Rare earth doped crystals for integrated quantum photonics

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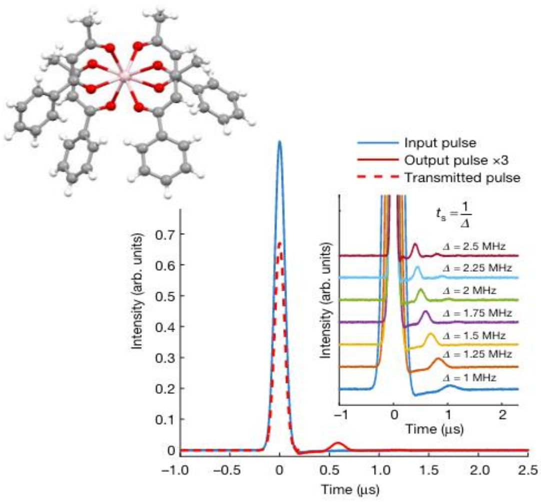
Systems with both spin and optical transitions offer a range of functionalities for quantum technologies. They allow storage and entanglement of photonic quantum states for quantum communications, interfacing processing nodes with optical networks for distributed quantum computing, or efficient detection for quantum sensing. Among various solid-state systems currently considered, rare-earth doped materials stand out as they combine, at cryogenic temperatures, long-lived optical and spin quantum states. In addition, they offer optical transition in a wide spectral range, including telecom wavelengths, high chemical stability, and easy doping in many hosts, thus enabling using large ensembles of centers with uniform properties.

Quantum-grade rare earth doped materials are developed in different forms. They include bulk crystals, like Y_2SiO_5, in which many early demonstrations were performed [1], and more recently nanostructured materials such as nanoparticles, or molecular crystals, aiming at integration into nanophotonics devices. In this talk, we will present some of our recent results in the field [2-4], as well as the challenges to be addressed to bring rare-earth doped materials up to the highly demanding requirements of quantum technologies.



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