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Searching for the BCS phase at nonzero isospin asymmetry

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According to perturbation theory predictions, QCD matter in the zero-temperature, high-density limits of QCD at nonzero isospin chemical potential is expected to be in a superfluid Bardeen-Cooper-Schrieffer (BCS) phase of u and \bar{d} Cooper pairs. It is also expected, on symmetry grounds, that such phase connects via an analytical crossover to the phase with Bose-Einstein condensation (BEC) of charged pions at $\mu_I \geq m_\pi/2$. With lattice results, showing some indications that the deconfinement crossover also smoothly penetrates the BEC phase, the conjecture was made that the former connects continuously to the BEC-BCS crossover. We compute the spectrum of the Dirac operator, and use generalized Banks-Casher relations, to test this conjecture and identify signatures of the superfluid BCS phase.

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