Anatomy of the Class I protostar L1489 IRS with NOEMA at 3mm

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Over the past few years, chemical studies have revealed multiple structures in the vicinity of young stellar objects (YSOs). It has become evident that specific physical conditions are associated with the emission of particular molecular lines, allowing us to use molecular probes of the YSO physics. Consequently, chemical surveys are now necessary to fully constrain the origin of the observed structures. Several surveys have been conducted to explore the chemistry of YSOs, focusing on Class 0 and Class II objects. However, our knowledge of intermediate objects, i.e. Class I objects, remains limited.

To bridge the gap and establish the relationship between observed structures and molecular line emission at the Class I evolutionary stage, we investigated the spatial distribution of key molecular gas species in the low-mass Class I protostar L1489 IRS (IRAS 04016+2610), a source part of the ChemYSO survey.

In this talk, I will present the identified structures using the brightest lines of our 3mm survey conducted with NOEMA and IRAM-30m, at high spatial and high spectral resolution. We identified a new ~3000 AU long streamer in HC3N, C2H and c-C3H2 emission, likely associated with more localized accretion shocks probed in SO. It may originate from the nearby prestellar core L1489 and is likely responsible for the formation of an external warped disk in this system. In addition, two ~10000 AU bubbles are seen with the dense molecular tracers HCO+, CS and HCN around the YSO, which may result from the magnetic pressure as observed in numerical simulations. We also retrieve previously identified structures, like an outflow in HCO+ and another streamer in C2H. Additionally, potential indicators of a second outflow appear in CS and HCN emission, but its nature remains to be confirmed. This could be the direct evidence of a binary system.

Reference:
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