Full second order theory of trapped Bose condensates at finite temperatures

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We present a finite temperature field theory treatment of the collective excitations of a trapped Bose condensate that consistently includes the dynamics of the thermal cloud. Our treatment emphasizes finite size aspects of the problem, which prevent writing down simple expressions for widths and shifts. For spherical traps we show the excitations couple strongly to a small number of modes, giving rise to rich resonance structure in the excitation spectra. These should be resolvable in suitable experiments. From the spectra we can deduce approximate frequency widths and shifts of the excitations. For the breathing mode the decay rate picture fails. At higher temperatures the spectrum splits into two distinct regions and the largest resonance shifts upwards. A similar effect in the analogous mode in the anisotropic trap would explain features observed in the experiment,which as yet have not been fully understood [1].

[1] D.S.Jin et al, Phys.Rev.Lett. **78**, 764 (1997).