

Laser Wakefield Acceleration at the ZEUS laser facility at the University of Michigan

Karl Krushelnick^{1*}, J. Latham¹, A. Maksimchuk¹, J. Nees¹, G. Kalinchenko¹, B. Hou¹, Y. Ma¹, A. McKelvey¹, T. Shi¹, P. Campbell¹, A. Antoine¹, M. Balcazar¹, J. Cardarelli¹, N. Ernst¹, R. Fitzgarrald¹, C. Graham¹, H. Huang¹, Q. Qian¹, L. Weinberg¹, I. Jovanovic¹, C. Kuranz¹, A. Thomas¹, and L. Willingale¹

¹ *Gerard Mourou Center for Ultrafast Optical Science, University of Michigan USA 48109*

* kmkr@umich.edu

The past two decades have witnessed the development of revolutionary light sources having the unprecedented ability to probe new physical regimes and control matter with atomic scale precision. The ongoing development of multi-Petawatt lasers around the world will allow exploration of fundamental yet unanswered questions regarding non-linear Quantum Electrodynamics in relativistic plasmas, including non-perturbative quantum radiation reaction and electron-positron pair production mechanisms. Further experiments enabled by such lasers will include pump-probe experiments using femtosecond x-rays as a probe of material dynamics on ultra-short timescales, the production of GeV ion beams, the generation of instabilities in electron-positron jets, the exploration of vacuum polarization effects, relativistic shocks and the production of “exotic” particles such as pions and muons. I will describe the new NSF funded ZEUS facility under construction at the Center for Ultrafast Optical Science (CUOS) at the University of Michigan. ZEUS will be a dual-beamline 3 PetaWatt laser system that will provide unique capabilities for research. This will be a new high power laser user facility for US scientists as well as for the wider international research community, and will have an open and transparent external review panel for facility access and 30 weeks per year dedicated to external user experiments. After completion in late 2023, the ZEUS laser system will be the highest-power laser system in the US. Initial measurements from laser wakefield acceleration experiments during the commissioning phase of the facility will be discussed.

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