Update on SBS Back Tracker GEM @ UVa

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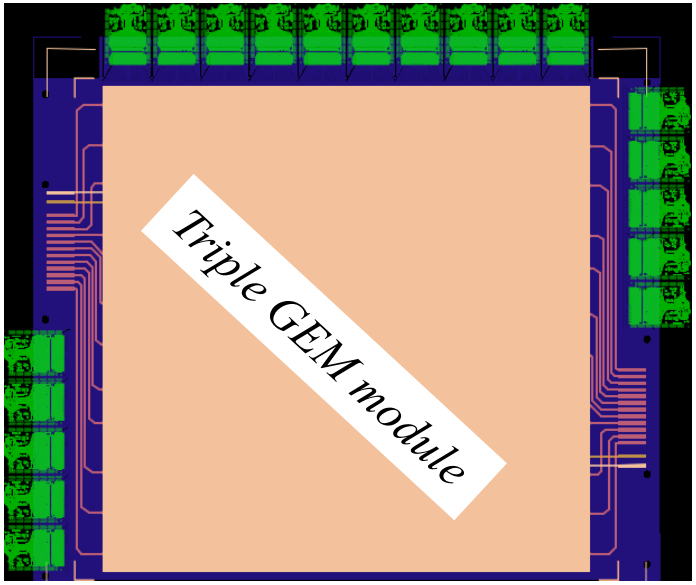
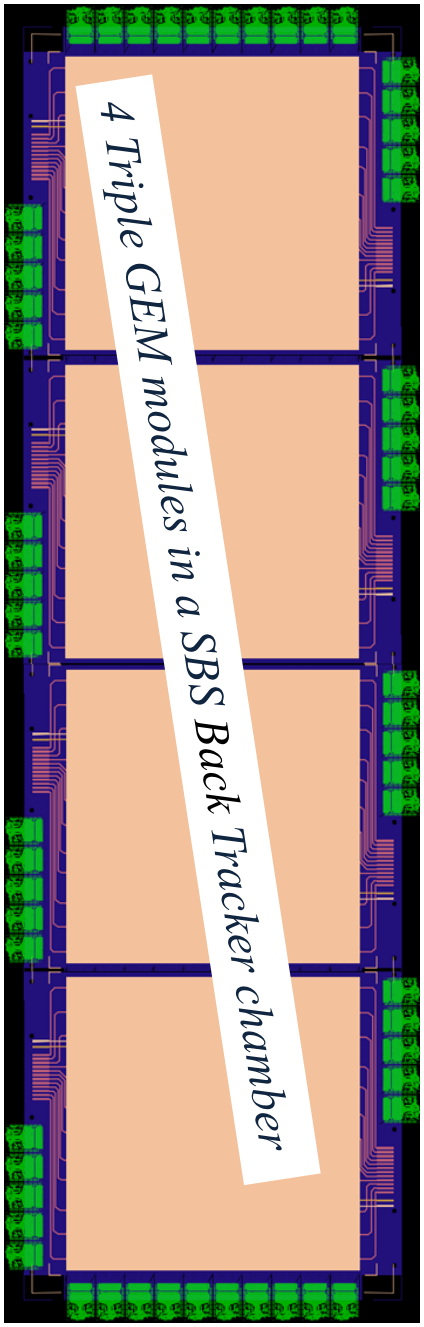
- Preliminary tests and results
- Improvements for the next two prototypes

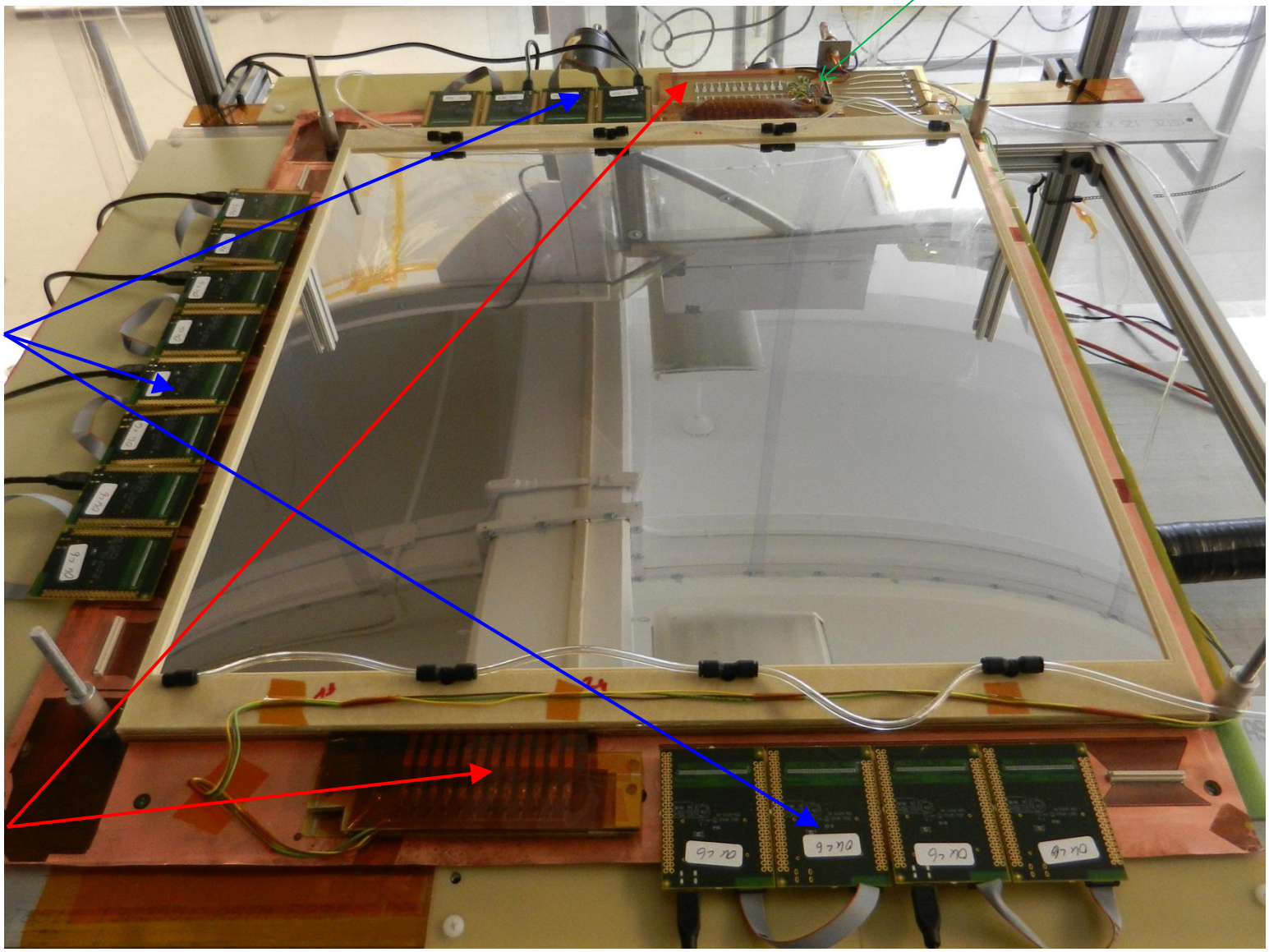
Design of 50 ×50 cm^2 Back Tracker GEM





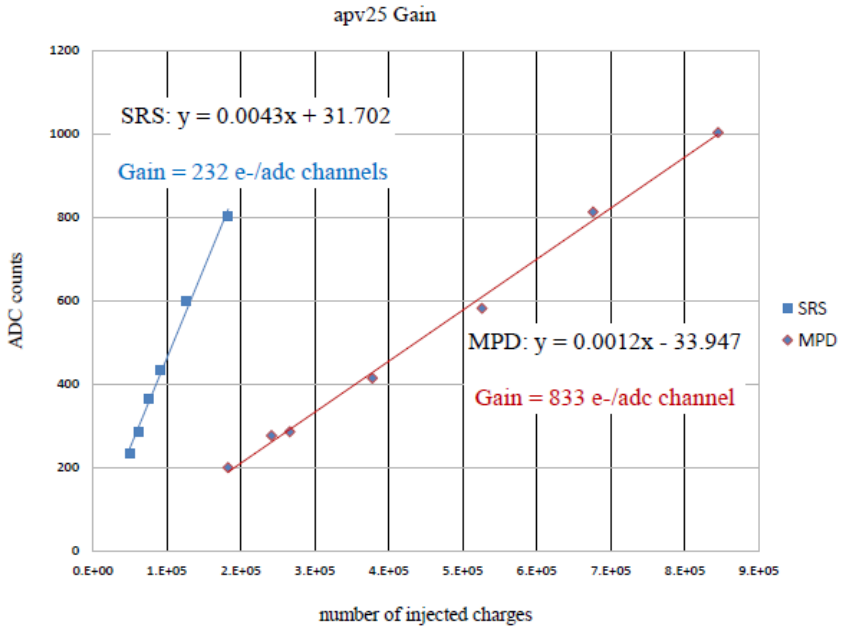
- Module of 50 × 50cm^2 to replace the 40 × 50cm^2
  - 32 modules to be built instead of 40 for the 8 SBS Back Tracker GEM chambers ➔ Reduce the overall cost and dead area
- No protective resistors on the GEM foils ➔ external resistor board
  - Individual HV test of all the sectors at different stages of the assembly and safer to operate during the assembly
- Wider GEM frames and readout honeycomb support along x-axis
  - 30 mm instead of 8 mm, alignment holes away from active area
  - Room for strips connectors and GEM HV sectors electrodes
  - Holes for mechanical positioning of the chamber on the frame

SBS Back Tracker GEM module Proto 1

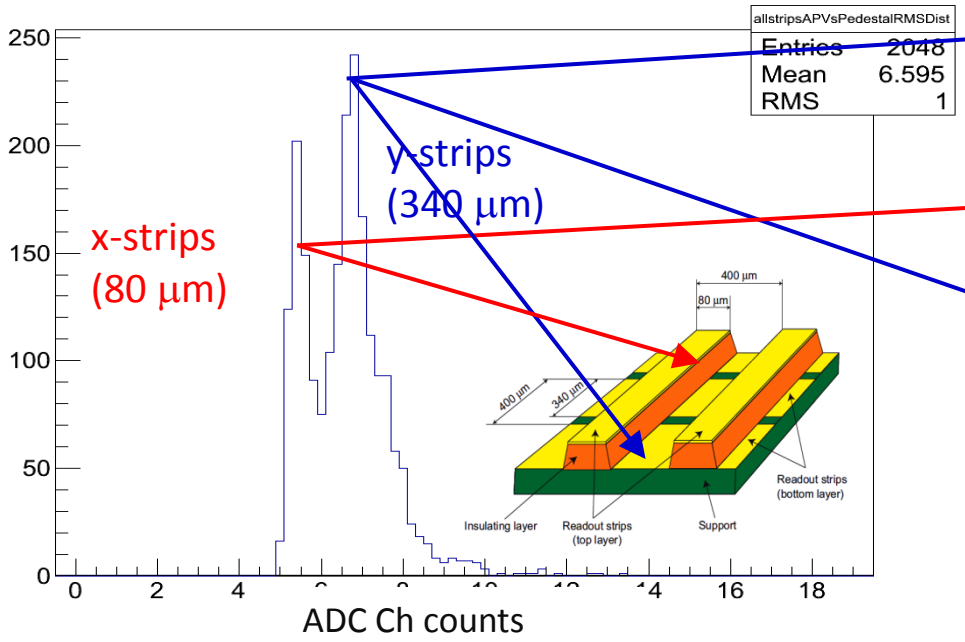


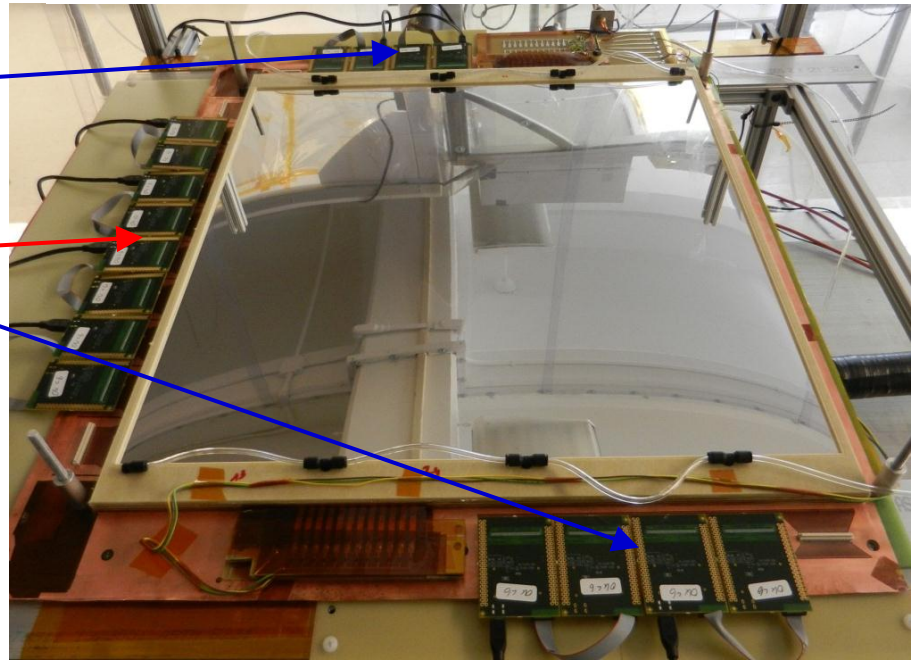
Pedestal RMS noise

- For 50 × 50 cm2 COMPASS-like readout, typical rms after common mode correction of the baseline is on average of 6-7 adc counts for apv25-SRS
  - @ 230 e-/adc ➔ ~ 1200 to 1500 ENC
  - a cut at 5 sigma for zero suppression ➔ ~ 6000 e-

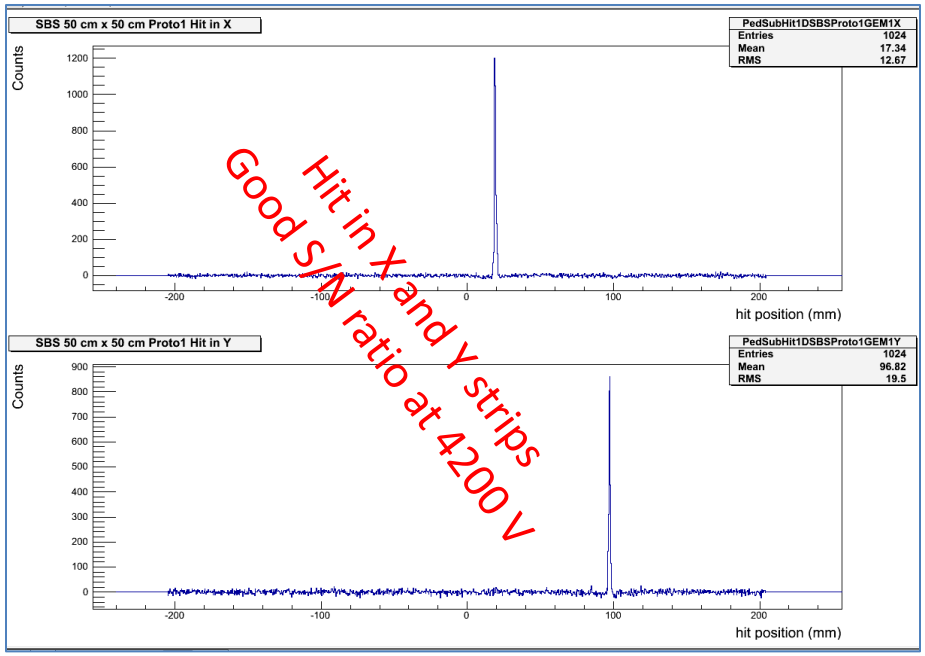


Pedestal RMS noise distribution over 16 APV

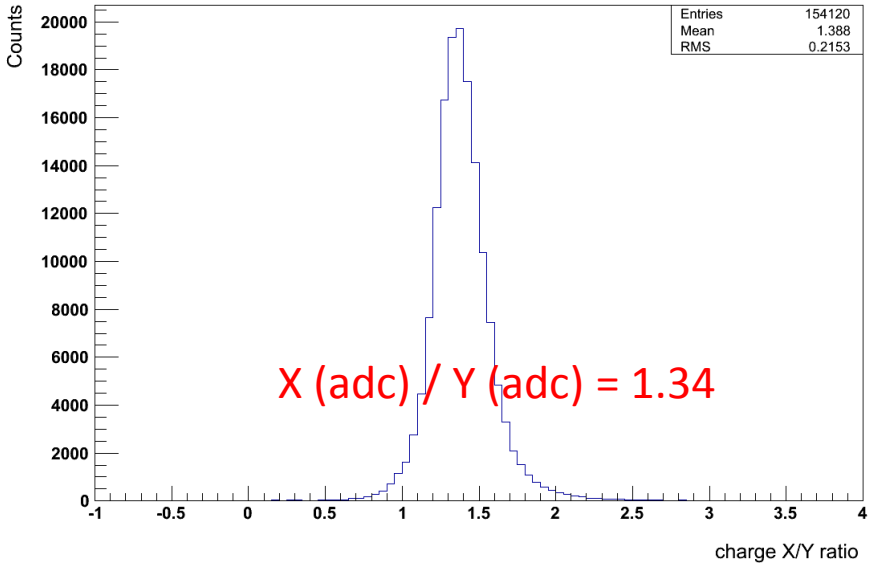




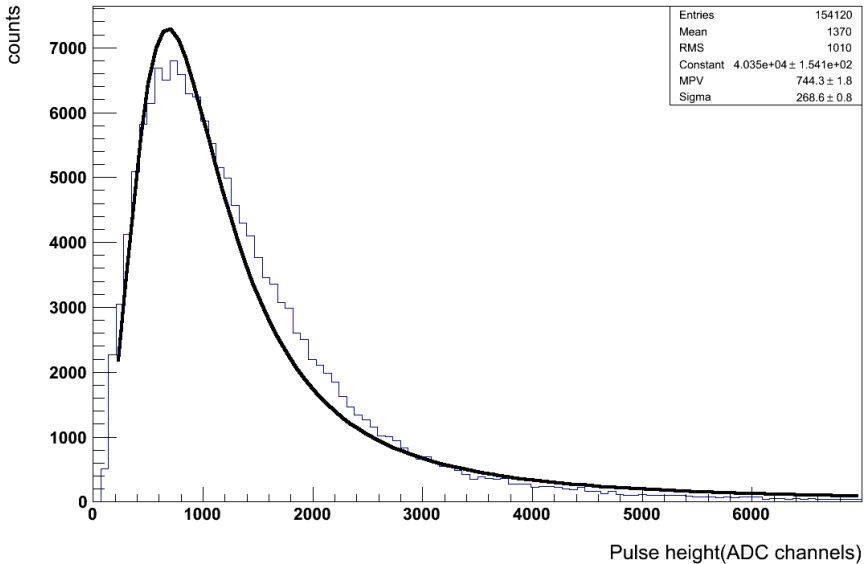
Preliminary test with cosmic data



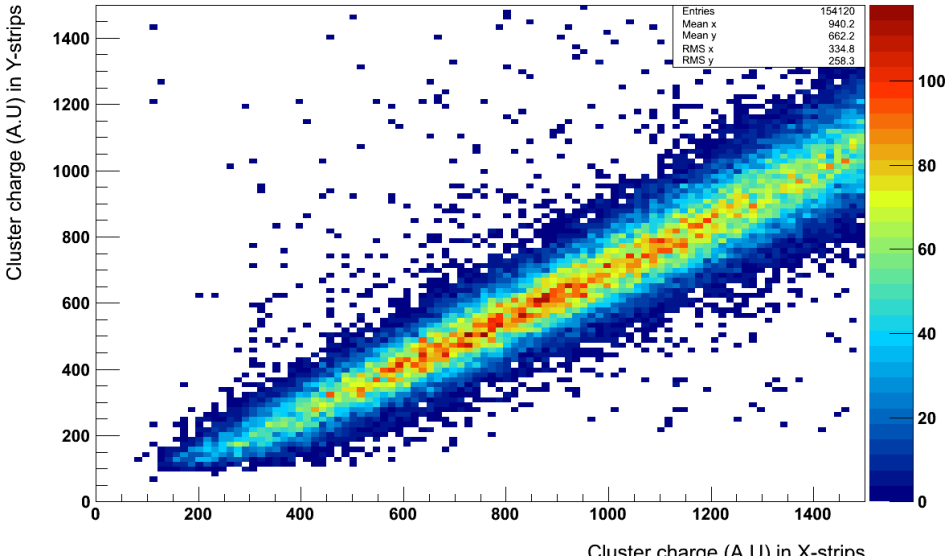
X-Y strips charge sharing ratio



Cluster ADC sum distribution

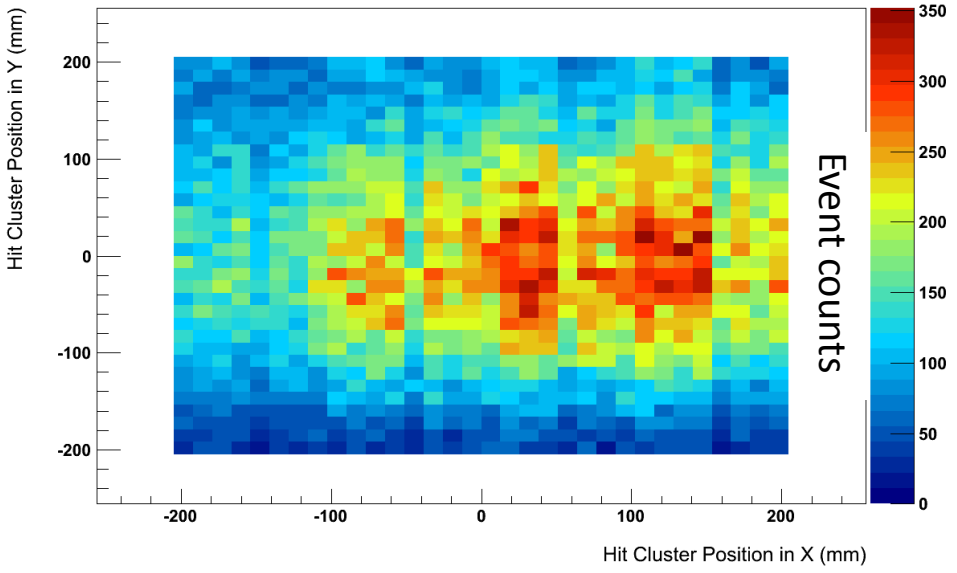


X/Y strips charge sharing correlation

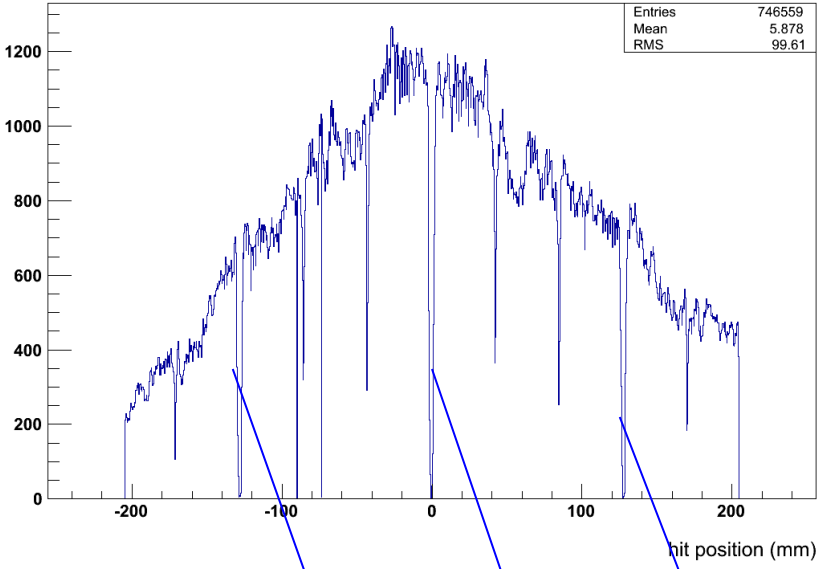


Preliminary test with cosmic data

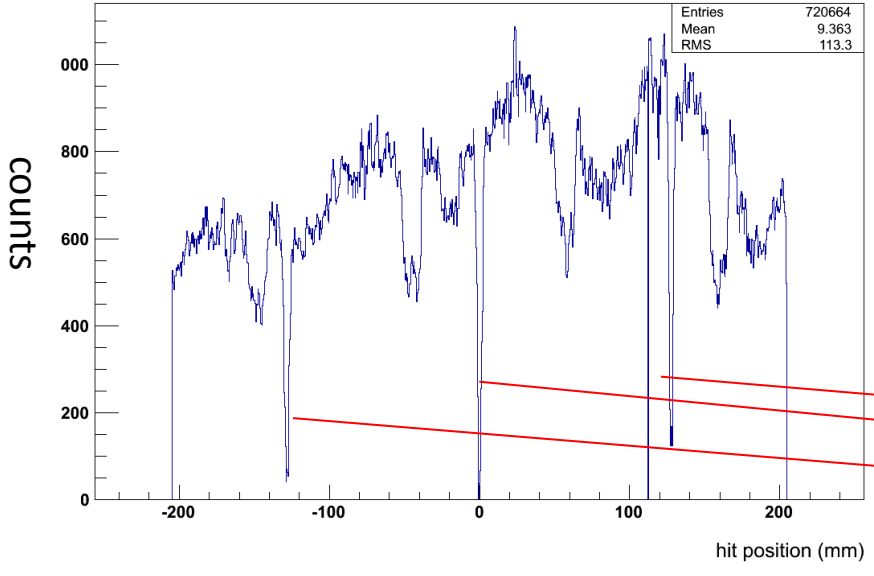
Event cluster position 2D map

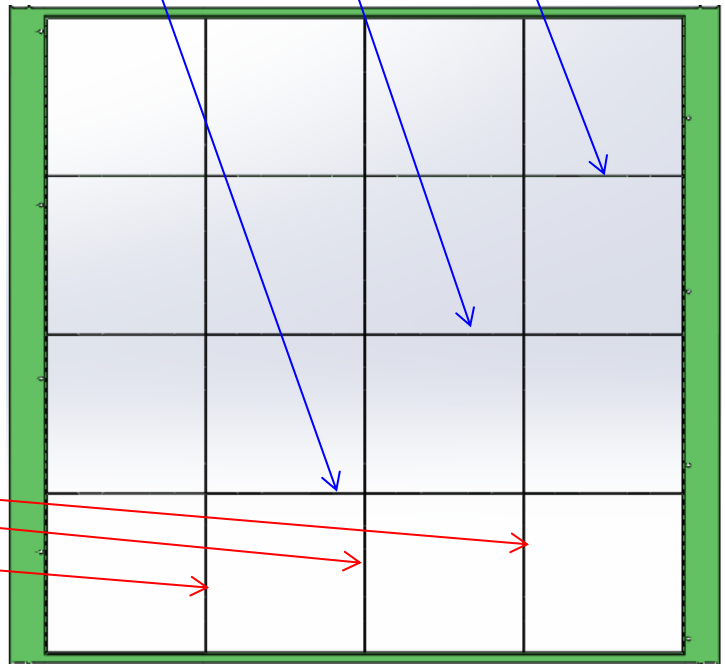


Hit count distribution on Y-strips



Hit count distribution on X-strips



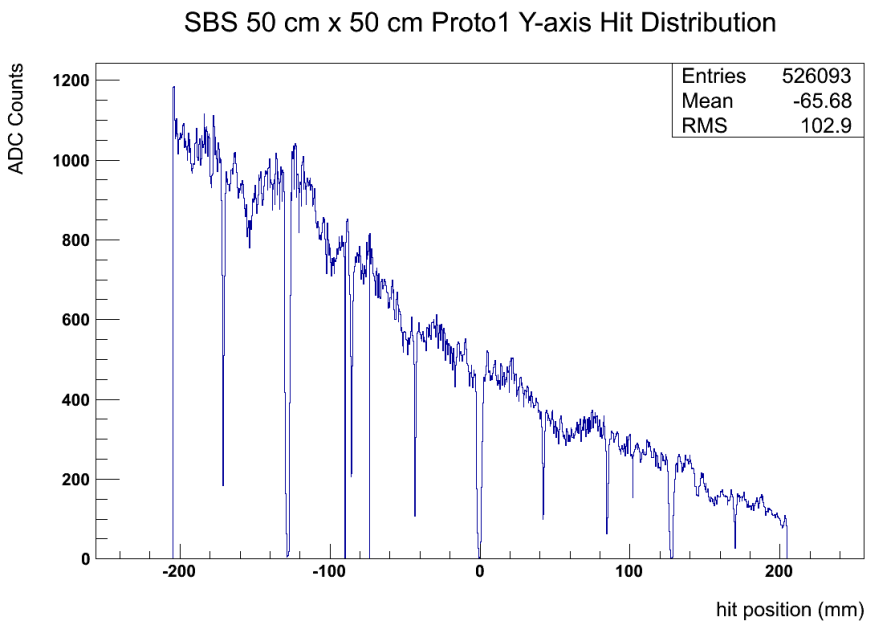


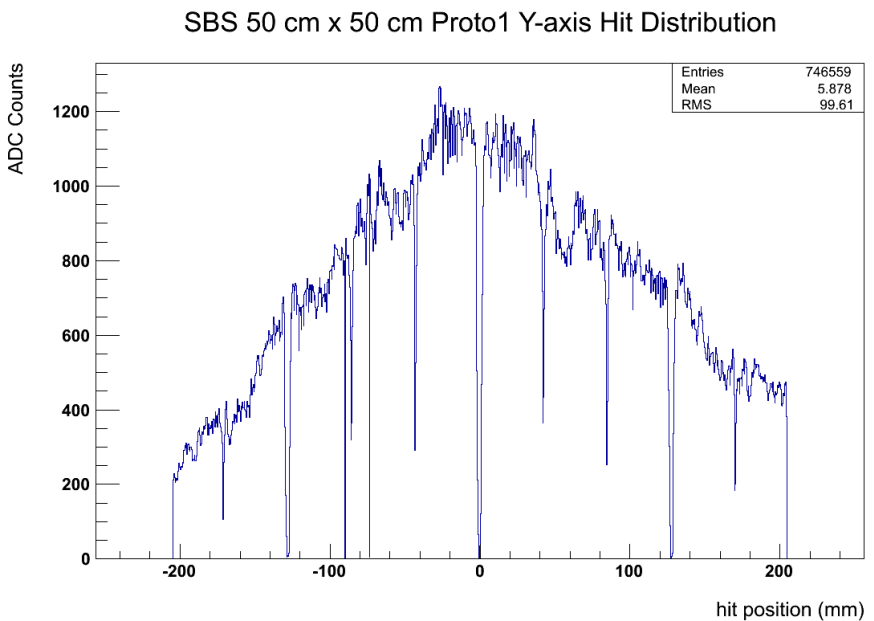
Non uniformity from the scintillator counters

We use 2 set of 3 scintillators paddle in coincidence for the trigger on cosmic

Changing the arrangement of the paddles in the set up lead to a big changes in the hit distribution profiles

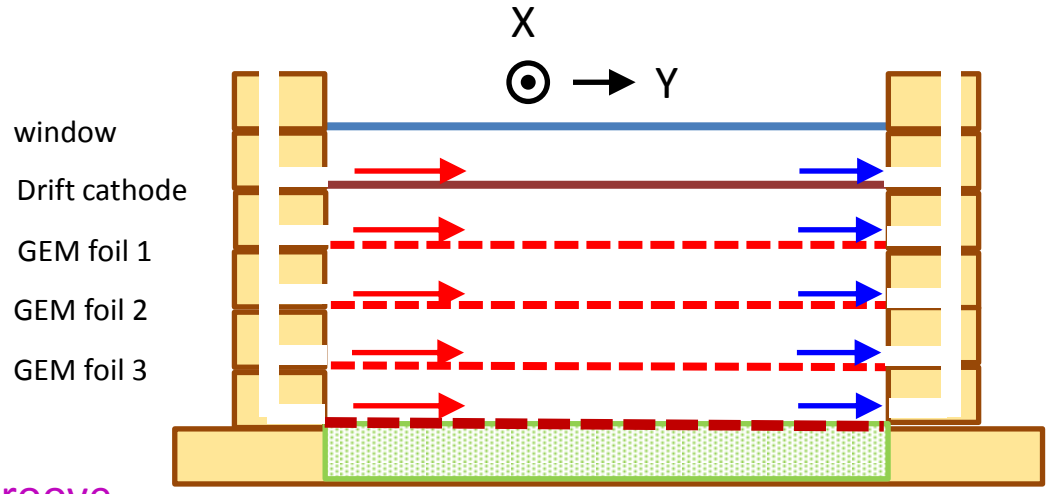
Main source of the non uniformity here





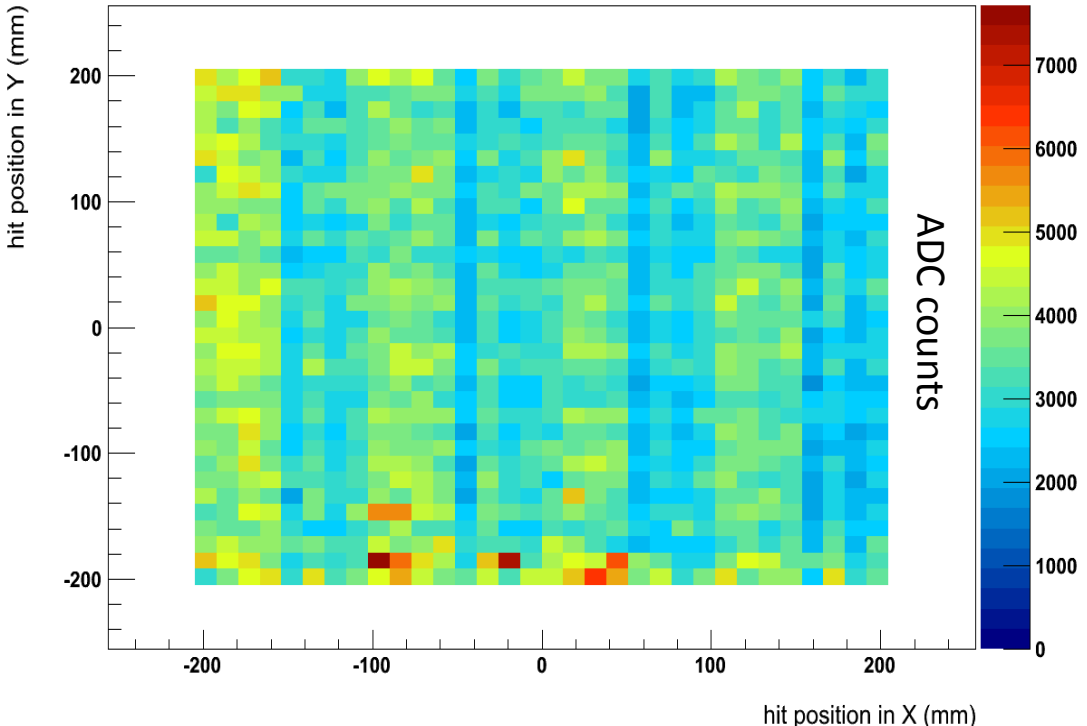
Gain (non) uniformity of the chamber

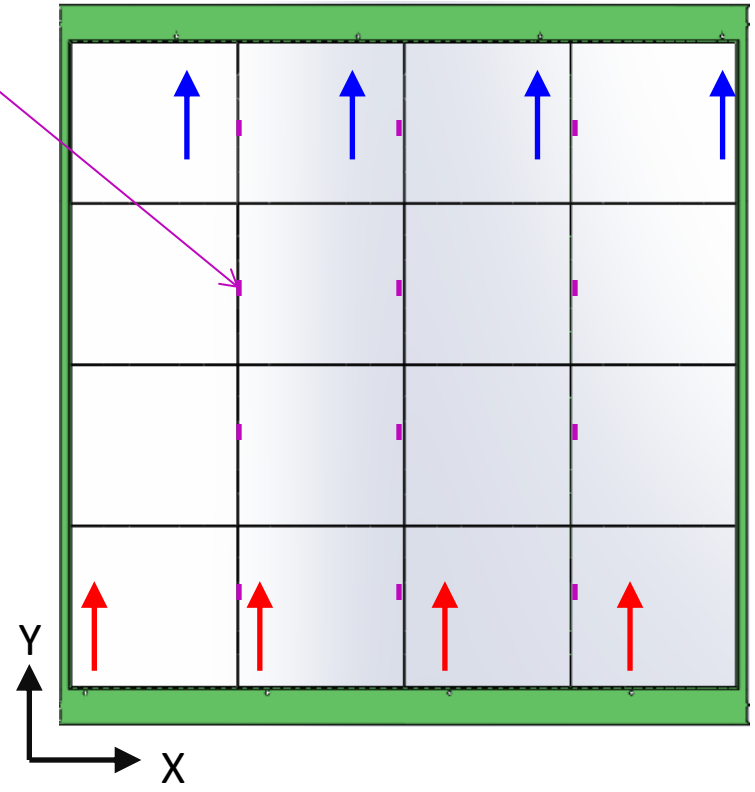
- Gas flow uniform in Y direction ➔ gas inlet and outlet
- We suspects a non uniformity of the gain due to the gas flow in the X direction
- The gas flow in X is facilitated by groove in the spacer but not sure if it is



Groove

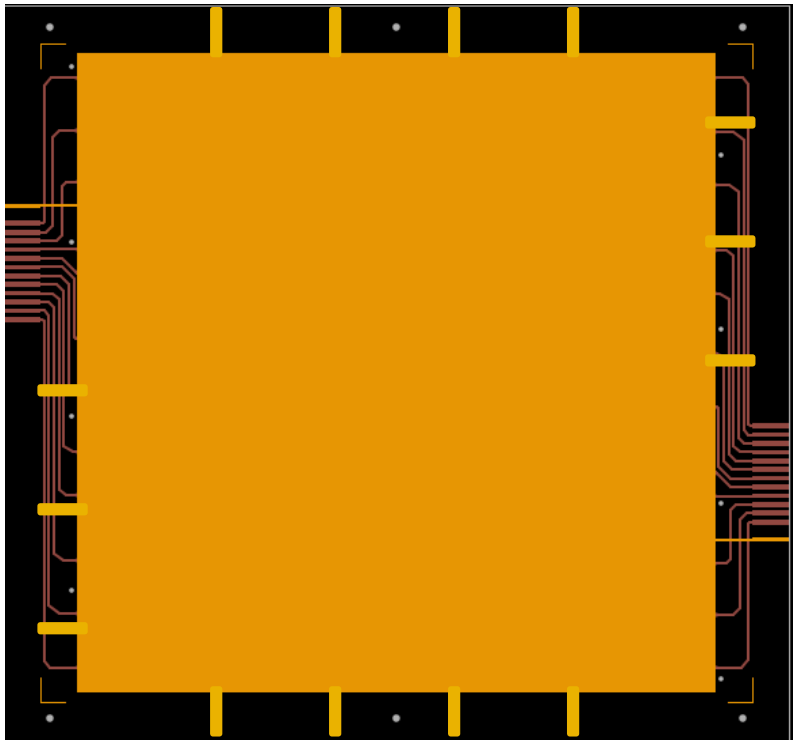
Mean cluster adc counts 2D map





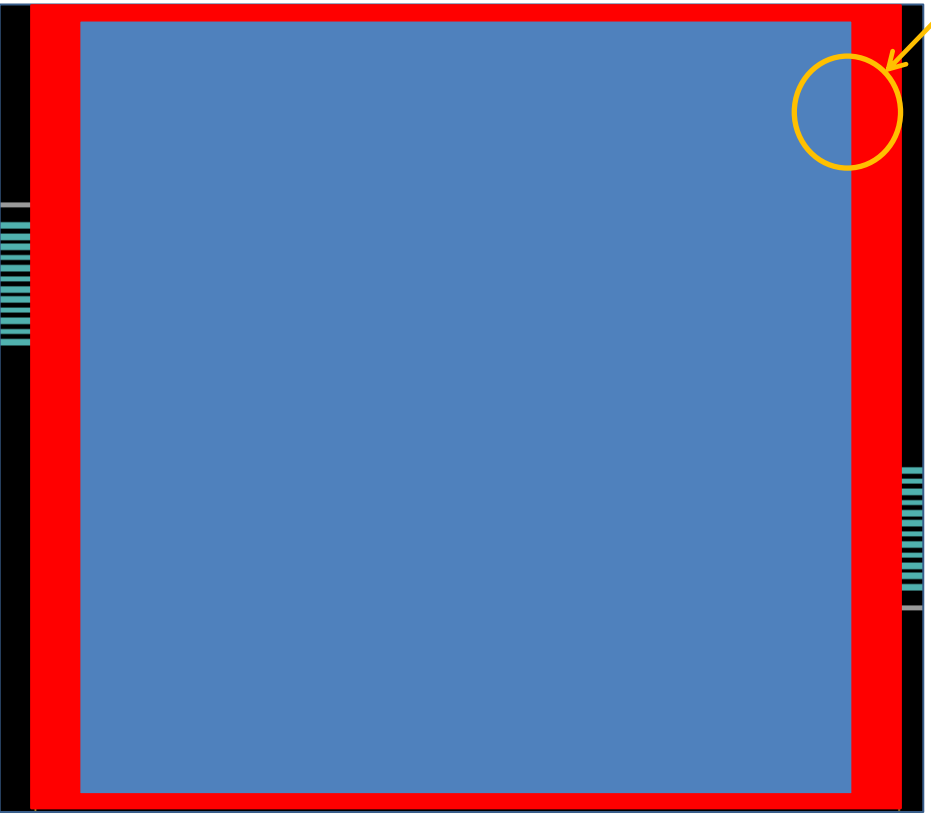
Suggestions for improvements for the next two prototypes

Faraday cage shielding using GEM foil common electrode



Safe area around the frame on GEM foil

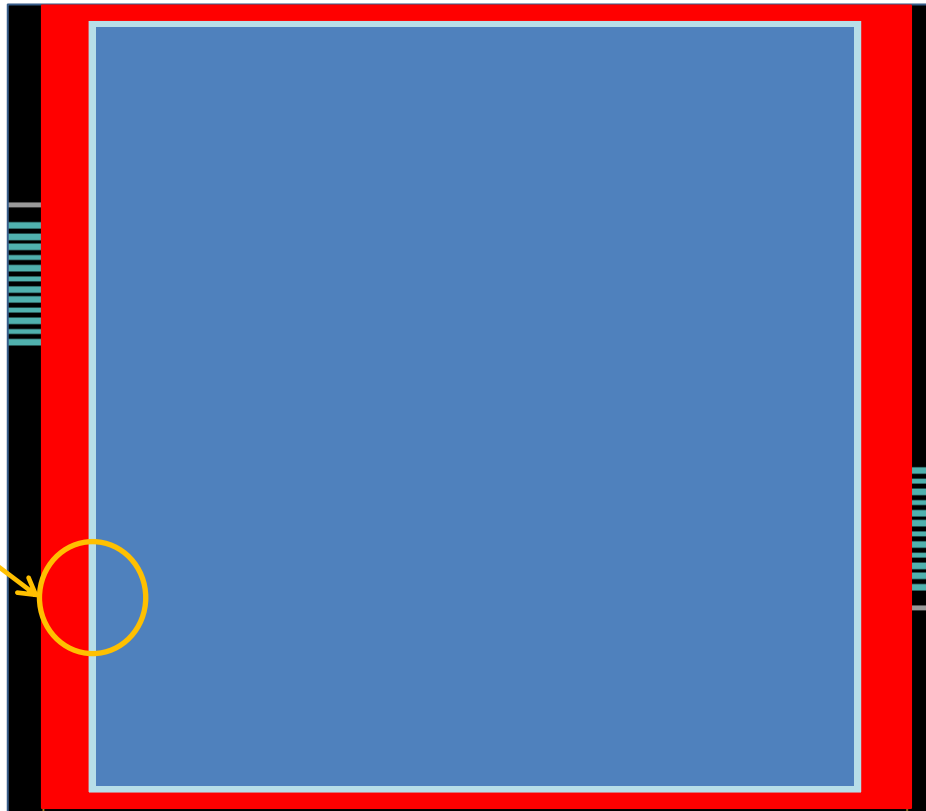
Current design



Problem

- No space between the GEM Frame (inner part) and the GEM foil active area
- Glue can leak onto the foil during assembly ➔ Sector will spark at high rate ➔ but Can be cured

Proposed modification

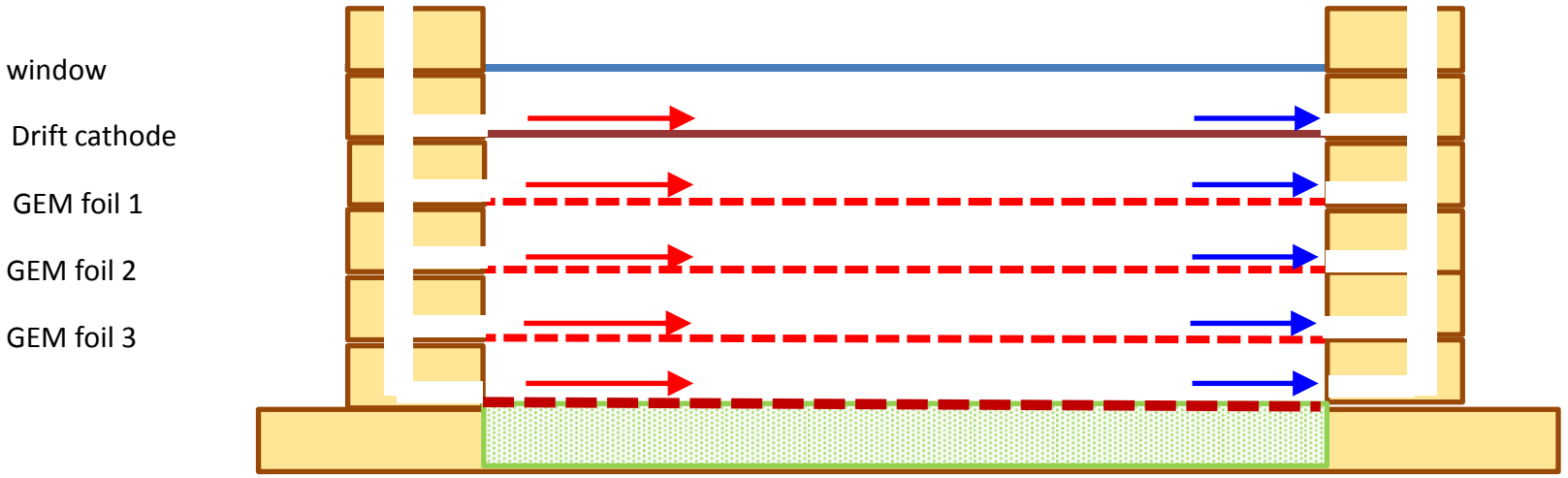


Solution

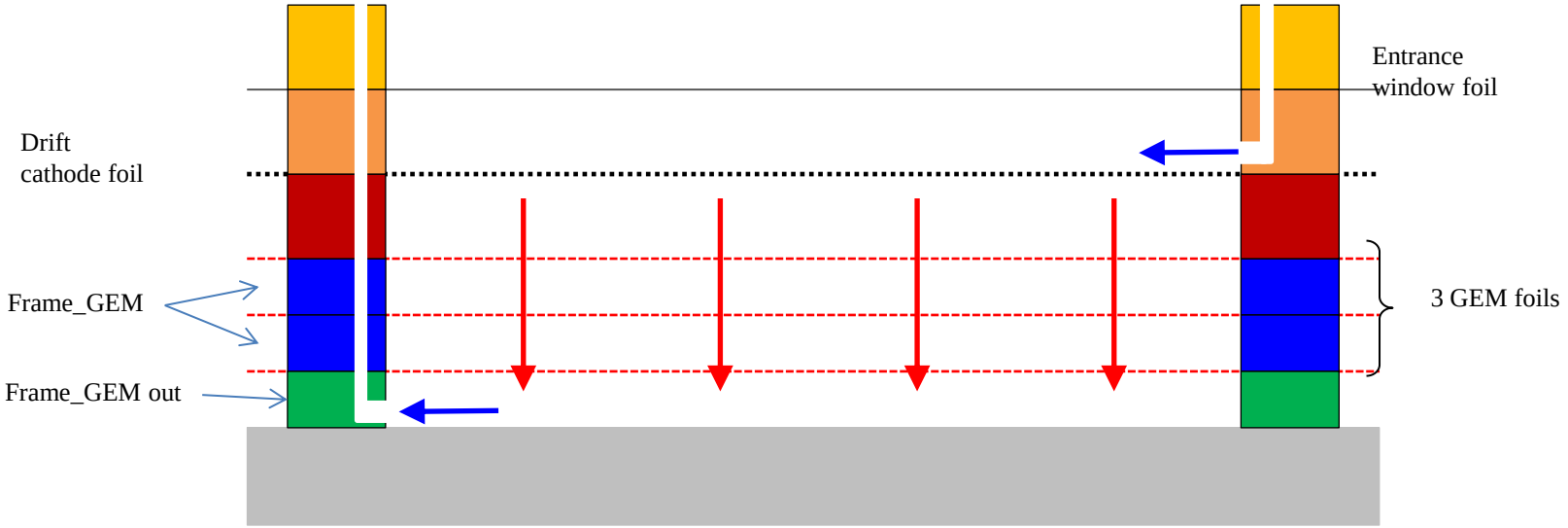
- We propose 1 mm clearance between the frame (inner part) and the GEM foil active area ➔ Kapton foil with no holes

New Gas distribution scheme for the chamber

Current gas distribution scheme

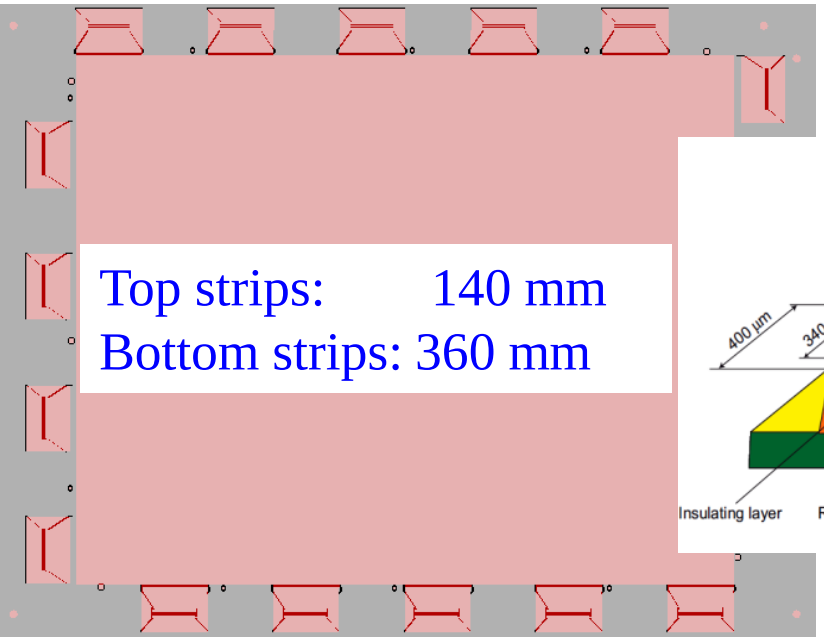


Proposed gas distribution scheme

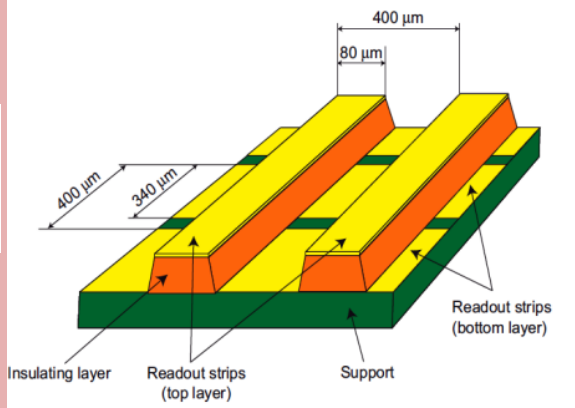


Charge sharing and 2D readout strips width

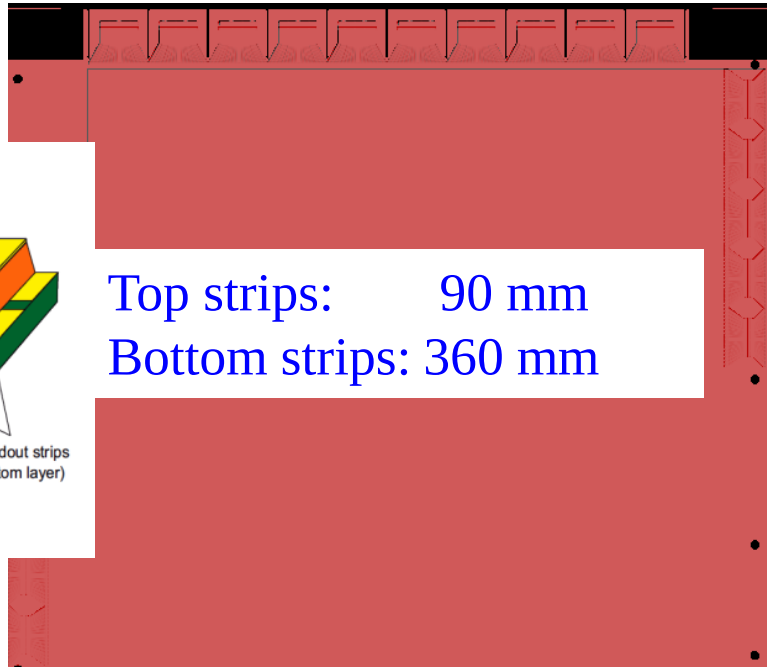
old design 40 x 50 cm²



Top strips: 140 mm
Bottom strips: 360 mm

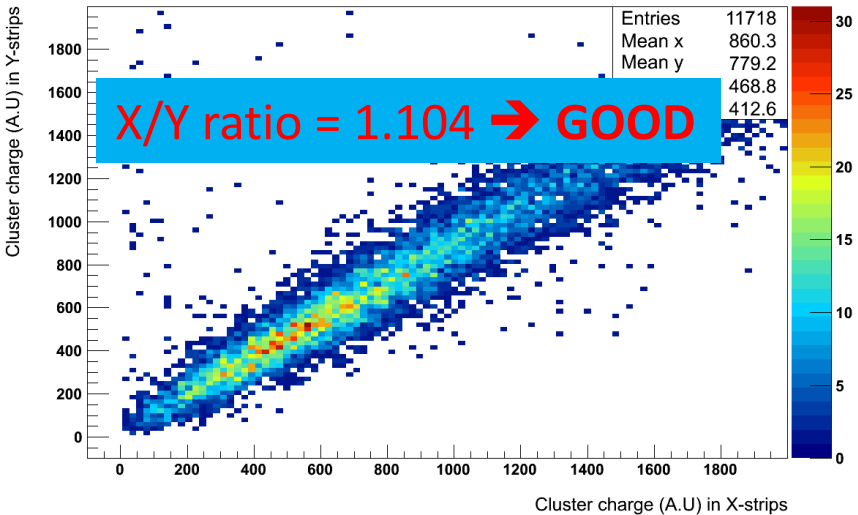


new design 40 x 50 cm²

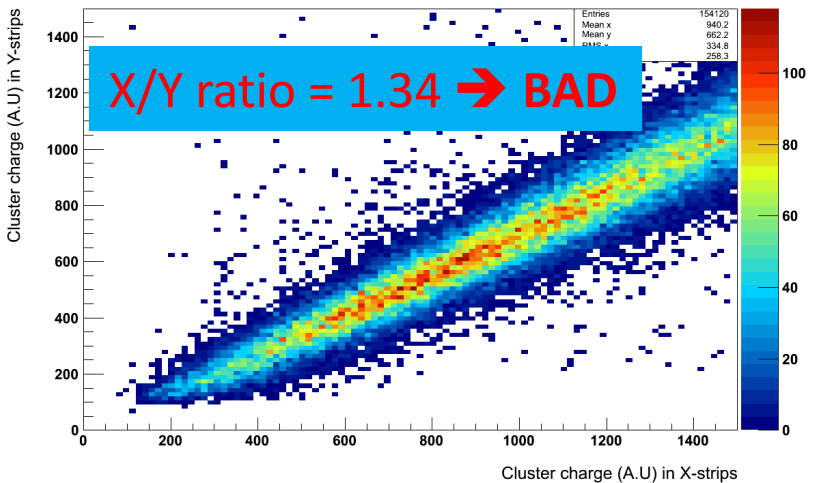


Top strips: 90 mm
Bottom strips: 360 mm

Tracker GEM1 Charge sharing with 11718 good events

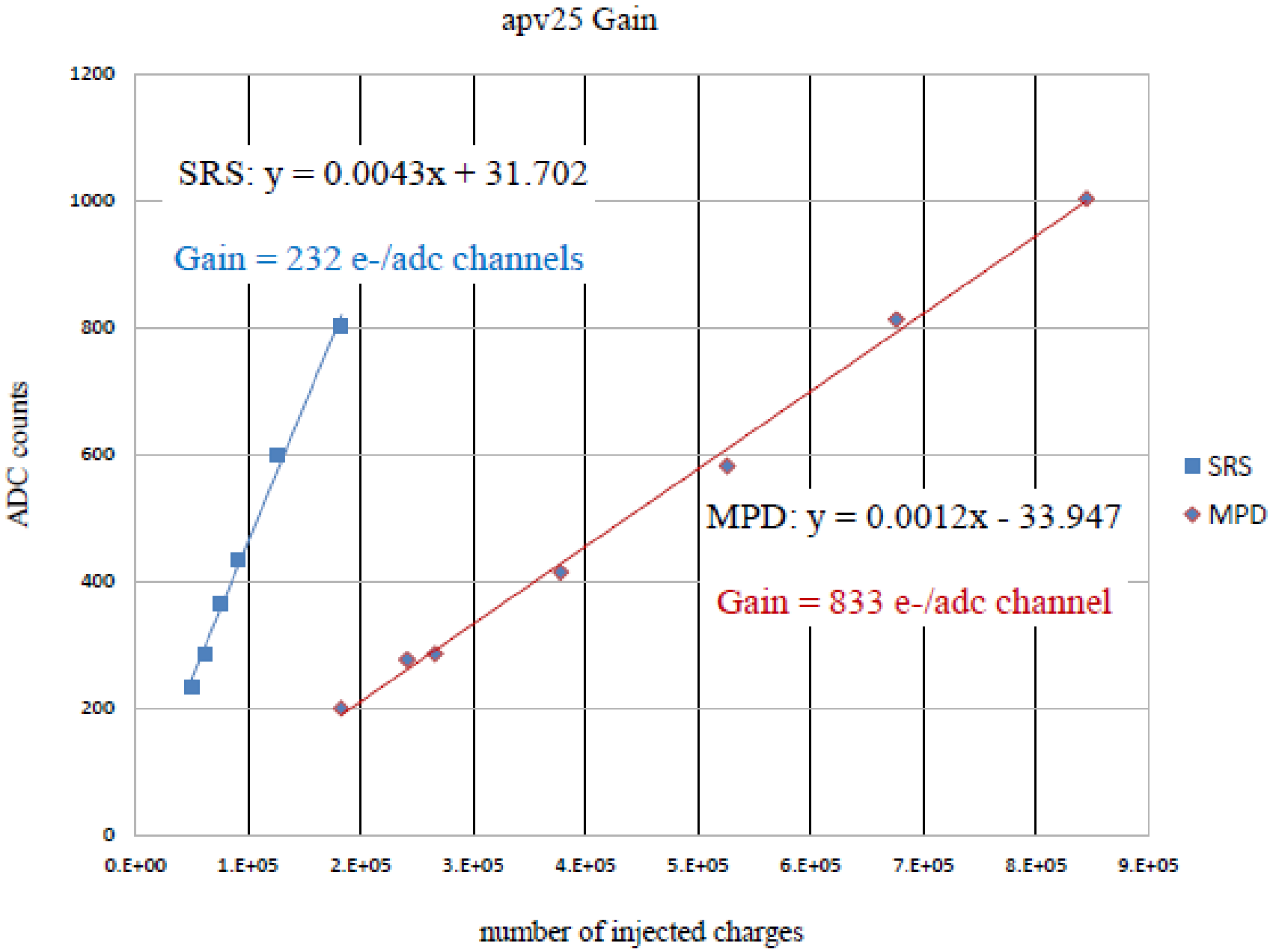


SBS 50 cm x 50 cm Proto GEM1 2D Charge Sharing



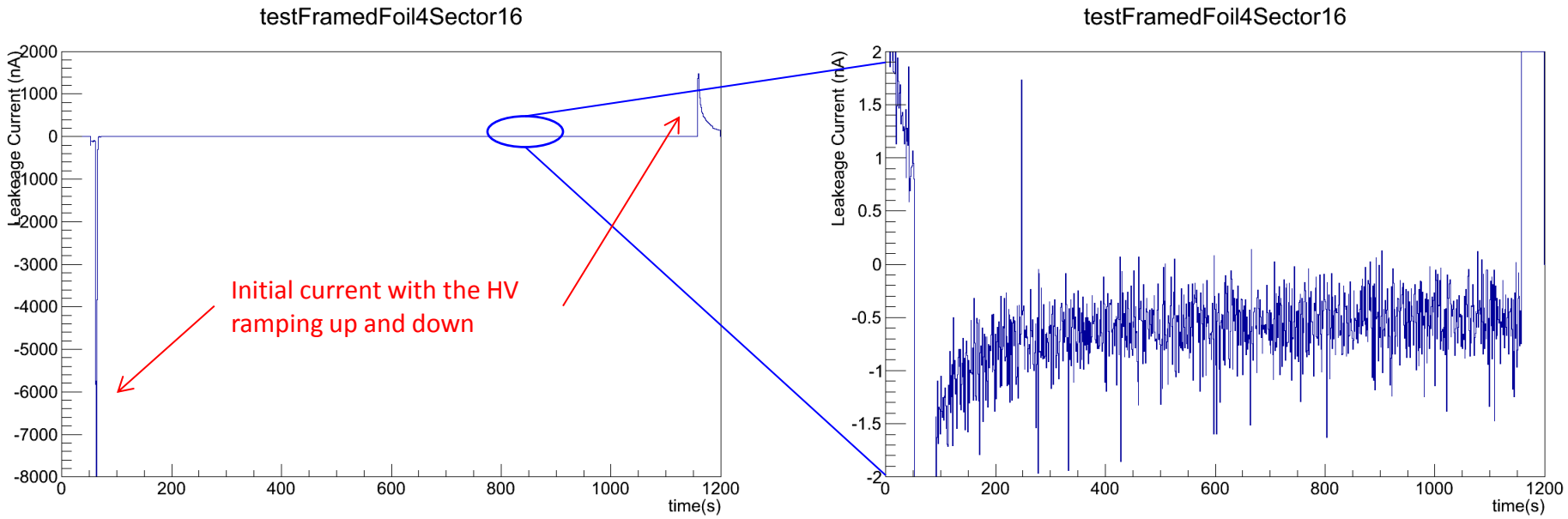
BACKUP

APV25 Gain: MPD vs SRS



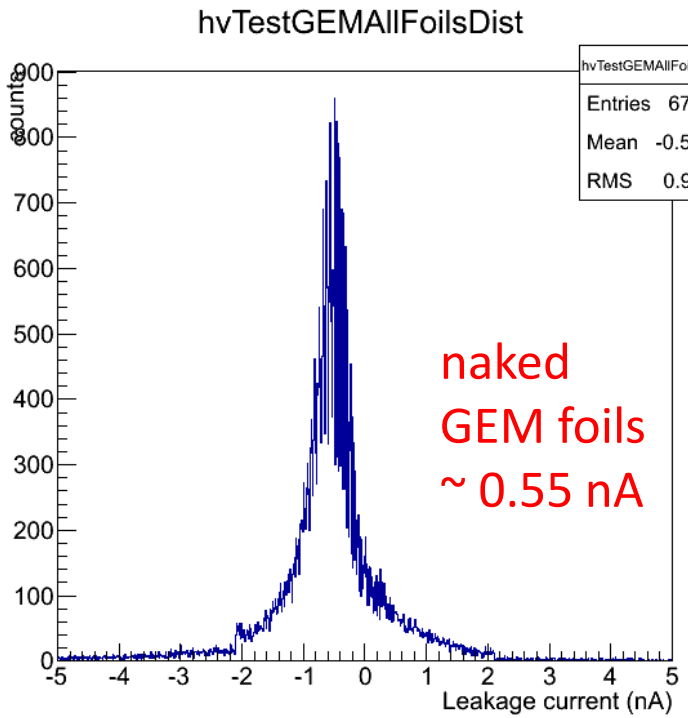
HV test of the GEM sectors

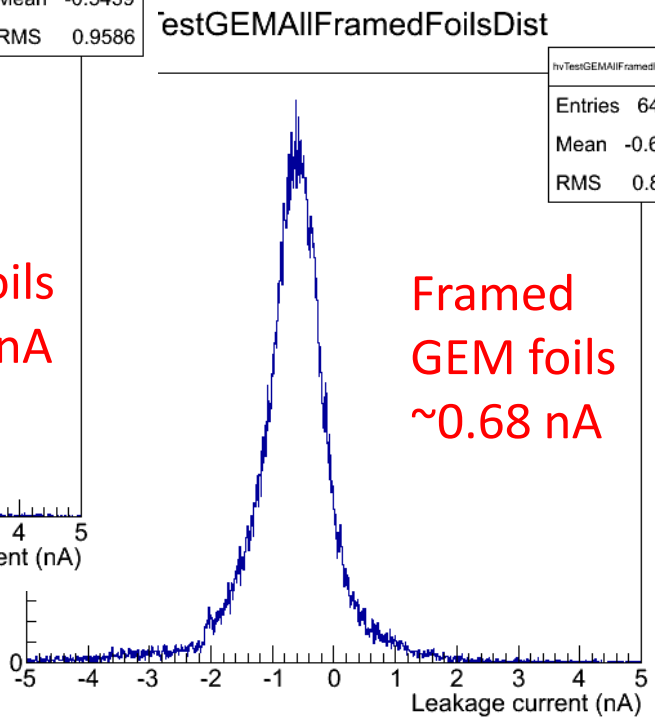
- We use an Iseg EHS 6 kV HV module in a Wiener crate, HV controlled through an internet protocol.
- Fast ramp up mode at a rate of 1200 V/s.
- The leakage current in the GEM is measured using a Keithley 6487 picoammeter, at sampling rate of 120 ms with a Labview interface and saved in txt file.
- HV GEM sector ~ 2 nF and with a resistance the HV module is ~ 50 MΩ, (once the voltage is achieved this resistance is shunted automatically within the supply).
- HV of 550 V, the initial current is a couple of μA, then quickly drops and stabilizes to less 1 nA leakage.
- We leave the HV for about 2 min and if no spark ➔ sector is good

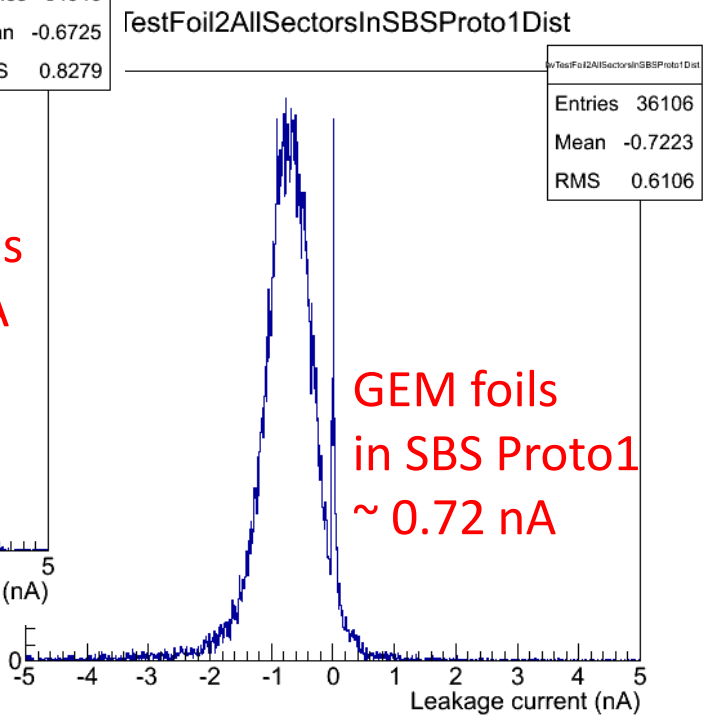


HV test of the GEM sectors

- Distribution of leakage current over all the 72 sectors (24 sectors per GEM foil and 3 foils per chamber)
- HV Test is performed at 550V in N2 for naked, framed foils and in chamber foils
- Average leakage current < 1 nA for all the tests







Recovering of a bad HV sector

Excess of glue leaked onto the sector during assembly ➔ sector recovered after curing on N2 or at 50 degree