Are jets ubiquitous in young forming stars ? CALYPSO IRAM-PdBI survey of jets in Class 0/I protostars

L. Podio[1], B. Tabone[2], C. Codella[1], F. Gueth[3], and the CALYPSO team

[1] INAF-Osservatorio Astrofisico di Arcetri, Largo E. Fermi 5, 50125 Firenze, Italy

[2]Leiden Observatory, Leiden University, P.O. Box 9513, NL-2300 RA Leiden, NL

[3]IRAM, 300 rue de la Piscine, 38406 Saint-Martin-d'Hères, France

While jets have been extensively studied from millimetre to optical wavelengths, there is the need of a statistical study to assess their importance in the star formation process.

As part of the CALYPSO large programme (e.g., Maury et al. 2019) we analysed IRAM-PdBI high angular resolution observations of a sample of Class 0 and Class I protostars in the CO 2-1, SiO SiO 5-4, and SO 6_5-5_4 lines. The goal is to assess the presence of jets and to constrain their properties (position angle, velocity, width, mass loss rate, and molecular abundances) (see, e.g., Codella et al. 2014, Santangelo et al. 2015, Podio et al. 2016, Lefèvre et al. 2017).

Extended blue- and red-shifted emission in the CO 2-1 line, which probes outflowing material, is detected in all sources in the sample, i.e. 21 out of 21 Class 0 and 3 out of 3 Class I protostars. Interestingly, the stronger accreting sources, i.e. those with internal luminosities > 1 $L_\odot$ (accounting for 60% of the sample), also show collimated high-velocity jets detected in the SiO 5-4 and SO 6_5-5_4 lines.

While the CO emission is wide, SiO is very collimated out to 2000 au distance from source (~3º-12º), while SO shows intermediate collimation (~8º-45º). Radial velocities up to ~20-80 km/s are detected, which translates in deprojected jet velocities of 100-200 km/s, while typical mass loss rates are of 10^{-6} $M_\odot$/yr.

The survey shows that ejection phenomena are ubiquitous at the protostellar stage but only strongly accreting sources (L_{int} > 1 $L_\odot$) drive collimated jets which are detected in the SiO and SO lines. The origin of this chemical selectivity will be discussed in the context of dusty and dust-free jets.

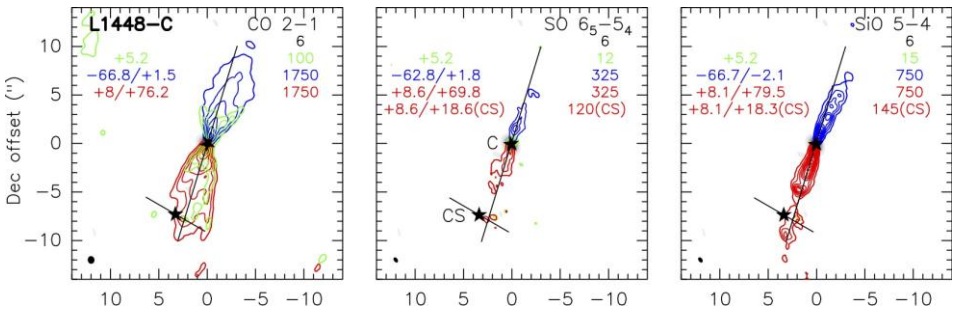

Figure 1. Observations of the Class 0 protostar L1448-C in CO 2-1 (*left*), SO 6_5-5_4 (*center*), and SiO 5-4 (*right*). The systemic, blue-, and red-shifted velocity intervals (in km/s) and the 5σ intensity (in mJy*km/s/beam) are labeled in green, blue, and red respectively. The continuum (in mJy/beam) is in black. The stars indicate the protostars (Maury et al. 2019), the black solid line the jets PA, the ellipse the beam size.

References

[1] Codella, C., Maury, A. J., Gueth, F., et al. 2014, A&A, 563, L3

[2] Lefèvre, C., Cabrit, S., Maury, A. J., et al. 2017, A&A, 604, L1
[3] Maury, A. J., Andrè, P., Testi, L., et al. 2019, A&A, 621, A76
[4] Podio, L., Codella, C., Gueth, F., et al. 2016, A&A, 593, L4
[5] Santangelo, G., Codella, C., Cabrit, S., et al. 2015, A&A, 584, A126