Modelling the dust emission from low-mass prestellar cores

Undergraduate internship at IPAG
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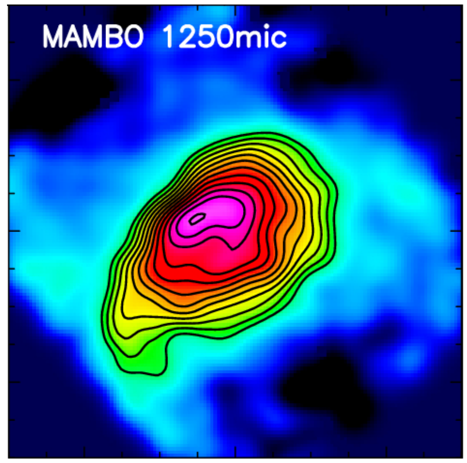

Prestellar cores are the first building blocks in the process of star formation. They are also the chemical factory during which the molecular inventory is considerably enriched. Whether — and to which extent — this molecular content is preserved in the planetary system(s) that will eventually form within a prestellar core remains an open, and fundamental, question. Understanding the physical and chemical properties of prestellar cores is therefore of paramount importance.

Prestellar cores form within large molecular clouds over typically one million year, during which the density increases steadily. A conspicuous feature of the radial profile of the density is an inner plateau with nearly constant density, of the order of a few 1e4 cm-3, surrounded by an envelope with a radially decreasing density. The density profile in the envelope is usually $n(r) \sim r^{-2}$. However, the central density, the radial extent of the inner plateau, and the extent and radial profile in the envelope are not universal quantities and depend on each core.

We are currently observing the L1498 prestellar core with the new NIKA2 camera installed at the IRAM-30m telescope, operating simultaneously at 2mm and 1.3mm. Previous map of the L1498 core were obtained more than 15 years ago at 1.3mm (right panel in the above Figure). which lead to a density profile which is not consistent with maps obtained at shorter wavelengths with the *Herschel* satellite (see Magalhaes et al 2018). With the two new maps at 2mm and 1.3mm, we expect significant improvement over the previous density profile.

We propose an internship, at the undergraduate level, to derive the density profile and the dust properties in the L1498 prestellar core, through analytical modeling and MCMC minimization. The intern is expected to develop a new routine based on existing (or publicly available) modules. The intern will work at IPAG, a leading institute in star and planet formation studies, in an international environment, with many graduate and PhD students and post-docs. The intern will be a member of the team SPECTRE.

The proposed work will consist in:

- analyze the dust emission maps from the L1498 core to derive the density profile;
- derive dust properties (emissivity, spectral index)
- depending on the intern skills: understand and, potentially, develop new data processing methods, in order to ensure that the peak flux is properly measured.

Methods:

- analytical: matter radiation interaction; modified black-body emission
- numerical: MCMC minimization; scientific programming language: fortran, C, python, depending on the intern skills

Duration:

- up to 4 months