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Laser-plasma accelerator-based free-electron laser program at ELI Beamlines (ELI ERIC)

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The laser-plasma accelerator-based Free Electron Laser development program at ELI-ERIC (ELI Beamlines, Czech Republic) aims to utilize the unique properties of plasma accelerators to create compact FELs with exceptional performance regarding brightness, coherence, and pulse duration. The program is based on the advanced high-power, high-repetition-rate L2-DUHA laser system developed at ELI Beamlines. This program involves extending the LUIS experimental setup to test and validate the performance of the laser-plasma accelerator-based extreme ultraviolet (EUV) free electron laser (FEL), integrating high-power laser, plasma source, and electron beam transport line with relevant diagnostics to create a comprehensive test bed for the EuPRAXIA LPA-based soft X-ray FEL development. The mitigation of the main challenges will be discussed in the framework of this report. The potential integration of the LPA-based soft X-ray FEL setup into the existing infrastructure of the ELI Beamlines Facility will be presented. The laser-plasma accelerator-based FEL development program at ELI Beamlines represents an innovative effort to enhance the capabilities of ELI Beamlines as a user-oriented European Facility, thereby opening new possibilities for scientific research and industrial applications.

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