Erratum: Is the Kerr black hole a super accelerator? **[Phys. Rev. D 97, 044019 (2018)]**

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In the paper, a counterintuitive, but still imaginable,¹ situation, in which the energies $g(\mathbf{v}_n, \dot{\alpha}_n(p_n))$ diverge with n even though $g(\mathbf{v}_n, \dot{\alpha}_n(q_n))$ do not, is overlooked. To close this loophole, the displayed equation

$$\lim_{n \rightarrow \infty} g(\mathbf{v}_n, \dot{\alpha}_n(q_n)) = \infty \quad (11)$$

should be replaced by

$$\lim_{n \rightarrow \infty} g(\mathbf{v}_n, \dot{\alpha}_n(p_n)) = \infty. \quad (15)$$

Now, the following two corrections will duly modify the proof²:

I. Equations (5) and (6) should be replaced by

$$\begin{aligned} \frac{E_{\text{c.m.}}^2(\alpha, \mu; o)}{2m_\mu m_\alpha} = & \frac{m_\mu^2 + m_\alpha^2}{2m_\mu m_\alpha} - \varepsilon_\mu \varepsilon_\alpha + \frac{1}{r\Delta} \left[L_\mu L_\alpha (2M - r) + 2\varepsilon_\mu \varepsilon_\alpha \left(r^2(r - M) + a^2(r + M) - aM \left(\frac{L_\mu}{\varepsilon_\mu} + \frac{L_\alpha}{\varepsilon_\alpha} \right) \right) \right. \\ & - M \sqrt{2\varepsilon_\mu^2 r^2 + 2(L_\mu - \varepsilon_\mu a)^2 - L_\mu^2 r/M + (\varepsilon_\mu^2 - 1)r\Delta/M^2} \\ & \left. \times \sqrt{2\varepsilon_\alpha^2 r^2 + 2(L_\alpha - \varepsilon_\alpha a)^2 - L_\alpha^2 r/M + (\varepsilon_\alpha^2 - 1)r\Delta/M^2} \right], \end{aligned} \quad (5)$$

whence according to Ref. [19]

$$E_{\text{c.m.}}^2|_{r=r_H} = m_\alpha^2 + m_\mu^2 - \frac{m_\alpha m_\mu}{2M^2} L_{\alpha H} L_{\mu H} + \frac{m_\alpha m_\mu}{4M^2} \left[(L_{\alpha H}^2 + 4M^2) \frac{L_{\mu H} - L_\mu}{L_{\alpha H} - L_\alpha} + (L_{\mu H}^2 + 4M^2) \frac{L_{\alpha H} - L_\alpha}{L_{\mu H} - L_\mu} \right], \quad (6)$$

where

$$L_{\varpi H}(\varepsilon_\varpi) \equiv (2r_H M/a) \varepsilon_\varpi, \quad \varpi = \alpha, \mu. \quad (7)$$

In Sec. II. between the paragraph beginning “Warning. In considering particle...” and the next one, the following passage must be inserted:

“For future use, note that when

$$\varepsilon_\mu, L_\mu, \text{ are constant,} \quad \varepsilon_\alpha, L_\alpha \text{ tend to constants,} \quad L_\mu \neq L_{\mu H}(\varepsilon_\mu) \quad (8a)$$

and

$$\frac{L_\alpha}{\varepsilon_\alpha} = \frac{L_{\alpha H}}{\varepsilon} + \varphi, \quad r(o) = r_H + \xi, \quad (8b)$$

where $L_{\alpha H}$, ε is a critical pair and φ and ξ are infinitesimal, the expression in the square brackets in (5) divided by $\varepsilon_\mu \varepsilon_\alpha$ has the form

¹We are grateful to K. Bronnikov for pointing this out.

²A more detailed version of the resulting paper will be uploaded to the arXiv.

$$A + \xi B + \varphi C - \sqrt{D_1 + \xi E_1 + O(\xi^2)} \sqrt{D_2 + \xi E_2 + \varphi F + G\varphi^2 + o(\xi) + o(\xi)}, \quad (9)$$

where the uppercase letters are some constants. Comparing this with (6), which says that for some constant Φ , $E_{\text{c.m.}}^2|_{\xi \rightarrow 0} \sim \Phi \varphi^{-1}$, we infer that

$$A, D_2, F = 0, \quad D_1, E_2, G \neq 0, \quad D_1 G = C^2. \quad (10)$$

Consequently, in the leading order, the expression (9) is equal to

$$\begin{cases} \frac{E_2}{2\sqrt{G}} \xi \varphi^{-1}, & \text{at } \xi = o(\varphi^2); \\ [C - \sqrt{D_1(E_2 + G)}] \sqrt{\xi}, & \text{at } \varphi \sim \sqrt{\xi}; \\ \sqrt{D_1 E_2} \sqrt{\xi}, & \text{at } \varphi = o(\sqrt{\xi}) \end{cases}$$

[that the coefficient in the square brackets (in the second line) is nonzero is seen from (10)]. It follows that

$$\text{conditions (8a), (8b) imply the divergence } E_{\text{c.m.}}(\alpha, \mu; o) \rightarrow \infty \quad (11)$$

[which does not follow automatically from (6), the latter being applicable only to the case $\xi = o(\varphi)$].”