DEUTERATED COMPLEX ORGANIC MOLECULES IN THE LABORATORY AND IN SPACE

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Isotopic fractionation is a set of chemical processes that distributes less abundant isotopes into molecules (e.g. D substitutes H). Deuterium fractionation is one of the best tools to follow the evolution of material across star and planet formation[a]. For example, the inheritance of water from pre-stellar cores to planets has been shown via observations and modelling of water deuteration in star-forming regions[b]. Water is inherited efficiently in the form of ice. Thick ice layers build up right before the protostar forms, and together with water, other molecules also freeze out and can be potentially inherited in later stages of star formation, as well as in forming planets. To assess what else is inherited together with water, and determine the level of molecular complexity that is available to forming planets, a systematic and comprehensive survey of deuterated molecules in star-forming regions is necessary. Unfortunately, the laboratory spectroscopy of deuterated isotopologues of abundant insterstellar molecules is far from complete, especially in the case of complex organic molecules (COMs). The Center for Astrochemical Studies (CAS) laboratories at the Max Planck Institute for Extraterrestrial Physics started a systematic study of deuterated COMs with a multidisciplinary approach that involves laboratory spectroscopy, radioastronomical observations, and chemical modelling. In my talk, I will present our projects, discuss the challenges of this work, and report on recent results (e.g. the first interstellar detection of doubly deuterated acetaldehyde[c]).

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[a]Ceccarelli, C.; Caselli, P.; Bockelée-Morvan, D; et al. 2014. Protostars and Planets VI, Henrik Beuther, Ralf S. Klessen, Cornelis P. Dullemond, and Thomas Henning (eds.), University of Arizona Press, Tucson, p.859-882

[b]Cleeves, L. I. ; Bergin, E. A.; et al. Science, Volume 345, Issue 6204, pp. 1590-1593 (2014)

[c]Ferrer Asensio, J.; Spezzano, S.; Coudert, L.; et al. 2023. Astronomy & Astrophysics, Volume 670, A177