

Title and Research Team

Project Title: Multi-scale Modeling of Plume-Spacecraft Interactions for Novel Propellants

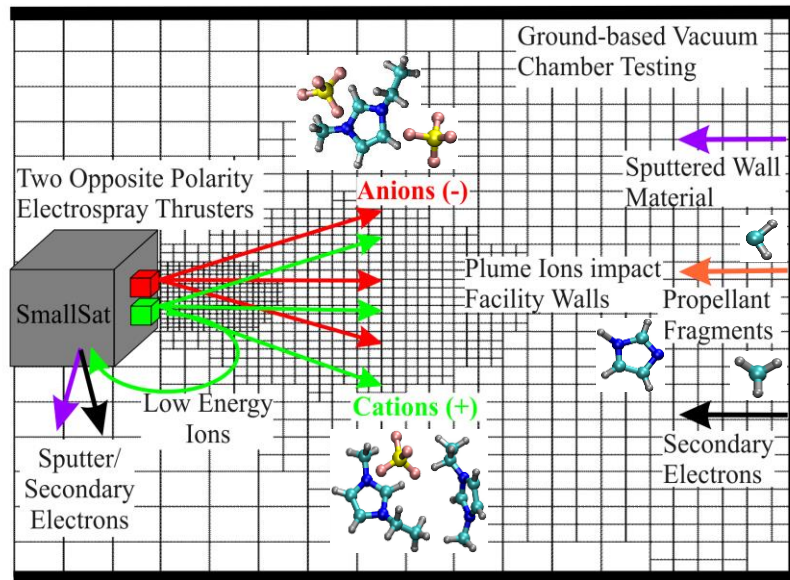
Solicitation: SpaceTech-REDDI-2018 Early Stage Innovations
Topic 1 - Modeling for Small Satellite Electric Propulsion

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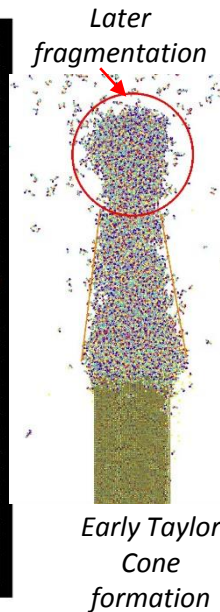
Approach

- Propose new electro spray thruster plume model based on kinetic, particle simulations of cation/anion interactions at multi-scales.
- At the 100 nm – 1 micron scale, coarsened MD-like simulations and PIC will model jet growth for ILs such as [EMI][BF₄] and [EMI][IM].
- 2 more length scales, micron – mm and mm – m using AMR/Octree grid-free in KMC and DSMC/PIC methods, to include Coulomb interactions and sputtered species.
- Fundamental experiments to measure secondary emissions and sputtered products from surfaces bombard by IL electro spray plumes.



Research Objectives

- Develop a model that will be used to interpret recent ground-based experiments and have the capability to extrapolate and predict plume-spacecraft interactions in the space environment.
- Study interactions of electro spray anions and cations with facility walls in terms of degree of secondary electron emission and sputtered wall material and propellant fragments.
- Innovation is in maintaining the chemical-atomistic nature of electro spray in the development of a 1 m-length scale plume model and the combined use of surface experiments to inform the model.



Project raises plume model TRL from 2 to 3.

Potential Impact

- There are presently no electro spray plume models.
- Model will provide a tool that can be used at NASA research centers to interpret ground based experiments.
- Proposed research will allow us to predict adverse spacecraft charging and sputtering due to espray thrusters in LEO and GEO orbits.
- While focusing on electro spray thruster plumes, the model development will be sufficiently general such that spacecraft effects from both ion and Hall thruster plumes and "cross-device" plume interactions may be assessed.