Trapped cold atoms with resonant interactions: unitary gas and three-body problem

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Near a Feshbach resonance, cold atoms are strongly interacting because the scattering length diverges. Moreover the interactions are short ranged, which generally allows to model them by a zero-range pseudopotential. The limit of infinite scattering length and zero range is called unitary limit.
We obtain analytical results for N particles at the unitary limit, in a harmonic isotropic trap.
More precisely, we show that the hyperradius, a collective degree of freedom describing the global size of the gas, is separable.
This allows us to determine how the many-body wavefunctions depend on the hyperradius.
We then restrict to N=3 particles. We solve completely the 3-body problem, by using Efimov's approach. For bosonic particles, we find two types of eigenstates: universal states which only depend on the trapping frequency, the particles' mass and Planck's constant; and efimovian states which also depend on a 3-body parameter, similarly to the 3-body bound states in free space discovered by Efimov.
In an experiment, we predict that the universal states are long-lived, which is unusual for bosonic atoms. We show that this lifetime is determined by the coupling between universal and efimovian states induced by the non-zero range of interactions.
Other results for N particles with resonant interactions concern N-body resonances and virial theorems.