Fluence and energy optimization of laser-driven proton beams for medical applications

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Over the last decades, charged particle acceleration using ultra-intense and ultrashort laser pulses have been one of the most attractive topics in the relativistic laser-plasma interaction research. One of the most challenging ideas driving recent activities is using laser plasma as a source of high energy ions for the purposes of medical applications. In the framework of the ELIMED network, we started to design and realize a first prototype of a beam transport line (BTL) that will allow delivering laser-driven proton beams with optimized properties and sufficient repetition rates in order to perform first dosimetric and radiobiological irradiations with such kind of beams. A focusing element, consisting of four quadrupoles has been designed and is already under construction. This element will allow to reduce the divergence of the beam emerging from the target, improving the transmission efficiency of the entire transport system. Moreover, we have already realized a first prototype of an energy selector system (ESS), based on permanent dipoles, capable to control and select in energy laser-driven proton beams. Monte Carlo simulations and experimental tests have been performed to characterize the device. Recently, the first experimental run with the ESS prototype using a laser-driven ion beam has been performed at the Queen’s University in Belfast with the TARANIS laser-driven proton beam. In this contribution a description of different solutions studied for the BTL depending on transmission efficiency and on energy spread will be presented. Moreover, preliminary results on the experiment performed at the TARANIS facility with the corresponding Monte Carlo simulations will be also discussed.