Signatures of Collective photon emission and ferroelectric exciton ordering in moiré crystals

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In this talk, I will present our recent observation of many-body interaction-induced ferroelectric ordering of moiré excitons in H-stacked WSe2/WS2 heterobilayer. Strong exciton-exciton repulsion leads to an excitonic Mott state with a large on-site energy Uxx 35 meV. Due to the interplay of anisotropic nature of dipolar interactions, large Uxx, and spatially indirect in-plane excitons in H- stacking, we observe signatures of ferroelectric ordering of moiré excitons in time-resolved photoluminescence spectra. In particular, we find a reduction in emission lifetime consistent with this ordering, which can be thought of as a novel cooperative phenomenon [1]. Our observations open new avenues to explore a system of correlated moiré electrons and excitons as a rich platform to study and create quantum matter in a driven-dissipative setting and also a many-body quantum open system simulator to uncover novel cooperative phenomena.

[1] Luka Matej Devenica, Zach Hadjri, Jan Kumlin, Daniel Suárez-Forero, Runtong Li, Klevis Domi, Bosai Lyu, Weijie Li, Ludivine Fausten, Valeria Vento, Nicolas Ubrig, Song Liu, James Hone, Kenji Watanabe, Takashi Taniguchi, Thomas Pohl and Ajit Srivastava, Nature Materials (2026).