Administering an antidote to Schrödinger's cat

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Abstract

In 1935, Schrödinger imagined a cat in a box together with a poisonous substance that could be released based on the decay of a radioactive atom. Owing to it, the life of the cat and the state of the poison become entangled, and the fate of the cat is determined upon opening the box. This work presents an experimental technique that keeps the cat alive on any account, relying on the time-resolved HOM interference of photons generated using single 87Rb atoms in a high-finesse cavity.

Interpreting the first photon detection as the state of the poison and the second photon as the state of the cat, we demonstrate the ability to control the quantum state of the cat by implementing a sudden phase change between the inputs, administered conditionally on the outcome of the first detection.

References

[1] Álvarez et al., J. Phys. B 55 (2022) 054001
[2] Legero et al., App. Phys. B 77 (2003) 797
[3] Nisbet-Jones et al., New J. Phys. 15 (2013) 053007
[4] Nisbet-Jones et al., New J. Phys. 13 (2011) 103036
[5] Barrett et al., Quantum Sci. Technol. 4 (2019) 025008

Figures

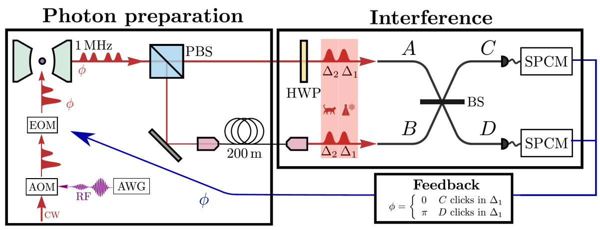

Figure 1: Two long photons with double-humped profiles [3] interfere in a 50:50 beam splitter (BS). Photons are emitted at a repetition rate of 1MHz from an atom-cavity source [4] driven by a laser pulse modulated by an acousto-optic modulator (AOM) and whose phase is changed using an electro-optic modulator (EOM). A fiber delay line of 200m ensures the simultaneous arrival of two sequentially emitted photons.

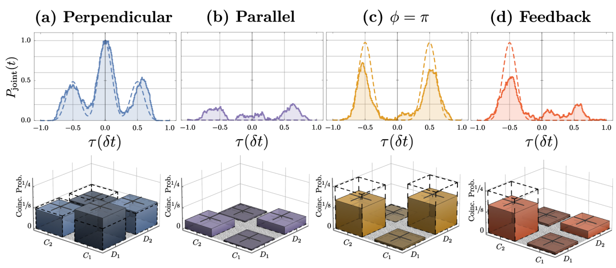

Figure 2: (top) The joint coincidence probability sliding histograms show the theoretical (dashed) and experimental (solid) values for the joint probability amplitude of two-photon detection. Figures at the bottom show the same coincidences sorted following to the exact detector-time-bin detections. (a) shows the random routing of photons with orthogonal polarisations. (b) and (c) show the interference between indistinguishable and fully distinguishable photons, resulting in no coincidences and enhanced coincidences. (d) shows the asymmetric pattern observed under feedback (adapted from [1]).