

TPC R&D at IFAE

Thorsten Lux



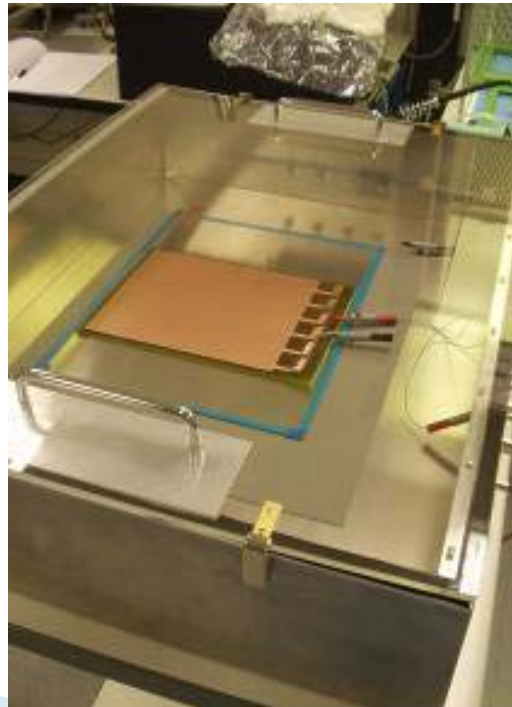
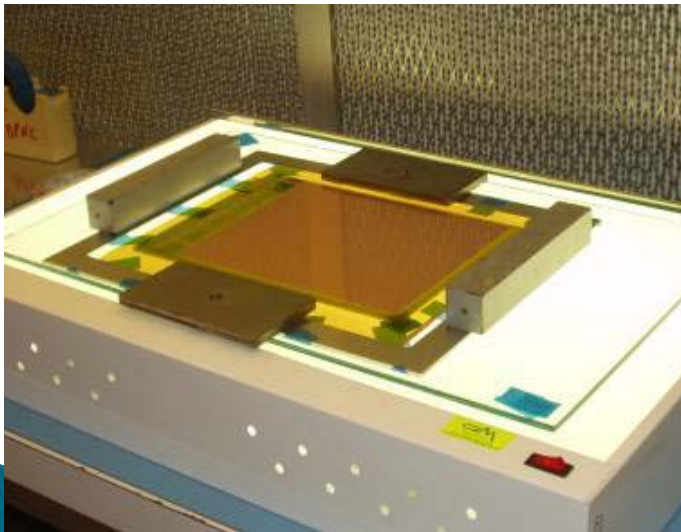
Group History

Working on TPCs since 2005:

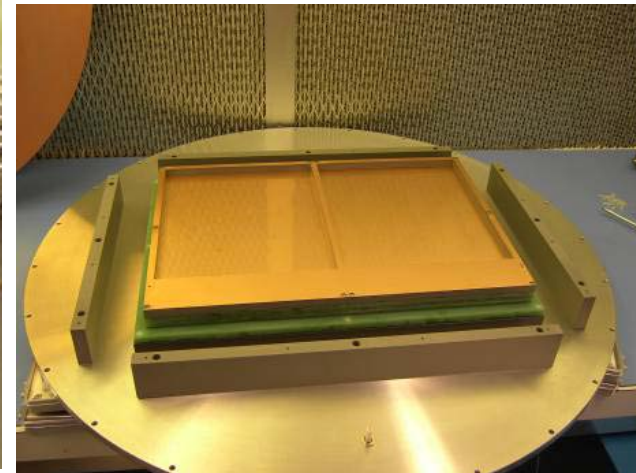
- 2005–2007: R&D for T2K TPCs
- 2007– : Event reconstruction and analysis of T2K TPC data
- 2006–2011: High pressure electroluminescence TPC R&D for NEXT
- 2011 – : Continued with ambient and high pressure gas detector R&D

T2K

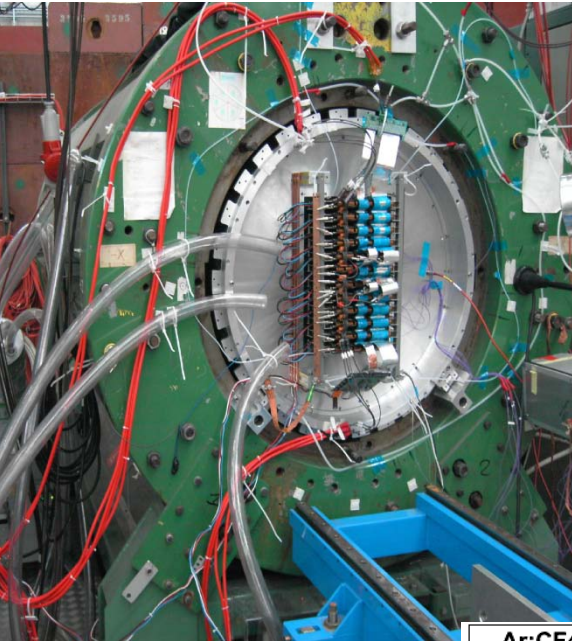
- 2005 T2K was planning the first MPGD TPC
- Question: Is the performance good enough? GEMs or MMs?
- Europe: Direct comparison of MM and GEMs in same TPC
- European GEM Group: IFAE, IFIC, Geneva, Bari



- 2 GEM tower
- 3 GEM each
- $\sim 20 \times 24 \text{ cm}^2$

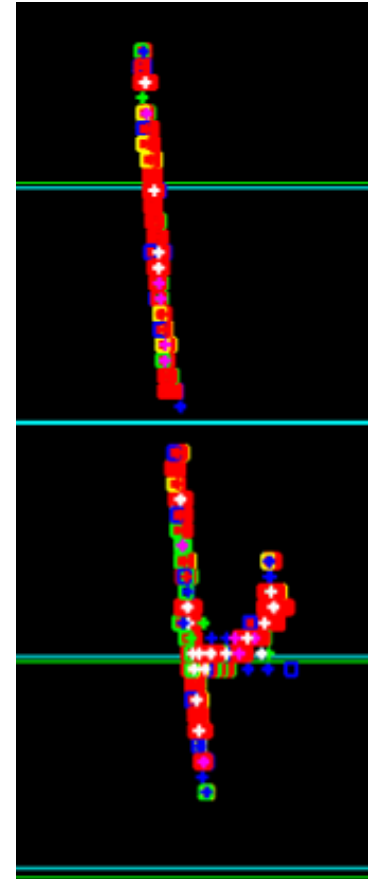
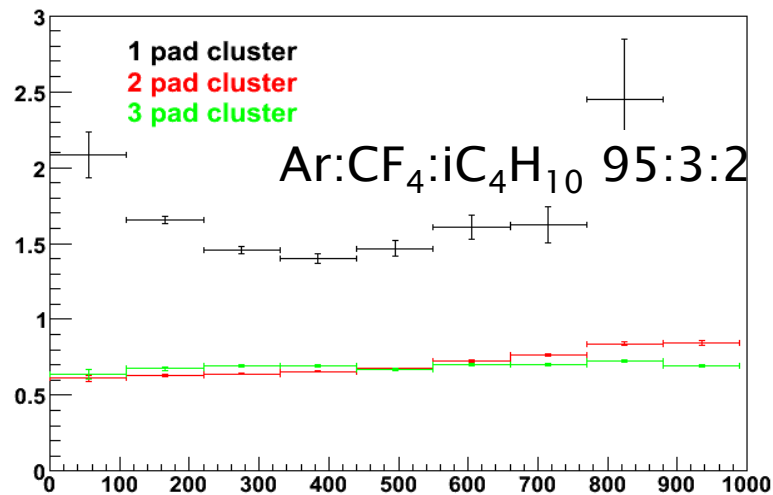


T2K

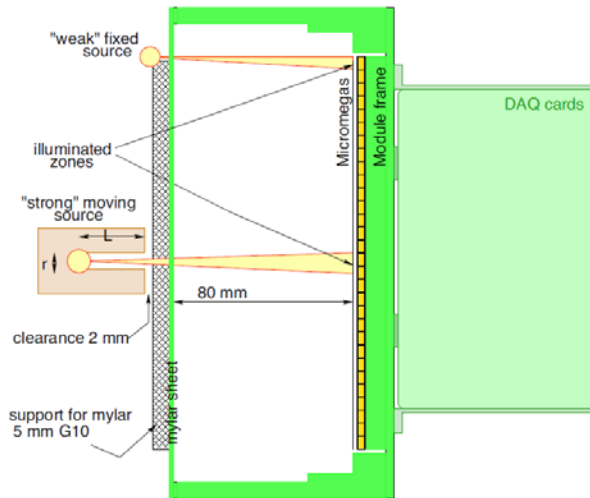


- HARP tests (E. Radicioni Talk)
- Measurements with various gas mixtures
- 1400 readout channels, ALICE electronics
- participated in the MM measurements
- contributed to T2K gas discussions

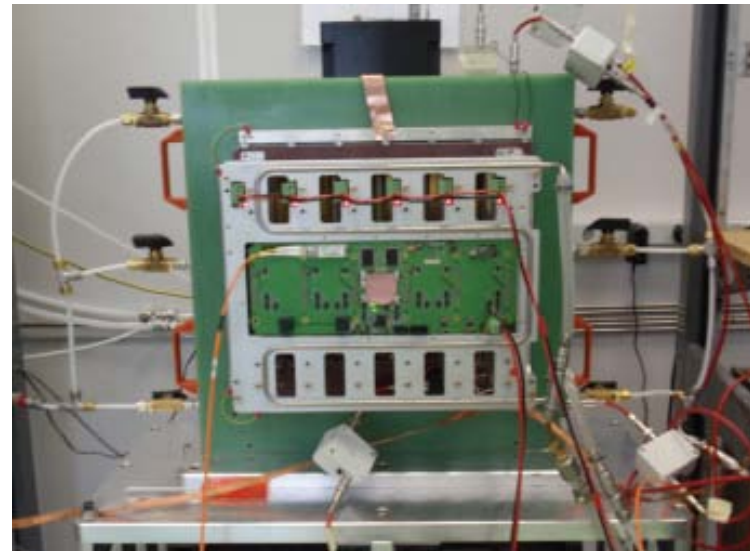
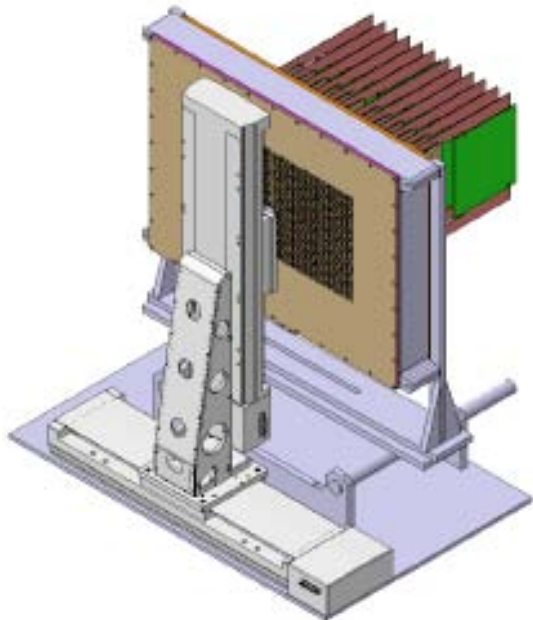
Ar:CF₄:iC₄H₁₀ 95:3:2 TF0.9



T2K

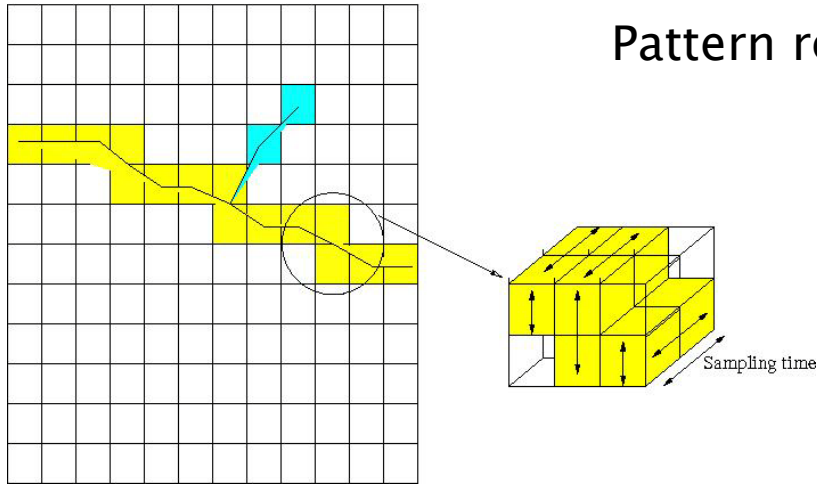


- worked on design and setup of testbench with UGe
- ~90 full size MM modules characterized



T2K TPC Event Reconstruction

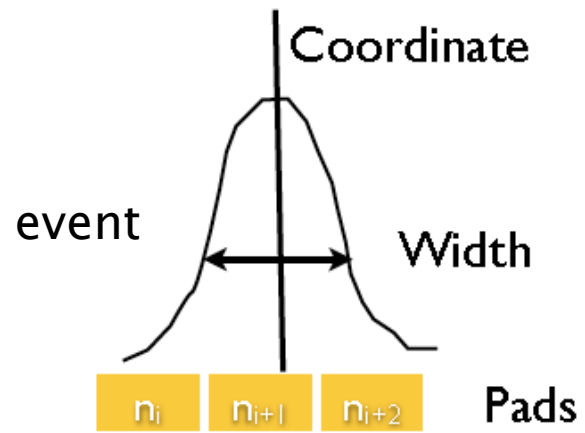
Pattern recognition based on cellular automata



$$\log \mathcal{L}_{row}^y = \sum_i n_i \log p_i + \text{constant}$$

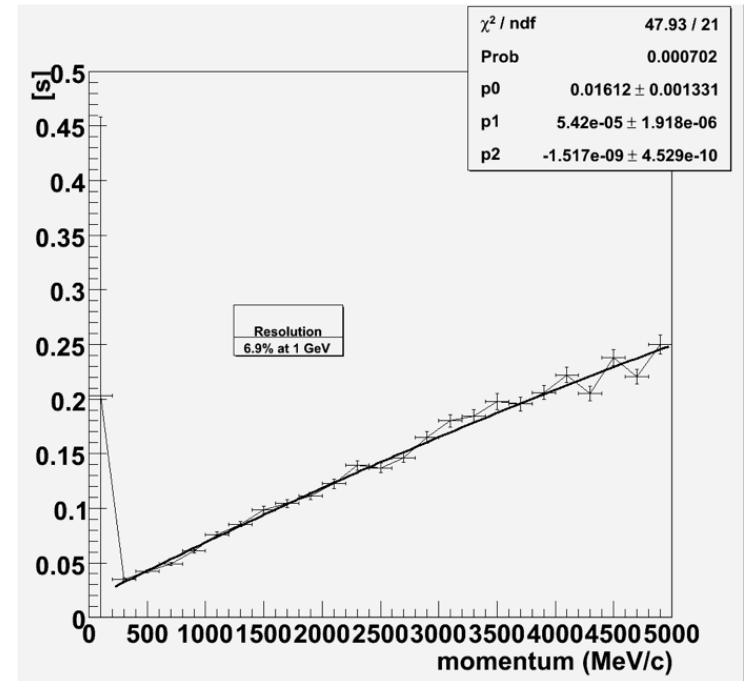
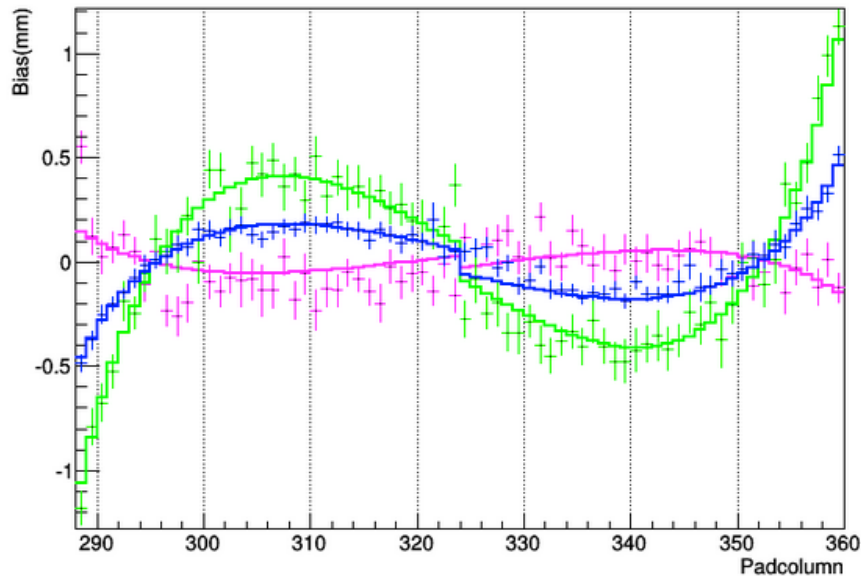
Parameter reconstruction based on event by event likelihood fit.

Also applied to electroluminiscence.



T2K TPC Event Reconstruction

Study of TPC performance.



Study of E and B field distortions inside T2K TPC.

High Pressure Setup: Overview

HP TPC (30 cm long, 30 diameter, up to 5 bar)

Preamp, ADC, APD power supply

Xenon recovery system

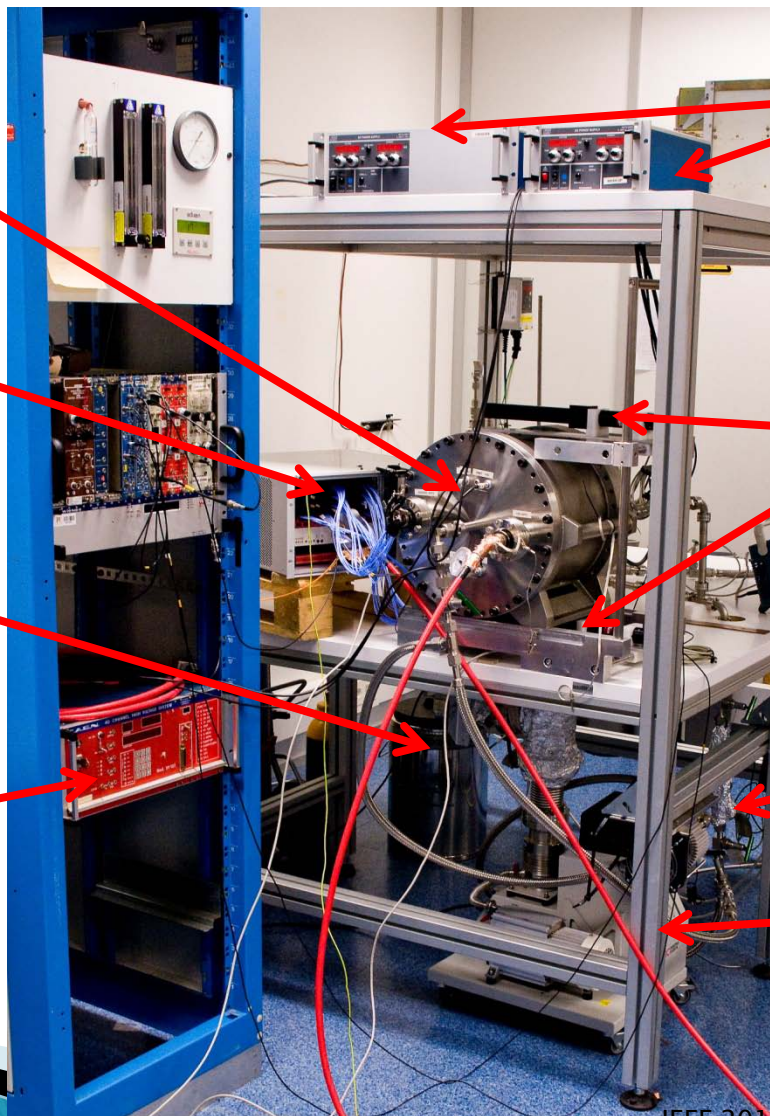
PMT power supply

HV power supplies (20 and 35 kV)

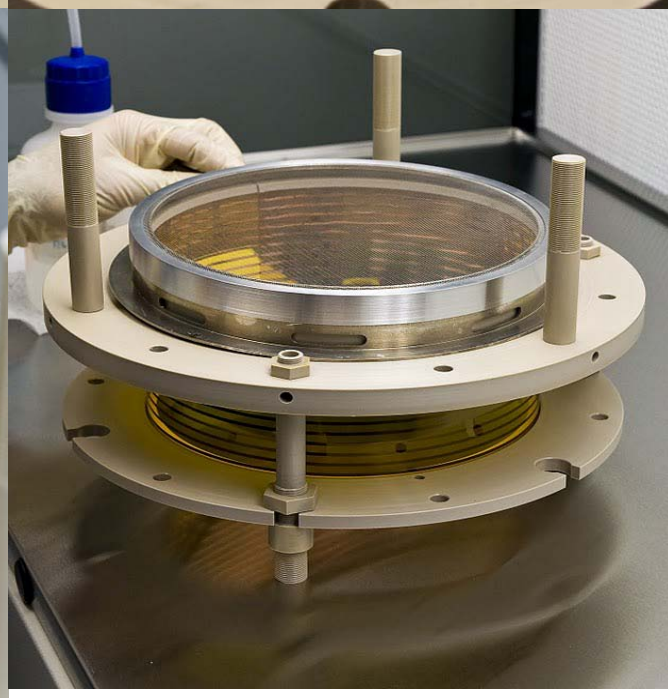
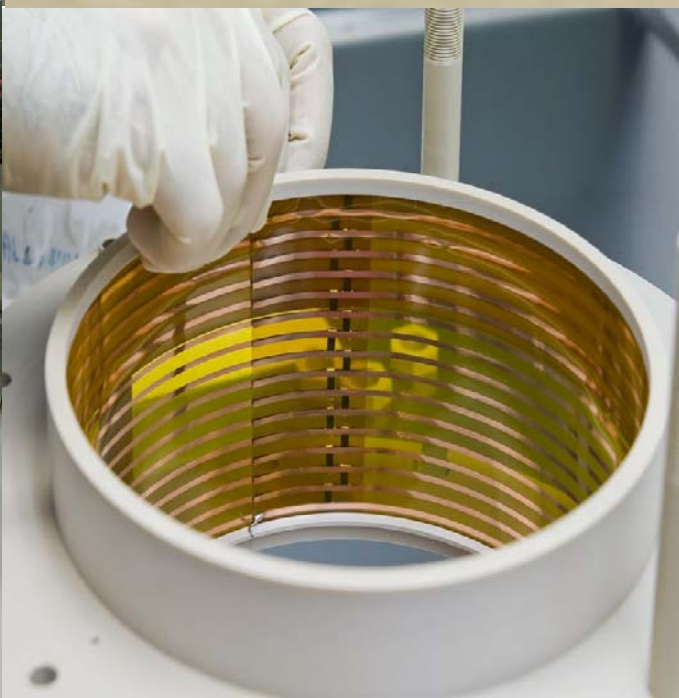
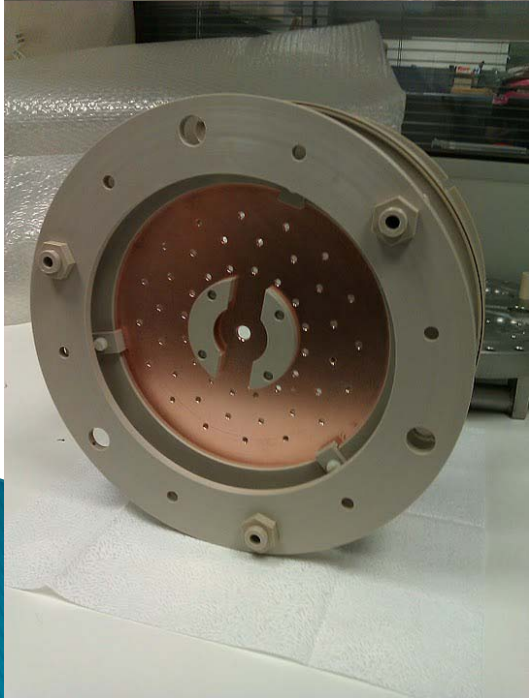
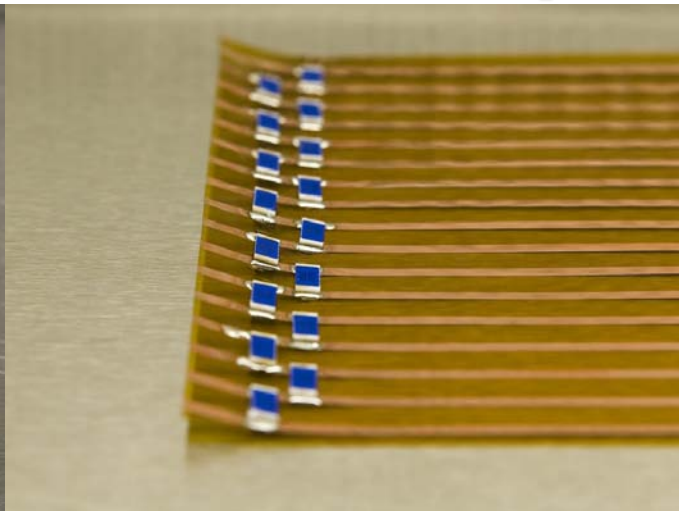
Cosmic ray trigger

Getter

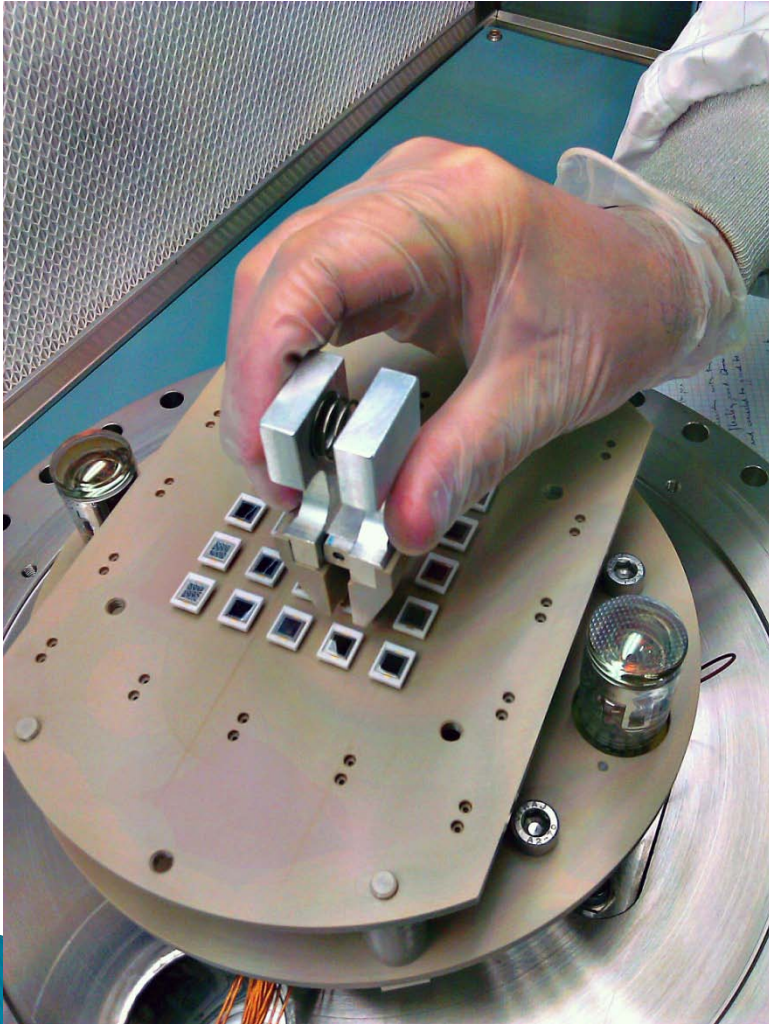
Vacuum pump system



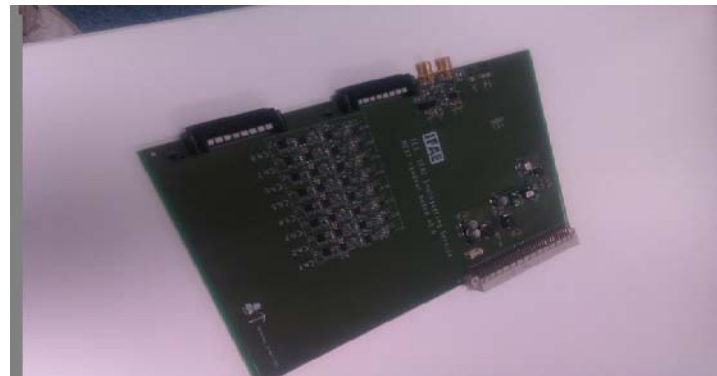
Experimental Setup: HP TPC



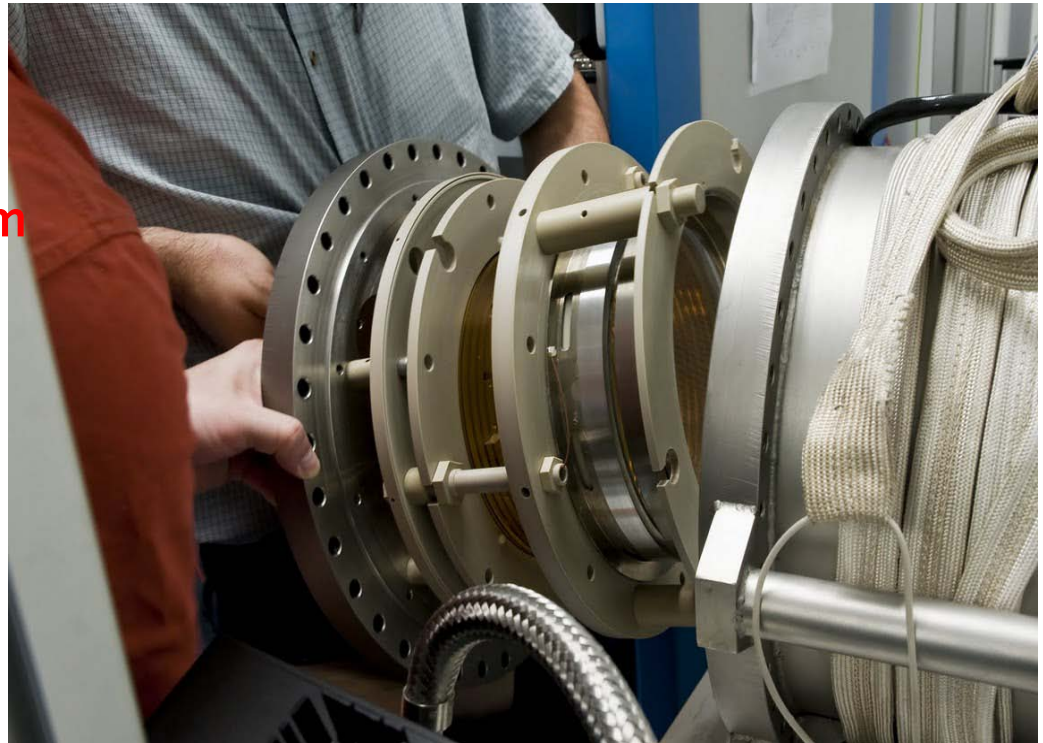
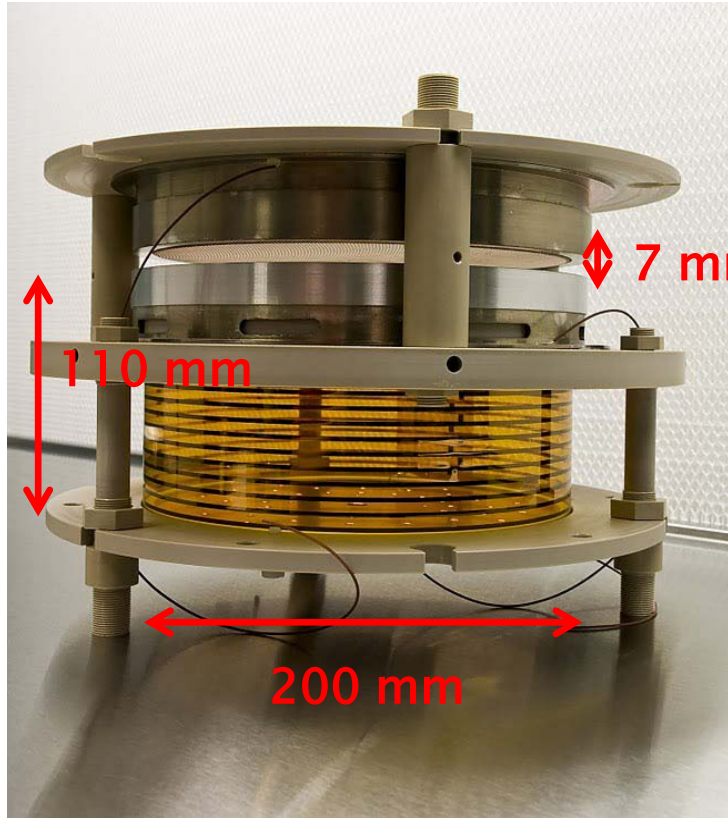
Experimental Setup: HP TPC



- ▶ Array of 5x5 S8664-SPL APDs from Hamamatsu (5x5 mm²)
- ▶ Pitch 15 mm
- ▶ 2 PMTs as reference
- ▶ Every APD has its own HV channel
- ▶ 24 APDs read out
- ▶ 3 custom made preamp/shaper boards (designed at IFAE)
- ▶ V1740 CAEN ADC for digitization
- ▶ DAQ based on Midas



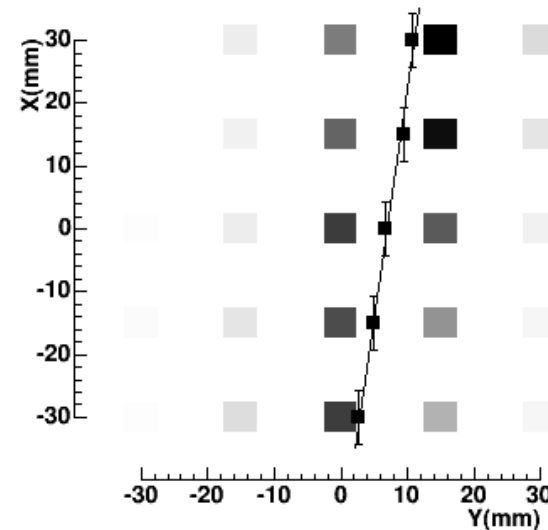
Experimental Setup: HP TPC



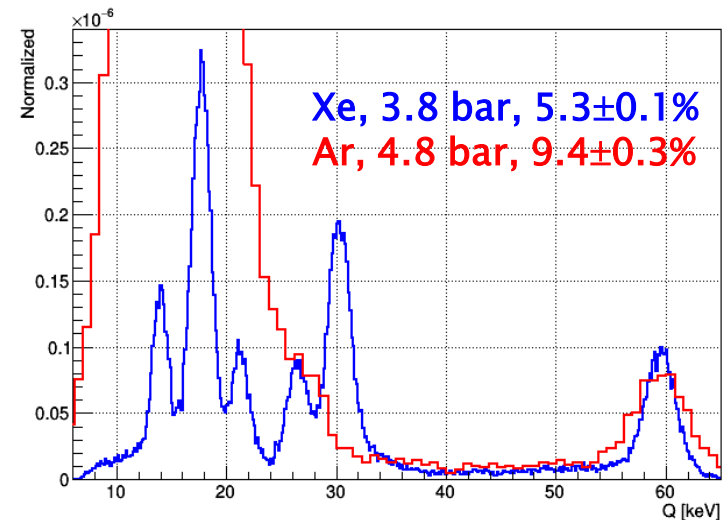
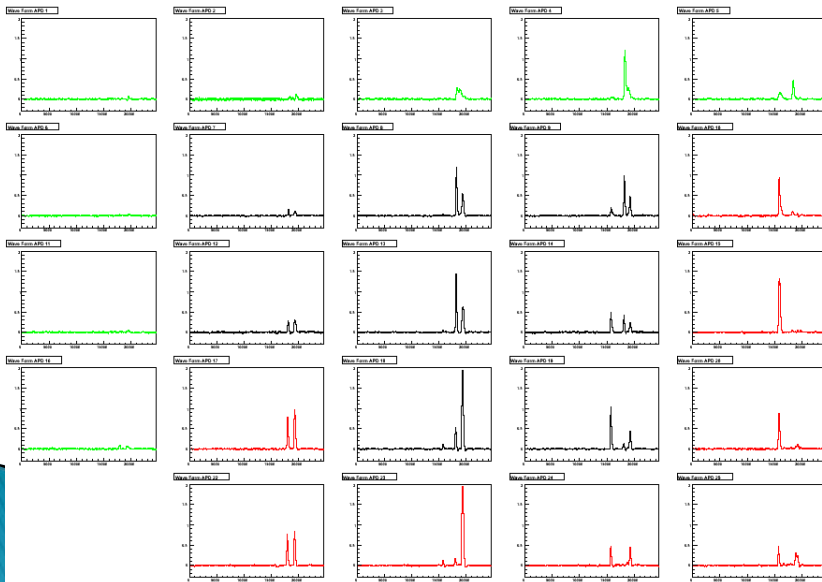
Some EL Results

- operation with pure Xe/Ar
- energy measurements

Event display



2 tracks



Current Status

Group:

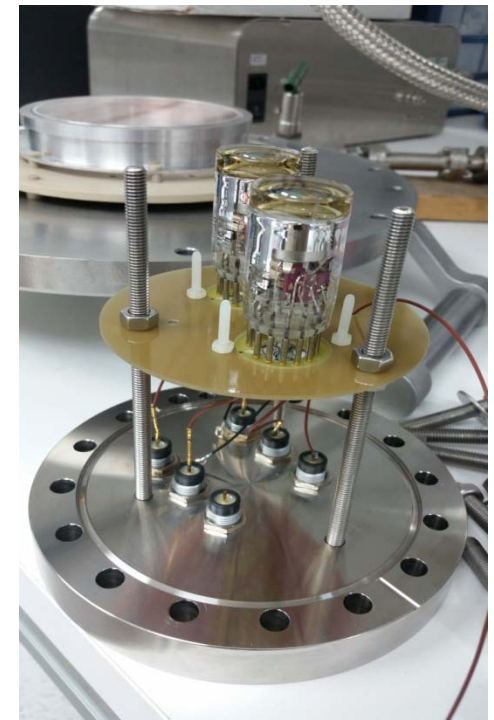
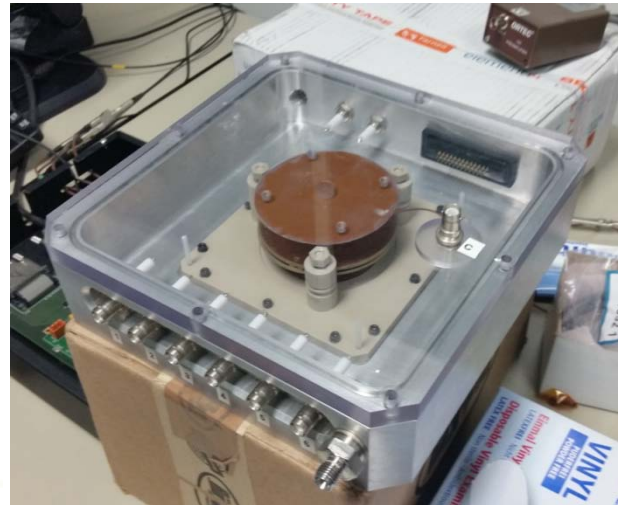
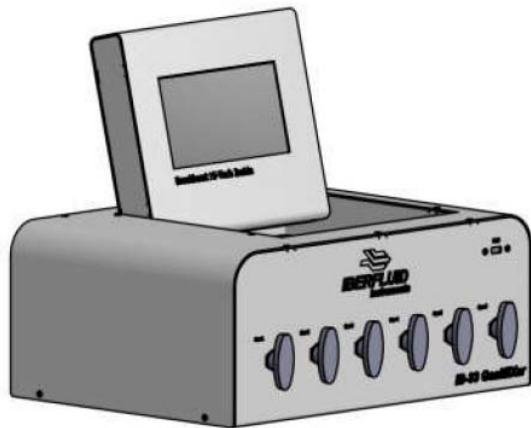
- ▶ 2 Seniors
- ▶ 1 MC PostDoc
- ▶ 2 T2K PhD students (1 finishing end of this year)
- ▶ 2 Undergrad hardware students

Projects:

- ▶ T2K (Analysis)
 - ▶ WA105 (Light readout)
 - ▶ Some small side projects like MWPC chamber for outreach
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Current Setups at IFAE

- ▶ 2 HP chambers for EL and charge readout measurements
- ▶ Ambient pressure detector
- ▶ Gas mixing system: Ar/Ne/Xe + CO₂, CH₄, iC₄H₁₀, CF₄



Conclusions

- ▶ Small group with limited resources
 - ▶ Were able to build up gas detector infrastructure over the last decade
 - ▶ Good workshop for R&D and beyond
 - ▶ Are and were involved in various neutrino TPC experiments (T2K, NEXT, WA105)
 - ▶ Worked with charge (GEM/MM) and light readouts
 - ▶ Long term experience in TPC event reconstruction and data analysis
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