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Experimental demonstration of a laser proton accelerator with accurate beam control through image-relaying transport

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Laser proton accelerator has been considered as one promising candidate for the future compact and low-cost radiotherapy system for malignant tumors. A Compact LAser Plasma Accelerator (CLAPA) has been built at Peking University, which can reliably generate and transport MeV energy protons with designed charge, spot and energy spread on to the irradiation platform. The transverse geometric emittance of laser accelerated proton beam entering the beam line has been measured using the quadruple triplet scan technique, showing a level of a few mm•mrad, which is comparable with the one from conventional accelerator. The energy accuracy of the laser accelerator is tested with a foil shielding method and is better than 3%. With the accurate beam control, Spread-out Bragg peak (SOBP), is demonstrated, for the first time, based on laser accelerated proton beams. Although the energy is low, it proves the ability of laser accelerator and takes the first step toward the future proton cancer therapy. As the next step, a full functional beam therapeutic beam line based on PW laser proton accelerator is proposed, aiming to effectively transport laser accelerated proton beam up to 250 MeV with 10-20% energy spread

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