Abstract Submitted
for the DPP14 Meeting of
The American Physical Society

Multi-GeV electron beam and high brightness betatron x-ray generation in recent Texas Petawatt laser-driven plasma accelerator experiments XIAOMING WANG, RAFAL ZGADZAJ, NEIL FAZEL, ZHENGYAN LI, XI ZHANG, WATSON HENDERSON, YEN-YU CHANG, RICK KORZEKWA, H.-E. TSAI, HERNAN QUEVEDO, GILLISS DYER, ERHARD GAUL, MIKAEL MARTINEZ, AARON BERNSTEIN, MICHAEL SPINKS, JOSEPH GORDAN, MICHAEL DONOVAN, VLADIMIR KHUDIK, GENNADY SHVETS, TODD DITMIRE, MICHAEL DOWNER, University of Texas at Austin — Compact laser-plasma accelerators (LPAs) driven by petawatt (PW) lasers have produced highly collimated, quasi-monoenergetic multi-GeV electron bunches with $\sim$ 100 pC charge [1], which are promising sources of ultrafast x-rays. Here we report three recent advances in PW-LPA performance brought about by optimizing the focal volume of the Texas PW laser with a deformable mirror. First, we accelerated electrons up to 3 GeV with hundreds of pC over 1GeV and <0.5mrad divergence. Second, we significantly improved shot-to-shot reproducibility (90% shots >1GeV, 10% >2GeV). Third, by introducing a double-peaked laser focus, creating a "double bubble" that subsequently merged [2], we significantly increased electron charge (0.5 nC) above 1 GeV, while producing brighter (10^{22}photon/mm^2/rad/0.1%), harder (up to 30keV) betatron x-rays, characterized by a multi-metal filter pack and phase-contrast imaging. We observe evidence of dimuon production [3] by irradiating a high-Z target with this high-charge, GeV electron beam. [1] Wang *et a*l., Nature Commun. **4**, 1988 (2013); Kim *et al.*, Phys. Rev. Lett. 11, 165002(2013). [2] Wen *et al.*, Phys. Plasmas **17**, 103113 (2010). [3] Titov *et al.*, Phys. Rev.-ST AB **12**, 111301 (2009).

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Date submitted: 11 Jul 2014 Electronic form version 1.4