Two-dimensional reconstruction by the multi-strip ionization chamber at PREF

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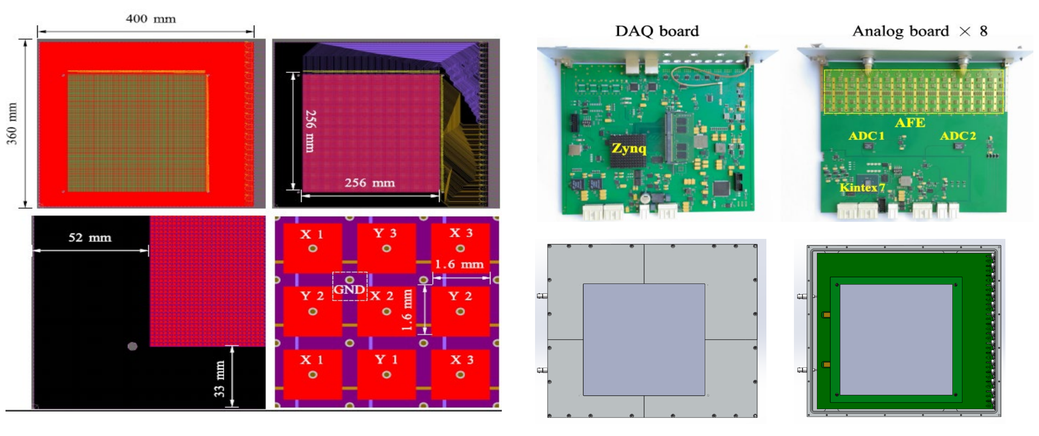
Abstract

The 60 MeV Proton Radiation Effects Facility (PREF) spent nearly 1 month at the commissioning phase, during which the multi-strip ionization chamber (MIC) at the experimental terminal offered the core parameters, beam spot, scanning area, scanning uniformity, beam flux. However, the projection distribution provided by the MIC loses some information, such as the flux and the uniformity in a selected area less than the scanning area. This paper used a method of two-dimensional reconstruction to provide a 2D uniformity of selected area. Revealing the trace of the pencil beam at a sampling rate of 10 kHz.

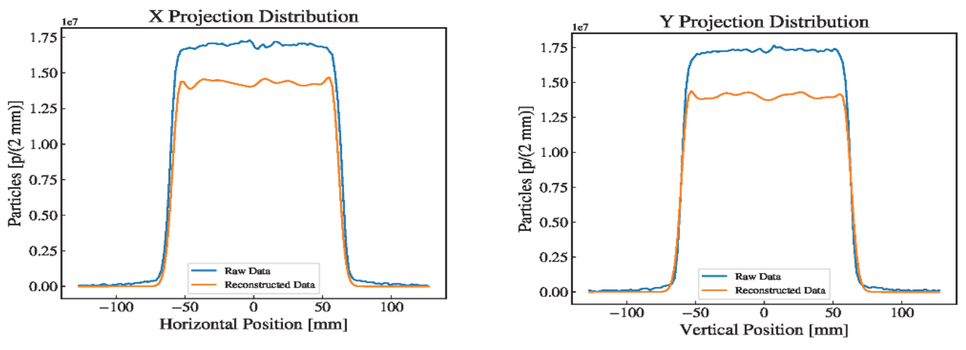
Multi-strip Ionization Chamber (MIC)



Parameters of MIC

- Basic parameters
  - Beam: Proton
  - Energy: 10 ~ 60 MeV
  - Intensity: 1 ~ 1E10 pps
- Basic parameters
  - Sensitive Area: 256 * 256 mm²
  - Sampling Rate: 10 ksps
  - Gap: 5 mm
  - Working gas: Air
  - Biased voltage: -800 V
- Anode of the Detector
  - Quantity: 1
  - Material: PCB
  - Sensitive Area: 256 * 256 mm²
  - Channels: 2560*2
  - Thickness: 1 mm
  - Anode shape: 2 * 2 mm²
  - Advantage: Read out from both sides
- Cathode of the Detector
  - Quantity: 2
  - Material: mylar with Al plated
  - Thickness: 2 μm mylar + 400 nm * 2 Al
  - Effective Area: 260 * 260 mm²

Projection Distribution



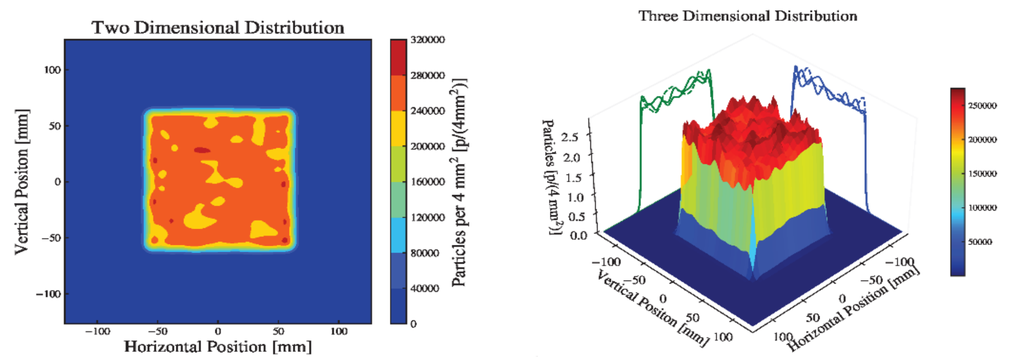
The comparison with raw data and reconstructed data

- The left figure is the horizontal projection distribution.
- The right figure is the vertical projection distribution.
- The blue lines are from raw data, the yellow for the reconstructed data.

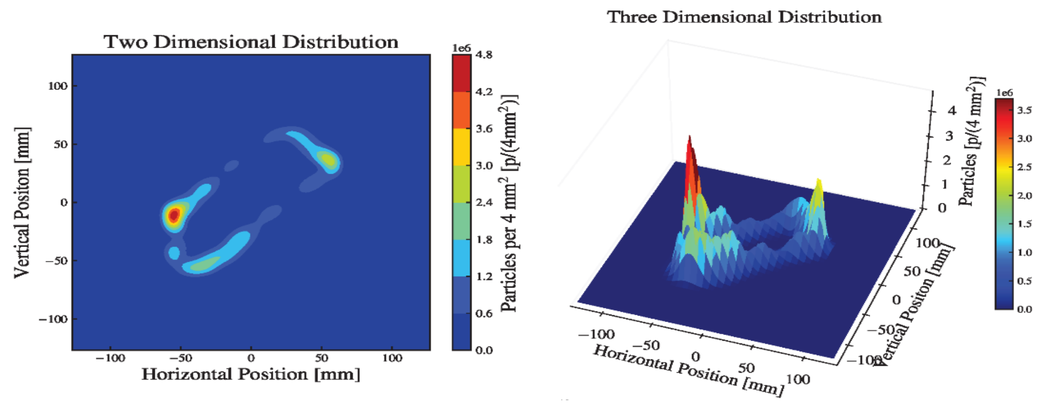
Two Dimensional Reconstruction

2D reconstruction of one spill

- The background of the figures
  - Beam Energy: 60 MeV
  - Intensity: 2E9 pps
  - Scanning Area: 120 * 120 mm²
- The left figure is the 2D reconstruction with a 2D view.
- The right figure is the 2D reconstruction with a 3D view.
- In the 3D view, the green lines are the contour of the horizontal, the blue are for the vertical.

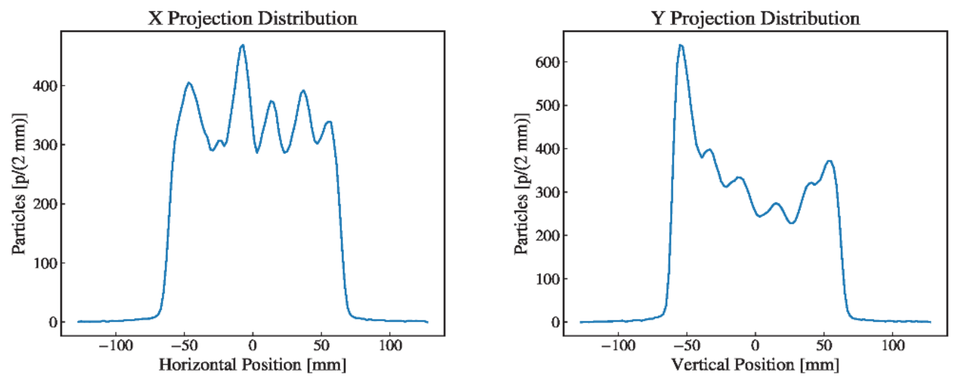


Trace of the Pencil Beam



Trace of 1D, 2D

- Scan magnet: Horizontal 110 Hz, Vertical 115 Hz
- Selected data: 1.015 s ~ 1.022 s
- The lower left figure is the horizontal projection of the trace.
- The lower right figure is the vertical projection of the trace.
- The upper left figure is the 2D reconstruction with a 2D view of the trace.
- The upper right figure is the 2D reconstruction with a 3D view of the trace.



Conclusions and Expectations

- Conclusions
- The ability of the 2D Guassian fitting in 100 μs
- The 2D uniformity of the selected area
- The trace reconstruction in one cycle
- Expectations
- Verification experiment
  - Verify the 2D uniformity with a film
  - A PIC is under development
  - A MIC with thinner anodes
- More analysis
  - More information about micro beam structure
  - Correction of every single profile