[E] 口頭発表 | セッション記号 P (宇宙惑星科学)：P-PS 惑星科学

2019年5月28日(火) 10:45 ~ 12:15 | A03 東京ベイ幕張ホール

[P-PS01] Outer Solar System Exploration Today, and Tomorrow

コンビーナ:木村 淳(大阪大学)、笠羽 康正(東北大学 惑星プラズマ・大気研究センター)、Kunio M. Sayanagi(Hampton University)、座長:Jun Kimura(Osaka University)、鎌田 俊一(北海道大学創成研究機構)

The giant planets provide many keys to understanding planetary processes. They play an important role in shaping our solar system, and the physical and chemical processes they harbor also provide a unique opportunity to study the phenomena relevant for studying Earth and other planets, including exoplanetary systems. In this session, we discuss a wide range of topics encompassing the giant planets and their moons, including their origins, interiors, atmospheres, compositions, surface features, and electromagnetic fields. To advocate for current and future outer planets exploration (Cassini, Juno, New Horizons, JUICE, and beyond), we also call for discussions on future missions to explore giant planet systems, including how to develop better international cooperation. Discussion in this latter category will include progress in developing a solar sail mission concept for observing the Jupiter system and its trojan asteroids.

10:45 ~ 11:03

[PPS01-11] Saturn's ring rain and Enceladus' subsurface ocean as seen by the Cassini Cosmic Dust Analyser

★Invited Papers

*Sean Hsu[1]、Sascha Kempf[1]、Mihaly Horanyi[1]、Ralf Srama[2]、James O'Donoghue[3] (1.LASP, University of Colorado, Boulder, CO, USA、2.IRS, University of Stuttgart, Stuttgart, Germany、3.NASA Goddard Space Flight Center, Greenbelt, Maryland, USA)

11:03 ~ 11:18

[PPS01-12] **Titan Trek: A New Online NASA Visualization and Analysis Portal for Saturn’s Largest Moon**

*Emily Law[1]、Brian Hamilton Day[2] (1.NASA Jet Propulsion Laboratory、2.NASA Ames Research Center)

11:18 ~ 11:36

[PPS01-13] Internal structure of icy moons: ice-ocean systems as commonly seen in the outer solar system

★Invited Papers

*Hauke Hussmann[1] (1.DLR Institute of Planetary Research)

11:36 ~ 11:51

[PPS01-14] Callisto as a keystone to reproduce the formation process of the Jovian system

*関根 康人[1]、鎌田 俊一[2]、青山 雄彦[3]、生駒 大洋[3]、谷川 享行[4] (1.東京工業大学地球生命研究所、2.北海道大学創成研究機構、3.東京大学大学院理学系研究科、4.一関高等工業専門学校)

11:51 ~ 12:09

[PPS01-15] Origin of Jupiter Trojan asteroids: To be explored by OKEANOS

★Invited Papers

*癸生川 陽子[1]、岡田 達明[2]、伊藤 元雄[3]、青木 順[4]、河井 洋輔[4]、松本 純[2]、Grand Noel[5]、Buch Arnaud [6]、豊田 岐聡[4]、Cottin Hervé[5]、圦本 尚義[7,2]、矢野 創[2]、岩田 隆浩[2]、森 治[2] (1.横浜国立大学、2.宇宙航空研究開発機構、3.海洋研究開発機構　高知コア研究所、4.大阪大学、5.LISA, Université Paris-Est Créteil、6.Ecole Centrale Paris、7.北海道大学)

12:09 ~ 12:15

Discussion

Saturn's ring rain and Enceladus' subsurface ocean as seen by the Cassini Cosmic Dust Analyser

*Sean Hsu[1], Sascha Kempf[1], Mihaly Horanyi[1], Ralf Srama[2], James O'Donoghue[3]

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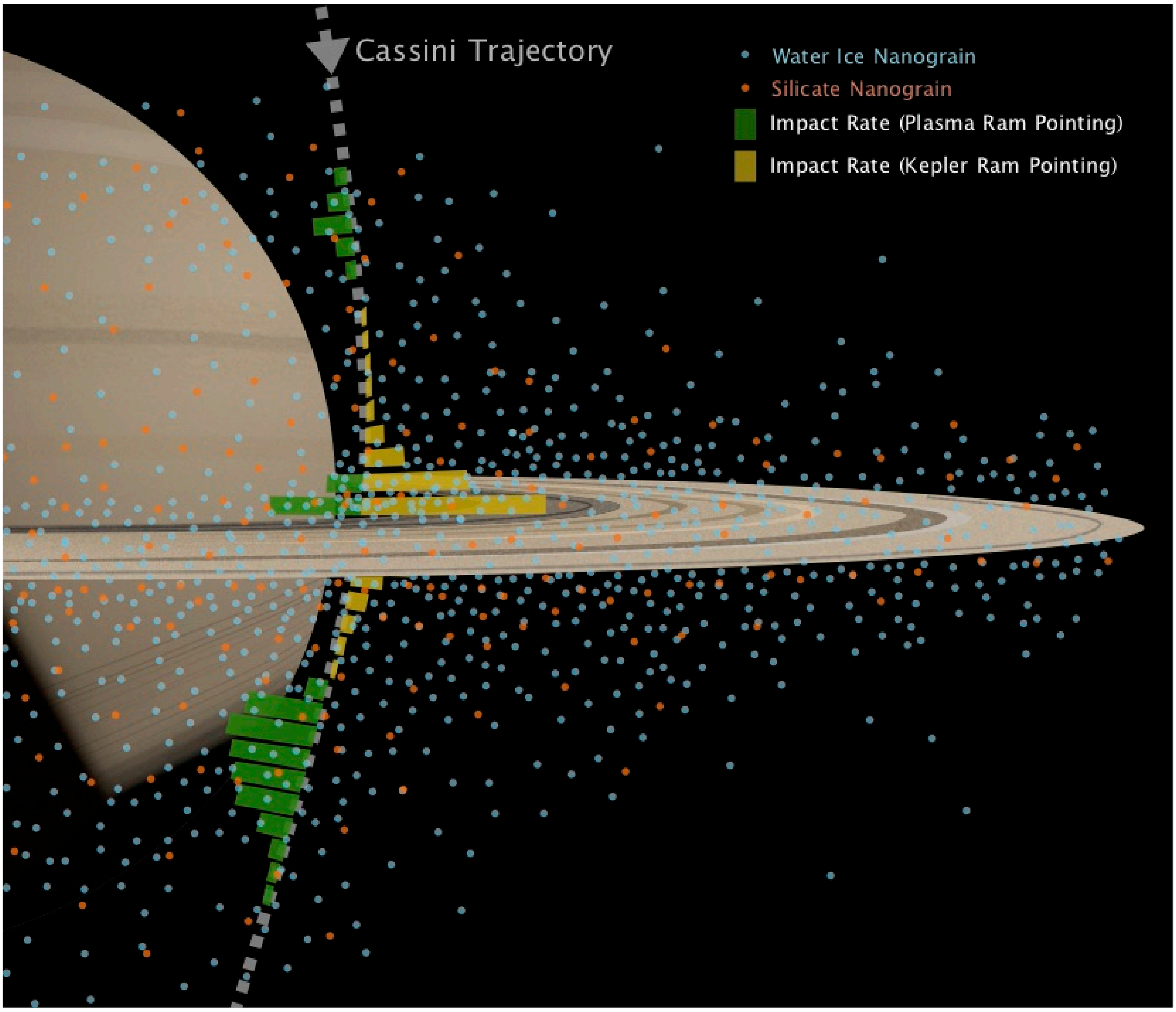
Dust particles serve as microscopic messengers carrying information from sources inaccessible by space probes. The compositional and dynamical information of various dust populations provided by the Cosmic Dust Analyser offer a unique perspective to examine the rings, moons, and their interactions in the Saturnian system. In this talk I will focus on the latest results from the Cassini Grand Finale mission about Saturn's ring rain, i.e., the ring-planet interactions driven by the infall of ring material to Saturn's atmosphere, and its implications about Saturn and its magnificent ring system. I will also provide a brief summary of other major findings by the Cassini Cosmic Dust Analyser, including the discovery of the subsurface ocean and hydrothermal activities within the geologically active moon Enceladus, the composition of interstellar grains, Saturn's diffuse rings, and the electromagnetic interactions of charged nanodust particles with the magnetosphere and the solar wind.

Keywords: Saturn, Dust, Planetary Rings


Cassini Trajectory
Water Ice Nanograin
Silicate Nanograin
Impact Rate (Plasma Ram Pointing)
Impact Rate (Kepler Ram Pointing)

Titan Trek: A New Online NASA Visualization and Analysis Portal for Saturn's Largest Moon

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In its investigations of Saturn's moons, NASA's Cassini mission and ESA's Huygens lander have returned an immense amount of data detailing the dynamic surface of Saturn's largest moon, Titan. In order to greatly facilitate dissemination, visualization, and analysis of this data, the Cassini mission has partnered with NASA's Solar System Treks Project (SSTP). SSTP has recently released a new online portal (https://trek.nasa.gov/titan/), Titan Trek, that enables mission planners, planetary scientists, engineers, students, and the general public to interactively access, visualize, and analyze Cassini's mapped data products of Saturn's largest moon.

The initial release of Titan Trek provides a suite of interactive tools and incorporates over 130,000 data products from the range of Cassini encounters with Titan, creating a comprehensive Titan research and educational web portal. Titan Trek data products include: Global Radar mosaic, Radar SAR BIDR BIFQI swaths, Global VIMS mosaics, Global ISS mosaic, Vector data (geological units of Afekan region, material flux based on dune orientation, fluvial networks), Nomenclature, ISS footprints, VIMS footprints, and Global radar topography.

We intend to continue to enhance the new Titan Trek portal with new data products as they are released by the Cassini mission including Huygens DISR, Global radiometry, scatterometry, VIMS, ISS, UVIS, CIRS, and other topography products.

Titan Trek is the latest addition to the NASA Solar System Treks Project (SSTP), available at https://trek.nasa.gov. NASA's Solar System Trek online portals provide web-based suites of interactive data visualization and analysis tools providing access to mapped data products from past and current missions for the Moon, Mars, Vesta, etc. As web-based toolsets, the portals do not require users to purchase or install any software beyond current web browsers. These portals are being used for site selection and analysis by NASA and a number of its international partners, supporting upcoming missions.

Keywords: Titan, Cassini, Visualization, Analysis

Internal structure of icy moons: ice-ocean systems as commonly seen in the outer solar system

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Among the icy satellites in the outer solar system, several objects have been identified that may contain substantial amounts of liquid water in their interiors. In particular the large satellites, e.g., Europa, Ganymede, Callisto, and Titan may contain subsurface oceans until the present day. However, the example of Enceladus shows that also smaller satellites can have sufficient internal heat sources to maintain liquid water layers. Also Pluto and Triton are potential ocean candidates. The available heat sources differ considerably among the icy moons depending on their initial composition, and thus the amount of radiogenic heating, the tidal interaction with the primary planet, their rheological states and -in some cases- their interaction with other satellites due to orbital resonances. In this talk the current knowledge on the ice-ocean systems in the outer solar system will be summarized. Prospects for their investigation with future planetary missions will be discussed.

Keywords: solar system, icy satellites, oceans

Callisto as a keystone to reproduce the formation process of the Jovian system

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Callisto is the outermost Galilean satellite, with 2410 km of radius and 1.83 g/cc of density. The size and mass are comparable to those of another Jovian moon, Ganymede and the largest moon of Saturn, Titan. Unlike Ganymede and Titan, however, heavily-cratered Callisto may have experienced only limited geological activities since its formation. Owing to the low geological activities, Callisto may serve as a “fossil” of the Jovian system formation in the early Solar System. Volatile and isotope compositions of ice materials on Callisto would reflect ice compositions of the building materials of the Jovian satellites, which is critical to constrain the disk temperature of the formation region of proto-Jupiter as well as both shock heating and size of infalling materials onto proto-Jupiter. The interior structure, namely degree of differentiation, of Callisto is essential to constrain the inflow rate of the building materials from the protoplanetary disk. In this talk, we discuss the key observations, e.g., surface materials and interior structure of Callisto, in future missions to constrain the formation process of the Jovian system.

キーワード：氷衛星、太陽探査、惑星形成
Keywords: icy satellite, Solar System exploration, planetary formation

Origin of Jupiter Trojan asteroids: To be explored by OKEANOS

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The Jupiter Trojan asteroids are expected to be a key to understand planet formation and solar system evolution. The Jupiter Trojan asteroids are an asteroid group at the Lagrangian point (L4 and L5) on the Jupiter’s orbit, and their spectral types are mainly D and P type, also called “Red” and “Less red”, respectively [1,2]. The origin of these asteroids was considered to be trapped by Jupiter according to the classical planet formation theory [3,4]. On the other hand, according to a relatively new theoretical study such as Nice model, the small bodies formed at the Kuiper belt region are disturbed by giant planet migrations, and some of them trapped at the current Jupiter orbit [5]. Thus, constraining planetary formation theories can be possible by investigating whether the Jupiter Trojan asteroids originated from the outer region of the solar system such as the Kuiper belt area or originated from the current Jupiter orbit region (the extension of the main belt asteroids). The stable isotopic ratios of light elements are expected to be an indicator of the origin of the Jupiter Trojan asteroids. Because heavy isotopes such as ^{2}H (D) and ^{15}N tend to incorporate into water and organic matter in low temperatures (<10-100 K) such as in the outer region of the solar system [6,7]. In fact, heavy isotopes are concentrated in materials from the outer region of the solar system such as comets, and materials from main belt asteroids such as chondrites often show relatively light isotopic ratios [8].

The OKEANOS (Outsized Kite-craft for Exploration and AstroNautics in the Outer Solar system) is a candidate for the upcoming strategic middle-class space exploration to rendezvous with and land on a Jupiter Trojan asteroid using a Solar Power Sail (SPS). The mission concept includes sampling and in-situ analysis of the materials of a Jupiter Trojan asteroid [9]. We plan to analyze isotopic and molecular compositions of volatile materials from organic matter, hydrated minerals, and ice, in order to understand origin and evolution of the Jupiter Trojan asteroids, using a multi-turn time-of-flight type high-resolution mass spectrometry (HRMS) system. Our goal is to improve our understanding of (1) planet formation/migration theories, (2) distribution and evolution of volatile substances in protoplanetary disks, (3) origins and evolution of organic matter, and (4) origin and evolution of the Solar System small bodies beyond the snow line.

References: [1] J. P. Emery et al., *Astronomical Journal*, 141, 25, 2011. [2] F. E. DeMeo and B. Carry, *Nature*, 505, 629, 2014. [3] F. Marzari and H. Scholl, *Astronomy & Astrophysics*, 339, 278, 1998. [4] F. Marzari and H. Scholl, *Icarus*, 131, 41, 1998. [5] A. Morbidelli et al., *Nature*, 435, 462, 2005. [6] T. Millar et al., *The Astrophysical Journal*, 340, 906, 1989. [7] R. Terzieva and E. Herbst, *Monthly Notices of the Royal Astronomical Society*, 317, 563, 2000. [8] B. Marty, *Earth. Planet. Sci. Lett.*, 313-314, 56, 2012. [9] T. Okada et al., *Planetary and Space Science*, 161, 99, 2018.

