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Heralded entanglement between solid-state qubits separated by 3 meters HANNES BERNIEN, BAS HENSEN, WOLFGANG PFAFF, GERWIN KOOLSTRA, MACHIEL BLOK, LUCIO ROBLEDO, TIM TAMINIAU, Kavli Institute of Nanoscience Delft, MATTHEW MARKHAM, DANIEL TWITCHEN, Element Six Ltd., UK, LILIAN CHILDRESS, RONALD HANSON, McGill University Department of Physics — Entanglement between spatially separated objects is one of the most intriguing phenomena in physics. Besides being of fundamental interest, entanglement is also a valuable resource in quantum information technology enabling secure quantum communication networks and distributed quantum computing. Here we present our recent results towards the realization of quantum networks with solid-state qubits. We have entangled two spin qubits in diamond, each associated with a nitrogen vacancy center [1]. The two diamonds reside in separate setups three meters apart. With no interaction between the two spins to mediate entanglement, we make use of a scheme based on quantum measurements: we perform a joint measurement on photons emitted by the NV centers that are entangled with the spins. The detection of the photons projects the spins into an entangled state. We verify the generated entanglement by single-shot readout of the spins in different bases. The entanglement reported here can in principle be combined with recently achieved initialization, readout and entanglement operations [2, 3] on local long-lived nuclear spin registers, enabling deterministic long-distance teleportation, quantum repeaters and extended quantum networks. [1] H. Bernien et al., submitted. [2] L. Robledo et al., Nature 477, 574 (2011). [3] W. Pfaff et al., Nature Physics 9, 29 (2013).

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