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Single-cycle relativistic pulse generation by laser foil interaction

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— A scheme producing nearly single-cycle relativistic laser pulses of wavelength 800 nm is proposed. When a laser pulse interacts with an overdense thin foil, the latter will be more transparent to the more-intense part of the laser, so that a transmitted pulse can be much shorter than the incident pulse. It is found that a transmitted pulse of duration 4 fs and peak intensity $3x10^{20}$ W/cm^2 can be generated [1] When two counter-propagating circularly polarized (CP) pulses interact with an overdense foil, the driving pulse (with larger laser field amplitude) will accelerate the whole foil, and the scattered pulse (with smaller laser field amplitude) is reflected by this flying-layer. Due to the Doppler Effect and varying velocity of the layer, the reflected pulse is up-shifted for frequency and highly chirped, thus could be compressed to nearly single-cycled relativistic laser pulse with short wavelength. Simulations show that a sub-femtosecond nearly single-cycled relativistic pulse can be generated with wavelength of 0.2μm after dispersion compensation. [2]

[1] L. Ji, B. Shen et al., Phys. Rev. Lett. 103, 215005 (2009)
[2] L. Ji, B. Shen et al., Phys. Rev. Lett. 105, 025001 (2010)

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