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Numerical studies for EuPRAXIA@SPARC_LAB plasma beam driven working point

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The realization of a plasma based user facility on the model of EuPRAXIA@SPARC_LAB requires to design a working point for the operation that allows to get an high accelerating gradient preserving a low emittance and low energy spread of the accelerated beam. Such beam is supposed to pilot a soft x-ray free electron laser, a device with very challenging requirements in terms of brightness and energy spread. The external injection beam driven scheme by means of an RF photoinjector allows a fine tuning of the working point parameters at the injection, but the high beam current dictates the maximum accelerating gradient that can be obtained while preserving energy spread. These parameters are mostly connected to each other depending on the plasma wavelength and on the separation phase between driver and witness. In this work several simulation scans are presented, varying at the same time the plasma density and driver-witness separation in order to show that, in a realistic working point for EuPRAXIA@SPARC_LAB, it is possible to find an ideal compromise for a witness with a peak current >1kA that allows to preserve the energy spread of the core (80% of the charge) below 0.1%, while maintaining an accelerating gradient of the order of GV/m. The study is completed with a parametric analysis with the aim of establishing the stability requirements of the RF working point and the plasma channel in order to preserve the energy jitter at the same level of the energy spread.

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Footnotes

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