Title

Broadband (THz-IR) dielectric spectroscopy of astrophysical ice analogues: Recent achievements and challenges

Authors

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Abstract

The study of interstellar and circumstellar laboratory ice analogues is an important scientific problem [1-4]. Broadband dielectric spectroscopy provides the complex dielectric permittivity as one of the key parameters when considering the physical properties of such ice, as well as comparing the results of laboratory studies and astronomical observations. Terahertz (THz) and infrared (IR) dielectric response of such ices is in a great need for modelling the dust continuum emission and radiative transfer in dense and cold regions, where thick icy mantles are formed on the surface of dust grains. In our recent research we present broadband spectroscopy of laboratory ice analogues, particularly, CO and CO_2 ices, along with the original methods of processing the experimental data [5-6]. Direct reconstruction of broadband dielectric response was developed. It is based on the features of THz pulsed spectroscopy (TPS) and the usage of Kramers-Kronig relations to additionally prepare the Fourier-transform IR spectroscopy (FTIR) data for merging it with the TPS one. The reconstructed results are analyzed in terms of analytical dielectric models with attribution to particular vibrational modes. Sensitivity of the measurements is also discussed carefully when interpreting the results. The necessity of further research is discussed in the context of ice structure analysis, where the annealing experiments and the studying of scattering in the IR frequencies seems to be the most promising ones.

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