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Enhancing the understanding of fragmentation processes in hadrontherapy and radioprotection in space with the FOOT experiment

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Proton therapy treatments are based on the characteristic depth-dose deposition profile of charged particles (i.e. the Bragg Peak). During treatment, target fragmentation takes place, leading to the production of low-energy, high-charge and therefore short-range fragments along the beam path. The higher-Z fragments produced may have higher biological effectiveness compared to protons, thus affecting the proton Relative Biological Effectiveness (RBE, i.e. biological effectiveness of protons compared to photons), nowadays assumed as a constant value (i.e. RBE=1.1) in clinical practice. In this context, precise fragmentation cross section data would be of great importance in order to further optimize proton treatments. At the same time, such data would help improving the design of the shielding of spaceships, especially in view of long distance travels (i.e., Mars human exploration).
The FOOT (FragmentatiOn Of Target) experiment has been designed to measure fragment production cross sections with ≈5% uncertainty. Target fragmentation induced by 50-250 MeV proton beams will be studied taking advantage of an inverse kinematic approach. Specifically,16O, 12C and 4He beams impinging on different targets (e.g., C_2, C_2H_4) will be employed, thus boosting fragments'energy and making their detection possible. Fragmentation cross section of hydrogen will be then obtained by subtraction. The same configuration also allows measuring the projectile fragmentation of the mentioned beams using direct kinematics, improving the accuracy of the transport Monte Carlo codes presently used for both hadrontherapy and space applications.
A dedicated "table-top"electronic setup was conceived. The setup consists in a pre-target monitor region, a magnetic spectrometer, a ΔE detector with TOF capabilities and a calorimeter. The detectors will be used to measure the fragments momenta, ΔE, TOF and kinetic energy. Alternatively, an emulsion spectrometer was designed in order to measure the production of low Z fragments that wouldn't cross the whole magnetic spectrometer.
The final design of the experiment will be presented together with performances in the cross section evaluation and neutrons detection capability at different energy ranges of interest for radiotherapy and space radiation protection.

Internet talk

Is this abstract from experiment?

Yes

Name of experiment and experimental site

FOOT experiment. Web page: https://web.infn.it/foot/

Is the speaker for that presentation defined?

Yes

Details

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