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Mapping of intense magnetic fields in relativistic laser plasma interaction

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The propagation of ultrashort laser pulse at relativistic intensity in micrometric scale underdense Helium plasma is studied in detail, exploring densities in the range of 1% to 10% n_c. The plasma is probed to simultaneously reconstruct the evolution in time of electron density and polar magnetic field.

Magnetic fields that are produced in plasma result from the propagation of hot electrons currents, therefore magnetic fields analysis appears to be a powerful tool for inferring the properties of the currents in plasmas, revealing the richness of processes invoked and giving crucial physical insights of the interaction.

Experimental data supported by 3D PIC simulations enable us to observe
more in detail the evolution of electron currents during and after the laser propagation and to explore the mechanisms of formation of the intense magnetic fields, in the order of ~MGauss.

Experiments are carried out in a range of densities where no experiments have been performed before. Theoretical works have shown that copious phenomena resulting from non linearity of physical processes and related instabilities are expected to be produced. Deeper exploration of the studied interaction goes in the direction of building gas-based laser ion sources.

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