Scaling laws for positron production in laser—
electron-beam collisions

T. G. Blackburn\textsuperscript{1*}, A. I. Ilderton\textsuperscript{2}, C. D. Murphy\textsuperscript{3} and M. Marklund\textsuperscript{1}

\textsuperscript{1}Department of Physics, Chalmers University of Technology, SE-41296 Gothenburg, Sweden
\textsuperscript{2}Centre for Mathematical Sciences, University of Plymouth, PL4 8AA, UK
\textsuperscript{3}York Plasma Institute, Department of Physics, University of York, York, YO10 5DD, UK
\*tom.blackburn@chalmers.se

Showers of gamma rays and positrons are produced when a multi-GeV electron beam collides with a super-intense laser pulse [1]. All-optical realisation of this geometry, where the electron beam is generated by laser-wakefield acceleration [2], is currently attracting much experimental interest as a probe of radiation reaction and QED effects. These interactions may be modelled theoretically in the framework of strong-field QED [3] or numerically by large-scale PIC simulation [4]. To complement these, we present analytical scaling laws for the electron beam energy loss, gamma ray spectrum, and the positron yield and energy that are valid in the radiation-reaction—dominated regime. These indicate that by employing the collision of a 2 GeV electron beam with a laser pulse of intensity 5×10\textsuperscript{21} W/cm\textsuperscript{2}, it is possible to produce 10,000 positrons in a single shot at currently available laser facilities.

References