STEREO/WAVES Science Nugget
October 31, 2012

**Nanodust in the Solar-Wind**

The solar system contains bodies and dust particles of mass extending over more than 35 orders of magnitude, from asteroids to sub-micron dust grains. Nano-particles lie near the low end of the mass distribution, at the frontier between macroscopic objects and atomic structures. Contrary to larger size objects, the dynamics of which are mainly controlled by the gravitational field of the Sun, the nanodust grains have a high electric charge relative to their mass, and therefore strongly interact with the solar wind's magnetic field. As a consequence, they are accelerated away from the Sun and reach velocities of hundreds of kilometer per second near the Earth orbit.

When a nano-grain impacts STEREO spacecraft at such a high velocity, it craters out and ionizes some of the spacecraft surface material. The free electric charges thereby generated produce an electric field that can locally perturb the complex equilibrium that determines the electrical potential of the antennas. When the impact occurs close enough to an antenna, this produces a high voltage pulse on this antenna.

Modeling this perturbation mechanism enabled us to derive a calibration for the nano-dust detection technique, and to scan the dust grains flux distribution in the 5-20 nm size range. This S/WAVES measurement constitutes the first ever detection of interplanetary dust in the nanometer size range.

In addition, S/WAVES proved to be a reliable dust detector in the sub-micron size interval, and in particular provided new measurements of the interstellar dust flux at an astronomical unit from the Sun.

*Interplanetary dust detection by radio antennas : mass calibration and fluxes measured by STEREO/WAVES*
A. Zaslavsky, N. Meyer-Vernet, I. Mann, A. Czechowski, K. Issautier, G. Le Chat, F. Pantellini, K. Goetz, M. Maksimovic, S. D. Bale and J. C. Kasper, Journal of Geophysical Research, 117, A05102, 2012

*In situ detection of interplanetary and Jovian nano dust with radio and plasma wave instruments*
N. Meyer-Vernet and A. Zaslavsky, in "Nano Dust in the Solar System: Discoveries and Interpretations" (Editors: I. Mann, A. Czechowski, N. Meyer-Vernet, Springer Astrophysics and Space Science Library), 2012

*Dust detection by the wave instrument on STEREO : nanoparticles picked-up by the solar wind ?*
N. Meyer-Vernet, M. Maksimovic, A. Czechowski, I. Mann, I. Zouganelis, K. Goetz, M. L. Kaiser, O. C. St. Cyr, S. D. Bale, Solar Phys., 256, 463, 2009

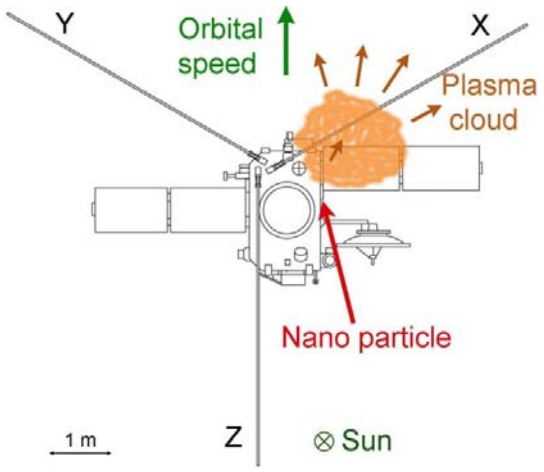


**Figure 1** : Schematics of the sun shaded side of STEREO A spacecraft. The velocity vector of a nano-grain is indicated in red. The plasma cloud generated after the impact is shown in orange (to scale).

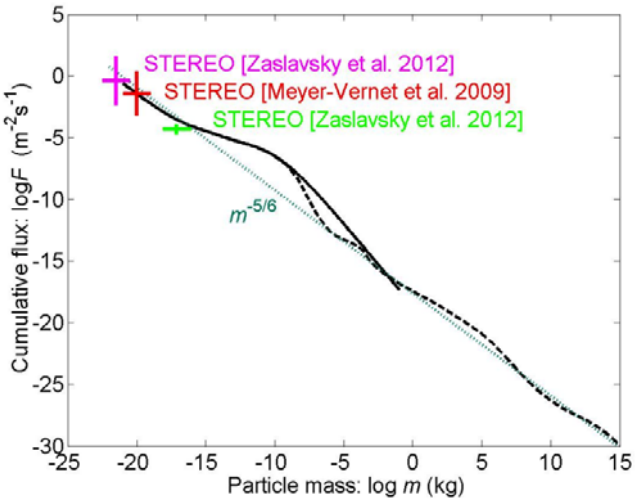


**Figure 2** : Cumulative flux of the interplanetary dust and bodies at an astronomical unit from the Sun. The flux measured by S/WAVES in different mass ranges are indicated as colored crosses. The black lines show interplanetary dust flux models by Grün et al. (1985) (solid) and Ceplacha et al. (1998) (dashed).