出國報告（出國類別：研究）

出國報告名稱
參加 AOGS 2015 論文發表、進行學術交流及國際合作的討論

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派赴國家：新加坡
出國期間：104/8/2-104/8/8
報告日期：104/8/14

摘要

由亞洲地球科學家組織的亞洲大洋洲地球科學學會(Asia Oceania Geosciences Society，簡稱AOGS)第12屆年會，在2015年8月2日至7日舉行。天文所及太空所葉永烜教授與數名研究生赴會，參加分組會議，主持有關外行星的論文發表會，並且進行學術交流及國際合作的討論。

目錄

壹、目的

參加新加坡的亞洲太洋洲地球科學學會年會(AOGS)第 12 屆年會，發表論文，進行科學及國際交流活動。

貳、過程

8/2（日）臺灣出發，抵達新加坡彰宜機場，入住離大會會場 Sun Tec 國際會議中心不遠的 Bayview 酒店。

8/3(一) 開會會議議程，上午場次題目爲未來深空探測計畫的構想，比較有印像者爲(a)南韓正在準備自己的探月計畫；(b) 德國科學家 J.Oberst 所提的火衛-Phobos 探測計畫;(c)一個德國工程師所提的核能推進機的研究成果；(d)日本早稻田 Prof. N.Hasebe 的 M-類小行星探測計畫；(e)和美國科羅拉多大學的李新林教授的奈米衛星計畫。當天下午便接著是兩個特別講座、會員大會和接待餐會。

8/ 4（二）~ 8/5（三）繼續參加行星科學領域的報告以及一些講座。

8/ 6（三）上午參加衛星和行星環的分組會議。跟著主持我組織的「外行星及系外行星研究」分組論文報告，一切順利。感覺是日本的「EXCEED」紫外光望遠鏡有很好的科學成果。當晚參加分組會議召集人的集合。

8/7（四）參加有關「月球探測」的分組論文報告，行星科學兩場演講「Prof. Maria Zuber (MIT)/Prof. Ichino Yoshikawa (Tokyo)」都很精彩。有機會和 Springer 出版公司的 Petra van S.女士交流討論地科叢書系列的合作可能性。

8/8 下午搭機回「蘇迪羅」颱風過後的臺灣

參、心得與建議

AOGS 是很重要並屬於亞洲科學家的地球及太空科學學會，非常值得臺灣學界的支持。這次在新加坡的理事會選舉，便選出中研院地球所的趙峯教授爲理事長，臺大大氣系的吳俊傑教授爲祕書長，將會在明年北京舉行的 13 屆年會時接手會務，大放光彩。

今次會議比較印像深刻者爲日本的「EXCEED」紫外光太空望遠鏡針對木星極光和木衛一「Io」的觀測結果。其長期測量結果已經得出不少重要成果，並指出木星磁層與太陽風作用之動力學尚有很多尚未明瞭者。此外，如和 NASA 的 JUNO 計畫結合，將預期會有很多重要突破。但整個

計畫的費用不高，而衛星系統科學酬載技術應是國內團隊可以支撐者，所以建議教育部及科技部研議如何與日本學界及日本宇航局在小型科學衛星的合作案。

肆、附錄

(1) 分組會議之組織和主持

Section PS - Planetary Sciences
Number: PS 08-06
Session: Title Outer Planets and Their Exoplanetary Analogs
Session Description: The past four decades have revealed never before seen views of the outer solar system, beginning with the Voyager missions starting in 1977 and continuing with Galileo orbiter and entry probe and the joint NASA-ESA-ASI Cassini Huygens mission that will culminate in a Grand Finale mission in 2017. These explorations have generated a wealth of unprecedented scientific data that have been instrumental in shaping our current understanding of the workings of the solar system. At the same time, exoplanet observations are beginning to yield composition and structure data of extrasolar giant planets, which are providing new insights into the origin and evolution of solar systems. This year also marks the tenth anniversary of the highly successful Huygens landing at Titan, an earth-like world. The New Horizons spacecraft will be at Pluto in July 2015. L, ooking to the future, NASA's JUNO spacecraft is on its way to Jupiter, preparations for ESA's Ganymede orbiter mission JUICE are on track for launch in 2025, and plans are being developed for the NASA Europa Clipper mission and a Uranus Orbiter with Probe mission in the 2020's. Following in the footsteps of successful lunar missions of Japan, China and India, and then the wonderful Indian Mars Orbiter Mission Mangalyaan, planetary scientists in Asia may soon join forces with their European and American colleagues in exploring the outer solar system. Thus it is timely to organize an AOGS session on outer planets to review significant scientific achievements in the areas of outer planetary and satellite atmospheres, magnetospheres, icy moons and the rings, including results on the Saturn system obtained by Cassini-Huygens, prior and anticipated observations of other outer planets and moons, and modeling of planetary phenomena. Because of tremendous advances made in the study of extrasolar giant planets, we solicit also abstracts on related topics – with a view to promote interdisciplinary dialog between planetary scientists and astrophysicists, in the international setting of, the 12th annual meeting of AOGS in Singapore.

Main Convener **Dr. Wing-Huen Ip** (National Central University, Taiwan), wingip@astro.ncu.edu.tw

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(2) 論文發表

PS04-D2-AM1-324-002

The Water Regime of Ceres and its Potential Habitability

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Ceres is the largest object in the main asteroid belt of the Solar System, accounting for ~1/3 of the total mass of the asteroid belt. The recent unequivocal discovery of water vapor associated with localized sources on Ceres confirmed its enrichment in volatiles as suggested by its low density and previous observations and theoretical models. Hence water must have played a significant role in the evolution of Ceres and even affected its current state. Spectral reflectance of Ceres surface reveals the pervasive signature of hydrated minerals and carbonates. The albedo and spectral homogeneity suggest that processes involving liquid-phase activity at the global scale may have occurred in the past. The current evolution models of Ceres indicate that liquid water was present following an early differentiation and drove hydrothermal activity for a few tens of My since its formation. Silicate leaching could lead to the concentration of soluble species in an ocean that could play a role in lowering the freezing temperature of that layer. The likely accretion of low-eutectic species such as ammonia hydrates could have promoted the long-term preservation of a deep liquid layer at the base of an icy shell over extended periods of time (possibly until present). The significance of water on Ceres and its active nature as revealed by Herschel observations and the previous marginal detection of OH not only suggest that Ceres is an object that potentially hides important clues about volatile history in the inner solar system, but also indicate a world of potential astrobiological interest. The Dawn spacecraft arrives at Ceres in March 2015 for its year-long rendezvous to perform detailed geological, spectroscopic, compositional, and gravity mapping. In the mean time, we have begun an observing campaign using ground- and space-based facilities covering wavelengths from UV to sub-mm, to fully characterize the nature of water and hydration features detected at Ceres, and to facilitate theoretical studies. We will discuss some early results from Dawn imaging data and the observations that will have executed that have indications about the status of water on Ceres.

PS07-D5-PM2-P-009

Nano Grains Motion and Spokes Formation by the Influence of Saturn's Gravity and Magnetic Field

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The formation of radial spokes on the Saturnian rings by the levitation of sub-micron dust was discovered by the Voyager mission (Smith et al., 1981). Several mechanisms have been proposed to explain the origin of this dynamical effect. These include the generation of fast-moving plasma clouds by meteoroid impact (Goertz and Morfill 1983) and the electrostatic charging of electron beams produced in atmospheric lightning in thunder storm system (Jones et al. 2006). This intriguing phenomenon has been investigated by the imaging camera experiment on the Cassini spacecraft. One

interesting result has to do with the detection of these spokes developed very long in radial direction and continuous growth of some spoke structures after their first appearance (Mitchell et al., 2013). One possible interpretation is simply that charged nano-dust were injected intermittently over a few hours in the source region in corotation with Saturn. Such process could be linked to the electron beam irradiation mechanism advocated by Jones et al. (2006). In this study, we compare the synthetic spoke structures from theoretical calculations with the Cassini images with a view to estimate the spatial dimension ad time duration of the electron beam source region in the Saturnian atmosphere.

PS08-6-D4-PM2-324-018
Titan and Triton
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Since the SOI in 2004, the international Cassini-Huygens mission has generated a tremendous wealth of scientific data on the Saturnian system for detailed investigations in the coming decades. The fundamental impacts to our understanding of our solar system can be appreciated by the exploration of Titan by the remote-sensing and in-situ instruments on the NASA Cassini spacecraft and the ESA Huygens atmospheric probe which celebrated the 10th anniversary of its successful descent to open our eyes to the fascinating landscape of Titan. If we follow the trend now established for the quest of the unknown territory of the outer planets, it can be envisaged that a new mission to Saturn and Titan/Enceladus will be planned and executed within the next two decades. In the same time scale, there would be initiatives to return to the two outermost planets, namely, Uranus and Neptune, to follow up the trail-blazing flyby reconnaissance of Voyager 2 spacecraft in 1989. From this point of view, an orbiter mission to Neptune with Triton flybys is of particular interest. Because of its retrograde motion around Neptune, Triton is generally believed to be a captured TNO (Trans-Neptunian Object) of respectable size (larger than Pluto). The active cryovolcanism is puzzling but could provide important clues to the putative resurfacing mechanism suggested for some large TNOs. The repeated measurements at close approaches by the Neptune Orbiter will allow us to probe the nature of such distant objects which are the key to the reconstruction of the solar system history and the fate of Earth’s biosphere. Same amount of scientific merits, if not more, can be related to Neptune’s ring system, atmosphere, pole-on magnetosphere, and interior. For exoplanetary analogs, there is also much to be said about Neptune being the prototype of ocean planet candidates like Kepler 22b. A Triton-Neptune Orbiter (TNO) mission is therefore a natural sequel to the Cassini-Huygens project with a wider participation from the international space agencies

PS08-06-D5-PM2-P-020
On the Structure and Dynamics of an Extended Oxygen Halo/Neutral Cloud of Callisto
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From radio occultation measurements by the radio science experiment on the Galileo spacecraft, it was found that the outermost Galilean moon of Jupiter, Callisto, possesses a sizable ionosphere. With its icy surface, Callisto's atmosphere should be composed of water-group neutrals, O2, CO, and CO2. As with the ionospheres of Mars and Venus, respectively, the dominant ion species in the Callisto ionosphere would be oxygen molecular ions. Exothermic electron-ion dissociative recombination should lead to the production of a population of hot oxygen atoms forming an extended halo surrounding Callisto as well as a neutral cloud along the orbit of Callisto. The oxygen neutral cloud together with the ionospheric outflow could be an important source of suprathermal and energetic

oxygen ions in the Jovian magnetosphere.

PS08-06-D5-PM2-P-021
Dust Halo and Curtains of the Saturnian Rings
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The motion of charged nano-dust grains is controlled by Saturn's gravitational force and Lorenz force in the rotating magnetosphere. Depending on the charge-to-mass (q/m) ratios, the trajectories could have a wide range of dynamical behaviors. Those with large q/M (>10^-5 e/m or electronic charge/proton mass) will move along the magnetic field direction until hitting the planetary surface in the southern mid-latitude hemisphere if launched from Kepler motion at radial distance within 1.53 planetary radii. Those launched at larger radial distance will be trapped in bounce motion above and below the ring plane. It is believed that the sharp boundary between the B and C rings could be the result of such magneto-gravitational orbital instability. Positively or negatively charged grains with q/M < 10^-5e/m will execute a complex set of trajectories. It is noteworthy that a class of positively charged grains can spiral into the equatorial region of Saturn while another class would spiral outward. During the Grand Finale phase of the Cassini project, there will be ample opportunity for the dust detector experiment to search for the presence of such dust halo and dust sheet in the vicinity of the ring system. For submicron-sized dust particles in quasi-Kepler motion, the perturbation effect by the Lorenz force represents an interesting mechanism of momentum exchange between the charged dust and Saturn's ionosphere. This means that orbital motion of distributed diffuse material in ring gaps could be subject to an additional drag force.

PS08-06-D4-PM1-324-011
Physical Consequences of Charge Exchange Process in the Saturnian Neutral Cloud
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The Saturnian system is embedded in a thick gas cloud generated by the water plume emission of Enceladus. As a result, the composition of the Saturnian magnetosphric ions is uniquely dominated by water-group ions. The population of corotating thermal ions is maintained by photoionization, electron impact ionization and charge exchange loss. Depending on the radial distribution of the thermal plasma and the ion temperature, the neutral atoms produced by charge-exchange effect could become an important source of the pickup ions in the outer magnetosphere. By the same token, those injected inward could supply an influx of oxygen-bearing atoms and molecules to the Saturnian ionosphere. In this work, we will apply thermal plasma models from the Cassini measurements and realistic neutral cloud models to estimate the heavy neutral atom injection rate to the outer magnetosphere and the water-group neutrals supply rate and the corresponding latitudinal distribution to the Saturnian ionsphere.

PS-08-06-D4-PM1-324-011
The Role of the O2/H2 Atmosphere of the Main Rings in the Coupling Dynamics Among Saturn’s Atmosphere, Ionosphere, and Magnetosphere
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The Cassini spacecraft, which has explored the Saturnian system since Saturn Orbital Insertion (SOI) in 2004, has already confirmed the presence of an O2 atmosphere over the main rings. During the Cassini Grand Finale mission, it focuses on the temporal variability in composition and spatial distribution in Saturn's atmosphere, ionosphere and magnetosphere, which are affected by seasonal and solar forcing. More information will be revealed to define the coupling between the main rings and the Saturnian system. In order to complement these efforts, we will describe the role of the O2/H2 atmosphere of the main rings in the coupling dynamics between Saturn's atmosphere, ionosphere, and magnetosphere, including investigating the causes of: 1) the time variability and radial dependence of the plasma density inside 4 Rs; 2) the latitudinal dependence of Saturn's ionospheric electron and H3+ density; and 3) the atomic H cloud around the main rings seen by Cassini UVIS.

PS-08-06-D4-PM2-324-014
Time Variation of ENA Fluxes Generated by Enegetic Particle Injection Events in the Saturnian Magnetosphere
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The ENCA detector for energetic neutral atoms is an important element of the MIMI experiment onboard the Cassini spacecraft (Krimigis et al., 2004). The energy range is between 5 keV to 220 keV with many energy steps. An mportant discovery of ENCA concerns the appearance of source regions of hydrogen ENAs rotating around Saturn outside the orbit of Enceladus (Paranicas et al., 2005). The luminosity of the ENA flux tends to brighten up in the mid-night to dawn sector which might be associated with the injection events of energetic charged particles which have higher occurrence frequency in this region. In this study, we examine the time evolution of a cloud of energetic ions in drift motion relative to the rotating magnetosphere. Besides the dispersal of the energetic ions as a function of their energies, the charge exchange interaction with the neutral cloud of Enceladus origin will be simulated.

References:

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