Supplementary Materials

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The Supplementary contains 3 Figures as complements to the main content, which are shortly described as follows,

S-Figure 1 shows the energy spectra and angular distributions of the probe electron beams in ten consecutive shots.

S-Figure 2 shows the energy spectra of the PWFA electron driver to be probed for ten consecutive shots with input laser energy of 550 mJ.

S-Figure 3 compares the field distributions created by one short bunch and by one short bunch followed by a long bunch.

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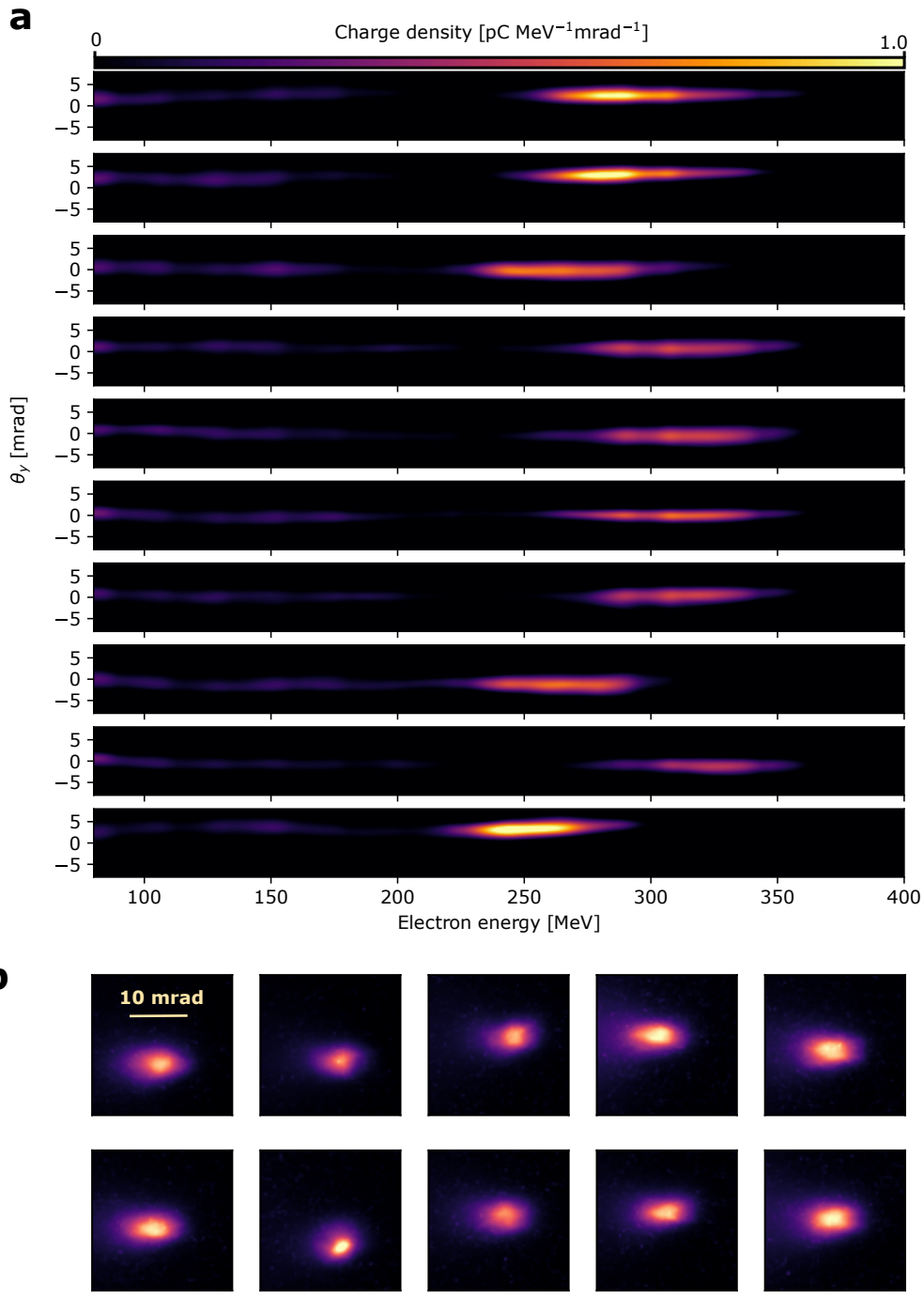
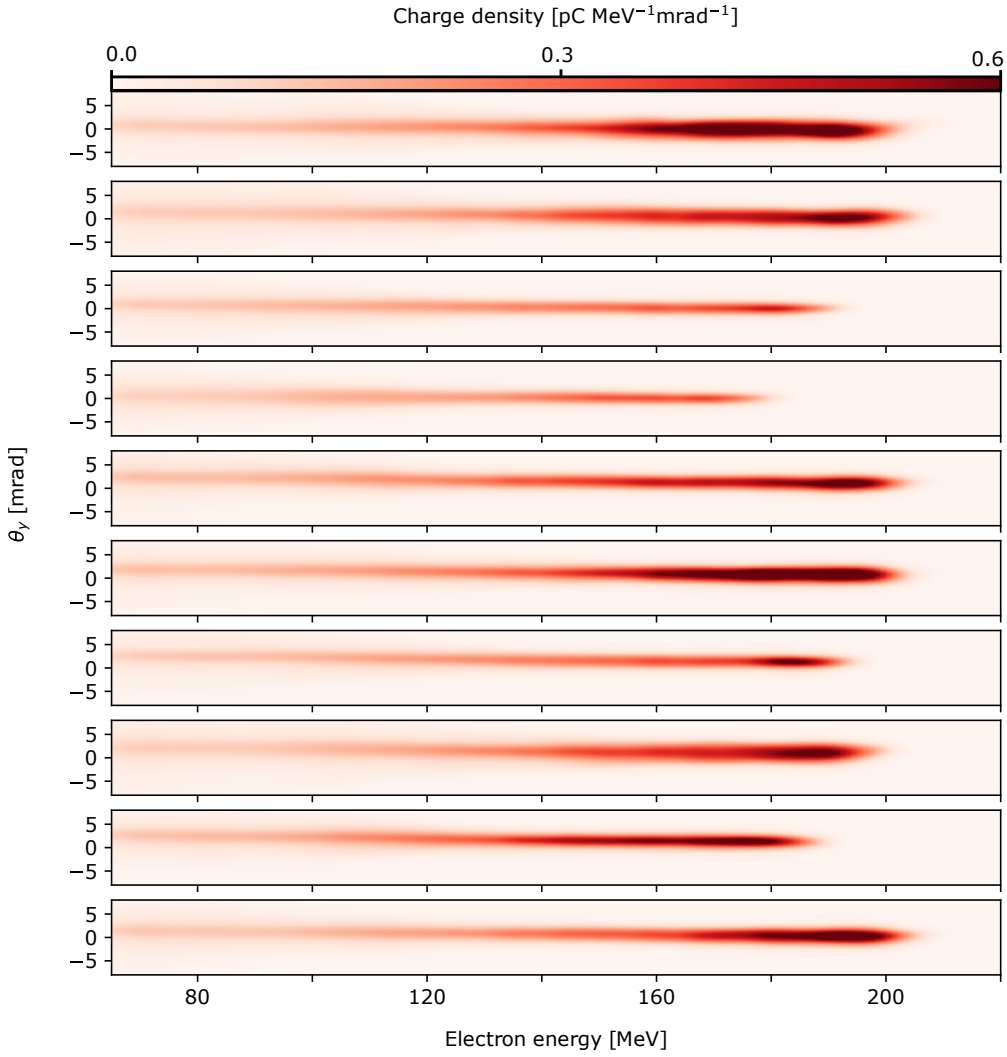
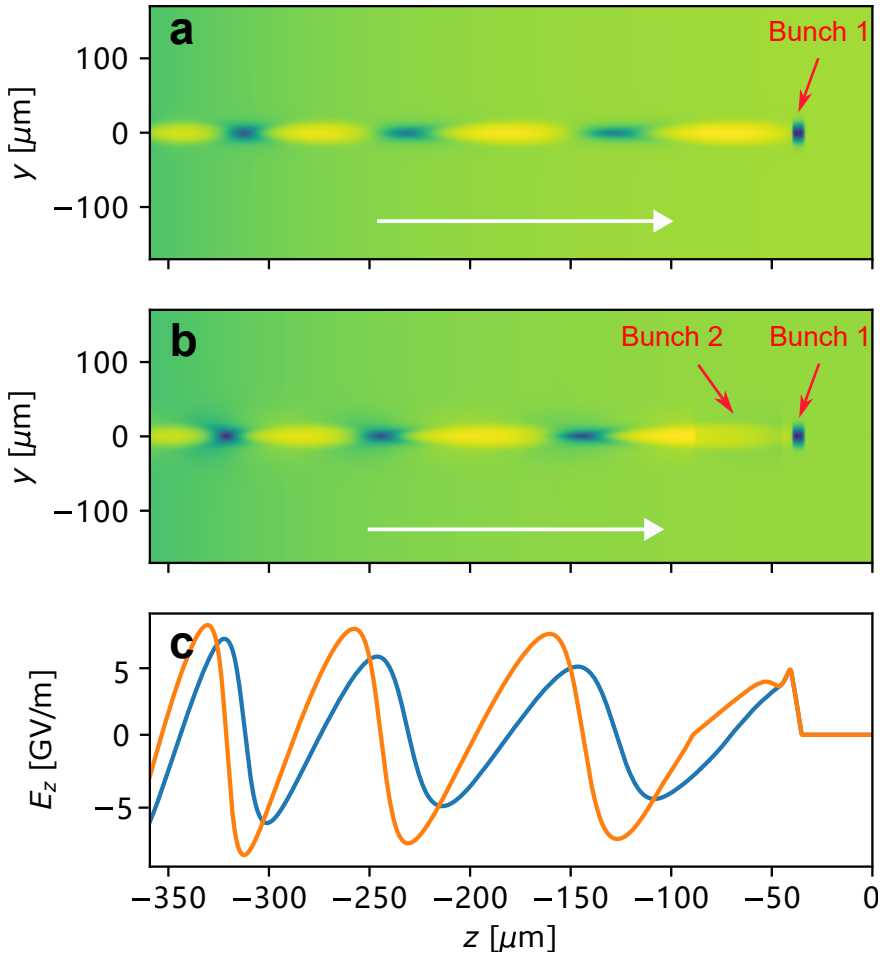


S-Fig. 1. (a) Energy spectra of the probe electron beam in ten consecutive shots. (b) Angular profiles of the probe electron beam in ten consecutive shots.



S-Fig. 2. Energy spectra of of the PWFA electron driver to be probed for ten consecutive shots with input laser energy of 500 mJ.



S-Fig. 3. (a) The simulated density distribution of the plasma wake driven by one short electron bunch of 100 pC with RMS radii of 8 μm and a pulse duration of 10 fs. (b) The simulated density distribution of the plasma wake driven by the same short electron bunch as above, followed by a long bunch of 200 pC with RMS radii of 20 μm and a pulse duration of 120 fs. (c) The E_z field longitudinal lineouts along the center axis of (a) (blue solid curve) and (b) (orange solid curve).