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Simulations of Hydrodynamic Optical-Field-Ionised Plasma Channels

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Recent results have demonstrated hydrodynamic optical-field-ionised plasma channels as being a promising plasma source for efficient, high-repetition-rate laser plasma accelerators.

Understanding the dynamics of these plasma waveguides is critical to improving their performance and for tailoring their modal properties to fit a given experimental setup. This can be challenging as the important physical processes span multiple orders of magnitude with ionisation/heating on femtosecond timescales, thermalisation on picosecond timescales, and expansion/waveguide formation on nanosecond timescales.

Here, we present simulation results capturing the key dynamics of these plasma structures from ionisation to waveguide formation and benchmark the results against experimental data. Further, we explore how key experimental parameters can be used to tune the waveguides properties.

Acknowledgments

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