Chemical impact of envelope accretion onto the nascent disk in L1527

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Class 0 and I sources are young protostars still embedded in their natal environment. In recent years, protostellar disks have been detected around Class 0/I protostars. Unlike protoplanetary disks, these young disks are still accreting material from a surrounding envelope. While several surveys have studied the protoplanetary disks around Class II pre-main sequence stars, only few studies have been conducted for Class 0 and I disks. The same can be said for studies focused on the chemical composition of the natal environment of Class 0 and I protostars. Its impact on the composition of protostellar and protoplanetary disks thus remains unclear. Spectral surveys at large scales targeting the envelope around young stellar objects are now necessary to link the small scales surveys to the natal environment of stars.

To start answering this question, we investigate the abundances of several molecular species in the large-scale envelope and the cavities of the borderline Class 0/I protostar IRAS 04368+2555 (L1527). The goal is to characterize the chemical composition of the natal environment of L1527, to see if there are changes when getting closer to the inner envelope, and compare the abundances with the ones at disk scales found in other studies.

In this talk, I will present the unbiased spectral survey we conducted using the NOEMA radio-interferometer and the IRAM 30m telescope. We covered almost the whole 3 mm band (from 72 GHz to 110 GHz) and observed a region of several thousand of astronomical units around the central protostar with a spatial resolution of ∼4". We calculated the abundances of more than 30 molecular species at different positions in the envelope and the cavities around L1527 using a local thermodynamical equilibrium model coupled with a Markov chain Monte Carlo algorithm. We found that the chemical composition of the envelope at 3000 au does not vary much from the one in the cavities or near the inner envelope. We compared our results with the chemical composition of protoplanetary disks and found similar abundances for the common species, which is consistent with chemical inheritance from the natal environment onto Class II disks. We also compared our results with a hot corino source, and found differences in chemical composition.