

Erratum: Ultra-Planckian quark and gluon scattering in agravity [Phys. Rev. D **112**, 025016 (2025)]

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This erratum concerns the article “Ultra-Planckian quark and gluon scattering in agravity,” *Phys. Rev. D* **112**, 025016 (2025). Several expressions in Sec. III have been corrected. These changes improve the accuracy of the results but do not affect the physical conclusions of the paper.

Equation (12) must read as

$$\begin{aligned}
 |\mathcal{M}|^2 = & \frac{f_0^4 t^2 u^2}{576 s^4 t^2 u^2} \left[3(979N_c^2 - 675)t^4 + 4648N_c^2 t^3 u + 2(2336N_c^2 + 2025)t^2 u^2 + 4648N_c^2 t u^3 + 3(979N_c^2 - 675)u^4 \right] \\
 & + \frac{4f_2^4}{576 s^4 t^2 u^2} \left[36(N_c^2 - 1)t^8 + 180(N_c^2 - 1)t^7 u + 3(205N_c^2 - 122)t^6 u^2 + 4(244N_c^2 - 45)t^5 u^3 \right. \\
 & + 2(581N_c^2 + 18)t^4 u^4 + 4(244N_c^2 - 45)t^3 u^5 + 3(205N_c^2 - 122)t^2 u^6 + 180(N_c^2 - 1)t u^7 + 36(N_c^2 - 1)u^8 \left. \right] \\
 & - \frac{8f_0^2 f_2^2 t^2 u^2}{576 s^4 t^2 u^2} \left[3(109N_c^2 - 67)t^4 + (511N_c^2 - 36)t^3 u + 2(209N_c^2 + 315)t^2 u^2 + (511N_c^2 - 36)t u^3 \right. \\
 & \left. + 3(109N_c^2 - 67)u^4 \right]. \tag{12}
 \end{aligned}$$

Equation (14) must read as

$$\begin{aligned}
 |\mathcal{M}|^2 = & \frac{1}{12288 \sin^4 \theta} \left[49152 f_2^4 (5 + 3 \cos 2\theta) + \sin^4 \theta \left(377529 f_0^4 - 334328 f_0^2 f_2^2 + 158288 f_2^4 \right. \right. \\
 & \left. \left. + 20(7065 f_0^4 - 6632 f_0^2 f_2^2 + 1808 f_2^4) \cos 2\theta + 5(375 f_0^4 - 200 f_0^2 f_2^2 + 176 f_2^4) \cos 4\theta \right) \right]. \tag{14}
 \end{aligned}$$

Comment on positivity and collinear behavior. The corrected expression (14) is strictly positive for all scattering angles $0 < \theta < \pi$ and for arbitrary real couplings f_0 and f_2 . The collinear structure is entirely contained in the prefactor of the first term, proportional to f_2^4 , leading to the behavior $|\mathcal{M}|^2 \sim f_2^4 / \sin^4 \theta$ near $\theta \rightarrow 0, \pi$. This behavior is the expected enhancement from spin-2 exchange in the t - and u -channels. In the limit where f_2 becomes asymptotically small (as expected from asymptotic freedom), this enhancement is suppressed and the angular distribution remains finite for all physical scattering angles.

Equation (15) must read as

$$|\mathcal{M}|^2 = f_2^4 (N_c^2 - 1) \left(\frac{s^2}{4t^2} + \frac{s}{4t} \right) + \frac{1}{192} \left[f_0^4 (979N_c^2 - 675) + 4f_2^4 (85N_c^2 - 2) - 8f_0^2 f_2^2 (109N_c^2 - 67) \right] + \mathcal{O}(t/s). \tag{15}$$

Comment on the forward scattering. The corrected result (15) shows explicitly the emergence of collinear singularities as $t \rightarrow 0$, controlled by the terms proportional to f_2^4 . If f_2 is treated as a fixed, nonvanishing parameter, the amplitude diverges as t^{-2} and t^{-1} , as expected from massless spin-2 exchange. However, in a realistic UV scenario where f_2 is asymptotically free, these contributions become parametrically suppressed and the forward amplitude remains finite and IR safe. In this case, the scattering amplitude is well-behaved even for small scattering angles, consistent with the expected properties of a UV-complete dimensionless gravitational theory.

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Technical note on polarization sums. The original calculation replaced the polarization sum by $\sum_{\lambda} \epsilon_{\lambda}^{\mu}(p) \epsilon_{\lambda}^{\nu*}(p) \rightarrow -\eta^{\mu\nu}$, which neglects the dependence on the gauge-fixing condition. The correct physical polarization sum reads

$$\sum_{\lambda} \epsilon_{\lambda}^{\mu}(p) \epsilon_{\lambda}^{\nu*}(p) = -\eta^{\mu\nu} + \frac{p^{\mu} n^{\nu} + p^{\nu} n^{\mu}}{p \cdot n},$$

where n^{μ} is a reference vector satisfying $n \cdot \epsilon(p) = 0$. We adopt the choice

$$n_1^{\mu} = \frac{p_2^{\mu}}{\omega}, \quad n_2^{\mu} = \frac{p_1^{\mu}}{\omega}, \quad n_3^{\mu} = \frac{p_4^{\mu}}{\omega}, \quad n_4^{\mu} = \frac{p_3^{\mu}}{\omega},$$

valid in the CoM reference frame, where $\omega = \frac{\sqrt{s}}{2}$. This choice corresponds to the axial (physical) gauge and ensures that only the two transverse physical polarizations contribute to the scattering amplitude. It also eliminates spurious longitudinal components and leads to the correct tensor structure of the squared amplitude.