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# The FragmentatiOn Of Target (FOOT) experiment

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The main goal of the FOOT experiment is to provide nuclear cross section measurements necessary in two different fields: hadrontherapy and radioprotection in space.
In the last decade, a continuous increase in the number of cancer patients treated with Particle Therapy (PT) has been registered, due to its effectiveness in the treatment of deep-seated solid tumors [1]. When the charged particles travel through the patient, nuclear interactions occur producing nuclear fragments that can cause side effects in regions outside the tumor volume. Nuclear fragmentation produces both light and heavy fragments: the first are produced within a wide opening angle, while the second close to the beam direction. To detect both types of fragments, the FOOT detector consists of two different configurations: an electronic setup [2] and an emulsion chamber [3].
Target (16O,12C) fragmentation induced by 150-250 MeV proton beam will be studied via inverse kinematic approach, where 16O and 12C beams, in the 150-200 MeV energy range, collide on graphite and hydrocarbons target to allow the extraction of the cross section on Hydrogen. This configuration explores also the projectile fragmentation of these beams. The electronic setup includes a pre-target region (a plastic scintillator and a drift chamber), a magnetic spectrometer based on silicon pixel and strip detectors, a scintillating crystal calorimeter able to stop the heavier fragments produced and to achieve the needed energy resolution, and finally a TOF and $\Delta E$ scintillating detector for particle identification. The emulsion chamber setup includes the same pre-target region as the electronic setup and a set of three different emulsion chambers for different purposes.
Regarding to the second FOOT mission, the XXI century will be characterized by a deeper exploration of the Solar System that will involve long term missions as the expedition to Mars. Health risks are associated to exposure to Galactic Cosmic Radiation (GCR), that is very energetic (on average around 700-1000 MeV/u) and produces showers of light fragments and neutrons by nuclear fragmentation when hitting the spaceship shields. Considering that the GCR are composed of 90% of protons, 9% of helium and the rest of heavy nuclei, the overlap with the measurements for hadrontherapy purposes is large, the main difference being the energy range.
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, LNS, GSI and HIT treatment centers, where the data taking is foreseen in the near future (2020). The detector, the performances, the physical program and the timetable of the experiment will be presented.

References
[1] M. Durante and J. Loeffler, Charged particles in radiation oncology, Nature Reviews Clinical Oncology, 7:37-43, 2010;
[2] G. Battistoni et al, The FOOT (FragmentatiOn Of Target) experiment, Proceedings of Science, 302, 2017;
[3] G. De Lellis et al, Emulsion cloud chamber technique to measure the fragmentation of a high-energy carbon beam, Journal of Instrumentation, 2, 2007.

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