The Anatomy of a Giant Molecular Cloud

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The advent of wideband, high spectral resolution receivers turns almost any pointed observation into an unbiased spectral survey. The challenge is to use these new possibilities to classify the different kinds of environments (shocks, photo-dissociation regions, dense cores, diffuse gas, etc...) of the interstellar medium according to the molecules they contain. We aim at using signal separation techniques like those used to distinguish different kinds of geological formations from Earth satellite images.

As a test bed, we used the IRAM-30m/EMIR 3mm receiver to image 0.5 square degrees of the south-western edge of the Orion B molecular cloud around the Horsehead nebula, NGC 2023, and NGC 2024, with a spectral resolution of 195 kHz ($\sim 0.6\,\mathrm{km\,s^{-1}}$), a typical spatial resolution of 23" (*i.e.*, 50 mpc or 10^4 AU at a distance of 400 pc) and a typical sensitivity of 0.1 K. We succeeded to image the isotopologues of CO as well as HCO^+, HCN, HNC, CN, CCH, C_3H_2, CS, SO, N_2H^+, SiO, CH_3OH, etc.

In this talk, I will present the data and our first results. In particular, I will show how tracers of different optical depth like the CO isotopologues will allow us to study the diffuse envelope and the dense cores, while various chemical tracers will reveal different environments (cold core, photo-dissociation regions, shocks in potential outflows, etc).

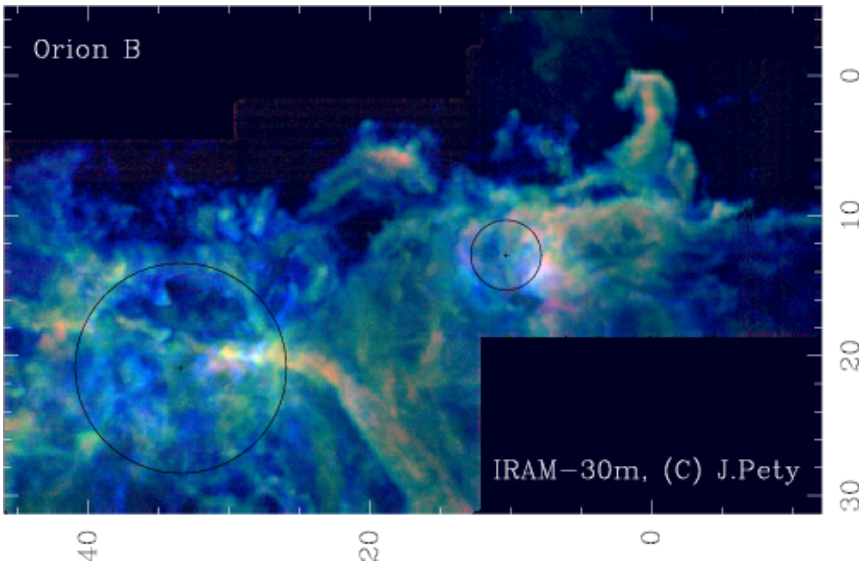

Figure 1: Composite image of the ^{12}CO (blue), ^{13}CO (green), C^{18}O (red) (J$= 1-0$) integrated line profile emission from the already mapped field of view. NGC 2023 and NGC 2024 are marked as the small and large circle, respectively. This illustrates that the detailed comparison of the different CO isotopologues will allow us to separate diffuse and dense gas.