INTERFERENCE OF SINGLE PHOTONS FROM DISSIMILAR SINGLE PHOTON SOURCES

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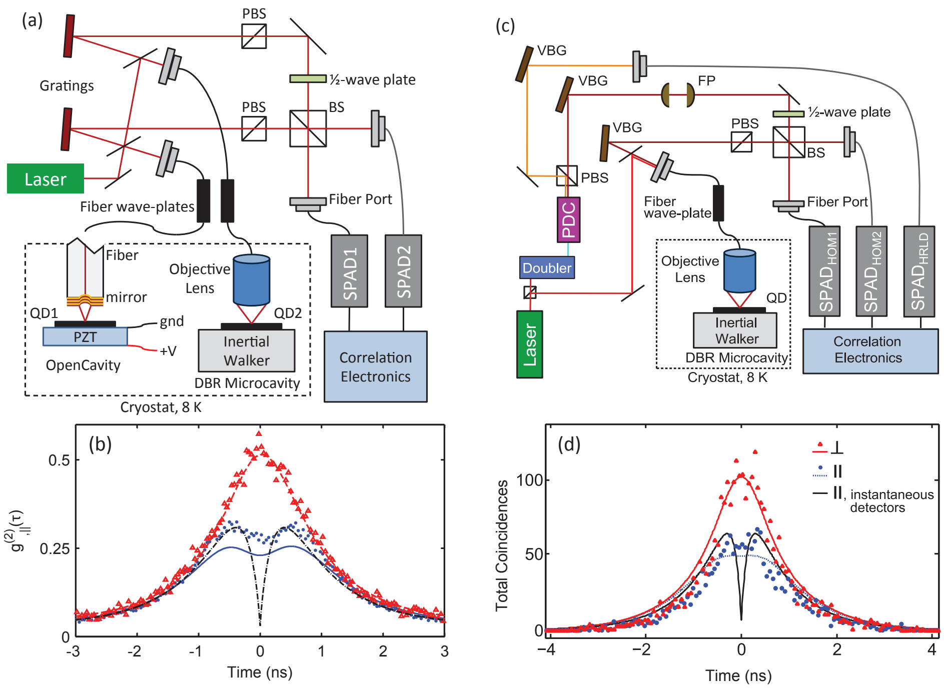
Two-photon interference has become a central topic in quantum information science, particularly in the context of quantum networks in which interconnects between separate, often dissimilar nodes are required. Here we describe two recent experiments on two-photon interference involving photons generated by semiconductor quantum dots (QDs) and photons generated by parametric down-conversion (PDC). Firstly we demonstrate and characterize interference between discrete photons emitted by two separate semiconductor QD states in different samples excited by a pulsed laser [1]. Their energies are tuned into resonance using strain. We find that photons have a total coalescence probability of 18% and the coincidence rate is below the classical limit. Secondly, We show how photons produced from a QD and by PDC in a nonlinear crystal can be manipulated to be indistinguishable. In this case we obtain a coalescence probability of 16%. In both cases the probability is limited by QD dephasing, and may thus be significantly increased with the incorporation of the QDs into high Purcell factor microcavities.



(a,b) 2-photon interference between two separate QDs. A piezoelectric (PZT) actuator is used to tune the QDs into spectral overlap. The interference is visible as a reduction in coincidences between perpendicular (red triangles) and parallel (blue discs) detection polarizations. (c,d) 2-photon interference between a QD and a heralded PDC photon. Coarse and fine filtering of the PDC photons is achieved with a volume Bragg grating (VBG) and a tunable Fabry-Perot interferometer, respectively. In both experiments, a common pulsed pump laser is used to create photons simultaneously.

References

[1] E. B. Flagg, A. Muller, S.V. Polyakov, A. Ling, A. Migdall, and G. S. Solomon, Phys. Rev. Lett. 104, 137401 (2010).

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