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Quartetting in fermion systems with differing chemical potentials

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In the ongoing effort to map the QCD phase diagram, the region of low temperature and moderately high density is particularly challenging for theorists. The phase structure in that region is determined by competition between Cooper pairing (driven by attractive strong interactions) and the strange quark mass (which is a source of flavor asymmetry, separating the Fermi momenta of the three quark flavors). There are various proposed outcomes of this competition, including crystalline (”LOFF”) condensates and deformed Fermi surfaces. We argue that a condensate of Cooper quartets rather than pairs is a strong candidate for the ground state. The quartet is favored by the same QCD attraction that drives Cooper pairing, but with four quarks rather than two it is easier to construct a translationally invariant condensate that includes different flavors without paying an energy penalty due to the flavor asymmetry. This concept is also applicable to other systems of fermions with flavor asymmetry, including ultracold atoms and nuclear matter.

On behalf of collaboration:

None

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