

Demonstration of Hard X-ray Self-seeded XFEL with High Brightness and Stability for Serial Femtosecond Crystallography

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Researchers at the Pohang Accelerator Laboratory XFEL demonstrated a hard X-ray self-seeded XFEL, achieving a peak brightness of 3.2×10^{35} photons $s^{-1} mm^{-2} mrad^{-2} 0.1\% BW^{-1}$ at 9.7 keV. The system produced a narrow bandwidth of 0.19 eV—about 1/70 of that in self-amplified spontaneous emission (SASE)—with 40 times higher spectral brightness and improved stability. The self-seeding performance was consistent across photon energies from 3.5 keV to 14.6 keV. At 14.6 keV, the XFEL achieved a bandwidth of 0.32 eV and a peak brightness of 1.3×10^{35} photons $s^{-1} mm^{-2} mrad^{-2} 0.1\% BW^{-1}$. The cleaner spectrum and higher reproducibility of the self-seeded FEL led to superior data quality in serial femtosecond crystallography (SFX) experiments, compared to SASE mode. A demonstration experiment using 9.7 keV self-seeded XFEL successfully mapped the **three-dimensional structure of lysozyme** from chicken egg white.

[1] Nam, I., Min, CK., Oh, B. et al. (2021) *Nat. Photonics* **15**, 435–441.