Experimental Observation of a Superfluid Gyroscope in Rubidium 87

N.L. Smith, E. Hodby, G. Hechenblaikner, S.A. Hopkins and C.J. Foot

Physics Department, University of Oxford
Clarendon Laboratory, Parks Road, Oxford
Tel 01865 272285
E-mail: n.smith2@physics.ox.ac.uk

A magnetically trapped Bose-Einstein condensate of Rubidium 87 is known to exhibit scissors mode oscillations [1] when the confining potential is suddenly rotated. This mode corresponds to a small angle transverse oscillation of the condensate around one of the axes of the confining potential. However, the behaviour of the scissors mode has been predicted to change when a quantized vortex is present in the condensate before the sudden rotation [2]. The effect of the vortex is to remove the degeneracy between two counter-rotating scissors modes and produce a slow precession of the condensate around the vortex line, while it is still undergoing faster scissors oscillations. When imaged from the side, in the plane of rotation, the scissors oscillation appears to grow and then disappear, only to reappear later. The precession period has been measured and is shown to be in excellent agreement with the theoretical predictions of Stringari [2]. The angular momentum per particle introduced by the vortex has also been shown to be related to the precession period.

The talk will discuss how this situation has been realized experimentally using a condensate of ^{87}Rb atoms in a rotating Time Orbiting Potential (TOP) trap. It will outline the experimental procedure used to create a single vortex reliably, how an angle is fitted to the condensate at a given time using absorption imaging, and present some preliminary data confirming the above effect.

[1] O. Marago, et al., Phys. Rev. Lett. **84**, 2056 (2000).
[2] S. Stringari, Phys. Rev. Lett. **86**, 4725 (2001).