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Analysis of efficient ion acceleration with multi-picosecond LFEX laser NATSUMI IWATA, AKIFUMI YOGO, Institute of Laser Engineering, Osaka University, KUNIOKI MIMA, The Graduate School for the Creation of New Photonics Industries, SHOTA TOSAKI, KEISUKE KOGA, HIDEO NAGATOMO, Institute of Laser Engineering, Osaka University, YASUAKI KISHIMOTO, Graduate School of Energy Science, Kyoto University, HIROAKI NISHIMURA, HORISHI AZECHI, Institute of Laser Engineering, Osaka University — We demonstrate an efficient proton acceleration reaching 30 MeV by using high contrast, kilojoule, picosecond laser LFEX at the peak intensity of 2.3×10^{18} W/cm^2 [1]. Owing to the large spot size of 70 μm FWHM, the target foil expands one-dimensionally during the multi-picosecond pulse duration time, which yields the electron heating beyond the ponderomotive scaling observed in the experiment. We present by a 1D PIC simulation that the electron temperature evolves in time while the electrons recirculate between the front and rear surfaces of the expanding plasma. A theoretical calculation for the ion maximum energy that takes the temperature evolution into account agrees with the experimental result quantitatively. Being supported by the experiment and simulation, our theoretical model for the non-isothermal plasma expansion dynamics will provide an important basis for understanding the multi-picosecond high intensity laser-plasma interactions and for various applications such as energetic ion beam generation for medical applications and fast ignition-based laser fusion. [1] A. Yogo, K. Mima, N. Iwata et al., submitted to Nat. Comm.

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