The silicon vacancy centre in diamond as a superb single photon source (and beyond?)

Lachlan Rogers, Kay Jahnke, Fedor Jelezko

Institut für Quantenoptik, Ulm University, Germany

Emitters of indistinguishable single photons are crucial for the growing field of quantum technologies. The goal of scalability requires that even photons from multiple emitters are indistinguishable. Typical solid-state single photon sources require tuning to improve spectral overlap between distinct emitters, but we have observed silicon vacancy (SiV\(^-\)) centres in diamond which intrinsically show almost identical emission. These uniform emitters have linewidths as narrow as 230 ± 30 MHz, which is close to the expected lifetime-limited value [1].

The centre’s implementation in quantum technologies has been hindered by contention surrounding its fundamental properties, but this has recently been largely resolved. Our optical polarization measurements of single centres in bulk diamond have established that the center has a \(\langle 111 \rangle\) orientated split-vacancy structure with \(D_{3d}\) symmetry. These recent developments in understanding the fundamental physics of SiV\(^-\) make it possible to tentatively explain why this colour centre is such a superb single photon source.

Enough is now understood about the silicon-vacancy centre for it to be worth considering its potential for quantum technologies beyond single-photon generation, and I will briefly engage in some speculation.


Figure 1: Single SiV\(^-\) centres are a spectrally stable over long time scales, and b extremely uniform. Five randomly selected sites showed an average linewidth of 280 ± 30 MHz and up to 83% spectral overlap.