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Generation of non-classical states of light using photonic crystal fibres

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Photonic crystal fibers (PCF) offer an important platform for χ^3-based nonlinear optics owing to the possibility to fully tailor their dispersion properties or modify the number of guided modes. We present here two ways to use these fibers in order to generate non-classical states of light, which are important tools for quantum technologies. First, we show the generation of bright correlated twin beams, based on modulation instability in a kagomé-lattice hollow-core PCF filled with argon at high pressure. In this experiment, we used 300 fs pump pulses from a Ti:Sa regenerative system (λ=800 nm) to generate modulation-instability sidebands. We then observed twin-beam squeezing up to 35% below the shot-noise level. This very bright source is spatially single mode and can exhibit only a few temporal modes (<5). Second, we introduce a new design of micro structured fiber for the generation of the photon-triplet state through a direct decay of pump photons. Similarly to the third harmonic generation, the phase matching is usually not satisfied for the fundamental spatial modes due to chromatic dispersion. The spatial overlap is therefore small and the efficiency of the process is consequently poor. Here, we use a hybrid solid-core PCF, in which total internal reflection occurs at down-converted wavelengths while an all-solid band gap governs the guidance mechanism at the pump wavelength. The overall dispersion is strongly influenced by these two mechanisms. Preliminary experiments on third harmonic generation confirm that the phase-matching between fundamental modes is indeed possible with this structure.

Biography

N Y Joly is an Associate Professor at the University of Nüremberg-Erlangen, where he works on photonic crystal fibers in close collaboration with the division of Prof. Philip Russell at the Max-Planck Institute for the Science of Light. His domain of research includes dynamics of fs-pulsed ring cavity as well as nonlinear optics in PCF. In particular, he is very interested in the nonlinear generation of new frequencies like supercontinuum generation.

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