

Interaction of multi-PW class laser pulses with underdense plasmas

M. Yano¹, A. Zhidkov², R. Kodama^{1,2,3}

¹ *Graduate School of Engineering, Osaka University, 2-1, Yamadaoka, Suita, Osaka
565-0871, Japan*

² *Country Photon Pioneers Center, Osaka University, 2-1, Yamadaoka, Suita, Osaka
565-0871, Japan*

³ *Country Institute of Laser Engineering, Osaka University, 2-1, Yamadaoka, Suita, Osaka
565-0871, Japan*

Petawatt class femtosecond lasers and x-ray free electron lasers open up a new page in research fields related to space and vacuum physics. Regular electron sub-systems undergoing super-acceleration generated by these new instruments, which may be important experimental objects for vacuum and space-time researches, are shown to be created in underdense plasma irradiated by multi-PW laser pulses with intensity over 10^{22} W/cm². For the first time interaction of multi-PW laser pulses with underdense plasma, in the regime of strong relativistic wave-breaking, is investigated via 3D particle-in-cell simulation. Effects of pulse self-focusing, ion motion, and radiation reaction on the interaction and formation of regular electron sub-systems under super-acceleration are examined. We estimate scattering broadening of Thomson scattering from the electron sub-system for detection of space time effects.