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Role of field ionization in magnetic field generation from the Inverse Faraday Effect SAMUEL MARTINS, RICARDO FONSECA, LUIS SILVA, GoLP/CFP, Instituto Superior Tecnico,, FRANK TSUNG, WAREN MORI, University of California Los Angeles, CA 90095, U.S.A. — The diversity of mechanisms that can generate high intensity magnetic fields and the difficulty in identifying the different phenomena responsible for the measured fields have been a source of strong controversy. One of the possible mechanisms is the Inverse Faraday Effect (IFE), a magneto-optical effect, where a longitudinal B field is generated by a circularly polarized beam propagating in a medium with free electrons. One of the mechanisms that have not been fully taken into account in existing models is the ionization that occurs when the laser interacts with the neutral gas to generate the plasma, in particular when the ionization rate is comparable to the laser frequency, the scenario relevant for ultra-intense lasers. In order to quantitatively study the role of this mechanism, we develop a model for IFE that includes ionization. The model is then compared with three-dimensional particle-in-cell simulations in osiris 2.0. An overall good agreement is verified between theory and simulations. We conclude that gases with higher ionization potentials generate higher magnetic fields in the longitudinal direction, leading to enhancements one order of magnitude higher than in the pre-ionized scenario.

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