

Parametric amplification of matter waves in dipolar spinor Bose-Einstein condensates

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Abstract

In this presentation we analyze the spinor dynamics in spinor Bose-Einstein condensates (with particular emphasis on the Rb87 $F=1$ case). Starting from an initial condensate in the Zeeman state $m=0$, the initial stages of the dynamics are characterized by a correlated pair creation into $m=+1$ and -1 which closely resembles parametric amplification in quantum optics. This coherent dynamics is induced by spin-changing collisions, which having a very low energy scale associated, are very sensitive to other small energy scales. In particular, as we shall discuss in detail in this presentation, the spinor dynamics is shown to be largely modified by the weak magnetic dipole-dipole interactions. We analyze in detail the dipolar effects (in particular the modification of the parametric amplification depending on the magnetic-field orientation) and how these effects are extremely sensitive with respect to even rather weak magnetic field gradients in the experiments. In the last part of this presentation, we shall discuss the formation of spatial patterns in the parametrically amplified clouds in $m=+1$ and -1 .