Erratum: Nonentangling channels for multiple collisions of quantum wave packets [Phys. Rev. A 85, 032713 (2012)]

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We would like to correct a typo in Eq. (D15) and clarify the derivation of the ballistic spread criterion given by Eq. (23) in our paper. These corrections do not affect the validity of the results reported in the paper.

(i) Equation (D15) in our paper had incorrect sign before the term $\frac{4}{3}n^2$. The correct form of this equation is

$$\tilde{t}(n) \approx \frac{2y_{\mathrm{m0}}}{v_{x0}} n\left[1+\epsilon^2\left(\frac{4}{3}n^2 - n - \frac{1}{3}\right)\right]. \tag{1}$$

(ii) Equation (23) in our paper represents the ballistic-spread criterion for the validity of the approximations used in the paper. The derivation of this criterion, however, did not properly account for the fact that, on the one hand, the time intervals between the collisions become significantly longer as n approaches n_{max}, while, on the other hand, $y_{\mathrm{M}}(t)$ simultaneously becomes significantly larger than y_{M0} thereby allowing the ballistic spread to be larger. The above two effects compensate for each other. Therefore, the resulting criterion for the ballistic spread remains, up to the prefactor $1/\pi$, the same as Eq. (23) of our paper.

The derivation of Eq. (23) as well as the related Eqs. (20) through (21) and (D14) through (D16) in our paper used the approximation $\epsilon n \ll 1$, while the result was used for $\epsilon n \sim 1$. Instead, we should have used the limits $\epsilon \ll 1$ and $n \gg 1$ without requiring $\epsilon n \ll 1$. Such a calculation starting from Eqs. (D5) through (D7), (D10), and (D11) in our paper gives

$$y(n) \approx \frac{y_{\mathrm{m0}}}{\cos(2\epsilon n)}, \tag{2}$$

$$\tilde{t}(n) \approx \frac{y_{\mathrm{m0}} \tan(2\epsilon n)}{v_{x0}\epsilon}, \tag{3}$$

$$n(y_{\mathrm{m0}}; t) \approx \frac{\mathrm{Arctan}\left(\frac{v_{x0}\epsilon t}{y_{\mathrm{m0}}}\right)}{2\epsilon}. \tag{4}$$

The above three equations are obtained by integrating the continuum limit of Eqs. (D10) and (D11) of our paper over n, which is valid in the limit $n \gg 1$. These equations, when expanded for $\epsilon n \ll 1$, reproduce, in the respective order, Eq. (D14), the corrected Eq. (D15), and Eq. (D16) from our paper in the leading order in n. [Equations (D14) through (D16) in our paper were obtained by summing the series arising from Eqs. (D10) and (D11) over the discrete index n.]

Instead of Eq. (20), the derivation of Eq. (23) in our paper should have been based on the inequality

$$y_{\mathrm{M}}(t) \gg |\beta_x(t)| \approx \frac{t\hbar}{m_x \sigma_{0x}}. \tag{5}$$

Replacing $y_{\mathrm{M}}(t)$ by $y(n)$ given by Eq. (2) above, and t by $\tilde{t}(n)$ given by Eq. (3), and estimating $\sin(2\epsilon n) \sim 1$, we obtain

$$\frac{\epsilon\, m_x \sigma_{0x} v_{x0}}{\hbar} \gg 1, \tag{6}$$

which, up to the factor of $1/\pi$, is identical to Eq. (23) in our paper. This estimate remains valid in the vicinity of $n = n_{\mathrm{max}} \approx \pi/(4\epsilon)$.

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