ISSN 1598-5601

한국우주과학회보

Bulletin of The Korean Space Science Society

2024년 10월 제33권 2호

웹프로시딩

사단법인 한국우주과학회
The Korean Space Science Society

차 례

<사단법인 한국우주과학회 입회 안내>

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

▣ 보낼곳: 한국우주과학회
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국민은행 012-01-0603-888
예 금 주 한국우주과학회

▣ 회비납부안내

회원구분	입회비	연회비
학생회원(학부생)	10,000원	10,000원
정회원	10,000원	70,000원
회장, 부회장	-	150,000원
이사, 감사	-	150,000원

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

※ 뒷면의 입회원서를 복사하여 사용해 주십시오.

[표지사진 설명]

한국천문연구원은 우주항공청 수탁사업으로 자국 정지궤도 우주물체와 한반도 주변 중, 고궤도 영역의 우주감시를 위해 한반도와 동일한 경도대인 호주에 설치될 중, 고궤도 광학감시시스템(BRAHE 시스템)을 2023~2027년까지 개발하고 있습니다.

입 회 원 서

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선택</td><td colspan="7">- 중복선택 가능
☐ 태양우주환경분과 ☐ 우주탐사분과 ☐ 우주관측기기분과
☐ 우주감시분과 ☐ 초소형위성분과 ☐ 활동 안함</td></tr>
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위 본인은 귀 학회의 설립 목적과 취지에 찬동하여 이에 회원 가입을 신청합니다.

년 월 일

신청인: (인)

위 사람을 귀 학회의 회원으로 추천합니다(참고: 정관 7조 1항에 따라 추천인은 우리 학회 정회원이면 누구나 가능합니다.).

추천인 : 직장 및 직위	성명	(인)
추천인 : 직장 및 직위	성명	(인)

사단법인 한국우주과학회 귀중

한국우주과학회
2024년 가을 학술대회

일　　시 : 2024. 10. 28.(월) ~ 30.(수)

장　　소 : KB손해보험 인재니움 사천연수원

공동주최 : 한국마이크로중력학회

후　　원 :

GNTO 경남관광재단 GYEONGNAM TOURISM ORGANIZATION

재단법인 경남테크노파크

대한민국육군 Republic of Korea Army

한국과학창의재단 Korea Foundation for the Advancement of Science & Creativity

등록 및 안내

1. 등록

회원의 등록비는 270,000원이며, 정회원 중 석 · 박사과정(전일제) 학생은 200,000원, 학부생/군경은 150,000원입니다. 사전등록을 하신 회원은 학회보, 명찰을 수령하시기 바랍니다. 등록비 영수증과 참가확인증은 홈페이지에서 발행 가능합니다.

2. 발표자료 준비

구두발표: 발표자료는 파워포인트 파일로 준비하시기 바랍니다. 위촉된 심사위원이 우수 구두발표를 선정하여 폐회식 때 시상을 합니다.

포스터발표: 포스터 발표는 A0 사이즈 1장(A0 사이즈 1장 내에 들어갈 분량, 예를 들면 A3 8장) 크기이며, 10월 28일(월) 14시까지 지정된 장소에 게시하고, 29일(화) 19시까지 수거해 주시기 바랍니다. 집중발표 시간에 발표자는 자신의 포스터 앞에서 회원들의 질문에 답할 수 있도록 준비해 주시기 바랍니다. 위촉된 심사위원이 우수 포스터발표를 선정하여 폐회식 때 시상을 합니다. 포스터를 부착하지 않거나 학회 종료 후 수거하지 않은 회원은 추후 학회발표가 제한될 수 있습니다.

3. 발표장

2층 스타홀	201호	305호	306호
- Invited Talk (I), (II), (III) - 우주정책포럼 - 퀀텀에어로 소개 - 만찬	- 태양 및 우주환경 (I), (II), (III) - SS: 태양-우주폭풍 (I), (II)	- 우주감시 - 우주 지속가능성 워크숍 - SS: 국내주도 우주 망원경 기획 연구	- 안보우주 (I), (II), (III), (IV)
402호	**403호**	**404호**	**101호**
- 달 착륙과우주탐사 - SS: 우주탐사의 시작, 우리는 왜 대중소통에 관심 가져야 하는가 - SS: NASA/CLPS 월면 과학탐사 탑재체 - SS: 대학생 참여를 통한 미래세대 주도의 뉴스페이스 시대 인재 양성 - SS: 우주 제조 기술과 금성 탐사로의 확장	- 우주분야 여성인력 조사결과 공유 토론회	- SS: SpaceAI 2024: 인공지능, 우주를 만나다 - SS: 차세대 분광탐사 기획연구 - 우주천문 & 초소형위성 - 우주산업	- 한국마이크로중력학회 가을 학술대회

4. 교통 안내

가. 주소: 경상남도 사천시 곤양면 광포길 22 KB손해보험 인재니움 사천(Tel: 055-830-4300)

나. 진주역 셔틀버스 운행 안내

▶ 진주역 → 연수원(1회): 10월 28일(월) 9시 40분 진주역 출발(KTX 203 진주역 9시 15분 도착하는 기차 기준)

▶ 연수원 → 진주역(1회): 10월 30일(수) 13시 20분 연수원 출발(KTX 214 진주역 14시 34분 출발하는 기차 기준)

5. 구두발표 색인표

I - 1 - 1

세션번호 발표장 발표순서

2024 KSSS FALL CONFERENCE PROGRAM

Oct. 28. (Mon)

Time	Functions
9:30~	**등록(Registration)**
11:00~11:20	**개회사(Opening Ceremony): 박종욱 회장** **축사: 박동식 사천시장**
11:20~11:50	**Invited Talk I** **Room: 2층 스타홀** Chair: 곽영실(천문연) John Lee (우주항공청) KASA 임무본부의 추진방향
11:50~13:00	점심식사
13:00~14:30	**우주정책포럼** **Room: 2층 스타홀** 진행: 권윤영(천문연) 주제: 대한민국 미래 우주탐사
14:30~14:50	휴식(Break Time)

Room	201호		305호		306호		402호		404호	
Session I	**태양 및 우주환경 I** 좌장: 이준현(경희대)		**우주감시** 좌장: 유지웅(천문연)		**안보우주 I** 좌장: 최현주(ADD)		**달 착륙과 우주탐사** 좌장: 김주현(항우연)		**SS: SpaceAI 2024: 인공지능, 우주를 만나다** 좌장: 이강우(경희대)	
14:50~15:05	I-1-1	이대영 (충북대)	I-2-1	김홍래 (ADD)	I-3-1	이준왕 (육군)	I-4-1	이진성 (과기원)	I-5-1	문용재 (경희대)
15:05~15:20	I-1-2	김관혁 (경희대)	I-2-2	황나래 (천문연)	I-3-2	정영준 (육군)	I-4-2	김푸름 (연세대)	I-5-2	박은수 (천문연)
15:20~15:35	I-1-3	윤종연 (우주항공청)	I-2-3	이서은 (연세대)	I-3-3	이우석 (육군)	I-4-3	최기혁 (항우연)	I-5-3	박성홍 (천문연)
15:35~15:50	I-1-4	오대현(국가기상위성센터)	I-2-4	김재우 (과기원)	I-3-4	윤동호 (육군)	I-4-4	김효지 (카이스텔라)	I-5-4	김정헌 (천문연)
15:50~16:05	I-1-5	김지우 (연세대)	I-2-5	최진 (천문연)	I-3-5	최현주 (ADD)	I-4-5	조은진 (충남대)	I-5-5	조유진 (극지연)
16:05~16:20	I-1-6	이소연 (경희대)	I-2-6	이희재 (천문연)			I-4-6	안예선 (경희대)	I-5-6	김선우 (천문연)
16:20~16:35							I-4-7	정민섭 (천문연)	I-5-7	전세린 (충남대)
16:35~16:50							I-4-8	김은혁 (항우연)		
Session II	**태양우주환경분과 총회**		**우주관측기기분과 회의**		**안보우주 II** 좌장: 최호성(육군)				**초소형위성분과 총회**	
16:40~16:55					II-3-1	최만수 (천문연)				
16:55~17:10					II-3-2	민상웅 (한화시스템)				
17:10~17:25					II-3-3	이유진 (한화시스템)				
17:25~17:40					II-3-4	최성환 (한화시스템)				
17:40~	**이사회: 401호**									

Oct. 29. (Tue)

Time	Functions
08:30~09:00	**Invited Talk II** **Room: 2층 스타홀** Chair: 이대영(충북대) Peter H. Yoon (University of Maryland) Plasma Waves and Particle Analysis of Juno Mission
09:00~09:20	**Invited Talk III** **Room: 2층 스타홀** Chair: 최영준(천문연) 이강수(컴퍼니케이파트너스㈜) Global Space Industry Investment Trends and 'Company K-New Space Fund'
09:20~09:40	**퀀텀에어로 소개** **Room: 2층 스타홀** 전동근 대표(퀀텀에어로) 온디바이스AI를 활용한 우주환경 속에서의 미래 군 전력 증강 방안: Shield AI 전력을 중심으로
09:40~09:50	**경남투자청 소개**
09:50~10:20	휴식(Break Time)

Room	201호		305호	306호		402호		404호
Session III	SS: 태양-우주폭풍 I 좌장: 곽영실(천문연)		우주 지속가능성 워크숍 (I): 분야별 현황과 이슈 공유	안보우주 III 좌장: 박재홍(천문연)		SS: 우주탐사의 시작, 우리는 왜 대중소통에 관심 가져야 하는가 모더레이터: 문경수(과학탐험가, 플레이랩스)		우주분야 여성인력 조사결과 공유 토론회 (403호)
10:20~10:35	III-1-1	곽영실 (천문연)	일정 안내, 인사말 신상우 · 윤나영(항우연) 최은정(천문연) 정옥철(항우연) 윤기창 · 조정희 (우주환경센터) 황나래(천문연) 정영진(국방대)	III-3-1	최호성 (육군)	세션소개: 문경수(5')		11:55~12:55 점심식사 샌드위치 제공과 함께 토론회 (403호)
10:35~10:50	III-1-2	김수진 (천문연)		III-3-2	김정헌 (천문연)	III-4-1	정해임(천문연) (15')	
10:50~11:05	III-1-3	Miyashita Yukinaga (천문연)		III-3-3	홍준석 (천문연)	III-4-2	임석희(항우연) (15')	
11:05~11:20	III-1-4	이우경 (천문연)		III-3-4	신구환 (과기원)	III-4-3	노성찬(창의재단) (15')	
11:20~11:35	III-1-5	김정헌 (천문연)		III-3-5	박재흥 (천문연)	토론(토론자 전체) (30')		
11:35~11:50	III-1-6	정종일 (천문연)				질의응답 및 마무리 (10')		
11:50~13:00	점심(Lunch)							
Session IV	SS: 태양-우주폭풍 II 좌장: 김정헌(천문연)		우주 지속가능성 워크숍 (II): 라운드 테이블	안보우주 IV 좌장: 최호성(육군)		SS: NASA/CLPS 월면 과학탐사 탑재체 좌장: 최영준(천문연)		SS: 차세대 분광탐사 기획연구 좌장: 한정열(천문연)
13:00~13:15	IV-1-1	손지현 (경희대)	워크숍	IV-3-1	최성환 (천문연)	IV-4-1	심채경 (천문연)	IV-5-1	홍성욱 (천문연)
13:15~13:30	IV-1-2	김록순 (천문연)		IV-3-2	이금오 (항우연)	IV-4-2	설우형 (천문연)	IV-5-2	한정열 (천문연)
13:30~13:45	IV-1-3	권윤영 (천문연)		IV-3-3	신동윤 (페리지에어로스페이스)	IV-4-3	박현후 (경희대)	IV-5-3	최주현 (한국광기술원)
13:45~14:00	IV-1-4	박경선 (충북대)		IV-3-4	전완기 (ICEYE)	IV-4-4	윤석원 (서울대)	IV-5-4	임현호 (아주대)
14:00~14:15	IV-1-5	송인선 (연세대)		IV-3-5	김덕수 (한양대)	IV-4-5	남욱원 (천문연)	차세대 분광탐사 토론	
14:15~14:30	IV-1-6	이지희 (극지연)		IV-3-6	이재환 (육군)	IV-4-6	정민섭 (천문연)		

Time	Functions
14:30~14:50	휴식(Break Time)
14:50~16:20	**포스터 세션 (Poster Session): 집중 발표**
16:20~16:40	휴식(Break Time)
16:40~17:40	**정기총회: 305호**
18:00~20:30	**만찬(Banquet): 2층 스타홀**

Oct. 30. (Wed)

Time	Functions									
Room	201호		305호		306호		402호		404호	
Session V	**태양 및 우주환경 II** 좌장: 이하림(경희대)						**SS: 대학생 참여를 통한 미래세대 주도의 뉴스페이스 시대 인재 양성(학부생)** 좌장: 박경선(충북대)		**우주천문 & 초소형위성** 좌장: 문봉곤(천문연)	
08:30~08:45	V-1-1	송병권 (연세대)					V-4-1	조현서 (연세대)	V-5-1	김상혁 (천문연)
08:45~09:00	V-1-2	김은솔 (극지연)					V-4-2	이성호 (연세대)	V-5-2	민병희 (천문연)
09:00~09:15	V-1-3	이찬행 (천문연)					V-4-3	이현 (연세대)	V-5-3	박원기 (천문연)
09:15~09:30	V-1-4	조일현 (경희대)					V-4-4	오한준 (연세대)	V-5-4	장승원 (레오스페이스)
09:30~09:45	V-1-5	전민규 (경희대)								
09:45~10:00	V-1-6	이강우 (경희대)								
10:00~10:20	휴식(Break time)									
Session VI	**태양 및 우주환경 III** 좌장: 윤종연(우주항공청)		**SS: 국내주도 우주망원경 기획연구** 좌장: 이재진(천문연)				**SS: 우주 제조 기술과 금성 탐사로의 확장** 좌장: 김현준(항우연)		**우주산업** 좌장: 이형권 (레오스페이스)	
10:20~10:35	VI-1-1	Kil Hyosub (Johns Hopkins Univ.)	VI-2-1	정웅섭 (천문연)			VI-4-1	김현준 (항우연)	VI-5-1	오형재 (KAI)
10:35~10:50	VI-1-2	서정준 (천문연)	VI-2-2	류동욱 (항우연)			VI-4-2	윤학순 (스페이스린텍)	VI-5-2	김수빈 (경희대)
10:50~11:05	VI-1-3	김선정 (경희대)	VI-2-3	양유진 (천문연)			VI-4-3	김현준 (항우연)	VI-5-3	윤철환 (엠아이디)
11:05~11:20	VI-1-4	김대일 (경희대)	VI-2-4	윤형주 (항우연)			VI-4-4	이연주1 (IBS)	VI-5-4	김방엽 (항우연)
11:20~11:35	VI-1-5	안승우 (경희대)	우주망원경 기획연구 토론				VI-4-5	이연주2 (IBS)		
11:35~11:50	VI-1-6	Rahman Sumiaya (KHU)								
12:00~12:30	**폐회식(Closing Ceremony), 시상식**									
12:30~13:00	점심식사(Lunch)									

Poster Session

10. 29. (Tue) 14:50~16:20

Area	No	Author	Affiliation	Area	No	Author	Affiliation
달과 우주 탐사	P-1	김세린	천문연	우주천문	P-34	송현	서울대
	P-2	김우진	천문연		P-35	육영춘	항우연
	P-3	김주현	항우연	위성정보활용	P-36	김영선	항우연
	P-4	김희경	항우연		P-37	이재열	항우연
	P-5	박현후	경희대		P-38	전갑호	항우연
	P-6	백명진	항우연		P-39	전정남	항우연
	P-7	이석주	에너지공과대		P-40	정대준	항우연
	P-8	장경덕	항우연	초소형위성	P-41	김구혁	항우연
	P-9	장윤호	경희대		P-42	박종오	항우연
	P-10	조우인	경희대		P-43	서석배 1	항우연
	P-11	한조영	항우연		P-44	서석배 2	항우연
우주 인프라	P-12	강철	항우연		P-45	서성원	UST
	P-13	박영재	항우연		P-46	신현규	항우연
	P-14	송하룡	항우연	태양 및 우주환경	P-47	박진영	경희대
	P-15	전종협	항우연		P-48	이호진 1	천문연
우주감시	P-16	이일섭	항우연		P-49	이호진 2	천문연
우주산업	P-17	강금실 1	항우연		P-50	최지은	충남대
	P-18	강금실 2	항우연		P-51	손종대	천문연
	P-19	권경진	항우연		P-52	윤도현, 김태웅, 이홍영	충북과학고
	P-20	김고은	항우연		P-53	김선정	경희대
	P-21	김영윤	항우연		P-54	박은수	천문연
	P-22	박종석	항우연		P-55	이재원	경희대
	P-23	박종억	항우연		P-56	신승헌	경희대
	P-24	서기훈	항우연		P-57	김영재	경희대
	P-25	연정흠	항우연		P-58	윤준무	경희대
	P-26	이도경	항우연		P-59	이하림	경희대
	P-27	이재승	항우연		P-60	김보경	충남대
	P-28	이종태	항우연		P-61	윤종연	우주청
	P-29	정찬구	KAI		P-62	최규철	에스이랩
	P-30	최재동	항우연		P-63	이재욱	천문연
우주정책	P-31	이서림	항우연		P-64	함영배	극지연
우주천문	P-32	강준원	세종대		P-65	Hoang Ngoc Huy Nguyen	KASI
	P-33	김성은	경희대				

우주과학회 ‘24 가을 학술대회 우주정책포럼

우리나라는 2024년 5월 우주항공청을 설립하고, 미래 ‘5대 우주강국’ 도약을 목표로 힘찬 발걸음을 시작하고 있습니다. 제4차 우주개발진흥 기본계획은 우주탐사를 “우주 개척의 항로”로서 “우주탐사를 통해 세계 기술패권 경쟁시대에 우위를 점할 새로운 지식 창출 및 기술역량 확보로 우주경제의 새로운 영역을 개척하고 선도”한다는 목표를 선언하고 있습니다. 우주항공청은 이를 위해 우주탐사 로드맵, 달 착륙선 탑재체/이동기술, 지속 가능한 달 탐사, 우주분야 국제협력 전략 등 우주탐사 분야의 다양한 연구 사업들을 진행 중에 있습니다. 이에, 한국우주과학회 2024년 가을학술대회 우주정책포럼에서는 “대한민국 미래 우주탐사”를 주제로 현재 우주항공청에서 진행 중인 주요 연구들을 한 자리에 모아 공유하고 모든 학회 회원들과 토론하는 시간을 갖습니다. 이번 우주정책포럼은 우주항공청/한국우주과학회/한국항공우주학회 공동주최, 한국천문연구원/한국항공우주연구원의 공동후원으로 개최합니다.

- **제목:** 대한민국 미래 우주탐사
- **주최:** 우주항공청, 한국우주과학회, 한국항공우주학회
- **후원:** 한국천문연구원, 한국항공우주연구원
- **일시/장소:** 10월 28일(월) 13:00~14:30 / 2층 스타홀
- **진행:** 권윤영(한국천문연구원)

- **발제(50분) 및 패널토론(40분):**

  류동영(우주항공청): ISECG 글로벌 우주탐사 로드맵(GER) 2024 소개
  김종립(과학기술정책연구원): 대한민국 우주탐사 로드맵 수립 기획연구
  심채경(한국천문연구원): 달 착륙선 탑재체/이동기술 기획연구
  정서영(한국항공우주연구원): 안전하고 지속 가능한 달 탐사를 위한 국제논의 대응
  신상우(한국항공우주연구원): 우주 국제협력 전략과 한 · 미 협력

2024년 한국우주과학회 추계학술대회
우주 지속가능성(Space Sustainability) 워크숍

■ **추진목적**

○ 급증하고 있는 우주활동에 필요한 분야별 전문가 의견 공유

○ 거대군집위성, 능동적 우주물체 제거, 궤도상 서비스 등 새로운 우주시대에 대응하여 필요한 정책적 · 기술적 안전조치 논의

■ **개요**

○ 일시: 2024년 10월 29일(화) 10:10~14:40

○ 장소: 사천 KB 인재니움 연수원

○ 참석: 관련 분야 산, 학, 연 전문가

■ **주요 내용**

○ 분야별 현황과 이슈 공유(90')

○ 라운드테이블(80')

○ 종합 토의(20')

■ **세부일정**

시간	순서
10:10~10:20	○ 일정 안내 ○ 인사말(우주항공청, 우주위험감시센터)
10:20~11:50	○ 분야별 현황과 이슈 공유(각 15분) - UN 장기 지속가능성 가이드라인(신상우 · 윤나영, 한국항공우주연구원) - 우주상황인식에 대한 패러다임 전환(최은정, 한국천문연구원) - 우주안전 및 장기 지속가능성 기술 연구(정옥철, 한국항공우주연구원) - 우주전파환경(윤기창 · 조정희, 우주환경센터) - 어둡고 조용한 하늘(DQS)과 군집위성: 천문학과 우주지속가능성(황나래, 한국천문연구원) - 과학기술 · 국방 목적의 우주안보와 우주 지속가능성(정영진, 국방대학교)
11:50~13:00	○ 점심식사

시간	순서
13:00~14:20	○ 라운드테이블 주제 1: (데이터 공유/교환) 안전하고 지속가능한 우주활동을 위해 필요한 공공 부문과 민간부문의 데이터 공유/교환 현황과 개선 방안(40분) - 우리나라 공공부문과 민간부문의 데이터 공유/교환 역량 - 안전하고 지속가능한 우주활동을 위해 필요한 데이터 공유/교환 요구사항 - 공공부문과 민간부문의 데이터 공유/교환 협력 방안 - 데이터 공유/교환을 위한 도전 과제와 해결을 위한 정책 방안 주제 2: (우주물체등록) 안전하고 지속가능한 우주활동을 위해 필요한 우주물체 등록 절차 현황과 개선 방안(40분) - 국내 우주물체 등록절차 현황과 도전 과제 - 민간부문의 우주물체 등록 참여 촉진을 위한 인센티브와 규제 - 미등록 우주물체로 발생가능한 문제와 해결하기 위한 정책 방안 〈기본 규칙〉 - 모든 참석자는 발언권을 신청하고 발언함 - 참석자 간 질의응답을 적극 권장하며, 발언은 논의 주제에 한정함 - 토론의 주요 내용은 보고서로 작성하며, 개인 이름은 명시하지 않음
14:20~14:40	○ 종합 토의

우주분야 여성인력 조사 결과 공유 토론회 개최

■ **개요**

○ 목적: 유엔우주국(UNOOSA)에서 실시한 글로벌 우주분야 여성 참여 현황 조사 및 국내 우주분야 종사자를 대상으로 조사한 우주분야 젠더장벽 인식조사 결과 공유 및 토론

○ 주최 / 주관: 천문연구원 여성협의회, 항공우주연구원 여성협의회

○ 일시 / 장소: 2024년 10월 29일(화) / 11:55~12:55 / 403호

※ 점심(샌드위치) 제공

■ **개최 계획**

(사회: 이우경)

시간	내용	비고
11:55~12:00	- 인사말(천문연 및 항우연 여협) - 우주과학회 다양성위원회 소개	이우경/임조령
12:00~12:05	- UN 글로벌 우주분야 여성 참여 현황 조사 결과 소개	정서영
12:05~12:30	- 우주분야 젠더장벽 인식조사 결과	
12:30~12:50	- 토론(참가자 전체 참여)	임석희(진행)
12:50~12:55	- 마무리 및 단체 사진	

구두발표 논문 제목 및 시간표

10월 28일(월)

2층 스타홀

11:20 [IS-1]

KASA 임무본부의 추진방향

John Lee

우주항공청

201호

14:50 [I-1-1]

Nature of Switchbacks surrounding a Compact Series of Small-Scale Magnetic Flux Ropes Close to the Sun observed by Parker Solar Probe

Dae-Young Lee[1], Kyungeun Choi[2]

[1]*Chungbuk National University*
[2]*Space Sciences Laboratory, UC-Berkeley*

15:05 [I-1-2]

Temporal and Spatial Evolution of Cold Ions in the Inner Magnetosphere during Large Geomagnetic Storms

Khan-Hyuk Kim, Junhyun Lee

Kyung Hee University

15:20 [I-1-3]

Observations for the 2024 May Extreame Geomagnetic Storm(G5) Event in Korean Peninsula

Jong-Yeon Yun, Jae-Hyung Lee, JaeHun Kim, Ji-Hoon Ha, Sang Cheol Han, Wonhyeong Yi

Korea AeroSpace Administration, Korea Space Weather Center

15:35 [I-1-4]

Comparison of Electron Flux over Two Years from Particle Detectros: GK2A KSEM and GOES-16 MPS-HI

Daehyeon Oh[1], Jiyoung Kim[1], Paul T. M. Loto'aniu[2,3], Han-Cheol Lim[1], Dae-Young Lee[4], Dohyeong Kim[1]

[1]*National Meteorological Satellite Center, Korea Meteorological Administration*
[2]*Cooperative Institute for Research in Environmental Sciences, University of Colorado Boulder*
[3]*National Centers for Environmental Information, National Oceanic and Atmospheric Administration*
[4]*Chungbuk National University*

15:50 [I-1-5]

Impacts of Uncertainty of Solar and Magnetospheric Forcing in Effects of Lower-Atmospheric Forcing on the IT System

Jiwoo Kim[1], In-Sun Song[1], Wonseok Lee[2,3], Ja Soon Shim[2,4], Nicholas M. Pedatella[5,6]

[1]*Department of Atmospheric Sciences, Yonsei University*
[2]*NASA Goddard Space Flight Center, Greenbelt, MD 20771, USA*
[3]*Department of Physics, Catholic University of America, Washington, DC 20064, USA*
[4]*Science and Technology Institute, Universities Space Research Association, Huntsville, AL 35805, USA*
[5]*NSF National Center for Atmospheric Research, High Altitude Observatory, Boulder, CO 80301, USA*
[6]*COSMIC Program Office, University Center for Atmospheric Research, Boulder, CO 80307, USA*

16:05 [I-1-6]

Statistical Analysis and Understanding of the 29 June 2013 Flux Dropout Event

So-Yeon Lee, Jun-Hyun Lee

School of Space Research, Kyung Hee University

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14:50 [I-2-1]

Considerations for Satellite Orbit Operations during Solar Maximum

Hongrae Kim, Juyoung Lee, In-Young Hwang, Kyung-su Na

Agency of Defense Development

15:05 [I-2-2]

Dark and Quiet Skies: Astronomy and Large

Satellite Constellations

Narae Hwang[1,2]

[1]*Korea Astronomy and Space Science Institute*
[2]*IAU Center for the Protection of Dark and Quiet Sky*

15:20 [I-2-3]

Modeling and Simulation for Efficient Space Situational Awareness

Seo-Eun Lee[1], Hoyoung Hwang[2], Yong-Ik Byun[1]

[1]*Department of Astronomy, Yonsei University*
[2]*YSPACE Co., Ltd*

15:35 [I-2-4]

Development of Korean 3D Cell Model for Space Debris Environment Analysis

Jaewoo Kim[1], Jinsung Lee[1], Eun Jung Choi[2], Jin Choi[2], Jiwoong Yu[2], Junghyun Jo[2], Jaemyung Ahn[1]

[1]*Korea Advanced Institute of Science and Technology*
[2]*Korea Astronomy and Space Science Institute*

15:50 [I-2-5]

Development of a NSOS-Beta (Near Space Optical Survey-Beta): Progress Report

Jin Choi, Jung Hyun Jo, Hong-Suh Yim, Dong-Goo Roh, Myung-Jin Kim, Yunhak Kim, Ki-Pyoung Sung, Jang-Hyun Park, Jaemann Kyeong, Sungki Cho, Eun-Jung Choi, Jiwoong Yu, Seong-Yeol Yu, YeonGil Jung, Wookyung Lee, Hong-Kyu Moon, Min-Jung Kim

Korea Astronomy and Space Science Institute

16:05 [I-2-6]

Observation of the Close Approaching Asteroid 2024 MK using OWL-Net

Hee-Jae Lee, Myung-Jin Kim, Hong-Suh Yim, Dong-Goo Roh, Jin Choi, Jang-Hyun Park, Young-Sik Park, Jung Hyun Jo, Jaemann Kyeong, Jiwoong Yu, Hong-Kyu Moon, Yoon-Ho Park, Sungki Cho, Eun-Jung Choi

Korea Astronomy and Space Science Institute

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14:50 [I-3-1]

Development Plan for the Army's Space Policy and Manned Lunar Base Construction

Joon-Wang Lee

Republic of Korea Army HQ

15:05 [I-3-2]

How to Use Low-Orbit Satellite Images Efficiently for Military Use

Young-Joon Jung, Ho-Sung Choi

Republic of Korea Army HQ

15:20 [I-3-3]

Analysis of Space Warfare in the Era of Future Intelligentized Warfare: Focusing of Alternative Futures Method

Woo-seok Lee

Korea National Defense University

15:35 [I-3-4]

Characteristics of Shear Coaxial Injectors Applicable to Methane Reusable Launch Vehicle

Dong Ho Yun1, Hyeon Taek Jo2, Youngbin Yoon3,4

[1]*Korea Army Academy at Yeongcheon*
[2]*Korea Aerospace Research Institute*
[3]*Korea AeroSpace Administration*
[4]*Seoul National University, Korea*

15:50 [I-3-5]

An Analysis on Space Threat and Mitigation

Hyun Joo Choi, Hong Rae Kim, Kang Hee Lim

Agency for Defense Development

16:40 [II-3-1]

A Study on the Role and Operational Strategies of SLR in Space Security

Mannsoo Choi[1], Ki-Pyung Sung[1], Sung-Yeol Yu[1], Hyung-Chul Lim[1], Jong-Uk Park[1], Seok-Min Song[1,2]

[1]*Korea Astronomy and Space Science Institute*
[2]*Chungnam National University*

16:55 [II-3-2]

Round-Based Space Active Protection Technology

Sangwoong Min[1], HeeSun Noh[1], Ji-In Kim[1], Sangyeong Park[1], Sihyun Kim[1], Youngsoo Kim[2], Mansoo Choi[3], Myungwon Shin[4]

[1]*Hanwha Systems, Electro Optics System 4 Team*
[2]*Hanwha Systems*
[3]*Korea Astronomy and Space Science Institute*
[4]*Korea Research Institute for Defense Technology Planning and Advancement*

17:10 [II-3-3]

LEO Satellite-Based Communication Systems

Youjean Lee

Hanwha Systems Space Business Team

17:25 [II-3-4]

A Study on the Starlink Loss in 2022 and Indigenous Satellites Damage Cases due to the Space Environment Changes in 2024

Seonghwan Choi

Aerospace Business Division, Hanwha Systems

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14:50 [I-4-1]

Inclination-Cranking Multiple Mars Gravity-Assist to Sun-Earth L4

Jinsung Lee[1], Daniel J. Scheeres[2], Sang-Hyun Lee[1], Jaemyung Ahn[3]

[1]*Satellite Technology Research Center, KAIST*
[2]*Satellite University of Colorado, Boulder*
[3]*Korea Advanced Institute of Science and Technology*

15:05 [I-4-2]

Shape-Based Low-Thrust Asteroid Approaching Trajectory Design considering Optical Navigation Observability

Pureum Kim, Sang-Young Park

Yonsei University

15:20 [I-4-3]

A Study on the Variation of Vertical Distribution of Physical and Chemical Properties of Upper Atmosphere in the Region of Upper Mesosphere and Lower Thermosphere (100-300 km)

Gi-Hyuk Choi, Dae-Yeoung Kim, Joo-hee Lee

Korea Aerospace Research Institute

15:35 [I-4-4]

Expanding the Boundaries of Ceramic Art: The Creation of Moon Jars using Lunar Regolith Simulant

Hyoji Kim

Ceramic Artist and Researcher

15:50 [I-4-5]

Investigating the Influence of Grain Size on Spectral and Polarimetric Data of Apollo Lunar Soils

Eunjin Cho[1], Minsup Jeong[2], Chae Kyung Sim[2,3], Serin Kim[2,3], David Trang[4], Young-Jun Choi[2], Shuai Li[4], Sungsoo S. Kim[5], Yu Yi[1]

[1]*Chungnam National University*
[2]*Korea Astronomy and Space Science Institute*
[3]*Korea National University of Science and Technology*
[4]*University of Hawaii at Manoa*
[5]*Kyung Hee University*

16:05 [I-4-6]

Investigation of the Noise Correlation between the Inboard and Outboard Sensors of KMAG

Yesun Ahn, Ho Jin, Wooin Jo, Hyeonhu Park, Khan-Hyuk Kim

School of Space Research, Kyung Hee University

16:20 [I-4-7]

Analysis of Polarimetric Properties of the Reiner Gamma Swirl using Data from PolCam

Minsup Jeong[1], Young-Jun Choi[1], Sungsoo Kim[2], Kilho Baek[2], Bongkon Mon[1], Chae Kyung Sim[1], Dukhang Lee[1], Eunjin Cho[3], Serin Kim[1]

[1]*Korea Astronomy and Space Science Institute*
[2]*Kyung Hee University*
[3]*Chungnam National University*

16:35 [I-4-8]

Long-Term Monitoring of Lunar Terrain Imager

on-board Korea Pathfinder Lunar Orbiter

Eunhyeuk Kim

Korea Aerospace Research Institute (KARI)

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14:50 [I-5-1]

What Kinds of Problems in Space Science are Well Solved by Deep Learning?

Yong-Jae Moon[1,2]

[1]*School of Space Research, Kyung Hee University*
[2]*Department of Astronomy and Space Science, Kyung Hee University*

15:05 [I-5-2]

Applications of AI-Based Image Enhancement Techniques in Astronomy

Eunsu Park, SpaceAI Team

Korea Astronomy and Space Science Institute

15:20 [I-5-3]

SpaceAI 2024: Progress and Future Prospects

Sung-Hong Park[1], Seonghwan Choi[1], Jihye Baek[1], Eunsu Park[1], Jeong-Heon Kim[1], Hwanhee Lee[1], Roksoon Kim[1], Jongyeob Park[1], Yong-Jae Moon[2], Harim Lim[2], Chanwoo Kim[3], Taeyoung Kim[4]

[1]*Korea Astronomy and Space Science Institute*
[2]*Kyung Hee University*
[3]*KAIST SW Education Center*
[4]*AIFactory*

15:35 [I-5-4]

SpaceAI 2024 Citizen Scientist Track: 1st Astronomy & Space AI Competition

Jeong-Heon Kim[1], Sung-Hong Park[1,2], Jihye Baek[1], Seonghwan Choi1, Eunsu Park[1], Hwanhee Lee[1], Roksoon Kim[1], Jongyeob Park[1], Chanwoo Kim[3], Seungdo Lee[4], Suwoon Lee[5]

[1]*Korea Astronomy and Space Science Institute*
[2]*University of Science and Technology*
[3]*KAIST SW Education Center*
[4]*Elice Inc.*
[5]*Innowithus Inc.*

15:50 [I-5-5]

Preliminary Results of Auroral Recognition Procedure by using Deep Learning Technique in All-Sky Auroral Image Data

Yujin Cho[1,2], Geonhwa Jee[1,2], Mingyu Jeon[3], Hyuck-Jin Kwon[1], Ji Eun Kim[1], Young-Bae Ham[1,2], Changsup Lee[1,2], Ji-Hye Baek[4]

[1]*Korea Astronomy and Space Science Institute*
[2]*University of Science and Technology*
[3]*School of Space Research, Kyung Hee University*
[4]*Korea Astronomy and Space Science Institute*

16:05 [I-5-6]

AI-Based Telescope Alignment Simulation for K-DRIFT Pathfinder

Seonwoo Kim[1,2], Yunjong Kim[1,2], Youngwoo Cho[3], Jaewon Lee[4], Seonghwan Choi[1], JIhun Kim[1,2], Kyohoon Ahn[1], Se-Heon Jeong[1], Heuisung Cho[5], Hyuntaek Choi[6], Jongwan Ko[1,2]

[1]*Korea Astronomy and Space Science Institute*
[2]*University of Science and Technology*
[3]*KAIST Kim Jaechul Graduate School of AI*
[4]*School of Space Research, Kyung Hee University*
[5]*Radiant Solution*
[6]*Ansys Korea*

16:20 [I-5-7]

Preliminary Results on Aurora Identification from e-POP/FAI Images using Deep Learning

Se Rin Jeon[1], Junmu Youn[2], Woong Jeon[2,3], Se-Heon Jeong[3], Jeong-Heon Kim[3], Woo Kyoung Lee[3,4], Hyosub Kil[5]

[1]*Department of Geological Sciences, Chungnam University*
[2]*School of Space Research, Kyung Hee University*
[3]*Korea Astronomy and Space Science Institute*
[4]*University of Science and Technology*
[5]*The Johns Hopkins University Applied Physics Laboratory*

10월 29일(화)

2층 스타홀

08:30 [IS-2]

Plasma Waves and Particle Analysis of Juno Mission

Peter H. Yoon

Institute for Physical Science and Technology, University of Maryland, College Park, USA

09:00 [IS-3]

Global Space Industry Investment Trends and 'Company K-New Space Fund'

Kang-Soo Lee

Company K Partners

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10:20 [III-1-1]

Overview of the "Solar and Space Storms" Session

Young-Sil Kwak[1,2]

[1]*Korea Astronomy and Space Science Institute*
[2]*University of Science and Technology*

10:35 [III-1-2]

Observational Overview of Solar Sources for the May 2024 G5-Level Geomagnetic Storm

Sujin Kim[1], Sung-Hong Park[1,2], Eun-Kyung Lim[1], Hwanhee Lee[1], Ji-Hyun Yoo[1,3], Haein Lee[1,3], Ryun-Young Kwon[1], Jungjoon Seough[1], Rok-Soon Kim[1], Hannah Kwak[1], Yeon-Han Kim[1], Kyung-Suk Cho[1], Young-Sil Kwak[1,2], KASI Space Weather Research Group

[1]*Korea Astronomy and Space Science Institute*
[2]*University of Science and Technology*
[3]*Chungbuk National University*

10:50 [III-1-3]

Magnetospheric Response to Superstorms

Yukinaga Miyashita[1,2]

[1]*Korea Astronomy and Space Science Institute*
[2]*University of Science and Technology*

11:05 [III-1-4]

Unusual Ionospheric Disturbances over Korea during the Geomagnetic Storm of May 10-12, 2024

Woo Kyoung Lee[1,2], Hyosub Kil[3], Byung-Kyu Choi[1], Juneseok Hong[1], Se Heon Jeong[1], Jeong-Heon Kim[1]

[1]*Korea Astronomy and Space Science Institute*
[2]*University of Science and Technology*
[3]*Johns Hopkins University Applied Physics Laboratory*

11:20 [III-1-5]

Ionospheric and Thermospheric Responses during a May 2024 G5-Level Geomagnetic Storm for East Asian Sector and Global Perspective

Jeong-Heon Kim[1], Young-Sil Kwak[1,2], Tae-Yong Yang[1], Jongil Jung[1], Hosik Kam[1], Jaewook Lee[1], Woo Kyoung Lee[1,2]

[1]*Korea Astronomy and Space Science Institute*
[2]*University of Science and Technology*

11:35 [III-1-6]

Strong Solar Activity of May 2024 Recorded on Cosmic Ray Neutron Monitor

Jongil Jung[1], Suyeon Oh[2], Young-Sil Kwak[1,3], Jongdae Sohn[1], Yu Yi[4], Geonhwa Jee[5], Yong-Kyun Kim[6]

[1]*Korea Astronomy and Space Science Institute*
[2]*Chonnam National University*
[3]*University of Science and Technology*
[4]*Chungnam National University*
[5]*Korea Polar Research Institute*
[6]*Hanyang University*

13:00 [IV-1-1]

Six-Hour Prediction of Southward Interplanetary Magnetic Field Bz using Deep Learning

Jihyeon Son[1], Yong-Jae Moon[1,2], Young-Sil Kwak[3], Kyung Sun Park[4], Hyun-Jin Jeong[1]

[1]*Department of Astronomy and Space Science, Kyung Hee University*
[2]*School of Space Research, Kyung Hee University*
[3]*Space Science Division, Korea Astronomy and Space Science Institute*
[4]*Department of Astronomy and Space Science/Basic Science Research Institute, Chungbuk National University*

13:15 [IV-1-2]

Understanding CME-CME Interactions and Their Impact on the May 2024 Geomagnetic Storm

Roksoon Kim[1], Jasmina Magdalenic[2,3], Brigitte Schmieder[3,4], Stefaan Poedts[3,5]

[1]*Korea Astronomy and Space Science Institute*

[2]*Royal Observatory of Belgium*
[3]*Katholieke Universiteit Leuven*
[4]*Observatoire de Paris*
[5]*University of Marie Curie-Sklodowska*

13:30 [Ⅳ-1-3]

Solar Energetic Protons as Indicators of Geomagneic Storms

Ryun Young Kwon, Hwanhee Lee, Ji-Hyeon Yoo, Haein Lee

Korea Astronomy and Space Science Institute

13:45 [Ⅳ-1-4]

Why do We still Need to Understand Severe Storm Event using a Global MHD Simulation?

Kyung Sun Park

Chungbuk National University

14:00 [Ⅳ-1-5]

The Impact of Lower Atmosphere Forecast Uncertainties on WACCM-X Prediction of Ionosphere-Thermosphere System during Geomagnetic Storms

In-Sun Song[1], Wonseok Lee[2], Ja Soon Shim[2], Guiping Liu[2], Geonhwa Jee[3]

[1]*Yonsei University*
[2]*NASA Goddard Space Flight Center*
[3]*Korea Polar Research Institute*

14:15 [Ⅳ-1-6]

Polar Middle Atmosphere Responses to the G5-Level Geomagnetic Storm of May 2024

Ji-Hee Lee[1], Geonhwa Jee[1,2], Young-Sil Kwak[3,4]

[1]*Korea Polar Research Institute*
[2]*Department of Polar Science, Korea University of Science and Technology*
[3]*Korea Astronomy and Space Science Institute*
[4]*Department of Astronomy and Space Science, Korea University of Science and Technology*

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10:20 [Ⅲ-3-1]

Analysis of SWARM Satellite Data for Energetic Electron Flux Enhancement induced by NWC Transmitter

Ho-Sung Choi[1], Jaeheung Park[2]

[1]*Republic of Korea Army*
[2]*Korea Astronomy and Space Science Institute*

10:35 [Ⅲ-3-2]

The Utilization and Application of Ionospheric Data Assimilation Model from a Space Security Perspective

Jeong-Heon Kim[1], Se-Heon Jeong[1], Young-Sil Kwak[1,2], Jong-Kyun Chung[1]

[1]*Korea Astronomy and Space Science Institute*
[2]*University of Science and Technology*

10:50 [Ⅲ-3-3]

Severe GNSS Signal Disturbances over Korean Peninsula during Geomagnetic Storm

Junseok Hong[1], Byung-Kyu Choi[1], Jong-Kyun Chung[1], Woo Kyoung Lee[1], Hyosub Kil[2], Hyuck-Jin Kwon[3]

[1]*Korea Astronomy and Space Science Institute*
[2]*Johns Hopkins University Applied Physics Laboratory*
[3]*Korea Polar Research Institute*

11:05 [Ⅲ-3-4]

An Innovative CubeSat Platform for Earth Observation

Goo-Hwan Shin[1], Im-Hyu Shin[1], Il-Young Jang[1], Won-Ho Cha[1], Seung-Jun Cha[1], Chan-Goo Han[1], Mina Koo[1], Yongjun Park[2], Jaehun Jang[2], Jeongin Yun[2], Hyeongcheol Kim[2], Jeongwoo Ahn[2], Hyogeun Han[2], Hyosang Yoon[2], Bong-Kon Moon[3], Dae-Hee Lee[3], Jae-Jin Lee[3], Soojong Pak[4], Gun-Hee Kim[5], Kyung-Su Na[6], In-Young Hwang[6]

[1]*Satellite Technology Research Center, KAIST*
[2]*Spacecraft Prototyping Laboratory, KAIST*
[3]*Korea Astronomy and Space Science Institute, KASI*
[4]*Kyung Hee University*
[5]*Hanbat National University*
[6]*Agency for Defense Development*

11:20 [Ⅲ-3-5]

Progress Report: SNIPE in 2024

Jaeheung Park[1], Hosub Song[1], Jae-Jin Lee[1], Jongdae Sohn[1], Tae-Yong Yang[1],

Young-Joon Jung[1,2], Youngbum Song[1],
Ki Hwan Keum[1]

[1]*Korea Astronomy and Space Science Institute (KASI)*
[2]*Republic of Korea Army (ROKA)*

13:00 [Ⅳ-3-1]

Current Status and Future Plans of KASI's Adaptive Optics

Seonghwan Choi, Jihun Kim, and Kyohoon Ahn,
Ji-Hye Baek, Eunsu Park and Yunjong Kim

Korea Astronomy and Space Science Institute

13:15 [Ⅳ-3-2]

Developing an Additive Manufacturing Engine for Reusable Launch Vehicles

Keum-Oh Lee[1], Hyeonjun Kim[1], Jaesung Shin[1],
Yong-Oh Noh[2]

[1]*Korea Aerospace Research Institute*
[2]*Vitzronextech*

13:30 [Ⅳ-3-3]

Development of a Propulsion System Lineup for Realizing Korea's Sovereign Space Exploration Missions

Dongyoon Shin, Eunkwang Lee, Seonghyeon Seo

Perigee Aerospace Inc

13:45 [Ⅳ-3-4]

Small SAR Satellites Constellation as a Dual-Use Technology, and Its Tactical Application

Wanki Jun

ICEYE Oy

14:00 [Ⅳ-3-5]

42 Talks: Real-Time Collision Avoidance Negotiation Platform for Satellites by SpaceMap

Douglas DS Kim[1,2,3], Shawn Choi[1,2], Junny Joo[1],
Yusang Lee[1,4], Alan Lee[1], Peter Ryu[1,2]

[1]*SPACEMAP Inc.*
[2]*Voronoi Diagram Research Center, Hanyang University*
[3]*School of Mechanical Engineering, Hanyang University*
[4]*Department of Computer Science, Hanyang University*

14:15 [Ⅳ-3-6]

Development Trends of Reusable Space Launch Vehicle

Jeawhan Lee

Republic of Korea Army HQ

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10:35 [Ⅲ-4-1]

Analysis of Public Communication Status of Domestic and Foreign Space Agencies

Haeim Jeong[1], Dongmin Jeong[1], Hyeonju Kim[2],
Eunji Yi[1,3]

[1]*Korea Astronomy and Space science Institute*
[2]*Korea Aerospace Research Institute*
[3]*University of Science and Technology*

10:50 [Ⅲ-4-2]

Easy Access to Space Exploration: Open Opportunity in Space Development

SeokHee Lim

Korea Aerospace Research Institute

11:05 [Ⅲ-4-3]

Public Engagement in the Era of Space Exploration: A Case Study of Public-Private Collaboration in Youth Programs

Sung-chan Roh

Science and Technology Communication Team, KOSAC

13:00 [Ⅳ-4-1]

Science Instruments for the Lunar Surface in Collaboration with NASA's Artemis/CLPS Initiative

Chae Kyung Sim[1,2], Young-Jun Choi[1], Dukhang Lee[1],
Seul-Min Baek[1], Jehyuck Shin[1], Woohyeong Seol[1],
Jongho Seon[3], Minsup Jeong[1], Ho Jin[3],
Sung-Joon Ye[4]

[1]*Korea Astronomy and Space Science Institute*
[2]*Korea National University of Science and Technology*
[3]*Kyung Hee University*
[4]*Seoul National University*

13:15 [Ⅳ-4-2]

Calculation Process and Results of Deriving Level-1 Flux using the Forward-Fitting Method in

LUSEM

Woo-Hyeong Seol[1], Jongho Seon[2], Go Woon Na[2], Young-Jun Choi[1], Chae Kyung Sim[1,3], Seul-Min Baek[1], Dukhang Lee[1], Jehyuck Shin[1]

[1]*Korea Astronomy and Space Science Institute*
[2]*School of Space Research, Kyung Hee University*
[3]*Korea National University of Science and Technology*

13:30 [Ⅳ-4-3]

The Development of Lunar Surface MAGnetometer (LSMAG) Instrument

Hyeonhu Park[1], Ho Jin[1], Juhyeong Kim[1], Khan-Hyuk Kim[1], Seungmin Lee[1], Hyojeong Lee[2], Seongwhan Lee[2], Seul-Min Baek[3], Jehyuck Shin[3], Chae Kyung Sim[3], Dukhang Lee[3], Young-Jun Choi[3,4]

[1]*School of Space Research, Kyung Hee University*
[2]*NARA Space Technology*
[3]*Korea Astronomy and Space Science Institute*
[4]*Korea National University of Sceince and Technology*

13:45 [Ⅳ-4-4]

Measurement and Calibration of the LVRAD Advanced Particle Dosimeter and Spectrometer (APDS) for the Charged Particle Environment on the Lunar Surface

Sukwon Youn[1], Uk-won Nam[2], Sunghwan Kim[3], Hongjoo Kim[4], Hwanbae Park[4], Won-Kee Park[2], Jongdae Sohn[2], Chae Kyung Sim[2], Dukhang Lee[2], Seul-Min Baek[2], Jehyuck Shin[2], Woo-Hyeong Seol[2], Young-Jun Choi[2], Insoo Jun[5], Sung-Joon Ye[1]

[1]*Seoul National University*
[2]*Korea Astronomy and Space Science Institute*
[3]*Cheongju University*
[4]*Kyungpook National University*
[5]*Jet Propulsion Laboratory*

14:00 [Ⅳ-4-5]

Design and Performance of Neutron Sensor on the Lunar Surface

Uk-Won Nam[1], Sukwon Youn[2], Sunghwan Kim[3], Hongjoo Kim[4], Won-Kee Park[2], Jongdae Sohn[2], Chae Kyung Sim[2], Dukhang Lee[2], Seul-Min Baek[2], Jehyuck Shin[2], Woo-Hyeong Seol[1], Young-Jun Choi[2], Insoo Jun[5], Sung-Joon Ye[2]

[1]*Korea Astronomy and Space Science Institute*
[2]*Seoul National University*
[3]*Cheongju University*
[4]*Kyungpook National University*
[5]*Jet Propulsion Laboratory*

14:15 [Ⅳ-4-6]

Light Scattering Properties of Lunar Simulant JSC-1A depending on Its Microstructure

Minsup Jeong[1], Jinkyu Kim[2], Sungsoo S. Kim[2], Yuong-Jun Choi[1]

[1]*Korea Astronomy and Space Science Institute*
[2]*Kyung Hee University*

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13:00 [Ⅳ-5-1]

Feasibility Study for Next-Generation Spectroscopic Surveys with Dedicated Large Telescopes: Science Goals

Sungwook E. Hong[1,2], Jae-Woo Kim[1], Arman Shafieloo[1,2], Sang-Hyun Chun[1], Soung-Chul Yang[1], Jubee Sohn[3], Ho Seong Hwang[3], David Parkinson[1,2], Changbom Park[4]

[1]*Korea Astronomy and Space Science Institute*
[2]*Astronomy Campus, University of Science and Technology*
[3]*Seoul National University*
[4]*Korea Institute for Advanced Study*

13:15 [Ⅳ-5-2]

Current Status of Working Group for Conceptual Study of a Spectroscopic Survey Telescope

Jeong-Yeol Han[1,2], Jiwoo Lee[1,2], Jaehyun Kyeong[3], Hyoungkwon Lee[3], Chung-Uk Lee[1], Jae-Woo Kim[1], Byeong Gon Park[1], Yunjong Kim[1,2], Sungwook E. Hong[1,2], Junghun Yoo[4], Youngsoo Kim[5], Sangyoung Park[5], Jung-Hwan In[6], Young-Man Choi[7], Il Kweon Moon[8]

[1]*Korea Astronomy and Space Science Institute*
[2]*Korea National University of Science and Technology*
[3]*Leo Space Co., Ltd*
[4]*Green Optics Co., Ltd.*
[5]*Hanwha System Co., Ltd.*
[6]*Korea Photonics Technology Institute*
[7]*Ajou University*
[8]*Korea Research Institute of Standards and Science*

13:30 [Ⅳ-5-3]

Current Status of Low Thermal Expansion Materials for Space Optics: Large Diameter Mirrors

Ju Hyeon Choi, Seon Hoon Kim, Karam Han, Jung-Hwan In

Optical Lens Material Research Center, Korea Photonics Technology Institute

13:45 [Ⅳ-5-4]

Current Status of the Development of a Robotic Fiber Positioner System for Multi-Object Spectroscopic Telescopes

Hyunho Lim[1], Ho Seong Hwang[2], Jae-Woo Kim[3], Sungwook E. Hong[3], Jong Chul Lee[3], Young-Man Choi[1]

[1]*Ajou University*
[2]*Seoul National University*
[3]*Korea Astronomy and Space Science Institute*

10월 30일(수)

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08:30 [V-1-1]

Long-Term Characteristics of the Mesopause Wind observed from Meteor Radar at King Sejong Station, Antarctica and Comparison with SD-WACCM-X Simulations

Byeong-Gwon Song[1], In-Sun Song[1], Nicholas M. Pedatella[2,3]

[1]*Department of Atmospheric Sciences, Yonsei University*
[2]*NSF National Center for Atmospheric Research, High Altitude Observatory*
[3]*COSMIC Program Office, University Center for Atmospheric Research*

08:45 [V-1-2]

Long-Term Observations of Thermospheric Winds near the Southern Polar Cap Boundary

Eunsol Kim[1], Geonhwa Jee[1,2], Young-Bae Ham[1,2], Changsup Lee[1,2]

[1]*Korea Polar Research Institute*
[2]*University of Science and Technology*

09:00 [V-1-3]

Comparison of Electron Phase Space Densities measured with GK2A, GOES-16, and GOES-17

Chanhaeng Lee[1], Woohyeong Seol[1], Seonghwan Choi[1], Jongho Seon[2], Khan-Hyuk Kim[2], Dae-Young Lee[3]

[1]*Korea Astronomy and Space Science Institute*
[2]*School of Space Research, Kyung Hee University*
[3]*Department of Astronomy and Space Science, Chungbuk National University*

09:15 [V-1-4]

Correlations between the Waiting Time of C-Class Flares and the Strength of X-Class Flares

Il-Hyun Cho, Yong-Jae Moon, Kangwoo Yi, Jaewon Lee

Kyung Hee University

09:30 [V-1-5]

Real-Time Reconstruction of Solar Coronal Magnetic Fields using Physics-Informed Neural Operator

Mingyu Jeon[1], Hyun-Jin Jeong[2], Yong-Jae Moon[1,2], Jihye Kang[2], Kanya Kusano[3]

[1]*School of Space Research, Kyung Hee University*
[2]*Department of Astronomy and Space Science, Kyung Hee University*
[3]*Institute for Space-Earth Environmental Research, Nagoya University*

09:45 [V-1-6]

Unsupervised Classification of Solar Full-Disk Magnetograms using UMAP Algorithm

Kangwoo Yi[1], Yong-Jae Moon[1,2], Hyun-Jin Jeong[1]

[1]*Department of Astronomy and Space Science, Kyung Hee University*
[2]*School of Space Research, Kyung Hee University*

10:20 [Ⅵ-1-1]

ATHENA Mission: Goal and Objectives

Hyosub Kil[1], Larry J. Paxton[1], Woo Kyoung Lee[2,3], Young-Sil Kwak[2,3]

[1]*Johns Hopkins University Applied Physics Laboratory*
[2]*Korea Astronomy and Space Science Institute*
[3]*University of Science and Technology*

10:35 [Ⅵ-1-2]

The Two-Banded Structure of Ion-Scale Waves

in the Solar Wind: Linear Analysis and Hybrid Simulation

Jungjoon Seough[1], Sunjung Kim[2], Hwanhee Lee[1], Sung Jun Noh[3], Peter H. Yoon[4]

[1]*Korea Astronomy and Space Science Institute*
[2]*Kyung Hee University*
[3]*Los Alamos Laboratory, USA*
[4]*University of Maryland, USA*

10:50 [VI-1-3]
Bridging Kinetic and Fluid Approaches: Momentum- and Energy-Conserving, Hybrid-PIC Simulation Code

Sunjung Kim[1], Gwangson Choe[1], Dongsu Ryu[2], Sibaek Yi[1]

[1]*Department of Astronomy and Spce Science, Kyung Hee University*
[2]*Department of Physics, School of Natural Sciences, UNIST*

11:05 [VI-1-4]
NOAA Space Weather Scale Frequencies depending on Solar Cycle

Daeil Kim[1], Yong-jae Moon[1,2], Hyun-Jin Jeong[2], Jihyeon Son[2]

[1]*School of Space Research, Kyung Hee University*
[2]*Department of Astronomy and Space Science, Kyung Hee University*

11:20 [VI-1-5]
Comparison of Empirical and Deep Learning Models for Solar Wind Speed Prediction

Seungwoo Ahn[1], Yong-Jae Moon[1,2], Jihyeon Son[1]

[1]*Department of Astronomy and Space Science, Kyung Hee University*
[2]*School of Space Research, Kyung Hee University*

11:35 [VI-1-6]
Near Real-Time Generation of Solar Coronal Parameters based on MAS Simulation using Deep Learning

Rahman Sumiaya

Kyung Hee University

305호

10:20 [VI-2-1]
Planning Study on KASI Space Telescope Projects

Woong-Seob Jeong, Yujin Yang, Jeonghyun Pyo, Bomee Lee, Youngsoo Jo, Il-Joong Kim, Jaeyeong Kim, Yongjung Kim, Seongchol Bang, Jae-Joon Lee, Jongwan Ko, Min-Su Shin, Yeon Kil Jung, Jeong-Yeol Han, Bonkon Moon, KASI Qrontier Space Telescope Team

Korea Astronomy and Space Science Institute, Korea

10:35 [VI-2-2]
Expanding Earth Observation Camera Technology for Application in Space Telescopes

Dongok Ryu

Korea Aerospace Research Institute

10:50 [VI-2-3]
SPHEREx: All Sky Spectral Survey

Yujin Yang

Korea Astronomy & Space Science Institute

11:05 [VI-2-4]
A Study for Spacecraft Attitude Control System for the Development of a Korean Space Telescope

Hyungjoo Yoon

Korea Aerospace Research Institute

402호

08:30 [V-4-1]
대학생 참여를 통한 미래세대 주도의 뉴스페이스 인재 양성

Hyunseo Cho, Myoha Yoon, Sungho Lee, Hanjun Oh

Yonsei University

08:45 [V-4-2]
우주 개발 관련 국내 대학 학생들의 활동 및 인식 현황

이성호

연세대학교 전기전자공학부

09:00 [V-4-3]
인공위성 개발에 대한 학부생들의 도전: 캔위성 프로젝트의 성과와 미래

이현

연세대학교 천문우주학과

09:15 [V-4-4]
우주를 향한 첫걸음: 모형 로켓을 통한 대학생들의 뉴스페이스 참여

오한준

연세대학교 기계공학부

10:20 [VI-4-1]
Enabling Venus Exploration using In-Space Pharmaceutical Manufacturing Technology and Nuri Launch Vehicle

Hyeonjun Kim[1], Yeon Joo Lee[2], Daeban Seo[1]

[1]*Korea Aerospace Research Institute*
[2]*Planetary Atmospheres Group (PAG), Institute for Basic Science (IBS)*

10:35 [VI-4-2]
Space Medicine Research and Manufacturing Technology Development in Low Earth Orbit

Younghoon Lee, Jinyang Chung, David Jeon, Vu Huu Pham, Hargsoon Yoon

Space LiinTech Inc.

10:50 [VI-4-3]
Introduction to In-Space Pharmaceutical Manufacturing Technology

Hyeonjun Kim, Daeban Seo

Korea Aerospace Research Institute

11:05 [VI-4-4]
CLOVE Project: Long-Term Venus Monitoring Project using LEO CubeSats to Characterize Atmospheric Variability

Yeon Joo Lee[1], Antonio Garcia Munoz[2], Young-Jun Choi[3], Harald Michaelis[4], Matthias Grott[4], Kyungin Kang[5], Bong-kon Moon[3], Emmanuel Marcq[6], Masateru Ishiguro[7], Semyeon Oh[1], Evgenij Zubko[1], Thomas Behnke[4], Christian Althaus[4], Zizung Yoon[8], Juan Cabrera[4], Heike Rauer[4], Thomas Granzer[9], Daphne Stam[10], Sebastien Lebonnois[11], Takeshi Imamura[12], Minbae Kim[1], Rommy L. S. E. Aliste Castillo[1], David Wolter[4]

[1]*Planetary Atmospheres Group (PAG), Institute for Basic Science (IBS)*
[2]*AIM, CEA, CNRS, Universit Paris-Saclay, Universite de Paris, Gif-sur-Yvette, France*
[3]*Korea Astronomy and Space Science Institute (KASI)*
[4]*DLR Institute of Planetary Research, Berlin, Germany*
[5]*SaTReC, KAIST*
[6]*LATMOS/IPSL, UVSQ Universite Paris-Saclay, Sorbonne Universite, CNRS, Guyancourt, France*
[7]*Seoul National University*
[8]*Korea Aerospace University*
[9]*Leibniz-Institute for Astrophysics Potsdam (AIP), Potsdam, Germany*
[10]*Private, Netherlands*
[11]*LMD/IPSL, CNRS, Paris, France*
[12]*Graduate School of Frontier Sciences, The University of Tokyo, Kashiwa, Japan*

11:20 [VI-4-5]
Venus Exploration: Scientific Perspectives

Yeon Joo Lee[1], Hyeonjun Kim[2]

[1]*Planetary Atmospheres Group (PAG), Institute for Basic Science (IBS)*
[2]*Korea Aerospace Research Institute (KARI)*

404호

08:30 [V-5-1]
A Study on Astronomer Song I-Yeong of the 17th Century

Sang Hyuk Kim[1], Byeong-Hee Mihn[1,2,3]

[1]*Korea Astronomy and Space Science Institute*
[2]*University of Science and Technology*
[3]*Chungbuk National University*

08:45 [V-5-2]
Astronomical Records in the Goguryeo Annals: An Investigation of the Goguryeo-Sacho (高句麗史抄) and Goguryeo-Saryak (高句麗史略)

Byeong-Hee Mihn[1,2,3], Ki-Won Lee[4]

[1]*Korea Astronomy and Space Science Institute*

[2]*University of Science and Technology*
[3]*Chungbuk National University*
[4]*Daegu Catholic University*

09:00 [V-5-3]

Airborne Experiment of PolCube Polarimetric Camera System

Won-Kee Park[1], Bongkon Moon[1,2], Woojin Kim[1,2], Minseop Jeong[1], Daehee Lee[1,3], Young-Jun Choi[1,2], Chang-Han Kang[4], Jung Sub Byun[4], Eunkyung Kim[5]

[1]*Korea Astronomy and Space Science Institute*
[2]*University of Science and Technology*
[3]*Korea Advanced Institute of Science and Technology*
[4]*Busan Techno Park*
[5]*Busan Metropolitan City*

09:15 [V-5-4]

Design and Analysis of Earth Observation Optical Camera for Low Earth Orbit CubeSat

Seungwon Jang[1,2], Jaehyeon Kyeong[1], Youra Jun[1], Hyoungkwon Lee[1], Taeseok Yang[1], Namhee Kim[1]

[1]*LeO SPACE Inc.*
[2]*Hanbat National University*

10:20 [VI-5-1]

Introduction of Verification Method and Result of CAS500-4 (Compact Advanced Satellite500-4) ETB (Electrical Test Bed)

Hyoungjae Oh, Jaehwee Doh, Jongjin Jang

Korea Aerospace Industries, Ltd.

10:35 [VI-5-2]

Development of Educational Newtonian Reflective Telescope using Additive Manufacturing

Subin Kim[1], Seeun Lee[1], Nagyung Ko[2], Minseo Jung[3], Heejung Yu[1], Dohoon Kim[1], Soojong Pak[1]

[1]*Kyung Hee University*
[2]*Youngshin Girl's High School*
[3]*Somyong Girl's High School*

10:50 [VI-5-3]

Screening Test Evaluation of Space-Grade High-Reliable SRAM Memory with Hermetic Package based on MIL-PRF-38535

Cheol-Hwan Youn[1], Seong-Geuen Jeong[1], Ki-Sang Park[1], Mi-Young Park[2]

[1]*MID*
[2]*Satellite Technology Research Center, KAIST*

11:05 [VI-5-4]

A Study on the Changes of Long-Periodic Orbital Elements of Inclined Geosynchronous Orbit by Selecting the Optimal Right Ascension of Ascending Node

Bangyeop Kim

Korea Aerospace Research Institute

포스터발표 논문 제목

10월 29일(화) 14:50~16:20

▶ 달과 우주 탐사

[P-1] Polarimetric Experiments of Lunar Soil by Grain Size

Serin Kim[1,2], Shuai Li[3], Minsup Jeong[1], Kilho Baek[4], Sungsoo S. Kim[4], Eunjin Cho[5], Young-Jun Choi[1], Chae Kyung Sim[1,2]

[1]*Korea Astronomy and Space Science Institute*
[2]*Korean National University of Science and Technology*
[3]*University of Hawaii at Manoa, USA*
[4]*Kyung Hee University*
[5]*Chungnam National University*

[P-2] The Comparative Study on Thermal Analysis of GrainCams based on the Mid-Latitude and Polar Regions

Woojin Kim[1,2], Bongkon Moon[1,2], Dukhang Lee[1], Dae-Hee Lee[1], Minsup Jeong[1], Jihun Kim[1,2], Sung-Joon Park[1], Yunjong Kim[1,2], Seonghwan Choi[1], Jehyuck Shin[1], Seul-Min Baek[1], Mingyeong Lee[1], Chae Kyung Sim[1,2], Young-Jun Choi[1,2], Sungsoo S. Kim[3]

[1]*Korea Astronomy and Space Science Institute*
[2]*Univesity of Science and Technology, Korea*
[3]*Kyung Hee University, Korea*

[P-3] A Proposal for a Science Traceability Matrix for Emerging Nations in Space Exploration

Joo Hyeon Kim

Korea Aerospace Research Institute

[P-4] Thermal Control Technology for Planetary Mission of Spacecraft

Hui-Kyung Kim[1,2]

[1]*Korea Aerospace Research Institute*
[2]*University of Science and Technology*

[P-5] Verification of KMAG Calibrated Data based on Observing Lunar Magnetic Anomalies

Hyeonhu Park[1], Ho Jin[1], Garrick-Bethell Ian[2], Khan-Hyuk Kim[1], Wooin Jo[1], Yesun Ahn[1]

[1]*School of Space Research, Kyung Hee University*
[2]*Earth & Planetary Sciences Department, University of California, Santa Cruz*

[P-6] CAP-W Payload Integration Test of the CAS500-4 Satellite

Myung-Jin Baek, Sang-Gyu Lee, Seok-Bae Seo, Sang-Burm Ryu, Eun-Su Kang, Hyeon-Cheol Lee

Korea Aerospace Research Institute

[P-7] LUTI to 3D Lunar Terrain: High-Resolution 3D Reconstruction of Apollo 15 Landing Site via Neural Radiance Fields

Dunam Kim[1], Jongmin Kim[1], Suwan Lee[1], Kibaek Park[1], Jo Ryeong Yim[2], Dong-Gyu Kim[2], Eunhyeuk Kim[2], Seokju Lee[1]

[1]*Korea Institute of Energy Technology*
[2]*Korea Aerospace Research Institute*

[P-8] Test Method for Spurious and Harmonic Emissions Measurement at Antenna Port for RF Equipment

Kyung-Duk Jang, Tae-Youn Kim, Jae-Woong Jang, Sang-Rok Lee, Chang-Eun Lee

Korea Aerospace Research Institute

[P-9] The Initial Results of SSCM Performances and Environment Tests

Yunho Jang[1], Hyeonji Kang[1], Seungmin Lee[1], Ho Jin[1], Ikjoon Chang[2], Ickhyun Song[3], Khan-Hyuk Kim[1], Minjae Kim[4]

[1]*School of Space Research, Kyung Hee University*
[2]*Department of Electronic Engineering, Kyung Hee University*
[3]*Department of Electronic Engineering, Hanyang University*
[4]*Department of Astronomy and Space Science, Kyung Hee University*

[P-10] KMAG Data Generation and Public Release

Wooin Jo[1], Ho Jin[1], Hyeonhu Park[1], Khan-Hyuk Kim[1], Ian Garrick-Bethell[2], Joo Hyeon Kim[3]

[1]*School of Space Research, Kyung Hee University*
[2]*University of California, Santa Cruz*
[3]*Korea Aerospace Research Institute*

[P-11] Investigation of Performance Testing

Facility for Spacecraft On-Board Propulsion System

Cho Young Han

Korea Aerospace Research Institute

▶ 우주 인프라

[P-12] Research on Satellite Project and Configuration Management by Project Life Cycle

Chul Kang

Korea Aerospace Research Institute+

[P-13] Analysis of Destruct Line Algorithm according to Launch Vehicle Malfunction Turn Scenario

Young-Jae Park

Korea Aerospace Research Institute

[P-14] A Performance Comparison of Synchronous and Asynchronous Fusion Algorithms for Launch Vehicle Tracking

Ha-Ryong Song, Byoung-Jin Moon

Korea Aerospace Research Institute

[P-15] Pyro-Shock Test System in Satellite

Jong-Hyub Jun, Hee-Kwang Eun, Nam-Jin Moon, Jin Park, Chang-Rae Cho, Tae Seok Oh

Korea Aerospace Research Institute

▶ 우주감시

[P-16] Impact of Heavy Ion Radiation Testing on TDI CMOS Image-Sensors for Low-Orbit Satellite

Ilseop Lee, Jong Pil Kong, Sang-Gyu Lee

Korea Aerospace Research Institute

▶ 우주산업

[P-17] Radiometric Calibration of Multi-Spectral Electro- Optical Instrument for Earth Observation

Gmsil Kang, Eung-Shick Lee

Korea Aerospace and Research Institute

[P-18] Earth Radiance Measurement through Solar Diffuser for PRNU Calibration of GOCI-II

Gmsil Kang, Sang-Soon Yong, Jo-Young Min

Korea Aerospace and Research Institute

[P-19] Verification Procedure of ESA Additive Manufacturing

Kyungjin Kwon, Dookyung Lee

Korea Aerospace Research Institute

[P-20] Optical Axis Alignment Simulation of the Aspheric Concave Primary Mirror using the Annular Stitching

Goeun Kim

Korea Aerospace Research Institute (KARI) Satellite Payload R&D Division

[P-21] Considerations for the Readiness Check of Integrated System Test of the Standard Platform based CAS500 Satellite

Youngyun Kim, Dongin Han

Korea Aerospace Research Institute

[P-22] Design Trends for Orbital Electric Thruster Thermal Management

Jong Seok Park, Jung Su Choi, Keun Joo Park, Hyoung Yoll Jun

GEO-KOMPSAT-3 Program Office, KARI

[P-23] A Study on the Use of Various Thermal Data Processing Temperature Sensors for Satellite Payload Development and Effective Operation

Jong-Euk Park, Haeng-Pal Heo

Korea Aerospace Research Institute

[P-24] Focus Mechanism Controller Design and Gain Tuning for Large Aperture Electro-Optical Camera Satellite

Ki-Hoon Seo, Youngsun Kim, Hyung-Yun Noh, Haeng-Pal Heo

Korea Aerospace Research Institute

[P-25] Analysis of Acoustic Tests of Space Borne High Resolution Camera

Jeoung-Heum Yeon, Jongguk Choe, Won-Beom Lee, Jong-Pil Kong

Korea Aerospace Research Institute

[P-26] Additive Manufacturing Verification Process Analysis in Standard Process

Dokyoung Lee, Kyungjin Kwon

Korea Aerospace Research Institute

[P-27] Directory-Level Access Control Method in Flight Software Configuration Management using Git

Jae-Seung Lee

Korea Aerospace Research Institute

[P-28] Solving EMC CM CE Problem due to Secondary Return Current Leakage in Satellite Electronic Equipment

Jong-Tae Lee, Haeng-Pal Heo

Korea Aerospace Research Institute

[P-29] Assessment of CAS500-4 (Compact Advanced Satellite500-4) Flight Model BUS Integrated System Test Result applied with CAS500 Standard Platform

Chan-Gu Jeong, HyoungJae Oh, Jongjin Jang, Jaehwee Doh

Korea Aerospace Industries. Ltd.

[P-30] Analysis of RF Interference Test Results between SBAS Payload and GNSS System

Jae-Dong Choi, Tae-Youn Kim

Korea Aerospace Research Institute

▶ 우주정책

[P-31] Coordinating Satellite Networks for Geostationary Satellite Programs

Seorim Lee

Korea Aerospace Research Institute

▶ 우주천문

[P-32] Development of Active Mode Matching Telescope in Kyung Hee University

Joonwon Kang[1], Minseok Song[1], Sumin Lee[1], Hojae Ahn[1], Changgon Kim[1], Chang-Hee Kim[2], Sungho Lee[2], Soojong Pak[1]

[1]*Kyung Hee University*
[2]*Korea Astronomy and Space Science Institute*

[P-33] Investigating Star Formation Rates and Dark Matter Halos in the SCOSMOS Field

Sungeun Kim[1,2]

[1]*Department of Physics and Astronomy, Sejong University*
[2]*Department of Astronomy and Space Science, Sejong University*

[P-34] The Correlation between Active Galactic Nuclei Activity and Star Formation: A Spectral Energy Distribution Analysis of Type 1 AGNs at z = 0.30 - 0.80

Hyun Song[1], Jong-Hak Woo[1,2], Changseok Kim[1]

[1]*Astronomy Program, Department of Physics and Astronomy, Seoul National University*
[2]*SNU Astronomy Research Center, Seoul National University*

[P-35] Gravitational Influence Analysis and Procedural Methods for Satellite Electro-Optical Payloads

Youngchun Youk, Shinwook Kim, Dongok Ryu

Korea Aerospace Research and Institute

▶ 위성정보활용

[P-36] Linear Model based Non-Uniformity Calibration Method for Satellite Electro-Optical Camera

Youngsun Kim, Haeng-Pal Heo

Korea Aerospace Research Institute

[P-37] Design of a Scheduler for Multi-Satellite Image Processing

Jaeyeol Lee, Jihyeon Yim, Min-A Kim

Korea Aerospace Research Institute

[P-38] Development of a Web-Based Satellite Data Order Management System for NEONSAT Constellations

Gab-Ho Jeun, Myung-Jun Lee, Da-Eun Lee

Korea Aerospace Research Institute

[P-39] System Design for Integrated Image Collection planning of Low Orbit Satellite

Jung-Nam Jun, Eun-Suk Lim, Seung-Hwan Kim, Da-Eun Lee, Min-A Kim, Ok-Chul Jung

Korea Aerospace Research Institute

[P-40] Analysis of the Thermal Cycling and Vacuum Tests for the CAP-W Payload of CAS-4 Satellite

Dae-Jun Jung[1], Jong-Un Kim[2], Sang-Gyu Lee[1]

[1]*Korea Aerospace Research Institute*
[2]*SATREC INITIATIVE*

▶ 초소형위성

[P-41] Proposed Disaster Recovery (DR) Operation Methods for Satellite Image Restoration

Guhyeok Kim, Min-A Kim, Gabho Jeun, Myung-Jun Lee

Korea Aerospace Research Institute

[P-42] Mass Production Management for the Small Satellite

Jong-Oh Park, Yong-Sik Chun

Korea Aerospace Research Institute (KARI)

[P-43] 1553 BMDX Analysis Software for CAP-W FM Test

Seok-Bae Seo, Sang-Gyu Lee, Myung-Jin Baek, Sang-Burm Ryu, Eun-Su Kang, Hyeon-Cheol Lee

Korea Aerospace Research Institute

[P-44] FM Integration Test of CAP-W

Seok-Bae Seo, Sang-Gyu Lee, Myung-Jin Baek, Sang-Burm Ryu, Eun-Su Kang, Hyeon-Cheol Lee

Korea Aerospace Research Institute

[P-45] Model Reference Adaptive Control for Satellite Attitude tracking with Uncertainty

Sungwon Seo[1], Morgan Choi[2], Insang Moon[3], Seonho Lee[3], Inhoi Koo[3]

[1]*University of Science and Technology*
[2]*University of Science and Technology*
[3]*Korea Aerospace Research Institute*

[P-46] Memory Reference and Verification Environments for Satellite Flight Software using Onboard Computer Simulators

Hyun-Kyu Shin

Korea Aerospace Research Institute

▶ 태양 및 우주환경

[P-47] Study on the Space Weather Development of Republic of Korea Air Force

Jinyoung Park[1], Yong-Jae Moon[1,2]

[1]*School of Space Research, Kyung Hee University*
[2]*Department of Astronomy and Space Science, Kyung Hee University*

[P-48] Initial Study on Automatic Design of Optimal Space Radiation shielding using Genetic Algorithm

Hojin Lee[1,2], Jongdae Sohn[1,2], Ji Eun Choi[3]

[1]*Korea Astronomy and Space Science Institute*
[2]*University of Science and Technology*
[3]*Chungnam National University*

[P-49] Development of CUBE-FCOR for Solar F-Corona Observation

Hojin Lee[1,2], Heesu Yang[1]

[1]*Korea Astronomy and Space Science Institute*
[2]*University of Science and Technology*

[P-50] Concept Study on Automatic Design Method of Optimal Space Radiation Shield using Genetic Algorithm

Ji Eun Choi[1], Jongdae Sohn[2,3], Hojin Lee[2,3]

[1]*Chungnam National University*
[2]*Korea Astronomy and Space Science Institute*
[3]*University of Science and Technology*

[P-51] Total Ionizing Dose Result of Arduino and Raspberry Pi as On-Board Computer Candidates for a Super Low Earth Orbit Optical Satellite

Jongdae Sohn[1,2], Hojin Lee[1,2], Jaeyoung Kwak[1,2], Junga Hwang[1,2], Hyosang Yoon[3]

[1]*Korea Astronomy and Space Science Institute, Korea*
[2]*University of Science and Technology, Korea*
[3]*Korea Advanced Institute of Science and Technology, Korea*

[P-52] Study of the Solar Wind-Magnetosphere Interaction during the Solar Minimum

Do-Hyun Yun[1], Tae Woong Kim[1],
Hong Yeong Lee[1], Ha-Neul Kim[1], Se-Yeol Kim[1],
Ji-Woong Jang[1], Min-Gi Son[1], Young Gyun Ahn[1],
Kyung Sun Park[2]

[1]*Chungbuk Science High School*
[2]*Department of Astronomy and Space Science, Chungbuk National University*

[P-53] Energy-Conserving, Full-PIC Simulation Code for the Study of Space and Astrophysical Plasmas on GPUs

Sunjung Kim[1], Gwangson Choe[1], Dongsu Ryu[2],
Sibaek Yi[1]

[1]*Department of Astronomy and Space Science, Kyung Hee University*
[2]*Department of Physics, School of Natural Sciences, UNIST*

[P-54] Development of Space Environment Big Data Pipeline and API

Eunsu Park, Jongyeob Park, Ji-Hye Baek,
Seonghwan Choi

Korea Astronomy and Space Science Institute

[P-55] Preliminary Results of Image Compression of Solar SDO/AIA by Deep Learning

Jaewon Lee[1], Yong-Jae Moon[1,2]

[1]*School of Space Research, Kyung Hee University*
[2]*Department of Astronomy and Space Science, Kyung Hee University*

[P-56] A Data-Centric Approach to Enhancing Object Detection in Solar Images

Seungheon Shin[1], Jaewon Lee[1], Mingyu Jeon[1],
Yong-Jae Moon[1,2]

[1]*School of Space Research, Kyung Hee University*
[2]*Department of Astronomy and Space Science, Kyung Hee University*

[P-57] Investigation of the Optimal Methods for Automatic Detection of Coronal Mass Ejections by Deep Learning

Youngjae Kim, Yong-Jae Moon

School of Space Research, Kyung Hee University

[P-58] Determination of DEMs from Solar Orbiter/EUI/ FSI with Deep Learning

Junmu Youn[1], Harim Lee[1], Hyun-Jin Jeong[1],
Jin-Yi Lee[1], Eunsu Park[2], Yong-Jae Moon[1]

[1]*Kyung Hee University*
[2]*Korea Astronomy and Space Science Institute*

[P-59] Preliminary Prediction of Solar Active Region Evolution using Deep Learning

Harim Lee[1], Eunsu Park[2], Jihyeon Son[1],
Yong-Jae Moon[1,3]

[1]*Department of Astronomy and Space Science, College of Applied Science, Kyung Hee University*
[2]*Korea Astronomy and Space Science Institute*
[3]*School of Space Research, Kyung Hee University*

[P-60] Time-Distance Helioseismology of Plasma Flows Beneath Solar Active Region: NOAA AR12738

Bogyeong Kim[1], Sung-Hong Park[2], Yu Yi[1]

[1]*Chungnam National University*
[2]*Korea Astronomy and Space Science Institute*

[P-61] Comparison of MUF Values using Domestic Ionosphere Observation Data and Korean Ionosphere Prediction Model

Jong-Yeon Yun, Wonhyeong Yi

Korea AeroSpace Administration, Korea Space Weather Center

[P-62] Selection of Sporadic E-Layer Occurrence Prediction Model Candidate Group and Analysis of Test Results

Kyu-Cheol Choi[1], Dae-Kyu Shin[1], Seung-Jun Oh[1],
Yong-Ha Kim[1], Jong-Yeon Yun[2]

[1]*SELab. Inc.*
[2]*Korea Space Weather Center*

[P-63] Investigating the Relationship between Wind Shear and Sporadic E Layers over the Korean Peninsula

Jaewook Lee[1,2], Young-Sil Kwak[1,2],
Jeong-Heon Kim[2], Tae-Yong Yang[2], Jong-Yeon Yun[3]

[1]*University of Science and Technology*
[2]*Korea Astronomy and Space Science Institute*
[3]*Korea Space Weather Center*

[P-64] TIEGCM Simulations of Ion Drift in

Comparison with the Observations in the Southern Polar Cap Region

Young-Bae Ham[1,2], Geonhwa Jee[1,2]

[1]*Division of Ocean and Atmosphere Sciences, Korea Polar Research Institute*
[2]*Department of Polar Sciences, University of Science and Technology*

[P-65] A Study on the Occurrence Characteristics and Sources of Daytime Ionospheric Irregularities in the Mid and Low Latitudes of the East-Asia Region

Hoang Ngoc Huy Nguyen[1,2], Young-Sil Kwak[1,2], Woo Kyoung Lee[1,2], Hyosub Kil[3]

[1]*Korea Astronomy and Space Science Institute*
[2]*University of Science and Technology*
[3]*Johns Hopkins University Applied Physics Laboratory*

구두발표 논문 초록

10월 28일(월) 2층 스타홀

Invited Talk I

Chair: 곽영실(천문연)

11:20 [IS-1]

KASA 임무본부의 추진방향

John Lee

우주항공청

201호

I-1 태양 및 우주환경 I

Chair: 이준현(경희대)

14:50 [I-1-1]

Nature of Switchbacks surrounding a Compact Series of Small-Scale Magnetic Flux Ropes Close to the Sun observed by Parker Solar Probe

Dae-Young Lee[1], Kyungeun Choi[2]

[1]*Chungbuk National University*

[2]*Space Sciences Laboratory, UC-Berkeley*

Switchbacks and small-scale magnetic flux ropes (SMFRs) are important components in the evolution of the solar wind, frequently observed by various satellites across the heliosphere. Recently, we reported on SMFRs observed as a compact series within a narrow Carrington longitudinal range during three Parker Solar Probe (PSP) encounters. In these events, SMFRs were found to be embedded in more fluctuating background solar wind conditions, characterized by frequent instances of switchbacks. The two phenomena are likely interconnected. In this presentation, we share further progress in understanding the nature of switchbacks and their association with SMFRs. Specifically, we demonstrate that switchbacks exhibit rotational features in the magnetic field and are accompanied by plasma flow jets, which predominantly move perpendicular to the local magnetic field and exhibit vortical behavior. Additionally, we clarify how these switchbacks differ from (partial) crossings of heliospheric current sheets.

15:05 [I-1-2]

Temporal and Spatial Evolution of Cold Ions in the Inner Magnetosphere during Large Geomagnetic Storms

Khan-Hyuk Kim, Junhyun Lee

Kyung Hee University

To understand the temporal and spatial evolution of low-energy (< 10 eV) ions within the inner magnetosphere (L < 6.5) during geomagnetic storms, we performed superposed epoch analyses of partial ion densities of H^+ (n_H), He^+ (n_{He}), and O^+ (n_O) obtained from the Van Allen Probes' flux data in the 1–10 eV energy range. The analyses were carried out for an ensemble of 14 large storms (Dst < −100 nT) over a 6-year period from September 2012 to September 2017. We examined the ion density ratio (n_H/n_e, n_{He}/n_e, and n_O/n_e) normalized to the electron number density (n_e) and found that the n_O/n_e ratio dramatically increases during the early recovery phase outside the model plasmapause. The enhanced n_O/n_e ratio persisted for a period exceeding three days subsequent to the Dst minimum. The variation of the n_{He}/n_e ratio observed outside the plasmapause exhibited a trend similar to that of n_O/n_e ratio during the recovery phase. However, the n_{He}/n_e ratio is more than an order of magnitude smaller than the n_O/n_e ratio. In contrast to the n_{He}/n_e and n_O/n_e ratios, the n_H/n_e ratio does not exhbit a significant increase during the recovery phase. The values of the n_H/n_e ratio inside and outside the plasmapause are similar. We also examined the pitch angles of cold ions and found that the enhanced He^+ and O^+ ion populations during the recovery phase show field-aligned pitch angle distribution. This indicates that these enhanced cold heavy ions are traveling directly from the ionosphere along the background magnetic field.

15:20 [I-1-3]

Observations for the 2024 May Extreame Geomagnetic Storm(G5) Event in Korean Peninsula

Jong-Yeon Yun, Jae-Hyung Lee, JaeHun Kim, Ji-Hoon Ha, Sang Cheol Han, Wonhyeong Yi

Korea AeroSpace Administration, Korea Space Weather Center

Due to the geomagnetic storm that occurred on May 11, 2024, the highest alert level G5 was issued, and a space weather disaster of the code "Yellow" was issued in Korea, which lasted for about 10 days. The cause of the geomagnetic storm was the frequent solar flare that occurred between May 8 and May 10 at the highly active region 3665, which resulted in a number of CMEs reaching the Earth at around 01:33 on May 11(KST), and a G5 issued at 08:35. The KSWC analyzed the timing of the CME's arrival on Earth through a prediction model and operated a response team according to the disaster situation. From May 10 to May 13, when geomagnetic storm were active, the effects of geomagnetic storm were observed at the

observation facility operated by the KSWC, and we would like to introduce this.

15:35 [I-1-4]

Comparison of Electron Flux over Two Years from Particle Detectros: GK2A KSEM and GOES-16 MPS-HI

Daehyeon Oh[1], Jiyoung Kim[1],
Paul T. M. Loto'aniu[2,3], Han-Cheol Lim[1],
Dae-Young Lee[4], Dohyeong Kim[1]

[1]*National Meteorological Satellite Center, Korea Meteorological Administration*
[2]*Cooperative Institute for Research in Environmental Sciences, University of Colorado Boulder*
[3]*National Centers for Environmental Information, National Oceanic and Atmospheric Administration*
[4]*Chungbuk National University*

The increasing social reliance on artificial satellites in various fields, including communications, navigation, and climate monitoring, underscores the importance of accurate and timely space weather observations. These observations help in mitigating the potential disruptions caused by strong space weather events, such as solar energetic particles which can penetrate satellite electronics and have significant impacts on satellite operations. The Korean Space Weather Monitor (KSEM) on the GEO-KOMPSAT-2A (GK2A) satellite, which has been operational since July 2019 in geostationary orbit at 128.2°E longitude. This presentation provides the recent results from a comparative study between the KSEM Particle Detector (PD) aboard GK2A satellite and the Magnetosphere Particle Sensor-High (MPS-HI) on the GOES-16 satellite.

15:50 [I-1-5]

Impacts of Uncertainty of Solar and Magnetospheric Forcing in Effects of Lower-Atmospheric Forcing on the IT System

Jiwoo Kim[1], In-Sun Song[1], Wonseok Lee[2,3],
Ja Soon Shim[2,4], Nicholas M. Pedatella[5,6]

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[5]*NSF National Center for Atmospheric Research, High Altitude Observatory, Boulder, CO 80301, USA*
[6]*COSMIC Program Office, University Center for Atmospheric Research, Boulder, CO 80307, USA*

The ionosphere-thermosphere (IT) system is sensitive to external forcings from above and below. Highly energetic and magnetized solar particles can be the sources of the forcing from upper IT system. Simultaneously, tides, planetary waves, and gravity waves are the sources of the forcing from below the system. In fact, numerous studies have highlighted the effects of space environments, as well as the continuous impacts of disturbances from the lower atmosphere caused by upward-propagating perturbations within the IT system, even during periods of geomagnetic storm. For these reasons, inaccuracies in simulating solar/magnetospheric and lower-atmospheric forcing are crucial in determining the predictive performance of the IT system model. Besides, these forcing errors may interact nonlinearly within the model, making it difficult to isolate the errors associated with each effect. In this study, we examine how the IT system responds to lower atmospheric forcing using hindcasts of the IT system, then we investigate how uncertainties in solar/magnetospheric forcing influence the effects of the lower atmospheric forcing on the IT system. The model employed in this study is Whole Atmospheric Community Climate Model with Thermal and Ionosphere eXtension (WACCM-X) version 2.2, its lower atmospheric dynamics is specified with the Modern-Era Retrospective Analysis for Research and Applications version 2 (MERRA-2) reanalysis data. The uncertainty of the solar/magnetospheric forcing is examined by comparing effects of the three high-latitude electrostatic potential methodologies; the Heelis model, the Weimer-2005 model and the Assimilative Mapping of Geospace Observations (AMGeO) data assimilation model. This comparison focuses on the geomagnetic storm occurred in March 2013, relatively strong event with a minimum Dst index reaching about −120 nT.

16:05 [I-1-6]

Statistical Analysis and Understanding of the 29 June 2013 Flux Dropout Event

So-Yeon Lee, Jun-Hyun Lee

School of Space Research, Kyung Hee University

Van Allen Probes (VAP) observed abrupt dropout in electron and proton fluxes for about 8 minutes from ~6:45 UT on June 29, 2013, during the main phase of a geomagnetic storm. For the electron flux, the low-energy electron fluxes below ~40 eV are enhanced, while the fluxes of the other energies are decreased. On the other hand, the proton fluxes are decreased in all energies. At this time, VAP was at ~22 MLT and at L ~6.5. The dropout seen in this event is accompanied by fluctuations in magnetic fields. In addition, the spacecraft potential is increased showing that these events affect the charging of the spacecraft. In this paper, we present the detailed features of the flux dropout events observed on June 29, 2013. Also, we present the results of statistical analysis for similar events.

305호

I-2 우주감시

Chair: 유지웅(천문연)

14:50 [I-2-1]

Considerations for Satellite Orbit Operations during Solar Maximum

Hongrae Kim, Juyoung Lee, In-Young Hwang, Kyung-su Na

Agency of Defense Development

Recently, the accuracy of orbit prediction has been declining due to increased atmospheric drag and fluctuations in solar activity during the solar maximum. This study discusses changes in orbits during the solar maximum and important considerations for orbit prediction, based on actual satellite operational cases. Additionally, we present the key factors that must be accurately estimated during orbit determination through sensitivity analysis.

15:05 [I-2-2]

Dark and Quiet Skies: Astronomy and Large Satellite Constellations

Narae Hwang[1,2]

[1]*Korea Astronomy and Space Science Institute*
[2]*IAU Center for the Protection of Dark and Quiet Sky*

The proliferation of large satellite constellations in low Earth orbit (LEO) has become a defining feature of modern space exploration. However, alongside the promise of enhanced connectivity and global communication, the increasing density of satellites poses significant challenges for astronomy and space science as well as the preservation of the night sky. The unprecedented growth in the number of satellites in LEO orbits results in the escalating number of radio-emitting and sunlight-reflecting sources in the sky, which not only hampers celestial observations from the ground and the space, but also affects our relationship with the night sky. This talk explores the multifaceted relationship between astronomy, space science, the night sky, and large satellite constellations, and then share recent developments on the dark and quiet skies (DQS) protection happening in the various international organizations and communities.

15:20 [I-2-3]

Modeling and Simulation for Efficient Space Situational Awareness

Seo-Eun Lee[1], Hoyoung Hwang[2], Yong-Ik Byun[1]

[1]*Department of Astronomy, Yonsei University*
[2]*YSPACE Co., Ltd*

As the number of artificial space objects increases exponentially, space situational awareness (SSA) becomes increasingly important. To ensure safe and sustainable space activities, we need to establish an internationally coordinated space traffic management (STM) system, which requires significantly improved SSA capabilities. We note that SSA should take the form of general surveillance for multiple unspecified objects, rather than tracking specific targets with known orbits. Unfortunately, existing electro-optical surveillance systems in Korea (both civil and military) have been designed primarily for targeted observations. In order to contribute to international STM efforts and ensure space sustainability, it is crucial to develop a new global SSA network capable of detecting and tracking uncooperative objects with unknown orbital properties.
This study aims to model and simulate the expected outcomes of different sensor types and various global deployments. We consider the US military SSN radar network, LeoLabs Space Radars, and the planned YSPACE optical sensor network. These systems differ significantly in terms of cost and function; we are currently comparing the revisit frequency of space objects residing in different orbital volumes. Interim results are presented here.

15:35 [I-2-4]

Development of Korean 3D Cell Model for Space Debris Environment Analysis

Jaewoo Kim[1], Jinsung Lee[1], Eun Jung Choi[2], Jin Choi[2], Jiwoong Yu[2], Junghyun Jo[2],

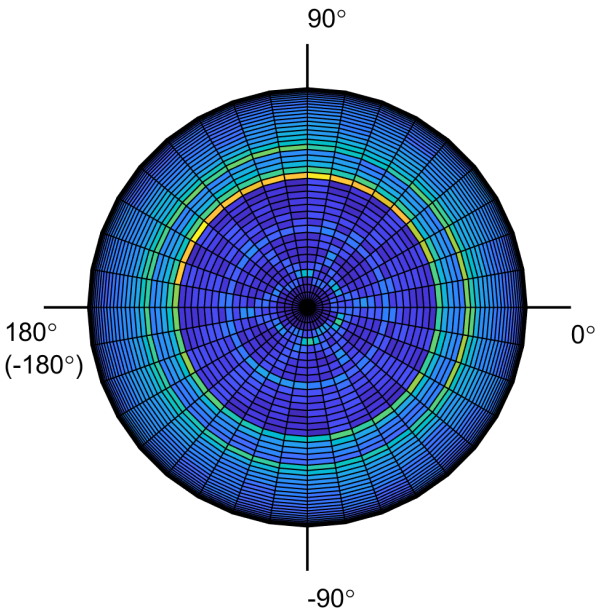

Fig. 1. Space object sptial density visualization using the developed 3D cell model (Northern Hemisphere).

Jaemyung Ahn[1]

[1]*Korea Advanced Institute of Science and Technology*
[2]*Korea Astronomy and Space Science Institute*

The Korea Advanced Institute of Science and Technology (KAIST) and Korea Astronomy and Space Science Institute (KASI) have been working jointly to develop space debris models for a risk analysis framework. Currently, a three-dimensional cell model is being formulated to evaluate space object density and orbital collision risk for specific targets of interest. This paper presents an overview of the project's current developmental status, with a particular focus on the creation of the 3D cell model and its potential applications in risk analysis.

15:50 [I-2-5]

Development of a NSOS-Beta (Near Space Optical Survey-Beta): Progress Report

Jin Choi, Jung Hyun Jo, Hong-Suh Yim, Dong-Goo Roh, Myung-Jin Kim, Yunhak Kim, Ki-Pyoung Sung, Jang-Hyun Park, Jaemann Kyeong, Sungki Cho, Eun-Jung Choi, Jiwoong Yu, Seong-Yeol Yu, YeonGil Jung, Wookyung Lee, Hong-Kyu Moon, Min-Jung Kim

Korea Astronomy and Space Science Institute

South Korea's dedicated Space Situational Awareness infrastructure, known as NSOS-beta (Near Space Optical Survey-beta), is currently under development to detect, track, identify, and monitor space objects in the mid-to-high Earth orbit region near the Korean peninsula. The primary goal of this system is to track Korean MEO/GEO (Medium Earth Orbit/Geostationary Earth Orbit) space objects, as well as secondary targets that may pose a threat to Korean space assets. To achieve this, the system also surveys the high Earth orbit region. NSOS-beta has been named the BRAHE telescope system (Beyond Surveillance for Space Risk of the Korean High Earth Orbit Region). The progress status of the BRAHE telescope system's development will be presented.

16:05 [I-2-6]

Observation of the Close Approaching Asteroid 2024 MK using OWL-Net

Hee-Jae Lee, Myung-Jin Kim, Hong-Suh Yim, Dong-Goo Roh, Jin Choi, Jang-Hyun Park, Young-Sik Park, Jung Hyun Jo, Jaemann Kyeong, Jiwoong Yu, Hong-Kyu Moon, Yoon-Ho Park, Sungki Cho, Eun-Jung Choi

Korea Astronomy and Space Science Institute

The close approach of an asteroid to Earth presents a valuable opportunity to study the evolution of its physical properties, while also being a significant event that requires preparation in case of a potential impact. While some asteroid approaches can be predicted in advance, in most cases asteroids are only detected a few hours to days before their closest approach, often missing critical observation opportunities. Therefore, it is crucial to observe and detect these asteroids as quickly and efficiently as possible once their approach is predicted.
In this presentation, we will share the observational results of asteroid 2024 MK, which closely passed by Earth. The close approaching asteroid 2024 MK, approximately 150 meters in size, passed near Earth at a distance of about 0.77 *LD* on June 29, 2024. Our observations were conducted using the OWL-Net (Optical Wide-field patroL Network). This network system is equipped with a chopper system, allowing the capture of multiple observation points in a single exposure. Therefore, OWL-Net maximizes the collection of data in limited observation windows, enabling the precise analysis of the asteroid's orbit, spin state, and physical properties such as shape. From our observations, we confirmed that 2024 MK is a non-principal axis rotator with periods P_1 = 30.1764 minutes and P_2 = 43.9362 minutes. We also determined that the asteroid has an elongated shape, with a ratio of its longest to shortest axes of approximately 3.56. Additionally, simultaneous observations were made from OWL-Net Morocco and Israel station, which allowed us to analyze variations in the asteroid's light curve due to geometry, and improve orbital precision by accounting for parallax effects. These observations not only help refine the orbit and physical properties of 2024 MK but also provide insights for future near-Earth asteroid monitoring efforts, enhancing our preparedness for potential impact threats.

306호

I-3 안보우주 I

Chair: 최현주(ADD)

14:50 [I-3-1]

Development Plan for the Army's Space Policy and Manned Lunar Base Construction

Joon-Wang Lee

Republic of Korea Army HQ

The Army recognizes that the construction of a manned lunar base offers derivative and applied technologies that could be utilized on Earth.
As a signatory of the Artemis Accords, the Republic of Korea must explore ways to enhance cooperation with the United States and other nations. It is crucial to focus on areas where

Korea can maintain a competitive edge.
In particular, the importance of exploring the lunar South Pole should be emphasized. A phased approach to unmanned, semi-manned, and fully manned lunar base construction should be implemented, and the Army is developing space policy measures to support policy discourse at each phase.

15:05 [I-3-2]
How to Use Low-Orbit Satellite Images Efficiently for Military Use

Young-Joon Jung, Ho-Sung Choi
Republic of Korea Army HQ

With the recent Republic of Korea Armed Forces launch of high-resolution military reconnaissance satellites and the development of ultra-small constellation satellite systems, the number of military satellites is increasing, and the supply of military satellite images is expected to expand.
However, in the current military, satellite images are only used by some higher-level units due to security and satellite image transmission issues, and the use of satellite images is restricted in many units.
As it is expected that a large amount of military satellite images will be produced in the future, we will present an efficient utilization plan so that all units in the Republic of Korea can use the satellite images through a study of cases of foreign militaries using military satellite image.

15:20 [I-3-3]
Analysis of Space Warfare in the Era of Future Intelligentized Warfare: Focusing of Alternative Futures Method

Woo-seok Lee
Korea National Defense University

This paper applies the alternative futures method of the Manoa School to analyze the future of space warfare in the era of intelligentized warfare in 2050. To do so, we first identified the militarization of outer space as a driver of change in space warfare from the past to the present and future, and predicted that a new trend of change led by the commercialization of outer space will be strengthened to promote the weaponization of outer space. Based on these analyses, four future space warfare scenarios were developed, with the militarization and commercialization of outer space as the two pillars of change. Next, the ROK military's preferred future scenario was established as a continued growth scenario in which both militarization and commercialization of outer space are growing trends, and the ROK military plays a leading role in the space domain and wins a space warfare. This resulted in three lines of effort and 11 detailed tasks to realize the preferred future. Then compared the above with the strategic guidelines in the current Korean National Defense and Space Strategy. As a result, we reevaluated the potential and utilization of the civilian space industry and proposed two sources of power to prepare for the most likely orbital warfare scenarios.

15:35 [I-3-4]
Characteristics of Shear Coaxial Injectors Applicable to Methane Reusable Launch Vehicle

Dong Ho Yun[1], Hyeon Taek Jo[2], Youngbin Yoon[3,4]
[1]*Korea Army Academy at Yeongcheon*
[2]*Korea Aerospace Research Institute*
[3]*Korea AeroSpace Administration*
[4]*Seoul National University, Korea*

Recently, reusable launch vehicles using liquid methane engines is a prevailing trend triggered by reducing launch costs. In the development of reusable launch vehicles, thrust control technology that maintains engine performance even while adjusting thrust is crucial This study analyzes the thrust control performance of shear coaxial injectors used in a 3-ton-class methane rocket engine, depending on the shape of the injector. Four types of injectors were fabricated with recess length and oxidizer taper angle as shape variables, and the spray characteristics and combustion characteristics were compared and analyzed according to the stepwise thrust from 100% to 20%.

15:50 [I-3-5]
An Analysis on Space Threat and Mitigation

Hyun Joo Choi, Hong Rae Kim, Kang Hee Lim
Agency for Defense Development

Korea is building its presence in space rapidly and the importance of space assets in Korea's defense is becoming more critical. As the importance of space assets grows, protecting them from potential threat would become a key factor in Korea's defense. A good understanding of potential threat to space assets and strategies for mitigating the threat are required for protecting national interest. An analysis on potential threat, both natural and artificial, on space assets and ways to mitigate them are presented.

402호

I-4 달 착륙과 우주탐사

Chair: 김주현(항우연)

14:50 [I-4-1]

Inclination-Cranking Multiple Mars Gravity-Assist to Sun-Earth L4

Jinsung Lee[1], Daniel J. Scheeres[2], Sang-Hyun Lee[1], Jaemyung Ahn[3]

[1]*Satellite Technology Research Center, KAIST*
[2]*Satellite University of Colorado, Boulder*
[3]*Korea Advanced Institute of Science and Technology*

This presentation explores the use of multiple Mars gravity-assist trajectories via resonance orbital structures to achieve a high-inclination trajectory to the Sun-Earth L4 Lagrange point. Monitoring solar activities from the L4 point is critical for space weather forecasting, especially for future human space missions beyond Earth. Traditional approaches to achieving such trajectories have focused on altering the spacecraft's semi-major axis rather than its orbital inclination. This study diverges by leveraging gravity assists to reach the desired inclination while maintaining a circular orbit around the Sun with a semi-major axis of 1 AU at the end of the transfer period. The research compares this method to a phasing trajectory, revealing that the proposed approach requires less launch energy (C3) and can transport more mass to the final orbit. The paper also discusses optimizing the trajectory using both chemical and electric propulsion systems. The findings suggest a more efficient pathway to the L4 point.

15:05 [I-4-2]

Shape-Based Low-Thrust Asteroid Approaching Trajectory Design considering Optical Navigation Observability

Pureum Kim, Sang-Young Park

Yonsei University

In interplanetary missions to small asteroids, the concept of an approaching phase is often adopted as the last phase of the interplanetary transfer trajectory. During this approaching phase, the spacecraft is expected to slowly approach the target asteroid while performing preliminary scientific activities and optical navigation to achieve successful rendezvous. To fully utilize optical navigation during this phase, constraints exist on the asteroid-spacecraft distance and phase angle, ensuring the spacecraft's on-board camera can detect the target asteroid. To further enhance the optical navigation performance, approaching trajectory design can be updated to increase the optical navigation observability. In this study, we extend the use of shape-based low-thrust trajectory design methodology based on finite Fourier series, which has often been used for preliminary fuel-optimal trajectory design, to this approaching trajectory design that considers optical navigation observability. We first discuss the ideal orbital state representation for this problem. Then, we present an application example: a baseline fuel-optimal low-thrust trajectory is updated using the suggested method, and the effects on fuel use and observability are discussed.

15:20 [I-4-3]

A Study on the Variation of Vertical Distribution of Physical and Chemical Properties of Upper Atmosphere in the Region of Upper Mesosphere and Lower Thermosphere (100-300 km)

Gi-Hyuk Choi, Dae-Yeoung Kim, Joo-hee Lee

Korea Aerospace Research Institute

The Upper Mesosphere and Lower Thermosphere (100–300 km) is the entry point to the Thermosphere (500–2,000 K) where atmospheric elements begin to ionize and the lowest temperature (180 K) at the Mesopause begins to rise again. The 120 km point is the turbopause, where the homogeneity of atmospheric composition (Homosphere) by diffusion is broken and a heterogeneous atmosphere (Heterosphere) begins to form depending on molecular weight.

The altitude zone of 100–300 km is an important zone in space development, and it is also the starting point (altitude 120 km) where space vehicles, space debris, and meteorites re-enter the atmosphere. Although the air density is extremely low as 10^{-7} to 10^{-10} kg/m^3, it is an important parameter that affects the landing accuracy of re-entry space vehicles and ICBMs. Therefore, space-developing countries consider the related data strategically important and do not open it. Recently, re-entry research has been actively conducted in Korea, and atmospheric data between 100 and 300 km is an important input parameter when implementing re-entry in actual space in the future. Therefore, in this study, we analyzed the vertical distribution during days and nights, seasons, and solar activities over the Korean Peninsula using the upper atmosphere modeling S/W (ECMWF (0–80 km) + NRLMSISE-00 (80–300 km)) developed in the re-entry research conducted between 2019 and 2021 in Korea Aerospace Research Institute (KARI).

15:35 [I-4-4]

Expanding the Boundaries of Ceramic Art: The Creation of Moon Jars using Lunar Regolith Simulant

Hyoji Kim

Ceramic Artist and Researcher

This research explores the innovative application of Lunar regolith simulant in the creation of traditional Korean moon jars (dal hangari), presenting a unique intersection between ceramic art and space science. Utilizing lunar regolith simulant developed by space researchers, this study examines how the material properties-such as texture, color, and acoustic resonance-of moon jars evolve when new scientific materials are integrated. The objective of this research is to explore how traditional ceramic techniques can evolve through the application of modern scientific advancements, creating a dialogue between heritage craftsmanship and contemporary innovation. This study offers a novel perspective on material experimentation in the arts, contributing to the ongoing conversation about the fusion of tradition and space science.

15:50 [I-4-5]

Investigating the Influence of Grain Size on Spectral and Polarimetric Data of Apollo Lunar Soils

Eunjin Cho[1], Minsup Jeong[2], Chae Kyung Sim[2,3], Serin Kim[2,3], David Trang[4], Young-Jun Choi[2], Shuai Li[4], Sungsoo S. Kim[5], Yu Yi[1]

[1]*Chungnam National University*
[2]*Korea Astronomy and Space Science Institute*
[3]*Korea National University of Science and Technology*
[4]*University of Hawaii at Manoa*
[5]*Kyung Hee University*

The Hapke Radiative Transfer Model (RTM) is commonly used in planetary science to study particulate surfaces of airless bodies like the Moon. Key parameters, such as mineral composition, SMFe abundance, and regolith grain size, are used to simulate reflectance, which can also be inversely derived from observed spectra. In this study, we applied Hapke model to make reflectance spectra of Apollo 12 (12030, 12037) and Apollo 16 (61141, 65701) samples with a bulk grain size < 150 μm. By comparing the modeled spectra to data from the Reflectance Experiment Laboratory (RELAB), we estimated the grain sizes of the samples. Additionally, we analyzed polarimetric data for the same samples to examine the grain size effect on both spectral and polarimetric data.

16:05 [I-4-6]

Investigation of the Noise Correlation between the Inboard and Outboard Sensors of KMAG

Yesun Ahn, Ho Jin, Wooin Jo, Hyeonhu Park, Khan-Hyuk Kim

School of Space Research, Kyung Hee University

The Korea Pathfinder Lunar Orbiter (KPLO), launched on August 4, 2022, is the first Korean lunar mission. The KPLO MAGnetometer (KMAG), one of the payloads on KPLO, measures the magnetic field of the Moon and its surrounding space environments. Since the measured data includes various noises generated by the spacecraft, it is important to distinguish this interference from the observed data.
In the case of a short boom like KMAG, the observed magnetic field can be affected by unwanted signals from spacecraft sub-systems due to the short distance between the spacecraft and the magnetometer. To distinguish this interference, we investigated whether the inboard Magneto Resistance (MR) sensor could be used to identify noise signals.
The MR sensor is an inboard magnetometer that is part of KMAG's electronics box, located inside the KPLO spacecraft. Originally, the MR sensor was used for ground testing purposes. This sensor is very sensitive to the change of temperature, so temperature calibration is performed to check only the spacecraft interference.
Even if the sensitivity of the MR is low, if spacecraft noise can be detected, the amount of noise transmitted can be estimated through the outboard magnetometer. Therefore, it can be expected that noise which stands out in MR data will also appear in the magnetometer measurements. We also found similar signals generated in both the calibrated MR and KMAG magnetic field data.
We carried out investigations of interference signals by analyzing the relationship between calibrated MR data and KMAG magnetic field data. Using this correlation, we can infer and identify interference in the KMAG data by looking at MR sensor measurements. This suggests the potential use of MR sensors in other magnetometer data analysis, and it is expected that this approach will aid in defining spacecraft noise through subsequent studies.

16:20 [I-4-7]

Analysis of Polarimetric Properties of the Reiner Gamma Swirl using Data from PolCam

Minsup Jeong[1], Young-Jun Choi[1], Sungsoo Kim[2], Kilho Baek[2], Bongkon Mon[1], Chae Kyung Sim[1], Dukhang Lee[1], Eunjin Cho[3], Serin Kim[1]

[1]*Korea Astronomy and Space Science Institute*
[2]*Kyung Hee University*
[3]*Chungnam National University*

The Reiner Gamma Swirl is one of the most intriguing lunar swirls, known for its albedo anomalies on the lunar surface, which are linked to localized magnetic fields. These lunar swirls are notable for their distinctive brightness patterns, despite lack of any significant topographic or mineral differences. The mechanisms behind their formation, their timescale, and their

relationship to magnetic fields remain largely uncertain. Several studies, utilizing observational data from both Earth and lunar orbiters, have been conducted to explore these swirls. However, the polarimetric properties of lunar swirls are still not well understood. Recently, South Korea's first lunar orbiter, Danuri, equipped with the Wide-Angle Polarimetric Camera (PolCam), successfully gathered polarization data during its lunar orbits. One of PolCam's scientific goals is to produce global lunar maps detailing the degree of polarization and titanium distribution. PolCam's normal operations involve observing both the near and far sides of the moon at a spatial resolution of around 68 m/pixel, with phase angles ranging from 0 to 135 degrees. In this study, we examine the Stokes parameters, polarization degree, and grain size of the Reiner Gamma Swirl using the polarimetric data collected by PolCam to gain deeper insights into the characteristics of this lunar feature.

16:35 [I-4-8]

Long-Term Monitoring of Lunar Terrain Imager on-board Korea Pathfinder Lunar Orbiter

Eunhyeuk Kim

Korea Aerospace Research Institute (KARI)

A high resolution imaging system on-board Korea Pathfinder Lunar Orbiter (KPLO, or Danuri), Lunar Terrian Imager (LUTI) has been operated since the launch of KPLO on August, 5 2022. LUTI acquired images of lunar surface from Jan. 1, 2023 for studying candidates landing location of the Korean lunar landing mission. We monitored the operational characteristics of LUTI for a long time in order to release the LUTI calibrated images to international lunar science community. We found that the LUTI system is quite stable since the launch and the present calibration pipeline is still within the acceptable uncertainties. KARI/LUTI team will keep these monitoring activities until the termination of the KPLO mission.

404호

I-5 SS: SpaceAI 2024: 인공지능, 우주를 만나다

Chair: 이강우(경희대)

14:50 [I-5-1]

What Kinds of Problems in Space Science are Well Solved by Deep Learning?

Yong-Jae Moon[1,2]

[1]*School of Space Research, Kyung Hee University*

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

Recently, we have successfully applied novel deep learning methods to several problems in space science. In this talk, I will address what kinds of problems in space science are well solved by deep learning: (1) image translations between multi-wavelength images, (2) improvement of empirical models, (3) solving an inversion problem, (4) super-resolution of solar magnetograms, (5) pixel-to-pixel translation, (6) near real-time construction of solar coronal parameters, (7) transformation from 2D to 3D, and (8) time-series predictions. We present major results of these problems and discuss their advantages and future studies.

15:05 [I-5-2]

Applications of AI-Based Image Enhancement Techniques in Astronomy

Eunsu Park, SpaceAI Team

Korea Astronomy and Space Science Institute

In astronomy, most observational data is collected in the form of images, making efficient image processing and analysis techniques essential. Recently, rapid advancements in artificial intelligence (AI) technologies have led to groundbreaking achievements across various scientific fields, including astronomy. In particular, AI-based techniques have shown results that are comparable to or even surpass traditional methods in terms of speed and accuracy, enabling precise scientific analysis using high-quality observational data. This presentation will introduce AI-based image enhancement techniques, their applications to solar physics data, and discuss their potential for future development and research directions.

15:20 [I-5-3]

SpaceAI 2024: Progress and Future Prospects

Sung-Hong Park[1], Seonghwan Choi[1], Jihye Baek[1], Eunsu Park[1], Jeong-Heon Kim[1], Hwanhee Lee[1], Roksoon Kim[1], Jongyeob Park[1], Yong-Jae Moon[2], Harim Lim[2], Chanwoo Kim[3], Taeyoung Kim[4]

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[4]*AIFactory*

Since 2023, the SpaceAI Program Committee has organized an annual, collaborative program in which scientists, software engineers, industry experts as well as students/citizens all participate in as various project teams, in order to solve multidisciplinary, community-wide, targeted questions in space science and technology with artificial intelligence (AI). The program runs in parallel with a scientist track and a citizen

scientist track. The scientist track coordinates scientists and AI engineers to participate in peer-reviewed projects as team and supports the project teams providing a concentrated co-working environment, motivation, continuous advice and computing resources. The citizen scientist track opens up opportunities for students/citizens to have hands-on training in developing AI models with a variety of datasets obtained from space missions and science projects. In this presentation, we report the progress of this year's program SpaceAI 2024 and discuss how to maximize the practical use of the program not only for scientific research and technology development but also for public engagement in the context of open science. The details and schedule of SpaceAI can be found in the following webpage: https://spaceai.kasi.re.kr.

15:35 [I-5-4]

SpaceAI 2024 Citizen Scientist Track: 1st Astronomy & Space AI Competition

Jeong-Heon Kim[1], Sung-Hong Park[1,2], Jihye Baek[1], Seonghwan Choi[1], Eunsu Park[1], Hwanhee Lee[1], Roksoon Kim[1], Jongyeob Park[1], Chanwoo Kim[3], Seungdo Lee[4], Suwoon Lee[5]

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[4]*Elice Inc.*
[5]*Innowithus Inc.*

The citizen scientist track of the SpaceAI program aims to provide students and citizens with unique opportunities to learn AI basics and advanced techniques from experts in space science, astronomy, and space technology. Education/training programs with a series of lectures, hands-on activities (including preparation and process of datasets), and modeling competitions are planned to be offered to participants in this track. In this context, the SpaceAI program committee has organized an AI competition for undergraduate and graduate students in August this year, with a project focused on developing an AI model that detects features (such as sunspots, coronal holes, and prominences) in images of the Sun. Throughout the competition, participants have experienced how to use AI for inventing practical space applications with science data obtained from a space mission currently in operation. A vast amount of datasets, in which participants produced the labeling information of the solar features, will be utilized for improving associated space weather models. In this talk, we will address the importance of public engagement in science, based on our experience from the citizen scientist track of SpaceAI.

15:50 [I-5-5]

Preliminary Results of Auroral Recognition Procedure by using Deep Learning Technique in All-Sky Auroral Image Data

Yujin Cho[1,2], Geonhwa Jee[1,2], Mingyu Jeon[3], Hyuck-Jin Kwon[1], Ji Eun Kim[1], Young-Bae Ham[1,2], Changsup Lee[1,2], Ji-Hye Baek[4]

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[4]*Korea Astronomy and Space Science Institute*

Auroral image data have been collected with every 1-minute temporal resolution from the all-sky camera (ASC) at Jang Bogo Station (JBS), Antarctica since 2018. It has been a great challenge to process these large amount of data by conventional image analysis techniques to further analyze them in association with other upper atmospheric and magnetospheric observations at JBS. Over the last decade, the deep learning techniques have been extensively utilized in the space science community, in particular, dealing with large dataset. In order to investigate characteristics of the aurora occurring over JBS in more effective way, we attempt to utilize the deep learning technique. As an initial step, we applied deep learning technique for recognizing aurora in the all-sky images obtained from visible auroral ASC at JBS. We manually created binary masks for supervised learning. Since this process is time-consuming and labor-intensive, we employed transfer learning. We used a Fully Convolutional Network (FCN) with a ResNet-50 backbone pre-trained on a subset of the Microsoft Common Objects in Context (MS COCO) dataset. Thanks to transfer learning, our model showed good performance with only a few dozen image-mask pairs.

16:05 [I-5-6]

AI-Based Telescope Alignment Simulation for K-DRIFT Pathfinder

Seonwoo Kim[1,2], Yunjong Kim[1,2], Youngwoo Cho[3], Jaewon Lee[4], Seonghwan Choi[1], JIhun Kim[1,2], Kyohoon Ahn[1], Se-Heon Jeong[1], Heuisung Cho[5], Hyuntaek Choi[6], Jongwan Ko[1,2]

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[5]*Radiant Solution*
[6]*Ansys Korea*

We have developed the K-DRIFT (KASI Deep Rolling Imaging Fast Telescope) pathfinder, a freeform three-mirror optical telescope designed for observing low-surface-brightness (LSB) celestial objects. For the telescope alignment, we selected the secondary mirror (M2) as the compensator, and effectively

utilized the Sensitivity-Table method based on wavefront error data. To enhance mirror alignment accuracy, we are investigating the applicability of Artificial Intelligence (AI). In the AI-based algorithm, we adopted a similar approach to the classical method, selecting M2 as the compensator. Our approach starts from generating random errors in six degrees of freedom (decenter and tilt in the orthogonal coordinate system) and corresponding phase data across five fields. Convolutional Neural Network (CNN) models are then trained to predict M2 error position from input phase data. We simulated the alignment process using the AI algorithm under various conditions. We will introduce the alignment simulation results in this presentation.

16:20 [I-5-7]

Preliminary Results on Aurora Identification from e-POP/FAI Images using Deep Learning

Se Rin Jeon[1], Junmu Youn[2], Woong Jeon[2,3], Se-Heon Jeong[3], Jeong-Heon Kim[3], Woo Kyoung Lee[3,4], Hyosub Kil[5]

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[5]*The Johns Hopkins University Applied Physics Laboratory*

In this study, we present results on aurora identification using data from the Fast Auroral Imager (FAI) on the Canadian satellite enhanced Polar Outflow Probe (e-POP). The auroral oval boundary is crucial for predicting changes in the Earth's upper atmosphere. Space-based aurora observations provide valuable datasets for estimating this boundary. The e-POP/FAI captures auroral emissions in the 650 to 1,100 nm range (near-infrared) with a 25-degree field of view, typically pointing nadir. The initial step in estimating the auroral oval boundary from satellite images is the identification of auroras. Accurate aurora identification requires distinguishing them from clouds, icy surfaces, city lights, and other features. To streamline this process, we employ a CNN-based ResNeXt-50 deep learning model to automatically detect auroras in e-POP/FAI images. For our study, we used images from 2015 to 2016 for training and images from 2017 for testing. The training dataset includes 72,955 images. These results will contribute to developing a comprehensive dataset for modeling the auroral oval boundary.

306호

II-3 안보우주 II

Chair: 최호성(육군)

16:40 [II-3-1]

A Study on the Role and Operational Strategies of SLR in Space Security

Mannsoo Choi[1], Ki-Pyung Sung[1], Sung-Yeol Yu[1], Hyung-Chul Lim[1], Jong-Uk Park[1], Seok-Min Song[1,2]

[1]*Korea Astronomy and Space Science Institute*
[2]*Chungnam National University*

Satellite Laser Ranging (SLR) is a technology where lasers are fired from ground-based observation stations towards satellites in space, and the return time of the reflected laser is measured. By accurately measuring the round-trip travel time of the laser, which moves at the speed of light, precise distance measurements can be made. In the case of the LAGEOS satellite, the reference satellite for SLR, distance measurements with an RMS accuracy of 1 mm are achievable, making it the most precise satellite distance measurement system available today.

In Korea, two SLR systems developed by the Korea Astronomy and Space Science Institute (KASI) have been in operation at Sejong and Geochang. These systems are actively utilized in space science and space surveillance research. Recently, research into the application of SLR systems in space defense has intensified, leading to the establishment of cooperative frameworks between industry, academia, research institutions, and the military.

Due to the nature of SLR, initial orbital information of the target satellite is essential for accurate measurements. To address this requirement, initial observations using space surveillance infrastructures, such as optical and radar systems, are crucial for identifying and tracking space objects. This study explores the role of SLR in space security and proposes integrated operational strategies that combine SLR with other space surveillance systems.

16:55 [II-3-2]

Round-Based Space Active Protection Technology

Sangwoong Min[1], HeeSun Noh[1], Ji-In Kim[1], Sangyeong Park[1], Sihyun Kim[1], Youngsoo Kim[2], Mansoo Choi[3], Myungwon Shin[4]

[1]*Hanwha Systems, Electro Optics System 4 Team*
[2]*Hanwha Systems*
[3]*Korea Astronomy and Space Science Institute*
[4]*Korea Research Institute for Defense Technology Planning and Advancement*

Due to security reasons the content is not disclosed.

17:10 [II-3-3]
LEO Satellite-Based Communication Systems

Youjean Lee

Hanwha Systems Space Business Team

According to the current global satellite communication market trend, there is an increasing demand for NGSO or LEO satellite communication with high throughput and resilience, mainly focused on enterprise, home broadband, maritime/aviation.
To counteract, Hanwha Systems has accumulated over two decades of experiences and expertise in organizing satellite communication system which ranges from satellite core payloads and network devices such as network controllers, terminals and so on.
As a result, Hanwha Systems in collaboration with Eutelsat OneWeb (British-based firm providing LEO satellite internet) has been awarded a project by Korean government to build a tactical network based commercial LEO satellite communication with enhanced security, yet compatible with the existing TICN operated by Korean military force.

17:25 [II-3-4]
A Study on the Starlink Loss in 2022 and Indigenous Satellites Damage Cases due to the Space Environment Changes in 2024

Seonghwan Choi

Aerospace Business Division, Hanwha Systems

Despite mild space weather conditions, 38 of SpaceX's 49 Starlink satellites came crashing down in 2022, due to placement in low earth orbits and increased atmospheric drag owing to satellite design. The National Oceanic and Atmospheric Administration's Space Weather Prediction Center forecasted a "severe solar storm" that's expected to hit Earth in May. These geomagnetic storms happen every so often, but as the Sun approaches the maximum of its 11-year solar cycle, the space weather is getting more intense. In order to stably operate space assets such as military reconnaissance satellites and micro-satellite constellation to be operated by our military in the future, there needs lessons learn of Starlink Loss in 2022. Therefore, i studied the impact of changes in the space environment on Indigenous satellites and damage cases caused by solar activity in May of this year. And i proposed the satellite damage preparation and countermeasures against the Space Environment Changes.

10월 29일(화) 2층 스타홀

Invited Talk II

Chair: 이대영(충북대)

08:30 [IS-2]
Plasma Waves and Particle Analysis of Juno Mission

Peter H. Yoon

Institute for Physical Science and Technology, University of Maryland, College Park, USA

JUNO is a NASA space probe orbiting the planet Jupiter, built by Lockheed Martin and operated by NASA Jet Propulsion Laboratory. It was launched from Cape Canaveral Air Force Station on August 5, 2011, as part of NASA's New Frontiers Program. After five years of journey the spacecraft entered a polar orbit of Jupiter on July 5, 2016, and since then it began a scientific investigation of the planet, which includes measuring Jupiter's composition, studying the gravitational field, its magnetic field, and investigating physical processes in the polar magnetosphere. The polar magnetospheric study includes the aurora phenomena and radio emission mechanism. Juno is the second spacecraft to orbit Jupiter after Galileo (1995-2003). Juno is currently in an extended operation until September 2025. As part of the New Frontiers Data Analysis Program, the present speaker in collaboration with a team of Juno project scientists is carrying out a research project to analyze and model the plasma wave and radio emission processes in Jupiter's magnetospheric environment. The primary instruments used in such a research project are Jovian Auroral Distributions Experiment (JADE) that measures energetic particles (ions between 13 eV to 20 keV and electrons of 200 eV to 40 keV), Jovian Energetic Particle Detectors Instruments (JEDI), which measures ions between 20 keV to 1 MeV, and electrons from 40 keV to 500 keV, and Radio Plasma Wave Sensor, Waves. By utilizing the data from these instruments, our research team has thus far successfully modeled the wave and radio emissions phenomena in terms of a theory developed by the present speaker, which is based on the self-consistent quasilinear kinetic theory. This talk will overview the various subject matter related to the plasma waves and particle analysis of Juno mission.

2층 스타홀

Invited Talk Ⅲ

Chair: 최영준(천문연)

09:00 [IS-3]

Global Space Industry Investment Trends and 'Company K-New Space Fund'

Kang-Soo Lee

Company K Partners

This presentation looks at the global investment trends and prospects of venture capital in the space industry. In addition, we introduce the operation plan of 'Company K-New Space Fund', which is invested and supported by the Korea Ministry of Science and ICT to foster Korea's space industry. We look at changes in Korea's space startup ecosystem, including the opening of the Korea AeroSpace Administration (KASA), the emergence of New Space, the boom in the establishment of space startups, and the rush for KOSDAQ listings for space startups, and discuss future changes. Through a detailed introduction to the future management plan of 'Company K-New Space Fund', we share fundraising related know-how with space startups or prospective entrepreneurs preparing to startups. We analyze changes in the U.S. space startup market, such as the decline in U.S. venture capital investment in space startups and the decline in corporate value of listed space companies on the U.S. stock market, and based on this, forecast the future of the Korean space industry and seek ways to move forward. The domestic space industry is led by the government, public sector, and large corporations, and continues to grow with small and medium-sized companies with manufacturing capabilities and space startups based on innovative technologies. The Korean government recognizes the importance of fostering the space industry and is making efforts to stimulate private investment in the space industry. In order to utilize the potential of the private sector, we must create an environment in which private companies can participate in the space industry and achieve technological advancement through market competition. This is New Space.

Keywords: space startup, space economy, venture capital, new space, Company K New Space Fund

201호

Ⅲ-1 SS: 태양-우주폭풍 Ⅰ

Chair: 곽영실(천문연)

10:20 [III-1-1]

Overview of the "Solar and Space Storms" Session

Young-Sil Kwak[1,2]

[1]*Korea Astronomy and Space Science Institute*
[2]*University of Science and Technology*

The G5-level (extreme) geomagnetic storm that occurred from May 10 to 12, 2024, was the first G5-level storm since the Halloween Storm in late October 2003 during Solar Cycle 23, marking the strongest event of the current Solar Cycle 25. During this period, auroras were observed at various mid-latitude locations, including South Korea, far from the auroral oval.
Solar and space storms, driven by solar activity, are among the most significant space weather events affecting the near-Earth environment. These storms, triggered by solar flares, coronal mass ejections (CMEs), and high-speed solar wind streams, can severely disrupt satellite operations, communication systems, navigation, and power grids on Earth. Understanding the dynamics of solar storms, their interactions with Earth's magnetosphere, and the effects of geomagnetic storms on the Earth's upper atmosphere is essential for mitigating their impact on our increasingly technology-dependent world.
This special session will explore the causes and mechanisms of solar storms, including the processes that lead to the release of charged particles and the subsequent formation of geomagnetic storms, as well as their impact on Earth's upper atmosphere. Furthermore, this session will address the challenges in forecasting solar and space storms, emphasizing the limitations of current predictive models and the critical need for advances in real-time monitoring systems.

10:35 [III-1-2]

Observational Overview of Solar Sources for the May 2024 G5-Level Geomagnetic Storm

Sujin Kim[1], Sung-Hong Park[1,2], Eun-Kyung Lim[1], Hwanhee Lee[1], Ji-Hyun Yoo[1,3], Haein Lee[1,3], Ryun-Young Kwon[1], Jungjoon Seough[1], Rok-Soon Kim[1], Hannah Kwak[1], Yeon-Han Kim[1], Kyung-Suk Cho[1], Young-Sil Kwak[1,2], KASI Space Weather Research Group

[1]*Korea Astronomy and Space Science Institute*
[2]*University of Science and Technology*
[3]*Chungbuk National University*

This study reports the observational overview on the solar sources for the G5-level geomagnetic storm that occurred from May 10 to 12, 2024, the most intense event since the 2003 Halloween storm. The storm was triggered by a series of coronal mass ejections (CMEs) originating from the merging of two active regions 13664/13668, which formed a large and complex photospheric magnetic configuration and produced X-class flares in early May 2024. The photospheric magnetic field maps, magnetograms, indicates that the overall magnetic field direction was southward and more than a couple of pairs of highly sheared bipolar structures were associated with flares. Most significant CME driven by an X2.2 flare on May 9 was enough to catch up with and merge with a preceding slower CMEs associated with an X-class flares. The result of the WSA-ENLIL+Cone model simulations suggest that multiple CMEs departed separately at different times underwent merging processes during their propagations owing to their similar directions and different speeds. It implies that the CME-CME interactions play a significant role in producing the strong geomagnetic storm.

10:50 [III-1-3]

Magnetospheric Response to Superstorms

Yukinaga Miyashita[1,2]

[1]*Korea Astronomy and Space Science Institute*
[2]*University of Science and Technology*

Extremely intense geomagnetic storms (superstorms) rarely occur, but recently on 10 May 2024, a superstorm occurred after 20 years. During this superstorm, several spacecraft were in the magnetosphere. The GK2A and GOES 16 and 18 geosynchronous spacecraft observed sudden impulse due to sudden enhancement of the solar wind dynamic pressure, geosynchronous magnetopause crossings, and periodic dipolarizations and energetic particle injections associated with intense substorms called sawtooth events. During another superstorm that occurred on 30 October 2003, so-called “Halloween storm”, the Geotail spacecraft was in the magnetotail and observed that magnetic reconnection occurred at X∼-8 Re, much closer to Earth than usual, associated with an intense substorm. This observation implies that the magnetosphere extremely shrank during the superstorm. In this presentation, I summarize magnetospheric response to the 10 May 2024 and 30 October 2003 superstorms.

11:05 [III-1-4]

Unusual Ionospheric Disturbances over Korea during the Geomagnetic Storm of May 10-12, 2024

Woo Kyoung Lee[1,2], Hyosub Kil[3], Byung-Kyu Choi[1], Juneseok Hong[1], Se Heon Jeong[1], Jeong-Heon Kim[1]

[1]*Korea Astronomy and Space Science Institute*
[2]*University of Science and Technology*
[3]*Johns Hopkins University Applied Physics Laboratory*

This study presents observations of unusual ionospheric disturbances over Korea during the geomagnetic storm of May 10–12, 2024. Using a near-real-time ionospheric monitoring system developed by the Korea Astronomy and Space Science Institute, we identified three notable phenomena: a general reduction in total electron content (TEC) during the storm, particularly on the 12th; abrupt TEC increases at night on the 11th; and significant GNSS signal scintillations associated with these TEC increases. O/N2 maps from TIMED/GUVI data reveal an extension of O/N2 depletion to lower latitudes, persisting on the 12th. This aligns with the TEC reduction observed over Korea, suggesting a link between TEC depletion and changes in neutral composition. On the 11th, nighttime TEC values were comparable to pre-storm daytime values, accompanied by pronounced TEC perturbations and scintillations. We hypothesize that these nighttime TEC enhancements are related to the movement of the equatorial ionization crest to higher latitudes, with equatorial plasma bubbles or traveling ionospheric disturbances potentially causing the observed scintillations. This hypothesis will be further validated through various observations collected during the storm.

11:20 [III-1-5]

Ionospheric and Thermospheric Responses during a May 2024 G5-Level Geomagnetic Storm for East Asian Sector and Global Perspective

Jeong-Heon Kim[1], Young-Sil Kwak[1,2], Tae-Yong Yang[1], Jongil Jung[1], Hosik Kam[1], Jaewook Lee[1], Woo Kyoung Lee[1,2]

[1]*Korea Astronomy and Space Science Institute*
[2]*University of Science and Technology*

This study focuses on the ionospheric responses to the G5-level geomagnetic storm that occurred from May 10 to 12, 2024, from both local and global perspectives. As one of the most intense events since the 2003 Halloween storm, this geomagnetic storm was driven by a series of coronal mass ejections (CMEs), significantly impacting Earth’s magnetosphere and ionosphere. Geostationary satellite observations recorded substantial solar wind-driven changes, such as enhanced fluxes of high-energy particles, magnetic field fluctuations, and periodic particle injections. These disturbances led to an increased energy influx into the upper atmosphere, particularly over the polar regions, resulting in thermospheric heating and alterations in global atmospheric composition and ionospheric structure. In the East Asian sector, including the Korean Peninsula, ground-based observations revealed strong negative ionospheric storm effects,

linked to thermospheric heating and a decrease in the oxygen-to-nitrogen ratio (O/N2) at high latitudes. Additionally, magnetometer data from the East-Asian longitudinal sector captured global responses of storm-time prompt penetration electric fields. Additionally, we coupled the latest IRI-2020 model with the MSIS 2.1 model to calculate the characteristics of the negative ionospheric storm that occurred over the Korean Peninsula during this geomagnetic storm. We conducted a comparative analysis with satellite data and present a brief overview of the results.
These results provide critical insights into local and global ionospheric responses during extreme space weather events, highlighting the need for improved preparedness for future geomagnetic disturbances.

11:35 [III-1-6]

Strong Solar Activity of May 2024 Recorded on Cosmic Ray Neutron Monitor

Jongil Jung[1], Suyeon Oh[2], Young-Sil Kwak[1,3], Jongdae Sohn[1], Yu Yi[4], Geonhwa Jee[5], Yong-Kyun Kim[6]

[1]*Korea Astronomy and Space Science Institute*
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[3]*University of Science and Technology*
[4]*Chungnam National University*
[5]*Korea Polar Research Institute*
[6]*Hanyang University*

A cosmic ray neutron monitor measures neutrons as the secondary cosmic ray particles on the ground base. The count of neutrons detected by the neutron monitor originates from the primary cosmic ray in the energy range of approximately 500 MeV to several GeV. The particles in this energy range respond to solar activity. Thus, neutron monitors are effective instruments for studying and monitoring the space environment. There was extreme solar activity on May 8–11, 2024. During this period, Jang Bogo and Geochang Gamak neutron monitors detected coronal mass ejections as the decreasing count record of big Forbush decrease. They also responded to x-class flares accompanied by solar energetic particles and recorded the increasing in cosmic ray intensity as the ground level enhancement. Additionally, the geomagnetic field has experienced the extreme geomagnetic storm (Kp = 9 and Dst = −412 nT). This study presents the events recorded on two neutron monitors responded to strong solar activity.

306호

Ⅲ-3 안보우주 Ⅲ

Chair: 박재홍(천문연)

10:20 [III-3-1]

Analysis of SWARM Satellite Data for Energetic Electron Flux Enhancement induced by NWC Transmitter

Ho-Sung Choi[1], Jaeheung Park[2]

[1]*Republic of Korea Army*
[2]*Korea Astronomy and Space Science Institute*

Radio waves do not travel well through good electrical conductors like salt water, submerged submarines are cut off from radio communication with their command center at ordinary radio frequencies. Very low frequency (VLF) radio waves can penetrate seawater a few hundred feet, and many navies use powerful shore VLF transmitters for submarine communications. Australian NWC (North West Cape) signal transmitter is known to strongly interfere with the topside ionosphere. Recently, Mishin et al. (2010) concluded that interactions between the NWC signal and ionospheric plasma resulted in nonlinear plasma instabilities, giving rise to turbulence, and ultimately causing a loss of VLF signal. Xia et al. (2020) and ëmec et al. (2020) showed the characteristics of electron density and temperature associated with NWC. Ivarsen et al. (2021) also analyzed the Swarm A, B satellite and NorSat-1 satellite data. In this study, using the SWARM A and B satellite data, we will analyze characteristics and morphology of plasma perturbations around NWC site as well as conjugate region over multiple solar cycles.

10:35 [III-3-2]

The Utilization and Application of Ionospheric Data Assimilation Model from a Space Security Perspective

Jeong-Heon Kim[1], Se-Heon Jeong[1], Young-Sil Kwak[1,2], Jong-Kyun Chung[1]

[1]*Korea Astronomy and Space Science Institute*
[2]*University of Science and Technology*

For the space security, the Earth's ionosphere plays a critical role in ensuring reliable gound-satellite communication and satellite-based navigation systems. The ionosphere, being a highly dynamic region, is subject to a variety of local phenomena and anomalies that can severely affect trans-ionospheric radio signals. Accurate ionospheric models are therefore essential for maintaining the integrity of these systems, especially in a

defense and security perspective where uninterrupted and precise communication is paramount. While global ionospheric models have provided insights into large-scale space weather patterns, they often lack the spatial and temporal resolution needed to monitor and predict local ionospheric variations effectively. In particular, the Korean peninsula experiences unique ionospheric conditions that require a dedicated approach for real-time monitoring and forecasting. This is crucial for predicting and mitigating disruptions to ground-satellite communication and satellite-based navigation systems—an important aspect of national defense and space operations. To address these challenges, various approaches to ionospheric modeling have been developed, including theoretical, empirical, and data assimilation models. Among in these, data assimilation models integrate observational data with physical models to produce more accurate and timely predictions. In this presentation, we will introduce the concept of our developed data assimilation model, called the Korea Ionospheric Data Assimilation Regional Prediction Model (KIDARiM). This model has been developed to assimilate observational data from the Korean peninsula and its surrounding areas, enhancing the model's resolution, accuracy, and computing time. It can serve as a foundational model for more accurate predictions during ionospheric disturbances, marking a critical starting point from a space security perspective.

10:50 [III-3-3]

Severe GNSS Signal Disturbances over Korean Peninsula during Geomagnetic Storm

Junseok Hong[1], Byung-Kyu Choi[1], Jong-Kyun Chung[1], Woo Kyoung Lee[1], Hyosub Kil[2], Hyuck-Jin Kwon[3]

[1]*Korea Astronomy and Space Science Institute*
[2]*Johns Hopkins University Applied Physics Laboratory*
[3]*Korea Polar Research Institute*

The most of modern equipment including both civil and military purposes indispensably uses the global navigation satellite system (GNSS) for timing and positioning. The convenience of GNSS is a considerable asset, but its utilization is subject to a variety of error sources. The ionosphere is the most prominent factor contributing to these errors. The mid-latitude ionosphere exhibits relatively more stability when compared to the ionosphere at low and high latitudes. In the mid-latitudes, ionospheric electron density irregularities occur very rarely, and even when they do occur, they are of very small magnitude, so correction of ionospheric errors can be relatively easy. In particular, ground-based and satellite-based augmentation systems can correct the ionosphere in near-real time, and their availability is even better in the mid-latitudes. This is advantageous for users in mid-latitudes as they can be less affected by ionospheric errors. However, the severe GNSS signal disruption over Korean Peninsula occurred on November 5, 2023. In this rare case, the strong GNSS signal fade observed at all GNSS system group including augmentation system. These were originated from the strong ionospheric electron density fluctuations over Asian sector owing to geomagnetic storm. On the other hand, the ionosphere were not disturbed in both American and European sectors. It demonstrates that the mid-latitude ionosphere can also be strongly disturbed under the specific geomagnetic condition, and the users should keep in mind the possibility of the natural hazard on GNSS-based system. In this presentation, we will show the severe GNSS signal disturbance case over Korean Peninsula and discuss possible mechanisms.

11:05 [III-3-4]

An Innovative CubeSat Platform for Earth Observation

Goo-Hwan Shin[1], Im-Hyu Shin[1], Il-Young Jang[1], Won-Ho Cha[1], Seung-Jun Cha[1], Chan-Goo Han[1], Mina Koo[1], Yongjun Park[2], Jaehun Jang[2], Jeongin Yun[2], Hyeongcheol Kim[2], Jeongwoo Ahn[2], Hyogeun Han[2], Hyosang Yoon[2], Bong-Kon Moon[3], Dae-Hee Lee[3], Jae-Jin Lee[3], Soojong Pak[4], Gun-Hee Kim[5], Kyung-Su Na[6], In-Young Hwang[6]

[1]*Satellite Technology Research Center, KAIST*
[2]*Spacecraft Prototyping Laboratory, KAIST*
[3]*Korea Astronomy and Space Science Institute, KASI*
[4]*Kyung Hee University*
[5]*Hanbat National University*
[6]*Agency for Defense Development*

Earth observation missions using small satellites have now reached a fully mature stage. The latest semiconductor technology and miniaturization trends are encouraging Earth observation missions using CubeSat spacecrafts. The 18U-class SAPCE SCANeR for an Earth observation mission is being developed based on a standard bus platform in consideration of future mission diversity. A standard spacecraft bus platform with high-precision 3-axis attitude control and large-capacity power supply with solar array and battery is being developed. Therefore, this study presents research results and future plans for a future-oriented and innovative CubeSat platform.

11:20 [III-3-5]

Progress Report: SNIPE in 2024

Jaeheung Park[1], Hosub Song[1], Jae-Jin Lee[1], Jongdae Sohn[1], Tae-Yong Yang[1], Young-Joon Jung[1,2], Youngbum Song[1], Ki Hwan Keum[1]

[1]*Korea Astronomy and Space Science Institute (KASI)*
[2]*Republic of Korea Army (ROKA)*

The SNIPE mission is progressing smoothly since the launch in May 2023. After successful completion of the in-orbit test period, SNIPE-D raised its altitude by 5 km early in January 2024. During the ensuing 4 months, SNIPE-B gradually increased its orbit axis and finally caught up the SNIPE-D altitude at the beginning of May 2024. Serendipitously, an intense geomagnetic storm occurred thereafter with the minimum Dst index reaching −412 nT, which was the strongest event in the last two decades. During the storm period, SNIPE CubeSats were continuously collecting space weather data for about 60 hours around the storm peak. This presentation focuses on SNIPE operation in 2024, especially on ionospheric/thermospheric changes observed during the superstorm. Additionally, we summarize the lessons learned from SNIPE operations, which may be useful in designing future missions including SNIPE-2 and other Korean Earth-observing spacecraft.

402호

Ⅲ-4 SS: 우주탐사의 시작, 우리는 왜 대중소통에 관심 가져야 하는가

모더레이터: 문경수(과학탐험가, 플레이랩스)

10:35 [III-4-1]

Analysis of Public Communication Status of Domestic and Foreign Space Agencies

Haeim Jeong[1], Dongmin Jeong[1], Hyeonju Kim[2], Eunji Yi[1,3]

[1]*Korea Astronomy and Space science Institute*
[2]*Korea Aerospace Research Institute*
[3]*University of Science and Technology*

As the era of space exploration approaches, the importance of public communication activities is also growing. This study seeks to confirm the public communication activities of domestic and foreign space organizations using quantitative and qualitative methods and trend analysis.

We analyze the cases of Korea Astronomy and Space Science Institute and Korea Aerospace Research Institute, which are representative domestic astronomy-related research institutes, Hanwha, Boryeong, and Hyundai as industries, and NASA and ESA as foreign space agencies. Based on this, we discussed future improvement directions.

10:50 [III-4-2]

Easy Access to Space Exploration: Open Opportunity in Space Development

SeokHee Lim

Korea Aerospace Research Institute

I vividly recall the day in 9th-grade Earth Science class that ignited my lifelong passion for space. My teacher drew a massive sun on the blackboard, with a tiny Earth the size of a red bean orbiting it. The humbling realization of Earth's insignificance in the vast cosmos left a profound impression on me. From that moment, I was determined to explore the space and inspire others to do the same.

I shared my excitement about space, especially with younger generations as many as possible. I hoped to instill in them the same sense of wonder I had experienced. Whether it was curious elementary students, introspective teenagers, or even uninterested high schoolers, I aimed to spark their curiosity about the space.

Initially, my presentations focused on the basics of rocketry. However, I soon realized that not everyone are interested in my rockets. As I expanded my audience, I discovered that people were interested in a wide range of space-related topics, from satellites to astronomy. To accommodate these diverse interests, I shifted my focus to the broader theme of "The Universe (Space) and Me." By exploring the history of space exploration and encouraging audience members to ponder their place in the cosmos, I aimed to foster a deeper connection between individuals and the universe.

The successful launches of LV Naro and Nuri ignited my passion for launch services. Finally I understood the structure of ecosystem of space industry. It showed me that the new space age demands a multidisciplinary approach. The integration of non-space tech is revolutions of space industry.

Space exploration requires not only scientific and technological expertise but also a humanities inspired by the cosmos. While some individuals, often reffered to as "space enthusiasts", participate in competitions like rocketry challenges, satellite contests and hackathon to applications. Some informal events like Yuri's Night and World Space Week, where people come together to share their passion for space, are belong to them. In recent years, with the New Space Age, I've seen a growing interest in space among people from all walks of life.

We live where anyone can become a space explorer. By breaking down the psychological barriers that often prevent people and space enthusiasts from participating, we aim to create a more inclusive and accessible space community. Let's make together a future where everyone can leverage their own skill and contribute to this exciting endover.

To inspire more people to explore space, we need to offer classes that go beyond just one-time lectures. We need a series of classes that help students learn deeply about space. It is really important to create a learning plan that covers many different subjects related to space. At the same time it is imperative that all curriculum be developed concurrently that is suitable for the students' learning levels.

11:05 [III-4-3]

Public Engagement in the Era of Space Exploration: A Case Study of Public-Private Collaboration in Youth Programs

Sung-chan Roh

Science and Technology Communication Team, KOSAC

KOSAC designs and implements various initiatives based on policies aimed at disseminating science and technology culture to facilitate effective communication between the scientific community and the public. In the current era of heightened focus on space exploration, raising public awareness and societal interest in this field has become a critical mission for our foundation.
To address this, KOSAC has been actively collaborating with competent private sector entities in the space industry to launch innovative programs designed to elevate public interest in the age of space exploration. This presentation will provide an overview of the significance of public engagement in the space exploration era, showcasing various case studies of programs implemented by KOSAC, with a particular emphasis on our new initiatives developed through public-private partnerships.

201호

Ⅳ-1 SS: 태양-우주폭풍 II

Chair: 김정헌(천문연)

13:00 [Ⅳ-1-1]

Six-Hour Prediction of Southward Interplanetary Magnetic Field Bz using Deep Learning

Jihyeon Son[1], Yong-Jae Moon[1,2], Young-Sil Kwak[3], Kyung Sun Park[4], Hyun-Jin Jeong[1]

[1]*Department of Astronomy and Space Science, Kyung Hee University*
[2]*School of Space Research, Kyung Hee University*
[3]*Space Science Division, Korea Astronomy and Space Science Institute*
[4]*Department of Astronomy and Space Science/Basic Science Research Institute, Chungbuk National University*

In this study, we develop deep learning models to predict the 6-hour southward interplanetary magnetic field (IMF) Bz component. The model is based on a bidirectional long short-term memory method, and input parameters are solar wind data (V, N, T) and IMF components (Bt, Bx, By, Bz). The data are obtained from OMNI, whose period is from 2000 to 2022. We use the preceding 12 hours of data as input and the subsequent 6 hours of Bz data as target data. To focus on strong geomagnetic conditions, we consider periods where Bz values drop below the negative standard deviation (about −3 nT) for at least 6 hours. The model is trained and validated using a 12-fold cross-validation process, with each model trained over 8 months of data and tested over 4 months. Our models achieve an average RMSE ranging from 1.75 nT (30-minute prediction) to 2.55 nT (6-hour prediction), significantly outperforming traditional methods such as multi-layer perceptron and multiple linear regressor. Our model can capture both decreasing and increasing phases of Bz, showing reliable performance across varying geomagnetic conditions. Our results suggest a sufficient possibility for predicting Bz under specific conditions. We expect that our model can be used for subsequent space weather predictions such as global MHD simulations in the magentosphere.

13:15 [Ⅳ-1-2]

Understanding CME-CME Interactions and Their Impact on the May 2024 Geomagnetic Storm

Roksoon Kim[1], Jasmina Magdalenic[2,3], Brigitte Schmieder[3,4], Stefaan Poedts[3,5]

[1]*Korea Astronomy and Space Science Institute*
[2]*Royal Observatory of Belgium*
[3]*Katholieke Universiteit Leuven*
[4]*Observatoire de Paris*
[5]*University of Marie Curie-Sklodowska*

In May 2024, a significant geomagnetic storm occurred, driven by multiple Coronal Mass Ejections (CMEs) interacting in interplanetary space. This study investigates the complex interactions between these CMEs and their combined impact on geomagnetic activity. We analyzed solar radio bursts and proton event to holistically understand the stages of interaction between CMEs. Additionally, we utilized solar wind model to simulate these interactions and compared the results with actual observations. The compounded effects of CME-CME collisions resulted in amplified magnetic fields and increased geoeffectiveness, particularly when dense and fast CMEs overtook slower ones, forming complex, turbulent shock fronts. Our findings underscore the importance of understanding CME interactions in predicting the severity of space weather events, highlighting the need for enhanced forecasting models to account for the non-linear dynamics introduced by CME-CME interactions.

13:30 [Ⅳ-1-3]

Solar Energetic Protons as Indicators of Geomagneic Storms

Ryun Young Kwon, Hwanhee Lee, Ji-Hyeon Yoo, Haein Lee

Korea Astronomy and Space Science Institute

We present a new method for forecasting geomagnetic storms that enhances the hitting rate and reduces the false alarm rate. It is well established that geomagnetic storms are associated with fast solar coronal mass ejections (CMEs). These fast CMEs, traveling at supersonic speeds, generate shocks capable of accelerating solar energetic particles in interplanetary space as well as in the solar corona. Recognizing that geomagnetic storms are often linked to energetic particle events, we have developed a method that employs near real-time GOES proton flux data to improve the accuracy of geomagnetic storm forecasts. In this paper, we first present the statistics of geomagnetic storms in relation to solar activities, such as flares and CMEs, as well as solar cycles. We then demonstrate that the flux-time profiles of solar energetic particles serve as indicators of potential geomagnetic storms following flare and CME events, thereby acting as precursors for such storms.

13:45 [Ⅳ-1-4]

Why do We still Need to Understand Severe Storm Event using a Global MHD Simulation?

Kyung Sun Park

Chungbuk National University

We observed at least seven coronal mass ejections (CMEs) from the Sun, which passed through the Earth's magnetosphere for three days from May 10 to 12, 2024. During this period, the Dst index reached a minimum of −412 nT at 03 UT on May 11. Also, the AL index was below −1,500 nT for about ten times. This means that a powerful magnetic storm and several substorms occurred.

A global MHD simulation was performed to investigate how the strong solar winds impact the Earth's magnetosphere and ionosphere. The simulation result shows a highly compressed magnetosphere, with the magnetopause located even inside the GEO during the severe storm events. The cross-polar cap potential is exceptionally high for a strong magnetic storm. I will introduce some new results from the global simulation.

14:00 [Ⅳ-1-5]

The Impact of Lower Atmosphere Forecast Uncertainties on WACCM-X Prediction of Ionosphere-Thermosphere System during Geomagnetic Storms

In-Sun Song[1], Wonseok Lee[2], Ja Soon Shim[2], Guiping Liu[2], Geonhwa Jee[3]

[1] *Yonsei University*

[2] *NASA Goddard Space Flight Center*

[3] *Korea Polar Research Institute*

Impacts of lower atmosphere forecast uncertainties on the Ionosphere-Thermosphere (IT) system are investigated using the Whole Atmosphere Community Climate Model with Thermosphere and Ionosphere eXtension for April 2010 and March 2013 geomagnetic storms. For each storm, a specified-dynamics simulation (analysis run) is carried out by constraining the model dynamics using reanalysis data. Results of the analysis runs are used as initial conditions for forecast runs initialized on 20, 10, 5, 2, and 1 day before the storm onset time. The forecast runs show that errors in TEC appear in the equatorial region within 1−2 days after forecast starts and expand to high-latitudes after 10 days. These errors in TECs could be due to the deviations in the semidiurnal (SW2) and non-migrating (DE3) tides that also occur within 1−2 days after forecast starts. SW2 and DE3 tides could modify the E-region wind driven dynamo at low latitudes, affecting the vertical plasma drift in the F-region, leading to the forecast errors in TEC. The TEC forecast errors at high-latitudes could be due to the change in the column integrated O/N2, associated with tidal wind variations and resultant delayed change in vertical motions. The SW2 and DE3 tides can be affected by uncertainties in winds in the mesosphere and lower thermosphere (MLT) in the mid-to-high latitudes. The MLT wind uncertainties are correlated with gravity wave drag (GWD), suggesting that the uncertainties in GWD can be one of the major sources of IT forecast errors.

14:15 [Ⅳ-1-6]

Polar Middle Atmosphere Responses to the G5-Level Geomagnetic Storm of May 2024

Ji-Hee Lee[1], Geonhwa Jee[1,2], Young-Sil Kwak[3,4]

[1] *Korea Polar Research Institute*

[2] *Department of Polar Science, Korea University of Science and Technology*

[3] *Korea Astronomy and Space Science Institute*

[4] *Department of Astronomy and Space Science, Korea University of Science and Technology*

In this study, we investigate the atmospheric responses in the polar middle atmospheres of both the Northern and Southern Hemispheres during the intense 5-level geomagnetic storm of May 2024. We analyze temperature, ozone, and odd hydrogen oxide data from the MLS instruments, along with precipitating electron flux measurements from the POES satellite. Our results reveal an immediate increase in hydrogen oxide, significant ozone depletion, and temperature variations in the polar mesosphere and stratosphere. Additionally, we identify notable responses of HNO_3 and ClO in the polar lower stratosphere of both hemispheres. This analysis offers insights into the sensitivity of the polar middle atmosphere during one of the strongest geomagnetic storm events.

306호

Ⅳ-3 안보우주 Ⅳ

Chair: 최호성(육군)

13:00 [Ⅳ-3-1]

Current Status and Future Plans of KASI's Adaptive Optics

Seonghwan Choi, Jihun Kim, and Kyohoon Ahn, Ji-Hye Baek, Eunsu Park and Yunjong Kim

Korea Astronomy and Space Science Institute

Adaptive optics (AO) was initially proposed in the field of astronomy and has since advanced significantly in the fields of astronomy and defense. Recently, its applications have expanded into fields such as medical and biological imaging, precision inspection and manufacturing, and laser communications. Korea Astronomy and Space Science Institute (KASI) is conducting research to apply AO technology for high resolution imaging and real-time correction of atmospheric turbulence or optical system aberrations. Inparticular, we are focusing on developing precise control algorithms and high-speed data processing technologies to enhance AO performance. Additionally, research is underway to apply artificial intelligence (AI) into AO systems to improve their functionality and performance, as well as to adapt AO for space telescopes. These advancements not only contribute to the international field of astronomy but also aim to localize related technologies, fostering its adaption across various industries in Korea. In this talk, we will introduce current status and future plans of KASI's adaptive optics.

13:15 [Ⅳ-3-2]

Developing an Additive Manufacturing Engine for Reusable Launch Vehicles

Keum-Oh Lee[1], Hyeonjun Kim[1], Jaesung Shin[1], Yong-Oh Noh[2]

[1]*Korea Aerospace Research Institute*
[2]*Vitzronextech*

Since SpaceX has developed and dominated the market for reusable launch vehicles, there has been a growing demand for reusable launch vehicles. Additionally, many modern engines, including SpaceX's Raptor engines, are heavily dependent on additive manufacturing, also known as 3D printing. In this study, the combustor of a 35-ton methane engine for a reusable launch vehicle was designed and manufactured using additive manufacturing, demonstrating the significant cost and component reduction that can be achieved.

13:30 [Ⅳ-3-3]

Development of a Propulsion System Lineup for Realizing Korea's Sovereign Space Exploration Missions

Dongyoon Shin, Eunkwang Lee, Seonghyeon Seo

Perigee Aerospace Inc

Currently, a significant challenge lies ahead in developing various in-space propulsion systems to support innovative space exploration missions. The newly established Korea AeroSpace Administration (KASA) includes these advancements in its ambitious space development plan. Depending on the specific objectives of each mission, the required propulsion system must have unique specifications, including thrust levels, mission lifetime, type of propellants, propellant conditioning methods, and ground operation capabilities. This article provides an overview of the current development status of several propulsion systems and discusses their potential to enable Korea's technology-independent and demanding exploration missions.

13:45 [Ⅳ-3-4]

Small SAR Satellites Constellation as a Dual-Use Technology, and Its Tactical Application

Wanki Jun

ICEYE Oy

Since ICEYE successfully launched the world's first miniaturized advanced SAR antenna on a small satellite in 2018, ICEYE's SAR constellation has successfully provided vital information and solutions to wide range of civil sector requirement, ranging from flood and wild fire monitoring, ocean oil spills, deforestation, and to port activities and maritime securities. The value of SAR for military application also has been demonstrated through extensive usage of SAR data for national security and intelligence, by such organizations as NRO and NGA. With the proliferation of small SAR satellites provided by ICEYE, 38 satellites launched to date, the ICEYE's SAR constellation has become a very important space born asset in many operational battlefields, as demonstrated in the Ukraine war. This fast revisiting and highest resolution ever SAR image intelligence is now considered as a very important tactical asset for the war, in the time of this increasingly non-conventional, mosaic warfare.

14:00 [Ⅳ-3-5]

42 Talks: Real-Time Collision Avoidance Negotiation Platform for Satellites by SpaceMap

Douglas DS Kim[1,2,3], Shawn Choi[1,2], Junny Joo[1], Yusang Lee[1,4], Alan Lee[1], Peter Ryu[1,2]

[1]*SPACEMAP Inc.*

[2]*Voronoi Diagram Research Center, Hanyang University*
[3]*School of Mechanical Engineering, Hanyang University*
[4]*Department of Computer Science, Hanyang University*

Geospace is becoming increasingly crowded raising the risk of collisions between satellites and between satellites and debris. The space catalogue will soon contain O (10^6) or more resident space objects (RSOs), which is two orders of magnitude larger than the current O (10^4) size. Human-rated missions are becoming more frequent. Therefore, it is necessary to perform the conjunction assessment (CA) accurately and quickly. Then, the collision-avoidance (COLA) maneuver trajectory, ideally together with an optimality measure, should be presented as swiftly as possible for conjunctions with a sufficiently high probability of collision. However, performing accurate CA/COLA in (near) real-time with the anticipated O (10^6) objects in the near-future space catalogue is challenging. We introduce SpaceMap's "42 Talks" platform, which can be used for the concurrent avoidance negotiation (CAN) of collision situations among involved parties in near real-time. The 42 Talks platform is powered by SpaceMap's algorithms for real-time CA and near real-time COLA, with consideration of tertiary conjunctions.

14:15 [Ⅳ-3-6]

Development Trends of Reusable Space Launch Vehicle

Jeawhan Lee

Republic of Korea Army HQ

Recently, there has been an increasing interest in the field of space transport. In May 2023, The Nuri (KSLV) succeeded in its third lauch, and the preparation for the fourth launch and the development of the next generation space launch vehicle have begun. In space transport field is operating of developing reusable space launch vehicle that can reduce costs to secure competitiveness due to a rapid increase in demand for launches. In this paper, we will briefly present the current status in development of the a reusable space launch vehicle.

402호

Ⅳ-4 SS: NASA/CLPS 월면 과학탐사 탑재체
Chair: 최영준(천문연)

13:00 [Ⅳ-4-1]

Science Instruments for the Lunar Surface in Collaboration with NASA's Artemis/CLPS Initiative

Chae Kyung Sim[1,2], Young-Jun Choi[1], Dukhang Lee[1], Seul-Min Baek[1], Jehyuck Shin[1], Woohyeong Seol[1], Jongho Seon[3], Minsup Jeong[1], Ho Jin[3], Sung-Joon Ye[4]

[1]*Korea Astronomy and Space Science Institute*
[2]*Korea National University of Science and Technology*
[3]*Kyung Hee University*
[4]*Seoul National University*

KASI is developing four payloads for deployment on the lunar surface, with support from the Korea Aerospace Administration (KASA), in collaboration with NASA's Commercial Lunar Payload Services (CLPS) initiative, as part of the Artemis program and facilitated by the KASI-NASA Exploration Working Group. The four payloads-LUSEM, GrainCams, LVRAD, and LSMAG-have been suggested as candidate payloads based on their scientific and technical merits. LUSEM will detect high-energy particles using solid-state telescopes and is set to operate on the Nova-C lander at Reiner Gamma in 2025. GrainCams will study the upper regolith's microstructure and dust particle behavior near the lunar surface. LVRAD will measure the lunar surface radiation environment, with a focus on potential biological impacts for future human exploration. LSMAG will measure the lunar magnetic field using fluxgate magnetometers and an accelerometer.

13:15 [Ⅳ-4-2]

Calculation Process and Results of Deriving Level-1 Flux using the Forward-Fitting Method in LUSEM

Woo-Hyeong Seol[1], Jongho Seon[2], Go Woon Na[2], Young-Jun Choi[1], Chae Kyung Sim[1,3], Seul-Min Baek[1], Dukhang Lee[1], Jehyuck Shin[1]

[1]*Korea Astronomy and Space Science Institute*
[2]*School of Space Research, Kyung Hee University*
[3]*Korea National University of Science and Technology*

The Lunar Space Environment Monitor (LUSEM) is one of the Korean candidate payloads for the Commercial Lunar Payload Services (CLPS) of the Artemis mission, scheduled to be mounted on the Nova-C lander to observe high-energy charged particles at the Reiner Gamma swirl on the Moon. LUSEM's energy range covers 50 keV–2 MeV for electrons and 50 keV –20 MeV for protons, and its field of view is 20° × 20°. It simultaneously observes both the lunar surface and the zenith. LUSEM is expected to contribute to the study of key scientific topics such as lunar surface radiation, space weathering, and magnetosphere-Moon interactions. To conduct a quantitative study of the space environment, the energy flux of charged particles must be derived from the initial observational data collected by the particle detector. In this study, the forward-fitting method was employed to convert the count data measured by the

instrument into particle flux. The forward-fitting method assumes the particle flux follows a predefined function, and adjusts the parameters of that function to best match the observational data with the model's predictions. To verify the suitability of the forward-fitting method, we applied it to the results of a Monte Carlo simulation conducted using Geometry ANd Tracking 4 (GEANT4). We will present the calculation process and the results of this application.

13:30 [Ⅳ-4-3]

The Development of Lunar Surface MAGnetometer (LSMAG) Instrument

Hyeonhu Park[1], Ho Jin[1], Juhyeong Kim[1], Khan-Hyuk Kim[1], Seungmin Lee[1], Hyojeong Lee[2], Seongwhan Lee[2], Seul-Min Baek[3], Jehyuck Shin[3], Chae Kyung Sim[3], Dukhang Lee[3], Young-Jun Choi[3,4]

[1]*School of Space Research, Kyung Hee University*
[2]*NARA Space Technology*
[3]*Korea Astronomy and Space Science Institute*
[4]*Korea National University of Sceince and Technology*

Lunar Surface MAGnetometer (LSMAG) had developed as one of the candidate scientific payload instruments for the NASA's Commercial Lunar Payload Services (CLPS) initiative based on the KASI-NASA exploration Working Group. The primary scientific objective of the LSMAG is to investigate the magnetic field on the Moon's crust and the interaction between the solar plasma and the lunar surface. This investigation will help enhancing our knowledge of lunar space weather and providing insights into the interior of the Moon.

The LSMAG's design has the heritage from Korea Pathfinder Lunar Orbiter magnetometer (KMAG). This instrument consists of two main units: Fluxgate Magnetometer Control Electronics (FCE) unit and Magnetometer (MAG) unit. The FCE unit controls the overall system, including communication with the sensors and lander. The MAG unit has three kinds of triaxial sensors: two fluxgate magnetometers (FGMs) and one anisotropic magneto-resistive (AMR) sensor, and one accelerometer.

All sensors are installed in 1-meter boom to minimize magnetic interference from the lander. The FGM has a measurement range of ± 2,000 nT with a resolution of 0.2 nT. The AMR sensor has a wider measurement range (± 80,000 nT) than the FGM for measuring an unexpectedly strong magnetic field exceeding the FGM's capacity and improving noise removal method. Additionally, the accelerometer provides the attitude of LSMAG and system vibration for the acquisition of more precise data. This also can help analyzing the lander attitude. We believe that the LSMAG will contribute to the future lunar exploration as one of the scientific instrument.

13:45 [Ⅳ-4-4]

Measurement and Calibration of the LVRAD Advanced Particle Dosimeter and Spectrometer (APDS) for the Charged Particle Environment on the Lunar Surface

Sukwon Youn[1], Uk-won Nam[2], Sunghwan Kim[3], Hongjoo Kim[4], Hwanbae Park[4], Won-Kee Park[2], Jongdae Sohn[2], Chae Kyung Sim[2], Dukhang Lee[2], Seul-Min Baek[2], Jehyuck Shin[2], Woo-Hyeong Seol[2], Young-Jun Choi[2], Insoo Jun[5], Sung-Joon Ye[1]

[1]*Seoul National University*
[2]*Korea Astronomy and Space Science Institute*
[3]*Cheongju University*
[4]*Kyungpook National University*
[5]*Jet Propulsion Laboratory*

The Advanced Particle Dosimeter and Spectrometer (APDS) is a radiation detector included in the Lunar Vehicle Radiation Dosimeter (LVRAD), a scientific payload for measuring the radiation environment on the lunar surface. The APDS is designed to perform the functions of an LET spectrometer and a proton energy spectrometer simultaneously. The thin and thick silicon photodiode sensors in the front of the instrument function as the LET spectrometer and the low-energy proton spectrometer. The CsI sensor and the thick silicon photodiode sensor at the back of the instrument function as the high-energy proton spectrometer. The comprehensive LET spectra for heavy ion beams were obtained using the APDS at the Heavy Ion Medical Accelerator in Chiba (HIMAC). The energy spectra for protons were obtained using the APDS at the Korea Institute of Radiological and Medical Sciences (KIRAMS). In this talk, the results of measurement and calibration of APDS using proton and heavy ion beams will be presented.

This work was supported by the National Research Foundation of Korea (NRF) Grant funded by Korea government (MSIT) (NRF-2020M1A3B7040417, NRF-2020M1A3B7108845).

14:00 [Ⅳ-4-5]

Design and Performance of Neutron Sensor on the Lunar Surface

Uk-Won Nam[1], Sukwon Youn[2], Sunghwan Kim[3], Hongjoo Kim[4], Won-Kee Park[2], Jongdae Sohn[2], Chae Kyung Sim[2], Dukhang Lee[2], Seul-Min Baek[2], Jehyuck Shin[2], Woo-Hyeong Seol[1], Young-Jun Choi[2], Insoo Jun[5], Sung-Joon Ye[2]

[1]*Korea Astronomy and Space Science Institute*
[2]*Seoul National University*
[3]*Cheongju University*
[4]*Kyungpook National University*
[5]*Jet Propulsion Laboratory*

The neutron measurement technique is crucial for understanding the radiation environment and detecting water on the Moon. For application in measuring the lunar environment, we have developed a neutron sensor consisting of NS-F for a fast neutron dosimeter and NS-E for a thermal/epithermal neutron spectrometer. The NS-F builds on the heritage of the LEO-DOS (Low Earth Orbit Space Radiation Dosimeter). The NS-E, designed to provide evidence of water, utilizes the CLYC scintillator, which can separate neutrons and gamma rays from the lunar surface radiation. Thus, the NS-E can be used as both a thermal/epithermal neutron spectrometer and gamma-ray spectrometer with a single sensor. This paper presents the design and properties of the neutron sensors developed for the LVRAD (Lunar Vehicle Radiation Dosimeter) instrument, which is a scientific payload proposed to the Commercial Lunar Payload Services (CLPS) program.

This work was supported by the National Research Foundation of Korea (NRF) Grant funded by Korea government (MSIT) (NRF-2020M1A3B7040417, NRF-2020M1A3B7108845).

14:15 [Ⅳ-4-6]

Light Scattering Properties of Lunar Simulant JSC-1A depending on Its Microstructure

Minsup Jeong[1], Jinkyu Kim[2], Sungsoo S. Kim[2], Yuong-Jun Choi[1]

[1]*Korea Astronomy and Space Science Institute*
[2]*Kyung Hee University*

We are currently developing GrainCams, a CLPS candidate payload, to understand the microstructure of lunar soil. The microstructure of lunar soil significantly affects its light scattering properties, which are also related to the soil's physical characteristics. To the physical properties of lunar soil, we conducted light scattering experiments using JSC-1A, a lunar regolith simulant. The experiment analyzed changes in light intensity and degree of polarization based on the phase angle between the incident and reflection angles. We found that the degree of polarization, as well as the light intensity, depends on the incident angle. We believe that changes in light scattering properties based on the incident angle are due to variations in the proportion of multiple scattering caused by the soil's microstructure and roughness.

404호

Ⅳ-5 SS: 차세대 분광탐사 기획연구

Chair: 한정열(천문연)

13:00 [Ⅳ-5-1]

Feasibility Study for Next-Generation Spectroscopic Surveys with Dedicated Large Telescopes: Science Goals

Sungwook E. Hong[1,2], Jae-Woo Kim[1], Arman Shafieloo[1,2], Sang-Hyun Chun[1], Soung-Chul Yang[1], Jubee Sohn[3], Ho Seong Hwang[3], David Parkinson[1,2], Changbom Park[4]

[1]*Korea Astronomy and Space Science Institute*
[2]*Astronomy Campus, University of Science and Technology*
[3]*Seoul National University*
[4]*Korea Institute for Advanced Study*

Various spectroscopic surveys have been conducted by major countries, creating significant scientific and technological achievements in astronomy. In particular, the development of observational instruments such as spectrographs and analysis techniques has continuously uncovered previously unknown research subjects such as dark matter, dark energy, and exoplanets. So far, spectroscopic surveys in Korea have mostly been performed by joining international projects led by foreign countries. These projects, due to their design and the size of the telescopes used, have technical limitations that generally allow only selective surveys of specific types of galaxies, making it insufficient to understand the universe as a whole. To overcome this, the Korea Astronomy and Space Science Institute (KASI) has started a feasibility study since 2024 to explore the possibility of an unbiased large-scale spectroscopic survey of 100 million stars and external galaxies brighter than a certain magnitude through visible and near-infrared medium-high dispersion spectroscopic observations. In this talk, we will introduce the three main science topics of the new spectroscopic survey: stars/exoplanets, extragalaxies/galaxy clusters, and cosmology/large-scale structures. We will also cover the activities of their working groups and derived system requirements.

13:15 [Ⅳ-5-2]

Current Status of Working Group for Conceptual Study of a Spectroscopic Survey Telescope

Jeong-Yeol Han[1,2], Jiwoo Lee[1,2], Jaehyun Kyeong[3], Hyoungkwon Lee[3], Chung-Uk Lee[1], Jae-Woo Kim[1], Byeong Gon Park[1], Yunjong Kim[1,2], Sungwook E. Hong[1,2], Junghun Yoo[4], Youngsoo Kim[5], Sangyoung Park[5], Jung-Hwan In[6], Young-Man Choi[7], Il Kweon Moon[8]

[1]*Korea Astronomy and Space Science Institute*
[2]*Korea National University of Science and Technology*
[3]*Leo Space Co., Ltd*
[4]*Green Optics Co., Ltd.*
[5]*Hanwha System Co., Ltd.*
[6]*Korea Photonics Technology Institute*
[7]*Ajou University*

[8]*Korea Research Institute of Standards and Science*

The Korea Astronomy and Space science Institute (KASI) is planning a spectroscopic survey telescope and is aiming to develop a large-aperture mirror of 6 or 10 meters to secure sufficient light and increase resolution. Since research through spectroscopic observation is a major scientific topic, it is necessary to develop a spectrometer that meets the purpose, and a working group is operating to develop elemental technologies such as design, materials, and polishing from requirements derivation to develop new concepts of telescopes and spectrometers. This presentation will introduce the operation of the working group for planning a spectroscopic survey telescope and the results of the conceptual study.

13:30 [Ⅳ-5-3]

Current Status of Low Thermal Expansion Materials for Space Optics: Large Diameter Mirrors

Ju Hyeon Choi, Seon Hoon Kim, Karam Han, Jung-Hwan In

Optical Lens Material Research Center, Korea Photonics Technology Institute

Large-diameter mirror materials for space telescopes requires materials with a very low coefficient of thermal expansion. Several products such as ZERODUR, ULE, and CLEARCERAM-Z and SiC has been used for optics in space applications. In this presentation, I would like to introduce the manufacturing processes and characteristics of various low-expansion materials and to introduce the manufacturing cases of large-scale telescope mirror materials. And I would like to introduce the current status of technology for low expansion materials.

13:45 [Ⅳ-5-4]

Current Status of the Development of a Robotic Fiber Positioner System for Multi-Object Spectroscopic Telescopes

Hyunho Lim[1], Ho Seong Hwang[2], Jae-Woo Kim[3], Sungwook E. Hong[3], Jong Chul Lee[3], Young-Man Choi[1]

[1]*Ajou University*
[2]*Seoul National University*
[3]*Korea Astronomy and Space Science Institute*

The robotic focal plane system facilitates multi-object spectroscopy (MOS) for hundreds to thousands of galaxies by employing a dense array of positioners that are tightly packed on the focal plane of a telescope. These positioners are constructed as SCARA robots, each driven by two rotational motors. Arranged densely on the focal plate, the positioners enable the fibers to move simultaneously to the positions of the target galaxies. However, the close arrangement can lead to collisions between positioners, making a path planning algorithm essential for preventing these collisions and ensuring precise fiber positioning. In this paper, we aim to develop a robotic fiber-optic positioning system capable of observing more than 19 objects per square degree (deg^2). In addition, we propose a new path planning algorithm to prevent collisions and ensure convergence of all positioners for given targets.

14:50~16:20 포스터 발표

10월 30일(수) 201호

V-1 태양 및 우주환경 II

Chair: 이하림(경희대)

08:30 [V-1-1]

Long-Term Characteristics of the Mesopause Wind observed from Meteor Radar at King Sejong Station, Antarctica and Comparison with SD-WACCM-X Simulations

Byeong-Gwon Song[1], In-Sun Song[1], Nicholas M. Pedatella[2,3]

[1]*Department of Atmospheric Sciences, Yonsei University*
[2]*NSF National Center for Atmospheric Research, High Altitude Observatory*
[3]*COSMIC Program Office, University Center for Atmospheric Research*

The mesopause region (z ~80–100 km) is an important region connecting the Earth's lower atmosphere and space environment. Although many observational studies have been conducted to understand the dynamics in the mesopause region, long-term observations exceeding one solar cycle (~11 years) have been rare, especially in the Southern Hemisphere (SH) polar region, where continuous observations are limited. For a better understanding of the dynamics in the mesopause region, investigation of vertical coupling processes that can induce variabilities in the region is needed, which can be done using the whole-atmosphere modeling. In this study, we investigate the long-term characteristics of the horizontal wind in the mesopause regions at King Sejong Station (KSS) in the Antarctic Peninsula (62.22°S, 58.78°W) using the 15-year (2007–2021) meteor radar observations and compare them with the simulations

of SD-WACCM-X (Specified Dynamics Whole Atmosphere Community Climate Model with thermosphere-ionosphere eXtension). The climatologies and variabilities of the horizontal winds in the mesopause region revealed in the observations and simulations are examined. The eastward wind bias appeared in the simulation in all seasons. In particular, the observed eastward winds above z = 90 km in the SH winter are not well reproduced by the SD-WACCM-X simulations. The simulated meridional winds are generally stronger than the observations, with more distinct annual variations below z = 90 km. In order to estimate the long-term trends of the mesopause winds at KSS, multiple linear regression is applied to both observations and simulations. In July (SH winter), statistically significant positive trends of the zonal wind are observed above z = 90 km, while no significant trends are found in the simulation.

08:45 [V-1-2]

Long-Term Observations of Thermospheric Winds near the Southern Polar Cap Boundary

Eunsol Kim[1], Geonhwa Jee[1,2], Young-Bae Ham[1,2], Changsup Lee[1,2]

[1]*Korea Polar Research Institute*
[2]*University of Science and Technology*

We study the climatology of upper thermospheric horizontal winds (~250 km) near the southern polar cap boundary using Fabry-Perot interferometer (FPI) measurements at Jang Bogo station (JBS), Antarctica, during 2014–2022. Both the zonal and meridional neutral winds showed a dominant diurnal variation which is the anti-sunward motion in the polar cap region. The magnitude of neutral winds increases with increasing solar activity (F10.7 index) and geomagnetic activity (Kp index), and the variability of winds is larger for high solar activity and geomagnetically disturbed time. The winds also show interplanetary magnetic field (IMF By and Bz) dependence. It is noticeable that the response of neutral winds to geomagnetic activity is larger for high solar activity than for low solar activity condition.

09:00 [V-1-3]

Comparison of Electron Phase Space Densities measured with GK2A, GOES-16, and GOES-17

Chanhaeng Lee[1], Woohyeong Seol[1], Seonghwan Choi[1], Jongho Seon[2], Khan-Hyuk Kim[2], Dae-Young Lee[3]

[1]*Korea Astronomy and Space Science Institute*
[2]*School of Space Research, Kyung Hee University*
[3]*Department of Astronomy and Space Science, Chungbuk National University*

Electron phase space density (PSD) is a significant physical quantity for understanding the Earth's radiation belt environment. Many studies have utilized PSDs to investigate phenomena that cause changes in the distribution of electrons in the radiation belt. Furthermore, comparing PSDs under stringent geomagnetic conditions allows for precise inter-satellite calibration, ensuring measurement consistency across different satellites. In this study, we investigated electron PSDs in geostationary orbits using data from the GK2A, GOES-16, and GOES-17 satellites. We will present the PSD calculation process and the results of the PSD comparison, including inter-satellite calibration.

09:15 [V-1-4]

Correlations between the Waiting Time of C-Class Flares and the Strength of X-Class Flares

Il-Hyun Cho, Yong-Jae Moon, Kangwoo Yi, Jaewon Lee

Kyung Hee University

Correlations between the waiting time of C-class flares and the strength of X-class flares are examined. For this, we use the operational list of GOES flares from 1996 to 2024, including non-AR events. It is shown that the strength of X-class flares is positively correlated with the waiting time of C-class flares on a global scale. In contrast, no significant correlation is observed across active regions. This suggests that the overall magnetic energy of the Sun as a whole remains relatively constant, while it varies during the evolution of an active region.

09:30 [V-1-5]

Real-Time Reconstruction of Solar Coronal Magnetic Fields using Physics-Informed Neural Operator

Mingyu Jeon[1], Hyun-Jin Jeong[2], Yong-Jae Moon[1,2], Jihye Kang[2], Kanya Kusano[3]

[1]*School of Space Research, Kyung Hee University*
[2]*Department of Astronomy and Space Science, Kyung Hee University*
[3]*Institute for Space-Earth Environmental Research, Nagoya University*

Nonlinear force-free fields (NLFFFs) are widely used for coronal magnetic field modeling. It requires solving parametric partial differential equations (PDEs) with different parameters given by observed photospheric vector magnetic fields. Conventional methods are time-consuming because they need to solve the parametric PDEs from scratch for each active region. In this study, we develop a physics-informed neural operator (PINO) that learns the solution operator from 2D photospheric vector magnetic fields to 3D NLFFFs. We validate our method using

an analytical NLFFF model. Then we train and evaluate our PINO with numerical NLFFFs from the Institute for Space-Earth Environmental Research database. The results show that our trained PINO successfully generates an NLFFF within one second for any active region on a single consumer graphics processing unit (GPU), making real-time extrapolation of NLFFFs possible. Our AI-generated NLFFFs are quite similar to the target NLFFFs for 60 active regions (ARs) qualitatively and quantitatively. The magnetic energy of the AI-generated NLFFFs of AR 11158 follows a comparable trend to the target NLFFFs.

09:45 [V-1-6]

Unsupervised Classification of Solar Full-Disk Magnetograms using UMAP Algorithm

Kangwoo Yi[1], Yong-Jae Moon[1,2], Hyun-Jin Jeong[1]

[1]*Department of Astronomy and Space Science, Kyung Hee University*
[2]*School of Space Research, Kyung Hee University*

In this study, we utilize Unsupervised Manifold Approximation and Projection (UMAP) to classify full-disk line-of-sight magnetograms. For this, we consider full-disk magnetograms at 00:00 UT from 1996 to 2019: the Solar and Heliospheric Observatory/Michelson Doppler Imager (1996–2010) and the Solar Dynamics Observatory/Helioseismic and Magnetic Imager (2011–2019), as well as Geostationary Operational Environmental Satellite X-ray flare data. The flare categories include B, C, M, X, and Non-flare events. By employing UMAP for unsupervised classification, we identify two distinct groups that may be related to solar cycle phase. However, we do not observe any clear trend of classification for the occurrence of flares within 24 hours. These results may imply potential links between magnetic field structures and solar cycle.

402호

V-4 SS: 대학생 참여를 통한 미래세대 주도의 뉴스페이스 시대 인재 양성(학부생)

Chair: 박경선(충북대)

08:30 [V-4-1]

대학생 참여를 통한 미래세대 주도의 뉴스페이스 인재 양성

Hyunseo Cho, Myoha Yoon, Sungho Lee, Hanjun Oh

Yonsei University

The space industry has now begun to develop into a form of industry beyond national R&D. For example, Korea's space market is currently larger than the bio market in 2008 when the College of Life Systems was established at Yonsei University. However, space development remains a state-led development area, not an industry form, in the public perception. In order to transform this perception toward the public, who will lead Korea, the space industry needs to approach future generations in a more friendly manner. The popularization of these industries will lead to public interest and, furthermore, investors' deep understanding of business models, which will drive the industry to revitalize. In the expression "industrial cooperation system with the university," the public recalls a rather rigid form of collaboration in which the school's research base and industry cooperate. However, in order to revitalize the industry and popularize the company, the industry is closely communicating with the school's field. Beyond simple cases such as promotion booths at festivals and the operation of snack events during exam periods, schools can cooperate in various ways to meet the needs of companies and industries, such as operating scholarship tracks or establishing contract departments to foster human resources in the long run. From the short-term cooperation system to the establishment of a long-term cooperation system, we consider industry-academic cooperation to get closer to students and future generations and discuss ways to do so.

08:45 [V-4-2]

우주 개발 관련 국내 대학 학생들의 활동 및 인식 현황

이성호

연세대학교 전기전자공학부

뉴스페이스 시대로 변화하는 지금, 대학생, 대학원생의 인식과 태도를 조사하기 위해 설문 조사를 수행하였습니다. 해당 조사의 목적은 한국 우주 산업에 대한 젊은 세대의 관심도와 참여도, 그리고 우주 개발에 대한 대중적 인식에 영향을 미치는 요인을 파악하는 데 있습니다. 설문 결과는 학생들의 우주 개발 관련 활동 참여가 증가하고 있으며, 그들의 관심이 대중문화와 밀접하게 연관될 수 있음을 시사하였습니다. 특히, 볼빨간 사춘기의 '우주를 줄게', 윤하의 '사전의 지평선'과 같은 대중 음악이 우주에 대한 관심을 고취시키는 역할을 하고 있다는 독특한 통찰이 도출되었습니다. 이러한 문화적 요소가 우주 개발에 대한 대중의 인식을 확장시키는 데 기여할 수 있음을 제시하며, 한국의 우주 산업 발전과 향후 인재 양성의 중요성을 강조합니다.

09:00 [V-4-3]

인공위성 개발에 대한 학부생들의 도전: 캔위성 프로젝트의 성과와 미래

이현

연세대학교 천문우주학과

발사체 비용의 감소와 큐브 위성의 보편화로 인해 인공위성을 우주로 올려보내는 것이 그 어느 때보다 쉬운 시대가 되었습니다. 이와 같은 변화는 정부 주도의 대규모 프로젝트뿐만 아니라, 민간 기업, 대학, 그리고 학부생들에게도 인공위성 개발에 대한 새로운 기회를 열어주고 있습니다. 이러한 환경 속에서 인공위성 제작에 관심을 가지고 있던 학부생들이 모여 동아리를 결성하고 캔위성 제작을 시작하였습니다. 동아리를 창립한 이후 지금까지 총 5개의 캔위성을 제작하였으며, KAIST 캔위성 경연대회에서 우수상 2회, AAS CANSAT 대회에서 결선 진출이라는 성과를 거두었습니다. 현재는 캔위성 부품의 모듈화, 기판과 소프트웨어의 자체 설계, 서브시스템 매뉴얼 작성을 통해 체계적인 설계, 제작, 운용 역량을 확보하는 데 주력하고 있습니다. 또한, 정기적인 교육, 캔위성 제작 워크숍, 산학연계 행사를 통해 학부생들에게 인공위성의 비전을 알리고, 이를 실현할 수 있는 기초 역량을 다져주고 있습니다. 이러한 활동을 통해 자체적인 개발 역량 향상과 더불어 학부생들의 인공위성에 대한 관심과 참여를 더욱 더 촉진하기를 기대하고 있습니다. 본 발표에서는 학부생들이 캔위성(CanSat)을 제작하면서 겪은 것과 성과, 그리고 앞으로의 목표를 다룰 것입니다.

09:15 [V-4-4]
우주를 향한 첫걸음: 모형 로켓을 통한 대학생들의 뉴스페이스 참여

오한준

연세대학교 기계공학부

최근 우주 산업은 정부 중심에서 민간 기업이 이끄는 '뉴스페이스' 시대로 빠르게 변화하고 있습니다. 이러한 변화 속에서 청년들이 우주에 대한 관심을 갖는 것은 그 자체로 미래 인재 양성의 중요한 출발점이 됩니다. 청년들의 호기심과 열정이 모일 때, 그것이 새로운 기술 혁신과 창의적 문제 해결 능력으로 이어지기 때문입니다. 이 발표에서는 대학생들이 모형 로켓 제작과 연구에 참여하면서 어떻게 우주 기술에 대한 이해를 높이고, 뉴스페이스 시대에 필요한 실질적인 경험을 쌓아가는지를 살펴봅니다. 모형 로켓은 발사체 기술의 기초를 배우는 동시에, 우주 산업에 한 발짝 더 가까워지는 실질적인 경험을 제공합니다. 이를 통해 학생들은 단순한 이론을 넘어 실제로 우주 개발에 기여할 수 있는 준비를 갖추게 됩니다. 본 발표는 청년들이 우주에 대한 관심을 바탕으로 모형 로켓 제작에 참여하며, 이 과정이 그들을 차세대 우주 산업을 이끌어갈 인재로 성장시키는 중요한 역할을 한다는 점을 논의합니다.

404호

V-5 우주천문 & 초소형위성

Chair: 문봉곤(천문연)

08:30 [V-5-1]
A Study on Astronomer Song I-Yeong of the 17th Century

Sang Hyuk Kim[1], Byeong-Hee Mihn[1,2,3]

[1]*Korea Astronomy and Space Science Institute*
[2]*University of Science and Technology*
[3]*Chungbuk National University*

Song I-Yeong (宋以穎, 1619–?) served as a professor of astronomy at the Office of Astronomy during the mid-Joseon Dynasty. Renowned for his expertise in astronomical observation, he recorded significant cometary events in 1661 and 1668. In 1669, Song designed and constructed a mechanical timepiece known as the Honcheonsigye, an armillary clock powered by a weight-driven mechanism. This study provides a comprehensive analysis of Song I-Yeong's life, his contributions to astronomical observations, and his perspective on the integration of Western astronomical knowledge, as reflected in his official roles and responsibilities.

08:45 [V-5-2]
Astronomical Records in the Goguryeo Annals: An Investigation of the Goguryeo-Sacho (高句麗史抄) and Goguryeo-Saryak (高句麗史略)

Byeong-Hee Mihn[1,2,3], Ki-Won Lee[4]

[1]*Korea Astronomy and Space Science Institute*
[2]*University of Science and Technology*
[3]*Chungbuk National University*
[4]*Daegu Catholic University*

Numerous astronomical records exist in Korea since the Three Kingdoms period (Silla, Goguryeo, and Baekje, BC 54–AD 935). This study analyzes the astronomical records found in the Goguryeo annals, specifically the *Goguryeo-Sacho* (高句麗史抄) and *Goguryeo-Saryak* (高句麗史略), authored by Park Chang-hwa (1889–1962). Park claimed these texts were hand- copied from a book discovered at the Imperial Household Library of Japan in Tokyo. To verify the authenticity of these Goguryeo annals, we classified the astronomical records into eight categories and grouped them into two: a calendrical data group (reign-name and calendar date) and a celestial phenomena group (solar eclipse, lunar eclipse, comet, daylight appearance of Venus, meteor/meteorite, and others). Records in each category were compared with those in the *Samguk-Sagi* (三國史記, History of the Three Kingdoms), Chinese chronicles, and modern astronomical computations. This paper presents the results of our analysis on the astronomical records in the Goguryeo annals.

09:00 [V-5-3]
Airborne Experiment of PolCube Polarimetric Camera System

Won-Kee Park[1], Bongkon Moon[1,2], Woojin Kim[1,2], Minseop Jeong[1], Daehee Lee[1,3], Young-Jun Choi[1,2], Chang-Han Kang[4], Jung Sub Byun[4], Eunkyung Kim[5]

[1]*Korea Astronomy and Space Science Institute*
[2]*University of Science and Technology*
[3]*Korea Advanced Institute of Science and Technology*
[4]*Busan Techno Park*
[5]*Busan Metropolitan City*

PolCube is an instrument to study aerosol distribution over Korean Peninsula and super thin cloud in earth atmosphere using two optical imaging cameras with polarization filter. It was developed as the payload for BusanSat, a 12U cubesat commissioned by Busan Metropolitan City. To confirm the functional feasibility of PolCube polarimetric camera system, we have carried out an airborne observation using the Engineering Qualification Model of PolCube. New mechanical structure has been designed to hold the Polcube EQM to make it as PolCube Airborne. PolCube Airborne has flown over Yellow Sea two times and over Busan New Port area to obtain optical 2D polarimetric image data. Initial inspection of raw image data showed that PolCube Airborne operated successfully. We describe in this presentation about the PolCube Airborne and its airborne experiment.

09:15 [V-5-4]

Design and Analysis of Earth Observation Optical Camera for Low Earth Orbit CubeSat

Seungwon Jang[1,2], Jaehyeon Kyeong[1], Youra Jun[1], Hyoungkwon Lee[1], Taeseok Yang[1], Namhee Kim[1]

[1]*LeO SPACE Inc.*
[2]*Hanbat National University*

With the advent of the New Space Era, the demand for low-cost, high-performance Earth observation cameras is growing, driven by the expansion of the small satellite market in Low Earth Orbit (LEO) and the increasing utilization of Earth observation data. In this study, we conducted an optical design and structural analysis of the payload for SPACEye1.5, which are currently under development by LeO SPACE Inc. The primary and secondary mirrors are composed of aluminum mirrors, and the optical performance of the system is analyzed to achieve a ground sampling distance (GSD) of 1.5 meters and a swath width of 14 kilometers at an altitude of 500 kilometers. Additionally, thermal analysis is conducted on the 12U payload structure to ensure its performance is maintained under orbital conditions.

201호

VI-1 태양 및 우주환경 III

Chair: 윤종연(우주항공청)

10:20 [VI-1-1]

ATHENA Mission: Goal and Objectives

Hyosub Kil[1], Larry J. Paxton[1], Woo Kyoung Lee[2,3], Young-Sil Kwak[2,3]

[1]*Johns Hopkins University Applied Physics Laboratory*
[2]*Korea Astronomy and Space Science Institute*
[3]*University of Science and Technology*

The space weather mission ATHENA (Aurora, THErmosphere, ionosphere for SpAceweather) has been developed by the Korea Astronomy and Space Science Institute (KASI) in collaboration with the Johns Hopkins University Applied Physics Laboratory (JHU/APL) since 2022. The mission's main payloads are two optical imagers: KASI/ROKITS+ and APL/GUVI+. These instruments produce images of auroras, atmospheric gravity waves, vertical neutral and plasma profiles, equatorial plasma bubbles, and traveling ionospheric disturbances. By selecting a noon-midnight sector orbit at an altitude of 600–800 km, the mission aims to address data gaps in auroral observations. The scientific goal of the mission is to "determine the space weather associated with thermosphere/ionosphere disturbances caused by auroral energy input and atmospheric gravity wave forcing." The engineering goal is to "improve satellite orbital predictions and communications by specifying thermosphere/ionosphere variability in the noon-midnight sector." The mission objectives are: (1) Determine the total external average energy and flux into the aurora and its propagation to lower latitudes. (2) Identify atmospheric gravity wave activities and their impact on thermosphere/ionosphere disturbances. (3) Assess the impact of thermosphere/ionosphere variability on low-Earth-orbit satellite operations and radio communications. This study discusses the mission's goals and objectives, as well as the science traceability matrix.

10:35 [VI-1-2]

The Two-Banded Structure of Ion-Scale Waves in the Solar Wind: Linear Analysis and Hybrid Simulation

Jungjoon Seough[1], Sunjung Kim[2], Hwanhee Lee[1], Sung Jun Noh[3], Peter H. Yoon[4]

[1]*Korea Astronomy and Space Science Institute*
[2]*Kyung Hee University*
[3]*Los Alamos Laboratory, USA*
[4]*University of Maryland, USA*

The electromagnetic waves at ion scales have been often observed

in the inner heliosphere. According to statistical analysis of the Parker Solar Probe (PSP) measurements, the majority of ion-scale waves, propagating preferentially quasi-parallel to the ambient magnetic field, in the solar wind frame, directs away from the Sun. It is expected that those waves are locally driven by the ion kinetic instabilities, which arise from the non-thermal properties of solar wind ions, including temperature anisotropy and different flow speed between ion species. A recent study reports the PSP observation associated with the ion-scale wave events that exhibit the two distinct wave packets with opposite polarization at different frequencies. With the aid of the linear dispersion analysis under consideration of the Doppler-shift effect, it turns out that the perpendicular temperature anisotropy of proton core and beam, as well as the field-aligned proton beam are likely to be the primary sources of free energy responsible for the generation of such wave packets. In this study, the linear Vlasov analysis of proton and beam cyclotron instabilities, as well as proton beam instabilities, is carried out to investigate the favorable conditions for the excitation of the two-banded structure of ion-scale waves. We further present the hybrid simulations of those instabilities and discuss the importance of the bi-directionally propagating waves as well.

10:50 [VI-1-3]

Bridging Kinetic and Fluid Approaches: Momentum- and Energy-Conserving, Hybrid-PIC Simulation Code

Sunjung Kim[1], Gwangson Choe[1], Dongsu Ryu[2], Sibaek Yi[1]

[1]*Department of Astronomy and Spce Science, Kyung Hee University*
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Space and astrophysical plasma phenomena, such as shock waves, magnetic reconnection, and particle acceleration, are commonly studied using kinetic approaches like full particle-in-cell (PIC) simulations or fluid-based magnetohydrodynamic (MHD) simulations. Full PIC simulations offer detailed insights into kinetic processes but are computationally demanding, especially for multi-scale problems. MHD simulations, while efficient for macroscopic processes, cannot capture kinetic effects. Hybrid simulations, which treat ions as particles and electrons as an inertialess, charge-neutralizing fluid, provide a balance between the detailed resolution of full PIC and the efficiency of MHD.

In this study, we present a novel hybrid simulation code optimized for Graphical Processing Units (GPUs) using OpenACC, ensuring both energy and momentum conservation—unlike many conventional hybrid codes. The core of our method involves solving coupled equations for ion dynamics and electromagnetic fields iteratively. The method guarantees strict conservation of both energy and momentum, with errors in conservation limited only by the convergence of the iteration. We describe the design and numerical implementation of the code and validate its performance through tests on plasma phenomena such as waves, instabilities, collisionless shocks, and magnetic reconnection. Our results show that the code accurately reproduces established solutions and maintains rigorous conservation laws, offering significant improvements in computational efficiency. This hybrid code provides a powerful approach for bridging the gap between full PIC and MHD simulations in space and astrophysical plasma research.

11:05 [VI-1-4]

NOAA Space Weather Scale Frequencies depending on Solar Cycle

Daeil Kim[1], Yong-jae Moon[1,2], Hyun-Jin Jeong[2], Jihyeon Son[2]

[1]*School of Space Research, Kyung Hee University*
[2]*Department of Astronomy and Space Science, Kyung Hee University*

In this study, we examine the relationships between the National Oceanic and Atmospheric Administration (NOAA) space weather scale frequencies and the maximum monthly sunspot number in each solar cycle: 1975 to 2020 for radio blackouts (R scales) and solar radiation storms (S scales), 1932 to 2020 for geomagnetic storms (G scales). Our main results are as follows. First, we find that NOAA space weather scale frequencies have strong solar cycle dependencies. Second, we propose new linear relationships between the frequency of certain scales (R1 to R4, and G1 to G4) and maximum monthly sunspot number. T-test results show that R1 to R3 and G1 to G4 relationships are statistically meaningful, but marginal for R4. Third,our results significantly reduce the root-mean-square error (RMSE) between observed and suggested frequencies compared to the NOAA's current frequencies. For example, in the case of solar cycle 24, our new prediction (74) for R3 scale is much closer to the observation (74) than the NOAA prediction (175), and our prediction (85) for G3 scale is much closer to the observation (40) than the NOAA prediction (200). Our work may provide a useful guideline for advancing the space weather scales.

11:20 [VI-1-5]

Comparison of Empirical and Deep Learning Models for Solar Wind Speed Prediction

Seungwoo Ahn[1], Yong-Jae Moon[1,2], Jihyeon Son[1]

[1]*Department of Astronomy and Space Science, Kyung Hee University*
[2]*School of Space Research, Kyung Hee University*

In this study, we compare representative empirical models with

a deep learning model (Son et al., 2023) for predicting solar wind speed at 1 AU. The empirical models are ESA's ESWF model, which uses the relationship between coronal hole area and solar wind speed, and NOAA/SWPC's WSA-Enlil model, which combines empirical methods with a magnetohydrodynamic (MHD) model. Our deep learning model predicts solar wind speeds over a 72-hour period using extreme ultraviolet (EUV) images. For the test set period from October to December each year between 2010 and 2020, we evaluate the models over this same period based on Carrington Rotations. The results show that our deep learning model significantly outperforms the empirical models, in view of Root Mean Square Error (RMSE) values. Specifically, the ESWF model has an RMSE of 124.8 km/s, while our model achieves 68.6 km/s. Similarly, the WSA-Enlil model records an RMSE of 112.9 km/s compared to 64.6 km/s for our model.

11:35 [VI-1-6]

Near Real-Time Generation of Solar Coronal Parameters based on MAS Simulation using Deep Learning

Rahman Sumiaya

Kyung Hee University

This study is the first attempt to generate the three-dimensional (3D) distribution of the solar corona parameters (density, radial velocity, and temperature) on a near real-time basis by deep learning. For this, we apply the pix2pixCC deep learning model to three-dimensional (3D) distributions of these parameters: synoptic maps of the photospheric magnetic field as input and the magnetohydrodynamic algorithm outside a sphere (MAS) results as output. For each parameter, we consider 169 Carrington rotations (CRs) data from 2010 June to 2023 February: 132 for training and 37 for testing. The key findings of our study are as follows: First, our deep learning models successfully reconstruct the 3D distributions of coronal parameters from 1 to 30 solar radii with an average correlation coefficient (CC: 0.98). Second, during the solar active and quiet periods, the AI-generated data exhibits consistency with the target MAS simulation data. Third, our deep learning models for each parameter took a remarkably short time duration (about 16 seconds for each parameter) to generate the results with NVIDIA Titan XP GPU. As the MAS simulation is a regularization model, we may significantly reduce the simulation time by using our results as an initial magnetic configuration to obtain an equilibrium condition. In the future, we hope that the generated solar coronal parameters can be used for near real-time forecasting of heliospheric propagation of solar eruptions.

305호

VI-2 SS: 국내주도 우주망원경 기획연구

Chair: 이재진(천문연)

10:20 [VI-2-1]

Planning Study on KASI Space Telescope Projects

Woong-Seob Jeong, Yujin Yang, Jeonghyun Pyo, Bomee Lee, Youngsoo Jo, Il-Joong Kim, Jaeyeong Kim, Yongjung Kim, Seongchol Bang, Jae-Joon Lee, Jongwan Ko, Min-Su Shin, Yeon Kil Jung, Jeong-Yeol Han, Bonkon Moon, KASI Qrontier Space Telescope Team

Korea Astronomy and Space Science Institute, Korea

The Korea Astronomy and Space Science Institute (KASI) has initiated a planning study on the next space telescope projects following the SPHEREx mission. Internationally, large-scale space telescope missions, such as the James Webb (NASA), Euclid (ESA), and XRISM (JAXA), are being successfully operated, and space agencies are planning their next space telescope missions. Since the KASI is being requested to participate in these upcoming missions, together with various demands for space telescope missions internally, it is good timing to review those plans under the leadership of the Korea AeroSpace Administration (KASA). The development of a space telescope, which requires substantial budgets and long development periods, must begin by drawing up an overall blueprint through collaboration between industry, academia, and research institutions. In line with this, we aim to discuss both the internationally collaborative space telescope missions currently under review and Korea-led missions and gather feedback from the related communities.

10:35 [VI-2-2]

Expanding Earth Observation Camera Technology for Application in Space Telescopes

Dongok Ryu

Korea Aerospace Research Institute

This paper explores the expansion of Earth observation camera technology for use in space telescopes, focusing on its potential for high performance optical systems in astronomical observation. By leveraging design techniques from Earth observation payloads, we optimized the optical system for space telescopes, refining key performance metrics for astronomical use. Simulations and analyses were conducted to achieve high resolution optical performance. In the assembly and alignment phases, the precise methods and technical expertise gained from Earth observation

projects were applied to ensure the accurate integration of optical components. Advanced technologies were used to minimize errors during assembly. Finally, testing procedures were developed to verify the optical performance of the system, based on proven methods from Earth observation payloads. This approach highlights the potential of extending Earth observation technology to space telescopes, addressing challenges and proposing solutions for the successful development of a space telescope.

10:50 [VI-2-3]

SPHEREx: All Sky Spectral Survey

Yujin Yang

Korea Astronomy & Space Science Institute

The SPHEREx (Spectro-Photometer for the History of the Universe, Epoch of Reionization, and Ices Explorer) is the NASA MIDEX astrophysics mission. It will provide the first all-sky infrared spectro-photometric data to probe the origin of our Universe, to explore the origin and evolution of galaxies, and to investigate whether planets around other stars could harbor life. As the sole international partner on the SPHEREx mission, the KASI SPHEREx team is significantly involved in various aspects of the project, including hardware development, data reduction pipelines, and major and legacy science cases. After finishing the fabrication of flight hardware, the performance of the SPHEREx instrument was successfully measured using the KASI-provided calibration facility including a cryogenic chamber and other optical components. The SPHEREx is now under satellite-level testing. The data reduction modules are also being evaluated. The SPHEREx is expected to be launched early next year. Here, we report the status of the SPHEREx project.

11:05 [VI-2-4]

A Study for Spacecraft Attitude Control System for the Development of a Korean Space Telescope

Hyungjoo Yoon

Korea Aerospace Research Institute

This study selects several representative international cases of space telescope development to examine their basic missions and main system designs. Based on this analysis, the requirements for the spacecraft attitude control system necessary for developing a Korean space telescope were derived. In particular, the technologies applied to achieve ultra-precise attitude stability were investigated. The Fine Guidance Sensor (FGS) of the Hubble Space Telescope (HST) and the James Webb Space Telescope (JWST), as well as the FGS of the recently launched ESA's Euclid Space Telescope, were reviewed. Through these international cases, a configuration plan for the attitude control system that can efficiently develop a Korean space telescope was proposed.

402호

VI-4 SS: 우주 제조 기술과 금성 탐사로의 확장

Chair: 김현준(항우연)

10:20 [VI-4-1]

Enabling Venus Exploration using In-Space Pharmaceutical Manufacturing Technology and Nuri Launch Vehicle

Hyeonjun Kim[1], Yeon Joo Lee[2], Daeban Seo[1]

[1]*Korea Aerospace Research Institute*

[2]*Planetary Atmospheres Group (PAG), Institute for Basic Science (IBS)*

With the recent success of both the development of the Nuri rocket and the Danuri mission, expectations of the government are growing. The government's future space development plan is taking shape, and discussions are taking place on how to create Korea's space economy. In this situation, a plan for a space economic ecosystem related to In-space pharmaceutical manufacturing was recently proposed by the Korea Aerospace Research Institute. This study offers a specific direction for generating demand by exploring the potential for Venus exploration using a space manufacturing platform and Nuri launch vehicle.

10:35 [VI-4-2]

Space Medicine Research and Manufacturing Technology Development in Low Earth Orbit

Younghoon Lee, Jinyang Chung, David Jeon, Vu Huu Pham, Hargsoon Yoon

Space LiinTech Inc.

Last decades, many trials for space medicine research have been applied in low earth orbit to find new solutions to overcome technical barriers in medicine and bioengineering areas on earth and demonstrated their potentials for their novel products development. Bioengineering and pharmaceutical companies increased their research activities for new drug development and manufacturing in international space station and under microgravity in low earth orbit. In this presentation, trends of space medicine research and industrial manufacturing technology development in LEO are introduced.

10:50 [VI-4-3]

Introduction to In-Space Pharmaceutical Manufacturing Technology

Hyeonjun Kim, Daeban Seo

Korea Aerospace Research Institute

The success of the Nuri launch vehicle has boosted South Korea's confidence in pursuing independent space development. In the new space era, the government has high expectations for commercial space development and is implementing supportive policies. However, it is challenging for companies to make profits in the space sector. The business model that relies on NASA's CLPS for providing lunar transportation services, like Intuitive Machines, is not sustainable without demand from public institutions. Even if a base is built on Mars, as envisioned by SpaceX, it will not be feasible without the establishment of a local commercial ecosystem. Until now, the space economic ecosystem has been led by the satellite industry. Therefore, the space pharmaceutical manufacturing industry, which manufactures drugs in space and delivers the produced drugs to pharmaceutical companies upon return to Earth, represents a highly promising business model with significant potential for the sustainability of a truly private industrial ecosystem. In this study, we aim to explore the current trends and possibilities.

11:05 [VI-4-4]

CLOVE Project: Long-Term Venus Monitoring Project using LEO CubeSats to Characterize Atmospheric Variability

Yeon Joo Lee[1], Antonio Garcia Munoz[2], Young-Jun Choi[3], Harald Michaelis[4], Matthias Grott[4], Kyungin Kang[5], Bong-kon Moon[3], Emmanuel Marcq[6], Masateru Ishiguro[7], Semyeon Oh[1], Evgenij Zubko[1], Thomas Behnke[4], Christian Althaus[4], Zizung Yoon[8], Juan Cabrera[4], Heike Rauer[4], Thomas Granzer[9], Daphne Stam[10], Sebastien Lebonnois[11], Takeshi Imamura[12], Minbae Kim[1], Rommy L. S. E. Aliste Castillo[1], David Wolter[4]

[1]*Planetary Atmospheres Group (PAG), Institute for Basic Science (IBS)*
[2]*AIM, CEA, CNRS, Universit Paris-Saclay, Universite de Paris, Gif-sur-Yvette, France*
[3]*Korea Astronomy and Space Science Institute (KASI)*
[4]*DLR Institute of Planetary Research, Berlin, Germany*
[5]*SaTReC, KAIST*
[6]*LATMOS/IPSL, UVSQ Universite Paris-Saclay, Sorbonne Universite, CNRS, Guyancourt, France*
[7]*Seoul National University*
[8]*Korea Aerospace University*
[9]*Leibniz-Institute for Astrophysics Potsdam (AIP), Potsdam, Germany*
[10]*Private, Netherlands*
[11]*LMD/IPSL, CNRS, Paris, France*
[12]*Graduate School of Frontier Sciences, The University of Tokyo, Kashiwa, Japan*

Venus presents significant temporal variations from days to years in the SO_2 gas abundance, unidentified absorbers' amount, zonal wind speed, and cloud top altitude. The nature of the variations has not yet been characterized especially for the weeks to years variations, resulting in difficulties in elucidating its physical and chemical mechanisms. This may be caused by a cascading occurrence of surface volcanic activity, an atmospheric dynamical oscillation, a Solar activity cycle, or a super-position of several sources. We plan to quantify variations in terms of periodicity and fluctuation level and generate input data based on our new observations for detailed model calculations ("CLOVE Project"). Our measurements will acquire disk-integrated reflectivity of Venus using a series of low-Earth orbit CubeSats (CLOVESats). The unique brightness of Venus in the sky makes CLOVESats possible to acquire essential data regardless of limited aperture size. Our first CLOVESat, CLOVESat-1, is planned to be launched in 2026. The Earth-orbit Planetary Camera (EPC) aboard CLOVESat-1 has equipped with carefully selected narrow-band channels to monitor SO_2 gas, the unknown absorber, cloud top altitudes, and vertical structure of clouds using flux and linear polarization measurements. The solar phase angle coverage of EPC will be 30−150 degree under the condition of 20-degree sun exclusion. The consecutive monitoring period is ~6 months between inferior and superior conjunctions of Venus regarding the Sun, i.e., a half of synoptic cycle (0.8 years). To compensate for the possible sensitivity degradation of detectors and the limited lifetime of a typical CubeSat, we plan to launch CLOVESat-2 and successors in the following years to accomplish at least 15 years of observations. Our data will provide essential clues to diagnose the current atmospheric dynamical and chemical status and energy balance of Venus, and to estimate the recent climate history, providing a temporal reference for future Venus missions, EnVision, VERITAS, and DAVINCI.

11:20 [VI-4-5]

Venus Exploration: Scientific Perspectives

Yeon Joo Lee[1], Hyeonjun Kim[2]

[1]*Planetary Atmospheres Group (PAG), Institute for Basic Science (IBS)*
[2]*Korea Aerospace Research Institute (KARI)*

NASA and ESA proceed with future missions to Venus in the late 20s and early 30s (DAVINCI, VERITAS, and EnVision). These missions will investigate the climate and geological evolution of the planet. As Earth's twin, Venus is not just a

planet but provides a natural laboratory showing how Earth-like planets can differ from each other, such as the diversity of planetary systems despite similar starting points. In this presentation, we will summarize what we know about its atmosphere and its interactions with the surface, including active volcanism, and what we do not know yet, such as an unknown absorber in the sulfuric acid clouds and variable atmospheric dynamics, including the global scale atmospheric circulations. We will discuss which future observations are mandatory to understand the system better. Such knowledge will benefit not only Venus research but also the Earth in the solar system and beyond, e.g., Earth-like exoplanets, which may experience active volcanism on their surface.

404호

VI-5 우주산업

Chair: 이형권(레오스페이스)

10:20 [VI-5-1]

Introduction of Verification Method and Result of CAS500-4 (Compact Advanced Satellite500-4) ETB (Electrical Test Bed)

Hyoungjae Oh, Jaehwee Doh, Jongjin Jang

Korea Aerospace Industries, Ltd.

CAS500-4 is the first satellite to utilize a standard platform developed to minimize design changes for CAS500-1 and 2. In addition, the CAS500-4 with CAP-W (Compact Advanced Payload for wide-swath) provide wide-field EO (Electro-optical) images. Before the satellite FM (flight model) is developed, we should be verified electrical interface design (HW, SW, Test Configuration) with ETB. Any discrepancies is founded in ETB that we should be resolved. And then, the results should be reflected in the FM design. In this paper, we will describe the test verification method and result of CAS500-4 ETB.

10:35 [VI-5-2]

Development of Educational Newtonian Reflective Telescope using Additive Manufacturing

Subin Kim[1], Seeun Lee[1], Nagyung Ko[2], Minseo Jung[3], Heejung Yu[1], Dohoon Kim[1], Soojong Pak[1]

[1]*Kyung Hee University*
[2]*Youngshin Girl's High School*
[3]*Somyong Girl's High School*

The Infrared Laboratory at Kyung Hee University has developed the Transformable Reflecting Telescope Kit (TRT Kit). The TRT Kit is an astronomical educational tool to aid students better understand the principles of telescopes through an open-structure design without an optical tube. The TRT Kit uses aluminum profiles for the telescope frame, similar to a vehicle frame, allowing the components to be modularized and assembled securely in aligned position. This design enables easy replacement and reassembly of telescope components. In this study, to be used as a student-participatory educational tool, we employed an additive manufacturing process using eco-friendly PLA material, which is lightweight, cost-effective, and allows for repeated production. The focusing mechanism, previously based on a linear stage, was replaced with a gearbox designed using worm and rack&pinion gears, allowing anyone to easily make The TRT Kit with 3D printer. The PLA-based TRT Kit underwent Finite Element Analysis (FEA), which confirmed its structural stability. The TRT Kit also allows for the design of various types of baffles to block stray light. The initial optical design and analysis were carried out using the open-source mathematical software GeoGebra. Simulations and secondary verification of the baffle structure were then performed using ZEMAX optical design software. Ultimately, we confirmed the optical quality of the telescope by performing the Point Spread Function (PSF) tests. The frame and modular structure concept utilized in the TRT Kit is being applied to space telescope design, and the 3D printing technology is being used in the production of the Engineering Qualification Model (EQM).

10:50 [VI-5-3]

Screening Test Evaluation of Space-Grade High-Reliable SRAM Memory with Hermetic Package based on MIL-PRF-38535

Cheol-Hwan Youn[1], Seong-Geuen Jeong[1], Ki-Sang Park[1], Mi-Young Park[2]

[1]*MID*
[2]*Satellite Technology Research Center, KAIST*

This study evaluates the results of initial defect screening according to the screening test procedures outlined in the MIL-PRF-38535 document. The evaluation includes visual inspections (both internal and external), thermal deformation tests, particle inspection inside the cavity, elimination of initial defects, and electrical testing.
The developed space-grade hermetic high-reliability SRAM memory package utilizes ceramic substrates, which are highly resistant to external environmental factors, and employs hermetic packaging technology. To assess the electrical functionality and performance of the space-grade SRAM memory, each test unit undergoes both screening tests and qualification based on the Quality Assurance Level (Class V) and microcircuit type.

Devices that fail the screening criteria must be removed from the lot immediately upon confirmation of failure, and retesting for acceptance is not permitted.
Among the screening items, the constant acceleration test will be conducted during the subsequent qualification phase after screening. Due to the characteristics of the ceramic material, internal inspection through X-ray (radiography) is not feasible; thus, screening will not include this test. The remaining test items will be evaluated accordingly.
This research has been funded by High Reliability Space-Grade Memory Components Development Program (2020M1A3B2A01084997) of the Korea Ministry of Science & ICT (MSIT).

11:05 [VI-5-4]

A Study on the Changes of Long-Periodic Orbital Elements of Inclined Geosynchronous Orbit by Selecting the Optimal Right Ascension of Ascending Node

Bangyeop Kim

Korea Aerospace Research Institute

Simulations and analysis of long-period Right Ascension of Ascending Node (RAAN) variation of satellites operating in geosynchronous inclination orbits were performed. Study on prediction of long-period orbit variation after the end of the mission life of satellites operating in geostationary and geosynchronous inclined orbits were performed and compared the results with the execution results of FreeFlyer, which is commercial orbit simulation tool. These simulation results can be used as reference material for finding the optimal operation RAAN of inclined geosynchronous satellite constellations.

포스터발표 논문 초록

발표시간 : 10월 29일(화) 14:50~16:20

[P-1] Polarimetric Experiments of Lunar Soil by Grain Size

Serin Kim[1,2], Shuai Li[3], Minsup Jeong[1], Kilho Baek[4], Sungsoo S. Kim[4], Eunjin Cho[5], Young-Jun Choi[1], Chae Kyung Sim[1,2]

[1]*Korea Astronomy and Space Science Institute*
[2]*Korean National University of Science and Technology*
[3]*University of Hawaii at Manoa, USA*
[4]*Kyung Hee University*
[5]*Chungnam National University*

Polarization properties of the Moon provide information about lunar soil, such as grain size. We have performed polarimetric experiments using Apollo soil samples to investigate the effect of grain size on the degree of polarization (DoP). This is the first polarimetric measurement of sieved lunar soil by grain size. The experiments have been conducted at four phase angles (15°, 20°, 25°, and 100°) in multi-band (B, V, and R). A total of five samples (14163, 14260, 61141, 61221, and 65701) from Apollo 14 and 16 missions were used. These samples have been divided into different size groups including the bulk group: XS (< 25 μm), S (25–45 μm), M (45–90 μm), L (90–150 μm), XL (> 150 μm) and S-bulk (< 150 μm). We show that DoP increases with the grain size up to the S size group, but larger size groups show various trends. This contrasts with results from terrestrial samples in which grain size and DoP are proportional. Additionally, for all samples, DoP is inversely proportional to the wavelength. This is consistent with the results of lunar soil simulant and lunar observation. We also discuss the inversion angle at phase angles between 15° and 25°.

[P-2] The Comparative Study on Thermal Analysis of GrainCams based on the Mid-Latitude and Polar Regions

Woojin Kim[1,2], Bongkon Moon[1,2], Dukhang Lee[1], Dae-Hee Lee[1], Minsup Jeong[1], Jihun Kim[1,2], Sung-Joon Park[1], Yunjong Kim[1,2], Seonghwan Choi[1], Jehyuck Shin[1], Seul-Min Baek[1], Mingyeong Lee[1], Chae Kyung Sim[1,2], Young-Jun Choi[1,2], Sungsoo S. Kim[3]

[1]*Korea Astronomy and Space Science Institute*
[2]*Univesity of Science and Technology, Korea*
[3]*Kyung Hee University, Korea*

GrainCams is one of the candidate payloads for the Commercial Lunar Payload Services (CLPS) of NASA. KASI is developing the GrainCams EQM, which comprises two cameras: SurfCam and LevCam. The objective of the SurfCam is to capture images of micro-structures (fairy castle structures) on the lunar surface. LevCam aims to detect levitating or lofted dust grains above the lunar surface.
GrainCams are exposed to operate in extreme thermal environments. To assess their safety under such conditions, thermal analyses were conducted in two different latitudes: mid-latitude (36.5°) and the lunar South Pole (89.9°). In this paper, we present the results of the thermal analysis of GrainCams and compare the finding at the two landing sites.

[P-3] A Proposal for a Science Traceability Matrix for Emerging Nations in Space Exploration

Joo Hyeon Kim

Korea Aerospace Research Institute

Space development primarily aims to utilize space resources to develop new technologies and industrial sectors, while space exploration focuses on acquiring scientific knowledge by investigating and measuring the physical and chemical properties of celestial bodies or Space beyond Earth's orbit. Consequently, the highest priority in the planning and proposal stages of space exploration missions should be the clear presentation of scientific goals and objectives.
To systematically establish the research and development processes required for space exploration, organizations such as NASA in the United States and ESA in Europe mandate the submission of a Science Traceability Matrix (STM) or similar matrices during the mission proposal stage. Despite variations in naming, these matrices serve a common purpose: to systematically and logically present the relationships between scientific goals, objectives, and the technical requirements needed to achieve them.
Currently, South Korea's only space exploration experience is through lunar exploration by Danuri lunar orbiter; however, future national space exploration plans include a lunar landing, Mars explorations, and other space missions.
In this presentation, we propose a Science Traceability Matrix tailored for emerging nations in space exploration, such as South Korea, which have experience in space development but limited exposure to exploration focused on scientific measurement to fulfill ultimate science objectives. The key proposed elements are "Inflexible requirement" and "Upper and Lower limits" of engineering requirements. The proposed STM element aims to address the imbalance in collaboration between space technology development and scientific mission objectives, and to establish a development system that fosters strong cooperation between science and technology, thereby enhancing the scientific achievement

in space exploration.

[P-4] Thermal Control Technology for Planetary Mission of Spacecraft

Hui-Kyung Kim[1,2]

[1]*Korea Aerospace Research Institute*
[2]*University of Science and Technology*

Satellites orbiting Earth are subjected to extreme thermal environments due to the conditions of cryogenic deep space and external heat influx. However, they benefit from Earth's relatively stable temperatures, allowing for thermal design aimed at maintaining thermal control. As a result, the thermal control design technology for satellites ensures high reliability and thermal safety. In contrast, interplanetary spacecraft and planetary surface missions beyond Earth's orbit encounter nearly uncontrollable external thermal environments, challenging conventional satellite thermal control technologies. These missions require thermal control technologies capable of enduring significant temperature fluctuations due to varying solar radiation levels based on distance from the Sun and mission orbit conditions. For instance, current solar cell technology may not provide sufficient power for spacecraft missions with the largest available solar panels due to their distance from the Sun, necessitating the use of radioisotope thermal power sources and employing supplementary radioisotope heat source to reduce heater power consumption, which is a key difference from satellites. This indicates that planetary spacecraft require different thermal control methods compared to satellites. This study analyzes the thermal control technologies necessary for planetary spacecraft by examining the thermal environmental conditions, missions, and thermal design cases of planetary spacecraft.

[P-5] Verification of KMAG Calibrated Data based on Observing Lunar Magnetic Anomalies

Hyeonhu Park[1], Ho Jin[1], Garrick-Bethell Ian[2], Khan-Hyuk Kim[1], Wooin Jo[1], Yesun Ahn[1]

[1]*School of Space Research, Kyung Hee University*
[2]*Earth & Planetary Sciences Department, University of California, Santa Cruz*

Korea Pathfinder Lunar Orbiter (KPLO, also named Danuri) launched on August 4, 2022, and is currently orbiting the Moon at an altitude of ~100 km. The KPLO magnetometer (KMAG), one of the scientific payloads is measuring the magnetic fields of the Moon and its surrounding. The measured magnetic field data from the KMAG are uploaded to the KARI Planetary Data System (KPDS) along with other instruments data and released to end user. Currently, the KMAG team has uploaded original (RAW) data from an instrument and partially processed (PP) data, which have not yet reached calibrated status. For the generation of calibrated (CAL) data, which is available to end users, we are performing in-orbit calibration of the KMAG. In this study, we show the verification results of CAL data based on observing lunar crustal magnetic anomalies. For the reference data, we use the surface vector mapping (SVM) data, which is a spherical harmonic model of the magnetic field data based on Lunar Prospector and Kaguya magnetometer data. This SVM model allows us to compare magnetic fields at the same altitude as the KPLO. From comparing KMAG observations and the SVM model, we confirmed the similar features of the magnetic anomaly regions such as Abel, Nam Byeong-Cheol, South Pole-Aitken, Reiner Gamma, and Mendel-Rydberg. We believe that this verification method will help to prepare for the CAL data upload.

[P-6] CAP-W Payload Integration Test of the CAS500-4 Satellite

Myung-Jin Baek, Sang-Gyu Lee, Seok-Bae Seo, Sang-Burm Ryu, Eun-Su Kang, Hyeon-Cheol Lee

Korea Aerospace Research Institute

CAP-W (Compact Advanced Payload with Wide Swath) is the payload of CAS500-4 satellite. The mission of CAP-W payload is to obtain 5 m of resonable resolution with swath width of more than 120 km to monitor national level of agriculture production environment, periodic growth, growth of the agricultural product and the forest trees. The flight model of the payload equipments such as EOS, IDHU, XTX and XAA have been manufactured and tested individually, but need to test the integrated payload to verify the integrity of the overall payload. In this paper, the CAP-W payload integration test is presented. The test preparation such as electrical ground support equipment setup, test configurations, test items and procedure is the key important factors to get meaningful test results.

[P-7] LUTI to 3D Lunar Terrain: High-Resolution 3D Reconstruction of Apollo 15 Landing Site via Neural Radiance Fields

Dunam Kim[1], Jongmin Kim[1], Suwan Lee[1], Kibaek Park[1], Jo Ryeong Yim[2], Dong-Gyu Kim[2], Eunhyeuk Kim[2], Seokju Lee[1]

[1]*Korea Institute of Energy Technology*
[2]*Korea Aerospace Research Institute*

A high-resolution digital elevation model (DEM) is crucial for advancing lunar geological research and supporting the Korea Pathfinder Lunar Orbiter (KPLO) mission. Traditional methods for generating DEMs of the lunar surface, including LDEM, SLDEM, and NAC DTM, are based on multi-view stereo and structure-from-motion. However, this approach results in pixel scales larger than those of the input images due to the creation

of a sparse point cloud, leading to coarser topographic representations that lack the fine details present in the original imagery. To address this limitation, we propose utilizing an AI-based learning algorithm, Neural Radiance Fields (NeRF), applied to Lunar Terrain Imager (LUTI) images to generate high-resolution DEMs. This learning-based algorithm allows us to generate high-resolution DEMs that maintain the pixel scale of the LUTI images, resulting in significantly improved resolution and accuracy compared to traditional DEMs. Furthermore, the derived DEM preserves fine topographic details, providing a more precise and detailed representation of lunar surface features.

[P-8] Test Method for Spurious and Harmonic Emissions Measurement at Antenna Port for RF Equipment

Kyung-Duk Jang, Tae-Youn Kim, Jae-Woong Jang, Sang-Rok Lee, Chang-Eun Lee

Korea Aerospace Research Institute

There are many RF transmitting and receiving sysems in the satellite, such as for sending and receiving telecommand & telemetry with the ground station, transmission of image data for optical camera or SAR radar, GPS signal reception, etc. Since these RF systems can cause mutual RF interference, the influence of RF interference signals must be verified at the satellite system level.

In order to reduce the influence of the system, efforts should be made to reduce RF interference signals at the unit level, and this is verified through testing. The test usually measures spurious and harmonic signals of RF signals generated at the antenna port of RF equipment to determine whether these signals are well suppressed below the desired level compared to the fundamental signal. This paper describes a method for performing measurement of spurious and harmonic emissions at antenna port generated by RF equipment. The test specifications, setup, procedure, and precautions are described in detail.

[P-9] The Initial Results of SSCM Performances and Environment Tests

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We are developing a Space Search Coil Magnetometer (SSCM) with a lightweight, low power consumption. The SSCM has a frequency range of 10 Hz to 20 kHz and a Noise Equivalent Magnetic Induction (NEMI) of ≦ 10 pT/Hz$^{1/2}$. The SSCM consists of a 3-axis SSCM module and a Search Coil Electronics module (SCE).

In this study, we performed Fast Fourier Transform (FFT) signal processing using FPGA (Field Programmable Gate Array) logic, which implements the same algorithm as the ASIC (Application Specific Integrated Circuit). The performance of the SSCM was verified through a comparison of the spectrogram generated using the FPGA FFT and the graph produced from the PC FFT. We also conducted environmental tests on the 3-axis SSCM module, including thermal cycling and vibration tests, based on the environmental conditions of the Korea Pathfinder Lunar Orbiter (KPLO).

We plan to complete the production of the ASIC chip in early 2025, followed by integrated performance and environment tests for the 3-axis SSCM module and SCE.

[P-10] KMAG Data Generation and Public Release

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In January 2024, the Korea Pathfinder Lunar Orbiter (KPLO) mission publicly released scientific data from space exploration for the first time in Korea. KPLO data is available through the KARI Planetary Data System (KPDS), which follows PDS4, NASA's standard for planetary exploration data management. In accordance with the required standards, the KPLO magnetometer (KMAG) created level products, each consisting of two components: a scientific data file and its corresponding metadata file. We defined data at various levels (Raw, Partially Processed, Calibrated) and generated metadata that describes both the content and structure of each data file, as well as the overall level product. The software was developed to automatically produce the metadata in XML format, and PDS validation was performed to verify the metadata before uploading it to KPDS. Currently, Raw and Partially Processed data from January to September 2023 are available on KPDS, along with Raw level of magnetic field data from the cruise phase, starting four hours after KPLO's launch on August 5, 2022 (UTC). Calibrated data, with magnetic field interference removed, will be released in December. Further data releases will follow as the KPLO mission continues beyond 2025.

[P-11] Investigation of Performance Testing

Facility for Spacecraft On-Board Propulsion System

Cho Young Han

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The testing for the verification of a spacecraft on-board propulsion system is indispensable indeed, in terms of the indigenous development or localisation of a propulsion system itself and associated components as well. Such an on-board propulsion system is operating in space entirely so that its performance testing on ground should be carried out under the condition of very low pressure. Besides such kind of a testing facility needs to be isolated due to the hazards of explosion and contamination from the exhaust gas just in case. In this study the references of the testing facility abroad are investigated. Presumable domestic location for the testing facility is also suggested coming up with an applicable idea.

[P-12] Research on Satellite Project and Configuration Management by Project Life Cycle

Chul Kang

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The project life cycle refers to a series of processes from the start to the end of a project. Each stage is performed sequentially and forms the structure of the project. The project life cycle consists of four stages: project initiation, project planning, project execution, and project closure. Configuration management can be defined as a series of activities to ensure integrity and traceability of changes during the project life cycle. In this paper, we will look at each stage of the life cycle for the execution of a satellite development project, describe a series of activities for performing configuration management at each stage, and suggest an improved method for ensuring integrity and traceability of changes in project execution.

[P-13] Analysis of Destruct Line Algorithm according to Launch Vehicle Malfunction Turn Scenario

Young-Jae Park

Korea Aerospace Research Institute

This study suggests a method for the Destruct Line generation algorithm according to the Launch Vehicle's malfunction turn scenario. A Destruct Line is a reference Line created to assist the Flight Safety Crew when the Launch Vehicle's flight Thrust Vector Control System has malfunctioned. The Destruct Line is an operating limit line of the Flight Termination System that causes debris from the projectile to fall into the Impact Limit Line. One of the Launch Vehicle's malfunction turn scenarios assumes that the Launch Vehicle approaches the ILL in the shortest time. This scenario is created by considering the worst-case scenario, However, such a scenario is unlikely to occur in practice. In real Launch Operation, The TVC angle is more likely to be fixed. In this paper, the Destruct Line generation algorithm was implemented based on a malfunction scenario in which the TVC angle was fixed. In addition, a comparative analysis was performed on the shortest time scenario and the TVC angle fixed scenario.

[P-14] A Performance Comparison of Synchronous and Asynchronous Fusion Algorithms for Launch Vehicle Tracking

Ha-Ryong Song, Byoung-Jin Moon

Korea Aerospace Research Institute

Data fusion in an aspect of target tracking takes advantage of redundant information measuring the same objectives to improve tracking performance. Tracking systems of NARO space center, similarly, various overlapped measurements including radars, telemetries and optical tracking are deployed from space center to foreign tracking station to cover large flight paths of space launch vehicle. In this paper, we apply synchronous and asynchronous data fusion to two distinct radars deployed in goheung and jeju respectively. In case of synchronous data fusion, converted measurement Kalman filters and GHK filters are utilized as local filters. On th other hand, for asynchronous fusion, centralized method is tested. We simulate these two algorithms for KSLV-II 2nd mission's radar data and represent performance comparison results.

[P-15] Pyro-Shock Test System in Satellite

Jong-Hyub Jun, Hee-Kwang Eun, Nam-Jin Moon, Jin Park, Chang-Rae Cho, Tae Seok Oh

Korea Aerospace Research Institute

A satellite should be developed by the various ground tests to verifying the launch environments like vibration, acoustic, and shock. Shock environment is critical for satellite mission since the main functional electronics can be damaged. Normally, shock environments such as faring and launch vehicle separation caused by launch vehicle's events. The others are made by satellite itself like solar array and appendages deployments. The former can be verified using ground test by real action for the satellite system. The latter case should be validated through shock test for each part on the basis of environment test spec by using the dedicated test machine. The test machine in KARI has the original features that the users have to identify for effective usage. There are the main parts in the KARI system including the actuation type and excitation capacity, absorbing plate, and resonator to generate the characteristic frequency.

And safe and stable testing is continuous interest for maintaining the test system.

[P-16] Impact of Heavy Ion Radiation Testing on TDI CMOS Image-Sensors for Low-Orbit Satellite

Ilseop Lee, Jong Pil Kong, Sang-Gyu Lee
Korea Aerospace Research Institute

Recently, CMOS-type photo-etectors, called 'CMOS image sensors', are being installed on satellites. CMOS image sensors have a great advantage over existing CCDs in that they can convert analog signals converted to electronics (or current) through the pixel area into digital signals within the image sensor. Conversion of analog signals to digital signals is performed in a readout integrated circuit (ROIC) containing an analog-to-digital converter (ADC). Integrated circuits, including these digital circuits (including some analog circuits), can be degraded or permanently damaged by heavy ion radiation. This paper describes the impact of heavy ion radiation testing on CMOS image sensors.

[P-17] Radiometric Calibration of Multi-Spectral Electro- Optical Instrument for Earth Observation

Gmsil Kang, Eung-Shick Lee
Korea Aerospace and Research Institute

Electro-optical cameras for a remote sensing observation of Korean peninsula from a low earth orbit or a geostationary platform have been developed by KARI (Korea Aerospace Research Institute). Radiometric calibration means to characterize a instrument's output response to an input radiance variation. Radiometric calibration is important for remote sensing application because radiance [W/um/sr/m^2] image for observed scene is retrieved from an output digital number by using a radiometric calibration coefficient. Radiometric calibration can be performed through on-ground calibration by using a known reference source. Also, there are in-orbit calibration methods to use the Sun or the Moon as a reference source. In case of a High-Resolution Camera for LEO platform, there is no on-board radiometric calibration devices. Regarding a geostationary electro-optical instrument, on-board calibration devices are integrated and radiometric characteristics are monitored periodically through mission lifetime.
In this paper, the methods of radiometric calibration for electro-optical camera for a low earth orbit and a geostationary orbit are introduced. Error contributors of radiometric calibration are discussed depending on the calibration methods. Radiometric correction for PRNU/non-linearity and pixel-by-pixel variation of radiometric response over spectral channels are discussed in term of relative calibration.

[P-18] Earth Radiance Measurement through Solar Diffuser for PRNU Calibration of GOCI-II

Gmsil Kang, Sang-Soon Yong, Jo-Young Min
Korea Aerospace and Research Institute

Currently, the GOCI-II (Geostationary Ocean Color Imager-II) is under mission operation to provide the observation of 12 spectral channels to monitor ocean color around the Korean Peninsula from a geostationary platform since 2020. There are on-board calibration devices, the solar diffuser and the diffuser aging monitoring device, to monitor the radiometric performance variation and to estimate radiometric gain parameters. Regarding a radiance image of uniform ocean scene retrieved by using in-orbit gain matrix, residual pattern is observed which is about 0.5% but it is recognized in uniform scene. The observation of the Earth through the solar diffuser has been performed to achieve gain matrix for the Earth radiance. It is understood that the one of the reasons for this residual PRNU is the difference of the input radiance spectrum between the solar spectrum and the ocean spectrum. There are different gain matrixes achieved through the on-ground calibration and in-orbit calibration. These two gain matrixes show slightly different shape.
In this paper, the observation results of the Earth through the solar diffuser is analyzed. Due to the weak signal from the Earth through solar diffuser, the observation has been performed with the maximum integration time and the maximum number of accumulation for several slots. But the measurement data shows still noisy characteristics. The new gain pattern has been retrieved by using on-ground calibration data and the Earth calibration data to compensate the noisy characteristics.

[P-19] Verification Procedure of ESA Additive Manufacturing

Kyungjin Kwon, Dookyung Lee
Korea Aerospace Research Institute

The mechanical structures that make up a satellite serve to support the satellite's major subsystems and protect critical equipment from launch vehicle impact. However, they are not only used as the main support structure, but also as antennas that are subjected to relatively small shocks and loads. In particular, the performance of antenna structures is highly dependent on their geometry, which is why 3D printing is gaining popularity.
3D printing manufacturing technology is one of the additive manufacturing methods, and although there are various methods, the application in the space field mainly uses the method of manufacturing products by melting and laminating metal powder. This allows for relatively complex geometries, unlike traditional mechanical manufacturing methods, and

provides a high degree of design freedom. However, it also requires a high level of understanding of the process, and the management of equipment and materials is technically challenging. Considering Korea's satellite development heritage, the application of 3D printing is extremely rare. Therefore, we will discuss the development and verification procedures for the application of 3D printing in terms of product assurance through the ECSS Standard applied by the European Space Agency (ESA) for systematic introduction.

[P-20] Optical Axis Alignment Simulation of the Aspheric Concave Primary Mirror using the Annular Stitching

Goeun Kim

Korea Aerospace Research Institute (KARI) Satellite Payload R&D Division

In this paper, we propose an optical axis alignment method for the aspheric concave primary mirror using the annular stitching. To achieve optimal performance from a telescope, the mirrors must be aligned precisely along the optical axis, with the primary mirror as the reference. Misalignment can lead to changes in the field of view and overall performance. Therefore, accurately measuring the optical axis of the primary mirror is crucial. If the dynamic range of the measuring instruments is sufficiently wide, the optical axis can be determined by aligning to minimize coma aberration. However, general instruments do not have a wide dynamic range. We present simulation results for the alignment of the optical axis of the primary mirror using annular stitching.

[P-21] Considerations for the Readiness Check of Integrated System Test of the Standard Platform based CAS500 Satellite

Youngyun Kim, Dongin Han

Korea Aerospace Research Institute

The second phase of CAS500 (Compact Advanced Satellite-500 kg) project is currently being carried out based on the standard platform developed in the first phase. By securing a standard platform capable of carrying various types of payloads, satellite development to meet the public demand of satellites at a relatively low cost is possible. The second phase of the CAS500 is being carried out based on the design technology, development technology, procedures, and specifications developed in the first phase of the project. When the assembly is completed by mounting each payload on the standard platform, the assembly state and function of the satellite are verified at the system test level. Based on heritage development technology, this study examines preparations and considerations in system tests for satellites with different types of payloads from standardized platforms. Through this, we intend to conduct this test of stable satellite development by identifying what needs to be considered when installing other payloads on the same platform and reflecting it in the procedure.

[P-22] Design Trends for Orbital Electric Thruster Thermal Management

Jong Seok Park, Jung Su Choi, Keun Joo Park, Hyoung Yoll Jun

GEO-KOMPSAT-3 Program Office, KARI

Typically, electric thrusters are subject to critical thermal management issues due to the heat dissipated by large power consumption and inefficiencies in their operation. The heat can lead to performance degradation and system damage if it is not effectively managed. Various thermal management techniques are employed to address this issue.
The GEO-KOMPSAT-3, a public telecommunication satellite, employs an electric propulsion system based on HEMPT EV0, which has been developed to apply to small satellites and constellations. So for incorporating in the GK3 satellite, thermal design enhancements are required to meet the thermal operating conditions in geostationary orbit.
In this paper, they are resented the thermal design trends of various electric thrusters in geostationary satellites and it is proposed appropriate solutions for their application in the GK3 satellite.

[P-23] A Study on the Use of Various Thermal Data Processing Temperature Sensors for Satellite Payload Development and Effective Operation

Jong-Euk Park, Haeng-Pal Heo

Korea Aerospace Research Institute

The payload mounted on satellites for various missions use various sensors to effectively operate themselves in space orbit based on accurate temperature information.
Satellite payloads go through mission-specific design, manufacturing, alignment, assembly, functional and performance testing from the development stage, and are finally tested to verify the implemented thermal design for operation in the space environment. Verified within the temperature range required for space environment operation to ensure high operational reliability. At this time, it is important to collect temperature information from nearby test equipment, but it is also important to collect temperature information of the payload and internal devices using the built-in temperature sensor to determine the current status of the payload and perform a more stable mission. It is utilized and essential for gathering basic information. The temperature sensor mounted on each unit uses various types of

temperature sensors depending on the characteristics and operating environment of the unit being used. Sensors are pre-validated using ground test equipment, assembled at payload and satellite level, and then validated again in terms of the overall system.
In this paper, we describe various temperature sensors mounted on each component to perform highly reliable missions on satellite payloads, their characteristics and implementation methods, ground processing and verification methods, and processing methods when performing major missions.

[P-24] Focus Mechanism Controller Design and Gain Tuning for Large Aperture Electro-Optical Camera Satellite

Ki-Hoon Seo, Youngsun Kim, Hyung-Yun Noh, Haeng-Pal Heo

Korea Aerospace Research Institute

Focus mechanism controller of large aperture electro-optical camera satellite adjusts the displacement between M1 and M2 mirrors that causes the focus change. Because of the high reliability and ease of implementation, the thermal focus control method can be used for the fine focus adjustment by heating two rings connected to M2. This paper introduces design and tuning result for thermal focus mechanism controller dedicated to the large aperture electro-optical camera. The designed controller heats two focus rings and maintains the target temperatures during imaging to get the best focus. In the design phase, the controller is verified on the simulation environment with proper control gain parameters to meet the target specification such as settling time, accuracy, etc. Then, actual gain tuning is carried out using the actual hardware of electro-optical camera. Tuning process is started using parameters from the simulation, but Ziegler-Nichols method can also be useful to find optimal gain parameters. The test results for a variety of gain parameters are presented and reviewed in this paper.

[P-25] Analysis of Acoustic Tests of Space Borne High Resolution Camera

Jeoung-Heum Yeon, Jongguk Choe, Won-Beom Lee, Jong-Pil Kong

Korea Aerospace Research Institute

Space borne satellite units must be designed to withstand the mechanical vibration environment generated during launch and must undergo a verification processes before launch through ground tests. The high-frequency excitation environment caused by the acoustic vibration of the lauch vehicle must also be verified before launch. The acoustic pressure caused by the launch vehicle excites the satellite panel and thus the unit mounted on the panel is excited. For units that are not large size or mounted inside the satellite, the acoustic test is replaced by the random vibration test. However, for units thar are large size in area and mounted outsize the satellite, it is desirable to conduct an acoustic test. This is because the load directly excited through acoustic pressure is greater that the load transmitted through the panel. High resolution camera has the large aperture size and mounted on the external panel of the satellite. Therefore acoustic test is desirable than the random vibration test. In this research acoustic test results of high resolution camera are analyzed. Camera subsystem level and satellite system level tests are performed for the verification of each level. Both test results are compared and analyzed.

[P-26] Additive Manufacturing Verification Process Analysis in Standard Process

Dokyoung Lee, Kyungjin Kwon

Korea Aerospace Research Institute

Additive manufacturing methods are increasingly being used in satellites nowadays. Verification method of additive manufacturing process is defined lately in NASA and ESA. The verification process composed of process qualification and hardware production. In process qualification, there are material control, process control and post AM process. Each process verified with sample test. In hardware production, Qualification model and sample test. In this paper, by investigating the verification procedure standards for additive manufacturing as analyzing the NASA and ESA verification methods, adequate verification process is suggested as several way in development step.

[P-27] Directory-Level Access Control Method in Flight Software Configuration Management using Git

Jae-Seung Lee

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Various version control tools have been used in flight software configuration management, such as SVN, CVS, Perforce, git, Mercurial, Bazaar, etc.. Recently git which is a distributed version control system is widely used for software configuration management. For the development of satellite flight software, many developers are required and some industries can be involved. Under the circumstances the security for source codes of the flight software is very important, and folder-level access control should be required. Git is a decentralized version control system, which means anyone can access anything in the current repository and store a copy of it locally. This paper introduces ‘submodule’ command and describes how to implement the folder-level access control. It is possible for the designated developers not to access to the specific folder by using ‘submodule’ command of git. This command can add one or more

modules into the working directory as against ‘clone’ command. Thus, the whole software project consists of several directories and individual directory can have its own access control.

[P-28] Solving EMC CM CE Problem due to Secondary Return Current Leakage in Satellite Electronic Equipment

Jong-Tae Lee, Haeng-Pal Heo

Korea Aerospace Research Institute

Electronic equipment mounted on satellites are required to have limited electromagnetic characteristics so as not to affect each other’s normal functioning. In the satellite equipment electromagnetic compatibility common mode conducted emissions test on the power line, a phenomenon of exceeding the common mode frequency domain specifications was discovered, which is an issue that can affect the power lines of other equipment. The problematic equipment has a design defect that causes the secondary power return to flow through the primary return. This document describes the steps we took to identify and correct the design flaws, and hopes that this will aid in the development of similar space born electronic equipment.

[P-29] Assessment of CAS500-4 (Compact Advanced Satellite500-4) Flight Model BUS Integrated System Test Result applied with CAS500 Standard Platform

Chan-Gu Jeong, HyoungJae Oh, Jongjin Jang, Jaehwee Doh

Korea Aerospace Industries. Ltd.

As according to National space development road map, CAS500 with 500 kg mass were developed for standard platform and export strategy model. CAS500-4 is the first satellite of utilizing a standard platform that has been developed to minimize design change. As the CASS00-4 FM (Flight model) BUS is successfully tested, CAP-W (Compact Advanced Payload for Wide-swath), capable of providing of the wide swath EO (Electro-Optical) images, can be integrated with CAS500-4 FM BUS applied with CAS500 standard platform. In this paper, we will describe Flight Model BUS Integrated System Test results of the CAS500-4 and the plan for the next year.

[P-30] Analysis of RF Interference Test Results between SBAS Payload and GNSS System

Jae-Dong Choi, Tae-Youn Kim

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The RF interference analysis between the SBAS (Satellite-Based Augmentation System) payload and GNSS (Global Navigation Satellite System) is a critical task that evaluates signal interference between satellites. The primary objective is to determine the impact of this interference on the performance of both systems and to implement necessary measures to minimize it if required. This analysis is essential to ensure that the SBAS system can coexist with the GNSS system while maintaining the reliability and performance of both. Proper interference analysis and mitigation strategies can enhance the safety and accuracy of the GNSS system.
To address these concerns, this study manufactured engineering models (EM) of the satellite’s top floor structure and antennas to analyze the multipath characteristics of each antenna. Additionally, tests were conducted to determine whether the SBAS L5 signal exhibits nonlinear characteristics after passing through the SSPA output. These analyses are expected to help evaluate the impact on receiver sensitivity due to frequency interference when using GNSS receivers for orbit determination in future FM model development and geostationary satellites.

[P-31] Coordinating Satellite Networks for Geostationary Satellite Programs

Seorim Lee

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The coordination of satellite networks takes the most time in the process of acquiring frequency resources. Such coordination activities must thus be implemented in a timely manner which calls for the effective and efficient use of technical as well as administrative resources. The coordination process begins after the ITU bureau publishes the coordination information, which contains the satellite networks with which coordination is required, initially beginning with letter correspondence thereafter followed by operator level meetings as well as national administration level meetings if detail coordination is deemed necessary. The process consists of many unpredictable factors that can inhibit and delay the overall process. This paper will look at the actual process of coordinating satellite networks to provide a better understanding of the time and effort that must be made and planned beforehand to acquire the necessary frequency resources for geostationary satellite programs within the regulatory timeframe of seven years.

[P-32] Development of Active Mode Matching Telescope in Kyung Hee University

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The mode-matching telescopes correct spatial mode mismatch in the Gravitational Wave detector system. In order to correct for time-varying spatial mode mismatch, we are developing active mirror modules including a tip-tilt mirror and a single-actuator deformable mirror. We will measure the deformed wave fronts using our Shack-Hartmann wavefront sensor system.

[P-33] Investigating Star Formation Rates and Dark Matter Halos in the SCOSMOS Field

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This study analyzes the star formation rates (SFRs) and dark matter halo properties of galaxies in the COSMOS (Cosmic Evolution Survey) field using multi-wavelength observations. By examining the SFRs of 4,677 galaxies, we investigate the star formation rate densities (SFRDs) across various redshifts and compare the present findings with previous studies. We also analyze the merger tree algorithm and halo clustering lengths to provide insights into the evolution of galaxy clusters and their connection with dark matter halos. The results emphasize the importance of incorporating different mass variables and provide new perspectives on cumulative SFRs and galaxy evolution.

[P-34] The Correlation between Active Galactic Nuclei Activity and Star Formation: A Spectral Energy Distribution Analysis of Type 1 AGNs at z = 0.30 - 0.80

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We investigate the correlation between Active Galactic Nuclei (AGN) activity and the star formation rate (SFR) at intermediate redshifts using a sample of approximately 5,500 SDSS type 1 AGNs.

Through spectroscopic analysis, we measured key AGN properties, including outflow kinematics, AGN luminosity, and the Eddington ratio. To minimize AGN contamination, dust emission was used as an SFR indicator. We employed the Code Investigating GALaxy Emission (CIGALE) for spectral energy distribution (SED) modeling, utilizing archival photometric data from UV to radio wavelengths to estimate dust luminosity. Parameters governing polar dust extinction and disk continuum slope were carefully adjusted to accurately model the different AGN continua.

Additionally, we evaluated the impact of FIR detection on dust luminosity by comparing SED models with and without FIR fluxes. Our results indicate that the absence of FIR fluxes does not significantly alter dust luminosity, confirming the reliability of SFR estimates for targets without FIR detection.

We found positive correlations between AGN luminosity and SFR, as well as between outflow strength and SFR, which are consistent with previous studies of local AGNs ($z < 0.3$). These findings suggest no evidence of immediate AGN feedback up to a redshift of 0.8. To enhance the accuracy of SED fitting, we plan to incorporate X-ray data from eROSITA, allowing for more precise SFR estimates.

[P-35] Gravitational Influence Analysis and Procedural Methods for Satellite Electro-Optical Payloads

Youngchun Youk, Shinwook Kim, Dongok Ryu

Korea Aerospace Research and Institute

Electro-optical payloads are essential for high-resolution Earth observation, and various physical factors affecting their performance must be carefully considered. This paper focuses on the analysis of gravitational influences on electro-optical payloads and outlines the procedural methods and techniques used to assess and mitigate these effects. Rather than conducting actual experiments, the study provides a systematic framework for evaluating how gravitational forces in an orbital environment impact optical alignment, focus, and overall performance. The proposed methods may serve as practical guidelines for optimizing payload performance and enhancing image quality in space missions.

[P-36] Linear Model based Non-Uniformity Calibration Method for Satellite Electro-Optical Camera

Youngsun Kim, Haeng-Pal Heo

Korea Aerospace Research Institute

There are several methods to calibrate the pixel by pixel non-uniformity for electro-optical camera system. Conventionally we get the offset and gain parameter by a dark measurement and a specific illumination level respectively. Also, it has been introduced to minimize the residual errors using least-square method for whole illumination levels. In the actual electro-optical system, non-linearity affects non-uniformity in the calibration process. The paper proposes the pixel non-uniformity correction method based on the pixel linear model relating system non-linearity. It uses a dozen levels of illumination measurements from dark to saturation acquired under the special calibration setup providing uniform intensity to all pixels. It produces the DSNU (Dark Signal Non-Uniformity) correction coefficient and the PRNU (Photo-Response Non-

Uniformity) correction coefficient for each pixel at once to minimize residual errors from pixel linear model. Especially it gives different weighting factor in the least-square method in order to show the good performance in dark condition or in weak illumination in which this error is conspicuous. Finally, the paper compares the suggested method with the other conventional methods, which are the averaging method and absolute and relative error minimization method. The results show the proposed method gives the best performance comparing other methods.

[P-37] Design of a Scheduler for Multi-Satellite Image Processing

Jaeyeol Lee, Jihyeon Yim, Min-A Kim

Korea Aerospace Research Institute

Korea Aerospace Research Institute is working on multi-satellite image processing such as Kompsat Series and CAS500-1. In order to process multi-satellite images with different rules and formats, we searched for the regularities and dividing points of all satellite images in the database. The common regularities among multi-satellite images can determine the available types, and the dividing points (delimiters) can be used to divide the types. Through this, we designed a multi-satellite image processing system, established an operation scenario, and created a task scheduler to build the system.

[P-38] Development of a Web-Based Satellite Data Order Management System for NEONSAT Constellations

Gab-Ho Jeun, Myung-Jun Lee, Da-Eun Lee

Korea Aerospace Research Institute

The NEONSAT constellation system, comprising 11 low-earth orbit optical earth observation satellites each weighing around 100 kg, is designed to continuously monitor the Korean Peninsula and respond promptly to disasters, emergencies, and national security issues. To enhance the efficiency of managing user orders for satellite information and products, an order management system has been developed. This system focuses on automating the evaluation of satellite image validity and the processing and distribution of satellite imagery, thereby improving the timeliness of data distribution.
This paper presents the functions and operational strategies of the developed order management system for NEONSAT constellations. The aim is to improve understanding of the satellite operation process, from user requests to imaging, data processing, and distribution.

[P-39] System Design for Integrated Image Collection planning of Low Orbit Satellite

Jung-Nam Jun, Eun-Suk Lim, Seung-Hwan Kim, Da-Eun Lee, Min-A Kim, Ok-Chul Jung

Korea Aerospace Research Institute

Due to the continuous development of Earth observation satellites, the need to integrate and operate multiple satellites has required.
An integrated imaging plan was created for multi-satellites and receiving plan were considered of the satellite's resource availability and reception conditions and based on this, operation scenario was defined. The integrated ICPS system was designed to have functions: components, database, GUI, and interface. In addition, the ICPS system is designed to automatically process without operator intervention in a series of processed from imaging and receiving.
This paper will describe the development and performance of the integrated ICPS system based on the above detailed design.

[P-40] Analysis of the Thermal Cycling and Vacuum Tests for the CAP-W Payload of CAS-4 Satellite

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The CAP-W (Compact Advanced Payload with Wide Swath) is an electro-optics camera that is installed on the CAS-4 (Compact Advanced Satellite-4) satellite. The CAP-W payload is equipped with five multispectral channels and has the capability to capture images with a wide range of swath width. The payload is specifically designed to capture images related to national agriculture, water resources, and forests.
In order to verify the performance of the CAP-W payload, a comprehensive set of in-orbit environment tests are planned, including vibration and thermal vacuum tests. The thermal vacuum test simulates the extreme temperature and pressure conditions of space and evaluates the payload's performance under these conditions.
In this paper, we outline the analysis for the thermal cycling / vacuum test of EOS and describe the test specification / setup for the CAP-W payload of the CAS-4 satellite. This approach will help ensure that the payload performs as expected in space and will provide valuable data for further analysis and improvement of future space payloads.

[P-41] Proposed Disaster Recovery (DR) Operation Methods for Satellite Image Restoration

Guhyeok Kim, Min-A Kim, Gabho Jeun,

Myung-Jun Lee

Korea Aerospace Research Institute

Korea Aerospace Research Institute stores raw data (L0F) for four low-orbit satellites, and in order to process satellite images, the L0F are restored and operated as processing storage. The importance of data storage is escalating with plans to operate additional NEONSAT, CAS500, including KOMPSAT series. Therefore, it is essential to establish a mechanism capable of recovering data even in the event of a disaster or equipment failure that hinders satellite image processing. Disaster Recovery (DR) typically involves restoring data after a disaster. From an IT perspective, DR not only addresses natural disasters but also extends to power outages, cyber-attacks, and equipment malfunctions. Applying DR to the storage systems and servers that manage satellite images is crucial, and this paper aims to outline appropriate strategies.

[P-42] Mass Production Management for the Small Satellite

Jong-Oh Park, Yong-Sik Chun

Korea Aerospace Research Institute (KARI)

Korea Aerospace Research Institute (KARI) had developed from large to medium satellites for public demand such as Korean peninsula observation for territory management, agriculture and forestry management, disaster monitoring and Lunar exploration etc.
Recently, very small satellites under 100kg grade are developing for various purpose with constellation. such as earth observation, communication etc.
In this paper, we will briefly introduce the mass production management to develop very small satellites simultaneously.

[P-43] 1553 BMDX Analysis Software for CAP-W FM Test

Seok-Bae Seo, Sang-Gyu Lee, Myung-Jin Baek, Sang-Burm Ryu, Eun-Su Kang, Hyeon-Cheol Lee

Korea Aerospace Research Institute

CAP-W (Compact Advanced Payload with Wide-swath) is the imaging payload of the CAS500-4 satellite. The CAP-W FM (Flight Model) has been completed its design and verified mission tests before its PSR. This paper explains 1553 BMDX file, a general 1553 format, processing software to analyze CAP-W FM 1553B data.

[P-44] FM Integration Test of CAP-W

Seok-Bae Seo, Sang-Gyu Lee, Myung-Jin Baek, Sang-Burm Ryu, Eun-Su Kang, Hyeon-Cheol Lee

Korea Aerospace Research Institute

CAP-W (Compact Advanced Payload with Wide-swath) is the observation payload of the CAS500-4 satellite. The CAP-W FM (Flight Model) has been finished its developments and verified 40-case mission tests. This paper describes FM integration tests of CAP-W before its PSR (Pre-Ship Review).

[P-45] Model Reference Adaptive Control for Satellite Attitude tracking with Uncertainty

Sungwon Seo[1], Morgan Choi[2], Insang Moon[3], Seonho Lee[3], Inhoi Koo[3]

[1]*University of Science and Technology*
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[3]*Korea Aerospace Research Institute*

A great amount of attitude control research has persisted in various missions such as satellite repair, maintenance, fueling and space debris resolution. The high-precision demands of spacecraft attitude control require very accurate dynamic models. However, it is not simple to obtain these explicit models due to the dynamic uncertainties such as a number of different sources, disturbances and model errors. It is continuously conducted to develop research on the control method to compensate for the model uncertainty of the inertial moment of the satellite occurred by measurement errors. Model reference adaptive control method is frequently used to reduce the uncertainty. In this paper, a model reference adaptive control is used to achieve satellite attitude tracking considering model uncertainties in its inertia parameters and control actuator alignment. Quaternion error kinematics and rotational dynamics of a rigid body are used in the algorithm. The Variable Structure Control is used to calculate reference model input. The simulation is executed by Matlab and the result shows that model reference adaptive control makes the true system converge to the true system trajectory in a short period.

[P-46] Memory Reference and Verification Environments for Satellite Flight Software using Onboard Computer Simulators

Hyun-Kyu Shin

Korea Aerospace Research Institute

The development process of satellite flight software involves various verification activities. Through static analysis and dynamic testing, such as code reviews, inspections, unit testing, and integration testing, the software's design is thoroughly examined, and its implementation is assessed to ensure it meets the specified requirements. Various development tools are employed in the development and verification activities of such software, and simulators that emulate the onboard computer,

where the flight software is installed, are also crucial development environments and tools. Software-implemented onboard computer simulators facilitate the acquisition of various information related to the operation of flight software more easily than actual hardware. This study explores the establishment of a memory reference and verification environment using external agents.

[P-47] Study on the Space Weather Development of Republic of Korea Air Force

Jinyoung Park[1], Yong-Jae Moon[1,2]

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

Currently, the Republic of Korea Air Force (ROKAF) is introducing the Space Weather Forecast & Alert System based on the ROKAF Space Power Development Plan(Space Odyssey project). However, there is no long-term development plans for space weather operations based on the ROKAF space power development plan yet. To ensure effective operations and consistent development, we propose the development direction of the Air Force space weather operations based on the Space Odyssey Project.

First, we examine the current status of domestic and international institutions that conduct space weather monitoring and forecasting, and compare them with the ROKAF. The comparison is made in view of the responsible departments and purpose of the space weather forecast and warning duties, relevant equipment and facilities, and the outputs of analysis and prediction models. Second, we collect opinions on the development direction of the ROKAF space weather operations through a survey of South Korean space weather experts. Finally, using the ROKAF Space Power Development Master Plan (Space Odyssey 2050) and related research papers, we propose a development direction with three phases in line with the ROKAF space power development plan.

By 2030, the operational system should be standardized to provide tailored operational support, considering the characteristics of the newly deployed space assets. In the 2030s, the space weather forecast and alert system should be advanced to establish an independent military forecast system, providing detailed forecast support to the specific needs of the military. After the 2040s, new observation facilities are to be introduced to establish a system capable of independent military observations and forecasts during both peacetime and wartime.

[P-48] Initial Study on Automatic Design of Optimal Space Radiation shielding using Genetic Algorithm

Hojin Lee[1,2], Jongdae Sohn[1,2], Ji Eun Choi[3]

[1]*Korea Astronomy and Space Science Institute*
[2]*University of Science and Technology*
[3]*Chungnam National University*

Satellites are continuously exposed to space radiation during their missions. When space radiation passes over electronic components, various problems such as TID (Total Ionizing Dose), SEE (Single Event Effect), and DD (Displacement Damage) occur. Therefore, satellite electronic components must be protected from space radiation. One way to protect them is to install a shield to physically reduce the energy and flux of space radiation reaching electronic components. Existing satellite shield designs are based on past satellite development heritage and modified to fit the current mission environment. Design and verification use Monte Carlo-based radiation simulation programs such as Geant4 (GEometry ANd Tracking) or MCNP (Monte Carlo N-Particle Transport). These methods have high reliability, but they have the disadvantage of being difficult to design a new type of shield and applying it to a new mission environment. In this study, we present a new design method and initial research results that can complement these shortcomings. We are developing a program (Advanced Shielding Through Radiation Algorithm, ASTRA) that can automatically calculate shielding by applying a genetic algorithm, which is a metaheuristic algorithm of optimization algorithm, to Geant4 and MCNP. ASTRA uses a genetic algorithm developed based on Charles Darwin's theory of evolution to search for optimal shielding calculation results considering parameters such as shielding material, number of layers, weight, thickness, TID attenuation rate, and mission environment. In this presentation, I will introduce the ASTRA program and its development contents.

[P-49] Development of CUBE-FCOR for Solar F-Corona Observation

Hojin Lee[1,2], Heesu Yang[1]

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The solar F-corona is scattered light from interplanetary dust particles (IDPs) evaporating from comets or asteroids as they approach the Sun. The F-corona light has never been accurately observed because it is weaker than the light from other coronas. One of the least understood properties is its polarized brightness and degree of linear polarization, as the degree of linear polarization is expected to be less than a few percent around 5 solar radii, which is comparable to the noise level in total solar eclipse observations. CUBE-FCOR is a balloon-mounted instrument that can observe the polarized brightness and degree of linear polarization of the Sun during the early morning hours at high altitudes (30–40 km), and measure the total irradiance of the F-corona. This instrument has a cube shape, a total mass of 6 kg (TBD), and consists of a camera, a battery, and a

reaction wheel. The data measured by CUBE-FCOR can provide clues about the composition and shape of dust particles, which may help infer the origin of the dust particles. This presentation will present the scientific and engineering goals, development process, and demonstration of CUBE-FCOR Development Model (DM).

[P-50] Concept Study on Automatic Design Method of Optimal Space Radiation Shield using Genetic Algorithm

Ji Eun Choi[1], Jongdae Sohn[2,3], Hojin Lee[2,3]

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[2]*Korea Astronomy and Space Science Institute*
[3]*University of Science and Technology*

Radiation transfers energy to the medium when it passes through it. space radiation also transfers energy when it passes through electronic components of satellites or people working in space, and this causes various effects such as TID (Total Ionizing Dose), SEE (Single Event Effect), and DD (Displacement Damage). One way to reduce these effects is to install a shield. The shield plays a role in reducing the energy and flux of radiation. The existing shield design method adds the developer's experience based on the heritage of past shield designs to meet the requirements. Currently, Monte Carlo-based radiation simulation programs such as Geant4 (GEometry ANd Tracking) and MCNP (Monte Carlo N-Particle Transport) are used. However, this method has the problem that it is difficult to design a new type of shield and it is difficult to apply to a new space environment. We are developing a system called ASTRA (Advanced Shielding Through Radiation Algorithm) by integrating AI (Artificial intelligence) into the Monte Carlo-based radiation simulation program. The genetic algorithm is one of the optimization techniques in AI, and it has the characteristic that the results converge to the optimum as the generations go by utilizing various parameters. That is, weights can be assigned to each parameter value obtained through the genetic algorithm, and ultimately it can be induced to evolve into a 'good' design. Considering the computing power, the generation evolution conditions (cloning, crossover, blending, extrapolation, mutation), population per generation, and generation range values of the genetic algorithm should be adjusted. In this presentation, I will introduce the application of the genetic algorithm.

[P-51] Total Ionizing Dose Result of Arduino and Raspberry Pi as On-Board Computer Candidates for a Super Low Earth Orbit Optical Satellite

Jongdae Sohn[1,2], Hojin Lee[1,2], Jaeyoung Kwak[1,2], Junga Hwang[1,2], Hyosang Yoon[3]

[1]*Korea Astronomy and Space Science Institute, Korea*
[2]*University of Science and Technology, Korea*
[3]*Korea Advanced Institute of Science and Technology, Korea*

In this time, we report total ionizing dose result of Arduino and Raspberry Pi as On-Board Computer (OBC) Candidates of Commercial-Off-The-Shelf (COTS) for a Super Low Earth Orbit (SLEO) optical satellite. The optical satellite aims to operate for more than two years with a mission to take high-resolution images with a resolution of 50 cm at an altitude of less than 300 km. This satellite is a small Earth observation satellite weighing about 100 kg for super low earth orbit. Arduino modules such as MKR1010, YUN, UNO, PICO, DUE, NANO and Raspberry Pi modules such as Zero W, 4B, 3+ Compute Lite, 3+ Compute, 3 Compute, 4 Compute were tested for total ionizing dose (TID) using 100 MeV protons, 10 MeV electrons, and 60 Co irradiation to select OBC candidates for ultra-low altitude optical satellites. We present the experimental results and the module and memory combination that can achieve the optimal performance as an OBC candidate of COTS. Furthermore, we present a structural shielding design plan in a structurally proposed environment through GEometry ANd Tracking (GEANT) 4 Monte Carlo simulation.

[P-52] Study of the Solar Wind-Magnetosphere Interaction during the Solar Minimum

Do-Hyun Yun[1], Tae Woong Kim[1], Hong Yeong Lee[1], Ha-Neul Kim[1], Se-Yeol Kim[1], Ji-Woong Jang[1], Min-Gi Son[1], Young Gyun Ahn[1], Kyung Sun Park[2]

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Understanding the correlation between solar activity and the Earth's magnetosphere is crucial for comprehending space weather phenomena and its potential effects on Earth. In this paper, we conduct a comprehensive examination of the impacts of both solar and non-solar factors on the Earth's magnetosphere using satellite observations.

Our analysis centers on the event of October 3, 2007, during which multiple significant fluctuations in the AE index were observed, indicating that substorms occurred due to the accumulation of energy in the magnetotail. This means that the magnetosphere can be significantly disturbed even during solar minimum.

We will introduce how magnetospheric disturbances affect the ionosphere, and also other related events.

The work is expected to enhance our understanding of the solar wind interaction with the magnetosphere and ionosphere for various space weather.

[P-53] Energy-Conserving, Full-PIC Simulation Code for the Study of Space and Astrophysical Plasmas on GPUs

Sunjung Kim[1], Gwangson Choe[1], Dongsu Ryu[2], Sibaek Yi[1]

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[2]*Department of Physics, School of Natural Sciences, UNIST*

Space and astrophysical plasmas have traditionally been studied using magnetohydrodynamic (MHD) and kinetic particle simulations. However, many observed phenomena require kinetic effects that MHD cannot capture, necessitating more advanced methods. Full particle-in-cell (PIC) simulations effectively address these kinetic needs, enabling the study of processes at microscopic scales. Despite their capabilities, the reliability of full-PIC simulations in long-term, multi-scale simulations can be compromised by accumulated errors in energy conservation.
In this study, we introduce a fully implicit, charge- and energy-conserving PIC simulation code designed for execution on Graphical Processing Units (GPUs) using OpenACC. Unlike typical PIC codes, which often lack robust energy conservation, our code implements a scheme that rigorously conserves the total energy of the system. This scheme employs an iterative method to solve the coupled equations governing particle dynamics and electromagnetic fields. Energy conservation is verified even in relativistic scenarios, with errors limited solely by the convergence of the iterative process.
We first outline the design and numerical implementation of the code. We then present test cases covering a wide range of plasma phenomena, including waves, instabilities, and magnetic reconnection. These tests demonstrate that our code not only reproduces established results or analytic solutions but also achieves superior conservation of both charge and energy. Furthermore, by utilizing multiple GPUs, our code achieves substantial performance gains compared to its CPU-based counterpart, offering a significant boost in computational efficiency.
With its strengths in both computational efficiency and energy conservation, this GPU-accelerated PIC code represents a valuable tool for the study of collisionless plasmas in space and astrophysical environments.

[P-54] Development of Space Environment Big Data Pipeline and API

Eunsu Park, Jongyeob Park, Ji-Hye Baek, Seonghwan Choi

Korea Astronomy and Space Science Institute

As part of the establishment of a big data network system for space environment, the Korea Astronomy and Space Science Institute (KASI) is developing a big data pipeline and Application Programming Interface (API). Space environment data is characterized by a large volume of observational data, a high velocity of data generation that includes secondary and tertiary data, such as modeling data, and a variety of data forms, necessitating the use of big data technologies. The space environment big data network system aims to serve as a next-generation network for global monitoring of space environment changes and for securing heliospheric space environment data. It will be operated to collect, store, process, and distribute large-scale space environment data. The space environment big data pipeline defines various functions required for handling data and is developing a library based on these functions. It includes capabilities for collecting and distributing various forms of data through multiple protocols and managing all data handled within the space environment big data system. In the future, a big data analysis solution will be provided to process and analyze space environment data acquired through the developed big data pipeline. Additionally, a Web API is being developed to provide easy and diverse access methods for distributing observational and analytical data stored in the big data network system to domestic and international researchers and the public. Plans are also in place to develop a Python API for integration with SpaceWeatherPy. This presentation will introduce the development process and status of the big data pipeline and API for the space environment.

[P-55] Preliminary Results of Image Compression of Solar SDO/AIA by Deep Learning

Jaewon Lee[1], Yong-Jae Moon[1,2]

[1]*School of Space Research, Kyung Hee University*
[2]*Department of Astronomy and Space Science, Kyung Hee University*

We present preliminary results of image compression of SDO/AIA by deep learning. As Korean space missions advance into deep space (e.g., L4), overcoming satellite communication constraints becomes essential. In the field of computer science, learnable image compression (LIC) methods based on deep learning significantly outperform traditional approaches. They excel in both compression rate (bits per pixel, bpp) and restoration quality metrics, such as peak signal-to-noise ratio (PSNR). We use LIC for SDO/AIA 171 and 304 images, which are expected to be used in deep space missions. We consider several pretrained LIC methods on ImageNet. Our preliminary results show that the best method outperforms the traditional compression methods such as JPEG. Furthermore, our study explores the optimal trade-off between compression rate and restoration quality for scientific purposes. Our study can demonstrate the potential of using LIC for future deep space solar observations and recommend appropriate compression rates for scientific research.

[P-56] A Data-Centric Approach to Enhancing Object Detection in Solar Images

Seungheon Shin[1], Jaewon Lee[1], Mingyu Jeon[1], Yong-Jae Moon[1,2]

[1]*School of Space Research, Kyung Hee University*
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Accurate detection of solar phenomena is crucial for understanding solar activity and its impact on space weather. While deep learning techniques have advanced object detection in various domains, their applications to solar image analysis have been limited. Most existing researches have focused on general deep learning methodologies, with insufficient attention to the unique characteristics of solar imagery. To address this gap, we present a data-centric approach to improve the performance of deep learning model for object detection in solar images specifically targeting coronal holes, sunspots, and prominences. By leveraging domain knowledge from solar physics, we analyze the effects of metadata integration in training data on the effectiveness of detecting solar phenomena. Our preliminary results show that using domain-specific information can improve detection capabilities and lead to more consistent and accurate identification of solar phenomena.

[P-57] Investigation of the Optimal Methods for Automatic Detection of Coronal Mass Ejections by Deep Learning

Youngjae Kim, Yong-Jae Moon

School of Space Research, Kyung Hee University

In this study, we investigate the optimal training methods based on convolutional neural networks (CNN) to enable automatic detection of coronal mass ejections (CMEs). We utilize Level 0.5 coronagraph images from the Solar and Heliospheric Observatory (SOHO)/Large Angle and Spectrometric Coronagraph (LASCO), along with the LASCO CME catalog provided by the Coordinated Data Analysis Workshops data center. To ensure robust training and evaluation, we compile a comprehensive dataset covering the SOHO LASCO CME catalog from January 1997 to August 2023. This dataset is divided into a training set (January–August) and a validation set (September) to account for solar cycle effects. Our CNN models are designed to classify each frame of the coronagraph images as either “CME” or “No-CME.” Using Class Activation Mapping (CAM) of the trained CNN, and leveraging their local maxima as prompts for the Segment Anything Model (SAM), we generate segmentation maps of CMEs for each frame. We evaluate three training approaches for the CNN classifier: (1) using only classification error as the loss function, (2) employing distillation from SAM using local maxima of CAM as positive point prompts, and (3) using distillation from SAM with both local maxima and minima of CAM as positive and negative point prompts, respectively. In this talk, we present preliminary results of these methods and discuss future studies.

[P-58] Determination of DEMs from Solar Orbiter/EUI/ FSI with Deep Learning

Junmu Youn[1], Harim Lee[1], Hyun-Jin Jeong[1], Jin-Yi Lee[1], Eunsu Park[2], Yong-Jae Moon[1]

[1]*Kyung Hee University*
[2]*Korea Astronomy and Space Science Institute*

In this study, we determine the differential emission measures (DEMs) using Solar Orbiter/Extreme Ultraviolet Imager (EUI) / Full Sun Imager (FSI) and AI-generated EUV data. The FSI observes only two full-disk extreme UV (EUV) channels (174 and 304 Å), which have a limitation for accurately determining DEMs. To solve this problem, we train and test deep learning models based on Pix2PixCC using the Solar Dynamics Observatory (SDO) / Atmospheric Imaging Assembly (AIA) dataset. The models successfully generate five-channel (94, 131, 193, 211, and 335 Å) EUV data from 171 and 304 Å EUV observations with high correlation coefficients. Then we apply the trained models to the Solar Orbiter/EUI/FSI dataset and generate the five-channel data that the FSI cannot observe. Here we use the regularized inversion method to compare the DEMs from the SDO/AIA dataset with those from the Solar Orbiter/EUI/FSI ones with AI-generated data. We demonstrate that, when SDO and Solar Orbiter are at the inferior conjunction, the main peaks and widths of both DEMs are well consistent with each other at the same coronal structures. Our study suggests that deep learning can make it possible to properly determine the DEMs using Solar Orbiter/EUI/FSI and AI-generated EUV data.

[P-59] Preliminary Prediction of Solar Active Region Evolution using Deep Learning

Harim Lee[1], Eunsu Park[2], Jihyeon Son[1], Yong-Jae Moon[1,3]

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Solar active regions are important for solar physics research and have been used as an input for various space weather forecasting models. In this study, we are developing a prediction model for solar active region evolution using video prediction methods based on deep learning. For the dataset, we use magnetograms observed by Solar Dynamics Observatory (SDO) / Helioseismic and Magnetic Imager (HMI). For magnetograms we use the Cylindrical Equal Area (CEA) projected HMI Active Region

Patches (HARPs) data provided by JSOC, which have an advantage that they have the same area per pixel, without any additional data pre-processing. We consider 720 HARPs within ± 30 degrees of the solar central meridian and with HARPs of 512 × 512 size from May 2010 to May 2023 (about 1 million images at 12 minute intervals). For the deep learning models, we consider several spatiotemporal prediction models, such as ConvLSTM and Top-tier video prediction models. Our models are designed to predict the change of active regions over the next 12 hours. Our study is a new attempt to predict the evolution of solar active regions using deep learning and is meaningful in providing useful information on solar activity forecasts.

[P-60] Time-Distance Helioseismology of Plasma Flows Beneath Solar Active Region: NOAA AR12738

Bogyeong Kim[1], Sung-Hong Park[2], Yu Yi[1]

[1]*Chungnam National University*
[2]*Korea Astronomy and Space Science Institute*

This study investigates the subsurface flow characteristics of the solar active region NOAA AR12738 through Time-Distance helioseismology to better understand the features of Active Regions. The findings show that strong up-flows are present at depths of 5–7 (Mm), gradually weakening as they move toward the surface. Furthermore, down-flows are identified beneath areas of negative magnetic flux, while converging flows are noted beneath positive flux closer to the Photosphere. Focusing on a beta-type active region with a relatively simple magnetic structure, this research suggests that future comparative studies with more complex magnetic regions may provide deeper insights into the fundamental mechanisms driving solar magnetic activity.

[P-61] Comparison of MUF Values using Domestic Ionosphere Observation Data and Korean Ionosphere Prediction Model

Jong-Yeon Yun, Wonhyeong Yi

Korea AeroSpace Administration, Korea Space Weather Center

The Korea Space Weather Center (KSWC) is currently conducting a pilot operation of MUF prediction based on the domestic region using the Korean ionosphere prediction model. MUF is the maximum Usable frequency for HF communication by reflecting the F layer, and it can be calculated using the altitude of the F layer and the critical frequency. The existing MUF services of the KSWC were limited to monthly HF forecasts that took into account the number of sunspots and real-time MUF services that utilized ionospheric observation data. However, with the development of a Korean ionosphere prediction model, it became possible to predict MUF through simulation of ionosphere changes over the Korean Peninsula for up to 72 hours. In this study, we verified the performance of the Korean ionosphere prediction model by comparing the MUF calculated using domestic ionospheric observation data and the MUF predicted by the prediction model.

[P-62] Selection of Sporadic E-Layer Occurrence Prediction Model Candidate Group and Analysis of Test Results

Kyu-Cheol Choi[1], Dae-Kyu Shin[1], Seung-Jun Oh[1], Yong-Ha Kim[1], Jong-Yeon Yun[2]

[1]*SELab. Inc.*
[2]*Korea Space Weather Center*

Sporadic E (Es) represents a thin layer of enhanced electron density in the ionospheric E region. The electron density at Es is 2–3 times greater than that of surrounding and even reaches to 10^{12} m^{-3}. The Es layer has a thickness of about 1–2 km and its horizontal length is tens to hundreds of km. The Es is a major factor influencing radio wave in the HF and VHF bands. In order to develop the predictive model for the occurrence of the Es, a group of machine learning model candidates was selected and tested. The Machine learning predictive model candidates are the XGB, RF, LGBM, and MLP models, and the prediction results were compared with the Baseline model results. As a result of the test, the XGB model showed the best prediction rate of 0.77, and the LGBM was the lowest at 0.68. The baseline model was 0.63, and all test model results showed better prediction rate than the baseline model. Further machine learning model tests will be conducted to develop a final predictive model.

[P-63] Investigating the Relationship between Wind Shear and Sporadic E Layers over the Korean Peninsula

Jaewook Lee[1,2], Young-Sil Kwak[1,2], Jeong-Heon Kim[2], Tae-Yong Yang[2], Jong-Yeon Yun[3]

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[3]*Korea Space Weather Center*

The Earth's ionosphere is composed of various regions including D, E, and F regions, with the E region located at an altitude between approximately 100 and 150 km. Thin layers of metallic ion plasma that form within the E region are known as Sporadic E (Es) layers. These Es layers can significantly impact HF radio communications and navigation signals. In middle latitudes, the formation of Es layers is often explained

by wind shear theory. However, measuring neutral winds in the E region is more challenging than in the troposphere. In this study, we utilized data from the Michaelson Interferometer for Global High-resolution Thermospheric Imaging (MIGHTI) onboard the Ionospheric Connection Explorer (ICON) satellite, as well as from a meteor radar located in Gyeryong, to measure the neutral winds in the E region. Additionally, ionosondes located in Jeju and Icheon were employed to detect the presence of Es layers over the Korean Peninsula. Our analysis, covering the period from December 2019 to November 2022, reveals that meridional neutral winds exhibit downward zero wind lines during the daytime, indicating that wind shears migrate from higher to lower altitudes during this period. Correspondingly, the occurrence rates of Es layers detected by the ionosondes in Jeju and Icheon also demonstrate a similar trend, moving from higher to lower altitudes during the daytime. This study provides clear evidence supporting the relationship between Es layer formation and wind shear theory in the middle latitudes.

[P-64] TIEGCM Simulations of Ion Drift in Comparison with the Observations in the Southern Polar Cap Region

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External forcings from the magnetosphere into the polar ionosphere, including particle precipitation and solar wind-driven magnetospheric electric field, play important roles in the dynamics and energetics of the high-latitude upper atmosphere. In order to account for these forcings in the model simulation for the ionosphere-thermosphere (IT) system, the most fundamental approach would be through the direct coupling between IT and the magnetosphere models. However, the Thermosphere Ionosphere Electrodynamics General Circulation Model (TIEGCM) generally utilizes empirical models for the high-latitude inputs. In this research, we compared the empirical model-driven TIEGCM simulation results with ground-based neutral wind and ion drift measurements obtained at Jang Bogo Station. We identified significant discrepancies, most noticeably in the ion drifts, where the TIEGCM simulation substantially underestimates the ion drift velocity. To minimize the discrepancy, we attempted to use the Assimilative Mapping of Geospace Observations (AMGeO) results as high-latitude inputs for the TIEGCM, rather than using the Heelis or the Weimer empirical models. The TIEGCM-AMGeO simulation shows much better agreement with the observations of ion drifts compared with the previous simulation.

[P-65] A Study on the Occurrence Characteristics and Sources of Daytime Ionospheric Irregularities in the Mid and Low Latitudes of the East-Asia Region

Hoang Ngoc Huy Nguyen[1,2], Young-Sil Kwak[1,2], Woo Kyoung Lee[1,2], Hyosub Kil[3]

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[2]*University of Science and Technology*
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In this study, we investigate the seasonal and altitudinal variations in the distribution of daytime ionospheric irregularity over the East Asian sector during a period of low solar activity (2017–2021). Our findings reveal that GNSS/TEC daytime perturbations consistently peak during the December solstice in East Asia across in all observed years. On the contrary, in-situ observations from low Earth orbit (LEO) satellites during the low solar activity period (2020–2021) show that electron density irregularities peak during the June solstice in the same region. This discrepancy between *in-situ* satellite and GNSS-TEC observations can be explained by different sources of ionospheric irregularities at varying altitudes. Using COSMIC radio occultation (RO) data, we examined the effect of altitudinal variation of daytime ionospheric irregularities over East Asia during a low solar activity period (2016–2018). The results reveal that at altitude below 420 km, the occurrence rate of daytime irregularities peak during the December solstice, while at higher altitudes, the occurrence rate peaks during the June solstice. Thus, daytime ionospheric irregularity patterns are opposite at low to middle altitudes compared to high altitudes. Our study suggests that remnants of plasma bubbles from the previous night could be the source of irregularities at higher altitudes, observable by LEO satellites, while TIDs are likely the source of bottomside TEC perturbations, as represented by GNSS-TEC observations.

한국우주과학회 제42차 정기총회

일 시 : 2024년 10월 29일(화) 16:40

장 소 : KB손해보험 인재니움 사천연수원

1. 정족수 확인 ····· 재무이사 이주희
2. 개회선언 ····· 회장 박종욱
3. 전회의록 낭독 ····· 재무이사 이주희
4. 사업보고 ····· 재무이사 이주희
5. 학술대회준비위원회 보고 ····· 위원장 김해동
6. 편집위원회 보고 ····· 위원장 지건화, 임형철
7. 포상위원회 보고 ····· 위원장 진 호
8. 감사보고 ····· 감사 최기혁
9. 안건 1. 2024년 결산(안) 심의 ····· 재무이사 이주희
10. 안건 2. 2025년도 예산(안) 심의 ····· 재무이사 이주희
11. 안건 3. 임원선출 규정 개정 건 ····· 회장 박종욱
12. 안건 4. 학회운영 규정 개정 건 ····· 회장 박종욱
13. 기타 토의 ····· 회장 박종욱
14. 폐회 ····· 다같이

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