Quantum network technology – the second life of rare-earth crystals

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Starting with the demonstration of lasing more than 50 years ago, the special properties of rare-earth crystals and glasses have given rise to the development of numerous solid-state lasers and amplifiers, which are crucial for the functioning of today's Internet. As a fascinating generalization of their use in optical communication infrastructure, it became clear during the past decade that, when cooled to cryogenic temperatures of a few Kelvin, rare-earth crystals also promise the creation of technology for quantum communication networks [1].

I will discuss recent advances towards the development of key ingredients of such networks: the reversible storage of quantum states of light in large ensembles of rare-earth ions (fig. 1) [2], as well as the creation of single photons using individual emitters coupled to a nanophotonic cavity (fig 2) [3,4]. This is interesting from a fundamental point of view, and paves the path towards a quantum repeater, which will ultimately enable quantum communications over arbitrary distances [5].

References

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Figures

Figure 1: A Tm:$Y_3Ga_5O_{12}$ crystal used for storing quantum states of light.

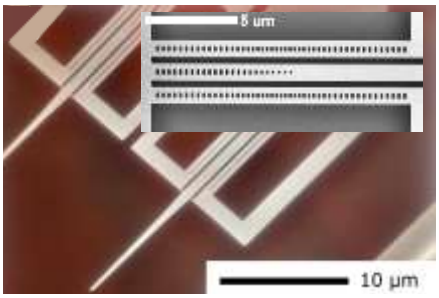

Figure 2: Silicon nano-photonic cavity on Er:$LiNbO_3$ (in collaboration with S. Gröblacher).