Invited talk

Vortex dynamics in strongly interacting Fermi superfluids

Roati G.[†1,2]
[1] *National Institute of Optics, CNR, Firenze, Italy*
[2] *LENS, University of Florence, Italy*

[†]giacomo.roati@ino.cnr.it

Topological defects play a fundamental role in shaping the properties and structures of diverse out-ofequilibrium physical and biological systems across a wide range of scales. These include planetary atmospheres, turbulent flows in classical and quantum fluids, and electrical signaling in excitable biological media[1]. In superfluids and superconductors, the motion of quantized vortices is tied to the onset of dissipation, which limits the superflow[2]. Understanding vortex dynamics remains a challenge due to the complex interplay among vortices, disorder and system dimensionality. We address this challenge by exploring vortex matter in strongly interacting Fermi superfluids made of ultracold atoms[3]. By designing specific vortex configurations and tracking their trajectories with high spatial resolution, we transform our system into an ideal "quantum laboratory" for probing the fundamental nature of vortex-driven instabilities and dissipation[4,5]. Our research paves the way for deeper insights into vortex-matter phenomena in strongly correlated superfluids.

[1] Spiral and Vortices, K. Tsuji and S. C. MÏler Editors, *Springer Nature* (2019).
[2] B. I. Halperin, G. Refael and E. Demler, *Int. J. Mod. Phys, B* **24**, 20n21 (2010)
[3] W. J. Kwon *et al.*, *Nature*, **600** (2021).
[4] D. Hernandez-Rajkov *et al.*, *Nat. Phys.* **20** (2024).
[5] N. Grani et *al.*, arXiv:2503.21628v1 (2025).