GEM and THGEM detectors for Digital Hadron Calorimetry

UC/UA/WIS/UTA test beam plans

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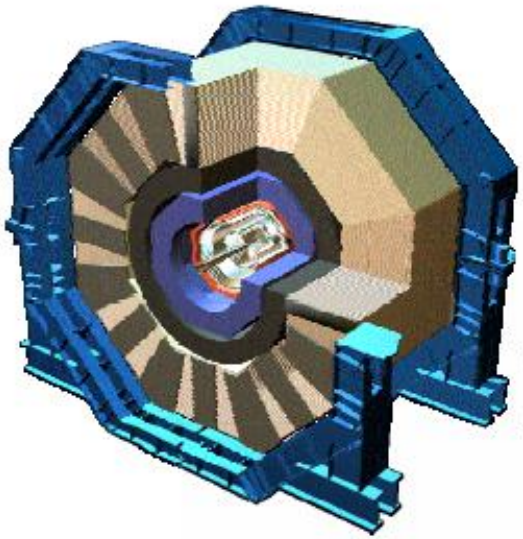
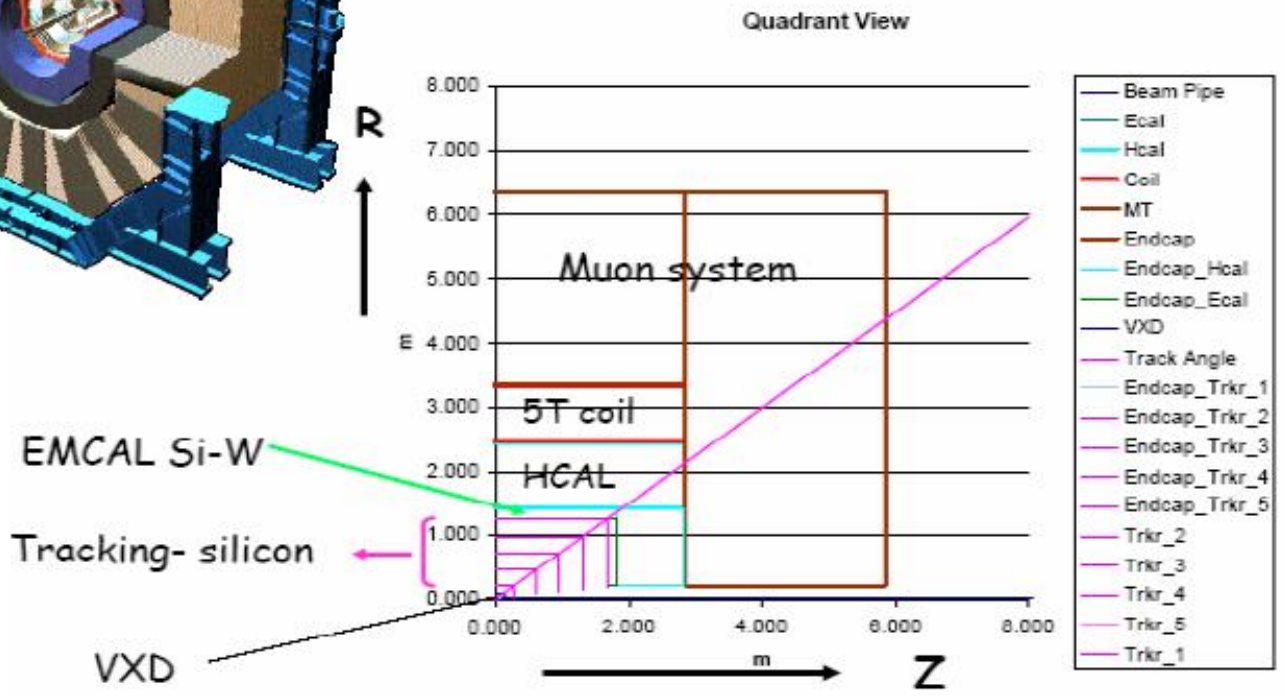
DHCAL for ILC

Design within the SiD Detector Concept,
but also as part of the CALICE collaboration

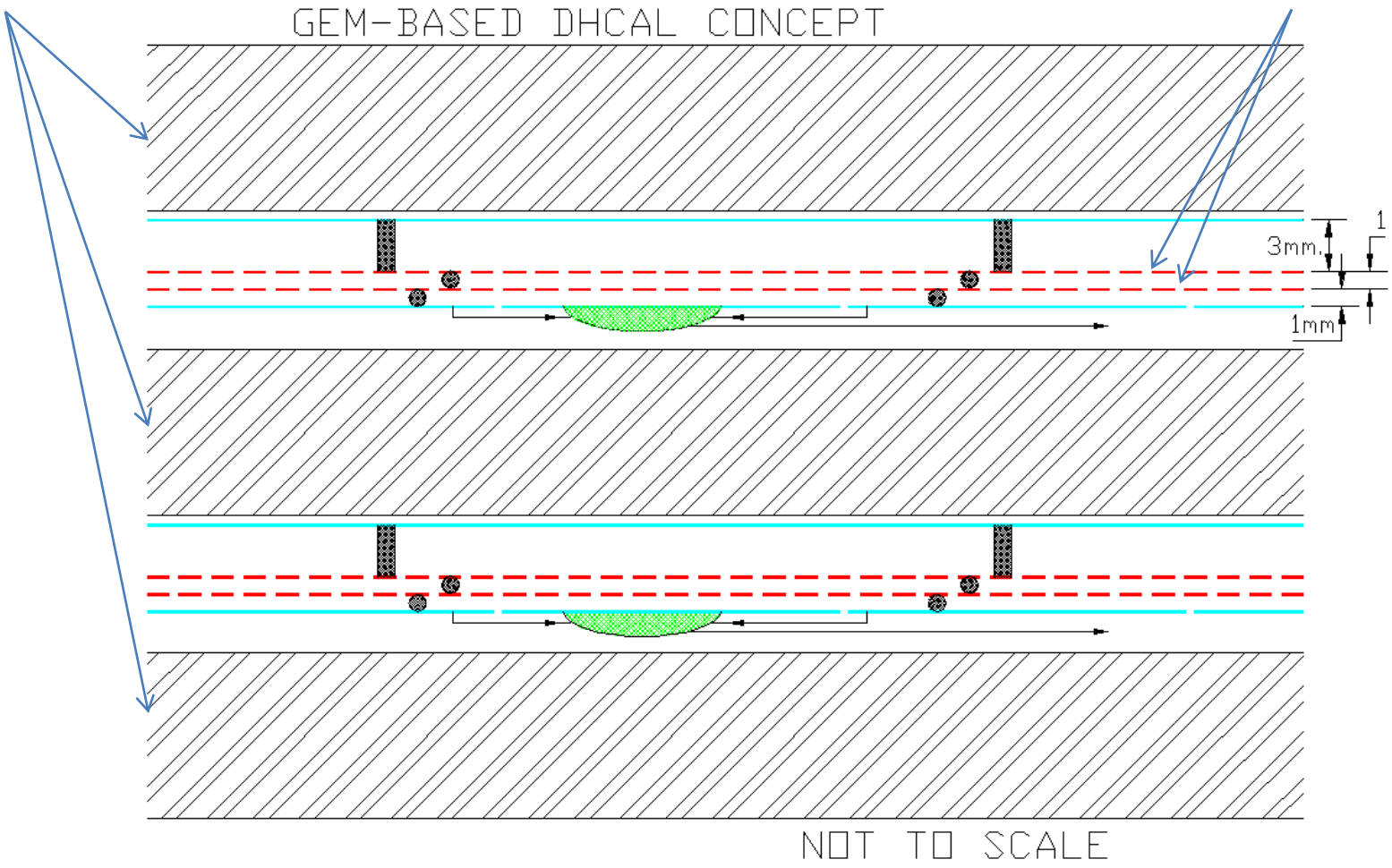




(TH)GEM – based Digital Hadron Calorimeter concept

20mm-thick Stainless steel absorbers

(TH)GEM



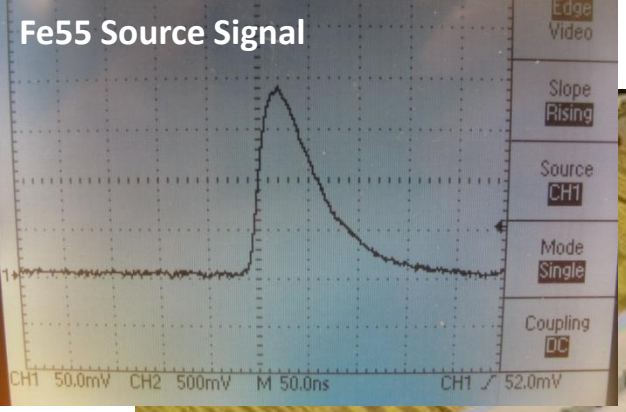
Test beam with two chambers

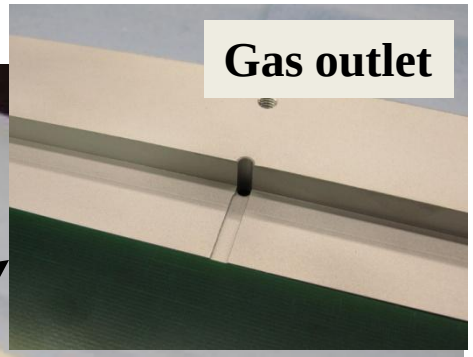
- GEM: 30x30 cm^2 Ar:CO_2 (70:30), UTA;
- THGEM: 10x10 cm^2 Ne:CH_4 (95:5), UA/UC/WIS/UTA.

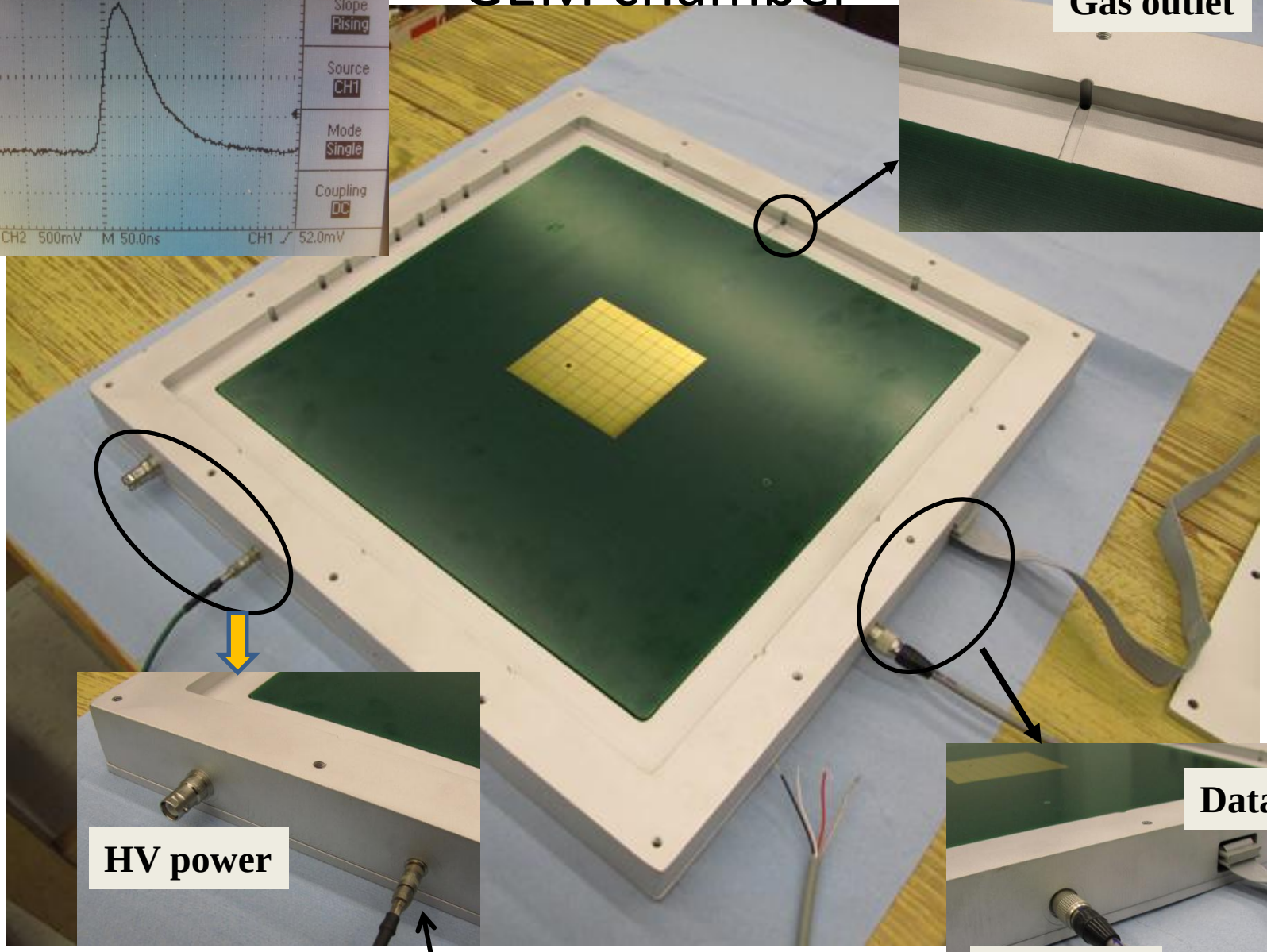
Both chambers are using the KPiX readout chip (8x8 cm^2):

•Developed in SLAC;
•Designed to operate in the synchronous environment of the ILC;
•Very low efficiency with asynchronous sources such as cosmics or radioactive sources;
-> Up to the present v7 KPiX chips have 64-channels (1 cm^2 pads)
-> Soon to move to 256 channels, then to 1024 channels.

GEM chamber


Fe55 Source Signal
Edge
Video
Slope
Rising
Source
CH1
Mode
Single
Coupling
DC
CH1 50.0mV CH2 500mV M 50.0ns CH1 ∕ 52.0mV

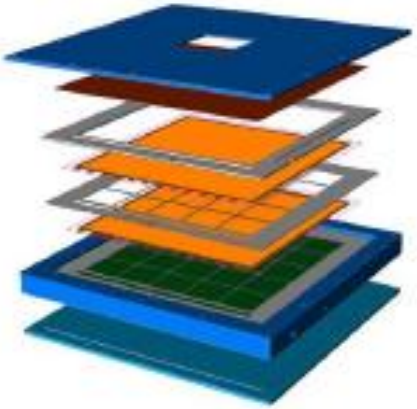

Gas outlet

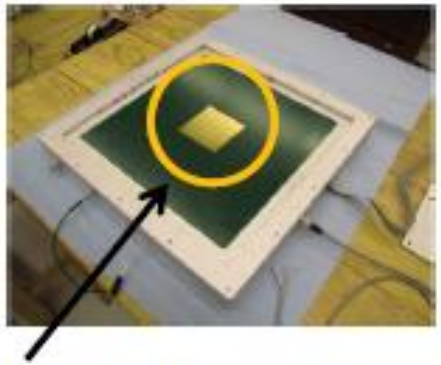

HV power
Analog signal
Data cable
LV power

30cm x 30cm GEM with 8x8 pads

- GEM Foils(3M)
  - 310x310 mm^2
  - Active area : 280x280 mm^2
- Active gas room
  - 350x350x6 mm^3 → For 3/1/1 gaps(d/t/i
- 64 readout channels(1x1 cm^2)

Chamber

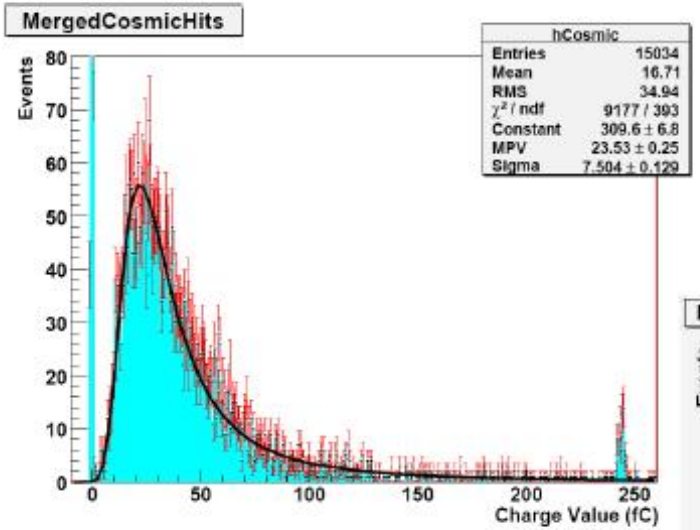




64-readout pads

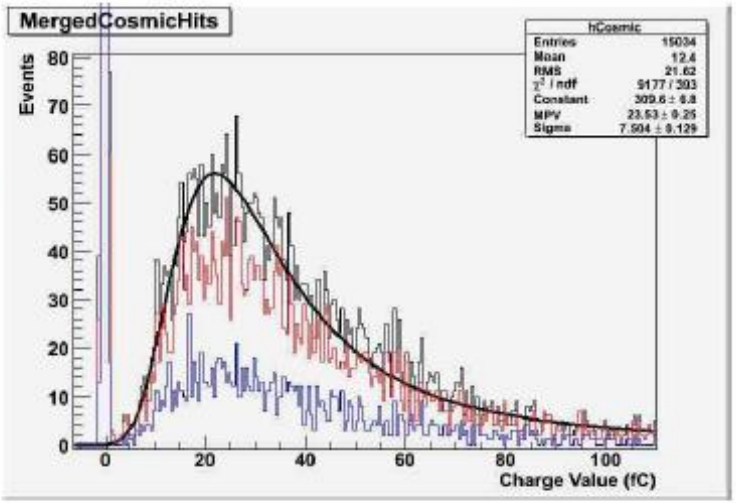
GEM chamber

Cosmic data – two runs merged



Highest charge only used

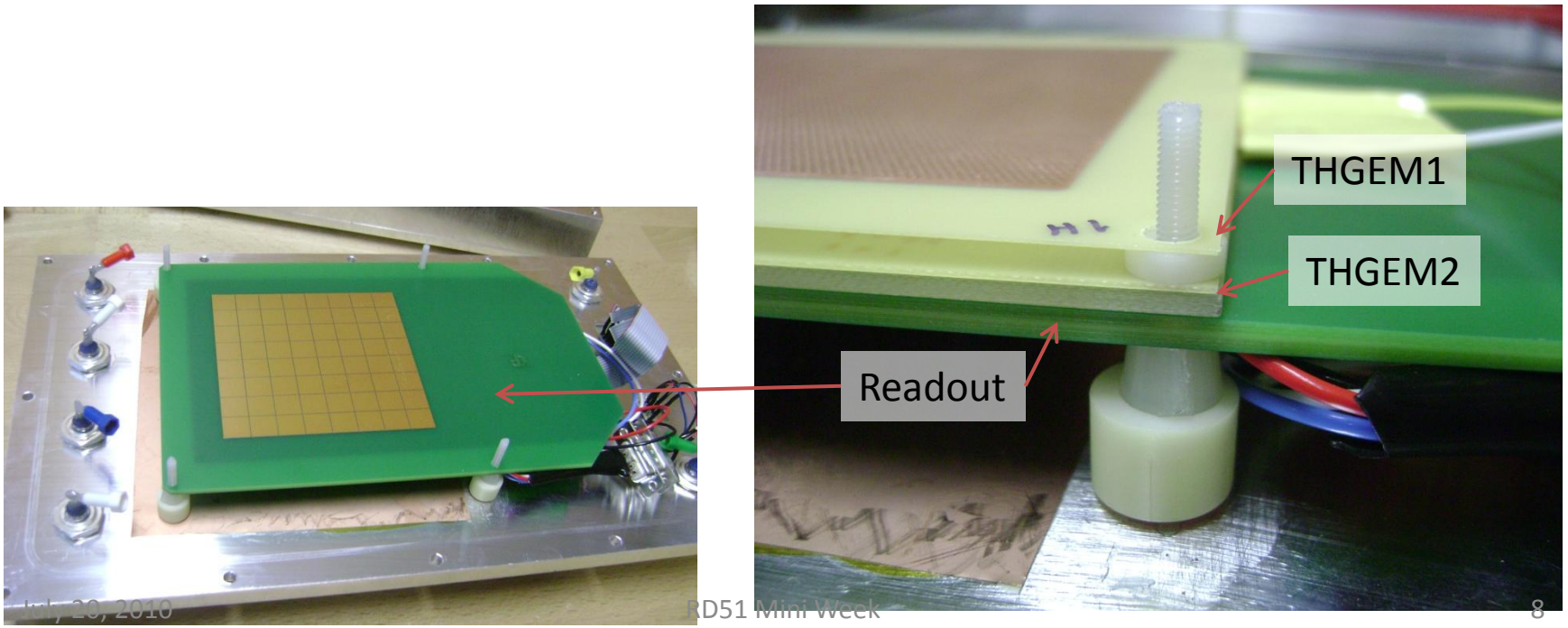
2010_04_12_10_48_52
2010_04_14_10_57_40
Summed Hits



Presented in Freiburg

THGEM chamber

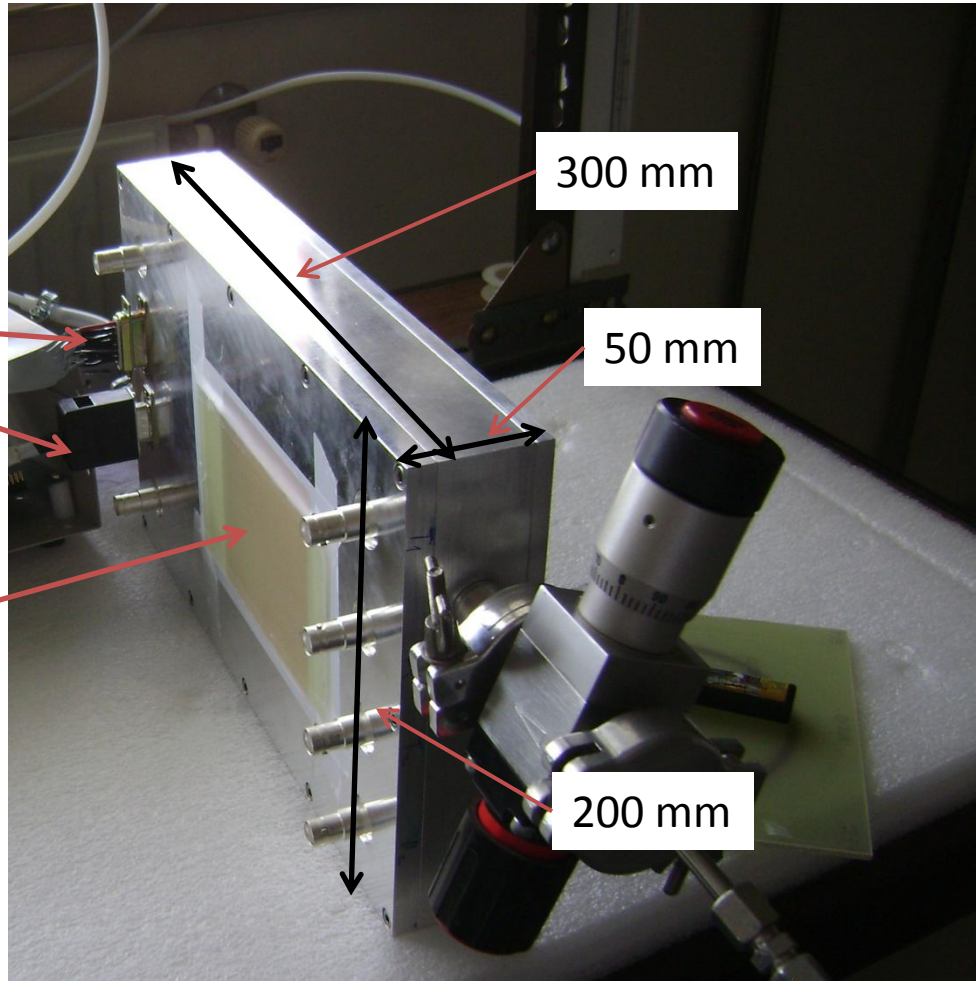
- THGEM area: 10x10 cm^2;
- Gas volume: ~280x180x32 mm^3;
- Ne:CH4 (95:5) mixture (non-flammable)
- Gaps: 3/2/2 mm (d/t/i) (might change).



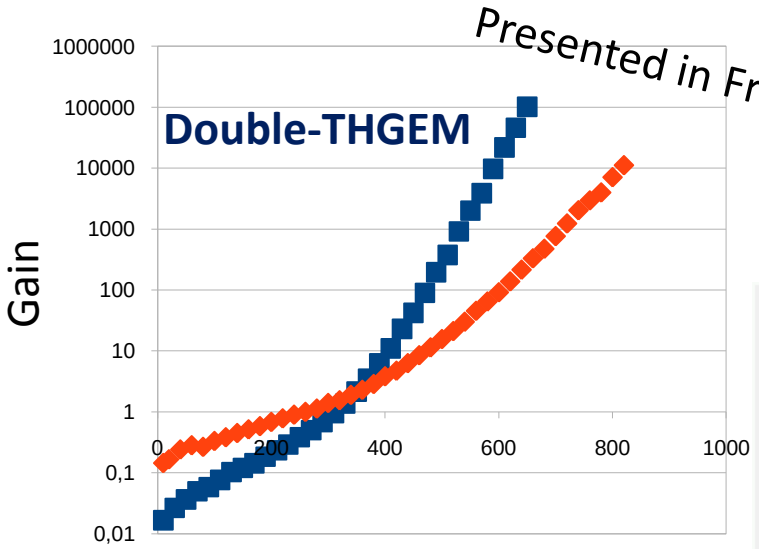
THGEM chamber

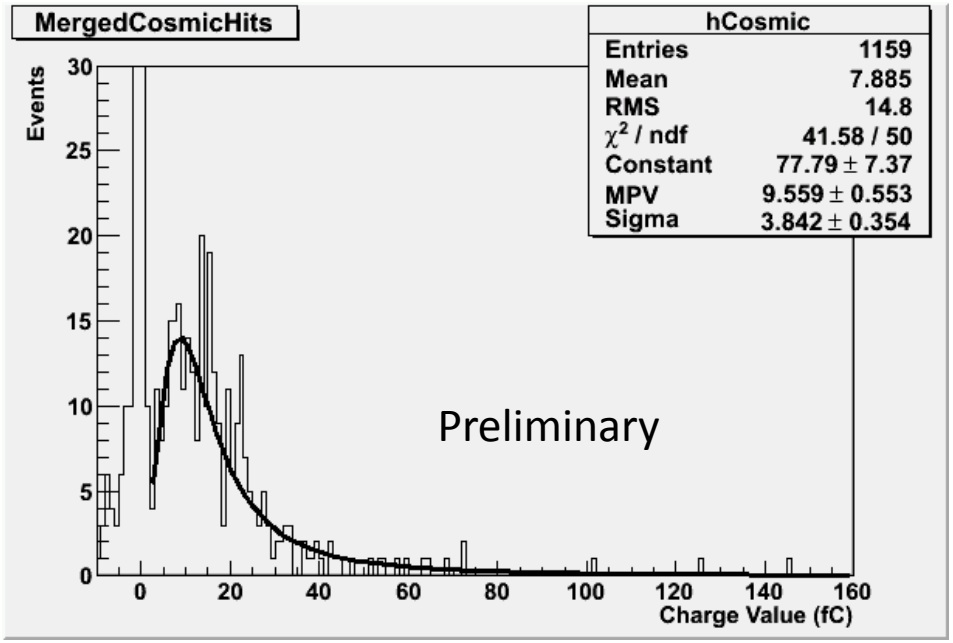
Data and power input/output

80*80 mm^2 window on both sides (only the G10 readout & THEMs are crossed by the beam)

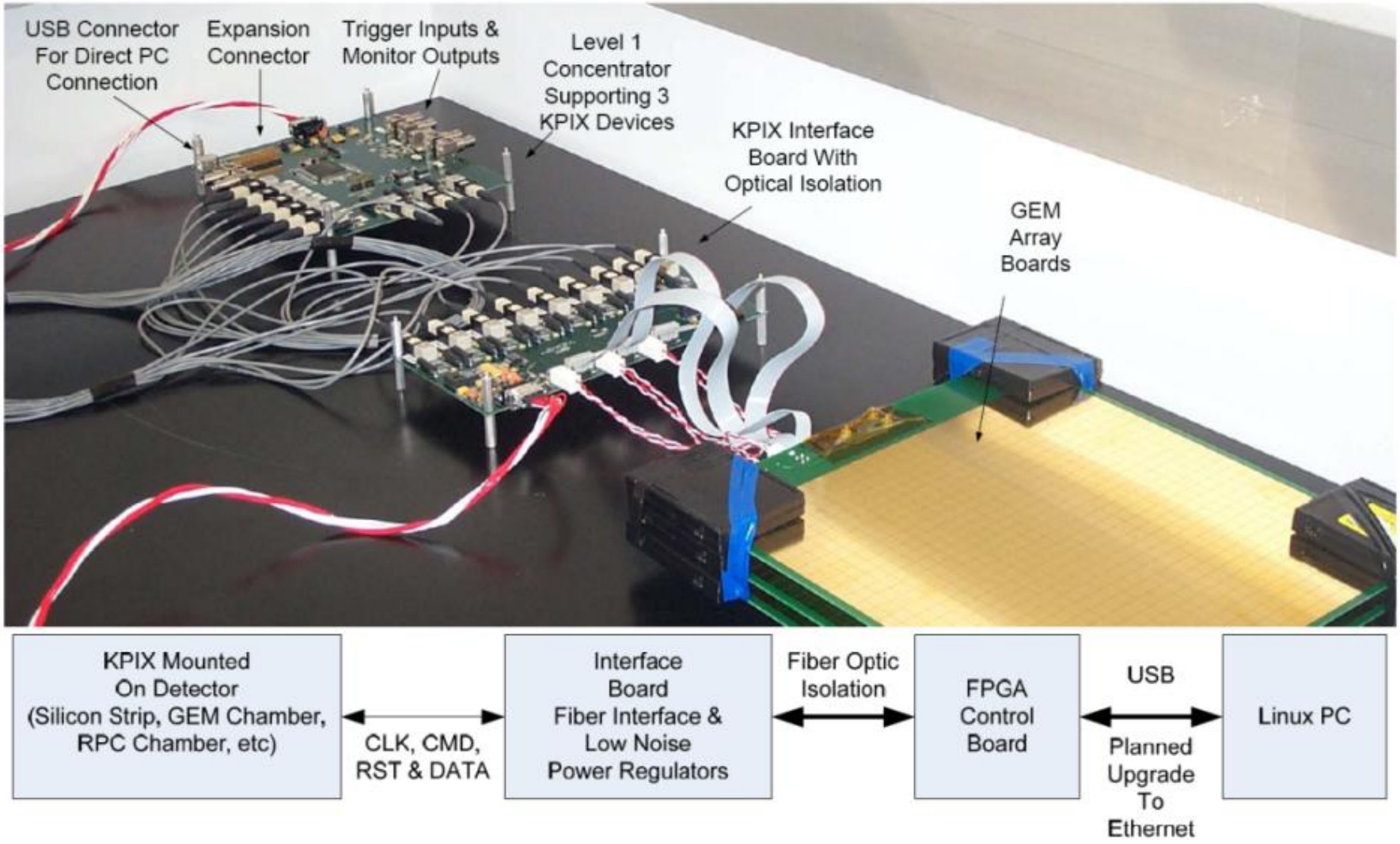


THGEM chamber





GEM-DHCAL/KPiX boards with Interface and FPGA boards



DHCAL studies for THGEM and GEM chambers:

•Establish working KPiX readout from both chambers, check data against previous results.

•Establish MIP signals, noise distributions for low rate beam in a number of pads.

•Measure the variation of MPV of Landau distributions with HV for a series of chamber positions/pads - we can not scan with the beam but have to move the chamber to hit different pad areas.

•Take combined data with THGEM, GEM chambers and tracker system to establish tracks/pads correlations.

•Take series of runs with the chamber stepped up/down across beam to measure efficiency for each pad, sharing of signals between pads.

•Rate/time resolution studies.

Some needs and possible issues

- KPiX linux computer remotely controlled from control room through ethernet;
- HV and LV also remotely controlled (CAEN SY2527);
- KPiX electronics must communicate with tracker to allow event correlation;
- Mechanics to hold large GEM chamber: under construction;
- Mechanics to hold THGEM chamber: only some adaptation to existing ones needed.

Thank you for your attention