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Repeated quantum error correction by real-time feedback on continuously encoded qubits JULIA CRAMER, NORBERT KALB, M. ADRIAAN ROL, BAS HENSEN, MACHIEL S. BLOK, QuTech and Kavli Institute of Nanoscience Delft, MATTHEW MARKHAM, DANIEL J. TWITCHEN, Element Six Innovation, RONALD HANSON, TIM H. TAMINIAU, QuTech and Kavli Institute of Nanoscience Delft — Because quantum information is extremely fragile, large-scale quantum information processing requires constant error correction. To be compatible with universal fault-tolerant computations, it is essential that quantum states remain encoded at all times and that errors are actively corrected. I will present such active quantum error correction in a hybrid quantum system based on the nitrogen vacancy (NV) center in diamond [1]. We encode a logical qubit in three long-lived nuclear spins, detect errors by multiple non-destructive measurements using the optically active NV electron spin and correct them by real-time feedback. By combining these new capabilities with recent advances in spin control, multiple cycles of error correction can be performed within the dephasing time. We investigate both coherent and incoherent errors and show that the error-corrected logical qubit can indeed store quantum states longer than the best spin used in the encoding [1]. Furthermore, I will present our latest results on increasing the number of qubits in the encoding, required for quantum error correction for both phase- and bit-flip. [1] J. Cramer et al. 2015; arXiv:1508.01388v1

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