Three-body contact for fermions

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The resonant Fermi gas, $i.e.$ two-component fermions in 3D interacting by a short-range potential of large scattering length a_2, is a textbook model describing cold atoms near a Feshbach resonance.

A key quantity is the 2-body contact C_2, which determines $e.g.$ the number of nearby fermion pairs, the tail of the single-particle momentum distribution, the derivative of the energy with respect to a_2, or the 2-body loss rate [1,2].

Based on the non-trivial power-law scaling of the 3-body wavefunction at short distances, we introduce the three-body contact C_3, in terms of which we express $e.g.$ the number of nearby fermion triplets, or the large-momentum tail of the two-particle momentum distribution. The formation rate of deeply bound dimers by three-body recombination is expressed in terms of C_3 and a parameter a_3 defined through the asymptotic behavior of the zero-energy 3-body wavefunction at distances between the range and $|a_2|$ [3].

We compute C_3 to leading order in the non-degenerate limit for the homogeneous gas, using the exact 3-body wavefunction at the unitary limit $a_2 = \infty$, and a diagrammatic approach at negative a_2. In the Feynman diagram technique, the three-body short-distance power-law scaling comes from a large-wavevector tail of the 3-body T-matrix [4].

It is an open challenge to measure C_3 and a_3 experimentally, and to compute C_3 in the degenerate regime.

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