Scale Invariance in Ultracold Gases

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The tunability of the interaction strength in ultracold gases using either optical lattices or a Feshbach resonance allows to realize many-body systems whose Hamiltonian is scale invariant. The origin and unique features of the associated continuous symmetry are discussed for the example of a two-component Fermi gas at infinite scattering length. Its superfluid state differs fundamentally from both a BCS or a BEC description. Beyond a universal equation of state and excitation spectrum, the gas also exhibits a maximum Josephson current, reflecting a minimum of the coherence length.

A scale invariant many-body problem also arises for zero range interactions in two dimensions. In the presence of an effective gauge field in the lowest Landau level, however, scale invariance is violated due to the non-commutative nature of the guiding center coordinates.

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