# International Conference in Viet Nam

# SPACE SCIENCE & TECHNOLOGY

National University SOKENDAI
The Graduate University for Advanced Studies

## Ho Chi Minh City, Viet Nam

**Venue:** International University
Viet Nam National University HCMC

**Date:** 12 - 15 December 2017

# TABLE OF CONTENTS

# AIMS & IMPLICATIONS

## AIMS

The main goal of the conference is to promote research activities on Space Sciences (Solar Physics, Planetary Science, Space Exploration, Ground-based and Space Telescopes) and Technology (Remote Sensing, GPS, Pico Satellites, Rockets) in Viet Nam and other Asian countries as well. In order to promote space science and its applications in Viet Nam and other Asian countries, many experts from JAXA, SOKENDAI[1] and other institutes such as KASI[2] in Korea, and ASIAA[3] in Taiwan will be invited to give talks and to discuss collaboration with Vietnamese participants. The collaboration may include offering internships to Japan for excellent students of the 4-year training program in space engineering of International University and training students at Master/PhD levels. The conference also aims to promote international collaboration between Viet Nam and other East Asian countries as well, through extensive discussion among participants.

[1] SOKENDAI: The Graduate University for Advanced Studies
[2] KASI: Korea Astronomy and Space Science Institute
[3] ASIAA: Academia Sinica, Institute of Astronomy and Astrophysics

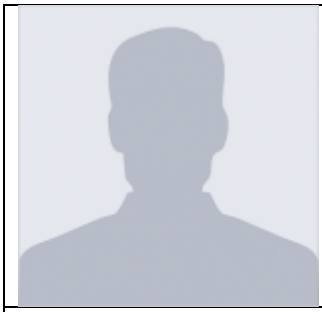
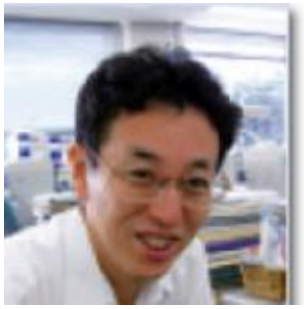
## IMPLICATIONS

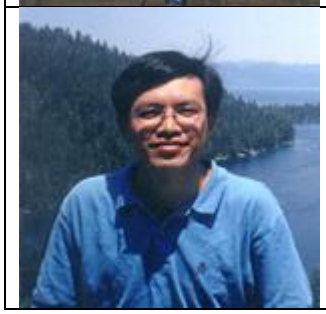
It is noteworthy that the conference is complementary or support event to APRSAF (Asian-Pacific Regional Space Agency Forum) held every year since 1993 in various countries in Asia. Viet Nam hosted AP-15 and AP-20 successfully.

# STEERING COMMITTEE

| | |
|---|---|
|  | **Huỳnh Thành Đạt**<br>*President*<br>Viet Nam National University Ho Chi Minh City<br>Viet Nam |
|  | **Châu Văn Minh**<br>*President*<br>Viet Nam Academy of Science and Technology<br>Viet Nam |
|  | **Hồ Thanh Phong**<br>*Rector*<br>International University<br>Viet Nam National University Ho Chi Minh City<br>Viet Nam |

# SCIENTIFIC ORGANIZING COMMITTEE

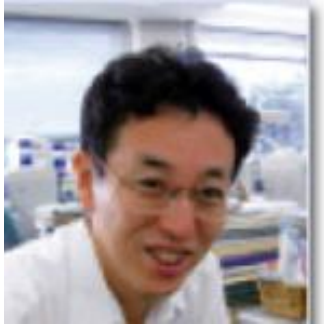
| | |
|---|---|
|  | **Ikko Funaki**<br>*Deputy director of International Strategy and Coordination*<br>Institute of Space and Astronautical Science<br>Japan Aerospace Exploration Agency<br>Japan |
|  | **Yuko Inatomi**<br>*Professor*<br>*Director of Department of Interdisciplinary Space Science*<br>Institute of Space and Astronautical Science<br>Japan Aerospace Exploration Agency<br>Japan |
|  | **Hideo Matsuhara (Co-Chair)**<br>*Professor of Department of Space Astronomy and Astrophysics*<br>Institute of Space and Astronautical Science<br>Japan Aerospace Exploration Agency, Japan<br>*Deputy chair of Department of Space and Astronautical Science*<br>National University SOKENDAI<br>Japan |
|  | **Phan Bảo Ngọc (Co-Chair)**<br>*Head of Department of Physics*<br>International University<br>Viet Nam National University Ho Chi Minh City<br>Viet Nam |
|  | **Young-Deuk Park**<br>*Principle Researcher*<br>Korea Astronomy and Space Science Institute<br>Korea |

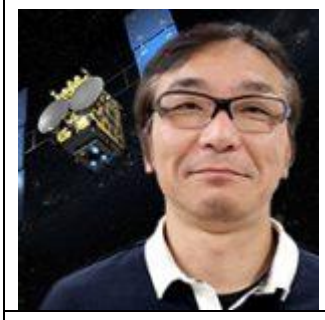
| | |
|---|---|
|  | **Hiroshi Shirakawa**<br>*Manager for International Cooperation Promotion*<br>International Relations and Research Department<br>Japan Aerospace Exploration Agency<br>Japan |
|  | **Yoshitsugu Sone**<br>Institute of Space and Astronautical Science<br>Japan Aerospace Exploration Agency<br>Japan |
|  | **Phạm Anh Tuấn**<br>*Director*<br>Viet Nam National Satellite Center<br>Viet Nam |
|  | **Bùi Trọng Tuyên**<br>*Vice-president*<br>Space Technology Institute<br>Viet Nam |
|  | **Shiang-Yu Wang**<br>*Deputy director*<br>Institute of Astronomy and Astrophysics<br>Academia Sinica<br>Taiwan |

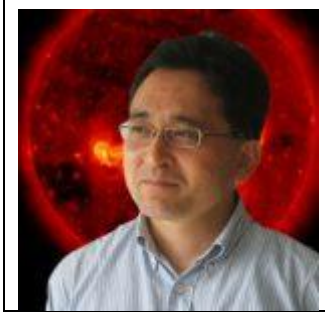
# LOCAL ORGANIZING COMMITTEE

| | |
|---|---|
|  | **Phan Bảo Ngọc (Chair)**<br>International University<br>Viet Nam National University Ho Chi Minh City |
|  | **Đào Văn Tiến Dũng**<br>International University<br>Viet Nam National University Ho Chi Minh City |
|  | **Nguyễn Thị Yến Nhi**<br>International University<br>Viet Nam National University Ho Chi Minh City |
|  | **Lê Thị Quế**<br>International University<br>Viet Nam National University Ho Chi Minh City |
|  | **Trịnh Thanh Thủy**<br>International University<br>Viet Nam National University Ho Chi Minh City |

# INVITED SPEAKERS

| | |
|---|---|
|  | **Yen-Hsyang Chu**<br>*Professor*<br>*Dean of College of Earth Science*<br>National Central University<br>Taiwan |
|  | **Paul T. P. Ho**<br>*General Director of East Asian Observatory*<br>Institute of Astronomy and Astrophysics<br>Academia Sinica<br>Taiwan |
|  | **Lê Xuân Huy**<br>*Head of Space Systems Design Department*<br>Viet Nam National Satellite Center<br>Viet Nam |
|  | **Yuko Inatomi**<br>*Professor*<br>*Director of Department of Interdisciplinary Space Science*<br>Institute of Space and Astronautical Science<br>Japan Aerospace Exploration Agency<br>Japan |
|  | **Ho Jin**<br>*Professor*<br>Kyung Hee University<br>Korea |

| | |
|---|---|
|  | **Naohiko Kohtake**<br>*Professor*<br>Graduate School of System Design & Management<br>Keio University<br>Japan |
|  | **Hitoshi Kuninaka**<br>*Deputy Director General of Space Exploration Innovation Hub Center*<br>Institute of Space and Astronautical Science<br>Japan Aerospace Exploration Agency<br>Japan |
|  | **Cynthia S. J. Liu**<br>National Applied Research Laboratories<br>National Space Organization<br>Taiwan |
|  | **Hideo Matsuhara (Co-Chair)**<br>*Professor of Department of Space Astronomy and Astrophysics*<br>Institute of Space and Astronautical Science<br>Japan Aerospace Exploration Agency<br>Japan<br>*Deputy chair of Department of Space and Astronautical Science*<br>National University SOKENDAI<br>Japan |
|  | **Kazuhisa Mitsuda**<br>*Research Director*<br>Institute of Space and Astronautical Science<br>Japan Aerospace Exploration Agency<br>Japan |

| | |
|---|---|
|  | **Shinichi Nakasuka**<br>*Professor*<br>Graduate School of Engineering<br>The University of Tokyo<br>Japan |
|  | **Phan Bảo Ngọc (Co-Chair)**<br>*Head of Department of Physics*<br>International University<br>Viet Nam National University Ho Chi Minh City<br>Viet Nam |
|  | **Shiro Ochi**<br>*Visiting Scientist*<br>Geoinformatics Center<br>Asian Institute of Technology, Thailand<br>*Researcher*<br>Satellite Applications and Operations Center<br>Japan Aerospace Exploration Agency<br>Japan |
|  | **Young-Deuk Park**<br>*Principle Researcher*<br>Korea Astronomy and Space Science Institute<br>Korea |
|  | **Taro Sakao**<br>*Professor*<br>*Hinode/Solar-B Project Manager*<br>Institute of Space and Astronautical Science<br>Japan Aerospace Exploration Agency<br>Japan |

| | |
|---|---|
|  | **Takehiko Satoh**<br>*Professor of Department of Solar System Sciences*<br>Institute of Space and Astronautical Science<br>Japan Aerospace Exploration Agency<br>Japan |
|  | **Phạm Anh Tuấn**<br>*Director*<br>Viet Nam National Satellite Center<br>Viet Nam |
|  | **Shiang-Yu Wang**<br>*Deputy director*<br>Institute of Astronomy and Astrophysics<br>Academia Sinica<br>Taiwan |
|  | **Ryoma Yamashiro**<br>*Associate Senior Engineer*<br>Epsilon Rocket Project Team<br>Japan Aerospace Exploration Agency<br>Japan |
|  | **Hajime Yano**<br>*Professor of Department of Interdisciplinary Space Science*<br>Institute of Space and Astronautical Science<br>Japan Aerospace Exploration Agency<br>Japan |

# PROGRAM SCHEDULE

## Tuesday - Dec 12, 2017

| | | |
|---|---|---|
| **8:00 - 8:15** | **On-site registration** | |
| **8:15 - 8:20** | **Introduction of guests** | |
| 8:20 - 8:25 | **Vu Hai Quan**<br>*Professor*<br>*Vice President*<br>Viet Nam National University HCMC<br>Viet Nam | Welcome speech from Viet Nam National University HCMC |
| 8:25 - 8:30 | **Ho Thanh Phong**<br>*Professor*<br>*Rector*<br>International University<br>Viet Nam National University HCMC<br>Viet Nam | Welcome speech from International University |
| **Section 1<br>Chairman: Hideo Matsuhara** | | |
| 8:30 - 9:10 | **Kazuhisa Mitsuda**<br>*Research director*<br>Institute of Space and Astronautical Science<br>Japan Aerospace Exploration Agency<br>Japan | Space science research activities in Japan |
| 9:10 - 9:50 | **Paul T. P. Ho**<br>*General Director of East Asian Observatory*<br>Academia Sinica<br>Taiwan | Development of Astronomy in Taiwan |
| 9:50 - 10:30 | **Young-Deuk Park**<br>*Principle Researcher*<br>Korea Astronomy and Space Science Institute<br>Korea | KASI Solar and Space weather Research |
| **10:30 - 10:50** | **Tea break** | |
| 10:50 - 11:30 | **Shinichi Nakasuka**<br>*Professor*<br>Graduate School of Engineering<br>University of Tokyo<br>Japan | Micro/nano/pico-satellite Innovation for Novel Ways of Space Science and Utilization |
| 11:30 - 12:10 | **Taro Sakao**<br>*Professor*<br>*Hinode/Solar-B Project Manager*<br>Institute of Space and Astronautical Science<br>Japan Aerospace Exploration Agency<br>Japan | Solar Physics from Space |
| **12:10 - 13:30** | **Lunch time** | |

| Section 2<br>Chairman: Kazuhisa Mitsuda | | |
|---|---|---|
| 13:30 - 14:10 | **Takehiko Satoh**<br>*Professor*<br>Institute of Space and Astronautical Science<br>Japan Aerospace Exploration Agency<br>Japan | Current and Future Studies in Solar System Science |
| 14:10 - 14:50 | **Hajime Yano**<br>*Professor*<br>Institute of Space and Astronautical Science<br>Japan Aerospace Exploration Agency<br>Japan | Astrobiology Space Experiments and Explorations in Japan: Current Status and Future Prospects |
| 14:50 - 15:10 | **Jean-Phillippe Combe**<br>Bear Fight Institute<br>United States of America | Principles and capabilities of spaceborne imaging spectrometry for Earth and Planetary Sciences |
| **15:10 - 15:30** | **Tea break** | |
| 15:30 - 15:50 | **Roksoon Kim**<br>Korea Astronomy and Space Science Institute<br>Korea | Space Weather Forecast Models performed in KASI/Space Weather Research Center |
| 15:50 - 16:10 | **Tam Dao**<br>International University<br>Viet Nam National University HCMC<br>Viet Nam | Study of ionospheric irregularities at low-latitude regions |
| 16:10 - 16:30 | **Khan-Hyuk Kim**<br>Kyung Hee University<br>Korea | Global distribution of equatorial Alfven velocity in the magnetosphere: A statistical analysis of THEMIS observations |

# Wednesday - Dec 13, 2017

| | | |
|---|---|---|
| **Section 3<br>Chairman: Paul T. P. Ho** | | |
| 8:30 - 9:10 | **Hitoshi Kuninaka**<br>*Deputy Director General of Space Exploration Innovation Hub Center*<br>Institute of Space and Astronautical Science<br>Japan Aerospace Exploration Agency<br>Japan | ISAS/JAXA's Solar System Exploration |
| 9:10 - 9:50 | **Phan Bao Ngoc**<br>*Head of Department of Physics*<br>International University<br>Viet Nam National University HCMC<br>Viet Nam | The first 4-year space engineering training program of Viet Nam |
| 9:50 - 10:30 | **Shiang-Yu Wang**<br>*Deputy Director of Institute of Astronomy and Astrophysics*<br>Academia Sinica<br>Taiwan | The Geospace Exploration Mission ERG and the LEP-e Instrument |
| **10:30 - 10:50** | **Tea break** | |
| 10:50 - 11:30 | **Hideo Matsuhara**<br>*Professor of Department of Space Astronomy and Astrophysics*<br>Institute of Space and Astronautical Science<br>Japan Aerospace Exploration Agency<br>Japan<br>*Deputy chair of Department of Space and Astronautical Science*<br>National University SOKENDAI<br>Japan | Introduction to Space Astronomy and Astrophysics |
| 11:30 - 12:10 | **Yuko Inatomi**<br>*Professor*<br>*Director of Department of Interdisciplinary Space Science*<br>Institute of Space and Astronautical Science<br>Japan Aerospace Exploration Agency<br>Japan | Materials Science under microgravity in Japan |
| **12:10 - 13:30** | **Lunch time** | |

| Section 4<br>Chairman: Young-Deuk Park | | |
|---|---|---|
| 13:30 - 14:10 | **Ryoma Yamashiro**<br>*Associate Senior Engineer*<br>Japan Aerospace Exploration Agency<br>Japan | Epsilon Launch Vehicle |
| 14:10 - 14:30 | **Le Xuan Huy**<br>*Head of Space Systems Design Department*<br>Viet Nam National Satellite Center<br>Viet Nam | Development of MicroSat Kit, First Vietnamese Micro-Satellite Toolkit for Space Systems Engineering Hands-on Training |
| 14:30 - 14:50 | **Hien Vo**<br>Vietnamese German University<br>Viet Nam | Developing a Space Engineering Program at an Undergraduate Institution |
| 14:50 - 15:10 | **Soojong Pak**<br>Kyung Hee University<br>Korea | Linear Astigmatism Free Three Mirror Telescope onboard MATS Satellite |
| **15:10 - 15:30** | **Tea break** | |
| 15:30 - 15:50 | **Dukhang Lee**<br>Kyung Hee University<br>Korea | Thermal Analysis and Passive Cooling Test of NISS onboard the NEXTSat-1 |
| 15:50 - 16:10 | **Seongwhan Lee**<br>Kyung Hee University<br>Korea | Introduction of the CubeSat series and Scientific Payloads of Kyung Hee University |
| 16:10 - 16:30 | **Jehyuck Shin**<br>Kyung Hee University<br>Korea | Development of the Magnetic Induction Coil Array-South (MICA-S) systems in Antarctica for geospace research |

# Thursday - Dec 14, 2017

| Section 5<br>Chairman: Shiang-Yu Wang | | |
|---|---|---|
| 8:30 - 9:10 | **Shiro Ochi**<br>*Visiting Scientist*<br>Asian Institute of Technology<br>Thailand<br>*Researcher*<br>Japan Aerospace Exploration Agency<br>Japan | JAXA's Space Technology for Applications and Collaboration in Asia |
| 9:10 - 9:50 | **Cynthia S.J. Liu**<br>National Applied Research Laboratories<br>National Space Organization<br>Taiwan | Development of Remote Sensing Space Programs in Taiwan |
| 9:50 - 10:30 | **Le Xuan Huy**<br>*Head of Space Systems Design Department*<br>Viet Nam National Satellite Center<br>Viet Nam | Development and Evaluation of Structure Thermal Model for NanoDragon Satellite |
| **10:30 - 10:50** | **Tea break** | |
| 10:50 - 11:30 | **Ho Jin**<br>*Professor*<br>Kyung Hee University<br>Korea | Korea Pathfinder Lunar Orbiter: KMAG payload |
| 11:30 - 11:50 | **Junga Hwang**<br>Korea Astronomy and Space Science Institute<br>Korea | Scientific Objectives of SNIPE mission |
| 11:50 - 12:10 | **Ji Hoon Bai**<br>Korea Advanced Institute of Science and Technology<br>Korea | Development of Flash LIDAR Simulator for Lunar Surface Environment Simulation |
| **12:10 - 13:30** | **Lunch time** | |

| Section 6<br>Chairman: Le Xuan Huy | | |
|---|---|---|
| 13:30 - 14:10 | **Naohiko Kohtake**<br>*Professor*<br>Keio University<br>Japan | Innovative Social Services with Geospatial and Space Technology |
| 14:10 - 14:50 | **Yen-Hsyang Chu**<br>*Professor*<br>*Dean of College of Earth Science*<br>National Central University<br>Taiwan | Advanced Ionospheric Probe Onboard FORMOSAT-5 Satellite - Characteristics and Preliminary Results |
| 14:50 - 15:10 | **Jaejin Lee**<br>Korea Astronomy and Space Science Institute<br>Korea | New Idea for Space Weather Research with Cubesat |
| **15:10 - 15:30** | **Tea break** | |
| 15:30 - 15:50 | **Nguyen Thi Mai Thu**<br>Viet Nam National Satellite Center<br>Viet Nam | S-Band Communications System for Monitoring Vessels Using Satellites |
| 15:50 - 16:10 | **Duy Hoang**<br>Leiden Observatory<br>Netherlands | Cosmic tsunami during the accretion of galaxy clusters |
| **18:00 - 21:00** | **Banquet at Van Thanh Tourist Village**<br>48/10 Dien Bien Phu<br>Ward 22, Binh Thanh District<br>Ho Chi Minh city | |

# Friday - Dec 15, 2017

| | | |
|---|---|---|
| **Discussion on collaboration** | | |
| **Session 1: Space Technology** | | |
| 8:30 - 9:30 | **Moderator: Pham Anh Tuan** | |
| | **Panelist**<br>- Naohiko Kohtake<br>- Kazuhisa Mitsuda<br>- Yoshitsugu Sone<br>- Shiang-Yu Wang | |
| **Session 2: Space Applications** | | |
| 9:30 - 10:30 | **Moderator: Jaejin Lee** | |
| | **Panelists**<br>- Naohiko Kohtake<br>- Shiro Ochi<br>- Phan Bao Ngoc<br>- Hiroshi Shirakawa<br>- Yoshitsugu Sone | |
| **10:30 - 10:50** | **Tea break** | |
| **Session 3: Space Science** | | |
| 10:50 - 11:50 | **Moderator: Hideo Matsuhara** | |
| | **Panelists**<br>- Paul T.P. Ho<br>- Kazuhisa Mitsuda<br>- Phan Bao Ngoc<br>- Young-Deuk Park | |
| 11:50 - 12:10 | **Phan Bao Ngoc**<br>*Head of Department of Physics*<br>International University<br>Viet Nam National University HCMC<br>Viet Nam | Concluding remarks |
| **12:10 - 13:00** | **Lunch time** | |

# ORAL PRESENTATIONS

Below is the list of oral presentations for the International Conference in Viet Nam: Space Science & Technology arranged based on the order in the program schedule.

**Tuesday, December 12, 2017 - 8:30 – 9:10**

**Title:** Space science research activities in Japan

**Authors:** Kazuhisa Mitsuda

**Content:** Space science in Japan started about 40 years ago with sounding rocket experiments followed by the launch of the first satellite Ohsumi. At that time, space science was mainly led by three subjects, space engineering, Geomagnetosphre science and X-ray astronomy. Presently it expanded to cover a wide range of astronomy and astrophysics, solar and Heliosphere sciences, and solar system explorations. In this talk present research activities and future missions on space science will be reviewed with an emphasis on astronomy and astrophysics.

**Tuesday, December 12, 2017 - 9:10 – 9:50**

**Title:** Development of Astronomy in Taiwan

**Authors:** Paul T. P. Ho

**Content:** Astronomy has grown rapidly in Taiwan during the last twenty years. When the Academia Sinica established the Preparatory Office of the Institute of Astronomy and Astrophysics (ASIAA) in 1993, there were only about five Ph.D. scientists working in Astronomy. Rapid growth became possible in Taiwan due to the help of external partners in astronomy projects, and a steady investment in instrument building programs. I will report here on the strategy pursued by the ASIAA and the current state of development in Taiwan.

**Tuesday, December 12, 2017 - 9:50 – 10:30**

**Title:** KASI Solar and Space Weather Research

**Authors:** Young-Deuk Park

**Content:** KASI is the Korean National Institute for Astronomy and Space science research which founded in 1974. Solar physics society of Korea is small but their activities are excellent all around the world. We installed the 4-chanel solar telescope and coelostat spectroscopic system by ourselves as well as contributed to install the 1.6 m new solar telescope at Big Bear Solar Observatory in USA and now we are preparing the coronagraph installing on the International Space Station by the international cooperation with NASA. KASI constructed the space weather research and predict center in 2007 and now we installed SDO data center of east Asia and RBSP data receiving center for space weather. We also have variety ground base instruments for solar physics and space weather research. At this talk, after a short introduce KASI, I will report the Korean solar physics and space weather research progress in now and future.

**Tuesday, December 12, 2017 - 10:50 – 11:30**

**Title:** Micro/nano/pico-satellite Innovation for Novel Ways of Space Science and Utilization

**Authors:** Shinichi Nakasuka

**Keywords:** micro/nano/pico-satellites, space utilization, deep space exploration, Earth observation

**Content:** Recent technology innovations by micro/nano/pico-satellites have been changing the ways of realizing space science and exploration, Earth observation, communication and other space utilization, making most of their strong features of extremely low cost and possibility of

quick development. University of Tokyo has been developing eight satellites, seven of which were already launched and successfully operated in space, including the world first CubeSat (2003) and world first micro-sized deep space exploration spacecraft (2014). Based on these "university satellite" technologies, venture companies are also appearing, which are creating new space industry. In the presentation, innovations by such satellites are discussed using some real examples, and future vision will be provided.

**Tuesday, December 12, 2017 - 11:30 – 12:10**

**Title:** Solar Physics from Space

**Authors:** Taro Sakao

**Keywords:** space solar physics, instrument development, space missions

**Content:** We present an overview of space solar physics in Japan. Since early 1980's a total of 3 satellites, Hinotori, Yohkoh, and Hinode, were put into orbit by the Institute of Space and Astronautical Science (ISAS), JAXA, for observing the Sun in X-rays, extreme-ultraviolet wavelengths, as well as in visible light. Each satellite mission has achieved remarkable scientific accomplishments in the field of solar physics, revealing magnetic activities in the corona such as flares and fine-scale activities in the photosphere and the chromosphere. In addition to such satellite programs, several sub-orbital missions, i.e., sounding rockets and balloons, have been conducted to develop, and demonstrate, key technologies aiming the subsequent orbital missions. Science as well as instrument development activities with these space solar programs will be presented, including how people, especially those of young generation, are involved in the programs.

**Tuesday, December 12, 2017 - 13:30 – 14:10**

**Title:** Current and Future Studies in Solar System Science

**Authors:** Takehiko Satoh

**Keywords:** Solar system bodies, Space probes, Venus, Mars, The moon

**Content:** The solar system bodies are the only objects accessible by space probes. Every solar system mission has two roles: one is to solve the outstanding problems, and another is to discover more problems to be solved by future missions. In this talk, I will review such examples including missions to the earth's nearby objects, such as Venus, Mars, and the moon. Recent PhD studies at our department will also be introduced.

**Tuesday, December 12, 2017 - 14:10 – 14:50**

**Title:** Astrobiology Space Experiments and Explorations in Japan: Current Status and Future Prospects

**Authors:** Hajime Yano

**Keywords:** Astrobiology, Cosmic Dust, Space Experiments, Deep Space Explorations, Sample Returns, Intact Capture, Planetary Protection, Ocean Worlds, Solar System Small Bodies

**Content:** Astrobiology research has been one of the rapidly growing interdisciplinary disciplines in Japan for the last 5 years. While astronomical observations of exo-planetary systems and extremophile search in the deep sea have been developed independently in the last two decades, it was only 2015 when the first astrobiology-driven space experiment called "Tanpopo" started to operate onboard the International Space Station.

The Tanpopo is a multi-year space experiment to test the panspermia hypothesis and chemical evolution of the terrestrial life by collecting organic-bearing micrometeoroids and exposing terrestrial extremophiles and astronomical organic analogs to the low Earth orbit up to 4 years. Its lessons and heritage are leading to develop a post-Tanpopo mission for more sophisticated exposure experiments to test various aspects of the origins and evolution of the early terrestrial life, as well as to prototype key technologies for an eventual sample return exploration to the

Ocean Worlds potentially holding deep habitats in the sub-surface oceans like Enceladus, Europa, Dawn and others. Planetary protection countermeasures must also be properly implemented to such future missions. This paper describes the current status and future prospects of Japanese astrobiology space experiments and explorations with major achievements and challenges ahead.

**Tuesday, December 12, 2017 - 14:50 – 15:10**

**Title:** Principles and capabilities of space borne imaging spectrometry for Earth and Planetary Sciences

**Authors:** Jean-Philippe Combe

**Keywords:** Imaging Spectrometry, Reflectance, Infrared, Planets, Asteroids, Earth, Surface composition, Mapping

**Content:** Spectrometry in Earth and Planetary Sciences: Spectrometry measures the dispersion of light for identification of the composition, as well as quantitative analyses at distance, in a non-destructive way. It uses the properties of interaction between electromagnetic radiation and matter, which is sensitive to molecular bonds and the physical state of materials. In Planetary Sciences, reflectance (passive) spectrometry in the ultraviolet, visible and near-infrared has become a powerful tool since the late 1960's for investigating the mineralogical and chemical composition of meteorites and lunar samples [1], surfaces and atmospheres of celestial objects from ground-based telescopic observation [2] or from spacecraft [3]. Most space missions now carry at least one point-spectrometer (that acquires one spectrum at a time and has a fixed orientation).

Mapping of surface composition by imaging spectrometry: Imaging spectrometers are superior to point spectrometers is that they add the spatial dimensions to the dataset, as they are designed for mapping remotely. At present, space exploration of the solar system relies heavily on imaging spectrometry, as exemplified by the payload of major spacecraft such as Galileo, Cassini, Dawn (NASA- USA), Mars Express, Venus Express and Rosetta (ESA-Europe) Chandrayaan-1 (ISRO-India), Chang'e 1 (CNSA- China) and Kaguya (JAXA-Japan). As a consequence, imaging spectrometers have led to numerous discoveries since the late 1990's such as identifications of minerals, salts, water and organic compounds, to name a few. In order to illustrate the concepts and scientific results, a selection of surface composition maps of various objects in the solar system will be presented during the conference:

– The discovery of H2O on Ceres (in the outer asteroid belt) by the Dawn mission.

– The mapping of minerals in basaltic rocks on the surface of Vesta (the inner asteroid belt), also with Dawn.

– The detection and distribution of hydroxyl (OH) at the surface of the Moon with Chandrayaan-1, Cassini and EPOXI missions, and the challenges posed by thermal emission.

– The distribution of CO2 on the surface of Enceladus (satellite of Saturn) by Cassini alongside a thermodynamical model of the interior.

From Planetary Sciences to Earth Sciences: Planets, especially those without an atmosphere, and small bodies such as asteroids and comets have been used for developing models in order to optimally interpret the data from imaging spectrometers. Over the years, the technology of building instruments and data analysis has much improved thanks to fundamental basic research in Planetary Sciences [4]. On Earth, imaging spectrometers are used mostly as airborne instruments such as AVIRIS [5] or HyMap [6] for local or regional projects related to geology and environment. Paradoxically, despite the impact that imaging spectrometry has made in Planetary Sciences, this type of data is rare in terrestrial observations (Hyperion onboard the Earth Observing-1 satellite was the exception [7]). Most instruments are thematic mappers that

make use of narrow ranges of radiation to carry out pre-determined scientific investigations, such as MODIS [8] or MERIS [9].

About imaging spectrometry of the Earth in the future: Imaging spectrometers are now built in increasingly large quantities for research laboratories, industries and agriculture. A number of manufacturers have the knowledge and experience to make small, light and accurate instruments that are more affordable than in the past [4]. The recent involvement and developments of certain countries – such as Viet Nam – in Space Science and Technology may bring some opportunities to consider further the type of science that can be done by remote-sensing from orbit around the Earth, both for research and for applications. Imaging spectrometry of the Earth may be one tool relevant for future observational data of our planet.

References:

[1] Van Tassel, R. A.; Salisbury, J. W., 1964, Icarus, 3, 264-269, doi: 10.1016/0019-1035(64)90022-3.

[2] McCord, T. B.; Johnson, T. V.; Kieffer, H. H., 1969, J. Geophys. Res., 74, 4385-4388, doi: 10.1029/JB074i017p04385.

[3] Hanel, R. A. et al., 1971, Icarus, 12, 48-62 doi: 10.1016/0019-1035(70)90031-X.

[4] Mustard, J. F., 2017, J. Geophys. Res. Planets, 122, 794–797, doi:10.1002/2017JE005315.

[5] Curran P. J.; Dungan J. L., 1989, Int. J. of Rem. Sens., 11, doi: 929-93110.1080/01431169008955067.

[6] Combe J-Ph et al., Geochem., Geophys., Geosys., .7, doi: 10.1029/2005GC001214.

[7] Biehl L.; Landgrebe D., 2000, Computers and Geos., 28, 1153-1159, doi: 10.1016/S0098-3004(02)00033-X.

[8] Guenther B. et al., 2002, Rem. Sens. of Environ., 83, 16-30, doi: 10.1016/S0034-4257(02)00097-4.

[9] Bezy, J. L.; Rast, M., 1999, Int. J. of Rem. Sens., 20, 1681-1702, doi: 10.1080/014311699212416.

**Tuesday, December 12, 2017 - 15:30 – 15:50**

**Title:** Space Weather Forecast Models performed in KASI/Space Weather Research Center

**Authors:** Roksoon Kim

**Keywords:** Space Weather Forecast, CMEs, Geomagnetic Storms

**Content:** KASI/Space Weather Research Center has been carrying out daily space weather forecast since 2011. For this, we established our own models including 1) flare forecast model based on the magnetic helicity injection rate of an active region, 2) radiation exposure assessment model for aviation route dose, 2) empirical geomagnetic storm forecast model based on initially observed CME parameters. And we also developed the forecast models for geomagnetic indices such as Kp and Dst. Therefore, we can cover both of the radio blackouts (R), the solar radiation storms (S), and geomagnetic storms (G), as known as NOAA Space Weather Scales. We also provide models that have been developed or verified by ourselves to national agencies that are officially responsible for the space weather forecast for public. In this presentation, we describe those models that we have been developed or upgraded.

**Tuesday, December 12, 2017 - 15:50 – 16:10**

**Title:** Study of ionospheric irregularities at low-latitude regions

**Authors:** Tam Dao

**Keywords:** Ionospheric irregularities, Low-latitude regions, Ground-based observations

**Content:** I have been studying about the ionospheric characteristics at low-latitude regions by using HF/VHF radars and GPS receivers, satellite data, and optical instruments in Viet Nam and Southeast Asian regions. One of the powerful instruments for studying field-aligned irregularity (FAI) in Southeast Asia is the Equatorial Atmosphere Radar (EAR). The EAR was installed at Kototabang (0.2oS, 100.3oE, dip lat. 10.4oS), Indonesia in 2000. The 16-beam measurement for the F-region FAIs is very useful to study the development of plasma irregularities at low geomagnetic latitudes. I will present a case study of post-midnight FAIs on 9 July 2010, when the coordinated radio and optical observations were available. An FAI event developed within the EAR's field-of-view (FOV) was examined to be generated around midnight. The rate of change of total electron content index (ROTI) obtained from GPS receivers in Southeast Asia, airglow images detected by an all-sky imager, and thermospheric neutral winds and temperatures obtained by a Fabry-Perot interferometer at Kototabang were examined. In additional, altitudes of the F-layer (h'F) observed with ionosondes at Kototabang, Chiang Mai, and Chumphon were also surveyed to understand the effect of neutral winds to the occurrence of small-scale plasma irregularity. Plasma irregularity is one of the issues in the low latitudes and equatorial ionosphere since it causes scintillation of the radio waves passing through the ionosphere, and degrades the ground-satellite communication and satellite-based positioning, such as Global Positioning System (GPS). Coordinate observations are very useful to investigate the physical relations of many related factors in the thermosphere. This plays an important role in leading future projects for developing and understanding space physics. My presentation gives a brief view of my study and my future plans working in Viet Nam.

**Tuesday, December 12, 2017 - 16:10 – 16:30**

**Title:** Global distribution of equatorial Alfven velocity in the magnetosphere: A statistical analysis of THEMIS observations

**Authors:** Khan-Hyuk Kim, Gi-Jeong Kim and Ho Jin

**Keywords:** Alfven velocity, electron density, MHD wave

**Content:** We have statistically examined the distribution of the equatorial Alfven velocity using the THEMIS magnetic field and electron density data obtained in the L range of ~4-12 and at all local times near the magnetic equator for 2008-2014. We observed a pronounced dawn-dusk asymmetry in the equatorial Alfven velocity. The velocity in the dawn sector is faster than that in the dusk sector. This is due to the duskside bulge in the plasmasphere. The radial profile of the velocity shows an increasing function of L between L = 4 and 10 in a region of noon to dusk, while a decreasing function in the dawn sector. By comparing these Alfven velocity distributions along the local time and radial distance, we discuss the occurrence distribution and propagation of MHD waves in the outer magnetosphere.

**Wednesday, December 13, 2017 - 8:30 – 9:10**

**Title:** ISAS/JAXA's Solar System Exploration

**Authors:** Hitoshi Kuninaka

**Content:** ISAS/JAXA cut into Solar System Exploration by twin spacecraft Sakigake and Suisei observing Halley's Comet in 1985. Since then, ten spaceships have been input into the deep space, some of which are still exploring. Akatsuki is orbiting around Venus and Hayabusa2 is approaching Asteroid Ryugu. Future missions, targeting on Moon, Mercury, Asteroid, Mars and Jupiter, are under research and development.

**Wednesday, December 13, 2017 - 9:10 – 9:50**

**Title:** The first 4-year space engineering training program of Viet Nam

**Authors:** Phan Bao Ngoc

**Content:** In this talk, I will present the 4-year training program in space engineering at International University-Viet Nam National University HCMC. In 2016, the program was launched to provide high quality human resources to the nation in satellite technology applications and space science. I will also discuss possible collaborations to promote space science and technology in Viet Nam.

**Wednesday, December 13, 2017 - 9:50 – 10:30**

**Title:** The Geospace Exploration Mission ERG and the LEP-e Instrument

**Authors:** Shiang-Yu Wang

**Content:** The Exploration and energization and Radiation in Geospace (ERG) mission explores the acceleration, transportation, and loss of relativistic electrons in the radiation belts and dynamics for the geospace storms. Nine different particle and wave instrument are on board the satellite to provide comprehensive observations at the inner magnetosphere for plasma/particles and fields/waves. The ERG (Arase) satellite was developed by the Institute of Space and astronautical Science (ISAS)/Japan Aerospace Exploration Agency (JAXA) with instruments developed by several universities and institutes in Japan and Taiwan. Academia Sinica, Institute of Astronomy and Astrophysics (ASIAA) developed the low energy electron analyzer (LEP-e) for the ERG satellite. The ERG satellite (Arase) was successfully launched in December 2016, and new observations have begun. In this talk, we will describe the overview of the ERG project and the LEP-e development.

**Wednesday, December 13, 2017 - 10:50 – 11:30**

**Title:** Introduction to Space Astronomy and Astrophysics

**Authors:** Hideo Matsuhara

**Keywords:** Space Telescope, X-ray astronomy, Infrared astronomy, submillimeter-wave, radio astronomy, cosmology

**Content:** In this review talk, I will present a brief introduction to astronomy and astrophysics based on observations with space telescopes. Space physics and chemistry are studied based on data of the deep space observations from the outer space using X-rays, infrared rays, and radio waves. The design of spacecraft for such missions and development of the onboard instruments, such as space telescopes as well as data analysis are also the main scope of this field.

Also as deputy chair of the department of Space and Astronautical Science, SOKENDAI, I will introduce the graduate course to obtain Ph.D. at ISAS, with an introduction of the special scholarship as well as research assistant opportunities.

**Wednesday, December 13, 2017 - 11:30 – 12:10**

**Title:** Materials Science under microgravity in Japan

**Authors:** Yuko Inatomi

**Keywords:** microgravity experiment, International Space Station, parabolic flight, nucleation and crystal growth, fluid behavior, combustion

**Content:** Material science in space aims at investigating fundamental phenomena such as crystallization of materials and behaviors of fluid, which are difficult to observe on Earth. Achievement of a diffusion-dominated condition in liquid under microgravity is regarded as the most promising method to lead to an understanding of phase change phenomena of material from fluid and to evaluate a new method for production of high-quality material. Overview of microgravity experiments for materials science in Japan will be presented briefly.

**Wednesday, December 13, 2017 - 13:30 – 14:10**

**Title:** Epsilon Launch Vehicle

**Authors:** Ryoma Yamashiro

**Keywords:** Epsilon, small launcher, small satellite, efficient launch operation, user-friendly

**Content:** The Epsilon Launch Vehicle is the newest version of Japan's solid propulsion rocket. Epsilon's objective is to increase space activities by providing small satellite manufactures with the efficient and user-friendly launch system. The first and second Epsilon succeeded in launching each satellite properly. The following flights and developments for further improvement have been planned. This presentation describes Epsilon's overview, Epsilon's development status, and its plan for the future possible users.

**Wednesday, December 13, 2017 - 14:10 – 14:30**

**Title:** Development of MicroSat Kit, First Vietnamese Micro-Satellite Toolkit for Space Systems Engineering Hands-on Training

**Authors:** Le Xuan Huy, Nguyen Huu Diep, Bui Nam Duong, Nguyen Tien Su, Cao Xuan Hiep, Tang Quang Minh, Nguyen Xuan Que, Le The Soat, Nguyen Truong Thanh, Hoang The Huynh, Vu Minh Duc

**Keywords:** MicroSat Kit, Micro satellite, Space Education, Hands-on Training

**Content:** MicroSat Kit (MSK) project started early 2017, has been developed by researchers of Viet Nam National Space Center (VNSC) for educational purpose, including designing and manufacturing a micro-class satellite in order to continue to adapt universities need of an effective satellite kit available for the variety of satellite missions. This paper mainly presents the development of the appropriate MSK. The MSK project has several objectives including: (1) To develop a toolkit and user manual for practical training, aiming at improving space engineering knowledge and skills; (2) To test the product by training new recruited staff and university students with interests in space technology; (3) To create opportunities for human resource development and new satellite components test. MSK simulates a cubic satellite with edge size of 30 cm and weight of 15 kg. Especially, it is equipped with 2 high-resolution cameras: one is to take pictures and the other is to monitor the real-time rotation of the solar panel(s). The final result of MSK development process is the first Vietnamese micro-satellite toolkit expectedly completed by the end of 2018.

**Wednesday, December 13, 2017 - 14:30 – 14:50**

**Title:** Developing a Space Engineering Program at an Undergraduate Institution

**Authors:** Hien Vo

**Keywords:** space engineering, balloon, cubesat

**Content:** The author has been involved in many space engineering projects using balloon and cubesat platforms – 3 National Science Foundation cubesat projects (and recently with unmanned aerial vehicle) with undergraduate students in USA and now Viet Nam. Working with only undergraduate students and limited budget and facility, he has trained over one hundred space engineers who are now working in industry and governmental research institute. Space engineering projects require a multi-disciplinary approach. He will outline the latest project in Viet Nam where his group is involved in the Attitude Determination and Control System sub-system for the U of Paris Diderot cubesat project Igosat.

**Wednesday, December 13, 2017 - 14:50 – 15:10**

**Title:** Linear Astigmatism Free Three Mirror Telescope onboard MATS Satellite

**Authors:** Soojong Pak, Woojin Park, Arvid Hammar and Seunghyuk Chang

**Keywords:** micro satellite, reflective telescope, optical design

**Content:** MATS (Mesospheric Airglow/Aerosol Tomography Spectroscopy) is Swedish micro-scale science satellite which will be lunched in 2019. In this presentation, we first introduce an innovative reflective telescope design concept based on confocal optical system. And we present

the optical design characteristics of the LAF-TMS (Linear Astigmatism Free Three Mirror System) for MATS, and the optical performance test results of the proto-model telescope.

**Wednesday, December 13, 2017 - 15:30 – 15:50**

**Title:** Thermal Analysis and Passive Cooling Test of NISS onboard the NEXTSat-1

**Authors:** Dukhang Lee, Bongkon Moon, Seiji Yoshida, Woong-Seob Jeong, Kyeongyeon Ko, Sung-Joon Park, Dae-Hee Lee, Won-Kee Park, Mingyu Kim, Youngsik Park, Jeonghyun Pyo, Il-Joong Kim, Goo-Whan Shin, Jangsoo Chae, Toshio Matsumoto and Takao Nakagawa

**Keywords:** Instrumentation, Space infrared telescope, Thermal analysis

**Content:** We present thermal analysis results of the Near-infrared Imaging Spectrometer for Star formation history (NISS) on the NEXTSat-1 satellite. The primary goal of the NISS thermal design is to reduce dark current and thermal noise to negligible levels using a micro Stirling cooler that actively cools the infrared (IR) detector to ~ 80K. To achieve the active cooling with the limited cooling power of the cooler (~ 0.6 to 0.7 W), we adopt a passive cooling technique that reduces temperature of the NISS telescope to ~ 200 K without consuming electric power. Despite the small volume allocated to NISS, we apply optimal thermal designs to the model to maximize the cooling performances. The results of the analysis show that the NISS telescope is cooled down to ~ 196 K within 8 days for the case of the normal attitude. We also find the IR detector is cooled to ~ 80 K within 12 hours using the cooler. To establish the reliability of the NISS thermal model, we perform a passive cooling test and a further analysis that uses the NISS model with the same environment as the test. The test results are found to be comparable to those from the analysis, demonstrating the reliability of our thermal model.

**Wednesday, December 13, 2017 - 15:50 – 16:10**

**Title:** Introduction of the CubeSat series and Scientific Payloads of Kyung Hee University

**Authors:** Seongwhan Lee, Jung-Kyu Lee, Hyojeong Lee, Jehyuck Shin, Ho Jin, Jongho Seon and Miri Jeong

**Keywords:** CubeSat, Small Satellite, Space payload

**Content:** CubeSat is one kind of small satellite that can be developed easier and cheaper through the Commercial Off-the-Shelf (COTS). Due to these advantages, the launch of CubeSat has rapidly increased worldwide in the 2000s as it is suitable for the quick technical demonstration and small-scale payload operation. Over the 600 CubeSats have been launched to date in worldwide. In Kyung Hee University (KHU), TRIO-CINEMA CubeSat was successfully launched in 2013 and it had two scientific payloads: the three-axis magnetometer of using magnetoresistive sensors and the Supra-Thermal Electron, Ion, Neutral (STEIN) detector. SIGMA CubeSat is planned to launch in end of 2017 and it had two scientific payloads: Tissue Equivalent Proportional Counter (TEPC) and fluxgate magnetometer. We have been developed not only CubeSats but also science payloads for space researches from the Low Earth Orbit (LEO) to Geostationary Orbit (GEO): Medium Energy Particle Detector (MEPD) of NEXTSat-1, Korean Space Environment Monitor (KSEM) of GK-2A. Now we have been developing the fluxgate magnetometers as a payload of Korea Pathfinder Lunar Orbiter (KPLO) lunar exploration program. In this paper, we introduce the various space missions of the KHU and analyze the trends in global change of CubeSat application.

**Wednesday, December 13, 2017 - 16:10 – 16:30**

**Title:** Development of the Magnetic Induction Coil Array-South (MICA-S) systems in Antarctica for geospace research

**Authors:** Jehyuck Shin, Khan-Hyuck Kim, Ho Jin, Hyomin Kim, Jong-Woo Kwon, Seungah Lee, Jaehee Park, Geonhwa Jee and Marc Raymond Lessard

**Keywords:** Magnetometer, Search coil magnetometer, Magnetosphere, Ionosphere, ULF waves

**Content:** We report on development and installation of ground-based magnetometers designed for operations in Antarctica, which are part of a network now called Magnetic Induction Coil Array-South (MICA-S). The MICA project aims to investigate the magnetic field waves occurring in geospace, which play a crucial role in magnetosphere-ionosphere coupling processes. It employs an induction-coil (or search-coil) magnetometer type which is designed to observe time-varying magnetic fields in the 1 mHz to 5 Hz frequency range. It provides bi-axial magnetic fields data sampled at the rate of 10 Hz and has resolutions of 0.1 pT/√Hz at 0.5 and 1 Hz. One of our MICA-S magnetometers has been installed at Korean Jang Bogo Station in Antarctica, acquiring good quality data. Two more systems are scheduled to be deployed at German Neumayer III Station in the austral summer 2017-2018 and Korean King Sejong Station in the following summer. The new MICA-S magnetometers will provide important data sets for magnetic field wave observations at extensive L-shell and local time ranges.

**Thursday, December 14, 2017 - 8:30 – 9:10**

**Title:** JAXA's Space Technology for Applications and Collaboration in Asia

**Authors:** Shiro Ochi, Kei Oyoshi and Shin-Ichi Sobue

**Keywords:** JAXA, International Collaboration, Space Technology, Remote Sensing, SAFE, Sentinel Asia

**Content:** JAXA conducts projects by utilizing its original earth observation satellite under the collaboration with Space Agencies and Remote Sensing Research Organizations in the region. Under the framework of APRSAF (Asia and Pacific Regional Space Agency Forum), SAFE (Space Applications for Environment) and Sentinel Asia are carried on. SAFE aims to contribute to the various environmental problems such as climate change and sustainable development in the region by using space technology. And Sentinel Asia works as a framework to support disaster emergency responses in collaboration with Space Agencies and Disaster Management Organizations in the region. On the other hand, JAXA has started bilateral research and technical cooperation programs with the countries in the region, such as DATACUBE project with Viet Nam. These projects are introduced in the presentation.

**Thursday, December 14, 2017 - 9:10 – 9:50**

**Title:** Development of Remote Sensing Space Programs in Taiwan

**Authors:** Cynthia S.J. Liu

**Content:** Taiwan's first self-reliant satellite, FORMOSAT-5, has been launched successfully on August 25th this year to resume the earth observation mission of the decommissioned FORMOSAT-2. FORMOSAT-5 is the first space program that NSPO takes full responsibility for the complete satellite system development including payloads. Key components of FORMOSAT-5 satellite such as on-board computer, flight software, CMOS (Complementary Metal-Oxide-Semiconductor) type remote sensing instrument, and AIP (advanced ionospheric probe) are among the first made-in-Taiwan space-qualified satellite units. In Commissioning phase, the Image Processing System (IPS) on ground is now conducting the calibration and image quality validation process; some validation result will be shown in this presentation.

The plan and development for constellation of microsatellites is in Progress, NSPO will keep up with the Trend of Remote Sensing evolving and committed to continuous support to the global community.

**Thursday, December 14, 2017 - 9:50 – 10:30**

**Title:** Development and Evaluation of Structure Thermal Model for NanoDragon Satellite

**Authors:** Vu Viet Phuong, Le Xuan Huy, Nguyen Dinh Chau Minh, Duong Bui Nam, Nguyen Tien Su, Trinh Thăng Long, Nguyễn Trường Thanh, Hoang The Huynh, Pham Minh Quan, Truong Xuan Hung and Pham Anh Tuan

**Keywords:** 3U Satellite, STM, NanoDragon, VNSC, Small Satellite

**Content:** Viet Nam National Space Center (VNSC) has been developing a nano satellite, NanoDragon, which sized in 3U standard. The first mission of NanoDragon is on-orbit-validating several research results related to satellite attitude determination and control system by VNSC in the period of 2011 to 2016. The second mission is acquiring Automatic Identification System (AIS) signal for vessel tracking and monitoring. The tentative orbit of NDG is Sun synchronization (SSO) with an altitude around 500km. A Structure Thermal Model (STM) then an Engineering-Flight Model (EFM) will be developed after mission definition phase. This paper is focused on the development processes of STM for NanoDragon, a model that has the function of verifying structural and thermal performance of satellite design. This model is not included real satellite components but several mass and thermal dummies those mimic mechanical and thermal features of the real ones. After integration, the STM will go through vibration and thermal tests to verify the design requirements.

**Thursday, December 14, 2017 - 10:50 – 11:30**

**Title:** Korea Pathfinder Lunar Orbiter: KMAG payload

**Authors:** Ho Jin, Khan-Hyuck Kim, Derac Son, Seongwhan Lee, Hyojeong Lee, Jung-Kyu Lee, Jehyuck Shin, Mangyu Lee, Dukhang Lee and Ian Garrick-Bethell

**Keywords:** Moon mission, Magnetometer, Space instrument

**Content:** Korea Pathfinder Lunar Orbiter (KPLO) is a first Korean Lunar exploration mission. KPLO is equipped with four payloads in Korea and one payload in United States. KMAG is one of Korean payloads to measure the Lunar surface magnetic field and near moon space environment. Moon has a no dipole magnetic field such as earth's global magnetic field. But there are many curious crustal magnetic anomalies. these features still do not well understand. This is a main scientific objective of KMAG payload and the study of space environment around moon is a second objective.

KMAG has three magnetometers which are mounted in the edge of the 1.2-meter boom. This paper shows a KMAG's requirements, instrument description, preliminary test results and Future Plan.

**Thursday, December 14, 2017 - 11:30 – 11:50**

**Title:** Scientific Objectives of SNIPE mission

**Authors:** Junga Hwang, Jaejin Lee, Jongdae Shon, Jaeheung Park, Young-Sil Kwak, Uk-Won Nam, Won-Kee Park and Young-Deuk Park

**Keywords:** Space Weather, Cubesat, Formation Flying, Magnetosphere, Ionosphere

**Content:** In order to resolve the spatial and temporal variations of the microscale plasma structures on the topside ionosphere, SNIPE mission consisted of four 6U nanosatellites (~10 kg) will be launched into a polar orbit at an altitude of ~600 km in 2020. Four satellites will be deployed on orbit at the same time and keep the cross-shape formation within a separation distance of ~100 km each other. The SNIPE mission aims to elucidate the various plasma phenomena with various scales' (100 m-10 km) structures in the topside ionosphere, especially the fine-scale morphology of high-energy electron precipitation, cold plasma density/temperature, field-aligned currents, and electromagnetic ion cyclotron (EMIC) waves. Especially the mission will observe the characteristics of the following phenomena: (1) high-latitude plasma irregularities, such as polar-cap patches; (2) field-aligned currents in the auroral oval; (3) electro-magnetic ion cyclotron (EMIC) waves; (4) hundreds keV electrons 'precipitations, such as electron microbursts; (5) subauroral plasma density troughs; and low-latitude plasma irregularities, such as ionospheric blobs and bubbles. We develop a 6U nanosatellite bus system as the basic platform. To achieve above scientific objectives, three types

of plasma instruments will be installed on all of each spacecraft; Solid State Telescope (SST), Langmuir Probe (LP), and Fluxgate Magnetometer (MAG).

**Thursday, December 14, 2017 - 11:50 – 12:10**

**Title:** Development of Flash LIDAR Simulator for Lunar Surface Environment Simulation

**Authors:** Ji Hoon Bai, Min-Hyun Cho and Min-Jea Tahk

**Keywords:** Flash LIDAR Simulator, Lunar Surface Simulation, Ray Tracing Problem, Digital Elevation Model

**Content:** This study develops a flash LIDAR (Light Detection and Ranging) simulator for the lunar surface environment simulation. The simulation of the lunar surface environment is an indispensable element in the design of the lunar missions such as the selection of the exploration site and the verification of the automatic landing algorithm. Using NASA's LOLA (Lunar Orbiter Laser Altimeter) digital elevation model, we solve the Ray Tracing problem considering the attitude of the probe LIDAR and thus provide the topographic information of the Moon for arbitrary position and posture. The implemented LIDAR simulator is expected to be useful for simulating the lunar surface and the lunar environment.

**Thursday, December 14, 2017 - 13:30 – 14:10**

**Title:** Innovative Social Services with Geospatial and Space Technology

**Authors:** Naohiko Kohtake

**Keywords:** Innovative Social Service, Space Technology, Capacity Building

**Content:** Development of space infrastructure is progressing with the integration of satellite observations, satellite navigation, and satellites communication. On the other hand, a cellphone network has explosively been expanding in human society. A real-time monitoring is no longer impossible with satellite imageries or digital maps. The technology development has a potential to reconstruct of social public services that have only used for data collections and observations. It is not only individual system developments, but also a chance to rebuild both the space system and the innovative social services. We established new consortium for creating innovative social services with geospatial and space technology in 2012. Several universities and companies in Asia join this consortium. Specialists teach various lectures related space engineering, remote sensing, global navigation, space law, and business to participants from universities and industries. They can make a plan to solve present and potential problem, as well as to carry out with lecture for system design and management. Then, all participants join actual projects in several countries based on skills and knowledge from these lectures and feedback their experiences to the consortium. The design of capacity building program by this consortium was awarded the Good Design Award 2017 in Japan. Our latest smart space applications and experience of capacity building will be reported.

**Thursday, December 14, 2017 - 14:10 – 14:50**

**Title:** Advanced Ionospheric Probe Onboard FORMOSAT – 5 Satellite – Characteristics and Preliminary Results

**Authors:** Yen – Hsyang Chu and Chi – Kuang Chao

**Content:** The FORMOSAT – 5 (FFS – 5) is a remote sensing satellite and was launched by Space Exploration Technologies Corp. (also known as SpaceX) at 2::551 2017/88/225 CST. The FS – 5 flies in a 98.28° inclination sun – synchronous circular orbit at 720 km altitude in the 1030/22230 LT sectors. Advanced Ionospheric Probe (AAIP) is a piggyback science payload developed by National Central University for FS-5 satellite to explore space weather/climate and seismic precursors associated with strong earthquakes. AIP is an all-in-one plasma sensor that measures ionospheric plasma concentrations, velocities, and temperatures in a time – sharing way and is capable of measuring ionospheric plasma irregularities at a sample rate up to 8,192 Hz over a wide range of spatial scales. Electroformed gold grids used in AIP, in theory, construct planar electric potential surfaces better than woven grids. Moreover, a plasma injection test performed in the Space Plasma Simulation Chamber has verified that no significant hysteresis is

found in current – voltage curves measured by AIP. It indicates that AIP can make an accurate measurement of the ionospheric plasma parameters in space. A flight test has also performed on Sounding Rocket IX and an Es-layer was successfully detected by AIP sensor between 100 and 103 km altitude with a density peak at 101.6 km altitude at night. Currently, AIP onboard FS-5 satellite is under an early orbit checkout stage. Preliminary results shall be available to present in this talk.

**Thursday, December 14, 2017 - 14:50 – 15:10**

**Title:** New Idea for Space Weather Research with Cubesat

**Authors:** Jaejin Lee, Junga Hwang and Youngdeuk Park

**Keywords:** Space Weather, Cubesat, Formation Flying, Magnetosphere, Ionosphere

**Content:** In this presentation, we introduce new space science mission developed by KASI, SNIPE (Small scale magNetospheric and Ionospheric Plasma Experiment). Observing particles and waves on a single satellite suffers from inherent space-time ambiguity. Recently, such ambiguity has often been resolved by multi-satellite observations, but the inter-satellite distances were larger than 100 kilometers. Hence, the ambiguity could be resolved only for large-scale (>100 km) structures while various micro-scale phenomena have been observed at the low altitude satellite orbits. To observe spatial and temporal variations of the micro-scale plasma structures on the topside ionosphere, four nano-satellites (~ 10 kg) will be launched into a polar orbit of the altitude of ~600 km. The four satellites will be deployed in orbit, and the distances of each satellite will be controlled from 10 km to 100 km by formation flying algorithm. The SNIPE mission is equipped with scientific payloads which can measure the following geophysical parameters: density/temperature of cold ionospheric plasmas, energetic electron flux, and magnetic field vectors. All the payloads should have a high temporal resolution (sampling rates of about 10 Hz (TBD)). This mission shall be launched in 2020.

**Thursday, December 14, 2017 - 15:30 – 15:50**

**Title:** S-Band Communications System for Monitoring Vessels Using Satellites

**Authors:** The Anh Nguyen Dinh, Mai Thu Nguyen Thi, Huy Le Xuan, Tuan Anh Vu and Duong Bach Gia

**Keywords:** Monitoring Vessels, Satellites, RF system, Horn antenna

**Content:** This paper introduces a novel S-band satellite communications system for monitoring vessels. The proposed system is composed of two main parts. The first part is a status data transmitter assembled on the vessel. Each transmitted message includes the vessel's important information such as name, identification, longitude, latitude and state. When the distance between the vessel and the shore is less than 50 nautical miles, the transmitter will directly communicate with ground stations and other vessels via VHF channels. On the other hand, when the distance is more than 50 nautical miles, the transmitter will actively change the frequency from VHF to S-band to communicate with satellites. This helps to overcome the distance limitation in monitoring vessels which conventional systems are facing. The second part is a S-band receiver installed at ground stations and on satellites. The receiver will gather data from vessels and transfer the information to ground stations. The receiver archives high sensitivity and low noise figure. A prototype has been fabricated and measured. The measurement results show a good agreement with those from simulations.

**Thursday, December 14, 2017 - 15:50 – 16:10**

**Title:** Cosmic tsunami during the accretion of galaxy clusters

**Authors:** Duy Hoang

**Keywords:** galaxies: clusters: intra-cluster medium, large-scale structure of Universe, radiation mechanisms: non-thermal, diffuse radiation, shock waves

**Content:** Galaxy clusters contain hundreds to thousands of galaxies and are the largest gravitationally bound structures in the Universe. Galaxy clusters form hierarchically through a sequence of mergers of smaller groups/clusters of galaxies. During the mergers, large-scale shock waves, hydrodynamic instabilities and turbulence in the intra-cluster medium (ICM) are generated. These energetic processes convert an enormous amount of gravitational energy (\sim10^{64} erg) into thermal and non-thermal energy. For example, they increase the ICM plasma temperature, accelerate electrons to relativistic speeds, amplify large-scale magnetic fields, and introduce bulk motions. The shock waves and turbulence that are imprinted into the ICM during these energetic merging events can be observed with radio telescopes and X-ray satellites.

Clusters that host radio emission at the opposite outskirts (namely relics) are some of the most interesting case studies for particle acceleration in clusters. In these very rare merging clusters there are instances of shock acceleration producing observable synchrotron emission on opposite sides of the cluster. Such double radio relics are thought to be caused by strong binary merging events occurring in the plane of the sky. These objects are particularly interesting since they allow the study of particle re-acceleration without the complication of projection effects. In this talk, I will present some of the observational results of double relic systems that were observed with low frequency telescopes such as LOFAR, GMRT, WSRT and VLA.

# POSTER PRESENTATIONS

Below is the list of poster presentations for the International Conference in Viet Nam: Space Science & Technology arranged by the last name of the first author in alphabetical order.

**Title:** Reconstruction of Lunar Digital Elevation Model using Shape from Shading

**Authors:** Min Hyun Cho, Young Jae Oh, Ji Hoon Bai and Min-Jea Tahk

**Keywords:** Lunar Digital Elevation Model, Shape from Shading, Lunar Orbiter Laser Altimeter (LOLA) Data

**Content:** This paper deals with a procedure to reconstruct a lunar surface based on fusion of Shape from Shading with absolute depth information exploited from Lunar Orbiter Laser Altimeter data. The generation of accurate lunar digital elevation model which contains altitude and terrain shape of mission area is critical for lunar exploration mission design. The photoclinometric approach based on Shape from Shading yields dense, high-frequency information while range scanning data from Lunar Orbiter Laser Altimeter complements the photoclinometric reconstruction with low-frequency, large scale reliable depth information. The proposed Shape from Shading algorithm utilizes the laser altimetry data as initial guess and iteratively calculates the high-frequency altitude information from high resolution image. The high-frequency depth variation caused by small crater and boulder is recovered by applying Shape from Shading.

**Title:** Performance Testing of Prime Focus Spectrograph Acquisition and Guide Camera

**Authors:** Nguyen Phuc Dat

**Keywords:** acquisition and guide, CCD sensor, camera gain, quantum efficiency

**Content:** During the internship, Dr. Hung-Hsu Ling guided me in the performance testing of the Acquisition and Guide (AG) cameras for the Prime Focus Spectrograph (PFS). The AG cameras consisted of 6 liquid-cooled FLI MicroLine 4720 cameras, each has an e2v CCD47-20 sensor (1024×1024 resolution) and a full well capacity of 100,000 e-. For each unit tested, we focused on the camera gain derivation, the readout variance evaluation, and the quantum efficiency measurement. Analysis of the image involved subtracting and averaging the frames; subtracting variance; computing statistical variance; finding the linear relation between photo-induced signal and shot noise variance, as well as deriving irradiance level on the sensor surface. We found that the results matched the vendor's claims, thus verify the performance quality of the cameras in the specified aspects.

**Title:** A search for debris disks around nearby late - M dwarfs using the James Clerk Maxwell telescope

**Authors:** Nguyen Thanh Dat, Phan Bao Ngoc

**Keywords:** planetary systems, brown dwarfs, debris disks, dust emission

**Content:** While debris disks have been found around A – to K – type stars and some early – M dwarfs, no debris disks have been detected around late – M dwarfs and brown dwarfs so far. We first searched for debris disk around three nearby late – M dwarfs by conducting observations at 850 μm with the SCUBA – 2 bolometer array at the James Clerk Maxwell Telescope. We did not detect any debris disks around these targets. We estimated upper limits to the dust mass of debris disks around them. Further search for debris disks around very close young brown dwarfs is needed to understand the formation of rocky planets around brown dwarfs.

**Title:** Estimating Masses of Galaxy Clusters from Automated Analysis of Chandra X-Ray ACIS Data

**Authors:** Alif Husnul Fikri, Hesti Retno Tri Wulandari, Kiki Vierdayanti, Annisa Novia Indra Putri and Dhimaz Ghilang Ramadhan

**Keywords:** Galaxy Cluster, X-ray, Chandra Satellite

**Content:** Clusters of galaxies are commonly used in constraining cosmological parameters. Mass is a physical yet not observable parameter that should be estimated for this purpose. Masses of galaxy clusters can be determined from the density and temperature profiles of the hot intracluster medium (ICM) in the clusters, which is observable in X-rays.

It takes a series of data processing to obtain density and temperature profiles of the ICM. Chandra scripts are available for most of these purposes, still some processes should be done 'by hands' and therefore are quite tedious and time consuming, especially if we have to work with many clusters. In this work we developed a script to automate the processes, to make data processing easier and faster. The automation script uses a standard reducing data process from Chandra, extracting spectrum from data, and simultaneously fit the spectra of multiple observations while performing the deprojection process. We report here mass determination of 5 relaxed galaxy clusters using Chandra X-ray ACIS data. To improve the statistics, especially in spectrum fitting, we analyzed multiple observations data for each cluster. We found that the results are in a good agreement with other mass determinations. Analyzing more clusters and use it for cosmological purposes is underway.

**Title:** Performance Testing of the Cartidge-type Multi-pixel Receiver at 1.5 THz based on HEB Mixers

**Authors:** Nguyen Ngoc Huy Hoang

**Keywords:** Power module distributor, beam splitter, Catridge-type Multi-pixel receiver

**Content:** Doing the intership, I was supervised by Dr. Ming-Jie Yang on the project:' Performing testing of 1.5THz Catridge-type Multi-pixel receiver based on HEB mixers". In this project, we use beam splitter mixers to split one transmission wave into multiple waves. And in the project, I use Matlab function to find the correct dielectric constants of the layers of the beam splitter. Afterward, using that data to find the thickness that give the transmission to the thickness that give the transmission to reflection ratio equal to 1. After that we can use that calculation to create each layer of the beam splitter.

**Title:** Analysis of magnetic anomalies on the lunar surface

**Authors:** Hyojeong Lee, Ho Jin, Seul-Min Baek, Jung-Kyu Lee, Khan-Hyuck Kim and Ian Garrick-Bethell

**Keywords:** Moon, Magnetic anomaly, Lunar magnetism

**Content:** The Moon has no global magnetic field like the Earth. However, moderate strength local magnetic fields can be measured near the surface of the Moon, which are referred to as magnetic anomalies. Even though previous missions have made measurements of magnetic anomalies, their formation mechanism is still not clear. Therefore, we have been researching lunar magnetism and measurement technologies to investigate their origin. Data used to study the lunar magnetic field include Magnetometer (MAG) and Electron Reflectometer (ER) data generated by Lunar Prospector (LP) mission launched in 1998 by the United States. In this paper, we studied several magnetic anomalies and developed source models of the magnetic field using these LP data sets. We analyze the ER data for the magnetic anomaly region and compare them with MAG data. We find that the strongest magnetic field is observed in different positions for the two data sets and the direction of magnetization in all anomalies is not the same. Therefore, we conclude that the geological origins of magnetic anomalies may be diverse.

**Title:** Preliminary Design of Korea Pathfinder Lunar Orbit Magnetometer (KMAG)

**Authors:** Seungah Lee, Hyojeong Lee, Seongwhan Lee, Jung-Kyu Lee, Jehyuck Shin, Mangyu Lee, Dukhnag Lee, Derac Son, Yu-Sung Jang, Sihyung Lee and Ho Jin

**Keywords:** magnetometer, lunar exploration, Moon, magnetic field

**Content:** The KPLO MAGnetometer (KMAG) is one of the five payloads on the Korea Pathfinder Lunar Orbiter (KPLO) spacecraft. The scientific goal of KMAG is to measure the DC and low frequency magnetic field variations near the lunar surface. KMAG consists of a boom structure containing three fluxgate magnetometers and Fluxgate magnetometer Control Electronics (FCE) with four electrical boards. The magnetometers have ±1,000 nT measurement range with 50 pT resolution and 10 Hz data sampling rate. The 1.2-meter-long boom includes the magnetometers and is deployed with 135 degree angle from a spacecraft to minimize electromagnetic interference. The FCE is composed of a housing structure and four electrical boards: Low Voltage Power Supply (LVPS), On Board Computer (OBC), digital board and analog board. In order to verify that KMAG system meets requirements, test plan was established for each development models. We had developed KMAG Engineering Model (EM) and carried out electrical function test, magnetometer calibration and environmental test. This paper presents the preliminary design and test results of the KMAG EM.

**Title:** Project on radiation pattern of 2 different types of antenna

**Authors:** Le Kim Long

**Keywords:** Horn antenna, radiation pattern

**Content:** One of the unique characteristics of any antenna is its radiation pattern. Determining how well the antenna can receive or transmit signals in a given direction is crucial to the successfulness of that antenna. In the project TIME – pilot I participated in, I contributed a part in revealing the radiation pattern of the horn antenna of the device. The horn antenna is mounted on a rotary stage and rotate an angle of 60 degrees centered at the incident rays. Measurements were carried out along E plane and H plane for co-polarization and cross-polarization. From the results, we can infer how signals behave at each direction with respect to the antenna.

**Title:** D-region ionospheric disturbances in low-mid latitudes due to solar flares during solar maximum period of the 24th solar cycle

**Authors:** Le Minh Tan, Tran Quoc Ha and Nguyen Ngoc Thu

**Keywords:** VLF signal, Solar flares, D-region ionosphere, Reflection height, Electron density gradient

**Content:** The radio waves at the Very Low Frequency (VLF) range from the VLF transmitters can propagate in the Earth-ionosphere waveguide (EIWG). When solar flares occur, the D-region ionosphere induced disturbances of the VLF signals. Analyzing the perturbations of the VLF/19.8 kHz signal from North West Cap, Australia recorded at Tay Nguyen University (TNU) (12.65oN, 108.02oE), Viet Nam and Dunedin (DUN) (45.78oS, 170.47oE), New Zealand to investigate the variation of Wait's parameters of EIWG due to solar flares, reflection height (h') and electron density gradient (β). The results reveal that the increase of β via X-ray intensity observed at a low-latitude station in TNU is slower than that observed at the mid-latitude station in DUN. This can be explained that the increase in β is contributed by ionization at the altitudes of 50–65 km as a result of galactic cosmic rays (GCRs) and the ionization by GCRs depends on the geomagnetic latitude with minimum at the equator. From the observations at both stations, we showed that the decrease of h' via the X-ray intensity in 2013 was slightly faster than that in 2014 and the β enhancement via the X–ray intensity in the mid-latitude region in 2014 is clearly slower than that in 2013. This may be caused by the significant decrease of the GCR intensity in 2014, a maximum solar year of the 24th solar cycle.

SST-2017@hcmiu.edu.vn
www.sst.phy.hcmiu.edu.vn
(84) (28) 3724-4270
Ext: 3326