Controlling the functionality of quantum materials by light

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The properties of complex quantum materials (QM), such as transition metal oxides, arise from the interplay of electrons, phonons, and magnons, making them highly sensitive to external parameters like pressure, doping, applied fields, and temperature. This susceptibility makes QM ideal for experiments where tailored electromagnetic fields can be used to induce novel properties on ultrafast timescales [1]. I will present our efforts to manipulate material properties through light, both in free space and optical cavities. Building on our recent demonstration that a metal–insulator transition in 1T-TaS can be controlled by resonant cavity coupling, I will outline recent results aimed at using optical cavities to sustain quantum coherence in high temperature superconductors.