ISSN 1598-5601

한국우주과학회보

Bulletin of The Korean Space Science Society

2025년 4월 제34권 1호

학회보 다운로드

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
34055 대전광역시 유성구 대덕대로 776
한국천문연구원 내
전화 042-865-3391
팩스 042-865-3392

▣ 은행계좌:
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

<table>
<tr><td>성 명</td><td colspan="2">한글
영문</td><td>성 별</td><td>남/여</td><td>생 년 월 일</td><td colspan="2">년 월 일</td></tr>
<tr><td>자택주소</td><td colspan="3"></td><td>우편번호</td><td></td><td>전 화</td><td></td></tr>
<tr><td>직장주소</td><td colspan="3"></td><td>우편번호</td><td></td><td>전 화</td><td></td></tr>
<tr><td>e-mail</td><td colspan="5"></td><td>이동전화</td><td></td></tr>
<tr><td>소 속</td><td colspan="3"></td><td>직 위</td><td colspan="3"></td></tr>
<tr><td rowspan="4">학 력</td><td>학위명</td><td>입학년도</td><td>학위취득일</td><td colspan="2">출신학교</td><td colspan="2">전 공</td></tr>
<tr><td>학사</td><td></td><td></td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td>석사</td><td></td><td></td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td>박사</td><td></td><td></td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td>분과회
선택</td><td colspan="7">- 중복선택 가능
☐ 태양우주환경분과 ☐ 우주탐사분과 ☐ 우주관측기기분과
☐ 우주감시분과 ☐ 초소형위성분과 ☐ 활동 안함</td></tr>
<tr><td>경 력</td><td colspan="7"></td></tr>
<tr><td>연구 업적</td><td colspan="7"></td></tr>
</table>

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
2025년 봄 학술대회

일　　시 : 2025. 4. 22.(화) ~ 24.(목)

장　　소 : 서울 한국과학기술컨벤션센터

포스터 집중 발표 : 2025. 4. 23.(수) 15:50~17:10

후　　원 :

KOFST 한국과학기술단체총연합회

KASA 우주항공청 우주환경센터

대한민국육군 Republic of Korea Army

등록 및 안내

1. 등록

회원의 등록비는 일반 정회원은 270,000원, 대학원생 정회원은 200,000원, 학생부과 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(세션별 좌장이 심사하지 않음).

포스터발표: 포스터 발표는 A0 사이즈 1장(A0 사이즈 1장 내에 들어갈 분량, 예를 들면 A3 8장) 크기이며, 4월 22일(화) 15시까지 지정된 장소에 게시하고, 24일(목) 10시까지 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

대회의실 1	중회의실 5	중회의실 6
- Invited Talk - 우주정책포럼 - SS: Frontier of Space Plasma Simulation - 태양 및 우주환경 I, II, III, Ⅳ - 우주감시	- SS: 우주항공청 우주환경센터 I, II, III - SS: 교육문화유산 - SS: L4 우주관측소 I, II	- SS: 달 착륙선 과학/기술 임무 - 우주탐사: I, II - SS: 달 표면 과학 · 기술 임무 탑재체 I, II, III
중회의실 7	**대회의실 2**	**소회의실 2**
- 안보우주 I, II, III, Ⅳ - SS: AI로 우주를 분석하다	- 전시부스 & 포스터 발표	- 아이돌봄

4. 교통 안내

가. 주소: 서울시 강남구 테헤란로 7길 22(역삼동 635-4) 한국과학기술회관 1관 지하1층(02-3420-1200)
나. 찾아오시는 길
▶KTX(SRT) 이용: 서울역(수서역) → 지하철 강남역(또는 역삼역) 하차

5. 구두발표 색인표

Ⅰ - 1 - 1
세션번호 발표장 발표순서

2025 KSSS SPRING CONFERENCE PROGRAM

Apr. 22. (Tue)

Time	Functions
11:00~	**Registration : Lobby**
13:30~13:40	**Opening Ceremony : 대회의실 1** **개회사 : 박종욱 회장 / 축사 : 강경인 우주과학탐사부문장(항공우주청)**
13:40~14:20	**Invited Talk I** **Room: 대회의실 1** Chair: 이유(충남대) 남인혁(UNIST) Laboratory Astrophysics with Ultra-Intense Lasers
14:20~14:30	휴식(Break Time)
14:30~15:45	**우주정책포럼** **Room: 대회의실 1** 진행: 권윤영(천문연) 주제: M2M이 시사하는 우주과학회 미래 학술활동 예측
15:45~16:00	휴식(Break Time)

Room	대회의실 1		중회의실 5		중회의실 6		중회의실 7	
Session I	SS: Frontier of Space Plasma Simulation 좌장: 박경선(충북대)		SS: 우주항공청 우주환경센터 I 좌장: 이재형(우주청)		SS: 달 착륙선 과학 · 기술 임무 좌장: 박진혜(우주청)		안보우주 I 좌장: 최호성(육군)	
16:00~16:15	I-1-1	박경선	I-2-1	이재형(15분)	I-3-1	박진혜	I-4-1	정해준
16:15~16:30	I-1-2	류동수	I-2-2	하지훈(15분)	I-3-2	김은혁	I-4-2	문대성
16:30~16:45	I-1-3	김은화	I-2-3	Shawn Dahl (20분)	I-3-3	전문진	I-4-3	김태윤
16:45~17:00	I-1-4	김선정	I-2-4	윤기창(20분)	I-3-4	김경자	I-4-4	이우석
17:00~17:15	I-1-5	손동희	I-2-5	문용재(20분)	I-3-5	심채경	I-4-5	김선욱
17:15~17:30	I-1-6	이시백		R2O 자유토론 (15분)	I-3-6	류동석	I-4-6	윤대겸
17:30~17:45	I-1-7	서정준						

Apr. 23. (Wed)

Time	Functions							
Room	대회의실 1		중회의실 5		중회의실 6		중회의실 7	
Session II	태양 및 우주환경 I / 위성정보활용 좌장: 박재흥(천문연)		SS: 우주항공청 우주환경센터 II 좌장: 조정희(우주청)		우주탐사 I 좌장: 심채경(천문연)		안보우주 II 좌장: 정영준(국방부)	
09:15~09:30	II-1-1	이종길	II-2-1	이동훈(18분)	II-3-1	이기욱	II-4-1	심재춘
09:30~09:45	II-1-2	윤준무	II-2-2	강지혜(18분)	II-3-2	이진아	II-4-2	김동환
09:45~10:00	II-1-3	오대현	II-2-3	권윤영(18분)	II-3-3	최기혁	II-4-3	한철희
10:00~10:15	II-1-4	김대일	II-2-4	최규철(18분)	II-3-4	이승민	II-4-4	김광회
10:15~10:30	II-1-5	최두영	II-2-5	전호철(18분)	II-3-5	한정열	II-4-5	박진우
10:30~10:45	II-1-6	김영재			II-3-6	김푸름	II-4-6	김덕수
10:45~11:00	휴식(Break Time)							
11:00~11:40	**우주청 우주과학탐사부분 정책 및 프로그램 소개** **Room: 대회의실 1** 진행: 진 호(경희대) 우주항공청 강경인 우주과학탐사부문장							
11:40~13:00	점심(Lunch)							
Session III	태양 및 우주환경 II 좌장: 김연한(천문연)		SS: 우주항공청 우주환경센터 III 좌장: 곽영실(천문연)		우주탐사 II 좌장: 김은혁(항우연)		안보우주 III 좌장: 박재흥(천문연)	
13:00~13:15	III-1-1	김수진	III-2-1	곽영실(20분)	III-3-1	Lasany Arfin Kunja	III-4-1	최호성
13:15~13:30	III-1-2	조일현	III-2-2	정세헌(20분)	III-3-2	김관혁	III-4-2	정종균
13:30~13:45	III-1-3	전민규	III-2-3	신승헌(20분)	III-3-3	박현후	III-4-3	양희수
13:45~14:00	III-1-4	이재진	III-2-4	Carina R Alden(15분)	III-3-4	이선우	III-4-4	윤재철
14:00~14:15	III-1-5	지은영			III-3-5	김동규	III-4-5	정영준
14:15~14:25	휴식(Break Time)							
Session IV	태양 및 우주환경 III 좌장: 이창섭(극지연)		SS: 교육문화유산 좌장: 이서구(천문연)		SS: 달 표면 과학 · 기술 임무 탑재체 I 좌장: 정민섭(천문연)		안보우주 IV: 임무중심 초소형위성시스템 연구 및 활용 좌장: 송영범(천문연)	
14:25~14:40	IV-1-1	Miyashita Yukinaga	IV-2-1	김상혁	IV-3-1	심채경	IV-4-1	이재진
14:40~14:55	IV-1-2	Madeeha Talha	IV-2-2	송인옥	IV-3-2	김성환	IV-4-2	신민수
14:55~15:10	IV-1-3	김지우	IV-2-3	민병희	IV-3-3	한정열	IV-4-3	김준현
15:10~15:25	IV-1-4	박진영	IV-2-4	박지원	IV-3-4	김경자	IV-4-4	송호섭
15:25~15:40	IV-1-5	정종일	IV-2-5	박장호			IV-4-5	박재흥
15:40~15:50	휴식(Break Time)							

Time	Functions
15:50~17:10	**포스터 세션(Poster Session): 집중 발표**
17:10~17:15	휴식(Break Time)
17:15~17:55	**Invited Talk II** **Room : 대회의실 1** Chair : 이대희(전문연) James W. Beletic (Teledyne Digital Imaging) The James Webb Space Telescope (JWST) Humankind's Greatest Space Science Facility
18:00~20:30	**만찬: 과총 1관 12층 아나이스홀**

Apr. 24. (Thu)

Time	Functions							
Room	**대회의실 1**		**중회의실 5**		**중회의실 6**		**중회의실 7**	
Session V	**태양 및 우주환경 IV** 좌장: 정종일(천문연)		**SS: L4 우주관측소 I** 좌장: 문용재(경희대)		**SS: 달 표면 과학 · 기술 임무 탑재체 II** 좌장: 박현후(경희대)		**SS: AI로 우주를 분석하다. 우주 데이터와 머신러닝** 좌장: 최성환(천문연)	
09:15~09:30	V-1-1	전 웅	V-2-1	조경석	V-3-1	백슬민	V-4-1	백지혜
09:30~09:45	V-1-2	길효섭	V-2-2	장종진	V-3-2	김선진	V-4-2	정세헌
09:45~10:00	V-1-3	송병권	V-2-3	이건희	V-3-3	정민섭1	V-4-3	손지현
10:00~10:15	V-1-4	이영숙	V-2-4	이진성	V-3-4	정민섭2	V-4-4	안교훈
10:15~10:30	V-1-5	송인선	V-2-5	김록순			V-4-5	윤준무
10:30~10:40	휴식(Break Time)							
Session VI	**우주감시** 좌장: 김명진(천문연)		**SS: L4 우주관측소 II** 좌장: 선종호(경희대)		**SS: 달 표면 과학 · 기술 임무 탑재체 III** 좌장: 백슬민(천문연)			
10:40~10:55	VI-1-1	김재우	VI-2-1	최성환	VI-3-1	조남석		
10:55~11:10	VI-1-2	감호식	VI-2-2	서정준	VI-3-2	이은지		
11:10~11:25	VI-1-3	최승환	VI-2-3	이찬행	VI-3-3	정태일		
11:25~11:40	VI-1-4	이희재	VI-2-4	손종대				
11:40~12:00	**Closing Ceremony : 대회의실 1** **우수 구두발표상, 우수 포스터상 시상식**							

Poster Session

4. 23. (Wed) 15:50~17:10

Area	No	Author	Affiliation	Area	No	Author	Affiliation
SS: AI로 우주를 분석하다: 우주 데이터와 머신러닝	P-1	이석주	한국에너지공과대	위성정보활용	P-33	정대준	항우연
					P-34	천이진	항우연
SS: 달 표면 과학/기술 임무 탑재체	P-2	이민경	천문연		P-35	이한별	국가기상위성센터
SS: 교육문화유산	P-3	김현남	경희대				
미소중력실험	P-4	김연규	항우연	초소형위성	P-36	박성우	항우연
	P-5	이주희	항우연		P-37	주한우	경상국립대
우주산업	P-6	김영윤	항우연	태양 및 우주환경	P-38	유대중	경희대
	P-7	전현진	항우연		P-39	백준호	경희대
	P-8	박종억	항우연		P-40	안승우	경희대
	P-9	김주현	항우연		P-41	유인상	항우연
	P-10	김민준	항우연		P-42	강신철	표준연
우주정책	P-11	양지모	항우연		P-43	이재욱	천문연
	P-12	임정흠	항우연		P-44	나현옥	경희대
우주천문	P-13	노형윤	항우연		P-45	이준현	경희대
	P-14	김성은	세종대		P-46	Masaru Kogure	Yonsei Univ.
우주탐사	P-15	김희경	항우연		P-47	Nguyen Ngoc Huy Hoang	KASI
	P-16	신상윤	항우연				
	P-17	이원범	항우연		P-48	Maria Sotirova Madjarska-Theissen	KASI
	P-18	이재희	경희대				
	P-19	홍예원	경희대		P-49	김지은	극지연
	P-20	김기덕	항우연		P-50	이진이	경희대
	P-21	김다연	항우연		P-51	양희수	천문연
	P-22	송영주	경희대	우주 인프라	P-52	양승은	항우연
	P-23	김나연	경희대		P-53	강 철	항우연
	P-24	조은진	천문연		P-54	박진형	항우연
	P-25	김상화	경희대		P-55	전종협	항우연
	P-26	임조령	항우연		P-56	현정훈	항우연
	P-27	안예선	경희대		P-57	박균상	항우연
	P-28	김영선	항우연		P-58	김승환	항우연
	P-29	김지석	항우연		P-59	최람미	항우연
	P-30	김민재	경희대		P-60	임현수	항우연
	P-31	장윤정	항우연		P-61	강수연	항우연
					P-62	손봉원	천문연
	P-32	박주호	항우연	우주감시	P-63	김명규	한양대

한국우주과학회 2025년 봄 학술대회 우주정책포럼

우주항공청은 제4차 우주개발진흥 기본계획을 통해 2032년 무인 달 착륙, 2040년대 달 기지 확보, 2035년 화성 궤도 탐사, 2045년 화성 착륙 및 표면 임무 등을 선언하고, 이들의 실현을 위해 박차를 가하고 있습니다. 이는 우리가 어린시절 그림 일기장에 그려오던 꿈을 실현하는 궁극의 우주 탐사 및 우주 개발 계획이라 할 수 있습니다. 한편 미국의 Moon-to-Mars, M2M은 국제협력을 통해 달을 전초기지 삼아 인류의 탐사 및 활동 영역을 화성과 그 너머로 확장하기 위한 계획으로, NASA는 이미 이러한 계획을 실행에 옮기고 있습니다. 우리나라의 계획 또한 미래의 추상적인 개념이 아닌 현재 진행 중인 실체로서 구체화 되어가고 있습니다. 예로, 2022년에 발사된 우리의 달 궤도선 다누리를 미국 NASA는 Artemis의 'Pathfinder'로써 성공적인 국제협력 사례로 손꼽았으며, 또한 우리는 NASA의 CLPS 프로그램의 과학탑재체를 개발하는 등 양국간의 활발한 협력을 전개해 오고 있습니다. NASA는 2022년부터 매년 개최하는 M2M 워크숍을 통해 'M2M Architecture' 개발 경과를 공유하며 우리 학회원분들을 포함한 전 세계 연구자, 우주전담기관의 기여를 기다리고 있습니다.

이는 M2M이 우리가 추구하며 실현하고 있는 구체적인 계획임과 동시에 미국을 비롯한 세계적인 추세임을 의미하며, 이 체계는 우리 우주과학회 미래 학술 활동의 중요한 '틀'이 될 것임을 의미합니다. 이에 한국우주과학회 2025년 봄 학술대회 우주정책포럼에서는 『M2M이 시사하는 우주과학회 미래 학술활동 예측』이라는 주제로 미래 우주과학회의 중요 학술 활동을 예측해 보고자 합니다. 이번 포럼은 M2M 관련 정보 공유를 주 목표로 하며, 전문가의 발표와 질의응답 형식으로 진행합니다.

- **제목:** M2M이 시사하는 우주과학회 미래 학술활동 예측
- **일시/장소:** 2025년 4월 22일 화요일 14:30~15:45 / 대회의실 1
- **진행:** 권윤영(천문연구원)

- **발표 및 토론:**

  Nujoud Merancy(NASA): NASA's Moon to Mars Architecture(20분)
  박승수(우주항공청): 달에서 화성으로: 한국형 Moon to Mars 탐사 전략과 추진 현황(15분)
  박현준(과학기술정책연구원): 지속가능한 우주탐사를 위한 민관협력 방향(20분)
  이 준(항공우주연구원): M2M 활동시 우주법 측면의 검토요소(20분)

초청강사 I
Invited Talk I

Laboratory Astrophysics with Ultra-Intense Lasers

Inhyuk Nam

Department of Physics, Ulsan National Institute of Science and Technology (UNIST)

Laboratory astrophysics with ultra-intense lasers is an emerging field that utilizes advanced laser technology to recreate and study extreme astrophysical conditions in a controlled environment. This approach allows us to explore high-energy density (HED) plasmas, providing valuable insights into phenomena such as the interior conditions of planets like Neptune and Uranus. Ultra-intense lasers have also enabled the exploration of quantum electrodynamics (QED) effects, paving the way for new extreme physics regimes in laser-matter interactions. These regimes are particularly relevant in extreme astrophysical scenarios such as gamma-ray bursts, black holes, and pulsar magnetospheres. Furthermore, using the laser, compact laser-plasma accelerators can generate high-energy particles, including electrons, protons, neutrons, and gamma rays, at a lab scale, simulating cosmic rays. These particles are then used to test semiconductor materials in extreme space environments. In this presentation, I will summarize these diverse applications of ultra-intense lasers in laboratory astrophysics.

강연자 간략 약력
- 2024년～현재: Associate Professor, Department of Physics, UNIST
- 2017년～2024년: Pohang Accelerator Laboratory (PAL), POSTECH
- 2016년～2017년: LCLS, SLAC National Accelerator Laboratory
- Laser-plasma accelerators, X-ray free electron lasers, Laboratory astrophysics, QED astrophysics

초청강사 II
Invited Talk II

The James Webb Space Telescope (JWST) Humankind's Greatest Space Science Facility

James W. Beletic, Ph.D.

Teledyne Digital Imaging

The James Webb Space Telescope (JWST) is NASA's flagship astronomy and astrophysics mission that was launched on December 25, 2021 and is operating in a halo orbit at Lagrange Point 2 (L2), 1.5 million km from Earth. With a 6.5-meter diameter primary mirror that is cooled to 50K and four infrared instruments, JWST is investigating four major science areas:

- First light and reionization: JWST is a powerful time machine with infrared vision that is looking back 13.5 billion years to see the first stars and galaxies forming in the early Universe.
- Assembly of galaxies: JWST's unprecedented infrared sensitivity enables astronomers to compare the faintest, earliest galaxies to today's spiral and elliptical galaxies, helping us understand how galaxies assemble over billions of years.
- Birth of stars and protoplanetary systems: JWST can see into massive clouds of dust that are opaque to visible-light observatories (like Hubble), where stars and planetary systems are being born.
- Planets and origins of life: JWST is telling us more about the atmospheres of extrasolar planets, and perhaps will even find the building blocks of life elsewhere in the Universe. In addition to other planetary systems, JWST will also study objects within our own solar system.

This presentation starts with the scientific motivation of JWST and reviews the major technological innovations that were needed to build the observatory. The four JWST instruments are presented with the optical path of the NIRSpec animated. The infrared focal plane arrays (FPAs) are presented and performance of the FPAs and telescope optics are reviewed; telescope performance is exceeding specification in spite of micrometeoroid hits on the primary mirror. The process of image data collection and processing is demonstrated by the iconic "Cosmic Cliffs" image (shown below). The presentation concludes with scientific examples that demonstrate the breadth of JWST capability and glimpse of the science that will be performed over the next two decades.

Speaker brief bio

- Chief Scientific Officer
- Dr. Beletic is the Chief Scientific Officer for Teledyne Digital Imaging, focusing his efforts on space missions. In this role, he is responsible for engaging current and prospective space customers to grow Teledyne's business across the full suite of Teledyne's imaging technologies. During 2013–2023, Dr. Beletic was the President of Teledyne Imaging Sensors, which is a world leader in the development and production of high performance infrared focal plane arrays (FPAs).
- Teledyne's FPAs are operating in instrumentation at every major ground-based telescope, most space astronomy missions (including JWST), and leading Earth and planetary science missions. Teledyne's FPAs are serving an increasing role in space defense missions.

구두발표 논문 제목 및 시간표

4월 22일(화)

대회의실 1

13:40 [IS-1]

Laboratory Astrophysics with Ultra-Intense Lasers

Inhyuk Nam

Department of Physics, Ulsan National Institute of Science and Technology (UNIST)

16:00 [I-1-1]

Introduction to Space Plasma Simulation

Kyung Sun Park

Chungbuk National University

16:15 [I-1-2]

A New High-Order Magnetohydrodynamic Code for Space Weather Modeling

Dongsu Ryu

UNIST

16:30 [I-1-3]

Application of the State-of-the-Art Full-Wave Solver, Petra-M, in Earth's and Planetary Ionospheric-Magnetospheric Plasmas

Eun-Hwa Kim[1,2], Syun'ichiShiraiwa[1]

[1]*Princeton Plasma Physics Laboratory, Princeton University, Princeton, NJ, USA*
[2]*Andrews University, Berrien Springs, MI, USA*

16:45 [I-1-4]

GPU-Optimized Energy-Conserving Particle-in-Cell Codes for Space and Astrophysical Plasmas

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*

17:00 [I-1-5]

A Comparative Analysis of High-Resolution Shock-Capturing Schemes for Two-Dimensional Magnetohydrodynamic Simulation of Flux Emergence in the Solar Atmosphere

Donghui Son[1], Yeonwoo Jang[1], Tetsuya Magara[1,2]

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

17:15 [I-1-6]

A Novel Approach to Coronal Magnetic Field Reconstruction with Applications to Solar Eruptions

Sibaek Yi[1], Gwangson Choe[1,2], Minseon Lee[2], Sunjung Kim[1]

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

17:30 [I-1-7]

Modeling the Multi-Scale Nature of the Solar Wind

Jungjoon Seough

Korea Astronomy and Space Science Institute

중회의실 5

16:00 [I-2-1]

Space Weather Forecasting at Korea Space Weather Center (KSWC): Current Status and Methodologies

Jae-Hyung Lee, Jaehun Kim, Ji-Hoon Ha, Sang Cheol Han, Wonhyeong Yi

Korea Space Weather Center, Korea AeroSpace Administration

16:15 [I-2-2]

Forecasting and Alert Systems for Solar Energetic Particles at Korea Space Weather Center

Ji-Hoon Ha, Jae-Hyung Lee, Jaehun Kim, Sang Cheol Han, Wonhyeong Yi

Korea Space Weather Center, Korea AeroSpace Administration

16:30 [I-2-3]

NOAA SWPC's Latest Space Weather Forecasting

Techniques (CME analysis)

Shawn Dahl[1], Kichang Yoon[2]

[1]*Space Weather Prediction Center (SWPC), NOAA*
[2]*Korea Space Weather Center (KSWC), KASA*

16:50 [I-2-4]

국제민간항공기구(ICAO) 우주환경 예측모델 개발동향: 국제민간항공기구(ICAO) 사례를 중심으로

윤기창, 조정희, 나현준

우주항공청 우주환경센터

17:10 [I-2-5]

Good Candidates of Research-to-Operation for Space Weather Forecasting

Yong-Jae Moon[1,2]

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

중회의실 6

16:00 [I-3-1]

Vision and Importance of South Korea's Lunar Lander Science and Technology Mission

Jinhye Park, Seungsoo Park, Ijeung Kim, Dong Young Rew

Korea AeroSpace Administration

16:15 [I-3-2]

Moon Exploration: Recent Activities

Eunhyeuk Kim

Korea Aerospace Research Institute

16:30 [I-3-3]

Key Considerations for Payload Accommodation on the Korea Lunar Lander

Moon-Jin Jeon, Yoon Hyungjoo

Korea Aerospace Research Institute

16:45 [I-3-4]

Significant Aspects of Lunar Resource Prospecting and Utilization for the Korean Lunar Lander Program

Kyeong Ja Kim[1,2]

[1]*Space Resources Exploration and Utilization Center, Korea Institute of Geoscience and Mineral Resources*
[2]*Resources Engineering, University of Science and Technology*

17:00 [I-3-5]

Understanding the Moon: Key Scientific Questions and Future Exploration

Chae Kyung Sim[1,2]

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

17:15 [I-3-6]

Analysis of Requirements of Lunar Surface Mobilities from Lunar Missions

Dongseok Ryu, Wonseo Lee, Hocheol Shin

Korea Atomic Energy Research Institute

중회의실 7

16:00 [I-4-1]

Strategic Narrative Approach to the U.S. Space Security Trends

Hae-Jun Jeong

Korea National Defense University

16:15 [I-4-2]

A Study on the Necessity of Utilizing a Korea Augmentation Satellite System for Improving the Operability of Manned-Unmanned Teaming System

Daeseong Mun

Defense Agency for Technology and Quality, DTaQ

16:30 [I-4-3]

The Role of the Army in Establishing an Effective National Defense Space Launch Site: Necessity, Implementation Progress, and Army's Contribution

Tae-Yoon Kim

Korea Aerospace Research Institute

16:45 [I-4-4]

A Legal Review for the Expansion of the Army

Space Forces Lift Capability

Woo-Seok Lee

Republic of Korea Army HQ, Policy Office

17:00 [I-4-5]
Like Flying a Drone Let's Launch a Satellite

Sun-Wook Kim[1,2]

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

17:15 [I-4-6]
The Development of Military Counterspace Capabilities and Suggestions for Improvement

Dae-kyum Yoon[1], Seok Min Song[2]

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

4월 23일(수)

대회의실 1

09:15 [II-1-1]
Comparative Analysis Using AI Method of Space Environment Data Extracted with GOLD Mission Image Noise

Jonglil Lee[1], Jaeheung Park[2], Dae-Young Lee[1]

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

09:30 [II-1-2]
Aurora Detection in Sequential e-POP/FAI Images Using Deep Learning and Explainable AI

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

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

09:45 [II-1-3]
Multi-Satellite Geostationary Observations of 2024 Space Weather Events with GK2A, Himawari-9, GOES-16 & GOES-18

Daehyeon Oh, Eunjeong Cha

National Meteorological Satellite Center, Korea Meteorological Administration

10:00 [II-1-4]
Selection of One EUV Channel along with Solar Magnetogram by a Multi-Domain Image Translation Method

Daeil Kim[1], Yong-jae Moon[1,2], Junmu Youn[1]

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

10:15 [II-1-5]
Heliospheric Current Sheet Thickness and Orientation Distribution within 1-33.6 au from Voyager 2: 1977-1990

Dooyoung Choi, Dae-Young Lee

Chungbuk National University

10:30 [II-1-6]
Interpretable Solar Flare Forecasting Derived by Deep Learning and Symbolic Regression

Youngjae Kim[1], Yong-Jae Moon[1,2], Jihyeon Son[2]

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

13:00 [III-1-1]
Statistical Study on Microwave Precursor for M and X-Class Flare

Sujin Kim[1], Hong-dal Jun[1], Jeongwoo Lee[2], Su-Chan Bong[1], Sung-Hong-Park[1,3]

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

13:15 [III-1-2]
Preliminary Results of a Comparison Between Ambient Solar Wind Speed and Coronal Temperature Observed from SDO/AIA

Il-Hyun Cho, Yong-Jae Moon

Kyung Hee University

13:30 [III-1-3]

Towards Improving DEM Determination from AI-Generated EUV Images of Solar Orbiter

Mingyu Jeon[1], Junmu Youn[1], Yong-Jae Moon[1,2]

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

13:45 [III-1-4]

Observations of the Butterfly Pitch Angle Distribution in the Inner Radiation Belt by the Snipe Mission During the May 2024 Superstorm

Jaejin Lee, Jaeheung Park, Tae-Yong Yang, Jongdae Sohn, Hosub Song

Korea Astronomy and Space ScienceInstitute

14:00 [III-1-5]

Study of Enhancing IRI Electron Density Profiles Using Machine Learning

Eun-Young Ji[1], Yong-Jae Moon[1,2], Young-Sil Kwak[3], Kangwoo Yi[1], Jeong-Heon Kim[3]

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

14:25 [IV-1-1]

A Long-Duration Pseudobreakup

Yukinaga Miyashita[1,2], Madeeha Talha[1,2,3]

[1]*Korea Astronomy and Space Science Institute*
[2]*University of Science and Technology*
[3]*Pakistan Space and Upper Atmosphere Research Commission, Karachi, Pakistan*

14:40 [IV-1-2]

Relation between Stepwise Development of Auroral Onset Arc and Low-Frequency Waves in the Near-Earth Magnetotail at Substorms Onsets

Madeeha Talha[1,2,3], Yukinaga Miyashita[1,2]

[1]*University of Science and Technology (UST)*
[2]*Korea Astronomy and Space Science Institute (KASI)*
[3]*Pakistan Space & Upper Atmosphere Research Commission (SUPARCO)*

14:55 [IV-1-3]

Evaluating the Impact of External Forcings on the Ionosphere-Thermosphere 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, USA*
[3]*Department of Physics, Catholic University of America, Washington, DC, USA*
[4]*Science and Technology Institute, Universities Space Research Association, Huntsville, AL, USA*
[5]*NSF National Center for Atmospheric Research, High Altitude Observatory, Boulder, CO, USA*
[6]*COSMIC Program Office, University Center for Atmospheric Research, Boulder, CO, USA*

15:10 [IV-1-4]

Study on Advancing the Space Weather Monitoring and Forecasting System of the 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*

15:25 [IV-1-5]

Relocation of the Daejeon Neutron Monitor to Gamak Mountain in Geochang and Initial Observational Data

Jongil Jung[1], Young-Sil Kwak[1,2], Jongdae Sohn[1], Suyeon Oh[3], Yu Yi[4], Youngkyun Kim[5], Seonghwan Choi[1], Paul Evenson[6]

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

17:15 [IS-2]

The James Webb Space Telescope (JWST) Humankind's Greatest Space Science Facility

James W. Beletic, Ph.D.

Teledyne Digital Imaging

중회의실 5

09:15 [II-2-1]

Space Weather Models for LEO Satellites: Progress and Future Plans

Dong-Hun Lee[1], Jongho Seon[1], Go Woon Na[1], Sunghwan Lee[1], Jae-Hyuk Lee[1], Seo-Hyun Park[1], Kyung-Chan Kim[2], JiWoo Seo[2], Sang-Young Park[3], Jee Hoon Kim[3], Hae-Dong Kim[4], Junghee Cho[5], Junchul Mun[5], Kichang Yoon[5]

[1]*Kyung Hee University*
[2]*Chungbuk National University*
[3]*Yonsei University*
[4]*Gyeongsang National University*
[5]*Korea Space Weather Center*

09:33 [II-2-2]

Development of an AI-based Model for Denoising Solar Magnetic Field and Improvement of Solar Synoptic Magnetic Field Maps

Jihye Kang[1], Yong-Jae Moon[1,2], Harim Lee[1], Hyun-Jin Jeong[1,3], Junmu Youn[2], Mingyu Jeon[2], Daeil Kim[2]

[1]*Department of Astronomy and Space Science, Kyung Hee University*
[2]*School of Space Research, Kyung Hee University*
[3]*CmPA, KU Leuven, Belgium*

09:51 [II-2-3]

Recent Discoveries on Solar Energetic Particle Accelerations and a Novel Approach for Predicting Solar Radiation Storms

Ryun Young Kwon, SWEET

Korea Astronomy and Space Science Institute

10:09 [II-2-4]

Prediction of Sporadic E Layer Occurrence Using Machine Learning Technique

Kyu-Cheol Choi, Dae-Kyu Shin, Seung-Jun Oh, Yong-Ha Kim

SELab. Inc,.

10:27 [II-2-5]

A Hybrid Deep Learning Framework for Near Advancement of Space Radio Environment Observation Data Processing Technology and Observation Equipment

Ho-Cheol Jeon[1], Jung-Gil Yuk[1], Ho-Young Jang[1], Ji-Hyeon Kim[1], Kang-Min Jeong[1], Jae-Hyun Lee[2]

[1]*Radar&Space Co., Ltd.*
[2]*Chungnam National University (CNU)*

13:00 [III-2-1]

KASI's Space Weather Research Activities and Strategic Recommendations for Korea's R2O System

Young-Sil Kwak[1,2], KASI Space Weather Research Team

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

13:20 [III-2-2]

A Hybrid Deep Learning Framework for Near Real-Time TEC Mapping and Forecasting over the Korean Peninsula Region

Se-Heon Jeong[1], Woo Kyoung Lee[1,2], Hyosub Kil[3], Jeong-Heon Kim[1], Young-Sil Kwak[1,2]

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

13:40 [III-2-3]

SWA-GPT: Space Weather Assistant with GPT

Seungheon Shin[1], Yong-Jae Moon[1,2], Jihyeon Son[2]

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

14:00 [III-2-4]

NASA Moon to Mars (M2M) Space Weather Research-to-Operation to Support Space Exploration

Carina Alden[1], Kichang Yoon[2]

[1]*M2M (Moon to Mars) Office, GSFC, NASA*
[2]*Korea Space Weather Center (KSWC), KASA*

14:25 [IV-2-1]

A Comparative Study of Automatic Water Clocks in East Asia from the 13th to 15th Centuries

Sang Hyuk Kim[1], Byeong-Hee Mihn[1,2,3], Kyung-Ha Lee[4]

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

14:40 [IV-2-2]

Expansion of Public Astronomy Education and Programs: The Need for a Sustainable and Open Platform

In-Ok Song

Korea Science Academy of KAIST

14:55 [IV-2-3]

The Evolution and Diversification of Angbuilgu in Joseon

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

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

15:10 [IV-2-4]

Research Trends in Quantum Technology in Astronomy and the Space Industry: A Bibliometric Analysis Based on WoS and Scopus

Jiwon Park[1,2], Jungwon Lee[3], Yonggi Kim[1,2]

[1]*Astronomy and Astrophysics Dept. Chungbuk National University*
[2]*Chungbuk Pro Maker Center, Chungbuk National University*
[3]*Basic Science Research Institute, Chungbuk National University*

15:25 [IV-2-5]

The Program Operation and Status of the Sobaeksan Astronomical Observatory Education Hall

Jang-Ho Park, Youngsik Park, Hanbyeol Choi

Korea Astronomy and Space Science Institute

중회의실 6

09:15 [II-3-1]

Distribution of U, Th, and Pb in Ryugu Rocks: Preliminary Results of a Secondary Ion Mass Spectrometry Study

Keewook Yi[1], Yuri Amelin[2], Changkun Park[3], Hwayoung Kim[3]

[1]*Korea Basic Science Institute*
[2]*Korea Basic Science Institute, Guangzhou Institute of Geochemistry, Guangzhou, China*
[3]*Korea Polar Research Institute*

09:30 [II-3-2]

Effect of Preserving Lie Group Structure in Dynamic Analysis near Small Celestial Bodies: Quantitative Analysis

Jinah Lee, Chandeok Park

Department of Astronomy, Yonsei University

09:45 [II-3-3]

Study on the Changes in the Upper Atmosphere (0-1,000 km) during Solar Maximum

Gi-Hyuk Choi[1], Dae-Young Kim[1], Young-Sil Kwak[2]

[1]*Korea Aerospace Research Institute*
[2]*Korea Astronomy and Space Research Institute*

10:00 [II-3-4]

Test Results of a Space Search Coil Magnetometer Engineering Model

Seungmin Lee[1], Ho Jin[1], Yunho Jang[1], Minjae Kim[1], Hyeonhu Park[1], Yesun Ahn[1], Sanghwa Kim[1], Jinsang Kim[2], Ickhyun Song[3]

[1]*School of Space Research, Kyung Hee University*
[2]*Department of Electronics Enginnering, Kyung Hee University*
[3]*Department of Electronics Engineering, Hanyang University*

10:15 [II-3-5]

Conceptual Design of Segmented Robot AI Space Telescope

Jeong-Yeol Han[1,2], Space Telescope Team

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

10:30 [II-3-6]

Choice of Problem Design and Metaheuristic for Efficient Low-Thrust Gravity Assist Trajectory Design

Pureum Kim, Sang-Young Park

Yonsei University

13:00 [III-3-1]

Comparability of the Shielding Capacities Between Space Suits Made from the Composite Material ABnC and Traditional Space Suits on Planetary Bodies

Lasany Arfin Kunja[1], Eojin Kim[2], Yu Yi[1]

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

13:15 [III-3-2]

Statistical Analysis of Moon-Originating Ions Observed by the Kaguya Spacecraft in the Earth's Magnetotail Lobes

Khan-Hyuk Kim[1], Jaehee Lee[1], Seul-Min Baek[2], Ho Jin[1]

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

13:30 [III-3-3]

Surface Composition Around the South Pole-Aitken Basin Suggest a Clue to the Origin of Lunar Magnetism

Hyeonhu Park[1], Ian Garrick-Bethell[2], Ho Jin[1]

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

13:45 [III-3-4]

3D Spiral Phase Plate Microscope for Lunar Regolith Grain Imaging

Sunwoo Lee[1,2], I Jong Kim[1], Nayeon Kim[2], Seunghyuk Chang[3], Changgon Kim[2], Dohoon Kim[2], Chae Kyung Sim[4,5], Minsup Jeong[4], Daewook Kim[6], Soojong Pak[2]

[1]*Korea Basic Science Institute*
[2]*School of Space Research, Kyung Hee University*
[3]*Center for Integrated Smart Sensors*
[4]*Korea Astronomy and Space Science Institute*
[5]*University of Science and Technology*
[6]*James C. Wyant College of Optical Sciences, The University of Arizona*

14:00 [III-3-5]

Imaging of Blue Ghost Mission 1 and IM-2 Nova-C by the KPLO LUTI Camera

Dong-Gyu Kim, Eunhyeuk Kim

Korea Aerospace Research Institute

14:25 [IV-3-1]

Preliminary Concept Design of Lunar Surface Infrared Spectrometer (LSIS)

Chae Kyung Sim[1,2], Sung-Joon Park[1], Bongkon Moon[1,2], Dae-Hee Lee[1,2], Minsup Jeong[1], Young-Jun Choi[1], Dukhang Lee[1,2]

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

14:40 [IV-3-2]

System Design of Particle Detector and Neutron Spectrometer for Future Korean Lunar Exploration

Sunghwan Kim[1], Uk-Won Nam[2], Sukwon Youn[3], Sung-Joon Ye[3], Chae Kyung Sim[2]

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

14:55 [IV-3-3]

Conceptual Design of Optical Camera System: Lunar Vision

Jeong-Yeol Han[1,2], Chae Kyung Sim[1,2], Minsup Jeong[1], Dukhaeung Lee[1,2], Hyoung Kwon Lee[3], Jaehyeon Kyeong[3], Jiwoo Lee[1,2], Seungkyun Ryu[4]

[1]*Korea Astronomy and Space Science Institute*
[2]*University of Science and Technology*
[3]*LeO SPACE Inc.*
[4]*IM Technology Inc.*

15:10 [IV-3-4]

Introduction to a Lunar Volatile Extraction Demonstrator for Future Korean Lunar Lander Exploration

Kyeong Ja Kim[1,2]

[1]*Space Resources Exploration and Utilization Center, Korea Institute of Geoscience and Mineral Resources*
[2]*Resources Engineering, University of Science and Technology*

중회의실 7

09:15 [II-4-1]

Development Direction of South Korea's Space Power in Light of the Establishment of the U.S. Space Force (USSF)

Jae-Chun Sim, Jae-Young Choi, Won-Sub Shin

Engineer Office, Republic of Korea Army Headquarters

09:30 [II-4-2]

Toward Developing Foundation Geospatial Intelligence Using Multi-Source Satellite Data and New Surveying Equipment

Donghwan Kim

Korea Army Academy at Yeongcheon

09:45 [II-4-3]

Design of a Cluster of Low-Orbit Reconnaissance Satellites for Detecting North Korean Transporter Erector Launcher (TEL)

Chulhee Han

Joint Chiefs of Staff

10:00 [II-4-4]

Consideration of Space Law Development through Lessons from the Ukraine-Russia War

Kwang-Hoi Kim[1,2], Da-Som Kim[1,2]

[1]*Army Training Command, Republic of Korea Army Infantry School*
[2]*Chonnam National University, Gradute School, Department of Political Science (Ph. D. Program, Enrolled)*

10:15 [II-4-5]

Event Cameras for Space Defense Applications: Leveraging Neuromorphic Vision for Enhanced Surveillance and Object Tracking

Jinwoo Park[1], Geon Kang[1], Dongyoon Kim[1], Jeajung Lee[1], Gimin Bae[2], Janghyong Lee[1]

[1]*Institute of Innovation for Future Army, Headquarters of Republic of Korea Army*
[2]*DDOK*

10:30 [II-4-6]

42Abaci: Toolkit for Understanding Constellation Behaviors

Deok-Soo Kim[1,2], Joonghyun Ryu[1,2], Jun Young Byun[3], Juhwan Kim[3], Yujeong Cho[3], Seunghwan Choi[1,2], Greg Gillinger[4], Alina Shymanska[1], Jae Wook Song[3], Kichun Lee[3]

[1]*SpaceMap Inc*
[2]*School of Mechanical Engineering, Hanyang University*
[3]*Department of Industrial Engineering, Hanyang University*
[4]*Integrity ISR*

13:00 [III-4-1]

Analysis of Ionospheric Plasma Disturbances Induced by NWC VLF Transmitter Using SWARM Satellite Data

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

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

13:15 [III-4-2]

Installing of the Astronomy and Space Exploration Observation Module at Antarctic Inland Basecamp

Jong-Kyun Chung, Chung-Uk Lee, Dongjoo Lee, Heesu Yang

Korea Astronomy & Space Science Institute

13:30 [III-4-3]

Next Generation Solar Telescope (NxST): Monitoring Solar Flares and Filament Eruptions

Heesu Yang, Seong-hwan Choi, Eun-Kyung Lim, Dunguk Song

Korea Astronomy and Space Science Institute

13:45 [III-4-4]

Development of Formation Flying Orbit Design and Control System to Establish Multi-Static SAR Mission of Korean Next SAR Satellite System

Jae-Cheol Yoon

KOMPSAT-6 Program Office, Korea Aerospace Research Institute

14:00 [III-4-5]

Integration of Civilian Space Surveillance And Collision Risk Analysis Technologies into Military Applications

Young-joon Jeong[1], Seok-Min Song[2],

Jong-gun Noh[1], Gyongmin Jeon[1]

[1]*Republic of Korea Ministry of National Defence*
[2]*Korea Astronomy and Space Science Institute*

14:25 [IV-4-1]
Lessons Learned from DoyoSat (SNIPE) Mission

Jaejin Lee[1], Jaeheung Park[1], Tae-Yong Yang[1], Jongdae Sohn[1], Hosub Song[1], Youngbum Song[1], Kihwan Keum[1], Hae-DongKim[2], Wonsub Choi[3], Dong-Hyun Cho[4], Min-Ki Kim[3], Jin-Hyung Kim[3], Jiseok Kim[3], Kiduck Kim[3], SeongMin Lim[5]

[1]*Korea Astronomy and Space ScienceInstitute*
[2]*Department of Mechanical and Aerospace Engineering, Gyeongsang National University*
[3]*Korea Aerospace Research Institute*
[4]*Department of Aerospace Engineering, Pusan National University*
[5]*Agency for Defense Development*

14:40 [IV-4-2]
Space Korean Multi Telescope Network: Constellation of Small Space Telescopes for Time-Domain and Multi-Messenger Astronomy

Min-Su Shin, Yujin Yang, Jae-Woo Kim, Yunjong Kim, Sungho Lee, Young-Soo Jo, Chung-Uk Lee, Young-Min Kim, Hong Soo Park, Kyuseok Oh

Korea Astronomy and Space Science Institute

14:55 [IV-4-3]
Agile Aerospace Approach to the Implementation of Nanosatellites Designed for Constellation Missions

Jun-Hyeon Kim[1], Myung-Kyu Lee[2], Seung-Jun Oh[2], Seul-Hyun Park[1]

[1]*Department of Mechanical Engineering, Chosun University*
[2]*Department of Mechanical Engineering, Graduate School of Chosun University*

15:10 [IV-4-4]
Ionospheric Observation Results of SNIPE Spacecraft during Geomagnetic Storm on May 10-12, 2024

Hosub Song[1], Jaeheung Park[1,2], Jaejin Lee[1]

[1]*Korea Astronomy and Space Science Institute*
[2]*Department of Astronomy and Space Science, University of Science and Technology (UST)*

15:25 [IV-4-5]
SNIPE and SNIPE-2

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

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

4월 24일(목)

대회의실 1

09:15 [V-1-1]
Validation of IGS GIM TEC over Oceanic Regions Using Jason Satellite Observations from 2002 to 2022

Woong Jeon[1,2], Woo Kyoung Lee[1,3], Yong-Jae Moon[2,4]

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

09:30 [V-1-2]
Assessment of Traveling Ionospheric Disturbance Generation by Solar Eclipses and Terminators

Hyosub Kil

Korea Astronomy & Space Science Institute

09:45 [V-1-3]
Mesospheric and Lower Thermospheric Responses in the Antarctic Peninsula to the May 2024 Geomagnetic Storm

Byeong-Gwon Song[1], In-Sun Song[1], Geonhwa Jee[2], Jeong-Han Kim[2], Changsup Lee[2], Eunsol Kim[2], Young-Bae Ham[2]

[1]*Department of Atmospheric Sciences, Yonsei University*
[2]*Division of Ocean and Atmospheric Sciences, Korea Polar Research Institute*

10:00 [V-1-4]
A Study of Midnight Polar Summer Mesosphere in Association with Geomagnetic Disturbance Observed by PANSY Radar, Antarctica

Young-Sook Lee[1], Geonhwa Jee[2], Yongha Kim[1], Young-Sil Kwak[3]

[1]*Chugnam National University*
[2]*Korea Polar Research Institute*
[3]*Korea Astronomy and Space Scice Institute*

10:15 [V-1-5]

Impacts of Orographic Secondary Gravity Waves in the Upper Mesosphere of Whole Atmosphere Models

In-Sun Song

Department of Atmospheric Sciences, Yonsei University

10:40 [VI-1-1]

Progress of Space Debris Environment and Risk Analysis Framework Development

Jaewoo Kim[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*

10:55 [VI-1-2]

Development of Korean Enhanced Platform (KEPLER) and Database (SpaceBook) for Space Risk Response

Hosik Kam[1], Eun-Jung Choi[1,2], Jung Hyun Jo[1], Ki Pyoung Sung[1], Jin Choi[1]

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

11:10 [VI-1-3]

42 Talks: Vitual Meeting Platform for Space Traffic Management

Seunghwan Choi[1,2], Dong In Kang[1], Seonggoo Lee[1], Su Hyeok Roh[1], Ji Hyup Byun[1], Joonghyun Ryu[1,2], Deok-Soo Kim[1,2,3]

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

11:25 [VI-1-4]

Tracking and Impact Risk Assessment of Near-Earth Asteroids

Hee-Jae Lee[1], Myung-Jin Kim[1], Dong-Goo Roh[1], Jin Choi[1], Eun-Jung Choi[1,2], Sungki Cho[1], Jung Hyun Jo[1], Hong-Suh Yim[1], Jaemann Kyeong[1], Jiwoong Yu[1], Jeong Yoo Hong[1], Yun Hak Kim[1], HoSik Kam[1]

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

중회의실 5

09:15 [V-2-1]

Open New Horizon with the Korea-Led L4 Mission: 2025 April Progress Report

K. S. Cho, KASI L4 Feasibility Study Team

Korea Astronomy and Space Science Institute

09:30 [V-2-2]

Methodology of System Design and Sizing for L4 Spacecraft

Jong-Jin Jang

Korea Aerospace Industries, Ltd. (KAI)

09:45 [V-2-3]

Optimization of Chemical-Based Insertion Trajectory to Inclined Orbit around Sun-Earth L4

Gunhee Yi[1], Jinsung Lee[2], Jong-Jin Jang[3], Jaemyung Ahn[1]

[1]*Korea Advanced Institute of Science and Technology*
[2]*Satellite Technology Research Center, KAIST*
[3]*Korea Aerospace Industries, Ltd.*

10:00 [V-2-4]

Low-Thrust Multiple Earth Resonant Gravity Assist to 14.5° Sun-Earth L4 Point

Jinsung Lee

Satellite Technology Research Center

10:15 [V-2-5]

Remote Sensing Observations for Studying Heliospheric Physics and Space Weather in the L4 Mission

Roksoon Kim, L4 Team in KASI

Korea Astronomy and Space Science Institute

10:40 [VI-2-1]

Deep Space Optical Communications Plan for Korean-Led L4 Mission

Seonghwan Choi[1], Kyohoon Ahn[1], Hojin Lee[1], Chang-Hee Kim[1], Jongyeob Park[1], Ji-Hye Baek[1], Sungwon Park[2], Kyung-Suk Cho[1]

[1]*Korea Astronomy and Space Science Institute*
[2]*Korea AeroSpace Administration*

10:55 [VI-2-2]

Scientific Objectives of the L4 Mission within the Context of *In Situ* Measurements

Jungjoon Seough[1], Kyung-Suk Cho[1,2], Roksoon Kim[1], Yukinaga Miyashita[1,2], Jong-Dae Sohn[1,2], Jaeheung Park[1,2], Chanhaeng Lee[1], Seunguk Lee[3], Kwangsun Ryu[3], Yunho Jang[4], Ho Jin[4], Jongho Seon[4], Dae-young Lee[5]

[1]*Korea Astronomy and Space Science Institute*
[2]*University of Science and Technology*
[3]*Satellite Technology Research Center, KAIST*
[4]*Kyung Hee University*
[5]*Chungbuk National University*

11:10 [VI-2-3]

Conceptual Study of a High-Energy Particle Detector in the Heliosphere Assuming an L4 Mission

Chanhaeng Lee[1], Woo-Hyeong Seol[1], Jungjoon Seough[1], Jongdae Sohn[1], Seonghwan Choi[1], Kyung-Suk Cho[1], Jongho Seon[2], Khan-Hyuk Kim[2], Kwangsun Ryu[3], Dae-young Lee[4]

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

11:25 [VI-2-4]

Radiation Monitor for the Space Radiation Environment at the Lagrangian Point L4

Jongdae Sohn, Ukwon Nam, Jungjoon Seough, Kyung-Suk Cho, L4 Team

Korea Astronomy and Space Science Institute

중회의실 6

09:15 [V-3-1]

Conceptual Design Study of Comprehensive Lunar Space Environment Sensors (CLUSER)

Seul-Min Baek[1], Jaeheung Park[1], Woohyeong Seol[1], Junhyun Lee[1], Jungjoon Seough[1], Tae-Yong Yang[1], Jongdae Sohn[1], Jehyuck Shin[1], Ho Jin[2], Jongho Seon[2], Khan-Hyuk Kim[2]

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

09:30 [V-3-2]

Conceptional Design of a Radioisotope Thermoelectric Generator for a Warm Electronics Box in Korean Lunar Exploration

Sunjin Kim[1], Hui-Kyung Kim[2], Jong-Bum Kim[1], Kwang-Jae Son[1], Jin-Joo Kim[1], Jin Kim[1], Kilyoung Ko[1], Dong Young Rew[3], Jintae Hong[1]

[1]*Korea Atomic Energy Research Institute (KAERI)*
[2]*Korea Aerospace Research Instittue (KARI)*
[3]*Korea Aerospace Administration (KASA)*

09:45 [V-3-3]

Concept of Electron gun Experiment PackaGe (E2G)

Minsup Jeong[1], Bongkon Moon[1,2], Dae-Hee Lee[1,2], Sung-Joon Park[1], Chae Kyung Sim[1,2], Dukhang Lee[1,2], Jehyuck Shin[1], Mingyeong Lee[1], Woojin Kim[1], Eunjin Cho[1], Serin Kim[1], Young-Jun Choi[1,2]

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

10:00 [V-3-4]

The Operation Concept of a Dual Aperture Lunar Cave Multiband Camera (DALAE)

Minsup Jeong[1], Bongkon Moon[1,2], Dae-Hee Lee[1,2], Jeong-Yeol Han[1,2], Chae Kyung Sim[1,2], Dukhang Lee[1,2], Jaehyuk Shin[1], Eunjin Cho[1], Serin Kim[1], Young-Jun Choi[1,2]

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

10:40 [VI-3-1]

Concept Design of Mobility Technology for Lunar

Surface Exploration

Namsuk Cho[1], Jaeho Lee[1], Dae-Young Lee[2], Dongseok Ryu[3], Chae Kyung Sim[4]

[1]*Unmanned Exploration Laboratory*
[2]*Korea Advanced Institute of Science and Technology*
[3]*Korea Atomic Energy Research Institute*
[4]*Korea Astronomy and Space Science Institute*

10:55 [VI-3-2]

Pit Crater as a Potential Landing Site for Future Lunar Missions

Eunji Yi[1,2], Chae Kyung Sim[1,2], Minsup Jeong[1]

[1]*Korea Astronomy and Space Science Institute (KASI)*
[2]*University of Science and Technology (UST)*

11:10 [VI-3-3]

Development of Verification Methods for Lunar Surface Payloads

Taeil Chung, Jangguen Lee, Hyu-Soung Shin, Young-Jae Kim, Byeong-Kwon Jeong

Korea Institute of Civil Engineering and Building Technology

중회의실 7

09:15 [V-4-1]

Korean Data Center for SDO: Present and Future

Ji-Hye Baek[1], Sujin Kim[1], Seonghwan Choi[1], Jongyeob Park[1], Dongil Kim[2]

[1]*Korea Astronomy and Space Science Institute*
[2]*Ewha Womans University*

09:30 [V-4-2]

Optimizing Deep Learning Models for Ionospheric TEC Prediction: Insights from Storm-to-Quiet Day Ratios

Se-Heon Jeong[1], Woo Kyoung Lee[1,2], Hyosub Kil[3], Jeong-Heon Kim[1], Young-Sil Kwak[1,2]

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

09:45 [V-4-3]

Forecasts of 3-Day Solar Wind Speed and 6-Hour IMF Bz Using Deep Learning Models

Jihyeon Son[1], Yong-Jae Moon[1,2], Harim Lee[1], Kyung Sun Park[3], Young-Sil Kwak[4], Hyun-Jin Jeong[2,5]

[1]*Department of Astronomy and Space Science, Kyung Hee University*
[2]*School of Space Research, Kyung Hee University*
[3]*Department of Astronomy and Space Science/Basic Science Research Institute, Chungbuk National University*
[4]*Space Science Division, Korea Astronomy and Space Science Institute*
[5]*Centre for mathematical Plasma Astrophysics, Department of Mathematics, KU Leuven, Leuven, Belgium*

10:00 [V-4-4]

AI-Based Wavefront Sensing for Adaptive Optics

Kyohoon Ahn[1,2], Yeo Been[1,3], Ji-Hye Baek[1], Seonghwan Choi[1]

[1]*Korea Astronomy and Space Science Institute*
[2]*Subaru Telescope, National Astronomical Observatory of Japan*
[3]*University of Science and Technology*

10:15 [V-4-5]

Can We Properly Determine Differential Emission Measures from Solar Orbiter/EUI/FSI by Deep Learning?

Junmu Youn[1], HarimLee[1], Hyun-Jin Jeong[1,2], Jin-Yi Lee[1], Eunsu Park[3], Yong-Jae Moon[1]

[1]*Kyung Hee University*
[2]*KU Leuven, Belgium*
[3]*Korea Astronomy and Space Science Institute*

포스터발표 논문 제목

4월 23일(수) 15:50~17:10

▶ SS: AI로 우주를 분석하다: 우주 데이터와 머신러닝

[P-1] A Multi-View Lunar Dataset for Neural 3D Reconstruction Using LROC NAC and LUTI Imagery

Dunam 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*

▶ SS: 달 표면 과학/ 기술 임무 탑재체

[P-2] Current Status of Developing for Data Processing of SurfCam/GrainCams

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

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

▶ SS: 교육문화유산

[P-3] Case Study on the Development of an Observatory Management and Membership System

Hyunnam Kim, Yong-Jae Moon

Kyunghee University

▶ 미소중력실험

[P-4] Operating Procedures Development of Undersea Platform Air Management System

Younkyu Kim, Joohee Lee

Korea Aerospace Research Institute

[P-5] Special Regulation Plan for Underwater Platform Demonstration of Oxygen Generator

Joohee Lee, Younkyu Kim

Korea Aerospace Research Institute

▶ 우주산업

[P-6] Conceptual Design of The Compact Electrical Ground Support Equipment for ETB Test of CAS500 series

Young-Yun Kim, Dong-In Han

Korea Aerospace Research Institute

[P-7] Koreanized System Engineering Lifecycle and Review Requirements for Satellite Developments

Hyeon-Jin Jeon

Korea Aerospace Research Institute

[P-8] Research on Payload Simulator Design and Operation for Efficient Development and Verification of Satellite Payload System

Jong-Euk Park, Jong-Tae Lee, Gm Sil Kang, Eung Shik Lee

Korea Aerospace Research Institute

[P-9] Loss Function for Deep Learning-Based Semantic Segmentation in On-Orbit Servicing

Ju-Hyun Kim, Jae-Wook Kwon

Korea Aerospace Research Institute, KARI

[P-10] A Study on Satellite Electronics Verification Procedures at the Launch Site

MinJun Kim, Yun-Goo Huh

Korea Aerospace Research Institute

▶ 우주정책

[P-11] Management Strategies for Multi-Agency R&D Projects

Jimo Yang, Keunwoong Shin, Eungsik Park

Korea Aerospace Research Institute

[P-12] Satellite System Engineering Process Development for Korea Industries

Jeongheum Im

Korea Aerospace Research Institute

▶ 우주천문

[P-13] Orbit Thermal Analysis for Development of a Space Telescope Based on an Existing Earth Observation Telescope

Hyung-Yun Noh, Haeng-Pal Heo

Korea Aerospace Research Institute

[P-14] Correlation of Star Formation Rates and Mass Variables of Galaxies

Sungeun Kim[1,2]

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

▶ 우주탐사

[P-15] Applicability of Mars Climate Database (MCD) for Thermal Environment Conditions on Mars Surface Mission Thermal Analysis

Hui-Kyung Kim[1,2]

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

[P-16] Adaptive Satellite Performance Control System for Electro-Optical Payloads

Sang-Youn Shin

Korea Aerospace Research Institute

[P-17] Accuracy Measurement of Precision Sensors in a Thermal Vacuum Environment

Won-Beom Lee, Jeoung-Heum Yeon, Eung Shik Lee

Korea Aerospace Research Institute

[P-18] Statistical Analysis of Lunar Origin Ions Observed by Kaguya in the Solar Wind

Jaehee Lee[1], Khan-Hyuk Kim[1], Yewon Hong[1], Seul-Min Baek[2], Ho Jin[1], Yoshifumi Saito[3], Masaki N. Nishino[3], Shoichiro Yokota[4]

[1]*School of Space Research, Kyung Hee University*
[2]*Korea Astronomy and Space Science Institute*
[3]*Institute of Space and Astronautical Science, Japan Aerospace Exploration Agency*
[4]*Osaka University, Japan*

[P-19] Acceleration of Solar Wind Ions Backscattered at the Lunar Surface and Reflected by Lunat Magnetic Anomalies Observed by Kaguya

Yewon Hong[1], Khan-Hyuk Kim[1], Jaehee Lee[1], Seul-Min Baek[2], Ho Jin[1], Yoshifumi Saito[3], Masaki N. Nishino[3], Shoichiro Yokota[4]

[1]*School of Space Research, Kyung Hee University*
[2]*Korea Astronomy and Space Science Institute*
[3]*Institute of Space and Astronautical Science, Japan Aerospace Exploration Agency*
[4]*Osaka University, Japan*

[P-20] Analysis of Laser Beam Intensity Model Incorporating Jitter for Satellite Laser Communications

Kiduck Kim, Eui Keun Kim, Youn-Kyu Kim, Choon-Woo Lee

Korea Aerospace Research Institute

[P-21] Extracting and Analyzing Plug and Play Information of the GR712RC

Dayeon Kim

Korea Aerospace Research Institute

[P-22] Necessities of Lunar Traffic Control Management (LTCM) for Future Sustainable Lunar Exploration

Young-Joo Song[1,2], Moon-Jin Jeon[1], Soyoung Chung[1]

[1]*Korea Aerospace Research Institute*
[2]*Kyung Hee University*

[P-23] 3D Lunar Regolith Grain Measurement System Design Using Linear Astigmatism-Free Three-Mirror System and Feasibility Analysis

Nayeon Kim[1], Sunwoo Lee[1,2], Seunghyuk Chang[3], I Jong Kim[2], Changgon Kim[1], Dohoon Kim[1], Chae Kyung Sim[4,5], Minsup Jeong[4], Daewook Kim[6], Soojong Pak[1]

[1]*School of Space Research, Kyung Hee University*
[2]*Korea Basic Science Institute*
[3]*Center for Integrated Smart Sensors*
[4]*Korea Astronomy and Space Science Institute*
[5]*University of Science and Technology*
[6]*James C. Wyant College of Optical Sciences, The University of Arizona*

[P-24] Grain Size Dependent Spectral Data of Apollo Soil 67461 and Plans for Further Sample

Loans

Eunjin Cho[1], Minsup Jeong[1], Chae Kyung Sim[1,2], Serin Kim[1,2], Mingyeong Lee[1], Young-Jun Choi[1]

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

[P-25] Examining Apollo 16's Lunar Surface Magnetometer Data

Sanghwa Kim[1], Yesun Ahn[1], Hyeonhu Park[1], Wooin Jo[1], Ho Jin[1], Khan-Hyuk Kim[1], Seul-Min Baek[2]

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

[P-26] SPICE Data Applications in Mission Planning for Spacecraft Operations: A Case Study with KPLO

Jo Ryeong Yim, Dong-Gyu Kim

Korea Aerospace Research Institute

[P-27] KPLO Magnetometer Observation Results at an Average Altitude of 60 km in Lunar Orbit

Yesun Ahn[1], Ho Jin[1], Hyeonhu Park[1], Wooin Jo[1], Sanghwa Kim[1], Ian Garrick-Bethell[2], Khan-Hyuk Kim[1], Yunho Jang[1], Seungmin Lee[1], Minjae Kim[1]

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

[P-28] Conceptual Design of Focal-Plane Assembly considering Optical Constraints for Earth Observation Satellite Camera

Youngsun Kim, Haeng-Pal Heo

Korea Aerospace Research Institute

[P-29] Thermal Environment Testing Methods for Space Exploration Rovers

Ji-Seok Kim

Korea Aerospace Research Institute

[P-30] The Laboratory Test of Square-Barrel Calibration Coil for Three-Axis Search Coil Magnetometer

Minjae Kim, Ho Jin, Yunho Jang, Seungmin Lee, Hyeonhu Park

School of Space Research, Kyung Hee University

[P-31] Risk Analysis of Autonomous GNC Control System for On-Orbit Servicing

Yoon-Jeong Jang, Jae-Wook Kwon

Korea Aerospace Research Institute

[P-32] Earth Rate Estimation and Measurement for LEO-Satellite Ground Test

JooHo Park, Seung Hun Lee

Korea Aerospace Research Institute

▶ 위성정보활용

[P-33] Analysis of the Spectral Band Verification 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*

[P-34] The Utilization of Deformable Mirrors for Acquisition of Satellite Imagery with Subdecimeter Resolution

Yee-Jin Cheon[1,2]

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

[P-35] Current Status of GK2A/AMI Calibration

Hanbyul Lee, Euidong Hwang, Eun-Jeong Cha, Kwang Deuk Ahn

Korea Meteorological Satellite Center

▶ 초소형위성

[P-36] A Review on the Impact of Output Rated Power Excess of Solar Array Regulator

Sungwoo Park[1], Hyoungjun Jang[2]

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

[P-37] Optimal Reentry Trajectory Design for the Nano-Satellite with Limited Propellant

Hanwoo Ju

Gyeongsang National University

▶ 태양 및 우주환경

[P-38] Shear Flow Effect on Resonant Absorption of Propagating MHD Body Waves in a Flux Tube Under Photospheric Conditions

Dae Jung Yu

Kyung Hee University

[P-39] The Relationship Between Electron Density and Neutral Temperature Variations during Polar Hole Events

Junho Back[1], Khan-Hyuk Kim[1], Geonhwa Jee[2,3], Hyuck-Jin Kwon[2], Changsup Lee[2,3], Jeong-Han Kim[2]

[1]*School of Space Research, Kyung Hee University*
[2]*Korea Polar Research Institue*
[3]*University of Science and Technology*

[P-40] Comparison of Empirical and Deep Learning Models for Solar Wind Speed Prediction

Seungwoo Ahn[1], Jihyeon Son[2], Yong-Jae Moon[1,2], Hyun-Jin Jeong[1,3]

[1]*School of Space Research, Kyung Hee University*
[2]*Department of Astronomy and Space Science, Kyung Hee University*
[3]*Centre for mathematical Plasma Astrophysics, Department of Mathematics, KU Leuven, Belgium*

[P-41] Development of Cable Connectors for Reducing Electromagnetic Interference Noise in Satellite Electromagnetic Compatibility Testing

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

Korea Aerospace Research Institute

[P-42] Measurement of Cosmic-Ray Neutron Energy Distribution and Fluence at Various Altitudes

Sinchul Kang, Jungho Kim, Joong Hyun Kim, Hyeonseo Park, Young Soo Yoon

Korea Research Institute of Standards and Science

[P-43] Diurnal Variation of Neutral Winds and Their Role in Sporadic E Layer Formation Over the Korean Peninsula

Jaewook Lee[1], Young-Sil Kwak[1,2], Tae-Yong Yang[1]

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

[P-44] Development of Deep Learning Models for the Determination of CME 3-D Parameters

Hyeonock Na[1], Yong-Jae Moon[1,2]

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

[P-45] Statistical Study of Upstream Waves Using Cross-Phase Analysis from KPLO and THEMIS-ARTEMIS Observation

Junhyun Lee[1], Khan-Hyuk Kim[2], Ensang Lee[2], Ho Jin[2], Seul-Min Baek[1], Jungjoon Seough[1], Minsup Jeong[1], Chae Kyung Sim[1], Young-Jun Choi[1]

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

[P-46] Impact of Increasing CO_2 Concentration on Diurnal Tide with Zonal Wavenumber 1: Mesospheric Cooling and Tropospheric Warming Effects

Masaru Kogure[1], Huixin Liu[2], In-Sun Song[1]

[1]*Department of Atmospheric science, Yonsei University*
[2]*Department of Earth and Planetary Science, Kyushu University, Fukuoka, Japan*

[P-47] Seasonal Variation of Daytime Electron Density Irregularity Distributions in the Bottom and Top Sides of the Low Latitude F Region

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

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

[P-48] Radio Dimming Associated with Filament Eruptions in the Meter and Decimeter Waveband

Maria Sotirova Madjarska-Theissen[1], Zhenyong Hou[2], Hui Tian[2,3], Jingye Yan[3,4,5], Jiale Zhang[2], Yu Xu[2], Hechao Chen[6], Zhao Wu[7], Lin Wu[3,4,5], Xuning Lv[3,4,5], Yang Yang[3,4,5], Yujie Liu[3,4,5], Li Deng[3,4,5], Li Feng[8], Ye Qiu[9]

[1]*Korea Astronomy and Space Science Institute*
[2]*School of Earth and Space Sciences, Peking University, Beijing, China*
[3]*Key Laboratory of Space Weather, Chinese Academy of*

Sciences, Beijing, China
[4]*National Space Science Center, Beijing, China*
[5]*Radio science and technology center (π center), Chengdu, China*
[6]*School of Physics and Astronomy, Yunnan University, Kunming, China*
[7]*School of Space Science and Technology, Shandong University, Weihai, China*
[8]*Purple Mountain Observatory, Nanjing, China*
[9]*School of Astronomy and Space Science, Nanjing University, Nanjing, China*

[P-49] Auroral Height Estimation with Overlapping Observations from Jang Bogo Station and Cape Hallett in Antarctica

Ji Eun Kim, Hyuck-Jin Kwon, Changsup Lee, Geonhwa Jee, Young-Bae Ham

Korea Polar Research Institute

[P-50] Reconstructing the EUV Solar Corona Using a Global Solar Wind Model with Nonthermal Electrons

Jin-Yi Lee[1], Junmo An[2], John C. Raymond[3], Chengcai Shen[3]

[1]*Kyung Hee University*
[2]*Korea Astronomy and Space Science Institute*
[3]*The Center for Astrophysics | Harvard & Smithsonian*

[P-51] Hα Dark Blobs and Transparent Regions of Fan-shaped Jets

Heesu Yang[1], Maria Madjarska-Theissen[1,2,3], Eun-Kyung Lim[1], Daniel Nóbrega-Siverio[4,5,6,7]

[1]*Korea Astronomy and Space Science Institute*
[2]*Max Planck Institute for Solar System Research, Göttingen, Germany*
[3]*Space Research and Technology Institute, Bulgarian Academy of Sciences, Acad. Sofia, Bulgaria*
[4]*Instituto de Astrofísica de Canarias, Tenerife, Spain*
[5]*Universidad de La Laguna, Department of Astrofísica, Tenerife, Spain*
[6]*Rosseland Centre for Solar Physics, University of Oslo, Oslo, Norway*
[7]*Institute of Theoretical Astrophysics, University of Oslo, Oslo, Norway*

▶ 우주 인프라

[P-52] A Telemetry Generation and Replay Method for a Low Earth Orbit Satellite

Seung-Eun Yang

Korea Aerospace Research Institute

[P-53] Study on Configuration Management Approach for Satellite Development Using Ontology Concept

Chul Kang

Korea Aerospace Research Institute+

[P-54] Availability Analysis of GEO-KOMPSAT-3 Ground Station

Jinhyung Park

Korea Aerospace Research Institute

[P-55] Design Procedure for Satellite Component Shock Test Equipment

Jong-Hyub Jun, Jong-Min Im, Hee-Kwang Eun, Nam-Jin Moon, Seon-Je Jo, Jin Park, Chang-Rae Cho, Tae-Seok Oh

Korea Aerospace Research Institute

[P-56] Visibility-Constrained Attitude Planning for Celestial Observation by an Earth-Observing Satellite

Jeong Hoon Hyun

Korea Aerospace Research Institute

[P-57] Simulation of Arbitrary Imaging Direction for Low Earth Orbit Satellite

Kyun-Sang Park

Korea Aerospace Research Institute

[P-58] Study on Automated Nighttime Imaging Schedule Modification for KOMPSAT-3A

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

Korea Aerospace Research Institute

[P-59] Status of Satellite Image Processing Systems: Domestic and International Perspectives

Lammi Choi, Min-A Kim

Korea Aerospace Research Institute

[P-60] Core Technology Identification for Laser-Based Optical Ground Stations

Hyunsu Lim
Korea Aerospace Research Institute

[P-61] Development of Flight Software for On-Board Time Function on GEO Satellite

Soo-Yeon Kang, Jae-Yeop Jeong
Korea Aerospace Research Institute

[P-62] The SKA Project: Status and Korean Participation

Bong Won Sohn
Korea Astronomy and Space Science Institute

▶ 우주감시

[P-63] Enhancing Safety and Sustainability in Low Earth Orbit: An Analysis of SPD-3 and STM Technologies

Myung Kyu Kim[1], Alina Shymanska[2], Seunghwan Choi[2], Joonghyun Ryu[2], Deok-Soo Kim[2]
[1]*Hanyang University Mechanical Engineering*
[2]*SPACEMA*

구두발표 논문 초록

4월 22일(화) 대회의실 1

Invited Talk I

Chair: 이 유(충남대)

13:40 [IS-1]

Laboratory Astrophysics with Ultra-Intense Lasers

Inhyuk Nam

Department of Physics, Ulsan National Institute of Science and Technology (UNIST)

Laboratory astrophysics with ultra-intense lasers is an emerging field that utilizes advanced laser technology to recreate and study extreme astrophysical conditions in a controlled environment. This approach allows us to explore high-energy density (HED) plasmas, providing valuable insights into phenomena such as the interior conditions of planets like Neptune and Uranus. Ultra-intense lasers have also enabled the exploration of quantum electrodynamics (QED) effects, paving the way for new extreme physics regimes in laser-matter interactions. These regimes are particularly relevant in extreme astrophysical scenarios such as gamma-ray bursts, black holes, and pulsar magnetospheres. Furthermore, using the laser, compact laser-plasma accelerators can generate high-energy particles, including electrons, protons, neutrons, and gamma rays, at a lab scale, simulating cosmic rays. These particles are then used to test semiconductor materials in extreme space environments. In this presentation, I will summarize these diverse applications of ultra-intense lasers in laboratory astrophysics.

대회의실 1

I-1 SS: Frontier of Space Plasma Simulation

Chair: 박경선(충북대)

16:00 [I-1-1]

Introduction to Space Plasma Simulation

Kyung Sun Park

Chungbuk National University

Numerical simulations are handy tools for understanding and predicting space plasma phenomena, from the small to the global scale, despite certain assumptions in the simulation techniques. We introduce how simulation techniques and studies used in space plasma research are evolving and will develop in the future. A few researchers in Korea are utilizing and developing space plasma simulations in each field.
We discuss developing a K-space plasma model for the Sun and planetary space environment in the Heliosphere using our present technology and capabilities or further as necessary.

16:15 [I-1-2]

A New High-Order Magnetohydrodynamic Code for Space Weather Modeling

Dongsu Ryu

UNIST

Space weather, a branch of space physics, investigates the dynamic conditions within the Solar System and its heliosphere. This field relies on both observations and modeling, with simulations playing a crucial role in understanding space weather phenomena. Globally, various modeling frameworks have been developed, typically incorporating magnetohydrodynamic (MHD), particle-in-cell (PIC), and hybrid codes. In this talk, I will introduce a new high-order MHD code that has the potential to serve as the foundation for a future Korean space weather modeling framework. The code employs a high-order finite-difference weighted essentially non-oscillatory (WENO) scheme for spatial discretization and a high-order strong stability-preserving Runge-Kutta (SSPRK) method for time integration. Additionally, to maintain consistency with the WENO scheme's high-order accuracy, we have developed and implemented a novel constrained transport (CT) algorithm that enforces div(B) = 0 condition with a high-order accuracy. The accuracy and robustness of the code are demonstrated through tests involving wave propagation and complex flow dynamics.

16:30 [I-1-3]

Application of the State-of-the-Art Full-Wave Solver, Petra-M, in Earth's and Planetary Ionospheric-Magnetospheric Plasmas

Eun-Hwa Kim[1,2], Syun'ichiShiraiwa[1]

[1]*Princeton Plasma Physics Laboratory, Princeton University, Princeton, NJ, USA*
[2]*Andrews University, Berrien Springs, MI, USA*

The generation and propagation of plasma waves are common phenomena occurring in the Earth's and planetary ionospheres and magnetospheres. Plasma waves play a crucial role in space weather, as they can interact with energetic particles, induce electron and ion precipitation into the Earth, or accelerate particles within the magnetosphere. Additionally, plasma waves provide valuable information about background plasmas and are frequently used as diagnostic tools. To understand these wave

phenomena, such as the global structure of plasma wave propagation and the mechanisms behind their generation, numerical simulations are essential. One of the challenges in numerical wave simulations lies in the complexity of Earth's and planetary magnetospheres. Unlike simple dipole fields, these magnetospheres exhibit various configurations, including compressed, stretched, or twisted structures. This presentation introduces the state-of-the-art and open-source full-wave solver, Petra-M code, along with its applications for analyzing Earth's and planetary ionospheric and magnetospheric plasma waves. The Petra-M code utilizes the modular finite element method (MFEM) library, which allows for easy adaptation of boundary shapes, plasma density profiles, and realistic planetary magnetic fields. To incorporate realistic Earth's magnetic field into the Petra-M code, we use self-consistent magnetospheric flux models to represent compressed and stretched magnetic fields, along with geometries extracted from global magnetohydrodynamic (MHD) simulations. Using the Petra-M code, we investigate Alfven and electromagnetic ion cyclotron (EMIC) waves in various magnetic field configurations as well as high-frequency (HF) radio wave propagation in ionospheric density irregularities. We will also introduce upcoming scientific projects utilizing Petra-M wave codes, including studies on geomagnetic irregular Pi2 pulsations in the nightside magnetosphere and wave behavior in levitated dipole experiment devices.

16:45 [I-1-4]

GPU-Optimized Energy-Conserving Particle-in-Cell Codes for Space and Astrophysical Plasmas

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*

Full and hybrid particle-in-cell (PIC) simulations are widely used to investigate space and astrophysical plasmas at kinetic scales. However, long-term and multi-scale simulations often suffer from accumulated charge and energy conservation errors, which can degrade their accuracy and physical fidelity.
In this talk, we introduce EPIC-GOD and Hybrid EPIC-GOD, two novel PIC codes specifically designed to enforce local charge and total energy conservation—two critical properties often neglected in conventional PIC codes. Both codes solve the coupled particle and field equations using an iterative scheme that strictly enforces charge conservation via the continuity equation, while total energy conservation is guaranteed through iterative convergence.
We validate their accuracy across a range of plasma processes, including waves, instabilities, collisionless shocks, and magnetic reconnection, demonstrating excellent agreement with analytical solutions and benchmark results. Additionally, both codes are optimized for multi-GPU acceleration using OpenACC, achieving significant performance improvements over CPU-based implementations.
By combining strict conservation properties with high computational efficiency, our codes provide a robust framework for advancing the study of collisionless plasma dynamics in space and astrophysical environments.

17:00 [I-1-5]

A Comparative Analysis of High-Resolution Shock-Capturing Schemes for Two-Dimensional Magnetohydrodynamic Simulation of Flux Emergence in the Solar Atmosphere

Donghui Son[1], Yeonwoo Jang[1], Tetsuya Magara[1,2]

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

This study presents a comparative analysis of high-resolution shock-capturing schemes in two-dimensional magnetohydrodynamic (MHD) simulations of magnetic flux emergence in the solar atmosphere. We evaluate four distinct reconstruction techniques based on recent improvements to the weighted essentially nonoscillatory (WENO) and targeted essentially nonoscillatory (TENO) schemes. While these schemes have proven successful for the Euler equations of gas dynamics, their effectiveness in MHD simulations remains relatively unexplored. Our implementation combines the Harten-Lax-van Leer-discontinuities approximate Riemann solver for accurate flux computations, the generalized Lagrangian multiplier method for divergence control, and a third-order strong stability preserving the Runge-Kutta scheme for time integration. Numerical experiments reveal that these advanced schemes provide significant improvements in both accuracy and robustness in capturing complex MHD phenomena such as magnetosonic waves, MHD shocks, and magnetic buoyancy-driven instabilities. Among the tested methods, IMWENO-P proves to be the most physically consistent, effectively reproducing energy redistribution and compression patterns in line with theoretical predictions. These findings offer valuable insights into the strengths and limitations of each approach for simulating magnetic flux emergence dynamics.

17:15 [I-1-6]

A Novel Approach to Coronal Magnetic Field Reconstruction with Applications to Solar Eruptions

Sibaek Yi[1], Gwangson Choe[1,2], Minseon Lee[2], Sunjung Kim[1]

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

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

The coronal magnetic field plays a crucial role in solar eruptive phenomena and can be approximated as a nonlinear force-free magnetic field (NLFFF) due to the low plasma beta condition in the corona. Although numerous NLFFF methods and codes have been developed over the past two decades, each has its own shortcomings.
We have devised an NLFFF method using a poloidal-toroidal (PT) representation and developed the NFPT (Nonvariational FFF Code in Poloidal-Toroidal Formulation) code based on this approach. The PT representation not only satisfies the solenoidal condition of the magnetic field but also allows the implementation of photospheric boundary conditions using only poloidal and toroidal scalar functions. These boundary conditions are fixed initially and remain unchanged throughout the numerical iteration.
The NFPT code has been applied to Active Region 11974, which produced two solar flares and a halo CME. By analyzing a time sequence of our numerical solutions, we have identified the location where the flare-triggering reconnection begins and the connectivity changes responsible for each eruption.
Recently, we extended our NFPT code from Cartesian to spherical coordinates, yielding promising results in comparison with other NLFFF codes in spherical coordinates.

17:30 [I-1-7]
Modeling the Multi-Scale Nature of the Solar Wind

Jungjoon Seough

Korea Astronomy and Space Science Institute

The solar wind exhibits complex physical behavior across various characteristic spatial and temporal scales, It is crucial to emphasize that the coupling of physical processes across scales plays a vital role in the global dynamics and thermodynamics of the expanding solar wind. We present a theoretical method, the so-called the expanding box model of quasillinear kinetic theory, which incorporates the multi-scale nature of the solar wind evolution, including the feedback of small-scale processes on large-scale evolution. This accounts for expansion effects, Coulomb collisions, Alfven-wave turbulence, non-equilibrium velocity distribution functions, and kinetic microinstabilities. We will discuss the key components and applicability of this model, and validate it by comparing its results with measurements from the Parker Solar Probe. Furthermore, we will address potential improvements to the current model and outline future plans.

중회의실 5

I-2 SS: 우주항공청 우주환경센터 I

Chair: 이재형(우주청)

16:00 [I-2-1]
Space Weather Forecasting at Korea Space Weather Center (KSWC): Current Status and Methodologies

Jae-Hyung Lee, Jaehun Kim, Ji-Hoon Ha,
Sang Cheol Han, Wonhyeong Yi

Korea Space Weather Center, Korea AeroSpace Administration

Korea Space Weather Center (KSWC) of Korea AeroSpace Administration (KASA), plays a crucial role in mitigating the risks of space weather disasters. Our primary mission is to forecast and alert space weather events including Radio blackouts, Solar radiation, Geomagnetic and Ionospheric storms. Currently, we operate 23 observation instruments across 10 different types to observe space weather phenomena. As a Regional Warning Center of the International Space Environment Service (ISES), we provide space weather forecast and alert services. In this talk, I will outline the current status of space weather forecasting at KSWC. The solar flare forecast is based on results from the ASSA model as well as statistical data from sunspots and flares. For geomagnetic storms caused by Coronal Mass Ejections (CMEs), we use the CME Analysis Tool, the WSA-ENLIL model, and statistical analysis of solar wind observation data. For coronal holes, the probability of geomagnetic storms is calculated using the WSA-ENLIL model and observation data from 27 days prior. In terms of ionospheric storm forecasting, we are conducting a pilot forecasting service, providing information on the optimal frequencies for communication over a 500 km transmission and reception distance for the central and southern regions of the country.

16:15 [I-2-2]
Forecasting and Alert Systems for Solar Energetic Particles at Korea Space Weather Center

Ji-Hoon Ha, Jae-Hyung Lee, Jaehun Kim,
Sang Cheol Han, Wonhyeong Yi

Korea Space Weather Center, Korea AeroSpace Administration

During solar flares and coronal mass ejections (CMEs), solar energetic particles (SEPs) are generated, potentially disrupting satellite operations and increasing radiation exposure for high-altitude aircraft. To mitigate such effects, Korea Space Weather Center (KSWC) monitors SEP levels in geostationary orbit and provides relevant forecasts using satellite data and

predictive models. In this talk, we introduce KSWC's SEP forecasting system and the analysis methodology applied to satellite data from GOES, SDO, the LASCO coronagraph, and STEREO. Specifically, we utilize the following models for prediction: (1) For forecasting the >2 MeV 24-hour electron fluence, we employ a relativistic electron forecast model based on the average solar wind speed provided by the Space Weather Prediction Center of the National Oceanic and Atmospheric Administration (NOAA), USA; (2) For predicting the >10 MeV proton flux, we currently operate an empirical model based on machine learning, trained on solar flare and CME characteristics derived from satellite data. Additionally, we introduce the corresponding alert systems, currently in the demonstration phase, designed to prevent satellite damage caused by SEPs. These systems include alerts for >2 MeV electrons and >100 MeV protons.

16:30 [I-2-3]

NOAA SWPC's Latest Space Weather Forecasting Techniques (CME analysis)

Shawn Dahl[1], Kichang Yoon[2]

[1]*Space Weather Prediction Center (SWPC), NOAA*
[2]*Korea Space Weather Center (KSWC), KASA*

NOAA Space Weather Prediction Center (SWPC) is the world's leading space weather forecasting agency, providing public space weather alerts and warnings. It also serves as the World Warning Agency within the International Space Environment Service (ISES), playing a key role in global space weather forecasting.

SWPC provides daily space weather predictions using three specialized indices developed in-house: Solar Flare Activity or Radio Blactouts(R), Solar Radiation Storms (S), and Geomagnetic Storms (G). Additionally, it collaborates with FEMA, the national emergency management agency, to coordinate responses to space weather-related hazards.

This presentation will introduce SWPC's sunspot analysis techniques, solar wind forecasting methods based on high-energy electron and proton data observed at the L1 point (ACE satellite observations), and the critical procedures that forecasters follow in operational space weather forecasting.

Furthermore, it will highlight the enhanced prediction capabilities that will be enabled by the upcoming GOES-19 satellite, utilizing CCOR-1 coronagraph data for improved Coronal Mass Ejection Analysis of space weather forecasting.

16:50 [I-2-4]

국제민간항공기구(ICAO) 우주환경 예측모델 개발동향: 국제민간항공기구(ICAO) 사례를 중심으로

윤기창, 조정희, 나현준

우주항공청 우주환경센터

국제민간항공기구(ICAO)는 항공 안전에 영향을 미치는 우주환경 변화를 분석하고 이를 항공 운항에 반영하기 위해 국제우주환경정보센터(Space Weather Centers, SWXC)를 지난 2018년부터 지정하여 운영중에 있다. SWXC는 태양 활동 및 지구 자기권 환경을 실시간으로 모니터링하고, 항공기 운항에 영향을 줄 수 있는 우주환경 현상에 대한 경고 및 주의보를 발행하는 역할을 수행한다.

ICAO의 우주환경 정보 제공 체계는 전 세계 항공 산업의 안전성과 운항 효율성을 높이는 데 기여하고 있으며, 특히 흑점 폭발, 코로나물질방출(CME), 고에너지 입자 방출(SEPs), 지자기 폭풍, 전리권 교란 등의 현상을 분석하여 항공기 항법, 통신, 감시(Communication, Navigation, and Surveillance, CNS) 시스템에 미치는 영향을 최소화하는 것이 목표이다. 이를 위해 SWXC에서는 다양한 국가 및 기관에서 개발한 최신 우주환경 모델을 활용하여 실시간 예측 및 분석을 수행하고 있다.

본 발표에서는 ICAO의 우주환경 정보 제공 체계를 소개하고, 특히 연구(R)에서 운영(O)으로 전환(R2O)되는 과정에서 활용되는 우주환경 모델들을 중점적으로 다룬다. 현재 SWXC에서 활용하는 주요 모델로는 태양 플레어 예측 모델(NOAA의 SWPC 모델, ESA의 Solar Particle Radiation 모델 등), 코로나물질 방출(CME) 전파 모델(WSA-ENLIL, EUHFORIA 등), 지자기 폭풍 및 전리권 변동 모델(GMST, TIE-GCM 등)이 있으며, 이러한 모델들은 항공 운항 중 HF 통신 장애, 위성 항법 오류, 방사선 피폭 위험 등을 사전에 예측하고 대응할 수 있도록 지원한다.

특히, 이 발표에서는 이 ICAO의 우주환경정보센터를 지원/가입하기 위한 우주항공청의 역할과 향후 발전 방향을 함께 논의하며, 국제 협력을 통한 R2O 가속화 방안을 모색한다. 한국은 현재 우주환경센터를 중심으로 독자적인 우주환경 예보 역량을 구축하고 있으며, 향후 유럽 PECASUS 컨소시엄 및 미국 NOAA 등과의 협력을 통해 보다 정밀한 예측 모델을 개발하고, 항공 산업 및 기타 주요 분야에서 활용할 수 있는 실질적인 예측 시스템을 마련하는 것을 목표로 하고 있다.

향후 ICAO에서 적용되는 주요 우주환경 모델/연구결과를 공유 및 실제 적용을 위한 개선방향을 제안함으로써, 우주환경 정보가 국민 실생활에 본격적으로 활용되고 규범화되는 사례를 고찰하고, 우리나라의 우주환경 현업 개선방향을 제안한다

17:10 [I-2-5]

Good Candidates of Research-to-Operation for Space Weather Forecasting

Yong-Jae Moon[1,2]

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

In this talk, we introduce several good candidates of research-to-operation for space weather forecasting from our recent works: (1) Ensemble forecasting of major solar flares (Lim et al. 2019, ApJ), (2) X-ray flux profile prediction (Yi et al. 2020,

ApJL), (3) Deep reinforcement learning-based flare prediction (Yi et al. 2023, ApJS), (4) Solar limb flare prediction (Lee et al. 2024, ApJL), (5) Real time extrapolation of solar coronal 3-dimensional magnetic field (Jeon et al. 2025, ApJS), (6) Solar wind speed prediction (Son et al. 2023, ApJS) (7) Improvement of IRI global TEC maps (Ji et al., 2020, Space Weather), (8) Construction of global IGS-3D electron density model (Ji et al., 2024, JASTP) (9) One-day global TEC map forecast (Lee et al. 2021, Space Weather), and (10) New NOAA space weather scale frequency depending on solar cycle (Kim et al. 2025, JKAS). These research can be easily implemented for space weather operations.

중회의실 6

I-3 SS: 달 착륙선 과학 · 기술 임무

Chair: 박진혜(우주청)

16:00 [I-3-1]

Vision and Importance of South Korea's Lunar Lander Science and Technology Mission

Jinhye Park, Seungsoo Park, Ijeung Kim, Dong Young Rew

Korea AeroSpace Administration

The Moon, Earth's closest celestial body, is a prime target for space exploration due to its significant scientific and economic value. As a result, it has become a key objective for advanced space nations, many of which have already established medium- to long-term lunar exploration plans and are actively conducting missions. In alignment with this global trend, South Korea is advancing the development of its lunar lander, targeting a successful landing by 2032. As part of this initiative, the selection of scientific and technological payloads for the lander is currently underway. This mission is expected to enhance fundamental scientific research, contribute to the future utilization of lunar resources, and strengthen technological capabilities in space exploration.

16:15 [I-3-2]

Moon Exploration: Recent Activities

Eunhyeuk Kim

Korea Aerospace Research Institute

Both robotic and human explorations of the moon are still a hot topic of space exploration. There were two landing missions conducted recently. The first of two missions, blue ghost mission 1 (BG1) developed by FireFly landed safely near the lunar equator, while the more challenging landing mission by Intuitive Machines, IM-2 failed to land near the permanently shadowed regions of the lunar south pole. The orbital mission, Lunar Trailblazer co-launched with BG1 is struggling in communication (and probably attitude control) with a ground antenna. More lunar landing missions will be launched in 2025, and we will watch the human activities near the moon with the Artemis II mission. Korea Pathfinder Lunar Orbiter (KPLO) has completed the eclipse survival operation and entered the next extended mission stage. There are three orbiters in operation around the Moon (Chandrayaan-2, KPLO & LRO) in scientific perspective, and those orbiters have carried out extensive scientific activities to gather valuable information of the Moon. In the future, Japan and India will launch a lunar lander as well as a rover based on international cooperation, called LUPEX mission. I will summarize the recent lunar missions in general and also provide with insight on future lunar missions.

16:30 [I-3-3]

Key Considerations for Payload Accommodation on the Korea Lunar Lander

Moon-Jin Jeon, Yoon Hyungjoo

Korea Aerospace Research Institute

The successful integration of payloads on the Korea Lunar Lander requires careful consideration of electrical and mechanical interfaces alongside lander system development. This study analyzes past lunar missions, including Apollo, Luna, Chang'e, Chandrayaan, and CLPS landers, to identify key factors for power, data communication, and mechanical integration.

For electrical interfaces, we examine the 28V DC unregulated power bus, redundancy strategies, and data protocols such as RS-422, MIL-STD-1553B, CAN, and SpaceWire. Lander-rover wireless communication via UHF, S-band, or Wi-Fi is also evaluated.

For mechanical interfaces, we explore payload mounting methods, thermal control, vibration isolation, and rover deployment mechanisms.

A key conclusion is the importance of early-stage coordination between the lander and payload teams. Establishing Interface Control Documents (ICDs) from the conceptual design phase ensures standardization of connectors, mounting interfaces, and communication protocols, reducing integration risks.

By applying these lessons, Korea lunar lander can develop a reliable and flexible payload interface, enhancing mission success and supporting Korea's lunar exploration initiatives.

16:45 [I-3-4]

Significant Aspects of Lunar Resource Prospecting and Utilization for the Korean Lunar Lander Program

Kyeong Ja Kim[1,2]

[1]*Space Resources Exploration and Utilization Center, Korea Institute of Geoscience and Mineral Resources*
[2]*Resources Engineering, University of Science and Technology*

With the success of the Korea Pathfinder Lunar Orbiter mission, KASA is now preparing for another significant challenge in lunar lander exploration, which involves greater technical and scientific hurdles to be overcome by the government, engineers, and scientists in Korea. A number of lunar surface missions have been announced, and these missions focus on surface exploration to investigate both the lunar environment and its resources. These key mission objectives are important for Korean lunar mission planning. The Korean lander exploration program is planned to be launched by 2032, with the lander development program initiated in 2025. The final selection of payloads for the lander will be accomplished by reviewing proposals in the near future. Given these circumstances, examining the research status of international and domestic lunar exploration is crucial for understanding major scientific issues and current technological developments in lunar surface exploration. This presentation will cover important aspects of the selection of mission objectives, examples of payloads, and the conjunction of lunar resource exploration and utilization.

17:00 [I-3-5]

Understanding the Moon: Key Scientific Questions and Future Exploration

Chae Kyung Sim[1,2]

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

The Moon is a scientifically valuable planetary body that preserves a record of early solar system history and planetary evolution. Its surface, unaffected by atmospheric weathering or plate tectonics, offers a unique opportunity to study impact cratering, space weathering, and surface material interactions in an airless environment. The composition and physical properties of lunar regolith provide insights into long-term exposure to solar wind, micrometeorite bombardment, and magnetic field interactions. Understanding these processes is essential for reconstructing the Moon's history, assessing the evolution of airless planetary surfaces, and preparing for future exploration. The distribution and behavior of volatiles, the effects of space weathering on spectral properties, and the role of impact processes in shaping the lunar surface remain key scientific questions. Future missions will play a crucial role in addressing these topics, advancing our understanding of both the Moon and other airless bodies in the solar system. This talk will explore the importance of lunar science, recent findings, and the fundamental questions that guide ongoing and future exploration efforts.

17:15 [I-3-6]

Analysis of Requirements of Lunar Surface Mobilities from Lunar Missions

Dongseok Ryu, Wonseo Lee, Hocheol Shin

Korea Atomic Energy Research Institute

In the advancement of technology toward the space out of earth, the landers and surface mobilities for the moon, which are the easiest celestial bodies to reach, have been intensively attempted.
After 2020, as the space competing and moon rushing has intensified, not only the leading country but also small countries have attempted space missions. In order to develop lunar surface mobility, the requirements according to the selected mission must be considered in advance to the development. the major factors of mission, such as, mission period, mission terrain, payload mass, and volume, significantly affect to the requirements for the lunar surface mobility. In this study, the previous and the furue lunar mission was analyzed in view of the requirements of lunar surface mobility. Major factors that affect the requirements include mission period, mission terrain, payload mass, and volume. The requirements for lunar surface mobility are analyzed and organized for missions that have landed on the moon so far and future missions.
The specifications are classified in terms of long-term and short-term missions, robotic and crew missions, solo and cooperative missions, large and small sizes, wheeled and other method, etc. As a result, the requirements according to the characteristics of the target mission were analyzed.

중회의실 7

I-4 안보우주 I

Chair: 최호성(육군)

16:00 [I-4-1]

Strategic Narrative Approach to the U.S. Space Security Trends

Hae-Jun Jeong

Korea National Defense University

The launch of Sputnik 1 by the Soviet Union in 1957 marked a pivotal moment in global geopolitics, posing a profound challenge to the United States as the leader of the free world. In response, the U.S. government allocated substantial resources to space technology development, necessitating an effective persuasion to secure support from domestic audiences and allied partners. As the international system transitioned from a bipolar

(Cold War) system to a multipolar system following the Soviet Union's collapse, the United States faced intensified competition from China, Russia, and their allies. Consequently, the need for strategic persuasion to maintain U.S. dominance in space has persisted. One of the key mechanisms employed by the U.S. in this effort has been the use of 'strategic narratives'. Strategic narratives have played an increasingly significant role in modern warfare, as exemplified in the Russia-Ukraine war. Ukraine's ability to frame its resistance as a defense of "democratic values and identity" has effectively mobilized international support and strengthened national resolve.
In this context, this study examines how the United States has employed strategic narratives to sustain its space security objectives across different geopolitical environments. By analyzing U.S. space security discourse from the Cold War era to the present, this research explores key questions: What justifications has the United States provided for its continued expansion into space? What are the primary threats to U.S. space security? What are the ultimate objectives of U.S. space security policy? Through this analysis, the study offers simple insights into how Republic of Korea can formulate a defense space policy that secures public support and ensures strategic effectiveness.

16:15 [I-4-2]

A Study on the Necessity of Utilizing a Korea Augmentation Satellite System for Improving the Operability of Manned-Unmanned Teaming System

Daeseong Mun

Defense Agency for Technology and Quality, DTaQ

As the importance of the national location information industry grows globally, countries are operating their own global navigation satellite system (GNSS) or satellite-based augmentation system (SBAS). South Korea plans to establish the Korean Positioning System (KPS) by 2035 and is currently operating the Korea Augmentation Satellite System (KASS). To enhance interoperability and autonomy, key capabilities of Manned-Unmanned Teaming (MUM-T), precise location information is crucial. to overcome the limitations of GPS signals and counter North Korea's jamming attacks, introducing a Korean GNSS is necessary. Utilizing KASS before KPS can bridge the technological gap with neighboring countries. This study suggests that applying KASS to military equipments using GPS, such as surveillance equipment, drones, land systems, and firepower systems, can improve precision strike capabilities and reduce ammunition consumption. It also highlights that accurate location sharing can enhance battefield awareness and provide advanced autonomous driving and flying capabilities, maximizing the effectiveness of MUM-T operation.

16:30 [I-4-3]

The Role of the Army in Establishing an Effective National Defense Space Launch Site: Necessity, Implementation Progress, and Army's Contribution

Tae-Yoon Kim

Korea Aerospace Research Institute

The establishment of a national defense space launch site is a critical initiative to ensure timely and rapid responses to the growing demand for military satellites. This project is particularly essential for enhancing national security and strategic autonomy, as it enables the maintenance of a high level of security.
The project is initially being developed as a research and test facility by the Agency for Defense Development (ADD) and is planned to be subsequently transferred to the Army, facilitating its expansion into a fully operational military space launch base.
This study aims to examine the current progress of the national defense space launch site project and propose the Army's role in effectively advancing this initiative.

16:45 [I-4-4]

A Legal Review for the Expansion of the Army Space Forces Lift Capability

Woo-Seok Lee

Republic of Korea Army HQ, Policy Office

The army space forces lift capability is to place space assets such as satellites in space domain from ground launch facility. This is the most basic and essential condition for space operations. In particular, the space launch site is an important system that can become the center of preparation and execution of space operations beyond just technical facility for launching vehicles.
Currently, the MND has planned to build a defense space launch site by 2030. Initially, it is being built as a R&D facility in accordance with the ADD, but it is planned to expand to military space base in the future. In particular, the 3rd Space Development Working Committee in 2025 between the MND and the KASA is making progress by mutually agreeing to build a defense space launch site as part of the 'Second Space Center'. In this regard, Korea had accomplished the dualizing the space launch authorization system over the past two years. On the other hand, there are still no laws and systems for military use or protection of defense space launch sites. Therefore, this paper intends to derive policy implications through legal review for securing the effective operation of the defense space launch site.

17:00 [I-4-5]

Like Flying a Drone Let's Launch a Satellite

Sun-Wook Kim[1,2]

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

Expensive high-performance reconnaissance satellites have limitations in tracking enemy activities due to the limited number. they can complement each other with high-performance satellites by operating ultra-small cluster satellites.
Currently, various private institutions are developing and operating micro satellites, and our military has the ability to effectively. It is hoped that it will be an army that operates through the corps, divisions, and brigades of the army, assembles according to their purpose, like a drone, and launches them into space.

17:15 [I-4-6]

The Development of Military Counterspace Capabilities and Suggestions for Improvement

Dae-kyum Yoon[1], Seok Min Song[2]

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

This paper covers counterspace capability, one of the military operations carried out in space. Counterspace capability plays an essential role in keeping activities and assets safe in space while also becoming an increasingly important part of national security and military strategies. The aim of this paper is to explore the definition and overall concept of counterspace capability and seek ways for our military to improve its counterspace capability by analyzing empirical examples and weapon systems developed by major nations for use in space.

4월 23일(수) 대회의실 1

II-1 태양 및 우주환경 I / 위성정보활용
Chair: 박재흥(천문연)

09:15 [II-1-1]

Comparative Analysis Using AI Method of Space Environment Data Extracted with GOLD Mission Image Noise

Jonglil Lee[1], Jaeheung Park[2], Dae-Young Lee[1]

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

GOLD (Global-scale Observations of the Limb and Disk) mission fuv (Far Ultraviolet) instrument is not specifically designed for observing radiation belts or particle flux, since its geostationary orbit placement in October 2018, it has been providing observation images of the ionosphere-thermosphere. Previous studies, using SOHO (Solar and Heliospheric Observatory) image cases, have demonstrated the possibility of inferring high-energy particle flux. Utilizing observed image noise through machine learning algorithms or AI techniques to infer electron flux could extend the application to commercial purposes. Images acquired by various satellites launched for commercial purposes (e.g., weather images) could also be input into similar relational expressions to produce space science data. If the images from several operating commercial satellites can be utilized, it would be possible to obtain energy observations in locations not covered by existing science satellites (e.g., the United States' GOES, Korea's KSEM), such as over Africa. This represents a new method of utilizing previously underutilized image data and could significantly contribute to maximizing the utility of satellite data.

09:30 [II-1-2]

Aurora Detection in Sequential e-POP/FAI Images Using Deep Learning and Explainable AI

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

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

In this study, we employ a deep learning approach to detect auroras from sequential image observations captured by the Enhanced Polar Outflow Probe (e-POP)/Fast Auroral Imager (FAI). Estimating the auroral oval boundary is crucial for predicting changes in the Earth's upper atmosphere. Observing the polar region with a satellite provides valuable datasets for estimating this boundary. The e-POP/FAI captures auroral emissions in the near-infrared range (650–1,100 nm) at a one-second cadence. However, detecting auroras using a single-channel approach is challenging, as it is difficult to distinguish them from other features such as clouds and city lights. To overcome this problem, we employ a CNN-based ResNeXt-50 deep learning model to automatically detect auroras and discriminate them from non-auroral features, in e-POP/FAI images. The input of our model consists of three frames captured at two second intervals over a total duration of five seconds. Output of the model predicts whether auroras are present in the sequence. Additionally, we utilize the Eigen Class Activation Mapping (Eigen-CAM) method, which is an explainable AI, to highlight the location of auroral emissions. For our study, we used images from 2015 to 2016 for training and images from

2017 for testing. Our model demonstrates high performance, achieving an accuracy of 0.84, a probability of detection (POD) of 0.76, a false alarm ratio (FAR) of 0.09, and a critical success index (CSI) of 0.70. For further work, we will develop a pipeline for estimating the auroral oval using this deep learning method.

09:45 [II-1-3]

Multi-Satellite Geostationary Observations of 2024 Space Weather Events with GK2A, Himawari-9, GOES-16 & GOES-18

Daehyeon Oh, Eunjeong Cha

National Meteorological Satellite Center, Korea Meteorological Administration

Multi-point observations in geostationary (GEO) orbit provide critical insights into magnetospheric responses during extreme space weather events. This study analyzes two major geomagnetic storms in May and October 2024, using data from GOES-16, GOES-18, GK2A, and Himawari-9. Simultaneous multi-point observations of the same space weather events confirmed distinct magnetospheric responses depending on satellite location. Some satellites experienced direct exposure to interplanetary space, showing sharp electron flux drops and Bz reversals, while others recorded gradual flux variations and delayed Bz changes, reflecting indirect magnetospheric effects. These observations demonstrate that spatial variations in magnetospheric dynamics can be directly captured in geostationary orbit. Our findings highlight the importance of multi-point observations for a more comprehensive understanding of magnetospheric responses during space weather events. To maximize the effectiveness of such observations, continuous cross-calibration and data validation are essential. A three-dimensional analysis of space weather phenomena contributes to improving space weather models, enhancing satellite operation stability, and strengthening forecasting capabilities.

10:00 [II-1-4]

Selection of One EUV Channel along with Solar Magnetogram by a Multi-Domain Image Translation Method

Daeil Kim[1], Yong-jae Moon[1,2], Junmu Youn[1]

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

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

In this study, we present the selection of one Extreme Ultraviolet (EUV) channel along with solar magnetogram using a deep learning model based on multi-domain image translation. For this study, we use 3,425 paired data from the Solar Dynamics Observatory (SDO) Atmospheric Imaging Assembly (AIA) and the Helioseismic and Magnetic Imager (HMI) magnetogram. Among these, we use 2,891 pairs for training, while the others are used to test our model. We successfully generate other five EUV images from one input image using a single generator. Our main results are as follows. First, the overall generation performance of our model shows a good correlation coefficient (CC) value of 0.91, ranging from 0.89 to 0.93. Second, among the six combinations of inputs, HMI + 94Å shows the best performance for generating other EUV channels, as its CC reaches 0.93, followed by HMI + 131Å, which achieves a CC of 0.92. Third, our model shows the lowest performance for generating 94Å and 171Å, with a CC of 0.89. Our study may be a complementary tool for the selection of imaging instruments for deep space missions such as L4.

10:15 [II-1-5]

Heliospheric Current Sheet Thickness and Orientation Distribution within 1-33.6 au from Voyager 2: 1977-1990

Dooyoung Choi, Dae-Young Lee

Chungbuk National University

We report the identification of 188 heliospheric current sheet (HCS) crossing events observed by Voyager 2 from 1977 to 1990, covering heliocentric distances from 1 to 33.6 au. Analysis of these events reveals systematic trends, including a reduction of more than 30% in magnetic field intensity and increases exceeding 20% in both proton density and temperature. Application of the Harris sheet model to the identified events indicates that the HCS thickness spans over two orders of magnitude, ranging from 7×10^3 km to 2.5×10^6 km. In 84.6% of the cases, the HCS planes are located within ± 30° latitude of the equatorial plane, while 85.6% of the events align with the Parker spiral field. A considerable fraction of the crossings exhibits a dominant normal magnetic field component, suggesting the presence of rotational discontinuities. Comparison with previous studies-from the near Sun region to the heliosheath-reveals a general increase in HCS thickness with heliocentric distance. Notably across the range of 1–33.6 au, the HCS thickness remains significantly larger than the ion inertial length, indicating conditions that are generally unfavorable for magnetic reconnection. Overall, our study provides comprehensive insight into the evolution and structure of the HCS over the heliosphere.

10:30 [II-1-6]

Interpretable Solar Flare Forecasting Derived by Deep Learning and Symbolic Regression

Youngjae Kim[1], Yong-Jae Moon[1,2], Jihyeon Son[2]

[1]*School of Space Research, Kyung HeeUniversity*

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

Recently, deep learning models have been introduced with improved precision. However, their black-box nature presents limitations, hindering both the extension of scientific understanding and the incorporation of legacy knowledge into model revisions. In this study, we propose a interpretable solar flare forecasting that combines bi-directional long-short term memory (BiLSTM) with symbolic regression (SR). It offers both high accuracy and statistical comprehension of the solar flares. We utilize the time-series sequences of the Space-weather HMI Active Region Patches (SHARP) parameters, along with the Geostationary Operational Environmental Satellites (GOES) catalog of X-ray solar flare events. Our Bi-LSTM models are trained to classify if M- or X-class flare in the succeeding 24 hour or not. We derive interpretable formulae by symbolic regression, which is compatible with the mapping of the Bi-LSTM model. The simplest formula is determined by total unsigned current helicity and the absolute value of net current helicity. We will discuss its meaning and future studies.

중회의실 5

II-2 SS: 우주항공청 우주환경센터 II

Chair: 조정희(우주청)

09:15 [II-2-1]

Space Weather Models for LEO Satellites: Progress and Future Plans

Dong-Hun Lee[1], Jongho Seon[1], Go Woon Na[1], Sunghwan Lee[1], Jae-Hyuk Lee[1], Seo-Hyun Park[1], Kyung-Chan Kim[2], JiWoo Seo[2], Sang-Young Park[3], Jee Hoon Kim[3], Hae-Dong Kim[4], Junghee Cho[5], Junchul Mun[5], Kichang Yoon[5]

[1]*Kyung Hee University*
[2]*Chungbuk National University*
[3]*Yonsei University*
[4]*Gyeongsang National University*
[5]*Korea Space Weather Center*

With the rapid increase in the number of satellites in Low Earth Orbit (LEO), tailored space weather forecasting has become essential for satellite operations. This presentation summarizes ongoing research aimed at developing a space weather model for LEO satellites. The project focuses on key issues, including spacecraft charging phenomena, high-energy particle exposure, orbital decay due to atmospheric drag, and collision risks among satellite constellations. Initial efforts have successfully integrated satellite charging simulations using the Spacecraft Plasma Interaction System (SPIS), evaluated high-energy particle distribution models (AP8, VERB), and improved orbit prediction accuracy with modified atmospheric models, such as SGP4 combined with NRLMSISE-00 and JB2008. Furthermore, collision risk assessment indices, such as the Collision Rate Percentage Increase (CRI), have been adopted to quantitatively evaluate risks within large constellations. This ongoing work aims to enhance the accuracy and timeliness of space weather forecasting, ultimately supporting safer and more efficient satellite operations in the rapidly evolving LEO environment.

09:33 [II-2-2]

Development of an AI-based Model for Denoising Solar Magnetic Field and Improvement of Solar Synoptic Magnetic Field Maps

Jihye Kang[1], Yong-Jae Moon[1,2], Harim Lee[1], Hyun-Jin Jeong[1,3], Junmu Youn[2], Mingyu Jeon[2], Daeil Kim[2]

[1]*Department of Astronomy and Space Science, Kyung Hee University*
[2]*School of Space Research, Kyung Hee University*
[3]*CmPA, KU Leuven, Belgium*

This research aims to improve solar observation data for predicting space weather disaster monitoring by enhancing image quality and developing algorithms for solar synoptic magnetic field. Our AI-based denoising model significantly decreases noise levels in solar SDO/HMI magnetic field, from 8.14 G to 2.10 G. Existing global synoptic magnetic field data is derived from the central meridian data during 27-day solar rotation period. We are developing an improved deep learning model that generates solar farside magnetic field maps using STEREO/EUVI data sets. These data would be combined with SDO/HMI and Solar Orbiter/PHI to derive the improved solar synoptic maps. These advancements would contribute to more precise space weather forecasts.

09:51 [II-2-3]

Recent Discoveries on Solar Energetic Particle Accelerations and a Novel Approach for Predicting Solar Radiation Storms

Ryun Young Kwon, SWEET

Korea Astronomy and Space Science Institute

We introduce a novel approach for forecasting Solar Radiation Storms induced by the arrival of > 10 MeV protons at Earth from the Sun. Our forecasting model is designed to issue warnings for Solar Proton Events (SPEs) before their arrival at Earth, with a low false alarm rate of less than 20%. It has been

relatively well understood that SPEs result from a complex chain of phenomena, including solar flares, coronal mass ejection (CME) initiations driving coronal shocks, often observed as EIT/EUV waves, as well as CME propagation through interplanetary space leading to CME-driven shocks. However, their rapid transit to Earth taking an hour or so gives no time for the full analyses to make a meaningful forecast before the arrivals. In this paper, we first present recent findings regarding the properties of coronal shocks associated with SPEs. Our model uses the fact that early-arriving energetic protons are accelerated by coronal shocks close to the Sun that expand immediately following a flare, and the properties of these propagating shocks are influenced by the surrounding medium. Using a deep-learning-based three-dimensional coronal electron density model we developed, we determine the spatial propagation ranges and strengths of the shocks. These estimated shock properties, obtained without additional CME and shock analyses, enable us to predict the arrivals and fluxes of energetic protons in a timely manner. Whereas our model is limited in that predictions can only be made after a flare observation, it represents a significant advancement toward ultimate SPE predictions, as it can provide warnings prior to the occurrence of solar radiation storms.

10:09 [II-2-4]

Prediction of Sporadic E Layer Occurrence Using Machine Learning Technique

Kyu-Cheol Choi, Dae-Kyu Shin, Seung-Jun Oh, Yong-Ha Kim

SELab. Inc,.

The Sporadic E layer is a transient and localized electron density enhancement phenomenon that occurs at altitudes of 90 to 120 km and can affect HF and VHF band radio communication. Due to its sporadic nature, predicting the sporadic E layer is highly challenging. In this study, we utilized ionosonde data operated by the Korea Space Weather Center to (1) perform a statistical analysis of the sporadic E layer and (2) apply machine learning techniques to develop a model that can predict the monthly average occurrence rate of the sporadic E layer. The Sporadic E layer primarily occurred around noon during the summer, and there was a variation in occurrence rate depending on solar activity. Based on the statistical analysis results, input data for the machine learning model were selected, and the developed model produced prediction results that were approximately 22% more accurate (based on r-squared) compared to the baseline model. In the future, we plan to develop a model that can predict the occurrence of the Sporadic E layer 1 to 3 days in advance, and the developed models will be utilized in the forecasting operations of the Korea Space weather Center.

10:27 [II-2-5]

A Hybrid Deep Learning Framework for Near Advancement of Space Radio Environment Observation Data Processing Technology and Observation Equipment

Ho-Cheol Jeon[1], Jung-Gil Yuk[1], Ho-Young Jang[1], Ji-Hyeon Kim[1], Kang-Min Jeong[1], Jae-Hyun Lee[2]

[1]*Radar&Space Co., Ltd.*

[2]*Chungnam National University (CNU)*

Changes in the space environment caused by solar activity impact most infrastructures that rely on electricity, electronics, and radio waves, including communication, navigation, and power systems. Therefore, major countries that possess such infrastructures operate space weather observation systems to continuously monitor and track variations in the space environment. Similarly, South Korea operates 23 observation facilities across 10 types centered at the Jeju Space Weather Center under the Korea Aerospace Administration, providing public alert and warning services and building response systems to address the impacts of space weather.

With the emergence of next-generation communication technologies such as 5G and 6G, and growing concerns over the management and utilization of future frequency resources due to spectrum saturation, monitoring of solar activity has become increasingly important, especially as we approach the solar maximum of Solar Cycle 25. As frequency spectrum expansion into high-frequency bands (3–30 GHz) is anticipated, it is crucial to enhance observation equipment and data processing technologies to protect infrastructure assets from the effects of the space radio environment.

The research on the advancement of space radio environment observation equipment and data processing technologies aims to improve the quality of data derived from currently operating solar radio observation instruments (2.8 GHz, burst type) and geomagnetically induced current sensors. It also seeks to upgrade observation systems to expand the frequency range of solar radio flux measurements from a performance perspective. By conducting this research, we aim to strengthen the national space weather response system and enhance the accuracy and stability of observation data, ultimately improving the precision of alerts and warnings.

중회의실 6

II-3 우주탐사 I

Chair: 심채경(천문연)

09:15 [II-3-1]

Distribution of U, Th, and Pb in Ryugu Rocks: Preliminary Results of a Secondary Ion Mass Spectrometry Study

Keewook Yi[1], Yuri Amelin[2], Changkun Park[3], Hwayoung Kim[3]

[1]*Korea Basic Science Institute*
[2]*Korea Basic Science Institute, Guangzhou Institute of Geochemistry, Guangzhou, China*
[3]*Korea Polar Research Institute*

Introduction: Uranium and thorium are radioactive parent elements of U-Pb and Th-Pb isotope chronometers. Knowing the location of these elements in the rock is required for correct interpretation of Pb-isotopic ages obtained with high precision ID-TIMS analyses. Furthermore, concentration mapping allows identification of minerals with elevated Th and U concentrations that may be suitable for in-situ dating.

Samples and methods: We have measured concentration of U, Th a Pb, as well as the isotope composition of Pb, in Ryugu specimens A0063 and C0046 on KBSI SHRIMP IIe, using procedures of [1, 2]. These specimens were prepared for previous petrologic studies as ca. 5 mm epoxy mounts of 2–3 mm rock fragments. The mounts were imaged at KOPRI for element distribution of Na, Si, K, Fe, Cr, Mg, Al, Ca, Mn, P, S, Ti and Cl using WDS, and F, Sc, V, Co, Ni, Cu, Zn, Y and Zr using EDS. These element distribution maps were used for mineral identification and interpretation of SIMS isotope analyses. For SIMS analyses, the mounts were placed inside brass adaptors for standard 25 mm SHRIMP mounts that were designed and made at KBSI. In order to minimise sample loss, the mounts were analysed without repolishing. It was found that even small changes of the primary beam location within the sample area resulted in significant changes of the secondary beam focusing conditions. This problem is probably caused mount obliquity and proximity of the sample spots to the metal frame, which can be efficiently avoided in analyses of samples in regular 25 mm SIMS mounts. We are currently looking for a method of data normalisation that would allow obtaining accurate element concentrations despite these problems.

Results and discussion: U, Th and Pb concentrations have been measured in 40 spots in the specimen A0063, and 49 spots in the specimen C0046. The concentrations of Th, U and total Pb are 7.3 ± 5.3 ppb, 2.5 ± 1.5 ppb, and 467 ± 241 ppb, respectively (uncertainties are 1SD). Because of the secondary focusing variations mentioned above, these concentrations should be considered preliminary semi-quantitative. Concentrations of all three elements in dolomite, sulfides and magnetite are similar or lower than in the phyllosilicate-rich matrix, and the latter dominates the budget of these elements. Three analyses of apatite grains showed slightly elevated concentrations of U and Th, but these grains are too rare to significantly affect the overall distribution of these elements.

The elemental and isotopic ratios are unaffected by the abovementioned problem. The matrix has average Th/U ratio of 2.9 ± 1.1, and 238U/204Pb ratio of 0.14 ± 0.11. The weighted mean 206Pb/204Pb and 207Pb/204Pb analyses (with 95% confidence intervals) are 9.88 ± 0.17 (MSWD = 1.3), and 10.87 ± 0.19 (MSWD = 1.5), respectively, which is close to the TIMS data of [3], and are only slightly more radiogenic than the primordial Pb of the Solar System. One apatite grain yielded elevated U concentration of 35 ppb, and 206Pb/204Pb of 19.5. This result shows that searching other mounts for apatite can potentially yield some grains suitable for *in-situ* U-Pb dating.

References: [1] Yi K. and Amelin Y. (2024) J. Analyt. Sci. Technol., 15, 27. [2] Yi K. et al., (2024) LPS LV, #1833. [3] Yokoyama T. et al. (2022) LPS LIII, #1273.

09:30 [II-3-2]

Effect of Preserving Lie Group Structure in Dynamic Analysis near Small Celestial Bodies: Quantitative Analysis

Jinah Lee, Chandeok Park

Department of Astronomy, Yonsei University

This study aims to quantitatively analyze the effect of preserving the Lie Group structure in the dyanmic analysis in proximity of small celestial bodies. Due to their light masses and small sizes, small celestial bodies in the Solar System exhibit distinctive dynamical environments, necessitating precise dynamic analysis for safe proximity operations. The interaction between orbit and attitude motions, caused by gravity, depends on the size of both small celestial body and its probe. Notably, when a 500 kg probe orbits close to a celestial body which is less than 1 km in diameter, this interaction becomes approximately 0.1% of their gravitational potential. Given that the configuration manifold of orbit-attitude coupled motions belongs to Lie groups, this study focuses on the conservation of Lie group structure, such as the unit magnitude of quaternions. Quantitatively investigated is how influential the conservation of Lie group structure is for dynamic analysis near small celestial bodies. It reveals under what dynamical environments/ conditions it is necessary to preserve the Lie group structures for accurate propagation. One of the key findings lies in noticeably different dynamical behavior for orbit and attitude motions. Whether the structure is preserved or not results in

only decimeter level difference for orbit propagation even after 50 days. In contrast, the attitude propagation exhibits completely different orientations in just 5 days. Additionally, this study explores possible techniques for handling the propagation of orbit-attitude coupled motions using vector-based integrators.

09:45 [II-3-3]

Study on the Changes in the Upper Atmosphere (0-1,000 km) during Solar Maximum

Gi-Hyuk Choi[1], Dae-Young Kim[1], Young-Sil Kwak[2]

[1]*Korea Aerospace Research Institute*
[2]*Korea Astronomy and Space Research Institute*

Currently, 2025 is the year of solar maximum. During solar maximum, the solar wind stimulates the upper atmosphere, increasing the kinetic energy (temperature) of molecules and atoms, causing the atmosphere to expand. Recently, there are numerous practical Earth observation satellites and several thousand of satellites constellation for communication relay in low Earth orbit below 500 km. However, during solar maximum, the atmosphere expands, increasing drag, causing satellites to lower their altitudes and even crash. In addition, interest in reentry spacecraft has been growing both domestically and internationally. This is because conducting scientific and industrial experiments using the weightless environment in low Earth orbit (LEO) and returning the experimental results and samples to the ground will yield significant scientific results and economic benefits. Reentry begins at an altitude of 500 km after releasing from the launch vehicle to an altitude of 120 km. From the altitude of 120 km, as the atmospheric density increases and the spacecraft descends with hypersonic speeds of 20 times the speed of sound. It is exposed to high-temperature plasma of over 3,000℃ between 80 and 50 km, and then a parachute opens at an altitude of 20 km to land on the ground or the sea. Most reentry vehicles are unmanned and small, with a diameter less than 1 m, so they do not have their own attitude control system or thrusters and thus free fall. The orbital maneuver and ground landing accuracy of unmanned small reentry vehicles are largely determined by the accuracy of the vertical distribution data in the upper atmosphere. While low-altitude atmospheric modeling and data between 0 and 100 km in altitude have been widely disclosed, advanced space fairing countries are reluctant to disclose high-altitude atmospheric modeling and data up to an altitude of 100–1,000 km. This is because it affects the accuracy of reentry, which is a strategic core space technology. This is because it has a significant impact on the accuracy of long-range missiles, such as Inter Continental Ballistic Missiles (ICBMs). Therefore, modeling of the upper atmosphere from 0 to 1,000 km is necessary domestically, and in particular, modeling and data of the upper atmosphere at solar maximum are necessary for satellite safety and improvement of reentry accuracy. Accordingly, in this study, following the study of modeling and data construction of the upper atmosphere last year, research on modeling and data construction of the upper atmosphere at solar maximum period was conducted.

10:00 [II-3-4]

Test Results of a Space Search Coil Magnetometer Engineering Model

Seungmin Lee[1], Ho Jin[1], Yunho Jang[1], Minjae Kim[1], Hyeonhu Park[1], Yesun Ahn[1], Sanghwa Kim[1], Jinsang Kim[2], Ickhyun Song[3]

[1]*School of Space Research, Kyung Hee University*
[2]*Department of Electronics Enginnering, Kyung Hee University*
[3]*Department of Electronics Engineering, Hanyang University*

Space Search Coil Magnetometer (SSCM) are widely used to investigate the space environments. In this study, we present the test results of the SSCM Engineering Model (EM) which has been developed by Korean space challenge program. The SSCM consists of a MAG unit and Search coil Control Electronics (SCE) unit.

The MAG unit has a three-axis search coil sensor and a sensor-amp. The sensor-amp has a two-stage amplification to effectively amplify the voltage and preserve the frequency bandwidth. The SCE unit includes the Low Voltage Power Supply (LVPS), analog, and digital boards. The EM digital board generates the Fast Fourier Transform (FFT) power spectrum using a Field Programmable Gate Array (FPGA). The FPGA will be replaced with radiation hardened Application-Specific Integrated Circuit (ASIC) devices to reduce mass and power consumption.

To verify the angular response of the SSCM, we developed the square-barrel calibration coil, which generates a uniform magnetic field suitable for the SSCM. As a test result, the SSCM's frequency range covers 10 Hz-20 kHz and its Noise Equivalent Magnetic Induction (NEMI) is 6 $pT/Hz^{1/2}$ @1 kHz. We expect that the SSCM will contribute to future space exploration.

10:15 [II-3-5]

Conceptual Design of Segmented Robot AI Space Telescope

Jeong-Yeol Han[1,2], Space Telescope Team

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

When the Hubble Space Telescope (HST) and James Webb Space Telescope (JWST) are retired in the early 2030s, humanity will have the largest telescope to observe the universe, the Roman Space Telescope, at 2.4 m. NASA is

planning the Habitable World Observatory (HWO) telescope as a flagship program in the 2040s, but before that, there is an urgent need to have an ultra-high-performance space telescope that will allow humans to observe the universe before then. A space observatory with higher spatial resolution than the HST and shorter wavelengths than the JWST, which can provide unrivaled observations of the universe, is a flagship mission for humanity. We would like to plan a domestic-led international cooperation program that can provide new perspectives for mankind, and introduce a space telescope plan that combines advanced technologies such as segmented mirrors, robots, and AI, as well as interesting scientific purposes such as the world's first self-light and ultraviolet imaging, ultra-high-density astronomical observations and seek domestic participation and cooperation.

10:30 [II-3-6]

Choice of Problem Design and Metaheuristic for Efficient Low-Thrust Gravity Assist Trajectory Design

Pureum Kim, Sang-Young Park

Yonsei University

Shape-based approaches have proven effective for preliminary trajectory design of low-revolution low-thrust arcs, making them valuable for interplanetary mission planning. When integrated with global optimization techniques in a nested optimization framework, these approaches efficiently generate fuel-optimized low-thrust gravity assist (LTGA) trajectories. This nested strategy operates on two levels: the outer level employs global optimization metaheuristics, while the inner level utilizes shape-based arc optimization. However, incorporating metaheuristics inevitably increases computational time, highlighting the importance of selecting appropriate problem formulations and optimization algorithms. This study evaluates various combinations of problem designs and global optimization algorithms across multiple interplanetary LTGA scenarios to identify optimal choices for general mission design applications. While our current analysis focuses on single-objective LTGA problems with predetermined gravity assist sequences, we anticipate that our findings will extend to more complex scenarios, including multi-objective optimization problems and missions with flexible gravity assist sequences.

중회의실 7

II-4 안보우주 II

Chair: 정영준(국방부)

09:15 [II-4-1]

Development Direction of South Korea's Space Power in Light of the Establishment of the U.S. Space Force (USSF)

Jae-Chun Sim, Jae-Young Choi, Won-Sub Shin

Engineer Office, Republic of Korea Army Headquarters

Space power is not only a means of supporting military operations but is also emerging as a core power for the future. Neighboring countries recognize the significance of outer space and are formulating strategies to secure space superiority by concentrating their capabilities on space development. ROK also emphasizes the necessity of space power and is making efforts to secure it. However, preparations for its direct and indirect impacts remain insufficient. This study examines various factors that must be considered in securing and operating space power.

This research reviews how the U.S. Military has developed its space strategy and analyzes the militarization of space by major powers surrounding the Korean Peninsula, as well as the strategic and operational implications of the U.S. Space Force. By doing so, this study aims to suggest future directions for ROK at a critical juncture in the advancement of its space strategy.

09:30 [II-4-2]

Toward Developing Foundation Geospatial Intelligence Using Multi-Source Satellite Data and New Surveying Equipment

Donghwan Kim

Korea Army Academy at Yeongcheon

In terms of geospatial intelligence (GEOINT) development, the Defense sector of Republic of Korea has focused on imagery and imagery intelligence only among three elements of GEOINT (imagery, imagery intelligence, and geospatial information) during several decades. Specifically, geospatial information is an essential part of GEOINT. Geospatial information refers to data collected from various sources and can be categorized into aeronautical, maritime, topographic, elevation, human geography, geographic names and boundaries, and geodetic information. These seven categories are defined as Foundation GEOINT (National Geospatial-Intelligence Agency, 2018). In this study, we present multi-source satellite data, such as synthetic aperture

radar (SAR) and optical imagery, and new surveying equipment, including mobile LiDAR, to improve Foundation GEOINT.

09:45 [II-4-3]

Design of a Cluster of Low-Orbit Reconnaissance Satellites for Detecting North Korean Transporter Erector Launcher (TEL)

Chulhee Han

Joint Chiefs of Staff

Currently, North Korea (NK) is seriously threatening South Korea's security by deploying Transporter Erector Launcher (TEL). In order to detect NK's TELs, it is necessary to secure a constellation of low-orbit reconnaissance satellites that can monitor the entire NK. In this study, a model and simulation were conducted using the STK (Systems Tool Kit) to verify the necessity of a low-orbit satellite constellation and its operational performance at the planning stage. As NK's nuclear and missile threats become more sophisticated, the military needs to secure low-orbit reconnaissance satellites to respond to them. The average visit cycle across NK needs to be shortened to within the TEL deployment time, and key surveillance targets need to be monitored periodically. In order to design a cluster satellite with such capabilities, a high-resolution engineering-grade satellite and a ballistic missile orbit analysis model, STK, were used in this study. In this study, the number of low-orbit reconnaissance satellites required was presented, and the number of images that can be acquired when the satellite visits NK was presented. Finally, the capacity of the ground control station was designed.

10:00 [II-4-4]

Consideration of Space Law Development through Lessons from the Ukraine-Russia War

Kwang-Hoi Kim[1,2], Da-Som Kim[1,2]

[1]*Army Training Command, Republic of Korea Army Infantry School*

[2]*Chonnam National University, Gradute School, Department of Political Science (Ph. D. Program, Enrolled)*

In the Ukraine-Russia war, Starlink played acrucial role as both military and civilian communication infrastructure, highlighting the strategic importance of satellite communications in modern warfare. Existing space law primarily focuses on regulating state-centered space activities, revealing a legal gap regarding the military use of private satellite networks like Starlink. This necessitates a reassessment of space law development.

This paper examines the development strategies of space law, focusing on the utilization of Starlink during the Ukraine-Russia war.

First, there is a need to establish international regulations governing the military use of private satellite services. The case of Starlink demonstrates that a specific country or corporation can directly influence military operations through satellite infrastructure, necessitating international consensus on its regulation. Second, legal mechanisms must be implemented to ensure the neutrality of satellite services. Legal frameworks should be established in conjunction with international humanitarian law to limit or regulate private satellite operators' involvement in conflicts. Third, a legal balance must be struck between national security and commercial freedom. While states may intervene in private satellite operations to protect national security, this could conflict with the principle of free access to space. Therefore, clear international legal guidelines must be established.

In conclusion, the military application of Starlink exposes the limitations of existing space law, indicating that the international community must reassess the legal status of private satellite networks. To address this issue, discussions on revising space law through cooperation among international organizations and major nations are essential, alongside the establishment of institutional measures ensuring the peaceful use of private satellite.

10:15 [II-4-5]

Event Cameras for Space Defense Applications: Leveraging Neuromorphic Vision for Enhanced Surveillance and Object Tracking

Jinwoo Park[1], Geon Kang[1], Dongyoon Kim[1], Jeajung Lee[1], Gimin Bae[2], Janghyong Lee[1]

[1]*Institute of Innovation for Future Army, Headquarters of Republic of Korea Army*

[2]*DDOK*

This research explores the transformative potential of event-based cameras (neuromorphic vision sensors) for space defense systems, highlighting their revolutionary advantages and strategic implementation pathways. Event cameras, which asynchronously respond only to pixel-level brightness changes, represent a paradigm shift in imaging technology with sub-millisecond to microsecond-level temporal resolution (00 μm–0 ms), ultra-wide dynamic range (> 000dB), and minimal power consumption (00 mW) - critical parameters for the challenging space environment. We propose three key implementation strategies that leverage the inherent advantages of neuromorphic vision: (1) superior performance in extreme lighting conditions, enabling continuous space asset monitoring across day-night transitions without optical reconfiguration; (2) unprecedented motion tracking capabilities with microsecond precision allowing for accurate trajectory prediction of high-velocity objects including debris and potentially hostile spacecraft; and (3) dramatic reduction in data transmission requirements through sparse event-based encoding,

addressing the fundamental bandwidth constraints of space-base networks.

The neuromorphic processing architecture enables real-time decision-making with minimal latency, transforming space surveillance capabilities in several critical domains: high-speed object detection in cluttered orbital environments, precise tracking of small objects against bright backgrounds (including Earth albedo and direct sunlight), and autonomous threat assessment with minimal computational overhead. These capabilities directly address current limitations in conventional imaging systems that struggle with the extreme contrast conditions and rapid motion characteristics of the space domain. Our presentation details concrete implementation pathways for enhancing military space defense capabilities through neuromorphic vision technology, with particular focus on satellite protection systems, debris collision avoidance, counter-space threat detection, super-high speed object such as ICBM tracking, and autonomous response mechanisms. By emphasizing the biomimetic principles that make event cameras uniquely suited for the space environment, we demonstrate how this technology can provide a decisive advantage in maintaining space domain awareness and protecting critical space assets.

10:30 [II-4-6]

42Abaci: Toolkit for Understanding Constellation Behaviors

Deok-Soo Kim[1,2], Joonghyun Ryu[1,2], Jun Young Byun[3], Juhwan Kim[3], Yujeong Cho[3], Seunghwan Choi[1,2], Greg Gillinger[4], Alina Shymanska[1], Jae Wook Song[3], Kichun Lee[3]

[1]*SpaceMap Inc*
[2]*School of Mechanical Engineering, Hanyang University*
[3]*Department of Industrial Engineering, Hanyang University*
[4]*Integrity ISR*

Recognizing and analyzing satellite pattern-of-life (PoL) is essential for understanding on-orbit activities from both defense and commercial perspectives. This study introduces the core functionalities of 42Abaci, an analytic software platform designed to monitor, predict, and analyze the PoL of satellite constellations. 42Abaci enables detection of behavioral anomalies within constellations and provides automated alerts to registered users via email. 42Abaci's predictive capabilities support maneuver detection, offering valuable insights into potential intent behind observed satellite behaviors. Additionally, its digital twin feature facilitates real-time, multi-dimensional visualization of orbital dynamics—synchronized with the platform's analytic time window—allowing users to seamlessly assess both numerical data and visual patterns. This integrated approach supports the validation of findings, evaluation of operational scenarios, and development of strategic responses in an increasingly dynamic space domain.

대회의실 1

III-1 태양 및 우주환경 II

Chair: 김연한(천문연)

13:00 [III-1-1]

Statistical Study on Microwave Precursor for M and X-Class Flare

Sujin Kim[1], Hong-dal Jun[1], Jeongwoo Lee[2], Su-Chan Bong[1], Sung-Hong-Park[1,3]

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

We present statistical study on microwave precursors using microwave imaging data obtained by Nobeyama Radio Heliograph (NoRH). First of all, we have examined 17 GHz flux profiles of 162 M- and X-class flares observed by Nobeyama Radio Polarimeters (NoRP) from 2011 to 2024 and found only 12 flares has precursors, weak brightening, within 40 min before the start time of the flare. For the study, we also have used magnetograms obtained by Helioseismic Magnetic Imager (HMI) onboard Solar Dynamics Observatory (SDO). In the result, we summarized characteristics of precursors regarding to the location, photospheric magnetic field, polarization, and with of without EUV brightening. The result that only 12 flares out of 162 flares has microwave precursors seems to suggest that full-sun instrument (NoRP) is not proper to sense the precursor. Based on the result, we discuss the limitation for the detection of precursors and more effective approach to detect precursors.

13:15 [III-1-2]

Preliminary Results of a Comparison Between Ambient Solar Wind Speed and Coronal Temperature Observed from SDO/AIA

Il-Hyun Cho, Yong-Jae Moon

Kyung Hee University

We investigate the relationship between the speed of the ambient solar wind and the coronal temperature within the altitude range 1–1.2 solar radii. For this purpose, we define 66 slit positions along the solar limb in the 171 Å channel images obtained from the Solar Dynamics Observatory/Atmospheric Imaging Assembly (SDO/AIA) to construct time-distance images. Propagating intensity disturbances are consistently observed in these images. We calculate the propagation speed for each time-distance image and find that the speed increases as the slit position is located farther from the solar pole. The speed is found to be independent of the slit inclination. We will

calculate the differential emission measures (DEM) for these 66 slit positions and derive temperatures, enabling estimation of the local sound speeds. If the intensity disturbances are slow magnetoacoustic waves which propagate with the sound speed, in the ambient flow, the speed of the ambient solar wind can be defined as the observed propagation speed minus the sound speed. Its correlation with the coronal temperature is to be explored.

13:30 [III-1-3]

Towards Improving DEM Determination from AI-Generated EUV Images of Solar Orbiter

Mingyu Jeon[1], Junmu Youn[1], Yong-Jae Moon[1,2]

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

In this study, we explore methods to improve the determination of the differential emission measure (DEM) by enhancing AI-generated extreme ultraviolet (EUV) images of Solar Orbiter. In previous work, we developed deep learning models to generate synthetic EUV images of Solar Dynamics Observatory (SDO) using other EUV images of SDO and then applied the models to EUV images of Solar Orbiter. The previous research successfully determined DEM using AI-generated EUV images of Solar Orbiter, but there is room for improvement. First, we investigate preprocessing methods to produce more suitable AI-ready data from raw observational data. Second, we explore various deep learning techniques to improve image-to-image translation model performance. We present preliminary results of these approaches.

13:45 [III-1-4]

Observations of the Butterfly Pitch Angle Distribution in the Inner Radiation Belt by the Snipe Mission During the May 2024 Superstorm

Jaejin Lee, Jaeheung Park, Tae-Yong Yang, Jongdae Sohn, Hosub Song

Korea Astronomy and Space ScienceInstitute

This study reports on observations of high-energy electrons in the Inner Radiation Belt during the May 2024 superstorm using the Small Scale Magnetospheric and Ionospheric Plasma Experiment (SNIPE) mission. Observations were made at an altitude of about 530 km in the South Atlantic Anomaly (SAA) region using two CubeSats, SNIPE_B and SNIPE_D.SNIPE_B maintained a solar orientation, while SNIPE_D, rotating at a high speed of 50 degrees per second, allowed detailed measurements of electron pitch angle distributions. In particular, the rotation of SNIPE_D facilitated the detection of a butterfly pitch angle distribution observed most clearly in the energy range below 120 keV. This distribution showed a diffusion towards the loss cone, suggesting that it resulted from wave-particle interactions during the superstorm. This research provides critical insights into how superstorms affect electron dynamics within the inner radiation belt, potentially improving the accuracy of future space weather prediction models.

14:00 [III-1-5]

Study of Enhancing IRI Electron Density Profiles Using Machine Learning

Eun-Young Ji[1], Yong-Jae Moon[1,2], Young-Sil Kwak[3], Kangwoo Yi[1], Jeong-Heon Kim[3]

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

In this study, we develop a model to improve the electron density profiles of the International Reference Ionosphere (IRI) using machine learning. We make a model based on Multi-Layer Perceptron (MLP) to improve the global electron density profiles generated from IRI-2020 using electron density profiles observed by the COSMIC satellite from 2007 to 2019. The dataset is divided into training (2007–2013), validation (2014, 2019), and test (2015–2018) sets. Additionally, we aggregate data from six COSMIC satellites into a single dataset using a binning approach of 5° latitude × 15° longitude × 15 km altitude × 1 hr. We then evaluate the model's performance using the test dataset to assess its effectiveness in improving electron density predictions. The evaluation results show that our model demonstrates an improvement over the IRI model, with the correlation coefficient (CC) increasing from 0.76 to 0.88 and the root mean square error (RMSE) decreasing from 0.27 to 0.2 Furthermore, we can see that the prediction accuracy of electron density profiles improved not only in mid-latitudes but also in low-latitudes. These findings indicate that our MLP-based approach significantly enhances the accuracy of electron density predictions in the IRI model, particularly in capturing the vertical electron density distribution. This study demonstrates the potential of machine learning techniques in refining empirical ionospheric models, contributing to improved space weather forecasting and ionospheric research.

중회의실 5

III-2 SS: 우주항공청 우주환경센터 III

Chair: 곽영실(천문연)

13:00 [III-2-1]

KASI's Space Weather Research Activities and Strategic Recommendations for Korea's R2O System

Young-Sil Kwak[1,2], KASI Space Weather Research Team

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

Understanding, monitoring, predicting, and preparing for solar activity and space weather variability is essential to mitigate the risks and damages caused by sudden space weather events and to safeguard human life and technological infrastructure. Since initiating sunspot observations in 1987, the Korea Astronomy and Space Science Institute (KASI) has steadily developed and deployed a wide range of ground-based instruments for space weather research across Korea. The field entered a more structured phase in 2007 with the launch of the Korea Space Weather Research Project, which significantly expanded observational capabilities and research efforts. In recent years, KASI has established space-based observation systems, developed comprehensive databases and networks, and advanced predictive modeling and fundamental research on space weather. In response to the increasing globalization of satellite and communication networks and the growing era of space exploration, KASI is also leading efforts to build a global space weather observation network and research space weather changes and predictions extending to the heliosphere. This presentation highlights KASI's ongoing activities in space weather research. Additionally, from the perspective of a research institute engaged in space weather studies, we offer strategic recommendations for establishing a robust national Research-to-Operations (R2O) system in Korea aimed at enhancing the accuracy, timeliness, and effectiveness of space weather forecasting and preparedness.

13:20 [III-2-2]

A Hybrid Deep Learning Framework for Near Real-Time TEC Mapping and Forecasting over the Korean Peninsula Region

Se-Heon Jeong[1], Woo Kyoung Lee[1,2], Hyosub Kil[3], Jeong-Heon Kim[1], Young-Sil Kwak[1,2]

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

One of the projects currently underway in Korea Astronomy and Space Science Institute involves monitoring the ionosphere over East Asia in near real-time using Global Navigation Satellite System (GNSS) data. The total electron content (TEC), derived from GNSS measurements, serves as a crucial parameter for satellite communication and navigation systems. However, due to the geographical limitations of ground-based GNSS stations, especillay over oceanic regions, large data gaps in TEC measurements exist. To address this issue, we have developed a model that reconstruct TEC maps over and around the Korean Peninsula (26°–40.5°N, 120.5°–135°E) by filling in the data gaps using a deep learning technique. The model employs Deep Convolutional Generative Adversarial Network with Poisson Blending (DCGAN-PB) method. It was developed using 18 yr of TEC data, spanning from 2002 to 2019, for training and validation.

As an extension of this work, we have developed and evaluated an ionosphere prediction model to forecast TEC variations up to 24 hr ahead. This model employes a Convolutional Long Short-Term Memory (ConvLSTM) architecture, which is well-suited for handling spatio-temporal datasets, and uses reconstructed DCGAN-PB TEC maps as inputs. Our results demonstrate the outperfomance of our model compared to the International Reference Ionosphere model and a standard LSTM model. Ongoing research aims to improve forecasting performance not only under quiet geomagnetic conditions but also during magnetically disturbed conditions. Furthermore, we are in the process of developing a visualization system that provides near real-time DCGAN-PB-based TEC maps.

13:40 [III-2-3]

SWA-GPT: Space Weather Assistant with GPT

Seungheon Shin[1], Yong-Jae Moon[1,2], Jihyeon Son[2]

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

In this work, we introduce SWA-GPT (Space Weather Assistant with GPT), a space weather assistant system designed for forecasting and monitoring main space weather components: solar flares, solar energetic particles (SEPs), and geomagnetic storms. SWA-GPT is based on GPT-4o and integrates real-time space weather data from various web resources. By leveraging structured prompts and the reasoning-acting techniques, SWA-GPT enhances the accessibility and interpretability of space weather information. This approach reduces the need for manual data collection and enables users to efficiently verify space weather conditions in real time. The proposed system provides a simple and adaptable approach for developing AI assistants for space weather applications, enabling cost-effective implementation without requiring training data or additional infrastructure to run the assistants.

14:00 [III-2-4]

NASA Moon to Mars (M2M) Space Weather Research-to-Operation to Support Space Exploration

Carina Alden[1], Kichang Yoon[2]

[1]*M2M (Moon to Mars) Office, GSFC, NASA*
[2]*Korea Space Weather Center (KSWC), KASA*

NASA's Moon to Mars (M2M) program integrates advanced space weather forecasting capabilities to support NASA's deep space exploration, autonomous satellite operations, and radiation hazard mitigation for crewed and robotic missions. As human and robotic activities expand beyond low Earth orbit (LEO) to the Moon, Mars, and beyond, accurate space weather prediction becomes increasingly critical for mission safety and operational continuity.

NASA utilizes a range of state-of-the-art space weather models and forecasting tools to predict solar energetic particle (SEP) events, geomagnetic storms, and interplanetary conditions Key models include:

- WSA-ENLIL + Cone Model: A physics-based model that simulates solar wind propagation and CME evolution in interplanetary space, providing impact assessments for deep space missions.
- EPREM (Energetic Particle Radiation Environment Model): Used for predicting radiation exposure risks to spacecraft and astronauts by simulating SEP transport through the heliosphere.
- HERMES (Heliophysics Environmental and Radiation Measurement Experiment Suite): An advanced observational suite planned for deployment near the Moon to provide real-time space weather monitoring for Artemis missions.

NASA's space weather forecasting efforts, in collaboration with NOAA, the U.S. Space Force, and international partners, aim to improve operational resilience against space weather hazards. The integration of these models enhances mission planning, supports spacecraft autonomy, and provides critical warnings for astronaut safety.

This presentation will outline the latest advancements in NASA's space weather modeling, emphasizing its application to future deep space missions and interplanetary travel.

중회의실 6

III-3 우주탐사 II

Chair: 김은혁(항우연)

13:00 [III-3-1]

Comparability of the Shielding Capacities Between Space Suits Made from the Composite Material ABnC and Traditional Space Suits on Planetary Bodies

Lasany Arfin Kunja[1], Eojin Kim[2], Yu Yi[1]

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

For astronauts operating outside of the atmosphere of the Earth, radiation can increase the risk of cancer, damage the central nervous system, and cause degenerative tissue effects. To lower these risks and ensure future astronauts can embark on long-term mission, we need space suits which also offer some radiation shielding. One excellent candidate for flexible shielding materials to be used in space suits are composite fibers made from Boron Nitride Nanotubes (BNNP) and Aromatic Amide Polymer (AAP), known as AB_nC. Using SPENVIS simulations, we investigated the shielding properties of different AB_nC composites. We simulated the shielding against Galactic Cosmic Rays, which is most important radiation source in open space. Furthermore, we simulated shielding against the albedo radiation experienced on the surface of the Moon and of Mars, respectively. On these planetary objects the secondary radiation, in particular neutron radiation, is also responsible for a significant radiation exposure of future astronauts. In all simulations, we compared the effectivity of AB_nC relative to traditional materials used in space suits.

13:15 [III-3-2]

Statistical Analysis of Moon-Originating Ions Observed by the Kaguya Spacecraft in the Earth's Magnetotail Lobes

Khan-Hyuk Kim[1], Jaehee Lee[1], Seul-Min Baek[2], Ho Jin[1]

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

The spatial distribution of the properties of Moon-originating ions is studied using Kaguya data from 2008 to 2009 when the Moon was in the terrestrial magnetotail lobes. The lunar-origin ions were detected in the energy range of 20 to 2,000 eV at altitudes of approximately 30 to 120 km on the dayside. They mostly consist of heavy ions such as C^+, O^+, Na^+, Al^+, K^+, and Ar^+. We found that their energy levels rapidly change by a factor of approximately 5 to 10 within a few minutes when the spacecraft passes over mountainous terrains, without dependence on the solar zenith angle or satellite altitude. These significant changes in energy levels may be associated with the spatial variation of the sheath electric field on the lunar surface, rather than temporal variations in ambient plasma and solar conditions. The Moon-originating ions are probably energized by the near-surface electric field confined within the lunar photoelectron

sheath. We also found that the occurrence of Moon-originating ions is high within the Procellarum KREEP Terrane. This indicates a potential contribution to electrostatic charging based on crustal composition.

13:30 [III-3-3]

Surface Composition Around the South Pole-Aitken Basin Suggest a Clue to the Origin of Lunar Magnetism

Hyeonhu Park[1], Ian Garrick-Bethell[2], Ho Jin[1]

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

The Moon does not have a dynamo today, but there is strong evidence that it once possessed one. This evidence for the ancient lunar dynamo can be found in crustal magnetic anomalies. Recently, we found that some demagnetized craters, one of the magnetic anomalies are consistent with their destruction and removal of a ferromagnetic-rich surface layer. In these crater regions, the ferromagnetic minerals that can record ancient lunar magnetic fields are likely associated with magnetized basin ejecta. Furthermore, the iron-rich impactor that formed large basin could have lead to the high amount of magnetism since lunar materials are not highly ferromagnetic. In this study, we focus on the largest and oldest South Pole-Aitken (SPA) basin and investigate the relationships between iron and thorium around the SPA basin for magnetism. Because the thorium material is likely from the Moon's interior and the iron materials may come from inside the Moon and/or the projectile. We found that iron and thorium are highly correlated inside the SPA (R^2 ~0.64), whereas outside they are not. We also found a small ($\triangle$FeO = 0.45 wt.%) but statistically higher iron mean in the region of the SPA ejecta materials than in the background ($p < 0.01$). However, the thorium mean is statistically the same these two regions ($p > 0.05$).
This supports that the tentative discovery of large-scale deposit of exogenous iron, which in turn may help explain the magnetic anomalies there. Alternatively, it is possible that the region of the SPA ejecta materials represents high-iron lunar mantle material that is simply not correlated with thorium. Nonetheless, this would be an important discovery because it may imply different, and possibly more ferromagnetic compositions, are located here.

13:45 [III-3-4]

3D Spiral Phase Plate Microscope for Lunar Regolith Grain Imaging

Sunwoo Lee[1,2], I Jong Kim[1], Nayeon Kim[2], Seunghyuk Chang[3], Changgon Kim[2], Dohoon Kim[2], Chae Kyung Sim[4,5], Minsup Jeong[4], Daewook Kim[6], Soojong Pak[2]

[1]*Korea Basic Science Institute*
[2]*School of Space Research, Kyung Hee University*
[3]*Center for Integrated Smart Sensors*
[4]*Korea Astronomy and Space Science Institute*
[5]*University of Science and Technology*
[6]*James C. Wyant College of Optical Sciences, The University of Arizona*

The low-gravity and atmosphere-free environment, combined with the transient lofting of particles by solar wind and micrometeoroid impacts, causes the Moon's surface grains (10–200 μm in size) to adhere through intrinsic interparticle cohesion. This process forms a loosely aggregated, highly porous microstructure known as a "fairy castle". Ground-based photometric studies and the soil sample collection lack the necessary detail to fully characterize the structures. To address this limitation, we propose the design and optical simulation of a microscope optical system utilizing a spiral phase plate (SPP) for 3D structural interferometric observation of lunar regolith. This compact optical configuration, along with robust structural stability, is achieved by incorporating a linear astigmatism-free three-mirror system (LAF-TMS).
The SPP is a common component used to generate Laguerre-Gaussian beams, which carry orbital angular momentum. Placing the SPP at the Fourier plane of the imaging system induces self-interference between higher-order light diffracted from the target and the undiffracted 0th-order light, producing a spiral interference pattern at the detector. Similar to standard interference patterns used in metrology, adjacent bright fringes indicate a 2 π phase difference (or a wavelength variation) at the target. This SPP-based spiral interferometric pattern allows for 3D structural reconstruction without an additional reference beam, simplifying the optical setup through self-interference.
A conventional off-axis configuration to solve the obscuration issue of the secondary mirror which causes diffraction and signal loss, introduces linear astigmatism. Our design overcomes this by designing the three mirrors to share common focal points, mathematically eliminating linear astigmatism. This LAF-TMS design also offers significant advantages for space missions compared to transmissive optical systems. Reflective optical systems, unlike transmissive ones, do not require additional optical elements for chromatic aberration compensation. Furthermore, metal-based mirrors are considerably more robust against vibrations and impacts during launch and landing.
Therefore, the proposed optical system offers a highly simplified yet powerful approach to 3D structural analysis of lunar regolith. Optical simulations have verified its performance, demonstrating the potential for a space mission on the lunar surface.

14:00 [III-3-5]

Imaging of Blue Ghost Mission 1 and IM-2

Nova-C by the KPLO LUTI Camera

Dong-Gyu Kim, Eunhyeuk Kim

Korea Aerospace Research Institute

The Korea Pathfinder Lunar Orbiter (KPLO), also known as Danuri, developed by the Korea Aerospace Research Institute (KARI), was launched on August 5, 2022, and has been operating successfully in lunar orbit since January 2023. In early 2025, the mission was extended until the end of 2027. Among the scientific instruments on KPLO, the Lunar Terrain Imager (LUTI) has been operated to capture the high-resolution images of candidate landing sites for future Korean lunar missions and the landing sites of foreign lunar landers. Recently, LUTI successfully captured images of the Blue Ghost Mission 1 lander, which was launched on February 14, 2025, and landed near Mons Laterille on March 2, 2025. LUTI also imaged the IM-2 Nova-C lander, which was launched on February 26, 2025, and landed near Mons Mouton at the Moon's south pole on March 8, 2025. Both landers were developed under NASA's Commercial Lunar Payload Services (CLPS) program. This paper presents the LUTI images of these two landers and highlights notable features of their respective landing sites.

중회의실 7

III-4 안보우주 III

Chair: 박재흥(천문연)

13:00 [III-4-1]

Analysis of Ionospheric Plasma Disturbances Induced by NWC VLF Transmitter Using SWARM Satellite Data

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

[1]*Republic of Korea Army*

[2]*Korea Astronomy and Space Science Institute*

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, we analyze the SWARM A satellite data from January 2014 to September 2024. The irregularities at NWC emerge from 2000 LT, and last until dawn for the entire period of 2014–2024. We confirm annual and seasonal variations of the irregularities at NWC. In addition, the plasma irregularities at the conjugate point are shown, and their detailed shapes are given over a solar cycle.

13:15 [III-4-2]

Installing of the Astronomy and Space Exploration Observation Module at Antarctic Inland Basecamp

Jong-Kyun Chung, Chung-Uk Lee, Dongjoo Lee, Heesu Yang

Korea Astronomy & Space Science Institute

The Korea Astronomy and Space Science Institute (KASI) operates an astronomy and space exploration observation module installed at Jang Bogo Station (74.6°S, 164.2°E, elevation: 41 m) and at the Antarctic Inland Basecamp (75.0°S, 164.8°E, elevation: 1,000 m). This research presents an overview of module fabrication, operational status, renewable energy-based power system performance, and thermal characteristics inside and outside the module to evaluate the feasibility of remote astronomical observations in Antarctica. The observation module, built upon a 10-ft standard container frame, was specifically designed for inland Antarctic transport and incorporated 10 cm thick insulation panels to minimize cold-air influx. The power generation system consists of six solar panels (model SCM 150 W, 150 W maximum power per panel), one wind turbine (model LE-v150 Extreme, 200 W maximum power), and AGM Deep Cycle lead-acid batteries (model PVX-1040T, capacity 7.2 kW per battery module). Partial degradation of solar panels was observed when energy production exceeded battery capacity, suggesting the necessity of additional forced energy consumption strategies, such as heaters, to mitigate degradation. Temperature monitoring utilized NTC, MEMS, T-type, and PT-100 temperature probes installed at various positions (including interior floor, ceiling, walls, and external surfaces), precisely measuring a broad temperature range from −200℃ to +300℃. Continuous temperature measurements since March 2023 indicated stable interior temperatures even during extreme conditions such as polar nights, revealing a strong correlation between module temperature variations and solar elevation and azimuth angles. For future inland Antarctic astronomy and space exploration activities, improvements in battery efficiency through optimized housing design and management strategies suited for extreme low-temperature conditions are essential.

Keywords: Antarctica, Astronomy and Space Exploration Module, Jang Bogo Station, Renewable Energy, Temperature Measurement, Remote Observations in Polar Regions

13:30 [III-4-3]

Next Generation Solar Telescope (NxST): Monitoring Solar Flares and Filament Eruptions

Heesu Yang, Seong-hwan Choi, Eun-Kyung Lim, Dunguk Song

Korea Astronomy and Space Science Institute

We develop ground-based solar imaging-spectroscopic telescopes to acquire full-disk data of solar chromospheric lines using the drift-scanning method. We named the system as “Next Generation Solar Telescope (NxST) Global Network.” Our goal is to monitor solar flares and filament eruptions, investigate the precursors of the flares, and conduct statistical studies of chromospheric phenomena.

The system provides full-disk data with a time cadence of 150 sec and a spatial resolution of 3 arcseconds. The spectral resolving power (R) reaches approximately 40,000 at the Hα band using an echelle grating, allowing the measurement of velocities below ~10 km/s in the chromosphere. In this presentation, we introduce the results of test observations, data processing methods, and future development plans.

13:45 [III-4-4]

Development of Formation Flying Orbit Design and Control System to Establish Multi-Static SAR Mission of Korean Next SAR Satellite System

Jae-Cheol Yoon

KOMPSAT-6 Program Office, Korea Aerospace Research Institute

The development of KOMPSAT-8 system, which is the follow-on mission of the KOMPSAT-6, will be started in 2026. The KOMPSAT-8 system consists of one (1) primary satellite and three (3) small companion satellites. The primary satellite will independently provide High Resolution Wide Swath (HRWS) SAR image applying digital beam forming technology and the formation flying with primary and companion satellites will generate high accurate Digital Elevation Model (DEM) in near real time. The mean along track distance between primary and three companions should be 15 km and the cross track distance among three companions have to be 300-1,000 m in order to establish inter-satellite link and interferometric baseline for multi-static SAR mission.

In this research, Formation Flying Orbit Design and Control System, which can make entire four (4) satellites maintain multi-static SAR, was developed. First, relative orbit design was implemented for multi-static SAR. Second, orbit control plan for maintaining formation flying, fuel budget, antenna boresight direction analysis for inter-satellite link, satellite attitude pointing for SAR signal acquisition, and interferometric baseline monitoring, e.g. was performed.

The multi-static SAR mission using HRWS primary satellite and three small companion satellites will be the first case in the world on 2032 when the KOMPSAT-8 will be launched.

14:00 [III-4-5]

Integration of Civilian Space Surveillance And Collision Risk Analysis Technologies into Military Applications

Young-joon Jeong[1], Seok-Min Song[2], Jong-gun Noh[1], Gyongmin Jeon[1]

[1]*Republic of Korea Ministry of National Defence*
[2]*Korea Astronomy and Space Science Institute*

Republic of Korea’s first military reconnaissance satellite was launched on December 21, 2023. it is necessary for us to constantly monitor the collision risks of these satellites against resident space objects including enemy satellites. However, at present, the military lacks independent space domain awareness capabilities and assets, making it essential to utilize existing civilian technologies. This study analyzes the space surveilance and collision threat mitigation thchnologies of Republic of Korea’s leading space research institutions, KASI and KARI, the Republic of Korea Air Force, the U.S.-based nonprofit organization CelesTrak, and the Republic of Korean startup, proposing ways to integrate these technologies into the operation framework of the Republic of Korean military.

대회의실 1

IV-1 태양 및 우주환경 III

Chair: 이창섭(극지연)

14:25 [IV-1-1]

A Long-Duration Pseudobreakup

Yukinaga Miyashita[1,2], Madeeha Talha[1,2,3]

[1]*Korea Astronomy and Space Science Institute*
[2]*University of Science and Technology*
[3]*Pakistan Space and Upper Atmosphere Research Commission, Karachi, Pakistan*

Pseudobreakups (pseudosubstorms) are generally believed to be weaker, more localized, and more short-lived than substorms, but are similar to substorms, particularly the early stage of the substorm expansion phase. Previous studies defined the pseudobreakup by small latitudinal extent or short duration of auroral onset arc activity or poleward expansion. A distinct morphological difference, however, appears to be auroral

poleward expansion or auroral breakup. While substorm auroral onset arcs develop into poleward expansion, pseudobreakups subside without progressing to poleward expansion. Here, using Time History of Events and Macroscale Interactions during Substorms (THEMIS) data, we show a pseudobreakup event that lasted more than 10 min. It had a latitudinal extent of ~1 degree and was morphologically similar to usual short-lived pseudobreakups. Although the latitudinal extent may work to some extent to define the pseudobreakup, the duration does not seem to work. We suggest that the pseudobreakup should be defined morphologically by poleward expansion.

14:40 [IV-1-2]

Relation between Stepwise Development of Auroral Onset Arc and Low-Frequency Waves in the Near-Earth Magnetotail at Substorms Onsets

Madeeha Talha[1,2,3], Yukinaga Miyashita[1,2]

[1]*University of Science and Technology (UST)*
[2]*Korea Astronomy and Space Science Institute (KASI)*
[3]*Pakistan Space & Upper Atmosphere Research Commission (SUPARCO)*

From the end of the substorm growth phase to the onset of its expansion phase, a series of processes occur that can be observed as steps in the development of the auroral onset arc. This stepwise arc development includes: initial brightening (IB), further enhancement of the arc (FE; enhancement of a wavelike structure), and poleward expansion (PE). On the ground at high latitudes, stepwise changes in geomagnetic perturbations and pulsations (Pi1 and Pi2) show a strong correlation between these substorm magnetic signatures and the development of the auroral arc. Using data from the Time History of Events and Macroscale Interactions during Substorms (THEMIS) spacecraft, we investigated the behavior of Pi1 and Pi2 pulsations (low-frequency waves) in the near-Earth magnetotail (~8–11 Re). Preliminary analysis indicate that although the observations depend on the location of the spacecraft relative to the onset arc, small-amplitude and low-frequency Pi1 and Pi2 pulsations tend to occur before PE and sometimes before FE. Large-amplitude and high-frequency Pi1 and Pi2 pulsations manifest near after PE.

14:55 [IV-1-3]

Evaluating the Impact of External Forcings on the Ionosphere-Thermosphere 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, USA*
[3]*Department of Physics, Catholic University of America, Washington, DC, USA*
[4]*Science and Technology Institute, Universities Space Research Association, Huntsville, AL, USA*
[5]*NSF National Center for Atmospheric Research, High Altitude Observatory, Boulder, CO, USA*
[6]*COSMIC Program Office, University Center for Atmospheric Research, Boulder, CO, USA*

The ionosphere-thermosphere (IT) system is highly responsive to external forcings. Previous studies highlight that both precipitating high-energy magnetized particles from space and upward-propagating tides and gravity waves from the lower atmosphere influence the system, even during geomagnetic storms. Computational errors in modeling these forcings interact nonlinearly within the IT system, complicating model performance improvements. Thus, separating and analyzing these errors is essential. This study assesses the uncertainties in the lower-atmospheric and space environmental influences on the IT system. For this, the Whole Atmospheric Community Climate Model with Thermosphere and Ionosphere eXtension (SD WACCM-X) version 2.2 is used, with lower atmospheric effects constrained by nudging with MERRA-2 reanalysis data. Additionally, three high-latitude electrostatic potential estimation models in WACCM-X are compared: Heelis 1982, Weimer 2005, and the data assimilation-based Assimilative Mapping of Geospace Observations (AMGeO). Comparative analyses of three geomagnetic storms (April 2010, March 2013, and September 2017) reveal significant high-latitude uncertainties in all cases, with AMGeO capturing the temporal variability of electrostatic potential more accurately than the other models. While the RMSE and bias of the equatorial ionization anomaly (EIA) were similar to those of the Weimer model, AMGeO overall exhibits the better vaiability in the plasma distribution. These findings suggest that AMGeO makes the more precise simulations of ionospheric dynamics possible.
This research was supported by the KASI under R&D programs (2025-1-850-02) and G-LAMP and NRF grant (RS-2024-00442483).

15:10 [IV-1-4]

Study on Advancing the Space Weather Monitoring and Forecasting System of the 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*

The space weather monitoring and forecasting system of Republic of Korea Air Force (ROKAF) is currently being introduced. With this system, the ROKAF aims to enhance operational effectiveness by producing and utilizing operation-optimized

space weather intelligence.
In this study, we propose a roadmap for the future development of the Air Force's space weather support for operations. For this, we focus on the space weather monitoring and forecasting system with a vision based on the ROKAF Space Power Development Plan (Space Odyssey Project) extending to 2050. First, we compare the current status of the ROKAF with domestic and international space weather monitoring and forecasting institutions in terms of facilities and models for space weather monitoring and forecasting. Then, we collect opinions on the development direction of the ROKAF space weather operations through a survey of South Korean space weather experts. Finally, we propose a development direction aligned with the ROKAF space power development plan.

15:25 [IV-1-5]

Relocation of the Daejeon Neutron Monitor to Gamak Mountain in Geochang and Initial Observational Data

Jongil Jung[1], Young-Sil Kwak[1,2], Jongdae Sohn[1], Suyeon Oh[3], Yu Yi[4], Youngkyun Kim[5], Seonghwan Choi[1], Paul Evenson[6]

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

Cosmic ray neutron monitors (NMs) are essential ground-based instruments for detecting secondary neutrons. The energy range of cosmic ray particles detected by neutron monitor corresponds to solar modulation, and supports the research and monitoring of the space environment. Recently, Daejeon neutron monitor was relocated to Mt. Gamak in Geochang, in a move coordinated by the Korea Astronomy and Space Science Institute, due to maintenance issues. The relocation began in the early summer of 2023 and was completed in the spring of 2024. After the verification of post-installation, the NM at Mt. Gamak is producing high-quality data. The count rate of NM at Mt. Gamak increased by ~1.8 times compare to the Daejeon site, and barometric coefficient also increased from −0.6557 to −0.7101. In this presentation, we will introduce the NM at Mt. Gamak in Geochang and share initial observational data.

중회의실 5

IV-2 SS: 교육문화유산

Chair: 이서구(천문연)

14:25 [IV-2-1]

A Comparative Study of Automatic Water Clocks in East Asia from the 13th to 15th Centuries

Sang Hyuk Kim[1], Byeong-Hee Mihn[1,2,3], Kyung-Ha Lee[4]

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

The *Deungnu* (燈漏), an automatic water clock constructed around 1270 during the Yuan Dynasty, featured an innovative time-signaling system integrated with a traditional lantern-style structure. The *Heumgyeonggak-nu* (欽敬閣漏), built in 1438 during the early Joseon period, appears to have enhanced and refined the time-signaling functions of the *Deungnu* (Jeon 1994; Nam 1995; Yun et al. 2024). This study examines the influence of the Yuan Dynasty's *Deungnu* on Joseon's *Heumgyeonggak-nu*, with a particular focus on their time-signaling systems. A comparative analysis was conducted using historical records, technical documents, and reconstructed models of the Deungnu created in China. The *Deungnu*'s timekeeping mechanism consists of four levels. The top tier (4th level) displays the 4-Gods (四神) constellations. The third level features representations of the Dragon, Bird, Tiger, and Tortoise. The second level includes figurines of the 12-Gods (十二神) along with 100-Marks (百刻) scale. The first level houses four musicians responsible for playing a bell, drum, gong, and *Yo* (鐃), accompanied by figurines that indicate the 100-Marks time divisions, creating a dynamic visual timekeeping display. This study compares and analyzes the operation of the 4-Gods mechanism, the 12-Gods and 100-Marks timekeeping system, as well as the structural design and visual presentation of both water clocks. The findings confirm that while the *Heumgyeonggak-nu* inherited key technological elements from the *Deungnu*, it also incorporated significant innovations and advancements unique to the Joseon Dynasty.

14:40 [IV-2-2]

Expansion of Public Astronomy Education and Programs: The Need for a Sustainable and Open Platform

In-Ok Song

Korea Science Academy of KAIST

A diverse range of astronomy education and outreach programs is actively being conducted in our country. The efforts to promote astronomy among the public and within educational settings are already well established and it is already enough. However, most programs are conducted in a one-way format like top-down approach, which could be a limiting factor.
In particular, in teacher training programs, many participants express a desire for long-term engagement and network formation rather than a one-time educational experience. Beyond specialized information delivery, we propose a new type of program that encourages interaction and connectivity among participants. This program is designed around three core elements: sustainability, delocalization, and meaningful engagement. It aims to go beyond conventional education by fostering a platform where participants can actively contribute, collaborate, and enjoy a two-way learning experience.
Such an approach has already been validated through international programs. Initiatives like OAE-NAEC (Office of Astronomy for Education - National Astronomy Education Coordinator) and NASE (Network for Astronomy School Education) have demonstrated that participants are not merely recipients of education but active members in shaping networks and fostering continuous collaboration among educators. This presentation will introduce these cases and explore how similar concepts can be implemented within our astronomy education framework.
Finally, if our astronomy education and outreach programs follow a shared direction that the community agrees on, they can become a strong and lasting driving force for progress. However, this direction should not be forced but should develop naturally while respecting individual freedom. Just like the Drake Equation, where different factors come together to determine the final outcome, we need to find and combine the key elements that will shape the future of astronomy education. This presentation will explore the concept, direction, and possibilities of such an educational platform.

14:55 [IV-2-3]

The Evolution and Diversification of Angbuilgu in Joseon

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

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

In 1434, Jeong In-ji and Yi Sun-ji created an Angbu-ilgu by order of King Sejong in Joseon. King Sejong's Angbu-ilgu marked a significant advancement with its unique features: a rotating pinhole plate, celestial circumference degrees, 100 daily intervals, and animal god depictions representing the twelve double-hours. This innovative design, influenced by the Yuan Dynasty's Angyi, laid the foundation for subsequent developments. However, the Angbu-ilgu underwent substantial transformations in the late Joseon Dynasty. These later versions exhibited notable diversification, including smaller, portable designs crafted from ivory and jade, particularly under the Kang Geon family, and larger, stationary models made of brass, slate, and marble. This evolution reflected Joseon's new time system, technological advancements, and varying royal demands.

15:10 [IV-2-4]

Research Trends in Quantum Technology in Astronomy and the Space Industry: A Bibliometric Analysis Based on WoS and Scopus

Jiwon Park[1,2], Jungwon Lee[3], Yonggi Kim[1,2]

[1]*Astronomy and Astrophysics Dept. Chungbuk National University*
[2]*Chungbuk Pro Maker Center, Chungbuk National University*
[3]*Basic Science Research Institute, Chungbuk National University*

This study presents a bibliometric analysis of quantum technology—encompassing quantum computing, communication, sensing, and metrology—within astronomy and the space industry, drawing on journal publications indexed in Web of Science (WoS) and Scopus from 2000 to 2024. After a systematic screening and refinement process, we employed keyword co-occurrence, collaboration network analysis, topic modeling(STM), and time-slicing techniques using VOSviewer and CiteSpace.
The findings indicate a notable increase in quantum technology research in astronomical contexts since the late 2010s, focusing on space-based quantum communication (QKD), large-scale computational modeling of astrophysical phenomena, and precision measurements (e.g., gravitational wave detection and atomic clock development). Major contributing entities include the United States (NASA and prominent research universities), Europe (ESA, Max Planck Institute), and China (Chinese Academy of Sciences, Peking University). Since 2020, efforts related to satellite-based quantum communication and the application of quantum machine learning to large astronomical datasets have intensified.
These results underscore the expanding role of quantum technology in addressing the data-intensive and security-related demands of contemporary astronomy and space research. Future endeavors are encouraged to pursue in-orbit demonstrations, refine specialized quantum algorithms for extensive astronomical datasets, integrate quantum methods into precision measurement systems, and bolster international collaboration and standardization to fully realize the potential of these emerging technologies.

15:25 [IV-2-5]

The Program Operation and Status of the Sobaeksan Astronomical Observatory Education Hall

Jang-Ho Park, Youngsik Park, Hanbyeol Choi
Korea Astronomy and Space Science Institute

Sobaeksan Optical Astronomy Observatory (SOAO) operates various programs utilizing its education hall. It is divided into a research education program for the purpose of promoting the understanding of observational astronomy through astronomical observation research/training, and a public support program aimed at disseminating scientific culture to the public. We introduce details of the program(s) currently operating at SOAO education hall, and its status.

중회의실 6

IV-3 SS: 달 표면 과학 · 기술 임무 탑재체 I
Chair: 정민섭(천문연)

14:25 [IV-3-1]

Preliminary Concept Design of Lunar Surface Infrared Spectrometer (LSIS)

Chae Kyung Sim[1,2], Sung-Joon Park[1], Bongkon Moon[1,2], Dae-Hee Lee[1,2], Minsup Jeong[1], Young-Jun Choi[1], Dukhang Lee[1,2]

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

We propose the Lunar Surface Infrared Spectrometer (LSIS) as a candidate payload for a Korean lunar surface exploration mission in the early 2030s. LSIS is designed to conduct near-infrared spectroscopic observations of the lunar surface to investigate the distribution of water and/or hydroxyl, which are critical volatile species for understanding lunar hydration processes and validating theoretical models of lunar water dynamics, and supporting future in-situ resource utilization (ISRU), including human exploration and lunar base development. LSIS will operate in the 2–4 μm wavelength range distinguishing water ice from hydroxyl absorption features near 3 μm. LSIS can be mounted on a lunar lander or a mobile platform. This mission will contribute to international lunar exploration efforts and strengthen our position as a key partner in space research. Here, we present the science objectives of LSIS and current status of its concept design.

14:40 [IV-3-2]

System Design of Particle Detector and Neutron Spectrometer for Future Korean Lunar Exploration

Sunghwan Kim[1], Uk-Won Nam[2], Sukwon Youn[3], Sung-Joon Ye[3], Chae Kyung Sim[2]

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

Human exploration of the Moon is associated with substantial risks to astronauts and instruments due to space radiation. This includes chronic exposure to galactic cosmic rays and sporadic solar particle events on the Moon's surface. Additionally, the interaction of this radiation with the lunar soil results in neutral particles, such as neutrons and gamma radiation. In this study, we present the design of particle detectors capable of measuring solar activity on the lunar surface and the energy spectrum of charged particles in space, as well as neutron spectrometers that can detect the presence of water by measuring thermal and epithermal neutrons on the lunar surface. The particle detector is a Si-CsI scintillator-Si stacked structure that measures 1 to 100 MeV protons and heavy charged particles. The neutron spectrometer is designed to measure hydrogen concentration by separating thermal and epithermal neutrons using a CLYC scintillator. These scintillators also incorporate a function for analyzing the composition of the lunar crust through gamma-ray spectroscopy. Furthermore, considerations for lightweight design and low power consumption were considered to fit the lunar lander's mass and power budget requirements.

14:55 [IV-3-3]

Conceptual Design of Optical Camera System: Lunar Vision

Jeong-Yeol Han[1,2], Chae Kyung Sim[1,2], Minsup Jeong[1], Dukhaeung Lee[1,2], Hyoung Kwon Lee[3], Jaehyeon Kyeong[3], Jiwoo Lee[1,2], Seungkyun Ryu[4]

[1]*Korea Astronomy and Space Science Institute*
[2]*University of Science and Technology*
[3]*LeO SPACE Inc.*
[4]*IM Technology Inc.*

We present the conceptual design of the camera system for a Lunar Lander mission, Lunar Vision, to observe the landing site and its environment after landing and to image mineral abundances and composition. The camera system will observe lunar surface using polarimetric cameras to estimate the distribution of minerals such as FeO from the orbiter. We plan to obtain the detailed images using a rover after landing. This is expected to provide more sophisticated images than the orbiter data, ensuring the visual success of the lunar lander program.

15:10 [IV-3-4]

Introduction to a Lunar Volatile Extraction

Demonstrator for Future Korean Lunar Lander Exploration

Kyeong Ja Kim[1,2]

[1]*Space Resources Exploration and Utilization Center, Korea Institute of Geoscience and Mineral Resources*
[2]*Resources Engineering, University of Science and Technology*

A potential science payload to study the evolution of lunar volatiles from a candidate landing site has been studied in recent years. The proposed lunar payload is called the Lunar Volatile Extraction Demonstrator (LUVED). The LUVED consists of three modules such as sample collector, sample heater and gas analyser. These three modules are subdivided for main functions as each module. LUVED can be a powerful and important candidate instrument if future in-situ resource utilization is prioritised in conjunction with the identification and extraction of lunar resources to demonstrate the two mission objectives. At this stage, this type of instrument is considered to be a science and technology demonstrator that is well known from previous or prospecting missions on both Mars and the Moon. This talk will present a potential payload that can be considered for the Korean Lunar Exploration Lander to investigate both the identification of lunar surface volatiles and the separation of gases that are invaluable for future human activities on the Moon. An overview of the mission objectives for LUVED, including its current development, will be presented.

중회의실 7

Ⅳ-4 안보우주 Ⅳ: 임무중심 초소형위성시스템 연구 및 활용
Chair: 송영범(천문연)

14:25 [Ⅳ-4-1]
Lessons Learned from DoyoSat (SNIPE) Mission

Jaejin Lee[1], Jaeheung Park[1], Tae-Yong Yang[1], Jongdae Sohn[1], Hosub Song[1], Youngbum Song[1], Kihwan Keum[1], Hae-DongKim[2], Wonsub Choi[3], Dong-Hyun Cho[4], Min-Ki Kim[3], Jin-Hyung Kim[3], Jiseok Kim[3], Kiduck Kim[3], SeongMin Lim[5]

[1]*Korea Astronomy and Space ScienceInstitute*
[2]*Department of Mechanical and Aerospace Engineering, Gyeongsang National University*
[3]*Korea Aerospace Research Institute*
[4]*Department of Aerospace Engineering, Pusan National University*
[5]*Agency for Defense Development*

On May 25, 2023, four CubeSats named DoyoSat (Small scale magNetosperic and Ionosperic Plasma Experiment, SNIPE) were launched aboard the Nuri launch vehicle from the Naro Space Center in Goheung, Korea. DoyoSat marks Korea's first attempt at formation flying to investigate space weather [2]. Space weather, driven by solar activity, exhibits complex temporal and spatial variations that single-satellite observations struggle to distinguish. To overcome this problem, the DoyoSat mission employed formation flying operation with multiple satellites, adjusting inter-satellite distances and orbital configurations to obtain detailed space weather data. Of the four satellites launched, DoyoSat-3 failed to deploy from its dispenser, leaving only three satellites in orbit. DoyoSat-1 suffered a power system malfunction, rendering it inoperable, while DoyoSat-2 and DoyoSat-4 successfully conducted the mission. Nearly two years after launch, these two satellites remain in good condition, and are successfully maintaining stable inter-satellite distances. During two major space storms in 2023, they effectively executed observation tasks, yielding novel data on space weather dynamics. While DoyoSat spacecraft bus system consists of Electric Power Subsystem (EPS), Attitude Determination and Control Subsystem (ADCS), Communication Subsystems (COMS), Command and Data Handling Subsystem (CDHS), and Proportion Subsystem (PS), this presentation outlines key lessons learned from DoyoSat operations over the past two years.

14:40 [Ⅳ-4-2]
Space Korean Multi Telescope Network: Constellation of Small Space Telescopes for Time-Domain and Multi-Messenger Astronomy

Min-Su Shin, Yujin Yang, Jae-Woo Kim, Yunjong Kim, Sungho Lee, Young-Soo Jo, Chung-Uk Lee, Young-Min Kim, Hong Soo Park, Kyuseok Oh

Korea Astronomy and Space Science Institute

S-KMTNet (Space Korean Multi Telescope Network) is a space telescope constellation that is made of multiple small (< 100 kg) NUV-VIS-NIR telescopes operating in two different observation modes. The constellation of the telescopes aims to conduct rapid follow-up observations over NUV-to-NIR wavelengths responding to time-domain and multi-messenger astronomical events such as neutrino and gravitational wave transients. While waiting for the events, the constellation executes pre-scheduled observation to acquire deep images or time-series data. We present technical challenges and scientific instruments in this proposed concept.

14:55 [Ⅳ-4-3]
Agile Aerospace Approach to the Implementation of Nanosatellites Designed for Constellation Missions

Jun-Hyeon Kim[1], Myung-Kyu Lee[2], Seung-Jun Oh[2], Seul-Hyun Park[1]

[1]*Department of Mechanical Engineering, Chosun University*
[2]*Department of Mechanical Engineering, Graduate School of Chosun University*

In this presentation, we introduce an Agile approach to the implementation of nanosatellites designed for constellation missions utilizing Commercial Off-The-Shelf (COTS) components. Our approach emphasizes rapid development response, mass production, and reusability. By leveraging COTS components, we can streamline the production process, enabling the efficient and cost-effective manufacturing of large quantities of nanosatellites. This allows for reduced development time and cost while maintaining quality through fast feedback and continuous improvement. Additionally, by applying the Agile Stage-Gate methodology, we ensure adaptive responses and successful validation through iterative cycles of design, integration, and testing. This approach maximizes the efficiency of nanosatellite development and provides a flexible foundation to adapt to changes, making it ideal for large-scale constellation missions.

15:10 [IV-4-4]
Ionospheric Observation Results of SNIPE Spacecraft during Geomagnetic Storm on May 10-12, 2024

Hosub Song[1], Jaeheung Park[1,2], Jaejin Lee[1]

[1]*Korea Astronomy and Space Science Institute*
[2]*Department of Astronomy and Space Science, University of Science and Technology (UST)*

We analyzed electron density and temperature data from Langmuir probes aboard the Small Scale magNetospheric and Ionospheric Plasma Experiment (SNIPE) during a super geomagnetic storm in May 2024. SNIPE, consisting of four CubeSats launched on May 25, 2023, investigates microscale plasma structures in Earth's ionosphere and magnetosphere. Three CubeSats remain operational at altitudes of 500–550 km. Each carries instruments including Solid-State Telescopes, Magnetometers and Langmuir Probes. SNIPE observed for 60 hr storm-induced variations, notably the abnormal expansion of the Equatorial Ionization Anomaly and sub-auroral/auroral ionospheric changes. Ground-based GNSS and other satellites data comparisons support these findings.

15:25 [IV-4-5]
SNIPE and SNIPE-2

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

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

The Small scale magNetospheric and Ionospheric Plasma Experiment (SNIPE) mission consists of 3 CubeSats launched in May 2023 and have been in continuous operation for ~2 yr until now. The CubeSats successfully changed their orbit altitudes and fixed the relative drift of the ground tracks using onboard cold-gas thrusters. SNIPE also gathered space weather data, such as ionospheric plasma properties and high-energy electron flux coming from multiple directions, during the two superstorms in May 2024 and October 2024. Based on the lessons learned during the SNIPE operation, we propose to launch a follow-on mission, named SNIPE-2. In 2024, the Korea Astronomy and Space Science Institute (KASI) funded the pre-phase A study of SNIPE-2. The SNIPE-2 will be composed of six CubeSats with the full heritage of SNIPE but with improved science payloads, which can ensure seamless monitoring of Low-Earth-Orbit (LEO) space weather. Additionally, it will carry optical communication modules to implement inter-satellite communication and optimize downlink of science data toward ground stations. Finally, SNIPE-2 will spend the last part of its lifetime at a Very Low-Earth-Orbit (VLEO) below 350 km, where traditionally we do not have enough space weather data. This VLEO operation can further enhance the value of the collected SNIPE-2 data.

15:50~17:10 포스터 세션 집중 발표

대회의실 1

Invited Talk II

Chair: 이대희(전문연)

17:15 [IS-2]
The James Webb Space Telescope (JWST) Humankind's Greatest Space Science Facility

James W. Beletic, Ph.D.

Teledyne Digital Imaging

The James Webb Space Telescope (JWST) is NASA's flagship astronomy and astrophysics mission that was launched on December 25, 2021 and is operating in a halo orbit at Lagrange Point 2 (L2), 1.5 million km from Earth. With a 6.5-meter diameter primary mirror that is cooled to 50K and four infrared

instruments, JWST is investigating four major science areas:

- First light and reionization: JWST is a powerful time machine with infrared vision that is looking back 13.5 billion years to see the first stars and galaxies forming in the early Universe.
- Assembly of galaxies: JWST's unprecedented infrared sensitivity enables astronomers to compare the faintest, earliest galaxies to today's spiral and elliptical galaxies, helping us understand how galaxies assemble over billions of years.
- Birth of stars and protoplanetary systems: JWST can see into massive clouds of dust that are opaque to visible-light observatories (like Hubble), where stars and planetary systems are being born.
- Planets and origins of life: JWST is telling us more about the atmospheres of extrasolar planets, and perhaps will even find the building blocks of life elsewhere in the Universe. In addition to other planetary systems, JWST will also study objects within our own solar system.

This presentation starts with the scientific motivation of JWST and reviews the major technological innovations that were needed to build the observatory. The four JWST instruments are presented with the optical path of the NIRSpec animated. The infrared focal plane arrays (FPAs) are presented and performance of the FPAs and telescope optics are reviewed; telescope performance is exceeding specification in spite of micrometeoroid hits on the primary mirror. The process of image data collection and processing is demonstrated by the iconic "Cosmic Cliffs" image (shown below). The presentation concludes with scientific examples that demonstrate the breadth of JWST capability and glimpse of the science that will be performed over the next two decades.

4월 24일(목) 대회의실 1

V-1 태양 및 우주환경 Ⅳ

Chair: 정종일(천문연)

09:15 [V-1-1]

Validation of IGS GIM TEC over Oceanic Regions Using Jason Satellite Observations from 2002 to 2022

Woong Jeon[1,2], Woo Kyoung Lee[1,3], Yong-Jae Moon[2,4]

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

In this study, we validate the ground-based total electron content (TEC) over oceanic regions, derived from the International GNSS Service (IGS) Global Ionospheric Map (GIM), using Jason satellite observations from 2002 to 2022. While IGS TEC offers global coverage, its accuracy over oceanic regions may be limited due to the sparse distribution of ground-based observations. Previous literature indicates that the accuracy degrades depending on the distance from land or GNSS stations. Jason TEC, derived from altimetry observations, provides direct measurements of TEC over oceanic regions. By using the Jason TEC data, which has approximately 1-second time intervals, we investigate the dependence of IGS TEC performance on the distance from ground-based observation points. To achieve this, we create a dataset based on two criteria: the first is the distance from land, and the second is the distance from IGS stations used in GIM estimation. The results of the linear regression analysis in both cases show no significant differences between observations near and far from the ground-based observation points.

09:30 [V-1-2]

Assessment of Traveling Ionospheric Disturbance Generation by Solar Eclipses and Terminators

Hyosub Kil

Korea Astronomy & Space Science Institute

Solar terminators and eclipses are suspected sources of traveling ionospheric disturbances (TIDs). Atmospheric waves generated by pressure gradient forces during transitions between darkness and sunlight can give rise to TIDs. The coincident occurrence of ionospheric disturbances with terminators and eclipses, along with their propagation at the same speed, has been suggested as observational evidence of TIDs and their connection to these phenomena. We evaluate this hypothesis using total electron content (TEC) data over the United States from the ground-based Global Navigation Satellite System (GNSS). Detrended TEC data from the solar eclipses of August 2017 and April 2024 reveal two distinguishing features: (1) TEC depletions along the eclipse paths and (2) westward-moving TEC depletions along the sunrise terminator. These features can be interpreted as large-scale TIDs. However, rapid changes in ionospheric plasma density around sunrise and totality introduce substantial deviations between actual and detrended (filtered) TEC values. Since the characteristics of these deviations vary depending on the filtering methods used for detrending, the observed TEC perturbations—including large-scale TID-like features—around sunrise and eclipses may be false TID alarms. To further support the presence of false TID alarms around sunrise, we present electron density irregularity distributions derived from satellite data and GNSS TEC.

09:45 [V-1-3]

Mesospheric and Lower Thermospheric

Responses in the Antarctic Peninsula to the May 2024 Geomagnetic Storm

Byeong-Gwon Song[1], In-Sun Song[1], Geonhwa Jee[2], Jeong-Han Kim[2], Changsup Lee[2], Eunsol Kim[2], Young-Bae Ham[2]

[1]*Department of Atmospheric Sciences, Yonsei University*
[2]*Division of Ocean and Atmospheric Sciences, Korea Polar Research Institute*

The effects of geomagnetic storms on the ionosphere-thermosphere have been extensively investigated through both observational and numerical modeling studies. In contrast, storm-time responses in the mesosphere and lower thermosphere (MLT; z ~70–100 km) region have not been thoroughly examined due to the limited energy and momentum transfer into the MLT, as well as the sparse spatiotemporal coverage of MLT observations. The geomagnetic storm that occurred in May 2024, categorized as a G5-level (extreme) event, is characterized by a significant decrease in the Dst index to below −400 nT and a rapid increase in the Ap30 index during its main phase (between 17UT on 10 May and 02UT on 11 May). In this study, we investigate the variability in the MLT wind during the May 2024 super storm using meteor radar observations at King Sejong Station (62.22°S, 58.78°W) on the Antarctic Peninsula. To enhance the accuracy of horizontal wind estimations derived from observed radial velocities, a Gaussian-weighting technique was applied, which accounts for the spatiotemporal distribution of individual meteor echoes within each time-height bin. During the storm's recovery phase, enhancements of westward winds and equatorward winds are observed. To assess the variability of atmospheric tidal components during the storm, a wavelet analysis is performed. Both zonal and meridional winds exhibit prominent semidiurnal (12-hr) tidal signals near z = 94 km throughout the event, while quarterdiurnal (6-hr) tidal components are significantly amplified during the recovery phase. To explore the cause of the amplification of 6-hr periodicity in the MLT winds, two possible mechanisms will be discussed: (i) downward propagation of 6-hr periodic signals associated with Joule heating from the thermosphere, and (ii) in-situ generation of the 6-hr tides via nonlinear wave-wave interactions.

10:00 [V-1-4]

A Study of Midnight Polar Summer Mesosphere in Association with Geomagnetic Disturbance Observed by PANSY Radar, Antarctica

Young-Sook Lee[1], Geonhwa Jee[2], Yongha Kim[1], Young-Sil Kwak[3]

[1]*Chugnam National University*
[2]*Korea Polar Research Institute*
[3]*Korea Astronomy and Space Scice Institute*

The upper mesosphere and lower thermosphere at high latitudes are studied according to local geomagnetic activity with the PANSY incoherent scatter radar in Syowa, Antarctica, which is located in the auroral zone. The PANSY radar can provide unprecedented, continuous measurements of echo power and the radial velocity at 70–100 km since October, 2015.
The occurrence rate of the polar mesosphere summer echo (PMSE) at 80–90 km at Syowa station peaks with 87% at both 00 hr and 13 hr in magnetic local time in January 2016.
The midnight peak can be significant in that substorm may play an important role in generating PMSE. During substorms energetic electron precipitation may penetrate into the deep atmosphere. The characteristics of echo power and radial velocity are observed in terms of different levels of geomagnetic activities from pre- to post-midnight sectors in the summer.
We show a preliminary result and discuss any possible relations of the occurrence of scattered strong echo and their dynamics to local geomagnetic disturbances in the upper mesosphere in the near-midnight sector.

10:15 [V-1-5]

Impacts of Orographic Secondary Gravity Waves in the Upper Mesosphere of Whole Atmosphere Models

In-Sun Song

Department of Atmospheric Sciences, Yonsei University

In whole atmosphere models, parameterized gravity-wave (GW) processes are believed to be responsible for excessive westward vertical shear and large warming near winter polar mesopause. Observations and high-resolution modeling results suggest that those biases may be addressed by secondary GW processes. A simple parameterization of the effects of secondary GWs induced by orographic primary gravity waves is presented for use in low-resolution, high-top models. Sources for secondary GWs are specified using two symmetric intrinsic phase speeds in the direction of momentum forcing due to primary mountain waves. Primary (both orographic and nonorographic) GW forcing terms are assumed to vanish upward gradually from the middle mesosphere through dissipation and dispersion that is implemented introducing vertically decreasing intermittency factor for primary GWs. Momentum and thermal forcing due to parameterized primary and secondary GWs are computed using columnar Lindzen-type method. This parameterization is implemented in an in-house high-top mechanistic model and NCAR Whole Atmosphere Community Climate Model (WACCM). Comparison with climatology indicates that both secondary GW forcing and reduced primary GW forcing are important in the simulation of the observed structure of zonal-mean wind and temperature near the winter mesopause region.
This research was supported by the KASI under R&D programs (2025-1-850-02) and G-LAMP and NRF grant (RS-2024-00442483).

중회의실 5

V-2 SS: L4 우주관측소 I

Chair: 문용재(경희대)

09:15 [V-2-1]

Open New Horizon with the Korea-Led L4 Mission: 2025 April Progress Report

K. S. Cho, KASI L4 Feasibility Study Team

Korea Astronomy and Space Science Institute

The Sun-Earth Lagrange point L4 is considered as one of the unique places where the solar activity and heliospheric environment can be observed in a continuous and comprehensive manner. The L4 mission affords a clear and wide-angle view of the Sun-Earth line for the study of the Sun-Earth and Sun-Moon connections from he perspective of remote-sensing observations. *In-situ* measurements of the solar radiation, solar wind, and heliospheric magnetic field are critical components necessary for monitoring and forecasting the radiation environment as it relates to the issue of safe human exploration of the Moon and Mars. A dust detector on the ram side of the spacecraft allows for an unprecedented detection of local dust and its interactions with the heliosphere. The purpose of the present paper is to emphasize the importance of L4 observations as well as to outline a strategy for the planned L4 mission with remote and in-situ payloads onboard a Korean spacecraft. It is expected that the Korean L4 mission can significantly contribute to improving the space weather forecasting capability by enhancing the understanding of heliosphere through comprehensive and coordinated observations of the heliosphere at multi-points with other existing or planned L1 and L5 missions. In this talk, I will report current progress of the L4 feasibility study.

09:30 [V-2-2]

Methodology of System Design and Sizing for L4 Spacecraft

Jong-Jin Jang

Korea Aerospace Industries, Ltd. (KAI)

There are two main considerations in designing a spacecraft for the L4 mission. First, it must meet the requirements for the route to the L4 point, and second, it must observe the sun at the L4 point and simultaneously transmit the observed data to the ground station.

To this end, we must consider the constraints for sizing (SWaP) in spacecraft design. The most important factor is the amount of thrust (delta V) the spacecraft must provide, which was derived through our contracted tasks. The second is the functional and performance requirements of the spacecraft to match the payload mission characteristics. Additionally, we must consider the data transmission system to send collected data to the ground station. The third factor is the environmental conditions encountered during the route to and operation at the L4 point. This paper discusses the design of the spacecraft considering these factors and proposes an efficient design approach. Specifically, it details the design methodology for determining the sizing (SWaP) of the spacecraft's main and subcomponents based on each design element.

09:45 [V-2-3]

Optimization of Chemical-Based Insertion Trajectory to Inclined Orbit around Sun-Earth L4

Gunhee Yi[1], Jinsung Lee[2], Jong-Jin Jang[3], Jaemyung Ahn[1]

[1]*Korea Advanced Institute of Science and Technology*
[2]*Satellite Technology Research Center, KAIST*
[3]*Korea Aerospace Industries, Ltd.*

Amidst the rise of public attention on Korea-led space observation mission based on Sun-Earth L4, we developed a chemical-propulsion-based orbit-phasing trajectory, that inserts the spacecraft into an inclined heliocentric orbit around L4. It involves two chemical burns, by which the spacecraft enters and exits a transfer orbit with a smaller semi-major axis than that of the Earth. Different combinations of orbital parameters of initial orbit around the Earth form a multidimensional search space to minimize delta-v. General Mission Analysis Tool (GMAT), developed by NASA, is batch executed as a numerical propagator to solve the required delta-v for each combination and produce an optimal solution.

10:00 [V-2-4]

Low-Thrust Multiple Earth Resonant Gravity Assist to 14.5° Sun-Earth L4 Point

Jinsung Lee

Satellite Technology Research Center

We present a low-thrust, multiple Earth–resonance gravity-assist trajectory for insertion into an inclined Sun–Earth L4 periodic orbit, achieving substantial savings in launch energy compared to conventional approaches. The earlier mission concept employed the launch vehicle's main booster and upper stage to place the spacecraft on a 14.5° phasing trajectory around the Sun. In our proposed design, the spacecraft enters a resonant orbit with the Sun–Earth system and performs multiple Earth flybys, using low-thrust propulsion to steadily increase both its inbound and outbound hyperbolic velocities. By this method, we have identified a viable solution with a C_3 of approximately 22 km^2/s^2—about

30 km²/s² lower than the original trajectory—over a seven-year transfer duration, relying exclusively on low-thrust propulsion.

10:15 [V-2-5]

Remote Sensing Observations for Studying Heliospheric Physics and Space Weather in the L4 Mission

Roksoon Kim, L4 Team in KASI

Korea Astronomy and Space Science Institute

Lagrange Point 4 (L4) provides a distinct vantage point for directly observing solar activity, including flares, coronal mass ejections (CMEs), and solar energetic particles (SEPs) that travel toward Earth and beyond, influencing space exploration and technological systems. Additionally, measurements from L4 enhance the three-dimensional characterization of solar and heliospheric phenomena by complementing observations from Earth, L1, and L5. This presentation outlines the development of remote sensing instruments at L4, including a photospheric vector magnetograph, a chromospheric imaging spectrograph, an EUV imager, a white-light coronagraph, a heliospheric imager, and an X-ray spectrometer. By continuously tracking solar activity from the photosphere through the corona and into the heliosphere, the L4 mission will enhance our understanding of heliospheric physics and contribute to more accurate space weather predictions.

중회의실 6

V-3 SS: 달 표면 과학 · 기술 임무 탑재체 II

Chair: 박현후(경희대)

09:15 [V-3-1]

Conceptual Design Study of Comprehensive Lunar Space Environment Sensors (CLUSER)

Seul-Min Baek[1], Jaeheung Park[1], Woohyeong Seol[1], Junhyun Lee[1], Jungjoon Seough[1], Tae-Yong Yang[1], Jongdae Sohn[1], Jehyuck Shin[1], Ho Jin[2], Jongho Seon[2], Khan-Hyuk Kim[2]

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

Currently, we are in conceptual design phase of the CLUSER (Comprehensive Lunar Space Environment seonsoRs). This conceptual design study aims to achieve high-precision measurements of the lunar space environment by optimizing instrument performance and developing essential technologies for space environment observations. The CLUSER is designed to measure the in situ plasma and magnetic fields on the lunar surface. It includes fluxgate and search-coil magnetometers to measure temporal and spatial magentic field variations on the lunar surface, as well as low-energy particle detector (ranging from a few eV to tens of keV) and a high-energy particle detector (ranging from tens of keV to tens of MeV) to observe electrons and ions around the Moon. For a more comprehensive understanding of the lunar space environment, we propose operating all these instruments simultaneously. The key science objective of CLUSER is to understand the interaction between charged particles and the magnetic field on the Moon. Furthermore, these comprehensive observations of the lunar space environment are expected to contribute to fundamental scientific knowledge, particularly in the context of the Moon-to-Mars initiative.

09:30 [V-3-2]

Conceptional Design of a Radioisotope Thermoelectric Generator for a Warm Electronics Box in Korean Lunar Exploration

Sunjin Kim[1], Hui-Kyung Kim[2], Jong-Bum Kim[1], Kwang-Jae Son[1], Jin-Joo Kim[1], Jin Kim[1], Kilyoung Ko[1], Dong Young Rew[3], Jintae Hong[1]

[1]*Korea Atomic Energy Research Institute (KAERI)*
[2]*Korea Aerospace Research Insttitue (KARI)*
[3]*Korea Aerospace Administration (KASA)*

The Korean government recently announced that the Korean lunar lander is scheduled for launch in 2032 and will begin its lunar exploration mission that same year. Given the extremely harsh conditions of the lunar night, the lander must incorporate either radioisotope thermoelectric generators (RTGs) or radioisotope heater units (RHUs) to ensure survival and enable long-duration space missions.

In this conference, we will present the conceptual design of RTGs and RHUs for future lunar exploration, considering different radioisotopes (Pu-238 and Am-241) and various thermal power levels. Additionally, we will share simulation results for the WEB system, demonstrating specific technical solutions for ensuring survival on the lunar surface.

09:45 [V-3-3]

Concept of Electron gun Experiment PackaGe (E2G)

Minsup Jeong[1], Bongkon Moon[1,2], Dae-Hee Lee[1,2], Sung-Joon Park[1], Chae Kyung Sim[1,2], Dukhang Lee[1,2], Jehyuck Shin[1], Mingyeong Lee[1], Woojin Kim[1], Eunjin Cho[1], Serin Kim[1], Young-Jun Choi[1,2]

[1]*Korea Astronomy and Space Science Institute*

[2]*University of Science and Technology*

The Electron gun Experiment packaGe (E2G) is a scientific payload designed to study the properties of lunar regolith and levitated dust using an electron gun and UV light source. The primary objective of this mission is to capture high-resolution 3D microstructural images of the lunar surface and to actively generate and analyze levitated dust particles to better understand their formation mechanisms.
Lunar dust is a critical challenge in space exploration and has been identified as the top priority knowledge gap in lunar environmental studies in NASA's Moon to Mars Architecture. The levitation of fine lunar dust can pose serious hazards to astronauts, landers, and surface operations, yet its physical characteristics and formation mechanisms remain largely unknown. E2G aims to address this fundamental issue by experimentally inducing dust lofting and observing its behavior directly on the lunar surface.
Using light field camera technology, E2G will generate high-resolution 3D images of lunar regolith, while an electron gun will be employed to charge surface particles and trigger dust lofting. This will allow for the investigation of dust particle sizes, charging effects, and movement dynamics, providing essential data for future dust mitigation and control strategies in lunar and Martian missions.
This mission is proposed as a candidate payload for South Korea's Lunar Lander Program, marking a significant step in Korea's independent lunar exploration initiatives.
In this presentation, we will introduce the E2G payload, its scientific objectives, engineering design, and future applications for planetary exploration.

10:00 [V-3-4]

The Operation Concept of a Dual Aperture Lunar Cave Multiband Camera (DALAE)

Minsup Jeong[1], Bongkon Moon[1,2], Dae-Hee Lee[1,2], Jeong-Yeol Han[1,2], Chae Kyung Sim[1,2], Dukhang Lee[1,2], Jaehyuk Shin[1], Eunjin Cho[1], Serin Kim[1], Young-Jun Choi[1,2]

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

This study introduces the development of DALAE (Dual Aperture Lunar cAve multiband camEra), a pioneering compact multiband stereo camera designed for the world's first lunar cave exploration. DALAE is proposed as a scientific payload for Korea's future lunar lander, aiming to investigate the three-dimensional structure and geological characteristics of pit craters and lava tubes on the Moon.
Equipped with a four-channel multiband sensor, DALAE captures high-resolution images at 320 nm, 430 nm, 750 nm, and 950 nm wavelengths. By utilizing stereo imaging, the system will generate 3D terrain models of pit crater walls and lava tube interiors. This data will provide critical insights into the depth-dependent composition of lunar regolith, the gardening process of lunar soil, and the formation mechanisms of lunar lava tubes, which may serve as potential habitats for future human missions.
The payload will be deployed using a tethered micro-rover, allowing it to descend into pit craters and collect data beyond the reach of conventional orbiter observations. The technologies developed for DALAE are expected to be applicable not only to lunar exploration but also to future Martian cave exploration missions.
This presentation will detail the scientific objectives, design concepts, exploration strategies, and anticipated scientific contributions of DALAE, along with its development roadmap and ground validation plans.

중회의실 7

V-4 SS: AI로 우주를 분석하다. 우주 데이터와 머신러닝
Chair: 최성환(천문연)

09:15 [V-4-1]

Korean Data Center for SDO: Present and Future

Ji-Hye Baek[1], Sujin Kim[1], Seonghwan Choi[1], Jongyeob Park[1], Dongil Kim[2]

[1]*Korea Astronomy and Space Science Institute*
[2]*Ewha Womans University*

Korean Data Center for Solar Dynamics Observatory (KDC for SDO) was began with Letter of Agreement to collaborate on Heliophsics and Space Weather between Korea Astrnomy and Space Science Institute (KASI) and National aeronautics and Space Administration (NASA) in 2010. The main purpose of KDC for SDO is to archive AIA and HMI level-1 fully and to cover the East Asia for data service as Resident Archive. We have cooperated with Joint Science Operations Center (JSOC) in Stanford University to operate KDC and Korea Institute of Science and Technology Information (KISTI) to transfer very big size data (1.5 TB per day). We have a plan to support data handling Application Programming Interfaces (APIs) for data users and suggest to extend Heliophysics Science Data Network with integrating computer network, computing cluster, storage, and software.

09:30 [V-4-2]

Optimizing Deep Learning Models for Ionospheric TEC Prediction: Insights from Storm-to-Quiet Day Ratios

Se-Heon Jeong[1], Woo Kyoung Lee[1,2], Hyosub Kil[3], Jeong-Heon Kim[1], Young-Sil Kwak[1,2]

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

The ionospheric Total Electron Content (TEC) is a critical parameter for the accuracy of satellite communication and navigation systems. Geomagnetic storms, primarily driven by solar activities, introduce significant variability in the ionosphere, posing substantial challenges to TEC prediction. Conventional models often fail to capture the complex dynamics introduced by these irregular events, leading to inaccuracies in TEC forecasting. In this study, we are conducting experiments to explore how the deep learning model's predictive accuracy is influenced by variations in the ratio of storm to quiet days within our training dataset. This experiment enables us to evaluate the model's performance across diverse ionospheric conditions. Our deep learning approach employs the Convolutional Long Short-Term Memory (ConvLSTM) network, an innovative framework designed to capture spatial-temporal relationship for TEC map prediction (Jeong et al. 2024). As part of our dataset, we utilize TEC maps reconstructed from the Deep Convolutional Generative Adversarial Network – Poisson Blending (DCGAN-PB) model (Jeong et al. 2022). This model effectively preserves small-scale ionospheric structures observed in TEC data.

09:45 [V-4-3]
Forecasts of 3-Day Solar Wind Speed and 6-Hour IMF Bz Using Deep Learning Models

Jihyeon Son[1], Yong-Jae Moon[1,2], Harim Lee[1], Kyung Sun Park[3], Young-Sil Kwak[4], Hyun-Jin Jeong[2,5]

[1]*Department of Astronomy and Space Science, Kyung Hee University*
[2]*School of Space Research, Kyung Hee University*
[3]*Department of Astronomy and Space Science/Basic Science Research Institute, Chungbuk National University*
[4]*Space Science Division, Korea Astronomy and Space Science Institute*
[5]*Centre for mathematical Plasma Astrophysics, Department of Mathematics, KU Leuven, Leuven, Belgium*

We have developed two deep learning models to forecast two space weather components: 3-day solar wind speeds and 6-hour interplanetary magnetic field (IMF) Bz components. Firstly, the solar wind speed prediction model uses the last five days of SDO/AIA 19.3 and 21.1 nm images, along with solar wind speeds as input data. It consists of two networks: a convolutional layer-based network for images and a dense layer-based network for solar wind speeds. Our model successfully predicts solar wind speeds for the next 3 days, with a root mean square error (RMSE) ranging from 37.4 km/s (6-hr prediction) to 68.2 km/s (72-hr prediction). These results are much better than those of previous studies. The model can accurately predict sudden increases in solar wind speeds caused by equatorial coronal holes. Secondly, the Bz prediction model is a bidirectional long short-term memory (BiLSTM) based model using solar wind data (V, N, T) and IMF (Bt, Bx, By, Bz) in OMNI from 2000 to 2022 as input data. We use the preceding 12 hr of data as input and the next 6 hr of data as target data. We consider Bz values below the negative standard deviation (about −3 nT) for at least 6 hr. We apply 12-fold cross-validation to our model, using 8 months for training sets and 4 months for test sets. Consequently, a total of 12 models are trained, and they show an averaged RMSE ranging from 1.75 nT (30-minute prediction) to 2.55 nT (6-hr prediction). Our model can capture both declining and increasing phases of Bz. Although this study presents preliminary results in Bz prediction, we find a sufficient possibility for predicting Bz under specific conditions. We plan to develop deep learning models for other space weather components, such as solar wind density or geomagnetic indices.

10:00 [V-4-4]
AI-Based Wavefront Sensing for Adaptive Optics

Kyohoon Ahn[1,2], Yeo Been[1,3], Ji-Hye Baek[1], Seonghwan Choi[1]

[1]*Korea Astronomy and Space Science Institute*
[2]*Subaru Telescope, National Astronomical Observatory of Japan*
[3]*University of Science and Technology*

Wavefront sensing plays a crucial role in various imaging applications, such as adaptive optics (AO), space and astronomical observations, and biomedical imaging. Traditional wavefront sensing methods often suffer from limitations in linearity, accuracy, computational efficiency, and robustness under noisy conditions. Recent advancements in artificial intelligence (AI) have opened new possibilities for enhancing wavefront sensing capabilities.

We present the integration of AI in wavefront sensing to overcome the limitations of the traditional wavefront sensing methods. We also show the laboratory demonstration of the AI-based wavefront sensing using the non-linear curvature wavefront sensor for the Subaru Telescope's new AO system.

10:15 [V-4-5]
Can We Properly Determine Differential Emission Measures from Solar Orbiter/EUI/FSI by Deep Learning?

Junmu Youn[1], HarimLee[1], Hyun-Jin Jeong[1,2], Jin-Yi Lee[1], Eunsu Park[3], Yong-Jae Moon[1]

[1]*Kyung Hee University*
[2]*KU Leuven, Belgium*
[3]*Korea Astronomy and Space Science Institute*

In this study, we address the question of whether we can properly determine differential emission measures (DEMs) using Solar Orbiter/Extreme Ultraviolet Imager (EUI)/Full Sun Imager (FSI) and AI-generated extreme UV (EUV) data. The FSI observes only two full-disk EUV channels (174 and 304 Å), which is insufficient for accurately determining DEMs and can lead to significant uncertainties. To solve this problem, we trained and tested deep learning models based on Pix2PixCC using the Solar Dynamics Observatory (SDO)/Atmospheric Imaging Assembly (AIA) dataset. The models successfully generated five-channel (94, 131, 193, 211, and 335 Å) EUV data from 171 and 304 Å EUV observations with high correlation coefficients. Then we applied the trained models to the Solar Orbiter/EUI/FSI dataset and generated the five-channel data that the FSI cannot observe. We used the regularized inversion method to compare the DEMs from the SDO/AIA dataset with those from the Solar Orbiter/EUI/FSI dataset, which includes 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 consistent with each other at the same coronal structures. Our study suggests that deep learning can make it possible to properly determine DEMs using Solar Orbiter/EUI/FSI and AI-generated EUV data. As an extension, we determine the DEMs when the two instruments are at various angular separations, such as 60 degrees (L4 and L5) and 180 degrees apart. This suggests the possibility of applying our approach to an L4 mission.

대회의실 1

VI-1 우주감시

Chair: 김명진(천문연)

10:40 [VI-1-1]

Progress of Space Debris Environment and Risk Analysis Framework Development

Jaewoo Kim[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*

The Korea Advanced Institute of Science and Technology (KAIST) and the Korea Astronomy and Space Science Institute (KASI) have collaborated on developing space debris models intended for a risk assessment framework. At present, we are developing a three-dimensional cell model to estimate the density of space objects and assess collision risks for selected targets. This work provides a summary of the project's current progress and presents analysis results of example scenarios.

10:55 [VI-1-2]

Development of Korean Enhanced Platform (KEPLER) and Database (SpaceBook) for Space Risk Response

Hosik Kam[1], Eun-Jung Choi[1,2], Jung Hyun Jo[1], Ki Pyoung Sung[1], Jin Choi[1]

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

With the increasing risks from space, such as Earth reentry and on-orbit collisions of space objects, a comprehensive space situational awareness (SSA) system is essential. To address this, the Korea Astronomy and Space Science Institute (KASI) is developing KEPLER (Korea Enhanced Platform for Lowering Space Risk), an integrated data platform designed to support various user types, scheduled for completion by 2027. KEPLER continuously monitors both natural and artificial space objects to assess risks and protecting assets safety. KEPLER integrates observation and analysis data from both Korean and international sources. Moreover, it utilizes KASI's monitoring infrastructures enables users to plan and request observation missions flexibly, and incorporates international datasets for enhanced analysis. Additionally, KEPLER includes a space risk warning and alert system, providing analyzed data and information to the public, relevant institutions, and government agencies.
A key subsystem in KEPLER, SpaceBook, serves as an integrated database for space risk monitoring, systematically storing, analyzing, and distributing data on space objects, orbital dynamics, reentries, collisions, and observation missions. By utilizing these system, KEPLER aims to improve Korean capacity for SSA. This presentation will outline KEPLER's development, system architecture, data flow, and SpaceBook.

11:10 [VI-1-3]

42 Talks: Vitual Meeting Platform for Space Traffic Management

Seunghwan Choi[1,2], Dong In Kang[1], Seonggoo Lee[1], Su Hyeok Roh[1], Ji Hyup Byun[1], Joonghyun Ryu[1,2], Deok-Soo Kim[1,2,3]

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

Geospace is becoming increasingly crowded, significantly raising

the risk of collisions among satellites and space debris. With projections indicating that the space catalogue will soon expand to include O (10^6) resident space objects (RSOs)—a two-orders-of-magnitude increase from the current O (10^4)—the accurate and swift performance of conjunction assessments (CA) becomes essential. Given the rising frequency of human-rated missions, timely and precise collision-avoidance (COLA) maneuver trajectories, ideally optimized, must be rapidly generated for conjunctions exhibiting a high probability of collision. However, achieving accurate CA and near real-time COLA with the anticipated catalogue scale presents substantial challenges.
To address these complexities, we introduce SpaceMap's "42 Talks," a virtual negotiation platform enabling concurrent avoidance negotiation (CAN) among involved parties in near real-time. Powered by SpaceMap's advanced algorithms, "42 Talks" efficiently facilitates real-time CA and near real-time COLA, incorporating tertiary conjunction considerations, and significantly enhances collaborative decision-making in space traffic management.

11:25 [VI-1-4]

Tracking and Impact Risk Assessment of Near-Earth Asteroids

Hee-Jae Lee[1], Myung-Jin Kim[1], Dong-Goo Roh[1], Jin Choi[1], Eun-Jung Choi[1,2], Sungki Cho[1], Jung Hyun Jo[1], Hong-Suh Yim[1], Jaemann Kyeong[1], Jiwoong Yu[1], Jeong Yoo Hong[1], Yun Hak Kim[1], HoSik Kam[1]

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

Recent advancements in observational technology and large-scale survey programs have significantly increased the number of discovered asteroids. Consequently, impact risk assessment and mitigation efforts for near-Earth asteroids (NEAs) have become increasingly critical areas of research. Notably, while only seven asteroids had been detected before impacting Earth up until 2023, an additional four were reported in 2024 alone. Moreover, the near-Earth asteroid 2024 YR4, discovered in December 2024, gained significant attention due to its predicted impact probability reaching 3.1%.
In this presentation, we will discuss the process of tracking and observing NEAs and simulating their orbits to estimate impact probabilities and predict potential impact locations. Our approach assumes the use of both existing observational facilities operated by the Korea Astronomy and Space Science Institute (KASI) such as the Optical Wide-field patroL Network (OWL-Net), and newly developed systems: the Save Earth Joint Observations for the Next Generation (SEJONG) telescope and the Beyond Surveillance for Space Risk of the Korean High Earth Orbit Region (BRAHE) telescope system. The orbital simulations, used to calculate impact probabilities, were conducted using NEOPROP2, an enhanced orbit propagator developed by Astos Solutions for the European Space Agency (ESA). We will present preliminary results from this study and discuss future research directions and further analyses.

중회의실 5

VI-2 SS: L4 우주관측소 II

Chair: 선종호(경희대)

10:40 [VI-2-1]

Deep Space Optical Communications Plan for Korean-Led L4 Mission

Seonghwan Choi[1], Kyohoon Ahn[1], Hojin Lee[1], Chang-Hee Kim[1], Jongyeob Park[1], Ji-Hye Baek[1], Sungwon Park[2], Kyung-Suk Cho[1]

[1]*Korea Astronomy and Space Science Institute*
[2]*Korea AeroSpace Administration*

We have been studying deep space optical communications to support the Korean-led L4 Mission. This mission aims to enable remote sensing of the Sun and interplanetary space, as well as in-situ measurements of solar wind plasma and high-energy solar particle events at the Sun-Earth L4 point. The Heliophysics Exploration mission carries remote-sensing instruments, including a vector magnetograph and a spectrograph, which generate vast amounts of data, exceeding the capacity of RF communications for efficient transmission to the ground. To address this challenge, space optical communications—offering data rates tens to hundreds of times higher than RF systems—are essential for the mission. In this talk, we provide an overview of the optical communications plan and discuss ongoing technological developments, including Pointing, Acquisition, and Tracking (PAT), high-sensitivity photon detectors, high-photon-efficiency modems, and CCSDS communication protocols and standardization.

10:55 [VI-2-2]

Scientific Objectives of the L4 Mission within the Context of *In Situ* Measurements

Jungjoon Seough[1], Kyung-Suk Cho[1,2], Roksoon Kim[1], Yukinaga Miyashita[1,2], Jong-Dae Sohn[1,2], Jaeheung Park[1,2], Chanhaeng Lee[1], Seunguk Lee[3], Kwangsun Ryu[3], Yunho Jang[4], Ho Jin[4], Jongho Seon[4], Dae-young Lee[5]

[1]*Korea Astronomy and Space Science Institute*
[2]*University of Science and Technology*
[3]*Satellite Technology Research Center, KAIST*
[4]*Kyung Hee University*
[5]*Chungbuk National University*

A number of members in the heliospheric community of Korea along with the possible partners abroad have conducted a conceptual study on establishing the world's first heliospheric space observatory at Lagrangian point L4, one of the Sun-Earth gravitational equilibrium points. The L4 mission, along with space observatories at L1 and L5 (Vigil-L5), is expected to play a crucial role in establishing a heliospheric space environment monitoring system. We plan to equip the L4 mission with six in situ instruments, organized into two instrument suites: FIELD and PARTICLE. The FIELD suite includes a fluxgate magnetometer, a search coil magnetometer, and a radio and plasma wave detector, which measure the DC magnetic field as well as electromagnetic field fluctuations. The PARTICLE suite consists of a solar wind plasma analyzer, a high energy particle detector, and a radiation monitor, all of which measure particle fluxes, at different energy levels. In this talk, we will discuss various plasma phenomena observed in the interplanetary space, where the L4 mission will be positioned, and also outline the scientific objectives of the L4 mission within the context of *in situ* measurements.

11:10 [VI-2-3]

Conceptual Study of a High-Energy Particle Detector in the Heliosphere Assuming an L4 Mission

Chanhaeng Lee[1], Woo-Hyeong Seol[1], Jungjoon Seough[1], Jongdae Sohn[1], Seonghwan Choi[1], Kyung-Suk Cho[1], Jongho Seon[2], Khan-Hyuk Kim[2], Kwangsun Ryu[3], Dae-young Lee[4]

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

Observations at the Sun-Earth Lagrange Points are expected to become crucial satellite missions, ultimately enhancing the understanding of the solar environment by significantly expanding observations from a spatial perspective. Among these missions, observations from the L4 position, which leads Earth in its orbit around the Sun, are anticipated to offer complementary data to missions such as the United States SwFO mission planned for launch in late 2025 for the L1 point, and the European VIGIL mission for the L5 point, thereby making the scientific significance highly diverse and profound. In this paper, we aim to conduct a conceptual study of a high-energy particle detectors capable of measuring solar energetic particles in the energy range of approximately 30 keV to 100 MeV, which can be operated from the L4 position. We have analyzed the specifications and scientific objectives of high-energy particle detector payloads planned for missions such as L1 and L5, as well as those previously operated in solar environment missions. Additionally, we plan to deliberate on the types and ranges of observational physical quantities that need to be selected to maximize scientific outcomes when operating similar payloads for future L4 missions.

11:25 [VI-2-4]

Radiation Monitor for the Space Radiation Environment at the Lagrangian Point L4

Jongdae Sohn, Ukwon Nam, Jungjoon Seough, Kyung-Suk Cho, L4 Team

Korea Astronomy and Space Science Institute

This study focuses on the conceptual design of a radiation monitor aimed at investigating the space radiation environment and its biological effects at the L4 Lagrange point. L4 is one of the five Sun-Earth Lagrange points, located 60 degrees ahead and behind Earth's orbit, forming an equilateral triangle with the Earth and the Sun. Although L4 is relatively distant from Earth, it offers a stable vantage point with high strategic value, providing continuous observation of the entire cislunar space. In particular, L4 is regarded as the optimal location for long-term monitoring of solar activity, solar wind, and space radiation, as well as for assessing their impact on biological systems and spacecraft electronics. A radiation observation mission at L4 is expected to offer significant scientific value, contributing to space weather prediction, radiation risk assessment, and deep space exploration safety. In this paper, we present the scientific objectives and key payload specifications of the proposed radiation monitor, designed to characterize the radiation environment and biological effects at L4. The findings are anticipated to support the development of space radiation forecasting systems and enhance mission safety for future deep space missions.

중회의실 6

VI-3 SS: 달 표면 과학 · 기술 임무 탑재체 III

Chair: 백슬민(천문연)

10:40 [VI-3-1]

Concept Design of Mobility Technology for Lunar Surface Exploration

Namsuk Cho[1], Jaeho Lee[1], Dae-Young Lee[2], Dongseok Ryu[3], Chae Kyung Sim[4]

[1]*Unmanned Exploration Laboratory*
[2]*Korea Advanced Institute of Science and Technology*
[3]*Korea Atomic Energy Research Institute*
[4]*Korea Astronomy and Space Science Institute*

Mobility technology is crucial for the success and scalability of scientific exploration on the lunar surface. To ensure the stable and efficient traversal of a rover across the Moon's extreme terrain—characterized by rough and uneven terrain, low-density regolith, which is susceptible to slippage and sinkage, and craters—an optimized mobility solution is essential. This research focuses on the concept design of an advanced mobility solution for a lunar exploration rover and defines the core principles for a reliable and efficient locomotion mechanism in extreme environments. This research reviews various rover configurations, including those integrating scientific payloads, and proposes the technical specifications of the rover.

10:55 [VI-3-2]

Pit Crater as a Potential Landing Site for Future Lunar Missions

Eunji Yi[1,2], Chae Kyung Sim[1,2], Minsup Jeong[1]

[1]*Korea Astronomy and Space Science Institute (KASI)*
[2]*University of Science and Technology (UST)*

Korea's first indigenous lunar lander is scheduled for launch in 2032. A study on lunar surface science exploration payload/ mobility technology planning was conducted in 2024 to surveyed domestic researchers on their interest in developing payloads and rovers. According to the study, most researchers proposed lunar exploration missions that were agnostic to the landing site, while a few payloads required a landing in high-latitude areas or pit craters. Lunar polar regions are considered promising for scientific missions such as subsurface water ice exploration and are designated for international crewed missions in the near future. However, landing in these areas poses technical challenges due to steep slope, communication difficulties, and limited sunlight. On the other hand, lunar pit craters are relatively commonly found in the maria on the near side of the Moon, providing stable communication conditions and a relatively smooth landing surface nearby. Thus, pit craters can be considered as landing sites viable candidates for future landing sites. In this study, we examine lunar pit craters, discovered so far, referring to prior landing site selection processes and criteria used by countries that have successfully landed on the Moon, including the United States, China, Japan, and India. In addition, we assess landing site candidates that fulfill the needs of domestic researchers, provide high scientific value, and hold favorable conditions for landing and mission operations.

11:10 [VI-3-3]

Development of Verification Methods for Lunar Surface Payloads

Taeil Chung, Jangguen Lee, Hyu-Soung Shin, Young-Jae Kim, Byeong-Kwon Jeong

Korea Institute of Civil Engineering and Building Technology

Various lunar surface payloads are being developed for South Korea's lunar exploration missions. To ensure successful mission execution, performance tests in a simulated lunar surface environment are essential. As these payloads directly interact with the lunar surface, it is necessary to establish new space testing methods that incorporate lunar soil and account for the lunar environment. This study proposes methods for simulating the lunar environment, including the use of lunar soil simulants, and presents performance verification procedures tailored to the specific objectives of each payload.

포스터발표 논문 초록

발표시간 : 4월 23일(수)
15:50~17:10

[P-1] A Multi-View Lunar Dataset for Neural 3D Reconstruction Using LROC NAC and LUTI Imagery

Dunam 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*

We propose a specialized multi-view pushbroom imagery dataset and preliminary results applying neural rendering for 3D reconstruction of the lunar surface. Traditional stereo-based digital elevation models (DEMs) rely on precise disparity estimation, requiring explicit parallax matching between images. However, this approach often suffers from inconsistencies due to variations in lighting and imaging conditions. In contrast, neural rendering methods, such as neural radiance fields (NeRF), learn a continuous volumetric representation of the scene, enabling robust reconstruction without the need for direct feature matching. Our dataset consists of carefully curated LROC NAC and LUTI images from geologically significant regions, including the Tycho crater's peak and the Apollo 15 landing site. We extend an existing NeRF pipeline to handle pushbroom camera geometry and evaluate its performance on these diverse surface features. Experimental results suggest that neural rendering not only captures intricate lunar topography accurately but also demonstrates the potential of our curated dataset as a standard benchmark for future lunar DEM research and geologic analysis.

[P-2] Current Status of Developing for Data Processing of SurfCam/GrainCams

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

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

GrainCams is a set of cameras that is a candidate for commercial lunar payload service (CLPS) to obtain the motion of levitated dust (LevCam) and the microstructure of lunar upper regolith (SurfCam). In particular, SurfCam utilizes the light field technology, which stores light rays from the scene in individual pixels using a microlens array (MLA) enabling multiple scenes in a single exposure. Unlike traditional imaging methods used in space exploration, light field technology has not been applied in previous space missions. Therefore, a dedicated data processing algorithm is required to optimize SurfCam's functionality. To prepare the imaging performance test for the engineering qualification model (EQM) and the flight model (FM), we are developing and testing the algorithm using synthetic SurfCam images rendered with 3D graphics tool such as Blender. This approach allows for accurate simulation and validation before application to real images.
Here, we present the algorithm to extract scenes from raw image and share the progress of data processing development for SurfCam. We also address key challenges related to adapting light field imaging to SurfCam and present future plans.

[P-3] Case Study on the Development of an Observatory Management and Membership System

Hyunnam Kim, Yong-Jae Moon

Kyunghee University

University-affiliated observatories serve as vital institutions for education and research, accommodating a diverse range of visitors and operating regular educational programs. However, the lack of a structured membership management system and the fragmented administrative processes have posed challenges to efficient observatory operations. This study presents a case of developing a membership and management system for the observatory using Notion.
The newly implemented system includes (1) membership registration and management, (2) educational program scheduling and operation, (3) internal administration and document management, and (4) data-driven operational analysis. This transition from a manual management approach to a structured digital system has significantly improved the efficiency of observatory operations. Notably, the system was designed to enhance the organization of regular educational programs for elementary school students, improving educational effectiveness while reducing administrative workload.
We will discuss the process of system development and its operational outcomes, as well as explore the potential and scalability of digital transformation in observatory management. The goal is to provide a practical operational model for observatories and science education institutions in both domestic and international contexts.

[P-4] Operating Procedures Development of Undersea Platform Air Management System

Younkyu Kim, Joohee Lee

Korea Aerospace Research Institute

A research is being conducted to expand and utilize underwater spaces for human habitation. and to this end, we intend to create and demonstrate a living space module for humans to live tens of meters under the sea. In this study, an air management system for structures maintained at 1 atmosphere for humans to live in undersea structures is an essential facility. The air management system largely has basic functions such as oxygen supply, carbon dioxide removal, and air purification, and an integrated control device of the air management system is required to operate them in actual empirical research. This study describes the configuration of an air management system, a sensor device for air management, a safety device, and an integrated control device for operating it. The operating range, warning range, and emergency range of each device for integrated control of the air management system are defined, and reference values for each sensor information and criteria for each mode are defined. Through this, the operating procedures for general mode, warning mode, emergency mode, etc. are established based on the sensor's information according to the criteria defined in the basic operating procedure of each device, and an integrated control system of air management system is developed.

[P-5] Special Regulation Plan for Underwater Platform Demonstration of Oxygen Generator

Joohee Lee, Younkyu Kim

Korea Aerospace Research Institute

For the safety of the crew, the life support system for the underwater platform, including the oxygen generator, is designed and manufactured by applying the 'Submarine Rules' of the Korean Register. Additionally, the Ministry of Trade, Industry, and Energy's 'Act on the Promotion of Hydrogen Economy and the Management of Hydrogen Safety' are applied for safety because the oxygen generator using the water electrolysis method generates hydrogen. However, it is deemed necessary to have a special exception to the regulation to the extent that it does not deviate from the safety regulations in order to demonstrate the oxygen generator in the absence of clear management regulations for underwater structures in a closed environment. Therefore, in this study, we will discuss safety regulations related to life support systems and special exceptions to regulations.

[P-6] Conceptual Design of The Compact Electrical Ground Support Equipment for ETB Test of CAS500 series

Young-Yun Kim, Dong-In Han

Korea Aerospace Research Institute

The Compact Advanced Satellite 500 program (CAS500) is divided into two phases, with a total of five satellites being developed, manufactured, and CAS500-1 was launched. Phase 1 consists of two optical satellites, while Phase 2 includes three satellites carrying different payloads but sharing the same satellite bus. This shared bus development approach necessitated the design and manufacture of extensive electrical ground support equipment (EGSE) to assemble, integrate, and test the flight models. This paper explores the transition from a comprehensive EGSE used in the first satellite of Phase 1 of ETB (Engineering Test Bed) to that of a more compact and function-specific EGSE for subsequent satellites. The revised approach optimizes function, efficiency, reduces redundancy, and enhances resource utilization by repurposing existing EGSE for ETB. The functions of the compact EGSE are defined, and the necessary equipment is selected to ensure effective satellite integration and testing.

[P-7] Koreanized System Engineering Lifecycle and Review Requirements for Satellite Developments

Hyeon-Jin Jeon

Korea Aerospace Research Institute

Systems engineering must be effectively implemented in order to develop satellites efficiently. Systems engineering is a methodology for developing a system that safely meets stakeholders' functional, operational, and performance requirements throughout the project's lifecycle within limited cost and schedule.

Until now, the systems engineering requirements for the lifecycle and reviews of satellite development in Republic of Korea have followed those of NASA in the United States or ESA in Europe. As a result, there has been a gap between the actual satellite development process and the imposed systems engineering requirements.

To resolve this issue, research has been conducted on Koreanized systems engineering lifecycle and review requirements based on the reviews held throughout the lifecycle of satellite developments in Republic of Korea. And this paper presents the findings of that research.

The Koreanized systems engineering lifecycle and review requirements proposed in this paper are expected to serve as a standard for systems engineering in future satellite development in Republic of Korea.

[P-8] Research on Payload Simulator Design and Operation for Efficient Development and Verification of Satellite Payload System

Jong-Euk Park, Jong-Tae Lee, Gm Sil Kang,

Eung Shik Lee

Korea Aerospace Research Institute

In the development process of various payloads mounted on satellites to perform many missions, the need for a payload simulator can be being raised for efficient development and verification.
The payload simulator can help with an efficient development schedule by being involved in the design, production, and verification of each component that makes up the satellite payload from the development stage of the satellite payload system. In addition, by using the manufactured EM model, it is possible to quickly check whether the planned design is progressing through functional verification of the designed payload. Through testing and verification of each sub-unit and module for which design and production has been completed, and mission testing at the payload level, design verification for the mission performance of the satellite payload system can be performed. A basic payload simulator can be designed in a way that simply includes only the parts related to the operation of the payload system.
Additionally, it can be designed and configured to check more complex and practical functions and operations by adding a function to check various types of internal and external analog telemetry of the payload. Through this simulator, a highly reliable satellite payload system can be designed and verified in advance before assembly into the satellite bus during the payload development stage.
In this paper, we proposed and analyzed a payload simulator that can be used efficiently in the development, design, and operation of satellite payloads. This simulator, which will be useful for satellite testing, before launch ground testing, and processing, can be of great help in the development of various payloads.

[P-9] Loss Function for Deep Learning-Based Semantic Segmentation in On-Orbit Servicing

Ju-Hyun Kim, Jae-Wook Kwon

Korea Aerospace Research Institute, KARI

In on-orbit servicing robot technology, target recognition and pose estimation are considered core technologies, and extensive research has been conducted using camera images. Among them, semantic segmentation is regarded as a key technique for identifying target satellites or their components in space. Typically, semantic segmentation employs loss functions such as Binary Cross Entropy (BCE) and Dice loss. However, these loss functions have limitations in accurately distinguishing image boundaries and effectively capturing the structural characteristics of complex objects. In this paper, we propose a novel loss function that leverages eigenvalue calculations in edge regions to achieve more precise segmentation of complex satellite structures. Furthermore, experimental results demonstrate that the model trained with the proposed loss function achieves more precise semantic segmentation than models using conventional loss functions.

[P-10] A Study on Satellite Electronics Verification Procedures at the Launch Site

MinJun Kim, Yun-Goo Huh

Korea Aerospace Research Institute

Before launching a satellite into space from the launch site, several essential procedures and considerations must be addressed. This paper briefly discusses the necessary preparations from an electrical perspective prior to satellite launch. For satellite State of Health (SOH) checks and electrical fit checks at the launch site, connector configurations, interfaces, and EGSE (Electrical Ground Support Equipment) communication and power facility validation are required. Additionally, electrical interface compatibility between the satellite and launch vehicle—including connector inspection, cable verification, signal integrity, and grounding status—must be thoroughly verified. Furthermore, detailed considerations such as the layout and movement paths for the satellite and EGSE, the development and execution of relevant test procedures, coordination of mechanical tasks, and comprehensive scheduling—particularly in the context of rideshare missions—must be systematically managed.

[P-11] Management Strategies for Multi-Agency R&D Projects

Jimo Yang, Keunwoong Shin, Eungsik Park

Korea Aerospace Research Institute

The multi-agency R&D projects refer to national research and development projects jointly planned, executed, managed, and evaluated by two or more relevant central administrative agencies throughout the entire cycle. The development project of the Geo-Kompsat-3, initiated in 2021 by four ministries, is currently underway. This study aims to examine the approach of multi-agency R&D projects in the development of the geostationary public integrated communication satellite and explore the basis for the implementation and management of multi-agency joint projects after the enactment of the National Research and Development Innovation Act. Multi-agency R&D projects are classified into multi-agency joint projects and department-led collaborative projects according to their planning methods, and additional classifications, such as problem-solving oriented projects, can also be made based on the planning method. The purpose of multi-agency R&D projects is to prevent duplicate investments, enhance the efficiency of research and development investments, and promote cooperative research among ministries.

[P-12] Satellite System Engineering Process Development for Korea Industries

Jeongheum Im

Korea Aerospace Research Institute

Korea Aerospace Research Institute (KARI) has been developing and operating the KOMPSAT (Korea Multi-Purpose Satellite), GEO-KOMPSAT (Geostationary KOMPSAT) series, and so on. KOMPSAT series provide precise earth observation from low earth orbit. GEO-KOMPSAT series provide earth observation from geostationary orbit. In addition, KARI has also opened its era of space exploration by developing Korea's first lunar orbiter, Danuri. KARI has been referencing its own system engineering process for developing various satellite systems. However, other domestic satellite system developers who don't have their own system engineering process are minimizing system risks such as schedule delay and cost increase by modifying that of previous program or applying user defined one, rather than applying standard system engineering techniques. As the missions and required technologies of satellite systems that user demands become more complex and diverse. It is necessary to establish a standard Korean satellite system engineering procedure to ensure mission success for the satellite system to be developed in various forms. This paper describes the Korean satellite system engineering procedures which KARI is developing for Korea industries according to the request of the Korea Space Agency.

[P-13] Orbit Thermal Analysis for Development of a Space Telescope Based on an Existing Earth Observation Telescope

Hyung-Yun Noh, Haeng-Pal Heo

Korea Aerospace Research Institute

A preliminary orbit thermal analysis has been conducted for the development of a space telescope based on an existing Earth observation telescope. While Earth observation telescopes typically operate at near-ambient temperatures, the detector and its enclosure in space telescope must be maintained at extremely low temperatures, close to or below 100 K. In this study, we utilized the existing optical system design to develop a space telescope and predicted the minimum achievable temperature of the focal plane unit through orbital thermal analysis. The limitations of the current design were identified, and a preliminary design was proposed to achieve lower temperatures. Additionally, we discuss favorable orbital configurations and attitude strategies for the operation of the space telescope from a thermal perspective.

[P-14] Correlation of Star Formation Rates and Mass Variables of Galaxies

Sungeun Kim[1,2]

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

This study investigates the correlation between star formation rates (SFRs) and the properties of dark matter halos of galaxies within the COSMOS (Cosmic Evolution Survey) field using multi-wavelength observations. By examining diverse mass variables and cumulative star formation rates, we find a novel relationship between SFRs of galaxies and the characteristics of their dark matter halos.

[P-15] Applicability of Mars Climate Database (MCD) for Thermal Environment Conditions on Mars Surface Mission Thermal Analysis

Hui-Kyung Kim[1,2]

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

Mars, which is being explored as a potential next habitat for humanity after Earth, has a distinct thermal environment that differs from that of Earth. Therefore, it is essential to implement thermal control measures for Mars surface exploration mission to ensure reliable mission performance under Martian thermal conditions. While the initial thermal control design is based on methods used for conventional satellites, the unique thermal characteristics of Mars, which differ from those in Earth's orbit, may require a specialized thermal design approach. This study focuses on determining the thermal environmental conditions of the mission area, a prerequisite for the thermal analysis in the development of a Mars surface exploration surface mission. To achieve this, we utilized the Mars Climate Database (MCD), a highly reliable database widely used in various research. The thermal conditions obtained from MCD were applied to representative cases and compared with measurement data from scientific instruments as well as results from other Martian climate prediction models. Based on this analysis, it was propped a method for incorporating the derived thermal environmental conditions into thermal analysis for Mars surface exploration missions.

[P-16] Adaptive Satellite Performance Control System for Electro-Optical Payloads

Sang-Youn Shin

Korea Aerospace Research Institute

The mission of the EO (electro-optical) based low earth orbit satellite is provision of the high-resolution images required for

GIS (Geographical Information Systems) establishment and the applications for environmental, agriculture and ocean monitoring. The low earth orbit satellite has the payload on the satellite consists of EOS (electro-optical subsystem) and PDTS (Payload Data Transmission Sub-system). The overall EO based satellite performance can be defined by MTF, SNR. But the satellite performance is affected by many reasons and they come from both hardware, software itself and the payload system. Especially the compression affects the final satellite image quality. In this paper, the adaptive satellite image quality control system to optimize the payload performance is studied. The compression parameters can be determined and applied in real-time for the compression processing by analyzing target area characteristic features from the captured target area during the mission and the information that is already stored in the payload for the target area. To optimize the image quality under the mission plan, the effectiveness of the compression parameters for the local and overall target area conditions is presented.

[P-17] Accuracy Measurement of Precision Sensors in a Thermal Vacuum Environment

Won-Beom Lee, Jeoung-Heum Yeon, Eung Shik Lee

Korea Aerospace Research Institute

The optical system of a large-aperture camera is assembled through precise alignment work. To meet the required optical performance, the process involves evenly reducing various aberrations that appear during optical alignment and finding the optimal position within the mechanical interface conditions of the optical components. This ensures the assembly of the optical system. The mounted optical components have stability tolerances concerning their relative positions and angles to preserve optical performance. This is because even if the camera is exposed to external environmental changes and deformations occur, it needs to remain within the stability tolerances to maintain the required optical performance. In orbit, the camera needs to stay within the stability tolerances even with temperature changes under vacuum conditions. To verify this, a sensor appropriate for vacuum conditions is used to measure the tolerances. This precision measurement sensor's measurement accuracy is verified under thermal vacuum conditions before being used in the environmental test of the camera.
Therefore, this paper describes the performance verification of the precision measurement sensor.

[P-18] Statistical Analysis of Lunar Origin Ions Observed by Kaguya in the Solar Wind

Jaehee Lee[1], Khan-Hyuk Kim[1], Yewon Hong[1], Seul-Min Baek[2], Ho Jin[1], Yoshifumi Saito[3], Masaki N. Nishino[3], Shoichiro Yokota[4]

[1]*School of Space Research, Kyung Hee University*
[2]*Korea Astronomy and Space Science Institute*
[3]*Institute of Space and Astronautical Science, Japan Aerospace Exploration Agency*
[4]*Osaka University, Japan*

Neutral atoms or molecules in the lunar exosphere and on the lunar surface are ionized by solar UV radiation or solar wind bombardment. These photoionized and emitted ions are then picked up by the solar wind's motional electric field and interplanetary magnetic field. When a lunar orbiter detects these pickup ions, it provides information about the chemical composition of the lunar surface materials. In this study, we statistically examine ions originating from the Moon in the energy range of 20 to 200 eV, using Kaguya magnetic field and low-energy particle data from January 2008 to June 2009, when the Moon was in the solar wind. We identified heavy ions originating from the Moon, such as C^+, O^+, Na^+, Al^+, K^+, and Ar^+. These heavy ions are mostly distributed at high latitudes in the Northern Hemisphere. We discuss whether the asymmetrical distribution between the Northern and Southern Hemispheres is associated with temporal variations or spatial signatures.

[P-19] Acceleration of Solar Wind Ions Backscattered at the Lunar Surface and Reflected by Lunat Magnetic Anomalies Observed by Kaguya

Yewon Hong[1], Khan-Hyuk Kim[1], Jaehee Lee[1], Seul-Min Baek[2], Ho Jin[1], Yoshifumi Saito[3], Masaki N. Nishino[3], Shoichiro Yokota[4]

[1]*School of Space Research, Kyung Hee University*
[2]*Korea Astronomy and Space Science Institute*
[3]*Institute of Space and Astronautical Science, Japan Aerospace Exploration Agency*
[4]*Osaka University, Japan*

We analyzed data acquired by Kaguya on 17 March 2009, when it was in a polar orbit around the Moon at altitudes between approximately 42 and 50 km, to understand how and where solar wind ions backscattered at the lunar surface and reflected by lunar magnetic anomalies of Reiner Gamma and Sirsalis are accelerated. We observed that solar wind ions with an energy of approximately 700 eV are backscattered at lunar dayside surface with energy levels between 100 and 600 eV over a broad latitudinal range from the north pole to the south pole. The backscattered solar wind ions were energized up to 3,000 eV, which is 4 times the solar wind energy, when Kaguya passed over both magnetic anomalies located near the equatorial region. This energization is comparable to the maximum kinetic energy accelerated by the solar wind motional electric field ($-\mathbf{V}_{sw} \times \mathbf{B}_{IMF}$, where $\mathbf{V}_{sw}$ is the solar wind bulk velocity and $\mathbf{B}_{IMF}$ is the interplanetary magnetic field). We discuss whether the backscattered ions are locally energized near the magnetic

anomalies or if Kaguya missed acceleration of the ions backscattered at the lunar surface, using particle trajectory calculations.

[P-20] Analysis of Laser Beam Intensity Model Incorporating Jitter for Satellite Laser Communications

Kiduck Kim, Eui Keun Kim, Youn-Kyu Kim, Choon-Woo Lee

Korea Aerospace Research Institute

This research investigates the impact of platform jitter on satellite laser communication systems operating in the infrared spectrum. Unlike conventional radio frequency communications, optical systems require minimized beam divergence angles to maintain high data transmission rates and link stability across extended distances. However, these tightly focused beams create heightened sensitivity to micromovements caused by attitude control errors, external perturbations, and structural vibrations. These dynamic instabilities, collectively termed "jitter," significantly influence communication performance metrics.

Our study develops a refined model that accurately incorporates jitter effects for enhanced performance prediction and system design optimization. While traditional approaches have relied on simplified Gaussian beam models, practical implementation necessitates accounting for the inevitable platform instabilities in operational environments. The proposed methodology characterizes temporal beam center displacement as jitter and systematically analyzes the resultant intensity variations. This analytical framework provides insights for designing robust satellite laser communication systems capable of maintaining performance integrity under realistic operating conditions.

[P-21] Extracting and Analyzing Plug and Play Information of the GR712RC

Dayeon Kim

Korea Aerospace Research Institute

The GR712RC is a dual-core LEON3-FT SPARC V8 processor developed by Gaisler, widely used in aerospace and defense applications requiring high reliability. Typically, the Plug-and-Play (PnP) information of the GR712RC is utilized to detect system devices and SoC architecture and to initialize software drivers. Conventionally, this information is accessed through the info sys command of the GRMON debugging tool. However, extracting PnP information without GRMON can be inconvenient. In this paper, we propose a method to directly extract PnP information without GRMON using the laysim-GR712RC emulator and the BCC (Bare-C Cross Compiler). Specifically, we access the designated memory region where PnP information is stored, retrieve Vendor ID and Device ID from the Identification Register, and analyze the AHB base address and masking value from the Bank Address Register. The extracted data is then parsed and formatted to produce a human-readable output, including core information, AHB master/slave configuration, and IRQ assignments. This study demonstrates that PnP information can be obtained from the GR712RC without relying on GRMON, facilitating initial system inspection and basic debugging. Additionally, the proposed method provides a partial alternative to GRMON's functionality, contributing to future software-based automated system analysis and driver development.

[P-22] Necessities of Lunar Traffic Control Management (LTCM) for Future Sustainable Lunar Exploration

Young-Joo Song[1,2], Moon-Jin Jeon[1], Soyoung Chung[1]

[1]*Korea Aerospace Research Institute*
[2]*Kyung Hee University*

With the increasing number of lunar missions planned by various space agencies and private entities, Lunar Traffic Control Management (LTCM) has become a crucial factor in ensuring the safety and sustainability of future lunar exploration. Unlike Earth's well-established Space Traffic Management (STM), the lunar environment lacks a structured framework for traffic coordination, collision avoidance, and resource management. By surveying the current status of LTCM, a preliminary assessment of its necessity is emphasized. Key issues in establishing LTCM are also discussed, including growing orbital congestion at the Moon, potential conflicts in landing site selection, and the lack of a unified lunar situational awareness system. By analyzing real-world cases, such as KPLO's conjunction mitigation, and international frameworks like the Artemis Accords, this work suggests a preliminary framework for LTCM. Future LTCM must evolve through monitoring, coordination, and autonomous management to ensure the safety and success of upcoming missions. Additionally, future efforts must focus on developing monitoring networks, data-sharing protocols, and international regulatory frameworks to establish a safe and sustainable lunar operational environment.

[P-23] 3D Lunar Regolith Grain Measurement System Design Using Linear Astigmatism-Free Three-Mirror System and Feasibility Analysis

Nayeon Kim[1], Sunwoo Lee[1,2], Seunghyuk Chang[3], I Jong Kim[2], Changgon Kim[1], Dohoon Kim[1], Chae Kyung Sim[4,5], Minsup Jeong[4], Daewook Kim[6], Soojong Pak[1]

[1]*School of Space Research, Kyung Hee University*
[2]*Korea Basic Science Institute*

[3]*Center for Integrated Smart Sensors*
[4]*Korea Astronomy and Space Science Institute*
[5]*University of Science and Technology*
[6]*James C. Wyant College of Optical Sciences, The University of Arizona*

As lunar exploration research progresses worldwide, understanding the lunar environment has become increasingly critical. However, *in-situ* high-resolution observations of the lunar surface remain limited. To address this challenge, we propose an optical design for an imaging system that incorporates an off-axis reflective configuration and a spiral phase plate (SPP), a unique optical element that twists the wavefront of the incident plane wave beam. This system enables 3D interferometric observation of the microscopic structure of lunar surface particles. The proposed microscopic imaging system follows the basic optical configuration of a 4f system, placing an SPP between two lenses to generate self-interference-based spiral fringe patterns at the detector, enabling 3D reconstruction of the target. A linear astigmatism-free three-mirror system (LAF-TMS) acts as a collector lens, collimating beams reflected from the target. By sharing focal points, this design mathematically eliminates linear astigmatism, a common issue in off-axis optical systems, ensuring a compact and robust structure resistant to vibrations and impacts during launch. Additionally, the LAF-TMS is required to have the same length of focal length and the back focal length so that the target is located at the back focal plane while the SPP is located at the focal plane of the LAF-TMS. This unique optical configuration is essential for maximizing the performance of spiral interferometry. A tolerance analysis of the LAF-TMS was conducted to assess the feasibility of the system. With its robustness, simplicity, and high-resolution 3D structural analysis capability, the proposed optical system is a strong candidate for future lunar surface exploration missions.

[P-24] Grain Size Dependent Spectral Data of Apollo Soil 67461 and Plans for Further Sample Loans

Eunjin Cho[1], Minsup Jeong[1], Chae Kyung Sim[1,2], Serin Kim[1,2], Mingyeong Lee[1], Young-Jun Choi[1]

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

Reflectance spectra of the Moon provide various information about the surface, including mineral composition, space weathering effects (tiny metallic iron particles), and regolith grain size. Among these factors, we focus on the influence of grain size on the spectral data of Apollo soil 67461. Using the Hapke radiative transfer model, we analyze spectral data from the Reflectance Experiment Laboratory (RELAB) to derive the spectrally dominant grain size for various size fractions of the soil. Our analysis reveals that bulk soils (< 1 mm) exhibit spectral characteristics similar to smaller size fractions, as reported by Pieters et al. (1993). In addition to reflectance spectra, polarimetric properties are also influenced by grain size. Comparing grain size effects on spectral and polarimetric properties across different size fractions could provide insights into the optically dominant grain size of lunar soils. To further investigate this, we plan to loan Apollo soil 67461. In this presentation, we discuss our preliminary analysis and future sample loan plans.

[P-25] Examining Apollo 16's Lunar Surface Magnetometer Data

Sanghwa Kim[1], Yesun Ahn[1], Hyeonhu Park[1], Wooin Jo[1], Ho Jin[1], Khan-Hyuk Kim[1], Seul-Min Baek[2]

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

The magnetic field observations from both the lunar surface and orbiters have provided critical insights into the existence of lunar magnetic anomalies and the Moon's evolutionary processes. Unlike the global magnetic field distributions observed by lunar orbiters, the in situ magnetic field measurements on the lunar surface from the Apollo 12, 14, 15, and 16 missions exhibit highly complex spatial variations. However, the Apollo Lunar Surface Magnetometer (LSM) data have been significantly limited due to the scarcity of fully restored datasets and the necessity of an extensive calibration process.
In this study, we analyzed the raw three-month Apollo 16 LSM data (April to June 1975) obtained from the Planetary Data System. As preliminary results, we present the data validation results and calibration procedures, including the coordinate transformation.
We expect that this study will play an important role, not only serving as a fundamental data processing method for calibrating future lunar lander magnetometer observations but also providing major considerations for the mission planning of magnetic field measurements on the lunar surface.

[P-26] SPICE Data Applications in Mission Planning for Spacecraft Operations: A Case Study with KPLO

Jo Ryeong Yim, Dong-Gyu Kim

Korea Aerospace Research Institute

This study investigates the practical applicability of the SPICE Toolkit for mission planning through a case study utilizing the SPICE kernels of the Korea Pathfinder Lunar Orbiter (KPLO). The SPICE (Spacecraft Planet Instrument C-matrix Events) system, developed and maintained by NASA's Navigation and Ancillary Information Facility (NAIF), offers a reliable ancillary

data system that includes data formats, software libraries, and detailed guidelines for use, supporting precise calculations of spacecraft geometry and timing. NAIF recommends the system for broad use in both mission planning and scientific data processing. Although KPLO, launched in 2022 and currently in operation, generates and provides SPICE kernels to payload teams for scientific data processing, these kernels are not yet employed in mission planning. This study aims to explore potential applications of the SPICE kernels in satellite mission planning and evaluate their feasibility. Through this case study, we demonstrate that the SPICE Toolkit can be effectively integrated into the mission planning and scheduling for operations, as well as in target observation planning. The findings are expected to provide insights into how SPICE can extend beyond its conventional use cases and serve as a valuable tool for future spacecraft planning and ground operation support, particularly in the context of upcoming Korean space missions.

[P-27] KPLO Magnetometer Observation Results at an Average Altitude of 60 km in Lunar Orbit

Yesun Ahn[1], Ho Jin[1], Hyeonhu Park[1], Wooin Jo[1], Sanghwa Kim[1], Ian Garrick-Bethell[2], Khan-Hyuk Kim[1], Yunho Jang[1], Seungmin Lee[1], Minjae Kim[1]

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

The Korea Pathfinder Lunar Orbiter (KPLO, also known as Danuri) launched on August 4, 2022. After launch, the KPLO magnetometer (KMAG) has been continuously measuring the lunar crustal magnetic fields and surrounding the Moon. On February 19, 2025, the mission orbit was lowered from an average altitude of 100 km to 60 km. The lower orbital altitude enables a closer proximity to crustal magnetic source, resulting in the observations of stronger magnetic fields. Particularly, the measurements of lunar magnetic anomalies can providing improved insights into the structure and distribution of the lunar magnetism. In this presentation, we show the KMAG observation results at an average altitude of 60 km in lunar orbit. For comparison and verification, we use the KMAG data at previous altitude and surface vector mapping (SVM) data based on Lunar Prospector and Kaguya magnetometer dataset. This allowed us to identify relatively stronger field intensities and more detailed structures in the magnetic anomaly regions. We expect that the measurements at different low-altitude of < 60 km for about seven months would help to characterize the Moon's crustal magnetic properties.

[P-28] Conceptual Design of Focal-Plane Assembly considering Optical Constraints for Earth Observation Satellite Camera

Youngsun Kim, Haeng-Pal Heo

Korea Aerospace Research Institute

The Earth observation satellite camera is getting required very high performance in modulation transfer function (MTF). Even though a larger telescope including optics is needed for it, many realistic difficulties are companied in the process of system integration and test as well as mass, material and manufacturing in the optics itself. In this paper, it is proposed the design of focal plane assembly including the pixel arrangement considering the optical design constraints to improve the MTF on whole focal plane area. First, it is designed to minimize the degradation resulted from wave-front errors and focal-length deviation in off-optical axis. Second, the pixel arrangement to compensate the optical distortion is also considered to improve the performance in the TDI scan direction. Finally, the analytical results focused on the MTF performance are shown in the paper.

[P-29] Thermal Environment Testing Methods for Space Exploration Rovers

Ji-Seok Kim

Korea Aerospace Research Institute

As the need for space exploration increases, the development of rovers for deep space missions, including the Moon and Mars, is becoming more active. Rovers must operate in extreme space environments for extended periods, making rigorous thermal environment testing essential. However, the thermal conditions that rovers encounter differ significantly from those of satellite in Earth orbit, requiring distinct thermal control strategies for each celestial body. For instance, the Moon presents challenges such as extreme temperature variations and low thermal conductivity of the regolith, while Mars' thin atmosphere and varying solar radiation levels greatly influence its thermal environment. This study analyzes the thermal characteristics of these extraterrestrial environments and reviews corresponding thermal environment testing methods. By analyzing practical examples, we propose thermal environment testing methods and procedures from a different perspective than those used for satellites in Earth orbit. Furthermore, we identify the limitations of current thermal environment testing methods and propose directions for thermal environment testing in space exploration rover development. Through these approaches, we aim to enhance the reliability of rover thermal control technologies and establish a foundation for long-term space exploration missions.

[P-30] The Laboratory Test of Square-Barrel Calibration Coil for Three-Axis Search Coil

Magnetometer

Minjae Kim, Ho Jin, Yunho Jang, Seungmin Lee, Hyeonhu Park

School of Space Research, Kyung Hee University

We developed the Engineering Model (EM) of the Space Search Coil Magnetometer (SSCM). It consists of a MAG unit and a Search coil Control Electronics (SCE) unit. The SSCM's frequency range is 10 Hz to 20 kHz and the Noise Equivalent Magnetic Induction (NEMI) is 6 $pT/Hz^{1/2}$ at 1 kHz.
We performed the frequency response and NEMI tests in a magnetic shield chamber with a solenoid coil. However, for the angular response test, the SSCM should have rotated within a uniform magnetic field. Therefore, we need a new calibration coil design instead of a solenoid coil.
For the angular response test of the SSCM, a uniform magnetic field within a cylindrical space of Ø230 mm × 100 mm is required. If we use a Helmholtz coil, its diameter will exceed 2 m. Therefore, we made a square-barrel calibration coil with a relatively small size. In this presentation, we introduce the design of the square-barrel calibration coil and the preliminary test results of the three-axis SSCM using this system.

[P-31] Risk Analysis of Autonomous GNC Control System for On-Orbit Servicing

Yoon-Jeong Jang, Jae-Wook Kwon

Korea Aerospace Research Institute

On-Orbit Servicing (OOS) is a service that provides inspecting, repairing, upgrading, orbital attitude maintenance, refueling, parts replacement, and space debris removal for artificial objects flying in space orbit. In order to perform these missions, the location and attitude information of the target object, visual records of the status, and problem diagnosis simulated operations in a real environment, and procedures must be established in advance. This enables system to perform autonomous navigation and control, collision avoidance, etc. through GNC (Guidance, Navigation, and Control). In this paper contains the risk analysis that occur in terms of autonomy of the GNC system. The previously mentioned method maximizes operational efficiency while simultaneously increasing the mission success rate. It can be applied to modeling and simulation techniques based on analysis of major risk factors, quantitative risk assessment, and risk mitigation strategy development. Ultimately, it is possible to reflect this in the design of mission scenarios and prepare for reducing potential risk factors.

[P-32] Earth Rate Estimation and Measurement for LEO-Satellite Ground Test

JooHo Park, Seung Hun Lee

Korea Aerospace Research Institute

Space program has its own feature, which is test compleness before launch. Since it is not available directly to repair or retrieve the spacecraft from Space, verification test last sevral years on the ground. Many sensors and actuators are adopted for AOCS. Rate gyro is one of the important unit in AOCS. During the system test, in order to verify the status of the GRA, earth rate is utilized for the varification process. To be specific, the expected earth rate in spacecraft body frame is calculated first. Since the earth rate is measured in ECI frame, it should be rotated for the spacecraft body frame. Then, the measurement values from IST test and the expectation values will be compared for final verification decision. In this paper, we introduce the earth rate expectation in spaecraft body frame and the comparison result is discussed.

[P-33] Analysis of the Spectral Band Verification 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*

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.
The verification of spectral band response in earth observation space cameras ensures that the sensor correctly detects and differentiates spectral wavelengths within its designated bands. This process confirms that the sensor's spectral characteristics align with mission requirements and intended scientific or operational applications.
In this paper, we outline the analysis of the spectral band verification test and describe the test specification / setup for the CAP-W payload of the CAS-4 satellite including measurement of the actual spectral response of each band and comparison with the expected design values. This process is critical for achieving accurate remote sensing data, supporting applications such as environmental monitoring, climate studies, and resource management.

[P-34] The Utilization of Deformable Mirrors for Acquisition of Satellite Imagery with Subdecimeter Resolution

Yee-Jin Cheon[1,2]

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

It is well known that components misalignment, elements imperfections, or especially aberrations in optical systems can reduce internal performance, while heat and atmosphere can reduce external performance. For an application where it is difficult to control aberrations, active methods such as adaptive optics are used for correcting optical performance. Adaptive optics is a key technology utilized to enhance the performance of an optical system by manipulating the optical wavefront. This method can greatly improve the final output performance compared to a non-adaptive system. Employing an active means such as a deformable mirrors to manipulate a wavefront provides precise control of the shape of the wavefront. Since in the process of acquiring optical satellite imagery with subdecimeter resolution optical system experiences severe performance degradation such as aberrations, so called deformable mirrors (DM) whose surface can be deformed shall be employed. A deformable mirror in adaptive optics is typically made out of a reflecting optical surface that is mechanically deformed utilizing various mechanisms and actuators. The actuation types are divided into two. One is contactless technologies (e.g., electrostatic, electomanetic, magnetic actuation) in which electrical or magnetic field applies a force to mirror. The other one is contact technologies(e.g., electrostrictive, piezo/monomorph, photonic actuation) in which physical contact exists between actuator and the mirror.

[P-35] Current Status of GK2A/AMI Calibration

Hanbyul Lee, Euidong Hwang, Eun-Jeong Cha, Kwang Deuk Ahn

Korea Meteorological Satellite Center

The Korea Meteorological Administration (KMA) has been continuously monitoring weather conditions from Geo-Kompsat-2A (AMI), launched in June 2018, succeeding the COMS/MI. To ensure the highest possible accuracy of AMI data, KMA has been conducting regular vicarious and inter-calibration in the post-launch state, even though it has its own onboard calibration system using a solar diffuser and blackbody. Vicarious calibrations for the visible channel using deep convection clouds, ray-matching and lunar calibration, while inter-calibrations for the infrared channel was based on well-calibrated Low Earth Orbit (LEO) satellites.

Additionally to generate climate analysis data, the weather observation data from COMS/MI and GK2A/AMI is recalibrated based on the IR inter-calibration method. The EUMETSAT MetOp satellite series were referenced, as it is a well-calibrated satellite operating concurrently with KMA's two geostationary satellites. The recalibration process confirms the consistency and stability among historical satellites.

In this presentation, we will discuss the quality assessment for the visible and infrared channels using vicarious and inter-calibration methods, as well as the re-calibrated long-term (MI-AMI) infrared data.

[P-36] A Review on the Impact of Output Rated Power Excess of Solar Array Regulator

Sungwoo Park[1], Hyoungjun Jang[2]

[1]*Korea Aerospace Research Institute*

[2]*Korea Aerospace Industry*

Solar array regulators placed in the PCDU (Power Control and Distribution Unit) used for LEO satellite applications are typically responsible for regulating the amount of power generated by the solar array panels and controlling the battery charging current. In, addition, solar array regulators generally have parallel-operation configuration of a single module with an appropriate power capacity due to advantages such as design, manufacturing, redundancy and heritage. If the solar array regulator operates in the MPPT (Maximum Power Point Tracking) mode during the beginning period in where the LEO satellite enters daytime section from eclipse period, the solar array panel may generate excessive output power exceeding the design rating of the solar array regulator due to its low operating temperature. Therefore, various power limitation techniques are being applied to solar array regulators for LEO applications to protect solar array regulators from such excessive output power from solar panels. However, some errors in the design process may be misled and apply the reference value of the power limit circuit, and if the results are confirmed during the actual orbital operation process, an impact analysis on the solar power regulator hardware should be performed. In this paper, it is intended to derive and present the process and results of the impact analysis of the power stage of the solar array regulator assuming the error of setting the power limit threshold value of the solar array regulator.

[P-37] Optimal Reentry Trajectory Design for the Nano-Satellite with Limited Propellant

Hanwoo Ju

Gyeongsang National University

This study aims to design and analyze the optimal reentry trajectory for JINJUSat-2, a 6U-class satellite currently under development, considering constraints in onboard propellant availability. JINJUSat-2 will be equipped with a 0.5U-sized thruster, and due to its limited fuel capacity, achieving sufficient altitude decay through thrust maneuvers alone is expected to be challenging. Therefore, this study investigates how initial orbital adjustments using the thruster can influence subsequent natural orbital decay, and it optimizes propellant allocation and thrusting schedules to derive the most effective reentry strategy.

To this end, orbital decay scenarios of JINJUSat-2 are simulated

using STK, and Sequential Convex Programming (SCP) is applied to optimize fuel usage and reduce the time required for atmospheric reentry. The study aims to establish an optimal decay pattern and propellant utilization strategy that ensures controlled and efficient deorbiting.

[P-38] Shear Flow Effect on Resonant Absorption of Propagating MHD Body Waves in a Flux Tube Under Photospheric Conditions

Dae Jung Yu

Kyung Hee University

Resonant absoroption of magnetohydrodynamic (MHD) body modes in the presence of shear flow is theoretically investigated under photpsheric conditions. The waves are assumed to propagate in a cylindrical flux tube with a circular cross section and an inhomogeneity in radial direction. An analytical theory for resonant absorption in cusp (slow) and Alfven continua with flow shear is developed by assuming a thin boundary layer. The numerical solutions show that the flow shear overall suppresses resonant absorption of the forward and backward body modes compared to the surface modes. When the flow shear is sufficiently large, the backward waves become forward, and instability develops with a small increment.

[P-39] The Relationship Between Electron Density and Neutral Temperature Variations during Polar Hole Events

Junho Back[1], Khan-Hyuk Kim[1], Geonhwa Jee[2,3], Hyuck-Jin Kwon[2], Changsup Lee[2,3], Jeong-Han Kim[2]

[1]*School of Space Research, Kyung Hee University*
[2]*Korea Polar Research Institue*
[3]*University of Science and Technology*

Under quiet geomagnetic conditions, F-region electron density (NmF2) depletion, known as a polar hole, is frequently observed in the winter nighttime polar ionosphere. We identified forty-five polar holes in 2019 using the Vertical Incidence Pulsed Ionospheric Radar (VIPIR) with Dynasonde, installed at Jang Bogo Station (JBS), Antarctica. Previous studies have reported that the occurrence of polar holes is related to slow antisunward plasma convection across the polar cap in darkness and in the absence of an ionization source and attendant recombination. However, the recombination process is not determined by plasma convection across the dark polar cap. Thus, plasma convection is not the only factor contributing to the formation of a polar hole. Another possible factor influencing electron density depletion is the high concentration of the neutral molecules. Recent VIPIR observations at JBS reported that an exponential decrease in NmF2, with an e-fold decay time of less than 1 hour, is distributed in the region near the midnight sector under extremely quiet geomagnetic conditions. Due to the lack of an ionospheric heating source near the midnight sector under quiet geomagnetic conditions, we expect horizontal transport of neutrals toward the midnight region, where the neutrals are cold, driven by pressure gradient force. Consequently, the concentration of the neutral molecules increases as the neutral temperature decrease. In this study, we examine the relationship between the exponential decrease in NmF2, as measured by VIPIR, and variations in neutral temperature, as measured by the Fabry-Perot interferometer (FPI). We also discuss whether the VIPIR and FPI observations at JBS can be considered evidence of the horizontal transport of cooling neutrals in the polar thermosphere.

[P-40] Comparison of Empirical and Deep Learning Models for Solar Wind Speed Prediction

Seungwoo Ahn[1], Jihyeon Son[2], Yong-Jae Moon[1,2], Hyun-Jin Jeong[1,3]

[1]*School of Space Research, Kyung Hee University*
[2]*Department of Astronomy and Space Science, Kyung Hee University*
[3]*Centre for mathematical Plasma Astrophysics, Department of Mathematics, KU Leuven, Belgium*

In this study, we compare representative empirical models with a deep learning model for predicting solar wind speed at 1 AU. The empirical models are the Wang–Sheeley–Arge (WSA)–ENLIL model, which combines empirical methods with a magnetohydrodynamic (MHD) model, and the empirical solar wind forecast (ESWF) model, which uses the relationship between the fractional coronal hole area and solar wind speed. Our deep learning model predicts solar wind speed over 3 days ahead using extreme-ultraviolet (EUV) images and up to 5 days of solar wind speed data before the prediction date. We conduct our comparison over the test period of October–December for the years 2012–2020 and evaluate the models with respect to both the solar activity phase and the entire period. To validate the model's performance, we use two verification methods: a statistical approach and an event-based approach. For statistical verification during the entire period, our model outperforms the other empirical models, with a much lower mean absolute error (MAE) of 51.4 km/s and root mean squared error (RMSE) of 68.6 km/s, with a much higher correlation coefficient (CC) of 0.69. For the event-based verification for high-speed solar wind streams (HSSs), our model has superior performance in most of the six metrics evaluated within a ± 1-day time window. In particular, it achieves a high success ratio (SR) of 0.82, emphasizing the model's stable performance and ability to minimize false alarms. These results show that our deep learning model has strong potential for practical application as a reliable tool of fast solar wind forecasting with its high

accuracy and stability.

[P-41] Development of Cable Connectors for Reducing Electromagnetic Interference Noise in Satellite Electromagnetic Compatibility Testing

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

Korea Aerospace Research Institute

During satellite electromagnetic Compatibility testing, many units in the Engineering Model (EM) and Qualification Model (QM) are unable to use Flight Model (FM) cable connectors. Instead, custom cable connectors manufactured by the vendor are used, which can cause noise generated through these connectors to lead to failures in CE (Conduction Emissions) and RE (Radiated Emissions) tests. This study aims to develop cable connectors that help reduce EMI noise during satellite electromagnetic Compatibility testing.
Through numerous satellite electromagnetic Compatibility tests, it was observed that the inside of the custom cable connectors was hollow. To address this issue, a conductive material was inserted inside the connectors to prevent noise emission. Testing showed that this modification effectively reduced EMI noise compared to the initial condition. In this paper, we introduce this noise reduction method for satellite electromagnetic Compatibility testing and verify its effectiveness.

[P-42] Measurement of Cosmic-Ray Neutron Energy Distribution and Fluence at Various Altitudes

Sinchul Kang, Jungho Kim, Joong Hyun Kim, Hyeonseo Park, Young Soo Yoon

Korea Research Institute of Standards and Science

Galactic cosmic rays consist primarily of protons. However, their interactions with atmospheric particles generate secondary cosmic rays, including muons and neutrons. These secondary particles can reach the Earth's surface. Cosmic-ray neutrons contribute only a small fraction of total environmental radiation fluence. However, high-energy neutrons can affect semiconductor and memory devices, making precise measurements of their energy distribution and fluence necessary. For this purpose, the Korea Research Institute of Standards and Science (KRISS) developed a mobile neutron detection system for measurements at various locations. The system comprises two bare He-3 tube-type thermal neutron detectors and eight thermal neutron detectors, each coupled with a differently sized moderator. These detectors were mounted on a mobile platform and deployed across multiple locations to measure neutron energy and fluence at different altitudes. We will present the measured energy distribution and fluence of cosmic-ray neutrons at different altitudes.

[P-43] Diurnal Variation of Neutral Winds and Their Role in Sporadic E Layer Formation Over the Korean Peninsula

Jaewook Lee[1], Young-Sil Kwak[1,2], Tae-Yong Yang[1]

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

The Sporadic E (Es) layer is a thin and high-density plasma layer that forms at altitudes of approximately 100 to 150 km. Due to its high plasma density, the Es layer can significantly affect radio and satellite communications. At mid-latitudes, the Es layer is known to consist mainly of metallic ions and is primarily formed through wind shear in the neutral atmosphere. Although various approaches, including modeling, satellite-based measurements, and ground-based observations, have been employed to study the Es layer, there are limitations in measuring neutral atmospheric winds at Es-forming altitudes. As a result, the relationship between neutral winds and Es layer formation has only been observed only intermittently or under specific conditions. To better understand the diurnal variation of neutral winds and their role in the development and persistence of the Es layer, continuous observations are essential. In this study, we aim to investigate the relationship between the diurnal variation of neutral winds and the occurrence of Es layers over the Korean Peninsula. For this purpose we utilize neutral wind data from the Michaelson Interferometer for Global High-resolution Thermospheric Imaging (MIGHTI) onboard the Ionospheric Connection Explorer (ICON) satellite and Es layer data obained from Ionosonde measurements at Icheon and Jeju from December 2019 to November 2022.

[P-44] Development of Deep Learning Models for the Determination of CME 3-D Parameters

Hyeonock Na[1], Yong-Jae Moon[1,2]

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

We develop two deep learning models to determine three-dimensional parameters of coronal mass ejections (CMEs), using convolutional neural network (CNN) methods and synthetic CME images. Model 1 estimates four parameters (radial height, angular width, latitude, and longitude) from a single synthetic CME image. Model 2 estimates two parameters (radial height and angular width) from a single synthetic CME image and its source location (longitude and latitude). We generate 462,500 synthetic CME images with different three-dimensional parameter sets: 370,000 for training, 46,250 for validation, and 46,250 for testing. The root mean square (RMS) errors of the parameters

from the model 1 with test data sets are 0.46Rs for radial height, 2.0° for angular width, 1.0° for latitude, and 2.8° for longitude. For the model 2, the RMS errors are 0.25Rs for radial height, 1.0° for angular width. We also apply these models to several CME events observed by SOHO/LASCO C3. These results are compared with three-dimensional parameters obtained from a full ice-cream cone model.

[P-45] Statistical Study of Upstream Waves Using Cross-Phase Analysis from KPLO and THEMIS-ARTEMIS Observation

Junhyun Lee[1], Khan-Hyuk Kim[2], Ensang Lee[2], Ho Jin[2], Seul-Min Baek[1], Jungjoon Seough[1], Minsup Jeong[1], Chae Kyung Sim[1], Young-Jun Choi[1]

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

Upstream waves observed in the upstream region with frequencies ranging from 0.01 to 0.1 Hz are widely attributed to ions reflected at Earth's bow shock that move against the incoming solar wind. These wave phenomena are key to understanding the structure and dynamics of the foreshock and the broader interaction between the solar wind and Earth's magnetosphere. This study presents a statistical analysis of upstream wave propagation characteristics using magnetic field observations from the KPLO and THEMIS-ARTEMIS missions over a two-year interval spanning from January 2023 to December 2024. The three spacecraft, posed within ~1 R_E inside the upstream solar wind region, offer a configuration for analyzing wave propagation in space. We perform cross-phase analysis on time intervals where the wave signals show coherence values over 0.6 for durations longer than 10 min to extract wave propagation information. The wave propagation velocity between the two observation points can be determined in the spacecraft reference frame. By analyzing phase shifts between the two spacecraft, we determine the corresponding time lags, which are then used to calculate the wave propagation velocity in the spacecraft frame. When the propagation velocity is comparable with the solar wind reference frame, the waves show nearly zero-phase velocity. This result implies that the observed upstream waves are not propagating but passively transported by the solar wind flow. In this study, we will discuss how and where these waves are generated.

[P-46] Impact of Increasing CO_2 Concentration on Diurnal Tide with Zonal Wavenumber 1: Mesospheric Cooling and Tropospheric Warming Effects

Masaru Kogure[1], Huixin Liu[2], In-Sun Song[1]

[1]*Department of Atmospheric science, Yonsei University*
[2]*Department of Earth and Planetary Science, Kyushu University, Fukuoka, Japan*

The CO_2 concentration has increased since the Industrial Revolution (IPCC AR 6, 2021). According to the World Data Centre for Greenhouse Gases, the global mean CO_2 concentration reached 420 ppm in 2023, and this upward trend is expected to persist throughout the century. Rising CO_2 levels have led to warming in the troposphere while causing cooling in the stratosphere, mesosphere, thermosphere, and ionosphere.

Numerous studies have examined the thermodynamic impacts of these changes on atmospheric dynamics, particularly in the troposphere. However, the impacts on interactions between the lower, middle, and upper atmosphere — known as atmospheric vertical coupling — remain poorly understood. Since vertical coupling is primarily driven by atmospheric waves (e.g., Rossby waves, gravity waves, and tidal waves), this study explores how increasing CO_2 concentration affects atmospheric waves, with focus on the diurnal tidal wave with zonal wavenumber 1 (DW1).

DW1 tides dominate the equatorial mesosphere and lower thermosphere (MLT), with their energy largely confined to lower latitudes (± 30°N/S). They are generated in the troposphere, primarily due to solar radiation absorption by water vapor, and propagate upward to the lower thermosphere (~110 km). Their propagation is modulated by background wind and temperature variations in the middle atmosphere.

To examine the impact of increasing CO_2 concentration on DW1 tides, we conducted a long-term simulation (2000–2079) using WACCM-X with a horizontal resolution of 1.9° × 1.7°. CO_2 concentration was specified using historical observations until 2014, after which it followed the Representative Concentration Pathway 8.5 (RCP 8.5), meaning CO_2 concentration on the surface increased from ~370 ppm in 2000 to ~810 ppm in 2079. Since the upper limit of Fomichev non-LTE CO_2 cooling parameterization is 720 ppm, we analyze the simulation data up to June 2068, when CO_2 concentration at surface exceeds this limitation. Solar cycle activity was also specified using historical observations until 2014, and from 2015 onward, it was simulated by rewinding the solar forcing from 1850.

We derived monthly mean temperature amplitudes of the DW1 (1, 1) mode component, which is the predominant propagating mode in the equatorial MLT, and examined its trends across 20–110 km altitude. Notably, the DW1 amplitudes decreased at 90–110 km ($-2.8 \times 10^{-2} \pm 6.3 \times 10^{-3}$ K/year) but increased at 20–70 km (e.g., $2.3 \times 10^{-3} \pm 1.2 \times 10^{-4}$ K/year at 50–70 km). These findings suggest that increasing CO_2 concentration enhances DW1 source activity in the troposphere, primarily through increased solar radiation absorption by water vapor and latent heat release. However, DW1 dissipation above ~90 km likely intensifies, outweighing the positive contribution of the source activity.

To further investigate the tidal propagation under the increasing

CO_2 condition, we compared DW1 (1, 1) amplitudes between two periods: January 2003–December 2013 and December 2050 –November 2061. These periods are selected because they have similar mean F10.7 values and standard deviations (95.9 ± 26.6 sfu in 2003–2013 vs. 95.8 ± 23.4 sfu in 2050–2061). Note that the mean CO_2 concentration in 2050–2061 is 608 ppm at surface, which is 58% higher than in 2003–2013. The comparison indicates a 1–10 percent increase in amplitudes at ~40–80 km in 2050–2061 compared to 2003–2013. In contrast, amplitudes above ~82 km were lower, decreasing further with altitude. Consequently, amplitudes at 92–110 km decreased by 8–13% in 2050–2061 relative to 2003–2013.

Since tidal dissipation depends on vertical wavelengths, we estimated DW1 vertical wavelengths. Between ~55–82 km, vertical wavelengths in 2050–2061 were ~3 km shorter than those in 2003–2013 at maximum. This reduction could be linked to strong cooling in the ~50-70 km range, which increases the Brunt-Väisälä frequency at ~55–82 km. Above ~82 km, vertical wavelengths in 2050–2061 were comparable to or greater than those in 2003–2013. However, effective vertical diffusion due to gravity wave parameterization increased by ~5–15% around the equatorial MLT (~70–100 km). In summary, while the DW1 tidal source strengths the tide up to ~82 km altitudes due to the increasing CO_2 concertation, the tidal dissipation intensifies due to shorter vertical wavelengths at ~72–82 km and enhanced GW vertical diffusion at ~70–100 km.

This presentation will highlight the negative trend of the DW1 (1, 1) mode tide in the MLT region simulated by WACCM-X and discuss the underlying mechanisms driving this negative trend.

[P-47] Seasonal Variation of Daytime Electron Density Irregularity Distributions in the Bottom and Top Sides of the Low Latitude F Region

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

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

The occurrence rate of daytime electron density irregularities in the low-latitude F region exhibits different seasonal patterns in the Northern Asian sector, depending on the dataset used. This study examines this discrepancy using Beidou TEC data (2017–2021) and ion density measurements (2020–2021) from the Ionospheric Connection Explorer (ICON) satellite during a period of solar minimum. To further investigate the discrepancy, vertical TEC profiles (2016–2017) from the radio occultation (RO) experiment onboard the Constellation Observing System for Meteorology, Ionosphere, and Climate (COSMIC) are utilized. In the Northern Asian sector, the irregularity occurrence rate around the December solstice is higher than that around the June solstice when driven by Beidou TEC data. In contrast, the seasonal pattern derived from ICON data shows the opposite behavior. These observations are consistent with results from previous studies. The COSMIC/RO data reveal altitudinal variations in the seasonal irregularity occurrence pattern: the occurrence rate around the December solstice is greater than that around the June solstice in the bottomside, whereas the seasonal pattern on the topside exhibits the opposite behavior. Thus, the seasonal patterns on the bottomside and topside align with those derived from the Beidou TEC and ICON data, respectively. These findings suggest that Beidou TEC perturbations during the daytime are primarily driven by irregularities on the bottomside.

[P-48] Radio Dimming Associated with Filament Eruptions in the Meter and Decimeter Waveband

Maria Sotirova Madjarska-Theissen[1], Zhenyong Hou[2], Hui Tian[2,3], Jingye Yan[3,4,5], Jiale Zhang[2], Yu Xu[2], Hechao Chen[6], Zhao Wu[7], Lin Wu[3,4,5], Xuning Lv[3,4,5], Yang Yang[3,4,5], Yujie Liu[3,4,5], Li Deng[3,4,5], Li Feng[8], Ye Qiu[9]

[1]*Korea Astronomy and Space Science Institute*
[2]*School of Earth and Space Sciences, Peking University, Beijing, China*
[3]*Key Laboratory of Space Weather, Chinese Academy of Sciences, Beijing, China*
[4]*National Space Science Center, Beijing, China*
[5]*Radio science and technology center (π center), Chengdu, China*
[6]*School of Physics and Astronomy, Yunnan University, Kunming, China*
[7]*School of Space Science and Technology, Shandong University, Weihai, China*
[8]*Purple Mountain Observatory, Nanjing, China*
[9]*School of Astronomy and Space Science, Nanjing University, Nanjing, China*

Filaments and their eruptions are common phenomena on the Sun and other stars. However, they are rarely directly imaged in the meter and decimeter wavebands. We present two eruptive filaments that manifest as radio dimmings (i.e., emission depressions) using imaging data from DART in the 150–450 MHz frequency range. Simultaneous chromospheric observations show portions of these eruptive filaments as dark features. The sun-as-a-star flux curves of brightness temperature, derived from the DART images, exhibit obvious radio dimmings. The dimming depths range from 1.5% to 8% of the background level and show a negative correlation with radio frequencies and a positive correlation with filament areas. Our investigation suggests that radio dimming is caused by free-free absorption during filament eruptions, obscuring the solar corona. These results suggest a new method for identifying stellar filament eruptions.

[P-49] Auroral Height Estimation with Overlapping Observations from Jang Bogo Station and Cape Hallett in Antarctica

Ji Eun Kim, Hyuck-Jin Kwon, Changsup Lee, Geonhwa Jee, Young-Bae Ham

Korea Polar Research Institute

This study presents the initial procedures and preliminary results from comparing simultaneous auroral observations at 557.7 nm using all-sky cameras located at Jang Bogo Station (JBS, 74.62°S, 164.22°E) and Cape Hallett (72.31°S, 170.23°E, geomagnetic coordinates: 77.16°S, 60.69°W) in Antarctica. Cape Hallett provided two years of data collected using cameras equipped with 630.0 nm and 557.7 nm filters, while JBS employed cameras with filters at 630.0 nm, 557.7 nm, and 427.8 nm. Cape Hallett is located approximately 320 km from JBS, allowing overlapping auroral observations. This overlap enables the use of triangulation methods to determine auroral emission heights. However, initial analyses indicate that there are limitations due to the small number of overlapping events with suitable auroral shapes (e.g., arcs and clearly defined discrete structures such as rays), making accurate height calculation difficult. Current efforts focus on refining the process to estimate auroral emission heights more reliably across various auroral shapes.

[P-50] Reconstructing the EUV Solar Corona Using a Global Solar Wind Model with Nonthermal Electrons

Jin-Yi Lee[1], Junmo An[2], John C. Raymond[3], Chengcai Shen[3]

[1]*Kyung Hee University*
[2]*Korea Astronomy and Space Science Institute*
[3]*The Center for Astrophysics | Harvard & Smithsonian*

We reconstruct EUV emission in the solar corona using a global 3D MHD solar wind model with nonthermal electrons. Charge states are calculated using a time-dependent ionization model incorporating nonthermal electrons. These calculated charge states are then used to reconstruct the EUV emission. For comparison with observations, we integrate the reconstructed emission along the line of sight and analyze the differences. Finally, we discuss the nonequilibrium effects in the EUV solar corona.

[P-51] Hα Dark Blobs and Transparent Regions of Fan-shaped Jets

Heesu Yang[1], Maria Madjarska-Theissen[1,2,3], Eun-Kyung Lim[1], Daniel Nóbrega-Siverio[4,5,6,7]

[1]*Korea Astronomy and Space Science Institute*
[2]*Max Planck Institute for Solar System Research, Göttingen, Germany*
[3]*Space Research and Technology Institute, Bulgarian Academy of Sciences, Acad. Sofia, Bulgaria*
[4]*Instituto de Astrofísica de Canarias, Tenerife, Spain*
[5]*Universidad de La Laguna, Department of Astrofísica, Tenerife, Spain*
[6]*Rosseland Centre for Solar Physics, University of Oslo, Oslo, Norway*
[7]*Institute of Theoretical Astrophysics, University of Oslo, Oslo, Norway*

We investigate internal features of fan-shaped jets and their properties and evolution using high-resolution imaging and spectroscopic co-observations from the Visible Imaging Spectrometer (VIS) of the Goode Solar Telescope (GST) at the Big Bear Solar Observatory (BBSO) and the Interface Region Imaging Spectrograph (IRIS) together with data from the Atmospheric Imaging Assembly (AIA) on board the Solar Dynamic Observatory (SDO). We aim to investigate features that appear as blob-like structures at the edges of the jets and are only visible in absorption in the Hα line, which we call 'dark blobs', and a transparent region observed beneath the dark blobs creating a gap between the dark blobs and the trailing body of the jet in Hα images. The dark blobs have a cross-section of about 0.2–0.3 asc. The transparent region is seen in emission in the IRIS SJ 1330Å channel images. The blobs and the transparent region are associated with oscillating EUV brightenings at the leading edge of fan-shaped jets seen in the IRIS and AIA data. The IRIS Si IV 1394Å and 1403Å spectra of the brightenings show blue-shifted emission of about 25 km/s with non-thermal velocities of up to 40 km/s at the leading edge of the jets. Our findings may suggest that we detect the observational signatures of shock waves that generate and/or contribute to the evolution of fan-shaped jets.

[P-52] A Telemetry Generation and Replay Method for a Low Earth Orbit Satellite

Seung-Eun Yang

Korea Aerospace Research Institute

Telemetry is used to monitor the status of the satellite and receive payload data. The contact time of a LEO (Low Earth Orbit) satellite is very limited because of its orbital characteristic. It is difficult to manage a LEO satellite with only real time telemetry because most of the generated data is not delivered to ground. Therefore, state-of-heart and science data is collected and stored into mass memory all the time and transmitted to ground at contact section. Ground station monitor the status of the satellite through the replayed data. However, the transmitted stored data can be contaminated because of instability in

communication. The contaminated packet should be re-transmitted as soon as possible because the mass memory is overwritten by newly collected data. In this paper, the stored telemetry data replay process in mass memory is introduced. Especially, the re-transmit method of the contaminated packet is described to prevent loss of satellite telemetry data.

[P-53] Study on Configuration Management Approach for Satellite Development Using Ontology Concept

Chul Kang

Korea Aerospace Research Institute+

Satellite development projects are multi-disciplinary systems that require a high level of precision and complexity, making systematic management of various development artifacts and configurations essential. A satellite consists of multiple subsystems, including Structural System, Power System, Propulsion System, Attitude and Orbit Control System (AOCS), Thermal Control System, Telemetry, Tracking & Command (TT&C), and Assembly & Testing. Each subsystem is independently designed, developed, and verified. Throughout this process, numerous technical documents, configuration change histories, and test data are generated, and maintaining traceability and interrelationships between these artifacts is crucial.

Traditional Configuration Management (CM) systems primarily utilize document-based or database-driven approaches to manage artifacts. However, these conventional methods have limitations in clearly representing relationships between components. As development progresses, system complexity increases, and interdependencies between individual components grow, making it challenging to analyze the impact of changes across the entire system. Therefore, a more effective configuration management approach is required, and an ontology-based configuration management system is proposed as a solution.

[P-54] Availability Analysis of GEO-KOMPSAT-3 Ground Station

Jinhyung Park

Korea Aerospace Research Institute

The availability is one of the most important requirement for a satellite ground station. The aim of ground station is stable monitoring & control and operations of satellite. Availability is a quantitative measure of this goal. The Korea Aerospace Research Institute (KARI) launched and is operating COMS satellite in 2010, GEO-KOMPSAT-2A (GK2A) in 2018. Also, KARI plans to launch GEO-KOMPSAT-3 (GK3) in 2027. In this paper, we analyze the availability of the geostationary satellite ground stations operated and by KARI. And, we analyze the availability of GK3 ground station using result of COMS and GK2A. Based on the analysis result, KARI will develop more stable and reliable geostationary satellite ground system.

[P-55] Design Procedure for Satellite Component Shock Test Equipment

Jong-Hyub Jun, Jong-Min Im, Hee-Kwang Eun, Nam-Jin Moon, Seon-Je Jo, Jin Park, Chang-Rae Cho, Tae-Seok Oh

Korea Aerospace Research Institute

Shock testing is a critical process to verify the durability and reliability of satellite components under extreme launch and space environments. This paper outlines a systematic design procedure for developing new shock test equipment through benchmarking existing systems. The study emphasizes the importance of simulating realistic shock conditions, such as those caused by launch vehicle separation or pyrotechnic device activation, which are known to pose significant risks to satellite components. Key steps in the design process include requirements analysis, conceptual design, detailed design, manufacturing, and verification. Benchmarking revealed strengths and limitations of pyrotechnic and non-pyrotechnic systems, guiding the selection of optimal shock generation mechanisms and resonant structures. The proposed equipment integrates advanced measurement systems to ensure accurate data acquisition and repeatability while adhering to international standards. This research contributes to enhancing the reliability of satellite components and provides a foundation for future innovations in shock testing technology.

[P-56] Visibility-Constrained Attitude Planning for Celestial Observation by an Earth-Observing Satellite

Jeong Hoon Hyun

Korea Aerospace Research Institute

To calibrate onboard cameras, Earth-observing satellites perform celestial observations targeting stars and deep space. Star trackers are typically mounted to avoid direct exposure to the Earth, Sun, and Moon in order to maintain reliable attitude sensing for standard Earth-observation missions. However, during celestial observation missions-which are secondary to the satellite's primary Earth-imaging objective-dedicated attitude planning is required to ensure continuous visibility. I propose a hybrid framework that combines guided RRT with nonlinear optimization to generate a sequence of smooth attitude trajectories that satisfy visibility constraints throughout the maneuver.

[P-57] Simulation of Arbitrary Imaging Direction for Low Earth Orbit Satellite

Kyun-Sang Park

Korea Aerospace Research Institute

This study performs the calculation and simulation of arbitrary Earth observation directions for Low Earth Orbit (LEO) satellites. The observation direction of a LEO satellite is a crucial factor for performing arbitrary-direction imaging missions, as it varies depending on the observation area and the satellite's orbit. Using MATLAB, simulations were conducted to calculate and analyze the Earth observation direction under specific orbital conditions. This study models the geometric relationship between the satellite's position and the observation target, proposing an algorithm to define and calculate the observation direction. Based on this method for setting observation directions, it is expected to be used for planning arbitrary-direction imaging missions from the ground station.

[P-58] Study on Automated Nighttime Imaging Schedule Modification for KOMPSAT-3A

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

Korea Aerospace Research Institute

The currently operational KOMPSAT-3A is an optical satellite equipped with an IR sensor, enabling nighttime imaging. It is essential to capture images promptly for various urgent situations such as disasters and accidents occurring at night. This requires a process to modify pre-planned imaging schedules. The decision to change imaging schedules is made by considering various factors from an operational perspective, such as whether the satellite can image the specific area, and whether it will impact memory, previous imaging and data reception. Currently, emergency imaging requests at night are handled through operator intervention. However, there is a need to develop an automated capability to process these requests without operator intervention in the future.

[P-59] Status of Satellite Image Processing Systems: Domestic and International Perspectives

Lammi Choi, Min-A Kim

Korea Aerospace Research Institute

Satellite image processing systems play a crucial role in remote sensing, Earth observation, and various space applications. Over the years, advancements in satellite technology have significantly improved image acquisition, transmission, and processing capabilities. This paper presents an overview of the current status of satellite image processing systems, comparing domestic and international developments. It examines key technologies, system architectures, and recent innovations in data reception, cataloging, and product generation. Furthermore, the study highlights ongoing research efforts, emerging trends, and challenges in the field. By analyzing the progress in both domestic and global contexts, this paper aims to provide insights into the future direction of satellite image processing systems.

[P-60] Core Technology Identification for Laser-Based Optical Ground Stations

Hyunsu Lim

Korea Aerospace Research Institute

Recently, there is a trend to extend optical communications to not only inter-satellite links but also satellite-ground communications for high-speed data transmission, replacing the previously used high-frequency Ka/Ku bands. This paper presents a focused trend analysis to derive the core technologies essential for the development of laser-based optical ground stations. By reviewing current trends and examining relevant NASA/ESA projects, the study identifies key technological advancements and challenges in the field. Additionally, the global market landscape and various configurations of optical ground stations —ranging from tranporation type to fixed installations and unidirectional to bidirectional systems—are discussed. The insights gained from this analysis provide a clear roadmap for future research and development in this rapidly evolving domain.

[P-61] Development of Flight Software for On-Board Time Function on GEO Satellite

Soo-Yeon Kang, Jae-Yeop Jeong

Korea Aerospace Research Institute

The On-Board Time (OBT) of the geostationary (GEO) satellite which has been under development by Korea Aerospace Research (KARI) is provided and managed by satellite flight software. This OBT is generated by OBT component in flight software and managed based on the Real-Time Clock (RTC). OBT component provides 1Hz Interrupt Service Routine (ISR) and 50 HZ ISR for processing 1Hz RTC Interrupt and 50 Hz RTC interrupt. And It also detects and corrects 1Hz Phasing error and sends heartbeat signal to Reconfiguration Unit (RU) to notify RU that On-Board Computer is alive. OBT Component manages sub-minor cycle count for flight software scheduling. This paper introduces the overall functions of the RTC FPGA and describes the requirement for OBT component in flight software. Also We present the current status of the design and implementation of the satellite flight software for implementing the OBT function in this paper.

[P-62] The SKA Project: Status and Korean Participation

Bong Won Sohn

Korea Astronomy and Space Science Institute

The Square Kilometre Array (SKA) project represents a global collaboration to construct the largest and most sensitive radio telescope in history. Located in Australia and South Africa, the SKA will observe a vast frequency range from 50 MHz to 15 GHz, enabling unprecedented surveys of the sky with unparalleled sensitivity and speed. The SKA is being built in two phases; SKA1, scheduled to commence scientific observations in 2030, will comprise approximately 10% of the final telescope's collecting area.

The SKA is projected to generate immense datasets, on the order of 700 petabytes annually. The distributed management and provision of this data to users across SKAO member states presents significant computational and logistical challenges.

The SKA's scientific goals are transformative, aiming to address key questions in modern astrophysics. These include the early universe, the nature of dark energy and dark matter, galaxy evolution, the detection of gravitational waves, and the search for extraterrestrial life. The SKA is poised to revolutionize astronomical research.

With the Korea AeroSpace Administration (KASA)'s decision to participate in the SKA project, Korea is committed to playing a key role in both the construction of the SKA and the development of the SKA-VLBI (Very Long Baseline Interferometry) network. Korea also aims to contribute to the international SKAO effort through participation in an SKA Regional Centre. This talk will provide an overview of the SKA project's current status and detail Korea's comprehensive plan for participation.

[P-63] Enhancing Safety and Sustainability in Low Earth Orbit: An Analysis of SPD-3 and STM Technologies

Myung Kyu Kim[1], Alina Shymanska[2], Seunghwan Choi[2], Joonghyun Ryu[2], Deok-Soo Kim[2]

[1]*Hanyang University Mechanical Engineering*

[2]*SPACEMAP*

The rapid increase of Low Earth Orbit (LEO) satellites has boosted advanced Space Situational Awareness (SSA) and Space Traffic Management (STM) systems. The STM system is key to maintaining safe and stable space operations. This research analyzes United States STM policy based on the former Trump administration's Space Policy Directive-3 (SPD-3) and explores major STM technologies.

SPD-3 highlighted the safety, stability and operational sustainability in space operations. SPD-3 defined STM as activities of planning, coordination, and on-orbit synchronization to enhance the safety, stability and sustainability of space operations. SSA is defined as knowledge and description of space objects and surrounding environment to assist the safety, stability and sustainability of space operations. As United States want to maintain leadership in space, innovations in SSA and STM are essential and must be prioritized within science and technology (S&T). To fulfill these objectives, SSA coverage and accuracy should be improved by deploying updated sensors in space and on Earth. Encouraging private commercial enterprises to enter the space market is another key policy, leading to the transfer of certain space-related responsibilities from the Department of Defense (DoD) to the Department of Commerce (DoC). SPD-3 also emphasized the integration of data collection, starting the Open Architecture Data Repository (OADR) project.

Additionally, SPD-3 requested about improvement of Orbital Debris Mitigation Standard Practices (ODMSP), which are guidelines to minimize orbital debris risk. ODMSP provides standardized procedures throughout the life cycle of satellites, which ensures long-term sustainability and operational safety of the space environment. With these policies, United States aim to establish global standards for STM and keep the leadership in space.

Major STM technologies could be categorized into SSA system, sensor networks, data repositories and predictive data analytics. SSA system is a vital enabling system for STM, providing real-time information about space objects and the operational environment for effective STM implementation. Multiple sensors, which include optical, radar, radio frequency, and laser sensors, located in Earth orbit or on the ground to track space objects. These sensors measure distance by calculating signals between sensors and space objects, as well as determining speed by analyzing reflected signals. Radar sensors are commonly used in military purposes. Each sensor type has strengths and weaknesses, which make spacefaring nations deploy diverse sensors to improve coverage and accuracy. After acquiring SSA data from multiple sensor suppliers, collected data is integrated into OADR which is known as Unified Data Library (UDL). The UDL provides data to contracted customers based on classified ranks. With this data, satellite operators and military users conduct conjunction assessment and collision avoidance processes through predictive modeling with Artificial Intelligence (AI) and big data analytics. This process ensures safety and stability of space operations.

This research was initiated due to the growing number of satellites in LEO, causing significant space management problems. As analyzing the policies of spacefaring nation is helpful for the field, it aims to analyze United States STM policies in SPD-3, emphasizing basic role of SSA and importance of ODMSP for debris mitigation. Finally, research aims to provide insights for enhancing safety and sustainability of space operations.

분과 소개

우주감시분과

“우주감시분과”는 우주공간의 환경 보호와 감시, 우주 위험의 예방 및 대비 등 우주상황인식(Space Situational Awareness, SSA) 및 우주위험감시 분야에 대한 학술활동 및 네트워크 구축을 위하여 설립되었습니다. 본 분과는 한국천문연구원 박장현 회원을 초대 분과장으로 하여 2018년에 시작되었고, 한국천문연구원 최은정 회원이 2021~2022년 분과장을 맡아 활동하였습니다. 현재 KAIST 안재명 회원이 2023~2025년 분과장을 맡고 있고, KAIST 이동현 회원이 간사를, 한국천문연구원 김명진 회원, 세종대학교 김은희 회원, 한국항공우주연구원 성재동 회원, 한국천문연구원 최진 회원이 운영위원으로 활동 중입니다.

우주감시분과에서는 매년 우주과학회 봄/가을 학술회의에서 우주감시 Organized Session과 우주감시분과 워크숍을 개최하며, 해당 분야 연구 정보 공유와 저변 확대를 위해 노력하고 있습니다. 2024년에는 우주과학회 추계 학술회의기간 중(10월 29일, 사천 KB 인재니움 연수원), “우주 지속가능성(Space Sustainability) 워크숍”을 개최하였습니다. 해당 워크숍에서는 산/학/연 전문가들이 모여서 거대군집위성, 능동적 우주물체 제거, 궤도상 서비스 등 새로운 우주시대에 대응하여 필요한 정책적 기술적 안전 조치를 논의하는 뜻깊은 시간을 가졌습니다.

우주감시분과에서는 학계, 산업계, 연구기관, 그리고 군에 소속된 70여 명의 회원들이 적극적으로 활동 중입니다. 관심 있는 회원님들의 많은 참여를 기대합니다.

우주관측기기분과

■ 소개

우주관측기기 분과는 천문우주관측기기 관련 연구 활동을 증대하기 위해 2018년 5월 봄학술대회 때 창립총회를 거쳐 탄생하였습니다. 당시 47명의 회원으로 한국천문연구원 문봉곤 책임연구원을 초대 분과장으로 선출하였고, 또한 2기 분과장으로 재임하였습니다. 2022년 10월에 3기 분과장으로 한국천문연구원 한정열 책임연구원이 새로 취임하였습니다. 우리 분과는 한국천문학회 천문관측기기분과와 공동으로 매년 천문우주관측기기워크숍을 개최하고 있습니다. 이를 통해 광학, 광기계, 전자, 제어 소프트웨어, 시스템, 시스템 운영 관리, 데이터 처리 등 다양한 분야의 연구자 간 교류 및 대학·대학원 학생의 참여의 기회를 지속적으로 유도하고 있습니다. 아울러 우주관측기기의 국제적인 이슈를 논의하고 이에 대한 학술적인 지원과 정책적 판단의 자료를 공유하고 있습니다.

■ 활동내역

2018년부터 재개한 천문우주관측기기 워크숍이 2024년 14회째 진행되고 있습니다. 2024년 7월 3~5일 경주 황룡원에서 '2024년 제14회 천문우주 관측기기 워크숍'을 개최하였습니다. 2024년 천문우주관측기기 워크숍은 3일간 6개의 발표세션에서 총 106명의 참석자(일반회원 52명, 대학원생 40명, 후원업체: 14명)가 모여 총 45편 발표(초청강연 3편, 구두발표 39편, 포스터발표 3편)가 있었습니다. LIG넥스원, 그린광학, ㈜래디언트솔루션, 레오스페이스㈜, 스페이스빔, 한화시스템, 에이디솔루션, SpaceSCANeR, 에스엠테크 등 9개 패밀리 기업이 참가하였습니다. 여름학교는 광학설계 및 공차분석을 주제로 1일 동안 진행되었으며 27명의 천문우주학 및 관측기기 관련 대학교 학부생 참가했습니다.

■ 계획

2025년에도 한국천문학회 천문관측기기분과가 주도하는 천문우주관측기기 워크숍에 공동 주관을 맡아 진행합니다. 아울러 우리 분과는 SPIE(The International Society for Optics and Photonics) 국제 컨퍼런스의 국내 유치를 준비하고 있습니다.

2024 천문우주관측기기 워크숍 단체기념촬영

2024 천문우주관측기기 워크숍 기간 중에 진행한 여름학교

우주탐사분과

달 탐사로 시작된 우리나라의 우주탐사 시대를 준비하기 위하여 우주탐사 분야의 학술교류와 홍보를 수행하고, 인재양성과 교육 방안에 대해서 논의를 수행할 분과의 필요성이 대두됨에 따라 2015년 4월 우주탐사분과가 설립되었습니다.

우주탐사분과는 우주탐사선, 탑재체, 발사체, 지상시스템, 과학임무 연구와 우주탐사를 통하여 획득되는 탐사 데이터의 활용 등 우주탐사와 관련된 과학과 기술의 연구개발에 관한 학술교류, 정책의 제안과 논의 등을 활동 목표로 하고 있습니다. 이를 위하여 우주탐사분과는 학술대회의 우주탐사 분야의 세션 구성을 담당하고 있으며, 2024년에는 우주탐사 정책에 관한 범기관적 논의를 위해서 학회의 정책위원회와 함께 우주정책포럼을 2차례 수행하였습니다. 또한 우주분야의 학술용어가 연구자 간에 원활하게 소통될 수 있도록 수행된 학술용어정비사업에서 우주탐사 분야의 용어를 정비한 바 있습니다. 2025년에는 다양한 과학목표와 임무목적으로 수행하게 될 우리나라의 우주탐사의 계획과 방향성에 대해서 논의할 우주탐사 워크샵도 개최할 예정입니다.

1. 활동목표

우주탐사분과는 우주탐사 과학임무와 임무데이터의 활용 등 과학분야 연구와 탐사선, 탑재체, 발사체, 지상국의 개발 등 기술분야의 개발을 촉진하고, 성과를 높일 수 있도록 우주탐사 제반 분야의 교류와 논의를 목표로 합니다.

❖ 세부활동 목표

- ➢ 우주탐사 관련 학술모임 및 연구교류
- ➢ 우주탐사 관련 기관 간 협력 및 공동연구 추진
- ➢ 국내 우주탐사 분야 발전계획 논의 및 제안
- ➢ 우주탐사 관련 연구 및 기술의 진흥과 정책수립에 대한 지원과 건의
- ➢ 우주탐사 과학임무 개발과 과학연구 수행에 관한 논의
- ➢ 우주탐사에 관한 국제 공동 과학연구 및 기술개발을 위한 논의

2. 연혁 및 구성 (2025년 1월 기준)

❖ 회원 수: 86명

❖ 분과 문의

- ➢ 우주탐사분과 위원장: 김주현 (한국항공우주연구원, kl0630@kari.re.kr)
- ➢ 우주탐사분과 간　사: 심채경 (한국천문연구원, cksim@kasi.re.kr)

초소형위성분과

지난 2020년 4월 발족한 초소형위성분과는 최초 발기인 40명에서 출발하여 25년 3월 현재 91명으로 회원수가 증가한 상태이며, 2024년 제9회 초소형위성 워크샵을 성공적으로 주관하였다. 9회 초소형위성 워크샵에는 산학연 관군 관계자 약 500여 명이 참석하는 등 우리 학회 최대 규모의 워크샵이자 국내 뉴스페이스를 선도하는 민군 연구자들이 모이는 자리로 자리매김하고 있다.

나날이 발전하고 있는 초소형위성분과는 지난 2024년 추계학술대회 기간 중 분과회의를 개최하여 차기 분과장으로 천문연 이재진 박사를 선출하였으며, 제3대 이재진 분과장은 2025년 가을학회부터 분과를 맡게 될 예정이다.

올해 제10주년을 맞이하는 초소형위성 워크샵은 5월 28일(수)부터 30일(금)까지 부산 해운대 웨스틴조선 호텔에서 개최될 예정이며, 산업체의 날과 네트워킹, 투자사와의 네트워킹, 스타트업들의 3분 홍보 스피치, 첫째 날 환영칵테일 파티 및 10주년 축하공연, 29일 목요일에 공식 만찬등 다채로운 프로그램으로 준비하고 있다.

태양우주환경분과

태양우주환경분과는 태양-행성간 공간, 자기권, 전리권/고층대기 영역 학술활동 교류와 협력을 위하여 2015년 설립되었습니다. 학술모임 개최, 관련 기관 간 협력, 국가/국제차원의 태양우주환경 분야의 발전을 위하여 활동하고 있습니다. 분과 회원은 우주과학회 정회원으로 구성되며 연구자 및 관련 업무자로 현재 약 125명의 회원이 활동하고 있습니다.

2013년 전리권/고층대기 연구자들의 학술 교류 및 협력을 위하여 시작된 워크숍이 태양-행성간 공간, 자기권, 전리권/고층대기를 아우르는 태양우주환경분과 워크숍으로 확장되었습니다. 이후 여름/겨울 학교 개최가 제안되었으며 이에 따라 2025년 1월 처음으로 겨울학교와 워크숍을 함께 개최하였습니다.

2025년 태양우주환경 겨울학교 및 워크숍은 우주과학회/태양우주환경분과, 천문학회/태양우주환경분과, 천문연구원이 공동 주관하고 SELab에서 후원하였습니다. 겨울학교 기간 동안 경북대, 경희대, 서울대, 연세대, 전남대, 충남대, 충북대, 항공대, 극지연, 천문연 총 10개 기관에서 학부생 및 대학원생 36명이 참석하여 “태양폭풍과 지자기폭풍”을 주제로 박사급 연구원 15명의 멘토와 함께 지자기폭풍 분석 실습을 하였습니다. 또한 학생들은 그 결과를 워크숍에서 발표하였습니다. 모든 일정을 수료한 학생들에게 수료증을 수여하였으며, 겨울학교 강의 및 조별 발표 자료와 워크숍 초청 발표 자료를 태양우주환경분과 홈페이지에 공유하였습니다.

2024년 우주과학회는 충북대 국어문화원과 공동으로 학술용어정비사업을 진행하였으며 태양우주환경분과에서는 약 200개 용어를 정리하였습니다. 각 용어의 정의문, 사용예시 등을 포함하여 그 뜻의 전달을 정확히 하고자 하였으며 국어문화원에서 정확하고 이해하기 쉬운 용어로 다듬는 작업을 하였습니다. 태양우주환경분과에서 정리된 용어는 회원들과 공유 예정입니다.

태양우주환경분과 초대 분과 위원장은 곽영실 회원(한국천문연구원)이 역임하였으며 이후 유광선 회원(한국과학기술원), 오수연 회원(전남대학교), 지건화 회원(극지연구소)에 이어 2024년 1월부터 이진이 회원(경희대학교)이 맡고 있습니다.

2025년 태양우주환경 겨울학교 및 워크숍

2024 KSSS Honors

학술상

손영종(연세대학교)

한국과학기술단체총연합회 과학기술우수논문상

지건화(극지연구소)

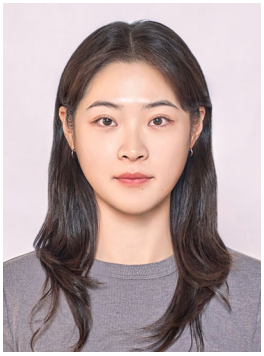
두진우주과학자상

이창섭(극지연구소)

신진 우주과학자상

감호식(한국천문연구원)

에스이랩상



조우인(경희대학교)

에스이랩상

강현지(경희대학교)

에스이랩상

이명규(조선대학교)

한국우주과학회보
제34권 1호 2025년 4월
전화 042-865-3391 (FAX: 042-865-3392)
학회 홈페이지 http://ksss.or.kr

발행인 박종욱
편집인 정종균 · 고미희
발 행 사단법인 한국우주과학회
인 쇄 ㈜거목문화사/거목인포(02-2277-3324)

학회 소재지 대전시 유성구 대덕대로 776 한국천문연구원 내
전화: 042-865-3391 / 팩스: 042-865-3392
학회대표메일: ksss@ksss.or.kr