LHD 学术报告

空天飞行科技
创新研究中心
LAB FOR AEROSPACE
SCIENCE & TECHNOLOGY

报告题目：

The Breakdown of the Fluid Approximation for Electrons in Mesothermal Plasma Expansion and Its Implications on Plasma Plume/Wake Models

报告人：

Prof. Joseph Wang

University of Southern California

时间：2018年7月11日（周三）14:00

地点：力学所1号楼312会议室

报告摘要：

Collisionless mesothermal plasma expansion is a classical plasma physics problem with many applications in electric propulsion, spacecraft-plasma interactions, and spacecraft charging. Most studies of plasma expansion have adopted a fluid approximation for electrons to simplify the solution of the electron dynamics and save on computational time. This talk presents results from a comparative study using fluid-electron based analytical solution, hybrid particle-ion fluid-electron particle-in-cell (PIC), and fully kinetic PIC simulations to study plasma plumes and plasma wakes. We show that a collisionless mesothermal plasma expansion may be characterized into two regions based on electron characteristics: a fluid-like expansion region and a kinetic expansion region. While the electrons in the fluid-like expansion region may be modeled as an equilibrium fluid, the electrons in the kinetic expansion region are strongly non-Maxwellian and anisotropic. The commonly used fluid approximation for electrons breaks down in the kinetic expansion region. A parameter based on the weighted deviation of the electron velocity distribution from the equilibrium is proposed to quantify the non-equilibrium degree and to predict the breakdown of the electron fluid assumption. The implications of this study on engineering application models will also be discussed. Additionally, a brief overview of research at the Laboratory for Exploration and Astronautical Physics (LEAP) at USC will be discussed before the main talk.