Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

PPS001-01 Room:101 Time:May 27 08:30-08:45

Possible Japanese contributions to the Jupiter system exploration in 2020's

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In this talk, a summary of the Japanese EJSM WG efforts made in the FY2010 will be given. The first issue is the planning of JMO (Jupiter Magnetosphere Orbiter). JMO is assumed to fly together with EJSM spacecraft, namely, JEO (Jupiter Europa Orbiter, to be provided by NASA) and JGO (Jupiter Ganymede Orbiter, to be provided by ESA), and is planned to perform imaging of the space environment that the Galilean moons are embedded in and whose dynamic behavior the two EJSM spacecraft will observe. The study on the JMO orbit design have shown that the imaging from a vantage point at high-latitude is possible as we utilize the gravity assist from Calisto to raise the inclination of the orbit. Together with the fruitful discussion regarding what instrument suite should be onboard JMO, it shows the exciting aspect of the multi-spacecraft exploration of the Jupiter system. The second issue is on the Japanese participation in JEO and JGO. Several members of the WG have been invited to join various intsrument teams that will submit their proposals once the call is made. While competetive at the micro-scale, at the macro-level, the JMO WG will support every invited members so that substantial Japanese contributions at the instrument level to THE mission of the 2020's are secured.

Keywords: EJSM, Jupiter system, Europa, Ganymede, Plasma imaging, JMO

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PPS001-02 Room:101 Time:May 27 08:45-09:00

Trojan Asteroids and the Early Evolution of the Solar System

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Trojan asteroids can be used to constrain Trojan formation mechanisms, giant planet formation/migration and the orbital structure in the asteroid and Kuiper belts. We performed numerical simulations totaling a few million massless objects under the gravitational influence of the four giant planets. Overall, Neptunian Trojans were obtained at the end of planet migration, composed of remaining local (primordial) and captured Trojan asteroids. In addition to Neptune, the other three giant planets were also able to capture and retain a significant population of Trojan objects from the planetesimal disk after planet migration. In general, captured Trojans yielded a wide range of eccentricities and inclinations, while local Trojans survived with colder orbital conditions. However, the bulk of captured objects decay over Gyr, providing an important source of new objects on unstable orbits (the Centaurs). Our results suggest the bulk of observed Jovian and Neptunian Trojan populations were captured from the primordial planetesimal disk during planet migration, but their high-i component ($>$20-25 deg) remain unexplained so far.

Keywords: Edgeworth-Kuiper belt, Solar system, Orbital resonances, Trojan asteroids, Neptune, Trans-Neptunian objects (TNOs)

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PPS001-03 Room:101 Time:May 27 09:00-09:15

Scientific Rationale for Exploring Jovian Trojans

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Jovian Trojan asteroids have been considered as one of a few remaining final frontiers within our Solar System, which may hold fundamental clues of the solar system formation and revolution, as suggested by the discussion about their genesis between the classic model and the more recent Nice model. The former suggests that Trojan asteroids are mainly survivors of building blocks of the Jupiter system, while the later claims that they must be intruders from outer regions after the planetary migration of gas planets settled. In the past, scientific investigations of these dark, distant asteroid reservoirs were largely depended upon ground observations by large optical and spectroscopic telescopes and few definite D-type analog meteorites were collected on the earth. However, thanks to recent development of observational technologies such as AOs, statistical studies of asteroids in Jovian L4 and L5 regions have been made possible and raised new questions about their compositions far beyond snow lines and internal structures implied by binary systems. This paper discusses major scientific questions about such not-well-known Jovian Trojans and the potential of in-situ observations and explorations of such bodies to resolve some of them, together with possible instrumental and operational options.

Keywords: Jovian Trojans, Nice Model, Solar System Formation, D-type Asteroids, Binary Asteroids, Exploration Project

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PPS001-04 Room:101 Time:May 27 09:15-09:30

Development of Solar Power Sail System for Future Jupiter System Exploration

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[1]JAXA

JAXA has been studying solar power sail technology for future outer solar system exploration and is planning to launch middle-sized Jupiter system probe in late 2010s. As a stepping stone for enhancing the technology readiness level toward this mission, a small solar power sail demonstration probe ”IKAROS” was developed and launched in 2010, which became world’s first solar sail in space and successfully demonstrated several essential technologies such as solar sail deployment, power generation by large area thin film solar cells and orbit control by solar sail. In this presentation, the achievements by the IKAROS probe and current development status of solar power sail for Jupiter system exploration.

Keywords: solar power sail, electric propulsion, Jupiter exploration

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PPS001-05 Room:101 Time:May 27 09:30-09:45

Turning point in differentiation history of giant icy satellites induced by dehydration of pristine hydrous rock

Jun Kimura[1*], Kiyoshi Kuramoto[1]

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From gravity data, it has been found that Ganymede has a small value of the moment of inertia (MoI) factor (0.3115), which suggests a highly differentiated interior (an outermost H_2O layer, a rocky mantle, and a metallic core). Also, existence of the intrinsic magnetic field strongly supports the existence of a (at least partially) liquid, iron-rich core. However, process of the internal differentiation including the core formation is highly unclear, and the size of Ganymede implies that only accretional heat is insufficient to segregate the water, rock, and metallic materials completely. On the other hand, Callisto has similar size to Ganymede but show larger value of MoI (0.355) implying incomplete differentiation. Many hypotheses to explain this contrasting characteristic between two moons have proposed. Here we suggest another hypothesis for the internal evolution in early stage and focus on a dehydration process of pristine rock-metal-mixed core.

Although Ganymede and Callisto share similar size and mass, estimated masses of rocky component including metal derived from the mean density of both moons are considerably different each other in the viewpoint of the thermal history. Assumed that both moons consist of two components (water with density of 930 kg^{-3} and rock with density of 3,300 kg m^{-3}), the mass of rocky component is equivalent to a rocky core with radius about 1,980 km for Ganymede and 1,750 km for Callisto. This means that the radiogenic heat amount is different (Callisto has about 70 % amount of Ganymede's radiogenic heat source), assumed the same concentration of radioactive elements. However a preliminary evaluation shows that the temperature of the primitive core in both moons will be exceed the liquidus of metallic component (1250 K) and the metallic core will be formed within 1-2 Gyr, given the viscosity law of dry peridotite for the primitive cores. This result contradicts the gravitational data and its aspect to the differentiated state. Therefore it is difficult to create the dichotomy of internal state between two moons only by the difference of their silicate fraction (which corresponds to the radiogenic heat source), and thus another factor is needed.

Dehydration of hydrous rock and associated rheological change might be a key to create the dichotomy. We assume rocky component is possibly hydrated during the accretion, and hydrous rock-metal-mixed pristine core starts to warm due to radiogenic heat after the end of accretion. Once the dehydration starts to occur, the temperature of rocky core would increase more rapidly and exceed the melting point of the metallic component, and thereby metal segregates from rocky material. If Ganymede which has larger amount of radiogenic heat has experienced the dehydration, and if Callisto has not, the dichotomy in differentiation state between both satellites would be explained.

To test above idea, we performed numerical simulations for the internal thermal evolution taking into account the heat transport by convection and conduction. In a reasonable range of viscosity is assumed for hydrated rocky core, model Ganymede experiences the dehydration of the pristine mixed-core and possibly the metallic component could segregates from the rocky materials in case of the high silicate content and/or higher viscosity of hydrous rock. On the other hand, Callisto does not undergo dehydration because of the smaller amount of radiogenic heat. The difference of radiogenic heat and the dehydration process have potential to create the dichotomy between two moons. Moreover, this may also explain the geological records on Ganymede showing the occurrence of global extension after the period of heavy bombardment. Global mapping with high spatial resolution in future mission on giant icy moons and improvement of accuracy in cratering chronology (e.g., current estimate on Ganymede's bright grooved terrain has uncertainty of an order of Gyr) are needed to examine our hypothesis.

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PPS001-06 Room:101 Time:May 27 09:45-10:00

Gas Accretion Flow onto Circum-Planetary Disks and the Disk Structure

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Satellite systems around gas giant planets are thought to be formed in circum-planetary disks, which are believed to exist at the gas capturing growing phase of giant planets. However, the structure of the circum-planetary disks are poorly known and thus current formation theories of satellite systems are forced to be constructed under not-well-established disk structures, which could impact the results.

In this study, we performed a series of hydrodynamic simulations of gas accretion flow onto circum-planetary disks from proto-planetary disks in order to analyze the structure of circum-planetary disks. We found that distribution of gas accretion flux onto the disk is well described by a power-law function of distance from the planet, which will be the basis to construct the circum-planetary disk structures in a steady state.

Keywords: satellites, giant planets, disks, hydrodynamic simulation

Japan Geoscience Union Meeting 2011
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PPS001-07 Room:101 Time:May 27 10:00-10:15

Polar motion of Titan forced by the atmosphere

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Titan's atmosphere possesses an equatorial component of angular momentum, which can be transferred to the surface and excite polar motion of Titan. The atmospheric excitation of Titan's polar motion is calculated using the wind and pressure data prediction from a general circulation model. The polar motion equation is solved considering Titan's triaxial shape and different hypothetical interior models. Titan's polar motion basically consists of a superposition of diurnal wobbles and semi-annual and annual wobbles caused by seasonal redistribution of wind and pressure pattern. If the entire interior of Titan is solid, the polar motion has amplitudes of a few meters and the paths of the diurnal and seasonal wobble are intermingled. If instead there is a subsurface ocean underneath the crust, the wobble amplitude could be larger by an order of magnitude. If the crust is thin, a resonance between the seasonal and Chandler wobble further increases the polar motion amplitude and makes the polar motion path elliptical. However, the external and internal coupling and the elastic restoring torque owing to Titan's triaxial shape strongly counteract the polar motion.

Keywords: Titan, polar motion

Japan Geoscience Union Meeting 2011
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PPS001-08 Room:101 Time:May 27 10:15-10:30

Investigations of the thermospheric dynamics of H_2 and $H_3{}^+$ in Jupiter

Takeru Uno[1*], Takeshi Sakanoi[1], Chihiro Tao[2], Yasumasa Kasaba[1]

[1]Tohoku Univ., [2]ISAS/JAXA

There have been many attempts to observe the Jovian thermospheric temperature with varying degrees of success. Early spectroscopic studies (e.g., Kim et al., 1990; Ballester et al., 1994) focused on the determination of the mean H_2 and $H_3{}^+$ temperatures or the vertical thermal structure in the northern and southern auroral regions. From high spectral resolution 2 um imaging observation, Raynaud et al., 2004 showed that the spatial distribution of the emission from H_2 and $H_3{}^+$ aurora are morphologically different. The origin of this morphological deference is still unknown. It potentially suggests the difference of emission altitude or the difference of energy injection to and the energy transfer between the neutral and plasma atmospheres.

We have studied this region by numerical simulations (e.g., Tao et al., 2009) and have compared them with multiple wavelength observation data of infrared aurora (2-4 um) taken with a ground-based telescope. In addition to the emission distributions, we focus on the temperature and wind velocity information to investigate neutral-ion coupling in the Jovian upper atmosphere: How and where does the energy input occur into the neutral and plasma upper atmospheres?

In Sep.-Oct. 2010, we conducted two observations using IRTF/CSHELL and SUBARU/IRCS. The IRTF/CSHELL observations were performed on Sep. 17, 19 and 26. Two different lines were observed alternatively, i.e., H_2 $S_1(1)$ 2.12 um and $H_3{}^+$ Q(1,0-) 3.953 um. The slit was positioned at the northern/southern polar region perpendicular to Jovian rotational axis. The high spectral resolution of CSHELL (R = 43,000) enable us the measurement of the line-of-sight velocity of $H_3{}^+$ and H_2.

Simultaneous H_2 and $H_3{}^+$ observations near 2.1 um took place on Oct. 12 using the SUBARU/IRCS. The slit is set along rotational axis (vertical to the auroral main oval) at northern/southern pole. In the polar region, H_2 emission lines $S_1(0)$, $S_1(1)$, and $S_1(2)$ at the wavelengths of 2.22, 2.12, 2.03 um and several $H\{3\}^+$ emission lines are detected. The wide spectral coverage and the high sensitivity of SUBARU/IRCS enable us the rotational/vibrational temperature measurement from the simultaneous observation of the distribution of emission lines.

We will report the difference in the spatial distributions of the emission, temperature, and line-of-sight velocity of neutral and plasma atmosphere, derived from the data of those observations.

Keywords: Jupiter, thermosphere, temperature, ionosphere, Infrared, spectroscopy

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PPS001-09 Room:101 Time:May 27 10:45-11:00

A dynamo driven by zonal jets at the upper surface: applications to giant planets

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We present a new possible dynamo mechanism for generating the magnetic fields of the giant planets. The mechanism relies on the presence of barotropically unstable differential rotation. We assume that zonal jet currents within the outer molecular hydrogen layer exert a drag at the top of the deep electrically conducting region. Because of the rapid rotation of the planet, this boundary forcing drives nearly geostrophic axisymmetric motions in the conducting region. For a given forcing, measured by the critical Rossby number Roc, a shear instability of the zonal flow develops in the form of a global Rossby mode. The wavenumber of the mode depends on the width of the zonal jets. For Ro $>$ Roc, we obtain self-sustained magnetic fields at magnetic Reynolds numbers greater than 103. The propagation of the Rossby wave and its nonaxisymmetric structure are both crucial for dynamo action. The amplitude of self-sustained axisymmetric poloidal magnetic field plausibly depends on the wavenumber of the shear instability, and hence on the width of the zonal jets. For narrow jets, the poloidal magnetic field is dominated by an axial dipole (jovian type) whereas in the case of wide jets, the axisymmetric poloidal field is weak (neptunian type?).

Keywords: dynamo, Rossby waves, Shear layers

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PPS001-10 Room:101 Time:May 27 11:00-11:15

Lightning and thundercloud observation in Jupiter by spacecraft and telescopes

Yukihiro Takahashi[1*], Mitsuteru Sato[1], Tetsuya Fukuhara[1], Yoav Yair[2]

[1]Hokkaido University, [2]Open University, Israel

Lightning discharge is an excellent tool to explore the planetary atmosphere as well as Earth based on the knowledge of the relationship between the atmospheric dynamics, especially the vertical convection, and electrical charge. It has been suggested for a decade that thunderstorms in Jovian atmosphere take important roles not only in the investigation of meteorology, which determines the large scale structures such as belt/zone and big ovals, but also in probing the water abundance of the deep atmosphere, which is crucial to constrain the behavior of volatiles in early solar system. We plan to make observation of thunderstorm activity based on lightning flash detection and cloud imagery using spacecraft and ground-based telescope. We would propose a very simple high-speed imaging unit onboard Jovian orbiter of EJSM, Optical Lightning Detector, OLD, optimized for detecting optical emissions from lightning discharge in Jupiter. OLD consists of radiation-tolerant CMOS sensors and two H Balmer Alpha line (656.3nm) filters. The different bandwidths of the filters enable us to estimate the depth of discharge. On the other hand, we also consider detecting the optical flashes using a ground-based 1.6 m reflector dedicated to planetary observation, which was installed at Nayoro, Hokkaido, this year by Hokkaido University. Here we introduce strategies to observe lightning optical emissions by this telescope with narrow-band high speed imaging unit. Continuous monitoring with such a ground-based facilities make it possible to compare lightning activity with variations of large-scale motions, leading to the understanding of the dynamics of Jovian atmosphere.

Keywords: Jupiter, thunderstorm, lightning, spacecraft, telescope

Japan Geoscience Union Meeting 2011
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PPS001-11 Room:101 Time:May 27 11:15-11:30

Polar Atmospheric Dynamics of Giant Planets

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[1]University of California Los Angeles

Spacecraft observations of Jupiter and Saturn since the early 1970s have identified three distinct dynamical regimes in the cloud-top winds. In the equatorial region, a fast, broad jetstream blows eastward where no vortices are found. In the mid-latitudes of both Jupiter and Saturn, many vortices exist between the numerous jetstreams that alternate in wind direction between eastward and westward. Closer to the poles, vortices become increasingly prevalent with latitude; however, Jupiter and Saturn critically differ in their atmospheric dynamics around the poles. On Jupiter, poleward of approximately 65 degree N/S latitudes, the banded structure that characterizes the lower latitudes becomes indiscernible, and the flow acquires an increasingly turbulent appearance with little zonal organization – we identify this regime as polar turbulence. Saturn, on the other hand, maintains zonally organized cloud bands up to the poles and lacks polar turbulence. The zonal structure of Saturn culminates in the southern hemisphere with a hurricane-like cyclonic vortex residing precisely at south pole, and the northern jetstream at 77 degree N follows a meandering path that manifests as a hexagonal cloud morphology when viewed from above. We will present numerical experiments that address the polar jetstream phenomena on giant planets, and the mechanism that separates the polar atmospheric dynamics regime from the lower latitudes.

Keywords: Planetary Science, Atmospheric Dynamics, Jetstream, Turbulence, Jupiter, Saturn

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PPS001-12 Room:101 Time:May 27 11:30-11:45

Seasonal and Temporal Variability of Jupiter and Saturn

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We report on the seasonal and temporal changes observed on Jupiter and Saturn, based on near- and mid-infrared data acquired from several observatories (NASA/InfraRed Telescope Facility, NAOJ/Subaru, ESO/Very Large Telescope) and provide compelling rationale for a coordinated network of large telescopes for continued ground-based observations. Jupiter has been experiencing an era of atmospheric global upheaval since 2005, the observed atmospheric changes being manifestations of changes in local meteorology and latent physical parameters of the system, and occur on various timescales and latitudes. The discrete storms in Jupiter's atmosphere have undergone significant changes over the past decade. The merger of the three white ovals into Oval BA and its subsequent color change in 2006 appear to be correlated to periodic interactions with the Great Red Spot (GRS). Subsequent episodes of GRS-Oval BA interactions in 2006, 2008 and 2010 provide snapshots of changes in the local meteorology. We identify relationships between latent physical variables of the spatially and temporally changing systems in terms of cloud opacities, aerosol distribution and thermal fields. The recent dramatic ongoing revival of the South Equatorial Belt (SEB) allows an unique insight into the dynamical processes that maintain belt/zone morphology. Ground-based near- and mid-infrared observations of Saturn from 1995 - 2009, covering half a Saturnian year, provide a rich data set to model seasonal changes in Saturn's atmosphere from autumnal equinox (1995) to vernal equinox (2009). Since 1995, as Saturn's south pole received increasing solar insolation, its albedo exhibits an increase in reflectivity at mid-latitudes in the southern hemisphere, decreasing towards the equator, anti-correlated with the thermal field. Similar to equatorial oscillations of temperatures on Earth and Jupiter, Saturn displays stratospheric temperature oscillations, with a period of half a Saturnian year, suggesting the influence of seasonal forcing. We anticipate development of similar phenomena in the next few years, as Saturn approaches northern solstice. Given the wealth of information from various spacecraft missions (Voyager, Galileo, Cassini) to both giant planets, many important questions remained unanswered, requiring continued exploration of these giant planets.

Keywords: Jupiter, Saturn, Atmospheres, Variability

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PPS001-13 Room:101 Time:May 27 11:45-12:00

Design study of Jupiter X-ray imaging spectrometer on EJSM JMO

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We present design and science study of the Jupiter X-ray imaging spectrometer as a payload candidate for the JMO (Jupiter Magnetosphric Orbiter) of EJSM (Europa Jupiter System Mission). EJSM is a joint international mission consisting of two flight elements developed by NASA and ESA to explore Europa and Ganymede, and one element by JAXA to observe the magnetosphere.

Jupiter is the most bright X-ray planet in the solar system. The current generation X-ray observatories (Chandra, XMM-Newton and Suzaku) have revealed various new aspects of Jovian X-ray emission. Jupiter's aurorae emit time variable X-rays via bremsstrahlung and charge exchange by energetic electrons and ions precipitation from the magnetosphere. Its low and middle latitude atmosphere exhibits scattering of solar X-rays. The diffuse X-ray emission seen in Jupiter's radiation belts suggests an inverse Compton scattering of tens MeV electrons. Io, Europa and Io Plasma Torus are also detected in X-rays. Hence, Jupiter and its vicinity is a reservoir of X-ray emissions. However, the low surface brightness and limited observation time hinder us to answer many basic questions such as what determines time variability of X-ray aurorae, what is the emission mechanism of Io, Europa, and Io Plasma Torus, and how necessary particles are accelerated and supplied in the radiation belts.

Driven by these scientific achievements and the remaining big puzzles, we have started to study design of an X-ray imaging spectrometer for EJSM JMO. Since JMO would allow high-latitude (10-30 deg inclination) measurements from large distances (>100 Rj), we can overview the whole Jupiter system in the X-ray band with an imaging and spectral capability. This in-situ measurement provides us with an unprecedented opportunity to observe Jupiter with extremely high photon statistics, time and angular resolution.

To realize the in-situ X-ray instrument for EJSM JMO, stringent mass and power limitations must be fulfilled. Also radiation and contamination of optical lights and debris must be taken care. The base line is a combination of an ultra-light weight X-ray telescope with the mass to area ratio of 10 kg/m2, and an imaging detector with the pixel number of ~1000 and a low power less than several tens W. In this presentation, we present scientific goals, requirements on instruments, and current design candidates for the X-ray telescope and detector.

Keywords: Jupiter, X-ray, aurora, radiation belt, instrument

Japan Geoscience Union Meeting 2011
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PPS001-14 Room:101 Time:May 27 12:00-12:15

Global ENA Imaging of the Magnetospheres of Saturn and Jupiter

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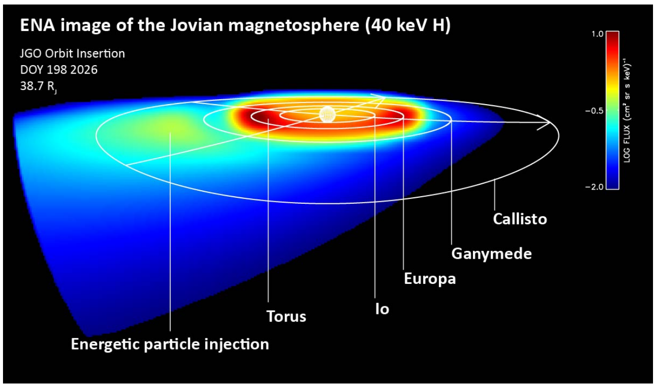
[1]JHU/APL

Jupiter's magnetosphere is by far the largest object in the sky if it would be visible from Earth. Its stellar-like transfer of angular momentum from the fast rotating planetary magnetic field to the space plasma environment is the engine that makes the Jovian magnetosphere also the biggest planetary particle accelerator within the solar system. Dense plasma originating from the Io and Europa region loads the fast rotating planetary magnetic field, stretching it into a magnetodisk until a multi-step process involving magnetic field ruptures ("reconnection") and plasma instabilities accelerates ions and electrons up to 100 MeV that bombard the surfaces of moons.

EJSM has required a synergistic approach within the JGO-JEO constellation to unravel fundamental and universal magnetospheric processes such as these, by using powerful combinations of in-situ and global imaging measurement. The Japanese Space Agency is also considering a possible Jupiter Magnetospheric Orbiter (JMO), enabling triple point measurements and multi-point imaging to ensure simultaneous and continuous observations - a key requirement for revealing how the magnetosphere couples to the ionosphere as well as to the plasma sources.

Energetic Neutral Atom (ENA) imaging is so far the only technique capable of obtaining global images of the magnetospheric energetic ion population in the ~3-300 keV range, which otherwise would have remained invisible. ENA cameras on Cassini and the terrestrial IMAGE mission have revealed global, explosive acceleration processes and their connection to the ionosphere, aurorae and radio emissions. Therefore, the technique is considered to be game-changing and one of the required measurement techniques in the payload definition for both JGO and JMO.

We present how ENA imaging has revealed the global magnetospheric dynamics of Saturn in a way that would not have been possible with only in-situ measurements. With this background we discuss how ENA imaging can be used at Jupiter to explore global acceleration, MI-coupling, relation to aurorae and radio emissions, transport, solar wind control, constrain torus neutral gas evolution and provide global context for moon-magnetosphere interactions. We use past measurements and a data-derived model to simulate ENA images through a realistic camera response function along the JGO orbit and explore the scientific value added by in-situ and imaging measurements from JMO. The presentation is concluded by summarizing the critical technical requirements of ENA cameras, such as energy and mass range, geometrical factor and background/foreground rejection that must be met in order to operate in the harsh Jovian environment while achieving the highest priority science objectives.



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PPS001-15 Room:101 Time:May 27 12:15-12:30

Dust-plasma interaction in Saturn's plasma disk

Shotaro Sakai[1*], Shigeto Watanabe[1], Michiko Morooka[2], Jan-Erik Wahlund[2]

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Plasma in Saturn's magnetosphere is co-rotating due to the rapid rotation of the planet. The co-rotation speed can slow down due to, for instance, mass loading. Past observations by the particle detectors for few hundred eV ions showed that the plasma speeds are close to the ideal co-rotation speed around 5 Rs and gradually slow down to 20–30% of the ideal co-rotation at 7 Rs.

On the other hand, the Cassini observation using the Langmuir Probe (LP) showed that the ion bulk speeds are close to Keplerian in the E ring. The E ring of Saturn consists of small (micron- and nano- meter sized) dust grains. These dusts are negatively charged inside 7 Rs and expected to contribute to the electro dynamics in the plasma disk. Also near Enceladus, which is a major source of the E ring dusts, the electron densities are significantly smaller than the ion densities and the ion speeds are near Keplerian in a large region. Recently the Cassini Plasma Spectrometer (CAPS) onboard Cassini also observed that the sub-co-rotation of the ions can be slow down to 40–50% of the ideal co-rotation.

We statistically investigated the ion bulk speeds in the equatorial region of the inner magnetosphere using the Langmuir Probe (LP) onboard the Cassini spacecraft. The LP observation showed that the ion speeds are about 50% of the ideal co-rotation speed at 4 Rs and has a clear increasing trend with the distance from Saturn. Beyond 7 Rs the ion speed values are spread toward the ideal co-rotation speed. This can be due to that the sub-micron sized negatively charged the E ring dust contribute to the plasma dynamics in the plasma disk.

We have also calculated the ion speeds using the three components MHD equations including dust to investigate the effect of the ion-dust coulomb collision to the ion speed. Our models show that the ion-dust collision can reduce the ion acceleration by the co-rotation electric field when the ion-dust collision frequency is comparable to the ion cyclotron frequency. We indicate that magnetospheric electric field may be also important for the dust-plasma interaction in Saturn's plasma disk.

In this presentation, we compare results of our model with the Cassini/LP observation and discuss the dust-plasma interaction in the plasma disk of Saturn. We also discuss based on our results that future exploration to Saturn plays very important roles in planetary sciences.

Keywords: Saturn, E ring, Dusty Plasma, Dust-plasma interaction, Exploration of Saturn

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PPS001-16 Room:101 Time:May 27 12:30-12:45

Plan for Observing Jupiter's Magnetosphere using the EUV Spectrograph Onboard the Sprint-A/Exceed Mission

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The EXCEED mission is an Earth-orbiting extreme ultraviolet (EUV) spectroscopic mission and the first in the SPRINT series being developed by ISAS/JAXA. EUV spectroscopy is suitable for observing tenuous gases and plasmas around planets in the solar system (e.g., Mercury, Venus, Mars, Jupiter, and Saturn). One of the primary observation targets is Jupiter, whose magnetospheric plasma dynamics is dominated by planetary rotation. In the EUV range, a number of emission lines originate from plasmas distributed in Jupiter's inner magnetosphere. The EXCEED spectrograph is designed to have a wavelength range of 55?145 nm with minimum spectral resolution of 0.4 nm, enabling the electron temperature and ion composition in the inner magnetosphere to be determined. The spectrograph slits have a field of view of 400 - 140 arc-seconds and an onboard target guide camera is used to stabilize attitude fluctuations to within 5 arc-seconds. With a large primary mirror (diameter: 20 cm) and high detection efficiencies (1?3%), EXCEED will measure Io plasma torus emission distributions with a good signal-to-noise ratio using an exposure time of 50 minutes and achieving spatial resolution of 20 arc-seconds. The previous observation of plasmas in the inner magnetosphere and the aurora with an EUV spectrograph was done by the Cassini spacecraft over a period of a few months. We re-examined the data obtained by the UVIS instrument to clarify the scientific objectives for the EXCEED mission. The UVIS observation sometimes showed sudden brightening in both the aurora and the Io plasma torus with a timescale from several hours to a few tens of hours. From the re-analysis of the UVIS data as well as radio waves (Cassini/RPWS) and the interplanetary magnetic field (Galileo/MAG) data, we found that the brightening events were related to a large-scale structure in the solar wind. However, because the Cassini observations had a lack of continuity due to the intermittent observation mode, it is difficult to make a definitive relation between the aurora and the plasma emissions in the inner magnetosphere. EXCEED plans to observe the variations in the aurora and in the radial structures of plasma emissions and should reveal the relationship between them in detail. The EXCEED observations are expected to investigate the radial plasma and energy transport processes in the rotation-driven magnetosphere.