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HYPERVELOCITY DUST IMPACTS ON THE WIND SATELLITE

Gas and dust make up a significant part of the Universe allowing for the formation of galaxies, stars, and planets. But the abundance of these materials in the Solar System and Milky Way risk damage to satellites and spacecraft. As the Solar System travels through the galaxy dust particles at speeds of up to 26 km/s enter the Solar System reaching as far as Earth. Even masses as small as $\sim 2.8 \times 10^{-16}$ kg can cause damage at these speeds to spacecraft cameras, antennae, thermal shields, or any exposed area of the spacecraft. Such damage of the spacecrafts from dust wastes the money put into the craft and decreases our ability to study space. Characterizing the interstellar dust (ISD) and the interplanetary dust (IPD) flux and direction over a solar cycle may be helpful in predicting such damage as well as providing understanding of the interstellar environment near the Solar System. We analyzed 11 years of dust measurements from 2002-2012 from the Wind spacecraft in order to define the direction and flux of the ISD and IPD moving through the Solar System over a solar cycle. When a dust particle impacts Wind, a local plasma cloud is generated causing a voltage spike to be detected by Wind's antennae. From the voltage spike, the direction of impact of the dust particle can be determined. Wind is positioned at L1 orbiting the Sun at the same rate as Earth. This causes the direction and flux of the ISD and IPD to show yearly modulation with Wind moving approximately into the ISD flow in March and away from it in August. We were able to characterize the interplanetary and interstellar dust flow based on this modulation; observed dust impact directions are consistent with ISD flow in March and fewer dust impacts are observed in August from the ISD direction as Wind moves with the ISD flow. In order to isolate the ISD component in March, the IPD measured in August is subtracted from the March data. Though there was no obvious correlation seen between the ISD and a single solar cycle, we found consistencies in data between the dust measurements taken by the Ulysses spacecraft and Wind when Ulysses crossed the ecliptic plane. This data showed a decreased flux of ISD in 1999 and a 30 degree shift in the ISD direction in 2003 from 1999. With Ulysses having a dust detector that can also identify ISD, the correspondence between it and Wind supports our conclusions concerning ISD flux and direction over the 11 years analyzed.