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Operational connection between predictability and entanglement in entanglement swapping from partially entangled pure states.  (English) Zbl 07600426
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Summary: Complementarity and entanglement are fundamental features of Quantum Mechanics that were recently related in triality equalities that involve quantum coherence, the wave aspect of a quanton, and quantum predictability and quantum entanglement, the particle aspect of a quanton. In this article, we give an operational connection between predictability and entanglement in entanglement swapping from initially partially entangled states. For this, we show that the predictability of the pre-measurement one-qubit density matrix is directly related to the probability of the partially entangled component of the post-measurement state. Going even further, we analyze the entanglement swapping for partially entangled states in the light of complementarity relations and show that, in the cases where the entanglement increases after a Bell-basis measurement, the predictability is consumed when compared to the initially prepared state.

MSC:
81-XX Quantum theory
82-XX Statistical mechanics, structure of matter

Keywords:
complementarity relations; predictability; entanglement; entanglement swapping

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References:
[1] Bohr, N., The quantum postulate and the recent development of atomic theory, Nature, 121, 580 (1928) · Zbl 54.1006.01
[2] Wootters, W. K.; Zurek, W. H., Complementarity in the double-slit experiment: quantum nonseparability and a quantitative statement of Bohr’s principle, Phys. Rev. D, 19, 473 (1979)
[3] Greenberger, D. M.; Yasin, A., Simultaneous wave and particle knowledge in a neutron interferometer, Phys. Lett. A, 128, 391 (1988)
[4] Englert, B.-G., Fringe visibility and which-way information: an inequality, Phys. Rev. Lett., 77, 2154 (1996)
[5] Angelo, R. M.; Ribeiro, A. D., Wave-particle duality: an information-based approach, Found. Phys., 45, 1407 (2015) · Zbl 1326.81009
[6] Bera, M. N.; Qureshi, T.; Siddiqui, M. A.; Pati, A. K., Duality of quantum coherence and path distinguishability, Phys. Rev. A, 92, Article 012118 pp. (2015)
[7] Bagan, E.; Bergou, J. A.; Cottrell, S. S.; Hillery, M., Relations between coherence and path information, Phys. Rev. Lett., 116, Article 160406 pp. (2016)
[8] Coles, P. J., Entropic framework for wave-particle duality in multipath interferometers, Phys. Rev. A, 93, Article 062111 pp. (2016)
[9] Bagan, E.; Calsamiglia, J.; Bergou, J. A.; Hillery, M., Duality games and operational duality relations, Phys. Rev. Lett., 120, Article 050402 pp. (2018)
[10] Basso, M. L.W.; Chrysosthemos, D. S.S.; Maziero, J., Quantitative wave-particle duality relations from the density matrix properties, Quantum Inf. Process., 19, 254 (2020)
[11] Basso, M. L.W.; Maziero, J., An uncertainty view on complementarity and a complementarity view on uncertainty, Quantum Inf. Process., 20, 201 (2021)
[12] Baumgratz, T.; Cramer, M.; Plenio, M. B., Quantifying coherence, Phys. Rev. Lett., 113, Article 140401 pp. (2014)
[13] Mishra, S.; Venugopalan, A.; Qureshi, T., Decoherence and visibility enhancement in multi-path interference, Phys. Rev. A, 100, Article 042122 pp. (2019)
[14] Dürr, S., Quantitative wave-particle duality in multi-beam interferometers, Phys. Rev. A, 64, Article 042113 pp. (2001)
[15] Englert, B.-G.; Kaszlikowski, D.; Kwek, L. C.; Chee, W. H., Wave-particle duality in multi-path interferometers: general concepts and three-path interferometers, Int. J. Quantum Inf., 6, 129 (2008) · Zbl 1192.81017
[16] Jakob, M.; Bergou, J. A., Quantitative complementarity relations in bipartite systems: entanglement as a physical reality
Basso, M. L.W.; Maziero, J., Complete complementarity relations for multipartite pure states, J. Phys. A, Math. Theor., 53, Article 465301 pp. (2020)

Qureshi, T., Predictability, distinguishability and entanglement, Opt. Lett., 46, 492 (2021)

Basso, M. L.W.; Maziero, J., Entanglement monotones connect distinguishability and predictability, Phys. Lett. A, 425, Article 127875 pp. (2021) - Zbl 1483.81022

Bilobran, L. O.; Angelo, R. M., A measure of physical reality, Europhys. Lett., 112, Article 40005 pp. (2015)

Basso, M. L.W.; Maziero, J., Complete complementarity relations: connections with EPR realism and decoherence and extension to mixed quantum states, Europhys. Lett., 135, Article 60002 pp. (2021)

Basso, M. L.W.; Maziero, J., Complete complementarity relations and their Lorentz invariance, Proc. R. Soc. A., 477, Article 20210058 pp. (2021)

Basso, M. L.W.; Maziero, J., Complete complementarity relations in curved spacetimes, Phys. Rev. A, 103, Article 032210 pp. (2021)

Basso, M. L.W.; Maziero, J., Predictability as a quantum resource, Quantum Inf. Process., 21, 187 (2022)

Zukowski, M.; Zeilinger, A.; Horne, M. A.; Ekert, A. K., “Event-ready-detectors” Bell experiment via entanglement swapping, Phys. Rev. Lett., 71, 4287-4290 (1993)

Bose, S.; Vedral, V.; Knight, P. L., Purification via entanglement swapping and conserved entanglement, Phys. Rev. A, 60, 194-197 (1999)

Bennett, C. H.; Bernstein, H. J.; Popescu, S.; Schumacher, B., Concentrating partial entanglement by local operations, Phys. Rev. A, 53, 2046-2052 (1996)

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