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Interplanetary Dust Observations by the Juno MAG Investigation

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The spin-stabilized and solar powered Juno spacecraft recently concluded a 5-year voyage through the solar system en route to Jupiter, arriving on July 4th, 2016. During the cruise phase from Earth to the Jovian system, the Magnetometer investigation (MAG) operated two magnetic field sensors and four co-located imaging systems designed to provide accurate attitude knowledge for the MAG sensors. One of these four imaging sensors – camera "D" of the Advanced Stellar Compass (ASC) - was operated in a mode designed to detect all luminous objects in its field of view, recording and characterizing those not found in the on-board star catalog. The capability to detect and track such objects ("non-stellar objects", or NSOs) provides a unique opportunity to sense and characterize interplanetary dust particles. The camera's detection threshold was set to MV9 to minimize false detections and discourage tracking of known objects. On-board filtering algorithms selected only those objects tracked through more than 5 consecutive images and moving with an apparent angular rate between 15"/s and 10,000"/s. The coordinates (RA, DEC), intensity, and apparent velocity of such objects were stored for eventual downlink. Direct detection of proximate dust particles is precluded by their large (10-30 km/s) relative velocity and extreme angular rates, but their presence may be inferred using the collecting area of Juno's large (∼55m2) solar arrays. Dust particles impact the spacecraft at high velocity, creating an expanding plasma cloud and ejecta with modest (few m/s) velocities. These excavated particles are revealed in reflected sunlight and tracked moving away from the spacecraft from the point of impact. Application of this novel detection method during Juno's traversal of the solar system provides new information on the distribution of interplanetary (μm-sized) dust.