Abstract Submitted for the DPP20 Meeting of The American Physical Society

Analysis of Tailored Laser Plasma Accelerator Gas Jet Targets¹ LIONA FAN-CHIANG, UC Berkelev, HANN-SHIN MAO, nLIGHT Nutronics, HAI-EN TSAI, TOBIAS OSTERMAYR, KELLY SWANSON, JEROEN VAN TILBORG, SAMUEL BARBER, SVEN STEINKE, CAMERON GEDDES, LBNL, WIM LEEMANS, DESY, ERIC ESAREY, LBNL, BELLA CENTER TEAM — The ability to precisely shape gas jets for controlled injection of electrons in laser plasma accelerators (LPAs) is crucial for developing high-quality electron beams. For a popularly used tailored gas jet, that of a plume impinged by a blade, verification of features has called for more detailed simulations and gas density diagnostics than those traditionally used. We combined full plume simulations and a high-resolution diagnostic that can handle asymmetry to advance the customization process. Three dimensional full plume fluid simulations were performed to show the flow dynamics and variation of those with experimental variables, such as pressure and laser height. In parallel, planar laser-induced fluorescence (PLIF) was prototyped for characterizing LPA gas jet targets. PLIF has the advantage of isolating thin slices of the gas plume using a laser sheet, providing more direct density information at regions of interest. The study found that blade position dramatically alters characteristic flow parameters, affecting plume axis, effective Mach number, and therefore density transition length. These results are being used to understand and design flow regimes for LPA targets in the BELLA Center.

¹Supported by the Director, Office of Science, DOE-HEP contract DE-AC02-05CH11231, by NSF contract PHY-1415596 and grant DGE 1752814, and by DOE-NNSA-DNN R&D (NA22).

Liona Fan-Chiang University of California, Berkeley

Date submitted: 02 Jul 2020

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