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## Many-Body Entanglement in Fermi Gases for Quantum Metrology

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We explore many-body entanglement in spinful Fermi gases with short-range interactions, for metrology purposes. We characterize the emerging quantum phases via Density-Matrix Renormalization Group simulations and quantify their entanglement content for metrological usability via the Quantum Fisher Information (QFI). Our study establishes a method, promoting the QFI to be an order parameter. Short-range interactions reveal to build up metrologically promising entanglement in the XY-ferromagnetic and cluster ordering, the cluster physics being unexplored so far.

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