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Dr. Christoph Simon visiting Physikalisches Institut, Universität Heidelberg

Dr. Christoph Simon came to the Physikalisches Institut at the Universität Heidelberg to discuss the Differences and similarities between Quantum Information Processing schemas with photons and neutral atoms.

My collaborators and students mainly work with neutral atoms. Therefore large emphasis was put on learning the concepts implementations and the advantages and disadvantages of using photons for QIPC. In the beginning Dr. Christoph Simon gave a set of lectures illustrating these basic principles. His lectures were for a large percentage of my new students here in Heidelberg the first time they got an in depth view into QIPC with photons. These gave us a good basis for further discussions and stimulus to look into new research directions.

One of the themes we discussed in more detail was the possibility to transfer schemes for quantum information processing with photons, to beams of guided neutral atoms. This is especially interesting since some of these might be implemented in our future atom chip experiments. An important aspect is here that atom optics in intrinsically non linear, and significant one atom non linearities can be achieved in tightly confining traps, as implemented on atom chips.

A straight forward implementation of photonic schemes with propagating atoms will have to take these non linearities in atom optics into account. The linear optics QIPC schemas will have to be revisited in detail. But on the other hand the well controllable non linearities in atom optics (controlled by confinement, Fastback resonances, dipole - dipole interactions) can be an advantage; they will allow direct implementations of controlled not gates.

A second topic discussed intensively was using schemas of studying coherence in photonic experiments, to be transferred to atomic or larger mesoscopic and macroscopic bodies with many degrees of freedom.

The visit of Dr. Christoph Simon at the Physikalisches Institut at the Universität Heidelberg gave us many new ideas and stimulated many new discussions. Some of the mechanisms discussed are now active part of our ongoing research effort on QIPC with neutral atom qubits on atom chips.

Prof. Dr. Jörg Schmiedmayer