Calibration of the ΔE-TOF detector at CNAO

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FOOT performance Meeting
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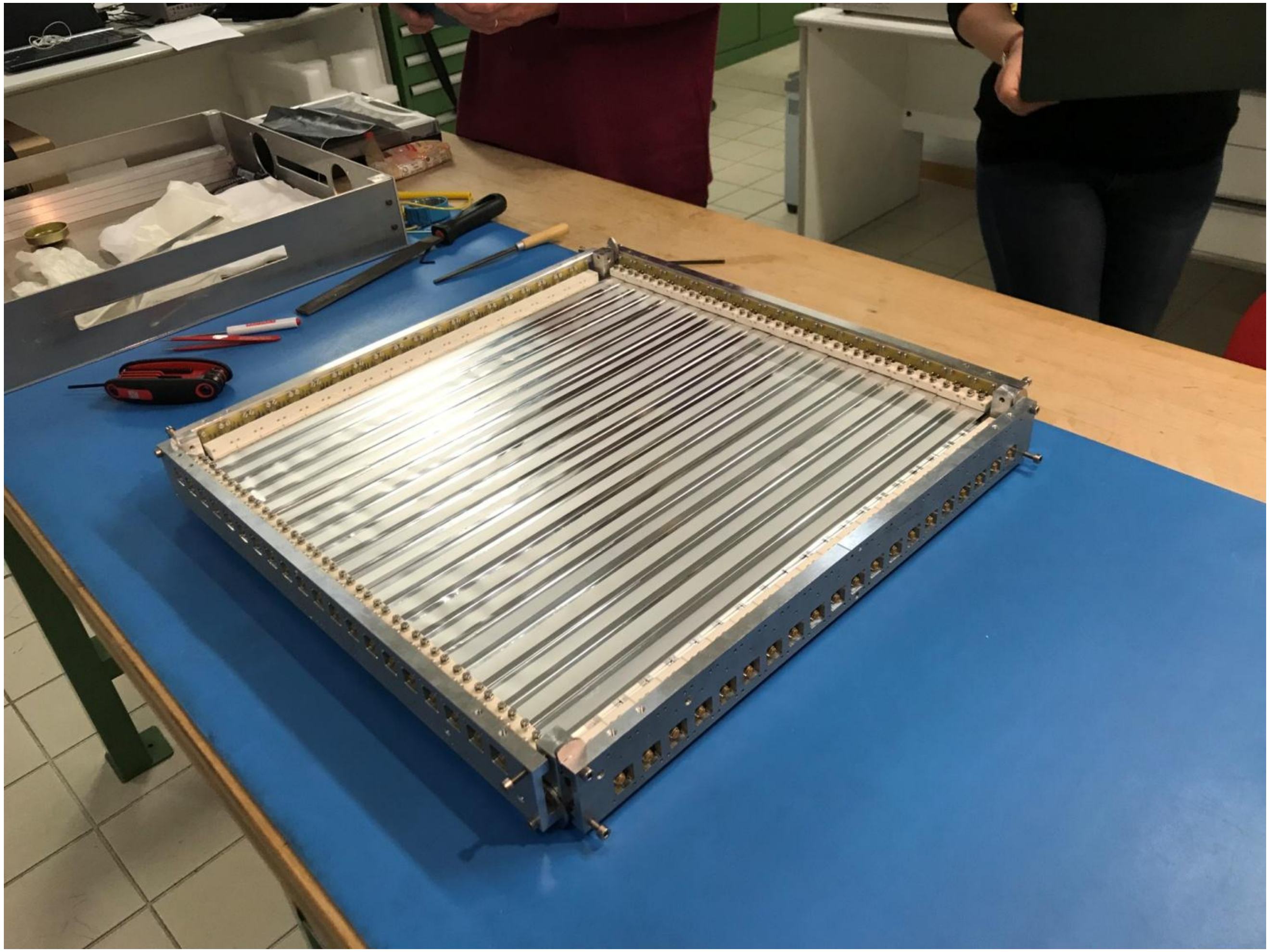
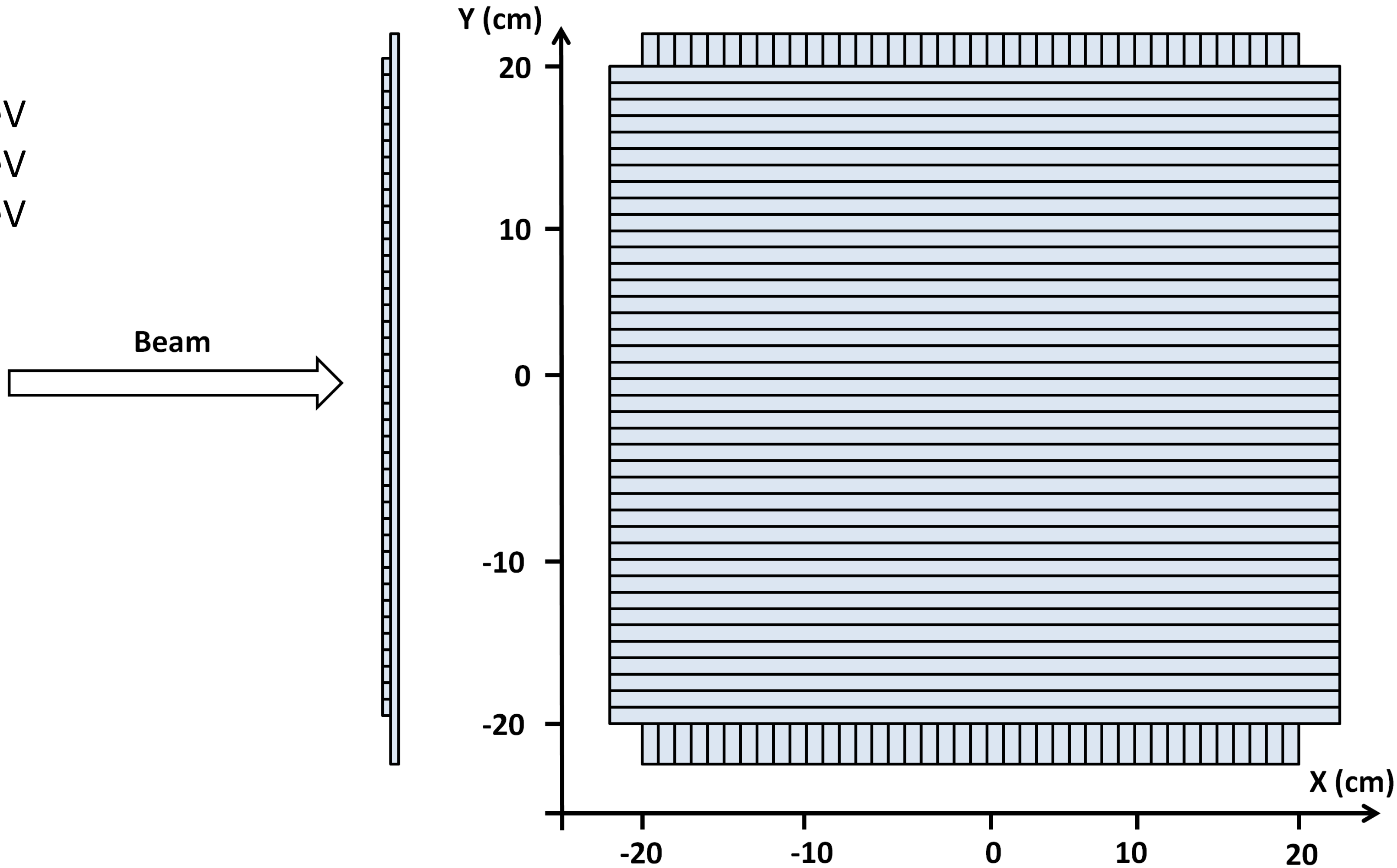
Final Detector Structure

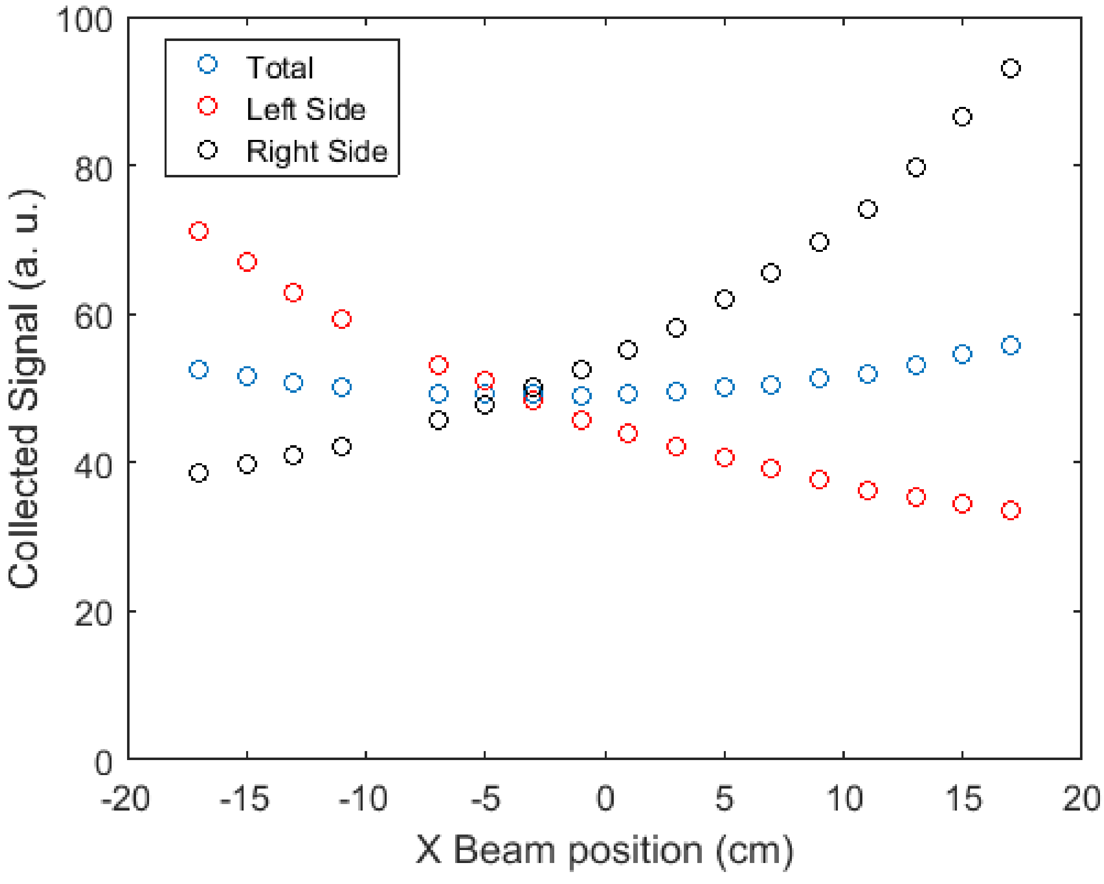


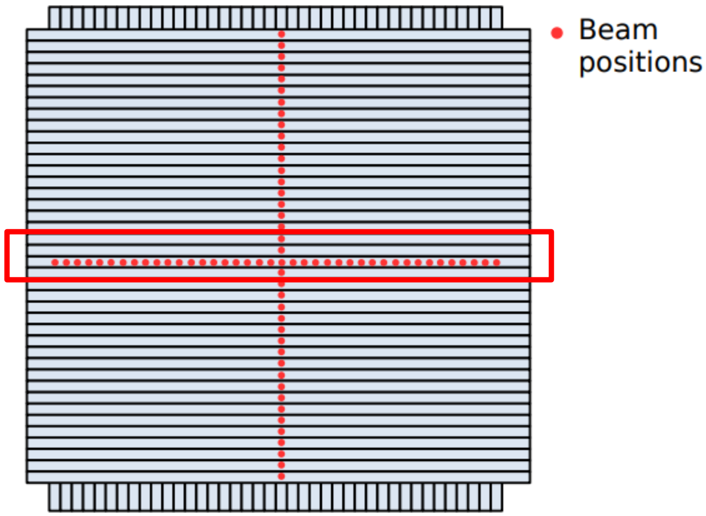
Detector Scan

- P 60 MeV
- C 115 MeV
- C 260 MeV
- C 400 MeV



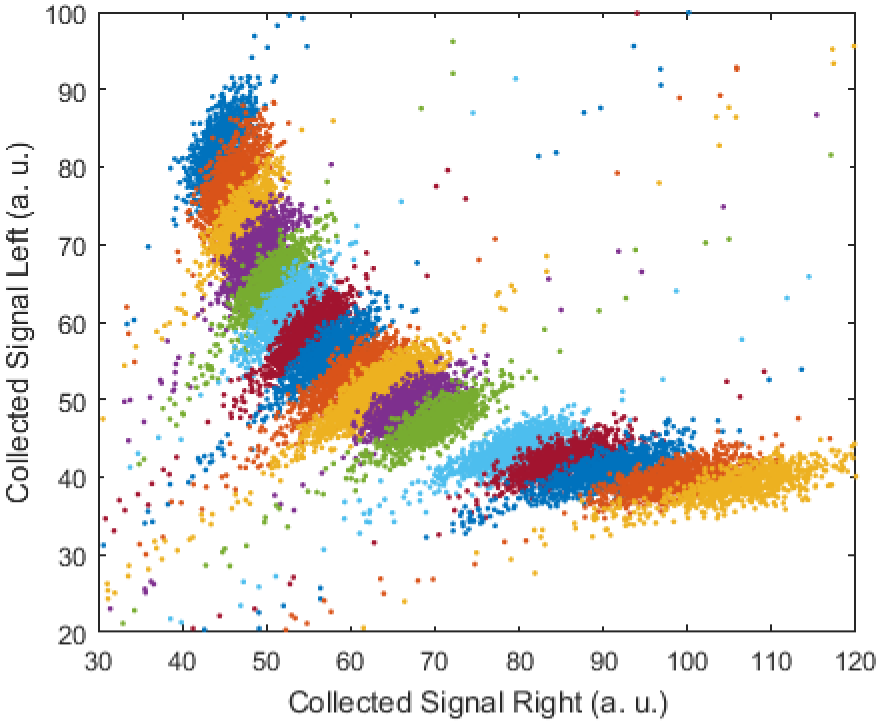
Central bar scan

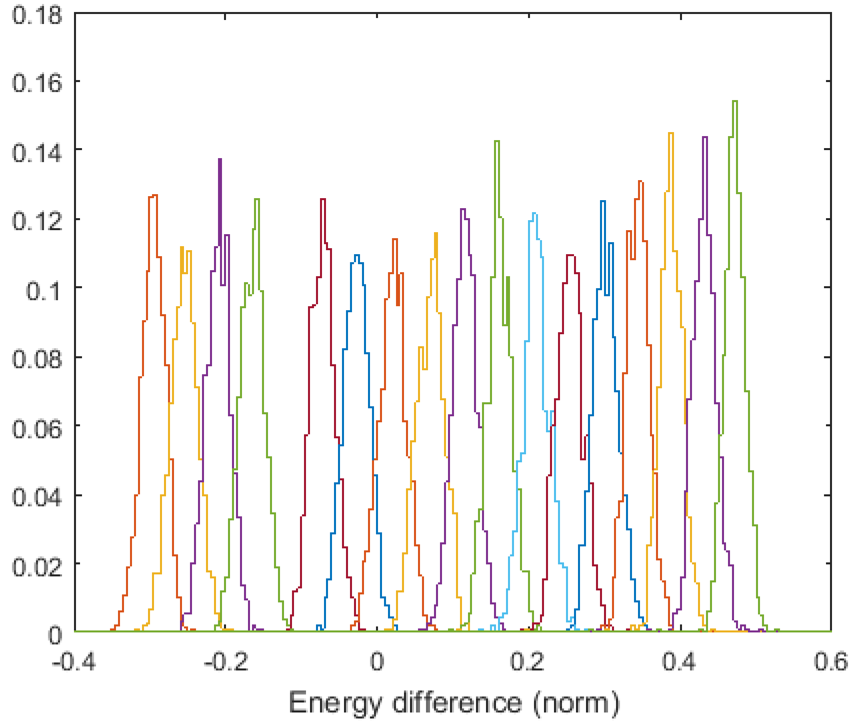




Bar identification

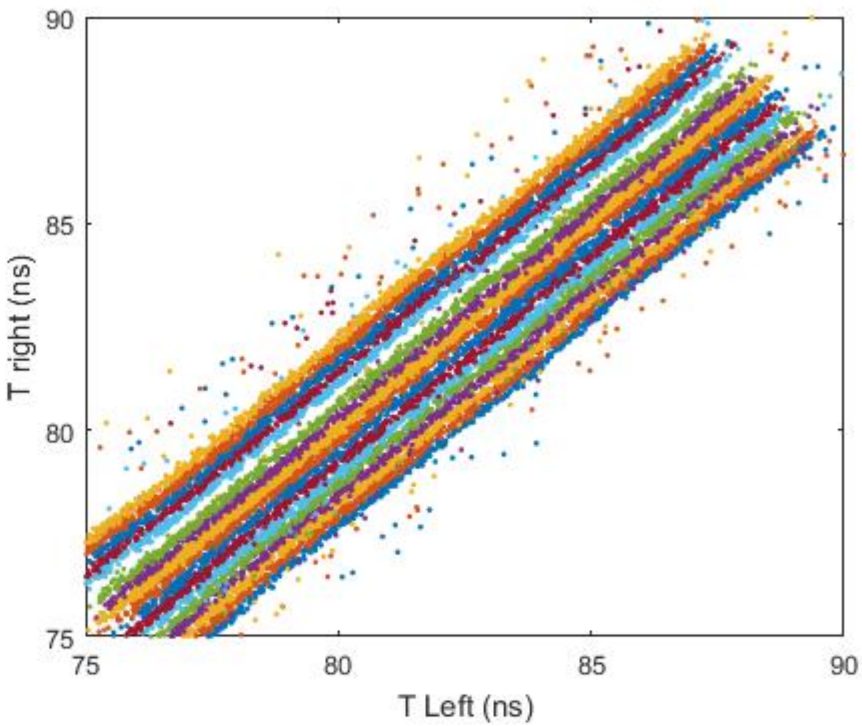
Signal collected at the two sides of the bar as a function of the beam position (irradiation has been performed at 2 cm step, at the center of each bar).

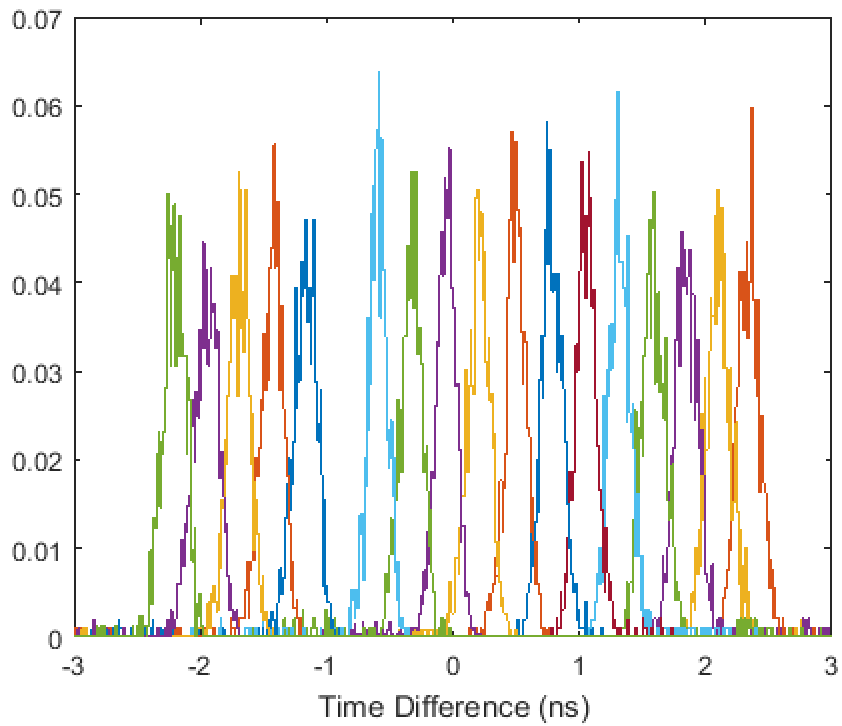




Bar identification (2)

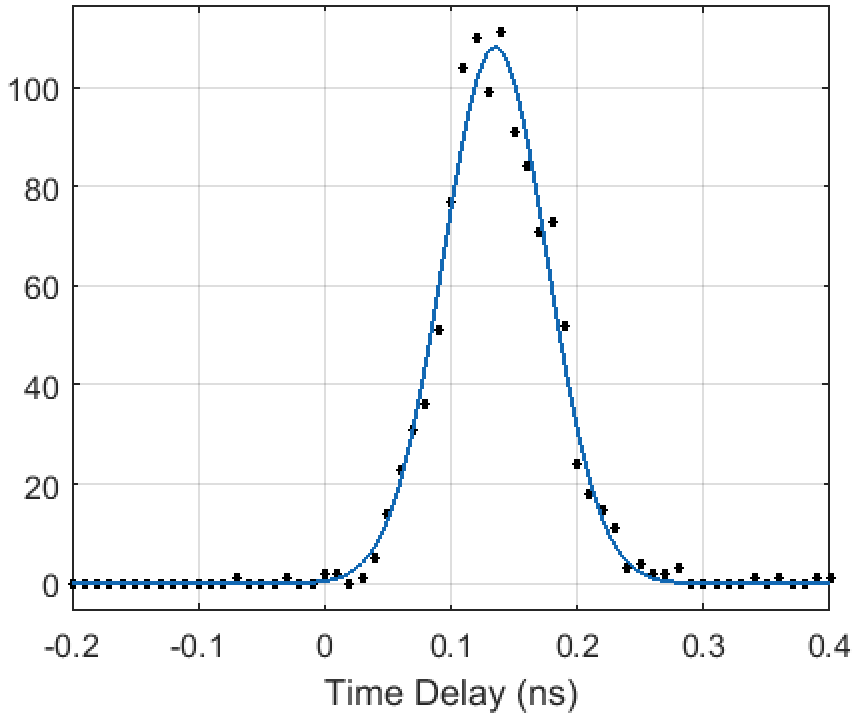
Trigger time at the two sides of the bar as a function of the beam position (irradiation has been performed at 2 cm step, at the center of each bar).
The absolute value of the trigger time is not related to the start counter, so it is not related to the Time of Flight of the particle.



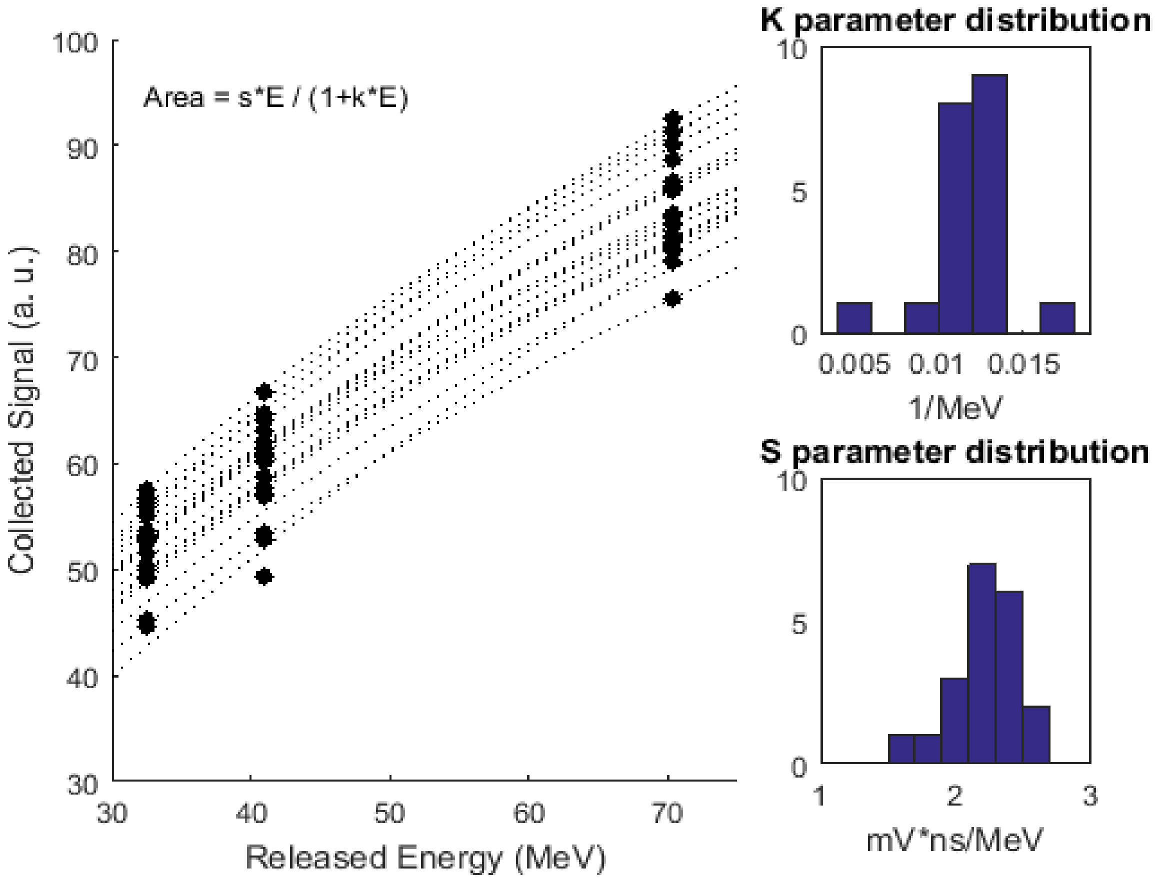


Time Resolution

Time resolution between the two central bars of the two layer, a std of about 40 ps was obtained.



Calibration



K parameter is in agreement with the results of the prototype.

Paper almost ready for submission

- Summarizes work with 2 single bars
  - **Direct irradiations** of bars
    - Energy and time resolution
      - Energy calibration
      - Time corrections
    - Z-identification and resolutions
    - Data vs MC (without detector response)
  - **Fragment measurements** at 3.2 and 8.3 degrees
    - Z-identification and resolutions
    - Data vs MC (without detector response)
- Journal still to be decided…

Charge identification performance of a ΔE-TOF detector prototype for the FOOT experiment

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Abstract

The goal of the FOOT (FragmentatiOn Of Target) experiment is to measure the production cross sections of fragments for energies, beams and targets that are relevant in particle therapy and radioprotection in space. FOOT is a fixed target experiment, consisting of various subdetectors to reconstruct the mass, charge, velocity and energy of fragments produced in nuclear interactions in a thin target. The ΔE-TOF subdetector is a plastic scintillator, which will measure the energy deposited by the fragments and the time of flight with respect to a start detector, allowing for the evaluation of the charge Z of the fragment. In this study, we present the charge identification measurements of the detector prototype, placed at angles of 3.2° and 8.3° with respect to the beam-axis, during a data taking performed at the CNAO proton therapy center. In both setups fragments with various charges were observed.

1. Introduction

In particle therapy (PT) beams of energetic protons or charged ions are used for cancer treatment. Thanks to the dependence of the energy loss on the velocity of charged particles (Bragg peak), very steep dose profiles can be realized with charged particle beams, so that surrounding tissue can largely be spared. At the same time, particle therapy is subject to uncertainties from positioning errors, interplay effects, organ motion, and physics modelling in dose calculations [1]. Nuclear physics processes are an important source of uncertainty. In fact, nuclear interactions and nuclear fragmentation can significantly modify the dose delivered to patients [2, 3], and a precise understanding of these processes is important