High-resolution inelastic X-ray scattering at LCLS-II-HE: preliminary plans and outlook

Hasan YAVAS

LCLS-II-HE upgrade will deliver two to three orders of magnitude higher average spectral flux (photons/s/meV) compared to storage-ring-based X-ray sources. This development can potentially extend the reach of inelastic X-ray scattering (IXS) to unexplored territories like measurements with signals that are currently too weak to detect. However, a more pronounced advantage of an IXS spectrometer at an X-ray FEL is likely related to the ultrashort pulses that are unique to LINAC-based sources. This new advancement will enable interrogation of collective modes associated with short-lived transient phases of materials that are controlled by various stimuli, including ultrafast mid-IR and THz pulses. In order to exploit this capability, we embarked on an extensive effort to build an IXS spectrometer as part of the Dynamic X-ray Scattering (DXS) Instrument. While this outlook is surely exciting, leveraging high average spectral flux for time-resolved IXS measurements appears to be an arduous task. The conventional spectrometer designs, honed at synchrotron facilities, can mostly be adopted. However, we realized that a renewed approach to monochromator designs is needed to preserve the FEL beam qualities, particularly the pulse duration.