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The observation of particles and waves using a single satellite inherently suffers from space-time ambiguity. Recently, such ambiguity has often been resolved by multi-satellite observations; however, the inter-satellite distances were generally larger than 100 km. Hence, the ambiguity could be resolved only for large-scale (> 100 km) structures while numerous microscale phenomena have been observed at low altitude satellite orbits. In order to resolve those spatial and temporal variations of the microscale plasma structures on the topside ionosphere, SNIPE mission consisted of four (TBD) nanosatellites (~10 kg) will be launched into a polar orbit at an altitude of 700 km (TBD). Two pairs of satellites will be deployed on orbit and the distances between each satellite will be from 10 to 100 km controlled by a formation flying algorithm. The SNIPE mission is equipped with scientific payloads which can measure the following geophysical parameters: density/temperature of cold ionospheric electrons, energetic (~100 keV) electron flux, and magnetic field vectors. All the payloads will have high temporal resolution (~ 16 Hz (TBD)). This mission is planned to launch in 2020.

The SNIPE mission aims to elucidate microscale (100 m-10 km) structures in the topside ionosphere (below altitude of 1,000 km), especially the fine-scale morphology of high-energy electron precipitation, cold plasma density/temperature, field-aligned currents, and electromagnetic waves. Hence, the mission will observe microscale structures of the following phenomena in geospace: high-latitude irregularities, such as polar-cap patches; field-aligned currents in the auroral oval; electro-magnetic ion cyclotron (EMIC) waves; hundreds keV electrons' precipitations, such as electron microbursts; subauroral plasma density troughs; and low-latitude plasma irregularities, such as ionospheric blobs and bubbles.

We have developed a 6U nanosatellite bus system as the basic platform for the SNIPE mission. Three basic plasma instruments shall be installed on all of each spacecraft, Particle Detector (PD), Langmuir Probe (LP), and Scientific MAGnetometer (SMAG). In addition we now discuss with NASA and JAXA to collaborate with the other payload opportunities into SNIPE mission.

#### [구 ST-05] Different Responses of Solar Wind and Geomagnetism to Solar Activity during

#### Quiet and Active Periods

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It is well known that there are good relations of coronal hole (CH) parameters such as the size, location, and magnetic field strength to the solar wind conditions and the geomagnetic storms. Especially in the minimum phase of solar cycle, CHs in mid- or low-latitude are one of major drivers for geomagnetic storms, since they form corotating interaction regions (CIRs). By adopting the method of Vrsnak et al. (2007), the Space Weather Research Center (SWRC) in Korea Astronomy and Space Science Institute (KASI) has done daily forecast of solar wind speed and Dst index from 2010. Through years of experience, we realize that the geomagnetic storms caused by CHs have different characteristics from those by CMEs. Thus, we statistically analyze the characteristics and causality of the geomagnetic storms by the CHs rather than the CMEs with dataset obtained during the solar activity was very low. For this, we examine the CH properties, solar wind parameters as well as geomagnetic storm indices. As the first result, we show the different trends of the solar wind parameters and geomagnetic indices depending on the degree of solar activity represented by CH (quiet) or sunspot number (SSN) in the active region (active) and then we evaluate our forecasts using CH information and suggest several ideas to improve forecasting capability.

#### [구 ST-06] Lunar Exosphere Simulated with Localized Sources

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We are planning to conduct Monte Carlo simulations for the Na exospheres of the Moon including localized sources on the surface in addition to the global isotropic and anisotropic sources, which were previously studied. The simulation models are based on Lee et al. (2011), who presented a satisfactory interpretation for the isotropic and anisotropic sources of the Lunar Na exosphere. We will compare our preliminary models with existing and the future lunar tail/exospheric observations by the LADEE and

NASA's coronagraph-monitoring programs. Ground-based data show global-scale outflows of Na in contrast to small-scale data usually obtained near the orbits of spacecraft.

## 항성 및 항성계 / 고천문학

### [구 SH-01] Evolutionary properties of red supergiants with MESA

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We investigate the evolutionary properties of red supergiant stars (RSGs), using stellar evolution model of Modules for Experiments in Stellar Astrophysics (MESA). In this study, we calculate models with mass range of 9-39M<sub>sun</sub> and several different convection parameters (e.g. mixing length, overshooting, and semiconvection) at SMC, LMC, Milky Way, and M31 metallicities. We compare the calculated evolutionary tracks with observed RSGs in SMC, LMC, Milky Way and M31, and discuss appropriate input physical parameters in model calculation. We find that a larger mixing length parameter is necessary for M31 metallicity to fit the positions of RSGs in H-R diagram, compared to lower metallicity environments. Theoretically predicted numbers of yellow supergiant stars (YSGs) are also compared with the observed population. We find that Ledoux models with semiconvection can better explain the number of YSGs. Finally, we investigate the final radius, final star mass, and final hydrogen envelope mass of RSGs and discussed the their properties as type II-P supernova progenitors.

### [구 SH-02] The CN-CH positive correlation in the globular cluster NGC 5286

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We performed low-resolution spectroscopy for the red giant stars in the Galactic globular cluster (GC) NGC 5286, which is known to show intrinsic heavy element variations. We found that these stars are clearly divided into two subpopulations

by CN index. These two subpopulations also show significant differences in the HK' and CH indices, where the CN-strong stars are more enhanced in both indices. From the comparison with high-resolution spectroscopic data of Marino et al. (2015), we found that the CN- and HK'-strong stars are also increased in the abundances of s-process elements and Fe. It appears that, therefore, these stars are later generation stars probably affected by supernova enrichment. In addition, NGC 5286 shows the CN-CH positive correlation among the whole sample, which is only discovered in the GCs with heavy element variations such as M22 and NGC 6273. Therefore, these results strengthen our previous suggestion that the CN-CH positive correlation may be associated with the heavy element variations in the GCs.

### [구 SH-03] Origin of Low-mass Hypervelocity Stars in the Galactic Disk

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We present the analysis of chemical abundances and kinematics for six hypervelocity star (HVS) candidates. These objects are G/K-type low-mass stars in the Galactic disk, while other HVSs previously found are B-type high-mass objects in the Galactic halo. The stellar orbits and kinematics of our HVS candidates suggest that they do not originate in the Galactic center or in an accretion event, indicative of yet-unknown mechanisms that produce kinematically-extreme disk stars. In order to study in detail their origin, we obtained medium-resolution (R~6000) spectra of these stars and derived abundances of several chemical elements (Mg, Ca, Si, Ti, Cr, Fe, and Ni). From the comparison of the chemical abundances with the Galactic stellar components (disk, bulge, halo, and dwarf galaxies) and the kinematic properties of our HVSs, we conclude that two of them are likely ejected from the Galactic disk, one originated from the Galactic center as for the young B-type HVSs, and the other one might be ejected from either the Galactic disk or other regions.

### [구 SH-04] ANALYSIS OF LONG PERIOD RADIAL VELOCITY VARIATIONS FOR HD 18438 AND HD 158996

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