Contribution ID: **38** Type: **Talk**

Bright Radiation Sources Driven by Ultrafast High-Intensity Lasers and Applications

Thursday, 6 November 2025 14:00 (20 minutes)

With the ongoing miniaturization and stabilization of laser wakefield accelerators (LWFA), tabletop X-ray sources based on such accelerators have shown great potential. Among them, Betatron radiation sources driven by ultrafast, high-intensity lasers feature micrometer-scale source size, femtosecond pulse duration, milliradian-scale divergence, and broadband spectra extending to tens of keV. These characteristics make them highly suitable for high-contrast imaging of microstructures, diagnostics of high-energy-density states in inertial confinement fusion (ICF), and ultrafast dynamic studies in multidisciplinary research. This presentation will showcase the recent development of a high-brightness Betatron hard X-ray source platform at the Shanghai Institute of Optics and Fine Mechanics (SIOM), Chinese Academy of Sciences. In particular, we report on Betatron sources driven by two high-power laser systems—a 1 PW/0.1Hz laser system at Shanghai Superintense Ultrafast Laser Facility (SULF) and a 200 TW/1 Hz laser—achieving critical energies in the range of 15–86 keV and photon yields exceeding 1010 photons per shot. We further demonstrate their application in X-ray phase-contrast imaging.

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