# Room temperature entanglement between single defect spins in diamond

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Negatively charged centres (NV) in diamond are one of the most remarkable colour defect centres in diamond. Its long coherence times and the possibility for single shot readout make it the ideal candidate for quantum applications. The entanglement of two NV centres is still an outstanding challenge promising to allow for a scalable quantum register.

In order to create coupled NV pairs a new mask implantation method was developed allowing for the use of MeV implantation energies lifting the probability to create a coupled pair to 3%. A suitable pair was selected using ground state depletion microscopy and double electron electron resonance. Entanglement was created by using simultaneous Hahn echoes. The resulting entangled state was analysed by means of a state tomography yielding a fidelity F=0.67±0.04. Additionally a phase measurement was conducted showing a global phase evolution between both entangled NVs. The influence of the charge state was investigated and compensated for. As a last step the intrinsic quantum memory given by the $^{15}$N was used to store the entangled state on the time frame of miliseconds. The experiments mark an important step towards a scalable room-temperature quantum device being of potential use in quantum information processing as well as metrology.

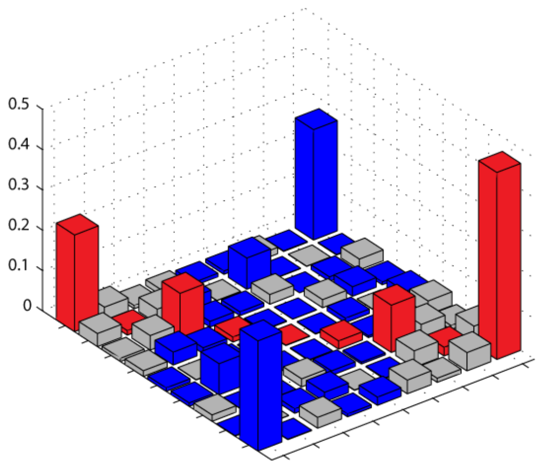


**Figure 1** measured tomography of an entangled $\Phi^{+}_{\mathrm{DQ}} = \frac{1}{\sqrt{2}}(|-1-1\rangle + |11\rangle)$ state