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Measurements and simulations of the longitudinal wakefields at free electron laser FLASH II

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Recent results of short-range longitudinal wake calculations in the undulator lines at the European XFEL predicted strong wakefield effect. Design of the vacuum system of FLASH 2 undulator is pretty much similar to that of the European XFEL. Bunch charge and the peak current are also in the same range as well. Thus, we expect comparable effects of the wakefields for both machines. Relevant experimental studies have been performed recently at FLASH 2. We traced energy of the lasing fraction of the electron bunch along the undulator by means of tracing central frequency of SASE FEL radiation. We measured radiation spectra of SASE FEL from 5 undulator modules with closed gaps at different positions along the undulator: 1-5, 2-6, ..., 8-12 keeping remaining 7 modules with open gaps. We detected clear red shift of the radiation spectra along the undulator which corresponds to the energy loss of the lasing fraction of the electron bunch of 5.4 MeV at the whole undulator length (or, 450 keV per one undulator section). Here we present and discuss both, experimental results from SASE FEL and simulation results of wakefields.

Footnotes

Igor Zagorodnov, Martin Dohlus, Torsten Wohlenberg, Short-range longitudinal wake function of undulator lines at the European X-ray free electron laser, Nucl. Instr. and Meth. A 1043 (2022) 167490

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