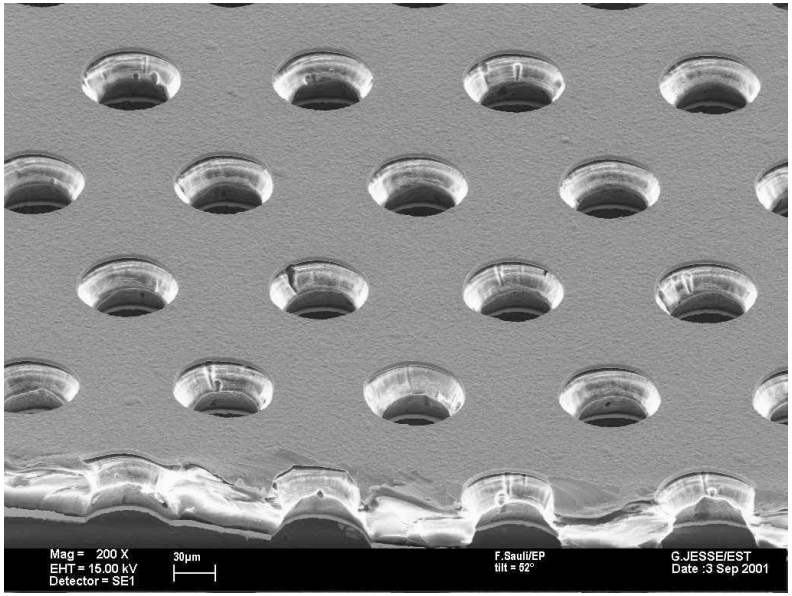
Status of GEM Development

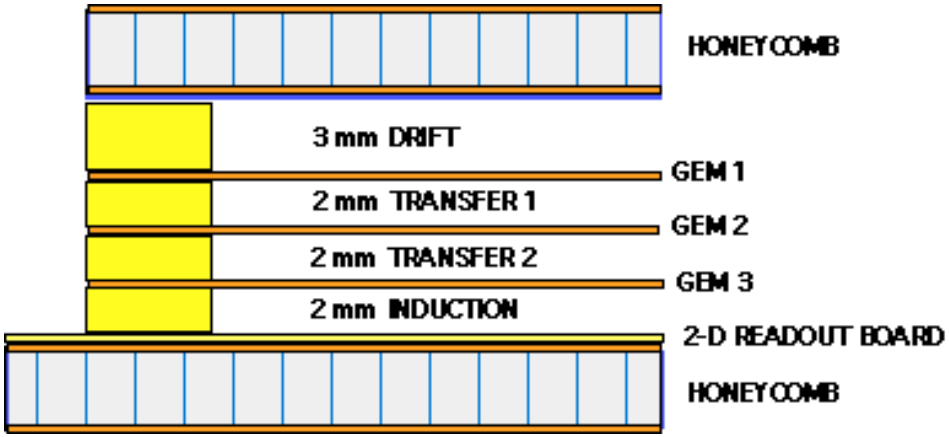
Frank Simon, MIT

STAR Collaboration Meeting, Boston, July 2006

- GEM Test Detector
- ^{55}Fe Source Tests
- Next Steps

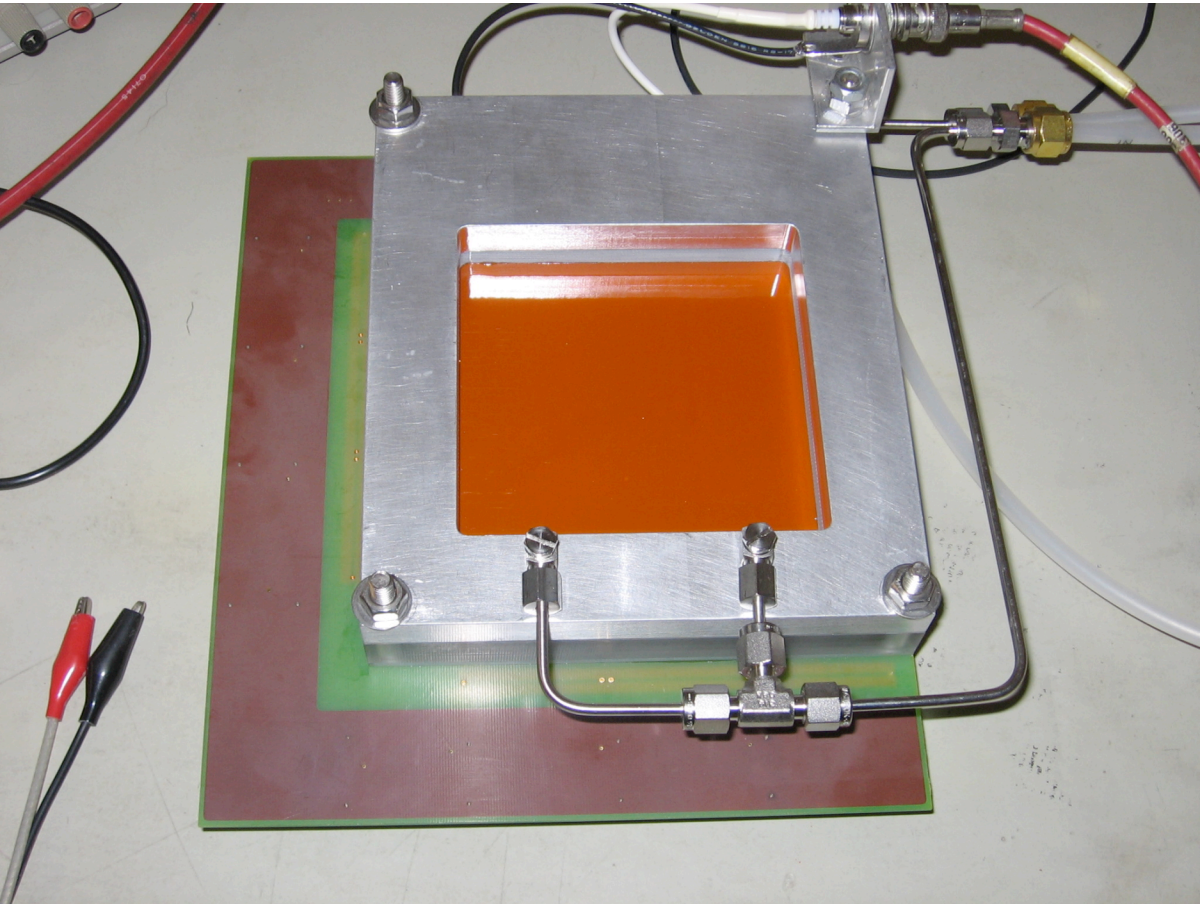
GEM Detectors: Overview





- Gas Electron Multiplier: metal-clad foil with large number of small holes
- Several foils can be cascaded to achieve higher gain with high stability
- Tripple-GEM design used (as in COMPASS)

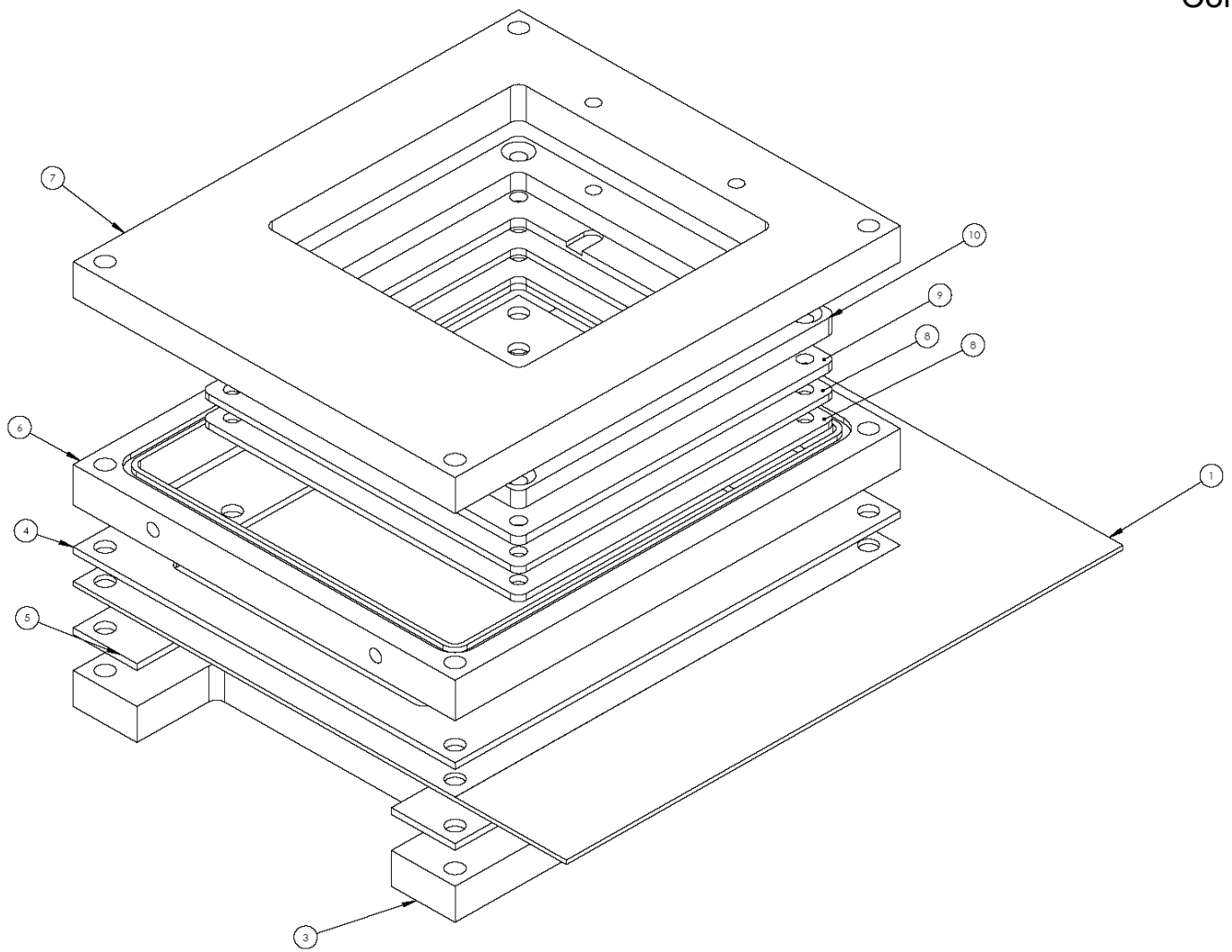
GEM Test Detector



Test Detector:

- Triple GEM
- HV distribution via resistor network
- Use of foils framed at BNL or Yale now possible

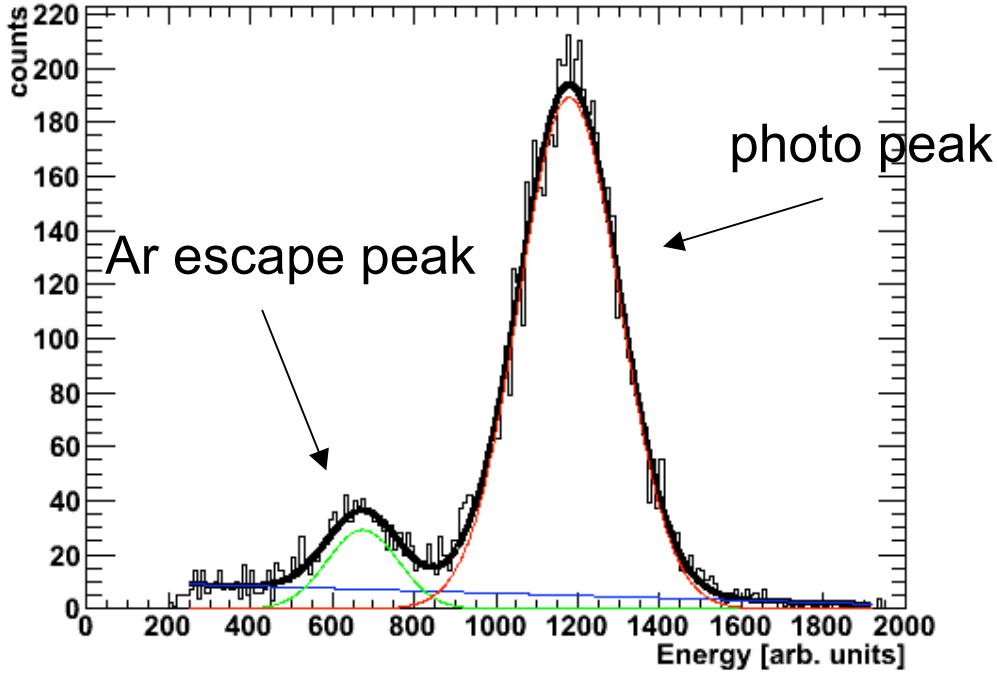
Test Detector: Details



Components:

1. 2D readout board
2. Bottom spacer (G10)
3. Bottom Al support plate
4. Top spacer (G10): 2.38mm
5. Al gas seal frame
6. GEM 1 frame (G10): 2.38mm
7. GEM 2 frame (G10): 2.38mm
8. GEM 3 frame (G10): 3.18mm
9. Drift frame (G10)
10. Top Al support cover

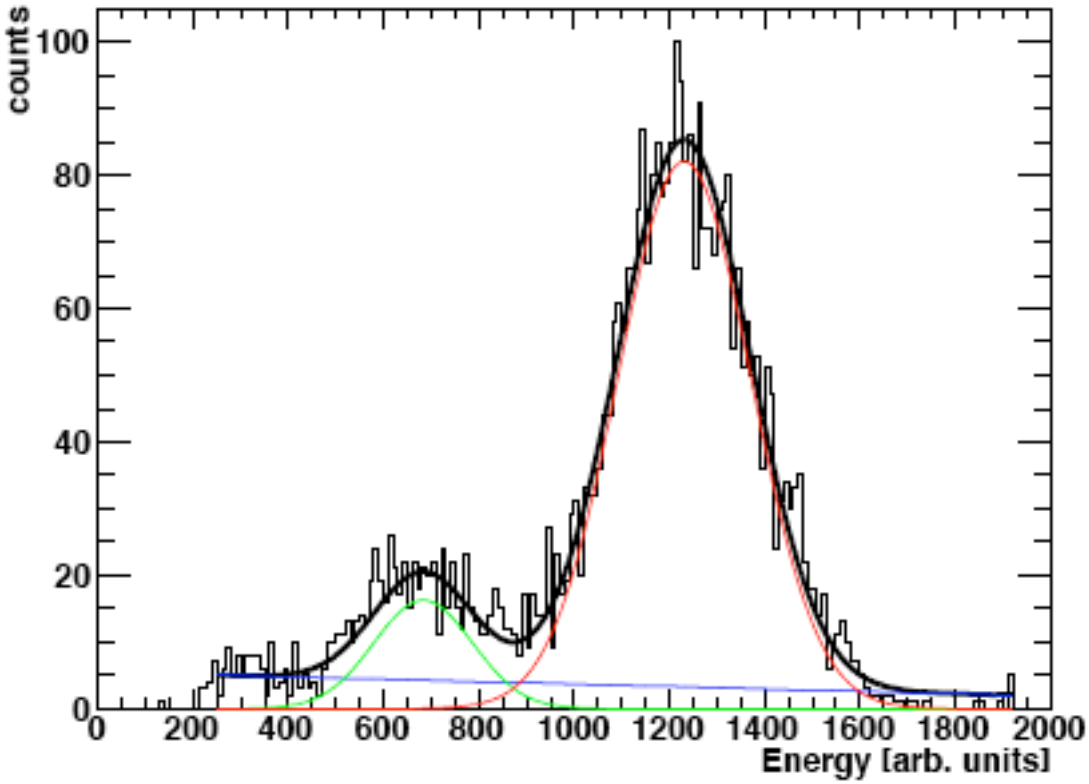
^{55}Fe Tests



- A group of 18 channels is combined and read out via a preamplifier / amplifier
- Trigger on the signal with simple discriminator threshold
- Digitization with standard CAMAC ADC
- CAMAC readout via PC
- Data acquisition based on ROOT

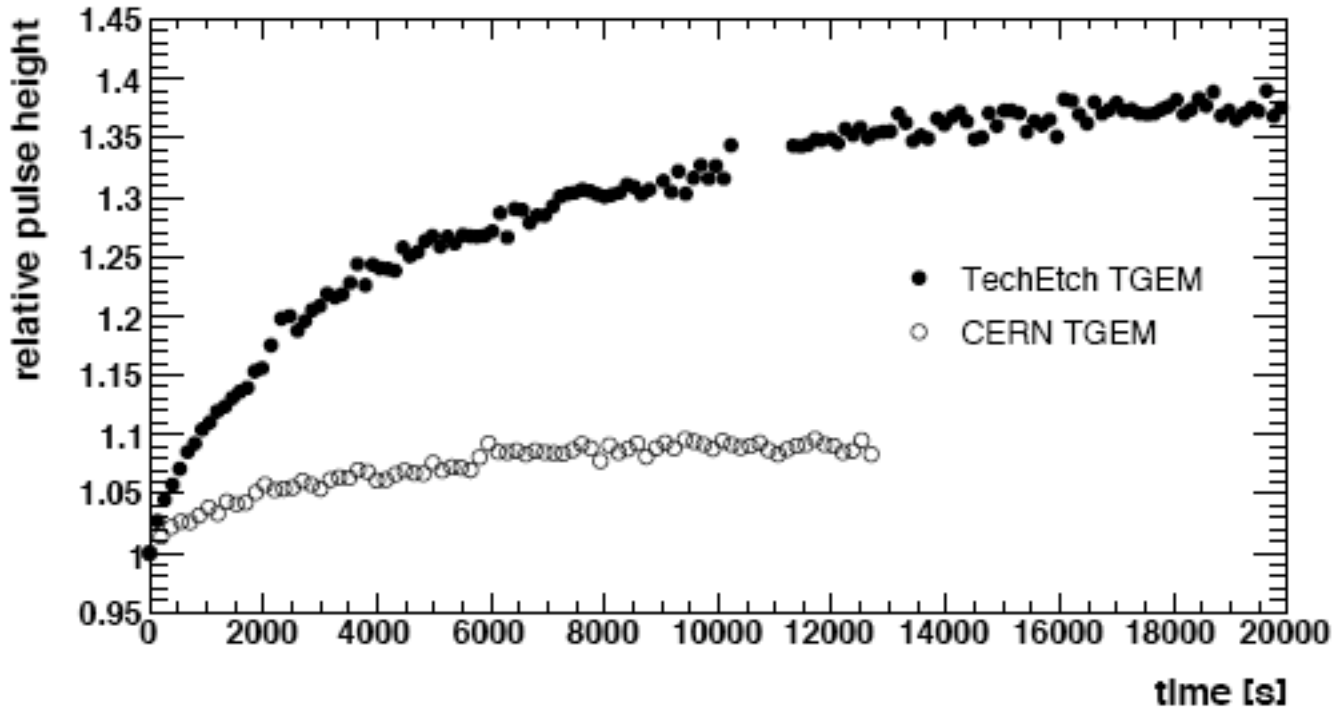
Here: Triple GEM with CERN foils, energy resolution ~ 20%

First TE Prototype



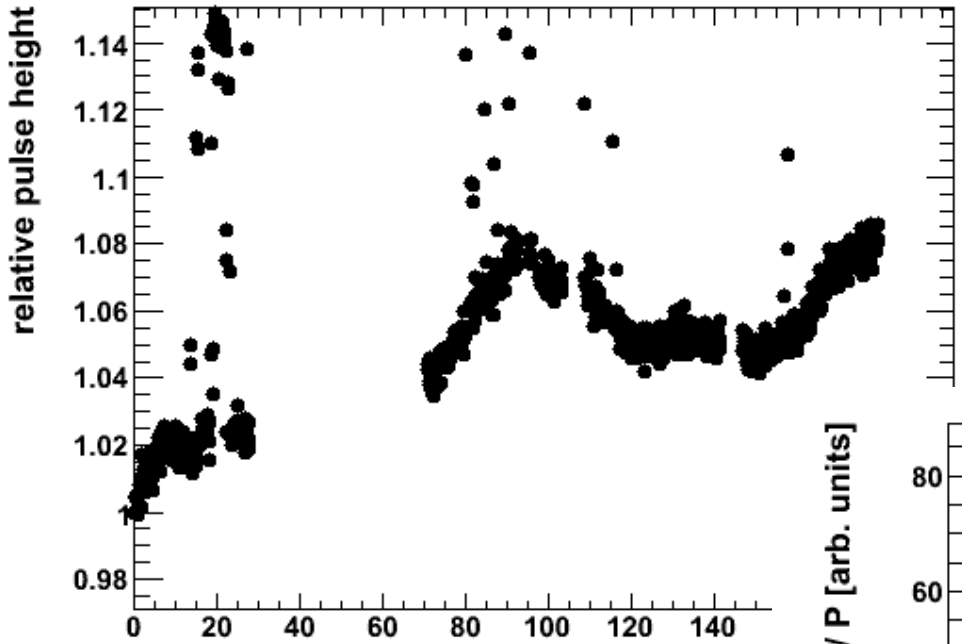
- Energy resolution comparable to CERN detector (here ~23%)
- Lower gain at the same voltage, but high gain can be reached by increasing the detector voltage
- Stable operation possible over days

Time Evolution of Gain: Charging Up

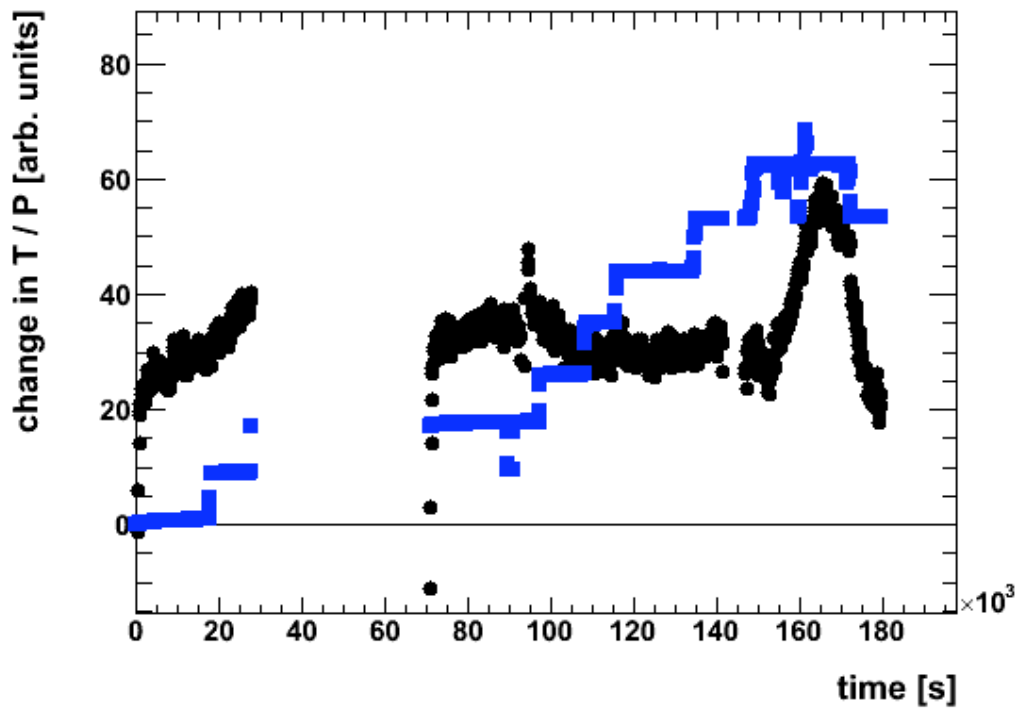


- Gain evolution (determined by relative pulse height) as a function of time, irradiation with low intensity ^{55}Fe source (~2 Hz/mm^2)
- TE detector shows significantly higher increase than CERN (~40% vs ~10%)

Time Evolution: New Measurement



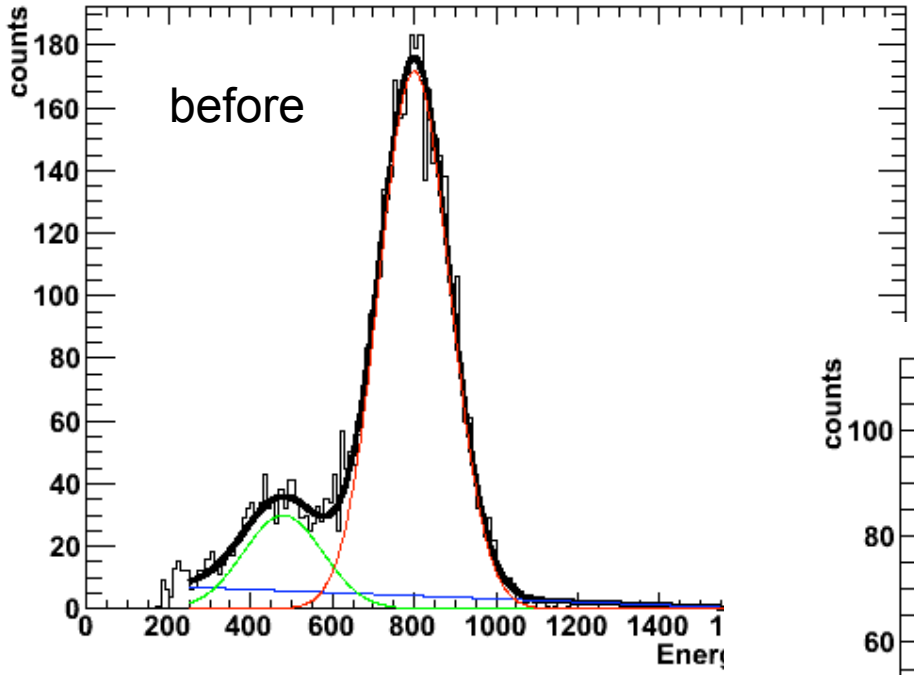
- New measurements with TE detector (after 3 month connected to gas)



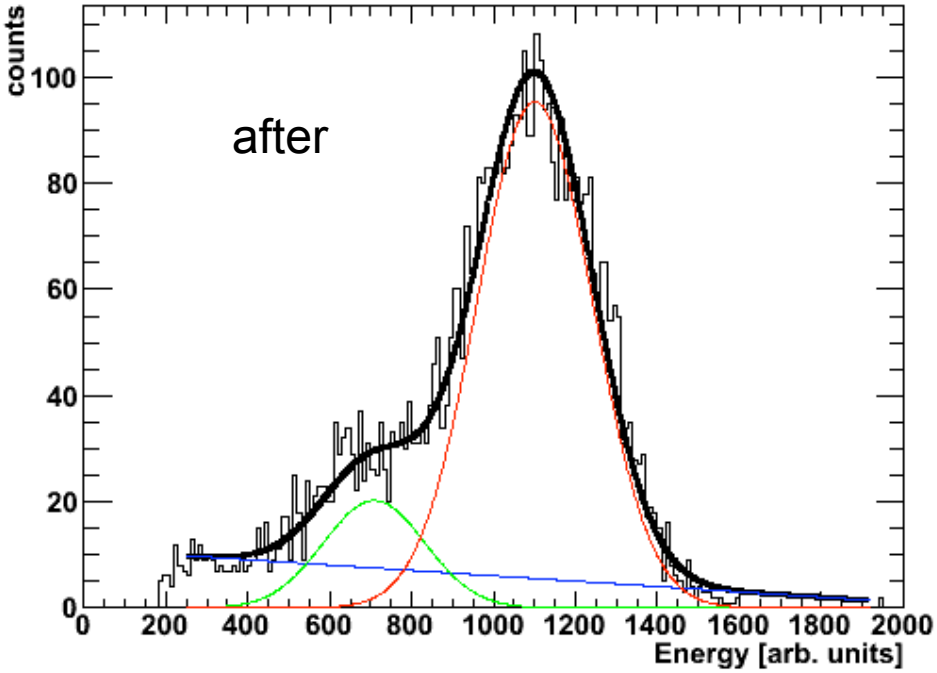
- Temperature and pressure monitoring available since last week

⇨ looking great, but…

High Intensity Irradiation



- Brief irradiation with high intensity ^{90}Sr source



- Gain increase by 37%
- Energy resolution before 21.6%, after 26%

⇨ charge-up problem not solved…

Summary & Next Steps

- Versatile setup to test triple GEM detectors at MIT
- Detectors based on TechEtch and CERN foils both give good-looking ^{55}Fe spectra with an energy resolution that is comparable to that observed with the COMPASS detectors
- The first detector based on TechEtch foils shows significant gain increase when irradiated
  - Optimization process with the manufacturer in progress

- Preparation for tests with “real” electronics (APV25 based system, see next talk by M. Plesko)
- Evaluate detectors with cosmics (efficiency, resolution)
- Develop a light weight prototype
- Possibly a test beam at FNAL next spring