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A single dopant atom in silicon sees the light[1]

SVEN ROGGE, University of New South Wales

Optical access to a single qubit is very attractive since it allows for readout with unprecedented high spectral resolution and long distance coupling. Substantial progress has been demonstrated for nitrogen-vacancy centers in diamond (Bernien, Nature, 2013). Optical access to qubits in silicon been an important goal but has to date only been achieved in the ensemble limit (Steger, Science, 2012). Here, we present the photoionization of an individual erbium dopant in silicon (Yin, Nature, 2013). A single-electron transistor is used as a single-shot charge detector to observe the resonant ionization of a single atom as a function of photon energy. This allows for optical addressing and electrical detection of individual erbium dopants with exceptionally narrow line width. The hyperfine coupling is clearly resolved which paves the way to single shot readout of the nuclear spin. This hybrid approach is a first step towards an optical interface to dopants in silicon.

[1]in collaboration with Chunming Yin, Milos Rancic, Gabriele G. de Boo, Nikolas Stavrias, Jeffrey C. McCallum, Matthew J. Sellars