Collective modes in Cu$_x$TiSe$_2$ measured with meV-resolution EELS\textsuperscript{1} MELINDA RAK, SEAN VIG, ALI HUSAIN, MATTEO MITRANO, SAMANTHA RUBECK, Univ of Illinois - Urbana, ANSHUL KOGAR, Massachusetts Institute of Technology, GORAN KARAPETROV, Drexel University, EMILIA MOROSAN, Rice University, PETER ABBAMONTE, Univ of Illinois - Urbana — The charge density wave (CDW) in 1T-TiSe$_2$ has been widely thought to be the result of an excitonic insulator transition. We recently observed a soft electronic mode in TiSe$_2$ using a new, momentum-resolved electron energy loss spectroscopy (M-EELS) technique, demonstrating a condensation of electron-hole pairs in this material. As TiSe$_2$ is doped with Cu to produce Cu$_x$TiSe$_2$, a superconducting dome emerges above $x \sim 0.04$. In this talk, I describe how the electronic collective mode evolves with Cu doping. We find that the temperature dependence of the electronic mode reverses as Cu is introduced and that the mode is much broader at low temperature as compared to the undoped material. Additionally, the electronic mode no longer has a positive dispersion at 300 K as described by the Lindhard function, but has a slightly negative dispersion for small momentum transfers. We will discuss the implications of these results for the excitonic insulator transition in TiSe$_2$.

\textsuperscript{1}This work was supported by the Gordon and Betty Moore Foundation’s EPiQS Initiative through Grant GBMF4542. An early prototype of the M-EELS instrument was supported by the DOE Center for Emergent Superconductivity under award no. DE-AC02-98CH10886.

Melinda Rak
Univ of Illinois - Urbana