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**Engineering Vibrationally Assisted Energy Transfer in a Trapped-Ion Quantum Simulator**

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Many important chemical and biochemical processes in the condensed phase are notoriously difficult to simulate numerically. Often, this difficulty arises from the complexity of simulating dynamics resulting from coupling to structured, mesoscopic baths, for which no separation of time scales exists and statistical treatments fail. A prime example of such a process is vibrationally assisted charge or energy transfer. A quantum simulator, capable of implementing a realistic model of the system of interest, could provide insight into these processes in regimes where numerical treatments fail. We take a first step towards modeling such transfer processes using an ion-trap quantum simulator. By implementing a minimal model, we observe vibrationally assisted energy transport between the electronic states of a donor and an acceptor ion augmented by coupling the donor ion to its vibration. We tune our simulator into several parameter regimes and, in particular, investigate the transfer dynamics in the nonperturbative regime often found in biochemical situations.