

First experimental results of beam driven plasma wakefield acceleration at FACET-II: beam matching and gamma-ray radiation

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The upgraded Facility for Advanced Accelerator Experimental Tests (FACET-II) at SLAC is currently delivering the first electron beams for beam driven plasma wakefield accelerator (PWFA) experiments. The design of this new machine is such that it can deliver beams with unprecedented parameters, in particular very high peak current and low emittance, making them perfectly suitable to explore the next milestones in the field of PWFA [1]. The talk will present preliminary results of the E-300 PWFA experiment at FACET-II in the one-bunch configuration. One of the main experimental goals of the E-300 experiment is the experimental demonstration of the preservation of the accelerated beam emittance. For this purpose a combination of a direct emittance diagnostic based on a single shot energy-resolved beam size measurement, and a non-destructive diagnostic based on betatron gamma-ray radiation [2] has been implemented. Simulations showed that betatron radiation emitted by electron bunches in PWFA can be used to retrieve the dynamics of the beam when propagating in the plasma and to experimentally reach the matching conditions, a key requirement to achieve emittance preservation at FACET-II. This talk will highlight the working principle of this betatron gamma-ray diagnostic technique and explain how it can provide insight to the not-yet measured matching and beam dynamics. The first gamma-ray experimental measurements at FACET-II and their correlation with the beam transverse dynamics will be presented.

References

- [1] C. Joshi *et al.*, Plasma Phys. Control. Fusion 60, 034001 (2018).
- [2] P. San Miguel Claveria *et al.*, Phil. Trans. R. Soc. A 377, 20180173 (2019).