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Ultrafast light-matter interaction: from transition metal oxides to van der Waals materials

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In quantum materials, exotic quantum states can emerge as a result of strong many-body interaction that are of charge, magnetic, orbital and structural origins. The delicate balance among these interacting degrees of freedom engenders not only a ground state, but also many other competing metastable states with distinct macroscopic properties. Despite static tuning methods, the rapidly developing ultrafast science has now made it possible to dynamically control quantum materials at an unprecedented level, that is, the direct manipulation of elementary excitations at their fundamental time and energy scales. Here, we show examples on how ultrafast laser excitation can lead to 'hidden'phases in strongly correlated transition metal oxides and Weyl semimetal materials. We also demonstrate, in atomic-thin transition metal dichalcogenides, the strong THz pulse can prompt quantum tunneling transport of excitons on the femtosecond timescale.

Field of Condensed Matter

Quantum Materials

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