Shaping Biphoton Temporal Waveforms with Modulated Classical Fields

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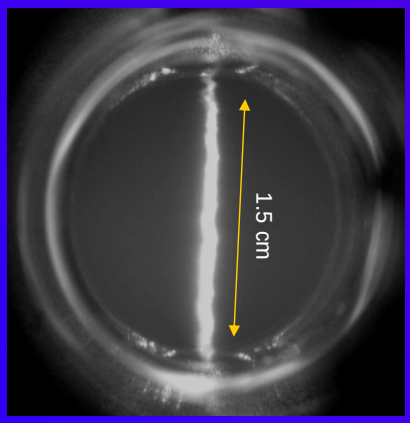
We experimentally demonstrate a technique for shaping the temporal quantum waveform of narrowband time-frequency entangled photon pairs generated in a cold atomic ensemble via four-wave mixing by periodically modulating the two input classical lasers. We show that the input field profiles can be transferred to the biphoton wave packets, and it is possible to generate nonclassical paired photons with a predesigned arbitrary shape of the correlation function.



^{85}Rb 2D MOT
(Fluorescence Image)

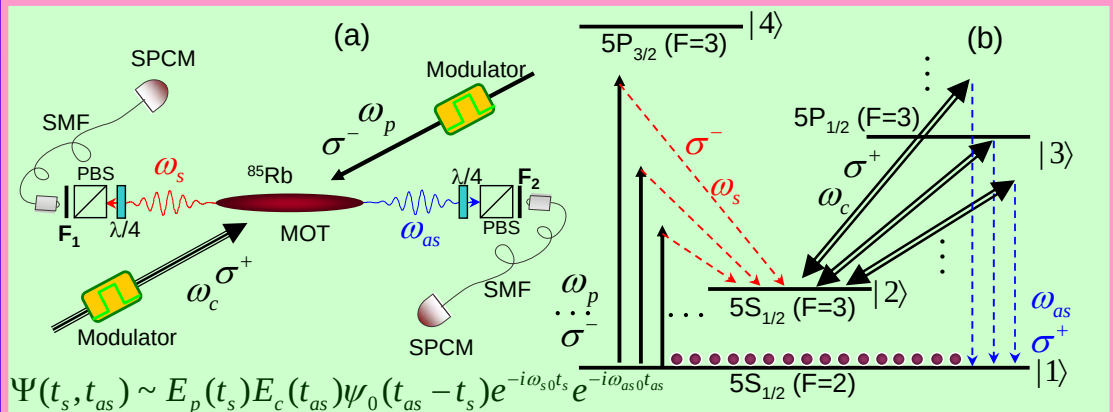


FIG. 1: Schematic of biphoton generation with modulated driving-laser fields. (a) Experimental configuration. (b) ^{85}Rb double-Λ atomic energy level diagram. The two-photon interference from multiple frequency channels maps the modulation on the classical fields to the biphoton quantum waveform.

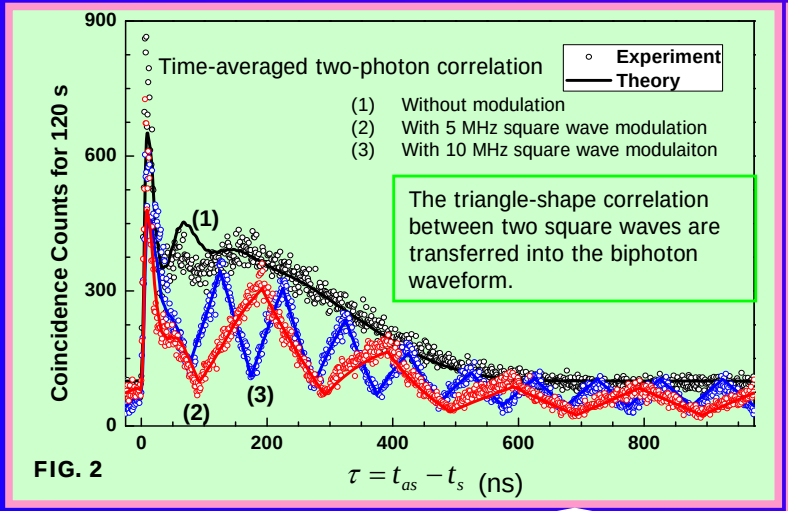


FIG. 2

Sine-wave Modulation

Square Modulations

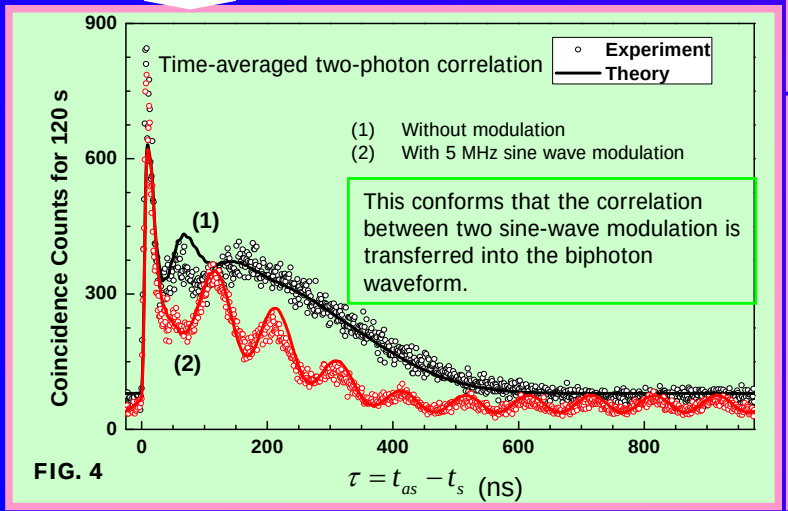


FIG. 4

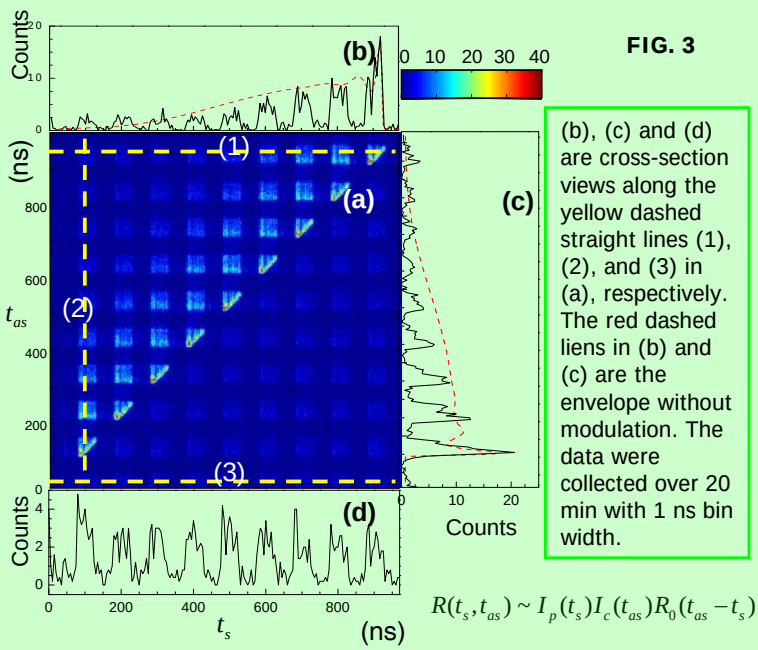


FIG. 3

(b), (c) and (d) are cross-section views along the yellow dashed straight lines (1), (2), and (3) in (a), respectively. The red dashed liens in (b) and (c) are the envelope without modulation. The data were collected over 20 min with 1 ns bin width.

2D two-photon correlation with 10 MHz square wave modulation

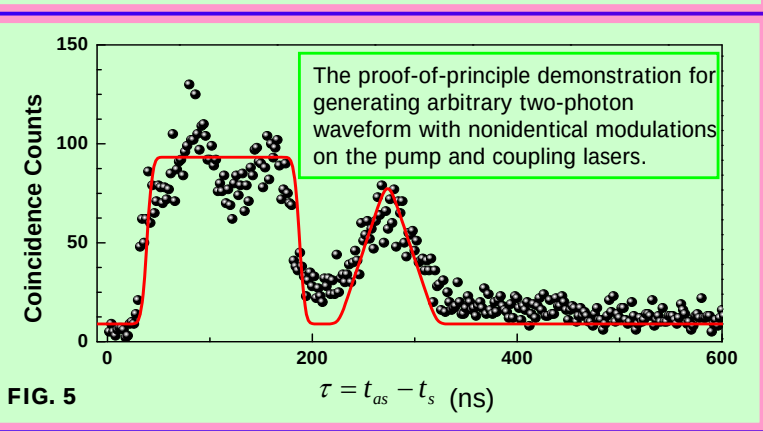


FIG. 5