

Topology of the Superconducting Heart of Neutron Stars: Effects of magnetic field topology and Gravitational-Wave Signatures

Mayusree Das, Armen Sedrakian, Banibrata Mukhopadhyay

IISc Bangalore

We present the first two-dimensional general relativistic study of superconducting regions in magnetars with toroidal magnetic fields. Using the XNS code, we map the distribution of type-II and type-I superconductivity for different field strengths and stellar masses. While low-mass stars preserve larger superconducting outer cores, higher-mass stars show reduced regions. Consistent with 1D models, the inner cores remain nonsuperconducting; however, our 2D results uncover novel torus-shaped normal regions absent in previous work. We further speculate on the indirect role of superconductivity on continuous gravitational wave emission from millisecond pulsars, highlighting PSR J1843–1113 as a key target for future detectors.