Dynamics of two interacting Bose condensates in a magnetostatic trap

M. Modugno, F. Dalfovo[1], P. Maddaloni[2], C. Fort, F. Minardi, and M. Inguscio

INFM - European Laboratory for Non Linear Spectroscopy, Università di Firenze, Largo E. Fermi 2, I-50125 Firenze, Italy
Tel +39-055-2307809, Fax +39-055-224072
E-mail: modugno@fi.infn.it,
[1] *Dipartimento di Matematica e Fisica, Università Cattolica Via Trieste 17, I-25121 Brescia, Italy*
[2] *Dipartimento di Fisica, Università di Padova, Via F. Marzolo 8, I-35131 Padova, Italy*

We have induced collective oscillations of a ^{87}Rb $|F = 2, m_F = 2\rangle$ Bose condensate in a Ioffe-Pritchard type trap, by suddenly changing its number of atoms, hence its internal mean-field energy. A rf-pulse tranfers 13 % of the atoms in the $|2,1\rangle$ state ($2 \cdot 10^4$ out of $1.5 \cdot 10^5$) and a negligible population in the remaining sublevels. Due to the presence of gravity the equilibrium position of $|2,1\rangle$ is placed 9 μm below that of $|2,2\rangle$ condensate. Once generated by the rf pulse, the $|2,1\rangle$ starts oscillating and undergoes periodical collisions with the $|2,2\rangle$. The latter represents, in a first approximation, just a deformation of the harmonic external potential experienced by the $|2,1\rangle$, thus causing a shift of its radial oscillation frequency ω_{1r}.

The main result of our work is a 5 % accurate measure of this frequency shift, that is as large as $0.06\omega_{1r}$. We have also measured the damping of this center-of-mass oscillation and the collective excitations of the $|2,2\rangle$ condensate via the observation of its aspect ratio as a function of its permanence time in the trap after the rf pulse.

These result have been compared with the predictions of a 2-dimensional model based on two coupled Gross-Pitaevskij (GP) equations, which captures the basic features of our system.