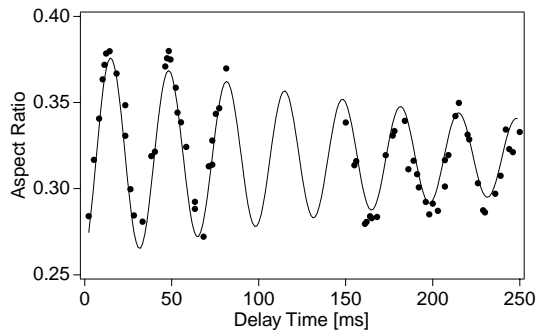


Study of collective excitations

Bose condensates are predicted to show superfluidity. As a first step towards the study of dynamic properties of a Bose condensate, we investigated the low energy collective excitations [1], contemporaneous with a similar study undertaken at Boulder [2]. Collective modes were excited by introducing a small time-dependent modulation in the trapping potential for a short period of time. When the perturbation was removed, the condensate was allowed to oscillate for a chosen time and was then released into ballistic expansion. The oscillatory behavior of the condensate was thus detected in velocity-space as shape oscillations in time-of-flight pictures (see figure).

The observed frequencies were in excellent agreement with the predictions of mean field theory, being one of the most accurate tests of this theory [1]. The nature of the damping is not yet fully understood, and requires more theoretical and experimental work.



Collective oscillations of a Bose condensate. Shown is the aspect ratio of the ballistically expanding cloud versus evolution time in the trap. These oscillations correspond to standing sound waves.

1. M.-O. Mewes, M.R. Andrews, N.J. van Druten, D.M. Kurn, D.S. Durfee, C.G. Townsend, and W. Ketterle, *Phys. Rev. Lett.* **77**, 988 (1996).
2. D.S. Jin, J.R. Ensher, M.R. Matthews, C.E. Wieman, and E.A. Cornell, *Phys. Rev. Lett.* **77**, 420 (1996).