Dissipative Dynamics of a Harmonically Confined Bose-Einstein Condensate

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Trapped Bose gases provide an ideal setting for the study of nonequilibrium phenomena in a many-body system. Some examples include condensate formation following a thermal quench, collective excitations as a function of temperature and the relaxation of highly nonequilibrium vortex states. In these, and many other situations, the underlying superfluidity plays an essential role in determining the dynamical behaviour.

In some recent experiments[1], the dipolar motion of a harmonically-confined Bose-Einstein condensate in the presence of a disorder potential produced by a laser speckle pattern was studied. The perturbation is the vehicle by which the collective centre of mass motion is dissipated by means of internal excitations and ultimately results in the breakdown of superfluidity. We have used an extension of the Harmonic Potential Theorem to provide a rigorous theoretical formulation of this behaviour and have determined the damping of the centre of mass motion in the linear response regime[2]. We find good agreement with the experimental data of Chen *et al.* but not with that of Dries *et al.* Possible reasons for this will be discussed.

[1]Y. P. Chen, J. Hitchcock, D. Dries, M. Junker, C. Welford and R. G. Hulet, Phys. Rev. A **77**, 033632 (2008); D. Dries, S. E. Pollack, J. M. Hitchcock, and R. G. Hulet, Phys. Rev. A **82**, 033603 (2010).

[2]Z. Wu and E. Zaremba, cond-mat arXiv:1101.1332.