FRONTIERS IN OPTICAL COHERENT AND ULTRAFAST SCIENCE
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A nugget from FOCUS:

Bose-Einstein Condensation at the University of Michigan

R. Sapiro, R. Zhang, G. Raithel February 2007

A Bose-Einstein condensate (BEC) is a state of matter in which cold atoms share the same quantum-mechanical wave-function, thus creating matter waves with large, macroscopic occupation numbers. In 1995, Professors Cornell (JILA), Wieman (JILA) and Ketterle (MIT) have, for the first time, achieved BEC in dilute atomic gases. In 2001, this achievement was rewarded with the Nobel Prize.

In a FOCUS seed funding activity, the first Bose-Einstein condensate at the University of Michigan has been created. At present, more than 30,000 atoms can be condensed in the University of Michigan BEC setup; the condensed atoms have temperatures below 20 nano-Kelvin. Since BECs are coherent matter waves, they behave in many ways analogous to laser beams. Due to their perfect matter-wave coherence, BECs are expected to lead to revolutionary applications in fields such as atom interferometry, precision measurement and nanotechnology. At the University of Michigan, it is planned to research on BECs in optical lattices, on the interaction of BECs with perturbing particles such as ions, and on atom-interferometric applications of BEC.

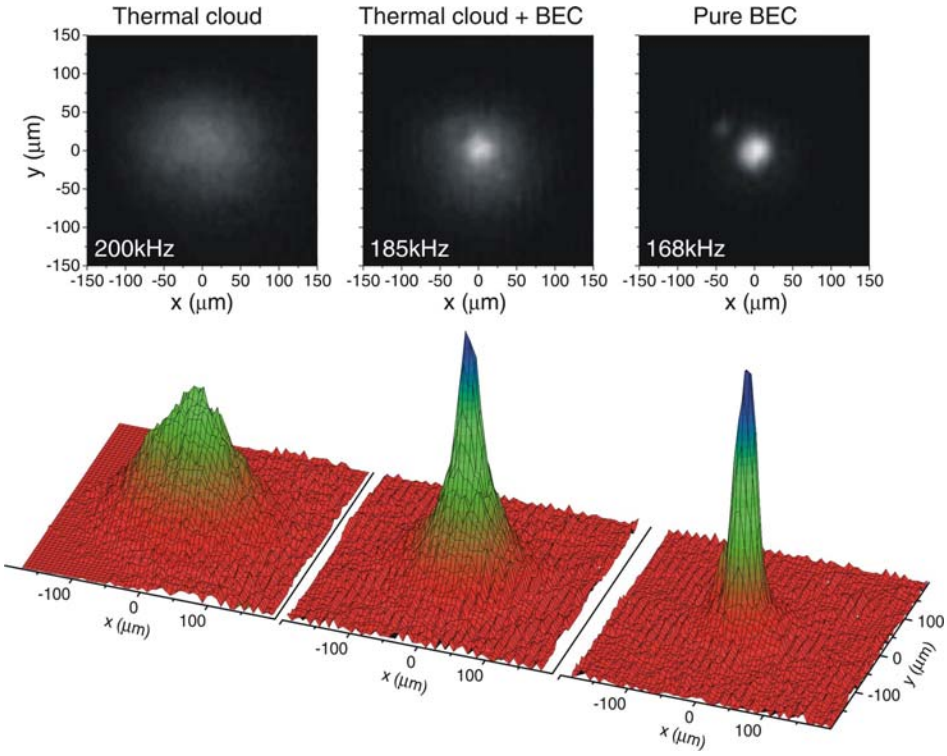

Figure: Images of clouds of laser-cooled ^{87}Rb atoms at various stages towards Bose-Einstein condensation (BEC). The images show the area density of the detected atoms as a function of coordinates x and y. The displayed area densities range from 0 to 8×10^8 atoms/cm^2; positions are given in units of micrometers. **Left:** Thermal cloud close to the formation of a BEC. **Middle:** Mixture of thermal atoms and a BEC. **Right:** Pure BEC of more than 30000 atoms at a temperature of less than 20 nano-Kelvin. The condensates manifest themselves in the form of cold, dense cores at the centers of considerably wider, hotter and less dense thermal clouds.