should not exceed 1,000 words and should include references. The Editorial Board may edit the Letters. In the case of comments on previously published articles, Letters to the Editor should be submitted no more than three months after the original paper has been published. The Editorial Board may contact the authors for a response to the Letters.

units in astronomy are recommended. Other common abbreviations are as follows (the same abbreviations are used for plural forms): hr (hour), sec (second), min (minute), day (not abbreviated), year (yr), and g (gravity).

한국우주과학회 제34차 정기총회

일 시 : 2016년 10월 27일 17:30

장 소 : 제주 해비치호텔&리조트

1. 정족수 확인 총무이사 최영준
2. 개회선언 회장 한원용
3. 전회의록 낭독 총무이사 최영준
4. 사업보고 총무이사 최영준
5. 학술대회준비위원회 보고 위원장 이대영
6. 학술보고 학술이사 이 유
7. 포상위원회 보고 위원장 김용기
8. 대외협력위원회 보고 위원장 문홍규
9. 감사보고 감사 강영운
10. 안건1. 2016년 결산(안) 심의 재무이사 이병선
11. 안건2. 2017년도 예산(안) 심의 재무이사 이병선
12. 기타토의 회장 한원용
13. 폐회 다같이

■ 한국우주과학회 제33차 정기총회 회의록 ■

- 소집연월일 : 2015년 10월 28일(수) 17:30
- 개최 장소 : 경주 드림센터
- 개최 일시 : 2015년 10월 28일(수) 17:30 - 18:30
- 참석 회원 : 국내 거주 정회원 650명 중 109명 참석

1. 사업보고(문홍규 총무이사)

문홍규 총무이사가 2015년도 정기 학술대회, 이사회 회의, 학회보, 학회 영문홈페이지 제작 및 운영, 한국지구과학회 연합회 정례회의 및 워크숍 참가에 대하여 보고하였으며 이의 없이 통과 됨.

2. 학술대회준비위원회 보고(이대영 학술대회준비위원장)

이대영 학술대회준비위원장이 학술대회준비위원회 구성과 학술대회 개최실적에 대하여 보고하였으며 이의 없이 통과 됨.

3. 학술보고(이유 학술이사)

이유 학술이사가 편집위원회 구성, 학술지 발간현황, 학술지 SCI(E)급 저널 등재 노력에 대하여 보고하였으며 이의 없이 통과 됨.

4. 포상위원회 보고(한원용 포상위원장)

한원용 포상위원장이 포상위원회 구성, 2015년 한국우주과학회 학술상, 두진 젊은 우주과학자상 및 에스이랩상 수상자 선정, 포상위원회 세부규정 개정, 제25회 과학기술우수논문상 수상자에 대하여 보고하였으며 이의 없이 통과 됨.

5. 감사 보고(양종만 감사)

천문석, 양종만 감사가 2015년 1월 1일부터 9월 30일까지의 업무 및 회계감사를 실시(2015년 10월 16일), 양종만 감사가 그 결과를 보고하였으며 이의 없이 통과 됨.

6. 대외협력 위원회 보고(김용기 대외협력위원장)

김용기 대외협력위원장이 2015 세계 빛의 해 기념세션 운영, SQM 16기 도입 및 한국천문우주과학관협회 인수, NASA 엠베서더 초청 및 강연 프로그램 4회 실시에 대하여 보고하였으며 이의 없이 통과 됨

■ 의결 안건

안건 1. 2015년도 결산(안) 승인 건

조중현 재무이사가 2015년 결산(안)을 보고하였으며 동의와 재청으로 원안대로 통과 됨.

안건 2. 2016년도 예산(안) 승인 건

조중현 재무이사가 2016년도 예산(안)에 대하여 보고하였으며 동의와 재청으로 원안대로 통과 됨.

안건3. 제 17대 회장 선출 건

학회 정관 제12조에 의하여 당 법인의 대표권이 있는 이사 민경욱의 2015년 12월 31일 임기만료로 인하여 차기회장을 선출하여

줄 것을 제안하고 임원 선출 규정에 따라 차기회장을 선출함.

차기 회장 선출을 위하여 정회원 자격을 취득한지 만 1년이 경과된 회원들로부터 온라인으로 후보를 추천 받은 결과 10명 이상의 추천을 받은 김용하 회원(충남대)과 한원용 회원(천문연)이 후보로 결정되어 총회에서 무기명 비밀선거를 실시함. 투표에 정회원 109명이 참여했으며, 한원용 회원이 과반수의 득표를 얻어 차기 회장으로 선출, 민경욱 의장이 이를 공표하고 한원용 회원은 즉석에서 취임을 승낙함.

안건4. 감사 선출 건

민경욱 의장은 법인 감사 양종만, 천문석 회원이 2015년 12월 31일 임기만료로 인하여 후임 감사를 선출하여 줄 것을 제안하고 후보자로 강영운 회원, 양종만 회원이 추천 됨. 추천된 2인의 후보자를 감사로 선임하는 것에 동의와 재청이 있어 2인의 후보를 감사에 선임하기로 민경욱 의장이 공표하고 강영운 회원, 양종만 회원은 즉석에서 취임을 승낙함.

이상으로, 금일의 회의 목적인 안건이 전부 심의 종료되었으므로 의장이 폐회를 선언함.

위 결의를 명확히 하기 위하여 본 의사록을 작성하고 의장과 출석한 이사와 감사가 다음에 기명날인함.

오후 6시 30분 폐회

2015년 10월 28일
사단법인 한국우주과학회 제33차 정기총회

의 장 민 경 욱 인	부 의 장 김 용 기 인
부 의 장 최 기 혁 인	부 의 장 김 호 일 인
총무이사 문 홍 규 인	재무이사 조 중 현 인
학술이사 이 유 인	이 사 강 영 운 인
이 사 경 재 만 인	이 사 김 천 회 인
이 사 박 상 영 인	이 사 박 장 현 인
이 사 박 재 우 인	이 사 심 은 섭 인
이 사 이 대 영 인	이 사 이 병 선 인
이 사 진 호 인	이 사 한 원 용 인
감 사 양 종 만 인	

■ 사업보고 ■

1. 정기 학술대회 개최

- (1) 봄 학술발표회
 - 강릉 라카이샌드파인리조트
 - 일시 : 2016년 4월 28일(목) ~ 29일(금)
 - 논문발표 : 176편

- (2) 가을 학술발표회(우주전파센터컨퍼런스 공동발표)
 - 장 소 : 제주 해비치호텔&리조트
 - 일 시 : 2016년 10월 26일(수) ~ 28일(금)
 - 논문발표 : 208편

2. 학술지 및 학회보 발행

- (1) 영문학술지발간 : JASS Vol 33, NO. 1, 2, 3호 발간
- (2) 한국우주과학회보 Vol 25 NO 1, 2호 발간

3. 이사회

- 회의 개최 및 주요안건
- 가. 2015년도 3차 회의(2015. 10. 28.) 경주 드림센터
 - 2016년 예산(안) 승인
 - 신입회원 인준: 정희원 52명, 학생회원 8명
 - 2015년(2015.1.1~09.30) 결산(안) 승인
 - 학술대회 학생 등록비 지원: 박선미 외 3명
 - 2016년 봄 학술대회 개최 장소: 회장단에 위임
 - 2016년 사업계획(안) 승인
- 나. 2016년 1차 회의(2016. 02. 18.) 대전시 테크노참치
 - 포상위원회 구성 승인: 위원장 김용기, 포상위원 4명
 - 학술대회준비위원회 구성 승인: 위원장 이대영,준비위원4명
 - 편집위원회 구성 승인: 위원장 이유, 부위원장 이은상, 편집위원 32명
 - 학회발전기획위원회 설치 승인: 위원장 조중현
 - 학회활동 역량강화 위원회 설치 승인: 위원장 최기혁
 - 대외협력위원회 설치 승인: 위원장 문홍규
 - 2016년 가을 학술대회 개최: 회장단에 위임
 - 학회 운영에 대한 규정 변경 승인: 원안대로 승인 함.
- 다. 2016년도 2차 회의(2016.04.28.) 강릉 라카이샌드파인리조트
 - 신입회원 인준: 정희원 32명, 학생회원 2명
 - 학술대회 학생 등록비 지원: 송성현외 1명
 - 학술대회준비위원회 위원 추가 승인: 변용익, 이재우
 - 태양/우주환경 분과회 승인

- 장소: 강릉 라카이샌드파인리조트
- 일시: 2016년 4월 28일(목) ~ 29일(금)
- 발표논문: 총 176편
(초청강연 4편, 구두발표 80편, 포스터발표 92편)
- 참가인원: 등록 226명
- 총사업비: 30,240,190원
- (3) 2016년 가을학술대회 (10월 14일 현재)
 - 장소 :제주 해비치호텔&리조트
 - 일시 : 2016년 10월 26일(수) 14:00 ~ 28일(금) 12:00
 - 논문발표 : 초청강연 3편, 구두발표 80편, 포스터발표 125편, 총 208편
 - 등록인원 : 225명
 - 총사업비 예상: 42,000,000원

■ 학술보고 ■

1. 편집위원회 구성

- 임기 : 2016년 1월 ~ 2017년 12월
- 편집위원장: 이 유
- 부편집위원장: 이은상
- 편집실장: 김숙경
- 편집위원: 김방엽, 나자경, 박찬덕, 이기원, 이대희, 이병선, 이수창, 이재진, 이주희, 지건화, 최영준, Chung Yue Hui, Xinlin Li, Tapas Kumar Das, Edward F. Guinan, Boonrucksar Soonthornthum, Paul A. Evenson, David Ruffolo, eongwoo Lee, Eunhwa Kim, Ivan L. Andronov, Lee-Anne Mckinnell, Lin-Ni Hau, Vitaly P. Kim, Jiuhou Lei, Charles Lin, Huixin Liu, Valery Nakariakov, Yuichi Otsuka, Ilya Usoskin, Chao Xiong, Sungpil Yoon

2. Journal of Astronomy and Space Sciences 발간

- (가) 출판현황
 - 2015년 12월호 (Vol. 32, No.4) 영문 19편 출판
 - 2016년 3월호 (Vol. 33, No.1) 영문 8편 출판
 - 2016년 6월호 (Vol. 33, No.2) 영문 9편 출판
 - 2016년 9월호 (Vol. 33, No.3) 영문 11편 출판
- (나) 인쇄본 출판 : 학회 정회원과 기관회원 배부, 학회 보관 20부
- (다) On-line 출판 :
 - JASS 홈페이지(<http://janss.kr>)
 - KISTI에서 제공하는 과학기술학회마을
 - 한국연구재단(KCI)
 - ADS 등에서 무료로 원문 검색 가능

3. JASS SCI급 저널 등재신청 지원현황

- 2015년 6월호를 시작으로 9, 12월호, 2016년 3월 6월 9월호를 연속 제출함으로 지원절차를 완료하고 심사결과를 기다리는 중임.

■ 학술대회준비위원회 보고 ■

1. 학술대회준비위원회 구성

- 임기 : 2016년 1월 ~ 2017년 12월
- 학술대회준비위원장 : 이대영
- 학술대회준비위원 : 김복순, 변용익, 이주희, 이재우, 지건화, 진호

2. 학술대회 개최 실적 보고

- (1) 2015년 가을학술대회 및 제33차 정기총회
 - 장소: 경주 드림센터
 - 일시 : 2015. 10. 28.(수) 13:00 ~ 30.(금) 12:00
 - 발표논문 : 총 265편
(초청강연 6편, 구두발표 99편, 포스터발표 160편)
 - 참가인원 : 등록 265명
 - 총사업비 :53,168,460원
- (2) 2016년 봄 학술대회

4. 영어논문 작성법 무료강연 개최

- 일시 : 2016년 8월 17일(수) 14시 ~ 16시
- 장소 : 천문연 세종홀 1층 대회의실
- 강의 내용
 - How to write a research paper in English
 - Preparing for publication: Writing tips
 - The key to deep communication in English
 - : Organization
 - Journal Selection
- 강사 : Marisha Fonseca (영문교정 전문업체 Editage 소속)
- 참석자 : 32명

참석 / 강릉 라카이 샌드파인 리조트

- 2016년 5월 2일 International Workshop on Night Sky Brightness Measurements 참가 / 충북대학교
- 2016년 6월 14일~15일 제3차 디지털 천체영상물 제작 및 국내 밤하늘 밝기 측정 네트워크 회의 / 대전시민천문대

5. Asian Science Editors' Conference & Workshop 2016 참석

- 일시 : 2016년 7월 21일(수) ~ 23일(금)
- 장소 : 한국과학기술회관

■ 포상위원회 보고 ■**1. 포상위원회 구성**

- 임기 : 2016년 1월 ~ 2017년 12월
- 위원장 : 김용기
- 위원 : 최영준, 윤태석, 이 유, 손영중

2. 2016년 수상자 선정

- (가) 2016년 한국우주과학회 학술상 - 민경욱(과기원)
- (나) 2016년 한국우주과학회 두진 젊은 우주과학자상 수상자
 - 송영주(항우연)
- (다) 에스에랩상 수상자 -(주)에스에랩 지원
 - 봄 학술대회: 최 진(천문연)
 - 가을 학술대회: 정종일(충남대)
- (라) 제26회 과학기술우수논문상 수상
 - (시행처: 한국과학기술단체총연합회)
 - 수상자: 이 유(충남대)
 - 수여일: 2016년 7월 13일
 - 논문제목: 3D Modeling of Lacus Mortis Pit Crater with Presumed Interior Tube Structure
 - 게재지명 : JASS 32권 2호, 113-120

■ 대외협력위원회 보고 ■**1. NASA 앰배서더 사업**

- NASA/JPL Solar System 앰배서더 Paul Yun(윤명현)교수 초청, 강연 프로그램 8회 실시

2. SQM활용 국내 밤하늘 밝기 측정 네트워크 구축 현황

- 2016년 4월 29 한국우주과학회 봄학술대회 대중천문 세션

■ 감사 보고 ■

(사)한국우주과학회 2016년 감사보고서

회계년도 : 2016. 1. 1.~ 2016. 9. 30.

사단법인 한국우주과학회장 귀하

본 감사는 2016년 10월 13일, 2016년 1월 1일부터 2016년 9월 30일까지 한국우주과학회에 대한 회계감사 및 업무감사를 실시하였다.

회계부문에서는 회계기간에 해당하는 결산서, 손익계산서, 대차대조표를 검토한 결과 재무제표의 모든 항목이 제반 규정대로 정확하게 표시되었으며, 차년도 사업예산도 규정에 따라 적법하게 계획되었다. 재무제표를 뒷받침하는 회계장부와 지출결의서, 통장 등 증빙서류도 제대로 정리되었으며, 통장잔액과 장부잔액이 일치한다는 사실을 확인하였다.

학술행사 사업으로 2016년 봄 학술대회가 4월 28일~29일 강릉 라카이샌드파인에서 개최되었으며, 총 226명 등록하여 176편의 논문이 발표되었다. 봄 학술대회 사업비로 30,240,190원 사용되어 예년과 비교할 때 예산집행이 적절하게 이루어졌다.

2016년 9월 30일 현재 학회 유동자산은 305,686,893원이며 보통예금으로 96,686,893원, 정기예금으로 200,000,000원, 두진 젊은우주과학자상 예금으로 9,000,000원을 운영하고 있다. 2016년 9월 30일 현재 2015년 말 대비 총자산이 29,824,816원만큼 증가하였다. 12월 결산시에는 가을학술대회 행사비 지출을 하고 나면 손익이 현재보다 다소 줄어들 것으로 예상되나, 학회 자금 운용이 예산대비 합리적으로 이루어지고 있음을 확인하였다.

사업부문에서는 2016년 발행된 JASS Vol.33, No.1 ~ No.3에 대한 학술지 발행사업비로 총 21,373,159원 사용되었다. 발행된 논문은 JASS 3월호(Vol.33, No.1) 8편, JASS 6월호(Vol.33, No.2) 9편, JASS 9월호(Vol.33, No.3) 11편 총 28편의 논문이 발간되었다. 또한 JASS SCI급 저널 등재신청을 하였고 심사를 기다리는 중이다. 2017년 사업 계획 부문에서는 각 위원회별로 사업내용과 예산이 합리적으로 계획되었음을 확인하였다.

이상과 같이 2016년 9월 30일 기준으로 한국우주과학회 사업부문과 결산 회계처리 내역을 감사한 결과 결산서와 다르지 않다는 사실을 확인하고 이에 서명 날인한다.

2016년 10월 13일

사단법인 한국우주과학회

감사 강영운 (인)

감사 양종만 (인)



■ 안건1. 2016년도 결산(안) 승인건 ■

1. 2016년도 결산서(2016.01.01.~09.30.)

단위(원)

수입			지출		
과목	금액		과목	금액	
1.회비수입	23,800,000		1. 발행사업비	21,373,159	
1-1 연회비		23,800,000	1-1 인쇄비		6,782,600
1-2 특별회비		-	1-2 편집비		-
2.기부금	-		1-3 영문교열,ME		10,949,058
2-1 자정기부금		-	1-4 심사비 외		2,586,501
3.학술발표회	60,038,000		1-5 과편협등록비		255,000
3-1 봄학술대회		35,478,000	1-6 논문인용지원금		800,000
3-2 가을학술대회		24,560,000	2. 학술행사비	30,240,190	
4.계재료	13,631,020		2-1 봄학술대회		30,240,190
4-1 JASS		13,631,020	2-2 가을학술대회		-
5.광고수입	11,000,000		2-3 비정기학술대회		-
5-1 연구홍보		5,000,000	3. 비정기활동사업비	1,212,662	
5-2 기업광고		6,000,000	3-1 대중화 사업 등		1,212,662
6.지원금	26,470,000		4. 위원회 사업비	-	
6-1 과총		26,470,000	5. 회의비	2,567,000	
6-2 연구재단		-	5-1 이사회/임원회		2,093,000
6-3 기타지원금		-	5-2위원회		474,000
7.용역비	-		6. 용역비	-	
7-1 용역비		-	6-1 용역직접비		-
8.사업수익	-		6-2 용역간접비		-
8-1 용역간접비		-	7. 급료와 임금	37,115,570	
9.사업외수익	1,774,369		7-1 내부인건비		37,115,570
9-1 예금이자		74,331	7-2 퇴직금정산		-
9-2 인지세		-	8. 4대보험료	2,500,920	2,500,920
9-3 사무지원비		346,668	9. 우편료/통신비	683,630	683,630
9-4 국제환급금		1,353,370	10. 세금과공과/연회비	7,294,342	
10.출판비	-		10-1 연회비		3,660,000
			10-2 카드수수료		2,266,432
			10-3 법인등기비용		-
			10-4 기타공과금		1,362,410
			10-5 송금수수료		5,500
			11. 광고비	330,000	330,000
			12. 경조사비	50,000	50,000
			13. 인쇄복사비	-	-
			14. 사무용품비	787,000	787,000
			15. 출장비	1,734,100	1,734,100
			16. 제행사비	1,000,000	1,000,000
			17. 제잡비	-	-
			18. 정보화사업비	-	-
			18-1 홈페이지리뉴얼		-
			19. SCI등재	-	-
수입계 ①	136,713,389		지출계 ④	106,888,573	
전년도 이월금 ②	275,862,077	(2015.12.31)	차기 이월금 (⑤)=③-④	305,686,893	*회계장부 잔액
합계 (③)=①+②	412,575,466		합계	412,575,466	

전년도이월금	275,862,077
당기손익(+)	29,824,816
차기이월금	305,686,893

2. 전년도(2015 회계년도) 결산서

2015년도 결산서

기간: 2015.1.1~2015.12.31.

(사)한국우주과학회 (단위:원)

수입			지출		
과목	금액		과목	금액	
1.회비수입	31,780,000		1. 발행사업비	46,013,373	
1-1 연회비		26,580,000	1-1 인쇄비		20,485,300
1-2 특별회비		5,200,000	1-2 편집비		-
2.기부금	0		1-3 영문교열,ME		15,351,036
2-1 지정기부금		0	1-4 심사비 외		9,377,037
3.학술발표회	75,578,000		1-5 과편협등록비		350,000
3-1 봄학술대회		22,140,000	1-6 논문게재 장려금		450,000
3-2 가을학술대회		53,438,000	2. 학술행사비	80,953,274	
4.개재료	37,343,704		2-1 봄학술대회		27,784,814
4-1 JASS		37,343,704	2-2 가을학술대회		53,168,460
5.광고수입	17,500,000		2-3 비정기학술대회		-
5-1 연구홍보		8,500,000	3. 비정기활동사업비	5,673,119	
5-2 기업광고		9,000,000	3-1 대중화 사업 등		5,673,119
6.지원금	31,660,000		4. 위원회 사업비	1,000,000	1,000,000
6-1 과총		31,660,000	5. 회의비	2,027,000	
6-2 연구재단		-	5-1 이사회/임원회		1,866,000
6-3 기타지원금		-	5-2 위원회		161,000
7.용역비	-		6. 용역비	-	
7-1 용역비		-	6-1 용역직접비		-
8.사업수익	-		6-2 용역간접비		-
8-1 용역간접비		-	7. 급여와 임금	49,879,580	
9.사업외수익	23,629,649		7-1 내부인건비		44,861,580
9-1 예금이자		8,298,372	7-2 퇴직금정산		5,018,000
9-2 인지세		-	8. 4대보험료	2,660,460	2,660,460
9-3 사무지원비		14,642,857	9. 우편료/통신비	286,256	286,256
9-4 국제환급금		688,420	10. 세금과공과/연회비	9,611,268	
			10-1 연회비		3,960,000
			10-2 카드수수료		3,102,958
			10-3 법인등기비용		677,480
			10-4 기타공과금		1,848,830
			10-5 송금수수료		22,000
			11. 광고비	330,000	330,000
			12. 경조사비	400,000	400,000
			13. 인쇄복사비	-	-
			14. 사무용품비	6,087,350	6,087,350
			15. 출장비	2,562,700	2,562,700
			16. 제행사비	700,000	700,000
			17. 제잡비	-	-
			18. 정보화사업비	-	-
			18-1 홈페이지리뉴얼		-
			19. 30주년기념사업비	4,970,000	4,970,000
			20. SCI 등재	529,500	529,500
수입계 ①	217,491,353		지출계 ④	213,683,880	
전년도 이월금 ②	272,054,604	(2014.12.31)	차기 이월금 (⑤=③-④)	275,862,077	*회계장부 잔액
합 계 (③=①+②)	489,545,957		합계	489,545,957	

전년도이월금	272,054,604
당기손익(+)	3,807,473
차기이월금	275,862,077

■ 안건2. 2017년도 예산(안) 승인 건 ■

1. 일반회계
- 2017년 수입(안)

기간: 2017. 1. 1. ~ 2017. 12. 31
(단위: 원)

2017년도 예산 수입(안)					
과목	2017년 예산(A)		2016년 가결산(B)		증감(A-B)
	대분류	소분류	대분류	소분류	
1. 회비수입	29,200,000		27,800,000		1,400,000
1-1 연회비		29,200,000		27,800,000	1,400,000
1-2 특별회비		0		0	0
2. 기부금	0		0		0
2-1 지정기부금		0		0	0
3. 학술발표회	80,000,000		80,038,000		-38,000
3-1 봄학술대회		35,000,000		35,478,000	-478,000
3-2 가을학술대회		45,000,000		44,560,000	440,000
4. 게재료	35,000,000		28,631,020		6,368,980
4-1 JASS		35,000,000		28,631,020	6,368,980
5. 광고수입	13,000,000		15,000,000		-2,000,000
5-1 연구홍보		6,000,000		8,000,000	-2,000,000
5-2 기업광고		7,000,000		7,000,000	0
6. 지원금	28,000,000		26,470,000		1,530,000
6-1 과총		28,000,000		26,470,000	1,530,000
6-2 연구재단		0		0	0
6-3 기타지원금		0		0	0
7. 용역비	0		0		0
7-1 용역비		0		0	0
8. 사업수익	0		0		0
8-1 용역간접비		0		0	0
9. 사업외수익	6,000,000		6,274,369		-274,369
9-1 예금이자		4,500,000		4,574,331	-74,331
9-2 인지세		0		0	0
9-3 사무지원비		400,000		346,668	53,332
9-4 국세환급금		1,100,000		1,353,370	-253,370
10. 출판비	0		0		0
		0		0	0
합 계	191,200,000		184,213,389		6,986,611

* 기관연회비는 2016년부터 특별회비 항목에서 연회비 항목에 포함하여 기재

- 2017년 지출(안)

기간: 2017. 1. 1. ~ 2017. 12. 31.
(단위: 원)

2017년도 예산 지출(안)					
과목	2017년 예산(A)		2016년 가결산(B)		증감(A-B)
	대분류	소분류	대분류	소분류	
1. 발행사업비	38,500,000		38,073,159		426,841
1-1 인쇄비		16,800,000		15,282,600	1,517,400
1-2 편집비		0		0	0
1-3 영문교열, ME		12,000,000		14,949,058	-2,949,058
1-4 심사비 외		8,200,000		6,586,501	1,613,499
1-5 과편협등록비		500,000		255,000	245,000
1-6 논문게재장려금		1,000,000		1,000,000	0
2. 학술행사비	75,000,000		72,240,190		2,759,810
2-1 봄학술대회		35,000,000		30,240,190	4,759,810
2-2 가을학술대회		40,000,000		42,000,000	-2,000,000
2-3 비정기학술대회		0		0	0
3. 비정기활동사업비	2,000,000		5,212,662		-3,212,662
3-1 대중회사업 등		2,000,000		5,212,662	-3,212,662
4. 위원회사업비	1,000,000		0		1,000,000
5. 회의비	2,600,000		2,967,000		-367,000
5-1 이사회/임원회		1,600,000		2,093,000	-493,000
5-2 위원회		1,000,000		874,000	126,000
6. 용역비	0		0		0
6-1 용역직접비		0		0	0
6-2 용역간접비		0		0	0
7. 급여와 임금	52,200,000		49,815,570		2,384,430
7-1 내부인건비		48,500,000		46,115,570	2,384,430
7-2 퇴직금정산		3,700,000		3,700,000	0
8. 보험료	3,000,000		3,250,920		-250,920
8-1 4대 보험료		3,000,000		2,669,200	330,800
9. 우편료/통신비	600,000		743,630		-143,630
9-1 일반우편비		600,000		228,330	371,670
10. 세금과공과/연회비	7,780,000		7,799,342		-19,342
10-1 연회비		3,650,000		3,660,000	-10,000
10-2 카드수수료		2,400,000		2,666,432	-266,432
10-3 법인등기비용		700,000		0	700,000
10-4 기타공과금		1,000,000		1,462,410	-462,410
10-5 송금수수료		30,000		10,500	19,500
11. 광고비	660,000		660,000		0
12. 경조사비	300,000		150,000		150,000
13. 인쇄복사비	0		0		0
14. 사무용품비	760,000		987,000		-227,000
15. 출장비	3,000,000		2,134,100		865,900
16. 제행사비	1,000,000		1,000,000		0
17. 제압비	0		0		0
18. 정보화사업비	1,800,000		0		1,800,000
18-1 홈페이지 리뉴얼		1,800,000		0	1,800,000
19. SD등재	1,000,000		0		1,000,000
지출계	191,200,000		185,033,573		6,166,427
차기이월(당기손익)	0		-820,184		820,184
수입계	191,200,000		184,213,389		6,986,611

2. 특별회계(정기예금)			
항목	2017년(A)	2016년(B)	증감(A-B)
특별회계(2015.12.31)	200,000,000	200,000,000	0
두진상(2015.12.31)	8,000,000	9,000,000	-1,000,000

한국우주과학회보	발행인	한원용
제25권 2호 2016년 10월	편집인	최영준 · 고미희 / 이 유 · 김숙경
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