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PW-class laser-driven super acceleration systems in underdense plasmas MASAHIRO YANO, ALEXEI ZHIDKOV, RYOSUKE KODAMA, Osaka Univ — Probing laser driven super-acceleration systems can be important tool to understand physics related to vacuum, space time, and particle acceleration. We show two proposals to probe the systems through Hawking-like effect using PW class lasers and x-ray free electron lasers. For that we study the interaction of ultra-high intense laser pulses with intensity $10^{22} - 10^{24}$ W/cm^2 and underdense plasmas including ion motion and plasma radiation for the first time. While the acceleration $w \sim a_0\omega_p/\omega_L$ in a wake is not maximal, the pulse propagation is much stable. The effect is that a constantly accelerated detector with acceleration w sees a boson's thermal bath at temperature $\hbar w/2\pi k_B c$. We present two designs for x-ray scattering from highly accelerated electrons produced in the plasma irradiated by intense laser pulses for such detection. Properly chosen observation angles enable us to distinguish spectral broadening from Doppler shift with a reasonable photon number. Also, ion motion and radiation damping on the interaction are investigated via fully relativistic 3D particle-in-cell simulation. We observe high quality electron bunches under super-acceleration when transverse plasma waves are excited by ponderomotive force producing plasma channel.

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