Inside Science Research — Physics News Update

Number 718 #1, February 2, 2005 by Phil Schewe and Ben Stein

Complex Hybrid Structures

Complex hybrid structures,part vortex ring and part soliton, have been observed in a Bose-Einstein condensate (BEC) at the Harvard lab of Lene Vestergaard Hau. Hau previously pioneered the technique of slowing and then stopping a light pulse in a BEC consisting of a few million atoms chilled into a cigar shape about 100 microns long.

In the new experiment, for the first time, two such light pulses are sent into the BEC and stopped. The entry of these pulses into the BEC set in motion tornado-like vortices. These swirls are further modulated by solitons, waves which can propagate in the condensate without losing their shape. The resultant envelope can act to isolate a tiny island of superfluid BEC from the rest of the sample.

The dynamic behavior of the structures can be imaged with a CCD camera by shining a laser beam at the sample. Never seen before, these bizarre BEC excitations sometimes open up like an umbrella. Two of the excitations can collide and form a spherical shell (the vortex rings taking up the position of constant latitudes). Two such rings, circulating in opposite directions, will co-exist for a while, but after some period of pushing and pulling, they can annihilate each other as if they had been a particle-antiparticle pair.

Hau (hau@physics.harvard.edu, 617-496-5967) and her colleagues, graduate student Naomi Ginsberg (ginsber@fas.harvard.edu) and theorist Joachim Brand (at the Max Planck Institute for the Physics of Complex Systems, Dresden), have devised a theory to explain the strange BEC excitations and believe their new work will help physicists gain new insights into the superfluid phenomenon and into the breakdown of superconductivity. (**Ginsberg, Brand, Hau,** Physical Review Letters, 4 February; lab website **http://www.deas.harvard.edu/haulab/**)

Back to Physics News Update