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Einladung zum Vortrag

Metabolism Imaging via Quantum Entanglement

von

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Ort: Erwin-Schrödinger-Hörsaal

9. Boltzmanngasse 5/Strudlhofgasse 4, 5.Stock

Abstract:

The detection of the two high energetic photons coming from the annihilation of an electron and a positron is a well-established successful technology to image metabolic processes in living bodies (PET: Positron Emission Tomography). During such a typical scan positronium atoms are formed which can as well decay into three photons. Due to technical limitations such events have never been registered, however, a new technology, the J-PET device, will change that [1]. Theoretical computations [2] show that the three photons are entangled and, surprisingly, even genuine multipartite entangled, which is a very strong type of entanglement. Even more surprisingly, under mixing genuinely multipartite entanglement survives. Observing the manifestations of entanglement may open a plethora of possibilities: for example, in the above picture, for any pixel one would also gain quantum information which may equip us with details on the microscopic scale and possibly some quantum biological markers.

Moreover, recent research on photons entangled in their angular momentum or/and polarisation degrees of freedom will be presented [3]. This research line will open the possibility to exploit higher dimensions and multipartite systems for formidable quantum technologies.

[1] e.g.: D. Kamińska, et al., *A feasibility study of ortho-positronium decays measurement with the J-PET scanner based on plastic scintillators*, Eur. Phys. J. C 76, 445 (2016)

[2] B.C. Hiesmayr and P. Moskal, *Genuine Multipartite Entanglement in the 3-Photon Decay of Positronium*, Scientific Reports 7, 15349 (2017).

[3] e.g.: B.C. Hiesmayr, M.J.A. de Dood and W. Löffler, *Four-photon orbital angular momentum entanglement*, Phys. Rev. Lett. 116, 073601 (2016); G. Carvacho, F. Graffitti, V. D'Ambrosio, B. C. Hiesmayr and F. Sciarrino, *Experimental investigation on the geometry of GHZ states*, Scientific Reports 7, 13265 (2017).