Some results with SRS readout and DAQ tests with THGEM

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Summary

Motivation

Detector

Data

Some analysis

Conclusions

1 Motivation

2 Detector

3 Data

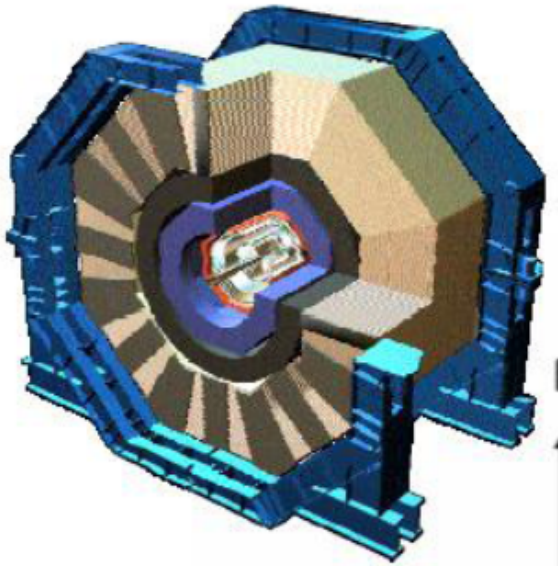
4 Some analysis

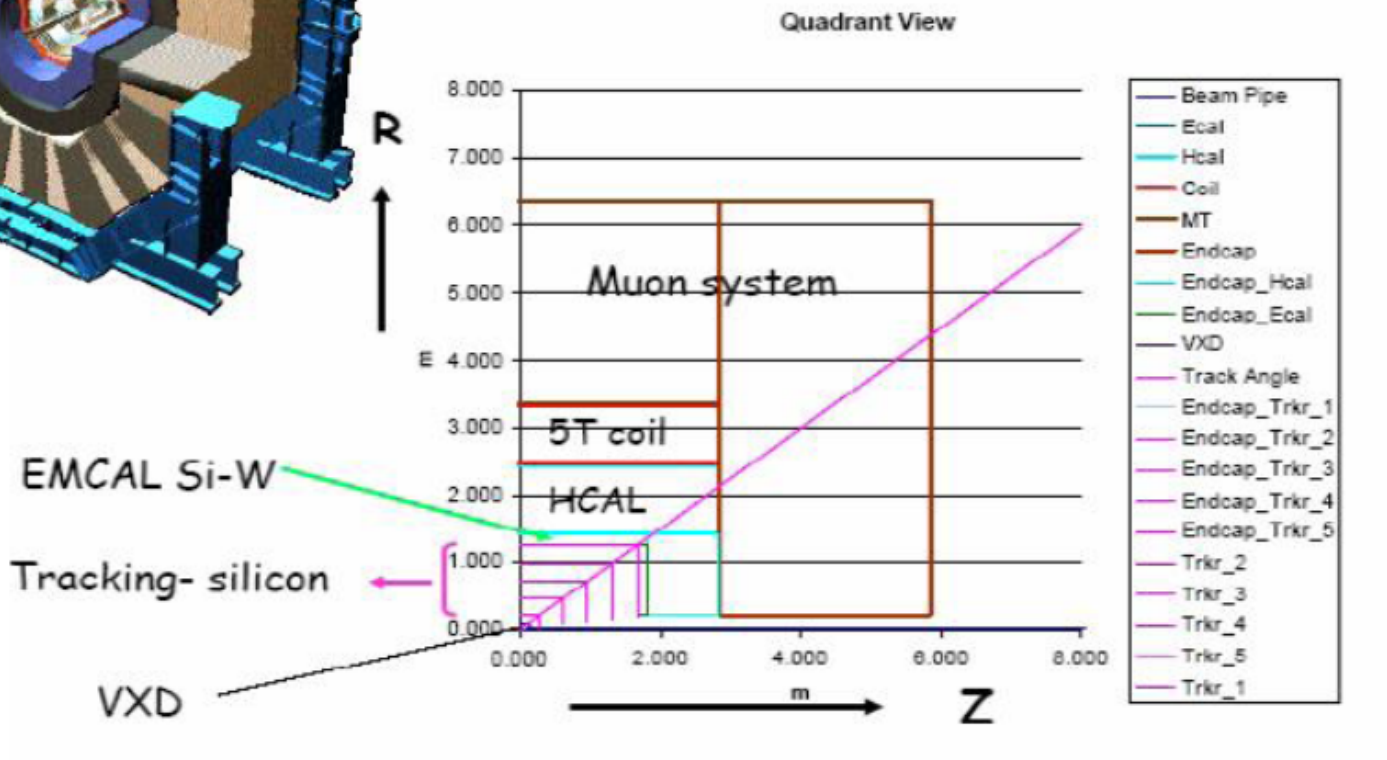
5 Conclusions

Digital Hadron Calorimetry for ILC

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

SiD

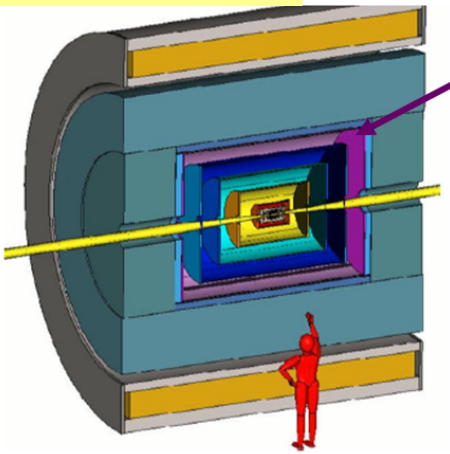


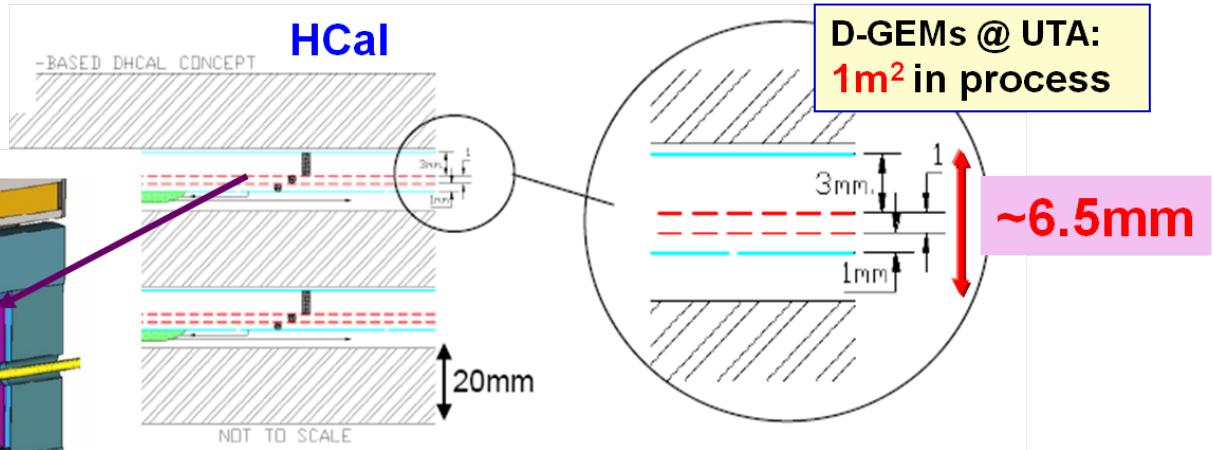


New concept for DHCAL: THGEM

A. White et al UTA

General detector scheme

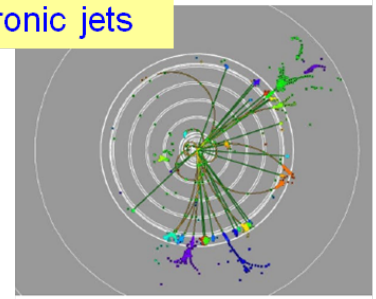


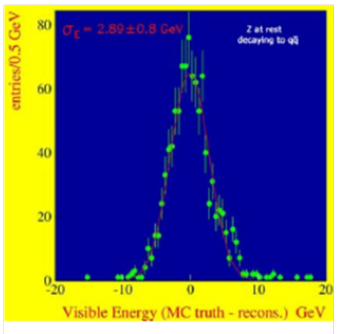


2 sampling layers (**out of 40**) with THGEM-based elements

Sampling jets + advanced pattern recognition algorithms
➔ Very **high-precision jet energy** measurement.

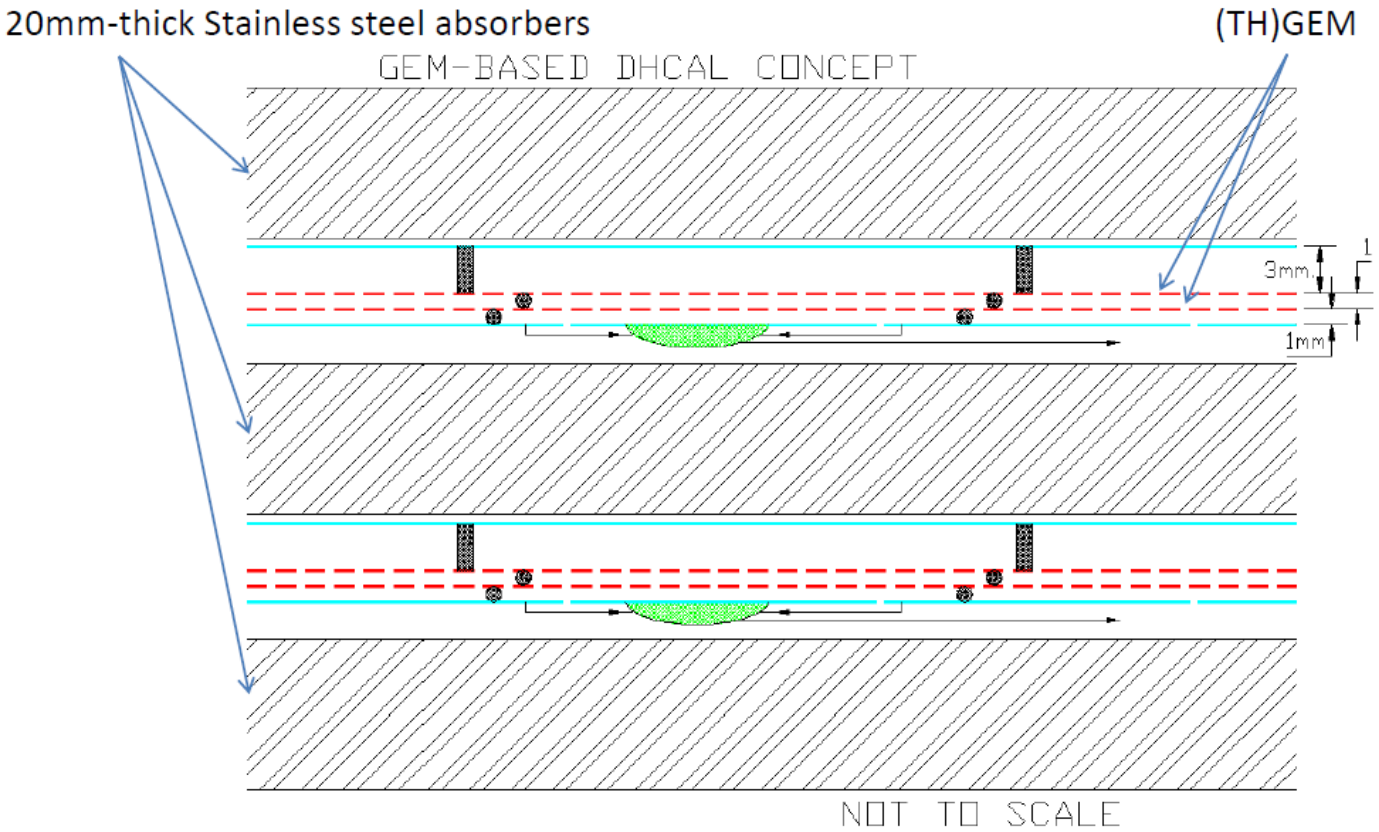
Simulated event w 2 hadronic jets





Reconstructed jet:
Simulated energy resolution
$\sigma/E_{jet} \sim 3\%$
(CALICE)

THGEM–based Digital HadronCalorimeter concept

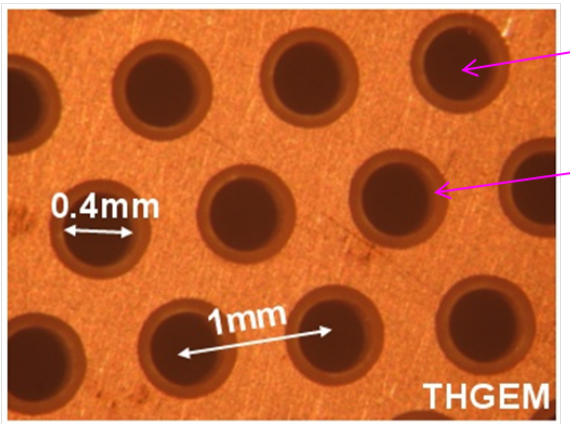


Aims

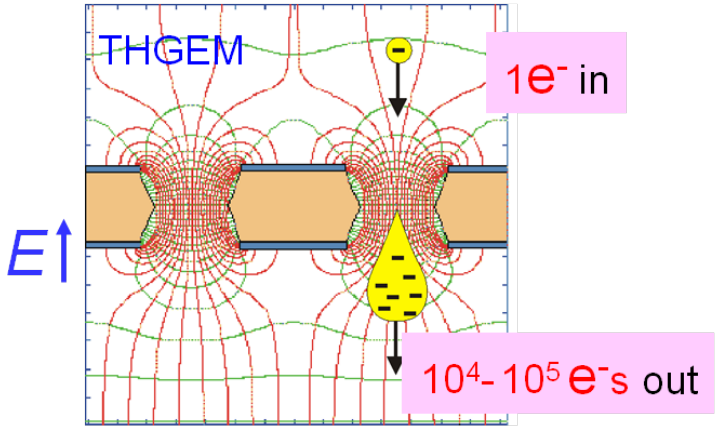
- Thickness of sensitive region: 6–8 mm, including readout electronics.
- 95 % efficiency;
- up to 1.7 particles/pad overlap is acceptable.

Thick Gas Electron Multiplier (THGEM)

~ 10-fold expanded GEM



Thickness 0.5-1mm



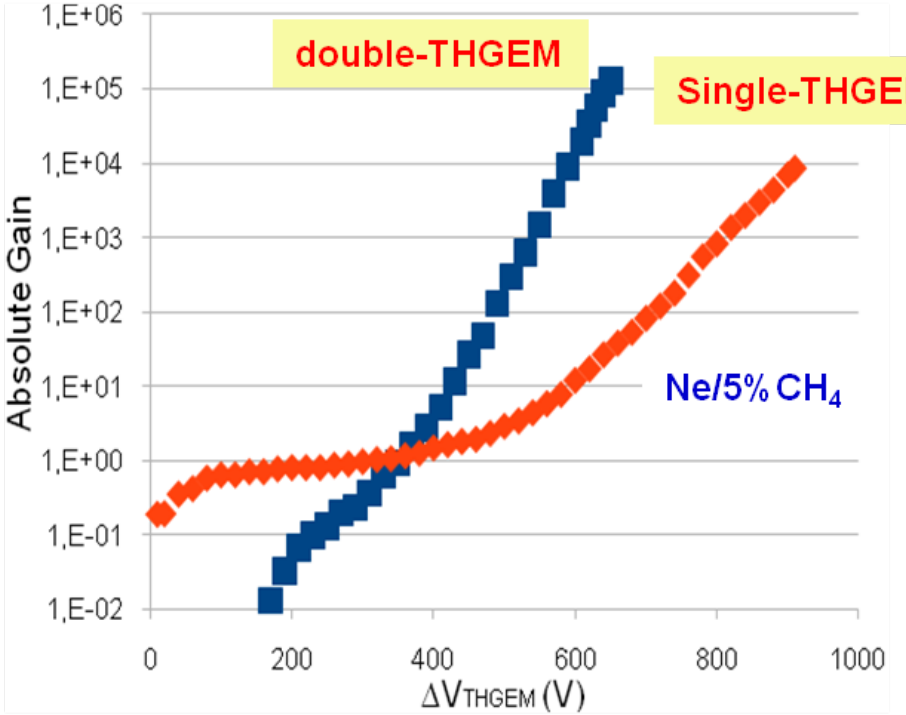
Double-THGEM: 10-100 higher gains

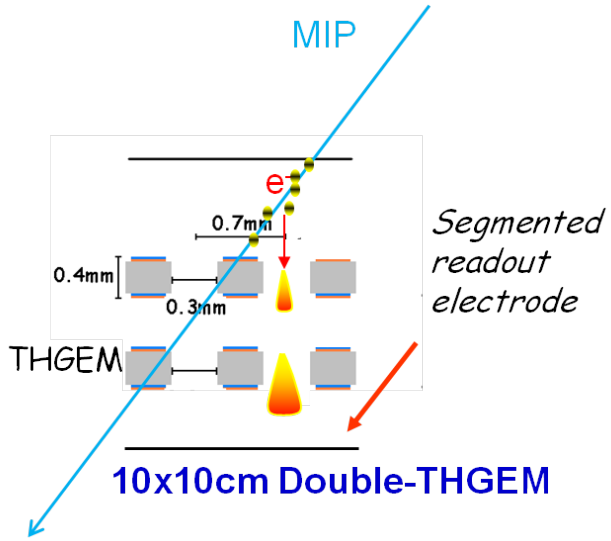
THGEM advantage for DHCAL:
SIMPLE, ROBUST, LARGE-AREA
Cheap: Printed-circuit technology
Digital counting➔
gain fluctuations not important

THGEM Recent review
NIM A **598** (2009) 107

- Robust, if discharge no damage
- Effective single-electron detection
- Few-ns RMS time resolution
- Sub-mm position resolution
- >MHz/mm^2 rate capability
- Broad pressure range: 1mbar - few bar

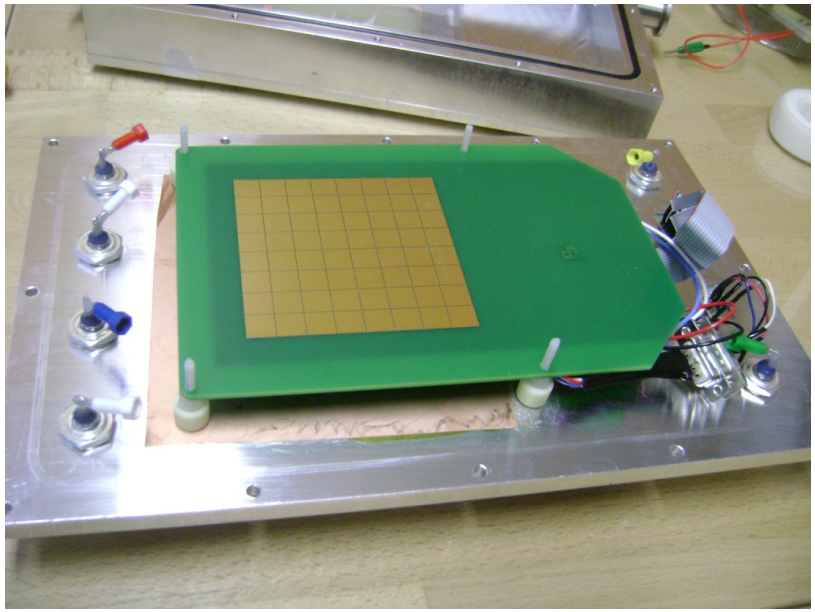
Previous results in Ne-mixtures





- High gain in Ne mixtures
- 2-THGEM: higher gains/lower HV
- But: low ionization ($n_{tot} \sim 40$ e/MIP)

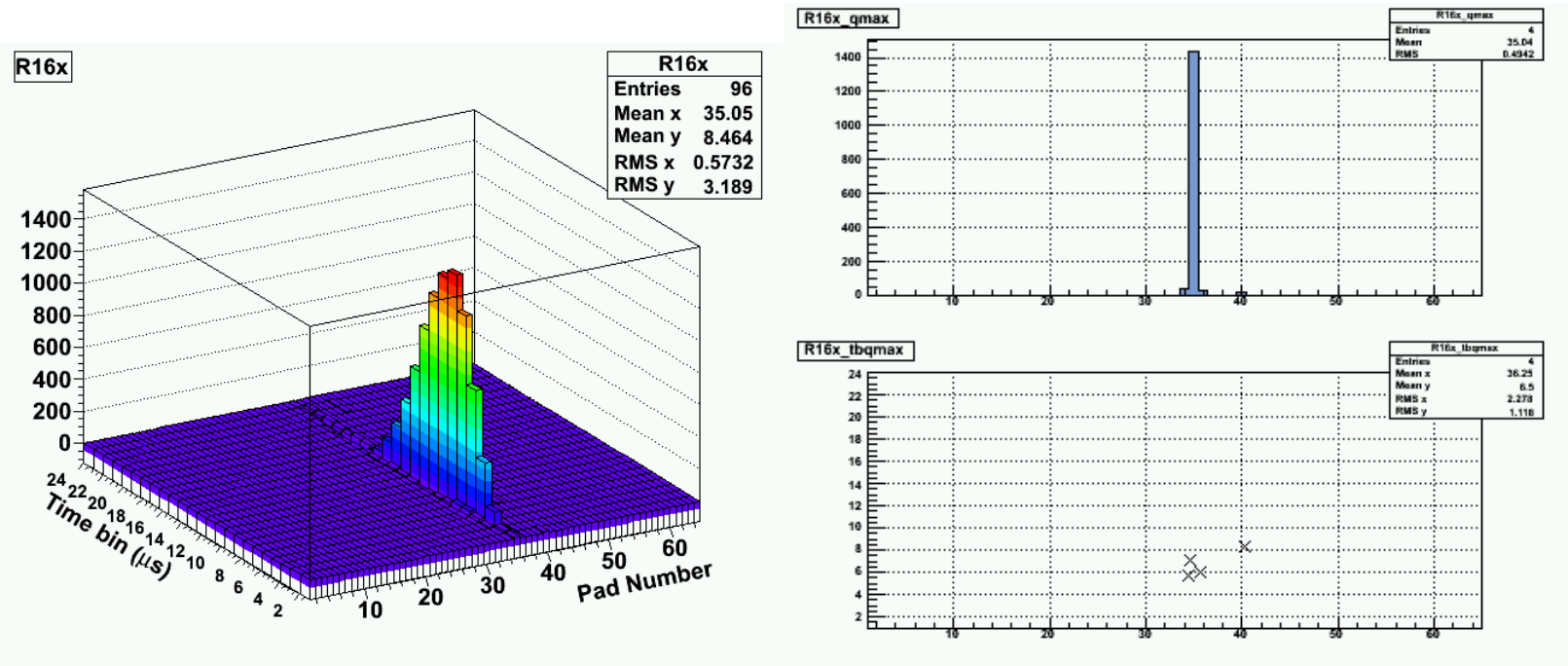
8×8, $1\ cm^2$ readout pads



ILC standard: KPiX readout chip

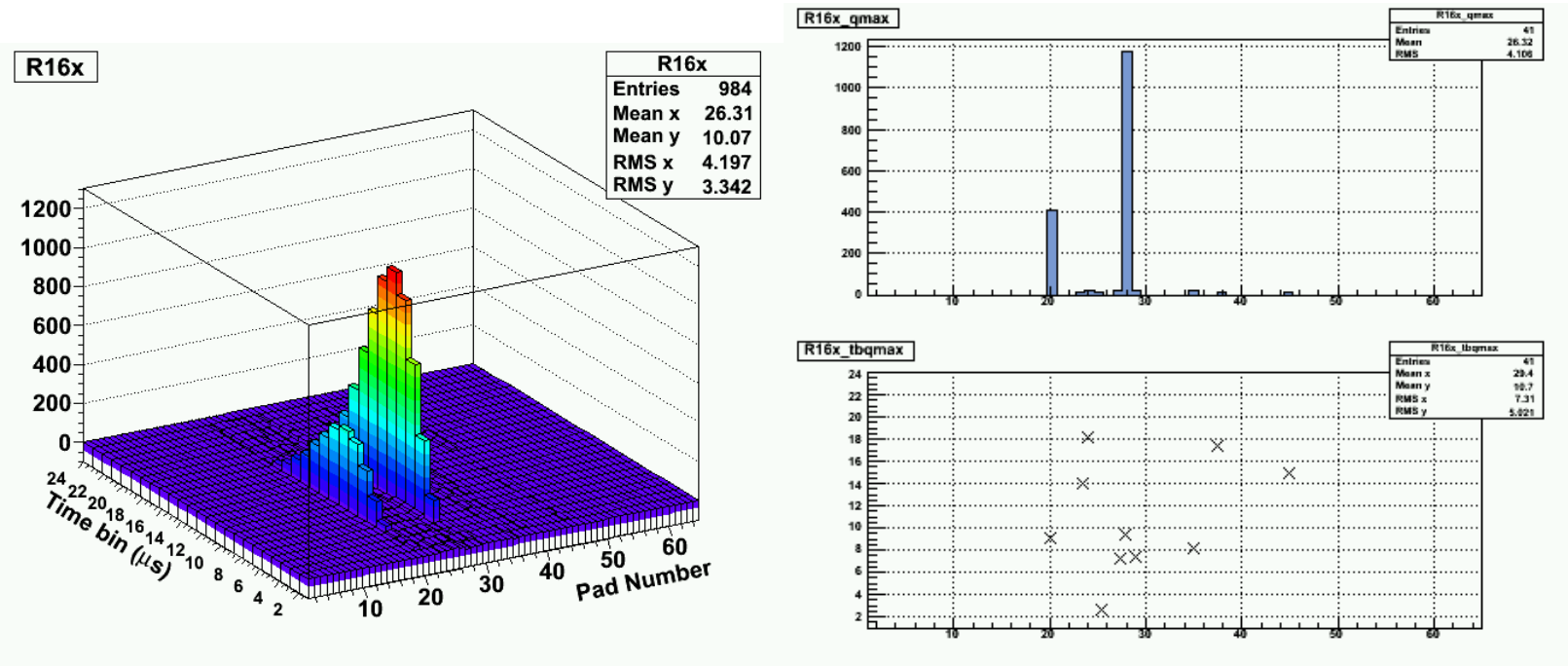
- Readout pads built at CERN workshop with the same geometry as KPiX
- 64 pads/channels, active area: $8 \times 8\,\mathrm{cm}^2$
- CERN-made pads connected to SRS APV

Off-line Display S/W



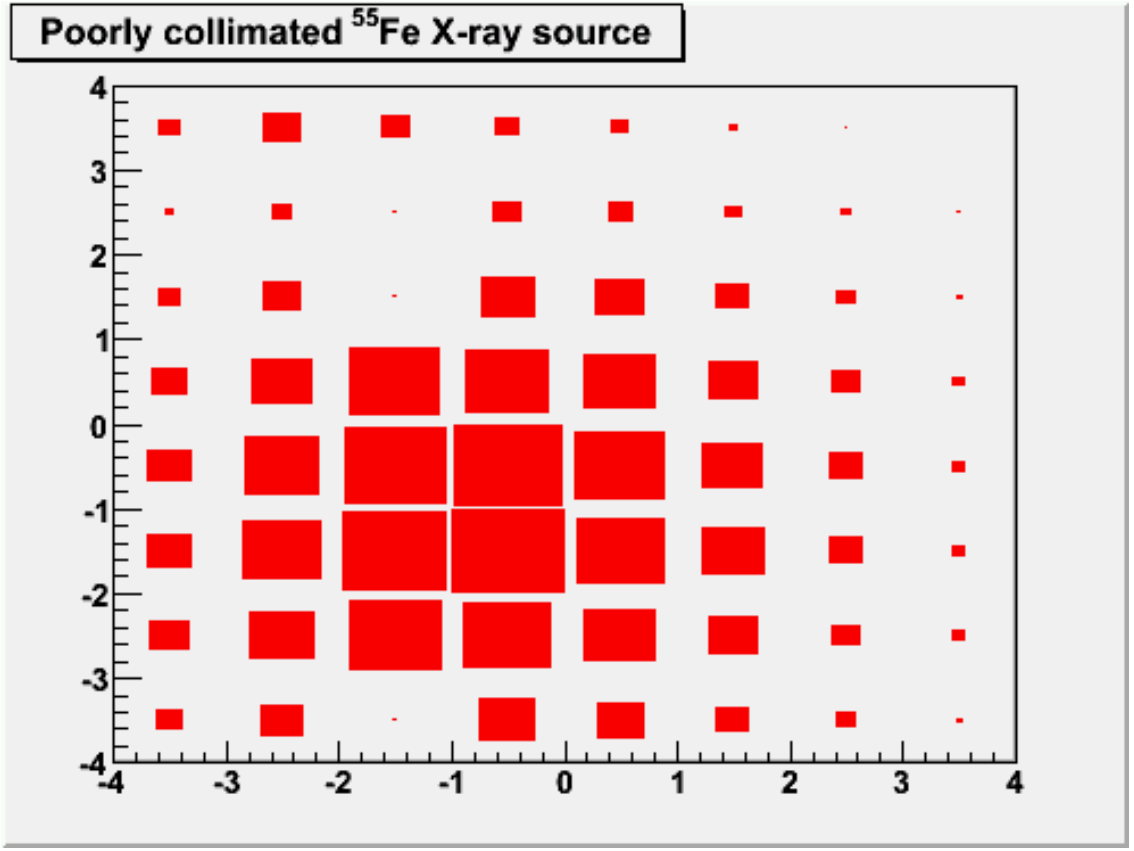
- Time and pad information for each event,
- key variables: `apv_qmax`, `apv_tbqmax`.

Off-line Display S/W



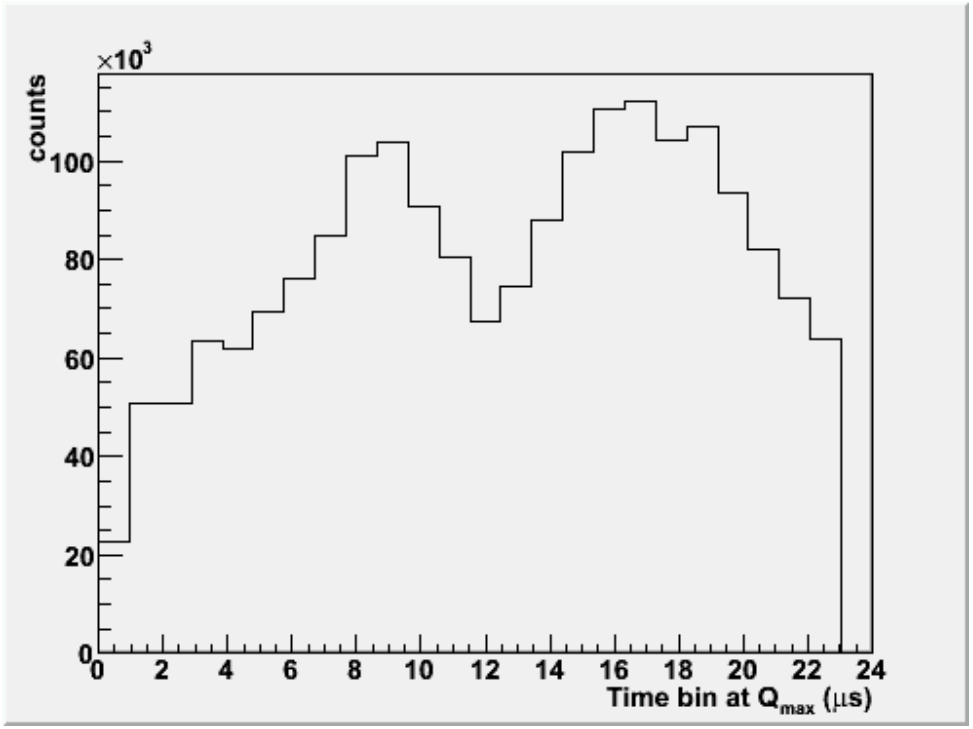
- Each event can be visualized separately,
- Charge shared between pads 20 and 28 (adjacent ones).

Some Analysis



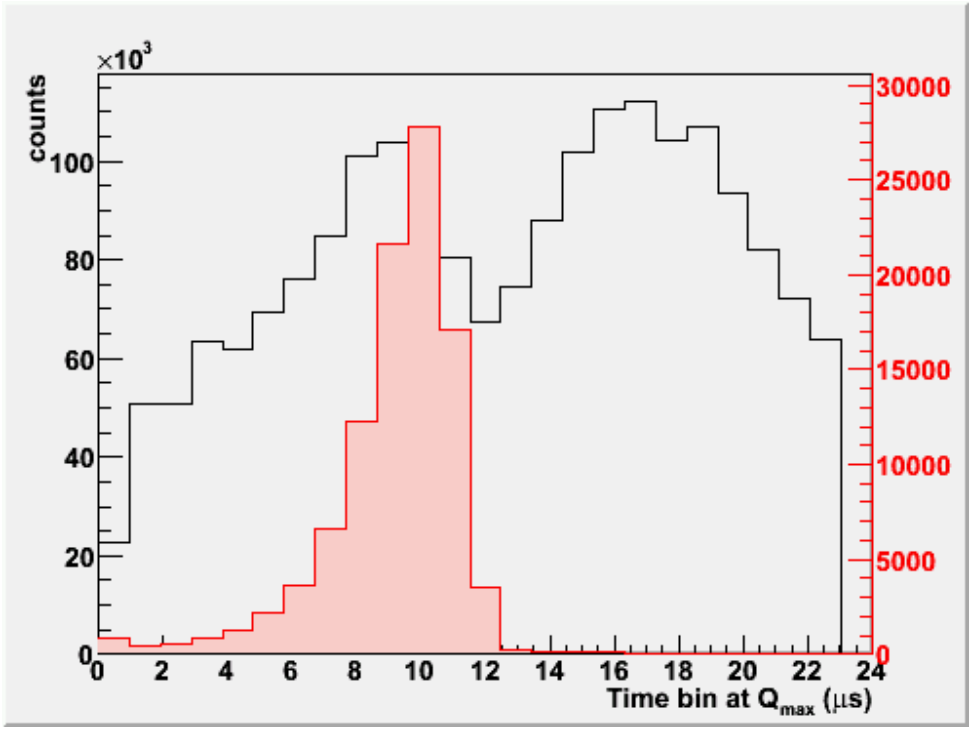
Pads in real geometry.

Using time information



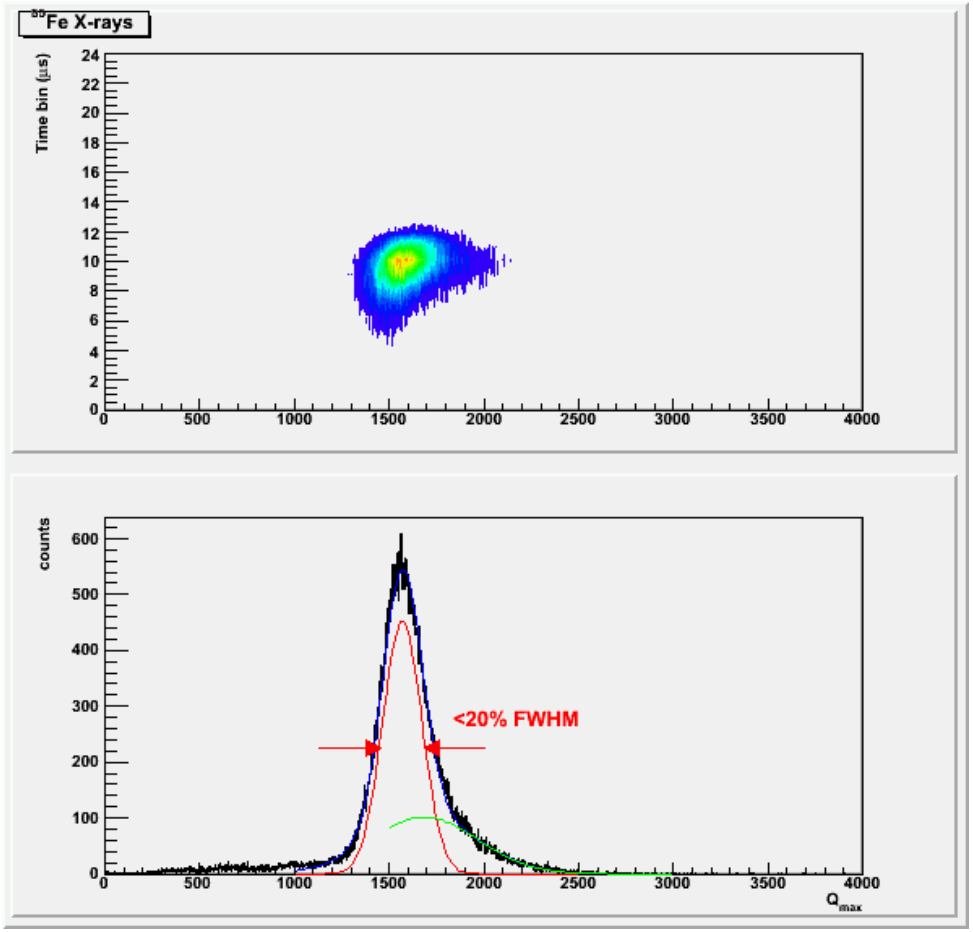
Time of Q_{max} for all pads.

Using time information



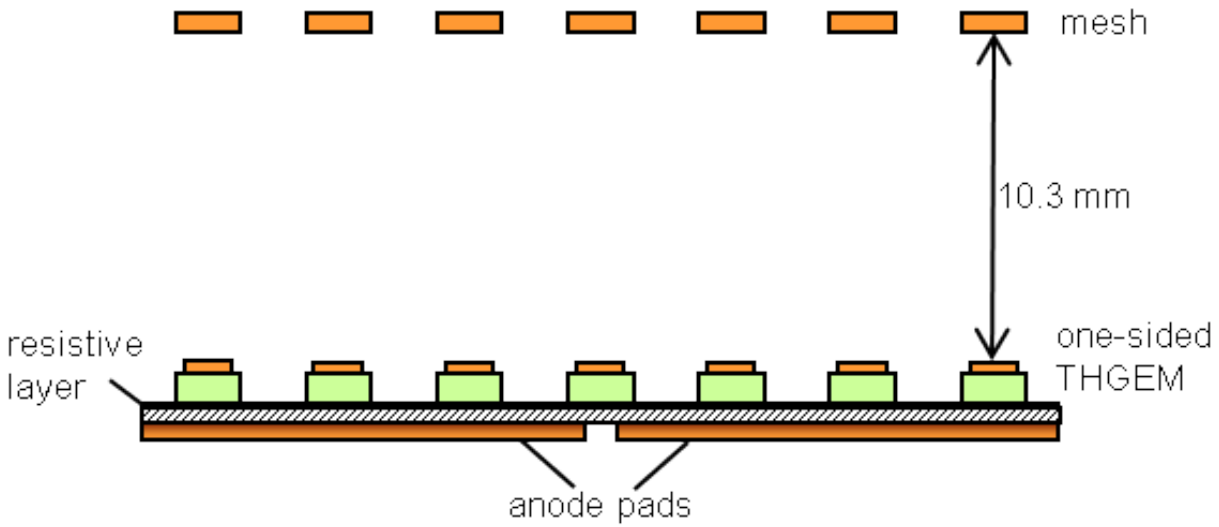
Only pads hit by charge (isolated pads discarded).

Pulse-height distribution



Only pad with higher Q_{max} and adjacent were used to build the distribution.

Resistive Well-THGEM

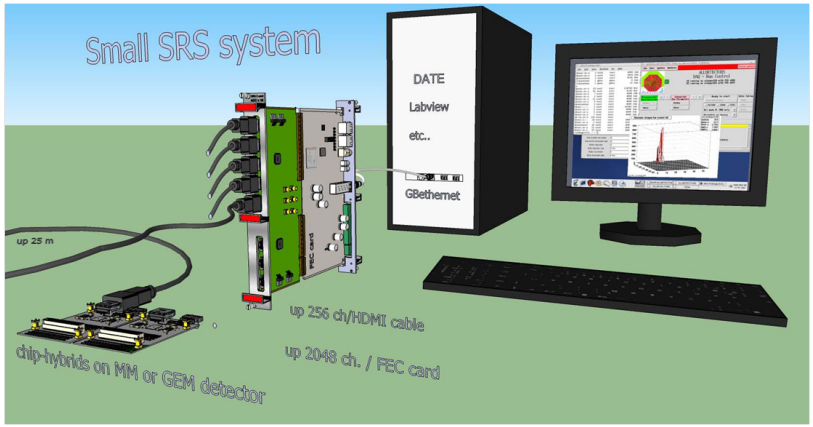


Advantages

- No induction gap
- Ground on both external electrodes
- Spark-protection of electronics

Data under analysis.

Conclusions



- Although still in a developing stage, fits THGEM requirements very well;
- Provides very useful amount of information;
- **Very important:** no damage, even when operating at severe spark regime.

Special thanks to:

- Leszek Ropelewski
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