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The FOOT (FragmentatiOn Of Target) experiment

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Particle Therapy uses protons and light ions beams for the treatment of deep-seated solid tumors. Due to the features of energy deposition of charged particles a small amount of dose is released to the healthy tissue in the beam entrance region, while the maximum of the dose is released to the tumor at the end of the beam range, in the Bragg peak region. However, nuclear interactions between beam and patient tissues induce fragmentation both of projectile and target and must be carefully taken into account.
In protontherapy clinical practice a constant RBE equal to 1.1 is adopted, regardless of the demonstrated RBE variations, which depends on physical and biological parameters. Among other mechanisms, nuclear interactions might influence the proton RBE due to secondary heavier particles produced by target fragmentation that can significantly contribute to the total dose: an unwanted and undetermined increase of normal tissues complications probability (NTCP) may occur. The FOOT experiment (FragmentatiOn Of Target) is designed to study these processes. Target ($16O$,$12C$) fragmentation induced by $150 - 250\ MeV$ proton beam will be studied via inverse kinematic approach, where $16O$ and $12C$ therapeutic beams, with the quoted kinetic energy, collide on graphite and hydrocarbons target to provide the cross section on Hydrogen. This configuration explores also the projectile fragmentation of these beams. The detector includes a magnetic spectrometer based on silicon pixel detectors and drift chambers, a scintillating crystal calorimeter with ToF capabilities, able to stop the heavier fragments produced, and a ΔE detector to achieve the needed energy resolution and particle identification. The experiment is being planned as a 'table-top'experiment in order to cope with the small dimensions of the experimental halls of the CNAO and HIT treatment centers and GSI, where the data taking is foreseen in the next years. The detector, the physical program and the timetable of the experiment will be presented as well as the results of a Monte Carlo study, based on the FLUKA code, which aims to evaluate the detector performance and the expected resolution on fragment identification and on the nuclear cross sections relevant for charged particle therapy.

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