[1]*School of Space Research, Kyung Hee Univsersity,*
[2]*Gyeonggi Science Highschool*
[3]*Department of Astronomy and Space Science, Kyung Hee University*

Kyung Hee university invented the Transformable Reflective Telescope (TRT) for optical experiment and education. The TRT kit can transform into three optical configurations from Newtonian to Cassegrain to Gregorian by exchanging the secondary mirror. We designed the Ebert-Fastie spectrograph as an extension of the TRT kit. The primary mirror of the TRT kit serves as both collimator and camera lens, and the reflective grating as the dispersing element is placed along the optical axis of the primary mirror. We designed and fabricated the grating holder and the source units using 3D printer. Baffle was also fabricated to suppress the stray light, which was reduced by 83%. The spectrograph can observe the optical wavelength range (4000Å~7000Å). Measured resolving power ($R=\lambda/\Delta\lambda$) was ~700 with slit width of 0.18mm. The spectrograph is optimized for f/24, and the spectral pixel scale is 0.49Å/pixel with Canon 550D detector. We present the sample spectra of discharged Ne, Ar and Kr gases. The flexible setting and high performance make this spectrograph a useful tool for education and experiment.

성간물질

[구 IM-01] Characteristic Chemical Correlations in Nearby Star-forming Molecular Clouds

Hyeong-Sik Yun[1], Jeong-Eun Lee[1], Neal J. Evans II[2,3], Stella Offner[3], Mark H. Heyer[4], Yunhee Choi[2], Yong-Hee Lee[1], Giseon Baek[1], Minho Choi[2], Hyunwoo Kang[2], Ken'ichi Tatematsu[5], Seokho Lee[5], Yao-Lun Yang[6], Brandt Gaches[4], How-Huan Chen[3]
[1]*School of Space Research, Kyung Hee University, Republic of Korea,* [2]*Korea Astronomy and Space Science Institute, Republic of Korea,* [3]*Department of Astronomy University of Texas, Austin, USA,* [4]*Department of Astronomy, University of Massachusetts, Amherst, USA,* [5] *National Astronomical Observatory of Japan, Japan,* [6]*RIKEN Cluster for Pioneering Research, Japan,*

Different molecular lines trace different physical environments (with various densities and temperatures) within molecular clouds (MCs). Therefore, multimolecular line observations are crucial to study the physical and chemical structures of MCs. We observed the Orion A and Ophiuchus clouds in six different molecular lines as a Taeduk Radio Astronomy Observatory Key Science Program (TRAO-KSP), "mapping Turbulent properties In star-forming MolEcular clouds down to the Sonic scale" (TIMES; PI: Jeong-Eun Lee). Here, we investigate the characteristic relations between the observed lines by performing the Principal Component Analysis (PCA). We also investigate the correlation between the line intensity distributions and the physical parameters, such as the gas column density and dust temperature. Finally, we will discuss how the correlations among different chemical tracers vary with the star formation environments

[구 IM-02] How do dense cores embedded in a pc scale filamentary clouds form, by gas flow motions along filamentary clouds and/or contracting motions by themselves?

Shinyoung Kim[1,2], Chang Won Lee[1,2], Philip C. Myers[3], Paola Caselli[4], Mi-Ryang Kim[1]
[1]*Korea Astronomy and Space science Institute,*
[2]*University of Science and Technology, Korea,*
[3]*Center for Astrophysics, Harvard-Smithsonian, USA,*
[4]*Max-Planck-Institut für Extraterrestrische Physik, Germany*

Understanding how the filamentary structure plays a role in the formation of the prestellar cores and stars is a key issue to challenge. We have observed two prestellar cores in surrounding filamentary environments in ^{13}CO, C^{18}0 (3-2) and HCO^+ (4-3) molecular lines with the Heterodyne Array Receiver Program (HARP) of the James Clerk Maxwell Telescope (JCMT), in order to search for the evidence related to the possible flow motions along the filament and/or the radial accretion (or infalling motions) of gas material toward the dense cores from their surrounding filamentary cloud. In L1544, the velocity gradient of 1.6 km s^{-1} pc^{-1} toward the core was measured in a small branch of filament lying on a radial direction of main filament while no velocity gradient along the main axis of filament in both ^{13}CO and C^{18}O lines. In L694-2, we found the velocity gradient of 0.6 km s^{-1} pc^{-1} along the filament in only ^{13}CO lines. The projected accretion rate of ~6 $M_\odot$ Myr^{-1} was estimated in both cases. The infall (or radially contracting) velocity of gas material was measured ~0.16 km s^{-1} in both ^{13}CO and HCO^+ lines and in both L1544 and L694-2, which leads to estimate a mass infall rate of ~20 $M_\odot$ Myr^{-1}. Our analysis suggests that our targets are at a stage where the gravitational contraction dominates the mass accretion through the surrounding filamentary

cloud. This is consistent with the fact that our targets are highly evolved prestellar cores on a verge of star formation. More detailed results will be presented at the meeting.

[구 IM-03] Filaments and Dense Cores in IC5146: Roles of Gravity, Turbulence, and Magnetic Field

Eun Jung Chung
Chungnam National University

Filamentary structures pervade the whole kind of molecular clouds from low- to high-mass star-forming clouds, and the non-star-forming clouds. It is supposed to be a prerequisite stage of star formation, and hence how filaments and dense cores form is one of the critical questions in the early star formation study. We investigated the dynamics and chemistry of dense cores in IC5146 using TRAO FUNS (TRAO Survey of the nearby Filamentary molecular clouds, the Universal Nursery of Stars) data. In addition, we performed polarization observation using JCMT Pol-2 polarimetry to investigate the magnetic field morphology within a core-scale. In the presentation, we will present the result of TRAO FUNS and JCMT/Pol2 observation toward the filaments and dense cores in the IC5146. We aim to reveal the roles of gravity, turbulence, and magnetic field in the formation of dense cores in the western hub-filament structure of IC5146.

[구 IM-04] Diagnosis of the Transitional Disk Structure of AA Ori by Modeling of Multi-Wavelength Observations

Kyoung Hee Kim, Hyosun Kim, Chang Won Lee, Aran Lyo
Korea Astronomy and Space Science Institute

We report on multi-wavelength observations of AA Ori, a Young Stellar Object in Orion-A star-forming region. AA Ori is known to have a pre-transitional disk based on infrared observations including Spitzer/IRS data. We construct its broadband spectral energy distribution (SED) by not only taking data in the optical and IR region but also including Herschel/PACS, JCMT/SCUBA, and SMA observational data. We use the Monte Carlo radiative transfer code (RADMC-3D) to reconstruct the SED with a viscous accretion disk model initialized by a radially continuous disk and finally having an inner and outer dusty disk separated by a dust-depleted radial gap. By comparing the model SEDs with different configurations of disk parameters, we discuss the limits to find a single solution of model parameters to fit the data. We suggest that some models with a modified inner disk surface density gradient and some degree of dust depletion in the inner disk can explain the AA Ori's SED, from which we infer that the inner disk of AA Ori has evolved. We present that model configurations of a pre-transitional disk with a large gap extended to 60-80 AU in a settled dusty disk of a few hundred AU size with a high inclination angle (~60°) also create model SEDs close to the observed one. To distinguish whether the disk has a just-opened narrow gap or a large gap, with an altered surface density of the inner disk extended to 10 AU, we suggest a further investigation of AA Ori with high angular resolution observations.

[구 IM-05] Observational Properties of Wolf-Rayet stars and Type Ib/Ic supernova progenitors

Moo-Keon Jung (정무건), Sung-Chul Yoon (윤성철)
Seoul National University (서울대학교)

We investigate the observational properties of Wolf-Rayet stars, suggest the constraint of their mass-loss rate and apply our results to the observed progenitor candidates of Type Ib/Ic supernovae (iPTF13bvn and SN 2017ein). For this purpose, we adopt the WR star models with various mass-loss rates and wind terminal velocities. We obtain the high resolution spectra of those models at the pre-supernova phase using the radiative transfer code CMFGEN. We verify the optically faint property of SN Ic progenitors and show that the optical faintness is mainly originated by the high effective temperature at the photosphere. We also show that a simple analytic model for WR winds using a constant opacity can roughly predict the photospheric parameters. We show that the change of the mass-loss rate and the terminal wind velocity critically affects the optical luminosity. We find the optical luminosities of SN Ic progenitor models with our fiducial mass-loss rate prescription are fainter than the detection limits. We also suggest the mass-loss rate of WR stars may not exceed 2 times of our fiducial value by comparing our predictions with the detection limit of SN Ib/Ic progenitors. The directly observed progenitor candidate of iPTF13bvn can be explained by our SN Ib progenitor models. We find that the SN 2017ein progenitor candidate is too bright and too blue to be a SN Ic progenitor.

[구 IM-06] Type Prediction of Stripped-envelope Supernovae by Wind-driven Mass Loss Progenitor Model