Japan Geoscience Union Meeting 2011
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PPS001-01 会場:101 時間:5 月 27 日 08:30-08:45

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

キーワード: EJSM, Jupiter system, Europa, Ganymede, Plasma imaging, JMO
Keywords: EJSM, Jupiter system, Europa, Ganymede, Plasma imaging, JMO

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トロヤ群天体と太陽系の起源と軌道進化
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.

キーワード: エッジワース・カイパーベルト, 太陽系, 軌道共鳴, トロヤ群天体, 海王星, 太陽系外縁天体
Keywords: Edgeworth-Kuiper belt, Solar system, Orbital resonances, Trojan asteroids, Neptune, Trans-Neptunian objects (TNOs)

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PPS001-03 会場:101 時間:5 月 27 日 09:00-09:15

木星トロヤ群探査で目指すべき科学的課題
Scientific Rationale for Exploring Jovian Trojans

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Hajime Yano[1*], Jupiter and Trojans Exploration Working Group Preparation Team[1]

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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.

キーワード: 木星トロヤ群, ニースモデル, 太陽系形成論, Ｄ型小惑星, 連星小惑星, 探査計画
Keywords: Jovian Trojans, Nice Model, Solar System Formation, D-type Asteroids, Binary Asteroids, Exploration Project

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PPS001-04 会場:101 時間:5 月 27 日 09:15-09:30

木星圏探査のためのソーラー電力セイル開発状況
Development of Solar Power Sail System for Future Jupiter System Exploration

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Ryu Funase[1*], Osamu Mori[1], Yuichi Tsuda[1], Hirotaka Sawada[1], Takanao Saiki[1], Junichiro Kawaguchi[1]

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JAXA では，ソーラー電力セイル技術を中心として，将来の外惑星探査で必須となる技術の実証を目的とした中型の木星圏探査機の打ち上げを 2010 年代後半に計画している．そのフロントローディングとして，小型の実証機（IKAROS）を 2010 年に打ち上げ，ソーラー電力セイルの展開技術，電力セイルによる発電技術，ソーラーセイルによる加速・航行技術の軌道上実証に成功した．本講演では，IKAROS の成果について紹介するとともに，木星探査用ソーラー電力セイルの開発状況について紹介する．

キーワード: ソーラー電力セイル, 電気推進, 木星探査
Keywords: solar power sail, electric propulsion, Jupiter exploration

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PPS001-05 会場:101 時間:5 月 27 日 09:30-09:45

巨大氷衛星内部の鉱物脱水作用がもたらす分化史の転換点
Turning point in differentiation history of giant icy satellites induced by dehydration of pristine hydrous rock

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Jovian moon Ganymede's interior appears to be clearly differentiated and has a metallic core, while Callisto has incompletely differentiated interior in spite of the similarity in their sizes. These bodies possibly contain a significant proportion of hydrated silicate like CI chondrite because of their H_2O-rich bulk composition. Here we propose that dehydration of pristine hydrous rock-metal-mixed core would trigger complete differentiation in the larger moon during the thermal evolution over the geological time, because of drastic change of rock rheology through the dehydration of rock. This may also explain the geological records on Ganymede showing the occurrence of global extension after the period of heavy bombardment.

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PPS001-06 会場:101 時間:5 月 27 日 09:45-10:00

周惑星円盤へのガス降着流と周惑星円盤構造
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

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PPS001-07 会場:101 時間:5 月 27 日 10:00-10:15

Polar motion of Titan forced by the atmosphere
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.

キーワード: Titan, polar motion
Keywords: Titan, polar motion

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PPS001-08 会場:101 時間:5 月 27 日 10:15-10:30

木星熱圏の H_2 および H_3^+ ダイナミクス
Investigations of the thermospheric dynamics of H_2 and H_3^+ in Jupiter

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

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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 会場:101 時間:5 月 27 日 10:45-11:00

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

キーワード: dynamo, Rossby waves, Shear layers
Keywords: dynamo, Rossby waves, Shear layers

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PPS001-10 会場:101 時間:5 月 27 日 11:00-11:15

探査機と望遠鏡による木星雷放電及び積乱雲の観測
Lightning and thundercloud observation in Jupiter by spacecraft and telescopes

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

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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.

キーワード: 木星, 積乱雲, 雷放電, 探査, 望遠鏡
Keywords: Jupiter, thunderstorm, lightning, spacecraft, telescope

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PPS001-11 会場:101 時間:5 月 27 日 11:15-11:30

Polar Atmospheric Dynamics of Giant Planets
Polar Atmospheric Dynamics of Giant Planets

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Kunio M. Sayanagi[1*], Jonathan L. Mitchell[1]

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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.

キーワード: Planetary Science, Atmospheric Dynamics, Jetstream, Turbulence, Jupiter, Saturn
Keywords: Planetary Science, Atmospheric Dynamics, Jetstream, Turbulence, Jupiter, Saturn

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PPS001-12 会場:101 時間:5 月 27 日 11:30-11:45

Seasonal and Temporal Variability of Jupiter and Saturn
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.

キーワード: Jupiter, Saturn, Atmospheres, Variability
Keywords: Jupiter, Saturn, Atmospheres, Variability

PPS001-13 会場:101 時間:5 月 27 日 11:45-12:00

木星探査衛星 EJSM JMO に向けた X 線撮像・分光装置の検討
Design study of Jupiter X-ray imaging spectrometer on EJSM JMO

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Yuichiro Ezoe[1*], Kumi Ishikawa[1], Takaya Ohashi[1], Tomoki Kimura[2], Atsushi Yamazaki[2], Kazuhisa Mitsuda[2], Masaki Fujimoto[2], Yoshizumi Miyoshi[3]

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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.

キーワード: 木星, X 線, オーロラ, 放射線帯, 観測装置
Keywords: Jupiter, X-ray, aurora, radiation belt, instrument

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Global ENA Imaging of the Magnetospheres of Saturn and Jupiter
Global ENA Imaging of the Magnetospheres of Saturn and Jupiter

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Pontus Brandt[1*], Donald G. Mitchell[1], Barry H. Mauk[1]

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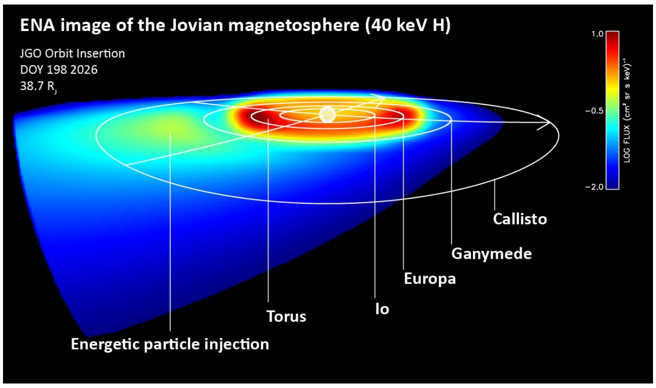
Jupiter's magnetosphere is by far the largest object in the sky if it would be visible from Earth. Its stellar-like transfer of angular momentum from the fast rotating planetary magnetic field to the space plasma environment is the engine that makes the Jovian magnetosphere also the biggest planetary 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.



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

PPS001-15 会場:101 時間:5 月 27 日 12:15-12:30

土星プラズマディスク中におけるダスト-プラズマ相互作用
Dust-plasma interaction in Saturn's plasma disk

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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.

キーワード: 土星, E リング, ダスティプラズマ, ダスト-プラズマ相互作用, 土星探査
Keywords: Saturn, E ring, Dusty Plasma, Dust-plasma interaction, Exploration of Saturn

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PPS001-16 会場:101 時間:5 月 27 日 12:30-12:45

SPRINT-A/EXCEED計画による木星磁気圏観測
Plan for Observing Jupiter's Magnetosphere using the EUV Spectrograph Onboard the Sprint-A/Exceed Mission

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Fuminori Tsuchiya[1*], Ichiro Yoshikawa[2], Masato Kagitani[1], Kazuo Yoshioka[3], Naoki Terada[1], Yasumasa Kasaba[1], Go Murakami[2], Kouichi Sakai[2], Tatsuro Homma[2], Atsushi Yamazaki[4], Tomoki Kimura[4], Munetaka Ueno[4]

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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.

PPS001-P01 会場:コンベンションホール 時間:5 月 27 日 14:00-16:30

2020 年代の木星系探査計画 (EJSM)
Towards EJSM (Europa Jupiter System Mission) in 2020s

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国際共同木星探査計画は、2020 年代の木星探査を目指して、2006 年より日欧のグループが、検討をはじめてきた。2007 年に LAPLACE という名称で ESA の COSMIC VISION に提案され、１次選考を通過した。その後、アメリカ NASA で計画していた Europa Explorer 計画と合同する形で、EJSM（Europa Jupiter System Mission）へと展開している。EJSM においては、NASA が JEO(Jupiter Europa Orbiter)（エウロパ周回機）、ESA が JGO (Jupiter Ganymede Orbiter)（ガニメデ周回機）、JAXA が JMO (Jupiter Magnetospheric Orbiter)（磁気圏観測機）を担当する。JEO と JGO は、２年間、木星の周囲を（イオやカリストを含む）衛星フライバイを繰り返して観測した後、エウロパ、ガニメデの周回軌道に入る。両衛星では、地下海の存在が確実視されており、生命の存在まで議論されている。レーダーなどで地下海の姿を明らかにすることが大きな目的である。現在もカッシーニが質の高い大量のデータを提供する土星系と比べると、木星とその衛星系の科学データは限定されている、ガリレオ探査機が周回機として長期間観測を行ったが、アンテナや観測機器のトラブルにより取得データが少なかった。木星極周回軌道により木星大気や重力を観測する JUNO 計画では、衛星や木星磁気圏の詳細探査は行われない。

現在、NASA,ESA は探査機を 2020 年に打ち上げて 2026 年に木星周回軌道に投入、2028 年に衛星周回ミッションへと移行する予定である。日本の JMO は、おそくとも 2020 年に打ち上げることができれば、2028 年に木星周回軌道に投入ができ、JEO-JGO の衛星周回時に外側の磁気圏を観測して重要な境界条件を与えることができる。また、軌道計画の検討の結果、カリストによる重力スイングバイを繰り返すことで、JMO の軌道傾斜角を上げて、木星本体のイメージングを行えることがわかった。このときに、カリストの表面、重力、磁場といった情報も詳しく調べることが可能である。カリストは、エウロパ、ガニメデといった天体と比べると未分化であると考えられている。慣性能率、磁場を正確に求めることで、内部の分化度や地下海の存否を解明することが可能である。

JAXA では、ソーラー電力セイルを用いて探査機を木星経由トロヤ群小惑星へと送り込む探査計画が検討されていた。これに相乗りする形で、木星に行くミッションに、JMO を搭載する検討も行っている。トロヤ群小惑星も、太陽系・木星系の起源を論じる上で非常に重要なターゲットであり、トロヤ群小惑星を組み合わせることで、木星系探査の科学価値は高くなる。ソーラー電力セイルは、太陽電池薄膜で発電してイオンエンジンで推進する機構である。2010 年には、金星ミッション「あかつき」に相乗りの形で、イカロス (Interplanetary Kite-craft Accelerated by Radiation Of the Sun) という技術実証衛星が行われた。

キーワード: 木星磁気圏, 木星探査, 氷衛星, トロヤ群小惑星, エウロパ, カリスト
Keywords: Jovian Magnetosphere, Exploration of Jupiter, Icy satellites, Trojan asteroids, Europa, Callisto

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PPS001-P02 会場:コンベンションホール 時間:5 月 27 日 14:00-16:30

Proposal for the survey of Enceladus by high energy neutrinos
Proposal for the survey of Enceladus by high energy neutrinos

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Enceladus is a small icy satellite of Saturn orbiting between Mimas and Tethys. In 2005 Cassini has identified characteristic surface features at the south pole of Enceladus such as high albedo and paralleled lineaments called " tiger stripes ", which emanate vapor plume [1]. These features suggest that Enceladus has young and active surface around the south pole region. On the other hand, at the north pole, Enceladus has surface whose albedo is lower than the south pole. Such asymmetry of the surface has aroused strong interests on the internal structure as well as its evolution as the origin.

To investigate the surface layer of Enceladus, electrical conductivity is an important information to constraint for the internal structure. Electrical conductivity depends on primarily on temperature [2]. If we can determine the value of conductivity, we can specify the property of ice such as temperature distribution of icy layer. In this presentation we propose a new method to determine the electrical conductivity of ice layer by detecting the radio waves induced by interaction between cosmic neutrino and ice.

When cosmic neutrinos flying in the outer space traverse through Enceladus, Cherenkov radiation induced by the weak interaction of neutrino with Enceladus is emitted. Radiations whose frequency is between a few hundreds of MHz and a few GHz (radio wave) become coherent and have such strong intensity that orbiting probe can detect. The number of detectable emissions depends on attenuation level of radio wave. The attenuation level of water ice can be approximated as A=0.0009s (dB/m) where A and s are attenuation level and electrical conductivity (in μS/m) respectively [3]. Thus, if we can count the number of emissions and determine their intensity level, electrical conductivity and temperature can be estimated. Since radio waves induced by neutrino interaction come from subsurface area of icy layer (~10 km in depth) local temperature distribution can be obtained by latitude-dependent summation for the emission in polar orbits.

To evaluate this method, we have performed a simulation about interaction of neutrinos with the icy layer and obtained that the number of detectable number of emissions and the shape of intensity distribution changed with the electrical conductivity of the layer. The strong point of this method is the passive detection of radio wave. Further more, accurate determination of electrical conductivity can make the rader system inspect the inner structure more precisely. We consider this radio detection method can be an useful tool to constrain the subsurface temperature of Enceladus.

References
[1] Porco et al. (2006), Cassini Observes the Active South Pole of Enceladus, *Science*, 311, 1393-1401
[2] Corr et al. (1993), Radar absorption due to impurities in Antarctic ice, *Geophys. Res. Lett.*, 20, 1071-1074
[3] Moore (2000), Model of Rader Absorption in Europan Ice, *Icarus*, 147, 292-300
Keywords: Enceladus, neutrino, electrical conductivity, temperature, passive detection

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PPS001-P03 会場:コンベンションホール 時間:5 月 27 日 14:00-16:30

Whistler-mode chorus enhancements and anisotropic electrons in the Jovian inner magnetosphere

Whistler-mode chorus enhancements and anisotropic electrons in the Jovian inner magnetosphere

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We reveal a close relationship between enhancements of whistler-mode chorus and development of energetic electron anisotropies in the Jovian inner magnetosphere by conducting a statistical survey of both wave and particle observations of the Galileo spacecraft. We studied the spatial distribution of intense chorus emissions in the Jovian magnetosphere and identified 104 chorus enhancements by analyzing plasma wave data in the frequency range from 5.6 Hz to 20 kHz obtained from the entire Galileo mission in the inner Jovian magnetosphere during the time period from December 1995 to September 2003. Enhanced chorus emissions with integrated wave power over 10^-9 (V/m)^2 were observed around the magnetic equator in the radial distance range from 6 to 13 R_J. A survey of energetic particle data in the energy range of 29 to 42 keV reveals that all of the identified chorus events were observed in the region of pancake pitch angle distributions of energetic electrons. Using empirical plasma and magnetic field models, we estimate that the ratio of the electron plasma frequency to the electron cyclotron frequency in this region is in the range from 1 to 10 which is suitable for efficient whistler-mode wave generation. The present study reveal the statistically significant correspondence between intense chorus and flux enhancement of energetic electrons having pancake pitch angle distributions in the Jovian magnetosphere.
Keywords: Jovian inner magnetosphere, whistler-mode waves, energetic electrons, Galileo observations

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PPS001-P04 会場:コンベンションホール 時間:5 月 27 日 14:00-16:30

InSb 赤外撮像装置電気回路系の開発
Development of the electronics for an infrared camera with InSb array

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We present the current status of development of the electronics on our infrared imaging camera with InSb 256x256 array. Infrared remote sensing of planetary atmosphere is one of the most powerful measurement tools to understand the dynamical and chemical processes in the atmosphere since there are many emission and absorption lines in the near-infrared range (1-5 um), and the solar flux becomes smaller compared to visible range. Further, it is essential to carry out continuous measurement with our own instrument since it is necessary to clarify the time variation of those phenomena with long-term data. In particular, we aim to clarify the Jupiter's H_3^+ auroral response to solar wind variation with statistical approach. We are therefore developing our own 1-5um infrared
imager. This imager has a 256x256 InSb array detector, a field of view is 110arcsec with a F12 telescope with a plate scale of 0.43arcsec/pixel. In the case of 3.4um Jovian H3+ auroral measurementg, we estimate S/N of the acquisition of data to be about 33 with 1 minute exposure using 60cm?/F12? telescope.

In this presentation, we focus on the electronics to control the detector. Functions of the electronics are summarized as follows. [1] Generating the timing of three kinds of clocks, selecting horizontal vertical lines and reading the frame of the detector. [2] Converting it into the voltage that adjusted an above clock timing to the detector. [3] Constant voltage (Bias) generation . [4] The amplification of the detector output, and A/D conversion.

To satisfy the function [1] we adopt the digital circuit system with FPGA (Field-Programmable Gate Array) and one-board computer which had a characteristic of incorporated Linux. Concerning on the functions [2] [3] [4], the analog circuit system are used .

This camera will be installed on the 60 cm telescope of Iitate observatory, Tohoku University, and other overseas facilities, and used to monitor the Jupter's H_3^+ aurora.

Japan Geoscience Union Meeting 2011
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PPS001-P05 会場:コンベンションホール 時間:5 月 27 日 14:00-16:30

ガニメデ磁気圏の非 MHD 的特徴について：ガリレオ探査機データに基づく極域波動ー粒子相互作用の調査
Non-MHD Aspects of Ganymede's Magnetosphere: Investigation of Polar Wave-Particle Interaction Based on Galileo's data

木村 智樹 [1*], 笠原 慧 [1], 藤本 正樹 [1]
Tomoki Kimura[1*], Satoshi Kasahara[1], Masaki Fujimoto[1]

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Jovian satellite Ganymede has small magnetosphere with characteristic scale lengths comparable to those of Mercury: e.g., size of the solid body, spatial expansion of the magnetosphere, and electron/ion gyroradii of ambient plasma. Comparative study of Ganymede's magnetosphere with Mercury will provide insights on the process universally existing in small planetary magnetospheres.

Basic characteristics of Ganymede's magnetosphere were revealed based on in-situ measurements by Galileo spacecraft during six encounters. Williams et al. (1997a, b, 1998, 2001, 2004) investigated particle dynamics (e.g., loss and pitch angle diffusion) in Ganymede's magnetosphere based on energetic electron/ion observations. Gurnett et al. (1996) and Kurth et al. (1997) indicated that Ganymede's magnetosphere is emitting radio and local plasma waves similar to planetary magnetospheres. Recently, global configuration of the magnetosphere and interaction with Jovian magnetosphere are also intensively investigated based on MHD simulations (Jia et al., 2009, 2010). However, non-MHD characteristics of Ganymede's magnetosphere have not been discussed in detail yet. For example, wave-particle interactions, ion kinetics, and polar field aligned particle accelerations.

This study addresses wave-particle interaction process in the polar cap region based on multi-instrumental observations during Galileo G02 flyby. Observations of high and low frequency wave, particle energy spectra, and pitch angle distribution revealed two kinds of magnetospheric regions: one where strong particle anisotropy by satellite surface loss is accompanied by electron and ion-related electromagnetic waves, and the other where there are weak surface interactions with electrostatic electron wave and no ion-related waves. The latter region corresponds to the ion upflow region (Jia et al., 2009) and locates near the open-closed boundary region of Ganymede's magnetosphere. We found that ion-related low frequency waves have significant energy flux into the Ganymede's polar ionosphere which is comparable to Jovian magnetospheric electron's energy input. This suggests the polar ionospheric heating by the energy from ion-related waves and subsequent ion upflow.

キーワード: 木星, ガニメデ, 磁気圏, 波動, 高エネルギー粒子
Keywords: Jupiter, Ganymede, magnetosphere, wave, energetic particle

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PPS001-P06 会場:コンベンションホール 時間:5 月 27 日 14:00-16:30

木星・土星の赤外オーロラ発光モデリングと観測データ解析への適用
Modeling of infrared auroral emission from Jupiter and Saturn and its applicability for observation data analysis

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Aurorae represent plasma environments around a planet. Outer planetary aurorae are observed in various wavelength from radio emission, infrared (IR), visible, ultraviolet, to X-ray. Since IR wavelength is observable from the ground with spatial information, it would be good tool for monitoring to investigate the variable environment. Recent observation by Cassini spacecraft provides spatially-resolved Saturn's IR auroral image. Since the IR emission relates with thermally excited H_3^+ ion, it reflects atmospheric temperature in addition to ionization by auroral electron and solar EUV. Previous modeling study relates the IR emission and H_3^+ column density and atmospheric temperature. This study newly attempts to test its applicability for monitoring not only atmospheric condition but also auroral electron. We investigate the dependence of IR emission spectrum on temperature and electron energy spectrum using an IR emission model accounting for ionization by auroral electron with various energy flux, ion chemistry, and H_3^+ non-LTE effects. IR emission increases with increasing electron energy for $<$10 keV and then decreases. This decrease reflects low temperature at low altitude and hydrocarbons which reduces H_3^+ by dissociative recombination. Emission line ratio varies by a few 10s% depends on electron energy and by a factor depends on atmospheric temperature. We will discuss its applicability to observed data analysis and requirement for observations.
Keywords: Jupiter, Saturn, infrared, aurora, spectrum