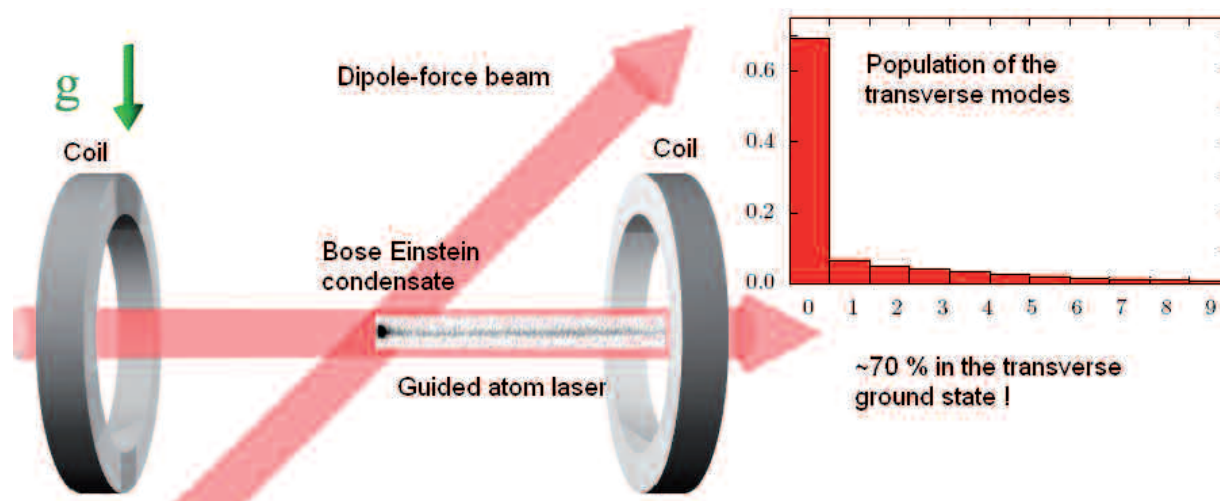


Quasi-monomode guided atom laser

An atom "laser" is a coherent beam of atoms which exhibits properties similar to that of a regular photon laser. In particular it constitutes a source of atoms orders of magnitude brighter than thermal atom beams that could be used to improve atom interferometers or to realize atom holography devices, with, for instance, nanolithography purposes. For most of its applications the control of the external degrees of freedom of the propagating beam is crucial. A simple way to realize this control is to use the dipole force resulting from an intense and red-detuned laser beam: atoms are attracted toward the region of high intensities, and are thus confined along the two directions of space perpendicular to the beam while they can almost freely propagate along the beam. In this configuration, the average excitation number of the transverse modes of the guided beam gives the quality of the atom laser. Indeed this quantity sets a limit on how well the transverse phase can be



engineered: the less excited, the better the control. The work reported by A. Couvert and co-workers has recently demonstrated a new scheme of producing such an optically guided atom laser relying on the progressive spilling of atoms from an optically trapped Bose-Einstein condensate using a magnetic force (see figure). The resulting atomic beam was measured to have an average excitation number of the transverse modes as low as 0.6, from which the authors deduce, using a thermodynamical

model, that almost 70% of the atoms are in the ground state of the transverse confinement. This result shows that, with this new scheme, it is possible to produce atom lasers in the quasi-monomode regime. ■

A. Couvert, M. Jeppesen, T. Kawalec, G. Reinaudi, R. Mathevet and D. Guéry-Odelin, 'A quasi-monomode guided atom laser from an all-optical Bose-Einstein condensate', *EPL* 83, 50001 (2008)