Monolithic Quantum Light Sources for Space QKD Applications

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Back in 2002, Toshiba released its pioneer Quantum LED design. [1] It opened a route for electrically driven quantum light sources (QLS) adapted to different spectral ranges and environments. Single photon and entangled photon pair sources are necessary to surpass security loopholes of current commercial QKD cryptographic systems based on decoy states. [2] They are also at the heart of linear optical quantum computing integrated devices. In harsh environments, like orbital-orbital or orbital-terrestrial quantum links, the number of optical elements must be kept at a minimum both for weight and vibration constraints. An electrically driven QLS connected to a simple power supply might have clear advantages in this environment over systems based on bulky optical setups and non-linear frequency conversion.

We will present our own design for an electrically driven QLS. [3] The device comprises of two separated electrical injection and electrical tuning regions in a bi-polar transistor configuration. The connection between them is purely optical and thus avoids the sheet resistance problems that plague other approximations, especially when applied to nanophotonic devices. The first fabricated devices show single photon emission with $g^2(0)<0.1$ at injection currents as low as 100 mA/cm^2 and fully linear conversion between electrical power and single photon flux.

[1]Z.Yuan et al Electrically Driven Single-Photon Source. Science 2002, 295, 102.

[2] S. Pirandola et al Fundamental limits of repeaterless quantum communications Nature Comm. 2017 8 15043.

[3] B. Alén *et al* "Tunable monolithic quantum light source and quantum circuit thereof" Patent pending EP/17382061.4, PCT/EP2018/052960. Date: Feb 8th 2017