Extraction of correlated 2-photons with near unity efficiency
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We report a source of 2-photons that can be extracted with near unit efficiency. The reduced mode area of solid-core microstructure fibers lets a light pulse induce significant nonlinear optical interaction inside a short fiber, making it easy to generate 2-photon entanglement. However, the photon extraction efficiency is low due to the small core size ($d \sim 1 \mu$m) that requires high numerical aperture (NA) lenses to couple light in and out of the fiber. Tapering the core at the fiber end to 10 $\mu$m allows the use of anti-reflection-coated lenses of smaller NA, to achieve a single-photon extraction efficiency of $\eta_f = 96\%$. Using a pair of volume holographic gratings for selecting any wavelength of interest increased our spectral transmittance for that wavelength to $\eta_g = (98\%)^2$, enabling a near unit efficiency in extracting a single photon from the fiber source: $\eta_f \eta_g = 92.2\%$. The final 2-photon detection efficiency of 10\% includes the efficiencies of single-photon detection modules ($\sim 70\%$ each) and single-mode fiber collection ($\sim 50\%$ per channel). At an average pump power of $P = 50 \mu$W and a laser repetition rate of $R = 76$ MHz, we detect 50 photon pairs s$^{-1}$ with $g^{(2)}(0) = 0.0055$ and a coincidence-to-accidental ratio of 900:1. Higher pair rates at the same $g^{(2)}$ level can be achieved by increasing $R$. With better photon detection, this source may enable loophole-free Bell tests.

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