# Exact relations for Fermi gases with large scattering length

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**Abstract**

For ultracold atomic gases with de Broglie wavelengths greatly exceeding the van der Waals range of the interaction, the inter-atomic forces can often be approximated as contact forces. Within the model of nonrelativistic particles with contact interactions, there are few parameters describing the interaction, the most well-known of which is the s-wave scattering length. The scattering length may be tuned to values greatly exceeding the van der Waals range for atomic gases near broad Feshbach resonances. Theoretical description of particles with contact interactions was plagued by ultraviolet divergences, somewhat analogous to what one encountered in relativistic quantum field theories. Notably, the kinetic energy and the interaction energy can both be UV divergent, but their sum, the total energy, remains finite. That finite total energy turns out to be a linear functional of the momentum distribution alone. The power-law tail of the momentum distribution, caused by the contact interaction, plays a special role in the functional. The coefficient of that tail is now called the contact, and it has been well studied both experimentally and theoretically. Recently people have extended the concept to other systems, such as Bose gases near s-wave resonances and Fermi gases near p-wave resonances.

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