Simulating Experimental Conditions of the HIIPER Space Propulsion Device

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Introduction:

The Helicon-Injected Inertial Plasma Electrostatic Rocket (HIIPER) is a two-stage electric propulsion system comprising of a helicon plasma source and an inertial electrostatic confinement (IEC) device. COMSOL has been used to predict results and simulate experimental diagnostics.

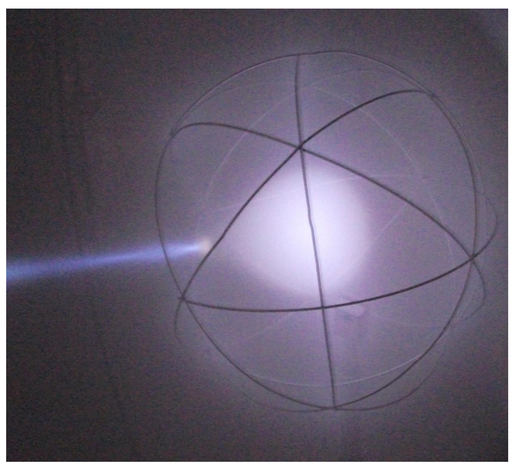

Figure 1. IEC in jet mode.

Computational Methods: Three COMSOL studies have been performed:

1. Gridded energy analyzer (GEA) potential profile
2. Helicon potential profile generated by spherical Langmuir probe
3. Cooling and heating curves of Faraday cup diagnostic

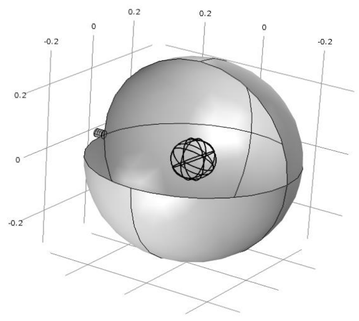

Figure 2. COMSOL model of the GEA inside the IEC chamber.

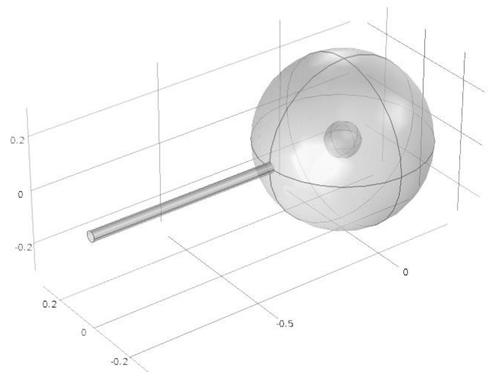

Figure 3. COMSOL model of the helicon dielectric tube attached to IEC.

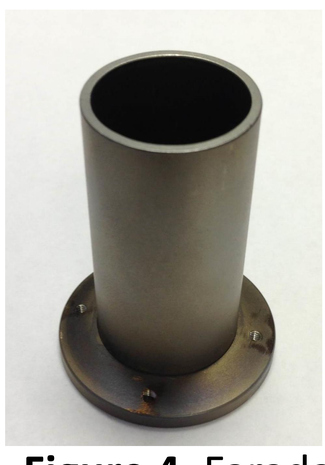

Figure 4. Faraday cup diagnostic and COMSOL model.

Results:

1. Potential profiles were generated for experiment and GEA

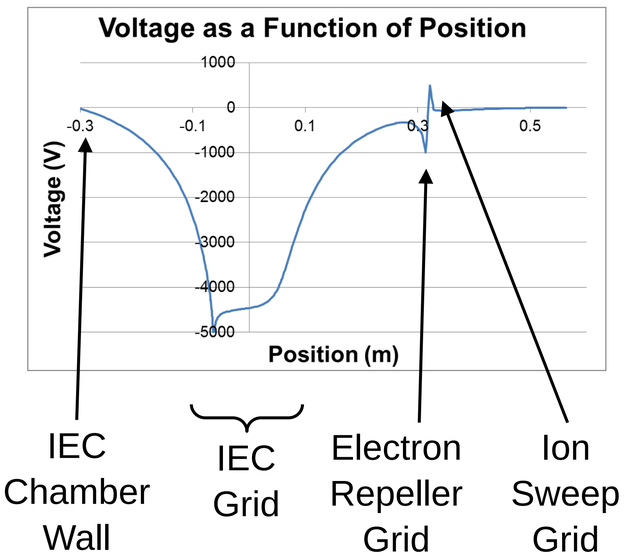

Figure 5. COMSOL potential profile.

2. Langmuir probe simulation showed a 25 V drop in helicon tube
3. Faraday cup cooling curve and heating calibration curve were generated

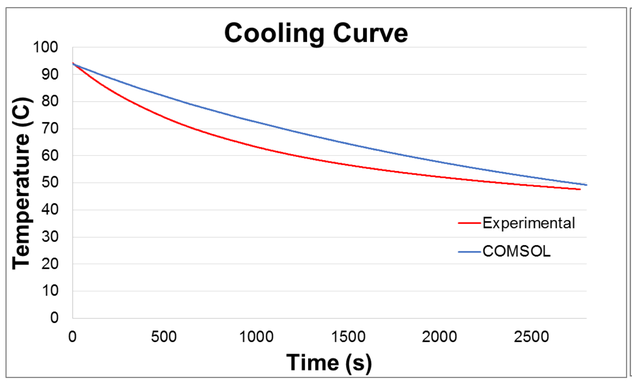

Figure 6. Cooling curve and heating calibration curve.

Conclusions: COMSOL numerical analysis on potential profiles has allowed for predicting experimental results. For Faraday cup, preliminary simulation results indicate a correlation with experimental results and allow for the extraction of thermal power values.

References:

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2. G. H. Miley, et al, "HIIPER Space Propulsion for Future Space Missions," in COMSOL Conference 2011, Boston, 2011.

3. P. Keutelian, et al, "Progress in Numerical Simulation of HIIPER Space Propulsion Device," in COMSOL Conference 2012, Boston, 2012.

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