UCLA

Plasma Physics Seminar

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1:00PM

Accelerating our understanding of the multi-scale dynamics of high-energy plasmas

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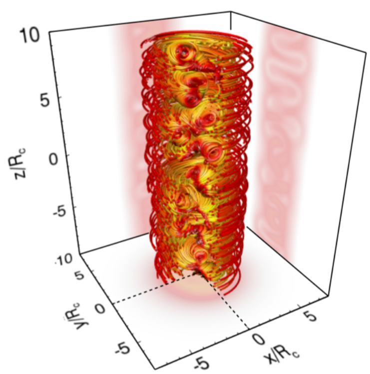
At the core of many long-standing challenges in plasma physics, from controlling nuclear fusion to understanding the acceleration of the most energetic particles in the Universe, is the problem of capturing the multi-scale interplay between kinetic processes and global plasma dynamics. State-of-the-art kinetic simulations are beginning to capture a sufficiently large dynamical range to probe fundamental aspects of this interplay. Advances in experimental capabilities are further allowing us to closely validate theoretical/computational models, and even probe beyond the range of scales accessible to our largest simulations. Moreover, the increasing quantity and quality of plasma data being produced is creating new opportunities for innovation in the way we tackle these long-standing challenges.



Fully kinetic simulation of the self-consistent development of the kink instability in a relativistically magnetized electron-positron jet

In this talk, I will discuss how state-of-the-art kinetic simulations are beginning to unveil the physics interplay between kinetic plasma processes and global plasma dynamics in the context of magnetic field generation and particle acceleration in relativistic astrophysical outflows. I will also discuss how techniques from the fields of Artificial Intelligence and Machine Learning can help us take full advantage of the data from high-fidelity numerical simulations and experiments to accelerate the discovery of reduced descriptions of kinetic plasma processes, and improve the physics fidelity of multi-scale plasma models for a broad range of applications.

Dr. Paulo Alves is a Research Associate at the High Energy Density Sciences Division at the SLAC National Accelerator Laboratory. He obtained his PhD in Plasma Physics at the Instituto Superior Tecnico in Lisbon, Portugal, in 2015. His research aims to understand the fundamental plasma processes that occur in extreme astrophysical environments (including those governing the generation and amplification of magnetic fields, and the acceleration of high-energy particles), and in high-energy-density laboratory experiments (including nonlinear optics in plasma, and the interplay between kinetic processes and hydrodynamic instabilities). He utilizes a combination of analytic theory and massively parallel kinetic plasma simulations to understand the nonlinear and multi-scale dynamics of plasmas in these systems from a first-principles perspective. He is also interested in combining modern techniques from Artificial Intelligence and Machine Learning with traditional theoretical and computational techniques from Plasma Physics to develop advanced computational algorithms for multi-scale plasma modeling, and to accelerate scientific insight from the increasingly complex and abundant data being produced by state-of-the-art plasma simulations and experiments.