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Surfing on waves of plasma

**Abstract**

Particle accelerators are big. Really big. But do they have to be? Our group explore through theory and experiment “plasma-based particle accelerators”, driven by some of the world’s highest power lasers. These laser pulses travel through a plasma (or ionised gas), driving a wake wave behind them like water waves following a boat. Huge electric fields are generated inside the plasma wave, which can be used to accelerate particles, allowing accelerators to be shrunk by a factor of 10,000. Computational modelling such as this allows us to investigate ideas and test theories ahead of experimental campaigns as well as deepen our understanding of results once they are complete. This image shows the plasma wave created by a laser pulse (the pink to blue contours indicating laser intensity). Electrons, shown in red, are trapped inside the plasma wave and surf it to reach ultra-high energies in just a few millimetres.