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Fluxtube dynamics in neutron star cores

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Although the detailed structure of neutron stars remains unknown, their equilibrium temperatures lie well below the Fermi temperature of dense nuclear matter, suggesting that the nucleons in the stars' interior form Cooper pairs and exhibit macroscopic quantum behaviour. In this talk, I will focus on the superconducting protons in the outer core, which are expected to show type-II properties. The presence of such a quantum condensate could impact on the neutron stars' large scale properties, because the magnetic field is no longer locked to the charged plasma but instead confined to fluxtubes. The motion of these structures thus governs the dynamics of the interior magnetic field. In order to examine if core magnetic field evolution could be driven on observable timescales, I will address several mechanisms that affect the fluxtube distribution in the outer core and determine their characteristic timescales for realistic neutron star equations of state. The results suggest that the timescale for each mechanism is not constant (as often assumed) but can vary by several orders of magnitude for different densities inside the star, being generally shortest close to the crust-core interface.

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