Quantum imaging and sensing

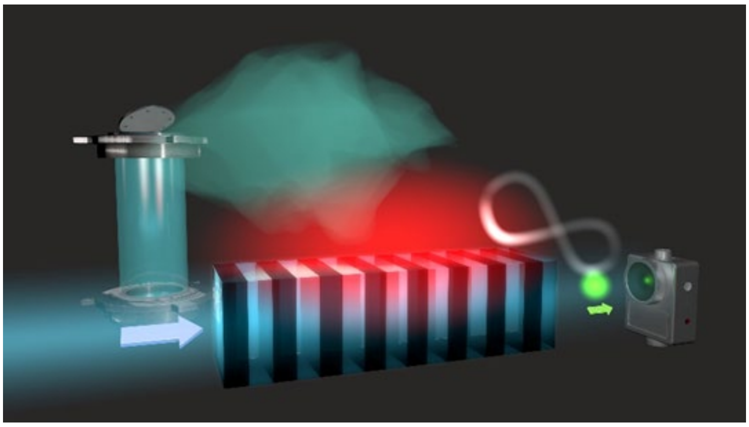
The strong correlations and entanglement present in quantum states of light, e.g. photon pairs generated by spontaneous parametric down-conversion, allow for novel sensing, spectroscopy, and imaging modalities. These can operate at lower intensities, with better signal-to-noise-ratio, and in extended spectral ranges compared to traditional approaches.

We are developing such imaging and sensing methods based on different measurement approaches. In Ghost Imaging, images are created based on the spatial correlations between the two photons of a pair, which enables to image objects without looking at them with a camera. Instead, a single-pixel detector observes the object illuminated by one photon of a pairs and the image is formed by correlating the detector measurements with the measurements of a camera that interrogates the paired photons that do not interact with the object. On the other hand, induced coherence by quantum interference of several photon-pair sources enables imaging and spectroscopy without detecting any of the photons the saw the object.

The task of the scientist is the development and optimization of such quantum sensing and imaging schemes, e.g. by implementing and testing dedicated photon state sources, specific measurement geometries, or improved data processing. Furthermore, the application prospects of the optimized methods shall be evaluated in realistic sensing scenarios.

Depending on the abilities and preferences of the candidate the following subjects would be covered

- Implementation and characterization of Ghost Image microscopy
- Realization of integrated spectroscopy based on induced coherence
- Conceptual development of quantum sensing modalities



Artistic sketch of an integrated sensing scheme for gas sensing with photon pairs, where the red photons interact with the substance under test but only their green partner photons are detected.

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