

The Ou-Mandel experiment revisited: producing delocalized Schrödinger cats by local frequency-time filtering

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In the OM experiment [1], spatial beating was observed in a photon coincidence measurement which comes from the interference of two paths containing two frequency filters at different centered frequencies. We propose a new interpretation of the fringe pattern observed in this experiment: a frequency-time cat state is post-selected out of the state produced by a SPDC source, and this structure can be revealed using the generalization of the HOM experiment proposed in [2]. Hence, we present a new way of engineering and detecting time-frequency entanglement by post-selection using frequency-time filtering. Finally, we propose a tomography for the post-selected state thanks to this scheme.

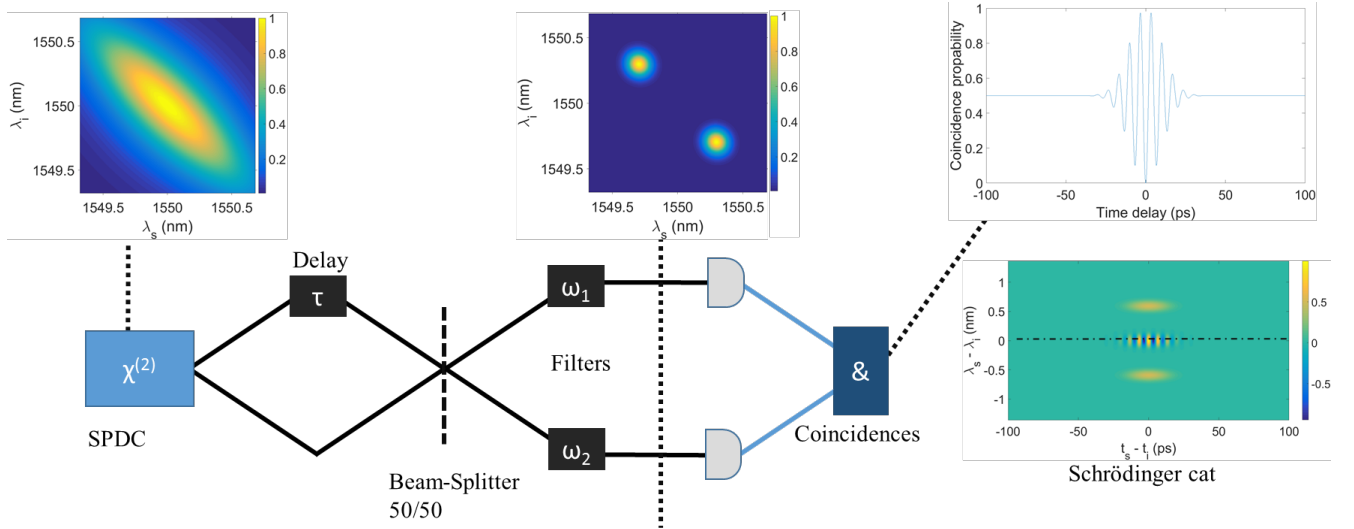


Figure 1: Anti-correlated photons (on the left) created by SPDC cross time shifter, beam-splitter and two Gaussian frequency filters. (On the right) The measure of coincidence shows a fringe pattern and the interference part of the Wigner function $W_-(\tau = t_s - t_i, 0)$ of a frequency-time cat state is matching which means that post-selection thanks to frequency filtering permits to select only the cat part from the wave function generated by SPDC process.

References:

- [1] Z.Y. Ou and L.Mandel Phys. Rev. Lett **61**,1 1988.
- [2] Boucher, G. and Douce, T. and Bresteau, D. and Walborn, S. P. and Keller, A. and Coudreau, T. and Ducci, S. and Milman, P. ,Phys. Rev. A **92**, 023804 (2013).
- [3] T.Douce, A.Eckstein, S.P. Walborn, A.Z. Khoury, S.Ducci, A.Keller,T.Coudreau and P.Milman, Nature **3**, 3530 (2013).