Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

MSD05-01 Room:106 Time:May 20 09:00-09:15

Small satellite for stratosphere-mesosphere science

SUZUKI, Makoto[1*], SANO, Takuki[1], SHIOTANI, Masato[2], Doug Degenstein[3]

[1]ISAS, [2]RISH, [3]Univ. Saskatchewan

Since the Numbus-7 satellite in 1978, various nadir looking Vis-UV backscattering observation and limb observations (Solar occultation, limb emission and limb scattering) have been supporting the studies of dynamics and chemistry of stratosphere and mesosphere.

Today, there have been working more than 10 instruments onboard the satellites such as, Aura, TIMED, NPP, Envisat, SciSAT-1, and Odin. In Japan, there had been strato-mesospheric observations using EXOS-C/LAS, EXOS-C/BUV, ADEOS/ILAS, ADEOS-II/ILAS-II and ISS/JEM/SMILES. But, there exists strong concern, among scientists who have been working on the limb observation1), atmospheric science community in general (WCRP/SPARC, SPARC measurement requirements WG), as well as UN/UNEP2), on the future continuation of various limb observations of stratosphere/mesosphere after the current satellite operations (other than operational OMPS-limb scattering observation after the NASA-NOAA JPSS-2 satellite).

This paper reports the preparation status on the international limb observation proposal including SMILES follow-on mission and other limb scattering, limb emission measurements.

SMILES had demonstrated high sensitivity of 4 K cooled SIS detector system, and its extraordinary usefulness for the chemistry of the stratosphere and mesosphere. But, we now clearly faced up to the limitations of ISS/JEM/SMILES as the demonstration mission as well as limitations of existing stratospheric-mesospheric observations. The basis of the description of phenomena in the stratosphere-mesosphere is 3D fields of temperature and O3 which confine chemistry, radiation, and dynamics, but we found that both the measurement precisions, and the spatial-temporal sampling are not sufficient for the requirements of atmospheric sciences. To overcome this situation, we should have a new satellite platform with combination of best instruments available (for precisions and accuracies) and multiple horizontal IFOV to improve spatial and temporal sampling.

SMILES follow-on mission should have following improvements, such as; (1) better temperature sensitivity using O2 emission line, (2) observations of lower-stratosphere and upper troposphere using the 200-300 GHz frequency region, (3) measurement of tracer and source species, such as H2O, N2O, CO, HCN, CH3Cl, etc, (4) optimization of observation frequencies for BrO etc, and (5) smaller vertical IFOV, shorter observation interval, as well as tomography retrieval.

In addition to the SMILES follow-on instrument, there should be observations of (a) daytime limb scattering and nighttime airglow observation (Odin/OSIRIS follow-on or a follow-on instrument of SCIAMACHY limb observation), (b) IR limb emission of temperature and O3 (similar to the TIMED/SABER, but using uncooled detector technology), (c) GPS occultation measurement (stratospheric temperature, ionospheric electron density).

Sience observation described above can be carried out by the ISAS small science satellite program, which can carry up to 200 kg science payload for the 450-500 km and 50-64 degree inclination orbit. (SMILES follow-on: 130 kg, OSIRIS follow-on: 20 kg = 10 kg x 2 IFOVs, uncooled IR limb sounder: 20 kg = 10 kg x 2 IFOVs, GPS occultation: 10 kg, Mission Data Processor: 5 kg, and two fine Star Sensors: 10 kg)

We will seek this satellite proposal through international collaboration, to the ISAS small science satellite program (#3 or later launches).

References

1) Minutes of 5th International Limb Atmospheric Science Conference, Helsinki, Nov. 2009.

2) UNEP, Satellite Networks, page 7 of Recommendations of the eighth meeting of the Ozone Research Managers of the Parties to the Vienna Convention, UNEP/OzL.Conv.9/6, Nov. 2011.

Keywords: stratosphere, mesosphere, Limb onservation, O3, sub-mm, Limb scattering

Japan Geoscience Union Meeting 2012
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MSD05-02 Room:106 Time:May 20 09:15-09:30

Present Status of the ELMOS Small Satellite Constellation

KODAMA, Tetsuya[1]*

[1]JAXA

Present status of the ELMOS small satellite constellation will be presented.

Keywords: ELMOS, small satellite constellation, GPS occultation, electron density, electron temperature, lithosphere-atmosphere-ionosphere coupling

MSD05-03 Room:106 Time:May 20 09:30-09:45

Development of MCE (Multi-mission Consolidated Equipment)

ODA, hirohisa[1]*

[1]JAXA

1.Overview
MCE (Multi-mission Consolidated Equipment) has following 5 mission equipments. MCE is attached to Kibo exposed facility, then perform each experiments.

IMAP ;Ionosphere, Mesosphere, upper Atmosphere and Plasmasphere mapping
GLIMS ; Global Lightning and Sprite Measurement Mission
SIMPLE ;Space Inflatable Membranes Pioneering Long-term Experiments
REX-J ;Robot Experiment on Japanese experiment module
HDTV-EF ;

IMAP, GLIMS, HDTV-EF are installed in MCE base plate (earth direction), because they need earth direction field of view. SIMPLE is installed in forefront of MCE, because SIMPLE has extendable must, and this must will extend after MCE is attached to Kibo exposed facility. REX-J is installed in second floor of MCE.

MCE will be mounted to Konotori, which is unmanned transfer vehicle to International Space Station. Konotori will be launched by H2B rocket. MCE will be attached to Kibo exposed facility by Kibo robot arm. Then, MCE will be received electrical power and communication from Kibo exposed facility. Experiments will be performed more than 2 years. After experiments, MCE will be mounted to Konotori, then jettisoned to earth atmosphere.

2.Development of MCE
Development of MCE started in Nov. 2008. PDR (Preliminary Design Review) was performed in Aug. 2009. CDR (Critical Design Review) was performed by each subsystem level from Dec. 2009. 5 mission equipments were handovered to MCE system from Jul. 2010 to Nov. 2010. MCE system level test was performed from Dec. 2010.

(1)Performance test
Performance of MCE was verified.

(2)Thermal vacuum test
Performance of MCE under space environment (high/low temperature and vacuum) was verified.

(3)Modal survey test
Acceralations of MCE were measured to verify MCE structural characteristics.

(4)Acoustic test
Acoustic environment during launch was loaded to MCE, to verify MCE resistance characteristic.

(5)Crew interface test
Operability of MCE by EVA (Extra Vehicle Activity) was verified.

(6)Electro-magnetic compatibility test
To verify that electromagnetic wave from MCE will not affect to circumstance. To verify that MCE perform normally under electromagnetic environment in International Space Station.

(7)Ground operation system interface test
To verify that communication (command and telemetry) between ground operation system and MCE was performed normally.

3.Future plan
MCE will be launched in 2012. MCE will be transported to Tanegashima space center. Then, MCE will be handovered to

Konotori.
Maintenance of ground operation system, development of on-orbit operation procedures, training of ground operators were performing to be ready for MCE on-orbit operations.

Keywords: kibo, MCE

Japan Geoscience Union Meeting 2012
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MSD05-04 Room:106 Time:May 20 09:45-10:00

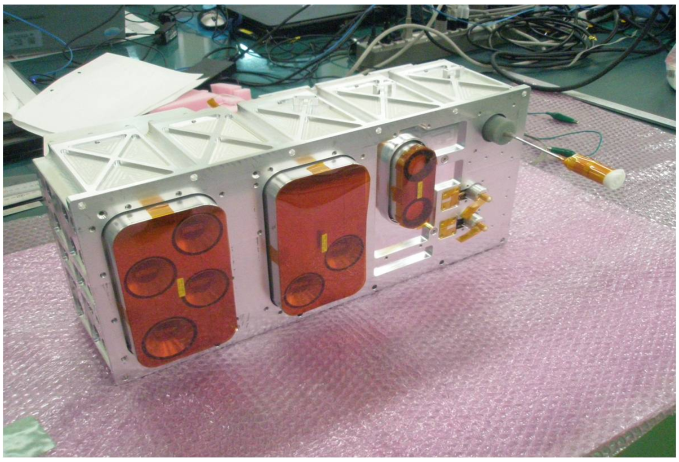
Global Lightning and Sprite Measurements from International Space Station

USHIO, Tomoo[1*], SATO, Mitsuteru[2], SUZUKI, Makoto[3], MORIMOTO, Takeshi[1], Ryohei Ishida[4], Masayuki Kikuchi[5], HOBARA, Yasuhide[6], TAKAHASHI, Yukihiro[2], YAMAZAKI, Atsushi[3]

[1]Osaka University, [2]Hokkaido University, [3]JAXA, [4]Osaka Prefecture University, [5]NIPR, [6]University of ElectroCommunication

The Global Lightning and sprIte MeasurementS (GLIMS) on the International Space Station (ISS) is a mission to detect and locate optical transient luminous events (TLEs) and its associated lightning simultaneously from the non-sun synchronous orbit, and is scheduled to be launch from Japan in 2012 as part of the multi-mission consolidated equipment on Japanese Exposure Module (JEM). Our mission goals are (1) to detect and locate lightning and sprite within storm scale resolution over a large region of the Earth's surface along the orbital track of the ISS without any bias, (2) to clarify the generation mechanism of sprite, and (3) to identify the occurrence conditions of TLEs. To achieve these goals, two CMOS cameras, six Photometers, VLF receiver, and VHF interferometer with two antennas, are installed at the bottom of the module to observe the TLEs as well as causative lighting discharges at nadir direction during day and night time. Though the luminous events so-called sprite, elves and jets have been investigated by numerous researchers all over the world based mainly on the ground observations, some important problems have not been fully understood yet such as generation mechanisms of columniform fine structure and horizontal offset of some sprites from the parent lightning discharges. In the JEM-GLIMS mission, observations from our synchronized sensors are going to shed light on above-mentioned unsolved problems regarding TLEs as well as causative lighting discharges. In this presentation, the scientific background, instrumentation, project summaries are given.

Keywords: Lightning, Sprite, ISS



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MSD05-05 Room:106 Time:May 20 10:00-10:15

Status of Global Lightning and Sprite Measurements on JEM-EF Mission (JEM-GLIMS)

SATO, Mitsuteru[1*], USHIO, Tomoo[2], MORIMOTO, Takeshi[2], SUZUKI, Makoto[3], YAMAZAKI, Atsushi[3], Masayuki Kikuchi[4], Ryohei Ishida[5], TAKAHASHI, Yukihiro[1], UMRAN, Inan[6], HOBARA, Yasuhide[7], SAKAMOTO, Yuji[8]

[1]Facultyl of Science, Hokkaido University, [2]Graduate School of Engineering, Osaka University, [3]ISAS/JAXA, [4]NIPR, [5]Graduate School of Engineering, Osaka Prefecture University, [6]STAR Lab., Stanford University, [7]Faculty of Electro-Communications, The University of Electro-Communications, [8]Graduate School of Engineering, Tohoku University

In order to study the generation mechanism and occurrence condition of Transient Luminous Events (TLEs), global occurrence rates and distributions of lightning and TLEs, we will carry out the lightning and TLE observation at Exposed Facility of Japanese Experiment Module (JEM-EF) of International Space Station (ISS). In this mission named JEM-GLIMS (Global Lightning and sprIte MeasurementS on JEM-EF) two kinds of optical instruments and two sets of radio receivers will be integrated into the Multi mission Consolidated Equipment (MCE). The optical instruments consist of two wide FOV CMOS cameras (LSI) and six-channel spectrophotometer (PH), and all these optical instruments are pointed to the nadir direction. In order to detect whistler wave in the VLF range excited by lightning discharges, one VLF receiver (VLFR) is installed. In addition to this, VHF interferometer (VITF) which measures VHF pulses emitted by lightning discharges is installed. JEM-GIMS will be launched by H-IIB F3 this summer. We have finished the fabrication of GLIMS instruments and all the environmental tests (EMC, vibration, and thermal vacuum) and have delivered GLIMS instruments to the system side. All system functional and environmental tests of MCE were also finished at the end of 2011. Now JEM-GLIMS with MCE has delivered to the launch site and the assembling of the HTV and rocket system are started. We will present the status of the JEM-GLISM mission and discuss the expected science outputs derived from this mission more in detail.

Keywords: lightning, sprite, ISS

Japan Geoscience Union Meeting 2012
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MSD05-06 Room:106 Time:May 20 10:15-10:30

Space-borne imaging observation of the Earth's upper atmosphere

SAITO, Akinori[1*], YAMAZAKI, Atsushi[2], SAKANOI, Takeshi[3], YOSHIKAWA, Ichiro[4]

[1]Dept. Geophysics, Kyoto University, [2]Institute of Space and Astronautical Science / Japan Aerospace Exploration Agency, [3]Planetary Plasma and Atmospheric Research Center, Graduate School of Science, Tohoku University, [4]The University of Tokyo

Space-borne observation of the Earth's upper atmosphere has been planned for the global observation of the ionosphere, mesosphere, thermosphere and plasmasphere by a Japanese scientist group. An observation from the international space station will be carried out from 2012. The mission is called ISS-IMAP. It uses two imagers, visible-light and infrared spectrum imager (VISI) and extra ultraviolet imager (EUVI). VISI will observe the airglow of 730nm (OH, Alt. 85km), 762nm (O2, Alt 95km), 630nm(O, Alt.250km) in the Nadir direction. EUVI will measure the resonant scattering of 30.4nm [He+] and 83.4nm [O+]. Its field-of-view is 15 degrees, and points the limb of the Earth to observe the vertical distribution of the ions. The altitude and inclination angle of the Orbital plane of ISS is around 350km and 51 degrees, respectively. Therefore the target of ISS-IMAP is the phenomena in the low- and mid-latitude regions. Another plan of the space-borne imaging observation of the upper atmosphere is the observation using a small satellite in the geo-transfer orbit. It combines the in-situ measurement, such as the Langmuir probe, imaging instruments, such as VISI, EUVI and FUV imager, and a GNSS receiver. The observation of this small satellite can fill the gap of our knowledge, and integrate the fragmentized information of the Earth's upper atmospheres.

Keywords: small-satellite, ionosphere, mesosphere, plasmasphere, thermosphere, imager

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MSD05-07 Room:106 Time:May 20 10:45-11:00

HDTV observation from International Space Station

SHINOHARA, Hideaki[1*], Keiji Murakami[1]

[1]JAXA

JAXA developed the High Definition Television Camera System for International Space Station(ISS) 'Kibo' Japan Experiment Module Exposed Facility (HDTV-EF) to demonstrate in the space exposure environment. The cameras of HDTV-EF are Commercial Off-The-Shelf. HDTV-EF is one of mission equipments installed into Multi- mission Consolidated Equipment (MCE). MCE will be launched by H-2 Transfer Vehicle 'Konotori' #3(HTV#3) in 2012. It is installed to 'Kibo' Exposed Facility. We report the Developement of HDTV-EF and the Image pick-up plan.

Keywords: HDTV, ISS

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MSD05-08 Room:106 Time:May 20 11:00-11:15

REX-J, Robot EXperiment on ISS/JEM to demonstrate an astronaut support robot

ODA, mitsushige[1*]

[1]oda, mitsushige

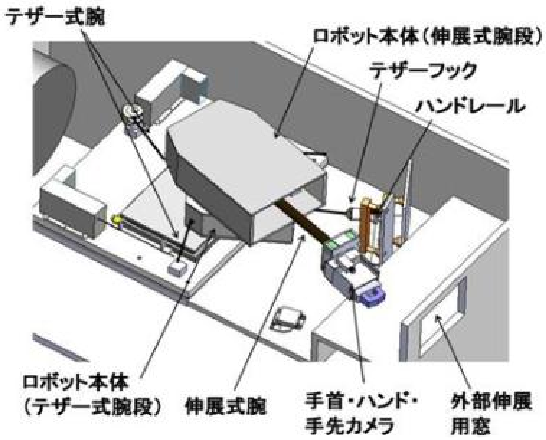
With the expansion of space activities, a large space facilities is now being constructed in space, has become its assembly, is required of astronaut extravehicular activity maintenance. Extravehicular activity of astronauts to radiation exposure, there is a risk of life-threatening such as micro-debris collision, however astronaut.

Therefore, we are conducting research on robot support of astronaut extravehicular activity, an alternative, which is planned at the International Space Station (ISS) and experimented.

Experiment has been called REX-J will be transported to the ISS / JEM in the machine to supply the space station in July 2007.

REX-J is different from various robots on the ground robots and space so far, pulled out (with the hook mechanism at the tip) that can be stretched tether from the robot also by a robotic arm that can stretch from the robot, in the space station, space flight attaching a tether hook the tip of the hand rail has been established for extravehicular activity when the chassis. Then, the robot is to navigate to the location intended by winding the tether. This mechanism is simple robot, the robot has a normal feature easily can have a redundant system more difficult to realize.

Keywords: space robot, astronaut support robot, REX-J



Japan Geoscience Union Meeting 2012
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MSD05-09 Room:106 Time:May 20 11:15-11:30

Over view of the UNIFORM project

FUKUHARA, Tetsuya[1*], Hiroaki Akiyama[2], Kane Ishibashi[3]

[1]Hokkaido University, [2]Wakayama University, [3]University of Tokyo

CO2 emitted from forest fire/peat fire is approximate 8 billion ton per year. Extinction of a forest fire is one of the most effective activities for the reduction of CO2 emission. We develop the satellite called the UNIFORM (UNiversity International FORmation Mission) that detect a forest fire by 10um micro bolometer camera at an early stage for contributing to digestive activities. This 50 kg class satellite realizes low cost, quick fabrication, and on-demand operation and we are planning the constellation operation of 3 satellites in this mission. We introduce the overview of the mission and specification of satellites in this presentation.

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MSD05-10 Room:106 Time:May 20 11:30-11:45

Thermal infrared sensor calibration plan of the ground mounted on a earth Observation micro satellite

KOMATSUDA, TADAYOSHI[1*], FUKUHARA TETSUYA[1], NAKAMURA RYOSUKE[2]

[1]Hokkaido University, [2]National Institute of Advanced Industrial Science and Technology

The 50 kg class satellite that detect a radiance of forest fire of 10 um band by a micro bolometer camera at an early stage for contributing to digestive activitiesin is developed in the UNIFORM (University International FORmation Mission) .

Verifications with ground truth for the detection of forest fire are need not only to estimate the brightness temperature from the satellite image but also to remove the slight effect of water vapor in 10 um band.

In the present study, we have acquired a ground truth data with the ASTER TIR observation in which the image of burning of hills in Nagasaki has been taken, and the absolute radiance in the burning area has been estimated from the ground data in sub-pixel scale.

We can correct the satellite data in each pixel by using the result.

And we will prepare a procedure of verification for the UNIFORM satellite before the launch.

Keywords: Micro satellite, Earth observation, Forest fire, Thermal infrared sensor, Ground calibration, Image processing

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Progress Report of the Development of microsatellite RISING-2 for cumulonimbus and sprite observation by multi-spectrum

SAKAMOTO, Yuji[1*], KUWAHARA, Toshinori[1], TAKAHASHI, Yukihiro[2], Kazuya Yoshida[1]

[1]Tohoku University, [2]Hokkaido University

The development of 50-kg microsatellite RISING-2 started in July, 2009 by Tohoku University and Hokkaido University. The primary mission is earth observation with a resolution of about 5 meters. The fabrication of flight model was completed at May, 2011, and now the update of on-board software and the evaluation with simulation environment are being carried out. In this presentation, a summary of mission and system design is reported.

The RISING-2 is the microsatellite which mass is about 50kg and the size is about 500x500x500mm. The orbit is sun synchronous and the altitude of circular orbit is planned from 600 to 800 km. The launch rocket and date is not decided, but the launch opportunities after 2013 offered by JAXA are applied for.

The primary mission is the earth observation with a resolution of 5 meters by using a Cassegrain reflector telescope which diameter is about 10 cm and the focus distance is about 1 meter. The visible infrared and multi spectral images of cumulonimbus clouds can be observed by using a liquid crystal tunable filter (LCTF) as well as usual color images. Continuously observing the cloud images with an interval of about 10ms, the detail structure of cumulonimbus clouds in multi spectrum can be constructed. This resolution is higher than images obtained by conventional satellites such as TRMM, which have 2-km resolution, and ground radar observatories. These observations are expected to solve a mechanism of guerilla heavy rain and contribute to the establishment of basic technology for weather forecasting.

The observation of sprite and transient luminous events are retried, which was planned by the former satellite RISING (SPRITE-SAT) but was not carried out because of bus system troubles. The instruments consist of two spectrum CMOS cameras, which FOV is 29 degrees each, and one wide-view CCD camera. The horizontal structure is solved by simultaneously observing sprites and lightning discharge phenomena. In the same years, several similar missions such as TARANIS, ASIM, and JEM-GLIMS are scheduled. The multiple observations in several missions will have the marvelous influence on the science of atmospheric electricity in the meteorology, the space and terrestrial physics, and the gamma-ray astronomy.

The RISING-2 can observe the designated position around the earth by using the three-axis attitude control system which consists of reaction wheels, star sensors and gyro sensors. The almost instruments of attitude control system including a central control unit, attitude sensors and wheels are newly developed in this project. The angular velocity can be dumped into less than 0.2 deg/s by magnetic torquers and magnetometers. The fine pointing control using wheels, gyro, and star sensors is carried out for 15 minutes in sunshine and 15 minutes in eclipse each.

The progress of evaluation tests with simulation environment is reported. Two types of simulators, the power system evaluation and the attitude control evaluation, are constructed. Imitating the solar generation power and the consuming power of electrical units, the working of on-board power system can be evaluated. Also, the dummy sensor data such as star sensors and gyro sensors are supplied to the on-board attitude control unit, and the rotation speed of wheels are measured. The external computer calculates the orbit and attitude motion, and the precision of attitude errors are evaluated.

Keywords: microsatellite, Cassegrain reflector telescope, liquid crystal tunable filter, cumulonimbus clouds, sprite

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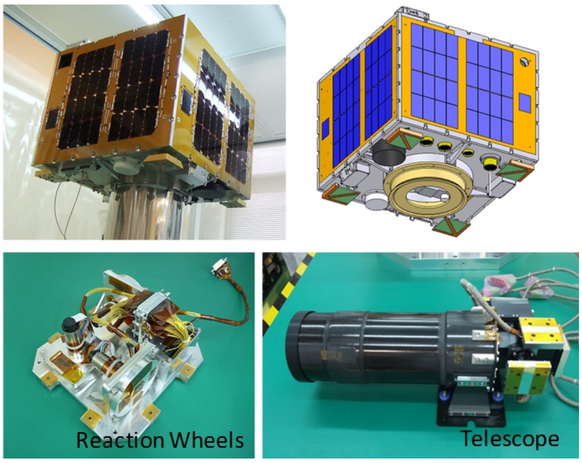

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MSD05-12 Room:106 Time:May 20 12:00-12:15

Development of Circularly Polarized Synthetic Aperture Radar for UAV and Microsatellite

SRI SUMANTYO, Josaphat Tetuko[1]*

[1]Center for Environmental Remote Sensing, Chiba University

Synthetic Aperture Radar (SAR) is a multi purpose sensor that can be operated in all-weather and day-night time. Recently, our Research Center is developing the Circularly Polarized Synthetic Aperture Radar (CP-SAR) onboard Unmanned Aerial Vehicle (UAV) and microsatellite to retrieve the physical information of Earth surface. In this research, the CP-SAR sensor is developed to radiate and receive elliptically polarized wave. The sensor is designed as a low cost, simple, light, strong, low power or safe energy, low profile configuration to transmit and receive left-handed circular polarization (LHCP) and right-handed circular polarization (RHCP), where the transmission and reception are both working in RHCP+LHCP. Then these circularly polarized waves are employed to generate the axial ratio image (ARI). This sensor is not depending to the platform posture, and it is available to avoid the effect of Faraday rotation during the propagation in ionosphere. Therefore, the high precision and low noise image is expected to be obtained by the CP-SAR.

Keywords: Synthetic Aperture Radar, Circular Polarization, Unmanned Aerial Vehicle (UAV), Microsatellite

MSD05-13 Room:106 Time:May 20 13:45-14:00

Geospace Exploration Mission: ERG project

MIYOSHI, Yoshizumi[1*], ONO, Takayuki[2], TAKASHIMA, Takeshi[3], ASAMURA, Kazushi[3], HIRAHARA, Masafumi[1], KASABA, Yasumasa[2], KUMAMOTO, Atsushi[2], MATSUOKA, Ayako[3], KOJIMA, Hirotsugu[4], SHIOKAWA, Kazuo[1], SEKI, Kanako[1], FUJIMOTO, Masaki[2], NAGATSUMA, Tsutomu[5], ERG Working Group[6]

[1]STEL, Nagoya University, [2]Tohoku University, [3]ISAS/JAXA, [4]RISH, Kyoto University, [5]NICT, [6]ERG Working Group

The ERG (Energization and Radiation in Geospace) is a geospace exploration mission in Japan for the solar maximum and subsequent declining phase of solar cycle 24. The mission is especially focusing on the relativistic electron acceleration mechanism in the context of the cross-energy coupling via wave-particle interactions as well as the dynamics of space storms. The interplay among different plasma/particle populations of the inner magnetosphere; plasmasphere, ring current/plasma sheet, and radiation belts is a key to understand the energetic particle accelerations. The cross-regional coupling such as magnetosphere-ionosphere via FAC and the potential electric fields causes the spontaneous variations of the ambient fields.

The ERG project consists of the satellite observation team, the ground-based observation team, and integrated-data analysis/simulation team, as well as the science working team and the project science team. The SPRINT-B/ERG satellite of ISAS/JAXA will be launched into inner magnetosphere in FY2014-2015. The comprehensive instruments for plasma/particles, field and waves are installed in the SPRING-B/ERG satellite to elucidate the electron acceleration processes. The newly developed system will directly measure the flow of the Poynting flux between particles and waves in the wave-particle interactions. The Japanese ground-network teams including magnetometer, SuperDARN radar, optical imager, VLF, etc. join the ERG project, which are very powerful tool for geospace remote sensing. The integrated data analysis and simulation team is now developing the simulation tools which can be compared directly with the observations. In this talk, we will present the current status of the ERG project and possible collaborations with other geospace satellite missions such as THEMIS and RBSP as well as the ground-based observations and simulation studies.

Keywords: Small Science Satellite, Geospace Exploration, Future mission

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Current status of the SPRINT-A/EXCEED mission under development

YAMAZAKI, Atsushi[1*], K. Uemizu[1], YOSHIKAWA, Ichiro[2], TSUCHIYA, Fuminori[3], YOSHIOKA, Kazuo[4], KAGITANI, Masato[3], MURAKAMI, Go[1], KIMURA, Tomoki[1], TERADA, Naoki[3], KASABA, Yasumasa[3], SPRINT-A project team[5]

[1]ISAS / JAXA, [2]Univ. Tokyo, [3]Tohoku Univ., [4]Rikkyo Univ., [5]Project name

The first satellite SPRINT-A of the SPRINT series, which is the JAXA's small satellite project, is now under development. The first electric and mechanical test using the flight model of the SPRINT-A satellite is now performed for the satellite to be launched in the next year. The mission payload, EXCEED, has the main telescope of the extreme ultraviolet imaging spectrometer (EUV), the camera guiding field-of-view (FOV) for feedback to the satellite attitude control system, and the mission data processor (MDP). The payload electronics are connected to satellite bus system with the space wire network. The objectives of the EXCEED mission are mainly two science topics: one is the atmospheric escape from the terrestrial planet by interaction with the solar wind plasma, the other is the plasma transfer mechanism in the Jupiter magnetosphere with the object of the extreme ultraviolet emissions from the Io torus and the Jupiter's aurora. The current status is reported in this presentation.

Keywords: Small scientific satellite, SPRINT satellite series, Atmospheric escape, Jupiter Io torus