Spinor dynamics in a multi-component Fermi gas

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Abstract

We investigate the time-evolution of trapped multi-component ($F > 1/2$) weakly-interacting Fermi gases. In theses sytems particles of different total spin scatter with a different s-wave scattering length for each channel. The effect of this is that spinor dynamics, a transfer of atoms between internal states, can occur, which cannot happen in a two-component ($F = 1/2$) nor an earth-alkaline SU(N) system. In our study we show that for typical experimentally parameters a purely semi-classical mean-field approach [1] is insufficient to capture all possible spin-related dynamics. We extend the description by adding the effect of spin-dependent binary collisions [2]. The Boltzmann-equation obtained from that approach allows us to distinguish and identify coherent and collision-induced incoherent spinor dynamics in such systems. With a numerical simulation of the kinetic equation we predict a number of different effects of the interplay of spin-dependent interactions and the quadratic Zeeman effect, including spin waves, oscillatory and exponential spinor dynamics and collsion-induced damping.

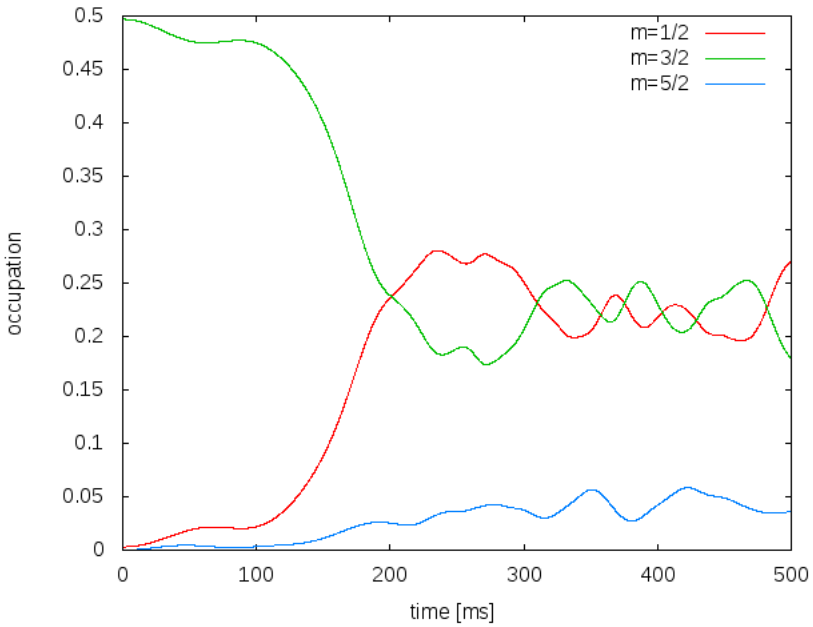

Figure 1: Time evolution of the occupation of spin components in a multi-component Fermi gas, starting almost fully prepared equally in $m = \pm 3/2$. States with m and $-m$ remain equally populated.

References

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[2] J. N. Fuchs, D. M. Gangardt, and F. Laloë, Eur. Phys. J. D **25**, 57 (2003)