

The Oxford Plasma Accelerator Laboratory

Tuesday, 19 September 2023 19:00 (1h 30m)

An overview is presented of the Oxford Plasma Accelerator Laboratory (OPAL), which houses a 600mJ (shortly to be upgraded to 1 J), 10Hz, 45fs Ti:Sapphire laser, and a suite of diagnostics tailored to the development of channel-guided laser-plasma accelerators. A channel is formed with a ~100mJ “channel-forming” beam, focused by an axicon. This channel guides the “drive” beam, thereby supporting extended acceleration [1].

In addition to standard diagnostics, we have developed and installed a plasma fluorescence diagnostic, for characterising the pressure uniformity of gas cells [2], and a single-shot 2-color interferometer to measure low-density ($\sim 10^{17} \text{ cm}^{-3}$) mixed plasma and neutral gas structures. A “leak diagnostic” images light transmitted through a high-reflectivity mirror placed immediately before the target. Coupled with novel analysis techniques, it enables simultaneous on-shot measurements of the channel-forming and drive beam focus positions. An active stabilisation system mitigates drift during long-term operation. Combined, these diagnostics enable high-resolution high-volume statistics to be collected on channel-guided laser-plasma acceleration.

OPAL will be used to test novel methods to enhance conditioned hydrodynamic optical-field-ionized (CHOFI) channels to facilitate meter-scale laser-plasma accelerators and improve controlled injection.

1. Picksley, A. et al. Phys. Rev. E 102, 053201 (2020).
2. Picksley, A. et al. <http://arxiv.org/abs/2307.13689> (2023).

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