



# The CHESS Key Programme : Spectral survey of pre-stellar cores

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The CHESS (Chemical HERschel Survey of Star forming regions) is a GT KP which aim is to carry out unbiased spectral surveys of star forming regions representing various evolution stages and mass ranges: pre-stellar cores, solar mass protostar, intermediate mass protostar, outflow shock, hot cores.

Pre-stellar cores represent the stage immediately before the formation of the protostar. They are dense and have low central temperatures. These physical conditions strongly influence pre-stellar core chemistry: they are characterised by the freeze-out of many chemical species. The freeze-out of abundant molecular species like CO is in turn responsible for high abundances of the ions  $H_2D^+$  and  $D_2H^+$ , which play a key role in the deuteration of molecular species. The CHESS spectral survey in pre-stellar cores will address these 2 important questions.

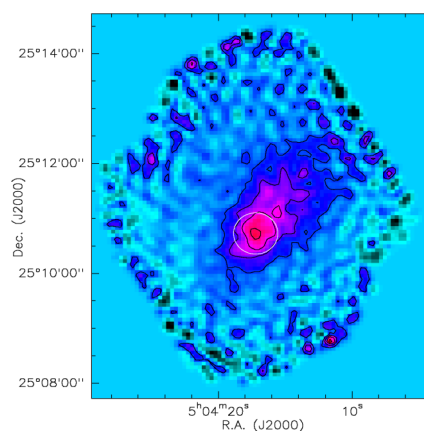


Figure 1: Dust continuum emission of L1544 at 1.3 mm (map from Ward-Thompson et al. 1999). The survey is carried out at the dust peak. The circle represents the Herschel beam in band 1

Two sources are targeted in this survey: L1544, a prototypical pre-stellar core in Taurus (Figure 1), which shows high degrees of molecular depletion, and 16293E, a warmer pre-stellar core, where the para form of  $D_2H^+$  at 692 GHz was detected (Vastel et al. 2004)

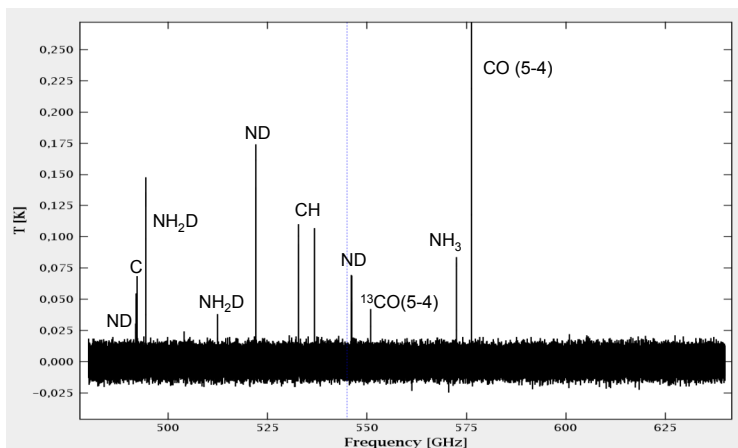


Figure 2: Synthetic spectrum calculated by the CASSIS software, assuming for all lines  $T_{ex} = 5$  K, with an rms of 5 mK

In L1544, the aim is to study the gradual freeze-out of molecular species on to the grain mantles: the C-bearing species are expected to be highly depleted, whereas N-bearing species should remain abundant in the gas phase. The spectral survey in band 1 will enable us to derive abundances of species like CH, ND, CO and  $NH_3$ . Figure 2 shows simulated spectra using the CASSIS software. The results will be confronted to those obtained towards the Class 0 protostar IRAS16293-2422, also observed in the course of the CHESS programme.

In 16293E, we will search for the ortho form of  $D_2H^+$  at 1.4 THz. Together with the previous ground observation of para  $D_2H^+$ , we can determine the total abundance of the species and study of the onset of molecular deuteration.

References:  
Vastel, C., Philipps, T.G., Yoshida, H. 2004, ApJ 606, L127  
Ward-Thompson, D., Motte, F., André, P. 1999, MNRAS 305, 143

Acknowledgements:  
Based on analysis carried out with the CASSIS software and CDMS spectroscopic databases and JPL molecular databases. CASSIS has been developed by CESR-UPS/CNRS (<http://cassis.cesr.fr>)