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Dense monoenergetic proton beams from chirped laser-plasma interaction

Benjamin J. Galow, Yousef I. Salamin, Tatyana V. Liseykina, Zoltan Harman, Christoph H. Keitel

(Submitted on 6 Jul 2011 (v1), last revised 27 Oct 2011 (this version, v3))

Interaction of a frequency-chirped laser pulse with single protons and a hydrogen plasma cell is studied analytically and by means of particle-in-cell simulations, respectively. Feasibility of generating ultra-intense (10^7 particles per bunch) and phase-space collimated beams of protons (energy spread of about 1 %) is demonstrated. Phase synchronization of the protons and the laser field, guaranteed by the appropriate chirping of the laser pulse, allows the particles to gain sufficient kinetic energy (around 250 MeV) required for such applications as hadron cancer therapy, from state-of-the-art laser systems of intensities of the order of 10^21 W/cm^2.

Comments:	5 pages, 4 figures
Subjects:	**Plasma Physics (physics.plasm-ph)**; Accelerator Physics (physics.acc-ph)
Journal reference:	Phys. Rev. Lett., Vol. 107, Issue 18, 185002 (2011)
DOI:	10.1103/PhysRevLett.107.185002
Cite as:	**arXiv:1107.1151 [physics.plasm-ph]** (or **arXiv:1107.1151v3 [physics.plasm-ph]** for this version)

Submission history

From: Benjamin Galow [view email]
[v1] Wed, 6 Jul 2011 15:05:29 GMT (286kb)
[v2] Sat, 10 Sep 2011 11:29:43 GMT (286kb)
[v3] Thu, 27 Oct 2011 19:27:12 GMT (286kb)

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