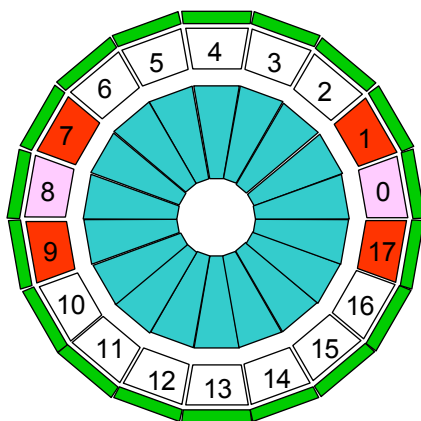
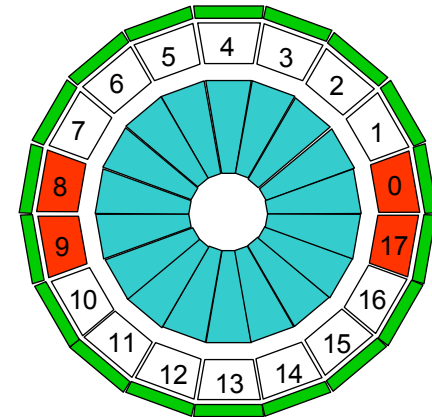


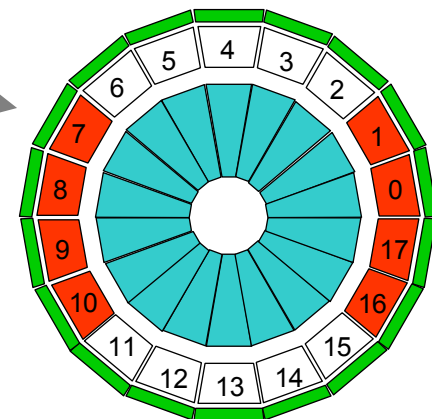
TRD: analysis of 2008 operation and commissioning program for 2009

Dariusz Miśkowiec (GSI Darmstadt)

- 🌐 survey data 2008
- 🌐 cosmic runs 2008
- 🌐 first calibration results
- 🌐 reconstruction performance
- 🌐 (more calibration in Münster)
- 🌐 cosmic plans for 2009



← now



Brief history of TRD supermodules

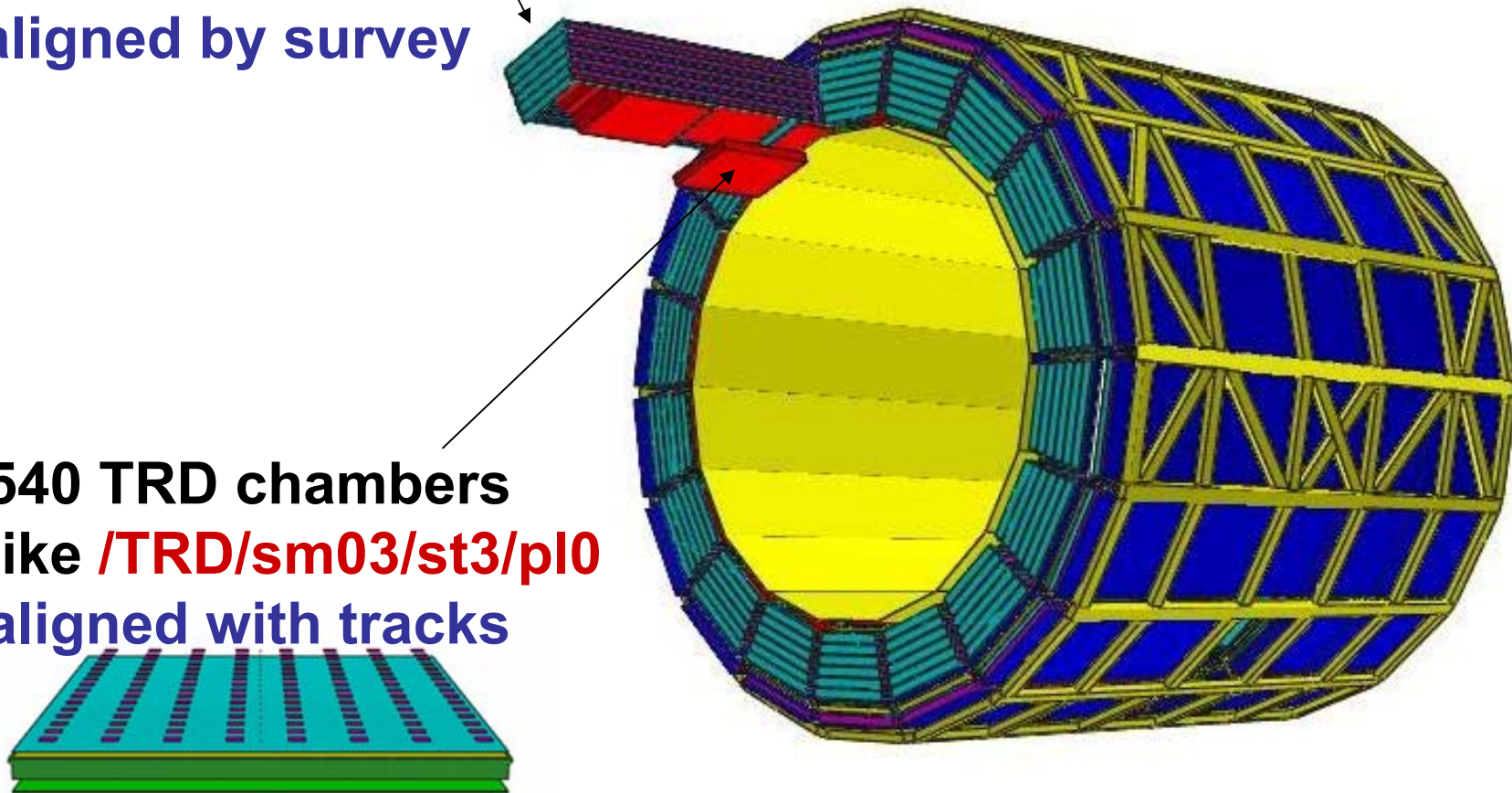
2006	2007	2008	2009
SM I caliper survey insert Sec 8 survey			disass. CERN repair GSI ass. Münster
SM II	assembled in Münster CERN	insert Sec 0 survey cosmics	disass. CERN repair GSI ass. Münster
SM III	assembled in Münster CERN test PS	repair CERN/GSI cosmics Münster	CERN insert Sec 7
SM IV	assembled in Münster	repair CERN insert Sec 9 survey cosmics	
SM V	assembled in Münster	insert Sec 17 survey cosmics	
SM VI		assembled in Münster	insert Sec 1

survey 2008

Alignable volumes in TRD

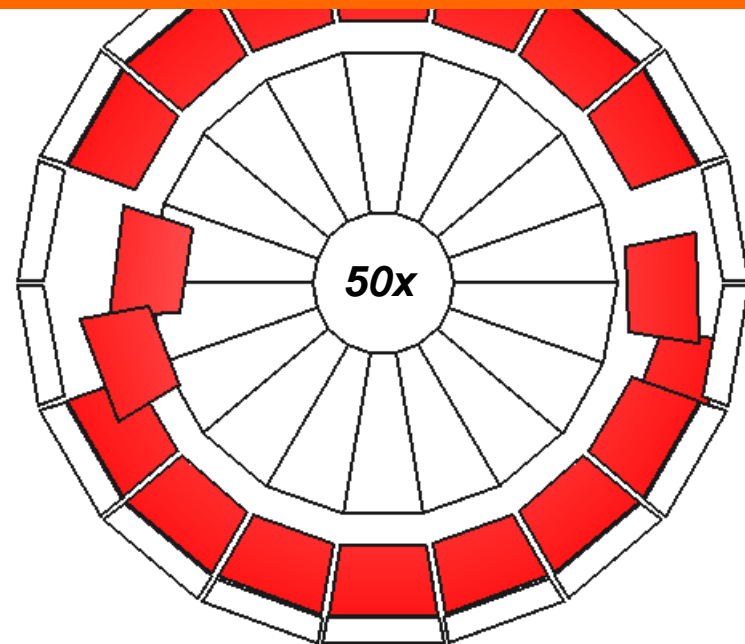
18 TRD supermodules
like **/TRD/sm03**
aligned by survey

540 TRD chambers
like **/TRD/sm03/st3/pl0**
aligned with tracks

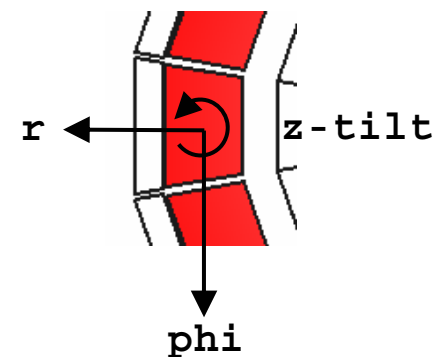


TRD survey June 2008

Only A-side measured
 Results translated into shifts/tilts
 Only shifts and z-tilt allowed
 Shifts in cm, tilts in degrees



SM	phi-shift	z-shift	r-shift	z-tilt
00	-1.196 ±0.071	-0.308 ±0.071	-0.510 ±0.071	-0.168 ±0.089
08	0.510 ±0.071	-0.260* ±0.071	-1.453 ±0.071	0.040 ±0.089
09	0.675 ±0.085	0.100 ±0.082	-0.815 ±0.084	0.220 ±0.111
17	-0.997 ±0.085	-0.750 ±0.082	0.259 ±0.084	-0.208 ±0.111



for comparison, SM08 survey Dec 2006

Only A-side measured

Only shifts allowed

Shifts in cm, tilts in degrees

SM	phi-shift	z-shift	r-shift	z-tilt
08	0.279	0.085	-1.554	

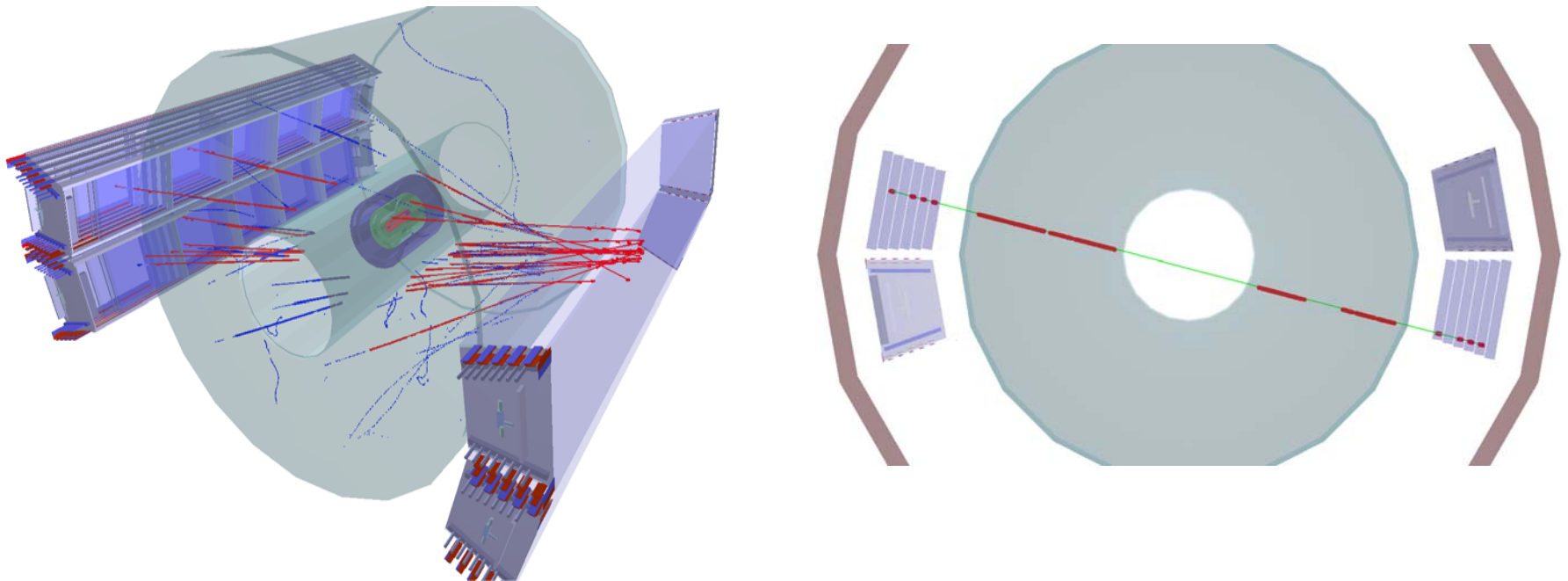
→surveys 2006 and 2008 agree within the specified resolution

→displacements by ~1 cm observed

runs 2008

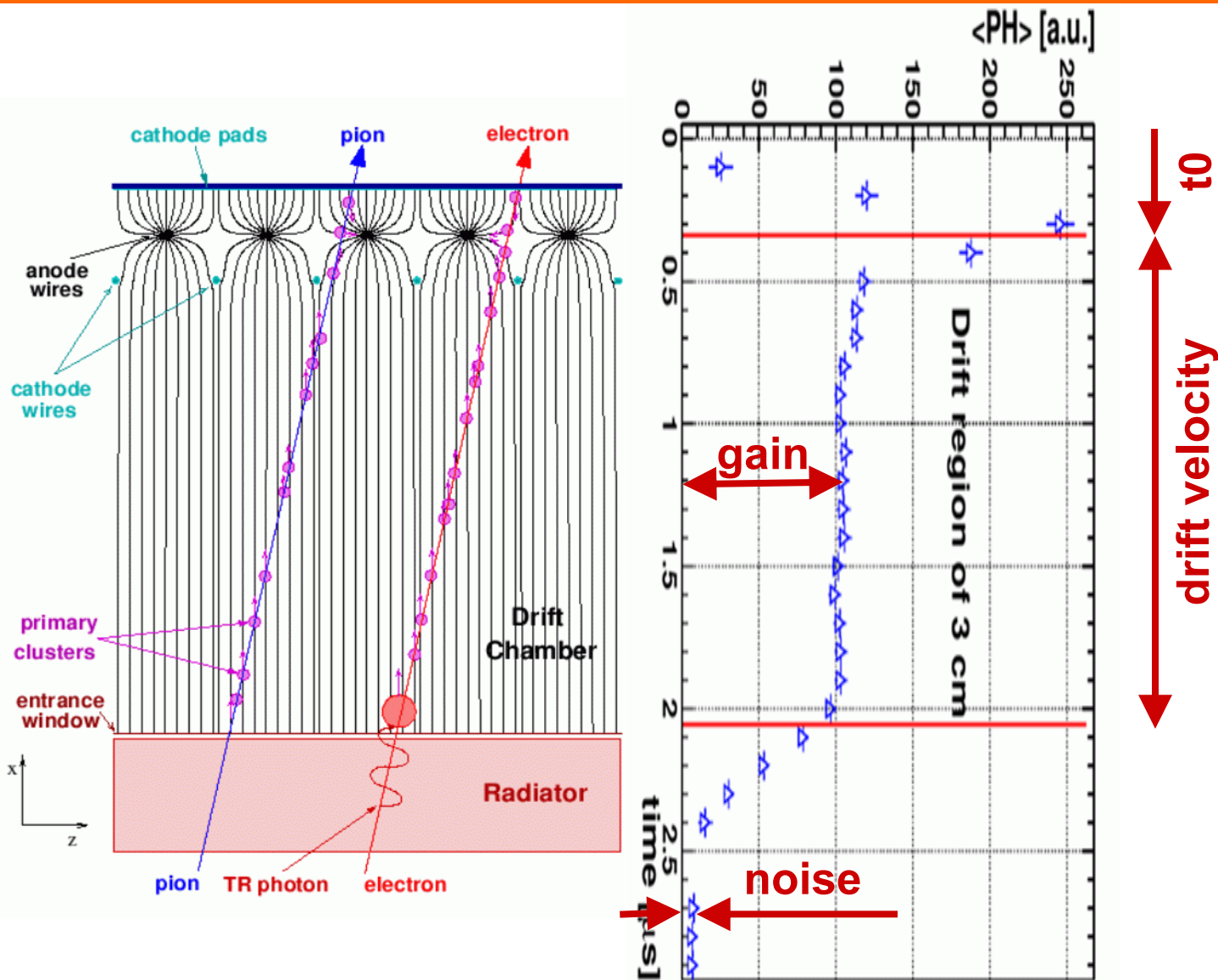
cosmic ray data 2008

- 🌀 August 2008 – TOF pretrigger and TRD L1 implemented
- 🌀 ~200 data-taking hours between August and October 2008
- 🌀 good-track rates:
 - 5-15 TRD tracks/h with SPD trigger
 - 150-300 tracks/h with TOF pretrigger and TRD L1
- 🌀 reconstruction performed at GSI
- 🌀 55 000 good tracks for calibration and alignment



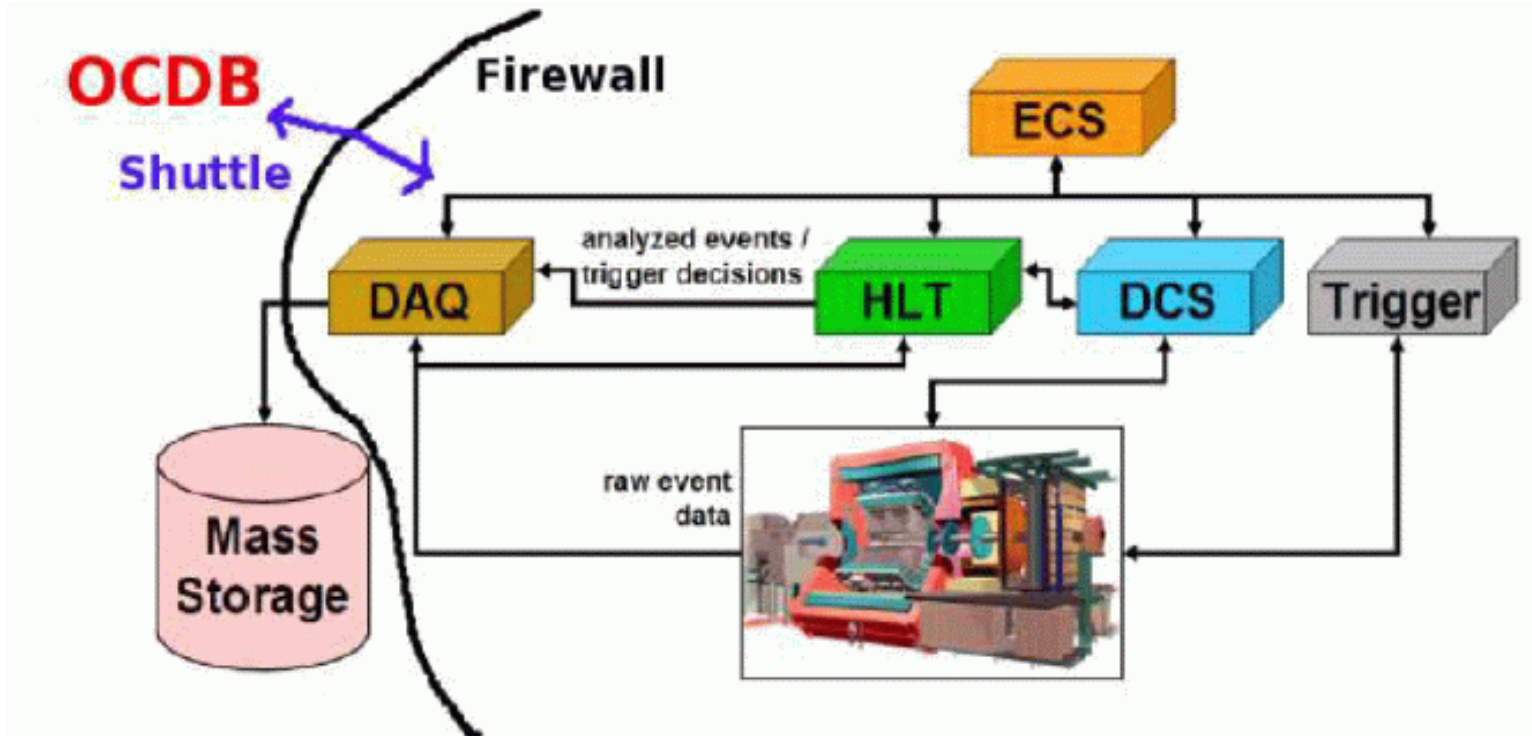
**calibration with
the 2008 runs**

TRD calibration parameters



TRD calibration methods

Raphaëlle Bailhache



- ☢ on DAQ machines: drift velocity, time offset, noise (ped runs)
- ☢ on HLT machines: drift velocity, time offset, gain (not yet)
- ☢ offline: drift velocity, time offset, gain

noise calibration

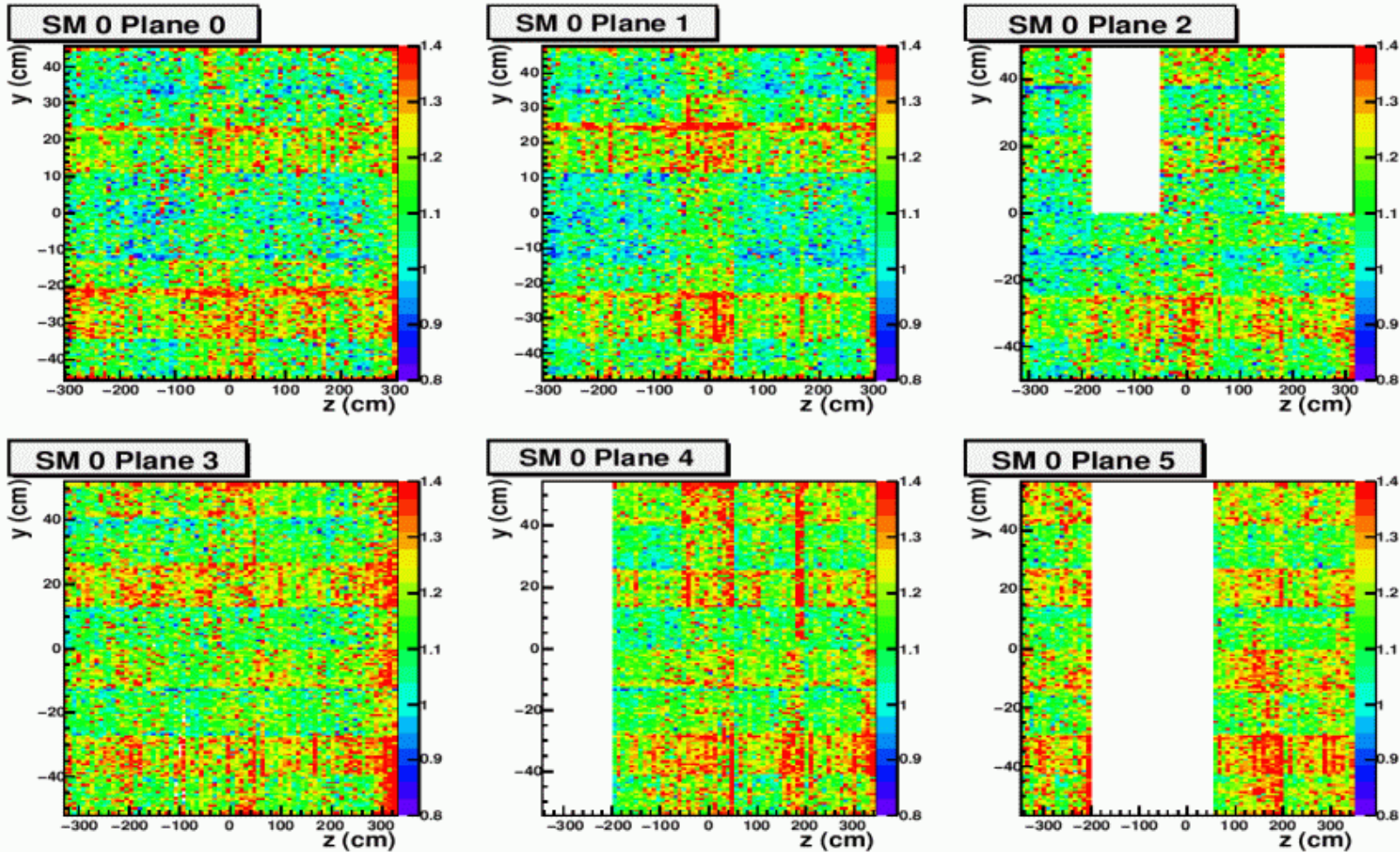
Raphaëlle Bailhache

- 🌐 **noise := width of ADC pedestal**
- 🌐 **pedestal run: 100 events without zero-suppression**
- 🌐 **based on noise, pad status: OK / dead / noisy**

noise

Pedestal run 38125 supermodule 0

Raphaëlle Bailhache



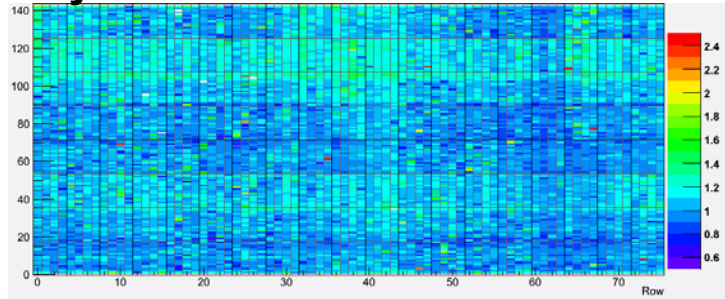
Mean noise of 1.16 ADC counts, about 1132 electrons

noise

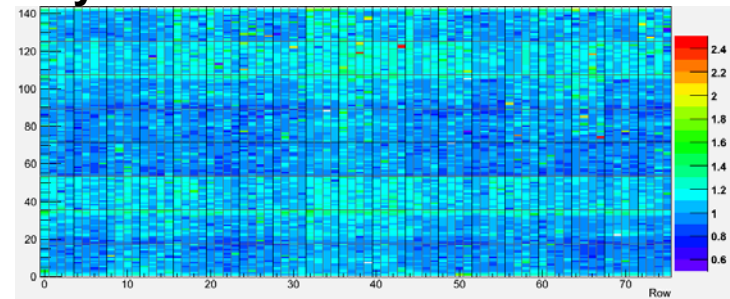
pedestal run 64511, December 2008, one stack of sm 07

Yvonne Pachmayer

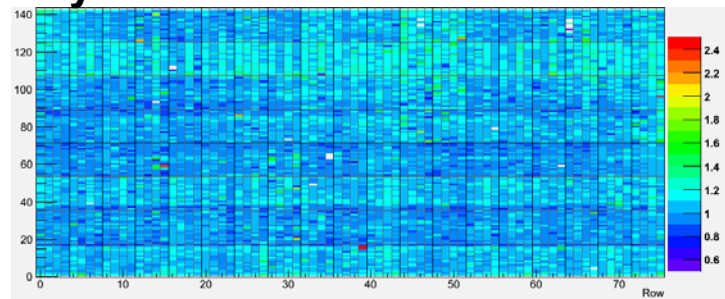
layer 0



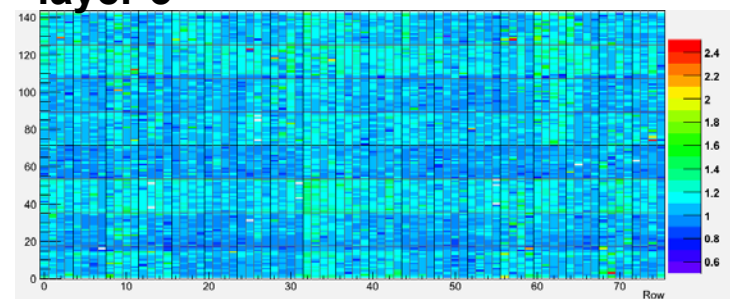
layer 1



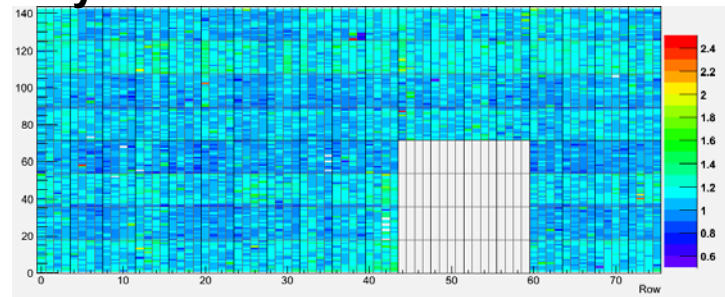
layer 2



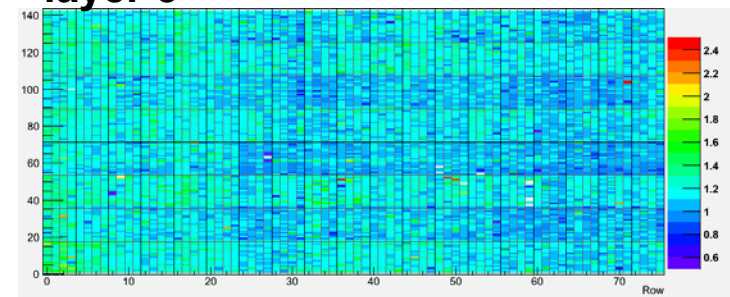
layer 3



layer 4



layer 5

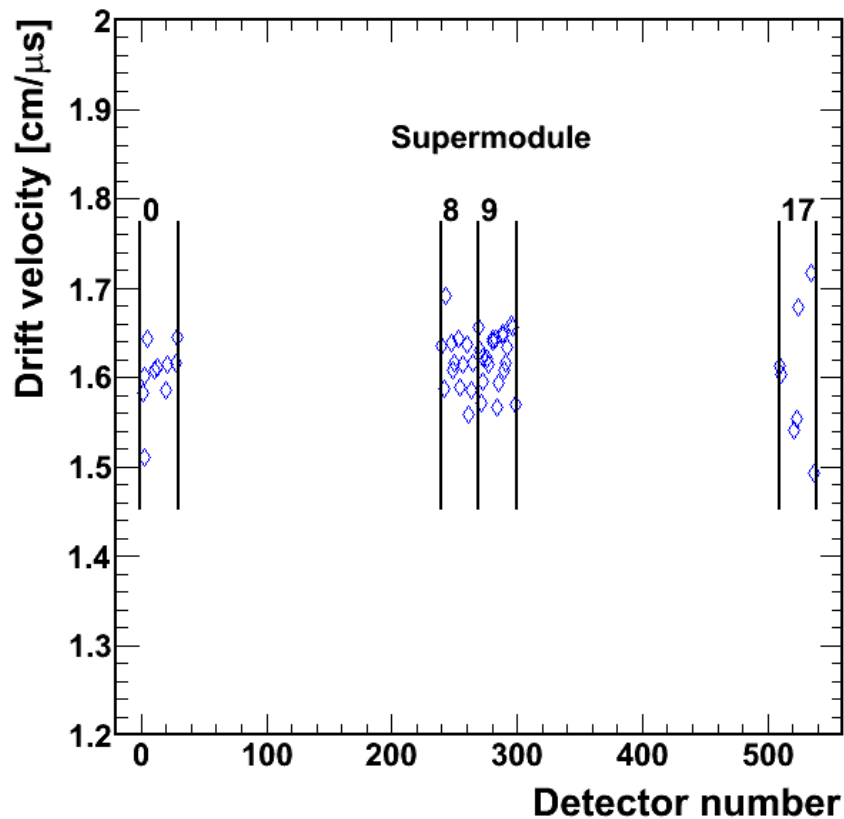


phi
↑
r →

mean noise 1.04 ADC counts

drift velocity

Raphaëlle Bailhache
offline calibration



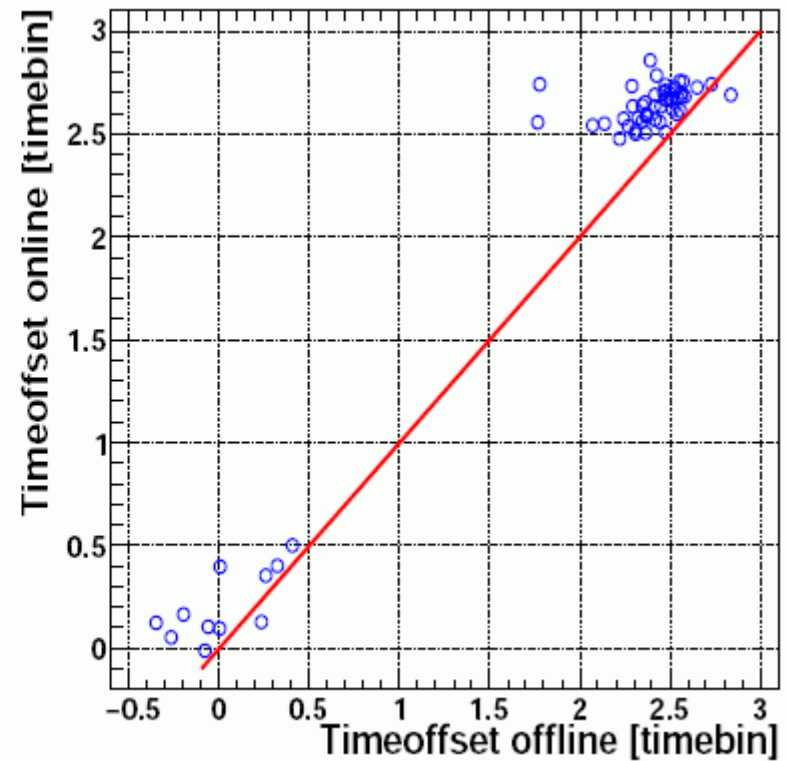
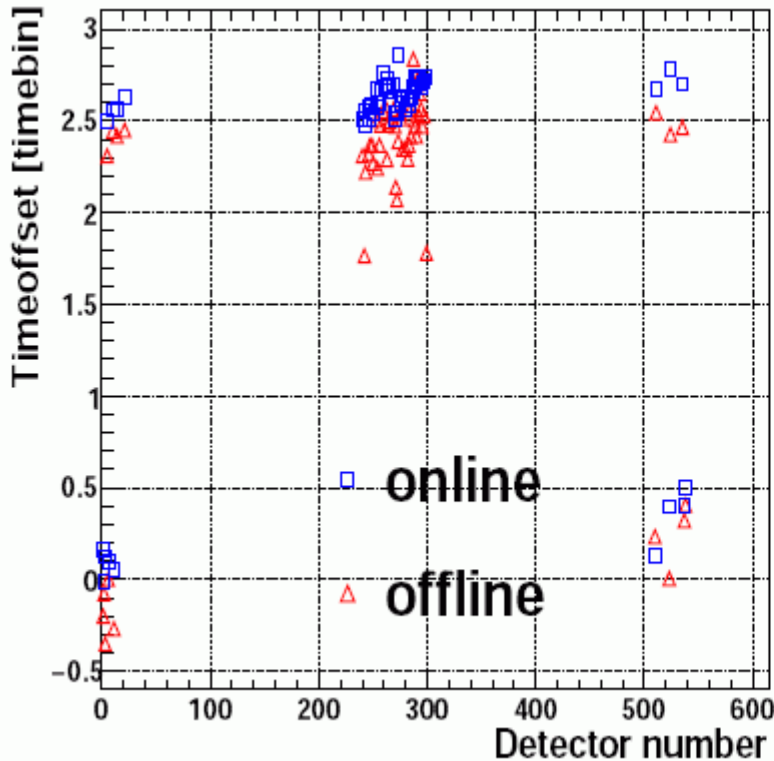
- ☢ **± 3.3% before calibration**
- ☢ **average 1.62 cm/μs (like in Garfield for ArCO₂)**

TRD running conditions in 2008

	nominal conditions	2008
gas	Xe,CO ₂ (15 %)	Ar,CO ₂ (18 %)
U_a (V)	1550	1450
U_d (V)	-2100	-1200
v_d (cm/ μ s)	1.5	1.61

time offset

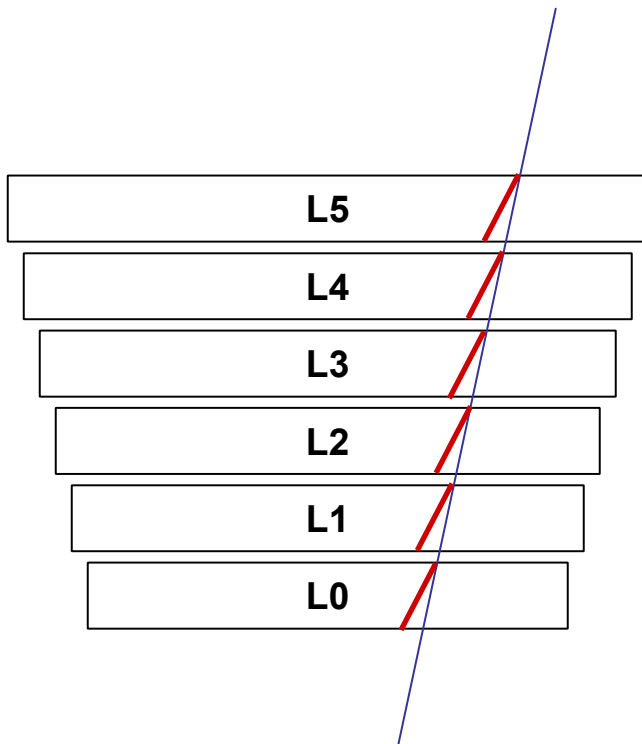
Raphaëlle Bailhache



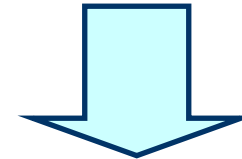
- ☢ **± 300 ns before calibration**
- ☢ **two groups of chambers**
- ☢ **20 ns difference between the two procedures**

drift velocity and time offset – alternative method

Raphaëlle Bailhache
offline calibration



alignment between tracklets and track

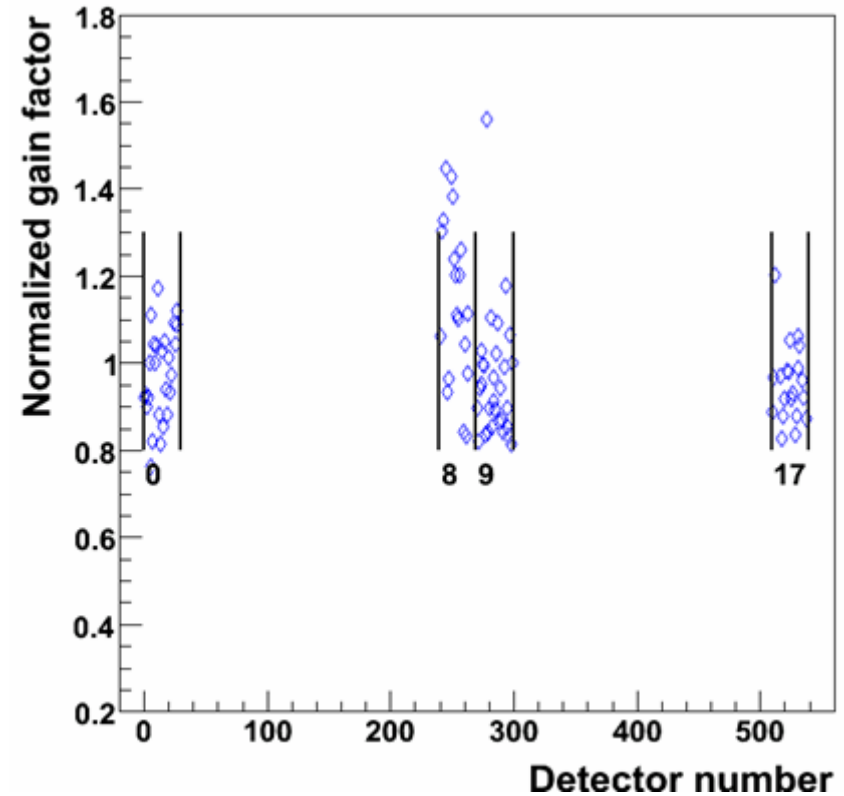
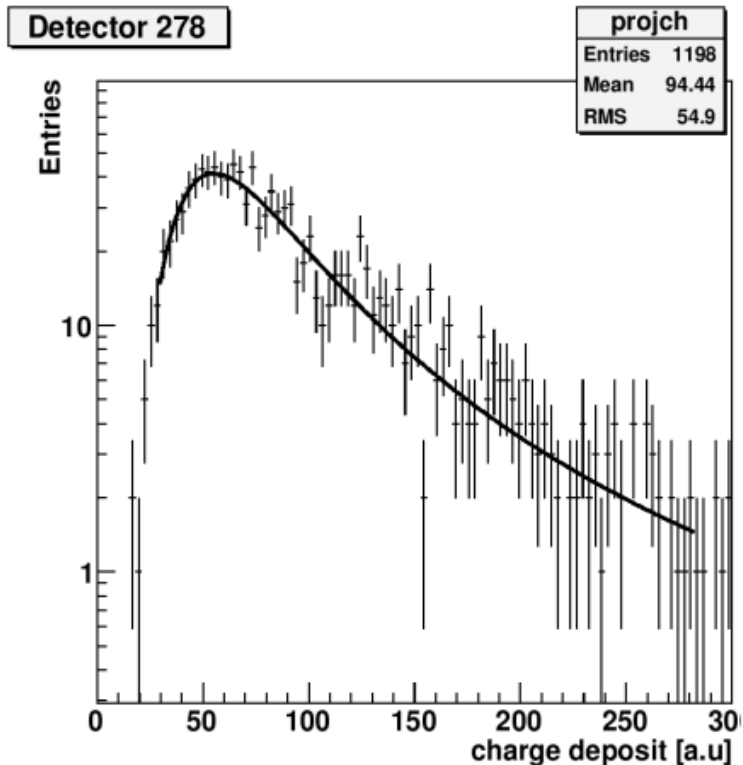


drift velocity and Lorentz angle

- 🌐 **SM08: average drift velocity 1.69 cm/ μ s**
- 🌐 **Lorentz angle consistent with 0 (OK for B=0)**

gain calibration

Raphaëlle Bailhache



- ☢ assume $dE/dx = \text{const}(\eta)$
- ☢ determine Landau peak position
- ☢ 100-1000 tracks per chamber

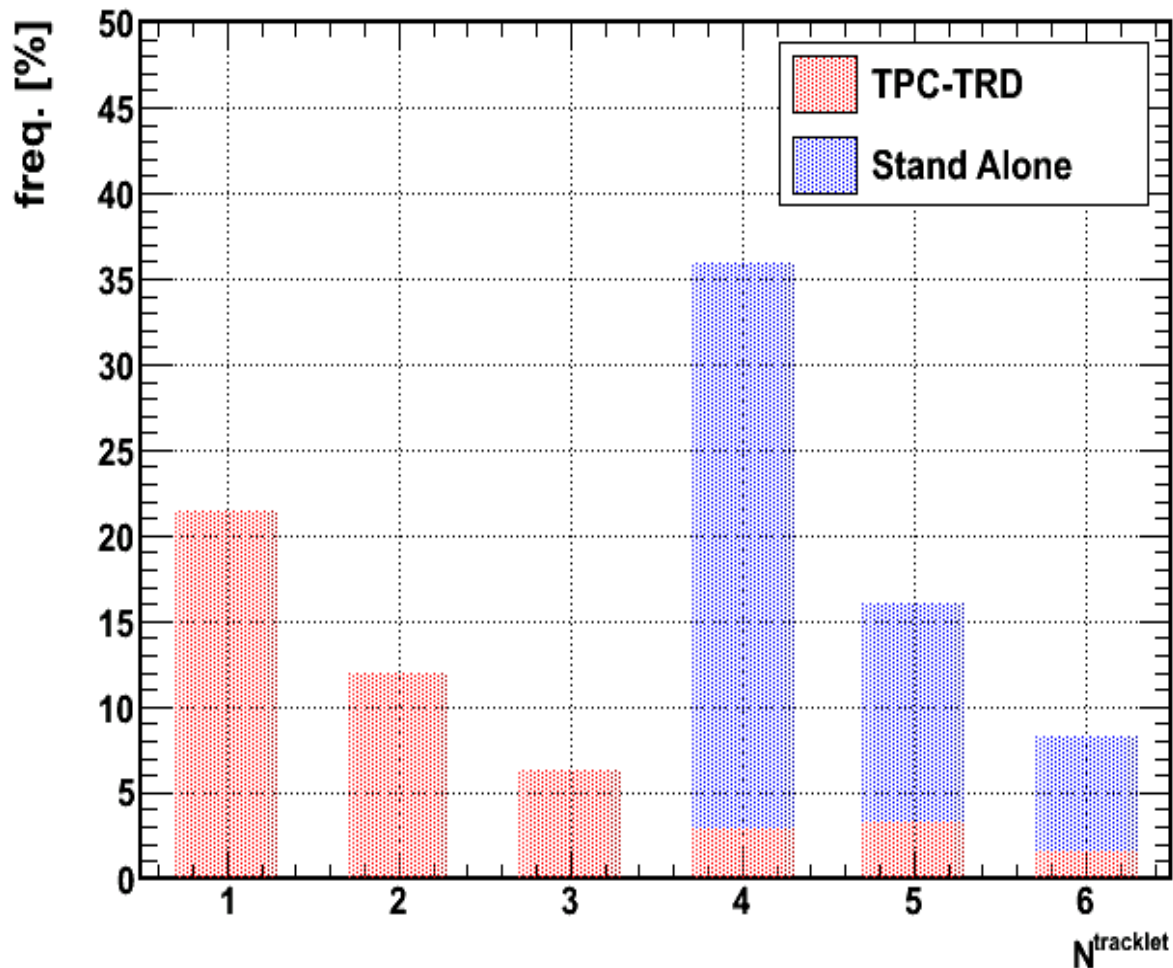
- ☢ $\pm 16\%$ before calibration
(better than the expected 20%)

**tracking
performance**

TRD tracking: 2 track models

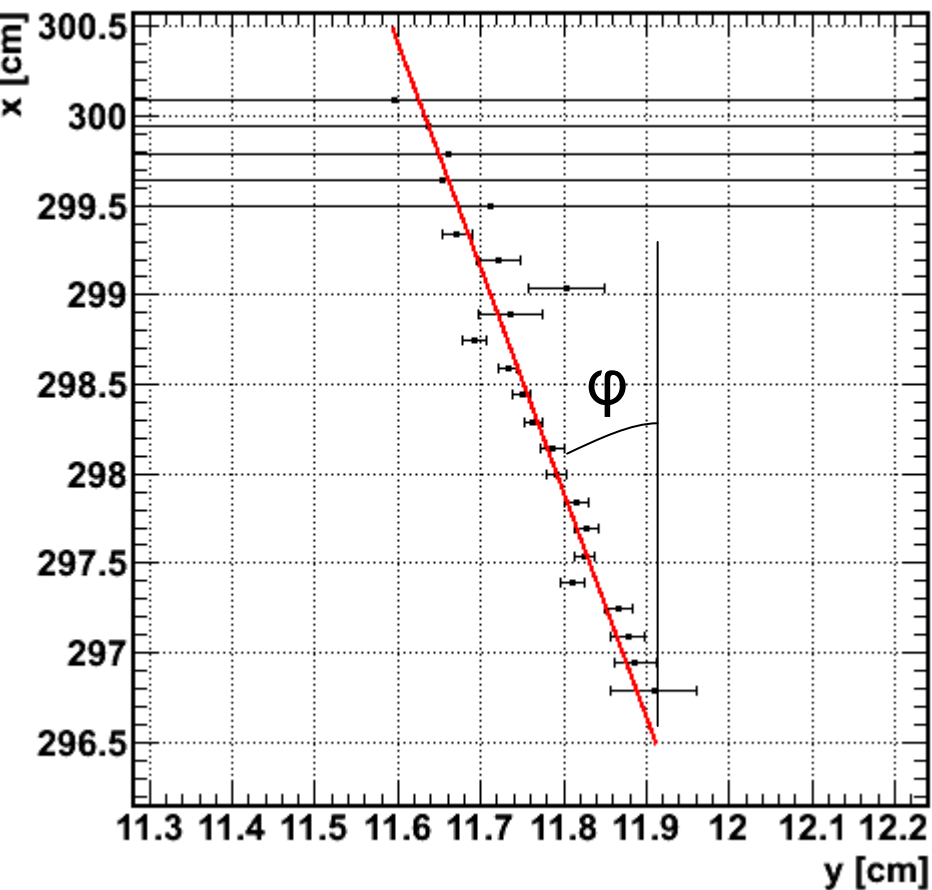
Markus Fasel

- 📍 **track extrapolated from TPC (Kalman)**
- 📍 **stand-alone TRD track (helix, 4 layers required)**

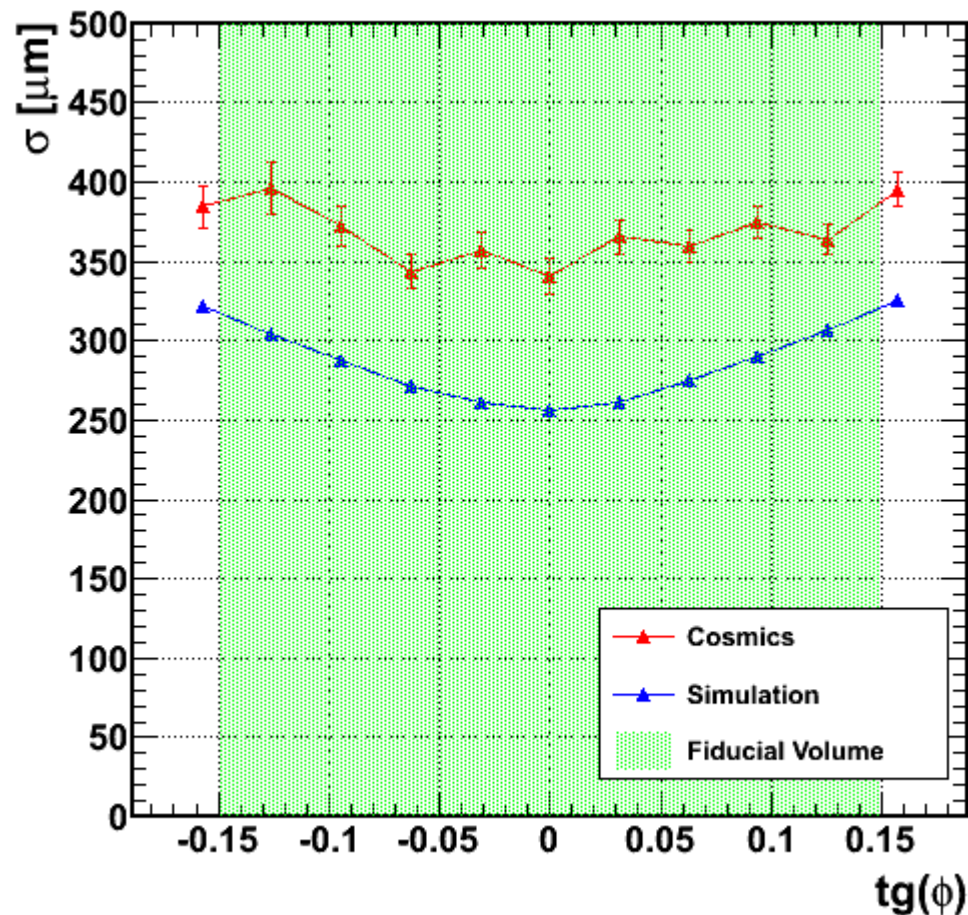


cluster-to-tracklet resolution

Markus Fasel



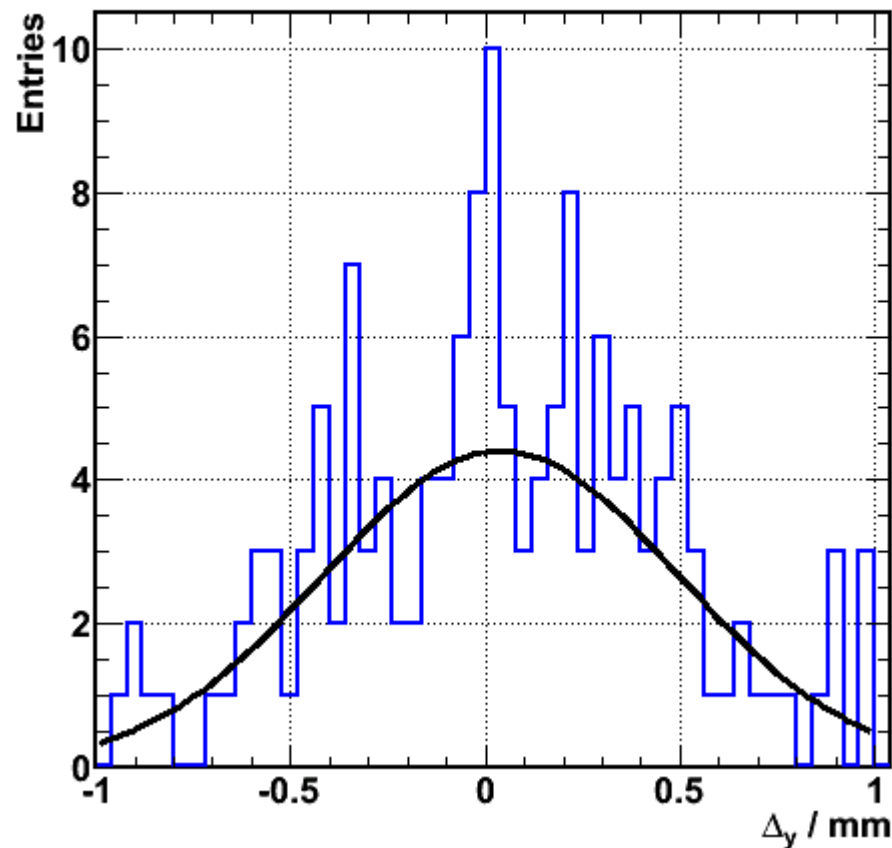
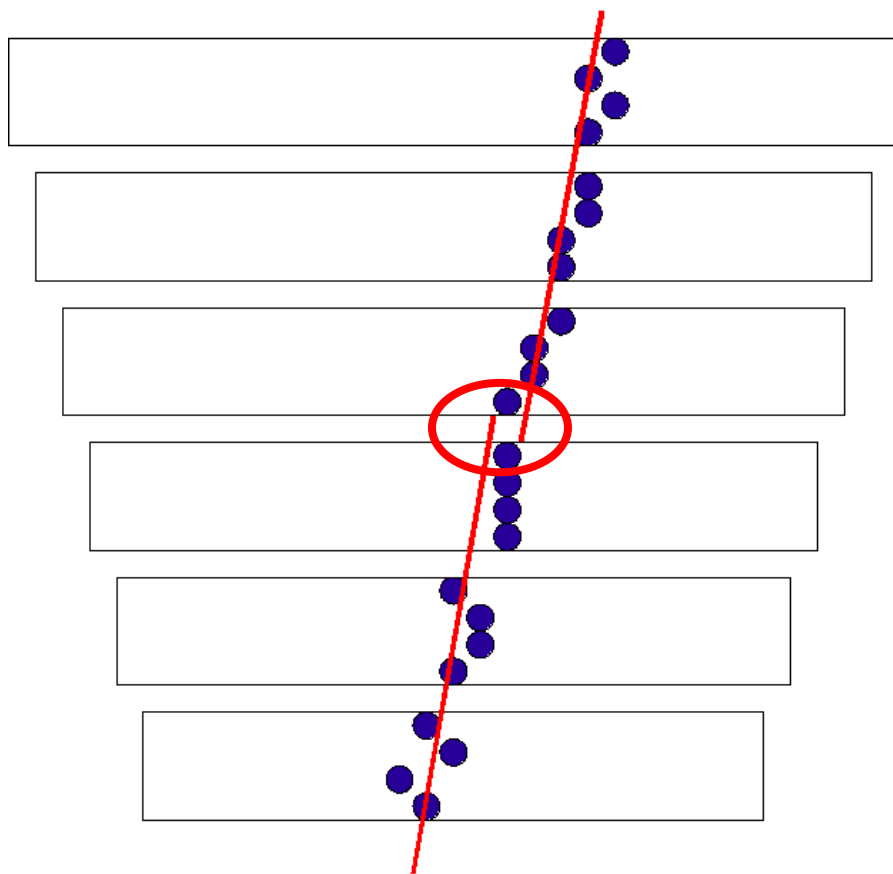
measured minimum: 350 μm



half-TRD-track to half-TRD-track resolution

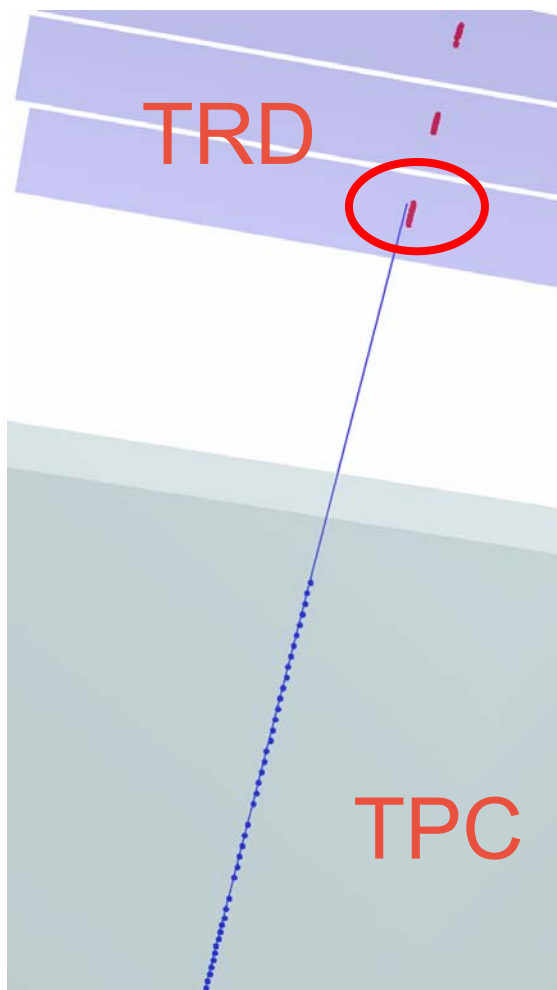
Markus Fasel

resolution: 330 μm

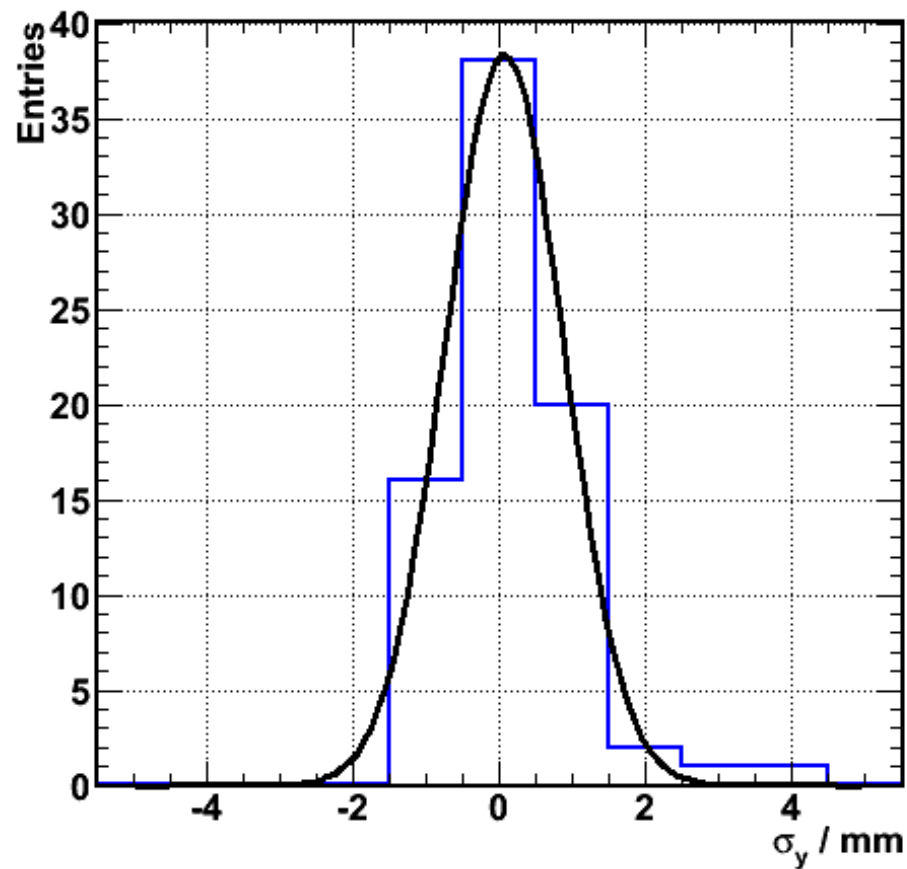


matching resolution TPC-TRD

Markus Fasel



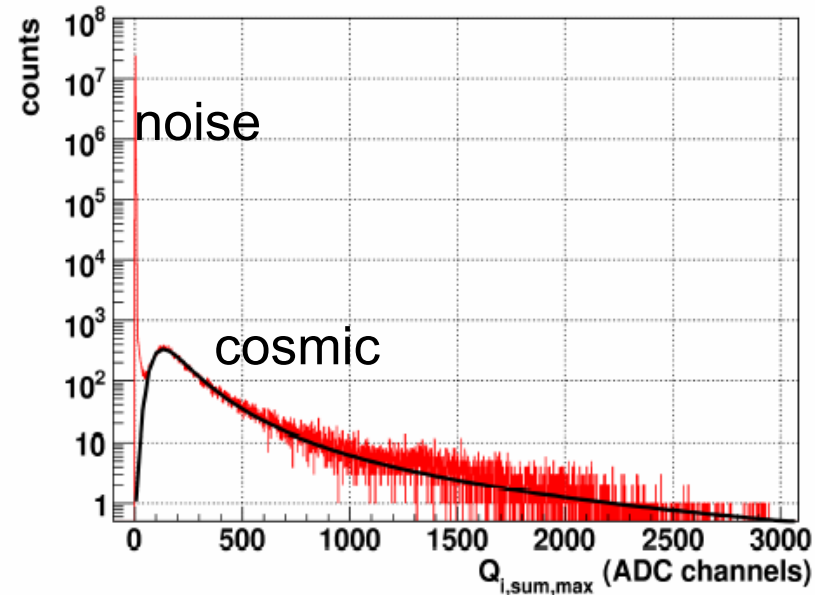
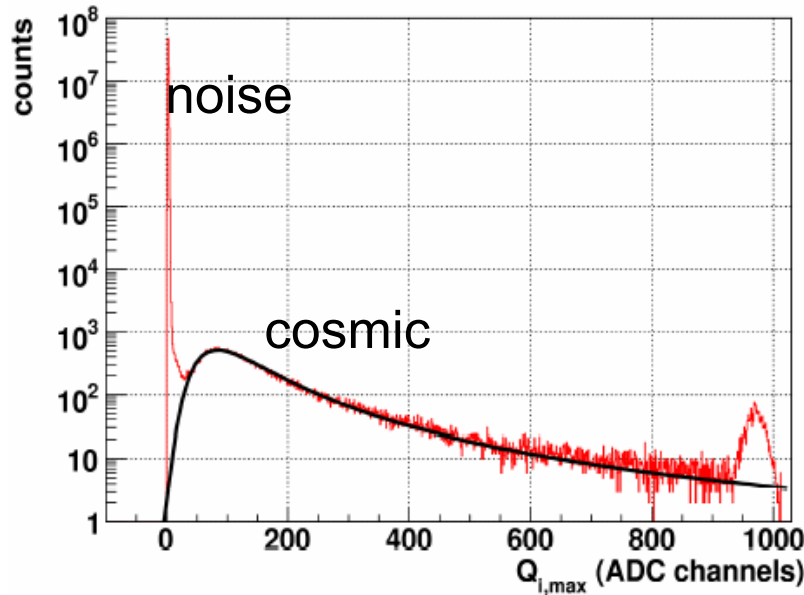
resolution: 807 μm



more calibration...
with Münster cosmics

tuning of zero suppression with cosmics in Münster

Svenja Wulff



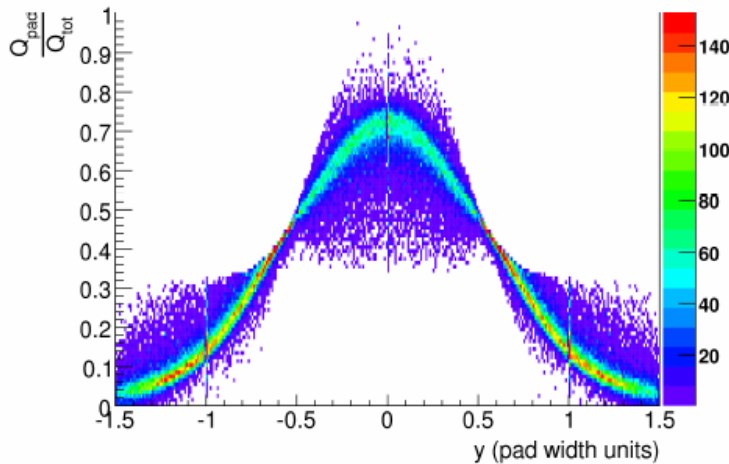
$Q_{i,max}$ = amplitude of the highest pad

$Q_{i,sum,max}$ = highest pad + 2 neighbors

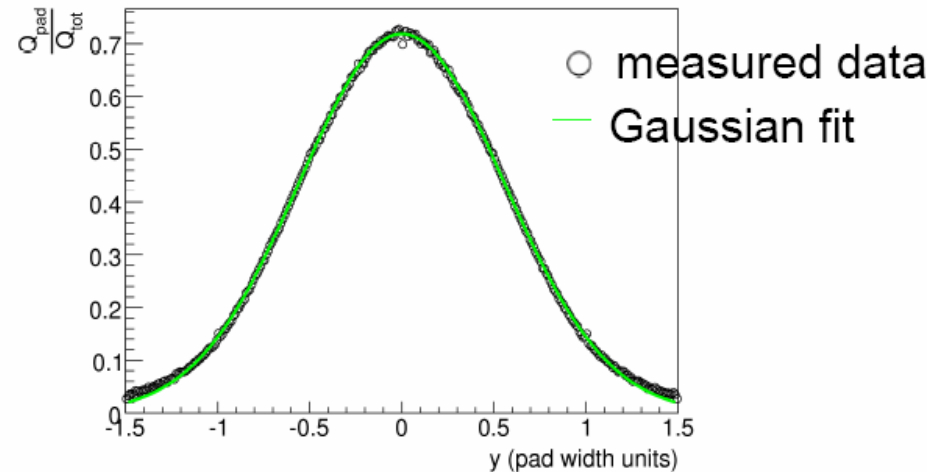
- 🌐 zero suppression condition: $Q_{i,max} < 6$ and/or $Q_{i,sum,max} < 10$
- 🌐 empty-event size (bytes/ROC): 10.0 11.5
- 🌐 no impact on position resolution

pad response function with cosmics in Münster

Svenja Wulff



PRF(y) as a function of the calculated y for 100 k events



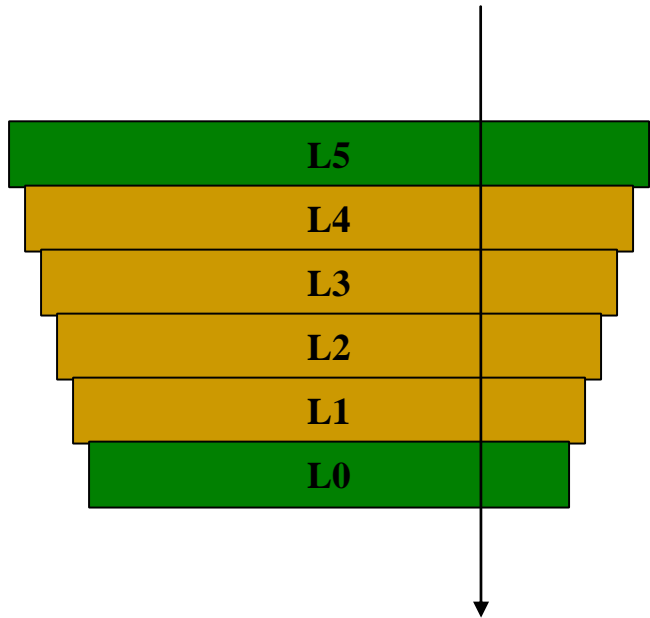
The variance of the Gaussian fit is used to calculate the displacement y for a given signal distribution:

$$y_{\text{rec}} = \frac{1}{w_1 + w_2} \left(w_1 \cdot \left(-\frac{W}{2} + \frac{\sigma^2}{W} \ln \frac{Q_i}{Q_{i-1}} \right) + w_2 \cdot \left(\frac{W}{2} + \frac{\sigma^2}{W} \ln \frac{Q_{i+1}}{Q_i} \right) \right)$$

$$w_1 = Q_{i-1}^2 \text{ and } w_2 = Q_{i+1}^2$$

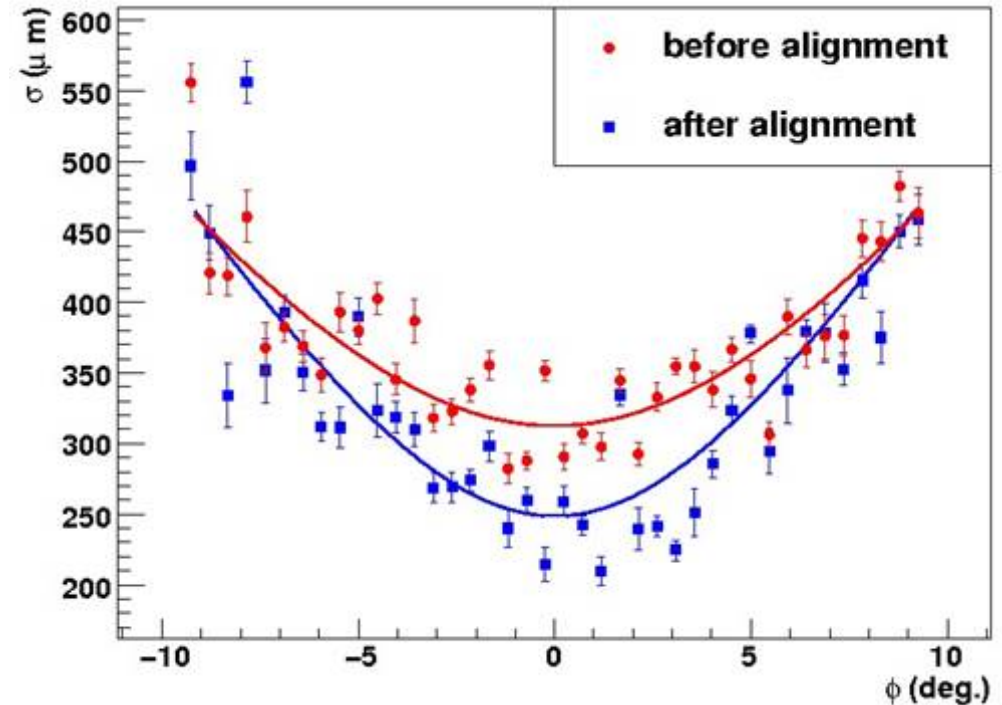
alignment with cosmics in Münster

Eva Sicking



standard offline (Cvetan)
procedure applied

cluster resolution



note: **Münster resolution** better than
Geneva resolution because of the
higher gain ($\langle \text{ph} \rangle = 120$ rather than 80)

remaining tasks with the 2008 data

- 🔴 **chamber alignment; compare to...**
 - 🔴 **survey (SM 0, 8, 9, 17)**
 - 🔴 **caliper measurement (SM 8)**
 - 🔴 **Münster alignment (SM 7)**
- 🔴 **calibration/alignment parameters into OCDB**

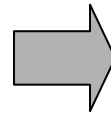
- 🔴 **tool for visualization of OCDB parameters (including time dependence)**
- 🔴 **tool for visualization of performance (including time dependence)**

**estimate
for 2009**

request for 2009

2008 data

- 🌐 runs 52636 – 62562
- 🌐 trigger: TOF pre + TRD L1



- 🌐 total duration 200 h
- 🌐 good track rate 150-300/h
- 🌐 total good tracks 55 000

2009 running:

- 🌐 6-8 supermodules (not 4)
- 🌐 2 x more TOF-to-pretrigger adapter cards
- 🌐 “good” track should be really good (with TPC)
- 🌐 → 0.1 Hz good-track rate

2009 request:

- 🌐 2000 good tracks per stack
- 🌐 → 80000 good tracks
- 🌐 → 9.5 days of data taking at 100% efficiency

summary

2008 cosmics

- 🌐 precious data for reconstr. software / calibration / alignment

2009 request

- 🌐 detectors participating: TPC, TRD, TOF
- 🌐 trigger: TOF pretrigger and TRD L1
- 🌐 duration (with 70% eff.)
 - 2 weeks without magnetic field
 - 2 weeks with magnetic field (?)

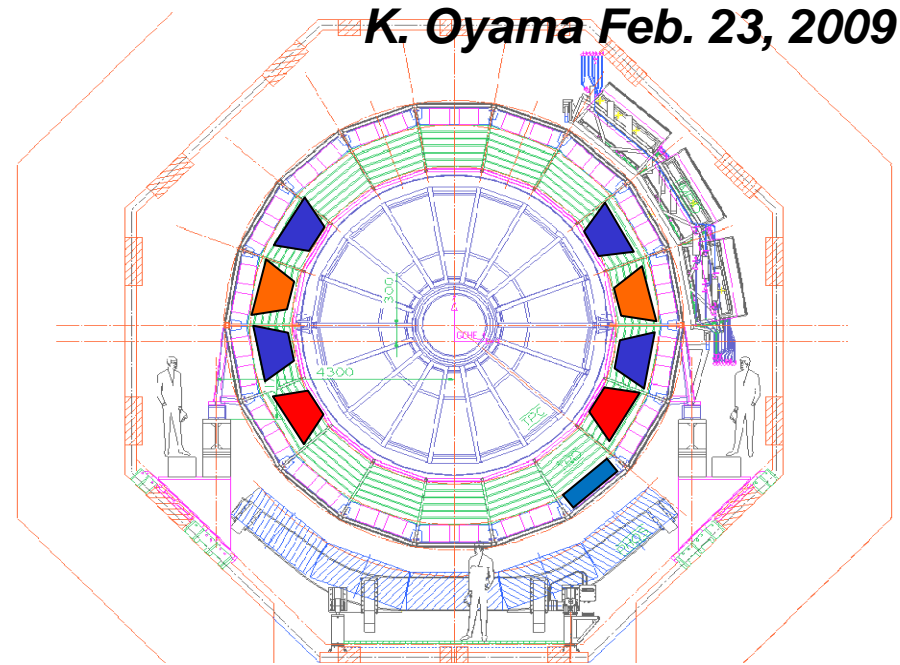
(please note duty factor in 2008: 200 h/3 months)

backup

TRD Requirements for 2009 Cosmic Run

Running Modes

- With maximum 6+1 super-modules.
 - **Blue** operational already.
 - **Orange** to be installed soon.
 - **Red** non-zero possibility.
- GTU-L1: fully operational for cosmic.
- Pre-trigger-L0: fully operational for TOF, T0 and V0.

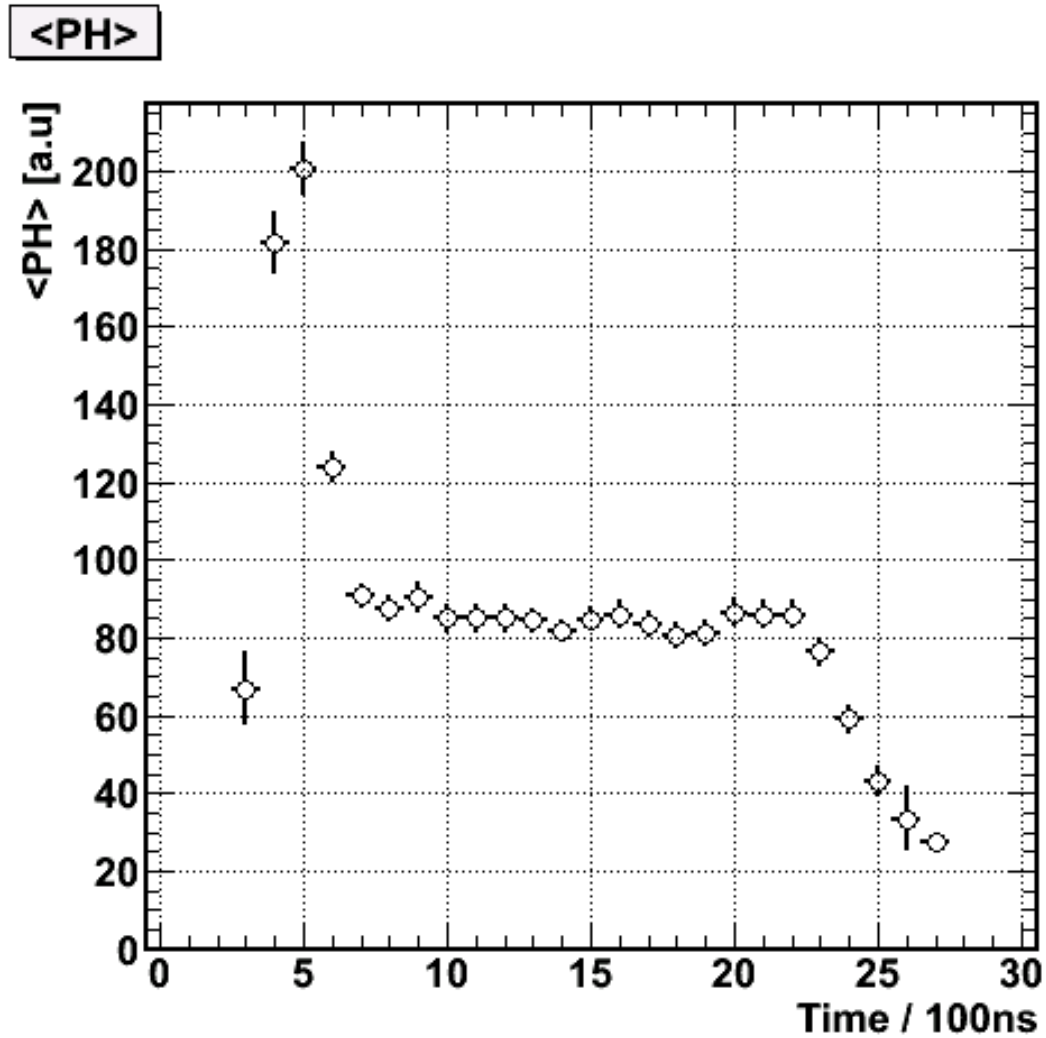


Needs

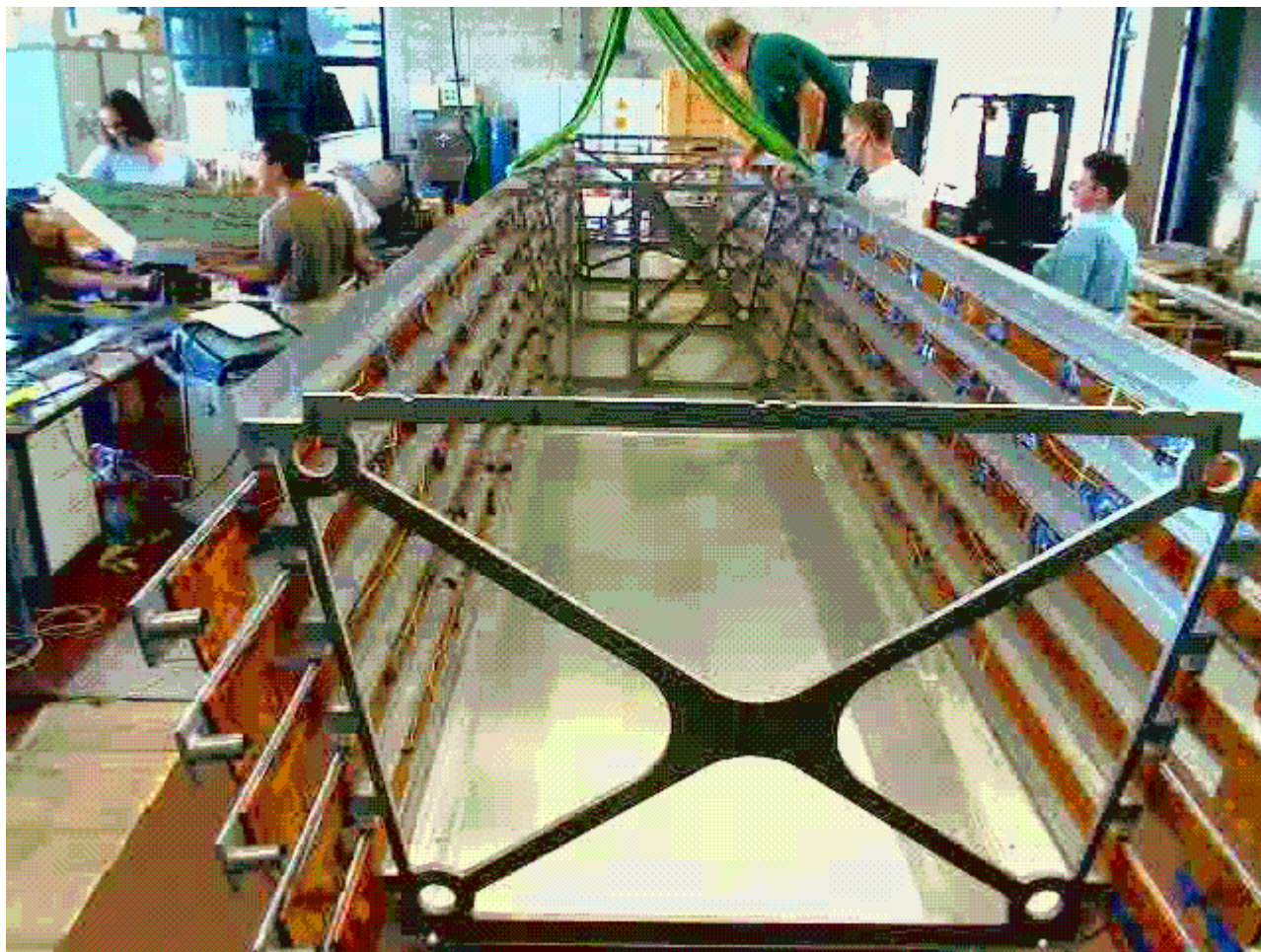
- Alignment, calibration, and gain study data ... 2000 “good” tracks for each stacks (set of 6 chambers) are required → 60k “good” tracks are required.
- Last year : TOF 4 sectors gave TOF-pre-trigger successfully. L0 rate ~ 3 to 5 [Hz]. Purity ~ 5 to 80 % (fluctuating).
 - we may assume like 1 [Hz] “trigger” rate this year.
- All tracks are not really usable.
We need “good” tracks penetrating all chambers, and associated with also TPC.
 - assumption: 0.1 [Hz] “good” track rate.
 - 600k [s] running time → 7 days (21 shifts) “good” run is enough for our business.
- Run mode: TRD-L0(pretrigger) and TRD-GTU-L1 → ITS. TPC. TRD. TOF.

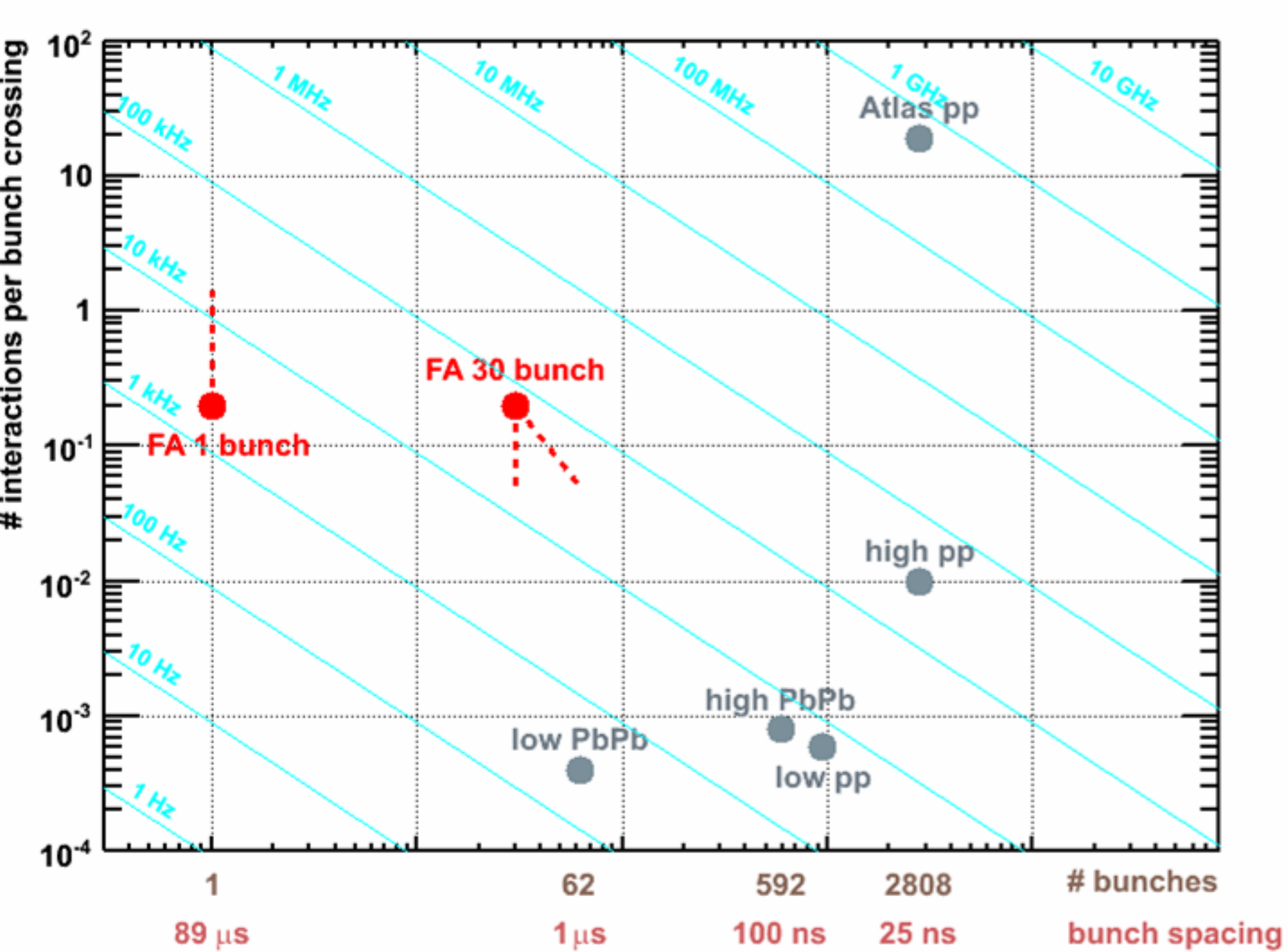
pulseheight vs drift time

Markus Fasel



supermodule assembly



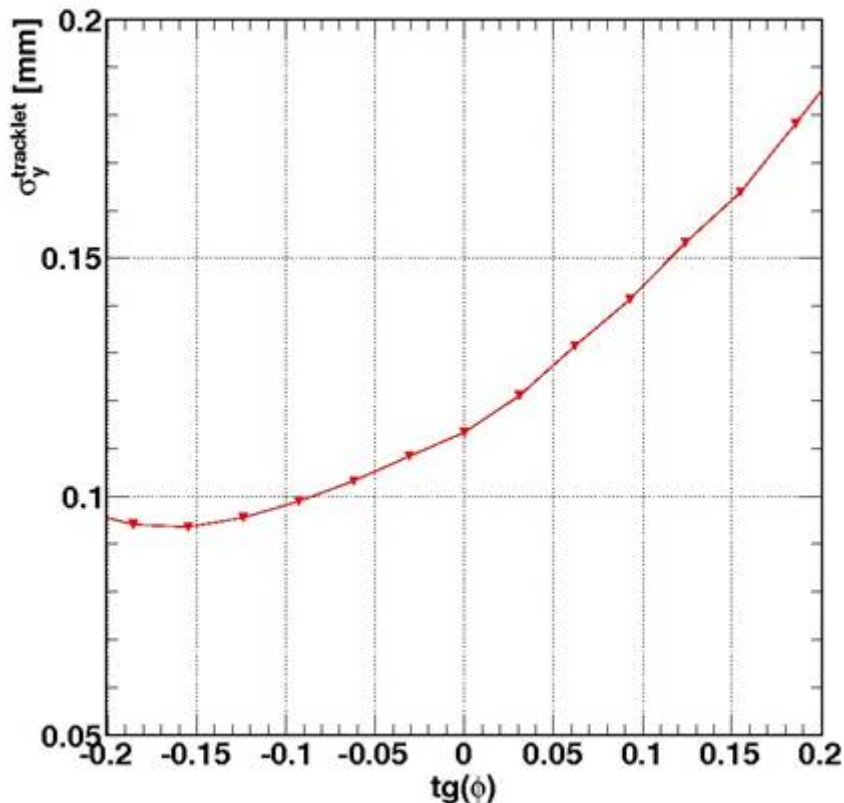


ALICE rates

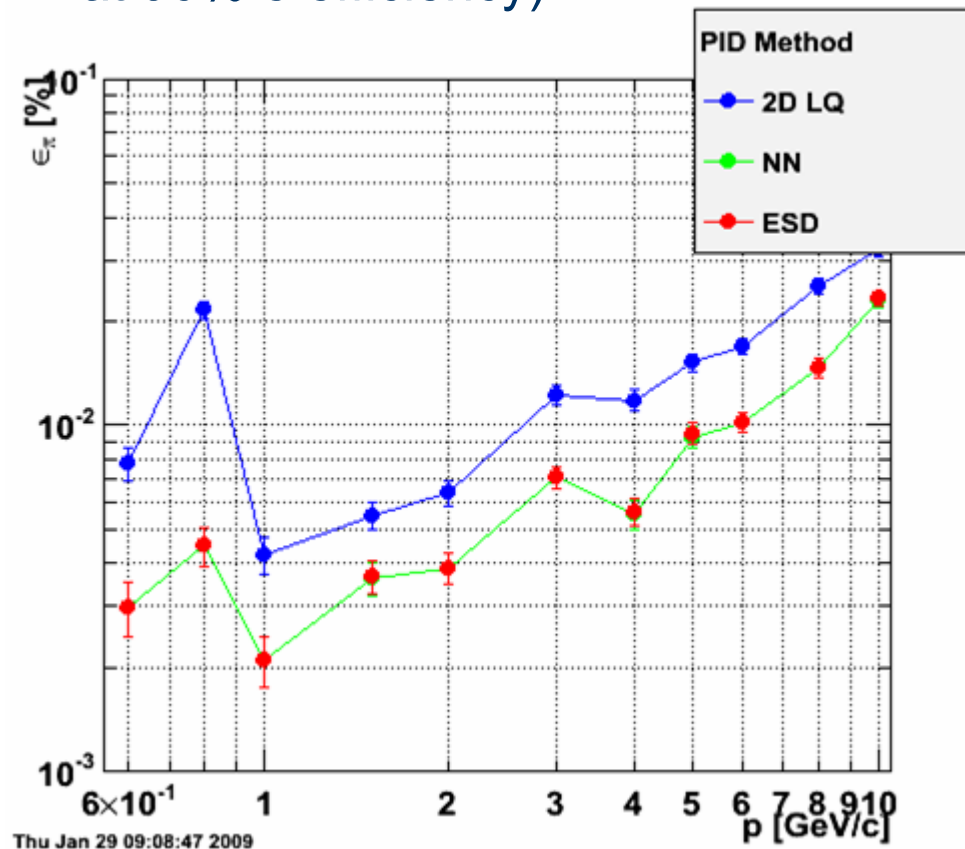
	Luminosity ($\text{cm}^{-1} \text{s}^{-1}$)	σ	interaction rate (Hz)	bunch spacing	Interactions per bunch crossing	interactions per TPC drift time
PbPb low	$5 \cdot 10^{25}$	8 b	400	1000 ns	0.0004	0.04
PbPb high	10^{27}	8 b	8000	100 ns	0.0008	0.8
pp low	10^{29}	70 mb	7000	75 ns	0.0006	0.35
pp high	$5 \cdot 10^{30}$	70 mb	350 k	25 ns	0.01	35
Atlas pp	10^{34}	70 mb	700 M	25 ns	19	

TRD performance, simulation

Position resolution (mean on chamber compared to MC)



Particle identification (pion efficiency at 90% e efficiency)



TRD template

