[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26日(日) 9:00 ~ 10:30 | 🏛A02 東京ベイ幕張ホール

[P-PS04] 火星と火星圏の科学

コンビーナ:宮本 英昭(東京大学)、臼井 寛裕(東京工業大学地球生命研究所)、松岡 彩子(宇宙航空研究開発機構　宇宙科学研究所　太陽系科学研究系)、Sushil K Atreya(University of Michigan Ann Arbor)、座長:Sushil Atreya

In view of unprecedented advances in our understanding of Mars, primarily due to new and ongoing observations of the planet with a number of spacecraft missions of the US, Europe and Asia, we propose a session on Mars. Mars is an object of intense scrutiny. Currently, eight spacecraft are operating at Mars, with six in orbit (Odyssey, MRO, MAVEN, Mars Express, Mangalyaan and TGO) and two on the surface (MSL-Curiosity and MER-Opportunity), the largest number ever at any given time. In addition, InSight is on track to land on Mars in November 2018, and several spacecraft are in various stages of implementation with launches scheduled for 2020 (Mars 2020, ExoMars 2020, Emirates Mars Mission Hope, Chinese Mars Mission and the Japanese Mars Terahertz Microsatellite), 2022 (ISRO's Mangalyaan 2), and 2024 (JAXA's MMX mission to explore Phobos, Deimos, and Mars). All this is a clear demonstration of public's strong fascination with and commitment to Mars exploration and the resulting scientific bonanza. Synergistic investigations with ongoing and already completed missions along with modeling studies and earth-based observations are gradually revealing the nature of Earth's most closely resembling planet that took on a different evolutionary track than our home planet. Morphology and variable phenomena seen on the surface (RSLs, e.g.) and in the atmosphere (methane) indicate that Mars is possibly currently active. Available data are providing a better understanding of Mars' present geologic and atmospheric state, climate evolution, and habitability. Thus, the scope of this session will be the recent results from a broad spectrum of Mars studies encompassing the interior, surface, atmosphere, plasma environment, and the Mars system including its two satellites. Abstracts on modelling, instrumentation and future mission plans are also encouraged.

9:00 ~ 9:15

[PPS04-01] Recent results from the MAVEN mission

*Dave A Brain[1,4]、Bruce Jakosky[1]、Janet Luhmann[2]、Gina DiBraccio[3] (1.University of Colorado、2.University of California Berkeley、3.NASA Goddard Space Flight Center、4.University of Tokyo)

9:15 ~ 9:30

[PPS04-02] From Clouds to Aurora to Atmospheric Escape: Highlights from MAVEN’s Imaging UltraViolet Spectrograph

★Invited Papers

*Nicholas McCord Schneider[1]、MAVEN/IUVS Science Team (1.LASP, University of Colorado Boulder)

9:30 ~ 9:45

[PPS04-03] Variation in Martian Crustal Magnetic Field Cusp Topology

*Tristan David Weber[1]、David Brain[1]、Shaosui Xu[2]、David Mitchell[2]、Jasper Halekas[3] (1.University of Colorado, Boulder、2.Space Sciences Laboratory, UC Berkeley、3.University of Iowa, Iowa City)

9:45 ~ 10:00

[PPS04-04] The Induced Global Looping Magnetic Field on Mars

*Lihui Chai[1]、Weixing Wan[1]、Yong Wei[1]、Tielong Zhang[2]、Willi Exner[3]、Markus Fraenz[4]、Eduard Dubinin[4]、Moritz Feyerabend[3]、Uwe Motschmann[3]、Yingjuan Ma[5]、J. S. Halekas[6] (1.Institute of Geology and Geophysics Chinese Academy of Sciences、2.Space Research Institute, Austrian Academy of Sciences, Graz, Austria、3.Institute for Theoretical Physics, TU Braunschweig, Braunschweig, Germany、4.Max Planck Institute for Solar System Research, Goettingen, Germany、5.Institute of Geophysics and Planetary Physics, University of California, Los Angeles, Los Angeles, CA, USA、6.Department of Physics and Astronomy, University of Iowa, Iowa City, IA, USA)

10:00 ~ 10:15

[PPS04-05] First Observation of Magnetic Pulsations on Martian Surface

*Peter J Chi[1]、Christopher T Russell[1]、Steve Joy[1]、Don Banfield[2]、Catherine L Johnson[3,4]、Yingjuan Ma[1]、Anna Mittelholz[3]、Yanan Yu[1] (1.University of California Los Angeles、2.Cornell University、3.University of British Columbia、4.Planetary Science Institute)

10:15 ~ 10:30

[PPS04-06] MRO/CRISM 火星リム観測による多重散乱を考慮したエアロゾル・ガス高度プロファイルのリトリーバル

*笠羽 康正[1]、豊岡 雅士[2]、青木 翔平[3]、Mahieux Arnaud[3,4]、中川 広務[2]、岩渕 弘信[2] (1.東北大学 惑星プラズマ・大気研究センター、2.東北大学 理学研究科 地球物理学専攻、3.Planetary Aeronomy, Belgian Institute for Space Aeronomy, Belgium 、4.University of Texas at Austin, USA)

Recent results from the MAVEN mission

*Dave A Brain[1,4], Bruce Jakosky[1], Janet Luhmann[2], Gina DiBraccio[3]

1. University of Colorado, 2. University of California Berkeley, 3. NASA Goddard Space Flight Center, 4. University of Tokyo

The Mars Atmosphere and Volatile EvolutioN (MAVEN) mission has been making science observations from Mars orbit since November, 2014, with the science goal of assessing the role that loss of atmospheric gas to space has played in changing the Martian climate through time. To achieve this objective, MAVEN measures the energetic inputs to the Martian upper atmosphere from the Sun (“drivers”), the properties of the regions of the upper atmosphere from which escaping particles are drawn (“reservoirs”), and the different escape processes as they occur today (“escape”). These data, and the models used to help understand them, allow us to constrain the influence of escape on the evolution of the Martian atmosphere over time. In this presentation we will summarize the main findings of MAVEN over more than 4 years of science observations, with an emphasis on recent results released over the past year. We will then present the status and future science plans for the mission as the spacecraft’s orbit is changed to prepare for increased relay activities in the coming months and years.

Keywords: Mars, Climate, Atmospheric Escape

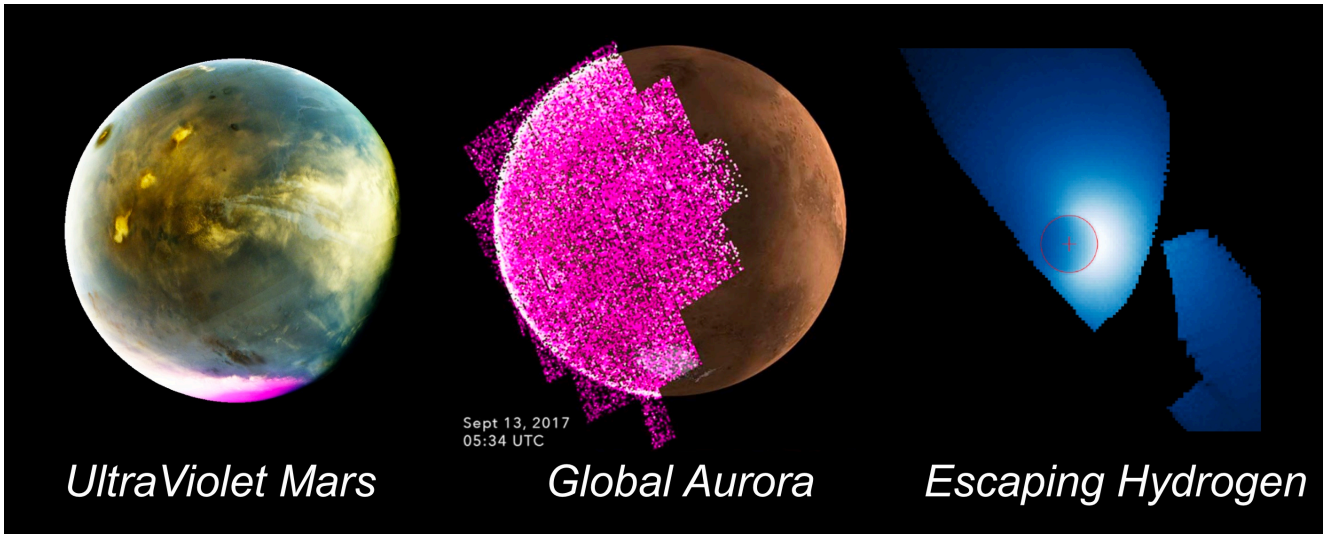
From Clouds to Aurora to Atmospheric Escape: Highlights from MAVEN’ s Imaging UltraViolet Spectrograph

*Nicholas McCord Schneider[1], MAVEN/IUVS Science Team

1. LASP, University of Colorado Boulder

The Mars Atmosphere and Volatile EvolutioN (MAVEN) mission’ s Imaging Ultraviolet Spectrograph (IUVS) observes Mars in the far and mid ultraviolet (110-340 nm), investigating lower and upper atmospheric structure and indirectly probing neutral atmospheric escape. The instrument is among the most powerful spectrographs sent to another planet, with several key capabilities: separate Far-UV & Mid-UV channels for stray light control; a high-resolution echelle mode to resolve deuterium and hydrogen emission; internal instrument pointing and scanning capabilities to allow complete mapping and nearly continuous operation; and optimization for airglow studies. After four Earth years in orbit (two Mars years), IUVS has assembled a large quantity of data and provided insights on present-day processes at Mars including dayglow, nightglow, aurora, meteor showers, clouds, and solar-planetary interactions. In this presentation, we will highlight key results obtained by IUVS, including: (1) dust storm and cloud activity from a synoptic perspective; (2) a surprisingly high level of auroral activity of three types; (3) long-term tracking of seasonally-modulated escape of hydrogen. We will present an overview of these results and a discussion of their implications for understanding Mars atmospheric dynamics and evolution.

Keywords: mars, atmosphere, ultraviolet, aurora, escape, clouds



Variation in Martian Crustal Magnetic Field Cusp Topology

*Tristan David Weber[1], David Brain[1], Shaosui Xu[2], David Mitchell[2], Jasper Halekas[3]

1. University of Colorado, Boulder, 2. Space Sciences Laboratory, UC Berkeley, 3. University of Iowa, Iowa City

The Martian magnetic field environment is complex. Crustal magnetic fields interact with the incoming interplanetary magnetic field (IMF) to produce a dynamic topological system that in turn constrains the motion of charged particles. The inflow of energetic electrons and the outflow of ionospheric particles are both channeled through regions of vertically oriented field referred to as magnetic "cusps". These cusp regions are consequently host to a range of energetic processes including field-aligned currents and aurora, and may be the source of substantial quantities of ion escape at Mars.
Here we present an analysis of variability in crustal cusps, using electron pitch-angle distributions and energy distributions measured by MAVEN to study how cusp topology varies with upstream solar wind conditions. We find that increased solar wind pressure causes an increase in the spread of open cusp regions on both the dayside and nightside of the planet, and that changes in IMF direction control which cusps preferentially open to the solar wind. Finally, we then pair these results with direct measurements of particle flux to begin an analysis of energy deposition and ion outflow in cusp regions.

Keywords: Martian Magnetosphere, Magnetic Topology, Martian Ionosphere

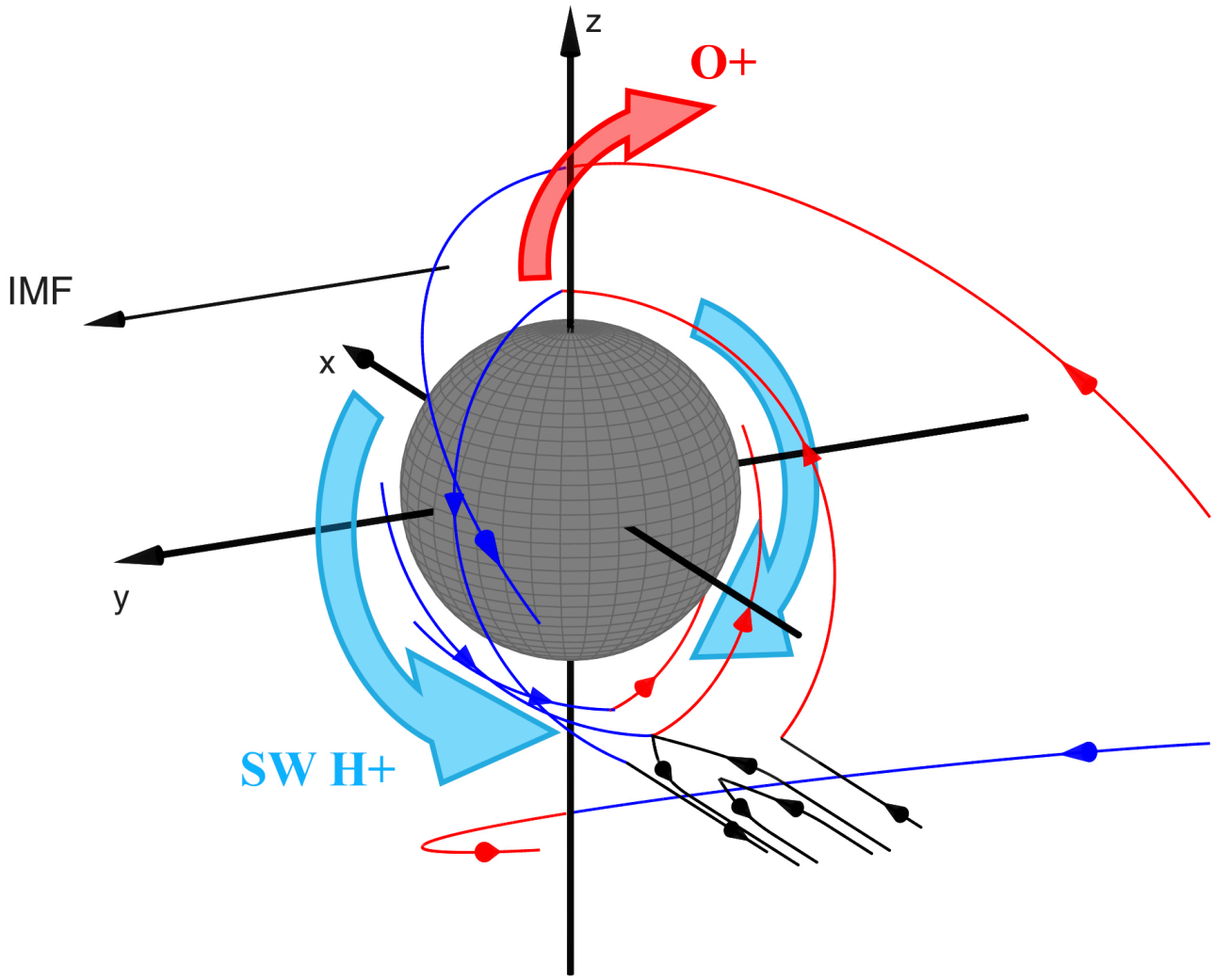
The Induced Global Looping Magnetic Field on Mars

*Lihui Chai[1], Weixing Wan[1], Yong Wei[1], Tielong Zhang[2], Willi Exner[3], Markus Fraenz[4], Eduard Dubinin[4], Moritz Feyerabend[3], Uwe Motschmann[3], Yingjuan Ma[5], J. S. Halekas[6]

1. Institute of Geology and Geophysics Chinese Academy of Sciences, 2. Space Research Institute, Austrian Academy of Sciences, Graz, Austria, 3. Institute for Theoretical Physics, TU Braunschweig, Braunschweig, Germany, 4. Max Planck Institute for Solar System Research, Goettingen, Germany, 5. Institute of Geophysics and Planetary Physics, University of California, Los Angeles, Los Angeles, CA, USA, 6. Department of Physics and Astronomy, University of Iowa, Iowa City, IA, USA

Magnetic fields inconsistent with draped IMFs and crustal fields have been observed on Mars. Considering the discovery of a global looping magnetic field around the Venusian magnetotail and the similarities in the solar wind interactions between Mars and Venus, we use MAVEN observations to investigate the global looping field on Mars and its formation mechanism. It is found that a global looping field also exists on Mars; therefore, this type of global looping field is a common feature of unmagnetized planetary bodies with ionospheres and it should also exist on Titan and near-Sun comets. The comparison of the looping fields on Mars and Venus shows that the looping field is stronger on Mars. Solar wind azimuthal flows around the magnetotail towards the -E magnetotail polar region (X_MSE<0,Y_MSE=0,Z_MSE}<-1R_M) are observed. We illustrate that the looping field can be formed by bending the draped field lines with these azimuthal flows, and that these azimuthal flows are associated with heavy ion plumes along the +E direction that are expected to be stronger on Mars than Venus. The current system associated with the looping field and its possible connection with the nightside ionosphere formations and ion escapes on Mars and Venus are discussed.

Keywords: Mars, Venus, induced magnetosphere, looping magnetic field



First Observation of Magnetic Pulsations on Martian Surface

*Peter J Chi[1], Christopher T Russell[1], Steve Joy[1], Don Banfield[2], Catherine L Johnson[3,4], Yingjuan Ma[1], Anna Mittelholz[3], Yanan Yu[1]

1. University of California Los Angeles, 2. Cornell University, 3. University of British Columbia, 4. Planetary Science Institute

Landed in the western Elysium Planitia on Mars on November 26, 2018, InSight is the first Mars surface mission that carries a magnetometer. One of the research topics that can be investigated by using the InSight FluxGate (IFG) magnetometer observations is ultra-low-frequency (ULF) magnetic pulsations. Past and ongoing Mars orbiter missions have observed several types of magnetic pulsations near the planet, but whether any of them can reach the Martian surface is an open question. We study the initial IFG data to examine whether and what types of magnetic pulsations are present on the Martian surface. We have found continuous pulsations (Pc) with frequencies at ~10 mHz occurring mostly near midnight. Pc at lower frequencies (of the order of 1 mHz) has also been found in the local morning. The data from the Temperature and Wind for InSight Subsystem (TWINS) confirm that these ULF oscillations in the IFG data are not caused by the wind-driven motion of the lander. Data from the Mars-orbiting MAVEN spacecraft show that the ~10-mHz magnetic pulsations observed by InSight are different from the upstream waves in the foreshock region but may be induced by the oscillations in the tail plasma sheet. The observed continuous pulsations on the Martian surface near midnight are distinct from what are typically observed on the Earth's surface at the same local hours. The different field and plasma environment at Mars raises interesting questions regarding how the magnetic pulsations in the induced magnetosphere propagate to the surface.

Keywords: Mars, NASA InSight mission, surface magnetic field, induced magnetosphere, solar wind interaction with Mars

MRO/CRISM 火星リム観測による多重散乱を考慮したエアロソ゛ル・カ゛ス高度フ゜ロファイルのリトリーハ゛ル

Retrieval of vertical aerosol and gas profiles considering multiple scattering from Martian limb observations by MRO/CRISM

*笠羽 康正[1]、豊岡 雅士[2]、青木 翔平[3]、Mahieux Arnaud[3,4]、中川 広務[2]、岩渕 弘信[2]
*Yasumasa Kasaba[1], Masashi Toyooka[2], Shohei Aoki[3], Arnaud Mahieux[3,4], Hiromu Nakagawa[2], Hironobu Iwabuchi[2]

1. 東北大学 惑星プラズマ・大気研究センター、2. 東北大学 理学研究科 地球物理学専攻、3. Planetary Aeronomy, Belgian Institute for Space Aeronomy, Belgium 、4. University of Texas at Austin, USA
1. Planetary Plasma and Atmospheric Research Center (PPARC), Tohoku University, 2. Dep. Geophysics, Tohoku University, 3. Planetary Aeronomy, Belgian Institute for Space Aeronomy, Belgium , 4. University of Texas at Austin, USA

Mars must somehow have lost most of its atmosphere and water. The evolution of the Mars environment is thought to have proceeded by atmospheric escape to space. In the last decades, there have been a renewed interest from lower to upper atmosphere to understanding the Martian climate. Vertical profiles of atmospheric gases and aerosols are thus the primary information for key processes in energy and mass transport into the upper atmosphere from below. Thanks to the aggressive explorations by MRO and MEx missions, there have been a lot of dataset of limb-viewing observations that can add new restrict the history of the Martian environment. However, these limb datasets haven’t started on the retrieval due to their computational costs in the process of radiative transfer calculations.

JACOSPAR is a fast RT code that considers multiple scattering that simulates the radiance and Jacobians in the fully spherical geometry, which has been developed for the terrestrial atmosphere. We have newly developed the retrieval code by applying JACOSPAR for Martian limb observation. For the first step to apply JACOSPAR to Martian limb observation, we modified two points for RT simulations to be optimized. First, we implemented a uniform distribution of line of sight within the field of view (FOV) in order to reduce the resultant variance of the calculated radiance along line of sight in the FOV. Second, we also optimized the threshold of Russian roulette method for the efficient calculation in the Monte Carlo simulation.

The evaluation results of Jacobians calculated by JACOSPAR showed the agreements accurate within 2% and 10% for absorption and scattering, respectively, in almost cases. In order to evaluate our retrieval code and its proper implementations, we have applied our retrieval code for the MRO/CRISM limb observations. We conducted spectral fitting to retrieve vertical profiles of number density of CO#CO,H#O,dust,andwatericefor the observed spectra by CRISM in the altitude range from 0 to 20 km. Here we newly attempted to retrieve the mean radius, and its variance of aerosols for the two cases of difference a priori conditions for the variance of aerosols’ radius of 0.5 and 1.2. We, however, still found the discrepancy of spectral slope and intensity between retrieved spectra and measured spectra. It is also noted that the repetitive variations of fitting profiles do not converge during the iterations. The possible explanation for the discrepancy of the spectral slope and intensity might be due to the treatments of aerosol properties. One of the solutions is to apply modified-gamma distribution for size distribution function, instead of log-normal distribution function applied for this study.

More precise and accurate treatment of size distribution function is required as a next step. The repetitive variations of fitting profiles might be caused by the sensitivity of the retrieval. The detailed evaluation of the retrieval sensitivity should also be required for the future work.

キーワード：火星、リトリーバル、大気、垂直構造
Keywords: Mars, Retrieval , atmosphere, vertical profile

