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Protostellar chemistry dominated by external irradiation

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In their youngest stages, protostars are deeply enshrouded by envelopes of gas and dust, material which later accretes onto the central object and the protoplanetary disc. The icy grain mantles in the envelope are the formation sites for many different complex organic molecules, a process which is strongly affected by external effects such as heating and irradiation, both due to changes in reaction rates and due to the evaporation of key species from the ice mantles (see e.g. Herbst & van Dishoeck 2009). To understand these effects, we have studied the molecular composition of irradiated protostars, and find that also moderate external irradiation levels can create PDR-like chemistry in a protostellar envelope.

We have performed an unbiased line survey of all deeply embedded sources in the nearby Corona Australis star-forming region using the APEX telescope. Many of the sources are located near the $\sim 3M_{\odot}$ Herbig Be star R CrA, which elevates the irradiation field to $G_0 \sim 1000$ in the protostellar envelopes (Lindberg & Jørgensen 2012). It heats the gas on $\sim 10\,000$ AU scales to ~ 30–50 K (Lindberg et al., submitted).

Towards R CrA-IRS7B, the most thoroughly investigated object in our study, we find that the chemistry differs greatly from other well-studied deeply embedded protostars. We find low abundances of complex organic molecules such as CH_3OCH_3 and CH_3CN, but instead elevated abundances of the photo-dissociation product CN and small carbon-chain species like HC_3N and C_2H. We interpret the observed chemical properties as a result of thermal evaporation of CO from the grain mantles and photo-dissociation reactions in the IRS7B envelope, both initiated by the irradiation from the intermediate-mass protostar R CrA.

REFERENCES

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