Information & communications Technology Promotion(IITP) grant funded by the Korea government(MSIP) (2018-0-01422, Study on analysis and prediction technique of solar flares).

### [포 SS-07] Taxonomic Classification of Asteroids Using KMTNet Data to Identify Asteroid Families

Sangho Choi, Howoo Chiang, and Young-Jong Sohn
[1]*Department of Astronomy, Yonsei Universe, Seoul 03722, Korea*

Identifying asteroid families, which are groups of asteroids with similar orbital properties, is important for understanding the formation and evolution of the solar system, and probing the origins of Near-Earth Objects (NEOs). Although asteroid taxonomy can be used to identify and refine asteroid families, there are numerous asteroids which are not taxonomically classified yet. Korea Microlensing Telescope Network (KMTNet) can be useful to investigate types of that asteroids, because the telescope can observe a number of asteroids at once by its large field of view. Using KMTNet data, we confirmed that the taxonomic classification of the asteroids is possible by plotting color-color diagram. There is a clear division between C-type and S-type, but ambiguous division between C-type and X-type. In the future, we will observe and classify asteroids which are not classified yet and utilize the data to identify and refine asteroid families.

### [포 SS-08] Stability of a magnetic structure producing an M6.5 flare in the active region 12371

Jihye Kang[1], Satoshi Inoue[2], Kanya Kusano[2], Sung-Hong Park[2], Yong-Jae Moon[1]
[1]*Department of Astronomy and Space Science, Kyung Hee University*
[2]*Institute for Space-Earth Environmental, Nagoya University*

We study the stability of the magnetic structure in active region (AR) 12371 producing an M6.5 flare on June 22 2015. We first perform a nonlinear force-free fields (NLFFFs) extrapolation to derive three-dimensional (3D) magnetic fields based on time series of observed photospheric magnetic fields. The NLFFFs well describe an observed sigmoidal structure with the shape of a double arc magnetic configuration. Next, we examine three possible instabilities (kink, torus, and double arc) to investigate how the M6.5 flare is triggered in the double arc loops. Consequently, the double arc loops are stable against kink and torus instabilities, but possibly unstable against the double arc instability before the flare occurrence. Finally, we discuss a probable scenario for the M6.5 flare.

## 항성/항성계/외계행성

### [포 SA-01] Spectroscopic and Photometric Investigation of BS Cassiopeiae

Min-Ji Jeong[1], Chun-Hwey Kim[1,2], Kyeongsoo Hong[3], Jang-Ho Park[1,4], Joh Na Yoon[1,2], Jae Woo Lee[4], Wonyong Han[4], Mi-Hwa Song[1]
[1]*Department of Astronomy and Space Science, Chungbuk National University, Cheongju, Korea*
[2]*Chungbuk National University Observatory, Jinchun, Korea*
[3]*Institute for Astrophysics, Chungbuk National University, Cheongju, Korea*
[4]*Korea Astronomy and Space Science Institute, Daejeon, Korea*

New high-resolution spectra and multi-band photometric data of BS Cas were obtained at the Bohyunsan Optical Astronomy Observatory in 2018 and at the Jincheon Station of the Chungbuk National University Observatory in 2011, respectively. We measured the radial velocities (RVs) for both components, and the effective temperature of the more massive star was determined to be 6262 ± 56 K. In addition, historical light curves showed strong time-dependant light variations at the total eclipse. These variations were modeled by a cool spot on the more massive component. Finally, the physical parameters of BS Cas by a simultaneous analysis of our RV curves with the photometric light curves were presented. Individual masses and radii of both components were deduced as $M_1$= 0.59±0.07 $M_\odot$, $M_2$=1.47±0.15$M_\odot$, $R_1$=0.94±0.03$R_\odot$ and $R_2$ =1.47±0.05$R_\odot$.

### [포 SA-02] Multi-color Light Curves of the Distant Dwarf Nova KSP-OT-201611a Discovered by the KMTNet Supernova Program

Youngdae Lee[1] (이영대), Dae-Sik Moon[2] (문대식), Sang Chul Kim[1,3] (김상철), Hong Soo Park[1,3] (박홍수), Sang-Mok Cha[1,4] (차상목), Yongseok Lee[1,4] (이용석)
[1]*Korea Astronomy and Space Science Institute, 776, Daedeokdae-ro, Yuseong-gu, Daejeon 34055, Republic of Korea,* [2]*Department of Astronomy and Astrophysics, University of Toronto, St. George, Toronto, ON M5S 3H4, Canada,* [3]*Korea University*

*of Science and Technology (UST), 217 Gajeong-ro, Yuseong-gu, Daejeon 34113, Republic of Korea,*
*[4]School of Space Research, Kyung Hee University, Yongin 17104, Korea*

We present multi-color, high-cadence photometric study of a distant SU UMa-type dwarf nova KSP-OT-201611a discovered by the Korea Microlensing Telescope Network (KMTNet) Supernova Program (KSP). From October 2016 to May 2017, two outbursts with an interval of approximately 90 days were detected in the BV I-bands. The shapes and amplitudes of the outbursts reveal the nature of KSP-OT-201611a to be a SU UMa-type dwarf nova of outside-in origin with a superhump and an inferred orbital period of 1.69 h. The two observed bursts show a distinctively different color evolutions during the bursts due most likely to the viscosity different in accretion disk between them. The observed quiescent magnitudes and properties of the source during the outbursts indicate that it is at a large distance (~7.3 kpc) and height (~1.7 kpc) from the Galactic disk, possibly belonging to the group of poorly-studied Population II dwarf novae. The continuous monitoring of this source may offer a rare opportunity to study a PopII dwarf nova.

### [포 SA-03] Dynamic structure of the Sim open clusters (심 산개성단의 역동적 구조)

Sang Hyun Lee[1,2](이상현), Gyuheon Sim[3](심규헌)
*[1]Korea Astronomy and Space Science Institute (한국천문연구원)*
*[2]Department of Physics, University of Ulsan (울산대학교 물리학과)*
*[3]Ulsan Science high school (울산과학고등학교)*

722 open clusters in the Sim open cluster catalogue show the outermost structure of open clusters. The catalogue is based on the proper motion and parallax of the stars. These results reveal the hidden structures of weak membership signals in the field star contamination. It contains the tidal tails, flattened structure along the galactic plane, interacting double clusters and very poor and spread clusters. We will show these interesting structures.

### [포 SA-04] KIC 6206751: the first R CMa-type eclipsing binary with γ Doradus pulsations

Jae Woo Lee[1] and Jang-Ho Park[1,2]
*[1]Korea Astronomy and Space Science Institute, Daejon 34055, Korea, [2]Department of Astronomy and Space Science, Chungbuk National University, Cheongju 28644, Korea*

We present the absolute properties of the double-lined eclipsing binary KIC 6206751 exhibiting multiperiodic pulsations. The *Kepler* light curve of this system was simultaneously solved with the previously published radial-velocity data. The results indicate that the binary star is a short-period semi-detached system with fundamental parameters of $M_1$=1.66±0.04 $M_\odot$, $M_2$=0.215±0.006 $M_\odot$, $R_1$=1.53±0.02 $R_\odot$, $R_2$=1.33±0.02 $R_\odot$, $L_1$=5.0±0.6 $L_\odot$, and $L_2$=0.96±0.09 $L_\odot$. We applied multiple frequency analyses to the eclipse-subtracted light residuals and detected the 42 frequencies below 2.5 days$^{-1}$. Among these, three independent frequencies of $f_2$, $f_3$, and $f_4$ can be identified as high-order ($38 \leq n \leq 40$) low-degree ($l=2$) gravity-mode oscillations, whereas the other frequencies may be orbital harmonics and combination terms. The ratios between the orbital frequency and the pulsation frequencies are $f_{orb}$:$f_{2\text{-}4}$ ≃2:3, which implies that the γ Dor pulsations of the detached primary star may be excited by the tidal interaction of the secondary companion. The short orbital period, and the low mass ratio and $M_2$ demonstrate that KIC 6206751 is an R CMa-type star, which is most likely evolving into an EL CVn star. Of seven well-studied R CMa-type stars, our program target is the only eclipsing binary with a γ Dor pulsating component.

### [포 SA-05] 3D Radiation-Hydrodynimics for surface turbulence of Low-mass Stars

Kiehunn Bach[1], Yong-Cheol Kim[1]
*[1]Yonsei University*

We investigate 3D radiation-hydrodynamics (RHD) for surface convection of the solar-type low-mass stars (M = 0.8, 0.9, and 1.0 Msun). The outer convection zone (CZ) of low-mass stars is an extremely turbulent region composed of partly ionized compressible gases at high temperature. Particularly, the super-adiabatic layer (SAL), the top of the CZ is the transition region where the transport of energy changes drastically from convection to radiation. In order to accurately describe physical processes, a realistic treatment of radiation should be considered as well as convection. As a starting model, the initial stratification in the outer envelope calculated using the solar calibrations in the context of the standard stellar theory. When the numerical fluid becomes thermally relaxed, the thermodynamic structure of the steady-state turbulent flow was explicitly collected. In this presentation, we compared thermodynamic properties of turbulent convection of the solar-type low-mass stars.