Contribution ID: **48**   Type: **Oral presentation (preferred)**

Material Damages and Burn-Through Detection for FEL Beams at LCLS

Friday, 31 May 2024 08:40 (20 minutes)

The Linac Coherent Light Source (LCLS) at SLAC is operating with a normal-conducting Linac (up to 17 GeV, 120 Hz) and a new superconducting Linac (up to 4 GeV, 1 MHz, since 2023). Free Electron Laser (FEL) beams can be generated by two adjustable gap undulators: one for soft X-rays and one for hard X-rays.

FEL beams are capable of damaging materials and the mechanism of the damages from normal-conducting and superconducting beams are different. For normal-conducting beams, the ablation from strong pulses and thermal fatigue from repeated pulses are the source of damage. For superconducting beams with high repetition rate, the heat can be accumulated between pulses and thus the damage can also come from the combination of high temperature and large pulses. It is critical to detect such damages so radiation safety interlocks can shut off FEL beams before all safety layers are drilled through.

This presentation introduces the analyses of material damages and the designs of burn-through detection for stoppers, collimators, and other radiation safety devices, and shows the tests using normal-conducting and superconducting FEL beams to verify the analyses and designs.

Scientific Topic 1

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Session Classification: Session 8 - Radiation damage to materials

Track Classification: Radiation damage to materials