representative coronal, photospheric, and chromospheric lines, respectively. Our results may be used as a secondary perspective in addition to primary scientific purposes in selecting a few channels of an UV/EUV imaging instrument for future solar satellite missions.

[구 SS-06] Halo CME mass estimated by synthetic CMEs based on a full ice-cream cone model

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In this study, we suggest a new method to estimate the mass of a halo coronal mass ejection (CME) using synthetic CMEs. For this, we generate synthetic CMEs based on two assumptions: (1) the CME structure is a full ice-cream cone, (2) the CME electron density follows a power-law distribution ($\rho_{cme}=\rho_0 r^{-n}$). The power-law exponent n is obtained by minimizing the root mean square error between the electron number density distributions of an observed CME and the corresponding synthetic CME at a position angle of the CME leading edge. By applying this methodology to 57 halo CMEs, we estimate two kinds of synthetic CME mass. One is a synthetic CME mass which considers only the observed CME region (M_{cme1}), the other is a synthetic CME mass which includes both the observed CME region and the occulted area larger than 4 solar radii (M_{cme2}). From these two cases, we derive conversion factors which are the ratio of a synthetic CME mass to an observed CME mass. The conversion factor for M_{cme1} ranges from 1.4 to 3.0 and its average is 2.0. For M_{cme2}, the factor ranges from 1.8 to 5.0 with the average of 3.0. These results imply that the observed halo CME mass can be underestimated by about 2 times when we consider the observed CME region, and about 3 times when we consider the region including the occulted area. Interestingly these conversion factors have a very strong negative correlation with angular widths of halo CMEs.We also compare the results with the CME mass estimated from STEREO observations.

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[구 SS-07] Quasi-Periodic Oscillations of Off-Limb Flaring Arcade Loops observed in the SDO/HMI Continuum

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In this study, we report oscillations of the total intensity of white light loops in the off-limb solar flare observed in 2017-Sep-10 with the SDO/HMI. The total intensity oscillations are correlated with the area of the flaring loop in the plane of the sky. The oscillatory pattern is well fitted by two consecutive damped oscillations. The period and damping time of the first oscillation are 12.9 minutes and 9.9 minutes, respectively. Those of the second oscillation are 11.7 minutes and 15.4 minutes. The excitation of the oscillations coincides with two consecutive type III radio bursts observed in meter range. Assuming the oscillations are magnetoacoustic waves in the flaring loops with the loop lengths ranging from 30 to 90 Mm, the temperature of the white light emitting loops could be in the range from 0.3 MK to 2.6 MK.

[구 SS-08] Sun-Earth Connection in Korean Historic Observations

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10세기부터 18세기까지 한국 역사서에 기록된 38개 흑점과 이와 연관된 것으로 보이는 25개의 적색 오로라를 조사하여 고대 흑점의 지구 영향성을 분석하였다. 고대 관측 시기를 1300년을 기준으로 이전의 온난기와 이후의 냉한기로 나누어 보면, 흑점의 관측 빈도는 두 기간에서 비슷하지만, 오로라는 냉한기에 집중적으로 관측된다. 특이하게도, 크기가 큰 흑점의 경우는 냉한기보다 온난기에서 관측 빈도가 세 배 이상 높다. 또한, 흑점과 관련된 오로라의 강도를 분석해보면 크기가 큰 흑점은 작은 흑점보다 2~3배 이상 지구영향성이 높다는 것을 알 수 있다. 우리는 1185년에 관측된 흑점이 수개월에 걸쳐 여러 차례 관측되었다는 것을 확인하였으며, 그 활동성 면에서 2003년 할로윈 이벤트와 유사했을 것으로 유추하였다. 향후 현대의 흑점 관측 스케치와 국제 흑점수의 관계를 정량화할 수 있다면, 유일하게 한국 역사서에만 찾아볼 수 있는 흑점의 크기 단위는 흑점수와 같이 태양활동의 지표로 사용될 수 있을 것으로 보인다.

[구 SS-09] Apophis Rendezvous Mission: I. Science Goals

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99942 Apophis is an Sq-type Aten group Near-Earth Asteroid (NEA) with an estimated size of 370 m. It will approach the Earth to come within the geostationary orbit during the upcoming encounter on April 13, 2029 to offer a unique chance to study its 1) global properties, 2) surface arrangements, and 3) their detectable changes expected to happen, in sub-meter scale. What measurable scientific goals for the asteroid in this "once a millennium" event could transform our knowledge of planetary science and defense?

The Apophis rendezvous mission aims to understand the characteristics of the small solar system body's nature. It also prepares for potential threats from natural objects by measuring in-situ surface, shape, rotation, and orbit changes expected to occur when the target asteroid passes close to the Earth in 2029. We will present an overview of the mission scheduled to be launched from late 2026 to early 2027 and introduce scientific objectives.

[구 SS-10] Apophis Rendezvous Mission: II. Payloads and Operation Scenario

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We plan to visit the Apophis, a Potentially Hazardous Asteroid (PHA). Apophis will have an extremely close encounter with the Earth on April, 2029. At the closest position, Apophis approaches 0.1 lunar distances from the Earth. The science goals are 1) mapping the surface of the asteroid before and after the encounter, 2) measuring surface roughness before and after the encounter, and 3) measuring interplanetary space environments such as magnetic field and dust particles. For the science goal, we are planning to employ five instruments for this mission, which are Polarimetric Asteroid Camera (PolACam), Asteroid Terrain Mapping Camera (MapCam), Laser Altimeter, Dust Particle Detector (DPDetector), Magnetometer (Mag). In this presentation, we plan to give a talk on the instruments.한기로 나누어 보면, 흑점의 관측 빈도는 두 기간에서 비슷하지만, 오로라는 냉한기에 집중적으로 관측된다. 특이하게도, 크기가 큰 흑점의 경우는 냉한기보다 온난기에서 관측 빈도가 세 배 이상 높다. 또한, 흑점과 관련된 오로라의 강도를 분석해보면 크기가 큰 흑점은 작은 흑점보다 2~3배 이상 지구영향성이 높다는 것을 알 수 있다.

[구 SS-11] Rotational instability as a source of asteroidal dust near Earth

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As implied by the zodiacal light and spacecraft impact measurements, the space between large bodies in our Solar System is filled with interplanetary dust particles (IDPs). IDPs give us deeper insight into the composition and evolution of the Solar System, as well as being a crucial reference for extrasolar research. IDPs can be interpreted as bearers of carbon and organic materials, and thus, their interaction with Earth can be considered as important factors for the birth of terrestrial life.

One of the key routes of IDPs entering Earth is via meteoroid streams (Love and Brownlee 1993).

The Geminid meteoroid stream is a notable example. Together with its source asteroid (3200) Phaethon, the Phaethon-Geminid stream complex (PGC) (Whipple 1983; Gustafson 1989) can potentially provide information on the properties and evolution of IDPs in near-Earth space. DESTINY+* is a JAXA/ISAS spacecraft planned to launch in 2024 to explore the physical and chemical features of near-Earth IDPs and uncover the dust ejection mechanism of active near-Earth asteroids, especially Phaethon (Arai et al. 2018).

Previous studies on the dust ejection mechanism of Phaethon have various degrees of success in explaining the ejection of submillimeter particles and try to recreate the dust replenishment rate of the Geminid stream. However, none of them are satisfactory for explaining the observed Geminid stream, especially for larger particles of a millimeter and centimeter scales. Inspired by the discovery of rotational mass shedding in the Main Belt region (Jewitt et al., 2014), we investigate a dust ejection scenario by rotational instability on Phaethon. Using the N-body integrator MERCURY6 (Chambers 1999; modified by Jeong 2014), we performed a long-term integration of dust particles of various sizes ejected at ~1 m/s. Through this process, we discuss the implications Phaethon's rotation may have on its ejection, the formation and evolution of IDP by this mechanism, and contribute to the DESTINY+ mission.

* Demonstration and Experiment of Space Technology for Interplanetary voYage Phaethon