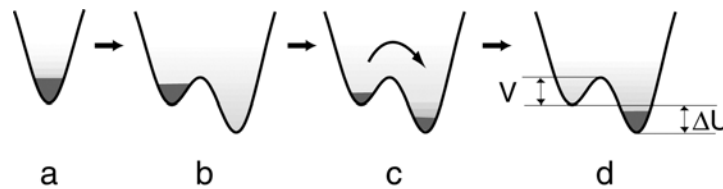


Distillation of Bose-Einstein condensates in a double-well potential

The characteristic feature of Bose-Einstein condensation is the accumulation of a macroscopic number of particles in the lowest quantum state. Condensate fragmentation, the macroscopic occupation of two or more quantum states, is usually prevented by interactions [1]. However, multiple condensates may exist in metastable situations. Let's assume that an equilibrium condensate has formed in one quantum state, but now we modify the system allowing for one even lower state. How does the original condensate realize that it is in the wrong state and eventually migrate to the true ground state of the system? What determines the time scale for this equilibration process? This is the situation, which we have experimentally explored by preparing a Bose-Einstein condensate in an optical dipole trap and distilling it into a second empty dipole trap adjacent to the first one [2]. The distillation was driven by thermal atoms spilling over the potential barrier separating the two wells and then forming a new condensate. This process serves as a model system for metastability in condensates, provides a test for quantum kinetic theories of condensate formation, and also represents a novel technique for creating or replenishing condensates in new locations.



Scheme for distillation of condensates in a double-well potential. (a) Condensates are loaded into the left well. (b) A new ground state is created by linearly ramping the trap depth of the right well from zero to the final value. (c) Atoms transfer into the right well via high-energy thermal atoms, and a new condensate starts to form in the right well. (d) The whole system has equilibrated.

1. P. Nozières, *Some Comments on Bose-Einstein Condensation*, in *Bose-Einstein Condensation*, edited by A. Griffin, D.W. Snoke, and S. Stringari (Cambridge University Press, Cambridge, 1995) p. 15.
2. Y. Shin, M. Saba, A. Schirotzek, T.A. Pasquini, A.E. Leanhardt, D.E. Pritchard, and W. Ketterle, *Distillation of Bose-Einstein condensates in a double-well potential*, preprint cond-mat/0311514.