Live from New York: Programmable Quantum Materials

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Quantum materials offer particularly appealing opportunities for the implementation of on-demand quantum phases. This class of materials host interacting many-body electronic systems featuring an intricate interplay of topology, reduced dimensionality, and strong correlations that leads to the emergence of "quantum matter'' exhibiting macroscopically observable quantum effects over a vast range of length and energy scales. Central to the nano-optical exploration of quantum materials is the notion of polaritons: hybrid light-matter modes that are omnipresent in polarizable media[1]. Infrared nano-optics allows one to directly image polaritonic waves yielding rich insights into the electronic phenomena of the host material supporting polaritons. We utilized this novel general approach to investigate the physics of on-demand hyperbolic exciton-polaritons in a prototypical atomically layered van der Waals semiconductor WSe_2 in which polaritons are prompted by femto-second photo-excitation[2].

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[1] D. N. Basov, Ana Asenjo-Garcia, P. J. Schuck, X. Zhu & Angel Rubio, "*Polariton panorama*" Nanophotonics 10, 549 (2021) https://infrared.cni.columbia.edu/research/polariton-panorama-2-2/

[2] A. J. Sternbach, S. Chae, S. Latini, A. A. Rikhter, Y. Shao, B. Li, D. Rhodes, B. Kim, P. J. Schuck, X. Xu, X.-Y. Zhu, R. D. Averitt, J. Hone, M. M. Fogler, A. Rubio, and D. N. Basov, "*Programmable hyperbolic polaritons in van der Waals semiconductors*" Science 371, 617 (2021).