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Superconducting phases in a two-component microscale model of neutron star cores

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Macroscopic quantum behaviour is prominent in many physical systems, ranging from superfluid phases in ultra-cold atomic gases and heavy-ion collisions to superconducting transitions in metals and exotic quantum phases in dense nuclear matter as well as quark matter. With the interiors of neutron stars in mind, we consider the scenario of two coupled coexisting condensates, where one is charged and the other one neutral. We are specifically interested in the effects of entrainment (the non-dissipative coupling between two quantum states) on the equilibrium phases of the superconducting proton condensate. In this talk, I will discuss how we study its properties by means of a Galilean invariant, zero-temperature two-component Ginzburg-Landau model for realistic neutron star equations of state and energy gaps. The resulting superconducting phase diagram provides insights into the microphysical magnetic flux distribution throughout the neutron star core.

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