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Spot size dependence of laser accelerated protons in thin multi-ion foils[1] TUNG-CHANG LIU, XI SHAO, CHUAN-SHENG LIU, University of Maryland, College Park, BENGT ELIASSON, Strathclyde University, JYHPYNG WANG, Academia Sinica, SHIH-HUNG CHEN, National Central University — We present a numerical study of the effect of the laser spot size of a circularly polarized laser beam on the energy of quasi-monoenergetic protons in laser proton acceleration using a thin carbon-hydrogen foil. The used proton acceleration scheme is a combination of laser radiation pressure and shielded Coulomb repulsion due to the carbon ions. We observe that the spot size plays a crucial role in determining the efficiency of proton acceleration. Using a laser pulse with fixed input energy and pulse length impinging on a carbon-hydrogen foil, a laser beam with smaller spot sizes can generate higher energy but fewer quasi-monoenergetic protons. We studied the scaling of the proton energy with respect to the laser spot size and obtained an optimal spot size for maximum proton energy flux. In particular, we provided a theoretical model interpreting the acceleration mechanism for non-penetration cases and the calculated optimal spot size agreed well with the 2D PIC simulation results. Using the optimal spot size, we can generate an 80 MeV quasi-monoenergetic proton beam containing more than 10^8 protons using a laser beam with power 250 TW and energy 10 J and a target of thickness 0.15 wavelength and 49 critical density made of 90% carbon and 10% hydrogen.

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