

Experimental observation of strong radiation reaction effects in the interaction of a high-intensity laser with a wakefield-accelerated electron beam

E. Gerstmayr^{1*}, J. M. Cole¹, K. Behm², T. G. Blackburn³, J. Wood¹, C. D. Baird⁴, M. J. Duff⁵, C. Harvey³, A. Ilderton^{3,6}, K. Krushelnick², S. Kuschel⁷, M. Marklund³, P. McKenna⁵, C. D. Murphy⁴, K. Poder¹, C. Ridgers⁴, G. M. Samarin⁸, G. Sarri⁸, D. Symes⁹, A. G. R. Thomas², J. Warwick⁸, M. Zepf^{7,8}, Z. Najmudin¹, S. P. D. Mangles¹

¹The John Adams Institute for Accelerator Science, Imperial College London, London, SW7 2AZ, UK

²Center for Ultrafast Optical Science, University of Michigan, Ann Arbor, Michigan 48109-2099, USA

³Department of Physics, Chalmers University of Technology, SE-41296 Gothenburg, Sweden

⁴York Plasma Institute, Department of Physics, University of York, York, YO10 5DD, UK

⁵SUPA Department of Physics, University of Strathclyde, Glasgow G4 0NG, UK

⁶Centre for Mathematical Sciences, Plymouth University, UK

⁷Institut für Optik und Quantenelektronik, Friedrich-Schiller-Universität, 07743 Jena, Germany

⁸School of Mathematics and Physics, The Queen's University of Belfast, BT7 1NN, Belfast, UK

⁹Central Laser Facility, Rutherford Appleton Laboratory, Didcot OX11 0QX, UK

*e.gerstmayr15@imperial.ac.uk

We report on an experiment performed at the dual 300 TW Astra-Gemini laser of the Central Laser Facility (UK) in 2015, colliding a highly relativistic electron bunch produced by laser wakefield acceleration (≈ 550 MeV) with a very intense laser pulse ($a_0 \approx 10$) to probe radiation reaction. The electron and the gamma-ray spectra from inverse Compton scattering were measured simultaneously and used to infer the conditions at the point of interaction independently. This method allows us to take into account the variation of the intensity at the collision due to the intrinsic fluctuations of the laser wakefield accelerator. Comparisons with several models show that only those including strong radiation reaction are able to bring both measurements into agreement. In addition, our results indicate some tension between quantum and classical models. The gamma-ray spectrum reached a critical energy of over 30 MeV, which is significantly higher than the energies reported in previous inverse Compton scattering experiments using laser-wakefield acceleration [1,2,3].

References

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