

# Observation of resonant wakefield excitation by pulse trains guided in long plasma channels

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The plasma-modulated plasma accelerator (P-MoPA) scheme [1, 2] provides a route for GeV-scale accelerators operating at kilohertz-repetition-rates driven by picosecond-duration laser pulses. In P-MoPA, trains of pulses are generated from a long, high-energy drive pulse via the spectral modulation caused by a low amplitude wakefield driven by a leading short, low-energy seed pulse. Our simulations, discussed elsewhere in this conference, show that temporal compression of the modulated drive pulse yields a pulse train that can resonantly drive a wakefield, allowing for acceleration of a test electron bunch to 1.5 GeV in a 100 mm long plasma channel [2,3].

We present the results of recent experiments with Astra-Gemini at the Central Laser Facility, UK for parameters relevant to the accelerator stage of the P-MoPA scheme. We demonstrate guiding of 2.5 J pulse trains in a 100 mm long plasma channel. Measurements of the spectrum of the transmitted laser pulse train show that a wakefield was resonantly excited in the plasma channel. We compare these experimental results with numerical simulations.

[1] S.M. Hooker et al., J. Phys. B, 47, 234003 (2014)

[2] O. Jakobsson et al., PRL, 127, 184801 (2021)

[3] J. J. van de Wetering et al., Phys E., 108,015204 (2023)

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