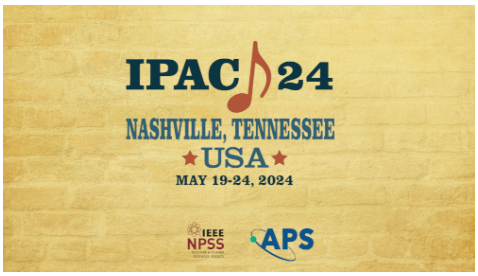

Contribution ID: **1441** Contribution code: **MOPG27** Type: **Poster Presentation**

Experimental characterization of the sensitivity of echo-enabled harmonic generation to operating parameters

Monday, 20 May 2024 16:00 (2 hours)

Echo-enabled harmonic generation (EEHG), a free-electron laser (FEL) scheme relying on two modulating sections, each consisting of an optical seed laser, an undulator and a magnetic chicane, has recently been implemented on the FEL-1 radiator line at the FERMI FEL user facility in Trieste, Italy. This setup imprints a density modulation onto a relativistic electron beam at a high harmonic of the seed frequency before injecting the electrons into the radiator, where they emit coherent soft x-rays. We have experimentally studied EEHG performance as a function of the properties of both seeds (modulation amplitude, frequency chirp) and the electron beam (slice energy spread, energy profile). We measured a relatively low output sensitivity to the properties of the first and a high sensitivity to the properties of the second seed, and simultaneously a high tolerance both to slice energy spread and to non-linear terms in the electron-beam energy profile. All of these observations are consistent with theoretical predictions. The emission of coherent, shot-to-shot stable radiation at harmonics of the second seed frequency as high as 50 sets the stage for a future upgrade of the FEL-2 line.

Footnotes

Funding Agency

Paper preparation format

LaTeX

Region represented

Europe

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Session Classification: Monday Poster Session

Track Classification: MC2: Photon Sources and Electron Accelerators: MC2.A06 Free Electron Lasers