BOSTON UNIVERSITY

Boston University College of Arts & Sciences
Center for Space Physics

2021—2022 SPACE PHYSICS SEMINAR SERIES

Impact Plasmas: Probing the Heliosphere through the Dust that Bombards Spacecraft

Cosmic dust grains are pervasive in the solar system and affect both the dynamics of space plasmas and the survivability of human-made spacecraft. Instruments on many scientific missions (such as Voyager, Cassini, and Parker Solar Probe) detect the aftermath of impacts through electromagnetic field measurements. The impact speed is so large (up to 72 km/s near Earth) that spacecraft material is ionized, creating a rapidly expanding plasma. Plasma and other ejecta from impacts alter the surrounding space environment and interact with the spacecraft itself through electrostatic and electromagnetic fluctuations. Impact plasmas offer an opportunity to learn about the tiny building blocks of our solar system and their role in the heliosphere.

In this talk, I discuss the physical mechanisms that govern impact plasmas from the theoretical, computational, and experimental perspectives. A complete description requires the solid mechanics of the surface and dust particle, the phase change and ionization in a high-energy density state, the transition between a highly collisional plasma to a collisionless plasma, the interaction with ambient electric and magnetic fields, and the mode conversion from waves within the plasma to free-space electromagnetic waves that propagate to a nearby sensor. The analysis, in combination with ground-based impact experiments, has driven the design of an in situ experiment. Furthermore, Parker Solar Probe has seen an unprecedented amount of peculiar field measurements associated with impacts. One ultimate objective is to use this combination of in situ impact measurements, theory, and simulations to solve the inverse problem: i.e., use field measurements from impacts to determine the mass, velocity, source, and composition of cosmic dust

Thursday, February 17th

4:00-5:00 p.m.

725 Commonwealth Ave | Room 502

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