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Compact tunable Compton x-ray source from laser wakefield accelerator and plasma mirror HAI-EN TSAI, XIAOMING WANG, JOSEPH SHAW, ZHENGYAN LI, RAFAL ZGADZAJ, ALEX AREFIEV, MIKE DOWNER, Univ of Texas, Austin, INSTITUTE FOR FUSION STUDIES, UNIVERSITY OF TEXAS AT AUSTIN TEAM — Compton backscatter (CBS) x-rays have been generated from laser wakefield accelerator (LWFA) electron beams by retro-reflecting the LWFA drive pulse with a plasma mirror (PM) [1] and by backscattering a secondary pulse split from the driver pulse [2]. However, tunable quasi-monoenergetic CBS x-rays have been produced only by the latter method, which requires challenging alignment. Here we demonstrate quasi-monoenergetic ($\sim$ 50% FWHM), bright (5 x 10^6 photon per shot) CBS x-rays with central energy tunability from 75 KeV to 200 KeV by combining a PM with a tunable LWFA. 30 TW, 30-fs (FWHM), laser pulses from the UT^3 laser system were focused (f/12) to spot diameter 11 micron, intensity $\sim$ 6x10^{18} W/cm^2 (a=1.5) at a 1-mm long Helium gas jet, yielding quasi-monoenergetic relativistic electrons. A thin plastic film near the gas jet exit efficiently retro-reflected the LWFA driving pulse into oncoming electrons to produce CBS x-rays without detecting bremsstrahlung background. By changing gas jet backing pressure, electron energy was tuned from 60 to 90 MeV, thereby tuning the CBS x-ray energy, which was determined by measuring transmission through a metal filter pack. The x-ray beam profiles recorded on an image plate had 5-10-mrad divergence.

[1] K. Ta Phuoc *et al.*, *Nature Photonics* **6**, 308 (2012).
[2] N.D. Power et al., *Nature Photonics* **8**, 28–31(2014).

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