

Unveiling and veiling an entangled light-matter quantum state from the vacuum

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The ground state of an atom interacting with the electromagnetic field in the ultrastrong coupling regime is composed of virtual photons entangled with the atom. We propose a method to promote to real the entire photonic state, while preserving the entanglement with the atom. We consider a four-level atom, with two of these levels ultrastrongly coupled to a cavity mode. The process is obtained by making use of either an ultrafast pulse or a multi-tone π -pulse that drives only the atom. An experimental realization of this proposal will enable the investigation of the exotic phenomena of emission of particles from the vacuum. Moreover, it will allow the inspection of the full structure of the ground state in the ultrastrong coupling regime, and to generate on-demand entangled states for quantum information processing.

[1] R Stassi, M Cirio, K Funo, N Lambert, J Puebla, F Nori. arXiv preprint arXiv:2110.02674, 2021. <https://doi.org/10.48550/arXiv.2110.02674>