



UNIVERSITÀ DI PAVIA
Dipartimento di Fisica
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AVVISO DI SEMINARIO

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Aula Dottorato

Dynamical multiferroic states in perovskites

Abstract: Angular momentum is traditionally associated with electronic degrees of freedom through spin and orbital motion, underpinning magnetism and forming the foundation of spintronics and orbitronics. Only recently it has become clear that the crystal lattice itself can carry angular momentum, in the form of chiral and axial phonons [1]. This recognition has triggered a conceptual shift in solid-state physics: phenomena traditionally associated with electronic angular momentum, including Hall, Zeeman, Barnett and Einstein-de Haas effects, have now been identified in the vibrational sector of matter. The ability to generate and control lattice angular momentum thus opens new opportunities to manipulate macroscopic properties of materials through their vibrational degrees of freedom.

In this talk, I will discuss how tailored terahertz excitations can be used to generate and control phonon angular momentum and to engineer dynamical multiferroic states in perovskite materials. I will show how the time-dependent electric polarization associated with circularly polarised phonons generates a giant and quasi-static magnetization in the unit cell of a nonmagnetic perovskite, as SrTiO_3 [2] and KTaO_3 [3]. I will then show that strain-driven control of phonon angular momentum can be achieved in ferroelastic perovskites, e.g. LaAlO_3 , with surprising consequences [5].

The final aim of this seminar is to attract attention on coherently driven phonon angular momentum states, able to couple (and trigger) emergent macroscopic properties in quantum materials.

[1] D.M. Juraschek et al. *Nature Physics* 21, 1532–1540 (2025).

[2] M. Basini et al. *Nature* 628, 534-539 (2024).

[3] C. Kadlec et al. *ArXiv:2608.27060*.

[4] M. Basini et al. *Physical Review Letters* 136, 156902 (2026).

[5] F. Graf et al. In preparation.