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TITLE: Observations of irradiated protostars show a lack of complex organic molecules

ABSTRACT BODY:

Abstract Body: In their youngest stages, protostars are deeply enshrouded in envelopes of gas and dust, material that later accretes onto the central object and the protoplanetary disc. The icy grain mantles are the formation sites for complex organic molecules. The formation of such molecules is strongly affected by external effects such as heating and irradiation, both due to changes in reaction rates and the evaporation of key species from the ice mantles. To understand these effects, we have studied the molecular composition of irradiated protostars.

We demonstrate the strengths of unbiased single-dish line surveys, which we use to study the chemical and physical properties of protostellar envelopes. We have performed line surveys of more than 50 sources in the nearby Corona Australis and Ophiuchus star-forming regions using the APEX telescope. Many of the Corona Australis sources are located near the intermediate-mass Herbig Be star R CrA, and we find that despite its moderate luminosity, the irradiation from this star enhances the H_2CO temperatures of the nearby protostellar envelopes from 10 K to at least 30-40 K. This drastically elevated temperature should be of crucial importance to the chemistry of these envelopes, due to thermal evaporation of many key species from the dust grain surfaces.

Towards R CrA-IRS7B, the most thoroughly investigated object in our study, we find that the chemistry differs greatly from other thoroughly investigated deeply embedded protostars (hot corinos and warm carbon-chain chemistry sources, WCCC). We find low abundances of complex organic molecules such as CH_3OCH_3 and CH_3CN, but instead elevated abundances of CN and some carbon-chain species like HC_3N and C_2H, although not to the same level as towards typical WCCC sources. 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 R CrA.

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