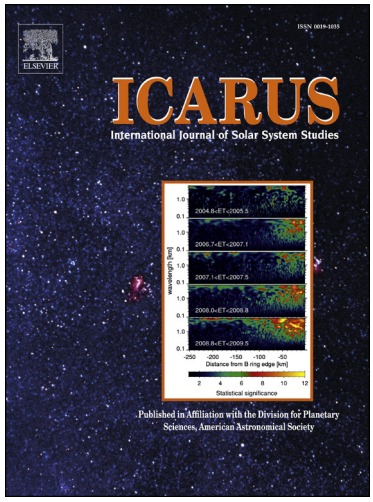

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An Estimate of the Dust Pickup Current at Enceladus

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Abstract. We demonstrate that the acceleration of submicron dust originating at Enceladus by a reduced co-rotating E-field is capable of creating a dust pickup current perpendicular to the magnetic field with values ranging from 3 to 15 kA (depending upon the effective grain charge). Such a current represents a new contribution to the total pickup current in the region. As such, we suggest that dust pickup currents, along with ion and electron pickup currents, are all active within the plume.

Introduction

One of the major discoveries of the Cassini mission is the very active space environment in the vicinity of the moon Enceladus. A primary source of this activity is the cometary-like jet of gas (Waite et al., 2006) and dust (Spahn et al., 2006) emitted from the south polar fissures (Porco et al., 2006). The neutral gas emitted at 100 kg/s is believed to undergo photo-ionization and charge exchange to form a substantial southerly-extended ionosphere that mass-loads the passing magnetic field lines (Tokar et al., 2006; Pontius and Hill, 2006). Ion densities on the order of $10^4/cm^3$ are detected in the proximity of the jet (Shafiq et al., 2011) with evidence of mass loading/plasma slowdown as far as 20 Enceladus radii (R_e) from the body (Tokar et al., 2006; Simon et al., 2011). The electron densities in the plume are not as large as the ion densities, with n_e/n_i dropping below 10% out to as far as 10 R_e south of the polar fissure (see Figure 5 of Morooka et al., 2011). This electron density reduction is due to the presence of submicron-sized dust that effectively absorbs most of the electrons (Farrell et al., 2009; Shafiq et