Abstract Submitted
for the DAMOP15 Meeting of
The American Physical Society

Two-photon interference with atom-resonanant photon pairs FEDERICA A. BEDUINI, JOANNA A. ZIELINSKA, VITO GIOVANNI LUCIVERO, MORGAN W. MITCHELL, ICFO - Institute of Photonic Sciences — We demonstrate atomic filtering of frequency-degenerate photon pairs from a subthreshold optical parametric oscillator (OPO). The filter, a modified Faraday anomalous dispersion optical filter (FADOF), achieves 70% peak transmission simultaneous with 57 dB out-of-band rejection and a 445 MHz transmission bandwidth. When applied to the OPO output, only the degenerate mode, containing one-mode squeezed vacuum, falls in the filter pass-band; all other modes are strongly suppressed. The high transmission preserves non-classical continuous-variable features, e.g. squeezing or non-gaussianity, while the high spectral purity allows reliable discrete-variable detection and heralding. Correlation and atomic absorption measurements indicate a spectral purity of 96% for the individual photons, and 98% for the photon pairs. Interference between an unknown two-photon state (a "biphoton") and the two-photon component of a reference state gives a phase-sensitive arrival-time distribution containing full information about the biphoton temporal wave function. Using a coherent state as a reference, we observe this interference and reconstruct the wave function of single-mode biphotons from a low-intensity narrow band squeezed vacuum state.

Reference: Phys. Rev. Lett. 113, 183602 (2014)

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Date submitted: 30 Jan 2015 Electronic form version 1.4