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Dilute limit of an interacting spin-orbit coupled two-dimensional electron gas

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The combination of many-body interactions and Rashba spin-orbit coupling in a two-dimensional fermion system gives rise to an exotic array of phases in the ground state. In previous analyses, it has been found that in the low fermion density limit, these are nematic, ferromagnetic nematic, and spin-density wave phases. At ultra-low densities, the ground state favours the ferromagnetic nematic phase if the interactions are short range (contact), and the nematic phase if the interactions are long range (dipolar). In this talk, we examine interacting two-fermion systems with spin-orbit coupling. These systems retain the physics of the dilute limit of the many-body system, while allowing us to solve the ground state exactly for each type of interaction. We determine the symmetries of the ground state, which uniquely determine the phase of the system. These phases could potentially be observed in two-dimensional GaAs heterostructures with quantum wells that lack inversion symmetry.

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