Compact and Efficient Linear Optical Generation of Dual-Rail Encoded Photonic Bell States

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Photonic quantum information processing is a promising route to reaching the quantum advantage. Using photons together with integrated optics is a sure way to compactification and scalability of optical schemes. Universal photonic quantum computing, as well as applications in quantum communication, require a reliable way to generate entangled photonic states. The generation of useful to computing dual-rail photonic Bell states takes at least 4 photons. To this date, existing schemes generate a specific Bell state with a maximum probability of 2/27, for which a 6-mode linear-optical interferometer and two-photon number resolving detectors are exploited [1]. Although using feed-forward, one can reach higher generation probabilities, and this comes at the cost of errors and photon loss by active switching introduced into the scheme, not to mention increased scheme complexity. In this talk, we introduce a compact 5-mode scheme with one photon resolving detector, which generates a Bell state with a probability of 1/9 – 50% higher than the known counterparts. This scheme is obtained *via* numerical optimization, which is also discussed in this work. You can take a closer look at [2].

References

[1] F V Gubarev, I V Dyakonov, M Yu Saygin, G I Struchalin, S S Straupe and S P Kulik, Phys. Rev. A **102**, 012604 (2020)

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