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Observation of annular point spread function of optical transition radiation from low-emittance e-beams emerging from a laser-plasma accelerator

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Because of their tiny accelerating cavities, laser-plasma accelerators (LPAs) can produce extremely low-emittance e-beams, but to date the smallest transverse LPA e-beam sizes have been characterized only indirectly inside the LPA by betatron x-ray spectroscopy. Here we report observations of visible optical transition radiation (OTR) imaged from a foil placed immediately (<1mm) outside a ~300 MeV, 300 pC bubble-regime LPA. We use a double foil: the first reflects the drive laser pulse; the front edge of the second foil (0.5-1mm downstream) rejects emission from the first foil, while its back surface emits OTR from transmitted LPA e-bunches. We observe radially polarized annular distributions with a strong central minimum, approximating the ideal point spread function expected from a point electron beam. The size and radial distribution of the OTR images, which we observe in conjunction with OTR and electron spectra, vary significantly and reproducibly as we translate the double foil over a ~1mm range along the e-beam propagation axis. We observe the smallest OTR images with the first foil several hundred microns from the LPA exit. We will present OTR data in conjunction with an e-beam propagation model.

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