ATLAS Test Beam Program

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ATLAS Collaboration

Summary

- ✓ Quick schedule overview
- ✓ Overview of the results achieved
  - ❄ Inner Detector
  - ❄ Barrel and End Cap Calorimeters
  - ❄ Muon spectrometer
- ✓ Future plans
  - ❄ Test Beam as pre-commissioning
  - ❄ 2002 and 2003 ATLAS Combined runs
  - ❄ 2004 ATLAS Barrel and End Cap Combined runs
- ✓ Conclusions

ATLAS 2002 testbeam

Version 6 (21/1/2002)
SPS schedule draft 0.3
27 May - 10 September 2002

2002 ATLAS Test Beam Schedule (SPS)

		P1A				P1B					P2A				P2B			
Beam Line	Subdetector	May		June				July						August				Sep.
		27	29	6	12	19	27	3	4	10	18	24	31	8	14	21	29	3
H8/SPS	Pixel			C					C						C	E		
	SCT		C	C						C					C	E		
	TRT															C		LE
	Tiles																	
	LAr barrel																	
	Muons													LE				
H6/SPS	HEC/EMEC																	
	EMEC																	
X5-GIF/SPS			MDT				TGC		RPC					CSC	RPC			

C xyz — Co-user periods

LE — Low energy period

E — Equal user period

MAGNET OFF: 6-12 June, 18-24 July, 14-21 August

Low energy on H8: 8-14 August, 3-10 September

Normal MD: beam starts at 8h

Long MD: beam starts at 12h

ATLAS 2003 testbeam

Version 1.0
SPS schedule draft 1.2
19 May - 8 September 2003

2003 ATLAS Test Beam Schedule (SPS)

		P1A			P1B				P1C					P2A			P2B		
Beam Line	**Subdetector**	**May**			**June**				**July**					**August**				**Sep.**	
		19	23	28	2	13	18	25	3	9	16	24	30	7	13	20	28	1	3
H8/SPS	Pixel	E	25	25	Scrubbing											C	HI	C	E
	SCT	E	25	25												C	C		E
	TRT	E	25	25											VLE				
	Tiles	E	25	25											C				E
	Muons	E	25	25		C		C	C	LE	C	C	C			C	HI	C	E
H6/SPS	FCAL																		
X5-GIF/SPS		RP C	RPC	RPC		RPC	RPC	RPC		TGC MDT		RPC		MDT	CSC RPC				

C — Co-user periods

LE — Low energy period

E — Equal user period

VLE — Very low energy period

HI — High intensity beam

Normal MD: beam stops at 8h

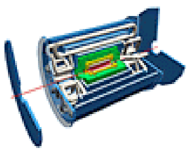
Long MD: beam stops at 10h

Very Long MD: restart at 16h

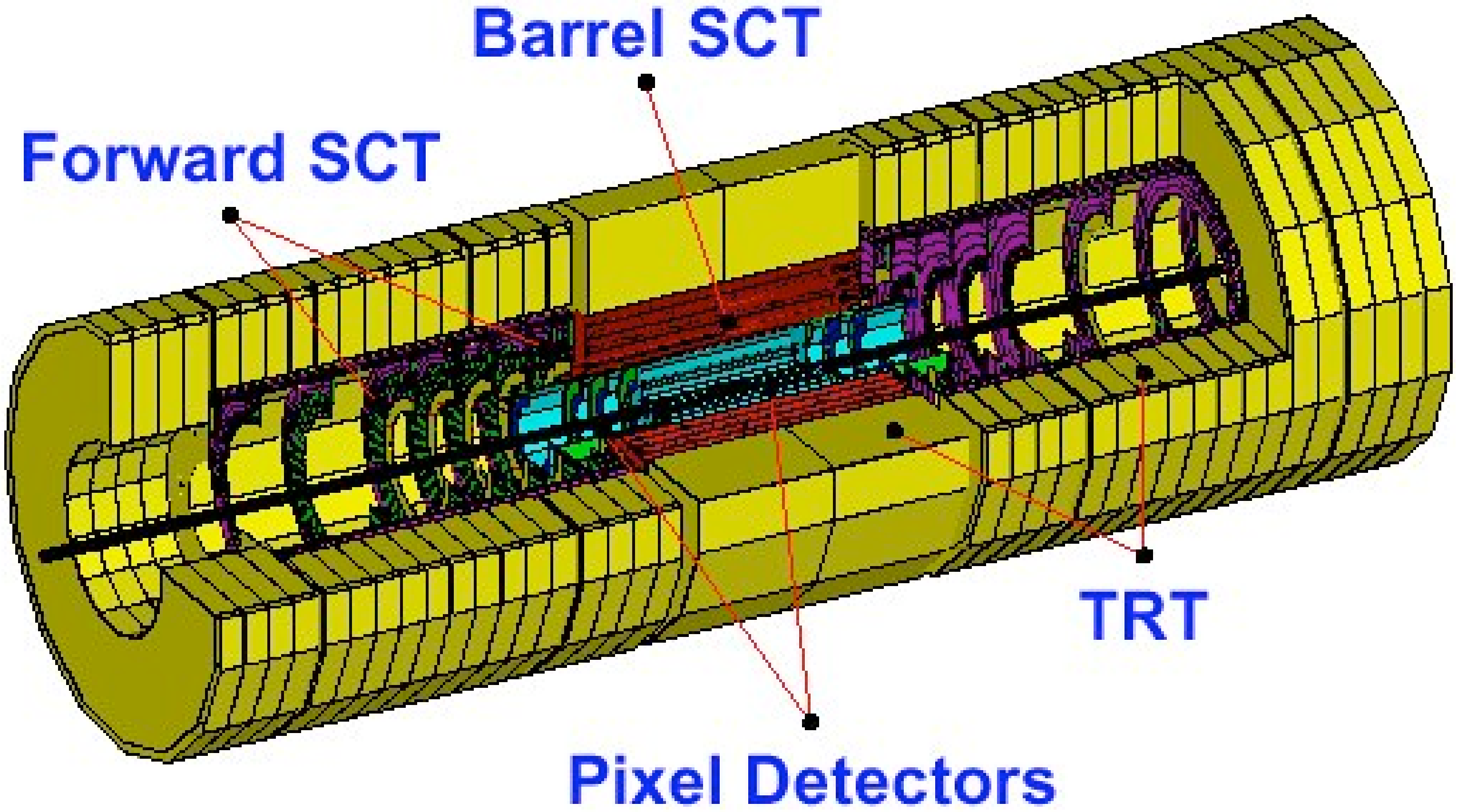
MAGNET OFF: June 12 – June 18, July 3 – July 29, July 24 – 30, August 20 – 27, Sept. 3 – 7

Low energy on H8: July 16 - 23

Very low energy: August 13 - 22



The Inner Detector



Pixel sub-detector

irradiated and unirradiated modules

✓ Accurate track reconstruction using high momentum beam

- Efficiency, resolution, noise

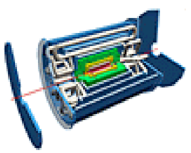
✓ Design verification in 2002

- Test of production and pre-production modules. Verification of performance of modules produced by different sites
- Efficiency and noise of the deep sub-micron front-end chip and sensors tested before irradiation and after 1.1×10^{15} n_{eq} cm^{-2} and 600 kGy dose

✓ High intensity test in 2003

- 10^8 hadrons/spill to study SEU on the front-end electronics. Setup moved to NA45 zone
- Multi-tracking events with an active target

✓ Test of production modules, ID combined testbeam, ATLAS Barrel combined testbeam (2004)



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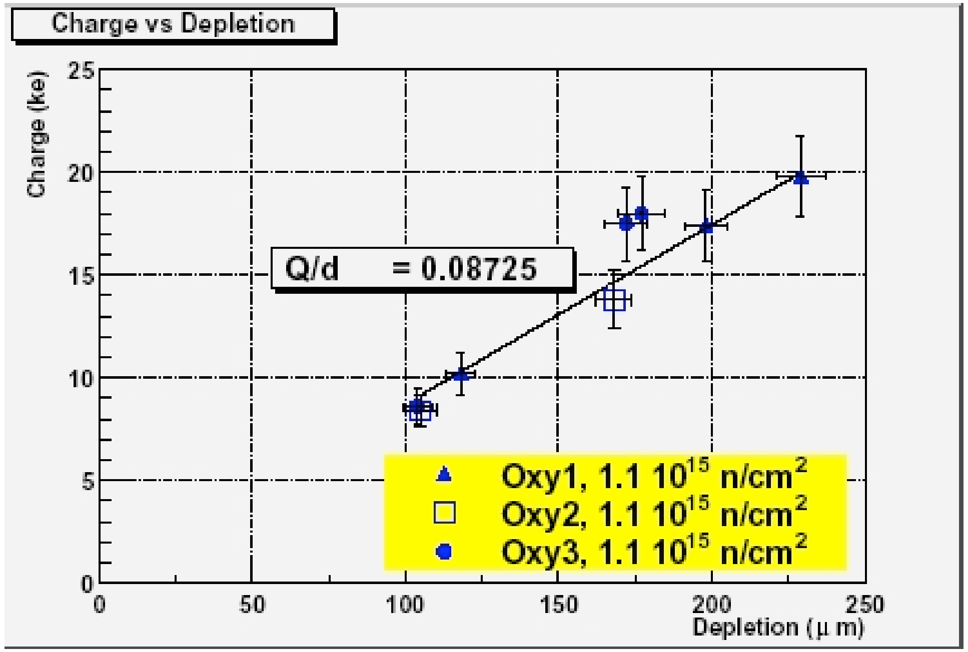
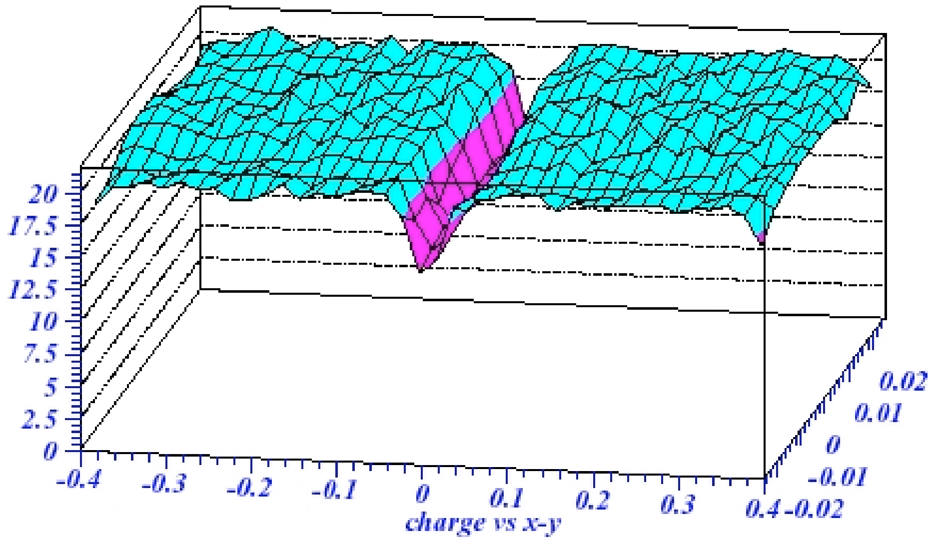
Results obtained in 2002: Pixel sub-detector



Average cluster charge: 20000 e at 600 V after irradiation (25000 e before, noise 400 e)

Irradiation: 1.1 x 10^{15} n_{eq} cm^{-2}, 600 kGy

ATLAS 10y: 10^{15} n_{eq} cm^{-2}, 550 kGy



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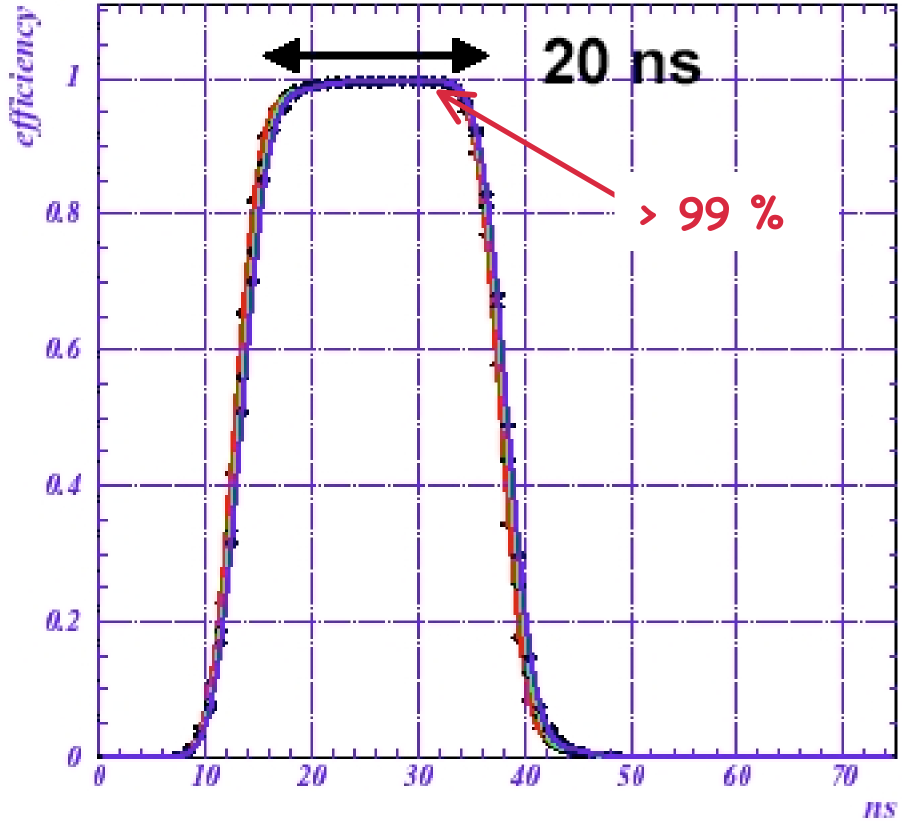
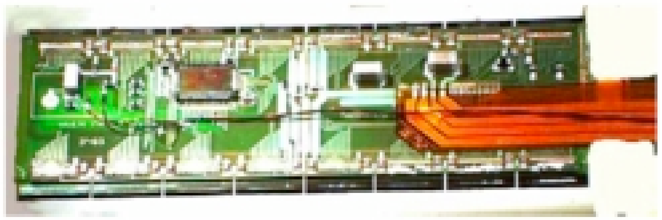


In ATLAS the pixels identify BC for a particle with eff. > 97 %

Measured the phase between time arrival and 40 MHz clock

Efficiency vs (beam trigger - beg. clock period)

In ATLAS adjustable phase per module (16x64 mm^2)



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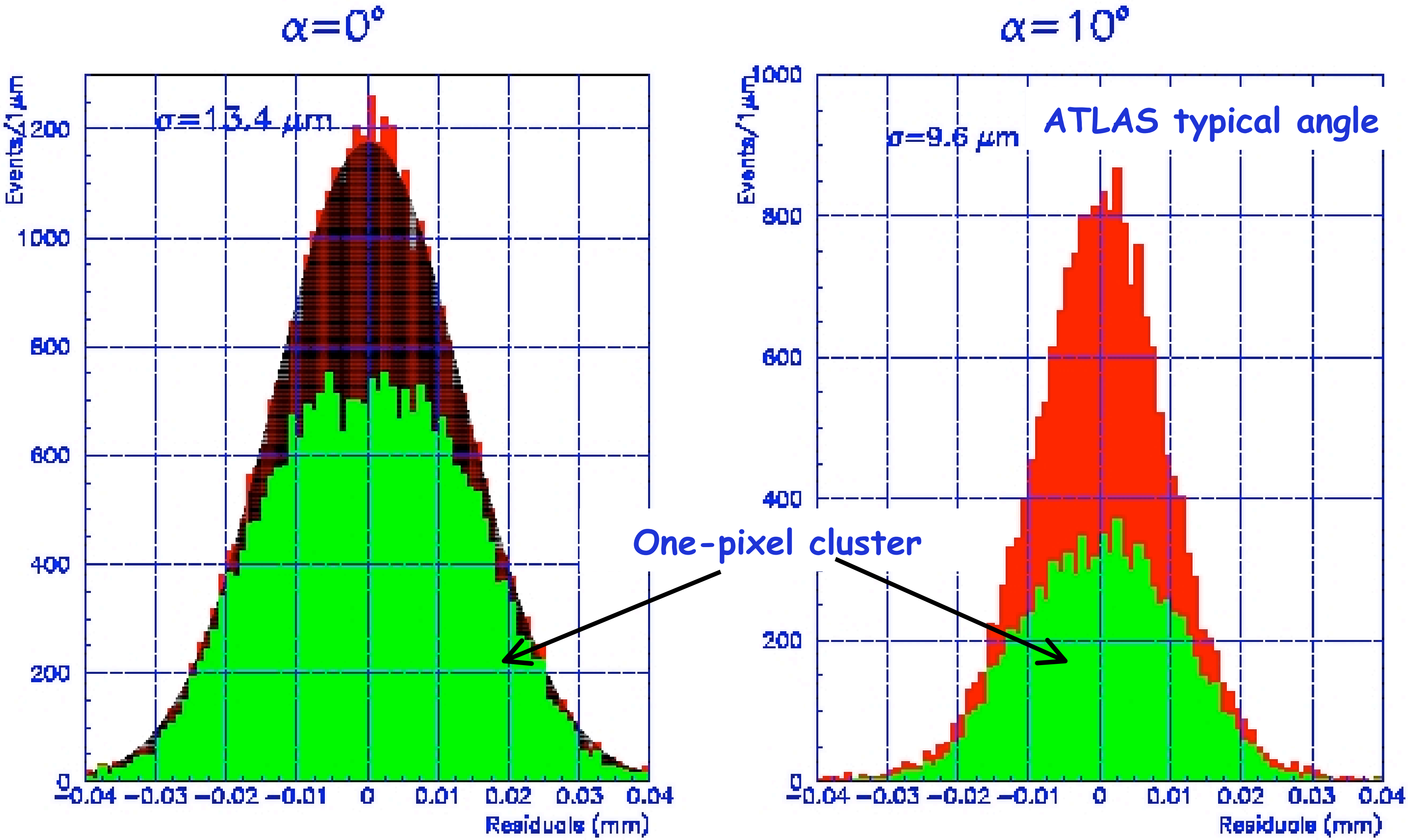
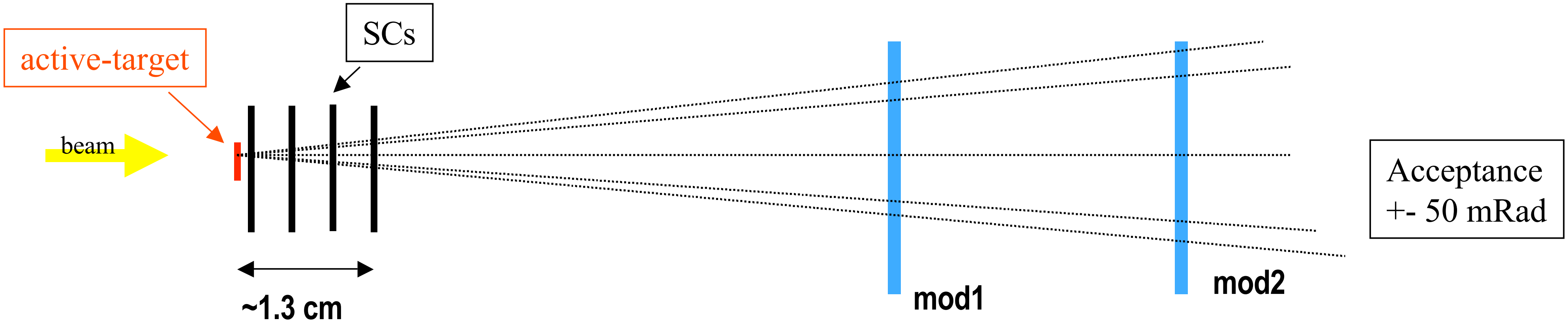


Position resolution (12 μm r-φ in ATLAS)

ATLAS pixel telescope in high-intensity H8 (2003)

- any number of single pixel chips, SCs (=2880 channels each, 7x8 mm^2) can be placed ~4mm apart
- a thin Si diode (active target) just in front of them is able to discriminate interactions (through pulse height)



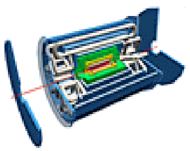
The Si-tgt selects interactions and the SC's detect particle "jets" to be then followed in the module(s) under test. Beam (=underlying events) will also be present (10^7 particles/s cm2).

This allows tests in a LHC-like environment and to study the effect of interactions in silicon (and compare with Geant4).

SCT sub-detector

irradiated and unirradiated modules

- ✓ Operation with 25 ns beam in 2001
- ✓ Tracking studies in 2002
- ✓ Tracking with bunched beam in 2003
  - Tracking arrays with positions to emulate real SCT
  - Operation of front-end in aggressive ATLAS-like zero-suppression mode (fully using the pipeline and out buffer for high trigger rate and beam occupancies)
  - 40 MHz structure to separate tracks and assign them to specific BC
  - Test with magnet (1.56 T) and low energy particles
  - Upstream target for multi-track events
- ✓ Participation to ATLAS combined run in 2003
- ✓ Test of production modules, ID combined testbeam, ATLAS Barrel combined testbeam (2004)



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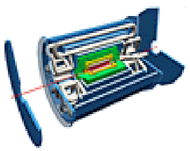
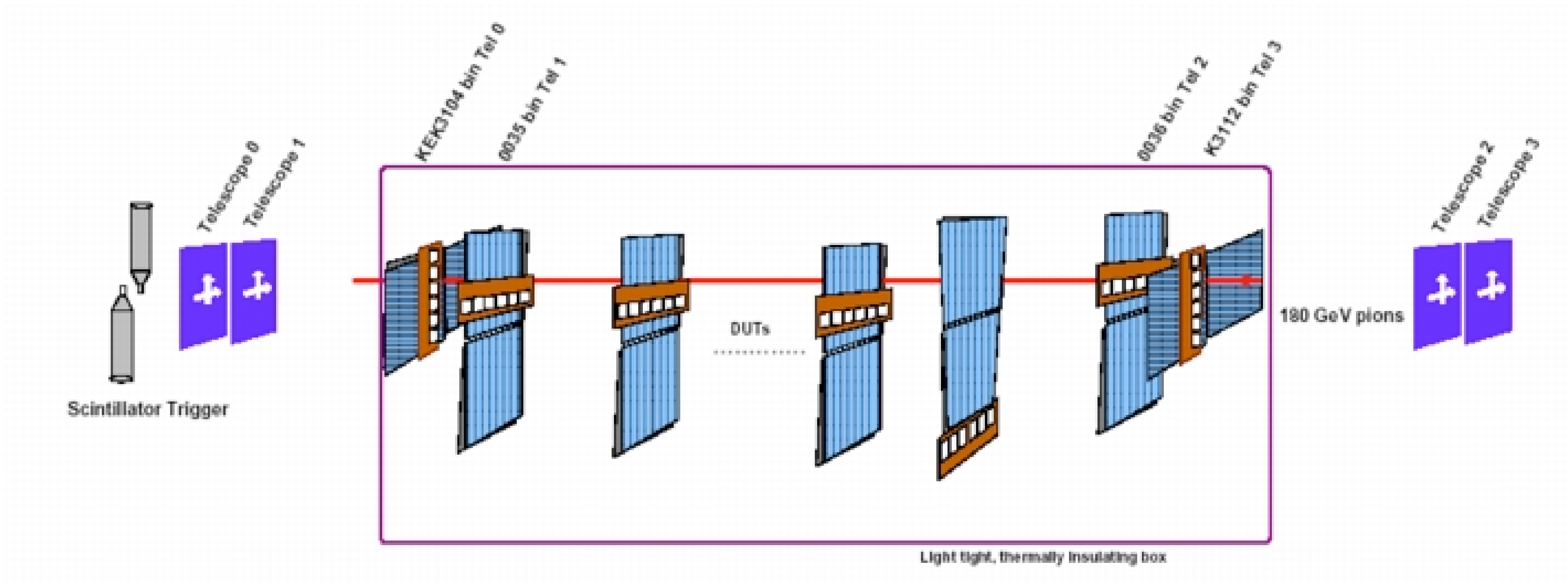


Results obtained in 2001 (25 ns): SCT sub-detector



4 outermost modules used as telescope

Fixed delay between signal deposition and sampling (optimized with 2.75 ns delay scan)

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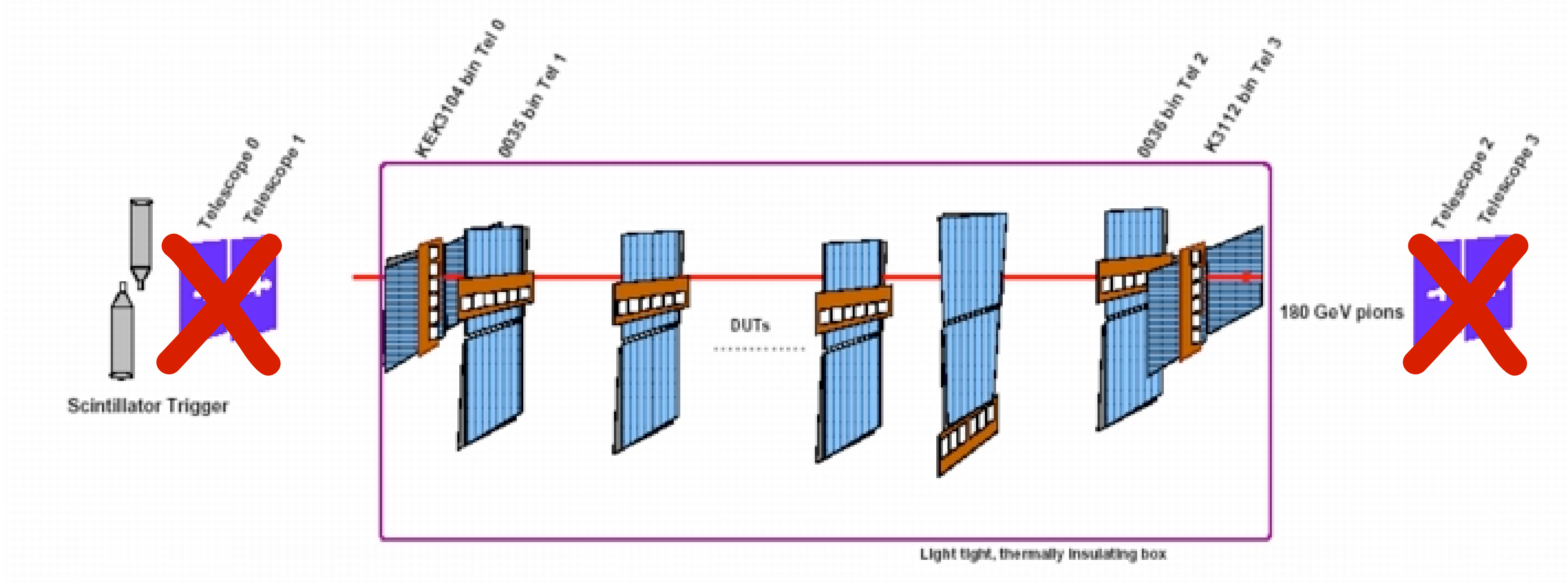

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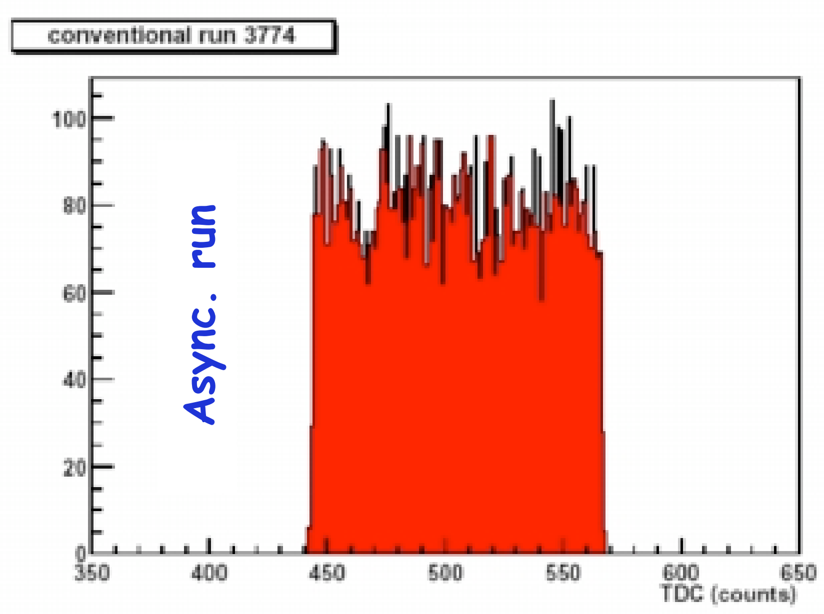
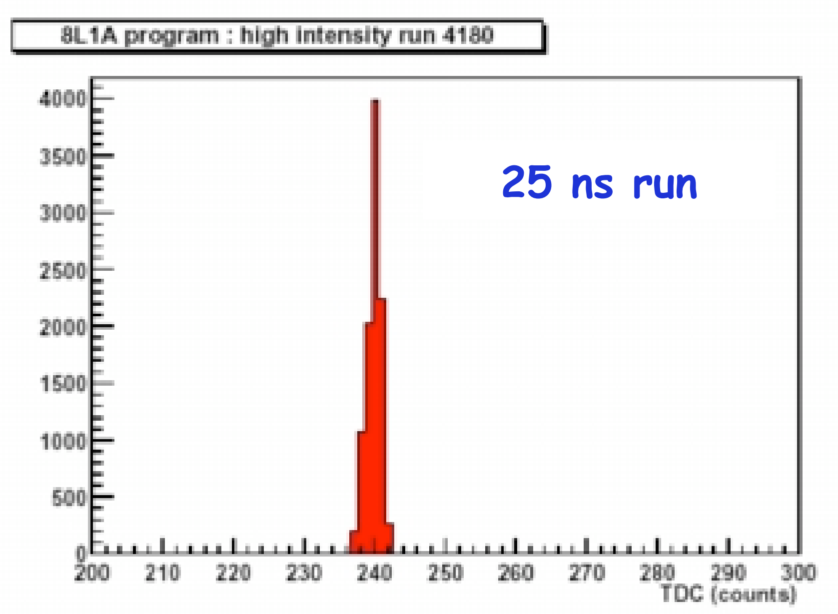
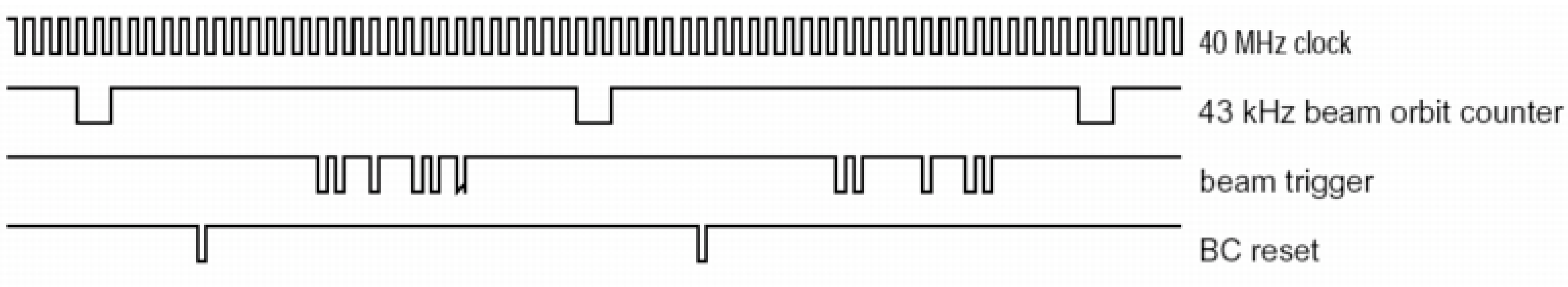




1 TDC count = 0.2 ns



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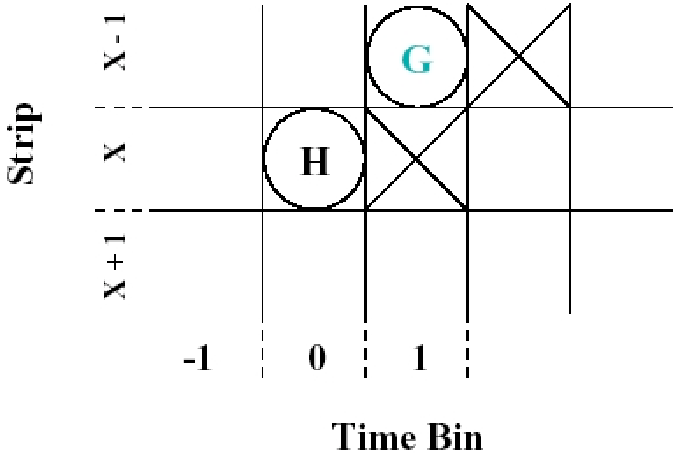
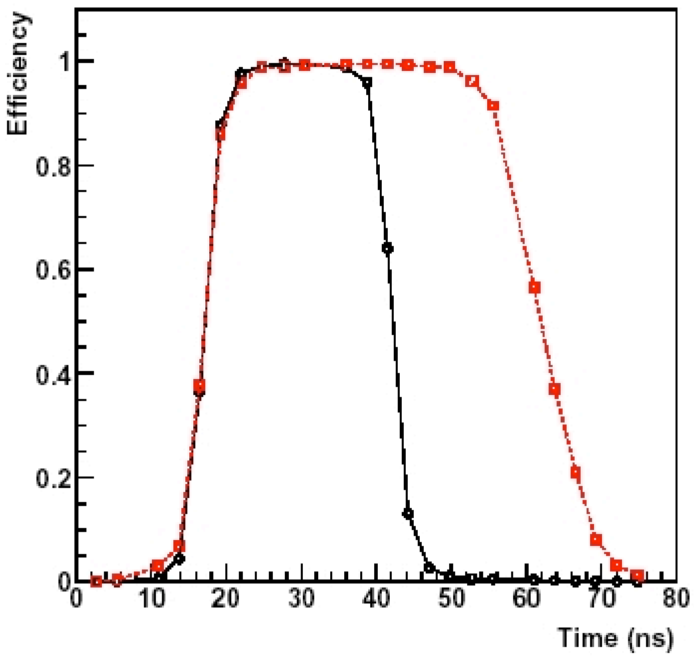
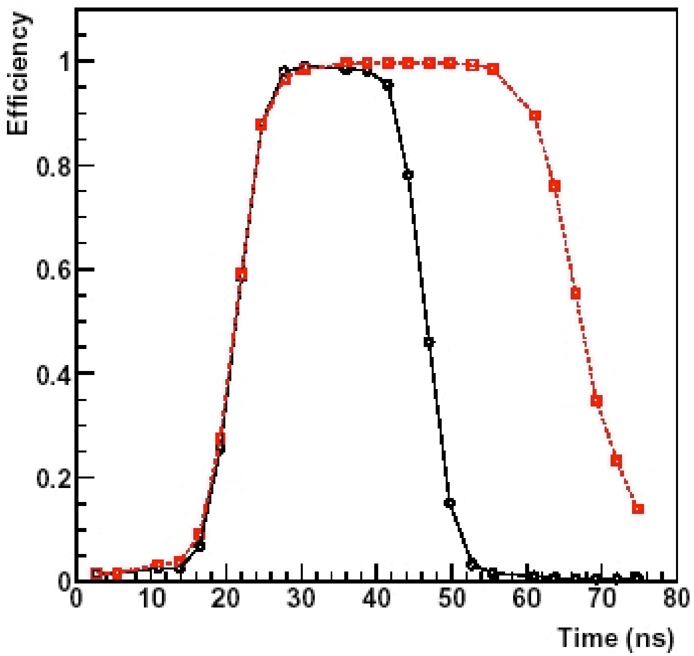
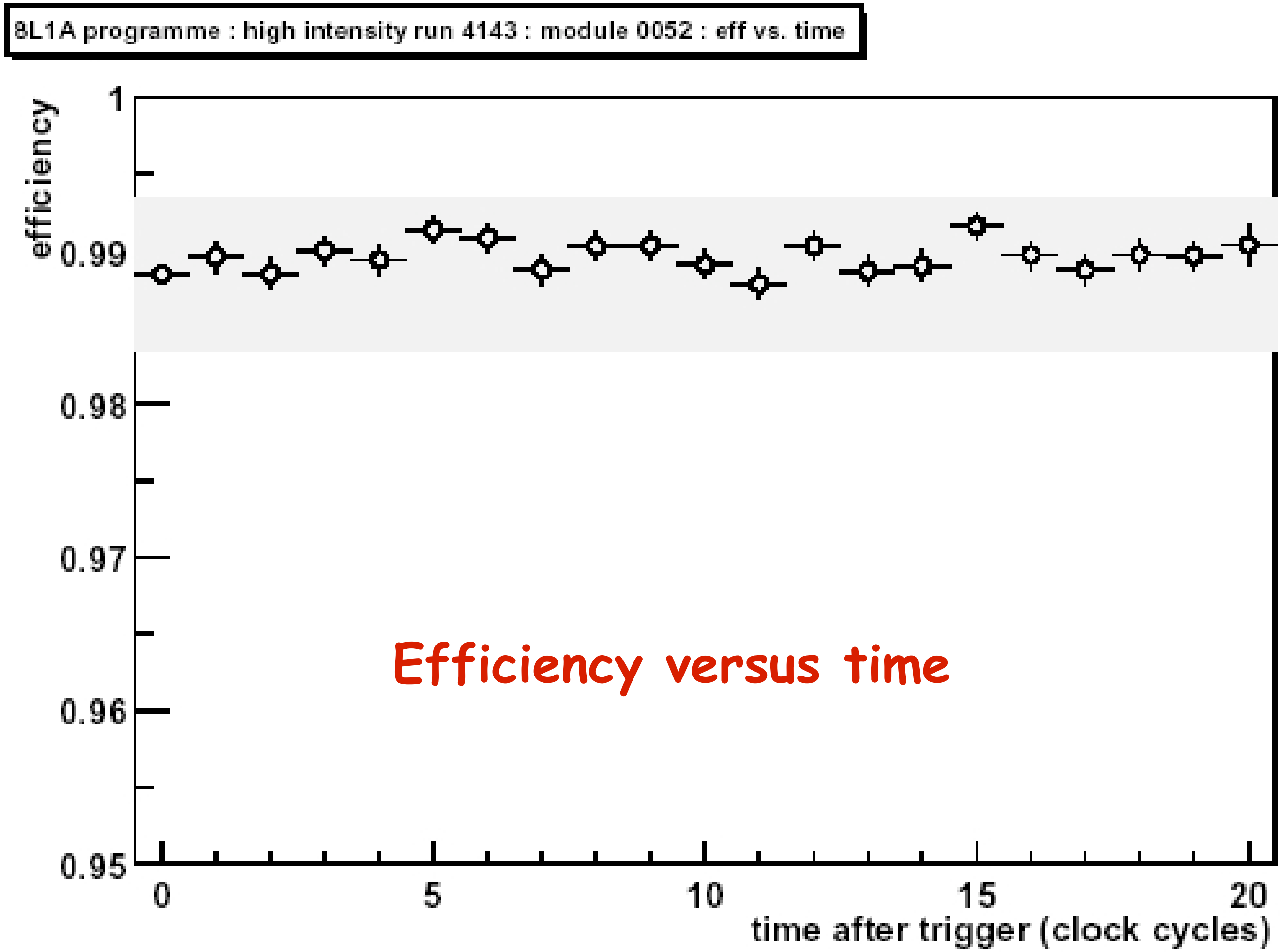


Edge sensing operation mode of the front-end chip to cut noise (Binary readout)





SCT: 25 ns high intensity



TRT sub-detector

- ✓ Drift time measurement accuracy and efficiency with new gas in 2002
- ✓ Validation of design and performance study of large detector parts for the particle identification in 2003
- ✓ Test of the final TRT ROD (test of zero-suppression)
- ✓ Study of signal shape, time and amplitude with particles
- ✓ Combined runs with Pixel and SCT in 2004
  - ❄ Global system performance
  - ❄ Data handling
- ✓ ATLAS Barrel combined testbeam (2004)

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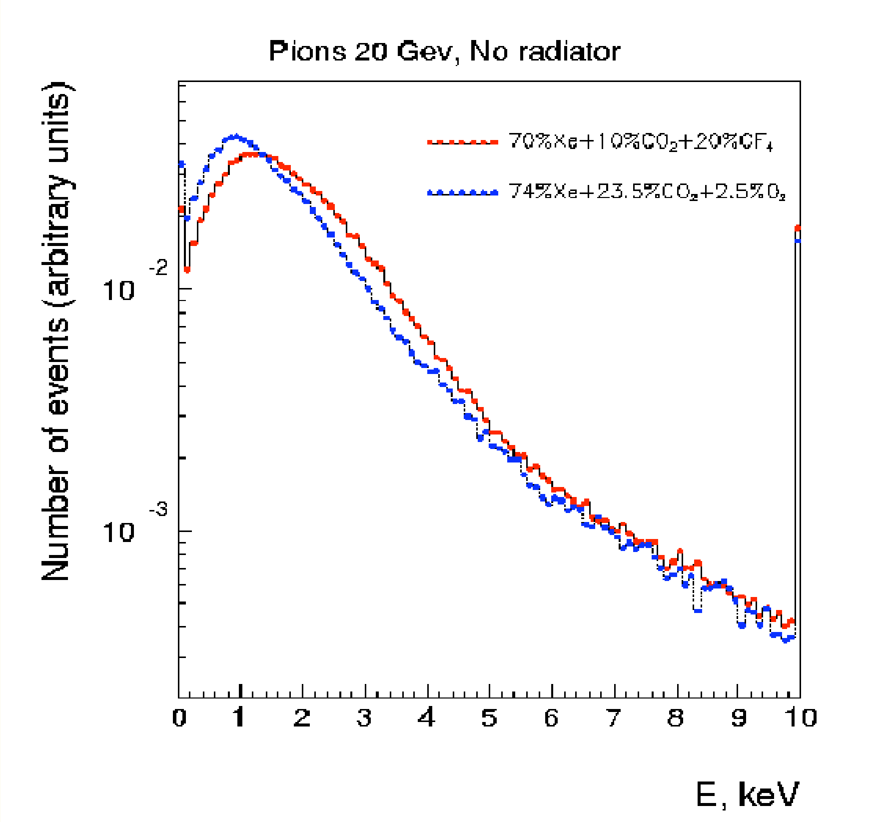
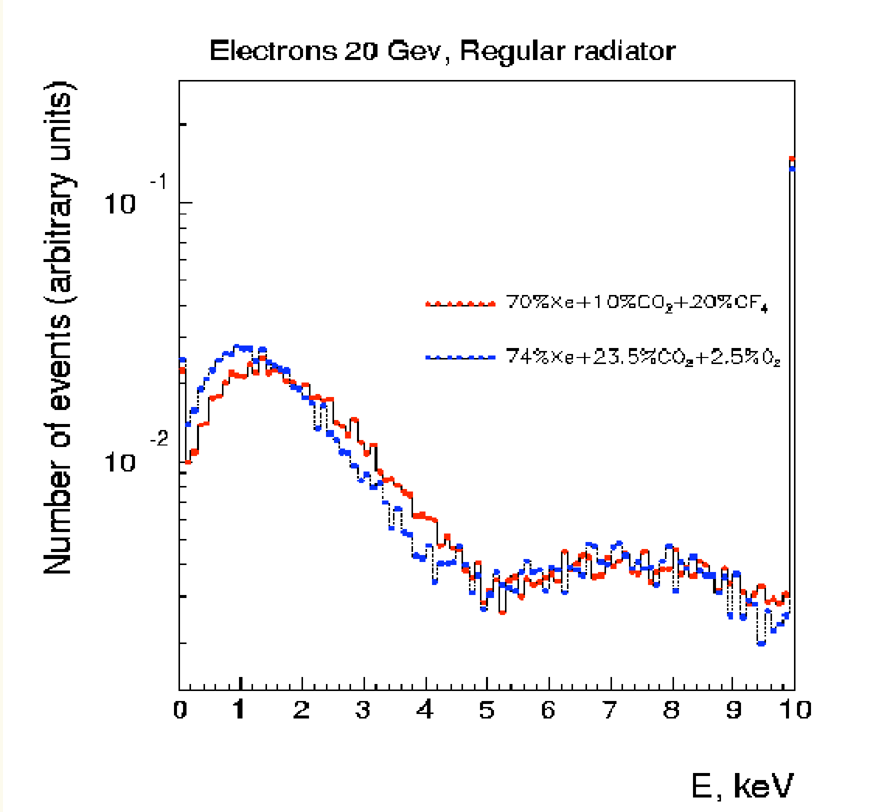
TRT: Test beam results 2002

dE/dX and TR: measurements

Pions 20 GeV



Electrons 20 GeV with TR radiator

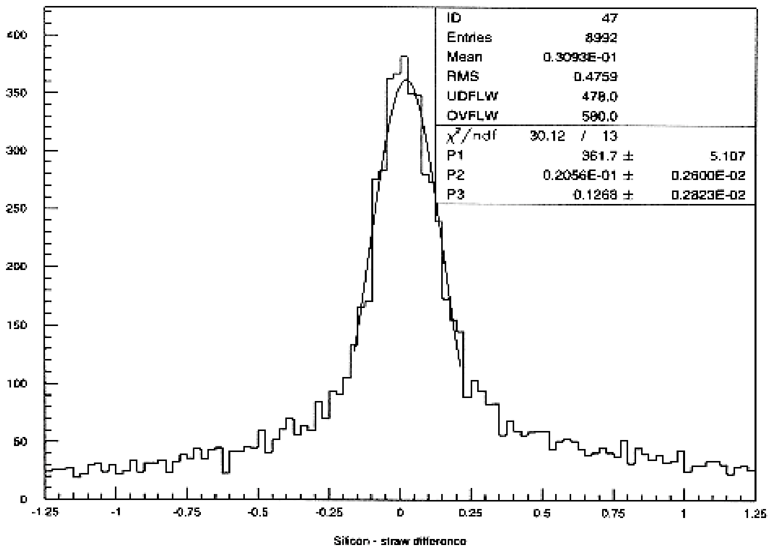


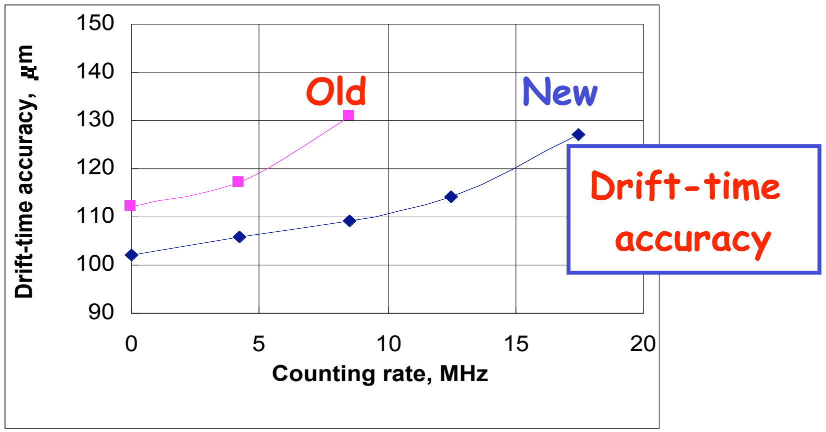
TRT: Test beam results 2002

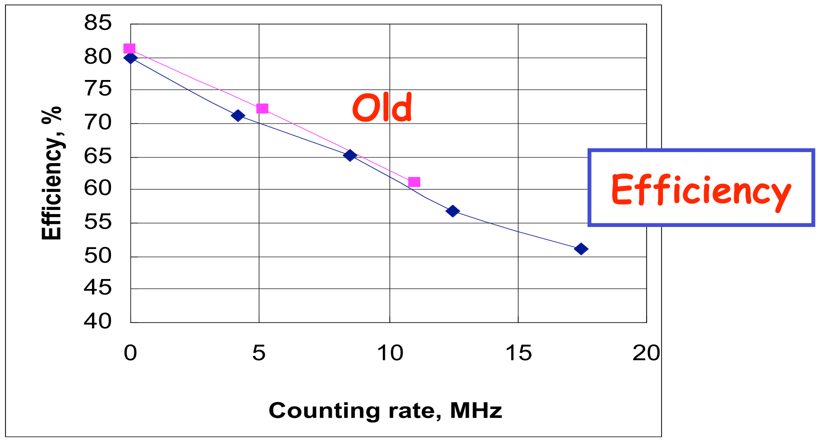
Drift-time measurements: high-rate operation

Comparison between TRT old and new gas mixtures.

New Gas, 17.5 MHz background counting rate







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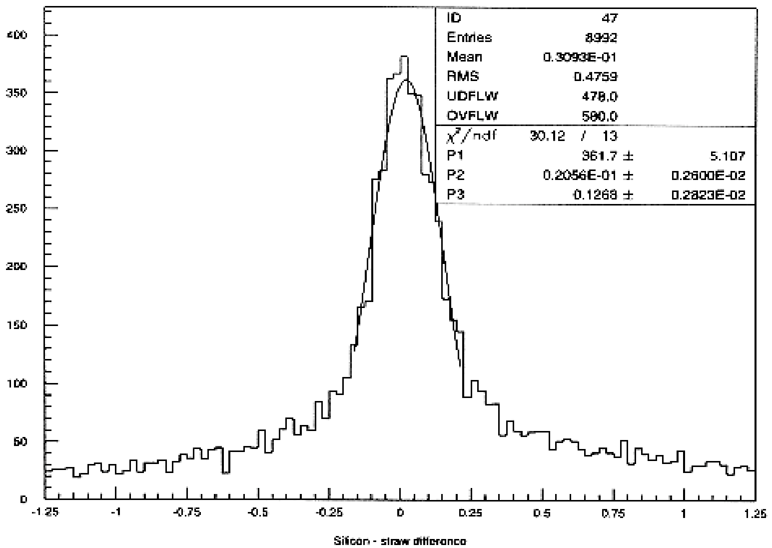

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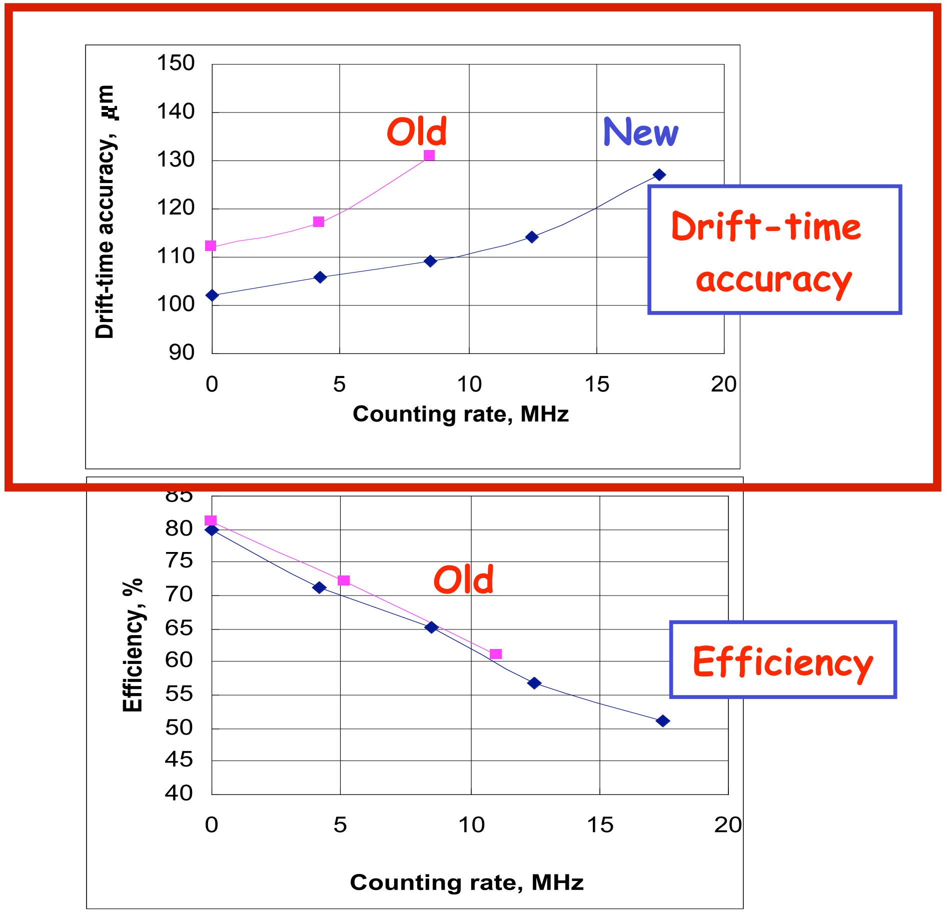
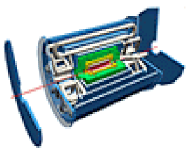




TRT Test Beam 2003: the goals

Barrel TRT performance study
for particle energy range
0.5-20 GeV

- Tracking performance

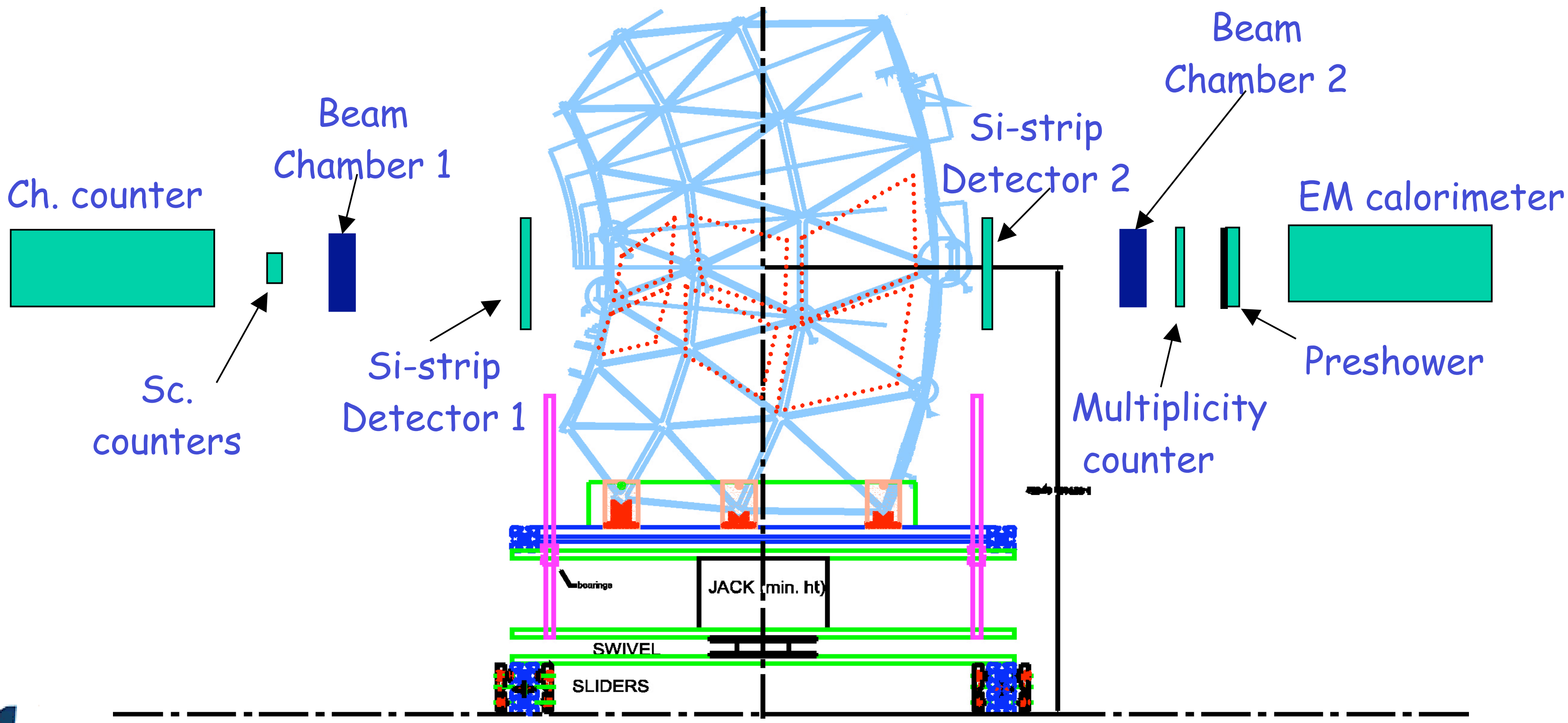
- Effect of multiple scattering in the detector material for momentum reconstruction.

- Particle identification (e/π separation). Particularly in the region 0.5-5 GeV, which is very important for the ATLAS B-physics program.

TRT Test Beam 2003

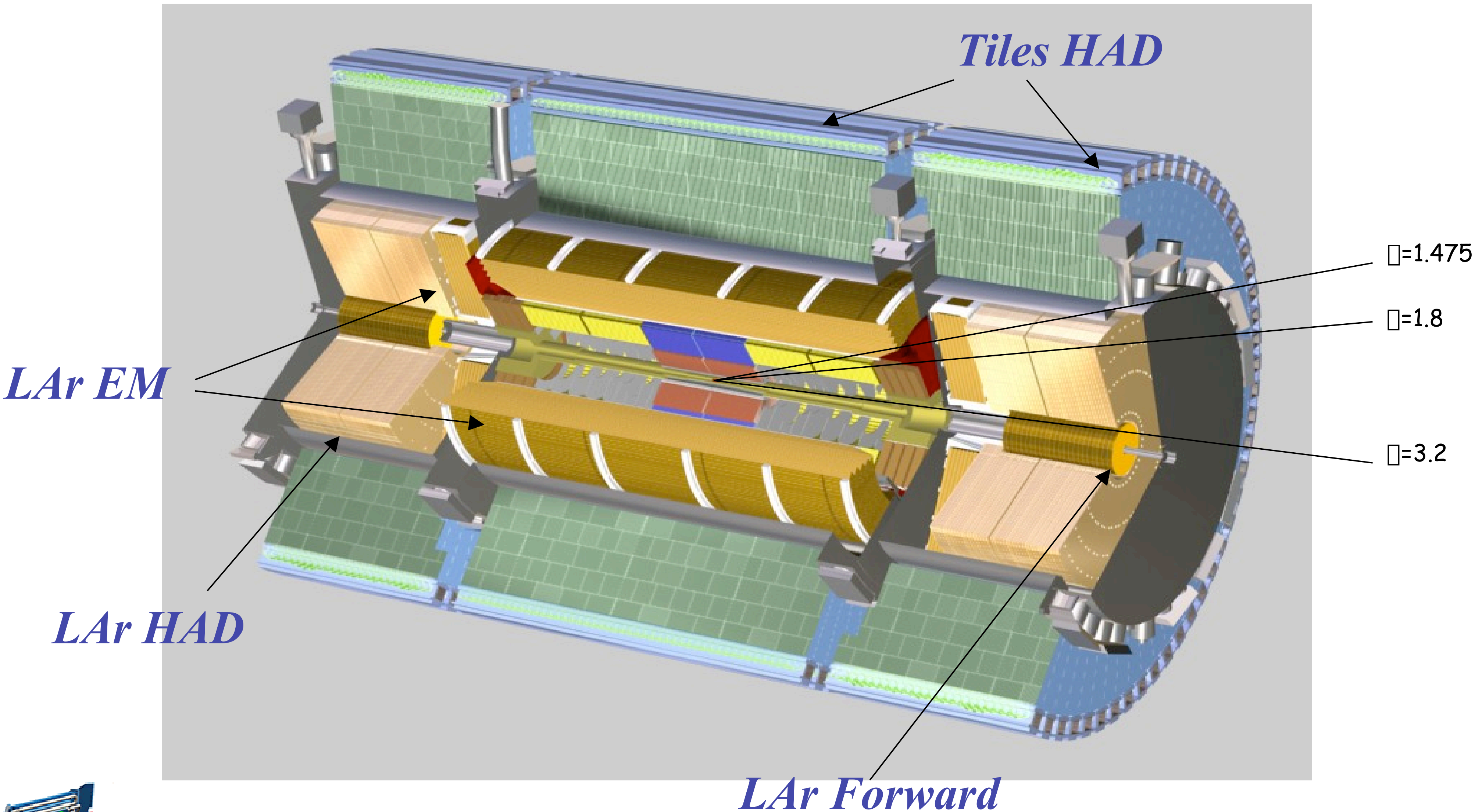
Low Energy Beam.

Maximum 6 TRT barrel modules
will be assembled (22.5° sector of the barrel TRT)



TRT Test Beam 2003

The Calorimeter System



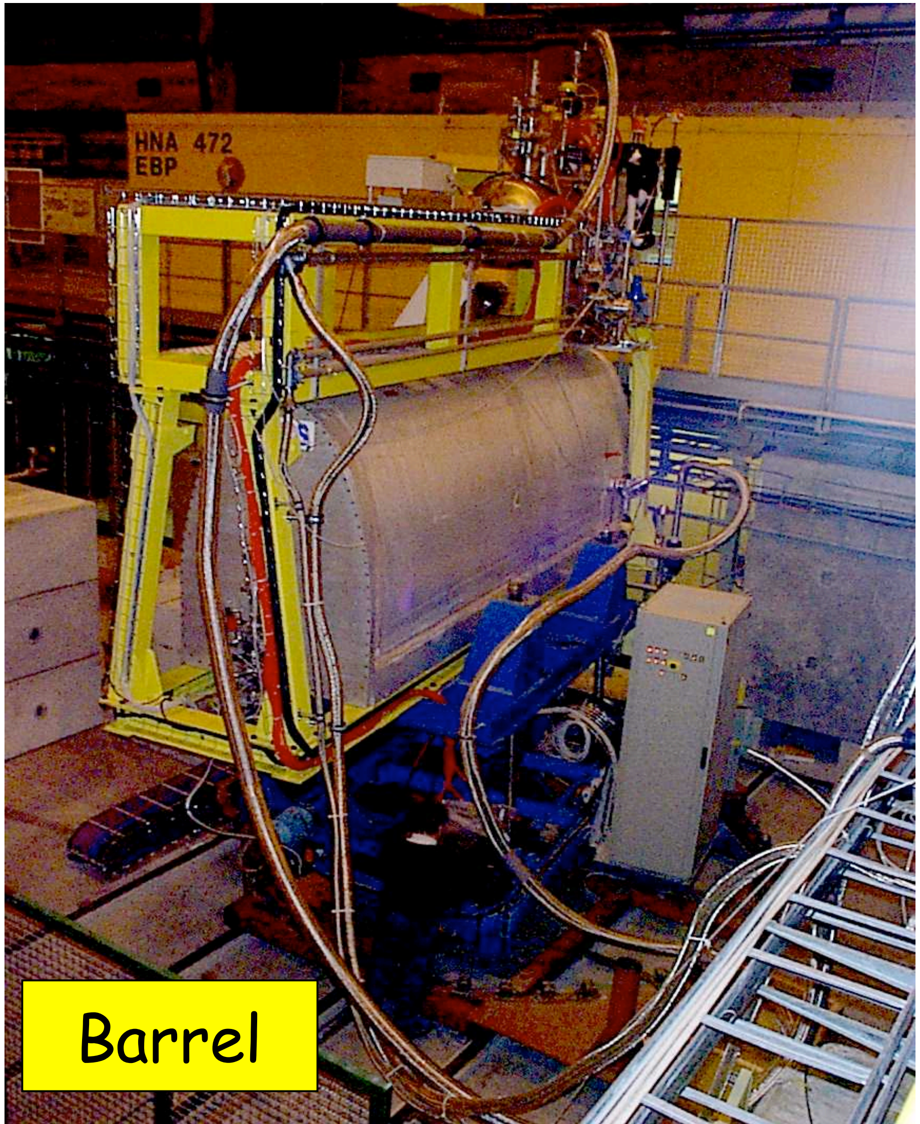
LAr Barrel e.m. calo Test Beam: 2002, 2004

- ✓ 2002 (production validation)
  - ❄ Complete the performance test and quality control program:
    - 2 barrel modules during two 2-weeks period
- ✓ Linearity response to electrons at ‰ level with B field measurements of beam line magnets (for W mass prec. measurement)
- ✓ 2004 (combined performance)
  - ❄ Combined barrel calorimetry run with the LAr barrel Module0
  - ❄ ATLAS Combined run

LAr EMEC Test Beam

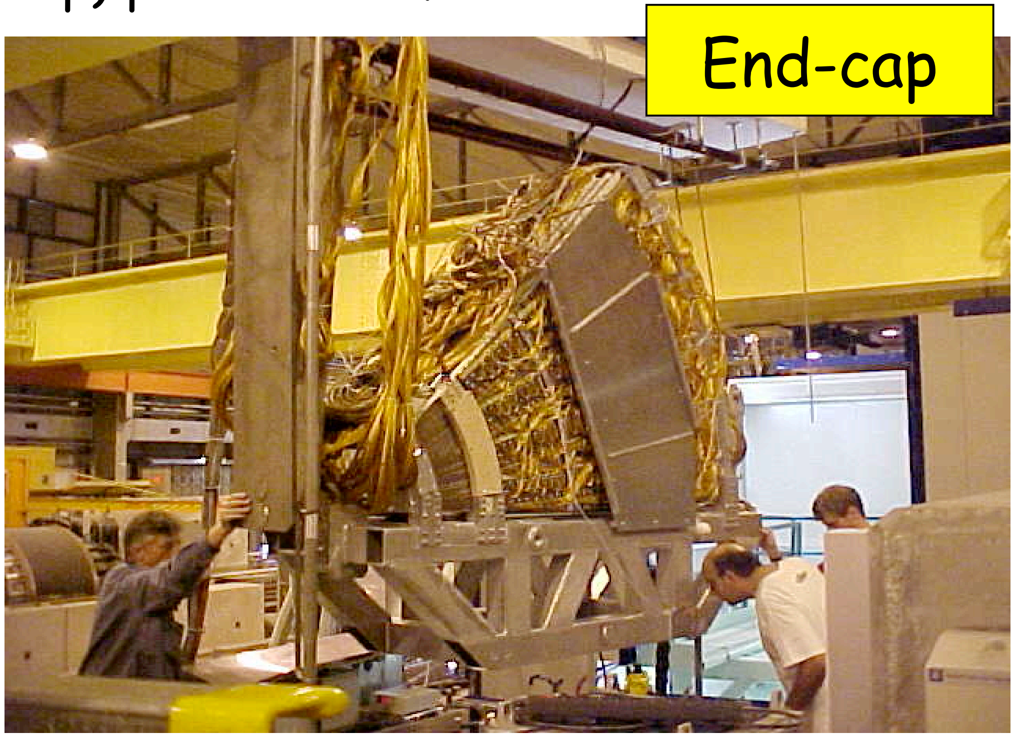
- ✓ Performance and quality control checks of 4 modules (reduced to 3 because of the SPS schedule cut)
  - 2 modules tested in 2001
  - 1 module tested in 2002
  - Same type of studies as for Barrel e.m. calo
  - Study of the electron drift in Argon
    - Ion build up (space charge) effect occurring at high luminosity and large rapidity
- ✓ Combined runs with HEC and HEC/FCAL
  - EMEC/HEC run in 2002
  - EMEC/HEC/FCAL most likely in 2004

LAr barrel and end-cap e.m. calo: Test-beam setups

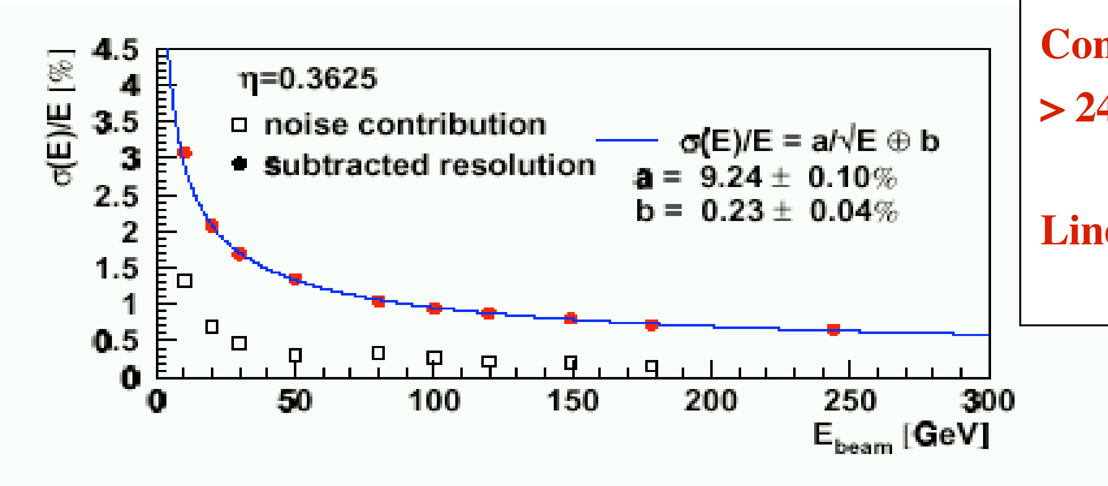


1999-2000: barrel and end-cap prototype modules (« module 0 »)

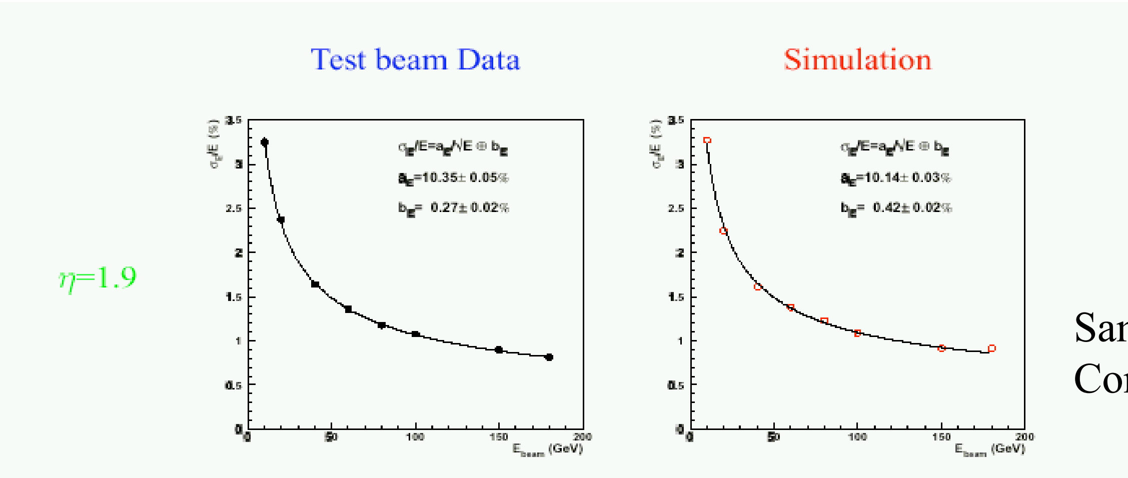
2001 – 2002: 7 (4 barrel and 3 end-cap) production modules



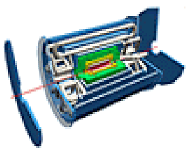
LAr e.m.: Energy Resolution



- Sampling term 10%/ E or better (for SM H)
- Constant term 1% or better (for Z' and H -> □)
- > 24 X_0 depth (to limit leakage effect on resolution)
- Linearity 0.5% up to 300 GeV (H -> □, H -> 4e)



Sampling : 10.4%
Constant : 0.27%



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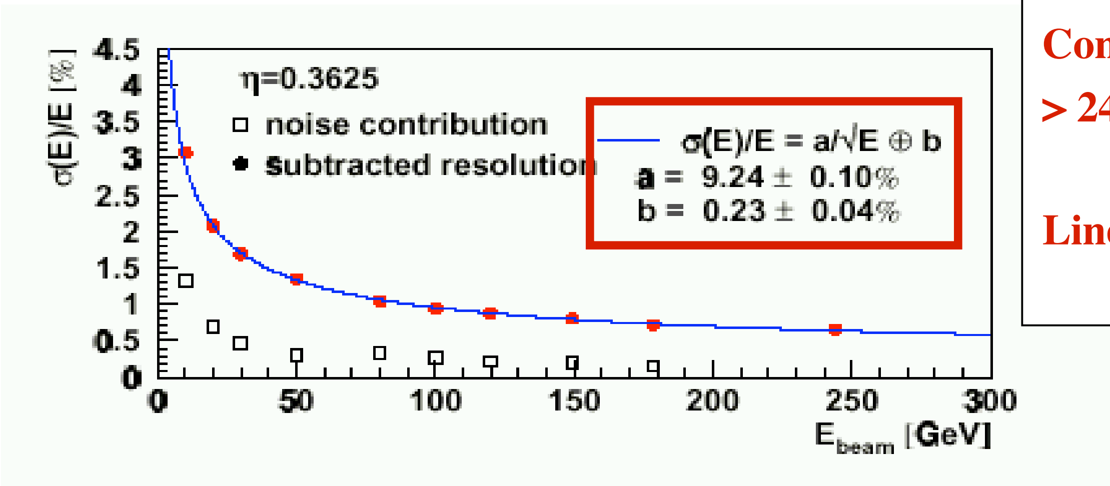

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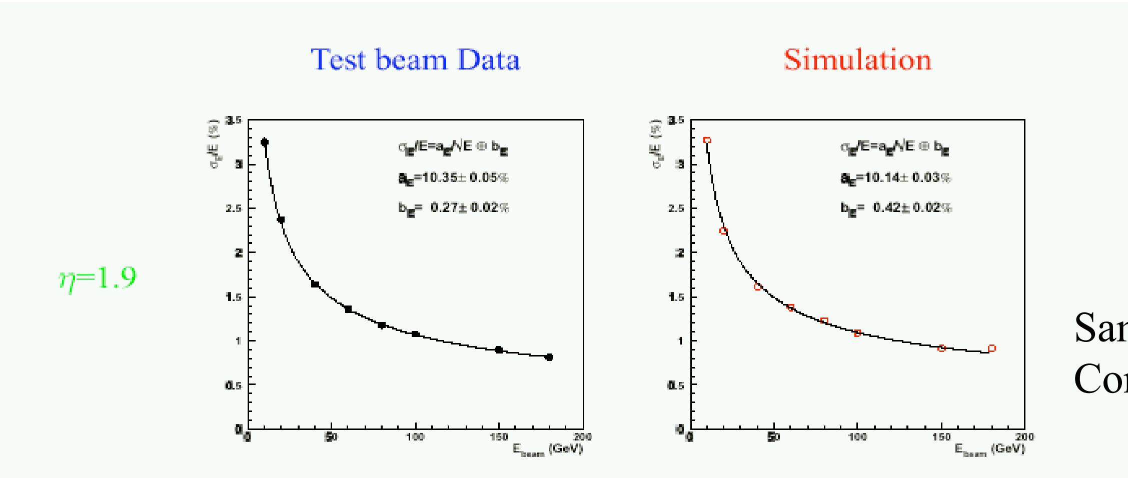

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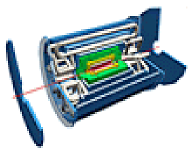
EMEC specifications

- a < 12.5%
- b < 0.5%



LAr e.m.: Energy Resolution

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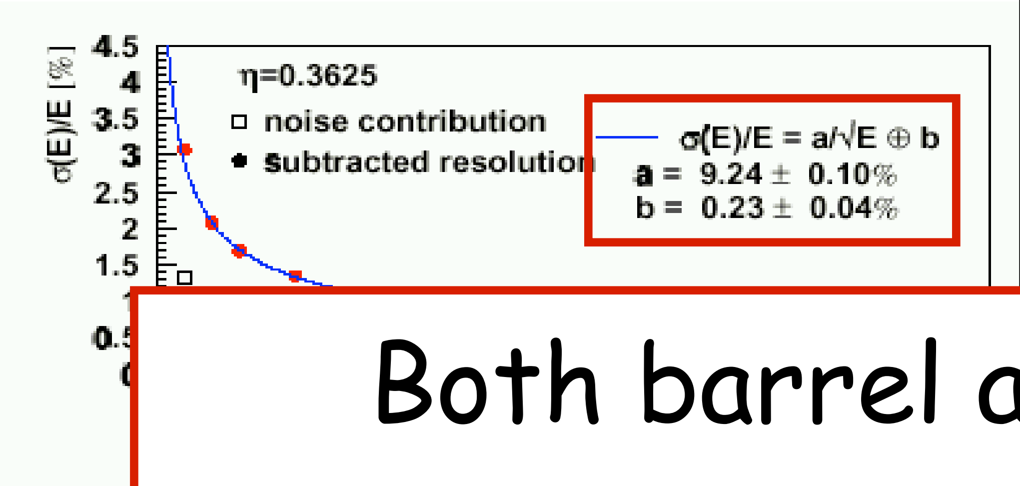
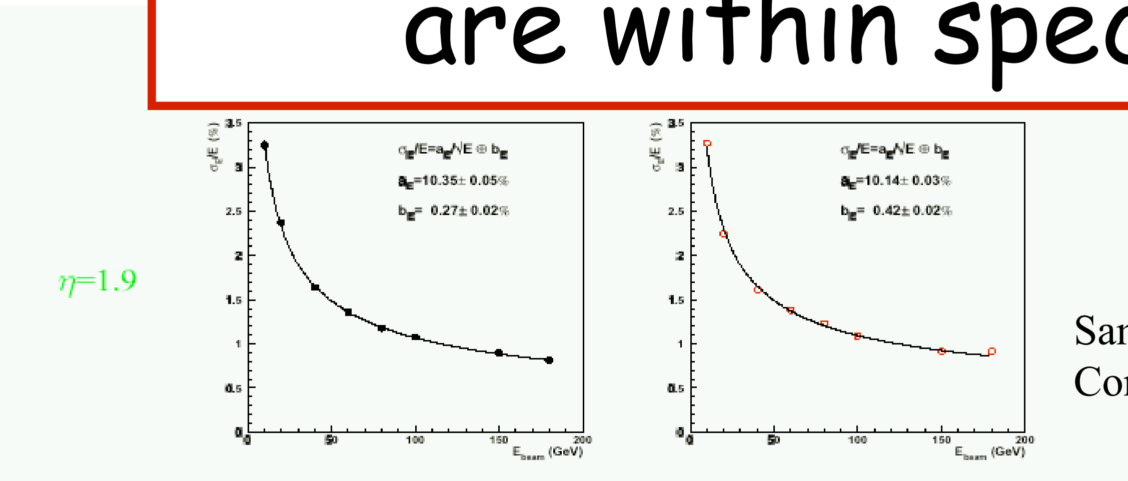


Both barrel and end-cap are within specification



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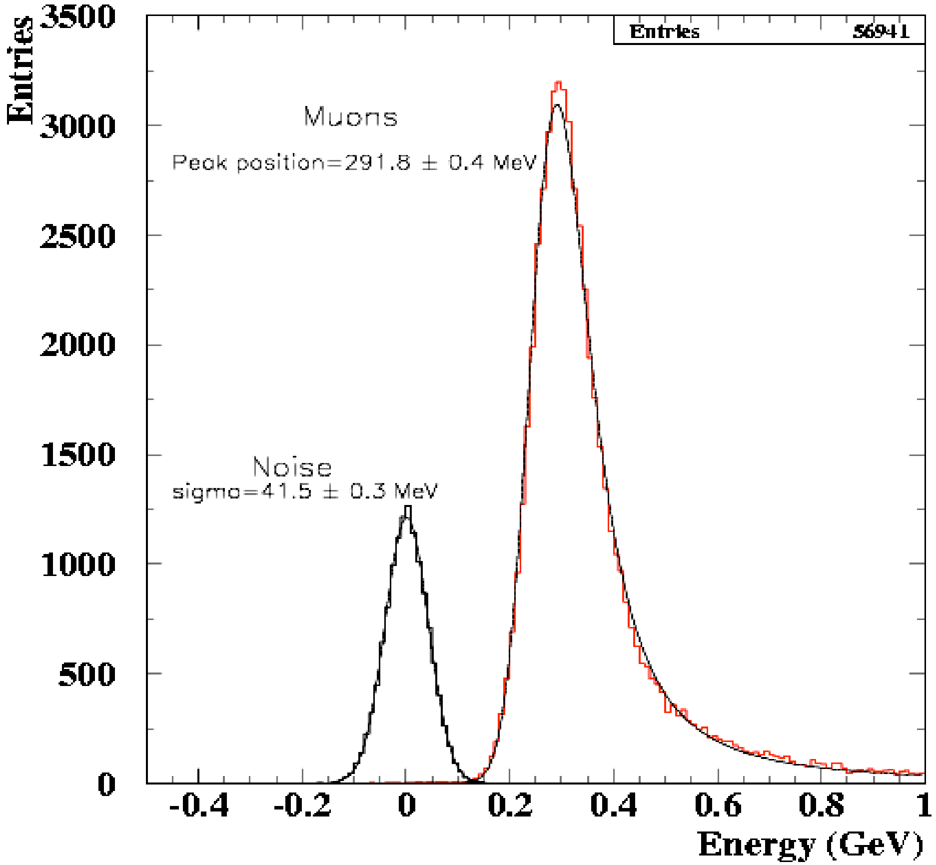
LAr e.m.: MIP Response



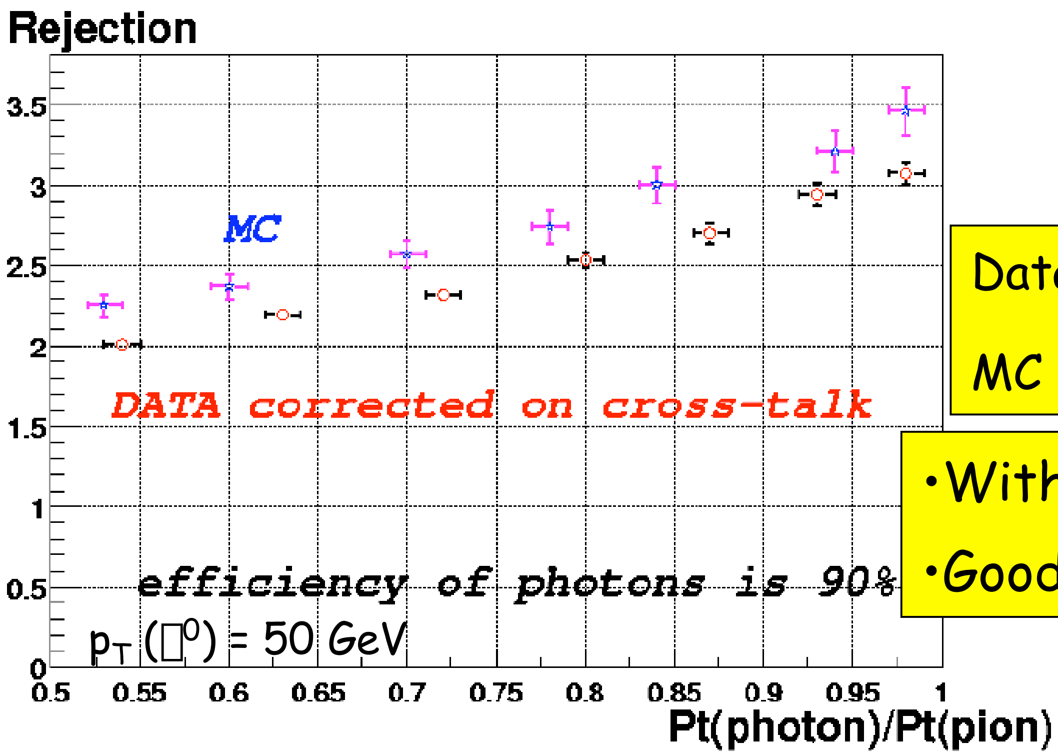
$\frac{\text{Signal}}{\text{Noise}}$ □ 7

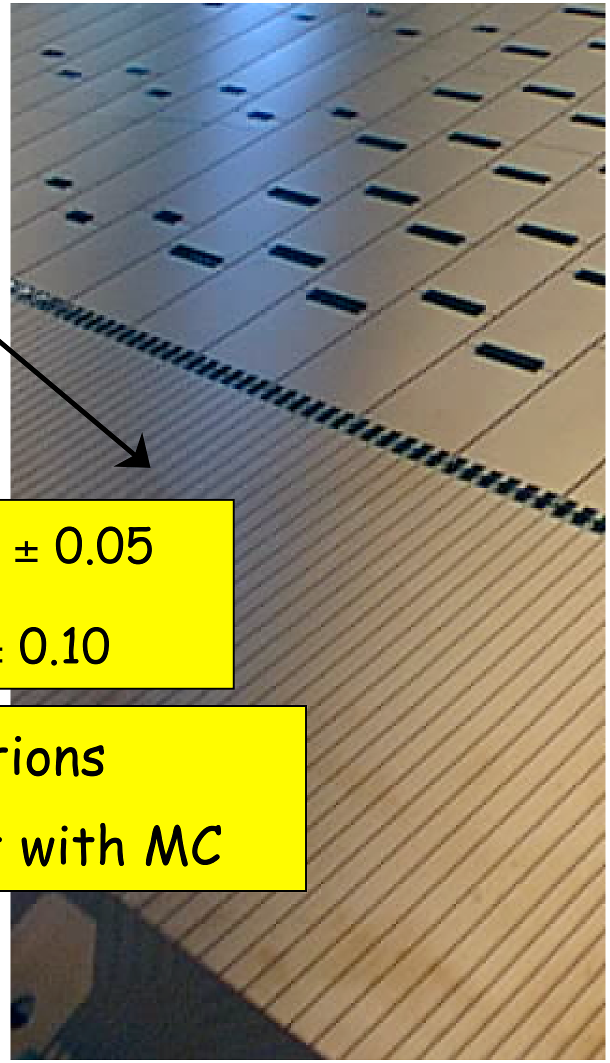
- Will be slightly worse at LHC : about 5 (different electronics)
- First use : Cosmic runs
- But also at LHC…

LAr e.m.: γ/π^0 separation

Barrel

- ✓ π^0 rejection needed to correctly identify γ (i.e. H→γγ)
- ✓ Uses calorimeter first sampling ("strips") fine η segmentation:
  - ❄ $\Delta\eta$ = 0.025/8 ≈ 5 mm
- ✓ Photon data from special runs on barrel module





Data : <R> = 2.60 ± 0.05

MC : <R> = 2.82 ± 0.10

- Within expectations
- Good agreement with MC

Tilecal testbeam runs

- ✓ Determination of the energy scale (pC to GeV conversion) for 8 modules/cylinder
  - ❄ 1 Barrel and 4 extended barrels in 2001
  - ❄ 3 Barrels and 6 extended barrels in 2002
- ✓ Timing tests with 25 ns beam
- ✓ e/h measurements
- ✓ $f(\pi^0)$ for protons and pions
- ✓ Implementation and integration of final ATLAS infrastructure (with major impact on other systems)
  - ATLAS DAQ prototype integration (2000)
  - DCS SCADA system with ELMB for temperature (2001) and for the other controls (2002)
  - Event Filter (2002 Combined run)

Tilecal testbeam runs

- ✓ Determination of the energy scale (pC to GeV conversion) for 8 modules/cylinder
  - ❄ 1 Barrel and 4 extended barrels in 2001
  - ❄ 3 Barrels and 6 extended barrels in 2002
- ✓ Timing tests with 25 ns beam
- ✓ e/h measurements
- ✓ f($\square^{0}$) for protons and pions
- ✓ Implementation and integration of final ATLAS infrastructure (with major impact on other systems)
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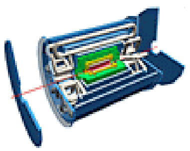

Tilecal calorimeter plans

- ✓ 2003 (Calibration period and 25 ns beam test)
  - ❄ Four 1-week periods
    - 8 ExtBarrels and 4 Barrels
  - ❄ Low energy test (down to 1 GeV during calibration)
  - ❄ 25 ns beam (further studies of time resolution)
- ✓ 2004 (Combined calorimetry)
  - ❄ Combined calorimetry run
  - ❄ ATLAS Barrel Combined run
- ✓ From 2006-on (stability and ageing)
  - ❄ Long term stability measurements of the stack Barrel Module 0, Barrel Module 65 and the two Extended Barrel Modules 65s (few weeks/year)
  - ❄ Services in North Area should be kept alive

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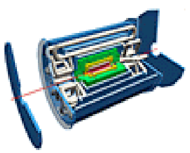
TileCal Calibration Schedule

Year	# of EBs Calibrated	# of LBs Calibrated
2001	4	1
2002	6	3
2003	8	4
Total	**18**	**8**
2004	Combined Tile/Lar/Muon/TRT Run	



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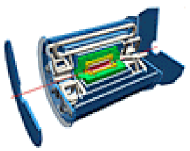
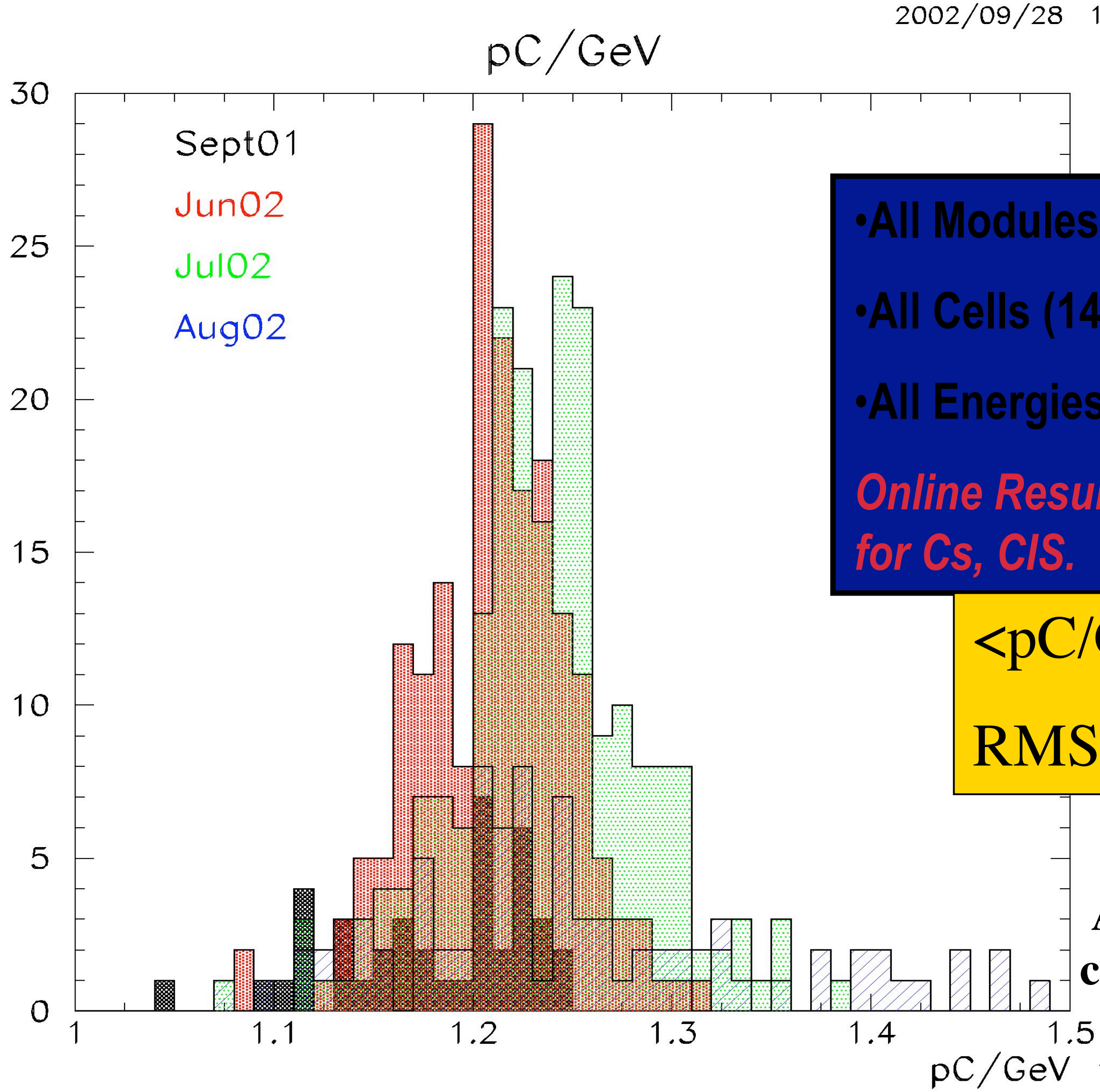


Tilecal: pC/GeV conversion



- All Modules (no M0) (10 EB, 4 LB)
- All Cells (1406)
- All Energies (no '01 20 GeV)

Online Results: No Corrections for Cs, CIS.

<pC/GeV> = 1.22

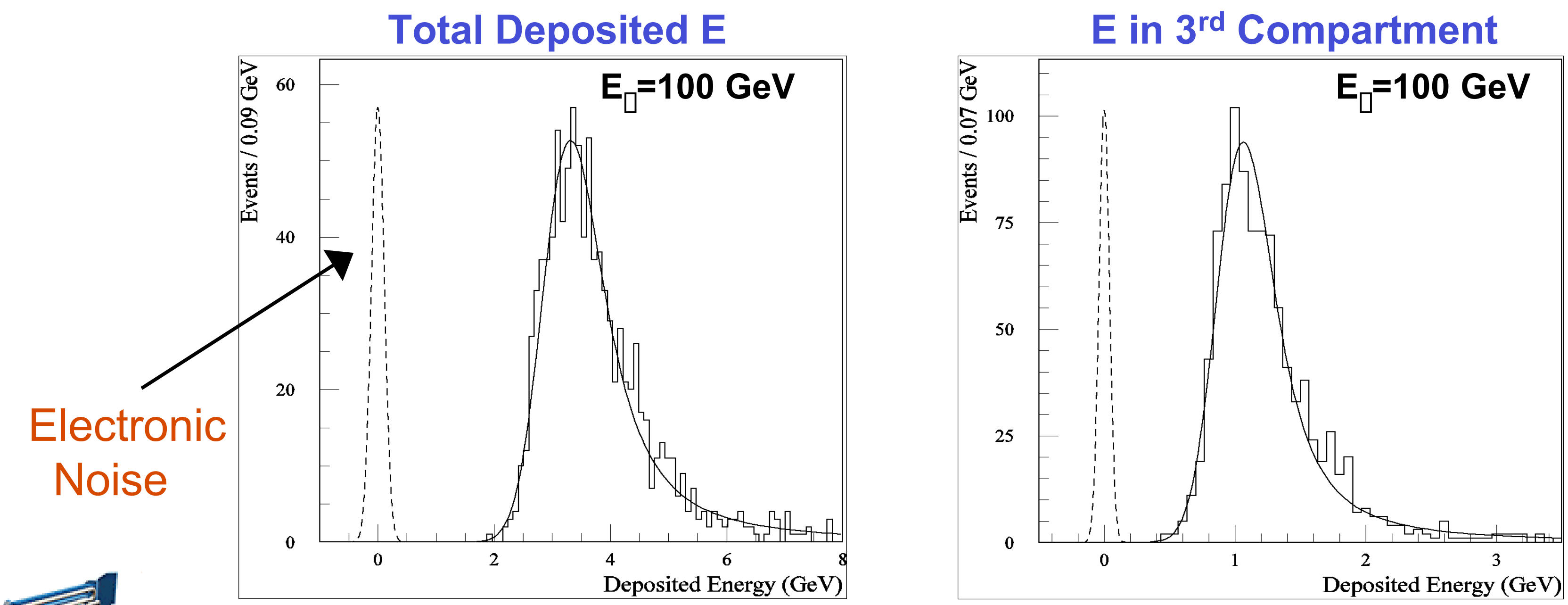
RMS = 4.8%

Around 2% when calibration applied

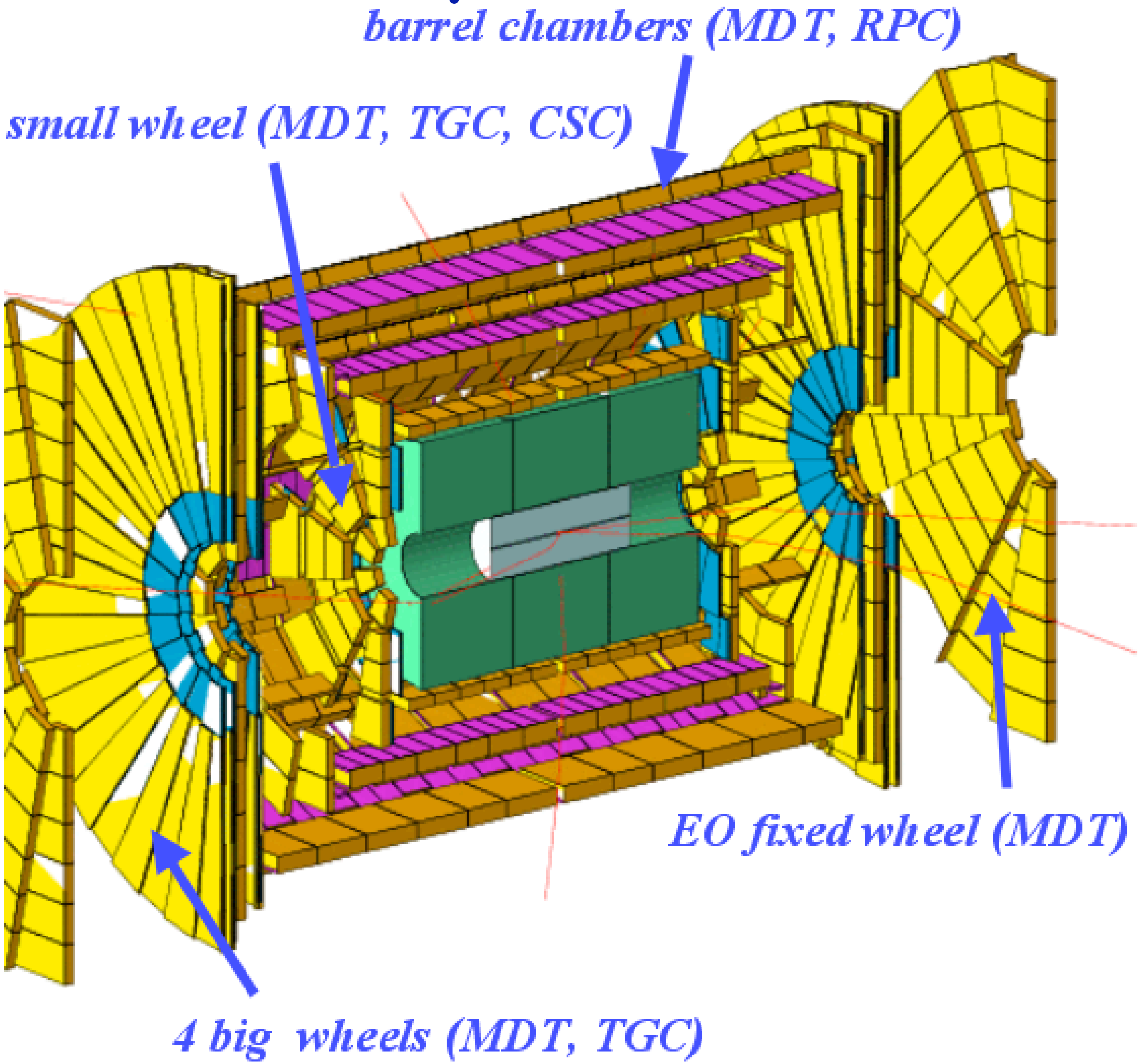
Analysis ongoing

Tilecal Test Beam Results

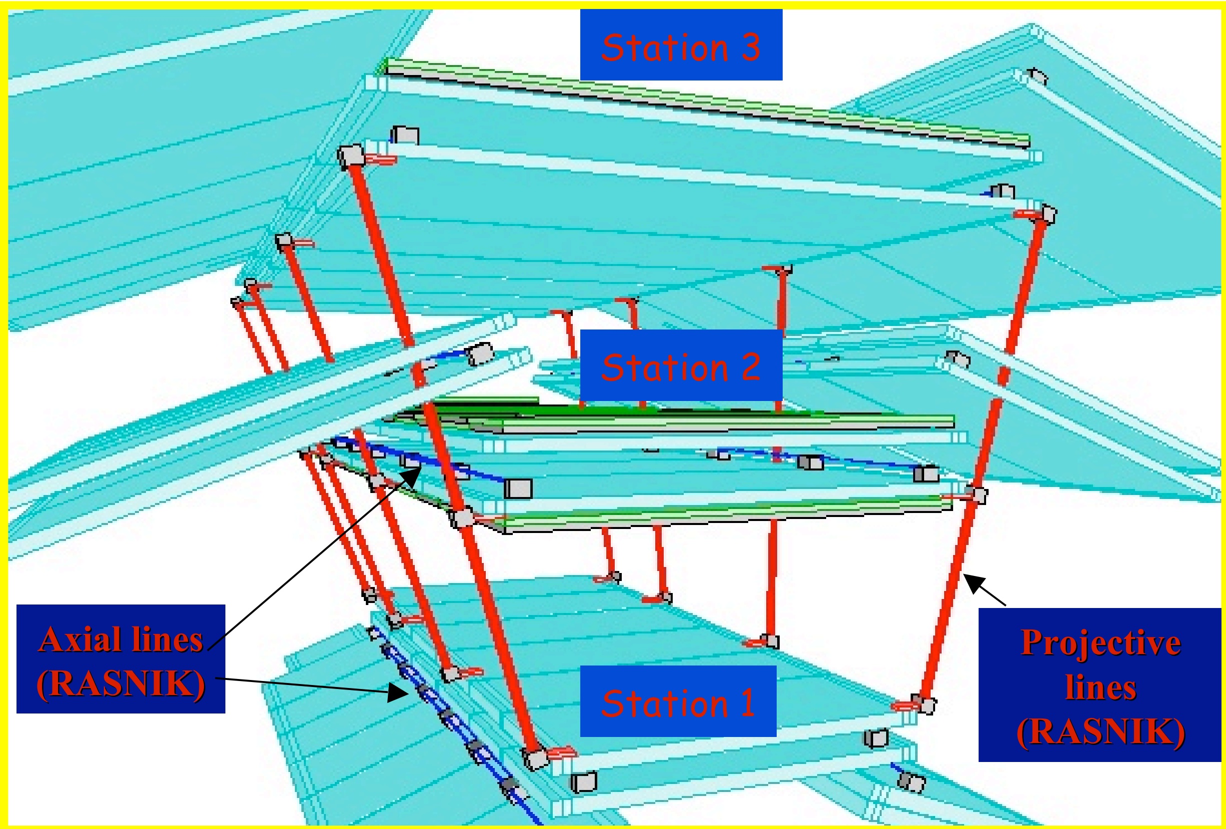
- ✓ Hadronic Tile Calorimeter: Response to □ (100 GeV) at □ = 1.3
  - Clean signal above electronic noise (~40 MeV) in outermost compartment
  - Important at high Luminosity where physics □'s may overlap other particles; minimum bias events deposit non-negligible amounts of E in innermost calorimeter layers



Muon spectrometer



Muon Barrel Alignment



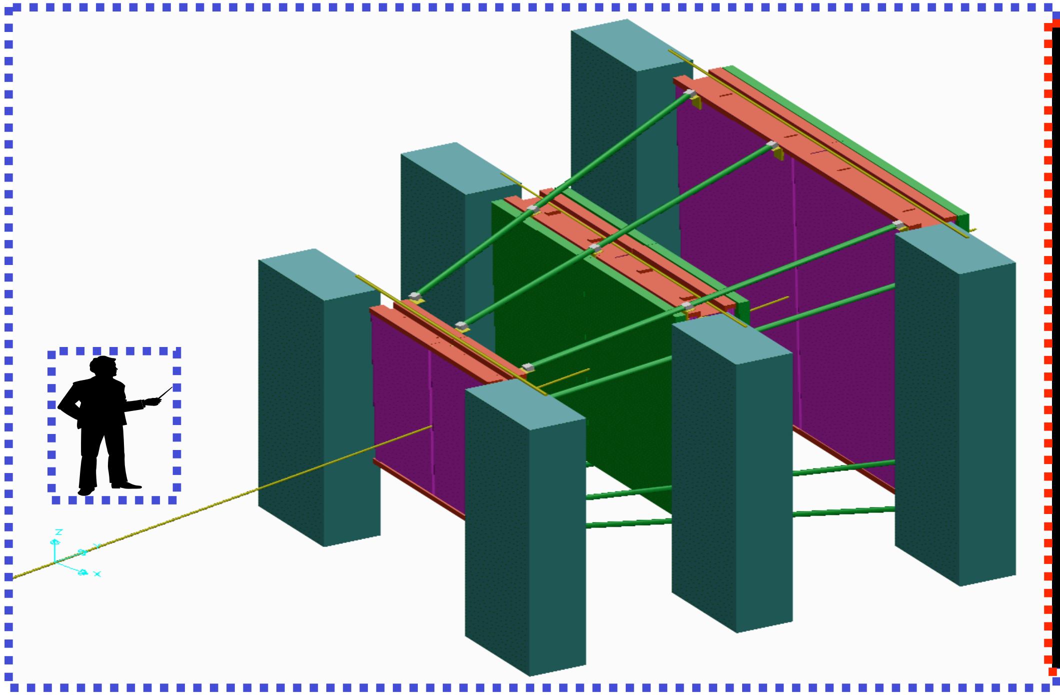
The relative chamber positions should be known with ~30 μm precision to ensure high Pt resolution

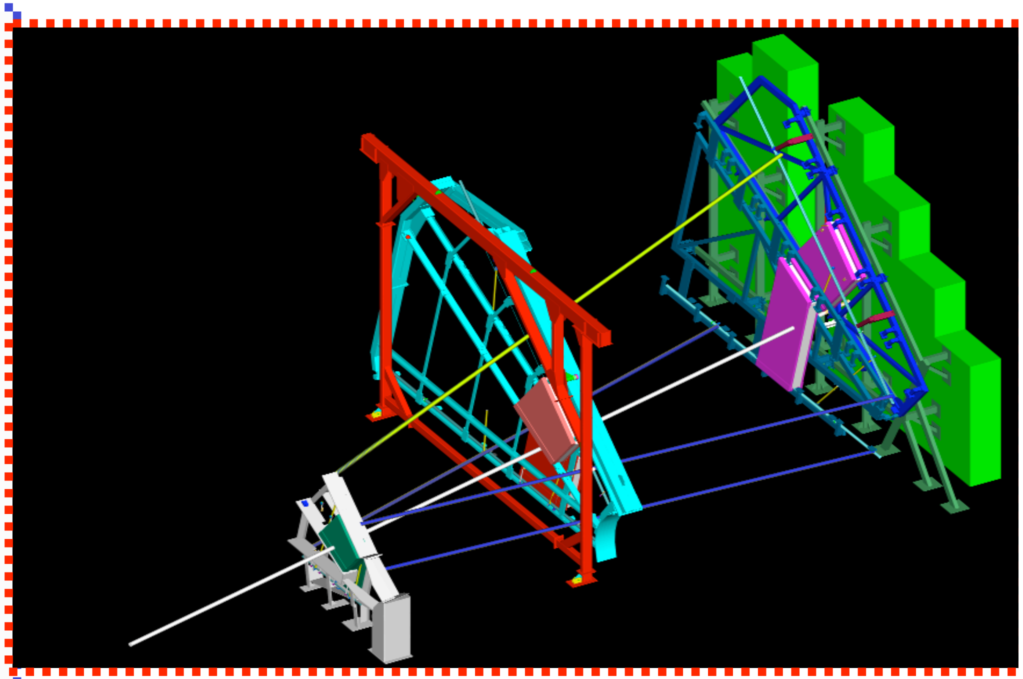
- alignment system based on optical elements (RASNIK) to reconstruct and monitor the geometry of the spectrometer with the required accuracy

- Projective Lines to monitor relative movements of stations
- Axial lines to monitor chambers movement within a station

2002: Muon Barrel & End Cap System Test

- Test the barrel and end-cap alignment concepts
- Test system and chamber performances with a barrel and end cap sector (6+6 chambers)


Barrel Sector


End Cap Sector

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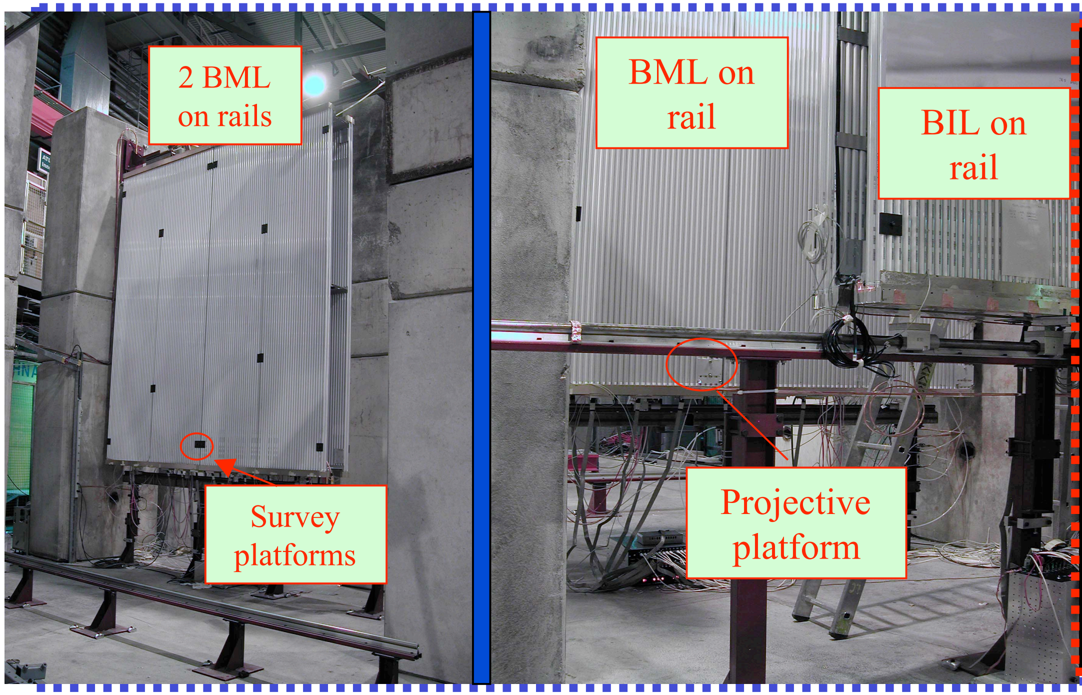
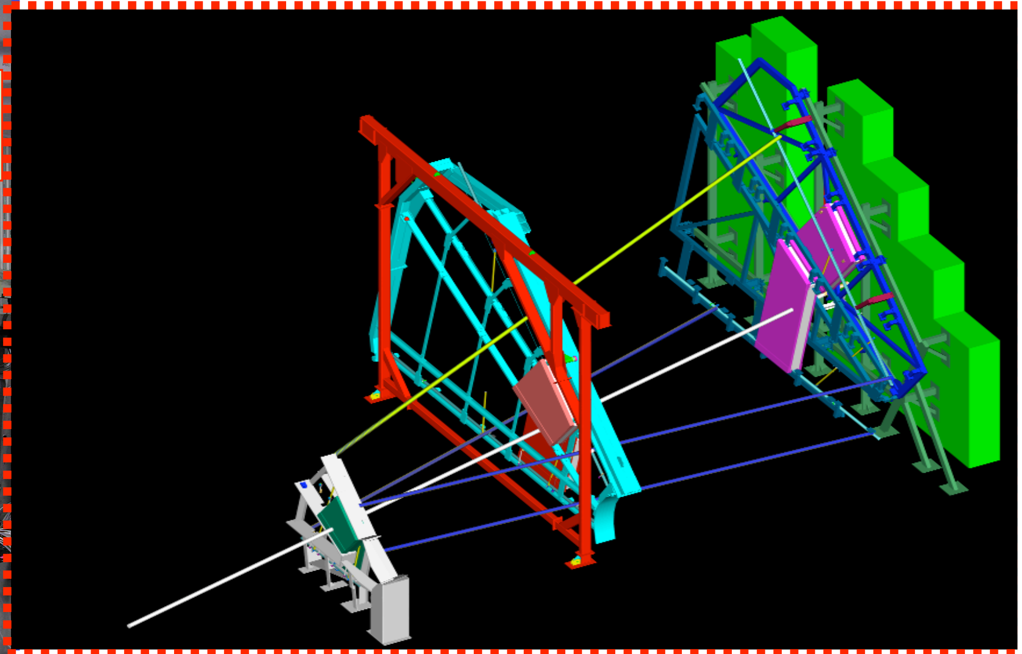


Barrel Sector



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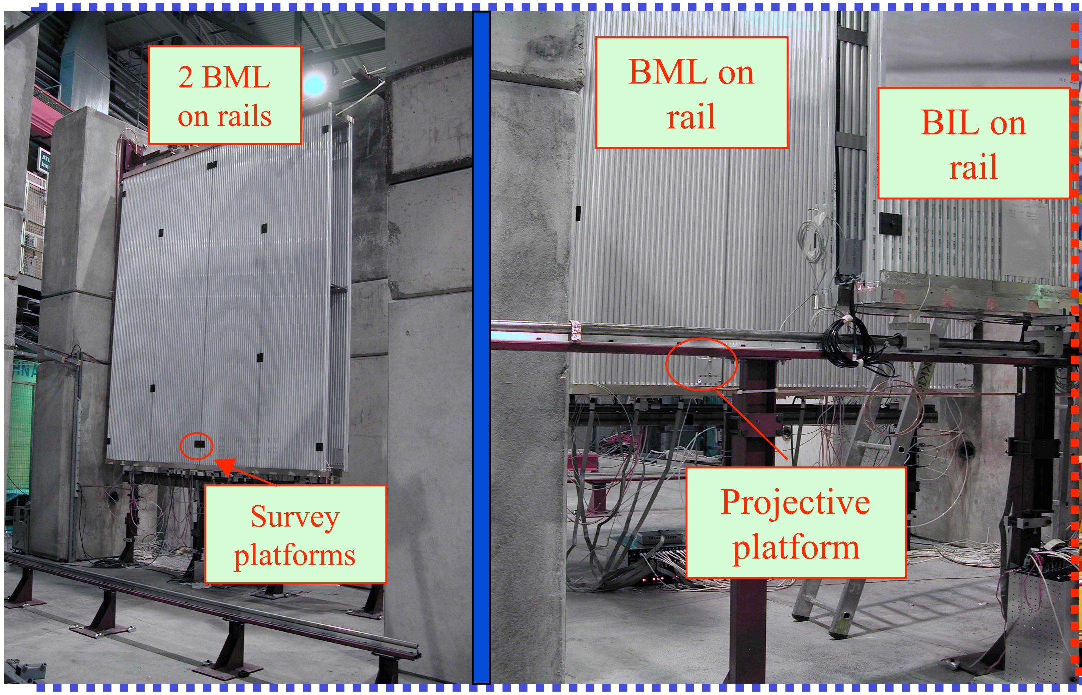
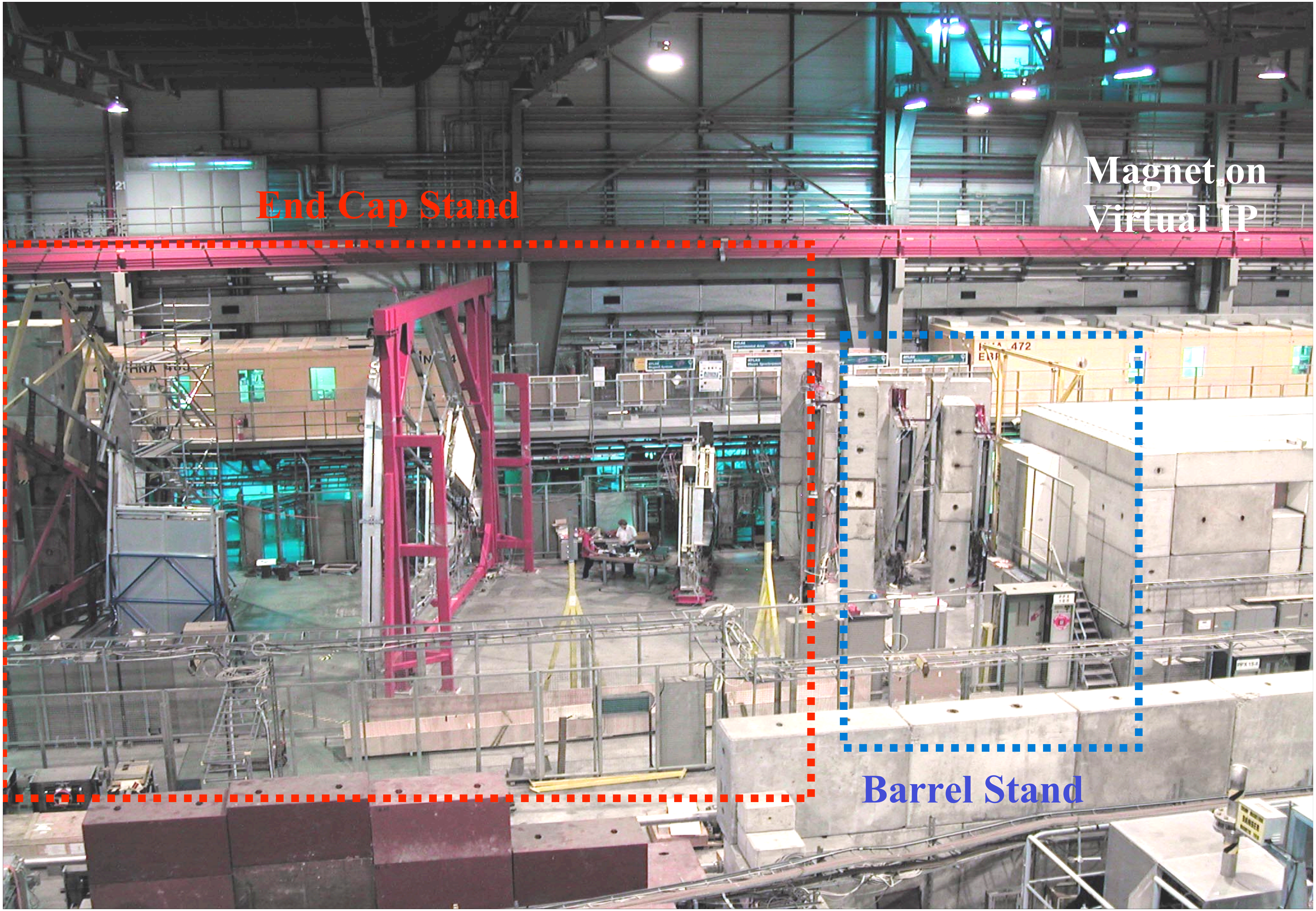
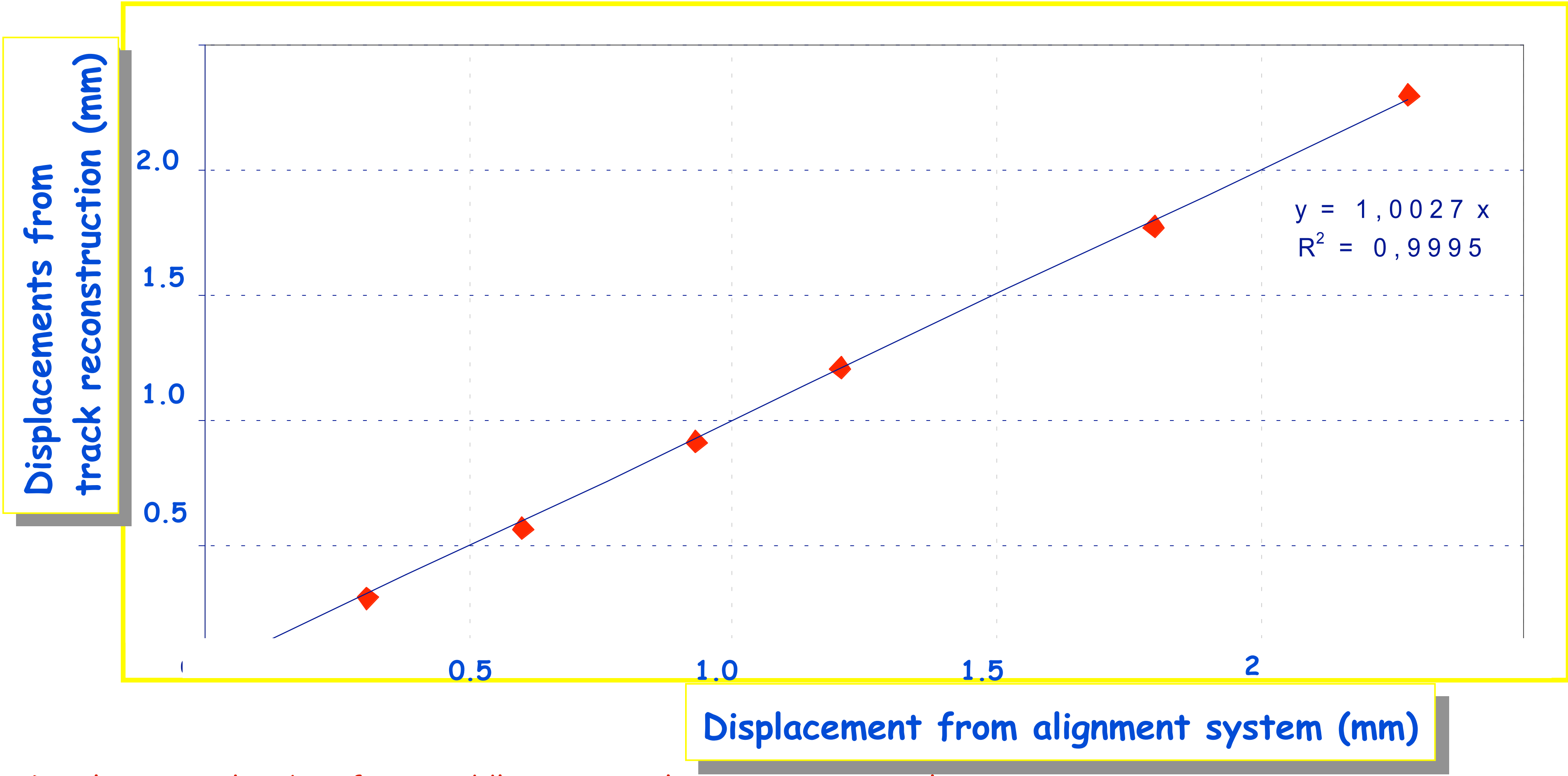


Barrel Sector

End Cap Sector


End Cap Stand
Magnet on
Virtual IP
Barrel Stand

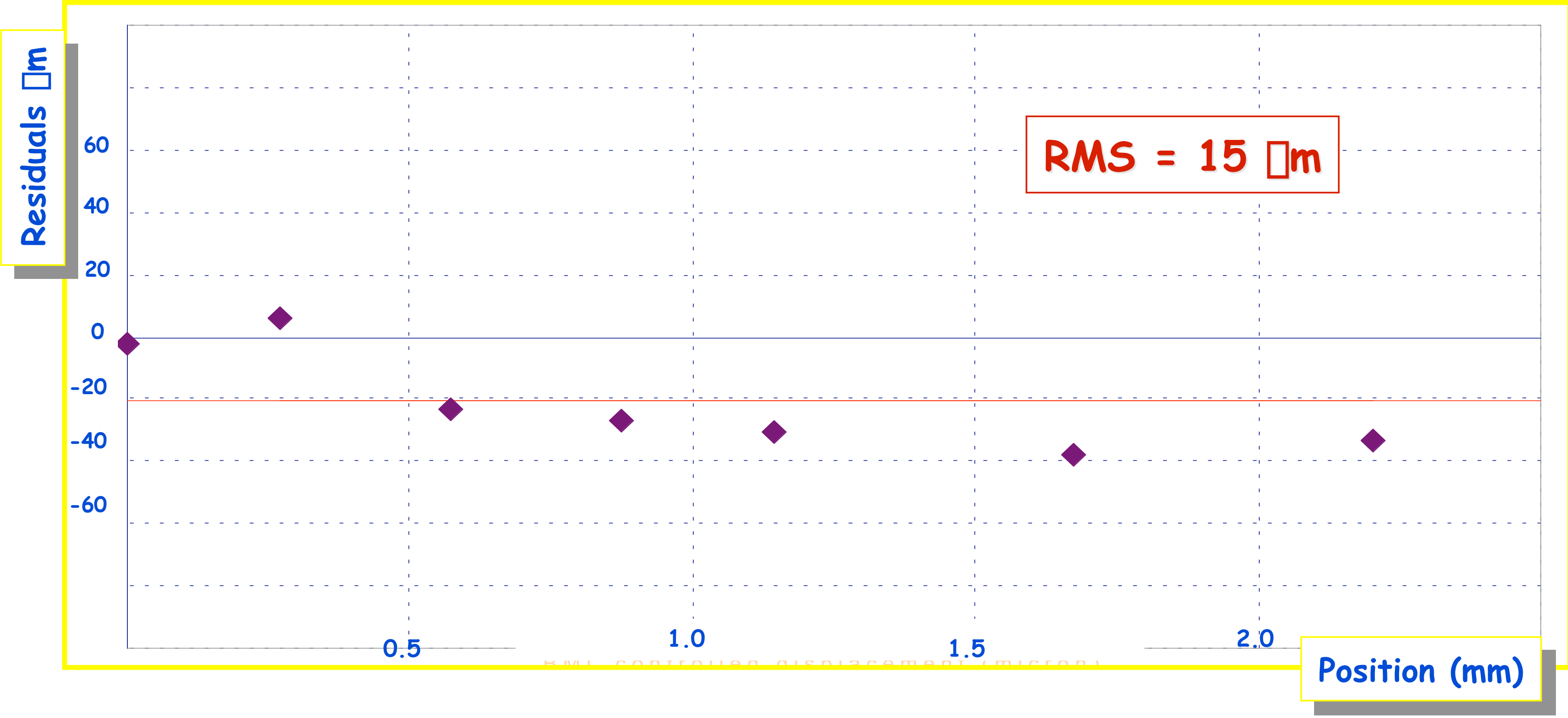
Muon: alignment test result



- Displace one chamber from middle station, along supporting rail
- Check alignment reconstructed position against track reconstructed position

Muon: alignment test result

Residual difference between chamber position using tracks and alignment system



The 15 m RMS of the residuals distribution proves the correctness of the alignment system concept

Muon trigger electronics tests: NOW

- ✓ TGC chamber test beam during the 25 ns period
- ✓ RPC chamber test beam with asynchronous beam
- ✓ Important tests of the trigger electronics on real production chambers
  - ❄ Spotting out possible problems in timing when the electronics is on a real chamber
    - Jitter
    - Setting up of delays for phase synch
  - ❄ Integration with the readout off-detector electronics

cs tests: NOW

g the 25 ns period

asynchronous beam

r electronics on real

ems in timing when the

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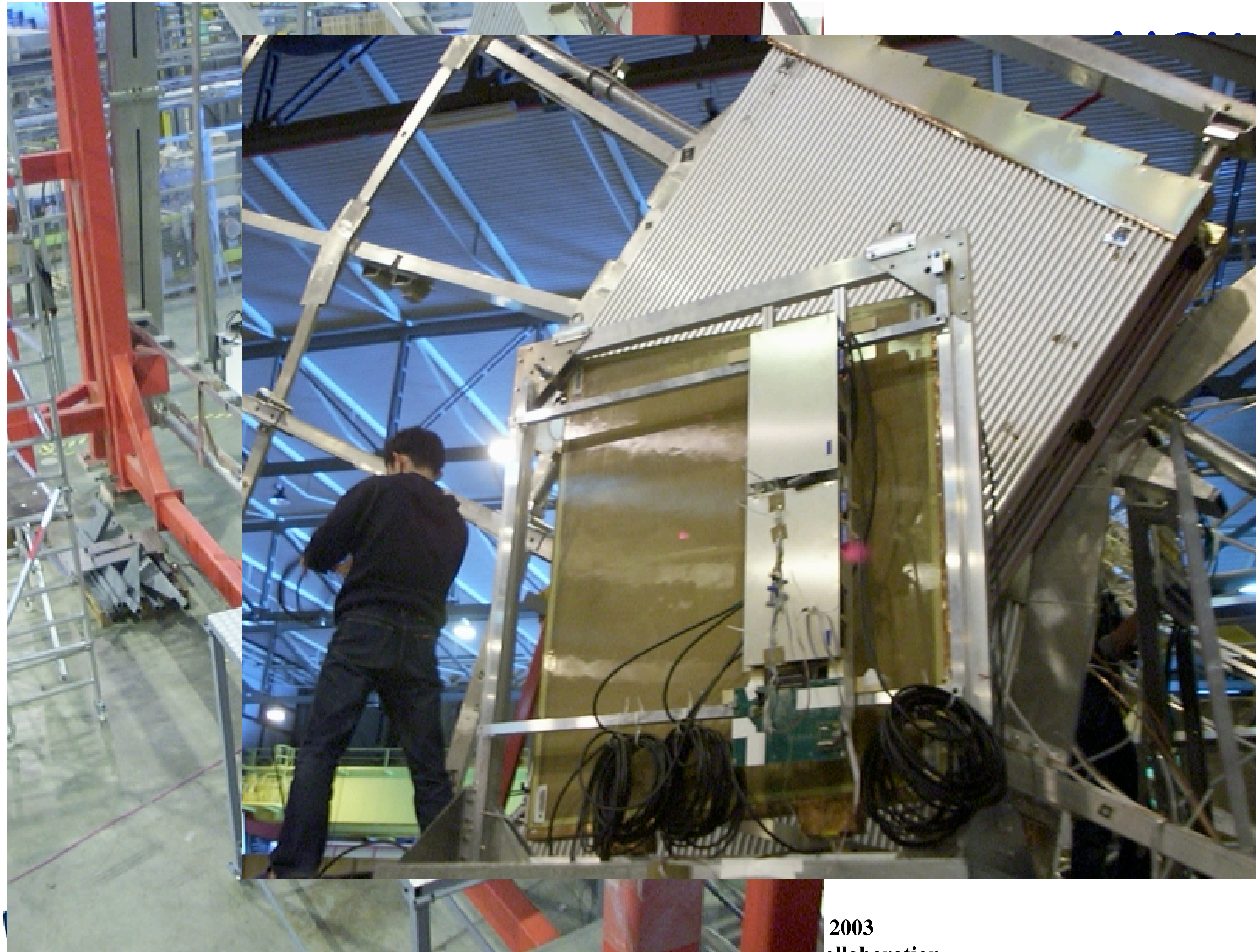
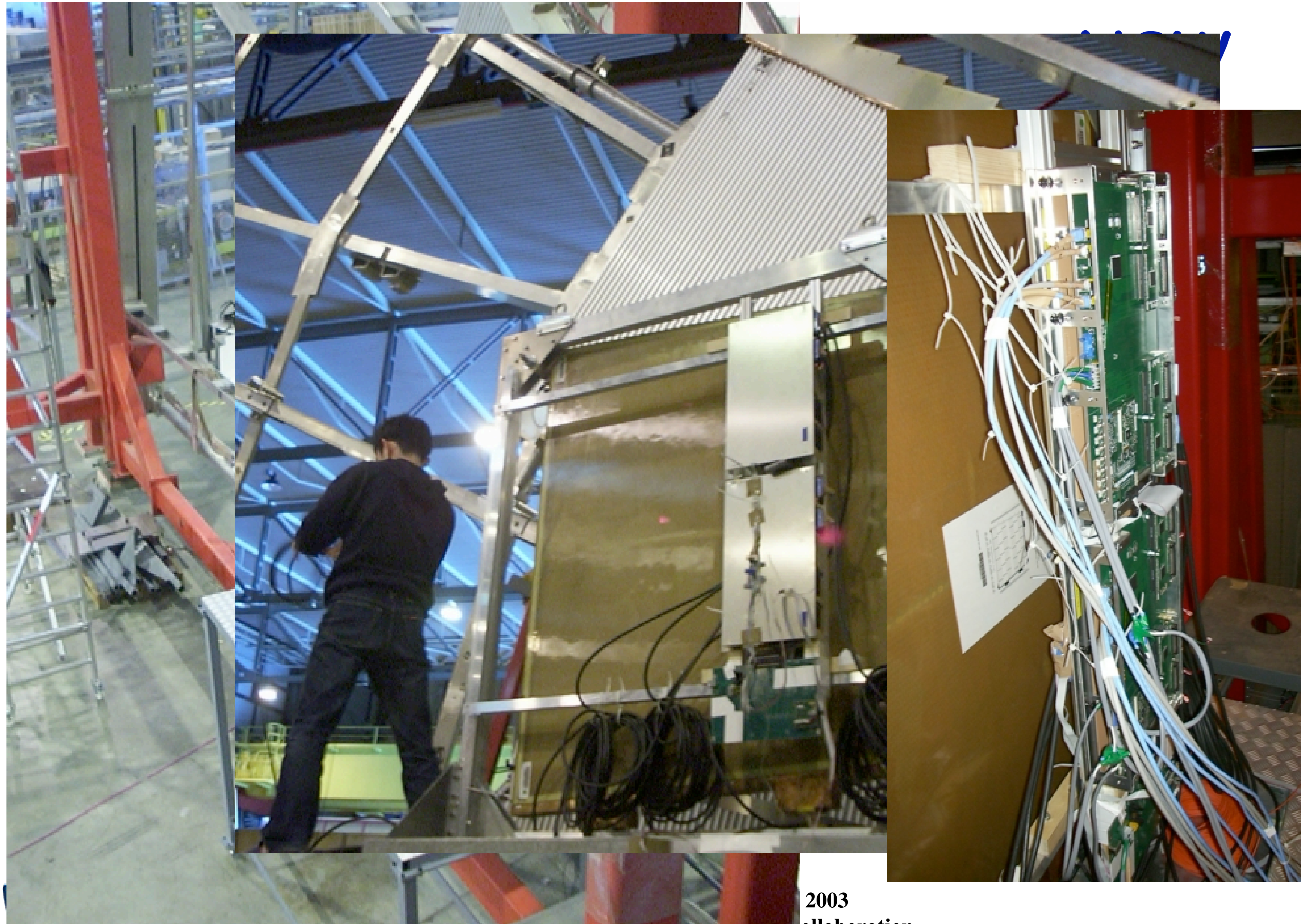
ut off-detector





Muon RPC ageing test at X5

- ✓ The test is going on continuously and is now reaching the limit of 3 Atlas years (90 mC/cm^2) including the safety factor of 5-10
- ✓ The gas closed loop system has been mounted and will be gradually introduced for 4 out of the 6 detector layers that are under test. The other two will remain in open flow
- ✓ Detection efficiencies are good
- ✓ A modest increase of the source off current is observed
- ✓ In July and August the set up has to be removed from X5 for ATLAS MDT and other non ATLAS users testing >>> long time required for reaching the limit of 10 Atlas years

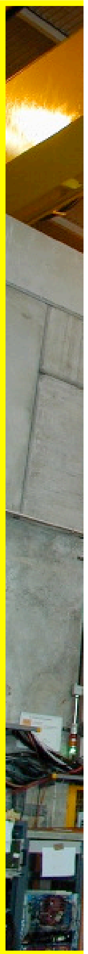
RPC Ageing test

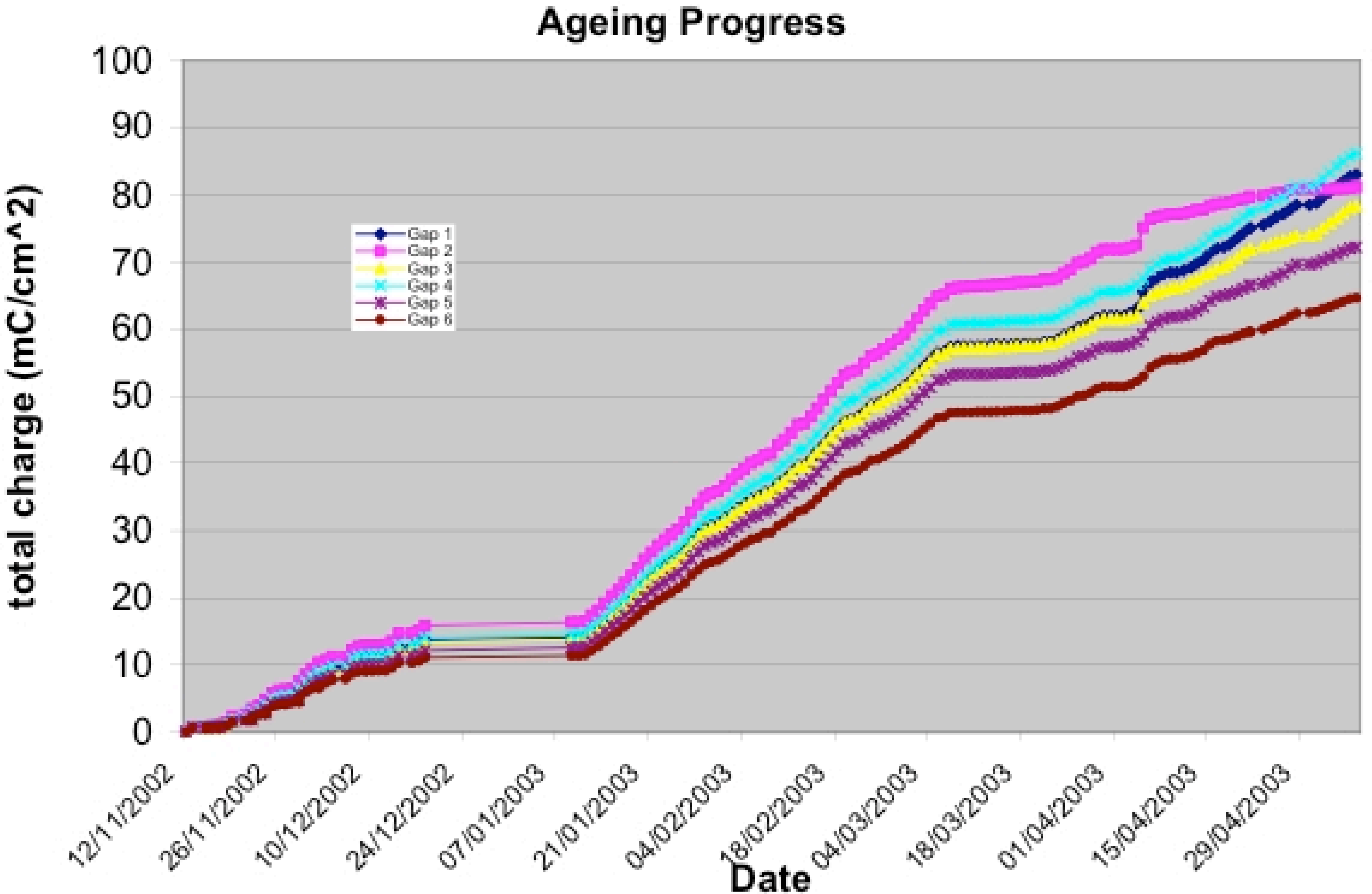
3 production RPCs currently ageing at the CERN Gamma Irradiation Facility

- Aim to integrate 300 mC/cm^2
  - 10 Atlas Years with safety factor > 5
- Measurement still ongoing
- Previous tests on RPC prototype showed good efficiency and time resolution after 8 ATLAS years

RPC Ageing test

3 |
th

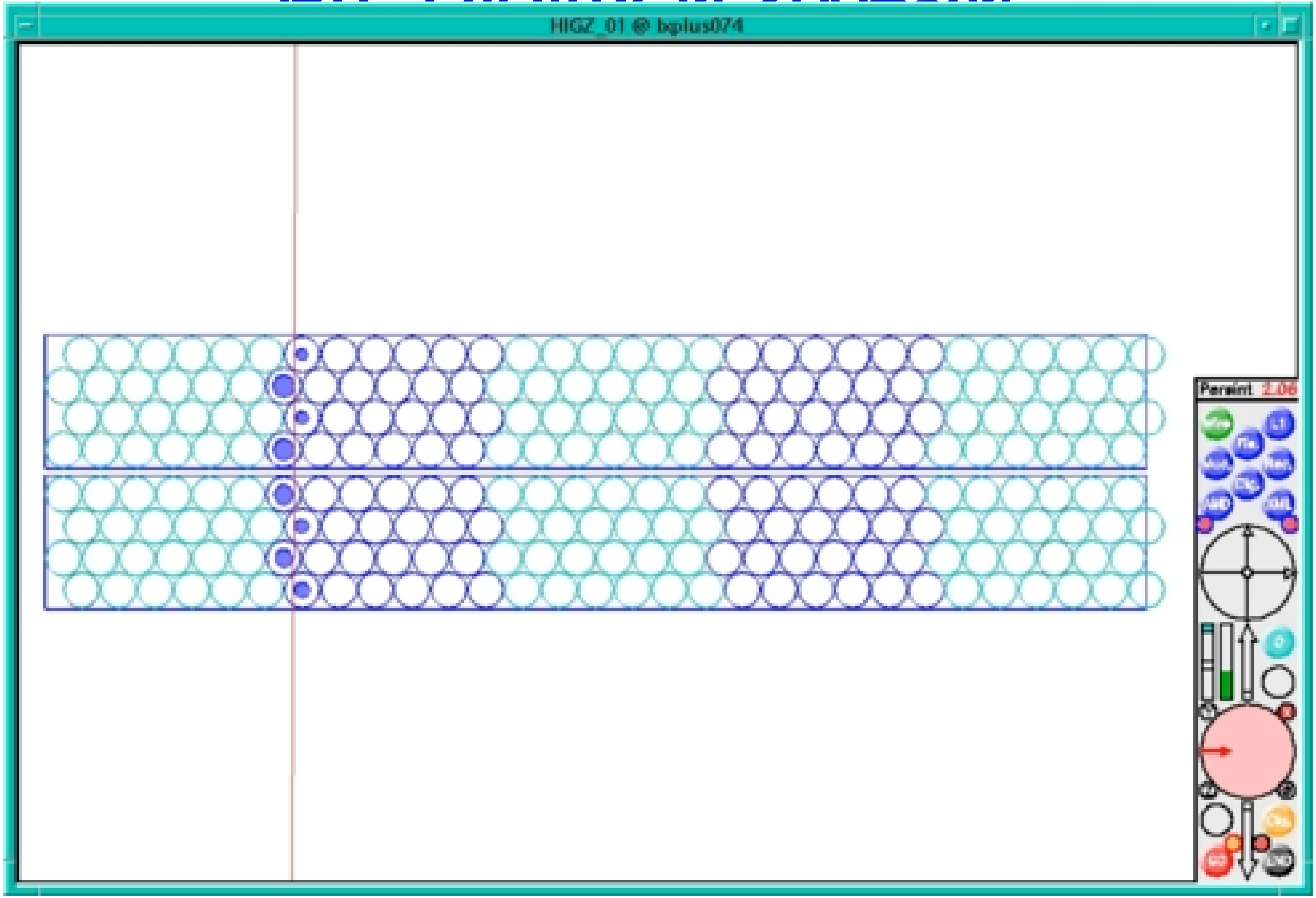




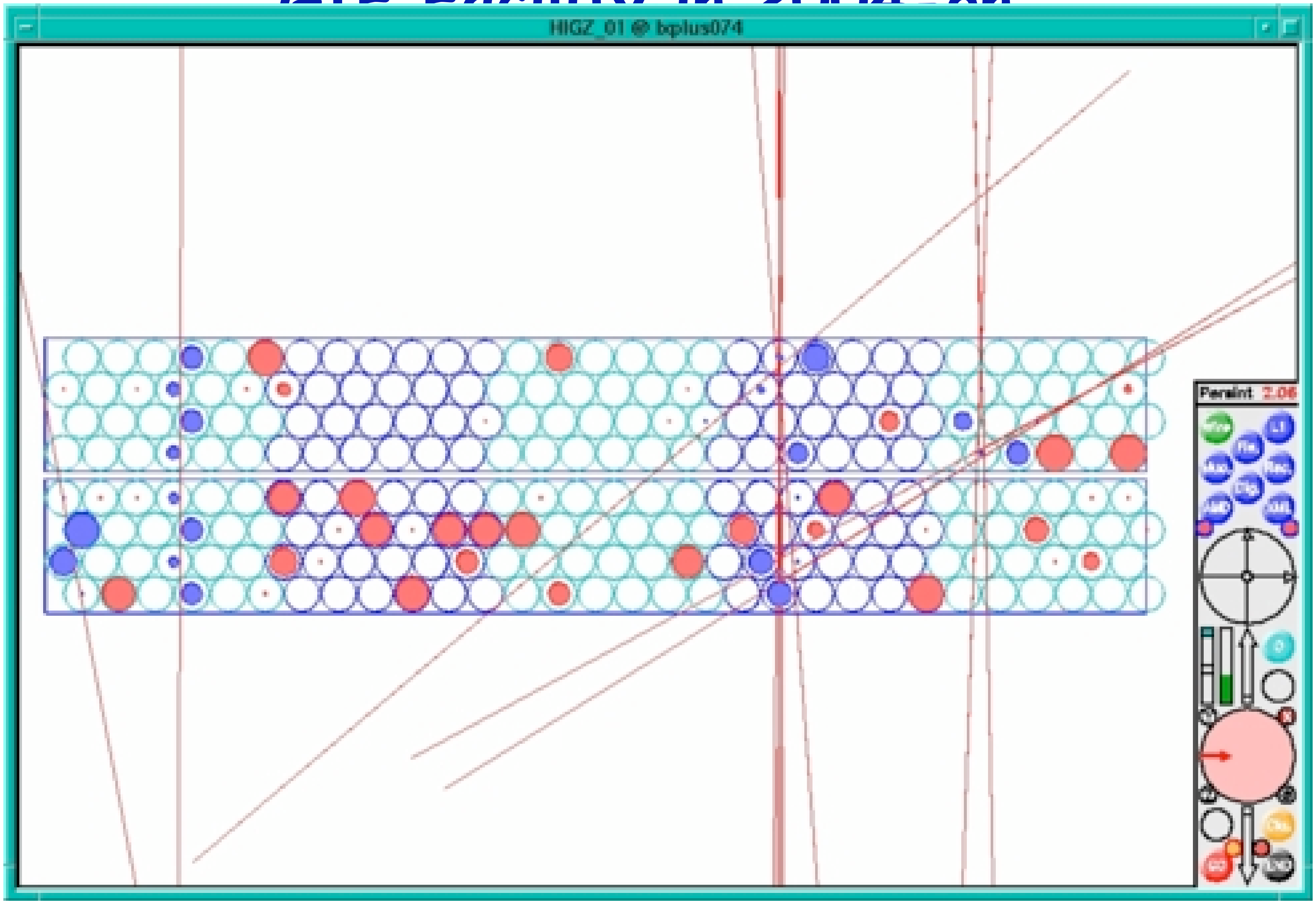
GIF Facility in 2004-on

- ATLAS Muon detector will need the GIF facility in future
  - Continue the trigger studies with background
  - Continue long term ageing of chambers
  - Possibility to have further studies even during LHC running in case of ageing problems

GTF Facility in 2004-on

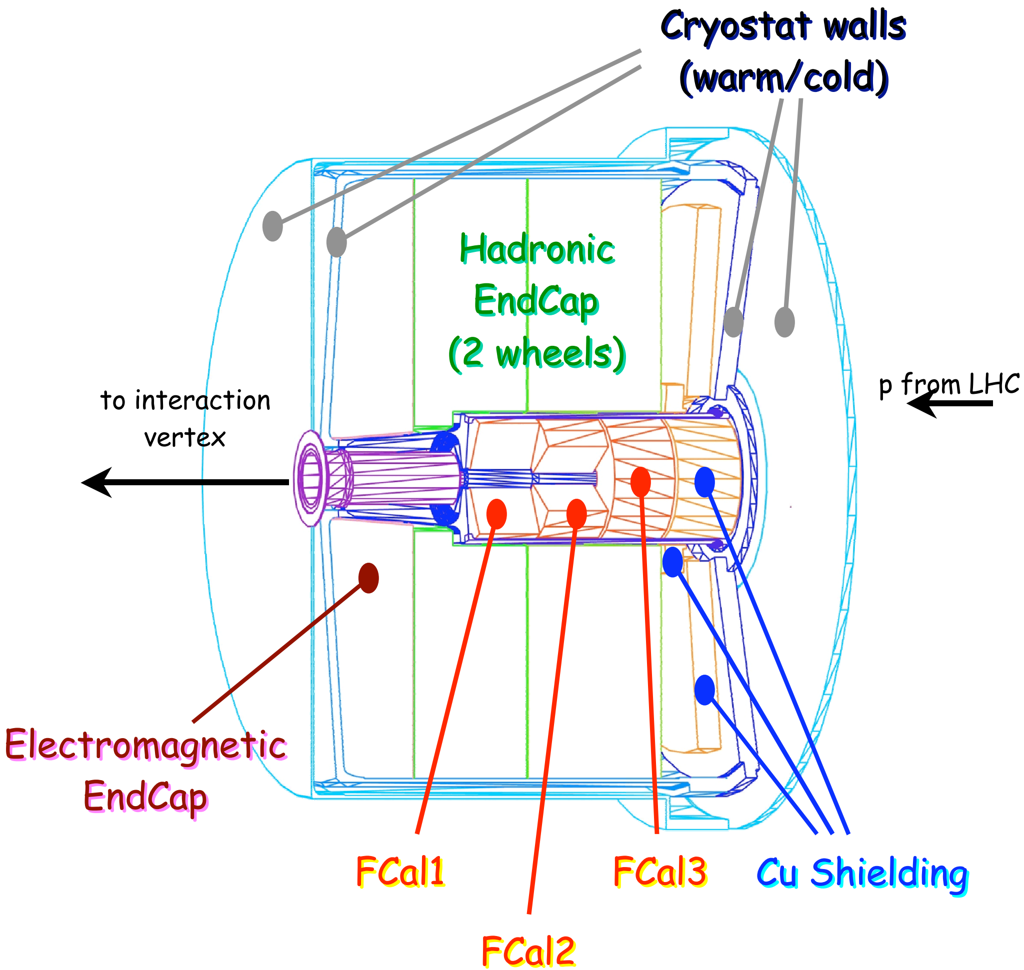


GIF Facility in 2004-on



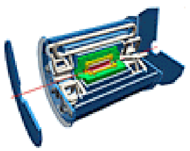
Preparing for the future…

End cap LAr calorimeters



FCAL test beam in 2003

- ✓ FCAL C module
  - ❄ Change of plans (FCAL A foreseen)
    - Module available sooner
- ✓ Test recommended by LHCC
    - High priority
    - 5 weeks scheduled (June-July 2003)
- ✓ Benchmark testing of Monte Carlo with testbeam data
  - ❄ Study of the specific readout geometry with thin tubular liquid argon gaps nearly parallel to beam direction
  - ❄ **Study of the "p_T cross-over" effect (study with a model of cryostat walls and beam pipe)**
    - **particles at the very inner FCAL edge can generate secondaries which can lead to a mis-measurement of the transverse momentum**



Very low energy beam line

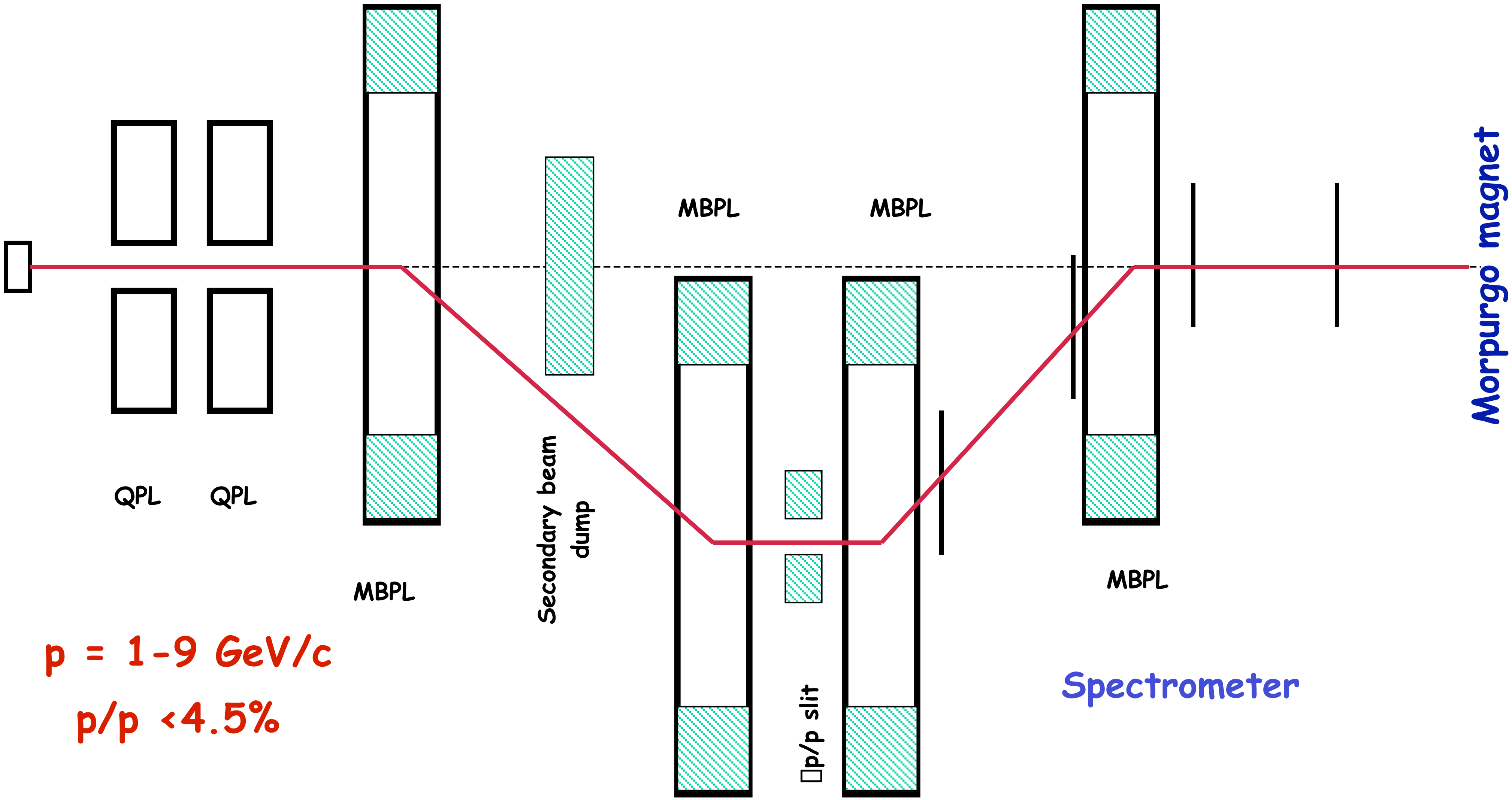
H8 beam line

✓ VLE setup:

- ❈ SPS -> T4 -> 20-50 GeV/c
- ❈ Secondary target
- ❈ Tertiary beam
- ❈ Spectrometer (4 dipoles + collimator)
- ❈ Beam instrumentation
- ❈ VLE beam to H8 Atlas

✓ Minor modifications to existing straight beam

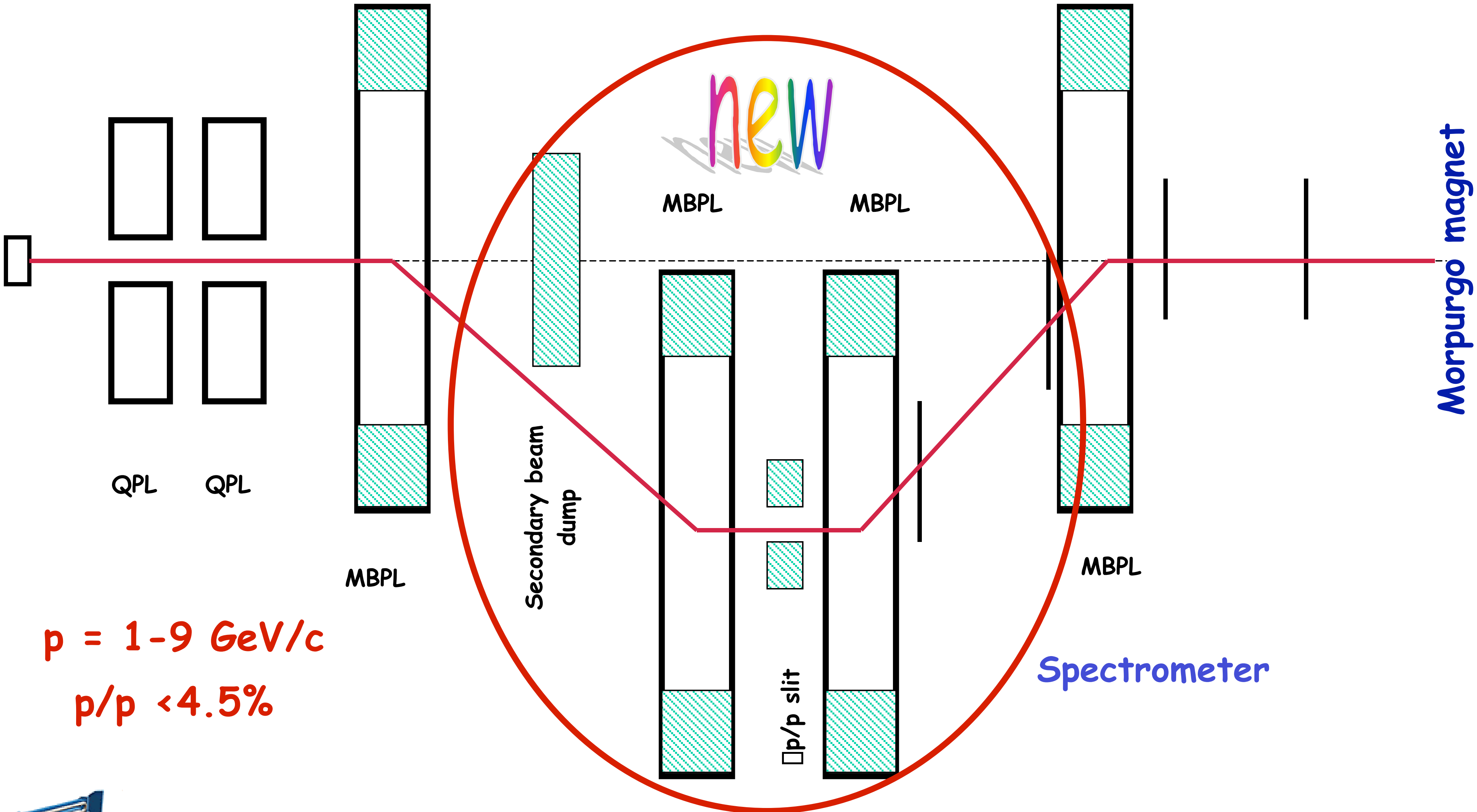
Low energy at H8



p = 1-9 GeV/c

p/p <4.5%

Low energy at H8



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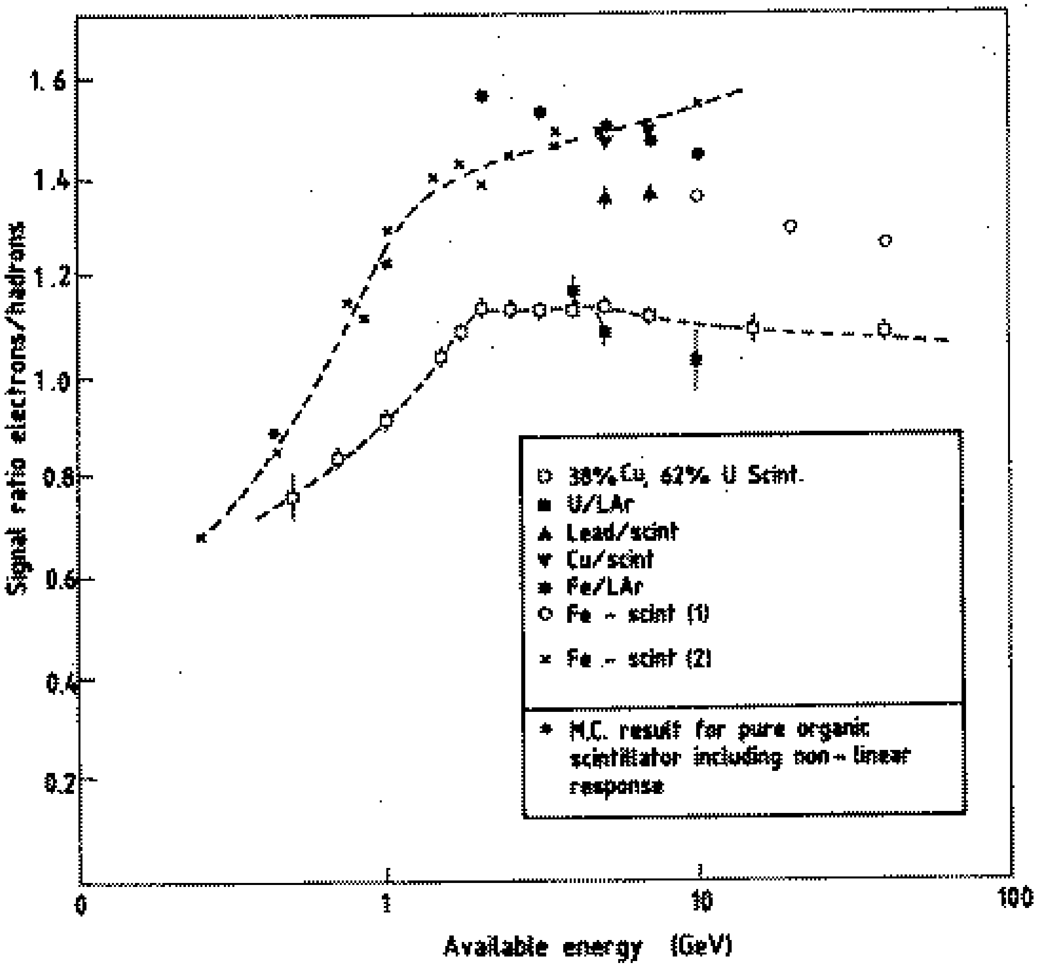
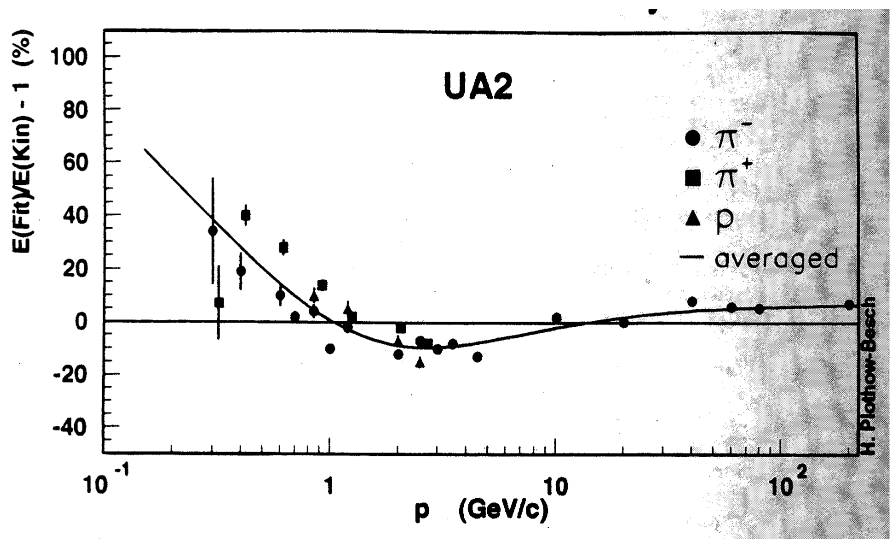
p/p <4.5%

Low energy studies



- ✓ Done by other experiments in the past
  - UA2 (NIM A244 (1984))
  - R807 (NIM A241 (1985))
  - ZEUS (NIM A290 (1990))
  - D0 (FERMILAB-Conf-93/049-E)
  - CDF (NIM A409 (1998))
- ✓ Hadron energy loss by ionization: e/h variation



Combined test beams

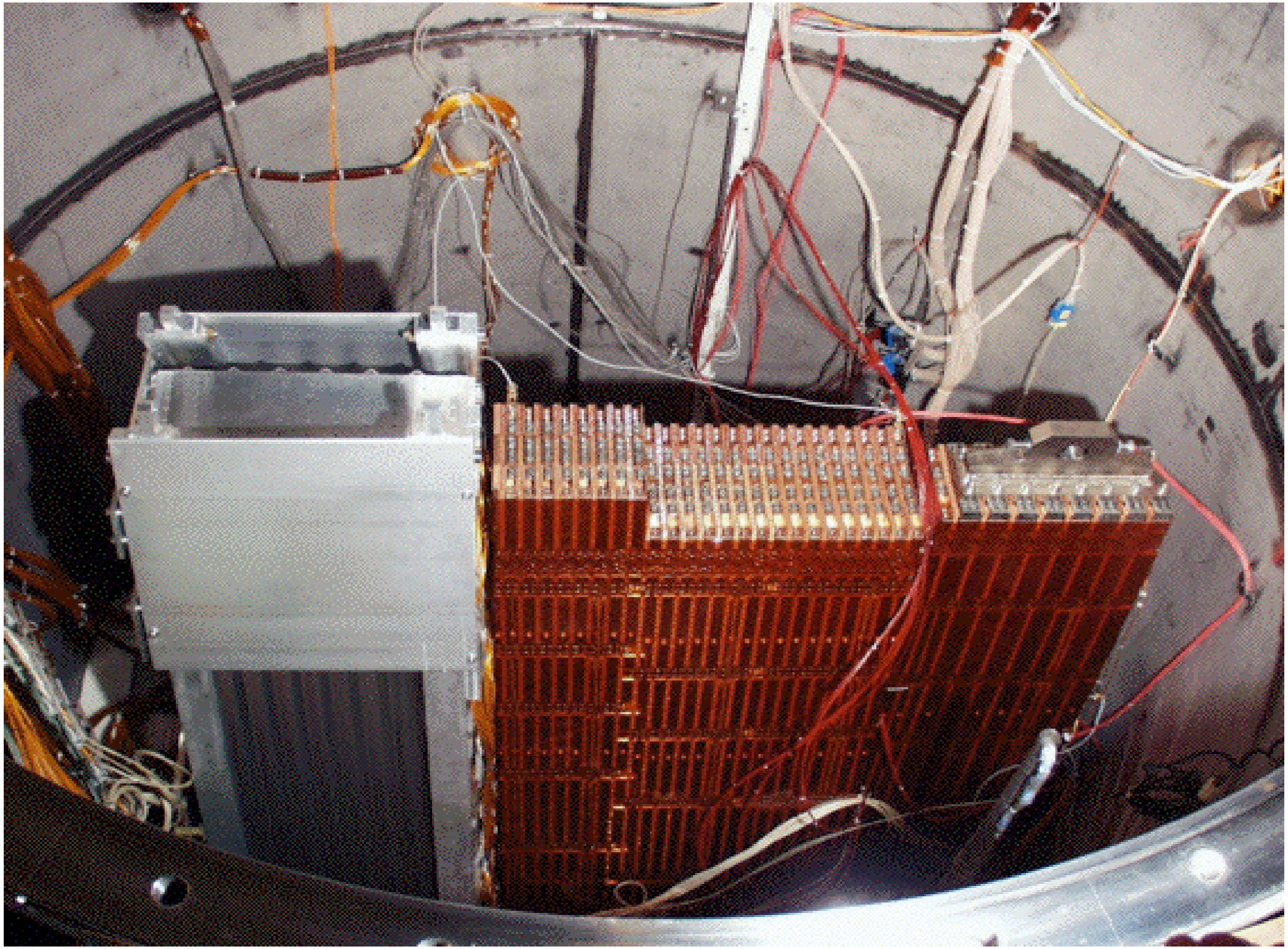
The combined way…

- ✓ Test beam is becoming an important pre-commissioning tool
  - ❄ Many sub-detectors exploit final electronics
  - ❄ A lot more emphasis to combined operations
- ✓ Two combined activities in 2002
  - ❄ Well organized HEC/EMEC combined run
  - ❄ Last minute Pixel-Tilecal-MDT run
- ✓ Future efforts
  - ❄ Pixel-SCT-Tilecal-Muon in 2003
  - ❄ HEC/EMEC/FCAL and ATLAS Barrel in 2004

HEC, EMEC, FCAL testbeams

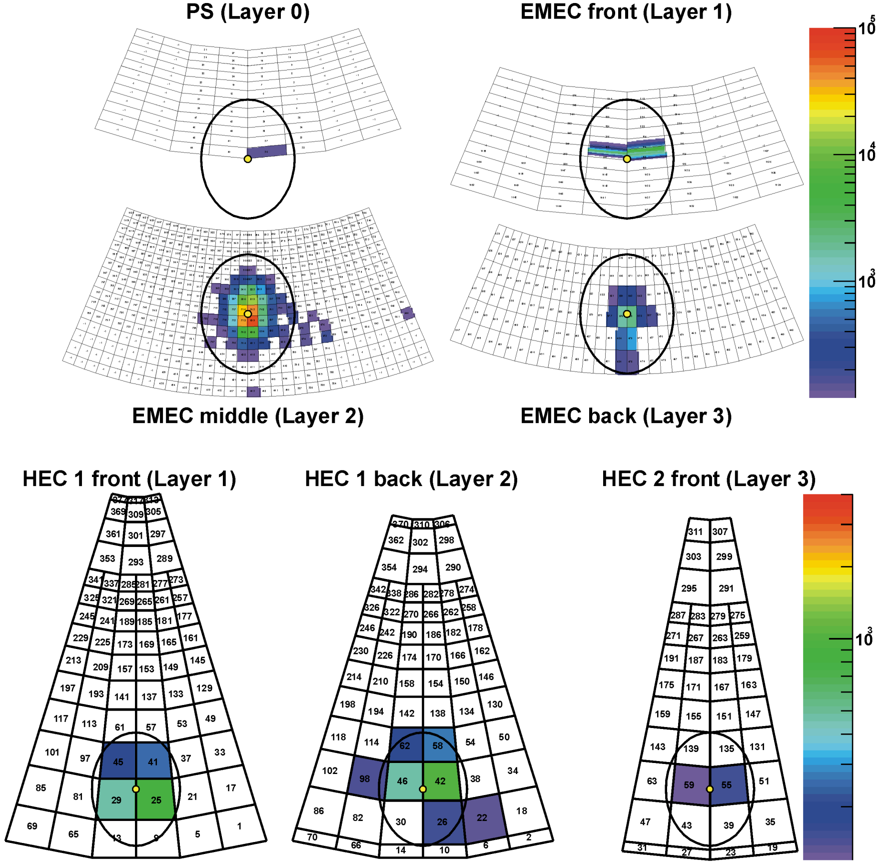
- ✓ 2002 (transition at η = 1.8)
  - ❄ Combined EMEC/HEC run recommended by LHCC
    - Electron/pion data
      - Comparison with Monte Carlo
      - Improvement/understanding of Monte Carlo
      - Use Monte Carlo jets in ATLAS
      - Get day 1 calibration constants to high precision
    - Study of transition regions
      - Checks as above
      - How correct is the geometry in the simulation
      - Reconstruction efficiencies for energy corrections

HEC/EMEC setup

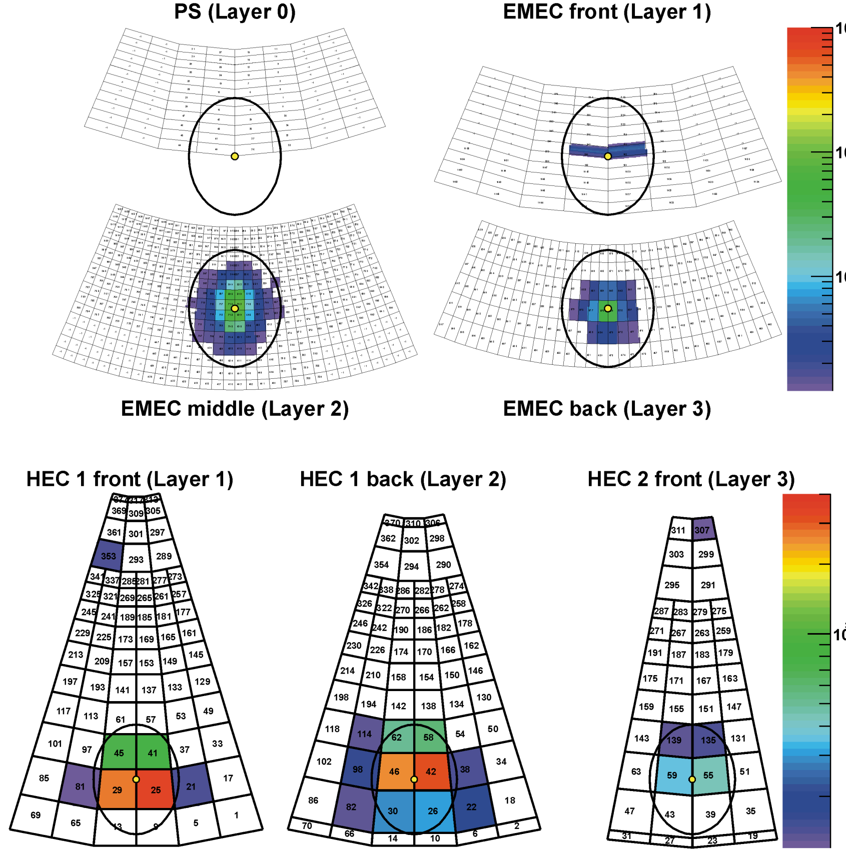


HEC/EMEC: first results

Electrons



Pions

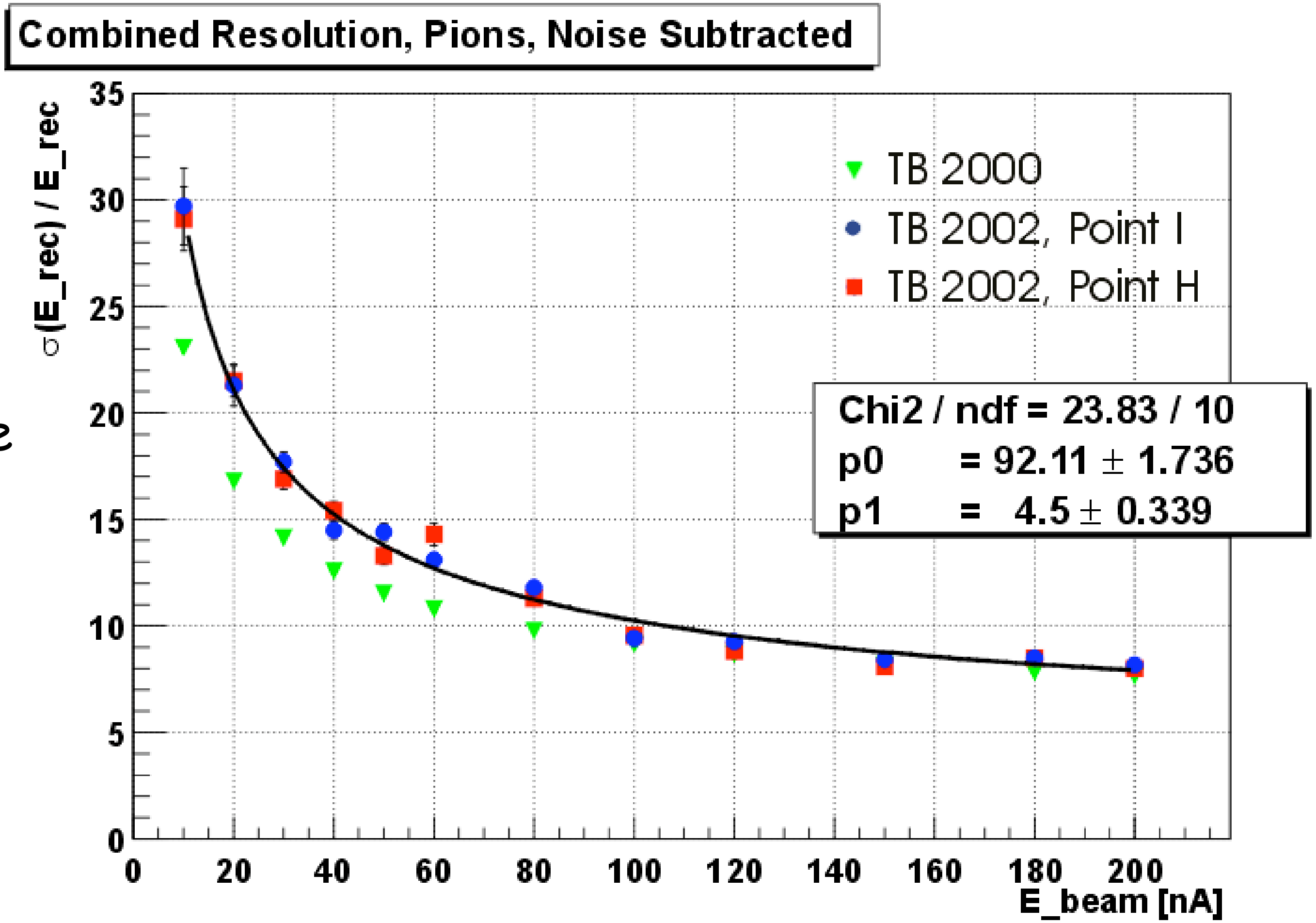


Combined Resolution

EMEC + HEC combined resolution (noise subtracted):

At low energies worse and at high energies about the same as in the HEC stand alone test beam

Note:
Possible difference in noise subtraction, twice as much leakage



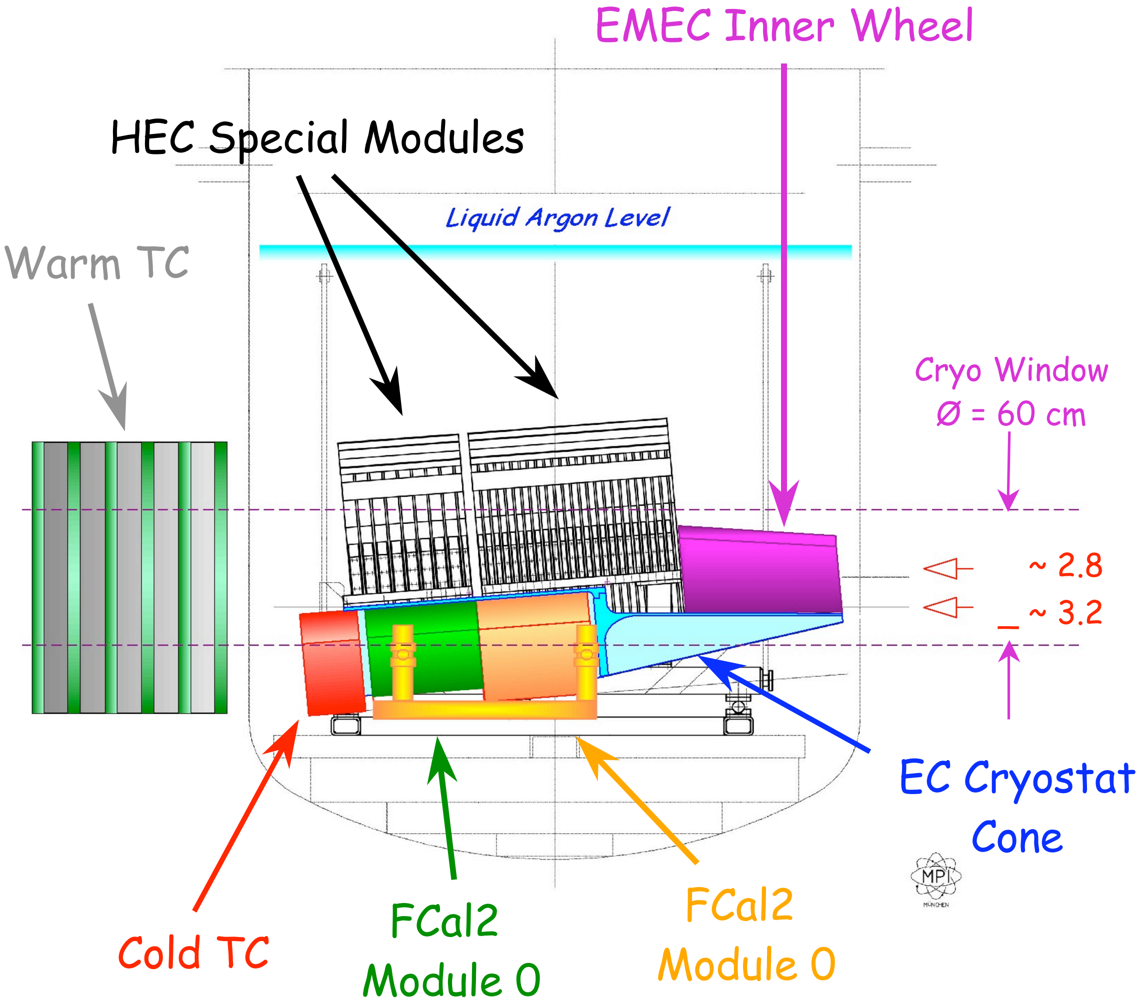
HEC, EMEC, FCAL testbeams: 2004 (η=3.2)

✓ complex material distribution in crack region between EMEC, HEC and FCal may require detailed simulations to understand the signals and detector acceptance in this region;

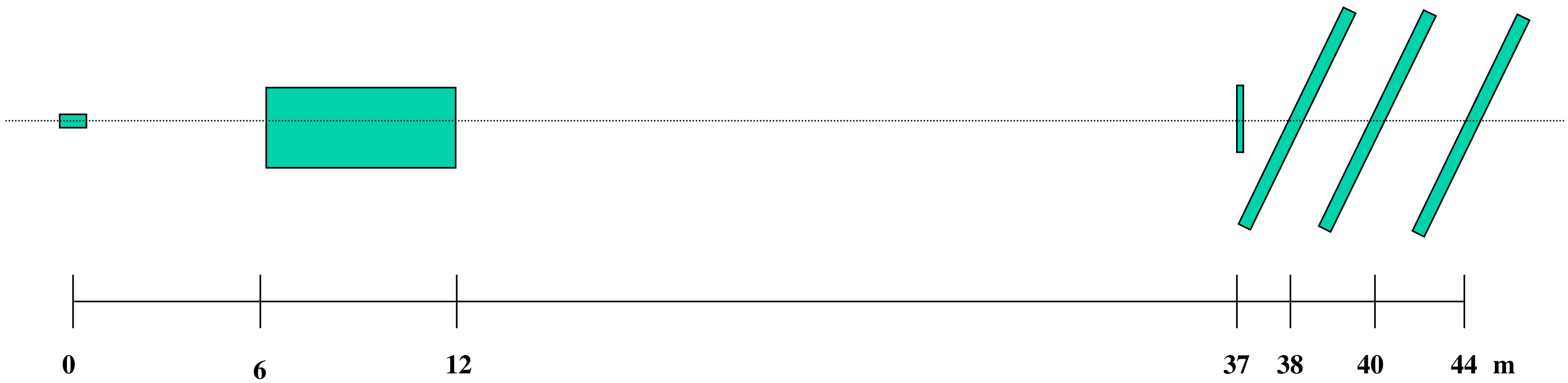
✓ high quality testbeam data is an important mean to understand the quality and prediction power of these simulations, especially for hadrons, for the expected signals;

✓ it also helps to develop signal correction algorithms based on the energy sharing between the modules, and "monitor" the corrections derived from Monte Carlos;

EMEC/HEC/FCAL setup



Pixel-Tilecal-Muon - Detector setup: full H8 line



Pixel beam telescope (fast readout, 125 μs busy)

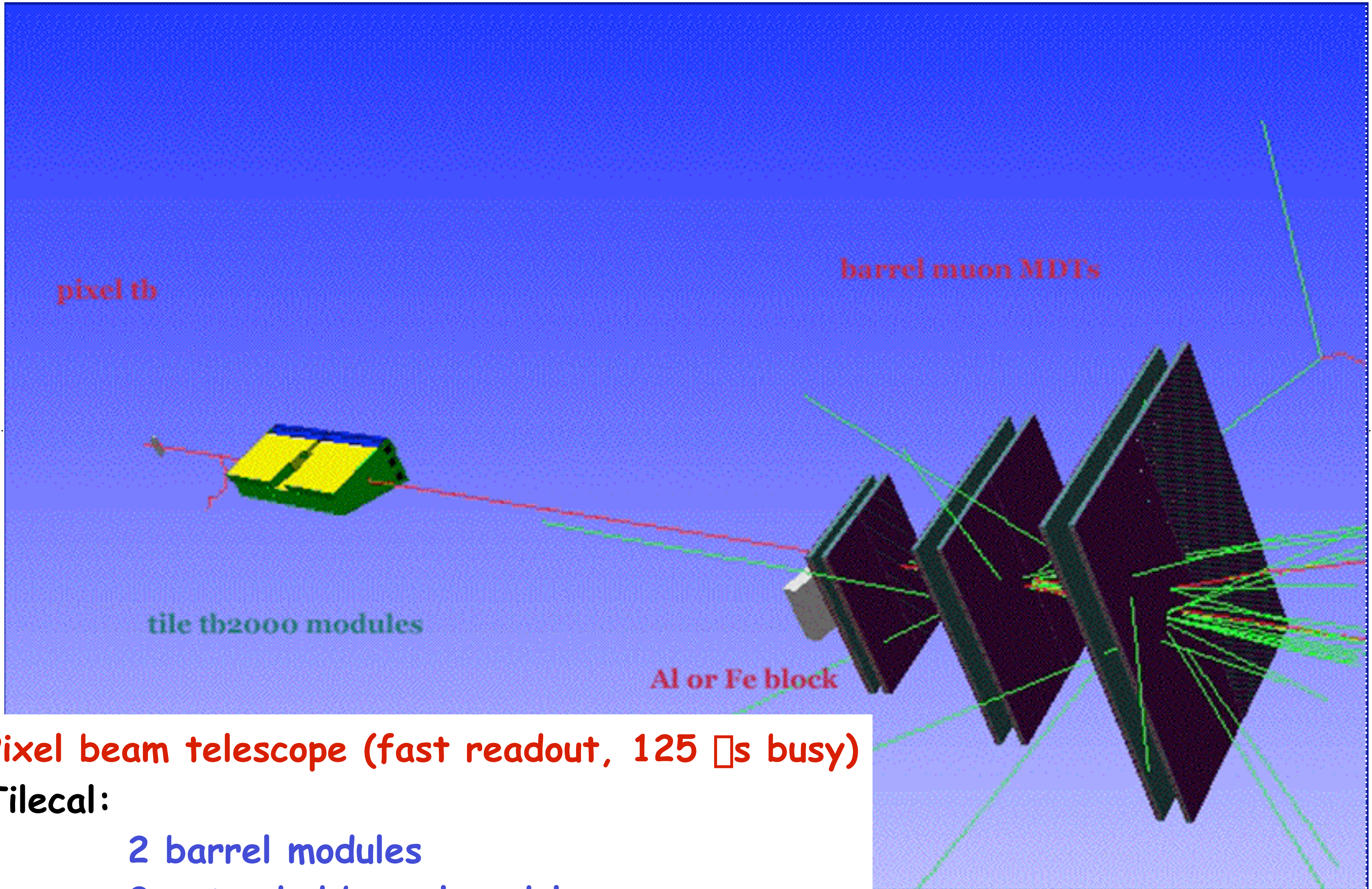
Tilecal:

- 2 barrel modules
- 2 extended barrel modules

MDT: 6 barrel chambers

ion

Pixel-Tilecal-Muon - Detector setup: full H8 line



Pixel beam telescope (fast readout, 125 μs busy)

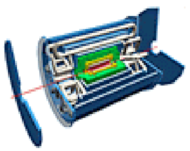
Tilecal:

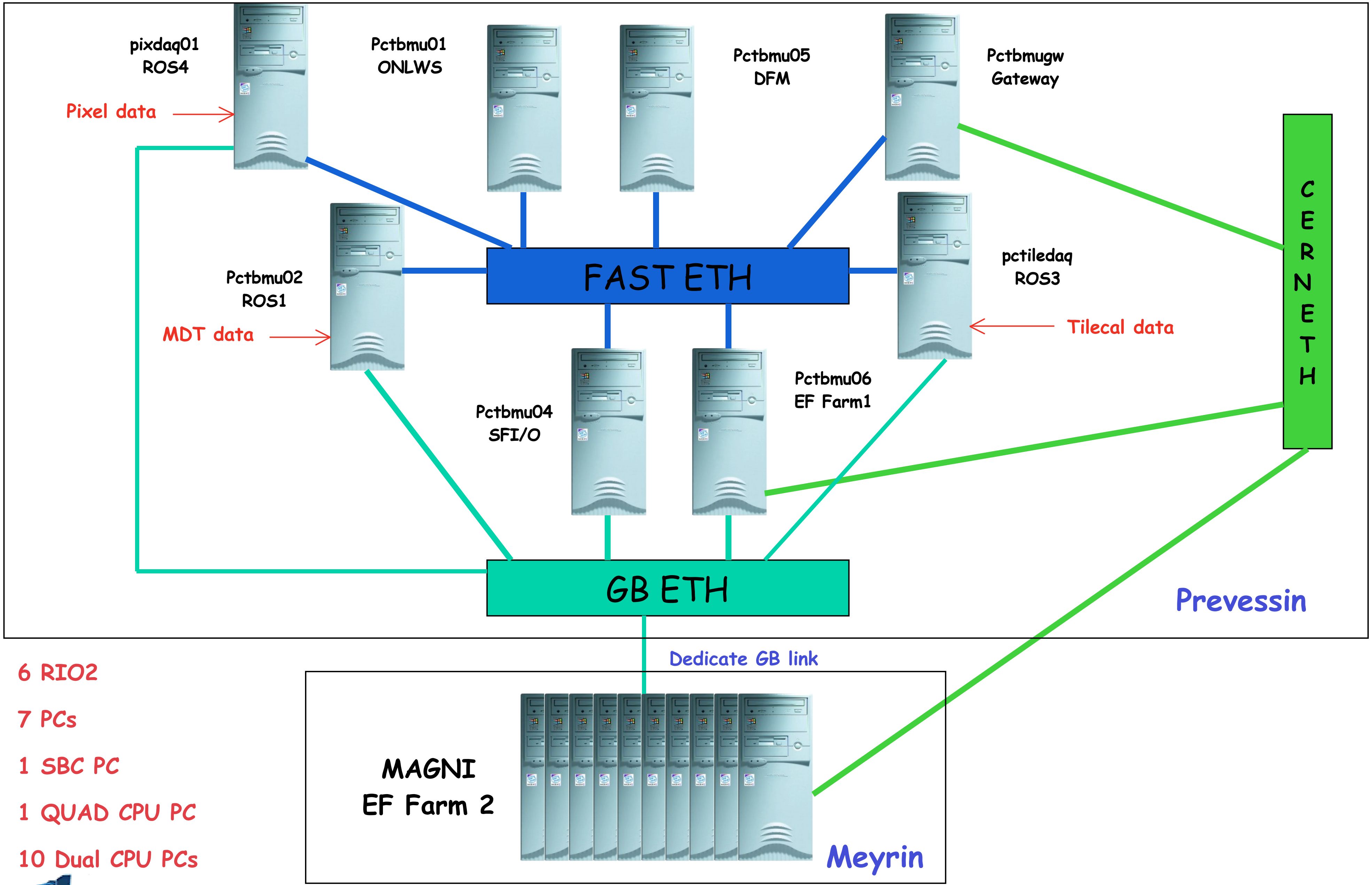
- 2 barrel modules
- 2 extended barrel modules

MDT: 6 barrel chambers

The main goals

- ✓ Organization of a common trigger and busy infrastructure across sub-detectors with different readout
- ✓ Integration of three different DAQ systems all based on current DAQ prototype for test beam
- ✓ Full DAQ/EF architecture implementation





6 RIO2

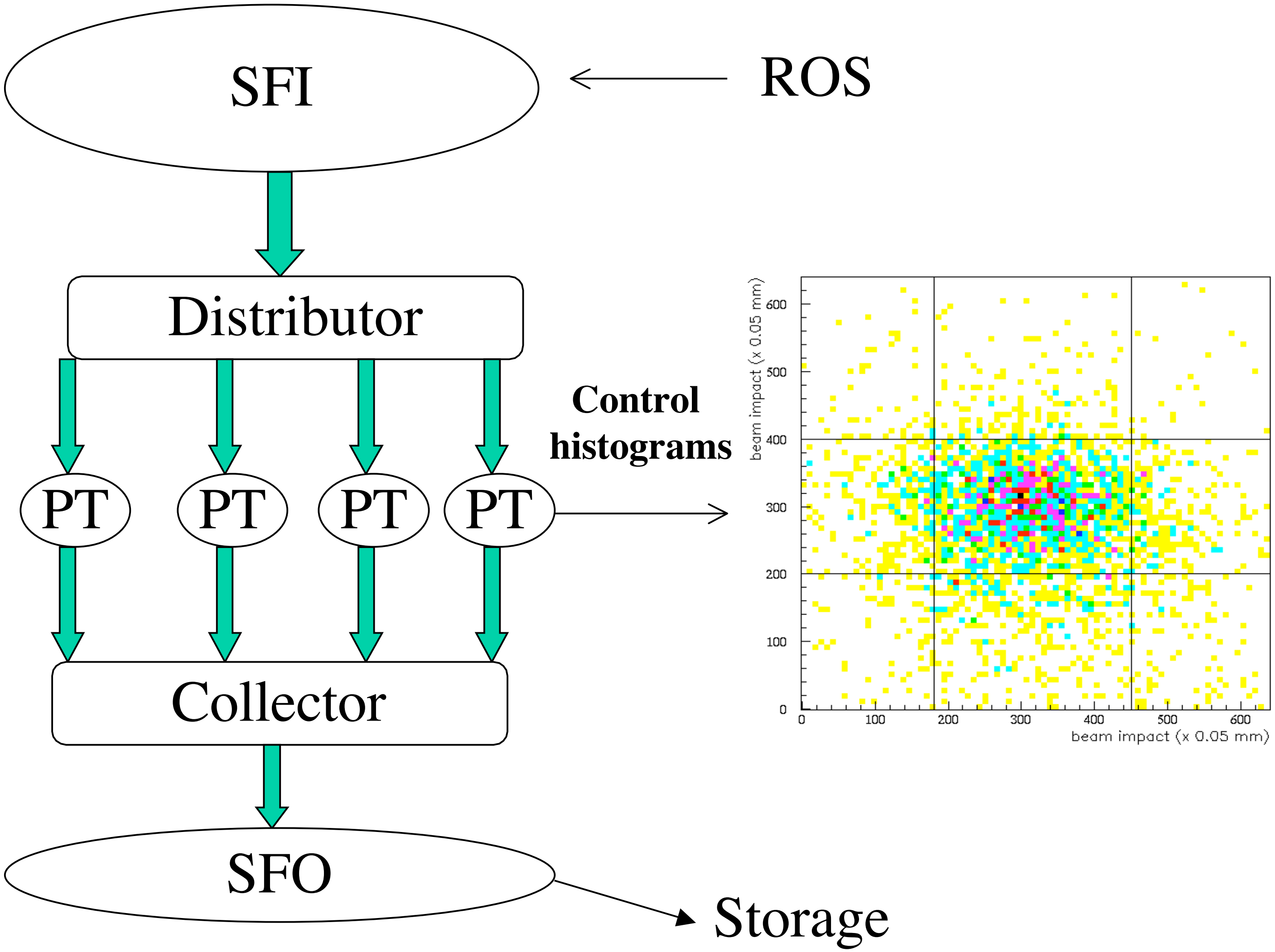
7 PCs

1 SBC PC

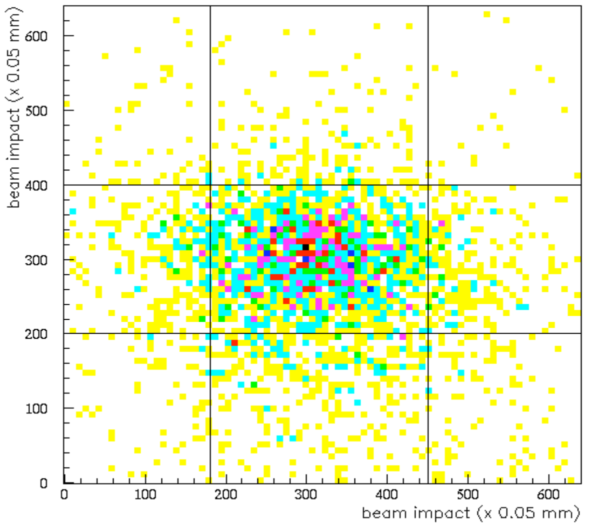
1 QUAD CPU PC

10 Dual CPU PCs

Event Filter: what happen in the farms

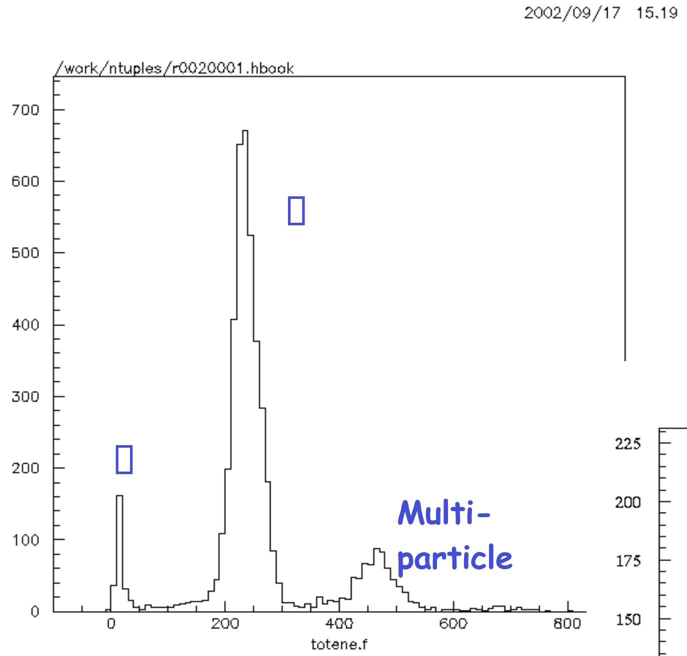


Event Filter: online plots



PIXEL

Beam profile



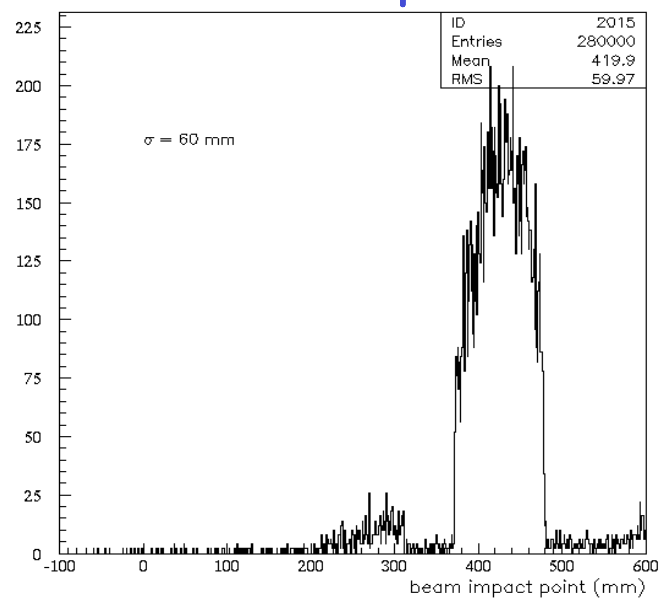
Multi-particle

TILECAL

Beam composition

MUON

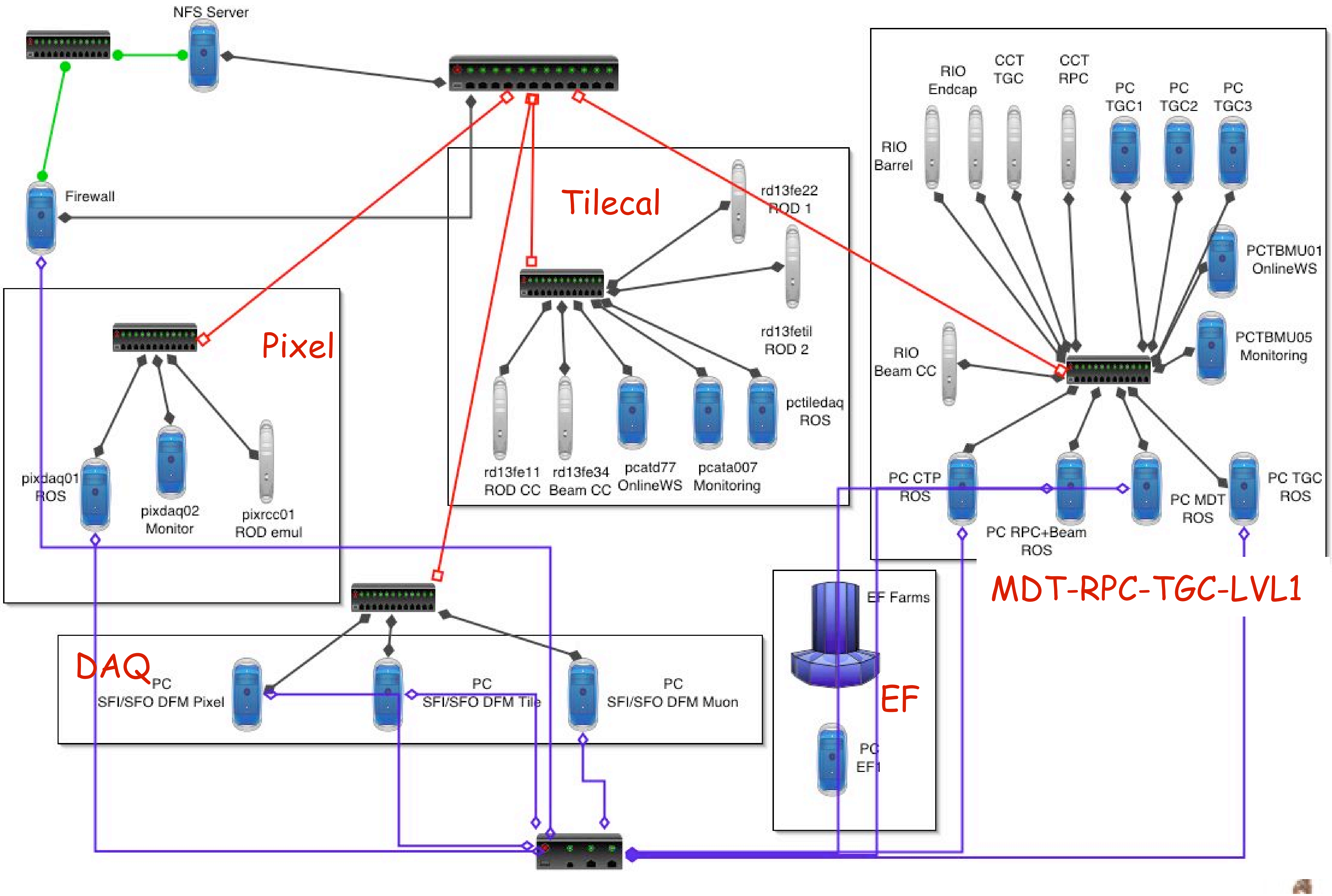
Beam profile



Expected beam spread in y = 54 mm

Measured = 60 mm (very preliminary online data)

Pixel-SCT-Tilecal Muon 2003 combined run: infrastructure

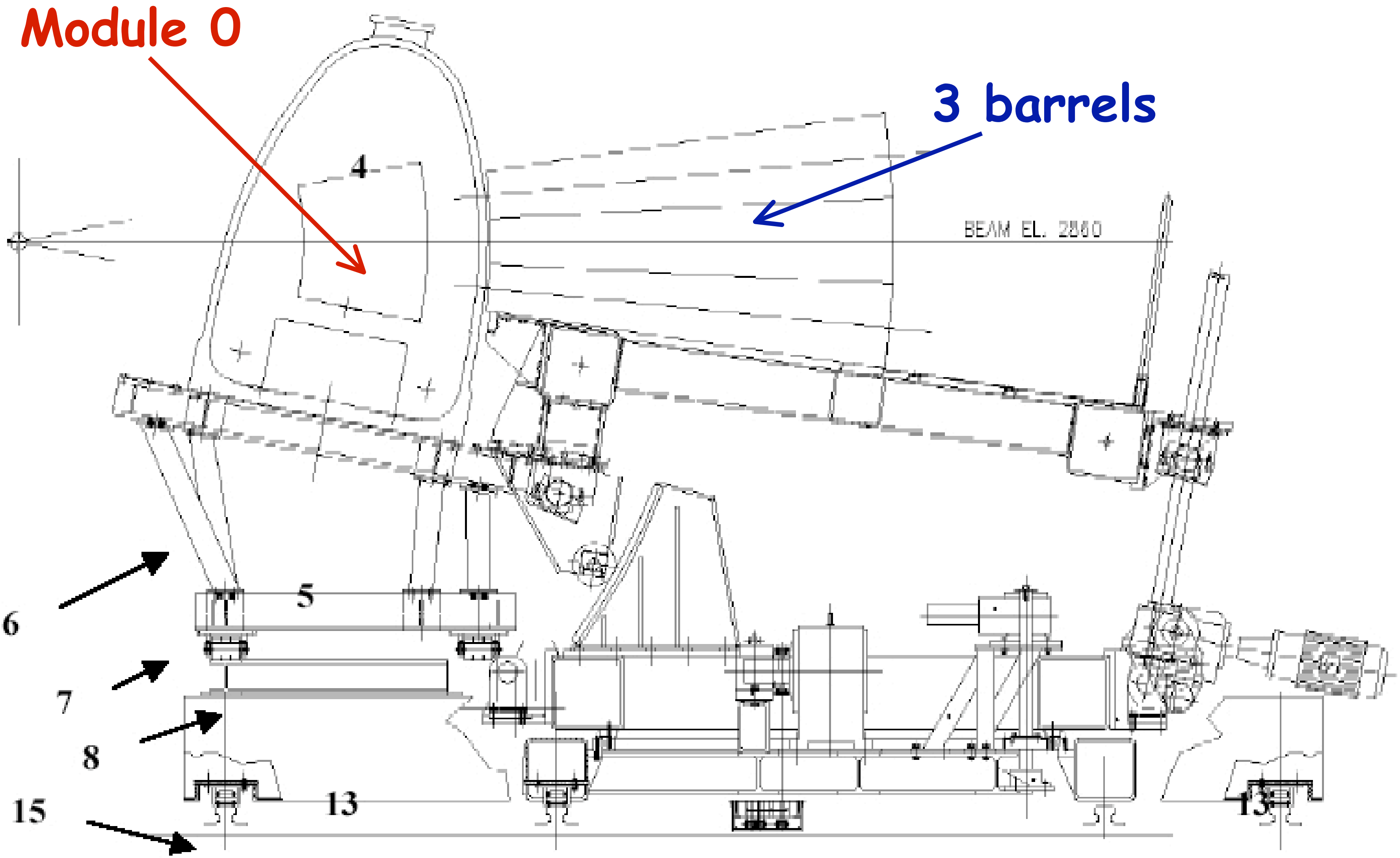


All that in preparation of…

ATLAS LAr/Tile calorimetry (2004)

- ✓ Two combined runs in 1994 and 1996
  - ❄ Setup with calorimeter prototypes
  - ❄ Different readout organization and module segmentations
- ✓ The combined run in 2004
  - ❄ Real-scale modules
  - ❄ Readout and DAQ à la ATLAS
  - ❄ Run also with the other barrel sub-detectors
  - ❄ It is one of the highest priority for the ATLAS test beam program in 2004, probably the last long test beam period before the LHC run (2006 run may be very short)

Combined barrel calorimeters setup

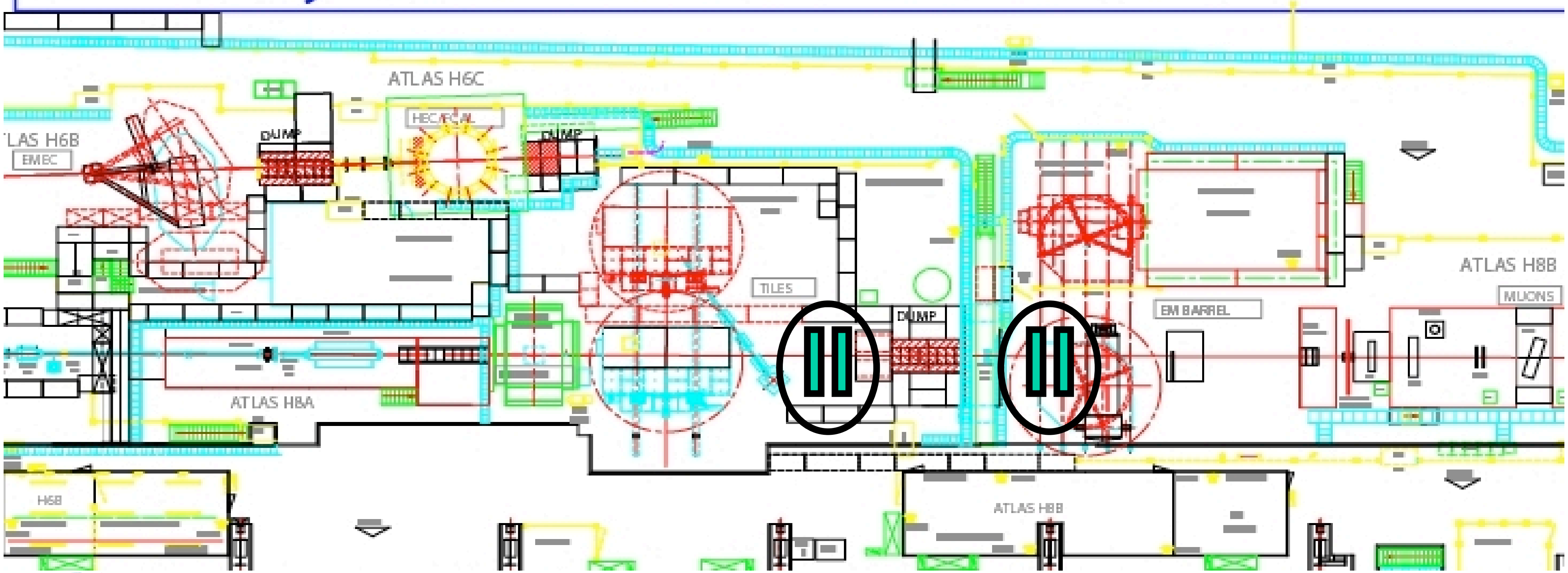


ATLAS barrel run

✓ TRT, SCT and Pixel very interested (common ID run)

✓ Muons: few chambers to be displaced

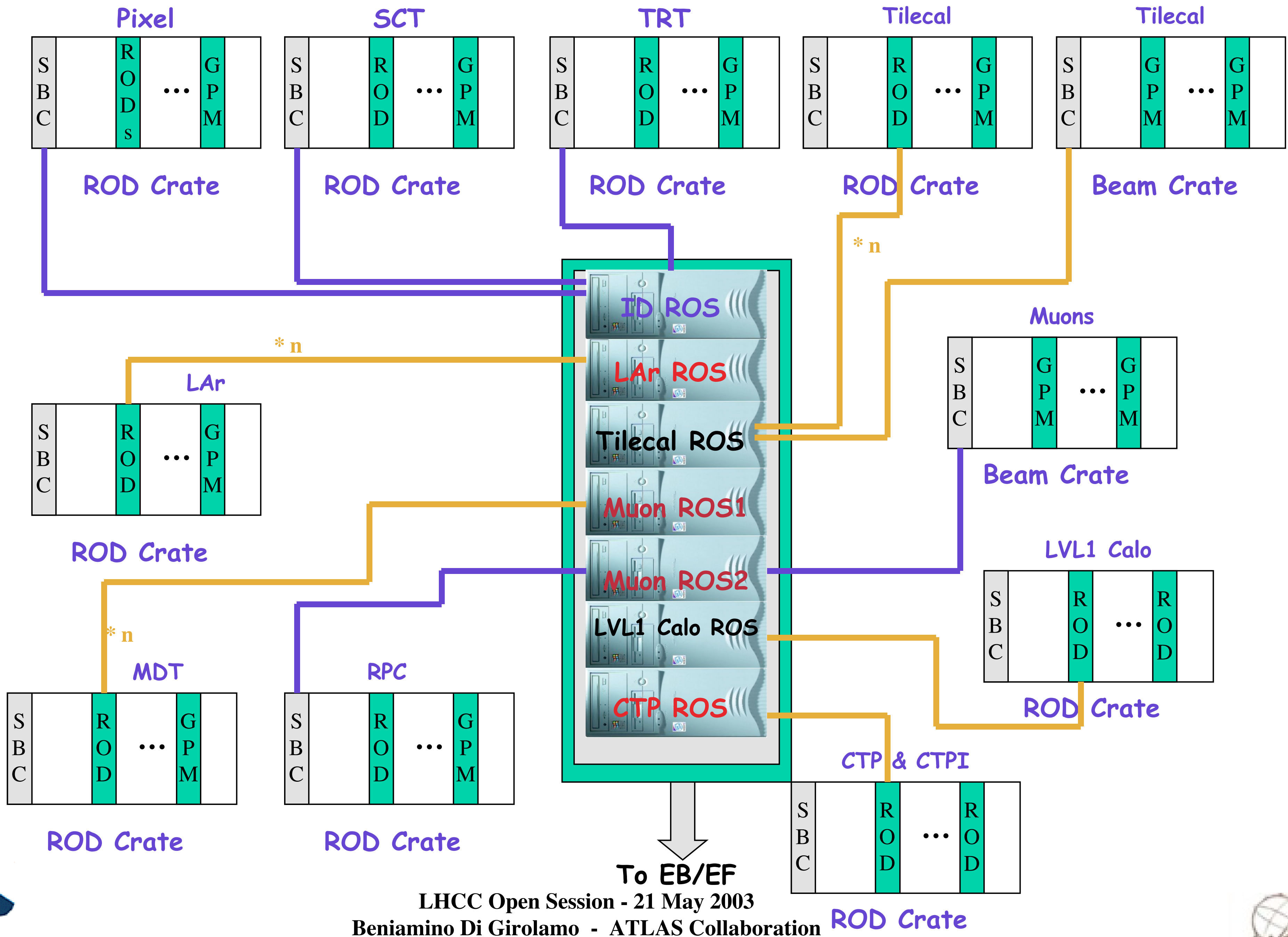
General layout of the ATLAS TEST BEAM areas .



ATLAS Combined Runs

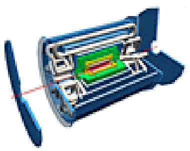
- ✓ Electronics
  - Final front-end and off detector
- ✓ DAQ
  - Final ATLAS architecture
- ✓ Participation of LVL1 Calo and Muon
  - Considering key tests for LVL1 (L1Calo and L1Muon into CTP) at the combined run
  - LVL1 Muon starting from 2003

Combined run 2004 - global layout



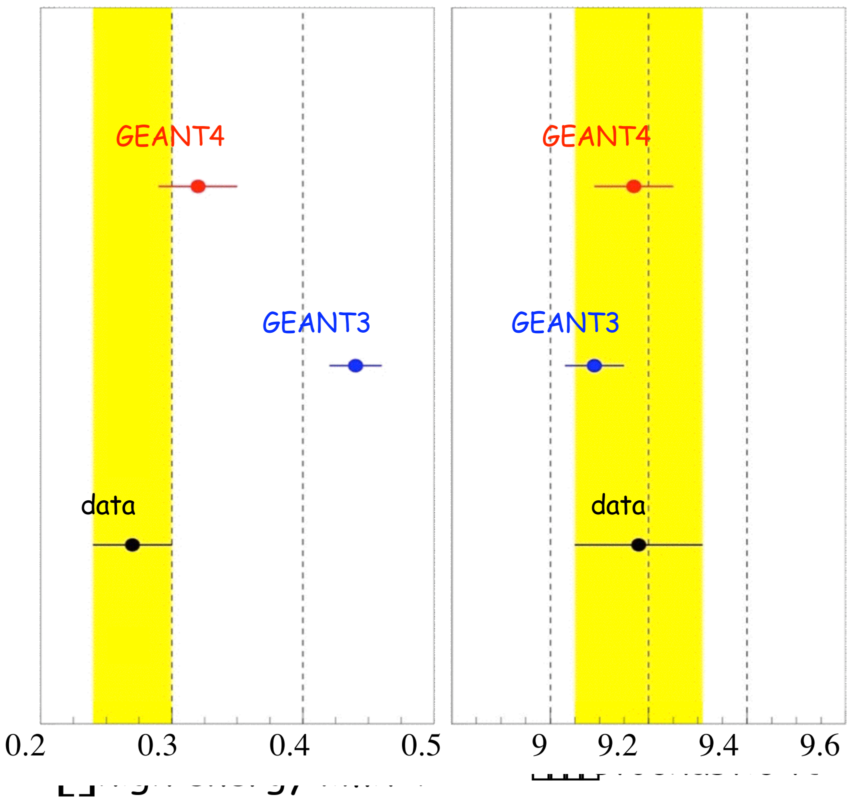
ATLAS Combined Runs:Offline and simulation

- ✓The most advanced tools can be used:
  - ❄Reconstruction programs (VERY USEFUL)
  - ❄G4 simulation
  - ❄Management of large data samples
- ✓The ATLAS barrel run can be seen as a powerful data challenge
- ✓Useful input to the simulation

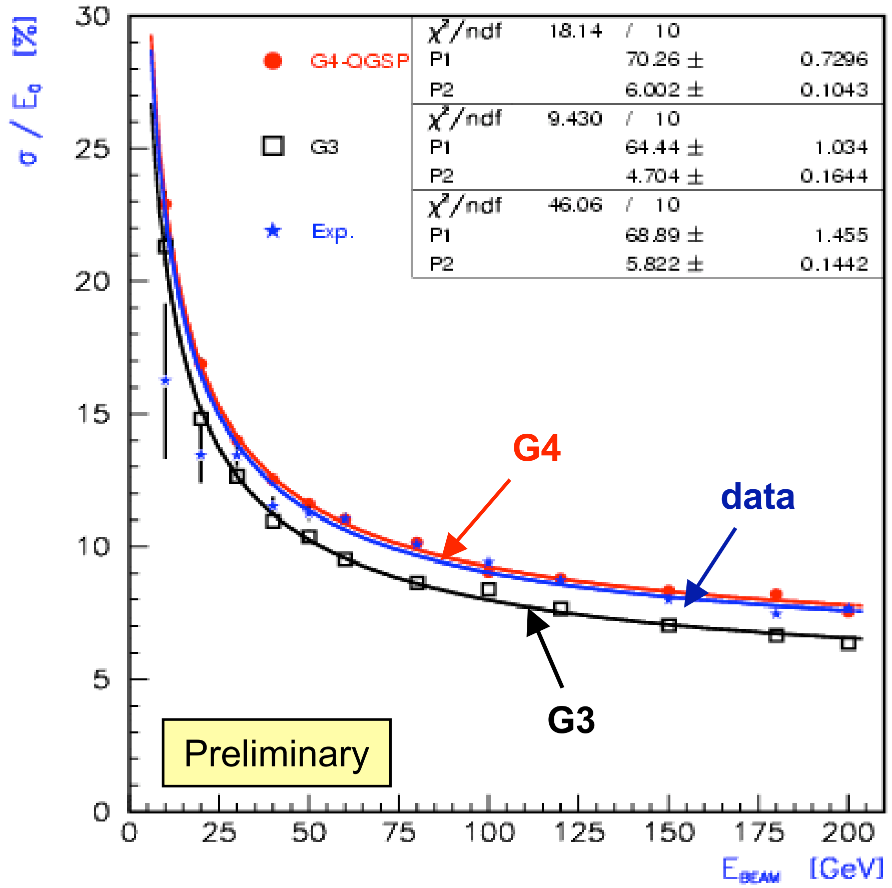


Examples of GEANT 4 validation work

LAr EM barrel electron energy resolution



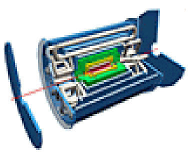
Pions in LAr HEC series modules



Extensive use is made of the ATLAS test beam data from all sub-systems (ID, LAr and Tile Calorimeters, Muons) in this validation process

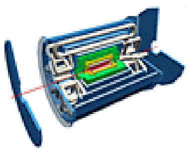
ATLAS Combined Runs: Program

- ✓ Classical studies
  - ❄ Energy sharing
  - ❄ Energy resolution, linearity and uniformity vs η, E
- ✓ Leakage
- ✓ Implementation of weighting techniques
- ✓ e/h measurements
  - ❄ Behaviour going down with the energy
- ✓ Calorimetry measurements with tracker and TRT
  - ❄ Hadron rejection (ATLAS Note Indet-20, 1992)
  - ❄ Help for low energy effects
- ✓ Tile 3rd compartment signal for muons
- ✓ Trigger strategies



Combined run: incremental setup

- ✓ The hardware will be added step by step
  - ❄ Deliveries of many production elements match the schedule
  - ❄ Learning separately about
    - Calorimetry
    - Inner Detector
    - Muon system
    - LVL1 Trigger and Calorimetry
    - LVL1 Trigger and Muon system
- ✓ Final integration
  - ❄ Full H8 line setup
  - ❄ Low energy beam
  - ❄ 25 ns beam (important for the Trigger electronics)



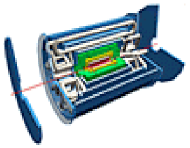
ATLAS Combined Runs: schedule and beam

2004   April - September

Beam Line	Subdetector	April			May				June					July				August				Sep.	
		15	21	28	5	12	19	26	2	9	16	23	30	7	14	21	28	4	11	18	25	1	8
H8/SPS	Pixel								25										LE	LE		25	
	SCT								25										LE	LE		25	
	TRT								25										LE	LE		25	
	Combined calo								25								LE		LE	LE		25	
									25								LE		LE	LE		25	
	Muons								25										LE	LE		25	
H6/SPS	HEC/EMEC/FCAL																						
X5-GIF/SPS																							

Possible scenario

~ 22 weeks in agreement with CMS



Conclusions

- ✓ A number of results achieved during test beams
  - ❈ Not always well known outside the community
  - ❈ Experience on final readout and trigger electronics
- ✓ Importance of the combined operations
  - ❈ Saving commissioning time
  - ❈ Calorimeter calibration knowledge important to get physics results as soon as possible after startup
  - ❈ Experience in combining detector-trigger information