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Development of laser-plasma accelerators at HZDR for FEL applications

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We present the development of laser-plasma accelerators at HZDR to produce high quality electron beams which enable the recent demonstration of free-electron lasing in the seeding configuration [1]. Driven by the 100TW- class arm of the DRACO laser, the accelerator can deliver up to nC total charge with spectral charge density reaching 10 pC/MeV, less than 1 mrad divergence at energies up to 0.5 GeV and peak currents of over 10 kA. Precise characterization of the drive laser on target (spatio-temporal coupling), plasma wave structures (few-cycle shadowgraphy) and generated electron beams (CTR imaging and spectroscopy) is paramount for controlled and stable multi-day operation, allowing for systematic studies of the output beam parameters. Results from each diagnostic will be discussed and a future perspective of using a hybrid LPA-based driven PWFA (LPWFA) concept for beam quality booster will be briefly mentioned.

References

[1] M. Labat, J.P. Couperus Cabadağ, A. Ghaith, A. Irman, et al. "Seeded free-electron laser drive by a compact laser plasma accelerator" Nature Photonics (2022), https://doi.org/10.1038/s41566-022-01104-w