# Erratum: Propagation of Sound in a Bose-Einstein Condensate [Phys. Rev. Lett. 79, 553 (1997)]

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We predicted that density perturbations should propagate along the axis of a cigar-shaped Bose-Einstein condensate at a speed $c = (n_0\tilde{U}/m)^{1/2}$, where $n_0$ is the density at the center of the cloud, $\tilde{U}$ characterizes the repulsive interaction between atoms, and $m$ is their mass. This prediction was based on an incorrect use of an energy functional.

We have since corrected our theoretical approach to reducing the three-dimensional sound propagation to a one-dimensional equation. We considered the quantum Lagrangian for a Bose-Einstein condensate [1] confined in a cylindrial tube which is infinite in the $z$ direction. We assumed a Thomas-Fermi solution in the radial direction by using a trial wave function of the form

$$\Psi(r, z, t) = \left(1 - \frac{V(r)}{\tilde{U}|\psi_z(z, t)|^2}\right)^{1/2} \psi_z(z, t), \tag{1}$$

where $V(r)$ is the confining potential. $\psi_z(z)$ had the form

$$\psi_z(z, t) = \sqrt{n(z, t)}\, e^{i\phi(z,t) - i\mu t/\hbar}. \tag{2}$$

Equations of motion were determined by minimizing the action $S$ of the system with respect to $n(z, t)$ and $\phi(z, t)$. We thereby obtained $c = (n_0\tilde{U}/2m)^{1/2}$, which differs from our earlier prediction by a factor of $1/\sqrt{2}$, and which agrees with recent results determined by different methods [2–4].

We reanalyzed our experimental data using an improved background subtraction and an improved fit function to measure the condensate length.

Figure 1 shows the new prediction and the corrected data points. The agreement at high density is good, whereas the discrepancy at low densities is larger than the statistical and estimated systematic errors. Since the lowest densities were achieved by radial decompression, they involve rather small aspect ratios of the condensate ($\leq$10, compared to aspect ratios of up to 30 in the compressed trap). In this regime, a one-dimensional treatment of sound propagation might not be appropriate.

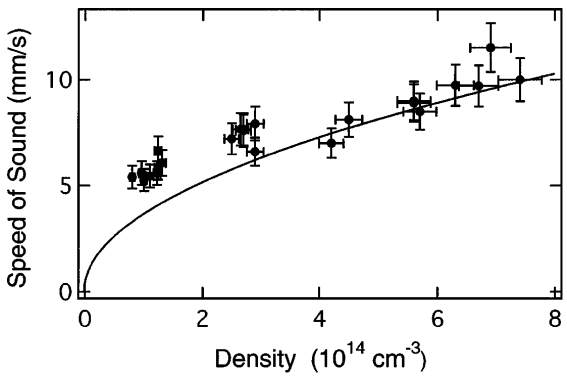


FIG. 1. Speed of sound versus condensate peak density. The solid line is the theoretical prediction with no adjustable parameter. The error bars indicate only the statistical error.

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[1] V. M. Péréz-García *et al.*, Phys. Rev. Lett. **77**, 5320 (1996).
[2] E. Zaremba, e-print cond-mat/9708237.
[3] G. M. Kavoulakis and C. J. Pethick, e-print cond-mat/9711224.
[4] S. Stringari, e-print cond-mat/980106.

  