Seminarankündigung

Dienstag, 4. Juni 2019
17:00 Uhr

WSI, Seminarraum S 101

“Quantum networks with erbium dopants”

A future quantum network will consist of quantum processors that are connected by quantum channels, just like conventional computers are wired up to form the Internet. In contrast to classical devices, however, the entanglement and non-local correlations available in a quantum-controlled system facilitate novel fundamental tests of quantum theory and numerous applications in distributed quantum information processing, quantum communication, and precision measurement.
While pioneering experiments have demonstrated the entanglement of two quantum nodes separated by up to 1.3 km, accessing the full potential of quantum networks requires scaling of these prototypes to more nodes and larger distances. To this end, a new technology that overcomes the bottlenecks of existing physical systems has to be developed.
In this context, our group explores individual erbium ions doped into silicate crystals. This system offers unique possibilities for global quantum networks as it combines second-long ground-state coherence with optical transitions in the telecommuni-cations frequency window where loss in optical fibers is minimal. However, harnessing individual erbium ions has been hampered by the ms-long lifetime of their optically excited states.
We plan to overcome this challenge using the concepts pioneered in cavity quantum electrodynamics with laser-cooled atoms. We target an unprecedented lifetime reduction by several orders of magnitude using resonators with ultra-small optical mode volume. In a first experimental approach, we embed micrometer thin crystals of yttrium orthosilicate into cryogenic Fabry-Perot resonators. In a second approach, we combine silicon nano-photonic structures with erbium dopants. This platform is compatible with standard semiconductor manufacturing techniques and thus has unique potential for up-scaling.
I will present the current status of these two experimental approaches, and give an outlook towards realizing global quantum networks with erbium-doped crystals.

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