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Particle acceleration in twisted plasma waves with orbital angular momentum

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Plasma accelerators have the potential to drastically reduce the cost and size of conventional devices. An unique property of plasma wakefields is that they can be shaped nearly arbitrarily. Because the wakefield results from the collective motion of electrons, we can access this topological freedom of the plasma by controlling the individual trajectories of plasma electrons.

With theoretical modelling and massively parallel particle-in-cell (PIC) simulations using the PIC code Osiris, we will investigate the properties of structured plasma waves that contain orbital angular momentum. Twisted plasma waves can generate helical particle bunches, where individual bunch particles execute spiralling trajectories, similarly to an helical undulator. Twisted plasma waves can be driven by light spring laser drivers, which are characterised by spiralling intensity profiles. We show that the phase velocity of twisted plasma waves driven by the light spring drivers can be regulated in parabolic plasma channels, and that this property might be attractive to extend the acceleration distances.

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