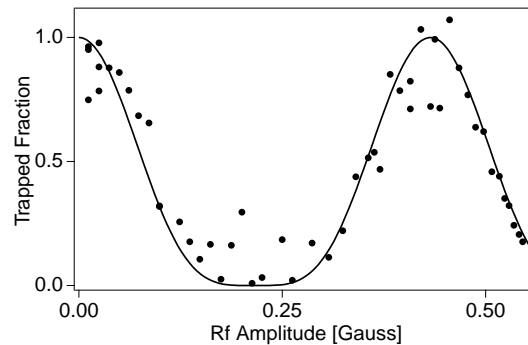


An output coupler for Bose condensed atoms

The observations of BEC have stimulated interest in atom lasers, coherent sources of atomic matter waves. The build-up of atoms in the ground state of a magnetic trap is analogous to stimulated emission into a single mode of an optical laser. An important element of a laser is an output coupler, which provides a controlled way of generating a coherent propagating beam. We demonstrated a scheme for doing this with Bose condensed atoms [1]. A variable fraction of atoms was extracted coherently from the condensate by applying rf radiation to the cloud, thereby coupling atoms to untrapped hyperfine states (see figure).

Fraction of atoms remaining trapped after the rf pulse which couples atoms out of the magnetic trap. The population undergoes Rabi oscillations. The solid line is the theoretical prediction.



The MIT atom laser operating at 200 Hz. The image (field of view 1.8 mm x 3.9 mm) shows pulses of coherent sodium atoms coupled out from a Bose-Einstein condensate confined in a magnetic trap. Every five milliseconds, a short rf pulse rotated the magnetic moment of the trapped atoms, transferring a fraction of these atoms into a quantum state which is no longer confined (“non-magnetic” $m=0$ state). These atoms were accelerated downward by gravity and spread out. The atom pulses were observed by absorption imaging. Each of them contained between 10^5 and 10^6 atoms.

1. M.-O. Mewes, M.R. Andrews, D.M. Kurn, D.S. Durfee, C.G. Townsend, and W. Ketterle, Phys. Rev. Lett. **78**, 582 (1997).