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RESEARCH HIGHLIGHT

Squeezed light goes flexible

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Since its first experimental demonstration, squeezed light has been the driving force to push forward the frontier of quantum optics [1]. Recently, with the rapid development of quantum information science, the study of squeezed light has entered a new stage, aiming at real-world impact beyond proof-of-principle demonstrations [2, 3]. One prominent example is Laser Interferometer Gravitational-wave Observatory (LIGO), which utilizes base-band squeezed light to enhance its sensitivity, leading to the first observation of gravitational waves [4]. In parallel, numerous studies are being pursued to leverage squeezed light to generate large-scale cluster states, an essential resource for photonic quantum information processing [5, 6]. Such cluster states can have profound impact for both quantum computing and quantum networks. The approach based on squeezed light is advantageous as it can be generated deterministically, in contrast to other probabilistic approaches.

Squeezed light is a fragile quantum resource which is very sensitive to loss and phase fluctuation. Therefore, very dedicated setup and device are required to generate high-quality squeezed light. As different applications, such as quantum sensing and cluster-state generation, have vastly different requirement on squeezed light, different setups and devices have to be specially designed for different applications. The lack of flexibility has greatly limited the development of quantum technologies based on squeezed light. While, several works have managed to generate different types of squeezed light with the same device, it still requires that only one type of squeezed light can be used each time [7–9]. And the switching operation among different types is normally achieved by tuning the temperature of crystal, polarization of input light, and seed beams, which normally require the re-alignment of the whole setup.

Recently, Tian *et al.* has developed a flexible squeezed light source, which can generate baseband squeezing and EPR entangled state at the same time [10]. The two different quantum resources can be utilized for different applications simultaneously, and no switching operation is required. The setup is based on a cavity-based parametric down-conversion process with broad phase matching. By utilizing different orders of frequency modes, both degenerate and non-degenerate processes are generated. After passing through low-loss filters, high quality base-band squeezing and EPR pairs with strong entanglement have been observed. This work represents a critical step toward flexible and versatile quantum resource, which will greatly facilitate the development of quantum technology based on squeezed light.

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