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Water ice in the era of JWST - bridging laboratory work and astronomical observation

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Water ice has been found to be ubiquitous in quiescent molecular clouds and star-forming regions. It is formed on the surface of tiny dust grains located in cold environments (˜10K). Satellite missions have concluded that water enters protoplanetary disks mostly as ice, and may later be delivered to planets. This emphasizes the need of knowing the basic properties of water ice, which will be observed without precedent spectral resolution and sensitivity with the James Webb Space Telescope (JWST). Since the ‘90s the Laboratory for Astrophysics in Leiden has dedicated many studies to understanding the water ice properties. Most recently, an intrinsic property of water-ice, the temperature-dependent UV-vis refractive index was derived. These values are important to quantify scattering and absorption efficiencies when building ice-grain models to interpret the protostellar spectra. However, the results obtained in Leiden are substantially different from what has been used so far in the literature. In this work, we will present a brand-new water ice refractive index at different temperatures and also cover the mid-IR range, which is crucial for JWST. When these new values are used to construct ice-coated dust grains, we promptly see that old refractive index values may hide important water ice features, and consequently lead to a misinterpretation of the astronomical observations of the protostellar spectrum. The results presented here will be essential to also interpreting archival data of previous satellite and ground-based telescopes, as well as can be used in future projects targeting water ice in space.

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