DEPARTAMENTO DE INGENIERÍA MECÁNICA TÉRMICA Y DE FLUIDOS
Tel.: 0034 951 95 23 69
dirdep031@uma.es

Universidad de Málaga
Arquitecto Francisco Peñalosa, 6
Campanillas, 29071 Málaga

Plasma Sources Science and Technology
Editor's Office

Málaga, March 15th, 2025

Dear Editor,

Please find attached an electronic copy of the manuscript *"Numerical investigation of a Hall thruster plume: domain size, boundary conditions, cathode location"*, by Adrián Domínguez-Vázquez, Jiewei Zhou, Alejandro Sevillano-González and Eduardo Ahedo, which we would like to submit for publication in your esteemed journal. This manuscript is neither copyrighted, classified, published, nor is being considered for publication elsewhere.

Numerical models used in Hall effect thruster research typically simulate an inevitably limited near plume region. Experimental data for validating the numerical results are primarily obtained from plume diagnostics. Therefore, three key aspects are critical for model validation: setting appropriate boundary conditions at the plume boundary to accurately represent the expected behavior of the current-free expanding plume into free space (or a large vacuum chamber); evaluating plume domain size effects; and analyzing the influence of the neutralizer cathode location on the coupling between cathode electrons and the ion beam. This work presents a comprehensive study on these three aspects using a 2D axisymmetric hybrid particle-in-cell/fluid code.

We introduce a novel model enforcing a net current-free condition at the plume boundary, overcoming limitations associated with the commonly used local zero current condition. Our findings demonstrate that the new model provides a more robust and reliable plasma solution in the plume against plume truncation, particularly when the cathode is located outside the magnetic separatrix in the plume. This improves the accuracy of the results obtained for smaller, computationally efficient plume domains, and is of central importance for validation of simulation results against experimental data from plume diagnostics. Moreover, the simulation results indicate that the discharge performance is enhanced when the cathode is located at the thruster axis due to the improved cathode-beam coupling, consistent with previous experimental and numerical studies.

We hope that the manuscript satisfies the publication requirements in PSST. The manuscript is sent in a single PDF document and separate files for text and figures are provided in LaTeX and PDF formats.

Yours sincerely,

Adrián Domínguez-Vázquez, Associate Professor
Universidad de Málaga (UMA)
Equipo de Propulsion Espacial y Plasmas (ep2.uc3m.es)
Universidad Carlos III de Madrid (UC3M)