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KINETIC MODELING OF ION THRUSTER PLUME PLASMA SURFACE INTERACTIONS

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Plasma surface interactions are an important aspect of spacecraft design. The spacecraft surfaces present in the backflow region of the plume can acquire a negative potential, attracting slow moving charge exchanged ions created in the core plume region[1]. The ions accelerating towards the surface can cause surface sputtering on protective coating present on the solar panels. In previous works, semi-kinetic approaches have been used to model plume backflow region[2]. In this work, we will perform a three-dimensional fully-kinetic numerical study of ion thruster plume plasma interactions with spacecraft surfaces where all species are considered as particles and their individual kinetics is resolved.
PIC-DSMC[3] will be used to perform numerical simulations. A hybrid MPI-GPU code, CHAOS[4], will be modified to include effects of charging and used for this work. We plan to present different surface boundaries in the backflow region of the plume and report the macro-parameters, such as ion and electron densities, and the kinetic parameters such as ion energy distribution and plasma-sheath thickness near the surface. Finally, we will estimate surface erosion for the surface using kinetic results and empirical relations[5], and compare those results with traditional plume plasma models.

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Authors: NUWAL, Nakul (University of Illinois Urbana Champaign); Dr LEVIN, Deborah (Professor, AE, UIUC)

Presenter: NUWAL, Nakul (University of Illinois Urbana Champaign)

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