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Controllable robust laser driven ion acceleration from near-critical density relativistic self-transparent plasma[1] BIN LIU, Ludwig-Maximilian-Universitaet, Muenchen, JUERGEN MEYER-TER-VEHN, Max-Planck-Institut for Quantenoptik, HARTMUT RUHL, Ludwig-Maximilian-Universitaet, Muenchen — We introduce an alternative approach for laser driven self-injected high quality ion acceleration. We call it ion wave breaking acceleration [1]. It operates in relativistic self-transparent plasma for ultra-intense ultra-short laser pulses. Laser propagating in a transparent plasma excites an electron wave as well as an ion wave. When the ion wave breaks, a fraction of ions is self-injected into the positive part of the laser driven wake. This leads to a superior ion pulse with peaked energy spectra; in particular in realistic three-dimensional geometry, the injection occurs localized close to the laser axis producing highly directed bunches. A theory is developed to investigate the ion wave breaking dynamics. Three dimensional Particle-in-Cell simulations with pure-gaussian laser pulses and pre-expanded near-critical density plasma targets have been done to verify the theoretical results. It is shown that hundreds of MeV, easily controllable and manipulable, micron-scale size, highly collimated and quasi-mono-energetic ion beams can be produced by using ultra-intense ultra-short laser pulses with total laser energies less than 10 Joules. Such ion beams may find important applications in tumour therapy. Reference: [1] B. Liu, et.al., Phys. Rev. Accel. Beams 19, 073401 (2016).

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