R&D of Fast Neutron Imaging detector based on Bulk-Micromegas Mini-TPC

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Outline

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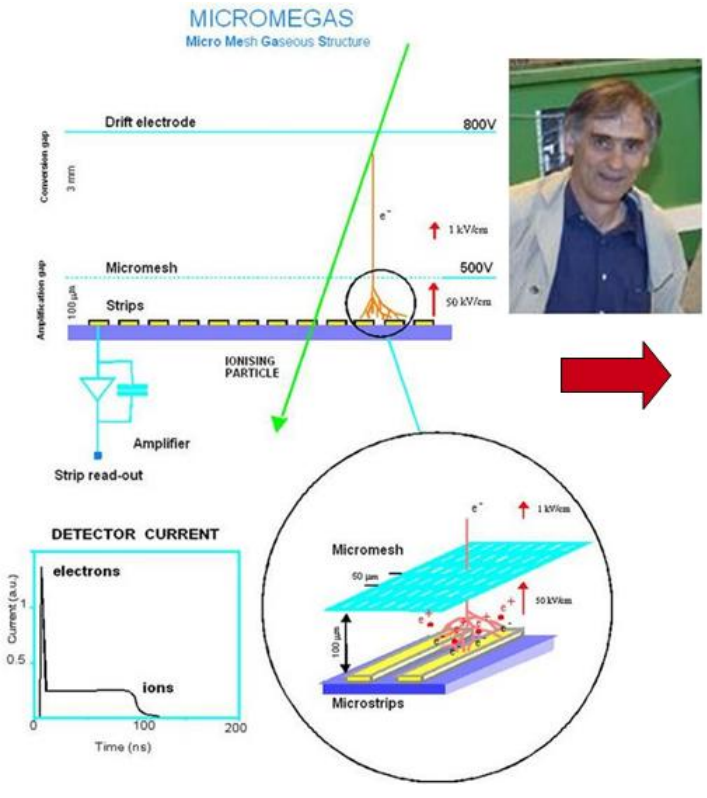
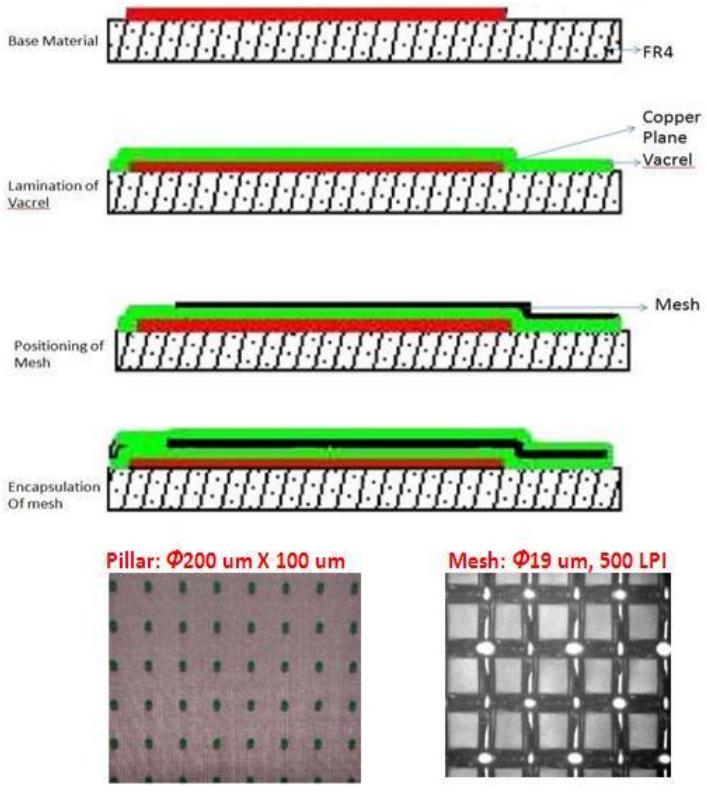
2. Structure of Fast Neutron Imaging(FNI) detector and it's readout PCB.
3. T2K-TPC DAQ system based on AFTER chip.
4. Gas system.
5. Cosmic setup and Test with Cosmic Ray - Muon.
6. Conclusion

1. Micromegas and Bulk-Micromegas

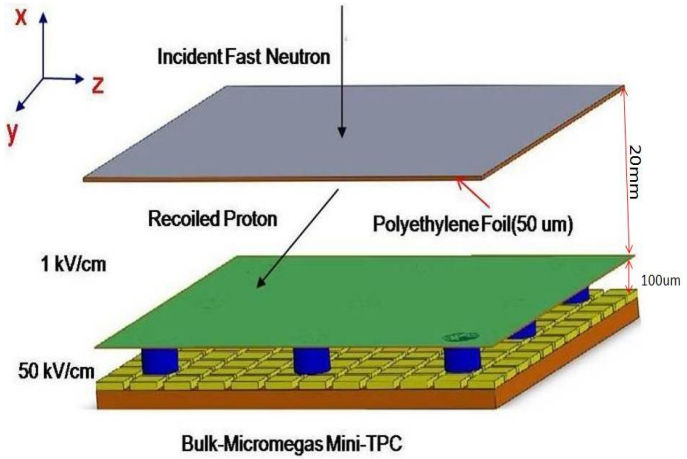
- Micromegas: Micro-Mesh Gaseous Structure, Y. Giomataris, et al., NIMA 376(1996)29
- Bulk-Micromegas Y. Giomataris, et al., NIMA 560(2006)405



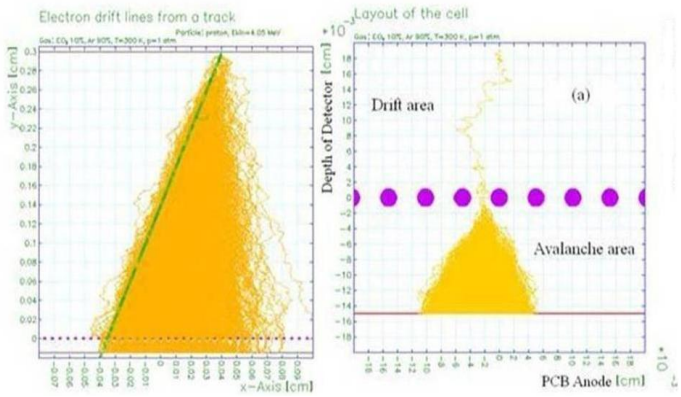


2. Basic Ideals

- Bulk-Micromegas Mini-TPC



Bulk-Micromegas Mini-TPC



Recoiled proton track and the drift lines of its ionized electrons

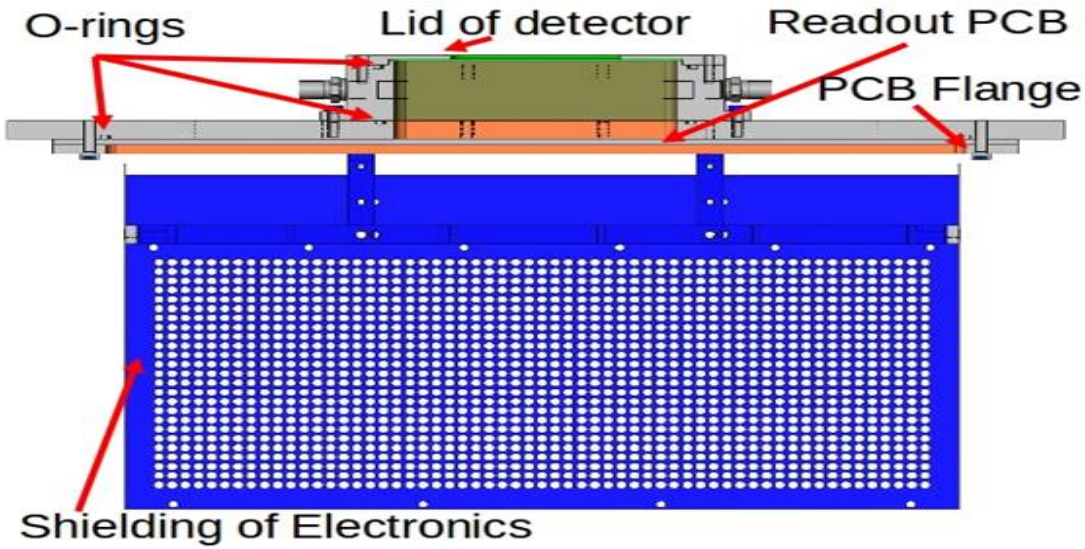
- Basic Ideals

1. Converter:
convert the fast neutron into the charged particle
2. plus Bulk-Micromegas mini-TPC:
it is a kind of very short drift-length TPC read out by Bulk-Micromegas

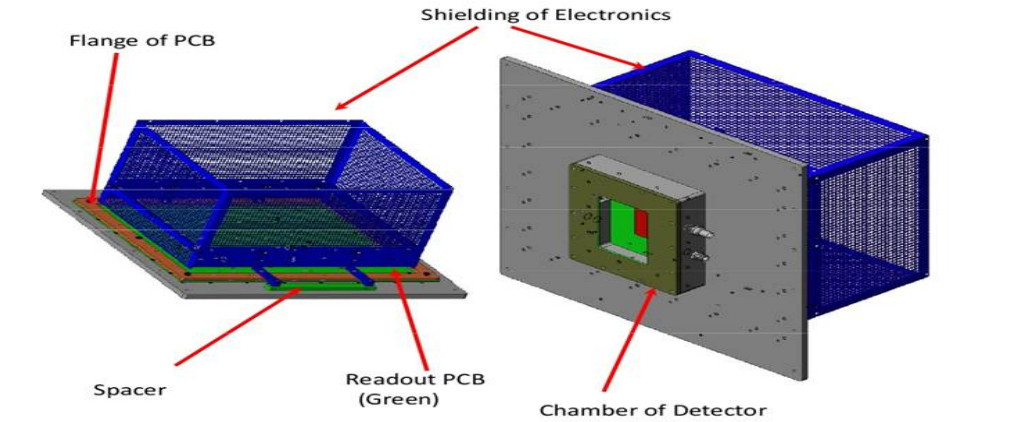
Advantages:

1. High spatial resolution:
$280\mu m$ which means high quality imaging
2. Low efficiency: 0.01-1 %, subject to the thickness and kind of converter, which make it suitable for the beam monitor /profile and imaging in very high radiation environments
3. Resistance to radiation:
possible used as a beam monitor

Structure of Fast Neutron Imaging(FNI) detector

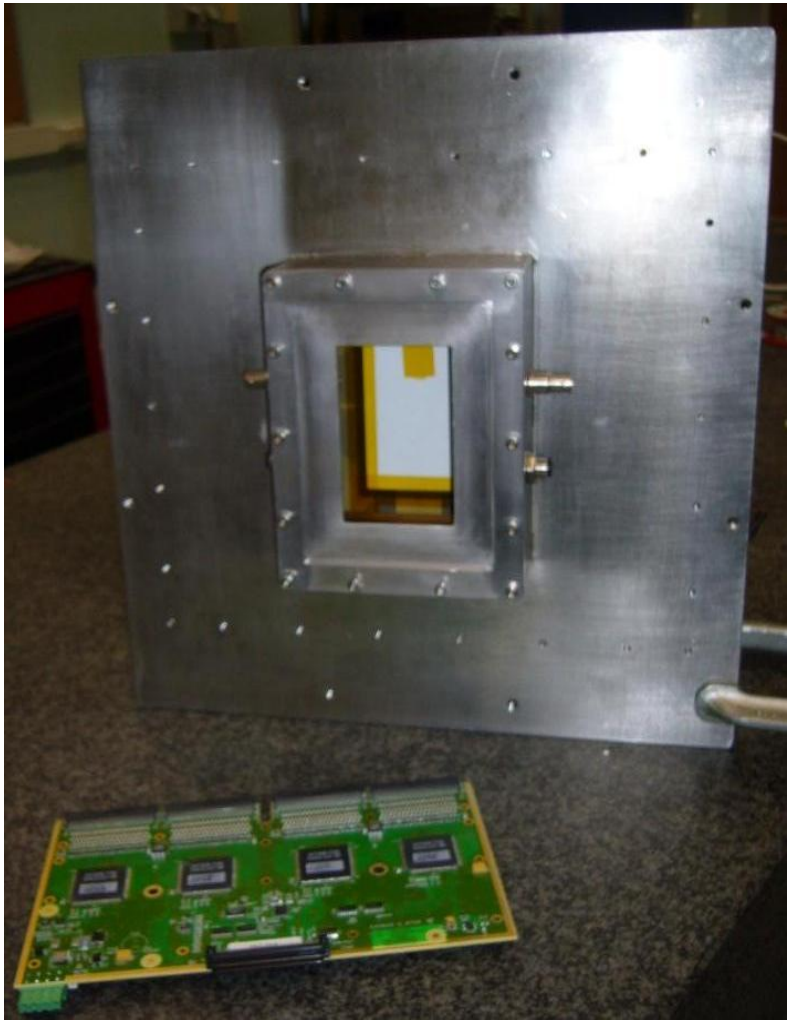


Cross-section of the mini-Micromegas TPC.



3D views of FNI detector.

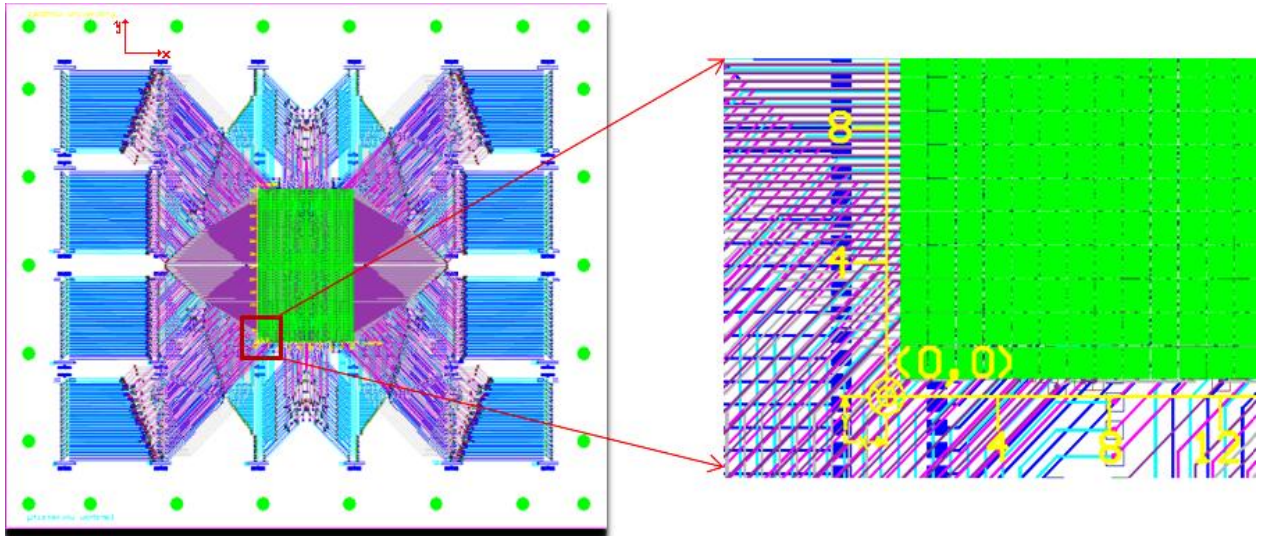
Structure of Fast Neutron Imaging(FNI) detector



Front sight of the FNI detector

assembled FNI detector

Fast Neutron Imaging detector readout PCB



This readout PCB is designed by our group

Dimension of readout PCB:

Total area: 365.5 mm X 306.0 mm

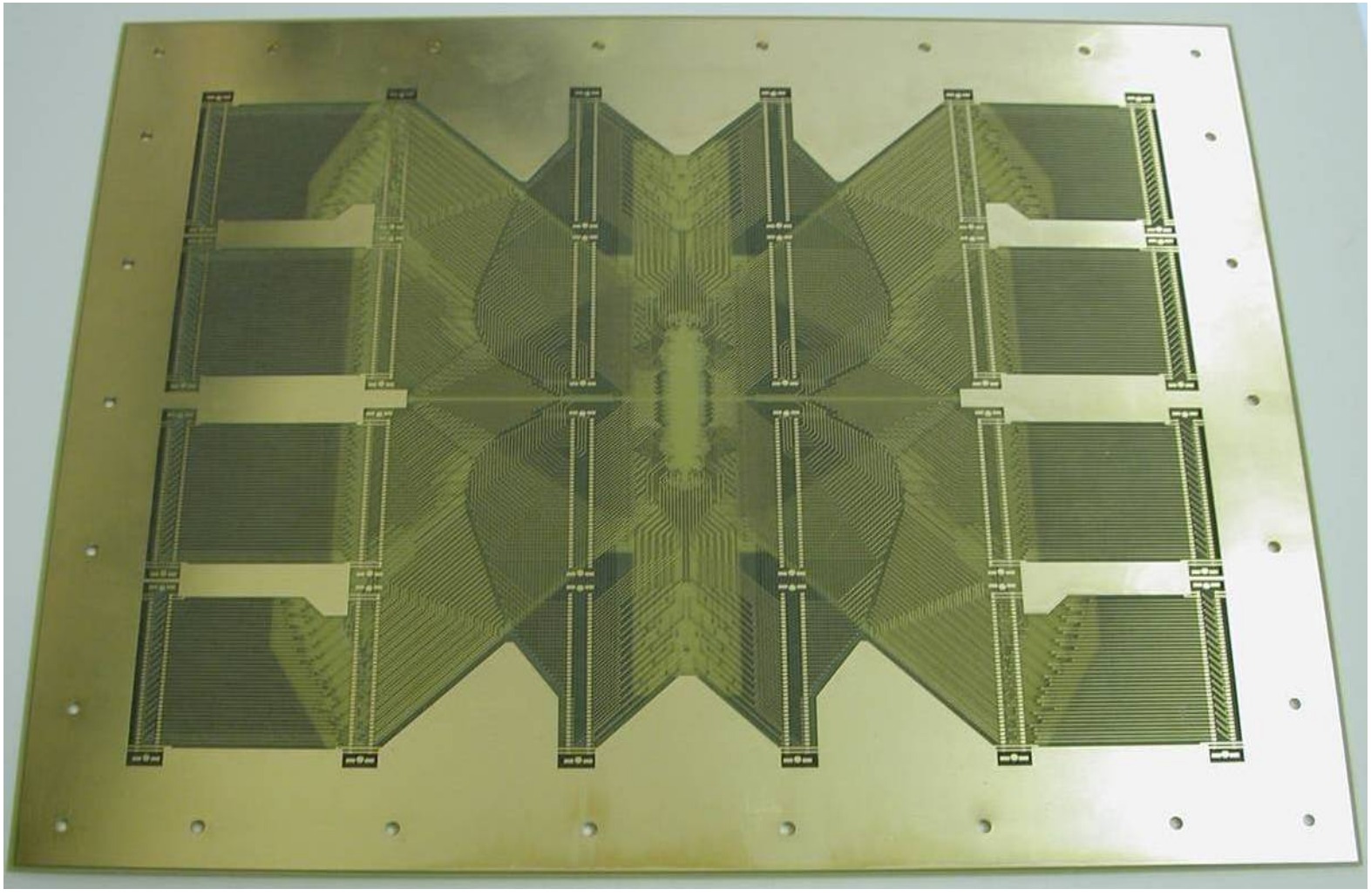
Sensitive area(green area): 57.4 mm X 88.6 mm

Pixel Number: 1,728(36X48)

Pixel Size: 1.75 mm X 1.50 mm

Pixel Distance: 0.1 mm in both X and Y directions

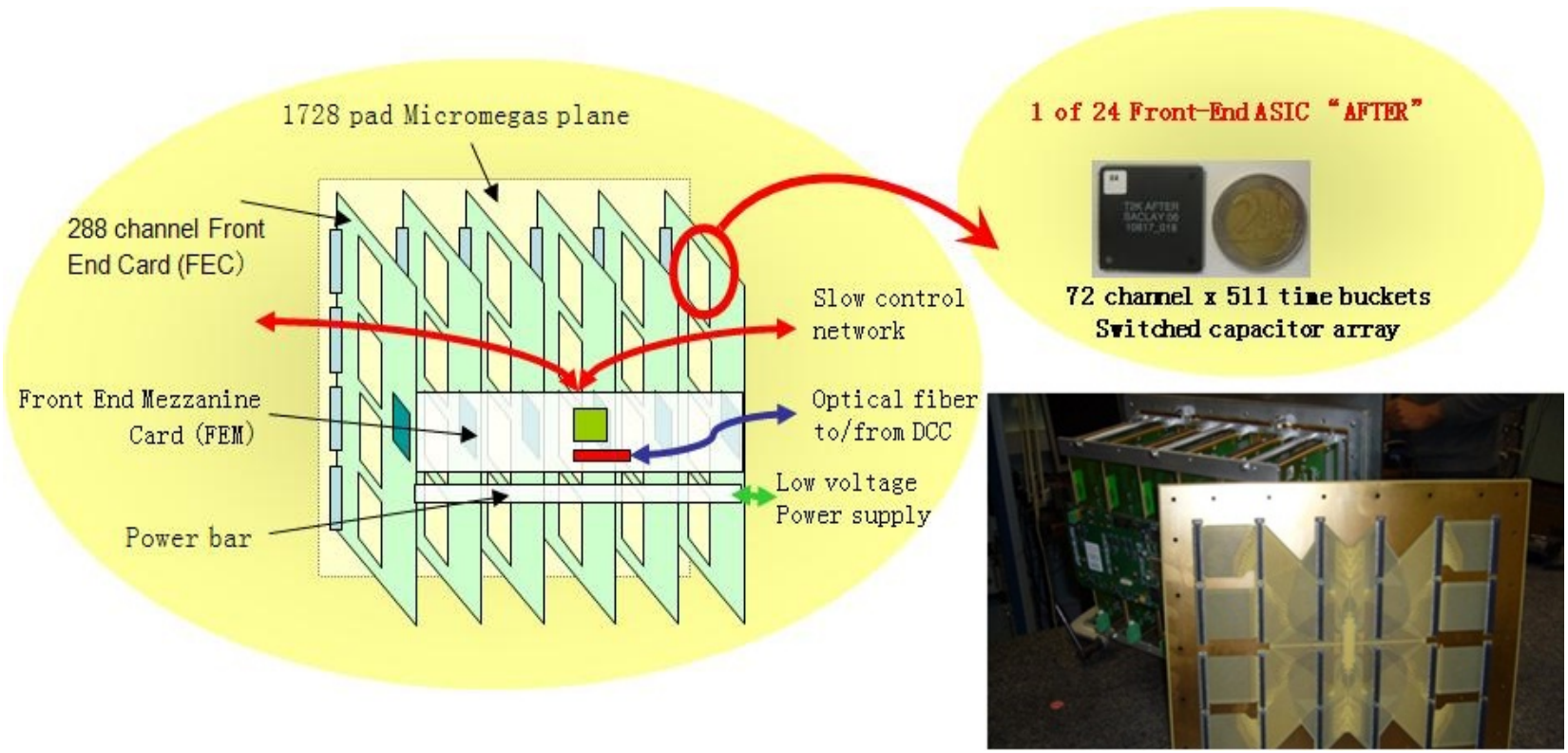
Fast Neutron Imaging detector readout PCB



the readout PCB we made

T2K-TPC DAQ system based on AFTER chip

- AFTER chip: 72 channels with preamplifier and shaper (support by CERN-Saclay)
- 6 boards with 4 chips each, multiplexed-output



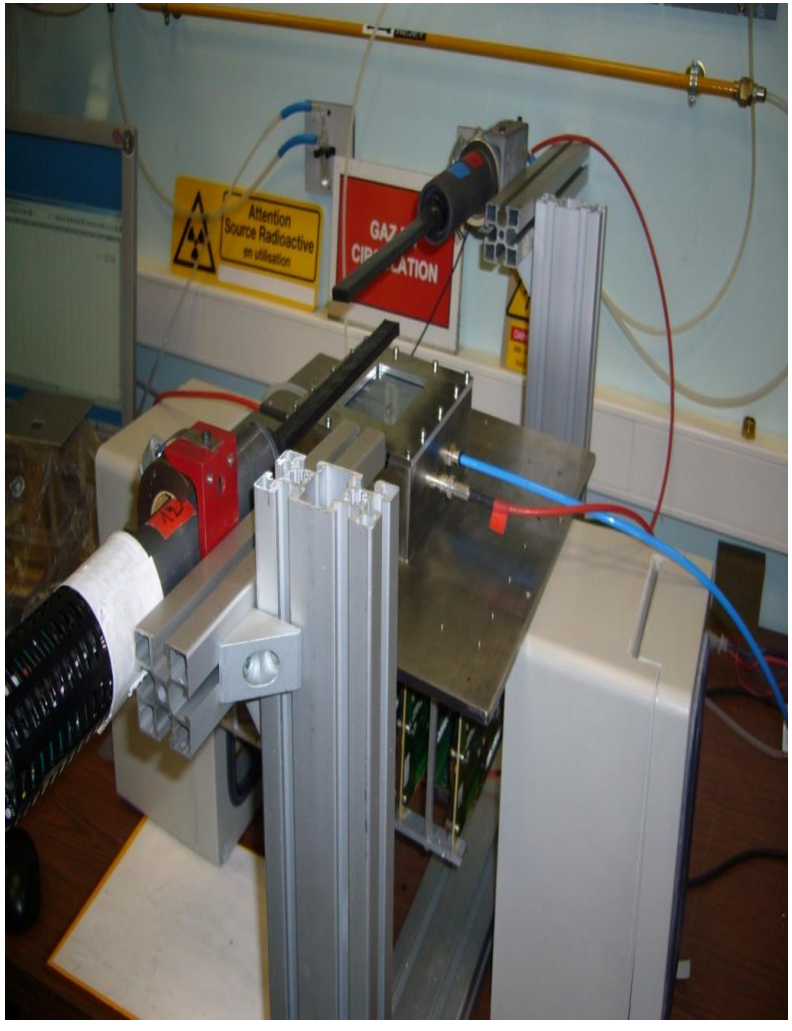
Gas system

- This is the three-channel gas mixing system.
  each channel is controlled by PC independently,
  so the precisely mixed gas can be easily got.
- In experiment 95%Ar+5%isobutane,or 95%Ar+2%isobutane+3% CF4 will be used.

Gas system

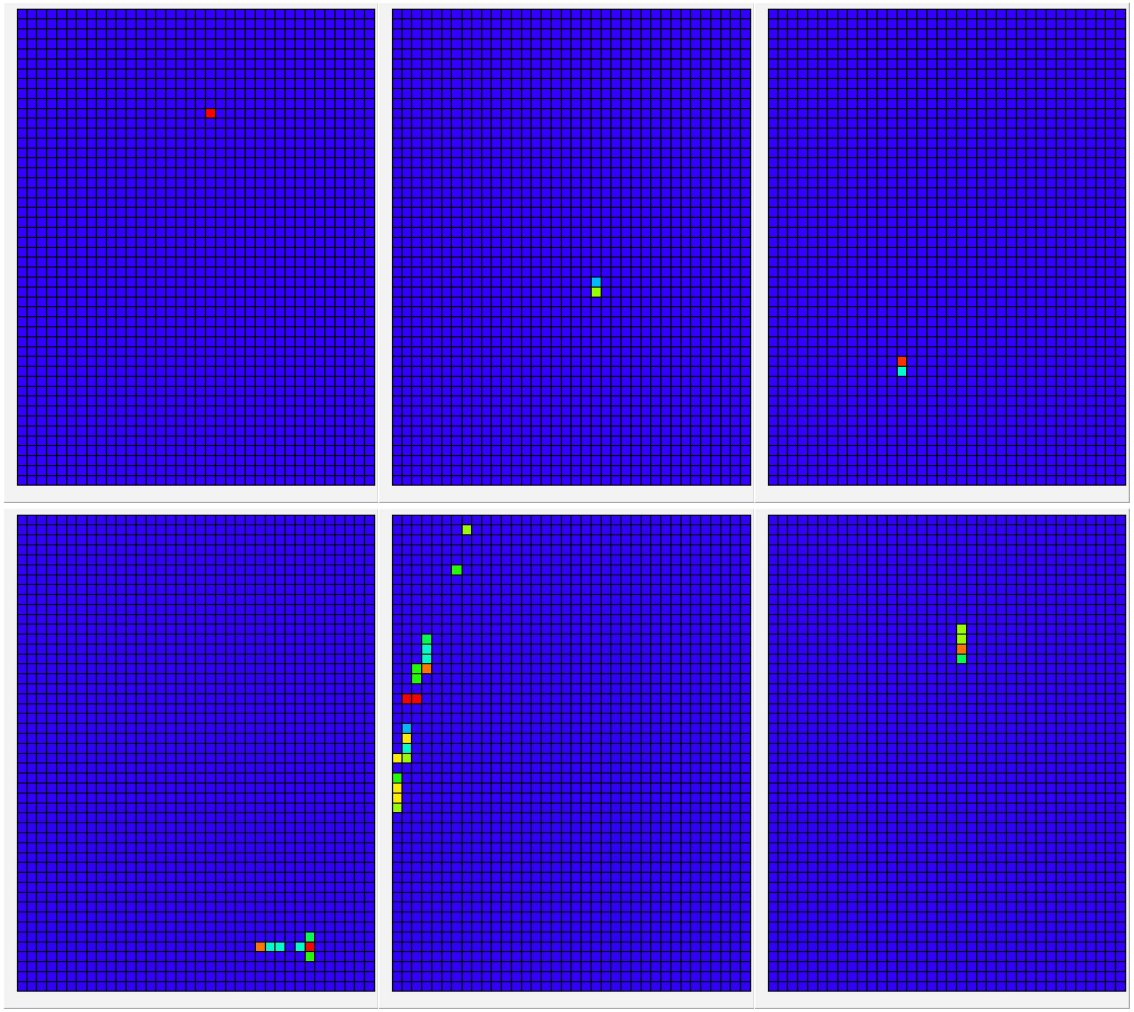
Cosmic setup

left sight of the cosmic setup



right sight of the cosmic setup

The latest test of cosmic rays



the cosmic rays are perpendicular to the pad plane

conclusion

- Achievement and On going work
  - The Fast Neutron Imaging detector has been assembled
  - Test with cosmic rays perpendicular to the pad plane proved the detector works well
  - Our team is testing with the cosmic rays which are parallel to the pad plane
- Future plan
  - It will be tested with the 14MeV neutrons in Lanzhou University this summer.
  - Plan to assemble another FNI detector

Acknowledgements

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  - IN CHINA this work support by the National Science Foundation of China,Grant No.:10875054 and 10605011 and by the Fundamental Research Funds for Central University, Grant No.lzu jbky-2010-24
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Thanks for your attention!

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