## Abstract Submitted for the DPP19 Meeting of The American Physical Society

All-optical structuring of laser-driven proton beam profiles LIESELOTTE OBST-HUEBL, MARTIN REHWALD, TIM ZIEGLER, JOSEFINE METZKES-NG, HANS-PETER SCHLENVOIGT, THOMAS KLUGE, AXEL HUEBL, STEPHAN KRAFT, MICHAEL BUSSMANN, RICHARD PAUSCH, IRENE PRENCIPE, THOMAS COWAN, ULRICH SCHRAMM, KARL ZEIL, Helmholtz-Zentrum Dresden-Rossendorf, CHRISTIAN RDEL, Friedrich-Schiller-Universitt Jena, SEBASTIAN GDE, European XFEL, CHARLES RUYER, RO-HINI MISHRA, FREDERICO FIUZA, JONGJIN KIM, CHANDRA CURRY, MAXENCE GAUTHIER, SIEGFRIED GLENZER, MICHAEL MACDONALD, WILL SCHUMAKER, SLAC National Accelerator Laboratory — Extreme field gradients intrinsic to relativistic laser-interactions with thin solid targets enable compact multi-MeV proton accelerators with unique bunch characteristics. Protons are accelerated in TV/m fields that are established within the micrometer-scale vicinity of the high-power laser focus. Substantially extending this picture, our recent results show a critical influence of the millimeter scale vacuum environment on the accelerated proton bunch. In a series of experiments, counter-intuitively, the spatial profile of the energetic proton bunch was found to exhibit identical structures as the fraction of the laser pulse passing around a target of limited size. Such information transfer between the laser pulse and the naturally delayed proton bunch is attributed to the formation of quasi-static electric fields in the beam path by ionization of residual gas. Essentially acting as a programmable memory, these fields provide access to a higher level of proton beam manipulation.

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