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Development of a high-resolution interstellar dust engineering model - technical implementation for fast simulations

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Abstract

Interstellar dust (ISD) is one of the constituents of the dust population observed in the solar system. Beyond 3 AU heliocentric distance, it represents the dominant component of the total dust population (cf. Abstract V.J. Sterken).

Due to the modulation by the solar magnetic field, the ISD exhibits a pronounced spatial and temporal variability. A high-resolution model of the Interstellar Dust (ISD) component has been developed to predict the densities and velocity field for a range of sizes and optical properties (radiation pressure factor β) of dust particles. To achieve the required resolution of 0.25 AU at a sufficient S/N ratio, a high number of trajectories had to be integrated numerically. Therefore the simulation has been adapted to make full use of the available computing cluster hardware.

Here we discuss the details of the model, the influence of different solar magnetic field prescriptions and of the physical properties used, the numerical approach, and the model's limitations. We also demonstrate the predictions of dust impact rates and velocities for present and future space missions, including heliocentric distances from ≤ 1 AU to ~ 10 AU.