Magnetic-field amplification in turbulent laser-plasmas

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The phenomenon of magnetic-field amplification due to the motion of turbulent plasma has been investigated in a series of experiments carried out at various high-energy laser facilities during the last four years. Plasma jets driven by intense laser irradiation pass through asymmetric grids, the collide head on, leading to developed turbulence. Thomson-scattering, soft-X-ray-imaging and proton-radiography diagnostics have allowed for a thorough characterisation of the plasma state, including measurements of temperature, flow velocities, turbulent spectra, and magnetic fields. Our key finding is that at sufficiently large magnetic Reynolds numbers, magnetic fields are amplified very efficiently, attaining dynamical strengths. The robustness of this conclusion has been confirmed subsequently via several extensions of the original experimental configuration. Our results lend support to theoretical expectations that plasma turbulence is responsible for the magnetic fields universally observed in various astrophysical environments, from stars to the intra-cluster medium.