Projects in Quantum Information Processes and Entanglement

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Vacancy for Bachelor/Master-thesis or HiWi position

We are seeking for motivated students with a strong interest in pure quantum mechanics and quantum information theory. We are offering Bachleor/Master projects or a project within a HiWi position regarding two broad topics (see below). The topics in this field typically include analytical work as well as numerical computations. Thesis projects can be written in german as well, if necessary.
If you are interested in working on such a project, please contact us by mail for further information.

Spatial entanglement in the SPDC process

Spontaneous parametric down-conversion (SPDC) has been a reliable process for the generation of entangled photon pairs. In this process, a nonlinear quadratic crystal is pumped by a laser field in order to convert (high-energy) photons into correlated or entangled photon pairs. The down-converted photons can hereby be entangled in orbital angular momentum (OAM) (high-dimensional entanglement), which can be used in quantum applications, such as quantum cryptography, quantum teleportation, or quantum computing.

Possible subjects for investigations could be:

- Characterization of optical beams with (OAM) (twisted lights), especially Laguerre-Gaussian beams as measurement-basis in SPDC
- Investigation of the conservation-rules of total angular momentum (TAM) in SPDC
- Controling the entangled state via shaping the pump beam
- Investigation of the properties of the nonlinear crystals used in SPDC

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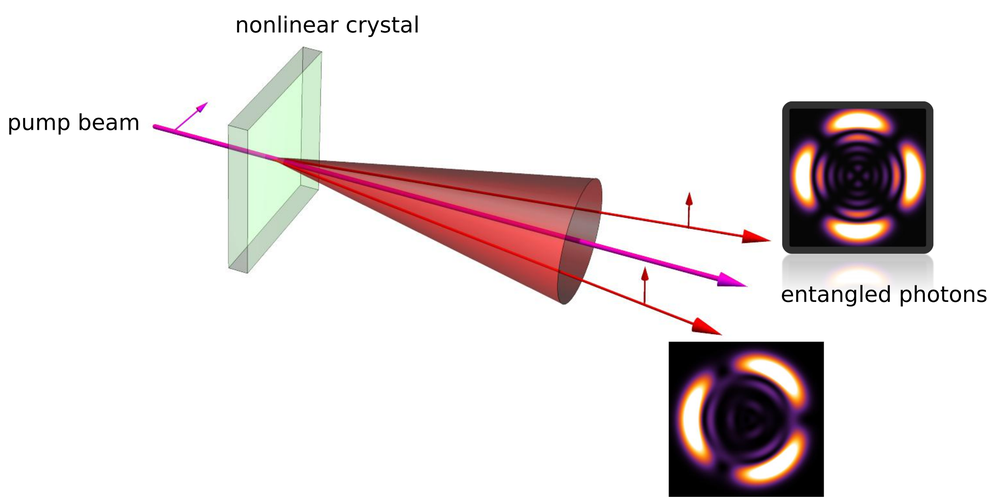

Dynamics of quantum information

In an interacting quantum system, correlations between different partitions arise that are never present in a classical system. To exploit the full potential of the quantum realm and realize quantum technology in the future, it is inevitable to gain a more profound understanding of multi-partite correlations in interacting quantum systems. We are concerned with the dynamics of quantum information, i.e., the build-up and propagation of quantum correlations during the non-equilibrium dynamics of the system.

Possible subjects regarding this topic could be:

- Analysis of the dynamics of correlations in closed quantum systems
- Numerical simulations of simple model Hamiltonians such as spin-chains
- Development of efficient schemes for (multi-partite) state transfer and entanglement distribution
- Method development for extracting observables from a quantum many-body system

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