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Near GeV Laser Electron Beam Accelerator and Synchrotron Source S. KNEIP, S.R. NAGEL, C. BELLEI, C. PALMER, J. SCHREIBER, S.P.D. MANGLES, Z. NAJMUDIN, The Blackett Laboratory, Imperial College London SW7 2AZ, UK, T. IBBOTSON, N. BOURGEOIS, S. HOOKER, University of Oxford, Clarendon Laboratory, UK, K. TA PHUOC, LOA, Ecole Polytechnique, France — Electrons are accelerated to near GeV quasi-monoenergetic beams with a self-guided laser plasma wakefield accelerator. Experiments were carried out on the 250 TW Astra Gemini Laser at the Rutherford Appleton Laboratory. Up to 12 J of 55 fs, 800 nm laser light was focused with an $f/20$ parabolic mirror onto the front edge of circular gas plumes with 3 to 15 mm length. Interferometric probing reveals self generated plasma channels extending to 15 mm in length. Exit mode imaging of the laser light from the end of the gas jet indicates self-guiding over the full interaction length. Electron beams with < 3 mrad divergence and < 5 mrad RMS pointing stability are observed for a range of plasma densities and interaction lengths. At constant plasma density, the maximum achievable electron energy is found to scale linearly with the interaction length, consistent with accelerating fields of 0.8 GeV/cm. A bright source of 10 keV synchrotron radiation from electrons undergoing betatron oscillations in the plasma channel is observed in laser direction. These experiments illustrate that near GeV electron beams can now be produced without the need for an external guiding structure.

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