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Comparison of the Spectro-Temporal Properties of Echo-Enabled and High-Gain Harmonic Generation Free-Electron Laser Pulses

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The external seeding scheme Echo-Enabled Harmonic Generation (EEHG) utilizes two modulators and two chicanes to manipulate the longitudinal phase space of an electron beam to achieve bunching at higher harmonics of the seed laser wavelength. High-Gain Harmonic Generation (HGHG) makes use of a single modulator-chicane setup, but is limited to lower harmonics due to more stringent requirements on the energy modulation and a consequently larger induced beam energy spread. In both seeding techniques, different combinations of energy modulation and longitudinal dispersion can result in the same amount of bunching at a certain harmonic. A comparison of EEHG and HGHG at the 15th harmonic is presented under particular consideration of the impact of the energy modulation amplitudes on the bunching properties and the spectro-temporal characteristics of the free-electron laser (FEL) radiation. The corresponding numerical modelling and simulations are performed within the parameter range of the future upgrade of the FEL user facility FLASH at DESY.

Summary

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