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O4.207 Can quantum stochastic effects be detected in ultra-intense laser-plasma interactions?

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When an ultra-intense laser pulse interacts with plasma, the accelerated electrons experience the back-radiation reaction due to the emission of electromagnetic radiation, and this has recently been experimentally evidenced [1]. The results suggest that both the quantum and classical nature of the back-radiation reaction have been detected. However, the situation is more subtle in the case of a laser-plasma interaction in which the laser plasma heating as well as the collective plasma effects may drastically effect the importance (and therefore the detection) of the quantum stochastic nature of the emitted radiation [2]. Our study is within the realm of radiation pressure acceleration (RPA) regimes involving thick targets. First, via QED-PIC numerical simulations performed with the EPOCH code, we show that the importance of the quantum stochastic heating strongly depends on the laser parameters such as polarisation and temporal profile. In doing so, via analytical criteria, we can deduce a range of laser-plasma parameters for which high-field phenomena triggered by quantum stochastic heating could be detected. Secondly, we demonstrate that the quantum stochastic heating induces an electrostatic instability at the front of the laser-piston [3] due to the enhancement of the electron heating of backward-directed electrons, which results in a peak in the ion energy spectrum as well as a decrease of the oscillations of the the longitudinal electric field. Initial conditions to obtain an optimal ion energy spectra are shown. Through this process, quantum stochastic heating improves the energy spread of the ion beam via RPA, in ultraintense laser-plasma interactions and could be relevant for Laboratory astrophysics.

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