The H_2CN/H_2NC abundance ratio: a new potential temperature tracer for the interstellar medium

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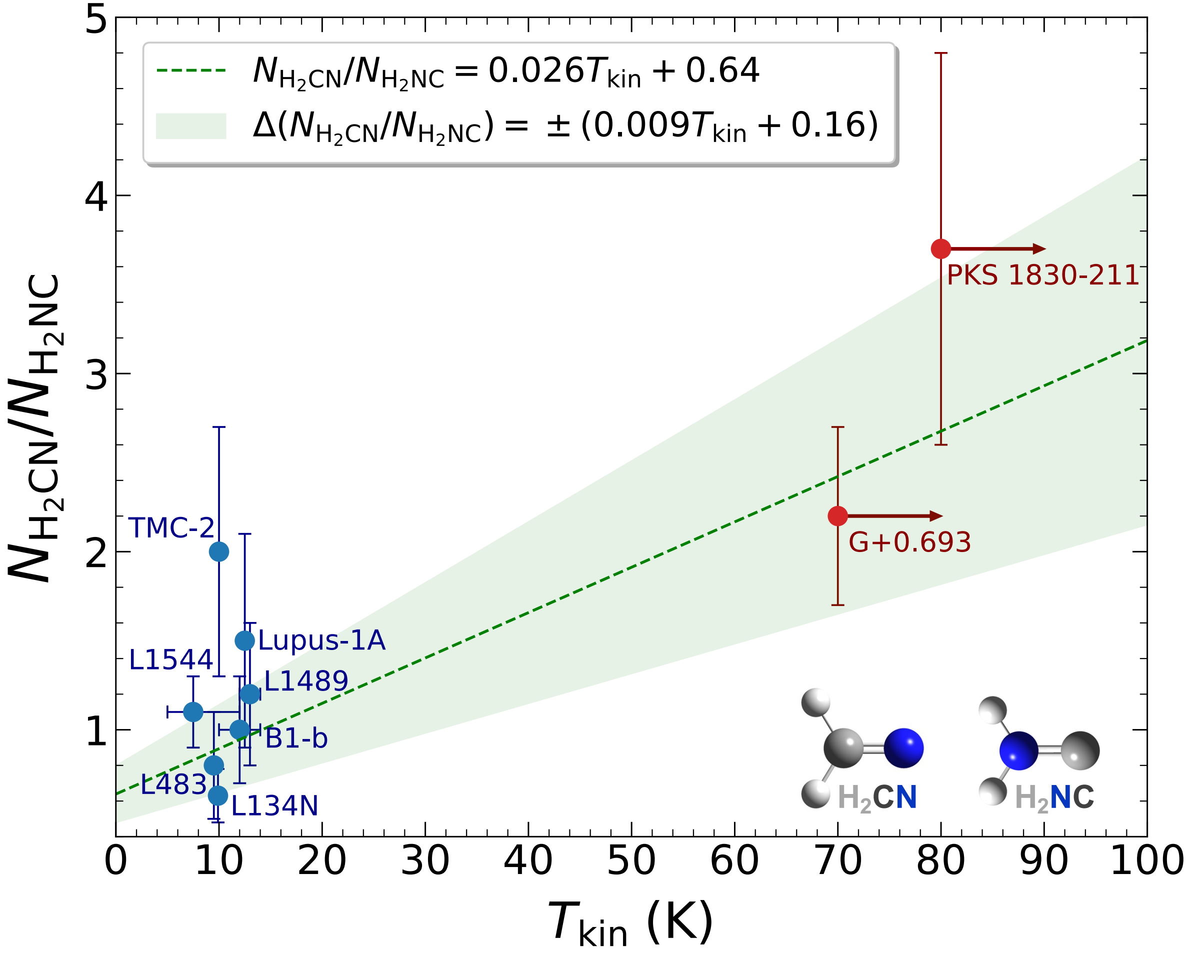

Figure. H_2CN/H_2NC ratio versus T_{kin} towards cold (T_{kin} ~10 K, blue points) and warm (T_{kin} > 70 K, red points) sources where H_2NC (and H_2CN) has been detected so far. The green dashed line depicts the linear fit we performed to the data to show that it increases with T_{kin}, while the green shaded region encompasses its 1σ level of uncertainty.

The H_2NC radical is the high-energy metastable isomer of the well-known H_2CN radical, which has been recently detected for the first time in the interstellar medium (ISM) towards a handful of cold galactic sources, besides just one warm but extragalactic object. These detections tentatively showed that the H_2CN/H_2NC isomeric ratio (i.e., the ratio of these two isomers column densities *N*) might increase with the kinetic temperature of the gas (T_{kin}), drawing a potential dependence on temperature similar to the better studied HCN/HNC abundance ratio. However, the shortage of detections in warm sources still prevents us from confirming this hypothesis and shedding light on these two isomers chemistry.

In this work, we present the first detection of both H_2CN and H_2NC isomers towards a warm source within our Galaxy, the Galactic Center G+0.693-0.027 molecular cloud (with $T_{kin} \gtrsim 70$ K), by using observations carried out with the IRAM 30m radiotelescope at Pico Veleta (Granada, Spain). We performed a Local Thermodynamic Equilibrium fit to the observed data, deriving an H_2CN/H_2NC abundance ratio of 2.2±0.5. Along with previous obervations, we suggest an increasing trend of this isomeric ratio with the gas temperature (see Figure), and we confirm that the H_2CN/H_2NC ratio is $\gtrsim$2 for sources with $T_{kin} > 70$ K, larger than what was previously found in colder sources (H_2CN/H_2NC ~ 1 for T_{kin} ~ 10 K). Thus, the H_2CN/H_2NC abundance ratio can be used as a temperature tracer for the ISM.

To explain this potential trend suggested by observations, we discussed possible chemical reactions forming and destroying these two radicals. The observed dependence of the H_2CN/H_2NC ratio on the gas T_{kin} cannot be fully explained only with the currently proposed formation and destruction pathways in the gas phase. In particular, grain surface reactions, including the $H_2NC \rightarrow H_2CN$ isomerization, deserve consideration to explain the higher isomeric ratios and H_2CN abundances observed in warm sources, where the molecules can be desorbed into the gas phase through thermal and/or shock-induced mechanisms.

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