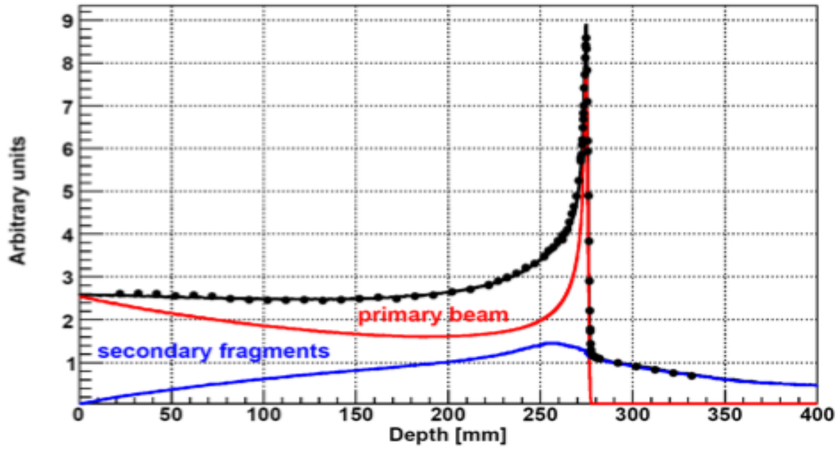
The FOOT (FragmentatiOn Of Target) experiment

Riunione gruppo 3
Bari, 2023

Istituto Nazionale di Fisica Nucleare

Aim

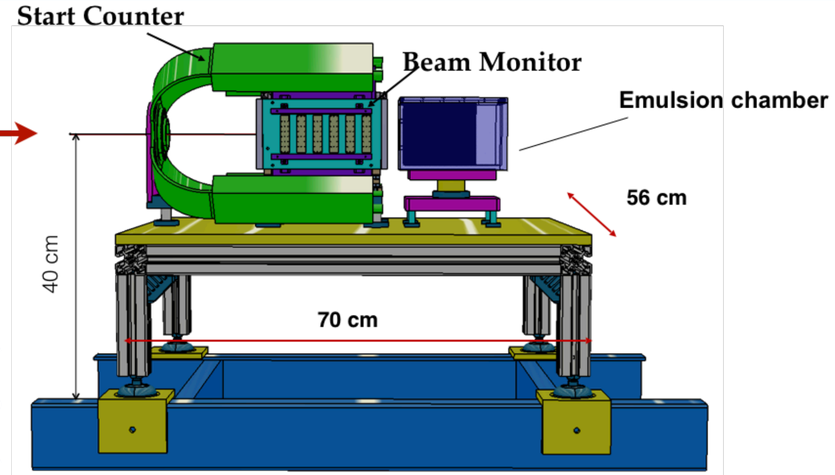
- Charge Particle Therapy efficiency currently limited by the lack of knowledge of the nuclear fragmentation cross sections in body tissues



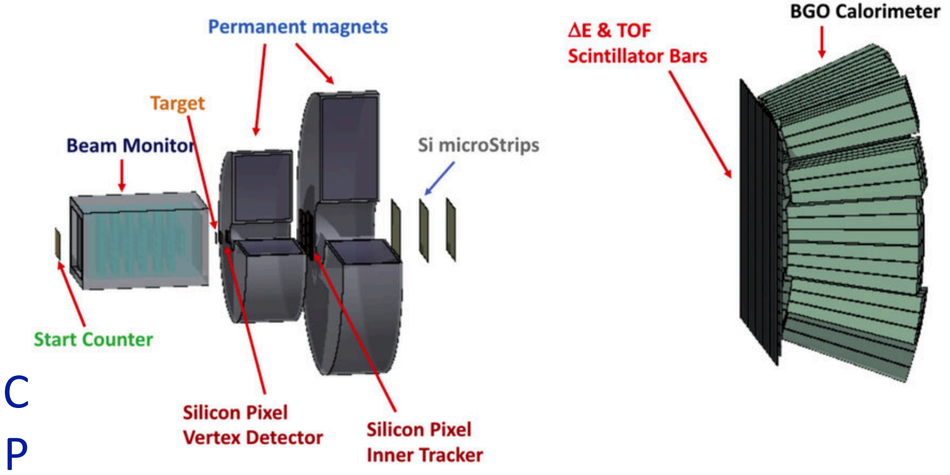
Exp. Data (points) from Haettner et al, Rad. Prot. Dos. 2006
Simulation: A. Mairani PhD Thesis, 2007, Nuovo Cimento C, 31, 2008

- **The FOOT experiment aims at measuring nuclear fragmentation cross sections to develop more precise Treatment Planning Systems for proton and ion therapy and Radio Protection in Space**
- Produced fragments ≤100 μm range: inverse kinematic to measure fragmentation cross section
- 2 complementary table-top setups: **nuclear emulsions spectrometer** to measure Z≤3 + **electronic setup** to measure Z≥3

NUCLEAR EMULSIONS SPECTROMETER



ELECTRONIC SETUP



Activities in Bari

NUCLEAR EMULSIONS SPECTROMETER

- Analysis of data taken with nuclear emulsion spectrometer
  - Fragments Charge measurement
  - Fragments Momentum measurement (Machine Learning)
  - Fragmentation Cross section
- Monte Carlo simulation for future data takings
- Data taking (brick assembling @CERN, beam exposure @CNAO, nuclear emulsions development @CERN/INFN_NA)

DATA TAKINGS ALREADY DONE:

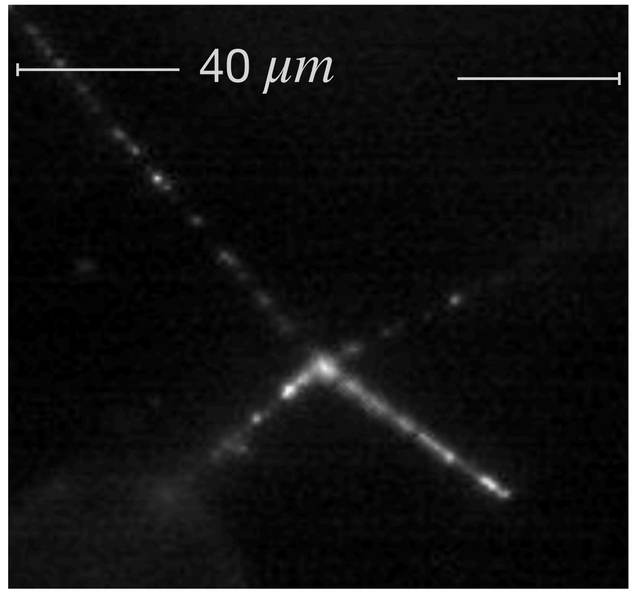
- 2019 - GSI:
  - ^{16}O 200 MeV/n on C_2H_4 target
  - ^{16}O 200 MeV/n on C target
  - ^{16}O 400 MeV/n on C_2H_4 target
  - ^{16}O 400 MeV/n on C target
- 2020 - GSI:
  - ^{12}C 700 MeV/n on C_2H_4 target
  - ^{12}C 700 MeV/n on C target

ELECTRONIC SETUP

- Evaluation of proton tracking efficiency of the MSD using data of the first test-beam (Trento 2021) carried out using all 6 planes of the complete sub-detector with protons of energy 70-228 MeV
- Data taking at CNAO: Assembly (and dismantling) of the MSD subdedector, integration in the FOOT DAQ system, tests and calibration with cosmic rays, online monitoring

Spin off in Bari:
PRIN “DAMON: Direct meAsureMent of target fragmentatiON”

- **Feasibility study for making a direct measurement of target fragments produced by a proton beam using Nano Imaging Trackers emulsions and optical microscopes overcoming the diffraction limits**
- People involved from Bari: G. Galati (PI), T. Maggipinto, S. My
  Other 2 units: INFN (LNGS), UniNA
- Contributo MIUR per Ricerca: 207,615
  Cofinanziamento Ateneo/Ente: 46,845
  Costo totale: 254,460



Participants and Request

- FTE 1.3

People Involved

- Giuliana Galati: 70% (local responsible)
- Benedetto Di Ruzza (UniFg): 20%
- Tommaso Maggipinto: 20%
- Salvatore My: 10%
- Marco Pappagallo: 10%

- Requests: 14500 Euro

Detailed Requests

- Missions: 12000 Euro
- Article publications: 2500 Euro

- Technical Support: none
- Laboratories: none