7th European Advanced Accelerator Conference

EAAC2025

Contribution ID: **461** Type: **Oral contribution**

Curved hydrodynamic optical-field-ionised waveguides

Wednesday, 24 September 2025 18:00 (20 minutes)

Curved plasma waveguides have been proposed as a means to: guide fresh laser pulses into multistage plasma accelerators [1, 2], replace plasma mirror tapes used to eject depleted laser pulses [3], and to bend electron bunches for radiation generation [4-6]. However, all curved channel experiments so far have employed discharge capillaries, which are prone to laser damage especially at high pulse repetition rates.

In contrast, hydrodynamic optical-field ionized (HOFI) channels are free-standing and hence immune to laser damage. Furthermore, they have been demonstrated to operate at kHz repetition rates [7-10]. We will describe experiments and simulations on the formation and operation of curved HOFI channels. Particle-in-cell simulations show, for a parameter regime relevant to PW-scale facilities, that curved HOFI channels can be used to introduce a fresh laser drive pulse in a staged laser-wakefield accelerator. A 100% electron capture efficiency can be achieved between stages although the asymmetric sheath fields led to emittance blow-up. We have demonstrated experimentally that introduction of the appropriate phase modulation can curve the trajectory of the channel-forming Bessel beam by more than 10 laser spot sizes in a distance of 120 mm. We will also present the results of experiments to generate curved HOFI channels.

Primary author: CHAN, Darren Zeming (University of Oxford)

Co-authors: Dr CHAPPELL, James (University of Oxford); Dr FEDER, Linus (University of Oxford); MCMAHON, David (University of Oxford); HARRISON, Alexander (University of Oxford); Dr THORPE, Stephen (University of Oxford and the Kavli Institute for Nanoscience Discovery); Dr LAHAYE, Ronan (University of Oxford); Prof. WALCZAK, Roman (University of Oxford); Prof. HOOKER, Simon (University of Oxford)

Presenter: CHAN, Darren Zeming (University of Oxford)

Session Classification: PS8: Plasma sources and related diagnostics

Track Classification: PS8: Plasma sources and related diagnostics