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High quality proton beams from laser plasma interaction with hybrid acceleration schemes

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The quality of laser accelerated proton beams is still low and hybrid schemes are a possible alternative for near term applications.
We achieve energy and angle selection with a transport line wihich renders the beam suitable post-acceleration. We show that with a pulse of intensity I ~ 10^21 W/cm^2 proton energies above 40 MeV are obtained from 3D PIC simulations as in the KPSI experiment. Various targets are considered and increasing the intensity up to I ~ 2 10^21 W/cm2 the number of protons in a 1 MeV slice at 30 MeV is at least 10^8 after selection by a pulsed solenoid and a collimator. We simulate the transport, injection into a compact linac and post-acceleration up to 60 MeV. The final protons number is decreased by one order of magnitude but the beam quality is excellent. A decrease by two orders of magnitude occurs if the selection is achieved by a multiplet of permanent magnetic quadrupoles. The charge, energy and final beam quality are at the threshold of interest for medical use.

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