

Space Physics Seminar

Thursday, September 10, 2015

Plasma Production and Radiation from Meteoroid Impacts on Spacecraft

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Abstract:

Spacecraft are routinely bombarded with both human-made and naturally occurring dust particles, which we will collectively refer to as hypervelocity particles. Hypervelocity particles possess enough energy to ionize and vaporize themselves as well as a significant portion of the spacecraft material upon impact, forming a plasma that rapidly expands into the surrounding vacuum. The associated electrical effects and potential for damage to satellite electronics through these processes remains largely unknown, but it has been proposed that under certain conditions this plasma can produce an electromagnetic pulse (EMP) which can threaten spacecraft electronics. This area of spacecraft engineering requires a deeper understanding of the underlying physics of the impact-generated plasma plume.

This thesis describes multi-physics simulations of hypervelocity impact plasmas. The simulations utilize a combination of smoothed particle hydrodynamics (SPH) and discontinuous Galerkin (DG) particle-in-cell (PIC) techniques running on graphical processing units (GPU). The results show a minimum velocity threshold of ~ 18 km/s for fully ionized plasma production, which matches the velocity threshold for EMP measurements from impact experiments. The fully ionized plasma produces electrostatic oscillations that can couple to an electromagnetic wave that propagates away from the plasma. Near the impact site, this wave has a field strength that far exceeds the specification to which spacecraft are currently designed. Understanding key parameters of impact plasmas, as well as any EMP mechanisms, will aid in designing more robust and reliable spacecraft that are well protected in the space environment.

3:30 pm

Refreshments
CAS Room 500

4:00 pm

Seminar
CAS Room 502

Next Week

- Nathan Schwadron
University of New Hampshire
- Interstellar Mapping and Acceleration Probe (IMAP)
– A New Mission Whose Time Has Come!



<http://www.bu.edu/csp/edoutreach/seminar/>



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