Ramsey-type matter interferometer with multiple Bose-Einstein condensates

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We report on a Ramsey-type interferometer realized with Bose-Einstein condensates [1] of ^{87}Rb in a magnetic Ioffe-Pritchard type trap. Two radio-frequency (rf) identical pulses are applied coupling different Zeeman sub-levels of the F=2 ground state. The condensate is initially produced in the $|F = 2, m_F = 2\rangle$ sublevel and the first rf pulse produces a superposition of different Zeeman sublevels evolving with different phases. After a variable delay, the second pulse is applied. We finally detect the population in different Zeeman sublevels resulting from the interference between different paths. The detection takes advantage from the fact that waiting enough time, condensates in different Zeeman sublevels are spatially separated. Condensates in $m_F = 2$ and $m_F = 1$ are trapped, the condensate in $m_F = 0$ expands and freely falls under gravity while condensates in $m_F = -1$ and $m_F = -2$ are repelled from the minimum of the magnetic field. The dynamics of the condensates deeply affects also the Ramsey-fringes visibility. Experimental results are presented with theoretical predictions based on mean-field theory.

[1] D. S. Hall, M. R. Matthews, C. E. Wieman, and E. A. Cornell *Phys. Rev. Lett.* **81** 1543 (1998).