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Pioneering All-copropagating Scheme for Biphoton Source in Hot atomic System

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Biphoton generation has emerged as a pivotal tool in quantum research, offering the capability to produce heralded single photons. Leveraging the strong temporal correlation between two photons, one photon can be used as a trigger, and we can effectively use the second photon to conduct research in quantum information, quantum simulation and communication. Biphotons generated via the four-wave mixing process in hot atomic systems exhibit distinctive characteristics, including stable high detection rates, adjustable frequency as well as linewidth. These traits are particularly advantageous for applications in quantum communication. However, the previous generation rate per linewidth (known as spectral brightness) of hot atom SFWM biphoton sources lagged significantly behind those produced via spontaneous parametric down-conversion processes. This disparity primarily stems from the necessity of phase matching for maximizing the generation rate in the four-wave mixing process, which requires all light to propagate in the same direction. Nevertheless, the presence of background light in experiments compromises the purity and characteristics of single photons, emphasizing the critical need to identify the sources of background light and develop appropriate solutions. Presently, we have achieved a significant milestone by generating the world's brightest biphoton source in a hot atomic system, achieving a generation rate of 3.8×10^6 pairs/s and a spectral linewidth of 3.4 MHz. This groundbreaking research not only signifies a pioneering accomplishment in the realm of All-copropagating scheme biphoton sources but also establishes a fundamental groundwork for advancing biphoton generation. Importantly, this method has been successfully applied to generate biphoton sources in cold atom systems and even directly within optical fibers, showcasing its versatility and potential impact across various platforms.

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