Realising Single Shot Measurements of Radiation Reaction for Inverse Compton Sources

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Modern, high-intensity laser systems can accelerate electrons to multi-GeV energies in laser-wakefield schemes. By employing a second, counter-propagating laser, those electrons can then be used to drive high-brightness X-ray sources via inverse Compton scattering (ICS). In order to increase the brightness of such sources, it is desirable to increase the intensity of the scattering laser. This leads to nonlinear ICS where multiple photons interact with a single electron and radiation reaction (RR) effects where the motion of the electron is significantly altered by its own emission. At the highest intensities pair production may occur, providing a laboratory analogue for some of the most extreme environments in the universe.

Recent experiments have shown that high-intensity laser-plasma experiments can reach the RR regime [1], however shot-to-shot fluctuations in laser pointing and electron beam profiles limit the precision with which RR can be measured. Using the 3D PIC code, EPOCH, we simulate laser-electron collisions and investigate a method for measuring RR effects in a single laser shot by comparing different regions of an electron bunch post-interaction. With the aid of improved detection methods, this may allow detailed, on-shot measurements to be made.

1. Cole, J. M., *et al.*, *Physical Review X*, **8**, 011020 (2018).
2. Arber, T. D., *et al., Plasma Physics and Controlled Fusion, **57**(11), 113001 (2015)*