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P1.2016 High-order harmonic generation in an electron-positron-ion plasma

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We show that high-order harmonic generation (HHG) in a solid-density target is significantly changed after an electron-positron pair plasma is produced [1], with strong and well-defined signals at harmonics of the plasma frequency (i.e., npe) present in the spectrum. The peradiation comes from the plasma wave excited by the laser-accelerated dense positron beam via the beam-plasma instability [2, 3]. The subsequent reflux of the positrons induces a counterpropagating plasma wave. The inverse two-plasmon decay between these counterpropagating waves will radiate harmonics at 2pe [4]. Furthermore, 3pe-radiation is also observed due to the higher-order plasma coalescence [5]. Particle-in-cell (PIC) simulations with OSIRIS 4.0 show that these signals are prominent and robust with different target density, pair density, and temperature [1]. For example, the 2pe-radiation is enhanced by more than 150 times (compared with the same electron-ion target without pair plasma generation) after a pair plasma is produced with a density fraction of just 0.05%. Therefore, these signals can be used as an in situ diagnostic for the pair plasma generation mechanism. In addition, the radiation enhancement at is up to be 3.9 ◊ 104 times, paving a way to the bright and compact extreme ultraviolet (XUV) radiation source.

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