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Title: Relaxing astromaterials under extreme conditions: microscopic simulations and anomalous properties

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Seminario de Física Teórica. Física. Edificio B

Viernes 15 de mayo de 2026. 12.30 h

Abstract:

Astromaterials have risen to the spotlight in the last decade, in the wake of the inauguration and planning of observatories, such as the Einstein Telescope (ET) able to constrain their properties. Such materials, appearing naturally in compact (white dwarfs, WD) or ultra-compact (neutron stars, NS) objects, have extreme physical properties: pressure, magnetic fields, resistance to deformations, among others.

In this talk I will review our progress in the modeling of ionic astromaterials that appear in NS crusts and WD cores. We use Molecular Dynamics (MD) simulations with state-of-the-art electrostatic potentials and focus on equilibrium and out-of-equilibrium properties. I will briefly show our results concerning finite-size effects on material phase transitions, the ionic equation of state of the NS outer crust, and relaxation phenomena.

Secondly, I will focus on our work where we showcased anomalous properties arising in warm ionic plasmas. Under certain conditions, these systems exhibit faster cooling from increasingly larger initial temperature values. I will explain our interpretation of such an effect in relation to oscillations in the velocity correlation function that hint at the existence of a non-trivial memory function. I will finally discuss examples of astrophysical scenarios where out-of-equilibrium conditions may affect astrophysical observables.