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Plasma Instabilities in Electric Propulsion Devices

Electric propulsion (EP) is a key enabling technology for the commercialization and exploration of space. EP-based systems, which use power from an external supply to accelerate ionized propellant, can achieve a higher specific impulse (>1500 s) than traditional forms of in-space propulsion; which translates to higher payload mass fractions, and in some cases, to faster transit times to deep space destinations. The advantages of EP have led NASA to designate the Hall thruster (HT) as a critical technology for deep space exploration. Before the HT can be qualified for long duration missions (>5 years), outstanding questions concerning the life, stability, and performance of the HT should be addressed. In particular, the onset of plasma instabilities can lead to anomalous effects for all three of these aspects of HT operation. Analytical and experimental work on the role of two of these types of instabilities is presented. The growth of ion-acoustic like turbulence in Hall thrusters is examined in the context of inducing anomalous cross-field electron transport and energetic ion production. The impact of 10-100 kHz, ionization-type “breathing mode” oscillations on thruster life and stability is also discussed.

About the Speaker: Dr. Benjamin Jorns is Asst. Prof. in the Dept. of Aerospace Engineering at the U. of Michigan and co-director of the Plasmadynamics and Electric Propulsion Laboratory. After receiving his PhD in Mechanical & Aerospace Engineering from Princeton U. in 2012, Dr. Jorns joined the electric propulsion group (EP) at the NASA Jet Propulsion Laboratory. His work there from 2012-16 combined experimental and analytical techniques to investigate propulsion systems for the next generation of NASA robotic missions. Dr. Jorns was also lecturer in the Mechanical and Aerospace Engr. Dept. at UCLA from 2013-15. His primary research interests include wear mechanisms and stability EP systems, turbulence and nonlinear processes in low temperature plasmas, developing new plasma diagnostics, and investigating breakthrough forms of in-space propulsion.