UCLA Department of Physics & Astronomy

COLLOQUIUM

Thursday, January 8, 2026 at 4 p.m.
PAB 1-434

Opportunities at the intersection of kinetic simulations of plasmas and machine learning

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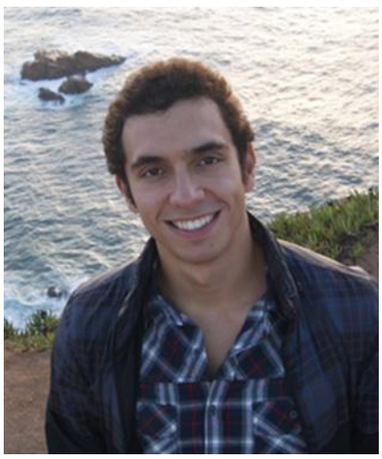

First-principles kinetic simulations have long been indispensable tools for advancing our understanding of plasma physics. With the advent of increasing computational power, these simulations can now tackle larger and more complex problems than ever before. However, as the size of these simulations grows, so too does the volume and complexity of the data they generate, presenting new challenges in data analysis and interpretation. Scientific Machine learning (SciML) is emerging as a powerful solution to these challenges, offering new ways to harness and analyze the vast datasets produced by fully kinetic simulations. Beyond data analysis, the computational underpinnings of SciML also present new opportunities to innovate in the way we tackle computational problems in plasma physics.

In this talk, I will give an overview of some of the exciting research avenues being explored at the intersection of kinetic simulations and SciML in plasma physics. I will then focus on two example avenues that my group has been pursing. The first consists in understanding how to use SciML to derive accurate yet simplified dynamical models of plasmas directly from the data of first-principles particle-in-cell simulations. These approaches hold the potential to create new theoretical frameworks and computationally efficient simulation models of plasmas. Second, I will discuss how computational methods from SciML, such as physics-informed neural networks, can be applied to solve complex inverse problems in plasma physics, including the full state reconstruction of plasmas from partial measurements/observations. Here, first-principles kinetic simulations serve as numerical experiments, providing the data necessary to understand both the potential and limitations of these innovative computational techniques, and to guide their development for plasma physics.

Refreshments at 3:30 p.m. PAB Patio. **Undergraduates Welcome!**