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Coherent control of rare earth ions in solids.

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Rare earth ions in solids are among the most remarkable quantum system. Record coherence times of a couple of hours and telecom emission wavelengths are only a few of their outstanding properties. Many application require single spin control. In the talk I will describe our attempts to position single rare earth ions with high accuracy and yield [1]. I will then discuss the spin coherence properties of single ions and the correlation of spin state and photon properties [2]. In addition our recent all-optical control of spin coherence [3] suggests that single rare earth ion spins are excellent quantum bits. I will compare their performance with other solid state spin quantum systems. References: [1] Kornher T. et al. Production yield of rare-earth ions implanted into an optical crystal, APL 108, 053108, 2016. [2] Kolesov R. et al. Mapping Spin Coherence of a Single Rare-Earth Ion onto a Single Photon Polarisation, Phys. Rev. Lett. 111, 120502, 2013. [3] Xia, K. et al. All-Optical Preparation of coherent Dark States of a Single Rare Earth Ion Spin in a Crystal, Phys. Rev. Lett. 115, 093602, 2015.