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MULTIDISCIPLINARY APPLICATIONS OF LASER-DRIVEN IONS: RATIONALE AND PRELIMINARY RESULTS OF THE ELIMED NETWORK

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Introduction: Nowadays, laser-accelerated ions represent a fascinating alternative in the field of non-conventional acceleration techniques. The ELIMED project aims to demonstrate the potential medical applicability of optically accelerated proton beams. Design, development and characterization of beam transport, selection and dosimetric devices for high-energy laser-driven proton beams will be presented.
Summary: Over the last decades, charged particle acceleration using ultra-intense and ultra-short laser pulses has been one of the most attractive topics in the relativistic laser-plasma interaction research. One of the most challenging ideas driving recent activities consists on using high power lasersto generate high-energy ions for medical applications. The high interest of the scientific community in laser driven ion schemes stems from the fact that conventional ion accelerators, beam transport lines and gantry systems are complex and expensive. More compact laser-based accelerators could significantly increase the future availability of high-energy ion beams in hospitals, thus providing particle therapy to a broader range of patients.
In this framework, the purpose of the ELIMED [1] network consists in demonstrating that laser-driven high-energy proton beams can be used for multidisciplinary applications and in particular in the hadron-therapy field. Indeed, the kick-off for medical applications and for radiobiological investigations will be given once the laser-accelerated proton beam transport, selection and dosimetry system is tested and fully operational. We started to design and develop a beam transport line prototype able to deliver laser-generated proton beams with optimized properties and adequate repetition rates. A focusing device consisting of four magnetic quadrupoles is currently under construction. The scope of this device will be to reduce the initial angular divergence of the particle beam accelerated from the target improving the transmission efficiency of the entire transport system. A prototype of the key component of the whole beam line, the Energy Selector System (ESS), able to control and select the laser-driven proton beams, has already been developed and experimentally characterized with mono-energetic proton beams at the LNS-INFN, Catania and LNL-INFN Legnaro, Italy, as well as laser-driven proton beams available at the TARANIS laser facility, Queen's University of Belfast (UK). Moreover, a Faraday cup prototype optimized for absolute dosimetry with high dose rates and intense ion beams has been designed and tests are ongoing. In this contribution, a description of the solution studied for

the beam transport selection and dosimetry, as well as preliminary results obtained with the ESS along with the Geant4 Monte Carlo simulation of such device, will be presented and discussed.

References:

1.D. Margarone, G.A.P. Cirrone, G.Cuttone and G. Korn AIP Conf. Proc. 1546, pp. 1-1 doi:http://dx.doi.org/10.1063/1.4816599

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