Determining Directionality of Interplanetary Dust Particles Using Waveform Data from Parker Solar Probe

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Interplanetary Dust (IDP) consists of the pummeled remnants of asteroids and comets, trapped in high velocity orbits around the Sun. When these fast moving particles (~20km/s) collide with a spacecraft, they explode into a plasma cloud, impacting the spacecraft and disturbing the electric field within the vicinity of the collision. These events cause voltage spikes in electric field instrument data on missions such as Voyager, Cassini, STEREO, MAVEN, WIND and Parker Solar Probe. These spacecraft use a system of field antennas arranged orthogonally or pseudo-orthogonally. When a dust impact occurs, the antennas register a voltage spike with the highest amplitude on the antenna nearest to the impact. Prior to the August 2018 launch of Parker Solar Probe, IDP within 0.3 AU of the Sun had never been measured in-situ, and predictions for its distribution vary by orders of magnitude. Now that Parker Solar Probe data are available, we are developing algorithms to identify dust impacts and to observe IDP at distances closer to the Sun than ever before. Dust impacts have successfully been identified in the waveform data and verified with the bandpass data. This provides good evidence that the identification method is reliable. The first two orbits of Parker Solar Probe data were examined and dust impact data were compared with a model which predicts the flux and direction of IDP close the the Sun. The dust populations considered in the model include particles shed by Jupiter-family comets and asteroids. Specifically, the model predicts the most likely direction of dust impacts on Parker Solar Probe. By comparing the amplitudes of dust impacts on each antenna, we used the data to determine the direction of observed impacts. During closest approach to the Sun, the model predicts that most impacts will be on the ram side of the spacecraft. The data show that antenna V4, located in the ram direction, does see the most high-amplitude impact signatures near perihelion. This, and other comparisons convey good agreement between the model and data.