Title: Chemical constraints on the dynamical evolution of the cold cores L694 and L429-C

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Abstract:

The trend of the chemical composition through the entire star formation is already set by the very early phases. The cold cores, characterised by low temperature (T<15 K), moderate densities (ranging from 10^3 to 10^6 cm−3) and high visual extinction (Av > 3 mag) allow the formation of thick ices at the surface of the grains. The species in the solid-phase will enrich the gas-phase through non-thermal desorption mechanisms or remain in the mantle to form complex organic molecules. The kind of species present in the ices, and subsequently in the gas-phase, is partly set by the physical history of the grains and initial abundances. To understand how the early phases will impact the later stellar formation, it is important to trace both phases and their physical environment to add constraints on the chemistry at play in these extreme environments.

In this study, we focus on the cold cores L694 and L429-C, both observed with infrared telescopes (both with IRTF, and Spitzer for L429-C) and with the IRAM 30m radiotelescope to map (300 x 300") the gas-phase abundances of a sample of molecules, focusing on CO, its isotopologues and methanol. Both cores have close physical parameters yet behave very differently in their abundances, as L694 is already infalling and L429-C on the verge of it. We present the difference in the observed abundances between the two cores, link it to the physical parameters derived in both sources and finally, focus on reproducing the observations with two sorts of model (static and dynamics) to understand what are the main constraints on the chemistry. We show that the static models need far more evolutionary time to reproduce the observations within a factor 10, whereas the dynamical models' evolutionary time is faster but fails to reproduce the lower density. A larger sample of cores, with a systematic method to derive the abundance, is needed to fully paint the picture of the chemical trend that can be found in these early environments.