**Title:**

A Tutorial on the EIT-based Biphoton Generation

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**Abstract:**

This tutorial will illustrate biphoton generation based on the electromagnetically induced transparency (EIT) effect [1]. The illustration utilizes our experimental data as examples.

Biphotons are pairs of time-correlated single photons. One utilizes the first photon of a pair to herald the coming of the second photon in the same pair. Thus, the former is called the heralding photon, and the latter is called the heralded photon. It is convenient to employ the heralded photons in a subsequent quantum operation.

We generated biphotons with the spontaneous four-wave mixing process in the double-Lambda configuration, consisting of a Raman transition and an EIT one. For the first time, the all-copropagation scheme was utilized in our systems, resulting in an excellent phase match. The phase-match condition enables us to achieve a biphoton linewidth of 50 kHz and a spectral brightness of 380,000 pairs/s/MHz. The linewidth and spectral brightness are the world records among all the biphoton sources of various generation processes and media in literature.

Compared with other kinds of biphoton sources, the EIT-based biphoton source has the following advantages: (1) Its frequency is stable and not controlled by temperature. The source has a continuously adjustable mode ranging more than 500 MHz and is very suitable for quantum repeaters. (2) Its linewidth is highly tunable, narrower than 300 kHz or broader than 3 MHz. The source is compatible with quantum devices with different characteristics. (3) Its ultrahigh spectral brightness is close to the ultimate limit. The source can achieve a high success rate in quantum communication.

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[1] J.-M. Chen, T. Peters, P.-H. Hsieh, and I. A. Yu,\* “Biphoton Sources based on the Spontaneous Four-Wave Mixing Process,” an invited review article to be published in Advanced Quantum Technologies.