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Dust Tomography of the Heliosphere

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The observations of the inward transport of interstellar dust and the outflow of near-solar dust provide a unique opportunity to explore dusty plasma processes throughout the heliosphere. The flux, direction and size distribution of interstellar dust can be used to test our models about the large-scale structure of the heliospheric magnetic field, and its temporal variability with solar cycle. The measurements of the speed, composition and size distribution of the recently discovered, solar wind-entrained nano-dust particles hold the key to understand their effects on the dynamics and composition of the solar wind plasma. Both the inflowing interstellar grains and the out-flowing nano-dust particles can be measured onboard a near Earth spacecraft at 1 AU, using recently developed dust detection techniques.

Dust is an important component of the heliospheric plasma environment. Dust carries significant mass, momentum and energy, yet the processes responsible for coupling it to the solar wind plasma flow remain largely unexplored. The nano-dust particles generated near the Sun and accelerated by the out-flowing solar wind, and the interstellar dust particles traversing the heliosphere can be measured at 1 AU, providing a ‘tomographic image’ of our heliosphere through dust measurements.

This talk will summarize the existing observations and the status of our theoretical understanding of dust dynamics in the heliosphere.

We will also briefly discuss the science goals of a possible mission to:
a) Explore the variability of the flow directions of ISD grains and verify the models of the large-scale magnetic fields and plasma distribution in the heliosphere, by comparing the accurately measured flux, mass, and the velocity vector of individual ISD grains with the calculated trajectories, using global MHD models of the outer heliosphere.
b) Explore the processes leading to the solar wind entrainment of small dust grains in the solar vicinity, and effects of dust loading on the dynamics and composition of the solar wind plasma flow, by comparing the flux, mass, and the velocity vector of nano-dust particles with our models of the inner heliosphere.