



Contribution ID: 12 Contribution code: TUP47

Type: **Contributed Poster**

Analysis of Spectral Contents in Hard X-Ray Self-Seeded Free-Electron Laser Operation at the European XFEL

Tuesday, 23 August 2022 17:40 (20 minutes)

Recently, Hard x-ray self-seeding (HXRSS) operations at the European X-ray free-electron laser (EuXFEL) opened a pathway towards the application of pulses with high spectral density (in terms of ph/eV per pulse) in the fields of applied physics, chemistry and biology, where the coherent radiation spectrum is essential. The spectrum of hard x-ray self seeding pulses is generally accompanied by a pedestal around the central seeded photon energy. The pedestal contains two separate components: normal self-amplified spontaneous (SASE) and sideband emissions that can be ascribed to long-wavelength modulations of the electron beam. The pedestal limits the spectral purity and can impact some user applications. In this report, we analyze the purity of HXRSS pulses in the presence of microbunching instability. We look at the spectral contents after and before saturation, and display the contribution of the pedestal in the HXRSS spectrum.

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Primary authors: MIRIAN, Najmeh (Deutsches Elektronen-Synchrotron); LONG, Tianyun (Deutsches Elektronen-Synchrotron)

Co-authors: LIU, Shan (Deutsches Elektronen-Synchrotron); Dr QIN, Weilun (Deutsches Elektronen-Synchrotron); SERKEZ, Svitozar (European XFEL GmbH); GELONI, Gianluca (European XFEL GmbH); GUETG, Marc (Deutsches Elektronen-Synchrotron)

Presenters: MIRIAN, Najmeh (Deutsches Elektronen-Synchrotron); LONG, Tianyun (Deutsches Elektronen-Synchrotron)

Session Classification: Tuesday posters

Track Classification: Seeded FEL