ID contributo: **2** Tipo: **non specificato**

Glitches in rotating supersolids

mercoledì 11 ottobre 2023 18:20 (20 minuti)

Glitches, spin-up events in neutron stars, are of prime interest as they reveal properties of nuclear matter at subnuclear densities. We numerically investigate the glitch mechanism using analogies between neutron stars and magnetic dipolar gases in the supersolid phase. In rotating neutron stars, glitches are believed to occur when many superfluid vortices unpin from the interior, transferring angular momentum to the stellar surface. In the supersolid analogy, we show that a glitch happens when vortices pinned in the low-density inter-droplet region abruptly unpin. These supersolid glitches show remarkable parallels with neutron star glitches: they are characterized by a rapid spin-up followed by a long post-glitch spin-down due to relaxation towards a steady state. Dipolar supersolids offer an unprecedented possibility to test both the vortex and crystal dynamics during a glitch. Here, we explore the glitch dependence on the supersolid quality, finding strong suppression at the supersolid-to-solid transition. This provides a tool to study glitches originating from different radial depths of a neutron star. Benchmarking our theory against neutron star observations, our work will open a new avenue for the quantum simulation of stellar objects from Earth.

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Classifica Sessioni: Compact stars