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

Yongje Jeong and Sung-Chul Yoon
Seoul National University

The hydrogen-rich envelope mass of a dying massive star is the key factor that determines the type and properties of the resulting supernova. Emulating wind-driven mass loss of single stars with the MESA(Modules for Experiments in Stellar Astrophysics) stellar evolution code, we made a grid of models for a large parameter space of initial mass (12 $M_\odot$ to 30$M_\odot$), metallicity (solar, LMC and SMC), hydrogen envelope mass (0.01$M_\odot$ to 10$M_\odot$) for progenitor stars in their final step of evolution. Our results suggest the final luminosity of the progenitor is largely determined by the initial mass, which means there is luminosity degeneracy for stars with the same initial mass but with different hydrogen-rich envelope masses. Since we can break this degeneracy by correcting luminosity with surface gravity (spectroscopic HR diagram), we can infer the exact mass property of an observed progenitor. The surface temperature drastically varies near the envelope mass of ~0.1M ☉ and surface temperature of ~10000 K, where the demarcation between the hydrogen-rich envelope and the helium core lies, which explains the rarity of 'white' supergiants. There also exists a discontinuity in the chemical composition of the progenitor envelope around this critical hydrogen-rich envelope mass of ~0.1 $M_\odot$, which can be tested in future observations of "flash spectroscopy" of supernovae.

[구 IM-07] Circumstellar Clumps in the Cassiopeia A Supernova Remnant: Prepared to be Shocked

Bon-Chul Koo[1], Hyun-Jeong Kim[1,2], Heeyoung Oh[3,4], John, C. Raymond[5], Sung-Chul Yoon[1], Yong-Hyun Lee[1,3], Daniel T. Jaffe[4]
[1]*Department of Physics and Astronomy, Seoul National University, Seoul, Korea.*
[2]*Department of Astronomy and Space Science, Kyung Hee University, Yongin, Korea.*
[3]*Korea Astronomy and Space Science Institute, Daejeon, Korea.*
[4]*Department of Astronomy, University of Texas at Austin, Austin, TX, USA.* [5]*Harvard-Smithsonian Center for Astrophysics, Cambridge, MA, USA*

Cassiopeia A (Cas A) is a young supernova remnant (SNR) where we observe the interaction of SNR blast wave with circumstellar medium. From the early optical studies, dense, slowly-moving, N-rich ``quasi-stationary flocculi'' (QSF) have been known. These are probably dense CNO-processed circumstellar knots that have been engulfed by the SNR blast wave. We have carried out near-infrared, high-resolution (R=45,000) spectroscopic observations of ~40 QSF, and here we present the result on a QSF knot (hereafter `Knot 24') near the SNR boundary of Cas A. The average [Fe II] 1.644 um spectrum of Knot 24 has a remarkable shape with a narrow (~8 km/s) line superposed on the broad (~200 km/s) line emitted from shocked gas. The spatial morphology and the line parameters indicate that Knot 24 has been partially destroyed by a shock wave and that the narrow line is emitted from the unshocked material heated/ionized by the shock radiation. This is the first detection of the emission from the pristine circumstellar material of the Cas A supernova progenitor. We also detected H Br gamma and other [Fe II] lines corresponding to the narrow [Fe II] 1.644 um line. For the main clump where we can clearly identify the shock emission associated with the unshocked material, we analyze the observed line ratios using a shock model that includes radiative precursor. The analysis indicates that the majority of Fe in the unshocked material is in the gas phase, not depleted onto dust grains as in the general interstellar medium. We discuss the non-depletion of Fe in QSF and its implications on the immediate progenitor of the Cas A supernova.

[구 IM-08] Kinematic Distances of the Galactic Supernova Remnants in the First Quadrant

Yong-Hyun Lee (이용현)[1,2], Bon-Chul Koo (구본철)[2], Jae-Joon Lee (이재준)[1]
[1]*Korea Astronomy and Space Science institute (한국천문연구원),* [2]*Seoul National University (서울대학교)*

We have carried out high-resolution near-infrared (NIR) spectroscopic observations toward 16 Galactic supernova remnants (SNRs) showing strong H_2 emission features. A dozen bright H_2 emission lines are clearly detected for individual SNRs, and we have measured their central velocities, line widths, and fluxes. For all SNRs except one (G9.9-0.8), the H_2 line ratios are well consistent with that of thermal excitation at T~2000 K and their line widths are broader than ~10 km s^{-1}, indicating that the H_2 emission lines are most likely from shock-excited gas and therefore that they are physically associated with the remnants. The kinematic distances to the 15 SNRs are derived from the central velocities of the H_2 lines using a Galactic rotation model. We derive for the first time the kinematic distances to four SNRs: G13.5-0.2, G16.0-0.5, G32.1-0.9, G33.2-0.6. Among the rest 11 SNRs, the central velocities of