A facility for X-ray and Optical Sum Frequency Generation Studies of Optically pumped valence charge excitations.

Main Message: X-ray and optical wave mixing using a 3rd generation synchrotron source and a MHz repetition-rate optical laser directly probes both the initial atomic-scale spatial structure of an optically pumped electronic excitation and the subsequent valence charge dynamics.

1. Introduction
   - Motivation – importance of optical absorption (photo-voltaics, photo-chemistry, ...)
   - Recent demonstration at LCLS of SFG with x-ray and optical beams in diamond (Nature article)

2. Relevant Theory
   - Inelastic x-ray diffraction from an optically excited electronic state
   - Wave equation model of SFG
   - Models of optically excited states

3. Apparatus and methods
   - Extension of ERL fiber laser
   - Dual beam operation
   - CCU and high resolution monochromator
   - Synchronization

4. Conclusion