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Michigan Institute for Plasma Science and Engineering

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Room 1010 Dow

Prof. Elaine Petro

Cornell University

Multiscale Modeling of Molecular Ion Beams and Beam-Surface Interactions

Electrospray ion sources are enabling technologies in the realms of satellite propulsion, biochemical analysis, and various surface processing industries. These applications motivate a deeper understanding of the physics of an expanding ion beam and the chemistry of particle collisions. Electrospray ion plumes challenge state of the art plasma modeling techniques due to the wide range of length and timescales over which key processes take place (i.e. nanometer-scale emission sites and centimeter scale operational volumes). Accompanying these spatial gradients are large density and velocity gradients in both the ion and neutral populations. Furthermore, the electrospray plume is a non-neutral plasma with non-Maxwellian distributions. We present state of the art numerical models of the dynamics and chemistry of an expanding molecular ion plume which are necessary to explore design variables, to understand operating conditions, and to improve performance. Beyond applications in satellite propulsion, we will discuss opportunities to utilize these ion sources in other relevant fields.

About the Speaker: Elaine Petro is an Assistant Professor in Mechanical and Aerospace Engineering at Cornell University and director of ASTRAlab, a research lab focused on sustainable space propulsion and exploration architectures. Elaine completed her Ph.D. at the University of Maryland, in the Space Power and Propulsion Laboratory, studying water plasma chemistry. She spent several years in the MIT Department of Aeronautics and Astronautics as a visiting student and post-doctoral researcher, studying electrospray thruster technology for small satellite platforms. For her work on electrospray model development, Petro received the 2023 AFOSR Young Investigator Program award. was named an ARCS Scholar, National Science Foundation and Amelia Earhart fellow, and was recognized as one of Aviation Week & Space Technology's Twenty20s emerging leaders in aerospace in 2016. Prior to graduate studies at UMD, Petro worked on the MAVEN Mars Orbiter, and James Webb Space Telescope, and Hubble Space Telescope missions at NASA's Goddard Space Flight Center. Elaine is passionate about diversity and inclusion in STEM and is a founding member of the national Women of Aeronautics and Astronautics organization.