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Michigan Institute for Plasma Science and Engineering

MIPSE Early Career Lecturer

Wednesday
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3:00 pm
Room 1003 EECS

Prof. Carmen Guerra-Garcia

Massachusetts Institute of Technology

Understanding and Controlling the Interactions of Plasmas with Flames and Flowing Gases

Electrical discharges in aerospace applications occur in complex, nonuniform environments featuring reactive and flowing gases. Understanding and controlling these plasmas requires a multiphysics approach and consideration of the coupling between plasma and its environment. One example is use of pulsed nanosecond discharges in plasma-assisted combustion. To combat climate change, reducing emissions of CO_2 and NO_x is critical. Pulsed nanosecond discharges have proven effective in stabilizing lean flames and mitigating combustion instabilities under lean conditions, which help minimize thermal NO_x formation. However, the interplay between flame and plasma presents ongoing challenges. This presentation will explore experimental and theoretical investigations into these two-way coupled interactions for fundamental and industry-relevant flames. Another example involves discharges in non-reactive, flowing gas environments, such as lightning arcs attaching to aircraft in flight or wind turbine blades. During the damaging current flow phase, an aircraft can travel ten times its length, causing the arc to interact with the fluid boundary layer and reattach to new locations (the swept stroke phase). Understanding the interplay between flow physics and electrical breakdown is essential for developing lightning protection systems. We will review experiments and models to address these interactions.

About the Speaker: Carmen Guerra-Garcia is the Charles Stark Draper Assoc. Professor of Aeronautics and Astronautics (A&A) at the Massachusetts Institute of Technology (MIT), where she leads the Aerospace Plasma Group at the intersection of aerospace engineering, low temperature plasma technologies, and gas discharge physics. She majored in Aeronautical Engr. at Polytechnic Univ. of Madrid (Spain) and obtained her SM and PhD in A&A from MIT. Prior to joining MIT, Guerra-Garcia was with the Boeing Research and Technology Europe and a visiting researcher at Princeton University. Guerra-Garcia has received NSF CAREER Award (2024), Office of Naval Research Young Investigator Award (2021) Intl. Fulbright Science and Technology Award (2009), Junior Bose Award for Excellence in Teaching (2024) and Earll M. Murman Award for Excellence in Undergraduate Advising (2021). She is a member of the APS Gaseous Electronics Conference Exec. Committee and the AIAA Plasmadynamics and Lasers Technical Committee. Guerra-Garcia's research spans from interaction of lightning with aircraft and wind turbines, to plasma technologies for ignition, combustion, and chemical conversion.