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Entanglement by measurement and Bell inequality violation with spins in diamond WOLFGANG PFAFF, TIM TAMINIAU, LUCIO ROBLEDO, HANNES BERNIEN, Kavli Institute of Nanoscience Delft, Delft University of Technology, The Netherlands, MATTHEW MARKHAM, DANIEL TWITCHEN, Element Six, Ltd., Ascot, United Kingdom, RONALD HANSON, Kavli Institute of Nanoscience Delft, Delft University of Technology, The Netherlands — Single spins in diamond have emerged as a promising platform for quantum information processing in the solid state. In particular, individual nuclear spins coupled to nitrogen-vacancy (NV) centers have been recognized as excellent candidates for solid state qubits, because they combine outstanding stability, excellent control by spin resonance techniques, and high-fidelity optical initialization and readout provided by the NV center. Here we report the achievement of a milestone towards quantum computation with spins: The creation of high quality quantum entanglement between two nuclear spins in diamond. Such entanglement is an important resource for quantum computation and lies at the heart of many key quantum protocols, such as teleportation and error correction. We show that we can produce entangled states of high fidelity using a projective quantum measurement. Our technique is non-destructive, and thus leaves the quantum information that is required for further computation unharmed. This enables us to demonstrate the violation of Bell's inequality for the first time with spins in the solid state. Reference: Pfaff et al., Nature Physics, doi:10.1038/nphys2444 (2012).

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