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Laser Wakefield Accelerator Design for the Extreme Photonics Applications Centre (EPAC)

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The Extreme Photonics Applications Centre (EPAC) is an ultra-short pulse, petawatt laser facility under construction on the Rutherford Appleton Laboratory Site in the UK. In Experimental Area 1, it will deliver stable electron beams at a rep rate of 10 Hz for industrial and academic users via laser plasma wakefield acceleration [1]. Simulation studies have been performed in order to understand the gas dynamics of the target, the laser interaction with the gas and the propagation of the accelerated electron beam further down the beamline.

The EPAC facility will offer a number of facility-designed target options to users for different applications. The first target that has been designed is a rectangular, slot gas jet. A prototype has been manufactured based on fluid simulations performed in code-saturne [2] and subsequently characterised.

Particle-in-cell simulations using FBPIC [3] guided by Bayesian optimisation, as in [4], have been performed to generate representative electrons beams from the accelerator. Outputs from these simulations have been fed into a magnetic lattice, simulated in elegant [5], to focus the electron beam at a distance of approximately 1 m from the point at which the electrons exit the plasma. The current beam transport has been designed for 1 GeV electrons but ultimately hopes to be flexible with regards to electron beam energy.

References

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