

## Quantum materials: insights from near field nano-optics

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I will discuss recent nano-optical experiments on two different classes of quantum materials: transition metal oxides undergoing the insulator to metal transition and graphene. Central to the nano-optical exploration of quantum materials is the notion of polaritons: hybrid light-matter modes that are omnipresent in polarizable media. Infrared nano-optics allows one to directly image polaritonic standing waves [Nature Materials 17, 134 (2018), Nature Materials 14, 1217 (2015), Nature Materials 16, 1077 (2017)] yielding rich insights into the electronic phenomena of the host material supporting polaritons [Nature 557, 530 (2018), Science 354, 195 (2016)]. I will give a progress report on the search for the role of the Berry phase in the properties of graphene via polaritonic imaging [Nature Photonics 10, 244 (2016)]. In a parallel development, we harnessed near field optics to uncover the elusive electronic and magnetic phases that occur only at the nano-scale in the vicinity of the insulator to metal transition in correlated oxides [Nature Physics 13, 80 (2017) and Nature Materials 15, 956 (2016)].