Interstellar dust in the solar system: The Ulysses perspective

Veerle Sterken[1], Peter Strub[2], Harald Krüger[2], Rudolf von Steiger[1], Eberhard Grün[3,4]

[1]*International Space Sciences Institute, Switzerland,* [2]*Max Planck Institute for Solar System Research, Germany,* [3]*Max Planck Institute for Nuclear Physics, Germany,* [4]*LASP, Univ. of Colorado, USA*

Trajectories of Interstellar dust (ISD) passing through the solar system and originating from the local interstellar cloud were studied in detail in the late 1970s. These trajectories mainly influenced by solar radiation pressure force, gravity and the magnetic field in the heliosphere and in its boundary regions. In 1992, interstellar dust was measured for the first time directly by in-situ measurements with the dust detector onboard Ulysses. The Ulysses data from 1992 until 2002 were analyzed by Landgraf et al. and the observed ISD flux was compared to the ISD flux in numerical simulations. From this, a rough estimate of the maximum β-value (the ratio of solar radiation pressure force to gravity for a specific particle) for the ISD was determined and one could constrain the particle properties by comparing simulations to observational data. Remarkable were the observations of 'big' interstellar dust particles with a mass of 10^{-15}-10^{-14} kg which are not compatible with astronomical observations of the wavelength-dependence of the extinction of starlight and the total dust mass as derived from cosmic abundances and measurements in the gas phase.

Since then Ulysses continued to measure interstellar dust until 2007 when the operation of the dust instrument was terminated. Krüger et al. reported a temporary shift in the flow direction of the dust in 2005. In 2012, Sterken et al. described the general flow and filtering characteristics of ISD in the solar system and took preparations for further analysis of - and comparison of simulations with - the Ulysses data [Sterken et al. 2014, in prep.]. Meanwhile, Strub and Krüger re-analyzed the whole dataset until the end of the Ulysses mission: from February 1992 until November 2007 [Strub et al. and Krüger et al., 2014, in prep.].

In this talk we briefly give an overview of the recent research on ISD in the solar system. We then focus on what we can learn from ISD trajectory simulations at Ulysses orbit and we propose possible solutions for understanding the observations and in specific the shift of dust that occurred in 2005 and the big masses as observed by Ulysses. We report on the current status of on-going projects and the steps needed to a thorough understanding of the ISD data by Ulysses.