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Many-Body Decay Quantified by a Complex Chemical Potential
GEORGE CRAGG, ARTHUR KERMAN — For species having negative s-wave scattering lengths, atomic condensation is impossible above some critical number of atoms. Nevertheless, for some species, Feshbach resonance coupling to a molecular state enables the effective scattering length, a, to be tuned to positive values, where it is believed to then result in stability. However, a many-body analysis of the resonant system reveals that while the ground state remains unstable against collapse, the usual low-density dependencies occur in an excited state with a complex chemical potential. Physically, the imaginary part quantifies the time of decay into collective phonon excitations of the collapsing ground state, thus revealing a unique decay rate dependency on both the scattering length and the density, $\sim\ a^{5/2}\rho^{3/2}$, which can be experimentally tested. Using our predicted rate, there is good agreement with the overall lifetime observed in ^{85}Rb.

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