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Quantum simulation by filtered Hamiltonian engineering ASHOK AJOY, PAOLA CAPPELLARO, Massachusetts Institute of Technology — We present a method for Hamiltonian engineering in quantum information processing architectures that requires no local control, but only relies on collective qubit rotations and static field gradients. The technique achieves a spatial modulation of the coupling strengths via a dynamical construction of a weighting function combined with a Bragg grating. As an example, we demonstrate how to generate the ideal Hamiltonian for perfect quantum information transport between two separated nodes of a large spin network. We engineer a spin chain with optimal couplings from a large spin network, such as naturally occurring in crystals, while decoupling all unwanted interactions. For realistic experimental parameters, our method can be used to drive perfect quantum information transport at room-temperature. The Hamiltonian engineering method can be applied to a variety of physical systems, for example trapped ions, or Rydberg atoms in optical lattices. It can be made more robust under decoherence and coupling disorder by a novel apodization scheme. Thus the method is quite general and can be used engineer the Hamiltonian of many complex spin lattices with different 2D or 3D coupling topologies.

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