Erratum: Bragg Spectroscopy of a Bose-Einstein Condensate [Phys. Rev. Lett. 82, 4569 (1999)]

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The Doppler broadened line shape in a Bose-Einstein condensate reflects its momentum distribution. We calculated the distribution $f(p_x)$ of momenta p_x along the x axis as the square of the Fourier transform of the condensate wave function

$$f(p_x) \sim \left[\int d^3\vec{r}\, e^{-ip_x x/\hbar} \Psi(\vec{r}) \right]^2, \tag{1}$$

where $\Psi(\vec{r})$ is the condensate wave function. However, this above expression is incorrect because we calculated $|\Psi(p_x, 0, 0)|^2$ instead of $\int dp_y\, dp_z\, |\Psi(p_x, p_y, p_z)|^2$. These two expressions agree only for separable wave functions.

Instead of Eq. (3) in our paper, we obtain the correct distribution in the Thomas-Fermi limit as

$$f(p_x) \sim \int dp_y\, dp_z \left| \int d^3\vec{r}\, e^{-i\vec{p}\cdot\vec{r}} \Psi(\vec{r}) \right|^2 \tag{2}$$

$$\sim \{2(4 + \kappa^2) J_1(\kappa) J_2(\kappa) + \kappa J_0(\kappa) [5\kappa J_1(\kappa) - 16 J_2(\kappa) + 3\kappa J_3(\kappa)]\}/\kappa^3, \tag{3}$$

where $\kappa = p_x x_0/\hbar$, x_0 is the Thomas-Fermi radius of the condensate in the x direction, and J_i denotes the Bessel function of order i. This distribution is similar to a Gaussian, but its rms width is undefined. We therefore fitted a Gaussian function to the distribution and extracted an effective rms width for the distribution, $\Delta p_x \approx 1.58\hbar/x_0$, which differs from our earlier value by only 2.5%. Since the uncertainties of the experiment were about 10%, the key results of the paper are not affected. Our new calculation agrees with other work [1].

We are grateful to S. Stringari for pointing out this mistake to us.

[1] F. Zambelli, L. P. Pitaevskii, D. M. Stamper-Kurn, and S. Stringari, cond-mat/9912089 (to be published).