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Strain engineered entangled photon sources: Electrical injection and Energy tunability

Entangled photon sources are playing a crucial role in photonic quantum information science. Self-assembled semiconductor quantum dots (QDs) are among the most promising sources for on-demand generation of entangled photons. Compared to real atoms, QDs have an undeniable advantage of being compatible with mature semiconductor technologies. For example the electrical injections have been realized, which is highly attractive for potential applications.

Unlike real atoms, however, the physical properties of QDs are highly random. This is a serious problem for fabricating QD quantum light sources where precise controls are needed. For the long-pursued entanglement swapping and the hybrid coupling schemes, the wavelength (energy) of the entangled photons must be tunable. By embedding the QDs in stretchable nanomembranes, our group has developed a unique strain tuning technique to engineer the QDs. In this talk I will first explain our technique by introducing a wavelength tunable single photon source. Then I will talk about our efforts in generating electrically triggered entangled photons with QDs. We have demonstrated an entangled light-emitting-diode with the fastest operation speed and highest yield ever reported. Finally I will introduce our latest generation of strain engineering platform, where the III-V QD sources are integrated on silicon substrate with ultra-small footprints. The wavelength tunable entangled photons are demonstrated with this novel platform, which will lead to several exciting experiments.

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