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Correction

Correction to: "Curved space and particle physics effects on the formation of Bose–Einstein condensation around a Reissner–Nordstrøm black hole"

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We have noticed that $\frac{-18}{5}$ in γ_2 in Eq. (24) in our paper [1] should be replaced by $\frac{-9}{5}$. After correction, γ_2 is replaced by

$$\gamma_2 = 2\left[\frac{-9}{5} + \frac{63}{40}\left(\frac{M}{Q}\right)^2\right]M. \tag{1}$$

Hence, Eqs. (25)–(27) in [1] are replaced by

$$(m^2 - \omega^2) - \frac{M^2}{9Q^4}\left(\frac{9}{5} - \frac{63}{40}\frac{M^2}{Q^2}\right)^2 = 0, \tag{2}$$

$$-\frac{3M^2}{Q^2}\left(\frac{9}{5} - \frac{63}{40}\frac{M^2}{Q^2}\right) + \left(\frac{9}{5} - \frac{9}{20}\frac{M^2}{Q^2}\right)\left(\frac{4}{5} - \frac{9}{20}\frac{M^2}{Q^2}\right) + (q^2 - m^2)Q^2 = 0, \tag{3}$$

$$\frac{2M}{3Q^2}\left(\frac{9}{5} - \frac{63}{40}\frac{M^2}{Q^2}\right)\left(\frac{9}{5} - \frac{9}{20}\frac{M^2}{Q^2}\right) - 2(qQ\omega - m^2M) = 0. \tag{4}$$

Accordingly, the solutions (29)–(33) for m, ω, and q given in the paper [1] get the following revised forms:

$$m_1^2 = -\frac{9\left(7M^4 + 2M^2Q^2\right)}{40Q^6}, \quad m_2^2 = \frac{9\left(7M^2 - 8Q^2\right)^2\left(4Q^2 - 3M^2\right)}{1600Q^6\left(Q^2 - M^2\right)}, \tag{5}$$

$$\omega_{1,2} = \mp\frac{3iM\left(7M^2 + 12Q^2\right)}{40Q^4}, \quad \omega_{3,4} = \mp\frac{3i\left(7M^4 - 22M^2Q^2 + 16Q^4\right)}{40\sqrt{Q^8\left(M^2 - Q^2\right)}}, \tag{6}$$

$$q_{1,2} = \mp\frac{3i\left(17M^2 - 8Q^2\right)}{20Q^3}, \quad q_{3,4} = \pm\frac{3iMQ\left(27M^2 - 28Q^2\right)}{40\sqrt{Q^8\left(M^2 - Q^2\right)}}, \tag{7}$$

where $\{m_1^2,\ \omega_{1,2},\ q_{1,2}\}$ and $\{m_2^2,\ \omega_{3,4},\ q_{3,4}\}$ are two different sets of solutions. We notice that $q_{1,2}$ are imaginary, so $\{m_1^2,\ \omega_{1,2},\ q_{1,2}\}$ are not physical solutions. Therefore, only the set $\{m_2^2,\ \omega_{3,4},\ q_{3,4}\}$ corresponds to physical solutions with the requirement $|Q| > M$. It is evident that these solutions cover a much wider ranges of m^2, ω, q than those in [1]. The new ranges are $1.44 < m^2Q^2 < \infty$, $1.2 < \omega Q < \infty$, $0 < qQ < \infty$ where m^2Q^2 and ωQ are in the order of 1 for most of the values of M and Q. qQ is in the order 10^{-1} for most of the values of M and Q.

Accordingly, ψ_ω in (28) in [1] gets the following revised form:

$$\psi_\omega = \exp\left\{\left(\frac{\pm 3M\left(7M^2 - 8Q^2\right)}{40Q^4\sqrt{Q^2 - M^2}}\right)\left[\left(2M^2 - Q^2\right)\left(\tan^{-1}\left(\frac{M - r}{\sqrt{Q^2 - M^2}}\right) - \tan^{-1}\left(\frac{M - \mathrm{r}_0}{\sqrt{Q^2 - M^2}}\right)\right)\right.\right.$$
$$\left. - \sqrt{Q^2 - M^2}\left(M\log\left(-2Mr + Q^2 + r^2\right) - M\log\left(-2M\mathrm{r}_0 + Q^2 + \mathrm{r}_0^2\right) + r - \mathrm{r}_0\right)\right]$$

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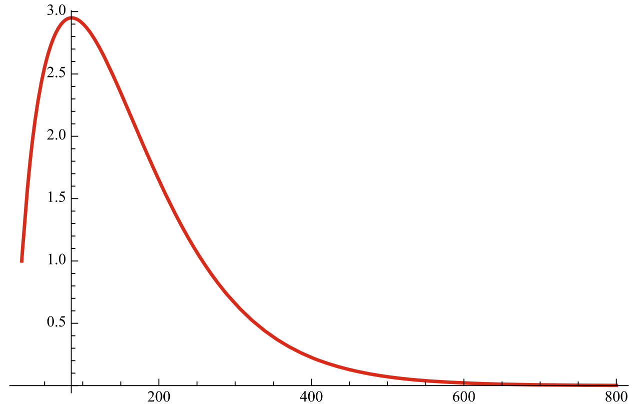

Fig. 1 $|\psi_\omega|$ versus $\bar{r}$ graph for $\bar{M} = 10$, $\bar{Q} = 17$, $\bar{r}_0 = 20$

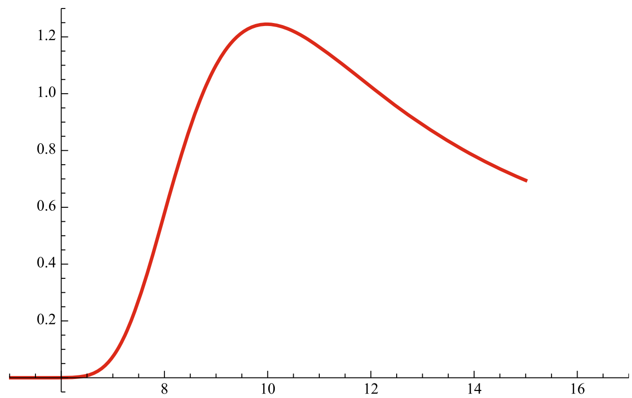

Fig. 2 $|\psi_\omega|$ versus $\bar{Q}$ graph for $\bar{M} = 10$, $\bar{r} = 20$, $\bar{r}_0 = 30$

$$
\begin{aligned}
&+ \left(\frac{3(6M^3 - 4MQ^2)}{40Q^2\sqrt{Q^2 - M^2}}\right)\left(\tan^{-1}\left(\frac{M - r}{\sqrt{Q^2 - M^2}}\right) - \tan^{-1}\left(\frac{M - \mathrm{r}_0}{\sqrt{Q^2 - M^2}}\right)\right) \\
&- \frac{3(3M^2 + 8Q^2)}{40Q^2}\left(\log(-2Mr + Q^2 + r^2) - \log(-2M\mathrm{r}_0 + Q^2 + \mathrm{r}_0^2)\right) \\
&+ 3\log(r) - 3\log(\mathrm{r}_0)\Bigg\},
\end{aligned} \tag{8}
$$

After this correction Fig. 1 in [1] is replaced by Fig. 1 above which is essentially the same as the one in [1]. Figure 2 in [1] now becomes irrelevant. Figure 3 in [1] is replaced by Fig. 2 above which is essentially the same as the one in [1].

The essential difference between the original paper and the one after the correction is: The case $|Q| < M$ is excluded after the correction. The allowed ranges of the parameters m^2, ω, q after correction for $|Q| > M$ are much wider than those obtained in [1] (and they include the ranges of parameters found in [1] as subcases).

Reference

1. R. Erdem, B. Demirkaya, K. Gültekin, Eur. Phys. J. Plus **136**(9), 972 (2021)