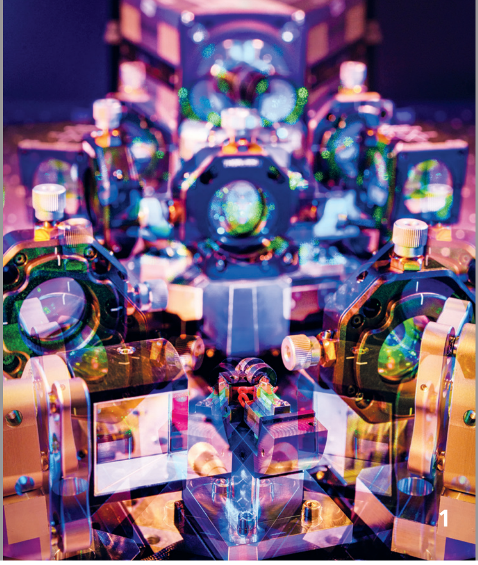

QUANTUM IMAGING WITH NON-DETECTED PHOTONS IN THE MID INFRARED RANGE

Task

Entangled photon pairs with widely shifted wavelengths can be generated by means of spontaneous parametric down conversion (SPDC). The Fraunhofer QUILT project is investigating how this can be used for imaging applications in wavelength ranges that are difficult to access.

Method

Within the QUILT project, Fraunhofer ILT is developing quantum interferometers that allow imaging analyses in the near (NIR) and mid infrared (MIR). Here, measurement wavelengths in the range from 1.5 to greater than 4.5 µm can be demonstrated. The associated detection wavelengths are in the visible spectral range and can be evaluated with sophisticated and cost-effective silicon-based camera systems. The photon pair sources newly developed for the application are based on lithium niobate crystals pumped by an optically-pumped semiconductor disk laser at 532 nm.

1 Nonlinear interferometer for quantum imaging.

Results

In a first interferometer with measurement wavelengths in the near infrared, it was possible to investigate fundamental interactions and to derive optimization criteria for the performance of the systems. Subsequently, Fraunhofer ILT developed an MIR quantum interferometer with which it was now possible to demonstrate imaging in the mid-infrared for the first time. To cover as large a wavelength range as possible in a single setup, the interferometer is constructed in a special long-pass configuration with broadband-coated optics.

Although the interferometer is illuminated at extremely low photon rates (~100,000,000 photons/second), short integration times of the CMOS camera – well below one second – can be used for imaging. Currently, the institute is analyzing methods for image acquisition with optimized imaging quality and refining them on the basis of this interferometer.

Applications

The existing setup will be used to carry out investigations for applications in life sciences and materials testing, among others. Furthermore, the results of this work will be transferred to a demonstrator for quantum coherence tomography, which will be used in industrial manufacturing processes.

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