Full Synthesis CO Imaging of YSOs
The Organic-Rich IRS 46 and the Bipolar-Outflow IRAS 05327+3404

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Some Class 0 young stellar objects (YSOs) have been found rich in organic molecules. Since most of the interstellar material accreted to the central protostar during the Class 0 phase is consumed by the forming protostar, a meaningful comparison between interstellar, solar nebular and cometary materials can only be made by studying the physical conditions and chemical compositions of the circumstellar envelopes and protoplanetary disks of Class I YSOs. Observations looking for organics in YSOs at stages later than Class 0 are thus essential for us to have a better insight into the evolution leading to the origin of life in protoplanetary disks. We thus observed the solar-type Class I source IRS 46 with the Submillimeter Array (SMA), and detected important organic molecules H_2CO and CH_3OH in the circumstellar disk which clearly indicates an organic-rich environment. Follow-up observations of SMA also detected CO 2-1 emission from IRS 46.

IRAS 05327+3404, also an young stellar object close to the Class I/Class II boundary and similar to the FU Orionis system L1551 IRS 5, exhibits a nebulous tail-like structure and a high-velocity outflow and was discovered in the field of a Galactic open cluster. The spectral type of the IRAS 05327+3404 central star was determined to be K2, and the spectral energy distribution shows the presence of significant circumstellar material. Near-IR and optical observations also suggest the existence of circumstellar material with the material arranged in a disk. Hence it is extremely important to study the circumstellar environment of IRAS 05327+3404 for a better understanding of the early stage of star formation. We therefore observed IRAS 05327+3404 with high angular-resolution millimeter-wave interferometer and a highly collimated gas outflow was uncovered.

To investigate the physical conditions of global environments of these two disk-forming YSOs in detail, we then used single-dish telescopes SMT (Submillimeter Telescope, @^{12}CO 2-1 emission) and KP12M (Kitt Peak 12m, @^{12}CO 1-0) to map the distribution of molecular hydrogen toward the IRS 46 and IRAS 05327+3404 surroundings, respectively. In addition, by combining interferometer and single-dish data, we may recover the missing flux of CO emission likely resulted from a uniformly distributed CO gas being totally resolved-out by the interferometer. The ultimate goal of our proposed study is thus to study the kinematics, physical condition, and actual spatial distribution of molecular hydrogen gas in these two low-mass star-forming regions.

We thus invite dedicated and self-motivated capable students to work on this exciting project on full-synthesis imaging of CO emission. Our project will not only provide excellent hand-on experiences in combining interferometric and single-dish millimeter-wave data, but also prepare young students for future astronomy study in radio!