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Multi-Run Quantum Error Correction in Coupled Electron-Nuclear Systems[1] ROBABEH RAHIMI DARABAD, DANIEL K. PARK, Institute for Quantum Computing, and Department of Physics and Astronomy, University of Waterloo, JONATHAN BAUGH, Institute for Quantum Computing, and Department of Chemistry, University of Waterloo, RAYMOND LAFLAMME, Institute for Quantum Computing, and Department of Physics and Astronomy, University of Waterloo, Perimeter Institute for Theoretical Physics — It has been a milestone in realizing quantum computing, to enhance our control over physical systems so that making quantum processors performing accurately and precisely in presence of environmental noise. For practical uses, quantum error correction should be employed in multi-run cycles in order to keep the encoded qubit, that is carrying the information, safe from noise. We have been working towards implementing multi-run quantum error correction in molecular systems that involve electron and nuclear spins. Electron spins of a molecular sample are used for pumping up the nuclear spin polarizations, in addition to addressing and manipulating the nuclear spins. The required experimental conditions for having access to refreshable ancilla qubits are very much enhanced by a careful design of the molecular sample. We report the progress and prospects towards overcoming the experimental challenges in terms of sample preparation; irradiation imposed free electron samples, free radical molecular spin systems, and triplet state photoexcitable co-crystal samples.

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