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Numerical Many Body Models for Synchrotron Spectroscopy of Quantum Materials

Significant research efforts are currently directed at the field of quantum materials, as many of these materials exhibit remarkable properties which may be suitable for next-generation device technologies. Synchrotron facilities, like the Canadian Light Source, are often utilized to study the properties of quantum materials via various forms of x-ray spectroscopy. However, interpreting the obtained spectroscopy data is often a significant challenge, as the connection from the fundamental quantum properties to the emergent spectral functions can be highly nontrivial. To this end, we design many-body quantum models which aim to capture the key properties of the materials while also having computable spectral functions which can be compared to experiment. In this talk, I'll introduce the models used and discuss strategic basis transformations and the numerical methods we employ. I will include recent results from studies of several highly interesting materials, including those exhibiting two-dimensional electron liquids and metal-insulator transitions. The concerted approach of synchrotron experiments and quantum many body models promises to be a key component of future work toward widespread quantum devices and other technologies utilizing quantum materials.