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Séminaire de Physique Nucléaire Théorique

Self-binding of a Fermi-Fermi atomic mixture with zero-range attraction in one dimension

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Self-binding in Bose-Bose atomic mixtures with zero-range interactions has received lots of theoretical [1] and experimental [2] attention in the recent years, and a few studies also discussed Bose-Fermi droplets [3]. Fermi-Fermi mixtures with zero-range interspecies attraction, however, are not expected to display self-bound states, since the fermions of one species should overcome a strong Pauli pressure to bind the fermions of the other. This repulsion is, in fact, the fundamental mechanism that provides the stability of atomic Fermi mixtures along the BCS-BEC crossover, in which the dimers repel and do not form larger clusters [4]. In our work [5], we find that a 1D Fermi-Fermi mixture with sufficiently large mass imbalance can form a self-bound state in the thermodynamic limit. This result elaborates our previous few-body analyses [6], and it is based on a mean-field theory in which the heavy fermions are described within the Thomas-Fermi approximation, which is exact in the limit of large mass ratios. Our work sets the basis for understanding liquid-like states in fermionic gases.

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