SOLVEiT: Simulating the Local Operational Volume of Electrospray ion Thrusters

Paulo Lozano (PI)
Massachusetts Institute of Technology
Department of Aeronautics and Astronautics

Elaine Petro (Post-Doctoral Researcher)
Massachusetts Institute of Technology
Department of Aeronautics and Astronautics

SPL space propulsion laboratory massachusetts institute of technology

Massachusetts Institute of Technology

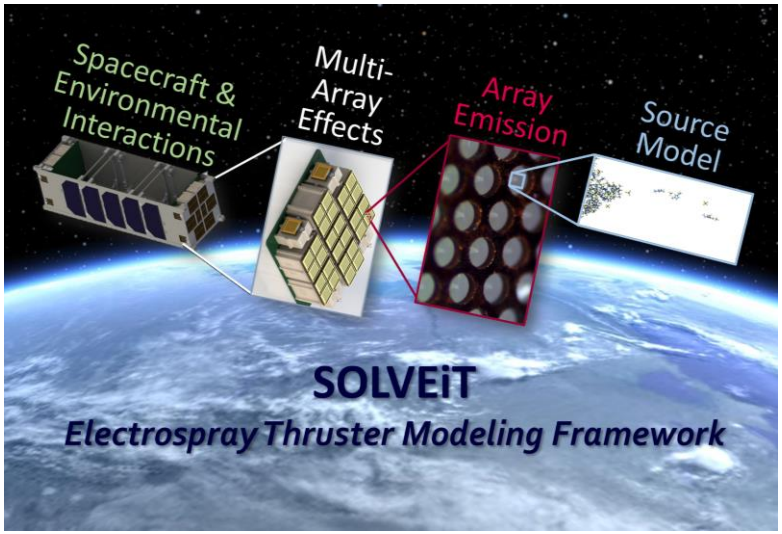
Research Objectives

Goal of this research program

- **Develop missing physical models** required to **capture the coupled interactions** between electrospray thruster arrays and host spacecraft

Innovation and Advancement of the State-of-the-Art

- Build **array source models** to connect fundamental microscale processes to **spacecraft-scale interactions**
- Create **new models for IL surface interactions** including **erosion** and **deposition**
- Integrate sub-models to **enable first spacecraft-level simulation** and **capture long time-scale effects**



TRL Levels

Initial: An integrated framework to study electrospray array thruster plumes does not exist and is currently **TRL 1**.

Upon Completion: All models will be developed and validated (**TRL 3**).

Approach

Multi-scale PIC simulations of **electrospray plumes** & their **interactions** will be developed and combined to create the **first integrated modeling framework** for electrospray **thruster arrays on SmallSat platforms**.

Model Components	Validation Technique(s)
Array Plume Characteristic & Interactions	*Space-resolved RPA/Faraday cup QCM deposition measurements*
IL Deposition & Erosion Rates	*AFM following long duration tests*
Spacecraft Charging Profile	*CubeSat testbed*

Potential Impact

Benefits to…

Space Science and Exploration

- Modeling will **improve reliability** and offset costly testing for **long-lifetime operation**
- Spacecraft-level modeling will provide the **ability to predict and mitigate degradation of sensitive spacecraft components** (optics, solar arrays) thus reducing risk and accelerating SmallSat infusion of EP.

"Spin-off" Technologies

- Other **focused ion beam applications** such as lithography, etching, and microfabrication will benefit from **better tracking and surface process models**.