CHARACTERIZING ELECTRON OSCILLATIONS IN A COLLISIONLESS, EXPANDING IMPACT PLASMA.
M. I. Zimmerman[1,2,*] , W. M. Farrell[1,2], and T. J. Stubbs[1,2,3]; [1]NASA Goddard Space Flight Center, Greenbelt, MD; [2]NASA Lunar Science Institute, Moffett Field, CA; [3]Center for Research And Exploration In Space Science and Technology, Univ. MD Baltimore County, Baltimore, MD; [*]michael.i.zimmerman@nasa.gov

Abstract: High-velocity meteoritic impacts on the Moon deliver energy and material to the lunar surface and exosphere. At high impact energies the target and impactor material can vaporize and ionize to form an impact plasma [1, 2]. Electromagnetic fields arise due to natural currents within the expanding plasma [2, 5, 7] and may have a lasting effect on the local evironment (e.g., through remnant magnetization of the heated impact site [2]).

The present work investigates the late collisionless stage of impact plasma expansion [cf. 3, 4] using 1D and 2D kinetic simulations [9, 10]. Emphasis is placed on characterizing plasma oscillations along the expanding ion front that could radiate a measurable electromagnetic signature of time-evolving plasma conditions (e.g. Figure 1). The results are consistent with theoretical and experimental evidence for electromagnetic radiation produced by dust impacts on spaceborne surfaces [e.g., 2, 5-8, and references therein]. Also, preliminary 2D simulations show that surface charging may play a role in shaping the particle velocity distributions at the surface, which could critically affect interpretation of experimental results, e.g. during a planned impact mission.

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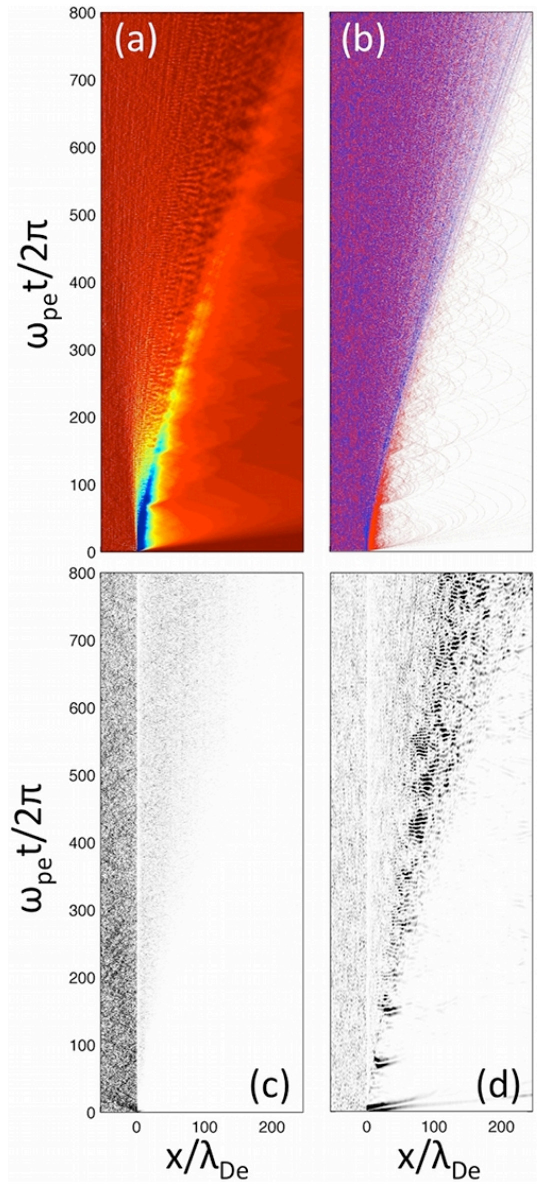

Figure 1: 1D simulation of (a) electric field and (b) net charge concentration normalized to T_e/λ_{De} and n0, respectively, during collisionless expansion of an impact plasma slab. The initial plasma-vacuum interface is at x=0, t=0, and λ_{De}, ω_{pe}, and T_e are the Debye length, plasma frequency, and temperature within the interior plasma, respectively. Wavelet power spectra show that the fastest oscillations ($\omega \sim \omega_{pe}$) tend to occur within the bulk plasma (panel c), while slower oscillations develop along the expansion front (panel d).