Magnetized high energy-density physics

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Generation of laser-driven quasi-static magnetic fields (B-fields), in the range of the kTesla, paves the ground for novel high energy-density physics (HEDP) investigations.

I will review results and physical understanding in driving such strong B-fields. At LULI [Santos2015] and Gekko-XII [Law2016] laser facilities, ns-scale B-field pulses, above 500 T at the centre of coils connected to laser-driven diodes, were spatially and temporally characterized by a multiple diagnostic platform. The mechanisms yielding the looping super-Alfvenic current-discharge are understood in terms of fast electron ejection from the laser-irradiated surface and the background plasma magnetization and current-neutralization. Optimization parameters were identified [Tikhonchuk2017].

We successfully applied these B-fields to magnetise solid-density [Bailly-Grandvaux2018] or laser-compressed targets [Sakata2018], and therein radially confine and guide relativistic electron beams over distances of the order of 100 μm. The magnetised transport yielded impressive enhancements on the energy-density flux into matter, isochoric heating and energy coupling efficiency into the core of the compressed spheres. This platform will be further applied to enhance proton beam acceleration from magnetised thin foils [Santos2018].

I will conclude by discussing experimental projects related to magnetohydrodynamics, magnetised atomic physics and magnetised inertial confinement fusion [Santos2018].

[Bailly-Grandvaux2018] M. Bailly-Grandvaux *et al.*, Nat. Comm. **9**, 102 (2018). [Law2016] K.F.F. Law *et al.*, Appl. Phys. Lett. **108**, 091104 (2016). [Sakata2018] S. Sakata *et al.*, Nat. Comm. **9**, 3937 (2018). [Santos2015] J.J. Santos *et al.*, New J. Phys. **17**, 083051 (2015). [Santos2018] J.J. Santos *et al.*, Phys. Plasmas **25**, 056705 (2018). [Tikhonchuk2017] V.T. Tikhonchuk *et al.*, Phys. Rev. E **96**, 023202 (2017).