Discovery of Electric Charge Order in a Potential Quantum Material

Scientific Achievement
A novel charge order phase was discovered in iron niobium disulfide, an intercalated transition metal dichalcogenide (TMD).

Significance and Impact
This is the first instance of a charge order phase in the intercalated TMDs, suggesting that Fe\textsubscript{x}NbS\textsubscript{2} is a strongly correlated electron system; it may have future applications in quantum computing, energy-efficient storage, and other frontier technologies.

Research Details
- Over- and under-intercalated samples were studied, in part, with X-ray scattering at NSLS-II's ISR beamline.
- Results show that excess Fe atoms (x = 0.35) lead to a new charge order, which is unexpected compared to the charge density waves that are known to arise in TMDs.
- Charge order modulation is attributed to a strong coupling between the local magnetism and the atomic lattice.

Work performed in part at NSLS-II


(a) The crystal structure of Fe\textsubscript{0.35}NbS\textsubscript{2}. (b) and (c) Charge order patterns in the over-intercalated (x = 0.35) sample.