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Uniform Laser-Driven Relativistic Electron Layer for Coherent Thomson Scattering

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A novel scheme is proposed to generate uniform relativistic electron layers for coherent Thomson backscattering [1]. A few-cycle laser pulse is used to produce the electron layer from an ultrathin (few nanometer) solid foil [2]. The key element of the new scheme is an additional foil that reflects the drive-laser pulse, but lets the electrons pass almost unperturbed. Making use of two-dimensional particle-in-cell simulations and well known basic theory, it is shown that the electrons, after interacting with both the drive and reflected laser pulses, form a very uniform flyer freely cruising with a high relativistic γ–factor exactly in the drive-laser direction (no transverse momentum). It backscatters the probe light with a full Doppler shift factor of $4\gamma^2$. The reflectivity and its decay due to layer expansion are discussed.

References:

[1] H.C. Wu, J. Meyer-ter-Vehn, J. Fernandez, B.M. Hegelich, Phys. Rev. Lett. 104, 234801 (2010).

[2] J. Meyer-ter-Vehn and H.-C. Wu, Eur. Phys. J. D 55, 433 (2009); H.-C. Wu and J. Meyer-ter-Vehn, Eur. Phys. J. D 55, 443 (2009).