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Turning qubit noise into an advantage: automatic state preparation and long-time dynamics for impurity models on quantum computers

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Noise is often regarded as a limitation of quantum computers.
In this work, we show that in the dynamical mean field theory (DMFT) approach to strongly-correlated systems, it can actually be harnessed to our advantage.
Indeed, DMFT maps a lattice model onto an impurity model, namely a finite system coupled to a dissipative bath.
While standard approaches require a large number of high-quality qubits,
we propose a circuit that harvests qubit noise (amplitude damping) to reproduce the dynamics of this model with a blend of noisy and noiseless qubits.
We find compelling advantages with this approach: a substantial reduction in the number of qubits, the ability to reach longer time dynamics, and no need for ground state search and preparation.
This method would naturally fit in a partial quantum error correction framework.

Authors: BERTRAND, Corentin (Eviden Quantum Lab); Prof. FERRERO, Michel (CPHT); AYRAL, Thomas (Eviden Quantum Lab); BESSERVE, Pauline (Eviden Quantum Lab)

Presenter: BERTRAND, Corentin (Eviden Quantum Lab)