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Proton and Ion Acceleration using Multi-kJ Lasers S. C. WILKS, T. MA, A. J. KEMP, M. TABAK, A. J. LINK, C. HAEFNER, M. R. HERMANN, D. A. MARISCAL, S. RUBENCHIK, P. STERNE, LLNL, J. KIM, C. MCGUFFEY, K. BHUTWALA, F. BEG, UCSD, M. WEI, GA, S. M. KERR, UAlberta, Y. SENTOKU, N. IWATA, OsakaU, P. NORREYS, A. SEVIN, OxfordU — Short (<50 ps) laser pulses are capable of accelerating protons and ions from solid (or dense gas jet) targets as demonstrated by a number of laser facilities around the world in the past 20 years accelerating protons to between 1 and 100 MeV, depending on specific laser parameters. Over this time, a distinct scaling with energy has emerged that shows a trend towards increasing maximum accelerated proton (ion) energy with increasing laser energy. We consider the physical basis underlying this scaling, and use this to estimate future results when multi-kJ laser systems begin operating in this new high energy regime. In particular, we consider the effects of laser prepulse, intensity, energy, and pulse length on the number and energy of the ions, as well as target size and composition. We also discuss potential uses of these ion beams in High Energy Density Physics Experiments. This work was performed under the auspices of the U.S. Department of Energy (DOE) by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344 and funded by the LLNL LDRD program under tracking code 17-ERD-039.

Scott Wilks
LLNL

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