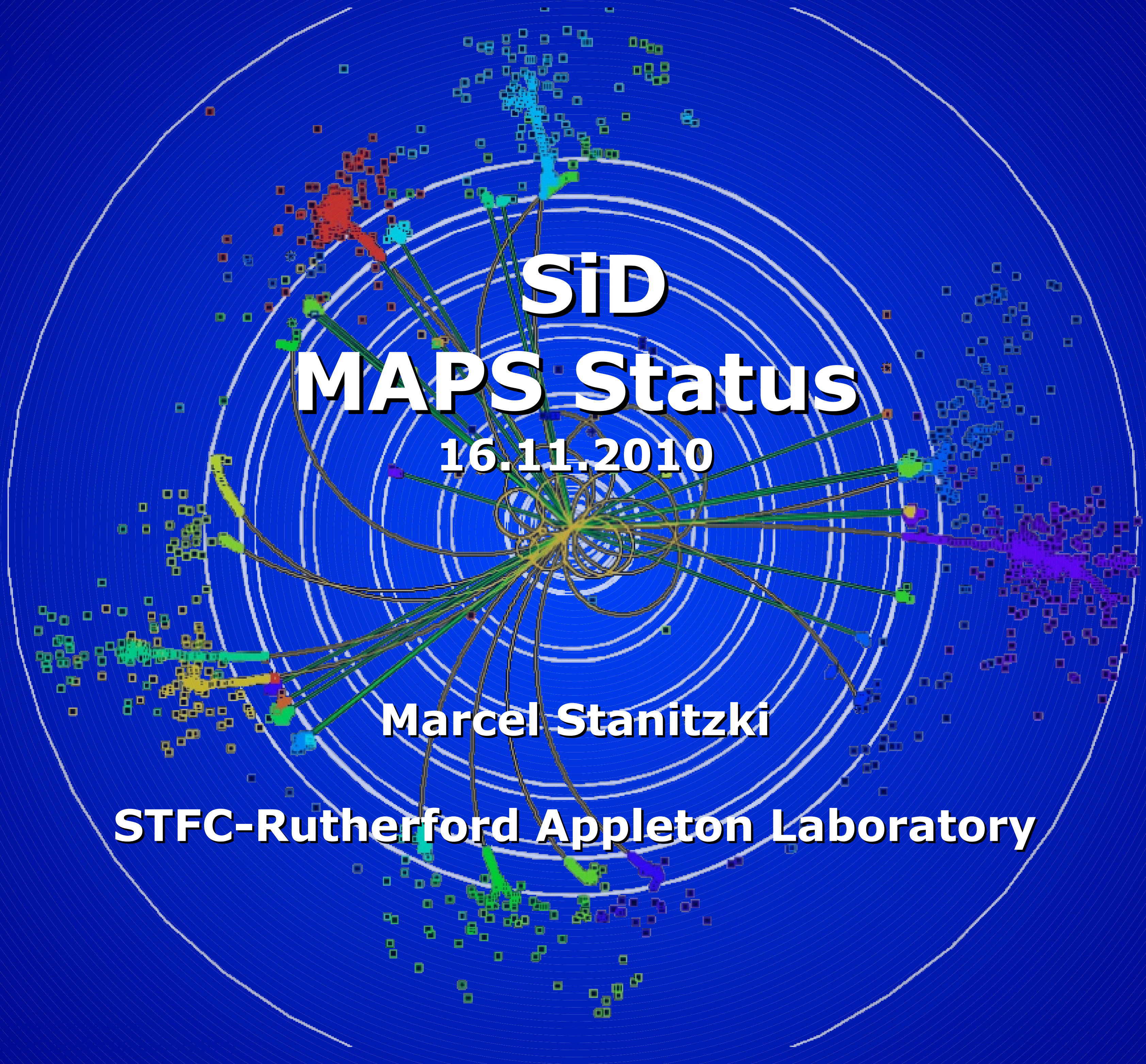


SiD MAPS Status

16.11.2010

Marcel Stanitzki

STFC-Rutherford Appleton Laboratory

Since the LoI

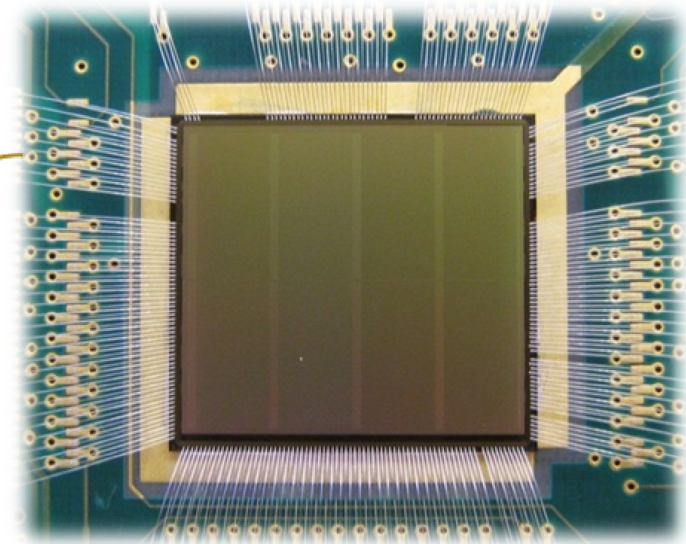
- Things didn't go well for us
  - On Bridging from Apr 2009
  - Completely cut in April 2010
- Only allowed us to keep going
  - With reduced man power
  - No big new submissions
  - No digital ECAL stack
- Our Budget for the next three years is not settled yet
  - Will probably know the impact by January
- We are still alive ...

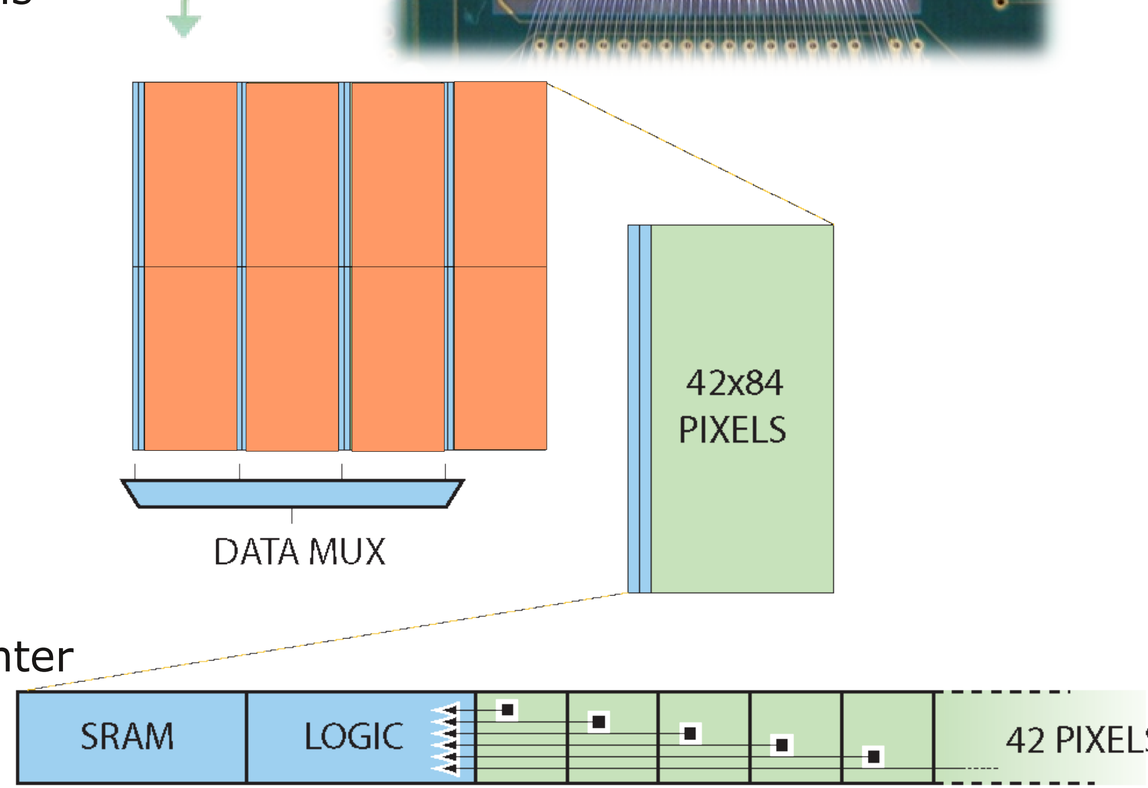
Latest Progress

- Had several testbeam campaigns
  - Big Thanks to EUDET for their support
- Mainly testing MIP so far
  - But have electron data with tungsten sheets
  - Work in progress

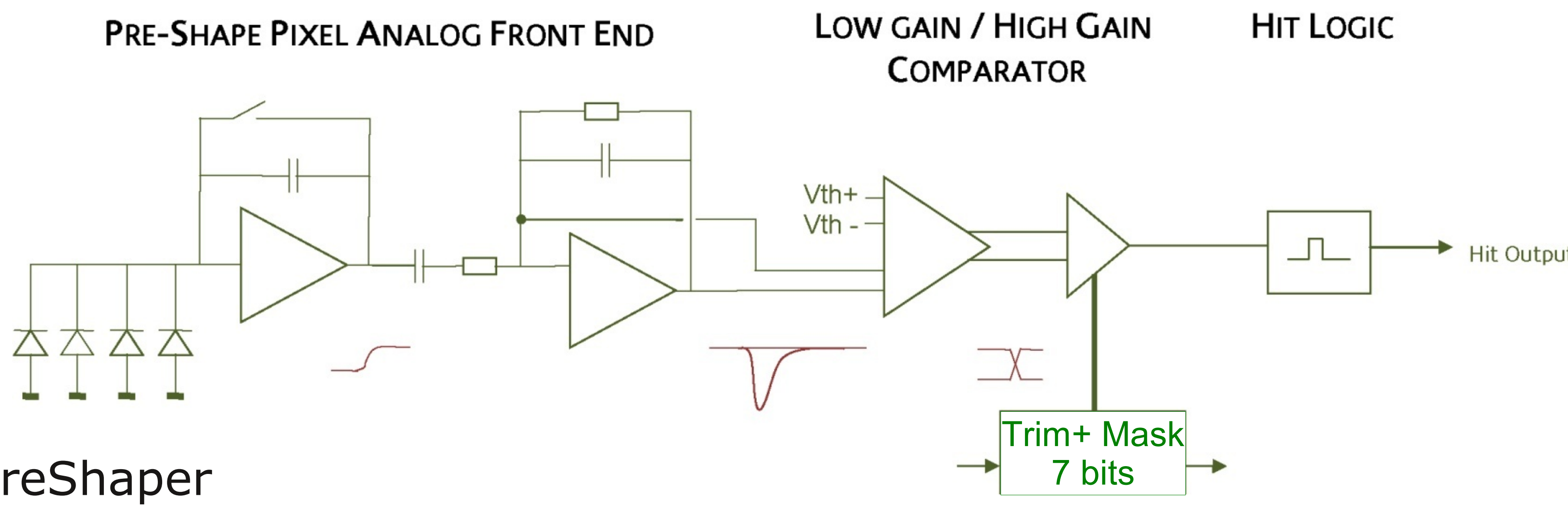
The TPAC 1.2 Sensor

- 8.2 million transistors
  - 28224 pixels , 50 x 50 μm
- Sensitive area 79.4 mm^2
  - of which 11.1% “dead” (logic)
- Four columns of logic + SRAM
  - Logic columns serve 42 pixels
  - Record hit locations & timestamps
  - Sparsification on chip
- Data readout
  - Slow (<5Mhz)
  - 30 bit parallel data output
- Developed for
  - Digital ECAL as Particle Counter

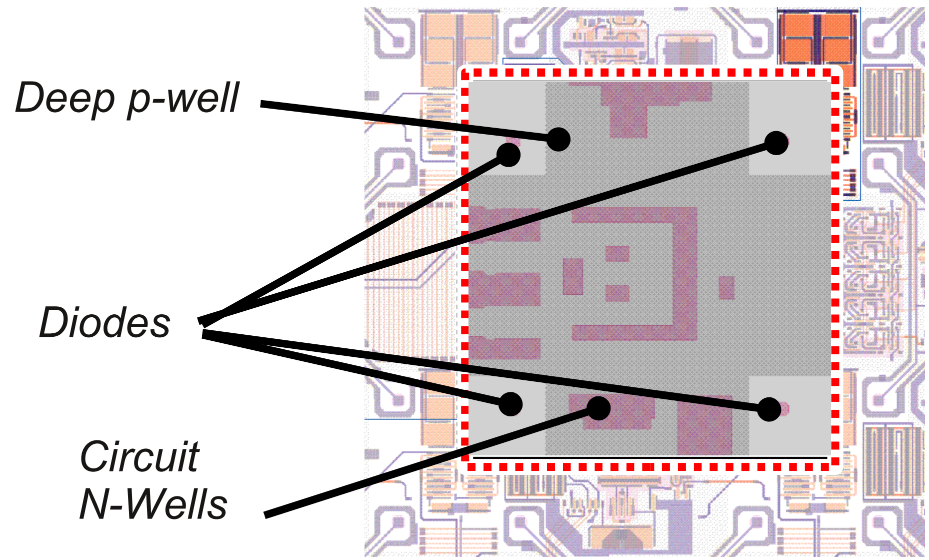




TPAC Architecture Details

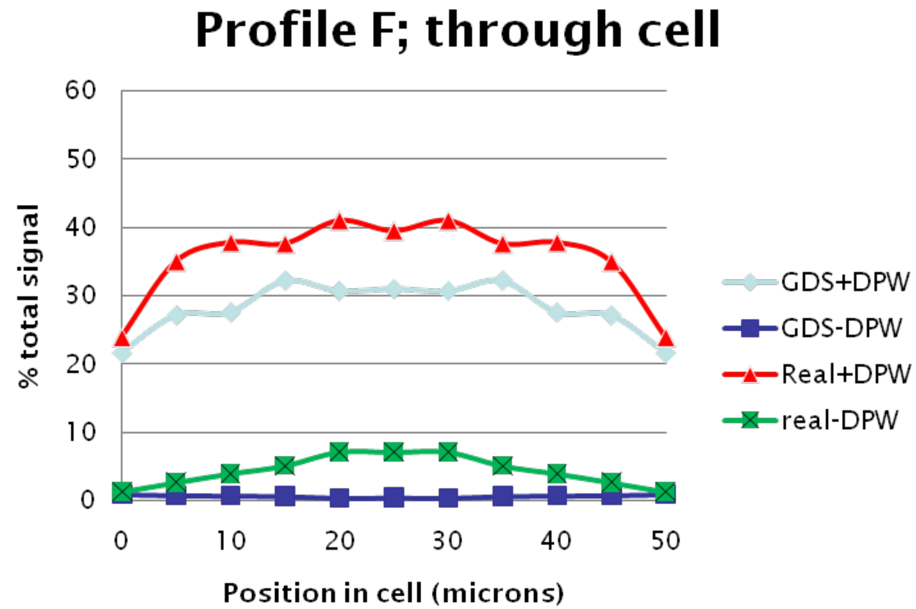


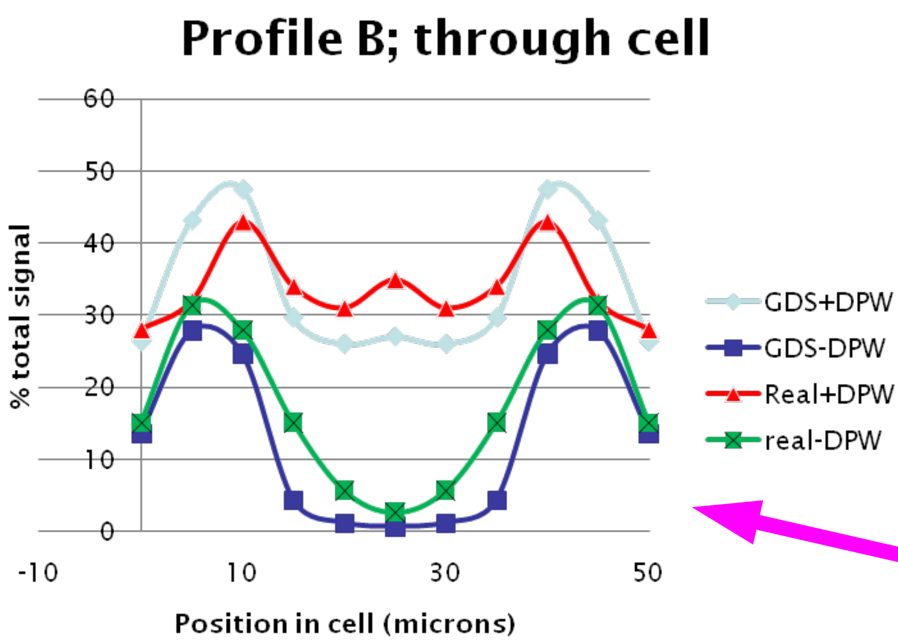
- PreShaper
  - 4 diodes
  - 1 resistor (4 MΩ)
  - Configuration SRAM & Mask
  - Comparator trim (6 bits)
- Predicted Performance
  - Gain 94 μV/e
  - Noise 23 e^-
  - Power 8.9 μW

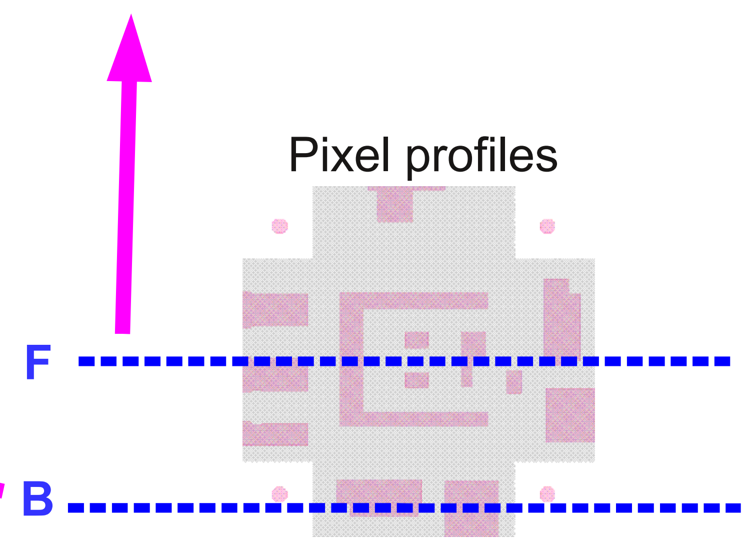


TPAC 1.X Results

- Using ^{55}Fe sources and IR lasers
  - Using the test pixels (analog output)
  - IR laser shows impact of deep p-well implant

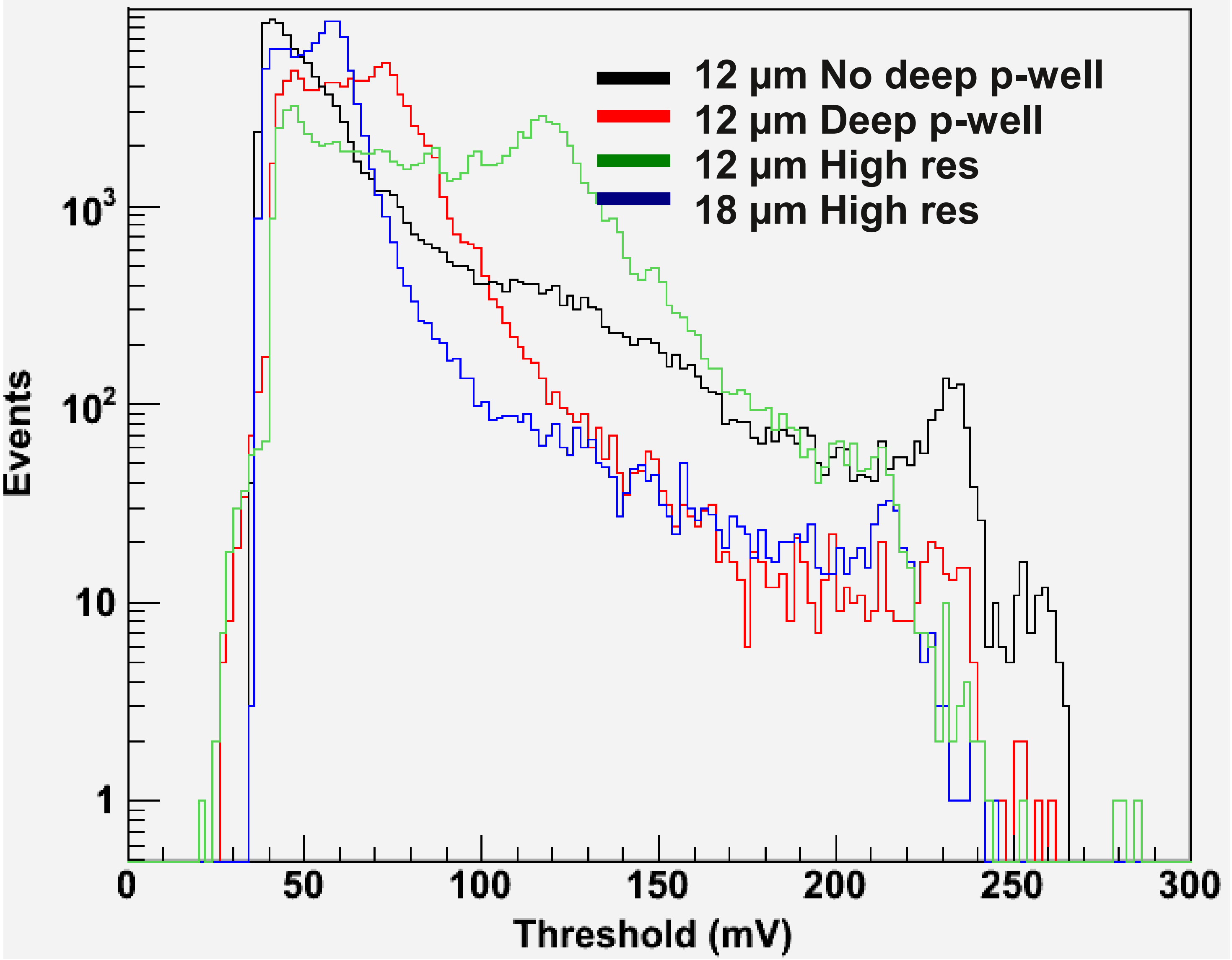






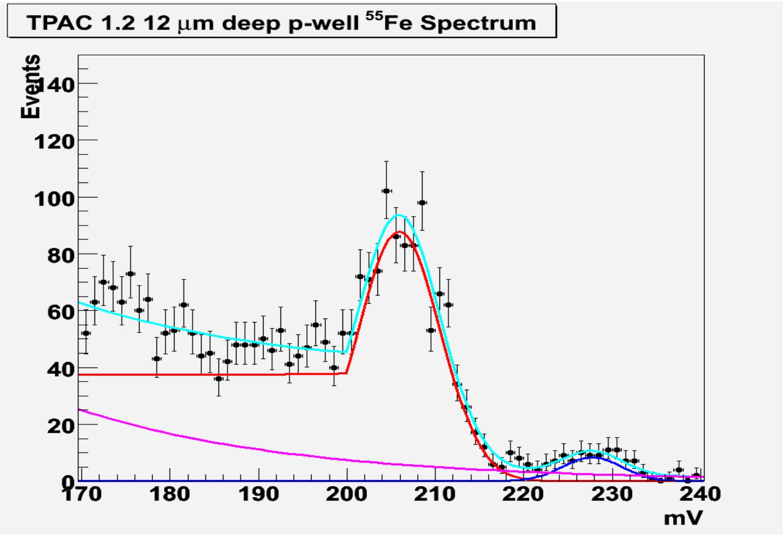
^{55}Fe Spectrum with TPAC 1.2

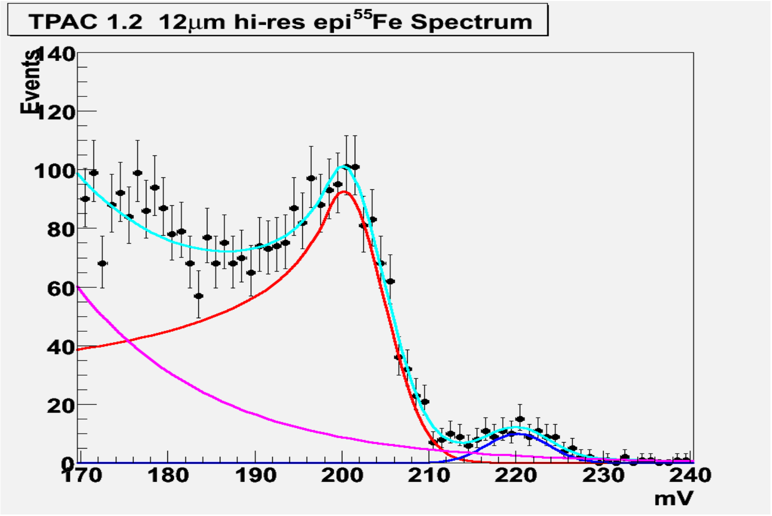
- Using test-pixels with analog out
- Powerful ^{55}Fe source
- Take 100k samples per sensor



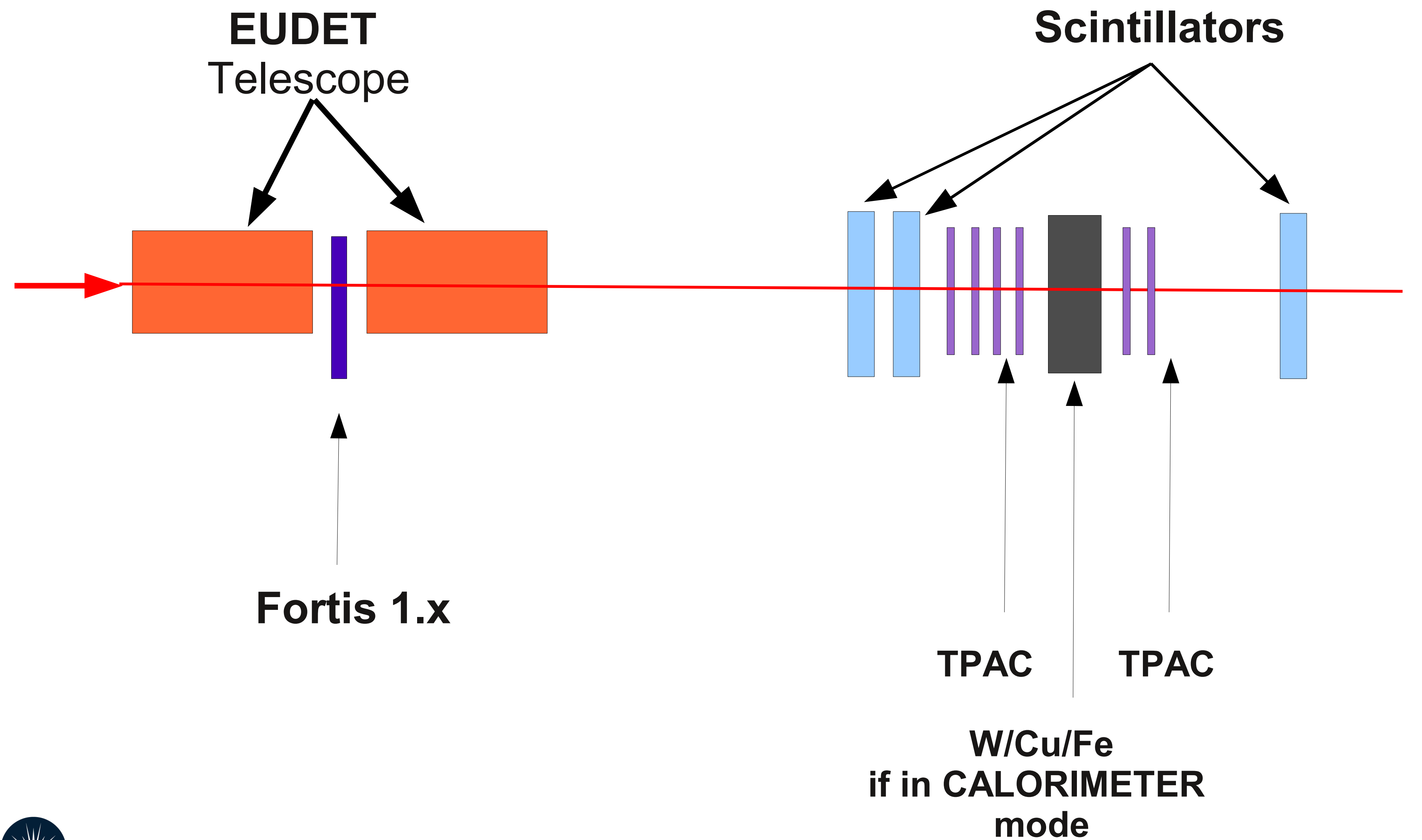
^{55}Fe Spectrum with TPAC 1.2

- ^{55}Fe source
  - Deep p-well
  - High -res
- Separation of K_α and K_β
- Hi-res sensor works

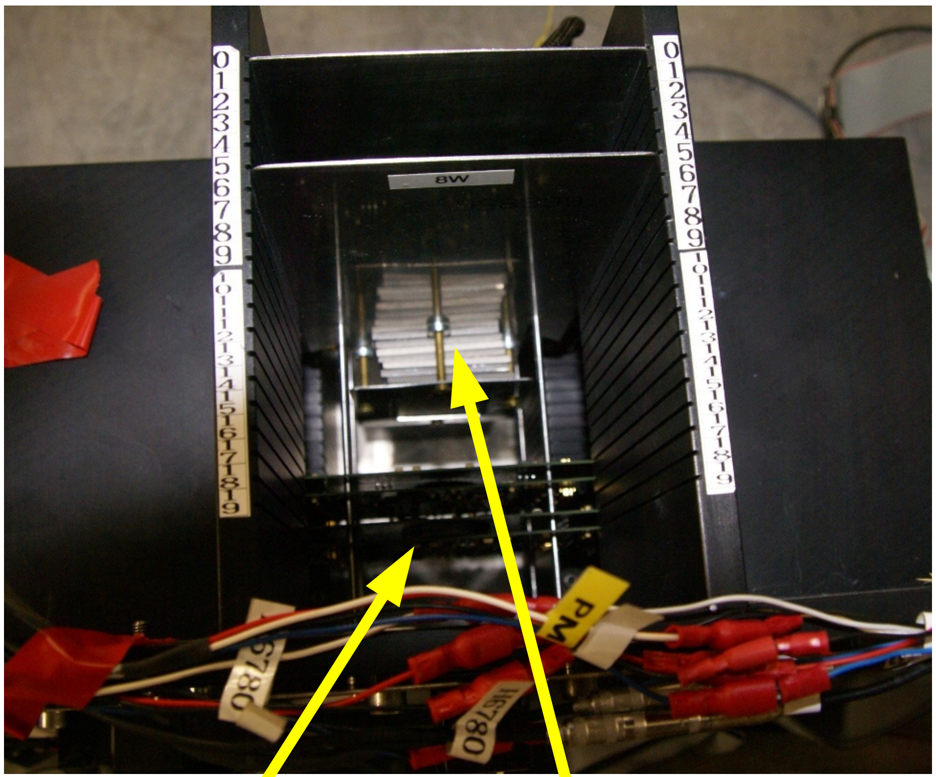


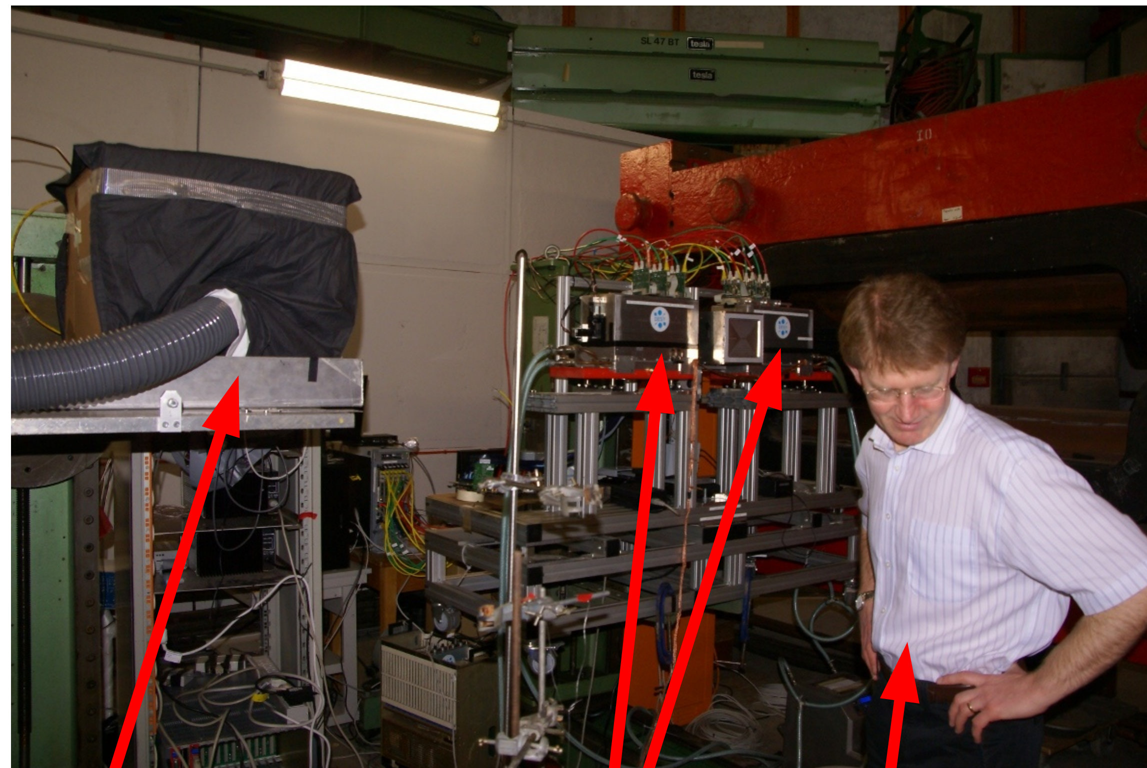


Common Testbeam setup



TPAC 1.2 Testbeam at DESY





4 TPAC sensors

Tungsten slab

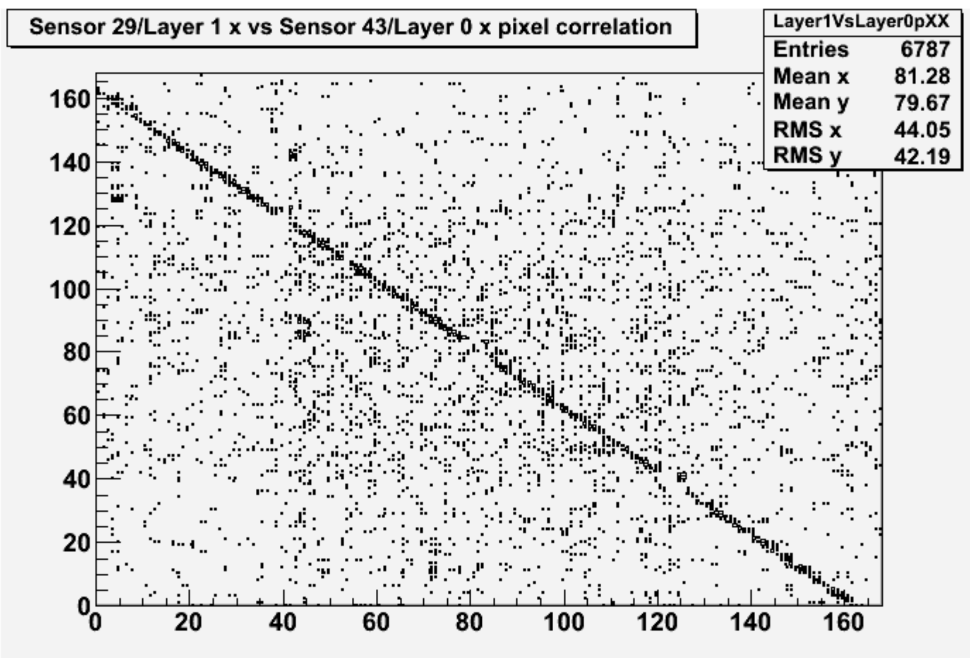
TPAC stack

EUDET Telescope

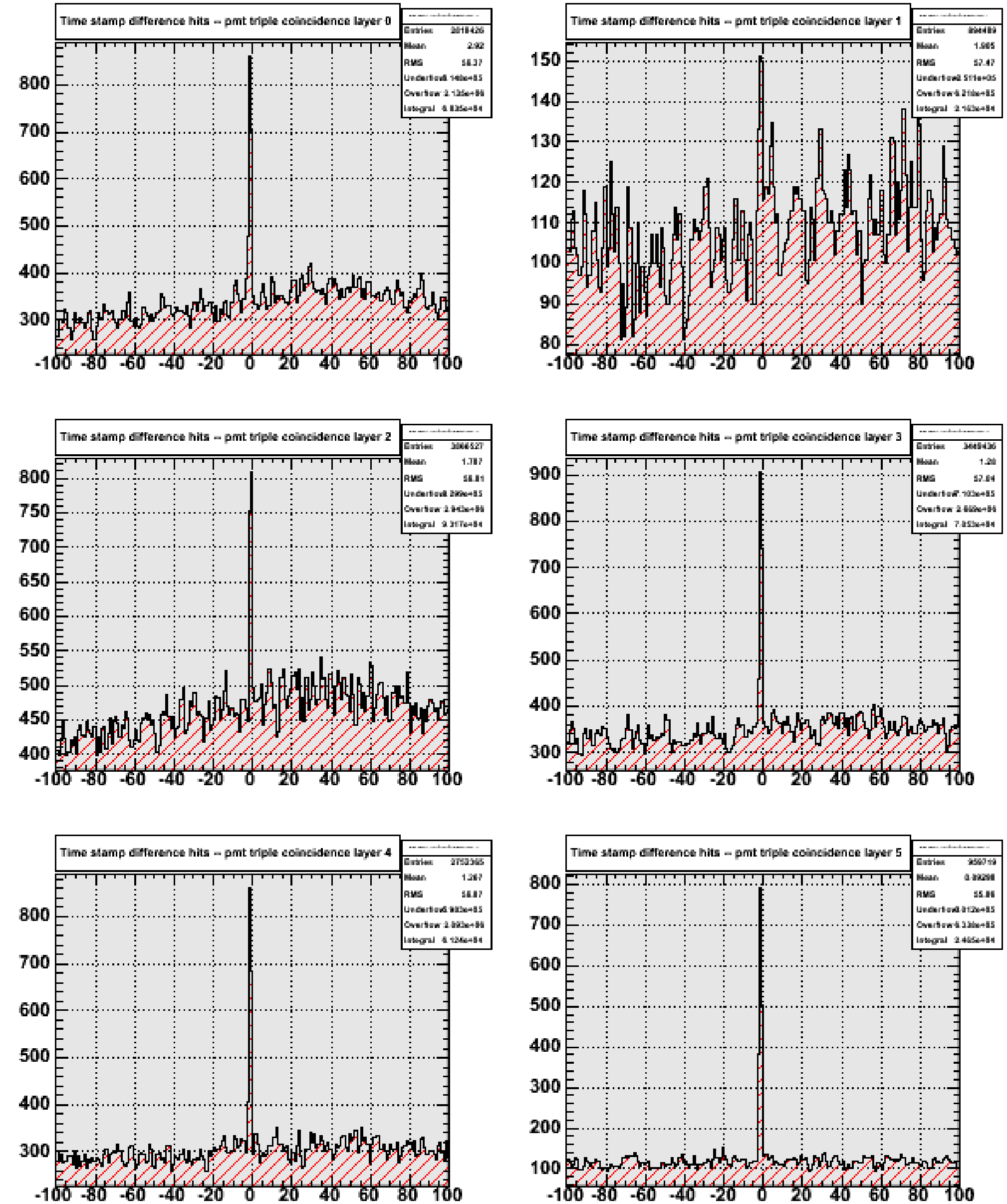
Nigel

TPAC 1.2 Testbeam

- Online plots
- 6 sensors (1 non deep p-well)



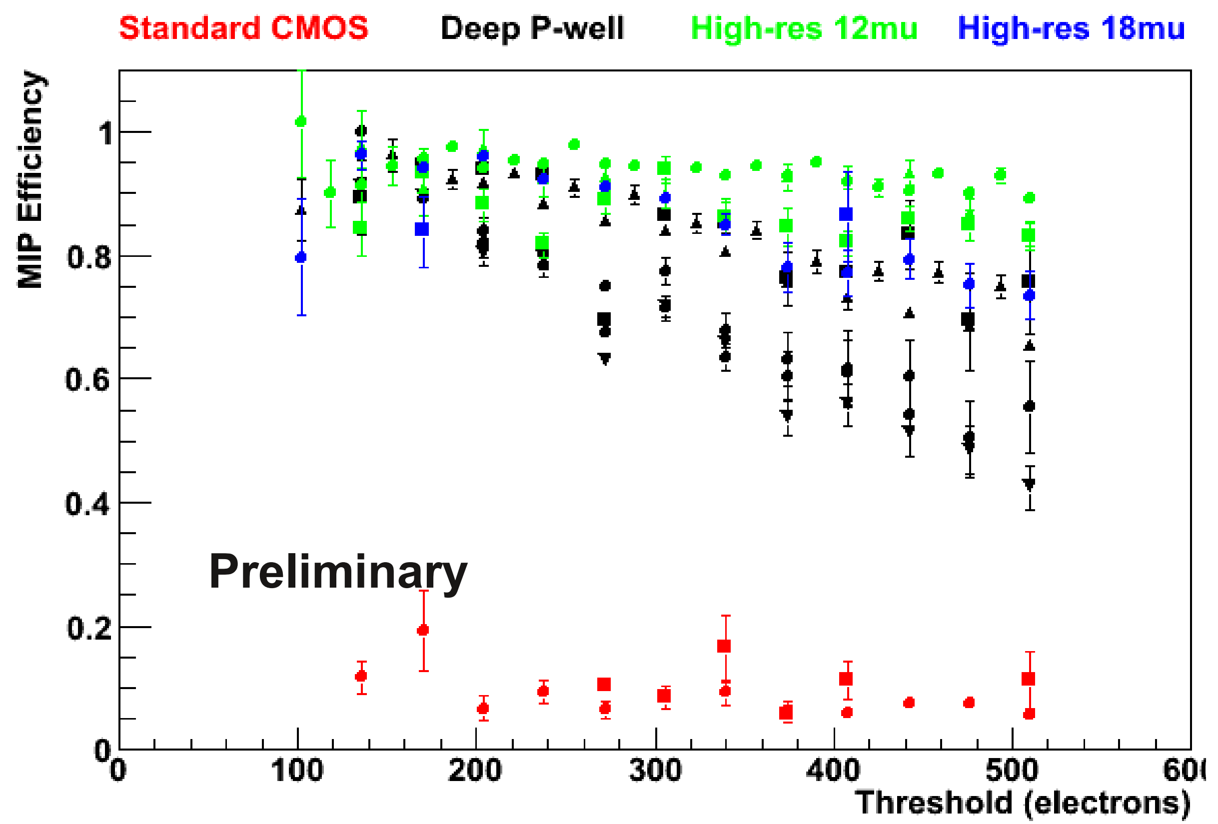
X-X correlation plot for two layers (back-to-back)



Hits in time with Scintillator hits

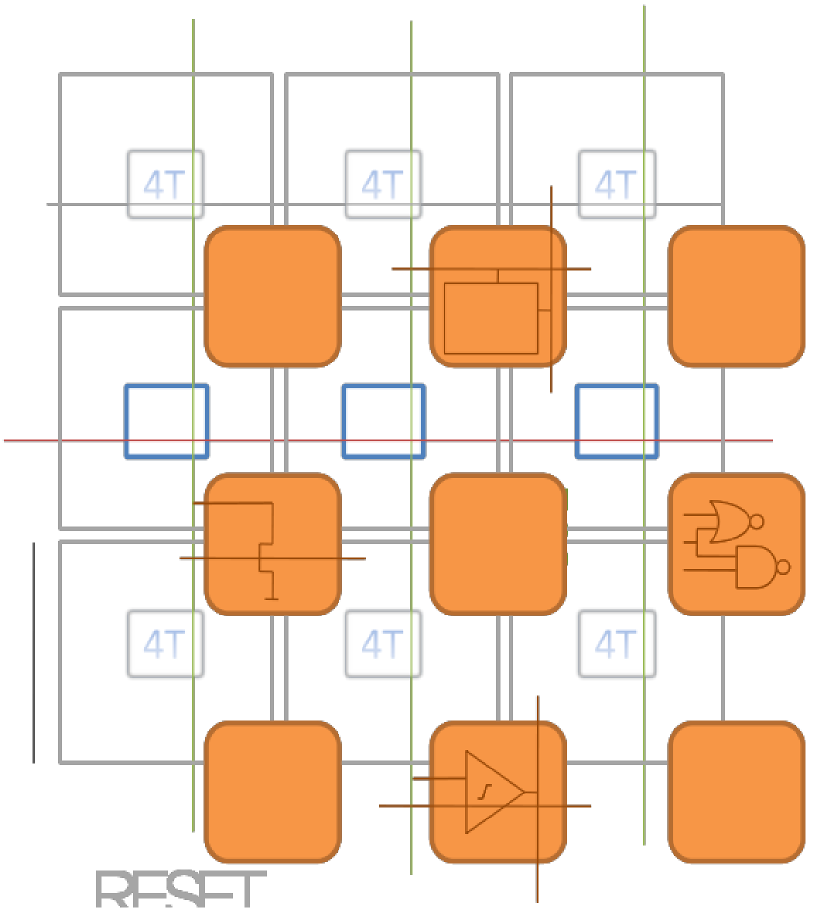
TPAC Testbeam Results

- No absorbers
- Due to use of in-pixel PMOS transistors, standard CMOS sensors have low efficiency
- Deep P-well shields N-wells and raises efficiency by factor ~5
- Adding high-resistivity epitaxial layer makes further improvement with resulting efficiency close to 100%



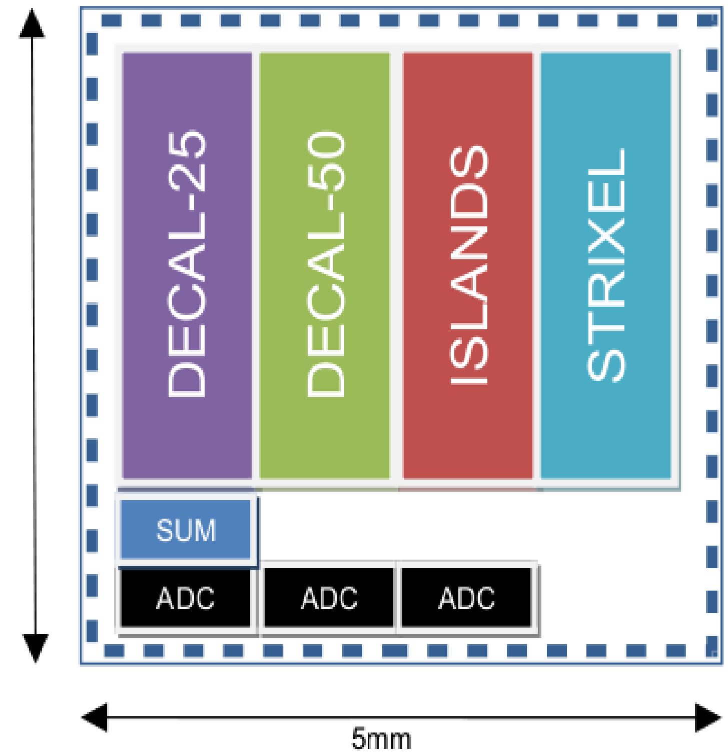
CHERWELL

- Using 4T + INMAPS + high-res
- New ideas
  - Embedded electronics "Islands"
  - Strixels (share electronics for one column)
- Two iterations
  - CHERWELL as technology testbed
  - CHERWELL2 as final device



CHERWELL

- 4T-based chip
  - 5 x5 mm with 4 variants
  - Common backend with ADC's
- DECAL-4T (2 variants)
  - Global Shutter (in-pixel storage)
  - Test pixel pitch and number of diodes
- Islands & Strixels (2 variants)
  - In-pixel electronics
  - ADC folded in column (for Strixel)
- Devices received in October



DECAL Chip

- Plans to make chip suitable to demonstrate the feasibility and superiority of digital electromagnetic calorimetry
- Requirements are
  - Area of 6 x 6 cm^2
  - Either single sensor or tile-able
  - Good yield
- 30 layers desirable (for good shower containment)
  - Limited by funding
- So far two options
  - TPAC 2.0 and DECAL-4T
  - Decision in Fall 2010

Technology choice

TPAC 2.0

- Based on TPAC series
- Pros
  - Proven design
  - DAQ Infrastructure
- Cons
  - Power consumption of current design limits sensor size (2x2 cm^2)
  - Can't stitch to 6x6 cm^2 sensor
  - More complicated assembly

DECAL-4T

- Based on CHERWELL series
- Pros
  - Low power low noise
  - Stitching
  - Easy assembly
- Cons
  - New design
  - DAQ modifications needed

Current Stack status

- Not gonna happen anytime soon
- Main reasons
  - Funding
  - Effort (related)
- Would have been a great demonstrator for digital calorimetry

Future Plans

- TPAC irradiation (being prepared)
  - Test radiation hardness (of generic interest)
- Finalize TPAC data analysis
- Testing of CHERWELL
- Work on software for simulation
  - Digitization with charge spread and clustering
  - Need LCIO extension for that (as RPC's)
- Test with PFA
  - As SLICPandora is now maturing ...