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, MIKAI MARTINEZ, AARON BERNSTEIN, MICHAEL SPINKS, JOSEPH GORDAN, MICHAEL DONOVAN, VLADIMIR KHUDIK, GENNADY SHVETS, TODD DIT-MIRE, 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 \cite{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 1 GeV and \(<0.5\text{mrad} \) divergence. Second, we significantly improved shot-to-shot reproducibility (90\% shots \( >1\text{GeV}, \ 10\% \ >2\text{GeV} \)). Third, by introducing a double-peaked laser focus, creating a “double bubble” that subsequently merged \cite{2}, we significantly increased electron charge (0.5 nC) above 1 GeV, while producing brighter \( (10^{22}\text{photon/mm}^2/\text{rad}/0.1\%) \), harder (up to 30keV) betatron x-rays, characterized by a multi-metal filter pack and phase-contrast imaging. We observe evidence of dimuon production \cite{3} by irradiating a high-Z target with this high-charge, GeV electron beam. \cite{1} Wang et al., Nature Commun. \textbf{4}, 1988 (2013); Kim et al., Phys. Rev. Lett. 11, 165002 (2013). \cite{2} Wen et al., Phys. Plasmas \textbf{17}, 103113 (2010). \cite{3} Titov et al., Phys. Rev.-ST AB \textbf{12}, 111301 (2009).