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Direct measurement of complex refractive index of CO ice using terahertz pulsed spectroscopy

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Experimentally determined optical constants and in particular absorption coefficients of astrophysical ice analogs in the terahertz region are missing. These data are very important to determine how the dust opacity changes when the grains are covered with ice mantles. Thus, more accurate mass determinations can be carried out using the dust continuum emission, especially in cold and dense regions where CO mainly resides in solid form on top of dust grain surfaces, forming thick icy mantles. We have measured the optical and dielectric properties in the THz region of interstellar ice analogs of astrophysically relevant species, starting with CO, using the time-domain pulsed THz spectroscopic technique (TPS). TPS has the unique advantage of being able to measure both the amplitude and phase of sub-picosecond THz pulses in a wide spectral range in a single measurement and, thus, to reconstruct directly the optical properties without the use of the Kramers-Kronig relations. Making use of a mathematical algorithm developed specifically for this project, we succeeded in the calculation of the CO ice optical properties from the THz spectral data. Based on these results, the dust opacity has been derived afterwards. The analysis of re corded data for other common ice components, such as water and carbon dioxide, is in progress.

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