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P5.4004 To control the angular momentum of trapped electrons in tapered foam target

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We have developed an analytical model to control the angular momentum of electrons trapped in ultra-relativistic laser-plasma interaction. The energy coupling from laser to plasma can be enhanced by using the foam target which regulates the near-critical density more efficiently in the medium. When laser is incident on the target, the ponderomotive force and self-generated electromagnetic fields associated with the laser affect the electrons. Owing to the tapered geometry of medium, the laser wavefront confronts hollow cone which results in an openmouth bubble. Inside the bubble, electrons are assumed to be accelerated in laser-piston regime [1] where the relativistic electrons form a density peak sheath at the head of laser pulse. When the electrostatic field overcomes the ponderomotive force the electrons start reflecting from the peak sheath. The reflected electrons follow the path of inner lining of the bubble and induce transverse self-injection. Non-linear scattering of laser field results the radiation reaction force which causes the self-injection of electrons in the laser pulse. The incident laser pulse carries large spin and orbital angular momentum which can be transferred to the particles via direct laser acceleration regime. The angular momentum associated with the energetic particle beams gives an additional degree of freedom which has potential applications in different fields such as condensed-matter spectroscopy and new electron microscopes [2].

References:

[1] Schlegel, T., Naumova, N., Tikhonchuk, V. T., Labaune, C., Sokolov, I. V., & Mourou, G. (2009). Relativistic laser piston model: Ponderomotive ion acceleration in dense plasmas using ultraintense laser pulses. Physics of Plasmas, 16(8), 083103.

[2] Taira, Y., Hayakawa, T., & Katoh, M. (2017). Gamma-ray vortices from nonlinear inverse Thomson scattering of circularly polarized light. Scientific reports, 7(1), 5018.

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