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Cosmic rays and star formation

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Cosmic rays (CRs) play a crucial role in the physics and chemistry of the interstellar medium (ISM). At the high densities found in molecular clouds, they represent the main ionising agent of the gas, affecting its heating and evolution. CRs ionise molecular hydrogen, quickly producing H3+, setting the gas ionisation fraction. The latter affects the timescale of ambipolar diffusion —the drift of neutral matter across the magnetic field lines—a mechanism that allows the collapse of subcritically magnetised prestellar cores. Furthermore, CRs initiate the rich chemistry of molecular ions in molecular clouds. In this regard, it is of particular importance the formation of H2D+, the precursor of deuterated species in the gas phase, and that of He+, the first step towards ammonia formation. In my review talk, I will describe the different physical and chemical properties of star-forming regions that are affected by CRs. I will focus, in particular, on how we can observationally measure their impact through the CR ionisation rate (CRIR), discussing the different methodologies used in recent years, and I will show the most recent results in these regards. I will conclude with a few details on the future perspective regarding the study of cosmic rays especially from an observational point of view.

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