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I2.J504 Magnetic field generation dynamics and reconnection driven by relativistic intensity laser-plasma interactions

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The extremely energetic class of astrophysical phenomena - including high-energy pulsar winds, gamma ray bursts, and jets from galactic nuclei - have plasma conditions where the energy density of the magnetic fields exceeds the rest mass energy density (sigmacold = B^2/(μ0nemec^2)), the cold magnetization parameter). Laboratory studies of magnetic dynamics and reconnection provide an important platform for testing theories and characterizing different regimes. Here, we present experimental measurements, along with numerical modeling, of short-pulse, high-intensity laser-plasma interactions that produce extremely strong magnetic fields (>100T). Three-dimensional particle-in-cell simulations show the plasma density and magnetic field characteristics can satisfy sigma cold > 1. The generation and the dynamics of these magnetic fields under different target conditions was studied using proton radiography, and relativistic intensity laserdriven, magnetic reconnection experiments were performed. Evidence of magnetic reconnection was identified by the plasma's X-ray emission patterns, changes to the electron spectrum, and by measuring the reconnection timescales. [A. E. Raymond, et al., Physical Review E, 98, 043207 (2018)]

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