Ice inventory in highly extincted star forming regions: First results of IceAge, a JWST ERS program

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Icy grain mantles are the main reservoir for volatile elements in star-forming regions across the Universe, as well as the formation site of prebiotic complex organic molecules (COMs) seen in our Solar System. The IceAge Early Release Science program [1] on the James Webb Space Telescope proposed to trace the evolution of pristine and complex ice chemistry in Chameleon I – a representative low-mass star-forming region – through observations of: the dense cloud, the pre-stellar core, a Class 0 protostar, a Class I protostar, and a protoplanetary disk.

Observations towards the pre-stellar core made in summer 2022 using the NIRCam, NIRSpec and MIRI instruments have allowed us to obtain high spectral resolution (R~1500-3000) and sensitivity (S/N>100) observations from 2.5 to 13 μm of two highly extincted background stars (Av < 100). In this talk, we will present the very first results of this program: a complete ice inventory towards these lines of sight, including derived column densities for expected ice species as well as the first detection of several species along lines of sight in a quiescent cold core [2]. We will also present the perspectives for the rest of the IceAge program, focussing on mapping the spatial distribution of ices down to ~20-50 au in the Chameleon I cloud to identify when, and at what visual extinction, the formation of each ice species begins. The high-resolution spectra available to the community thanks to the various instruments on the JWST promise to allow us to search for new COMs, as well as distinguish between different ice morphologies, thermal histories, and mixing environments even in the densest star-forming regions.

References

[1] McClure, M., Bailey, J., Beck, T., Boogert, A. C., Brown, W., Caselli, P., Chiar, J., Egami, E., Fraser, H. J., Garrod, R., Gordon, K. D., Ioppolo, S., Jimenez-Serra, I., Jorgensen, J., Kristensen, L. E., Linnartz, H., McCoustra, M., Murillo, N., Noble, J., Oberg, K., Palumbo, M. E., Pendleton, Y. J., Pontoppidan, K., M., van Dishoeck, E. F. & Viti, S. "IceAge: Chemical Evolution of Ices during Star Formation" 2017, *JWST cycle 0 ERS Accepted Proposal 1309*, arxiv: 2017jwst.prop.1309M

[2] McClure, M. K. *et al.* "IceAge I: Densest molecular cloud ice and organics inventory revealed by JWST" *to be submitted*