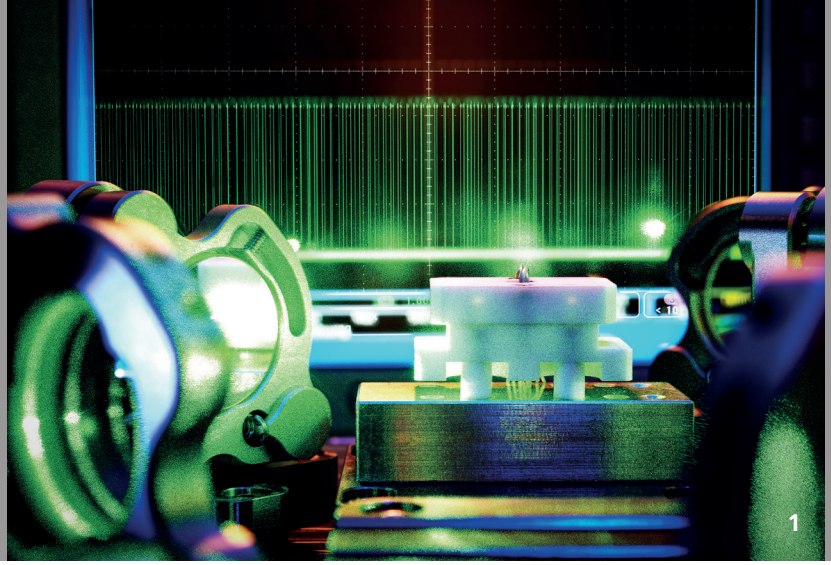

PARAMETRIC PHOTON SOURCES FOR QUANTUM IMAGING APPLICATIONS

Task

One focus of the so-called second quantum revolution is the generation, manipulation and detection of isolated or coupled exotic quantum states. Thanks to this revolution, basic research has been able to demonstrate a number of spectacular effects that now promise a wide range of application potential. Photonic quantum states, for example, play an important role in the field of quantum sensors and communication as well as in quantum computing. In the lighthouse project »QUILT«, sponsored by the Fraunhofer-Gesellschaft, Fraunhofer ILT is developing, among others, parametric photon sources for mid-infrared (MIR) imaging applications.

Method

Quantum imaging aims to use non-classical photon states to overcome the limitations of classical optics. For example, entangled photon pairs can be used to separate interaction and detection wavelengths in imaging processes. In this case, a photon of the entangled pair interacts with the sample, while the other one is detected and provides information about the interaction of its partner via the entanglement. Such pairs of entangled photons can be generated by parametric fluorescence in nonlinear crystals and their wavelengths chosen freely; yet they can be far apart from each other. This makes it possible to use highly sensitive silicon detection for quantum imaging in the MIR.

1 Source of entangled photon pairs based on parametric fluorescence.

Results

Fraunhofer ILT has designed and built a demonstrator for generating entangled photons based on parametric fluorescence. In it, a periodically poled crystal is pumped at 532 nm with an optically pumped semiconductor laser, and photon pairs are generated at about 810 and 1550 nm. For photon pairs, rates of more than 10^6 per second could be demonstrated. In the next step, the institute will investigate the imaging process in an interferometer and test it for future application potential. In parallel, sources with even greater wavelength spacing will be used to enable imaging in the MIR.

Applications

In addition to quantum imaging applications in biology and medicine, applications in quantum computing or quantum communication and sensor technology can also be addressed with the photon sources that have been demonstrated.

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