

All-Optical Studies of High-Field QED Processes: Experimental Limitations

G. M. Samarin¹, M. Zepf^{1,2}, G. Sarri¹

¹ *School of Mathematics and Physics, Queen's University Belfast, Belfast, UK*

² *Helmholtz Institute Jena, Fröbelstieg 3, 07743 Jena, Germany*

Uncovering the physics of processes such as quantum radiation reaction and photon-photon pair production remain some of the biggest challenges of experimental investigations in the realm of high-field Quantum Electrodynamics. The experimental limitations in the conventional dual beam all-optical setups which are standard to study these phenomena¹ are reviewed. Particular emphasis is made on the topics of spatial-temporal overlap of laser beams and how this translates to particle-laser synchronisation, spectral range and reproducibility of conventional laser wakefield accelerators², and the difficulty of measuring the products of extremely low cross-section events. Potential solutions for these problems and how they can be implemented in both current and prospective laser facilities are outlined.

[1] Cole, J. M., Behm, K. T., Gerstmayr, E., Blackburn, T. G., Wood, J. C., Baird, C. D, Duff, MJ, Harvey, C, Ilderton, A, Joglekar, AS, Krushelnick, K, Kuschel, S, Marklund, M, McKenna, P, Murphy, CD, Poder, K, Ridgers, CP, Samarin, GM, Sarri, G, Symes, D, Thomas, AGR, Warwick, J, Zepf, M, Najmudin, Z & Mangles, S. P. D. (2018). Experimental evidence of radiation reaction in the collision of a high-intensity laser pulse with a laser-wakefield accelerated electron beam. *Physical Review X*, 8(1), [011020]. DOI: 10.1103/PhysRevX.8.011020

[2] G. M. Samarin, M. Zepf & G. Sarri (2017) Radiation reaction studies in an all-optical set-up: experimental limitations, *Journal of Modern Optics*, 64:21, 2281-2288, DOI: 10.1080/09500340.2017.1353655.