creates a central cavity and a compressed shell at the ionized boundary. We analytically solve for the temporal evolution of a thin shell, finding a good agreement with the numerical experiments. We estimate the minimum star formation efficiency required for a cloud of given mass and size to be destroyed by an HII region expansion. We find that typical giant molecular clouds in the Milky Way can be destroyed by the gas-pressure driven expansion of an H II region, requiring an efficiency of less than a few percent. On the other hand, more dense cluster-forming clouds in starburst environments can be destroyed by the radiation pressure driven expansion, with an efficiency of more than ~30 percent that increases with the mean surface density, independent of the total (gas+stars) mass. The time scale of the expansion is always smaller than the dynamical time scale of the cloud, suggesting that H II regions are likely to be a dominant feedback process in protoclusters before supernova explosions occurs.

[구 IM-03] Efficient simulation method for a gas inflow to the central molecular zone

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We present hydrodynamic simulations of gas clouds that inflowing from the disk to a few hundred parsec region of the Milky Way. Realistic Galactic structures are included in our simulations by thousands of multipole expansions that describe 6.4 million stellar particles of a self-consistent Galaxy simulation (Baba, Saitoh & Wada, in prep.). We find that a hybrid multipole expansion model with two different basis sets and a thick disk correction well reproduces the overall structures of the Milky Way. We find that the nuclear ring evolves into 240 pc at T~1500 Myr, regardless of the initial size. For most of simulation runs, gas inflow rate to the nuclear region is equilibrated as ~0.02 Msun/yr, and thus accumulated gas mass and star formation activity is stabilized as 6 x10^7Msun and ~0.02M/yr, respectively. These stabilized values are in a good agreement with estimations for the CMZ. The nuclear ring is off-centered to the Galactic center by the lopsided central mass distribution of the Galaxy model, and thus an asymmetric mass distribution is arose accordingly. The lopsidedness also leads the nuclear ring to be tilted to the Galactic plane and to precess along the Galaxy rotation. In early evolutionary stage when gas clouds start to inflow and form the nuclear ring, the z-directional oscillations of the gas clouds results in the twisted, infinity-shaped nuclear ring. Since the infinity-shaped feature is transient only for first 100 Myr, the current infinity-shape observed in the CMZ may indicate that the CMZ forms quite recently.

[구 IM-04] Simultaneous observations of the H2O and SiO masers toward the late-type stars using KVN

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We present the results of simultaneous observations of the H2O and SiO masers emitted from the circumstellar envelopes of the late-type stars. These observations have been carried out at the K and Q bands using KVN since 2014 August and were scheduled to test the feasibility of multi-frequency phase referencing analysis on the maser lines. In order to increase the accuracy of group delay solution in the fringe search on the continuum source, the IF channels were randomly distributed within the available bandwidth of 500 MHz in each band. The positions of all maser spots are relatively described with respect to the position of the reference continuum source through the source frequency phase referencing technique, and this provides the astrometric position accuracy. Therefore, the relative locations of the H2O maser spots with respect to the SiO maser spots are determined from our observations, and the capability of the simultaneous multi-band observation of KVN is proved to be powerful to study the maser pumping mechanism around the late-type stars.

[구 IM-05] Clustering properties and halo occupation of Lyman-break galaxies at z ~ 4

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We investigate the clustering properties of Lyman-break galaxies (LBGs) at z ~ 4. Using the hierarchical galaxy formation model GALFORM, we predict the angular correlation function (ACF) of LBGs and compare this with the measured ACF from combined survey fields consisting of the Hubble eXtreme Deep Field (XDF) and CANDELS. We find that the predicted ACF is in a good agreement with the measured ACFs. However, when we divide the model LBGs into bright and faint subset, the predicted ACFs are less consistent with observations. We quantify the dependence of clustering on luminosity and show that the fraction of satellite LBGs is important for determining the amplitude of ACF at small scales. We find that central LBGs predominantly reside in $\sim 10^{11} h^{-1} M_{solar}$ haloes and satellites reside in haloes of mass $\sim 10^{12} - 10^{13} h^{-1} M_{solar}$. The model predicts fewer bright satellite LBGs than is inferred from the observation. LBGs in the tails of the redshift distribution contribute significant additional clustering signal, especially on small scales. This spurious clustering may affect the interpretation of the halo occupation distribution, including the minimum halo mass and abundance of satellite LBGs.

[구 IM-06] OH Emission toward Embedded YSOs

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High energy photons and mechanical energy produced by the process of star formation result in copious FIR molecular and atomic lines, which are important coolants of the system. Photons thermally or mechanically induced could dissociate water in the dense envelope to change relative abundances among the species of O, OH, and H2O. Here we analyze OH emission lines toward embedded young stellar objects (YSOs) observed as part of the Herschel open time key program, 'Dust, Ice, and Gas In Time (DIGIT)' in order to study the physical conditions of associated gas and the energy budget loaded on the OH line emission. According to our analysis of the Herschel/PACS spectra, OH emission peaks at the central spaxel in most of sources, but several sources show spatially extended emission structures. In the extended emission sources, the distribution of OH emission is correlated with that of [OI] emission and extended along the outflow directions. Considering the diversity of source properties, ratios between detected OH lines are relatively constant among sources. In addition, each OH line has strong correlation with bolometric luminosity. In order to determine the physical conditions of YSOs, we adopt several methods for the analysis of the OH lines: rotational diagram, non-LTE LVG analysis, and a 2-D PDR code. From the simple LVG analysis, we find that the thermal solution with the dense ($> 10^7 cm^{-3}$) and warm (~ 100 K) OH gas reproduces the ratios of detected OH lines. However, our self-consistent PDR 2-D model, which can deal with the IR-pumping effect from the central protostar as well as the warm dust in situ, cannot fit the observational results, suggesting that an irradiated shock model is necessary for a better interpretation.

태 양 계

[구 SS-01] The 10-μm Noth-Polar Bightening of Juptier: A Dynamical Phenomenon?

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Since its detection in 1980, the 8-μm north-polar brightening of CH_4 on Juptier has not moved from 180° (SysIII) longitude. The 8-μm CH_4 brightening is mostly thermal and very similar to that of 13-μm C_2H_2 emissions, but the morphology of these hydrocarbon north-polar brightenings are very different from that of the 3-μm H_3^+ auroral oval suggesting a significantly different excitation process yet unknown heating mechanism. Recently, Kim et al. (submitted to Icarus, 2015) found that that the center of the 3-μm CH_4 northern bright spot is located at ~200° (SysIII) longitude, which is ~20° west from the center of the 8-μm north-polar bright spot, and it does not coincide with the 3-μm H_3^+ bright spot. They found significantly high temperatures (500 ~ 850K) from CH_4 rotational lines on the 3-μm bright spot above the 1-μbar pressure level, while we find cooler temperatures (<350K) over the the 8-μm spot. They also found that the upper states of the 3-μm CH_4 bands are mostly populated by non-thermal excitations, such as