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Laser systems with accelerator-like performance, key for stable plasma electron beams

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Successful applications of laser-plasma accelerators require stable electron beams. The drive laser plays a crucial role in the generation of such beams: even slight variations in laser pulse quality on target deform the shape of the plasma wake and thereby the fields inside the plasma cavity with direct impact on the generated electron phase space. All efforts to improve the laser performance therefore directly benefit the electron beam performance.
The LUX plasma accelerator is operated in a collaboration of Hamburg University and DESY. Driven by the ANGUS laser system it has been designed to test and develop concepts towards stable plasma acceleration. Providing a platform which continuously delivers electron beams provides new opportunities to take data with high statistics and to understand mechanisms that have so far been buried in noise. Here, we discuss our approach to operate the ANUGS laser like an accelerator, implementing diagnostics, controls and feedback loops for increased performance. We will present recent experimental results, and correlate laser parameters with properties of the plasma electron beam. Finally, we will show current limitations in performance, discuss improvements in electron quality that can be expected from specific modifications in the laser, and provide an outlook on future development.

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