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Electron beam transport modeling in a linear induction accelerator for X-ray flash radiography

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X-ray flash radiography is a powerful diagnostic used worldwide for investigating the structural response of matter under impulsive loading during hydrodynamic experiments. These experiments require a specific X-Ray source generated by a Linear Induction Accelerator (LIA). LIAs produce an intense electron pulsed beam, with a high-energy and providing a high dose at 1 m. Therefore, comprehension and prediction of the electron beam dynamic are essential to guarantee correct realization of the hydrodynamic experiments. At CEA DAM, X-Ray flash radiography experiments are performed on the UK/FR joint facility EPURE, a unique triple-axis radiographic facility with two LIAs and one Inductive Voltage Adder "MERLIN".

In this study, envelope and particle-in-cell codes simulate the electron beam transport from the production of the beam in the injector to its transport along the accelerator. Thanks to the developed models, parametric studies are made about the influence of beam parameters, as the initial emittance, on the transport. Moreover, the developed codes take into account some beam instabilities, as the beam breakup instability or corkscrew motion. Studies show that the initial beam centroid offset has a significant impact on the beam instabilities during the transport. In addition, simulation results are compared with experimental data acquired on the EPURE facility, notably comparisons about our method to center the beam for limiting beam instabilities.

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Footnotes

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