The Physical Environment of the Organic-Rich Solar-Type Class I Young Stellar Objects IRS 44 and IRS 46

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A number of solar-type Class 0 young stellar objects (YSOs) have been found to be rich in organic molecules, which are present in hot corinos similar to hot molecular cores in massive star forming regions. Since most of the material accreted during the Class 0 phase is consumed by the forming protostar, a meaningful comparison between interstellar, solar nebular and cometary chemistries can only be made by studying the chemical composition of the circumstellar envelopes and disks of Class I sources. Observations looking for organics in YSOs at later stages other than Class 0 are therefore essential for us to have a better insight into the chemical evolution leading to the origin of life in protoplanetary disks. High angular resolution SMA (Submillimeter Array) observations of the Class I source IRS 46 detected H_2CO and CH_3OH in the disk which clearly indicate recent icy mantle evaporation hence the presence of an organically rich, hot-corino environment.

Follow-up observations of SMA also detected CO 2-1 emission from IRS 46 and its neighboring source IRS 44. The CO emission is mainly concentrated toward the Class I source IRS 44 and exhibits an unusual *gorge*-shape line profile with its line intensity dropping sharply to zero at the line center and a *gorge*-width of ~5 km s^{-1}. The *cliff*-like drop of intensity at the CO line center suggests that it is less likely due to an optical depth effect solely, but rather, a result of complete CO depletion in the disk or a probable uniform distribution of CO emission which can be easily filtered out by an interferometer array. Hence, to investigate the physical mechanisms which may be responsible for the "*missing*" CO emission, we thus used the single-element SMT (Submillimeter Telescope) to map the ^{12}CO and ^{13}CO 2-1 emission in the region to recover the missing flux of CO emission and to determine the true cause(s) making the *gorge*-like CO line profile, i.e., whether it is due to a uniformly distributed CO been totally resolved-out by the interferometer, or a complete self-absorption of CO molecular emission. The ultimate goal of our proposed study is thus to study the kinematics, the physical condition, and the actual spatial distribution of molecular gas in this important organic-rich, low-mass star-forming region.

In this summer student program, we thus invite self-motivated, capable and devoted students to work on this exciting full-synthesis imaging project, which will not only provide excellent hand-on experiences in combining interferometric and single-dish millimeter radio data, but also prepare dedicated young students for future astronomy study in radio!

(Please note, chemistry background is NOT essential and also NOT required.)