Retrieving transient magnetic fields of ultrarelativistic laser plasma via ejected electron polarization

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Ultrastrong magnetic fields evolving in plasma dynamics are accompanied by electrons' radiative spin flips. The spin polarization of spontaneously ejected electrons offers a new degree of freedom to retrieve the structure and magnitude of the transient plasma magnetic fields. Here we present the radiative spin polarization of ejected electrons from the interaction of an ultrastrong short laser pulse with near critical density plasma in an ultrarelativistic regime [1]. Our particle-in-cell simulations show explicit correlations between the angle resolved electron polarization and the structure and properties of the transient quasistatic plasma magnetic field. While the magnitude of the spin signal is the indicator of the magnetic field strength created by the longitudinal electron current, the asymmetry of electron polarization is found to gauge the island-like magnetic ascribed to the transverse current induced by the laser wave front. Our studies demonstrate that the spin degree of freedom of ejected electrons could potentially serve as an efficient diagnostic tool to identify strong plasma fields.

Reference:

[1] Z. Gong, K. Z. Hatsagortsyan, and C. H. Keitel, arXiv:2103.12164 (2021).