Bose-Einstein condensation of rubidium atoms in a triaxial TOP-trap

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We have realized Bose-Einstein condensation (BEC) of rubidium atoms in a triaxial TOP-trap. In a double-MOT setup, we first loaded up to 10^8 atoms into the lower MOT before initiating magnetic trapping. Circle-of-death evaporation by lowering the bias field of the TOP and a final radio-frequency evaporation phase then led to condensates of a few thousand atoms. Our setup is very compact, and we achieve high magnetic gradients ($\approx 1000\,\mathrm{Gcm}^{-1}$) with modest maximum currents of 230 A. We took considerable care in determining with high precision the absolute values of the magnetic fields involved, and we describe the methods used to achieve this. These precise measurements were needed as an input into numerical simulations of non-adiabatic motion in a TOP-trap [1, 2].

We have also conducted preliminary experiments on the condensates obtained in our trap and report measurements of the condensate fraction, peak density, and the free expansion of the condensates. For the latter, we numerically integrated the Gross-Pitaevskii equation, as our condensate numbers are rather low and, therefore, the Thomas-Fermi approximation is not strictly valid.

In an attempt to substantially increase the sizes of our condensates, we discovered that the transfer efficiency from the initial number of atoms in the MOT to the final condensate decreases rapidly with increasing initial number. We attribute this to cutting effects of the circle-of-death due to the increasing size of the atomic cloud. We compare the results for our apparatus with typical numbers reported by other groups using TOP-traps and find that this seems to be an almost universal limiting factor.

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