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Interplanetary and Interstellar Dust Near Earth (iDUNE): Exploring the Diversity of the Chemical Makeup of Solar System Bodies from 1 AU

Mihaly Horanyi (1), Eberhard Grun (1), Antal Juhasz (2), Sascha Kempf (1), Marcus M. Piquette (1), Petr Pokorny (3,4), Andrew Poppe (5), Julie Castillo-Rogez (6), Ralf Srama (7), Zoltan Sternovsky (1), Jamey Szalay (8), and Tibor Balint (6)

(1) Laboratory for Atmospheric and Space Physics, U. of Colorado, 1234 Innovation Drive, Boulder, CO 80303, USA , (2) Institute for Particle and Nuclear Physics, Wigner, RCP, 1121 Budapest, Hungary , (3) Space Weather Lab., Mail Code 674, GSFC/NASA, Greenbelt, MD 20771, USA, (4) Department of Physics, Catholic University of America, Washington, DC 20064, USA , (5) Space Sciences Laboratory, 7 Gauss Way, U. of California, Berkeley, CA 94720, USA , (6) Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109, USA, (7) Institut für Raumfahrtsysteme, U. Stuttgart, Raumfahrtzentrum Baden Württemberg, 70569 Stuttgart, Germany , (8) Department of Astrophysical Sciences, Princeton University, Princeton, NJ, 08540, USA

Interplanetary and interstellar dust particles (IDP and ISD) continually bombard the Earth. They ablate in the atmosphere, and their trajectories change due to drag forces by the time ground based optical and/or radar observations could fully characterize them. These particles carry valuable information about their parent bodies that can now be fully harvested by in dust measurements in space, using newly developed instrumentation to be placed onboard a proposed Earth orbiting spacecraft on a highly elliptic trajectory to mitigate near-Earth environment interferences.

Dust particles that are released by active comets, by dust impacts onto the surfaces of airless bodies, or by collisions between asteroids, for example, have initial orbital elements that are similar to their parent bodies, forming meteoroid streams. Depending on the size of these grains, their initial orbital elements will change and randomize over timescales of centuries or longer, and become part of the sporadic background of IDPs. In general, long period comets likely come from the Oort Cloud, and short period comets likely originate from the Kuiper Belt. Main belt asteroids have low inclination, nearly circular orbits. Hence, the orbital elements of the offspring dust particles from comets and asteroids can be used to identify their parents. Interstellar dust particles are entrained in the flow of interstellar gas across our solar system and can be identified by their narrow and distinct speed distribution and directionality.

Newly developed dust instruments are capable of measuring the mass, charge, composition, and velocity vector of impacting dust particles. By measuring the orbital elements of dust particles their source regions can be identified. This talk will summarize the scientific rationales for the iDUNE mission concept to explore the diversity of the chemical makeup of bodies in our solar system and beyond.