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Quantum Interference between nondegenerate entangled photons[1] CHANG LIU, J.F. CHEN, SHANCHAO ZHANG, SHUYU ZHOU, Department of Physics, The Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong, China, YOON-HO KIM, Department of Physics, Pohang University of Science and Technology (POSTECH), Pohang 790-784, Korea, M.M.T. LOY, G.K.L. WONG, SHENGWANG DU, Department of Physics, The Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong, China — We generate narrow-band entangled photon pairs from laser cooled atoms in a right-angle geometry and study their Hong-Ou-Mandel (HOM) two-photon quantum interference. When the two paths are balanced before the beam splitter, we observe a perfect destructive interference for both degenerate and nondegenerate photons. In particular, our results show that the path-exchange symmetry plays a more general critical role for observing the HOM interference, rather than the temporal or frequency indistinguishability of the photons and their simultaneous arrival at the beam splitter. The interference between the indistinguishable Feynman pathways leads to the HOM effect for both degenerate and nondegenerate paired photons. Furthermore, we also show that the quantum beat between nondegenerate photons can be measured with slow detectors by varying the relative path length difference, in addition to the direct observation of the quantum beat with fast detectors in an unbalanced-path configuration. Our results may lead to potential applications in linear optical quantum information processing involving photons at different wavelengths.

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