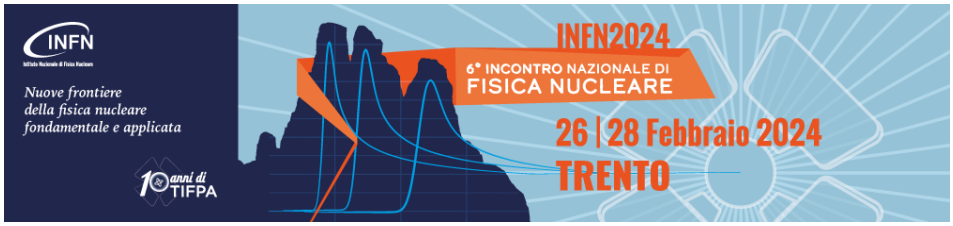

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Nuclear fragmentation cross sections measurements: the FOOT experiment

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Nuclear inelastic interactions have an important role in particle therapy, radiation protection and in theoretical nuclear model studies. In particle therapy, the uncertainties on the evaluation of the nuclear inelastic interactions can lead to a miscalculation of the dose deposition evaluated by the treatment planning systems. In addition, a precise estimate of the fragmentation of 16O and 4He ion
beams are essential to evaluate the possibility to include these new particles in the clinical practice. As far as radioprotection is concerned, space radiation is of particular interest: the knowledge on the nuclear inelastic interactions is fundamental to develop a proper shielding material for the future long-term and deep-space space missions.

The FOOT (FragmentatiOn Of Target) experiment aims to perform a set of double differential cross section measurements (d2σ/dΩdE) for the projectile fragmentation of 12C, 16O and 4He beams at 200-800 MeV/u on C and C2H4 targets and the differential cross sections (dσ/dE) in p-C and p-O collisions at 200 MeV/u, relevant for the target fragmentation process. The data will be used to
benchmark the current Monte Carlo simulation models, which are in general affected by significant uncertainties. In addition, the FOOT experiment can be used also for other studies in nuclear physics. For example, the fragmentation reaction can be exploited in the investigation of the nuclear clustering phenomenon for different α-conjugated nuclei at intermediate energies. This has been a long-standing area of study with different experiments conducted, but mainly at the Coulomb barrier and Fermi energy range.
Two experimental setups have been developed to detect heavy (Z≥3) and light (Z≤3) fragments. The formers are measured by a set of electronic detectors composed of a high precision tracking system in a magnetic field, a time-of-flight measurement system and a calorimeter. Light ions are instead detected by an emulsion cloud chamber spectrometer. Both apparatuses have been employed in different experimental campaigns with beams of 4He, 12C and 16O at different kinetic energies (200-700 MeV/u) on target of graphite and polyethylene (C2H4).

An overview of the FOOT experiment will be given. The capability of the apparatus and the preliminary results on the cross-section measurements will be presented. In addition, we shall discuss some results about the capability of the FOOT experiment to investigate α-clustering phenomena in the fragmentation of 12C and 16O ion beams at 200 and 400 MeV/u, with particular attention to the identification of intermediate channels (e.g.: 12C⟶8Be+α⟶3α).

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