Fiber-pigtailed bright source of indistinguishable single photons

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The quality of single-photon sources based on semiconductor quantum dots (QDs) is continuously improving in terms of brightness, purity, and indistinguishability. The deterministic fabrication of micro-cavities centered on single QDs has matured in recent years, allowing for reproducibility of high performances across multiple sources [1]. However, the operation of these devices generally requires complex and bulky optical and cryogenics setups.

To broaden the range of applications of this technology, we have developed a method to efficiently out-couple the emission of a single-photon source to a single-mode fiber, allowing an alignment-free and mechanically stable operation, even in a compact vibrating cryocooler. Other attempts have been reported in the literature [2], still not reaching the performances of their free-space counterpart. These fiber coupling methods are not bound to a specific working wavelength and are particularly interesting for telecom applications.

Our pigtailed device (Fig.1) is operated under pulsed near-resonant excitation [3] at 930 nm, showing 16 MHz single-photon rate at the fiber output (20 % efficiency). The emitted photons are characterized by their purity (98.7 %) and indistinguishability (97.6 %). Moreover, we show that these properties are stable for 10 hours of continuous operation (Fig.2) and over multiple cooling cycles. This work opens the way towards a plug-and-play system which can be deployed in non-academic environment, hosting several devices in the same cryocooler.

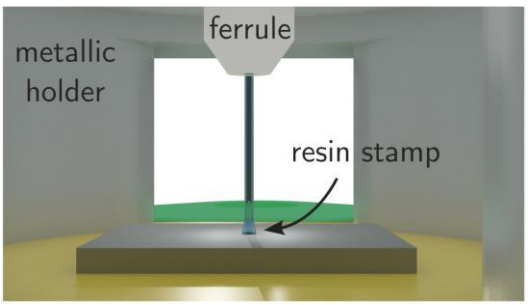

Figure 1: fiber pigtailed device detail

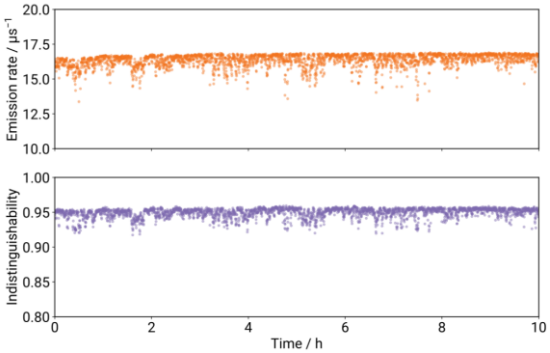

Figure 2: stability of the single-photon rate and indistinguishability

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