Numerical solution for scattering, absorption, and emission by large cometary dust particles

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Remote light-scattering and thermal infrared observations of comet's comae provide us with hints of physical properties of cometary dust particles such as size, shape, porosity, and composition. Interpretation of such observations requires accurate and efficient numerical methods and models. Unfortunately, the available numerical techniques are either too computer-intensive or introduce insufficient approximations. We present a self-consistent numerical solution for scattering and thermal emission problems by extending the recently introduced dense medium radiative transfer solution [1–4] to treat thermally excited radiation. Further, we combine the radiative heat transfer part to the conductive heat transfer equation by employing the finite-element method. The developed method will be applied to interpret the visible and superheating phase functions of the coma of the comet 67P/Churyumov–Gerasimenko measured by the Rosetta Optical, Spectroscopic, and Infrared Remote Imaging System and the Rosetta Visible and Infrared Thermal Imaging Spectrometer, respectively.

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