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Deuterated Molecules as Evolutionary Indicators of Class 0 Protostars

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H_2D^+ and higher deuterated isotopes, which are the key molecules for deuterium chemistry, exist primarily in cold (< 20 K) and CO depleted environments. Because their abundance is very sensitive to the temperature [1], it could be used as a tracer for the evolutionary stage of young protostars (Class 0). Unfortunately, H_2D^+ is very difficult to observe due to the low atmospheric transmission at its line frequencies. However, N_2D^+, whose abundance is closely related to the one of H_2D^+, is much easier to detect.
We observed N_2D^+ and N_2H^+ emission from 20 protostars ranging from very young protostars to Class 0/1 borderline objects. We found N_2D^+/N_2H^+ ratios between < 0.029 and 0.27, but for most objects the N_2D^+/N_2H^+ ratio lies below 0.1. This is approximately the same range the has been found in starless cores previously [2]. We found a clear decrease of the N_2D^+/N_2H^+ ratio with evolutionary stages, traced by dust temperature, CO depletion factor and other evolutionary indicators. Contrary to the evolutionary tracers, we did not find any correlation with line width and asymmetries of the line profile, which leads to the conclusion that large scale motions, such as infall, have only a minor influence on the deuterium fractionation.

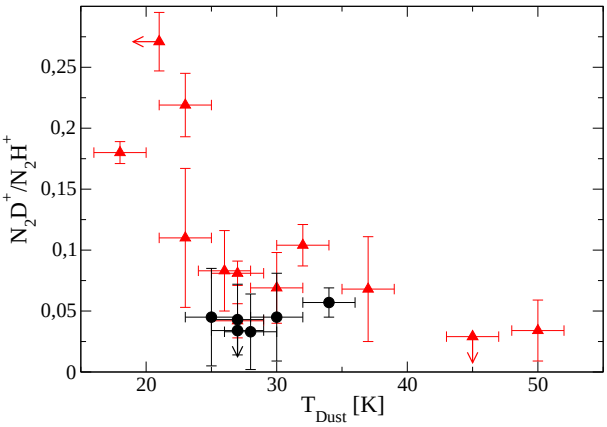

Figure 1: Dust temperature versus deuterium fractionation. The objects marked with triangles are the one located in the Perseus cloud.

[1] Flower et al. 2004, A&A, 427, 887
[2] Crapsi ert al. 2005, ApJ, 619, 379