TOTEM T2 2011 TEST BEAM PLANS

7th RD51 Collaboration Meeting

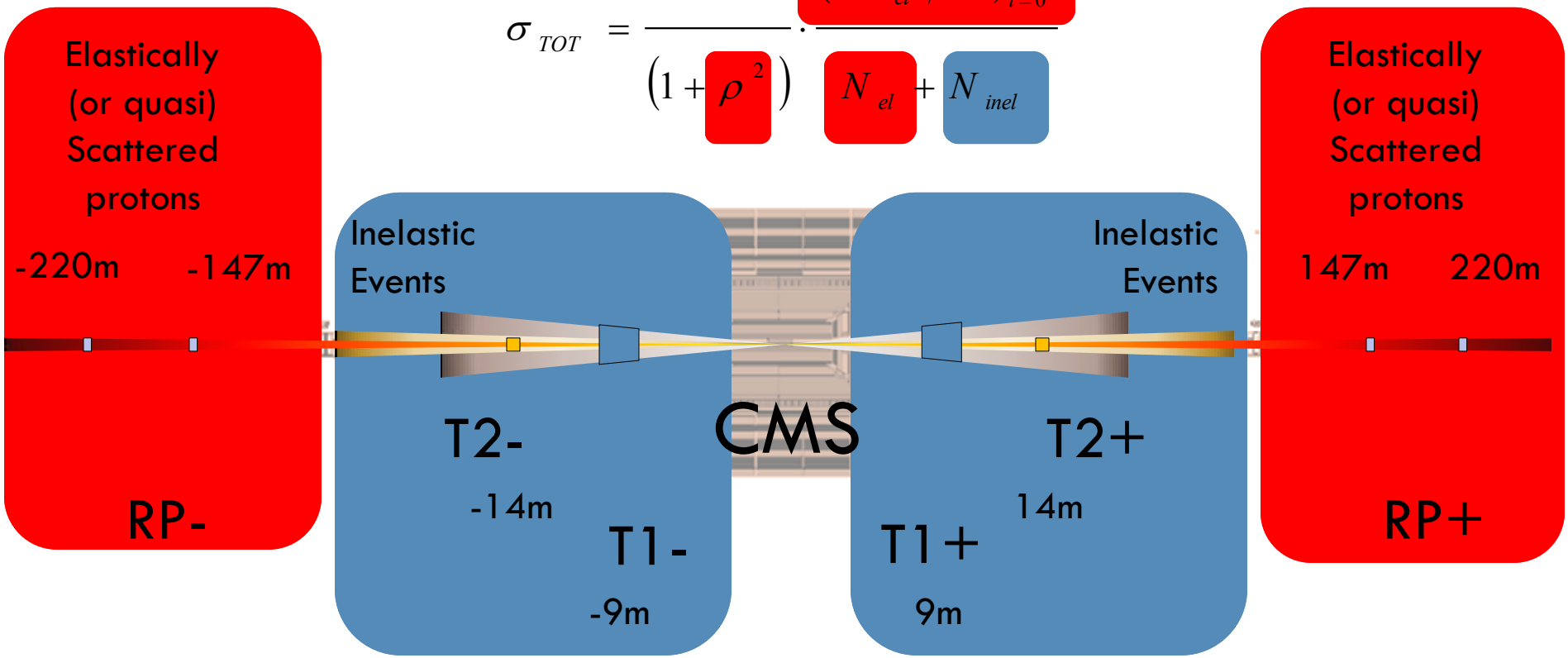
2011 TOTEM T2 Test Beam Plans

TB aim: Collect data for…

- 1. T2 optimization “Before the Long Shut Down”.
- 2. Triple GEM design optimization for forward regions & high luminosity (T2 optimization “During the Long Shut Down” and GEM RD)

TOTEM

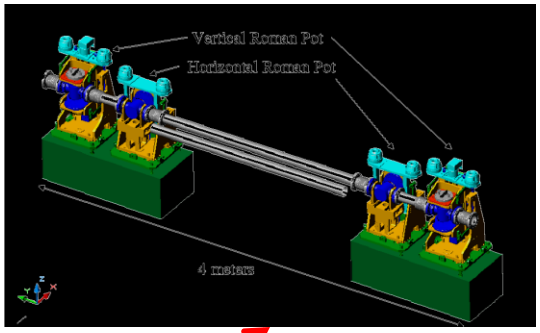
$$\sigma_{TOT} = \frac{16}{(1+\rho^2)} \cdot \frac{(dN_{el}/dt)_{t=0}}{N_{el} + N_{inel}}$$

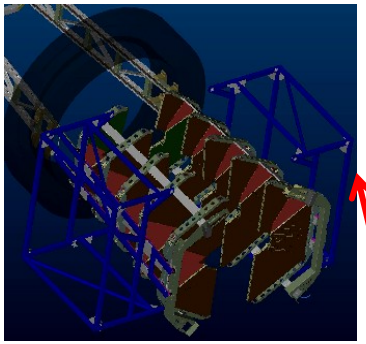


IP5

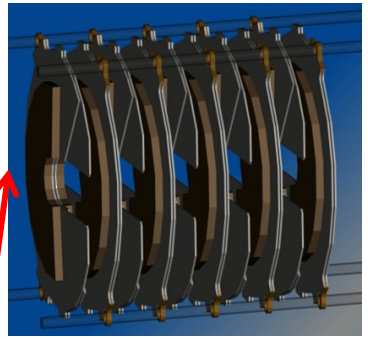
TOTEM

RP: edgeless Silicon detector

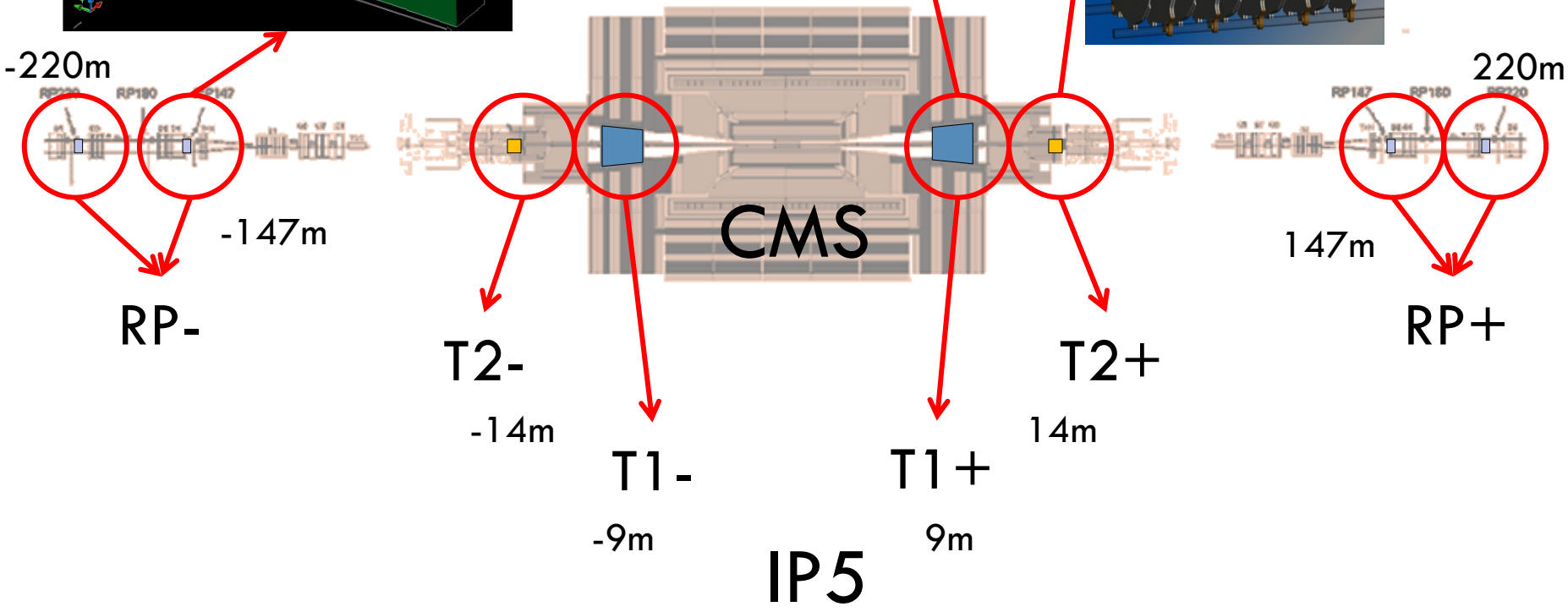




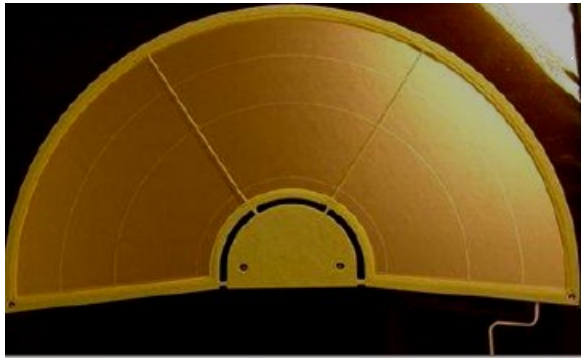
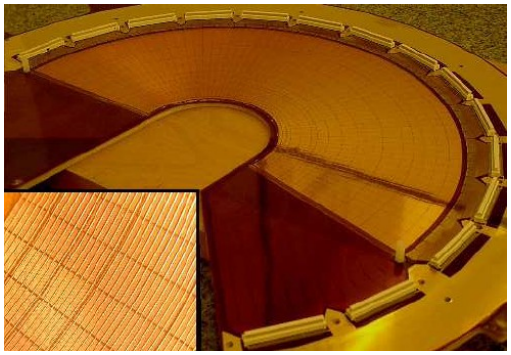
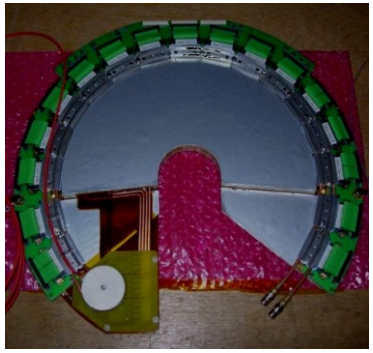
T1:CSC



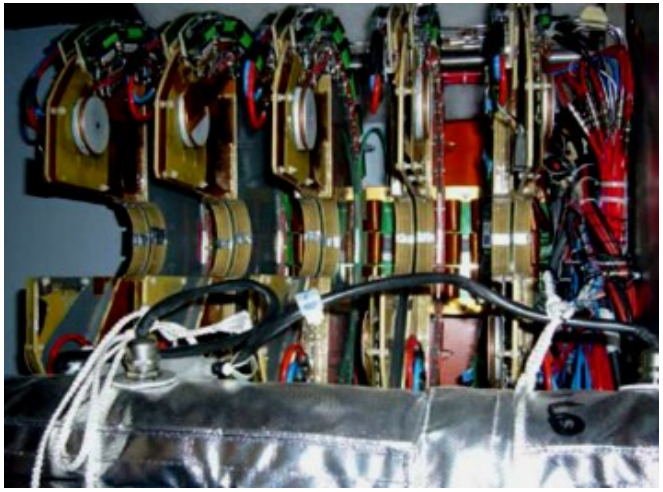
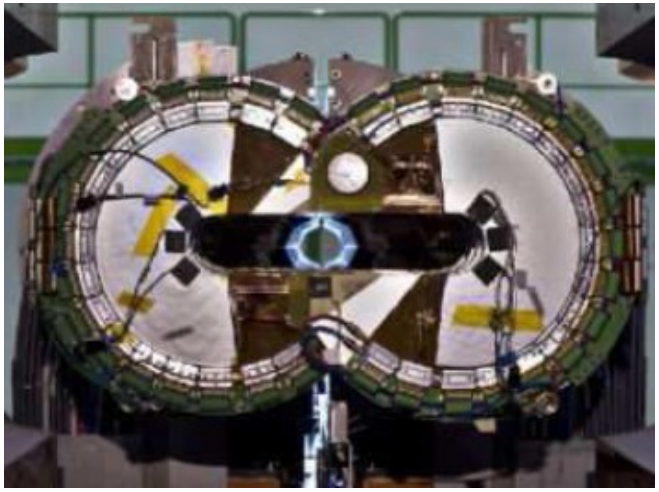
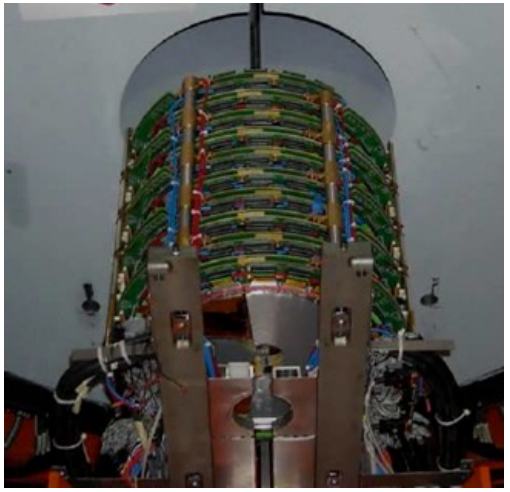
T2:
Triple GEM



TOTEM T2

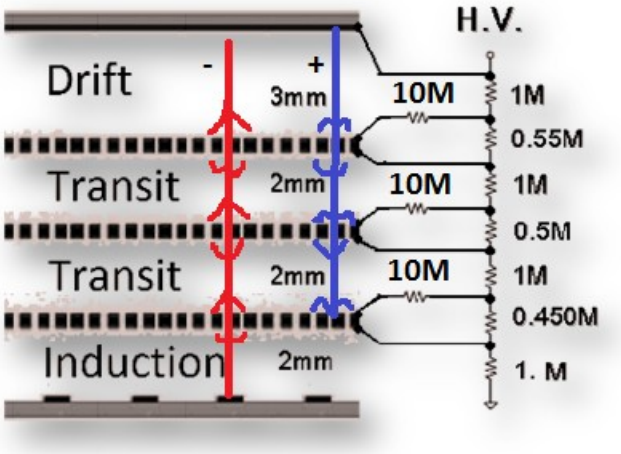
No problem with T2 in TOTEM dedicated run at Low-Medium Intensity.
However, if we want to profit of/take data in the high luminosity runs, we have to face one issue….

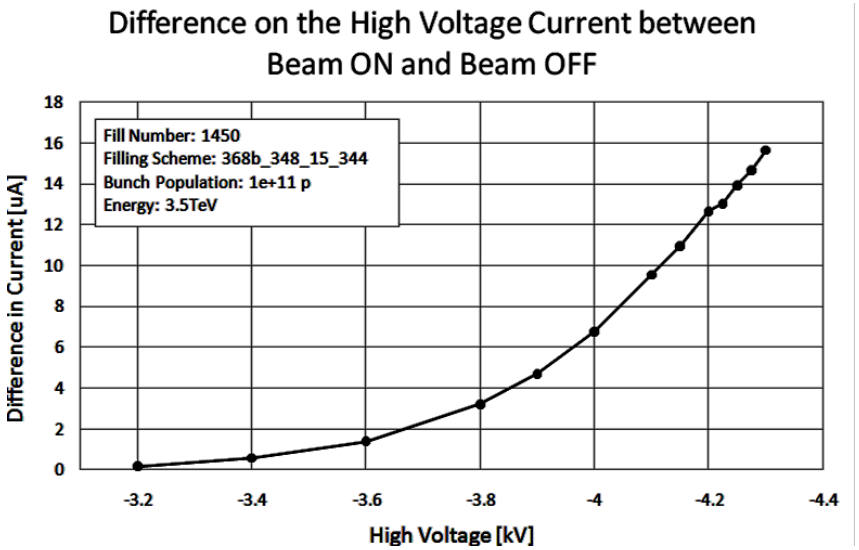




T2: a T2 limit with high luminosity

T2 Environment: Large amount of particles (primary and secondary) per collision.
T2 Gain: High GAIN to be efficient in the actual configuration

The amplified charge collected by the foils will cause a voltage drop across the 10Mohm protection resistors.





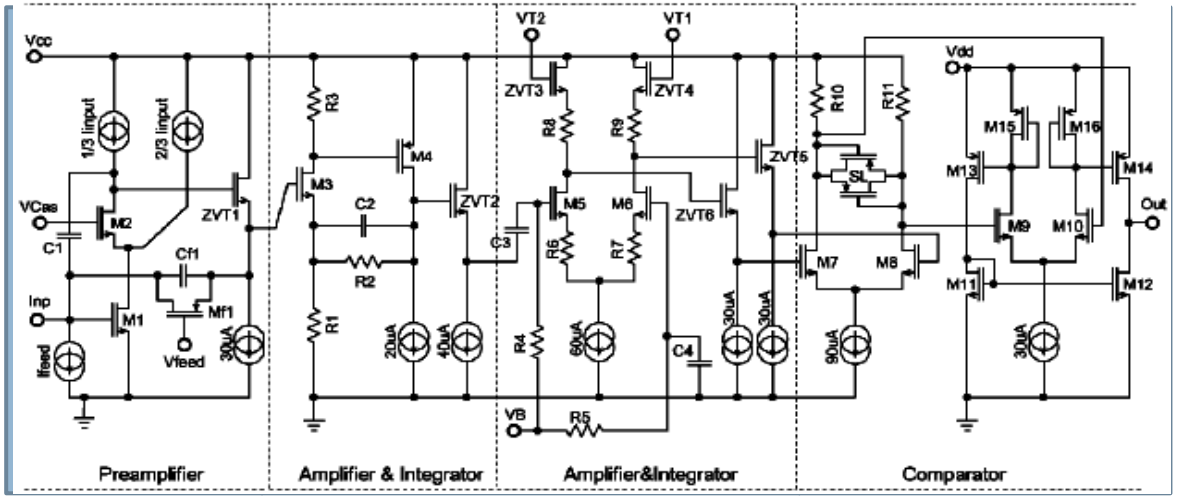
In high intensity beams the current flowing in the foils can reach few μA and the effect on the gain is not negligible.
MANDATORY: reduce as much as we can the detector GAIN

→Reduce Noise/Increase Signal.

1.T2 optimization: Noise

- Front End chip VFAT2
  - Internal Settings optimization

Preamplifier Shaper Comparator.

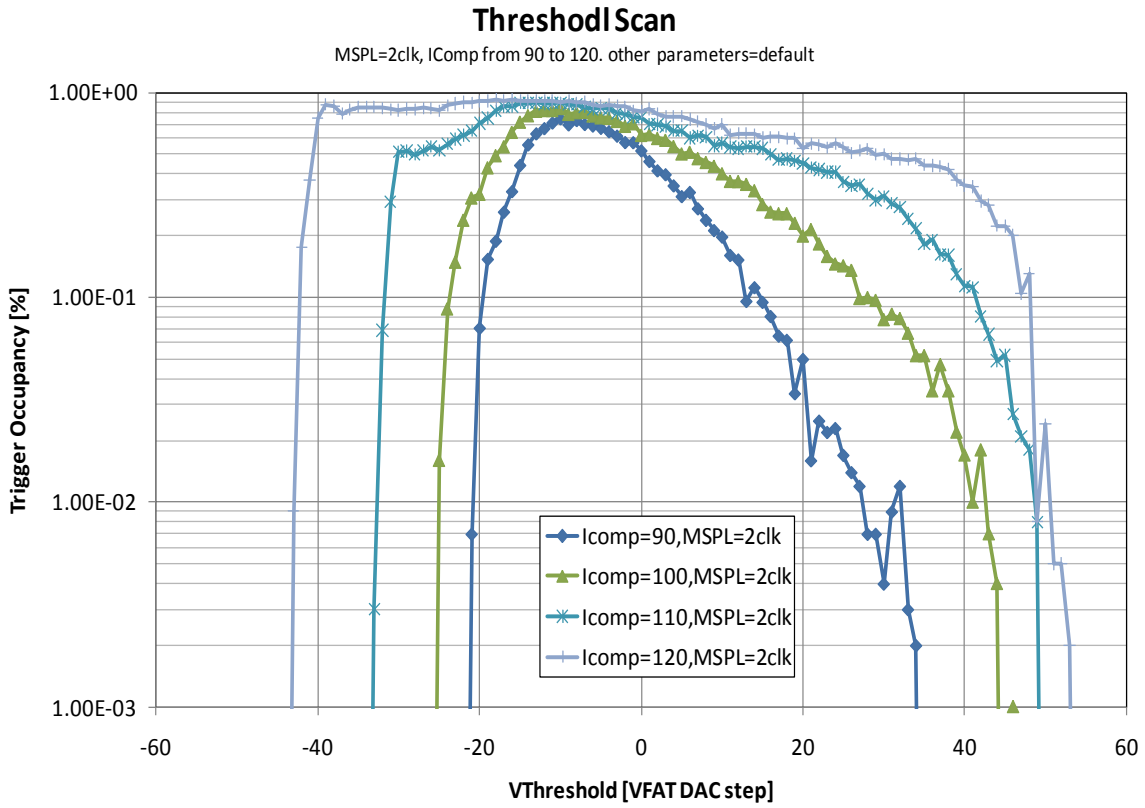


  - Simulation (P. Aspell)
  - Test Beam: Monitoring of the S/N ratio and Timing

DETECTOR UNDER TEST : TOTEM T2 TRIPLE GEM

1.VFAT2 Settings: one example

- Noise Scan vs the VFAT2 Comparator Current



A factor 2 in the Noise improvement.

We need to evaluate the effects on the Signal.

Laboratory tests on calibration pulses and data from IP5 promising.

Test Beam for systematic analysis for all the FE parameters that can be modified.

Reduce the Noise → Lower the Gain

1.T2 optimization: Signal

Gas mixture studies:

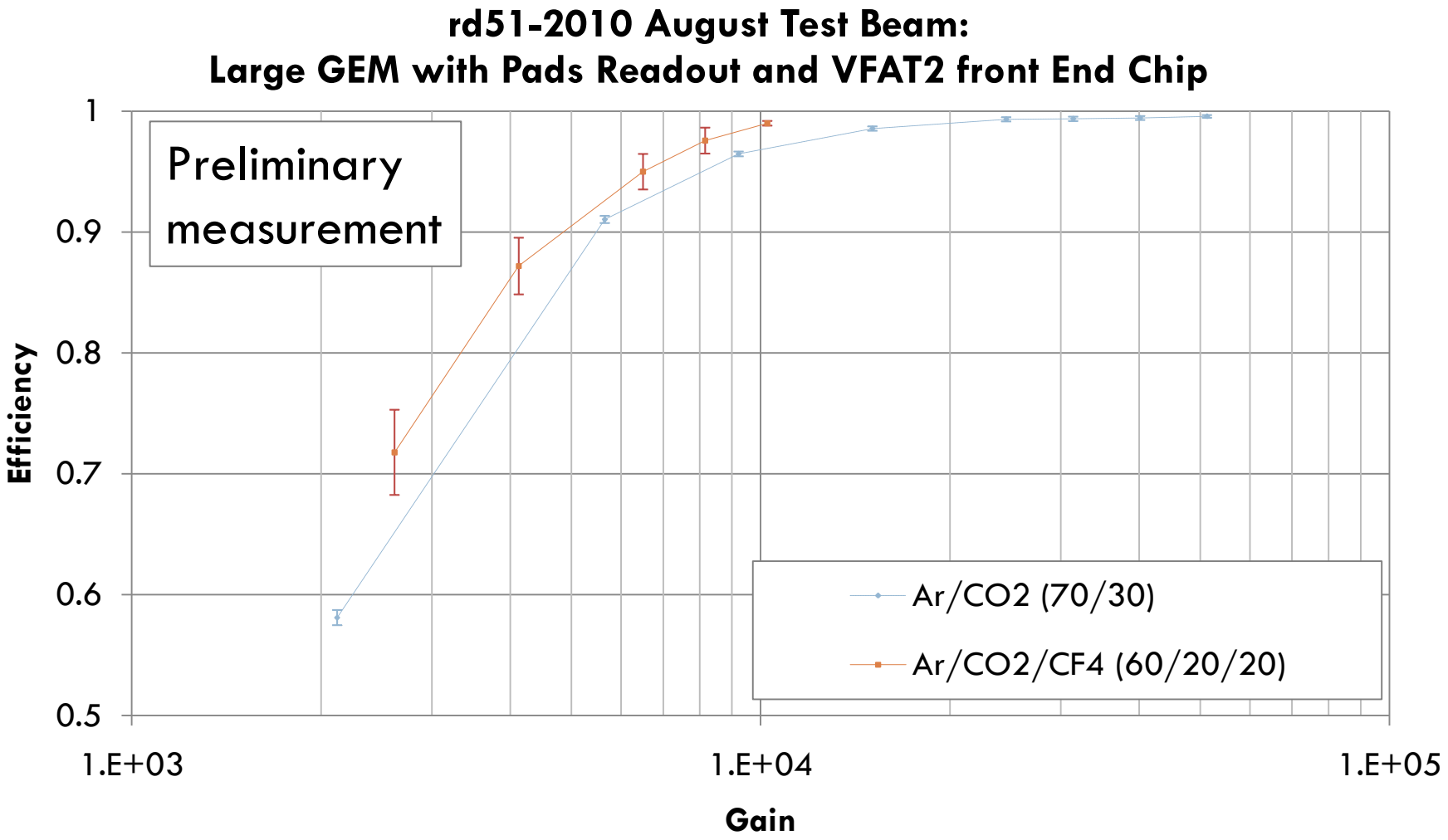
Actual mixture: Ar/CO2 70/30

- Migration to Ar/CO2/CF4 in a ratio optimized for the internal field configuration that we have.
  - Lab. Gain calibration Curves
  - Test Beam Efficiency and Timing Studies

Increase the Signal → Lower the Gain

(VFAT2 shaping time=22ns)

1. 2010 test beam: preliminary measurement with Ar/CO2/CF4



2.GEM in forward region at high Lumi.

- Test Ar/CO2/CF4 gas mixtures, field and internal structure (learning from LHCb & CMS studies)
  - From the actual 3:2:2:1 (Drift:Trans1:Trans2:Induct.) to:
    - Induction gap to1mm ← faster
    - Transit1 to 1mm ← reduce the "double gem" signal
    - Drift to 2mm and to 1mm ← less efficient but with shorter signals
    - Field optimization for Ar/CO2/CF4 (Frascati HV PS)
- Readout Foils (?) : according to the physics

Detector Under Test: 10x10 screwed GEM

2011 TOTEM T2 TB Plans: Summary

- 1. T2 (as it is now) optimization (BLSD*) → reduce the detector GAIN
  - Front end chip (Noise)
  - Gas mixture (Signal)
- 2. Triple GEM design optimization for forward regions & high luminosity
  - Gas mixture & fields & Internal structure (gaps).
  - Readout Planes

(*) Before the Long Shut Down

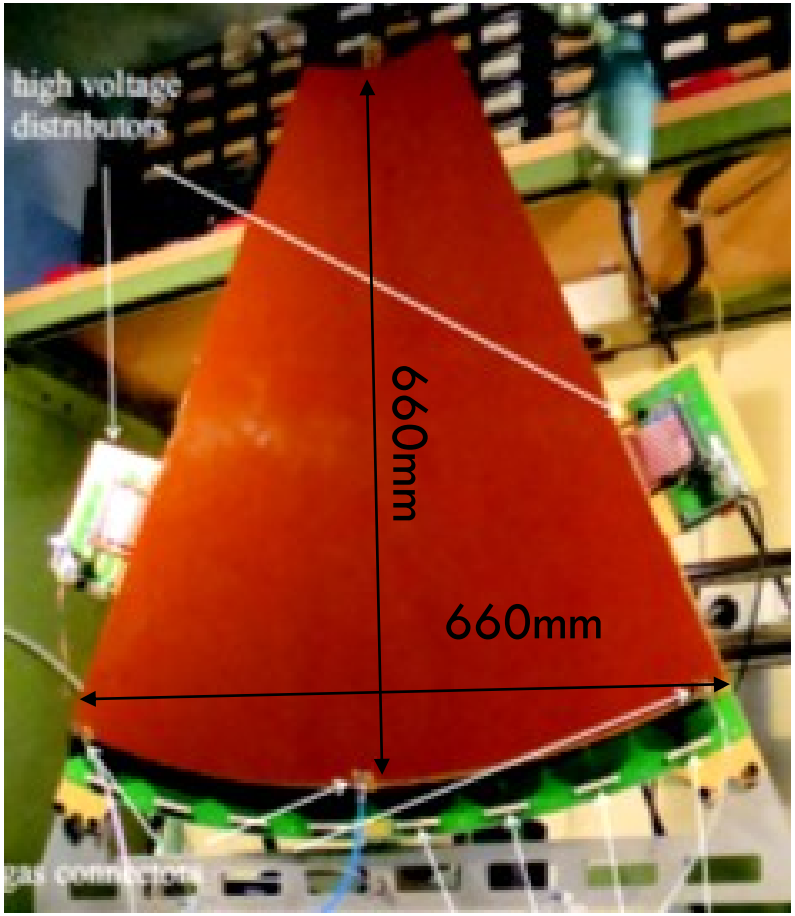
Thanks

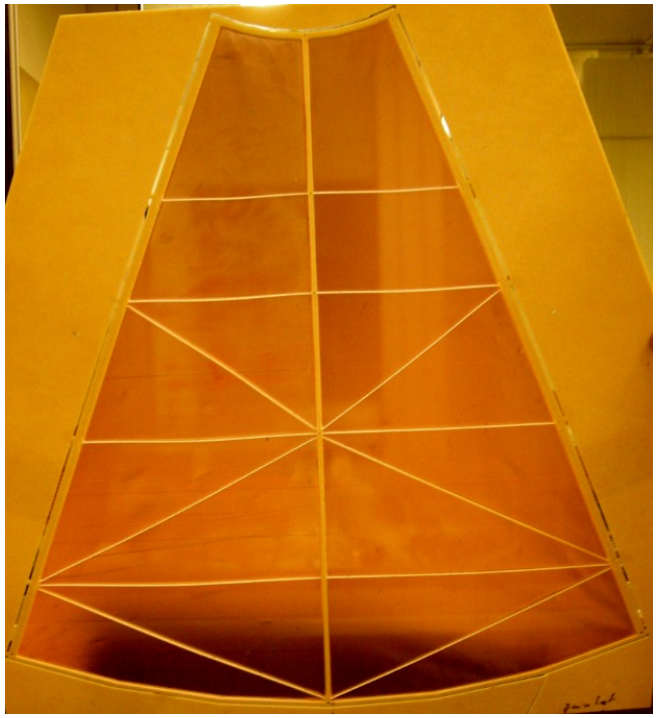
2010 Test Beam

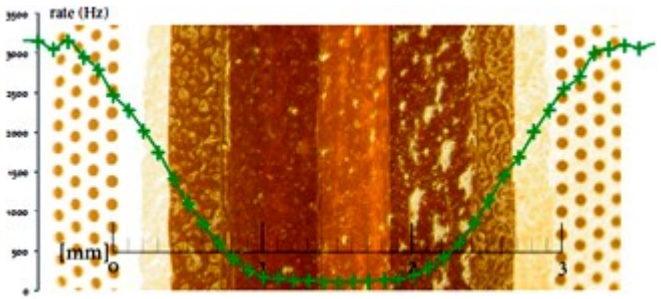
- Characterize the performance of the TOTEM VFAT2 front end chip with a Large GEM detector with large capacitance pads (a good candidate for a TOTEM T1 telescope upgrade).

2010: Large Single Mask Triple GEM

Large Triple GEM

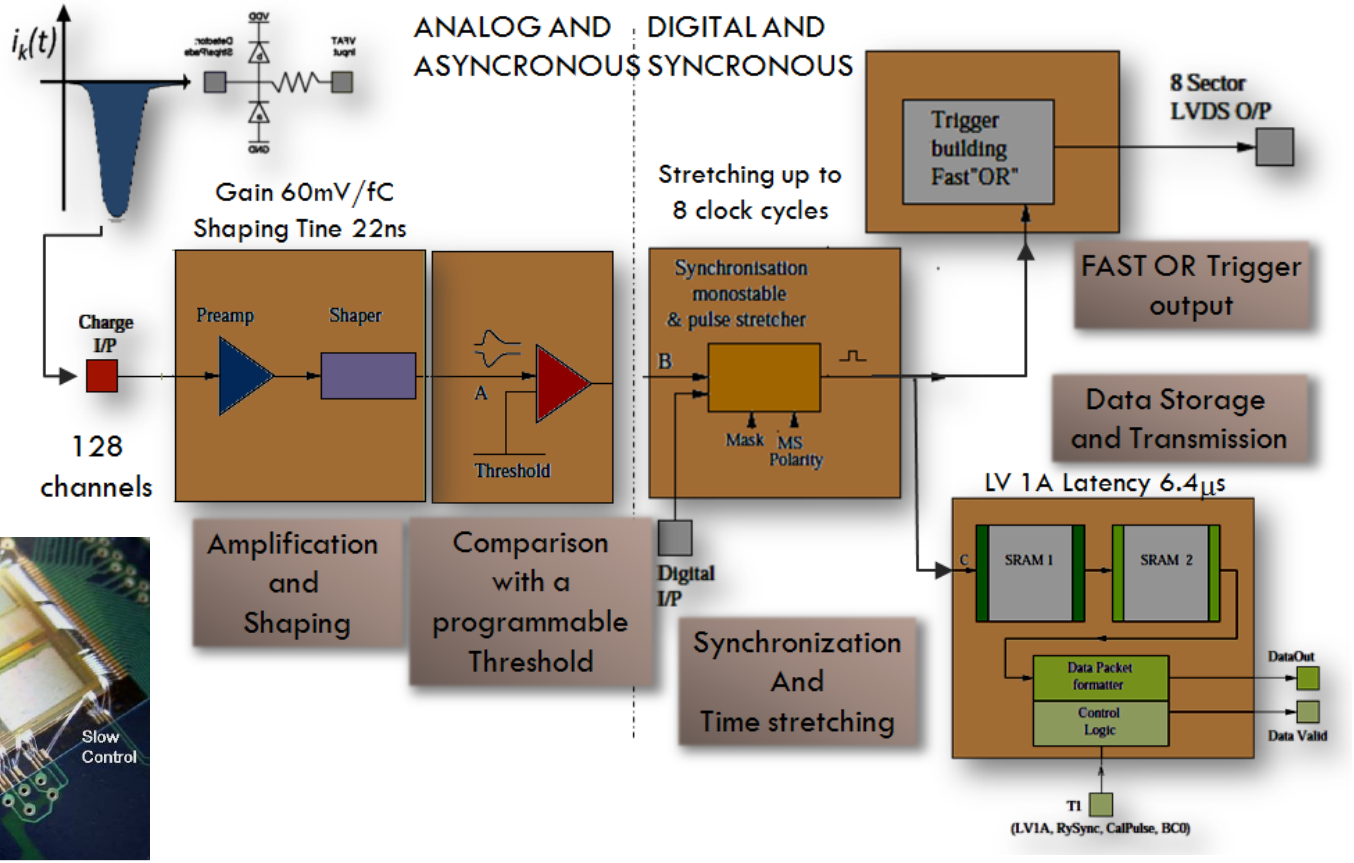


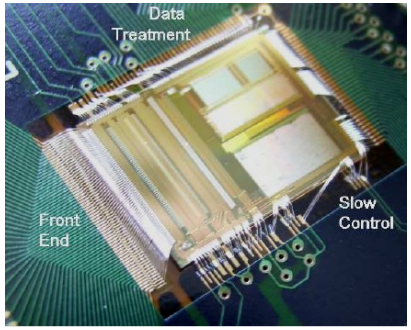




(GDD, ref, S.D.Pinto)

2010: VFAT2



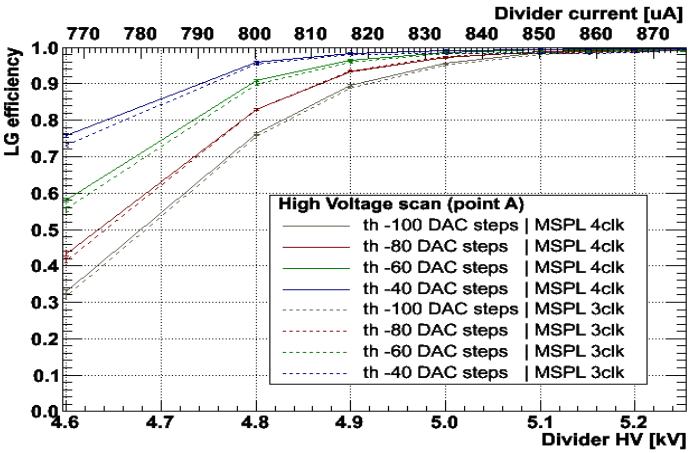


Triggering and tracking synchronous front-end ASIC designed primary for the TOTEM experiment and characterized by:

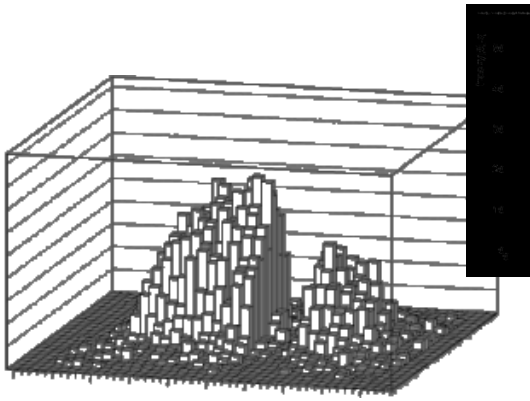
- Preamplifier-shaper-comparator readout chains (128) to detect signals above a programmable threshold.
- Fast-OR lines (up to 8) that merge channels of programmable sectors to provide a trigger signal.

2010: test beam results

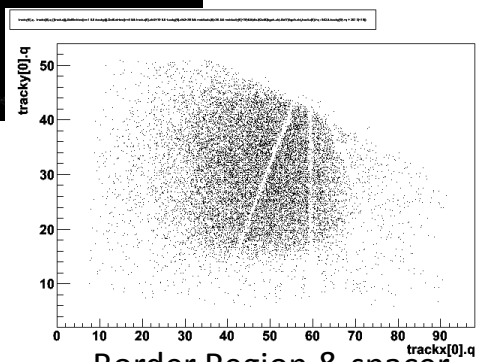
Efficiency vs Gain



Efficiency vs position (RD51 tracker)



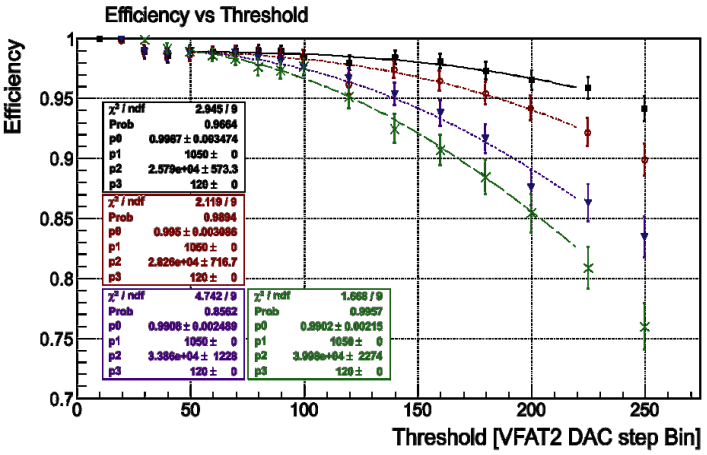
Splicing region & spacer



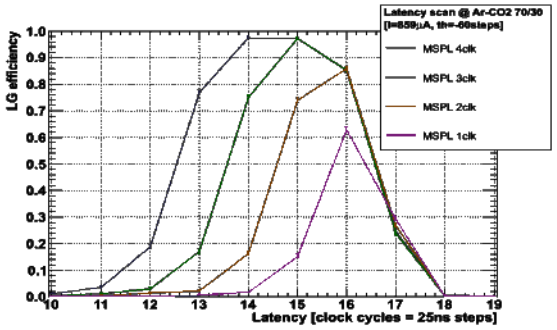
Border Region & spacer

Timing

Efficiency vs VFAT2 Threshold



Efficiency vs VFAT2 internal monostable streching (≈integration window)



Time Resolution [CMS Timing meas. System]