reported that formation of a rotation-supported disk at the earliest young stellar objects (YSOs) is largely suppressed by magnetic fields aligned to the rotational axis of YSOs: magnetic braking. Our recent ALMA observations toward L1448 IRS 2, which has a rotation detected and its magnetic fields aligned to the rotation axis (poloidal fields) in ~500 au scales, show that the fields switch to toroidal at the center in ~100 au scales. This result suggests that magnetic braking may not be so catastrophic for early disk formation even in YSOs with magnetic fields aligned to the rotational axis.

[구 IM-06] FUNS - Filaments, the Universal Nursery of Stars. I. Physical Properties of Filaments and Dense Cores in L1478

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Formation of filaments and subsequent dense cores in ISM is one of the essential questions to address in star formation. To investigate this scenario in detail, we recently started a molecular line survey namely 'Filaments, the Universal Nursery of Stars (FUNS)' toward nearby filamentary clouds in Gould Belt using TRAO 14m single dish telescope equipped with a 16 multi-beam array. In the present work, we report the first look results of kinematics of a low mass star forming region L1478 of California molecular cloud. This region is found to be consisting of long filaments with a hub-filament structure. We performed On-The-Fly mapping observations covering ~1.1 square degree area of this region using C18O(1-0) as a low density tracer and 0.13 square degree area using N2H+(1-0) as a high density tracer, respectively. CS (2-1) and SO (32-21) were also used simultaneously to map ~290 square arcminute area of this region. We identified 10 filaments applying Dendrogram technique to C18O data-cube and 13 dense cores using FellWalker and N2H+ data set. Basic physical properties of filaments such as mass, length, width, velocity field, and velocity dispersion are derived. It is found that filaments in L~1478 are velocity coherent and supercritical. Especially the filaments which are highly supercritical are found to have dense cores detected in N2H+. Non-thermal velocity dispersions derived from C18O and N2H+ suggest that most of the dense cores are subsonic or transonic while the surrounding filaments are transonic or supersonic. We concluded that filaments in L~1478 are gravitationally unstable which might collapse to form dense cores and stars. We also suggest that formation mechanism can be different in individual filament depending on its morphology and environment.

[구 IM-07] Chemical Differentiation of CS and N_2H^+ in Starless Dense Cores

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CS molecule is known to be adsorbed onto dust in cold dense cores, causing its significant depletion in the center region of cores. This study is aimed to investigate the depletion of CS molecule with optically thin $C^{34}S$ molecular line observations, including significance of its differentiation depending on the evolutionary status of the dense cores. We mapped five evolved starless cores, L1544, L1552, L1689B, L694-2 and L1197 using two molecular lines, $C^{34}S$ (J=2-1) and N_2H^+ (J=1-0) with NRO 45 m telescope. The H_2 column density and temperature structures of each targets were obtained by SED fitting for Herschel continuum images and the internal number density profiles by model fitting. All of the integrated intensity maps of $C^{34}S$ show depletion holes and ‘semi-ring-like’ distribution, indicating that the depletion of CS is clear and general. The radial profiles of CS abundance also show significant decrease towards the core center, while N_2H^+ abundance is almost constant or enhanced. We find that the more evolved cores with higher H_2 density tend to have a stronger depletion of CS. Our data strongly support claims that CS molecule generally depletes out in the central regions of starless dense cores and such chemical differentiation is closely related to their evolution.

[구 IM-08] The ice features of Very Low Luminosity Objects (VeLLOs): Unveiling their episodic accretion history through the spectroscopic observation of AKARI IRC

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Although mass accretion from the disk to the central protostar is a key process of low mass star formation, the accretion mechanism is still poorly understood. To investigate “episodic accretion”, which has been suggested as an accretion mechanism in low mass star formation, we have carried out near-infrared spectroscopic observations of three very low-luminosity objects (VeLLOs) and one background source, using InfraRed Camera onboard the AKARI space telescope. The ice absorption features of H_2O, CO_2, and CO were detected around the wavelengths of 3.0, 4.26, and 4.67 μm, respectively. In addition, we revealed the XCN ice feature, which is attributed to high energy UV photons produced by the episodic burst accretion. The comparisons of the ice abundances of our targets with those of other YSOs observed previously with AKARI IRC imply that the three VeLLOs had experienced burst accretions although they are now in a very quiescent phase.

[석 IM-09] New insights on the origin of multiple stellar populations in globular clusters

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In order to investigate the origin of multiple stellar populations in the halo and bulge of the Milky Way, we have constructed chemical evolution models for the low-mass proto-Galactic subsystems such as globular clusters. Unlike previous studies, we assume that supernova blast waves undergo blowout without expelling the pre-enriched gas, while relatively slow winds of massive stars, together with the winds and ejecta from low and intermediate mass asymptotic-giant-branch stars, are all locally retained in these less massive systems. We find that the observed Na-O anti-correlations in metal-poor GCs can be reproduced when multiple episodes of starbursts are allowed to continue in these subsystems. A specific form of star formation history with decreasing time intervals between the stellar generations, however, is required to obtain this result, which is in good agreement with the parameters obtained from our stellar evolution models for the horizontal-branch. The “mass budget problem" is also much alleviated by our models without ad-hoc assumptions on star formation efficiency and initial mass function. We also applied these models to investigate the origin of super helium-rich red clump stars in the metal-rich bulge as recently suggested by Lee et al. (2015). We find that chemical enrichments by the winds of massive stars can naturally reproduce the required helium enhancement (dY/dZ = 6) for the second-generation stars. Disruption of proto-globular clusters in a hierarchical merging paradigm would have provided helium enhanced stars to the bulge field.

[구 IM-10] Radial distribution of blue straggler stars in Magellanic Cloud clusters

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Using the high-resolution observational data obtained by the Hubble Space Telescope, we found that there is the diversity of the radial trends of blue straggler stars (BSSs) in young massive clusters (YMCs) in the Large Magellanic Cloud unlike BSSs in old globular clusters usually showing the segregated radial distributions. To understand the dynamical processes that lead to the none-segregated or even inversely-segregated radial distribution of BSSs, we performed direct N-body simulations for YMCs. Our numerical simulations show that the presence of black hole subsystems inside the cluster centre can significantly affect the dynamical evolution of BSSs and eventually lead to none- or inversely-segregated radial distribution of BSSs.

[구 IM-11] An exosolar planetary system *N*-body simulator II

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We present a general N-body exasolar system simulator in anticipation of upcoming searches for exoplanets and even exomoons by next generation telescopes such as James Webb Space Telescope. For habitable zones, traditionally defined by temperature, we here address the essential problem of dynamical stability of planetary orbits. Illustrative examples are presented on P-type orbits in stellar binary systems, that should be fairly common as in Kepler 16b. Specific attention is paid to reduced orbital lifetimes of exoplanets in the habitable zone by the stellar binary, that is propoesed by Maurice van Putten (2017). Especially, we focused on a classic work of complex three-body problem that is well known by Dvorak(1986). We charge his elliptic restricted three-body problem to extend unrestricted three-body problem to look into dynamical motions