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Study of self-generated magnetic field and electric field at the front of a strong shock in helium by multi-angle proton radiography[1]
RUI HUA, University of California, San Diego, JOOHWAN KIM, UCSD, MARK SHERLOCK, LLNL, MATHIEU BAILLY-GRANDVAUX, FARHAT BEG, UCSD, SCOTT WILKS, LLNL, CHRISTOPHER MCGUFFEY, UCSD, YUAN PING, LLNL, UCSD TEAM, LLNL COLLABORATION — We report the measurement of both the magnetic field and electric field at a Mach 6 shock front in a low-density helium gas system. In the experiments, strong shocks were generated using two long pulse beams of 1 kJ total energy in 0.5 ns square pulse from the OMEGA EP laser system. A shorter pulse laser of 10 ps, 400 J was applied to generate TNSA protons for radiography. Given the difference in responses of charged particles to magnetic and electric fields, protons probed the shock front region from multiple angles in order to distinguish the magnetic field from the electric field. Probing obliquely, constraining deflection patterns identified a strong magnetic field on the order of $\sim$ 5-7 T, while orthogonal probing revealed an electric field corresponding to $\sim$ 300 V. Simulations indicate that the Biermann battery effect and the electron pressure gradient at the shock front account for the generation of the magnetic field and electric field, respectively.

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Rui Hua
University of California, San Diego

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