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Towards a Seeded High Repetition Rate FEL: Concept of Seed Laser Beam Transport and Incoupling

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FLASH2020+ is an upgrade project for the FLASH facility at Hamburg. A main goal of the project is to generate fully coherent soft X-ray FEL radiation at a high repetition rate (MHz). The project will utilize two external laser seeding principles in order to produced Seeded FEL with tunable wavelength from 4-60 nm. In order to achieve this goal, both HGHG (High Gain Harmonic Generation) and EEHG (Echo-Enhanced Harmonic Generation) methods provide FEL emission at harmonics of a seed laser. For HGHG, a tunable UV laser system (297-317 nm) and for EEHG a combination of the tunable UV laser and fixed wavelength (343 nm) laser system would be used to cover the whole range of wavelengths between 4-60 nm.
In this contribution, we will describe the requirements of the seed laser to initiate the seeding process and will explain the concept of seed laser beam transport and incoupling into the modulators for FEL radiation production.
The first seed laser (Seed1) with fixed wavelength is transported about 28 meters from laser lab to the incoupling chicane. The second seed laser (Seed2) with a tunable UV wavelength is transported about 35 meters.
Our concept uses a full relay imaging system and in vacuum components for the laser transport in addition to high repetition rate diagnostics to deliver, monitor and control the beam and pulse parameters at the interaction with electron beam. We investigate the technical and engineering limitations for the design and address those challenges to provide the demanding seed laser parameters for generating high repetition rate seeded FEL.

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