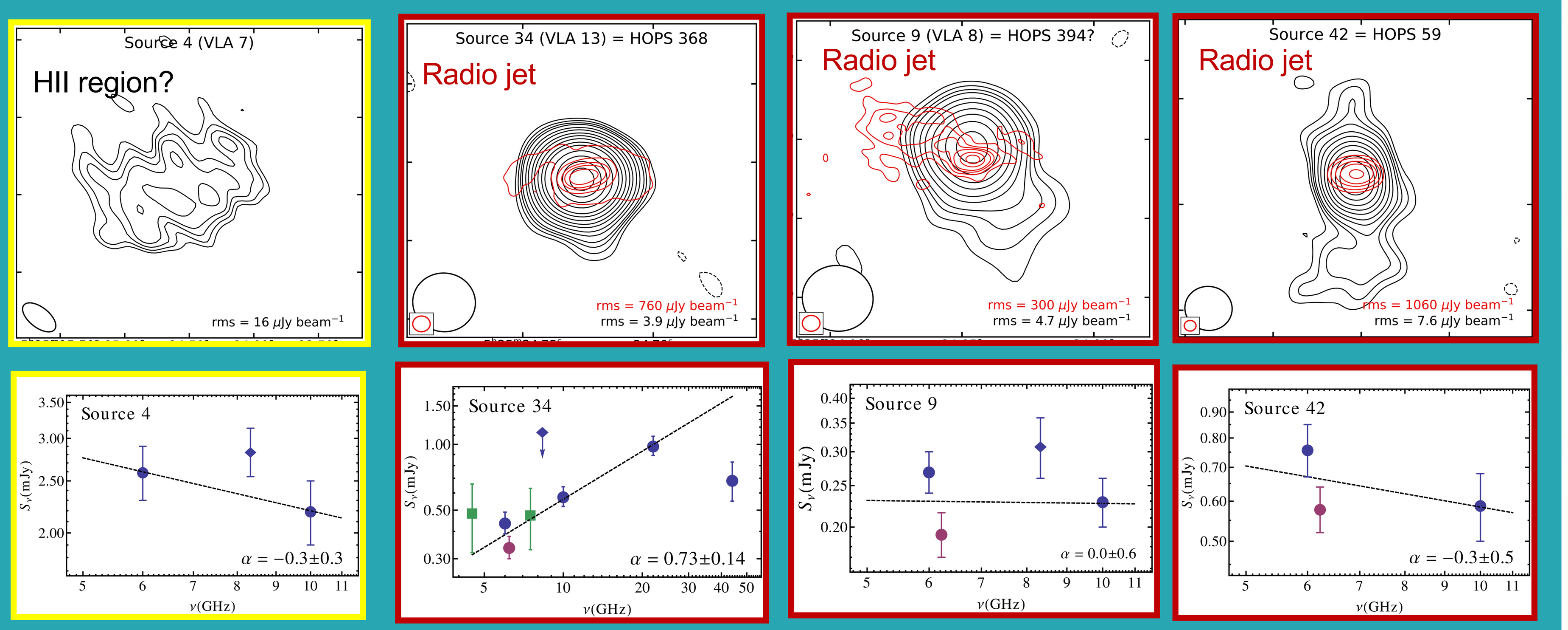
Deep VLA observations toward the OMC 2 region in Orion

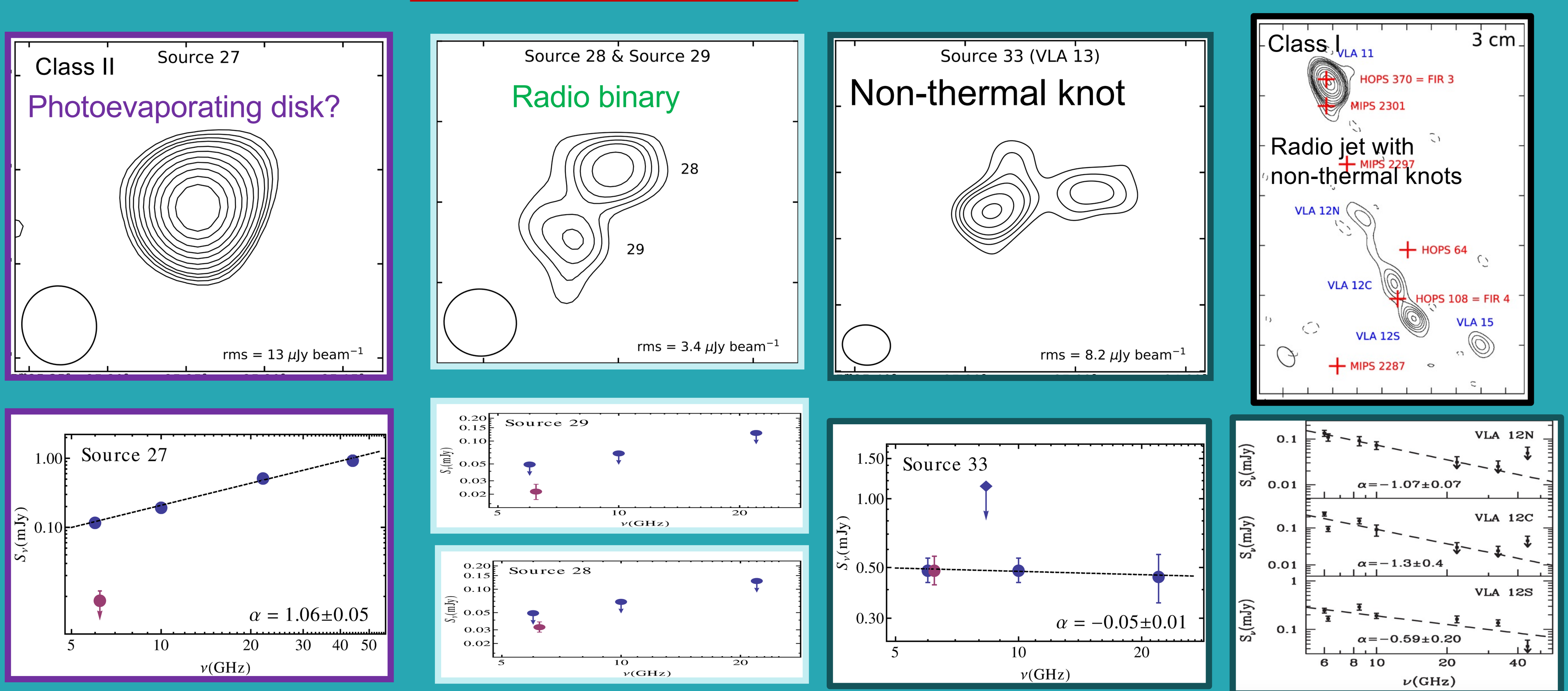
M. Osorio[1], A. K. Diaz-Rodriguez[2], G. Anglada[1], T. Megeath[3], J.J. Tobin[4], E. Furlan[5], J. F. Gómez[1], G., Blázquez-Calero[1], W. Fischer[6], A. Stutz[7], L.F. Rodríguez[8]

1. IAA-CSIC, Spain; 2. UK ARC, UM; 3. Toledo. U., USA; 4. NRAO, USA; 5. Caltech/IPAC, USA; 6. STSI, USA; 7. Concepcion U., Chile; 8. IRyA-UNAM; Mexico.

We present deep (3 μJy beam^{-1}) VLA continuum observations at 0.7, 1.3, 3, and 5 cm, reaching an angular resolution of ~0.4" (~150 au). The observations were centered on FIR4/HOPS108, in the Orion Integral Shaped Filament (ISF), covering the OMC 2 region and part of OMC 3. We report the detection of 57 radio sources in the FOV and hints of variability in a dozen of them. From the detected sources, 36 are likely young stellar objects (YSOs), 4 are tracing jet knots, and 6 may be tracing extragalactic sources. We identify the driving source of 9 molecular outflows. We also detect free-free emission that may be tracing photoevaporating disks. We found possible binaries, with separations ranging from 150 to 3000 au. These observations can be considered a pilot project that shows the potential of deep observations to be carried out with the new generation of radio interferometers such as the ngVLA and the SKA.

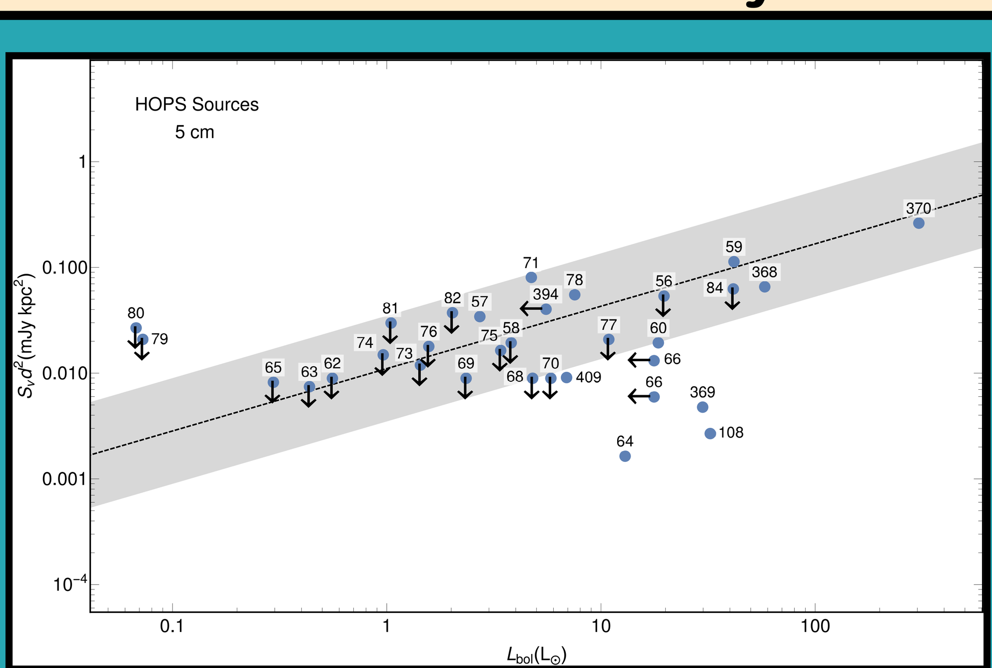
VLA maps at 5 cm and spectra of selected radio sources



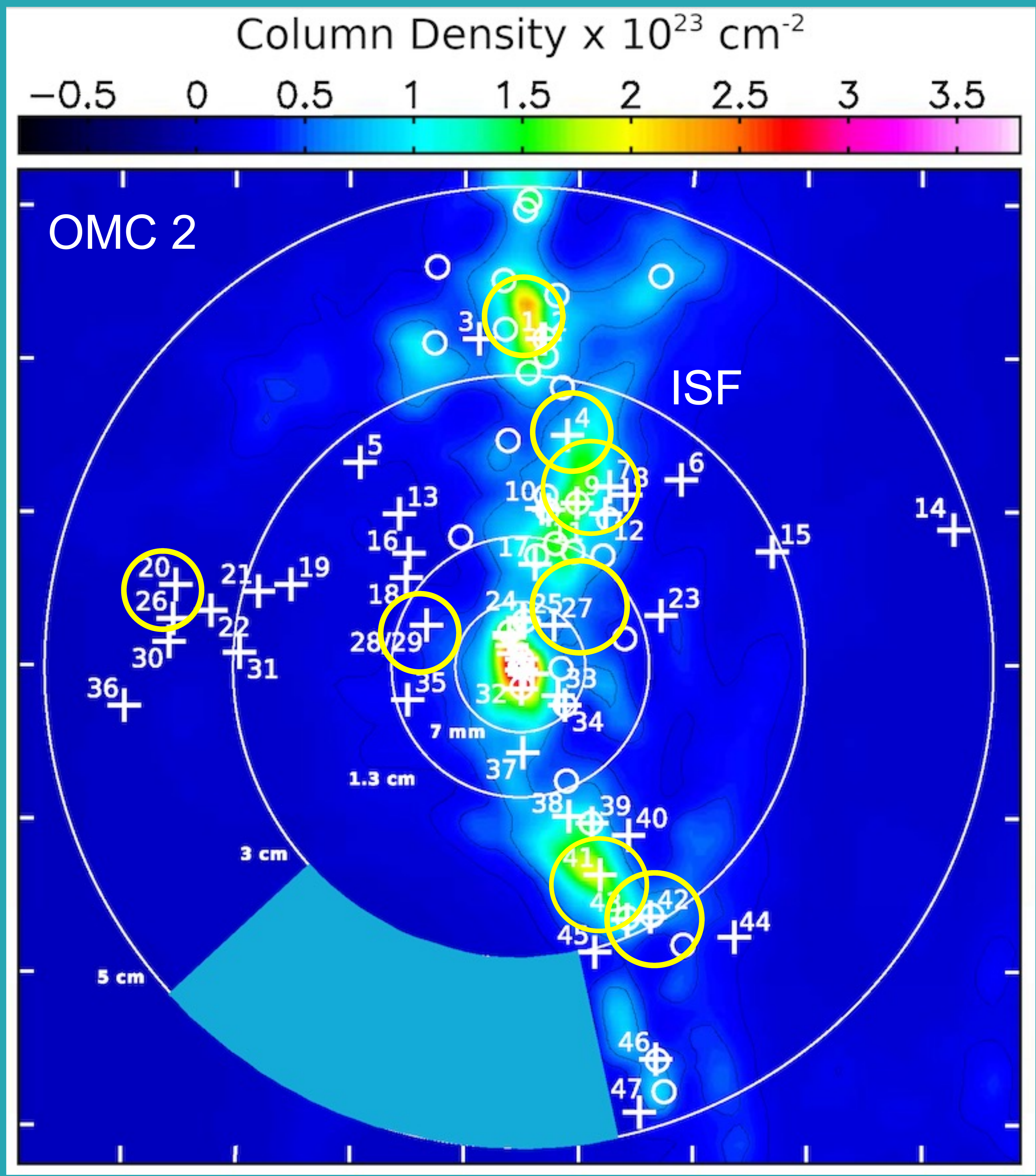


In general, the VLA 5 cm emission (black contours; this work and Osorio+2017) traces ionized gas, while the ALMA emission at 870 um (red contours; Tobin+2020) traces dust emission from possible disks (see https://planetstarformation.iaa.es).

Radio vs bolometric luminosity correlation

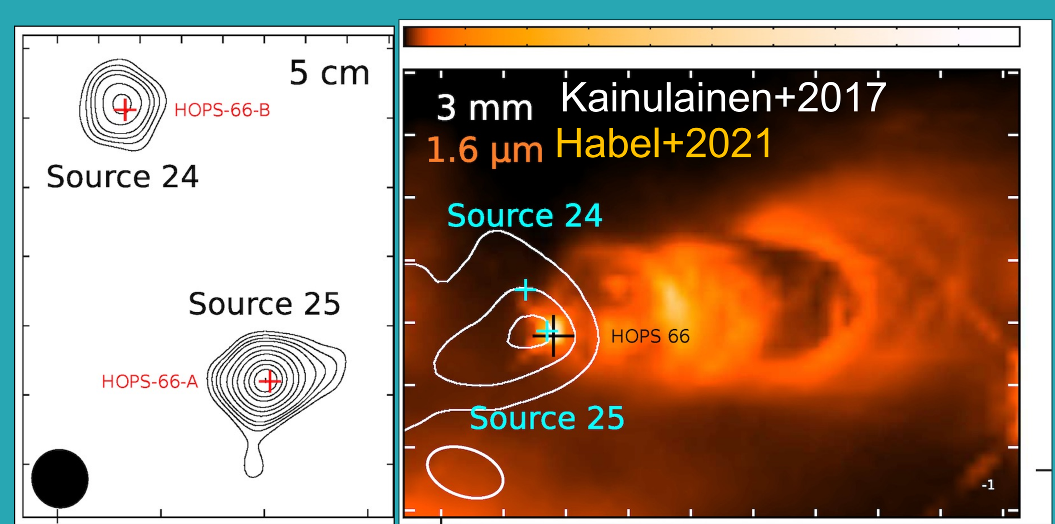


Plot of the radio luminosity (distance-corrected flux density at 5cm) for HOPS far-IR sources in the observed field with an accurate estimation of the bolometric luminosity (Furlan+2016). The sources follow the empirical correlation proposed by Anglada (dashed line; e.g., Anglada+2018) which is interpreted as a consequence of the connection between accretion (traced by the bolometric luminosity) and outflow (traced by the radio continuum). Labels in the plot correspond to the HOPS ID number. (HOPS = Herschel Orion Protostar Survey)

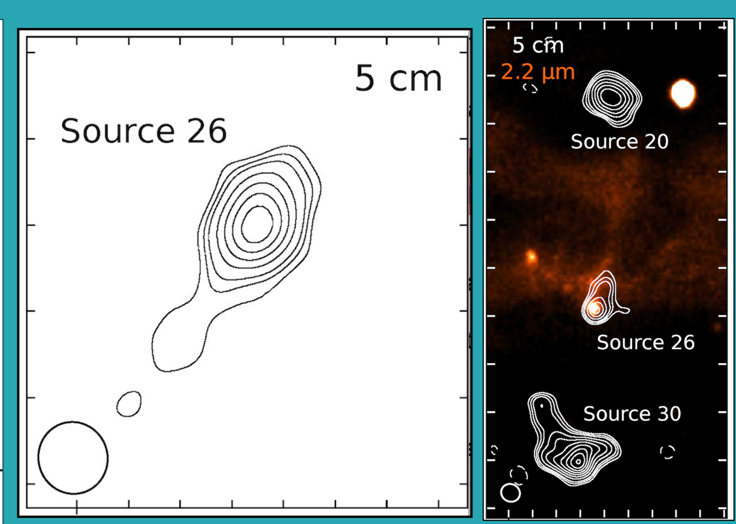


Positions of the detected radio sources (marked by +) overlaid on the column density map obtained by Stutz+(2018). Most of the detected radio sources fall on the ISF. Note, however, that a number of sources appear clustered along an east-west stripe perpendicular to the ISF. These sources may be older that those of the ISF. Small white circles mark the HOPS[1] sources. Yellow circles indicate the sources whose maps and spectra are shown on the left panels. Large concentric circles mark the region where the primary beam response is > 10% of that at the field center for each observed wavelength.

Comparison of the radio maps with observations at other wavelengths for Sources 24, 25, and 26



Radio map of the binary system composed by Sources 24 and 25 (Left). The E-W elongation of Source 25 is consistent with the direction of the monopolar cavity imaged by the HST (Right). Also, a CO outflow centered on Source 25 has been imaged (Sato+2023). This supports Source 25 as a radio jet driving the large scale outflow.



High-angular resolution radio map of Source 26 (Left). Comparison with a near-IR image and a lower resolution radio map of a larger field (Right) suggests that it could be an extragalactic jet with two extended lobes (Sources 20 and 30) with bow-shock morphology.

This survey shows the potential of deep VLA observations to reveal a large number of radio sources and their diversity, and serves as a pathfinder for upcoming ngVLA and SKA surveys.

REFERENCES:
Anglada+2018, A&A Rv 26, 3
Furlan+2016, ApJS 224, 5
Kainulainen+2017, A&A 600 A141
Habel+ 2021,ApJ 911, 153
Osorio+2017, ApJ 840,36
Tobin+2020, ApJ 890, 130
Sato+2023, ApJ 944, 92
Stuz+2018, MNRAS 473, 4890

Contact information:
Email: osorio@iaa.es
https://spfe.es/en/

Grant P20-00880, funded by: Grants PID2020-114461GB-100, CEX2021-001131-S, and PRE2018-086111 funded by: