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CORRIGENDUM • OPEN ACCESS

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Corrigendum: Simple sufficient condition for subspace to be completely or genuinely entangled (2021 *New J. Phys.* 23 103016)

Maciej Demianowicz[1,*], **Grzegorz Rajchel-Mieldzioć**[2] **and Remigiusz Augusiak**[2]

[1] Institute of Physics and Applied Computer Science, Faculty of Applied Physics and Mathematics, Gdańsk University of Technology, Narutowicza 11/12, 80-233 Gdańsk, Poland
[2] Center for Theoretical Physics, Polish Academy of Sciences, Aleja Lotników 32/46, 02-668 Warsaw, Poland
[*] Author to whom any correspondence should be addressed.

E-mail: maciej.demianowicz@gmail.com

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Proof of fact 1 in appendix B is inaccurately presented. This, however, does not affect any of the results from the paper as fact 1 remains true. In this corrigendum we give a corrected proof of this fact. For completeness, we provide here full revised appendix B.

Appendix B. Proof of fact 1

Proof. Consider a superposition of k pure mutually orthogonal states $|\phi_i\rangle$

$$|\Psi\rangle = \sum_{i=1}^{k} \alpha_i |\phi_i\rangle, \tag{1}$$

and recall that all the considered entanglement quantifiers can be wrapped up in a single formula

$$\mathcal{E}(|\psi\rangle) = 1 - \max_{|\varphi\rangle\in\mathcal{S}} |\langle\varphi|\psi\rangle|^2, \tag{2}$$

where $\mathcal{S}$ is any set considered in the main text.

Due to the triangle inequality $|x+y| \leqslant |x| + |y|$, the expression under the maximum on the right-hand side of the above for the superposition $|\Psi\rangle$ can be upper bounded as

$$\begin{aligned}|\langle\varphi|\Psi\rangle|^2 &\leqslant \left(\sum_{i=1}^{k} |\alpha_i||\langle\varphi|\phi_i\rangle|\right)^2 \\ &= \sum_{i=1}^{k} |\alpha_i|^2 |\langle\varphi|\phi_i\rangle|^2 + 2\sum_{i<j} |\alpha_i\alpha_j||\langle\varphi|\phi_i\rangle\langle\varphi|\phi_j\rangle|,\end{aligned} \tag{3}$$

which holds for any φ. Plugging this into equation (2) and using the fact that $\sum_i |\alpha_i|^2 = 1$, we obtain

$$\begin{aligned}\mathcal{E}(|\Psi\rangle) &\geqslant \sum_{i=1}^{k} |\alpha_i|^2 \mathcal{E}(|\phi_i\rangle) - 2\max_{|\varphi\rangle\in\mathcal{S}} \sum_{i<j} |\alpha_i\alpha_j||\langle\varphi|\phi_i\rangle\langle\varphi|\phi_j\rangle| \\ &\geqslant \sum_{i=1}^{k} |\alpha_i|^2 \mathcal{E}(|\phi_i\rangle) - 2\sum_{i<j} |\alpha_i\alpha_j| \max_{|\varphi\rangle\in\mathcal{S}} |\langle\varphi|\phi_i\rangle| \max_{|\varphi\rangle\in\mathcal{S}} |\langle\varphi|\phi_j\rangle|,\end{aligned} \tag{4}$$

where in the second inequality we have first exploited the fact that the maximum of the sum is upper bounded by the sum of maxima, and then bounded from above each maximum of products by the product of maxima. With the aid of the fact that $\max_{|\varphi\rangle\in\mathcal{S}} |\langle\varphi|\phi_i\rangle| = \sqrt{1-\mathcal{E}(|\phi_i\rangle)}$ this gives the claimed inequality. □

ORCID iDs

Maciej Demianowicz https://orcid.org/0000-0001-7018-582X
Grzegorz Rajchel-Mieldzioć https://orcid.org/0000-0003-2652-9482
Remigiusz Augusiak https://orcid.org/0000-0003-1154-6132