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Title: Validity of the scattering length approximation in strongly interacting Fermi systems

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We investigate the energy spectrum of systems of two, three, and four spin-1/2 fermions with short range attractive interactions both exactly and within the scattering length approximation. The formation of molecular bound states and the ferromagnetic transition of the excited scattering state are examined systematically as a function of the two-body scattering length. Identification of the upper branch (scattering states) is discussed and a general approach valid for systems with many particles is given. We show that an adiabatic ferromagnetic transition occurs, but at a critical transition point much higher than predicted from previous calculations, almost all of which use the scattering length approximation. In the four-particle system the discrepancy is a factor of 2. The exact critical interaction strength calculated in the four-particle system is consistent with that reported by experiment.