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Recent results on acceleration mechanisms and beam optimization of laser-driven proton beams

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Beam optimization of laser-accelerated protons is a crucial point for the development of applications in various areas. Several directions need to be pursued, namely (i) ptimization
of the high-energy end of the spectrum e.g. for dense lasma radiography, (ii) optimization of the low-energy end of the spectrum e.g. for isochoric heating of matter, (iii) enhancement of laser-to-protons conversion efficiency and reduction of divergence e.g. for fast ignition. We will present recent experimental results and simulations on these topics. New diagnostic capabilities open the way to precise time and space-resolved measurement of laseracceleration of protons [1]. We will show that high-energy protons in the TNSA regime could be enhanced using low-density plasmas [2] or reduced mass solid targets [3]. The laser-toprotons conversion efficiency is equally sensitive to laser and target parameters and can be increased using ultra-thin targets [4] or reduced mass solid targets [3]. Conversely, lowenergy
protons are relatively independent of laser and target conditions. In addition, we will present some results in exploring radiation-pressure acceleration of ions using circularly polarized laser pulses.

[1] P. Antici, J. Fuchs et al., Phys. Rev. Lett. 101, 105004 (2008).
[2] P. Antici„ J. Fuchs, et al., New J. of Phys. 11, 023038 (2009).
[3] S. Buffechoux et al., "Enhanced laser acceleration of protons from reduced mass targets", submitted (2009).
[4] P. Antici, J. Fuchs et al., IEEE Trans. On Plasma Sci. 36, 1817 - 1820 (2008).

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