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Corrigendum

Corrigendum: Quantum signaling in relativistic motion and across acceleration horizons (2017 *J. Phys. A: Math. Theor.* 50 355401)

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Equation (53) of [1], stating the leading order signal strength between a uniformly accelerated sender and a receiver in 3 + 1D Minkowski spacetime, is not correct. The correct expression for (53) is derived, and figure 5 of [1] is replaced.

Section 5.4 of [1] considers signaling from a uniformly accelerated sender to a resting receiver. The result for 3 + 1D Minkowski spacetime will be corrected in the following. The wordline of the accelerated sender is given by

$$t_A(\tau_A) = \frac{1}{a}\sinh(a\tau_A), \qquad x_A^1 = \frac{1}{a}\cosh(a\tau_A) \tag{1}$$

while $x_A^2 = x_A^3 = 0$, where τ_A is the sender's proper time and a their proper acceleration. The receiver is at rest at $x_B^1 = x_B^2 = x_B^3 = 0$. Both detectors are coupled to the field at all times, i.e., the switching functions are constant $\eta_D(\tau_D) \equiv 1$ for $D = A, B$. We use that the commutator has support only on the light cone, and use the sender's proper time as integration variable for the calculation of C_2 (see equation (9) of [1]).

$$\begin{aligned} C_2 &= \lambda_A\lambda_B \int \mathrm{d}t_1 \int^{t_1} \mathrm{d}t_2\, \chi_A(t_2)\chi_B(t_1)\mathrm{e}^{\mathrm{i}(\Omega_B\tau_B(t_1) - \Omega_A\tau_A(t_2))}\, [\phi(x_A(t_2)), \phi(x_B(t_1))] \\ &= \lambda_A\lambda_B \int_0^\infty \mathrm{d}t_1 \int_{-\infty}^\infty \mathrm{d}\tau_A\; \mathrm{e}^{\mathrm{i}(\Omega_B t_1 - \Omega_A\tau_A)} \frac{\mathrm{i}}{4\pi}\frac{a}{\cosh(a\tau_A)}\delta\left(t_1 - \frac{1}{a}\mathrm{e}^{a\tau_A}\right) \\ &= \frac{\mathrm{i}\lambda_A\lambda_B}{4\pi}\int_0^\infty \mathrm{d}t_1 \int_{-\infty}^\infty \mathrm{d}\tau_A\; \mathrm{e}^{\mathrm{i}(\Omega_B t_1 - \Omega_A\tau_A)} \frac{2a^2 t_1}{a^2(t_1)^2 + 1}\frac{1}{|at_1|}\delta\left(\tau_A - \frac{1}{a}\ln(at_1)\right) \\ &= \frac{-\mathrm{i}\lambda_A\lambda_B\operatorname{csch}(\pi y)}{2}\left(\frac{\mathrm{e}^{\frac{\pi y}{2}}\left(\frac{1}{x}\right)^{-1-iy}{}_1F_2\left(1; \frac{iy}{2}+1, \frac{iy}{2}+\frac{3}{2}; \frac{x^2}{4}\right)}{\Gamma(iy+2)} - \sinh\left(x + \frac{\pi y}{2}\right)\right) \end{aligned} \tag{2}$$

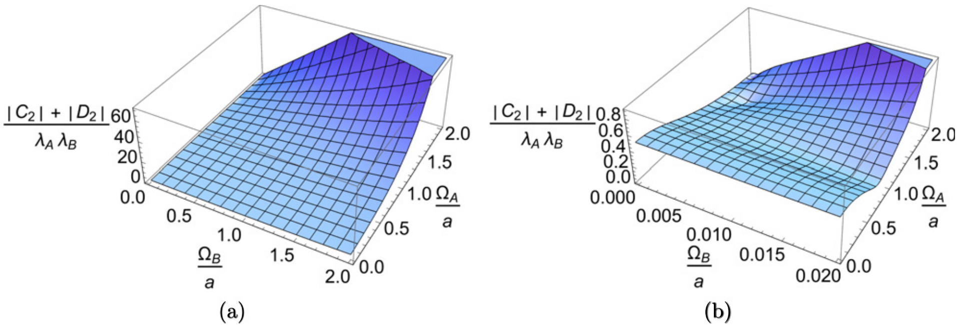

Figure 1. Leading order signal strength $\left(|C_2| + |D_2|\right) / (\lambda_A \lambda_B)$ across the acceleration horizon in 3 + 1D Minkowski spacetime as a function of the ratio between detector energy gaps Ω_A, Ω_B and proper acceleration a. This figure replaces figure 5 of [1]. Figure 1(b) shows non-trivial behavior of the total signal strength for low Ω_B/a not resolved in figure 1(a).

Here, as in [1], ${}_1F_2(a_1; b_1, b_2; z) = \sum_{k=0}^{\infty} \frac{(a_1)_k z^k}{(b_1)_k (b_2)_k k!}$ is the generalized hypergeometric function[1], and $x = \Omega_B/a$ and $y = \Omega_A/a$ are the ratio of detector frequencies and the proper acceleration. This expression for C_2 replaces equation (53) of [1], which cited an incorrect result of [2]. (Note that as discussed in [1], the corresponding expression for D_2 can always be obtained from C_2 by inverting the sign of Ω_B in C_2 and the overall sign of the resulting expression).

The resulting leading order signal strength $|C_2| + |D_2|$ between accelerated sender and resting receiver is plotted in figure 1, which replaces figure 5 in [1]. Both the limit $\lim_{y\to 0} C_2$ and $\lim_{x\to 0} C_2$ of (2) exist, i.e., there exist closed expressions for zero-gap detectors. The former is an expression in terms of hypergeometric functions, while the latter takes the simple form

$$\lim_{x\to 0} C_2 = \frac{\mathrm{i}}{4} \operatorname{sech}\left(\pi y/2\right). \tag{3}$$

This means that both in the limit of infinite acceleration $a \to \infty$, or equivalently when $\Omega_A, \Omega_B \to 0$, the leading order signal strength approaches

$$|C_2| + |D_2| \to \frac{\lambda_A \lambda_B}{2}.$$

The leading order signal strength $|C_2| + |D_2|$ exhibits non-trivial features for low Ω_B/a which appear on a smaller scale then resolved by figure 1a, but are shown in figure 1b.

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[1] See also: http://functions.wolfram.com/HypergeometricFunctions/Hypergeometric1F2/02/

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