Contribution ID: **64** Type: **not specified**

Bright X-rays from Plasma Accelerators: A Free Diagnostic Tool?

Plasma accelerators [1-4] hold great promise to dramatically reduce the size and cost of future electron accelerators, providing a route to increased access to accelerator facilities and reduced environmental impact. When two short electron bunches, separated in time by a few hundred femtoseconds, are focussed in to a plasma the space-charge force of the leading bunch expels plasma electrons from its vicinity. This creates accelerating and focussing electric fields for the trailing bunch with GV/m strengths, at least an order of magnitude greater than radiofrequency accelerators. As the trailing bunch accelerates in the wakefield it also oscillates, emitting a short burst of x-ray light, which itself has found multiple applications in medical and materials science [5-8]. The properties of the x-ray radiation come directly from the properties of the electron bunch, meaning that the x-ray signal encodes information on offsets, tilts and the so-called mismatching of the trailing bunch, all of which act to spoil the quality of the accelerated bunch.

In this project the latest GPU-accelerated simulation codes will be used to calculate the properties of the emitted x-rays in the FLASHForward experiment at DESY, one of the few facilities for electron-bunch-driven plasma acceleration worldwide. Time allowing, this can inform the design of an x-ray diagnostic for FLASHForward, which should provide a non-invasive and simple guide to improve the quality of electron bunches in our experiments.

The student should be proficient in the Python programming language and be keen to learn about multiple new physical concepts.

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MPA, FTX-AST

Project Category

B5. Computing

Special Qualifications

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