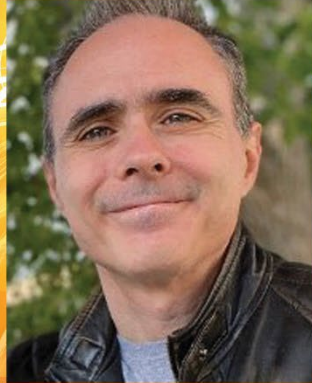




**Wednesday
November 5, 2025
3:10 pm
Room 1003 EECS**

Dr. Ioannis (Yiingos) Mikellides

NASA Jet Propulsion Laboratory

Plasma Physics Modeling and Simulations of Electric Propulsion Over the Last Two Decades at the Jet Propulsion Laboratory

The first ion engines were launched into orbit in the 1960s but it was not until the 1990s that their commercial use began in the U.S., followed by the first NASA flight on Deep Space 1 in 1998. Hall thrusters (HTs) followed a similarly long trajectory from the lab to deep-space flight. Since the 1970s thousands of HTs have flown in near-Earth orbit, yet it was not until NASA's Psyche mission in 2023 that HTs were used as primary propulsion beyond lunar orbit. Two challenges contributed to this protracted path. First, HTs are low-thrust, high-exhaust-speed devices that achieve large ΔV s but must operate for years in space. Flight qualification in vacuum facilities can be prohibitively costly and time-consuming. Challenges in qualifying a technology by test alone are not unique to electric propulsion (EP). Certification of the U.S. nuclear weapons stockpile now relies on physics-based modeling and simulations (M&S) requiring large investments. The second challenge is that investment in M&S for EP has been limited. Their inherently complex physics prohibited the advancement of first-principles M&S tools to a level that could make major impact on development. Instead, technology advancement depended largely on empirical scaling and laboratory testing. A focused effort on physics-based M&S began in the 2000's in the EP Group of the Jet Propulsion Laboratory (JPL). In this presentation I will highlight achievements made at JPL in the M&S of plasmas in EP, and discuss their impact on development, maturation and flight qualification of EP for NASA deep-space missions.

About the Speaker: Dr. Ioannis (Yiingos) G. Mikellides is a Senior Research Scientist and Principal Engineer at NASA's Jet Propulsion Laboratory. He received his Ph.D. in Aeronautical and Astronautical Engineering from The Ohio State University. In over three decades his theoretical investigations of applied plasma physics, supported by extensive numerical simulation, have spanned applications as diverse as high-pressure discharge chambers and hypersonic nozzles, ablative thrusters, magnetic nozzles in fusion propulsion, MHD shocks, rarefied EP plumes and astrophysical plasmas. He has developed OrCa2D and Hall2De, two novel scientific plasma codes that have been supporting the qualification of hollow cathodes and HTs for NASA's EP missions since he joined JPL in 2003. Hall2De has also been licensed to various institutions of government, academia and the private sector nationwide. His theoretical work has led to notable advances in our understanding of EP plasmas such as the prediction of ion acoustic turbulence in cathode discharges and the development of the first principles of magnetic shielding in HTs. He has published more than 60 refereed articles in aerospace engineering, applied physics, planetary/space sciences and astrophysics journals, and co-authored the 2023 book "Fundamentals of Electric Propulsion". He is a Fellow of the AIAA and the recipient of multiple recognitions including the NASA Exceptional Engineering Achievement Medal and the JPL Lew Allen and Edward Stone Awards. <https://www.jpl.nasa.gov/site/research/imikelli/>