In-situ Spacecraft Measurements of Interstellar Dust in the Solar System

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In the early 1990s, interstellar dust penetrating deep into the solar system was identified with the in-situ dust detector on board the Ulysses spacecraft. Between 1992 and 2007 Ulysses monitored the interstellar dust stream at high ecliptic latitudes between 3 and 5 AU. Interstellar dust impactors were also measured with the dust detectors on board Cassini, Galileo and Helios, covering a heliocentric distance range between 0.3 and 3 AU in the ecliptic plane. The interstellar dust stream in the inner solar system is altered by the solar radiation pressure force, gravitational focussing and the interaction of charged dust grains with the time varying interplanetary magnetic field (IMF). In particular, variations of the dust flux and impact direction can only be understood in terms of the grain interaction with the IMF.

The interstellar grains act as tracers of the physical conditions in the local interstellar medium surrounding our solar system. Our dust measurements with Ulysses imply the existence of a population of 'big' interstellar grains (up to 10^{-13} kg) and a gas-to-dust-mass ratio which is larger than the one derived from astronomical observations. This indicates a concentration of interstellar dust in the very local interstellar medium. In addition to interstellar particles, the Ulysses dust detector measured interplanetary dust in the zodiacal dust cloud, solar radiation driven so-called beta meteoroids coming from the inner solar system, and dust stream particles originating from the Jupiter system. We give an overview of the dust measurements from the entire Ulysses mission with particular emphasis on recent results from the interstellar dust measurements.

Keywords: dust; interplanetary magnetic field; interstellar dust; dust-plasma interaction.