FIssion Detector In AStrophysics (FIDIAS)

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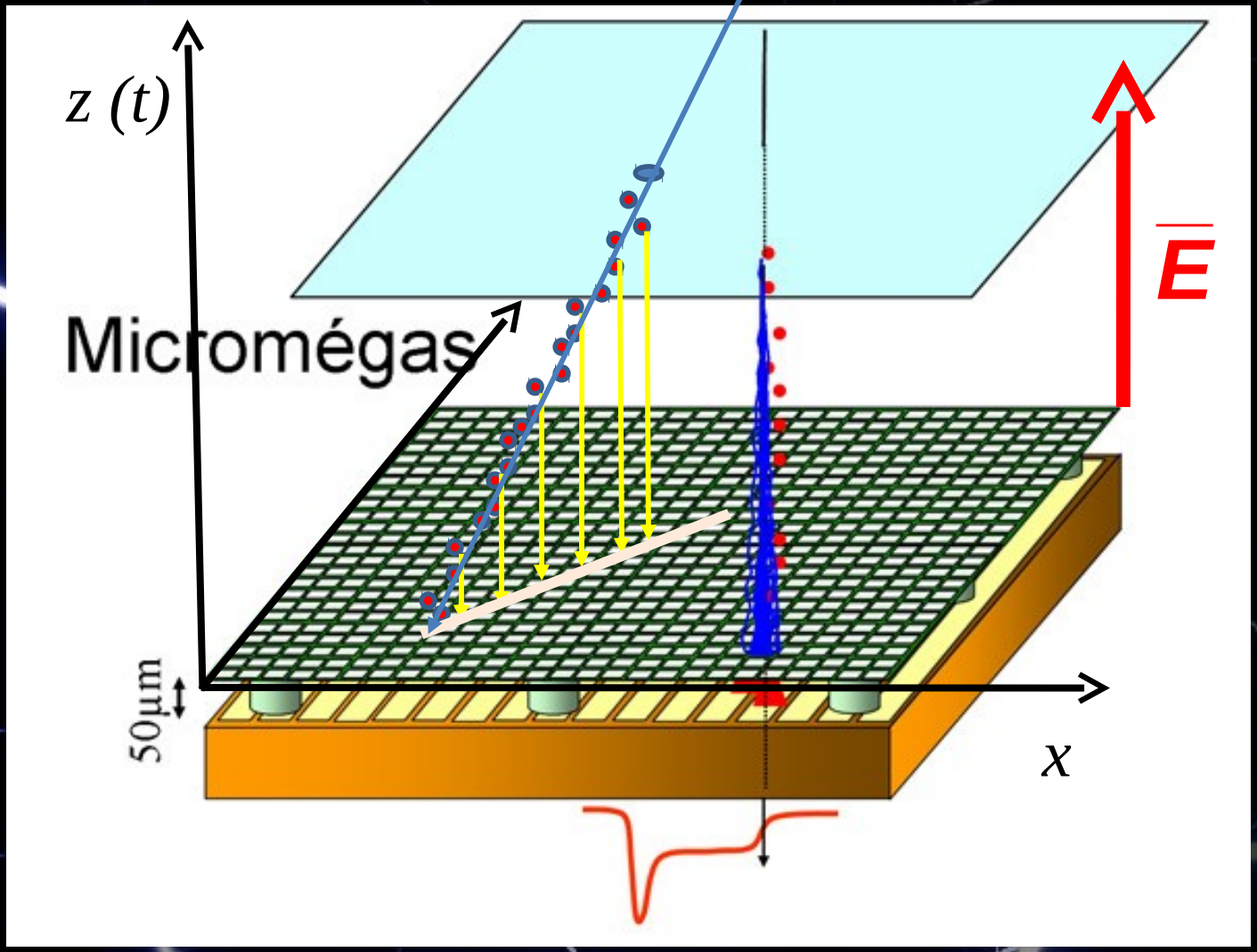
Overview

- MICROMEGAS Time Projection Chamber (TPC)
- Physics Case
- Design – Construction
- First Tests
- Results
- Prospects
- Conclusions

MICROMEGAS TPC



- Gaseous Detector
- Fast signals
- Fast recovery
- Tracking device
  - x,y from strips
  - z from t_{drift}

Physics Case

- **Nuclear Astrophysics**

  Recoils detection at capture reactions for cross section measurements

  e.g. $^{4}He(^{78}Kr,\gamma)$

- **Nuclear Physics: Fission fragments tracking**

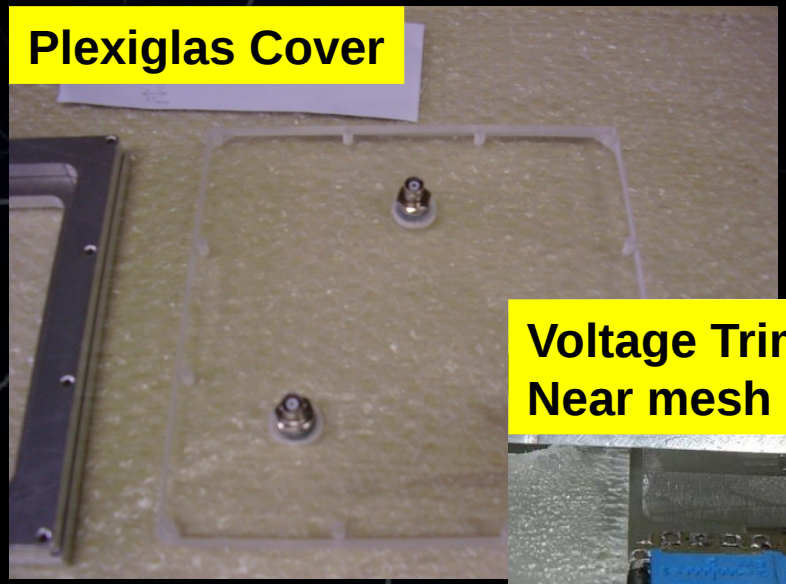
  Characterize neutron induced fission at thermal – MeV range neutrons

Design - Construction

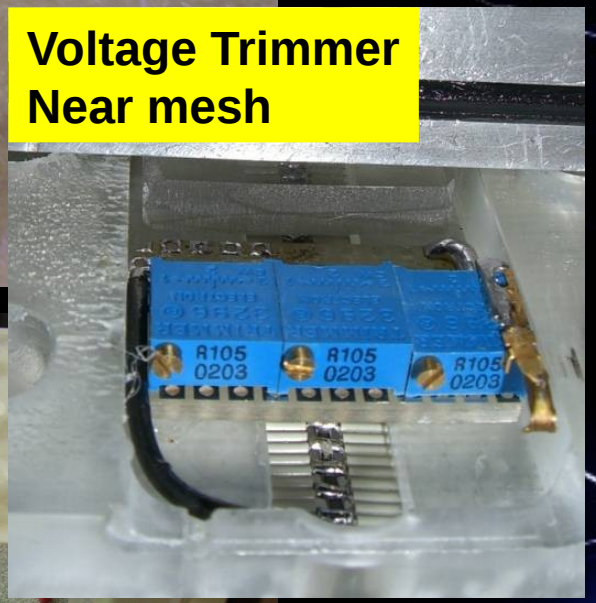
Excellent work by Lefteris Saragas (Technician) at INP, NCSR Demokritos

Aluminum Housing

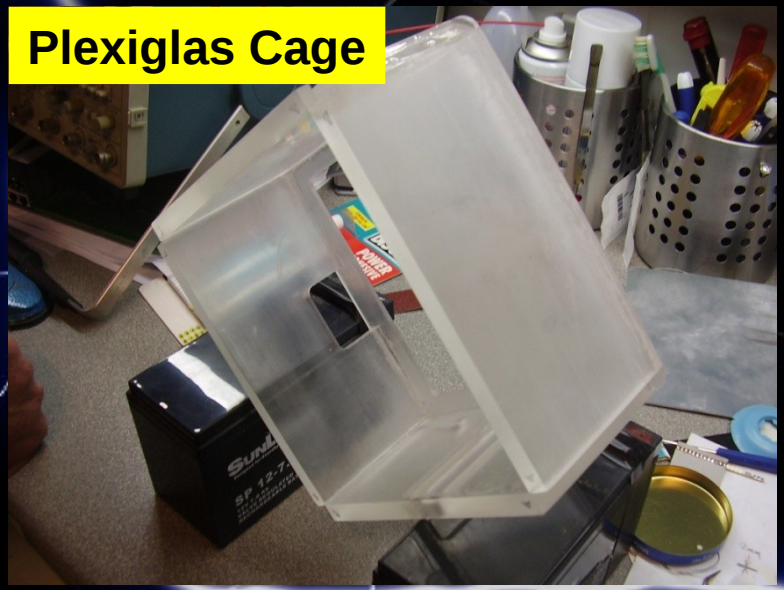
Plexiglas Cover



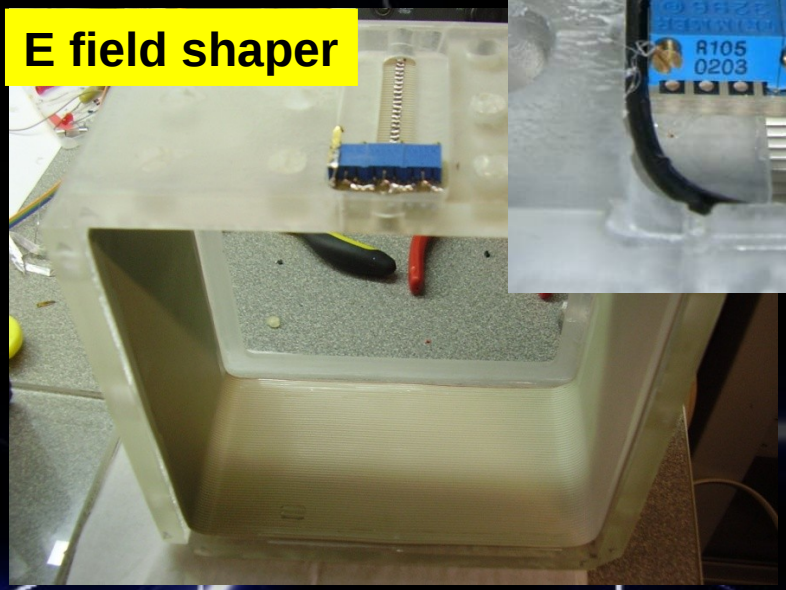
Voltage Trimmer Near mesh



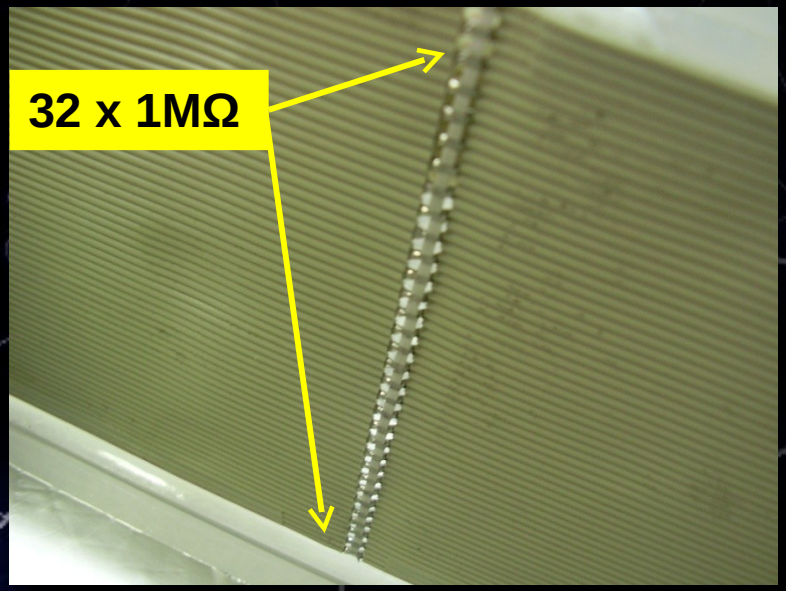
Plexiglas Cage

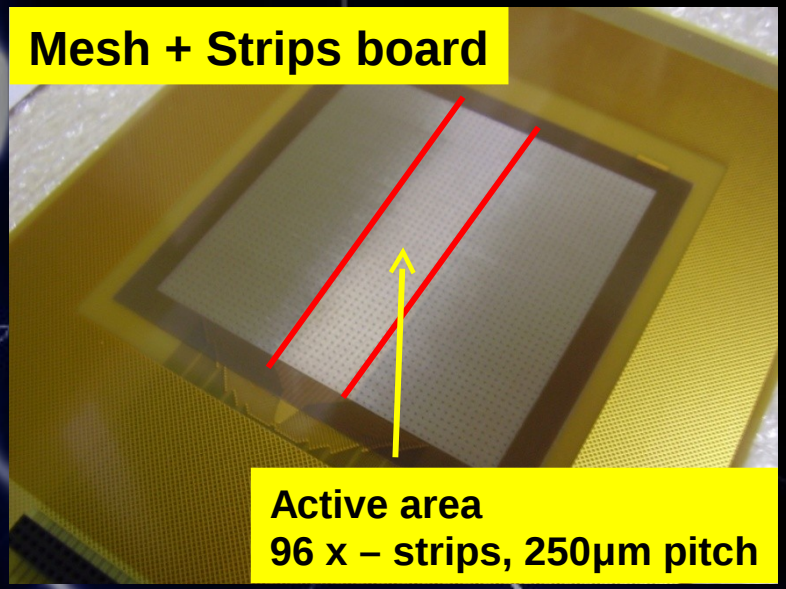


E field shaper

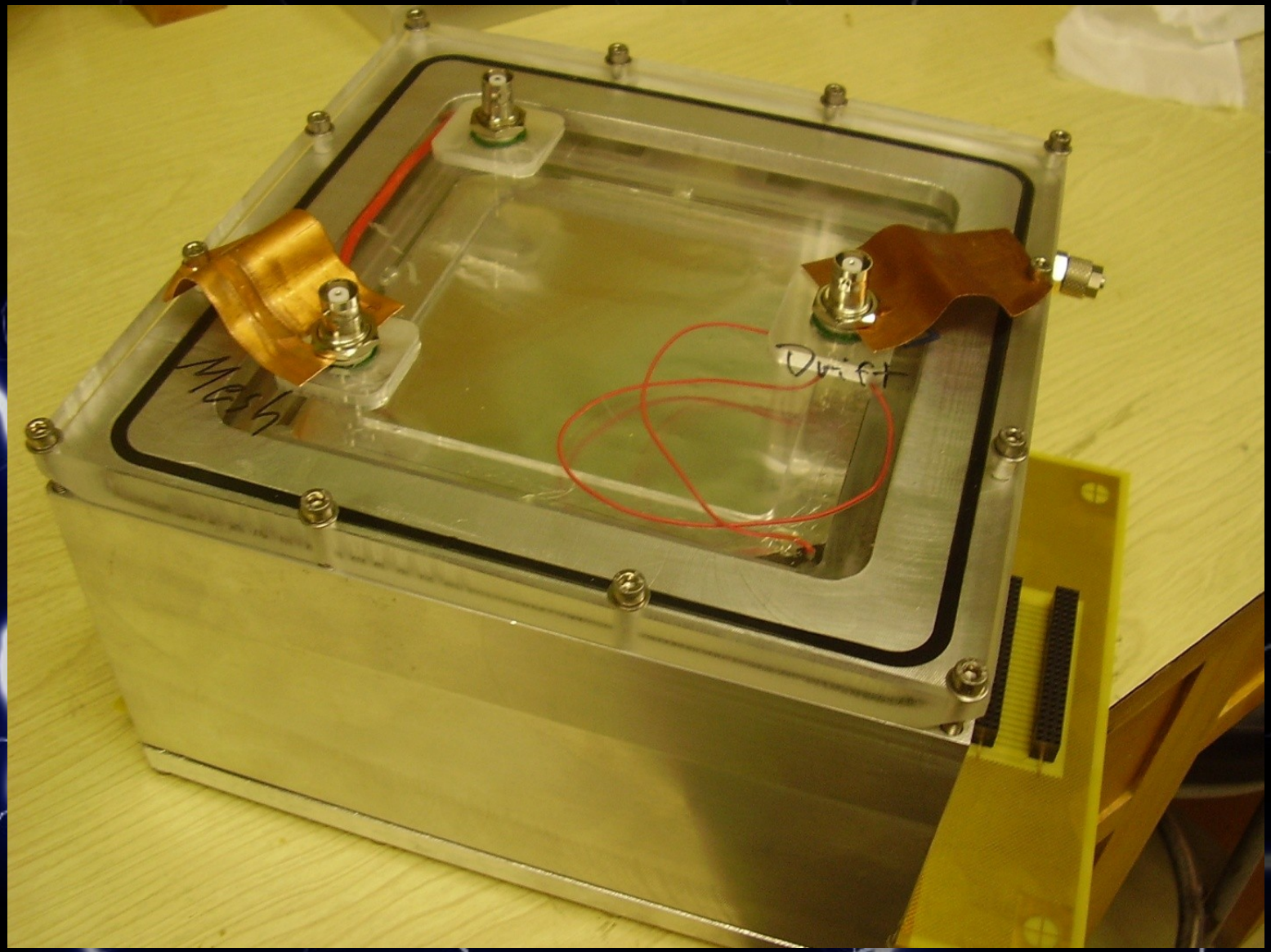


Design - Construction



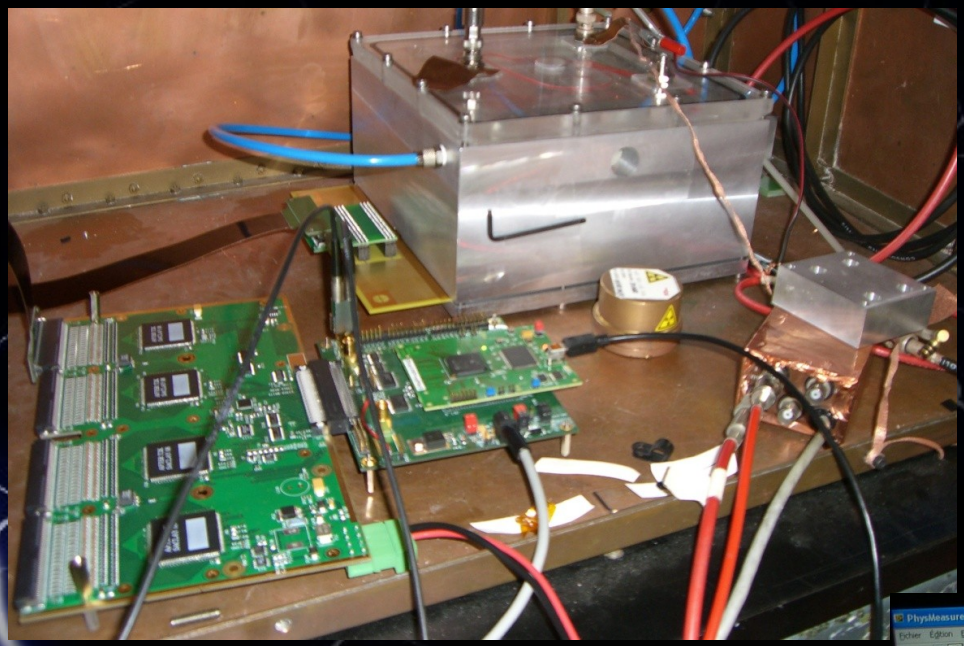


Design - Construction



Final Detector

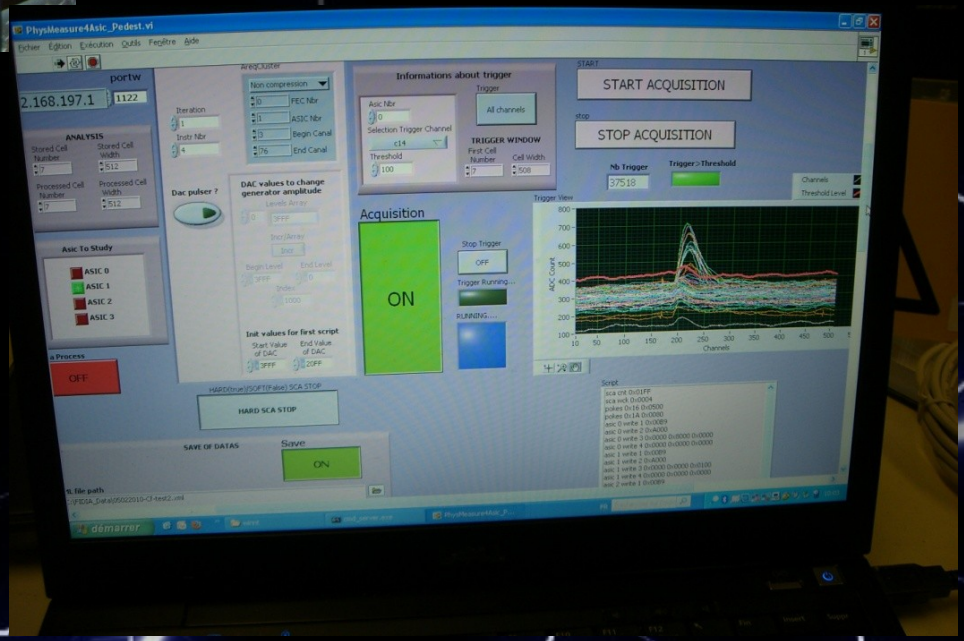
First Tests



READOUT ELECTRONICS

T2K AFTER Asic Electronics
Motherboard (4 x 72 channels)
Mezzanine to USB (Laptop) readout

Charge Sensitive Amplifiers
Shaping times: 0.1 – 1 μs
Sampling: 10 – 100 MHz
Slow readout: 1 Hz (expect improvements up to 100 Hz)

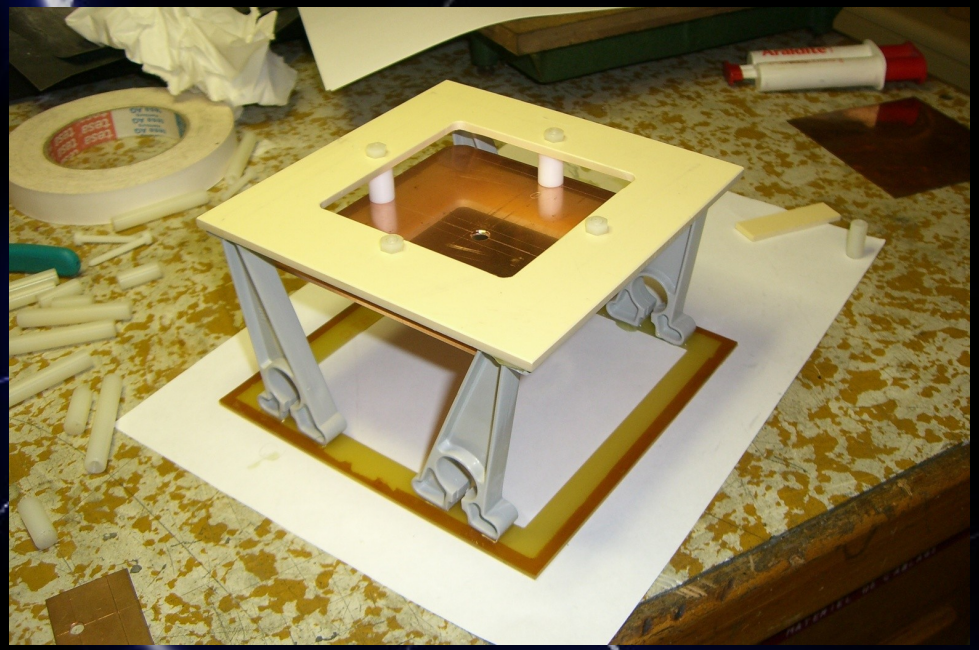


Micromegas Operating conditions:

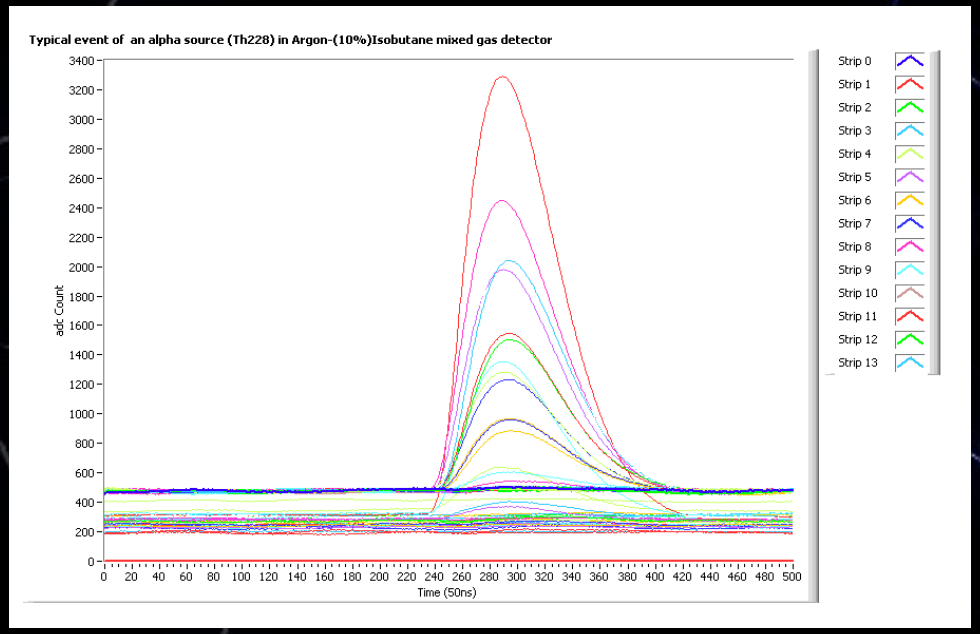
Gas: Argon (95%) + Isobutane (5%)
HV_{drift}: 2000 – 3000V
HV_{mesh}: 200 – 300V
E_{drift}: ~300 - 450 V/cm
Drift velocity: ~ 4 cm/μs

First Tests

1) **Sources Fe, Cd**
2) **Cosmics**: Drift space = 8cm
3) **Californium fission source:**
   Source support table – Drift electrode
   Drift space 6cm



Results (Preliminary)



time

Data Analysis

Event: 72 strips x 512 Time slots
(ADC value)

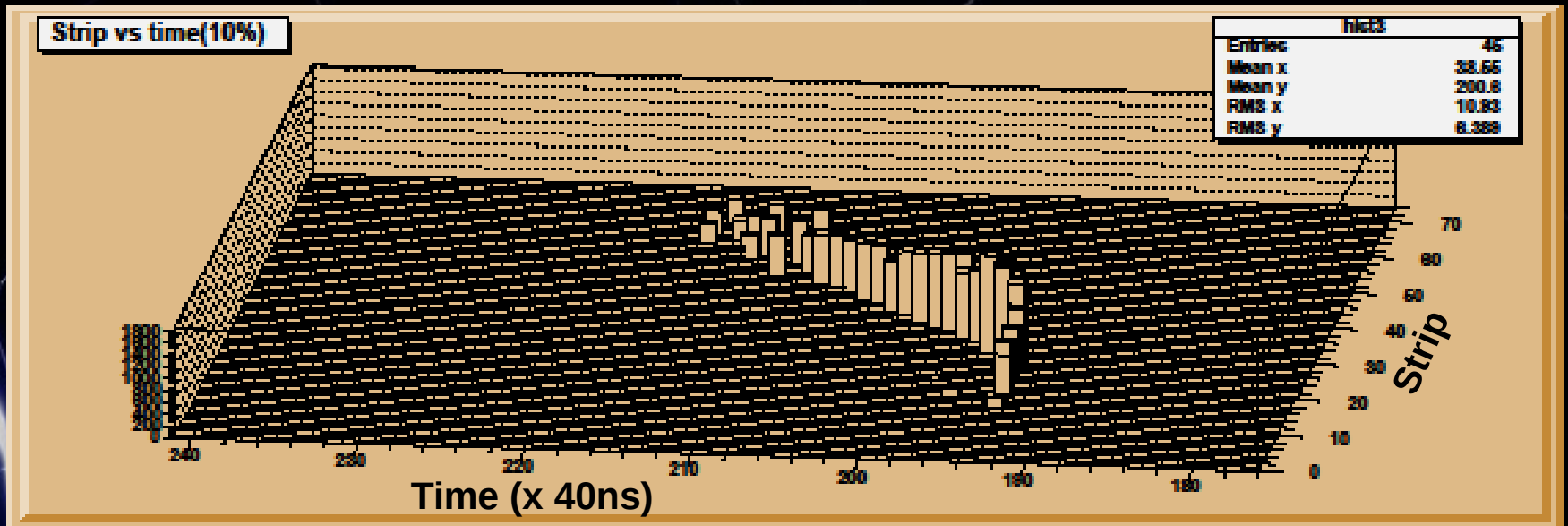
Time slot: 40 ns

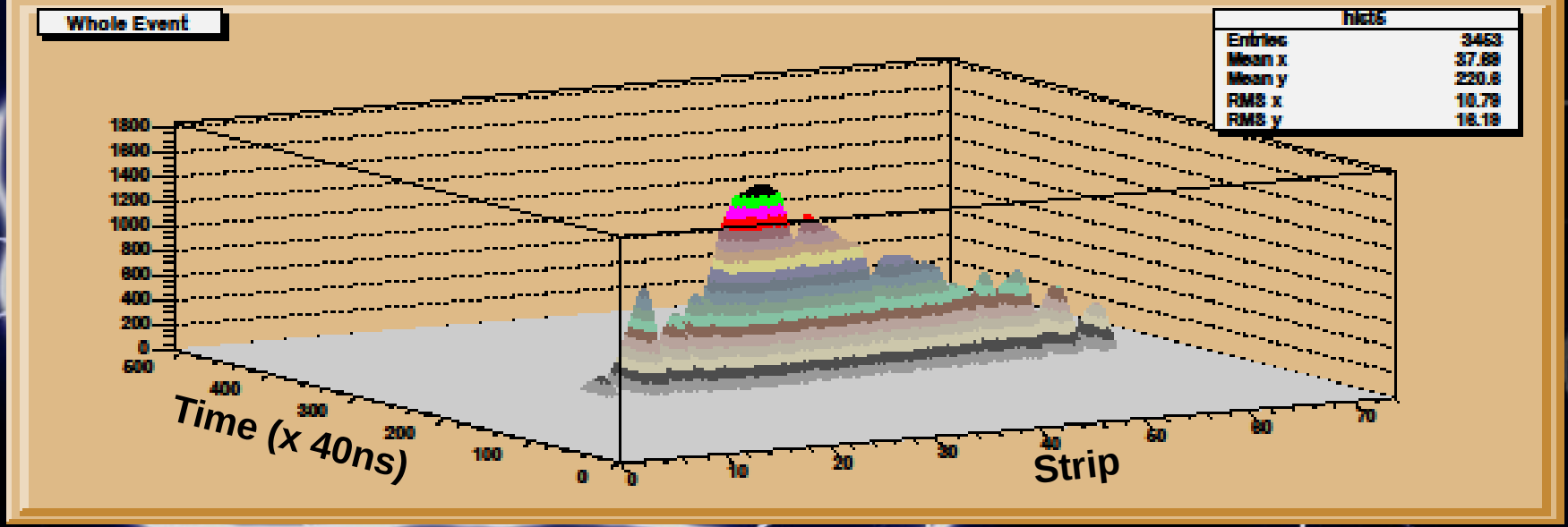
Analysis

1) Define: Pedestals, Sigma pedestal from the first 100 time slots
2) Defile signal: excess over (pedestal + 3*sigma)
3) Define per strip: Pulse Height + Start Time (10% of Pulse height)
4) Define Energy: Sum of all strips pulse heights
5) Perform Linear fit on: t = f (x)
6) Calculate Length of Track

Results (Preliminary)

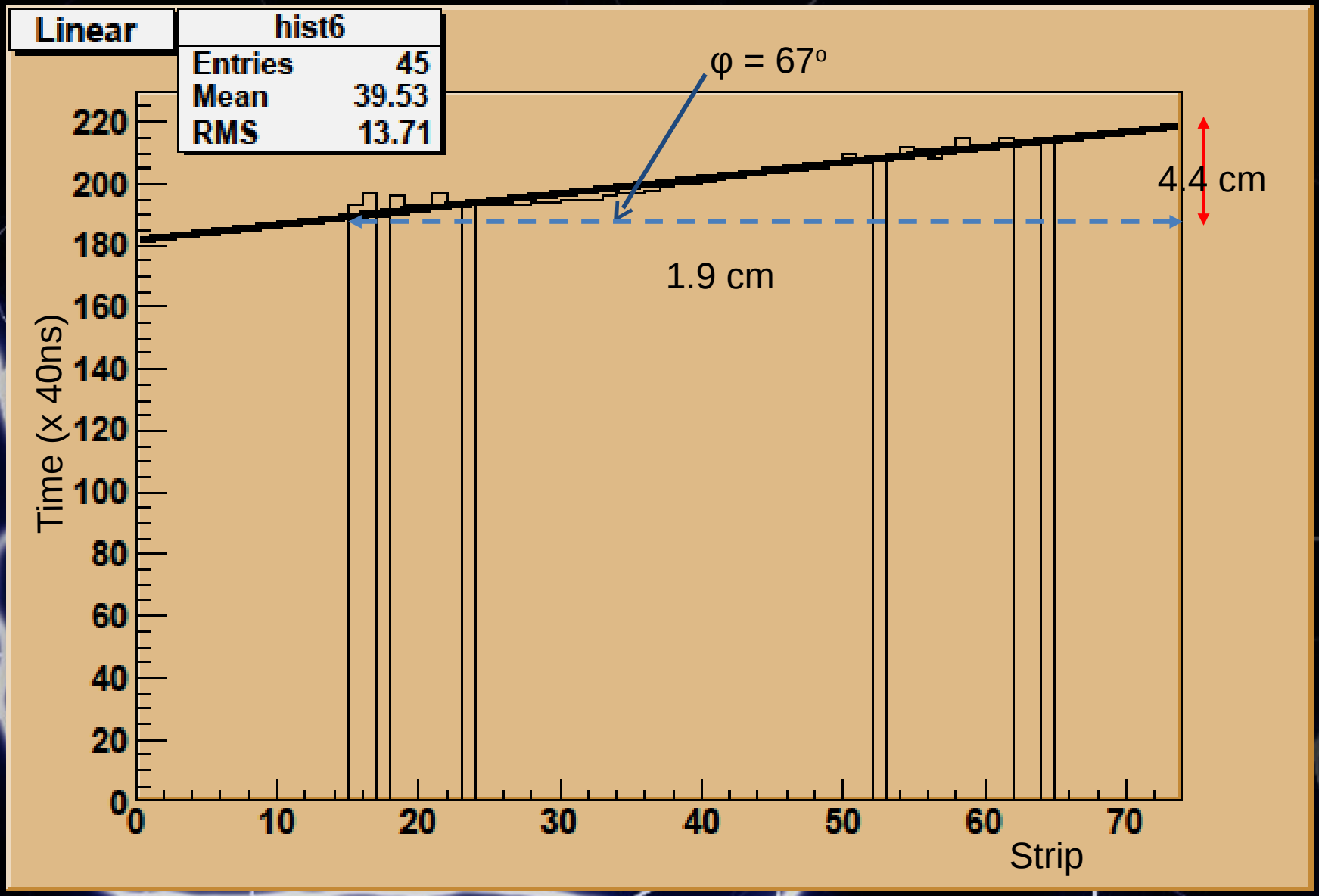
A Cosmic Ray Track





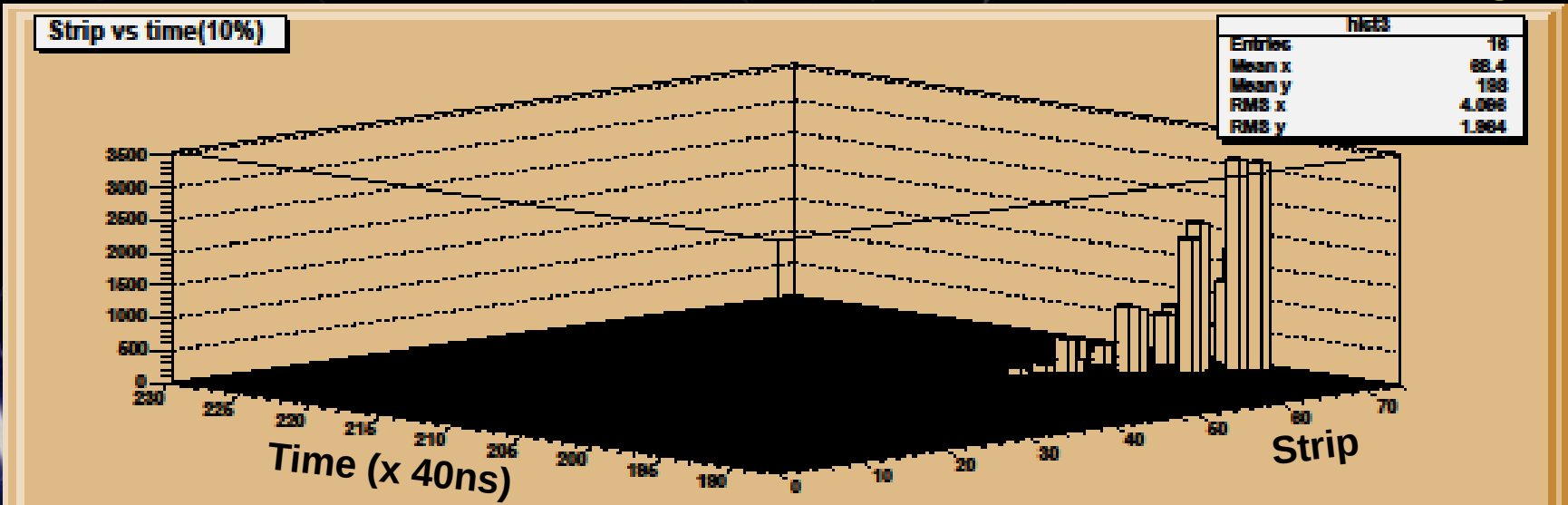
Results (Preliminary)

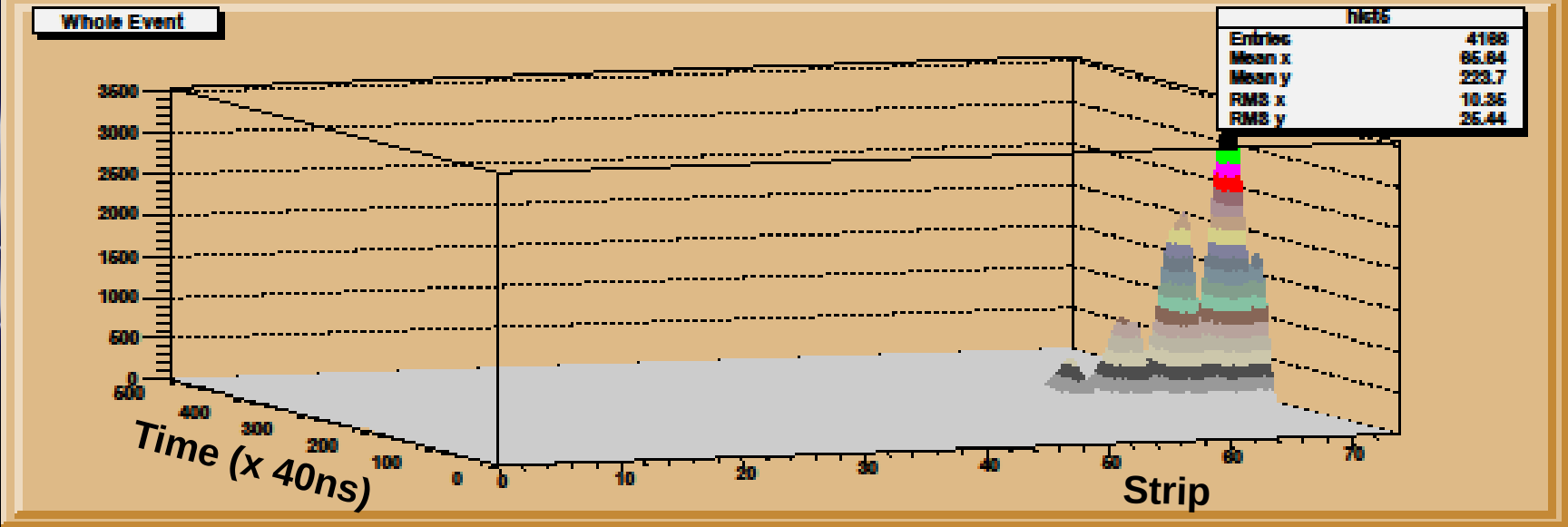
Track Fit



Results (Preliminary)

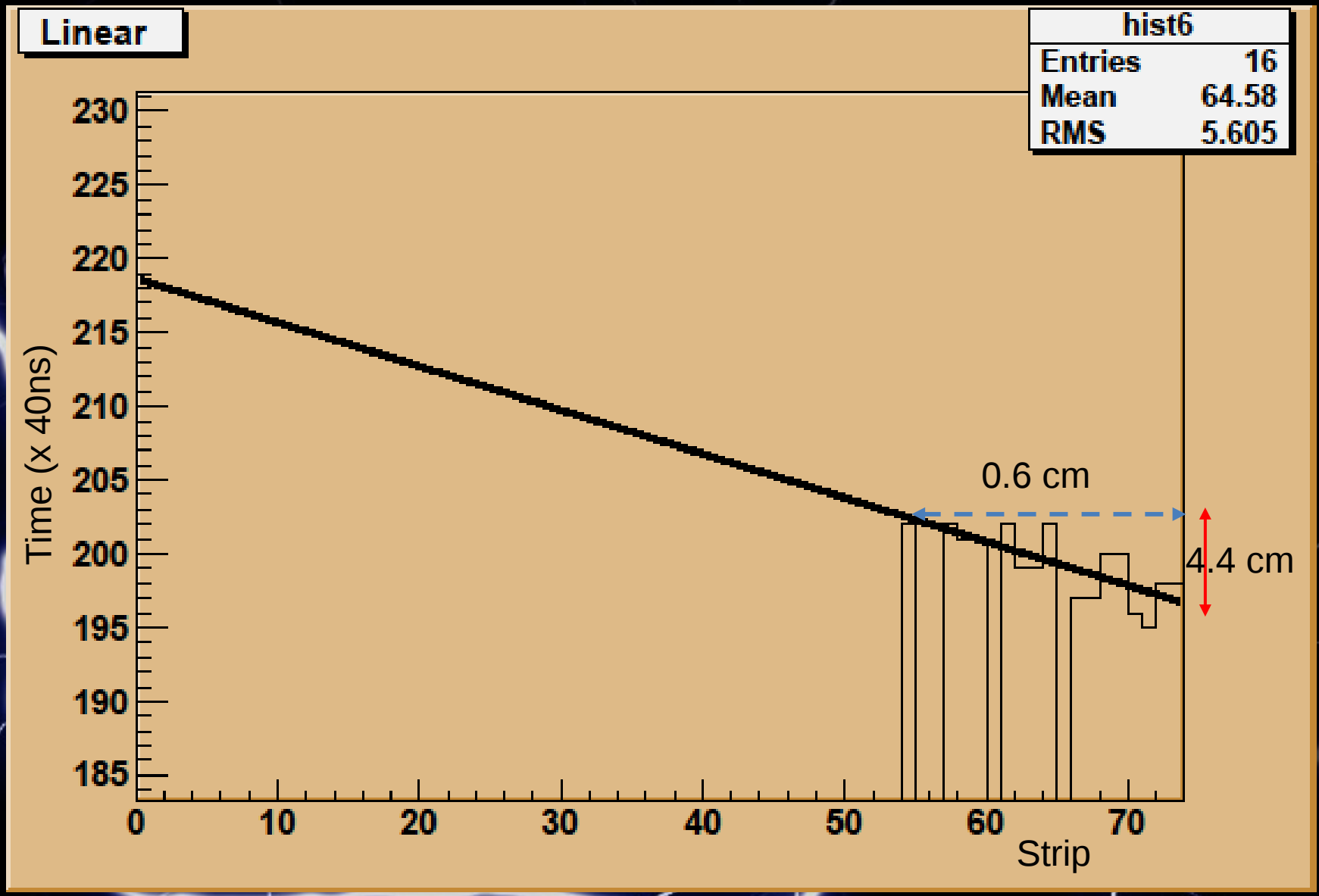
A Fission Fragment





Results (Preliminary)

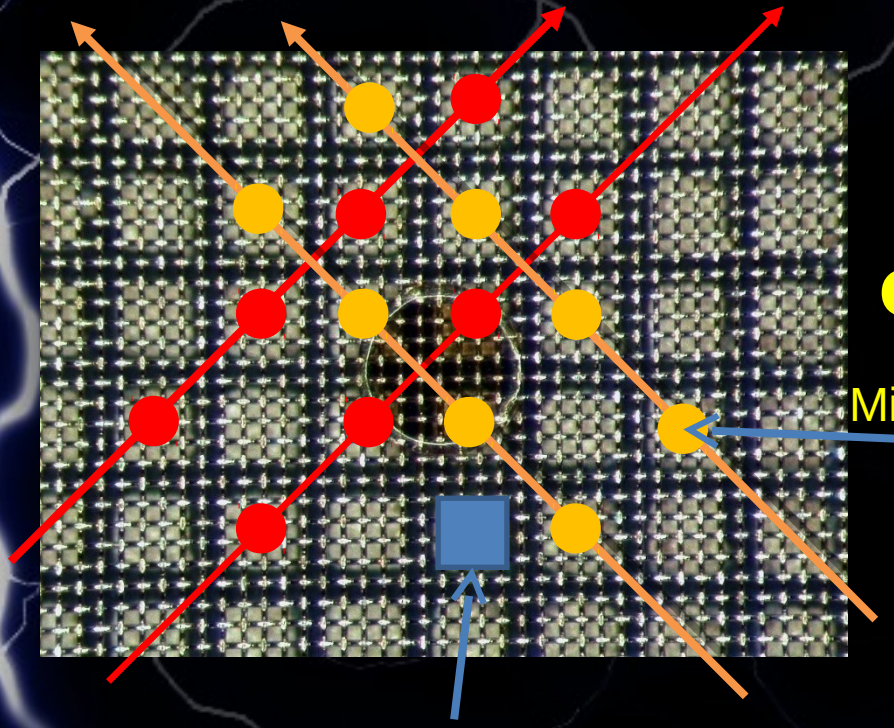
A Fission Fragment Track

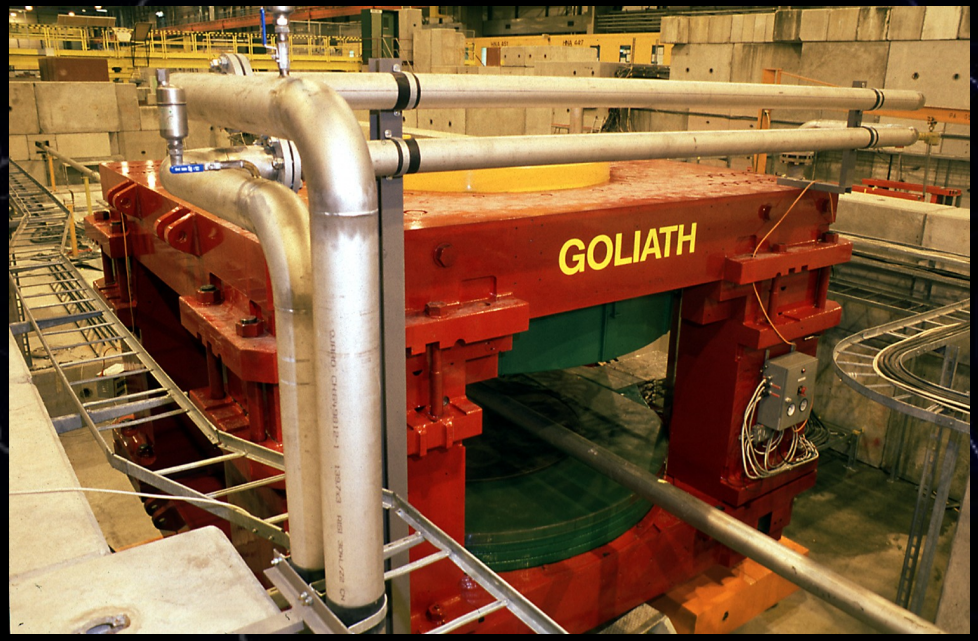


Test at CERN

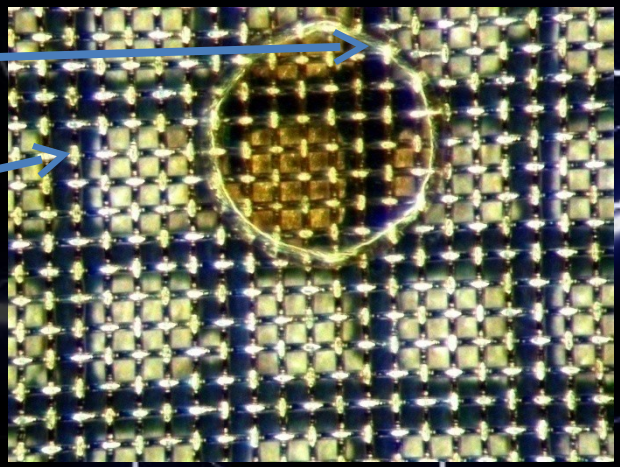
Full detector (10 x 10 cm²) with x – y strips

can be readout from the 2 ends of the circuit





Goliath Magnet at CERN ~1.5T



Perspective

1) Purchase the Readout Electronics for further tests
2) Work to develop new fast Readout Electronics
   (Common ASIC: CSA, Shaper, readout)
3) Further tests to optimize the Micromegas TPC for the different applications

Conclusions

- A Micromegas TPC has been designed and build at NCSR Demokritos. It was operated using T2K readout.
- This is the first time that a TPC has detected and Recorded Fission fragments
- Preliminary data analysis shows that the results are very encouraging