The evolution of ice mantles during the star formation process: an IceAge JWST study of Chamaeleon I

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Icy grain mantles are the main reservoir for volatile elements in star-forming regions. The IceAge Early Release Science program [1,2] on the James Webb Space Telescope proposes to observe infrared spectra of objects at various stages of star formation, from dense cloud to protoplanetary disk. By observing Chamaeleon I – a representative low-mass star-forming region containing objects at each of these stages – we aim to trace the evolution of pristine and complex ice chemistry that accompanies the physical evolution of the objects. The dense cloud was observed using the NIRCam, NIRSpec and MIRI instruments in summer 2022, providing high spectral resolution (R~1500-3000) and sensitivity (S/N>100) infrared spectra from 2.5 to 13 μm of two highly extincted background stars (Av < 100) and additional L and M band spectra towards hundreds more field stars. In this talk, we will present the first results of the IceAge program: a complete ice inventory towards observed 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 [3]. We will also present some more recent advances and give perspectives for the rest of the IceAge program, with a particular focus on the NIRCam observations that permit mapping the spatial distribution of ices down to ~20-50 au with the aim of identifying the onset of ice formation.

Figure 1: Star-forming region Chamaeleon I, imaged by the JWST NIRCam instrument.[4]

References

[1] http://jwst-iceage.org/

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[4] Press release 23/01/23 23 https://esawebb.org/news/weic2303/ Image Credit: NASA, ESA, CSA, and M. Zamani (ESA/Webb); Science: M. K. McClure (Leiden Observatory), F. Sun (Steward Observatory), Z. Smith (Open University), and the Ice Age ERS Team.

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