



Contribution ID: 2046 Contribution code: WEPA040

Type: **Poster Presentation**

Beam dynamics optimization of EuPRAXIA@SPARC_LAB RF injector

Wednesday, 10 May 2023 16:30 (2 hours)

At EuPRAXIA@SPARC_LAB an X-ray FEL user facility is driven by a plasma accelerator in the particle-driven configuration where an ultra-relativistic beam, the driver, through a plasma generates a wake of charge density useful for accelerate a witness beam. The electron bunches are generated through the so-called comb technique in an RF injector that consist of a 1.6 cell S-band gun followed by four S-band TW accelerating structures. The main working point foresees a 30pC witness and a 200pC driver longitudinally compressed in the first accelerating structure operated in the velocity-bunching regime, that allows to accelerate and manipulate the beam to reach proper transverse and longitudinal parameters. The optimization of the witness emittance is performed with additional magnetic field around the gun and the S-band structures and by shaping the laser pulse at the cathode. The paper reports on beam dynamics studies performed also for beams with higher charges to maximize the transformer ratio in the plasma and the beam brightness. In addition, the insertion of an X-band RF cavity after the gun is proposed aiming to shape the beam current distribution as needed and stabilize it with respect to RF jitters.

Funding Agency

Footnotes

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Yes

Primary author: SILVI, Gilles Jacopo (Istituto Nazionale di Fisica Nucleare - Sez. Roma 1)

Co-authors: BACCI, Alberto (Istituto Nazionale di Fisica Nucleare); MOSTACCI, Andrea (Sapienza University of Rome); GIRIBONO, Anna (Istituto Nazionale di Fisica Nucleare); VACCAREZZA, Cristina (Istituto Nazionale di Fisica Nucleare); FRANCESCONI, Daniele (Sapienza University of Rome); CHIADRONI, Enrica (Sapienza University of Rome); FAILLACE, Luigi (Istituto Nazionale di Fisica Nucleare); ROSSETTI CONTI, Marcello (Istituto Nazionale di Fisica Nucleare); CARILLO, Martina (Sapienza University of Rome); FERRARIO, Massimo (Istituto Nazionale di Fisica Nucleare); IOVINE, Pasqualina (Sapienza University of Rome); POMPILI, Riccardo (Istituto Nazionale di Fisica Nucleare)

Presenter: SILVI, Gilles Jacopo (Istituto Nazionale di Fisica Nucleare - Sez. Roma 1)

Session Classification: Wednesday Poster Session

Track Classification: MC5: Beam Dynamics and EM Fields: MC5.D09: Emittance manipulation, Bunch Compression and Cooling