



STATUS OF THE



EXPERIMENT

Fulvio Tessarotto

On behalf of the COMPASS Collaboration



Abstract

- *The COMPASS Collaboration*
- *The apparatus:*
 - *The polarised target*
 - *The tracking detectors*
 - *RICH and Calorimetry*
 - *Trigger, on-line and DAQ*
- *Analysis of 2001 data*
- *Physics signals from 2002 data*
- *Conclusions*



The Collaboration

- *1995: HMC and CHEOPS L.o.I. at CERN*
- *1996: COMPASS Proposal*
- *1997: CERN approval of the Experiment*
- *2000: Technical run*
- *2001: Commissioning + 2 weeks of data*
- *2002: Physics run*

28 Institutes from 12 Countries

220 Physicists

Initial program: 5 years of data taking



Physics goals

Nucleon spin structure

- Gluon polarization $\Delta G(x)$
- Flavour-dependent helicity functions $\Delta q(x)$
- Transverse-spin distribution functions $\Delta_T q(x)$
- Spin-dependent fragmentation ($\Delta D \Lambda_q$)

Spectroscopy

- Primakov reactions
 - **Polarizability of π and K**
- Glueballs and hybrids
- Charmed mesons and baryons
 - **Semileptonic decays**
 - **Double-charmed baryons**

Jura

Geneva Lake

COMPASS





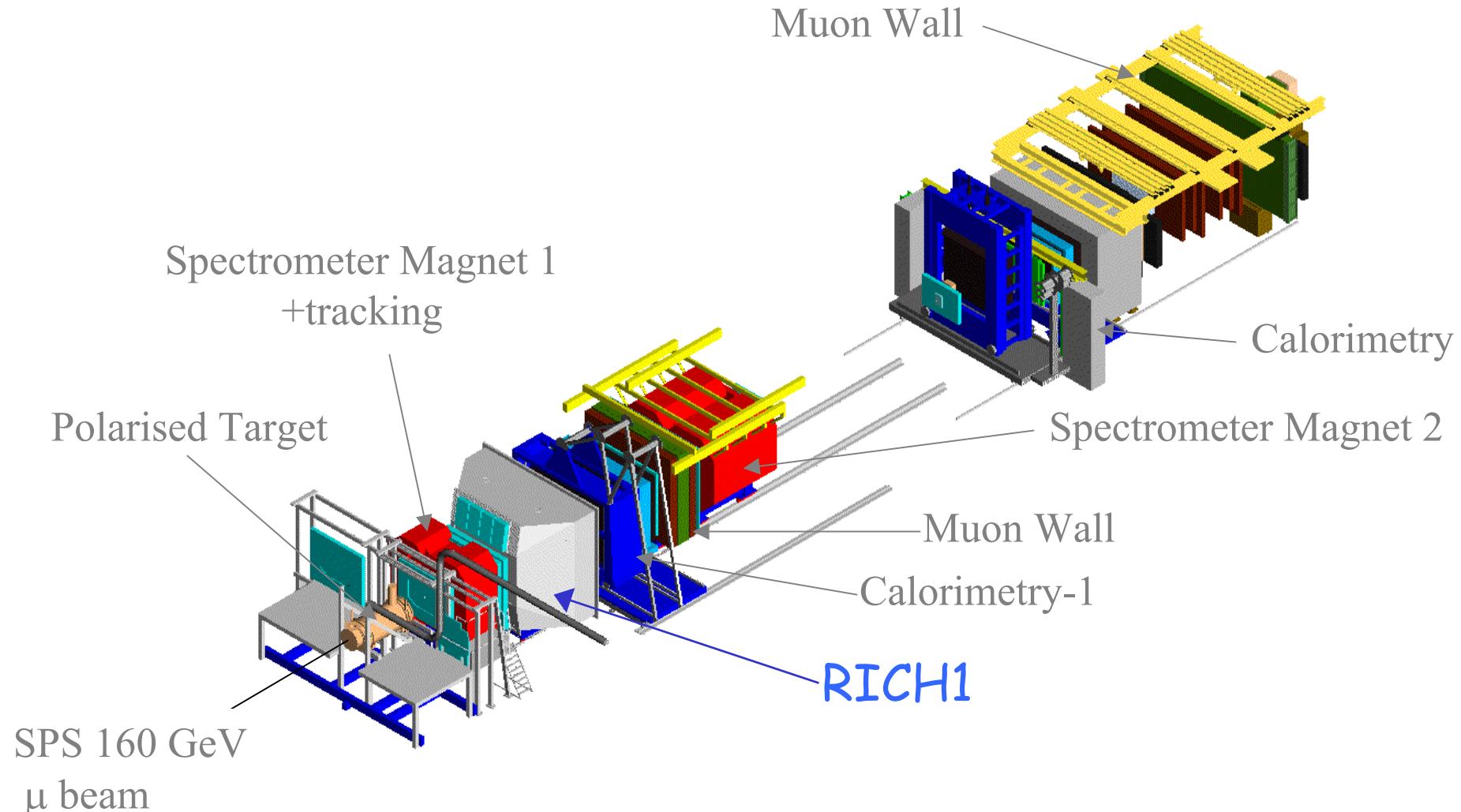
COMPASS in 2002

- CERN SPS μ^+ beam:
 - $E_\mu = 160 \text{ GeV}$, $P_B = -0.80$
 - Intensity: $2 \times 10^8 / \text{spill}$, $T = 14.4 \text{ s}$
- ${}^6\text{LiD}$ solid target:
 - $2 \times 60 \text{ cm}$ long, $f \approx 0.50$, $P_T \approx 0.5$
- 2 outstanding spectrometers:
 - LAS: 1.0 Tm , $\pm 70 \text{ mrad}$
 - SAS: 4.0 Tm , $\pm 40 \text{ mrad}$

$$\mathcal{L} \approx 5 \times 10^{32} \text{ s}^{-1} \text{ cm}^{-2}$$



The COMPASS Apparatus



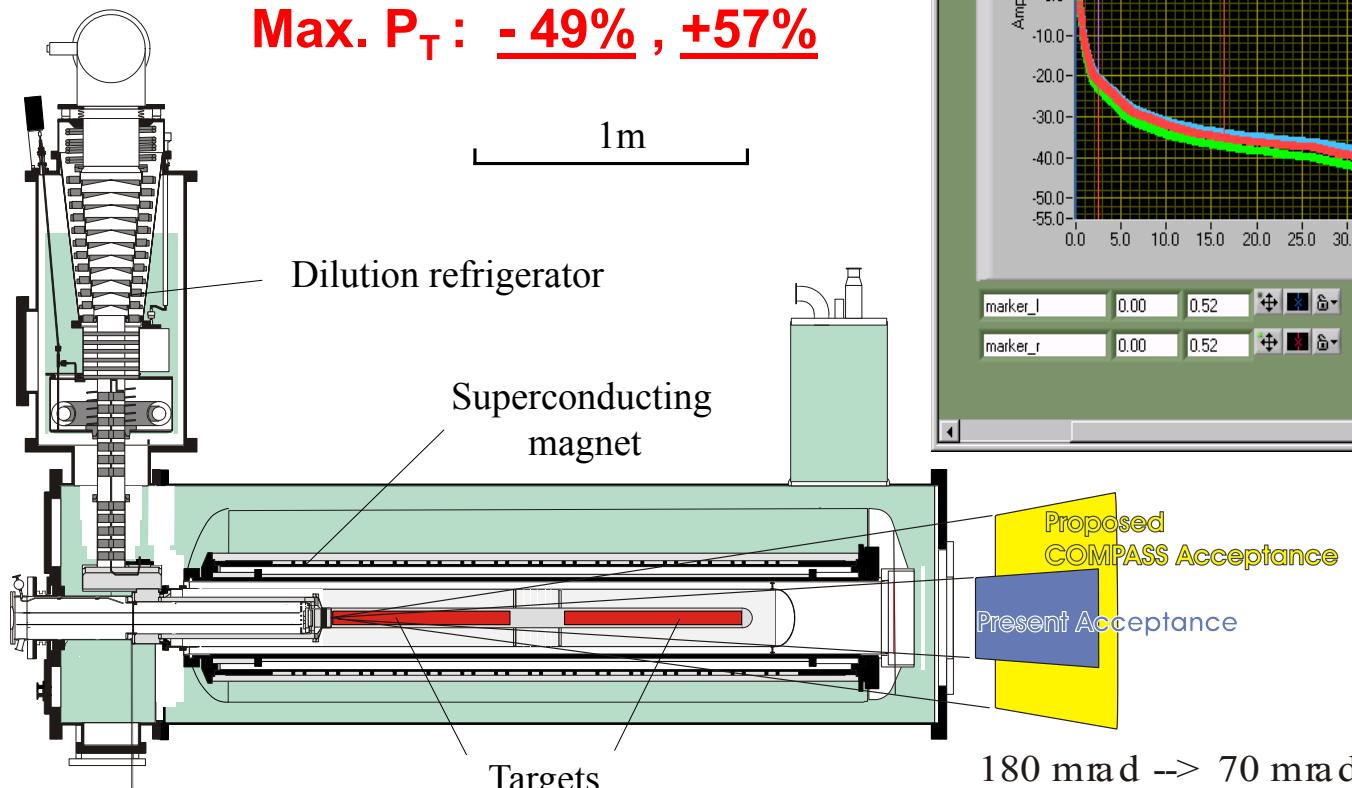


^6LiD Target

2 halves polarised in opposite directions

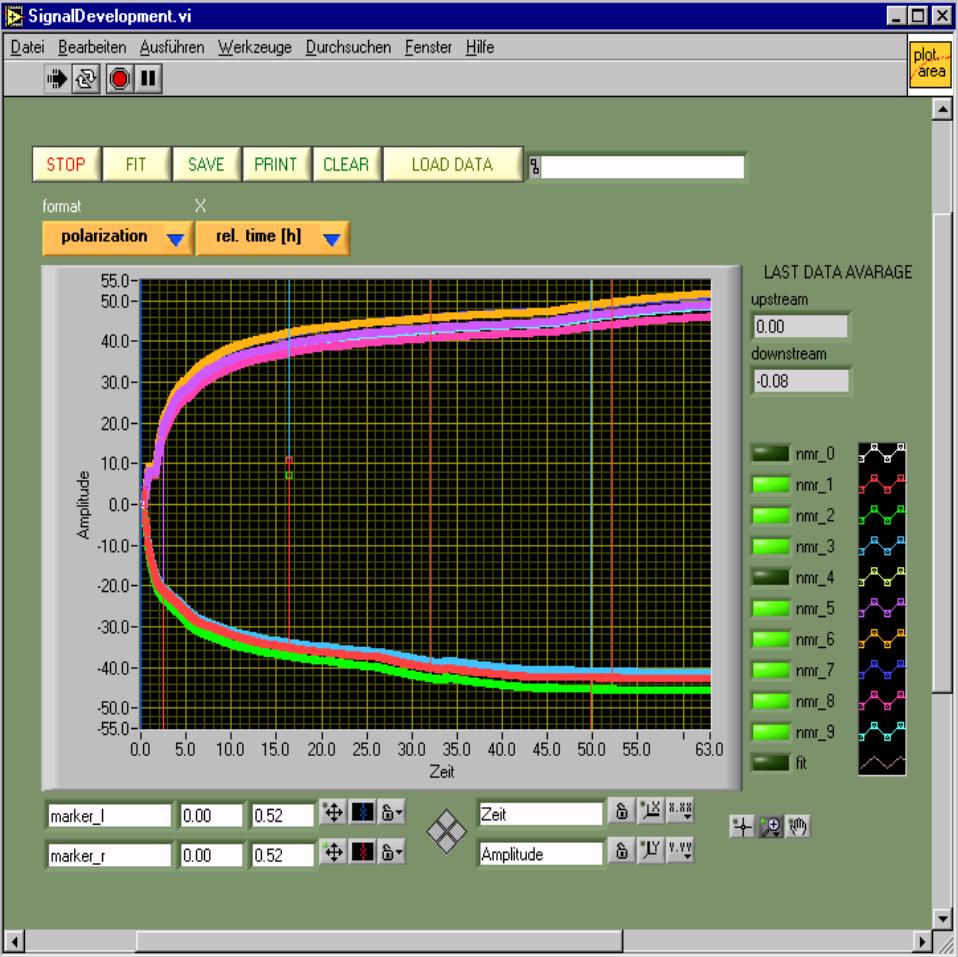
Dynamic Nuclear Polarization
Frequency Modulation

Max. P_T : -49% , +57%



September 11, 2002

Fulvio Tessarotto



Dilution factor ~50%

Solenoid: 2.5 T

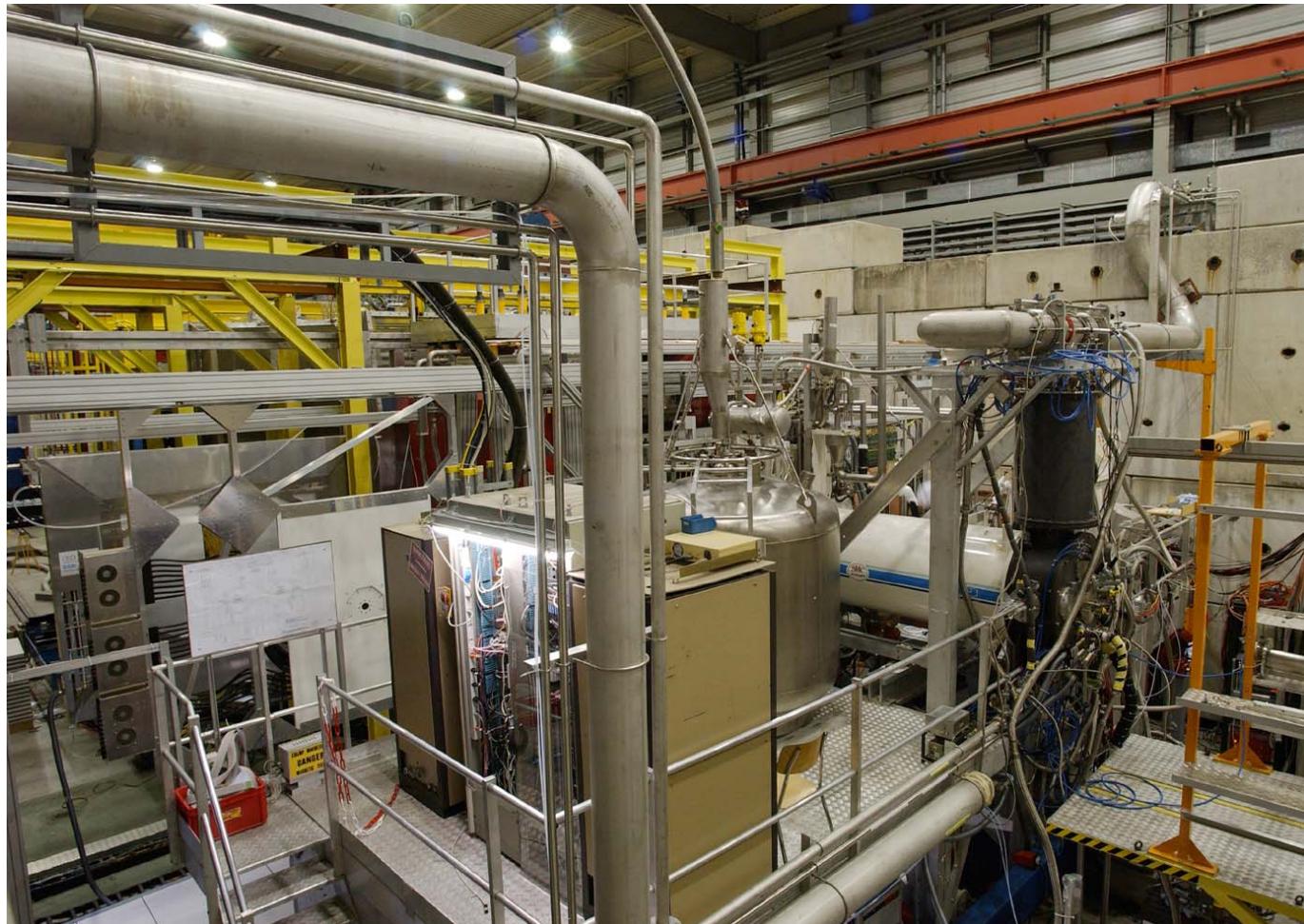
Dipole: 0.5 T

Relaxation time:
>1000 h for 0.5 T

180 mrad \rightarrow 70 mrad
(CERN and INFN Trieste)

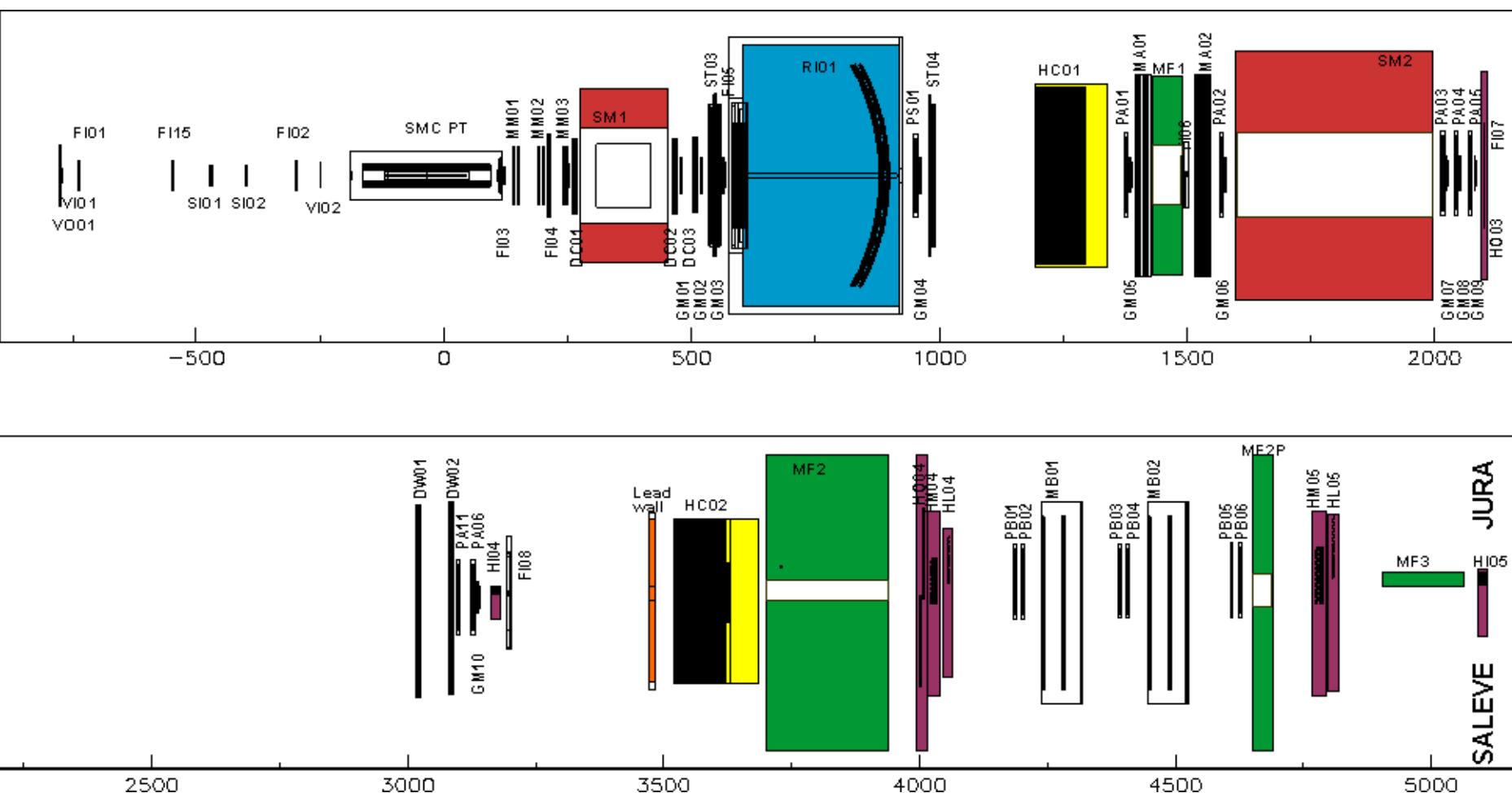


The target region in the hall



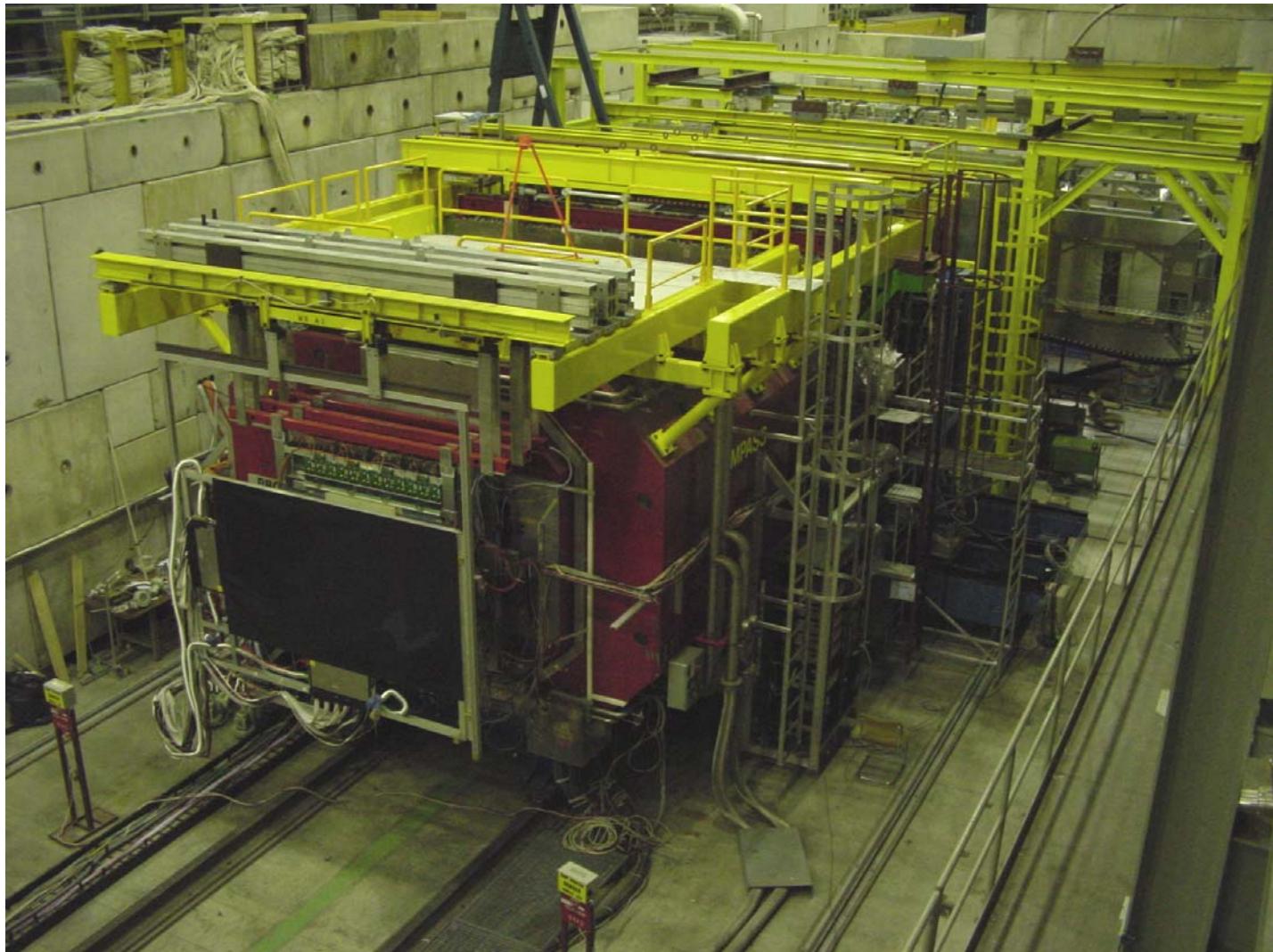


The Apparatus in “COMGEANT”





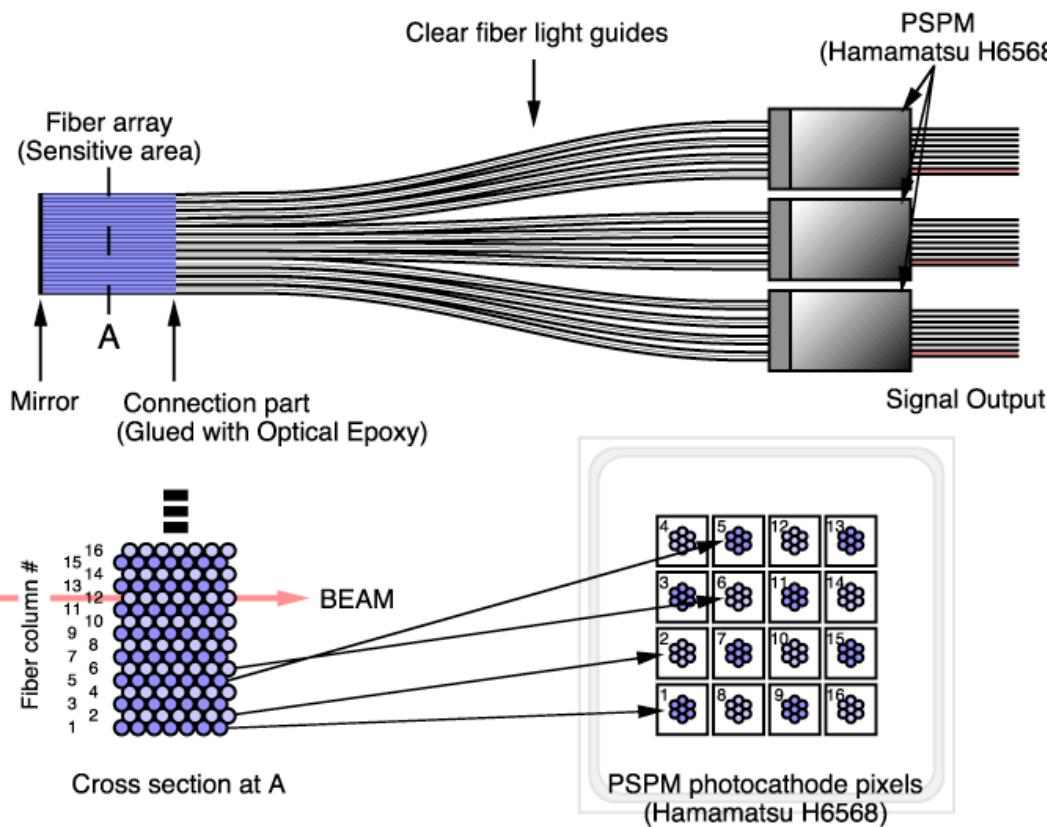
SM2 and the LAS region





Scintillating Fibers Hodoscopes

9 stations: 21 coordinates

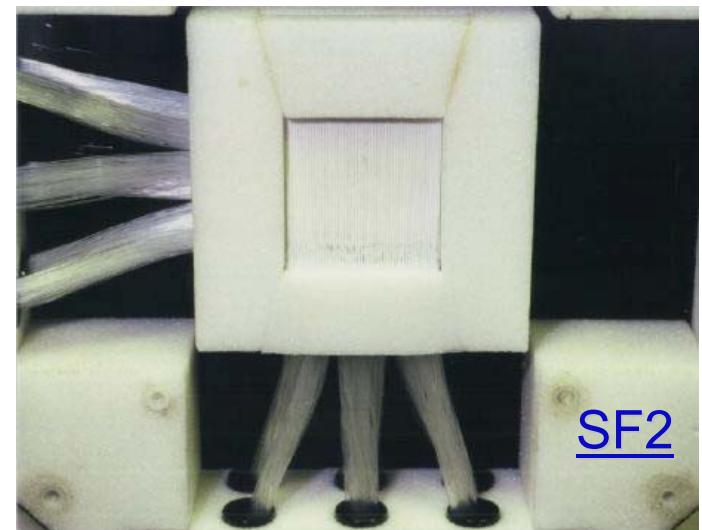


Rate capability > 5 MHz per channel

Efficiency: 99%

Space resol. 130 – 250 μm

Time resol. < 400 ps



Sensitive area:

7-layers of Kuraray SCSF-78MJ 0.5 mm Ø

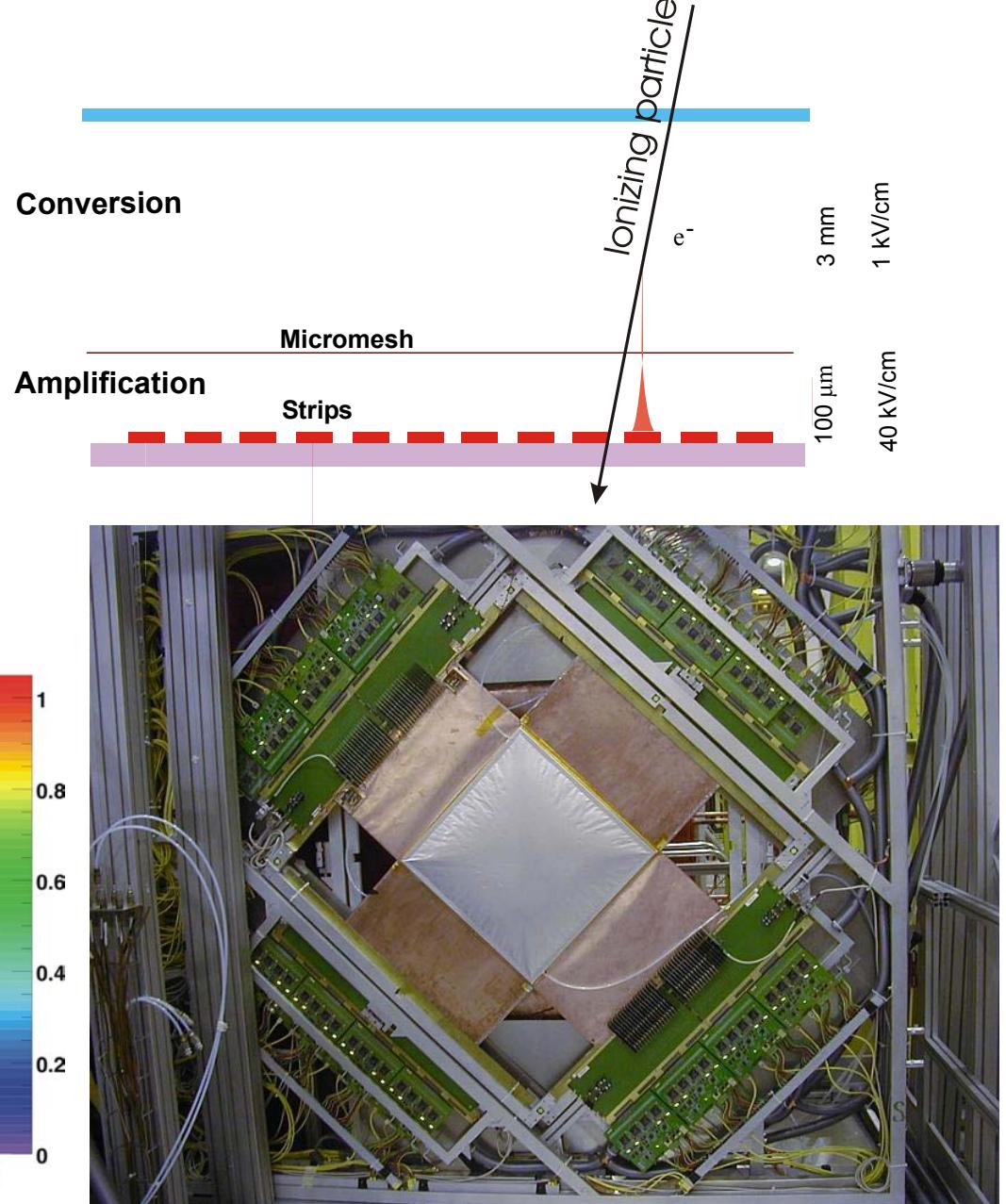


$$\mu \Omega$$

12 planes 40 x 40 cm²

Space resolution: 70 μm

Time resolution: 8 ns



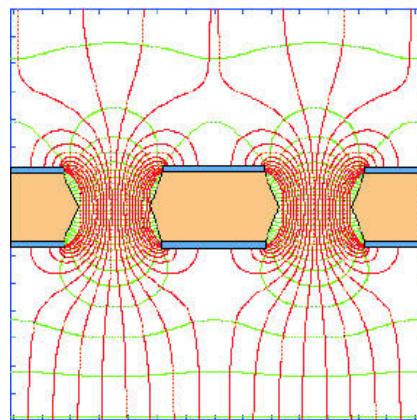
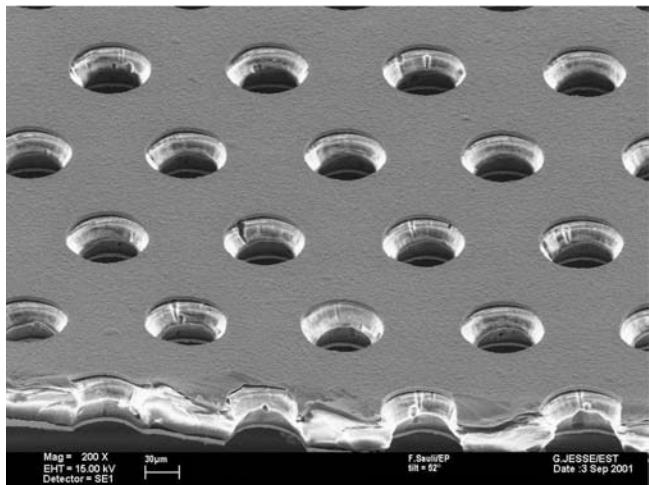
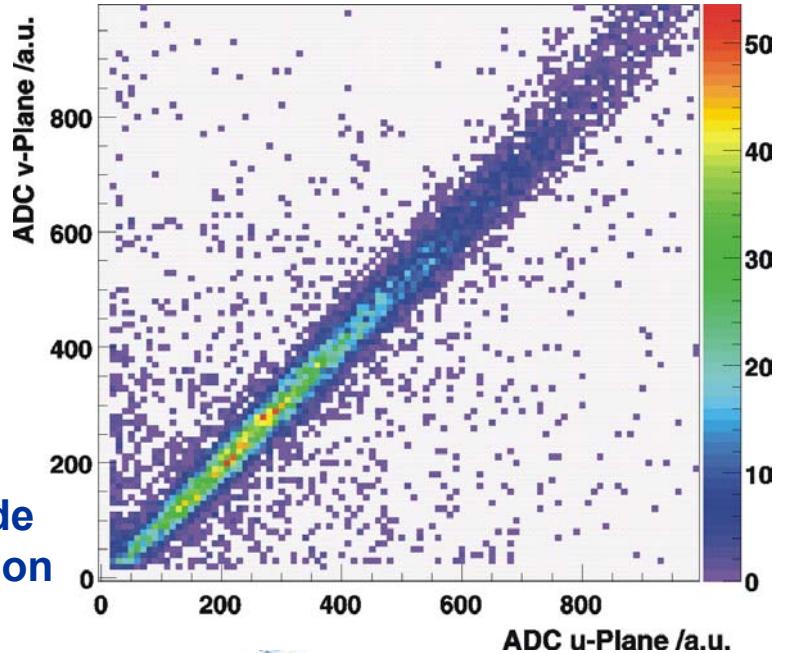


GEM

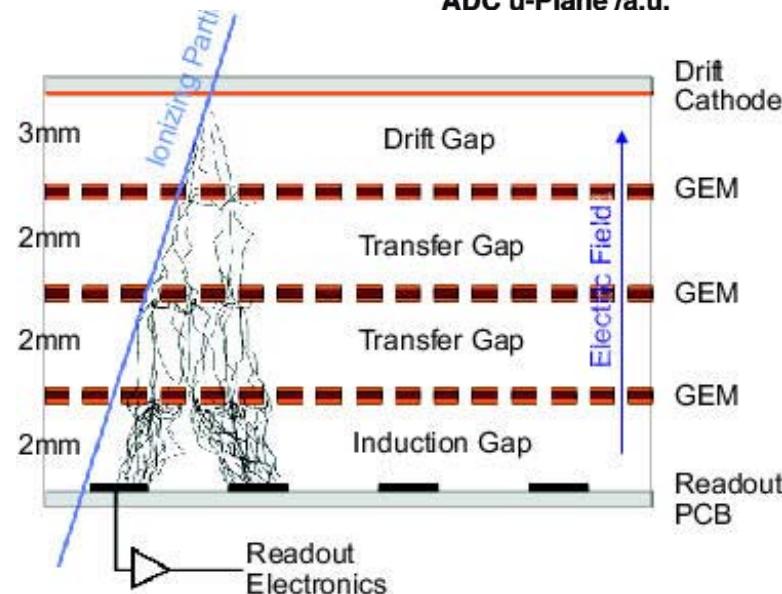
20 triple GEM detectors
with 2 dimensional r/o

- Space resolution: 70 μm
- Efficiency $\sim 96 - 97\%$
- Time resolution: 15 ns

amplitude
correlation



(two dimensional)



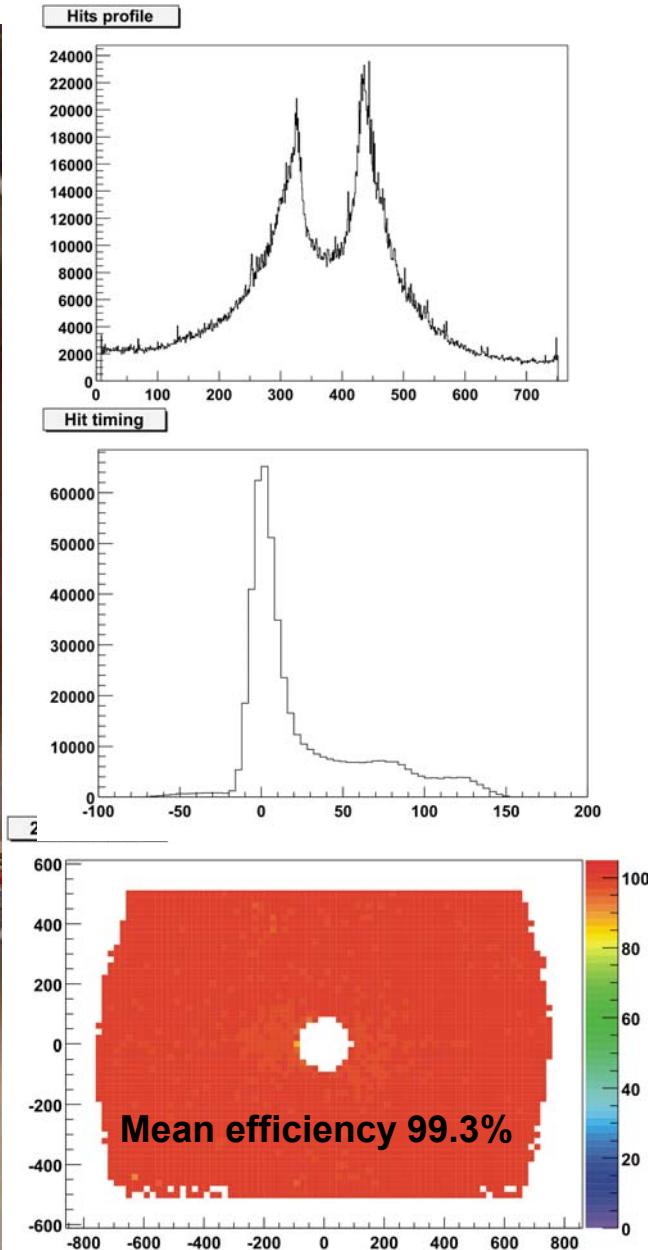
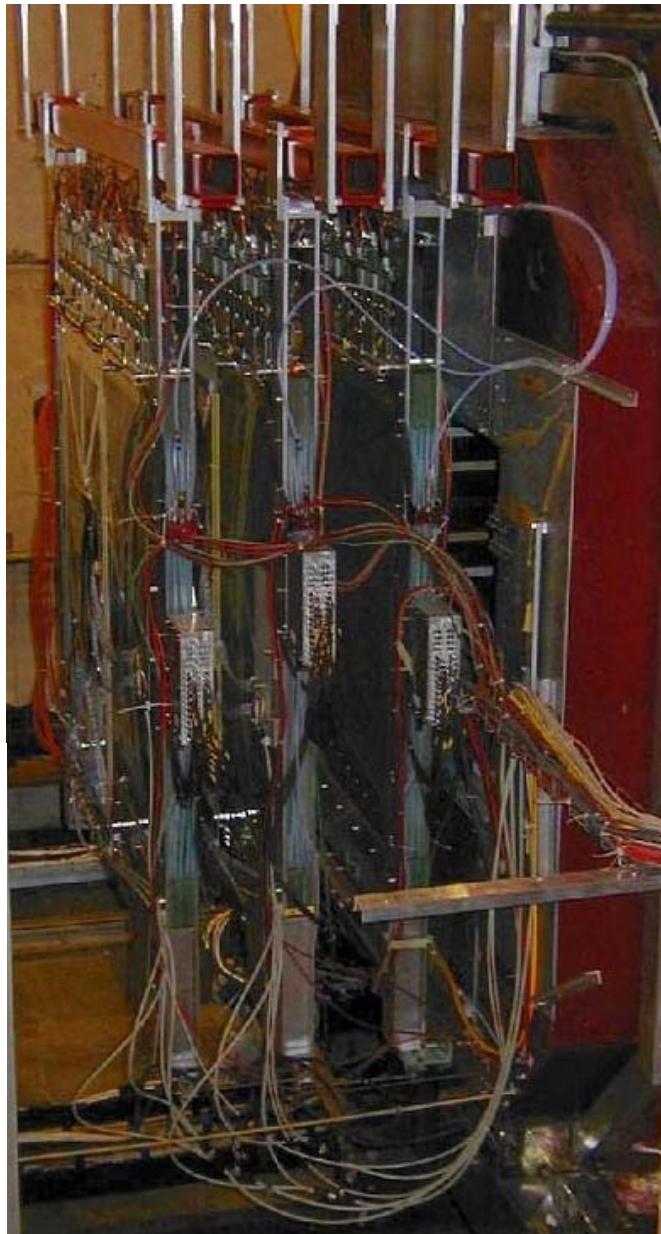


MWPCs

Total of 34 planes

SAS Tracking

- Gas mixture:
70% Ar, 20% CF₄, 10% CO₂
- High voltage: 4.25 kV
- Discr. threshold: 4fC



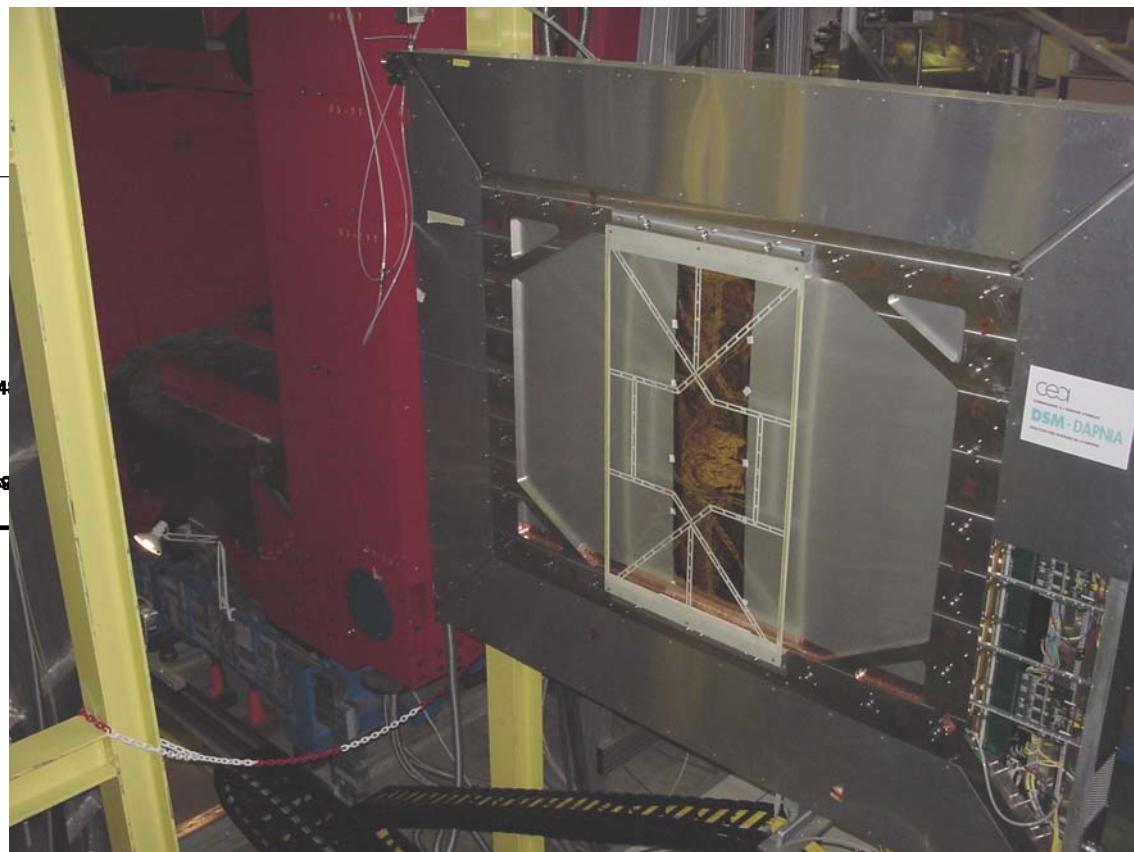
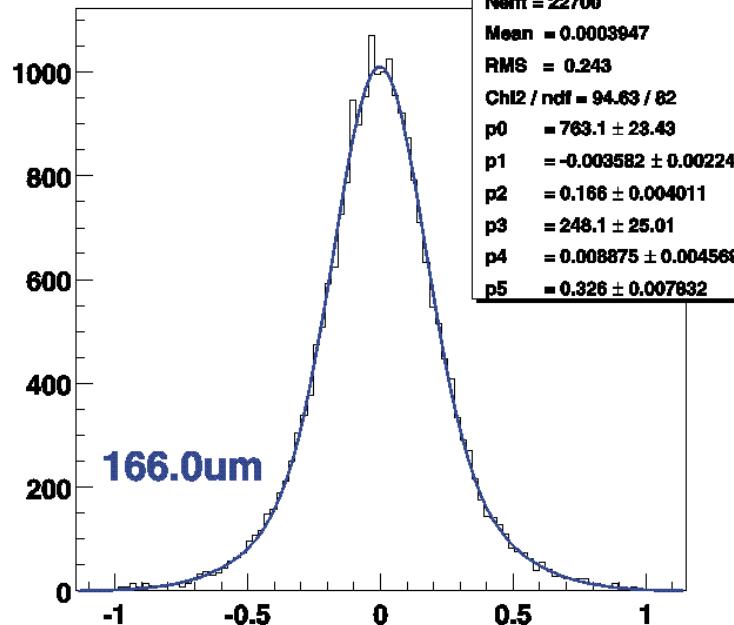


Drift Chambers for LAS

3 chambers with 8 coordinates each

Efficiency: 95 - 99.8 %

DC01X1__T_du_::T_fnd&&abs(T_duIn)<1&&Chi2/(T_cmt)-3



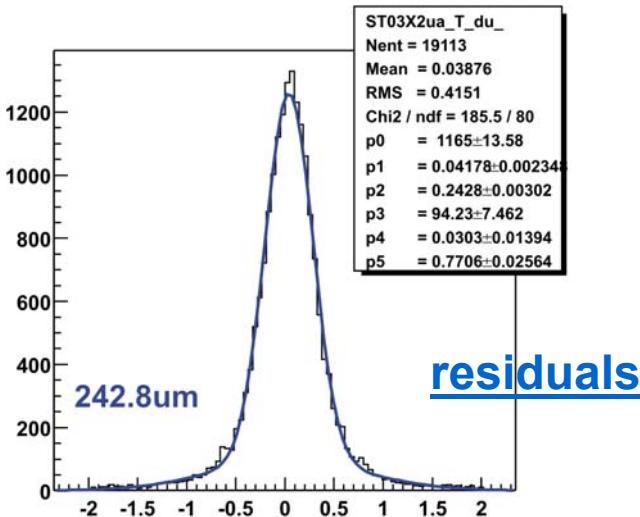
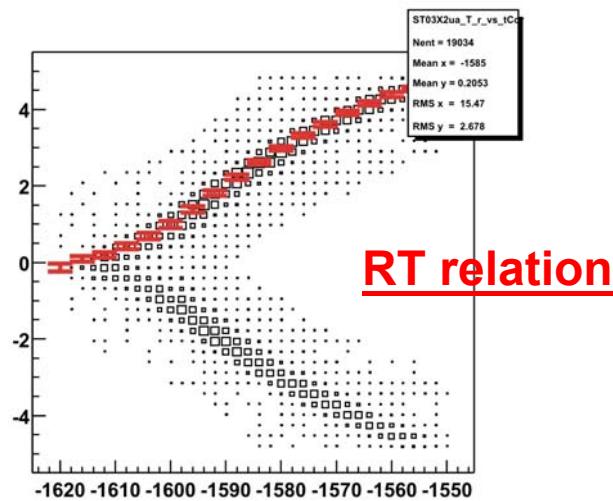


Drift Chambers for SAS



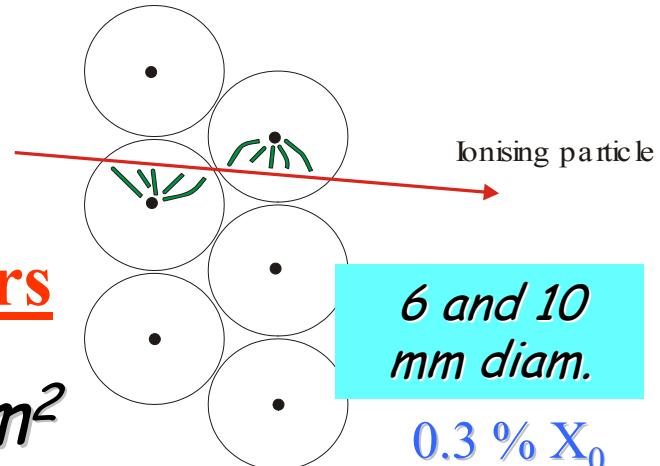


STRAWs

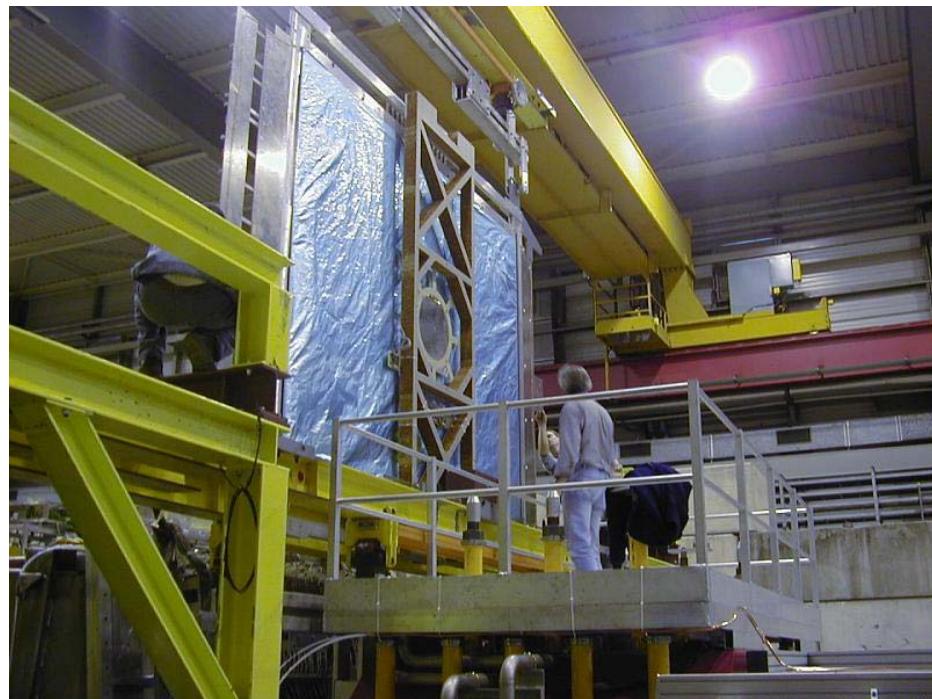


1 Module =
6 double layers

$$3.2 \times 2.4 \text{ m}^2$$



Installation of a double layer





HCAL 1

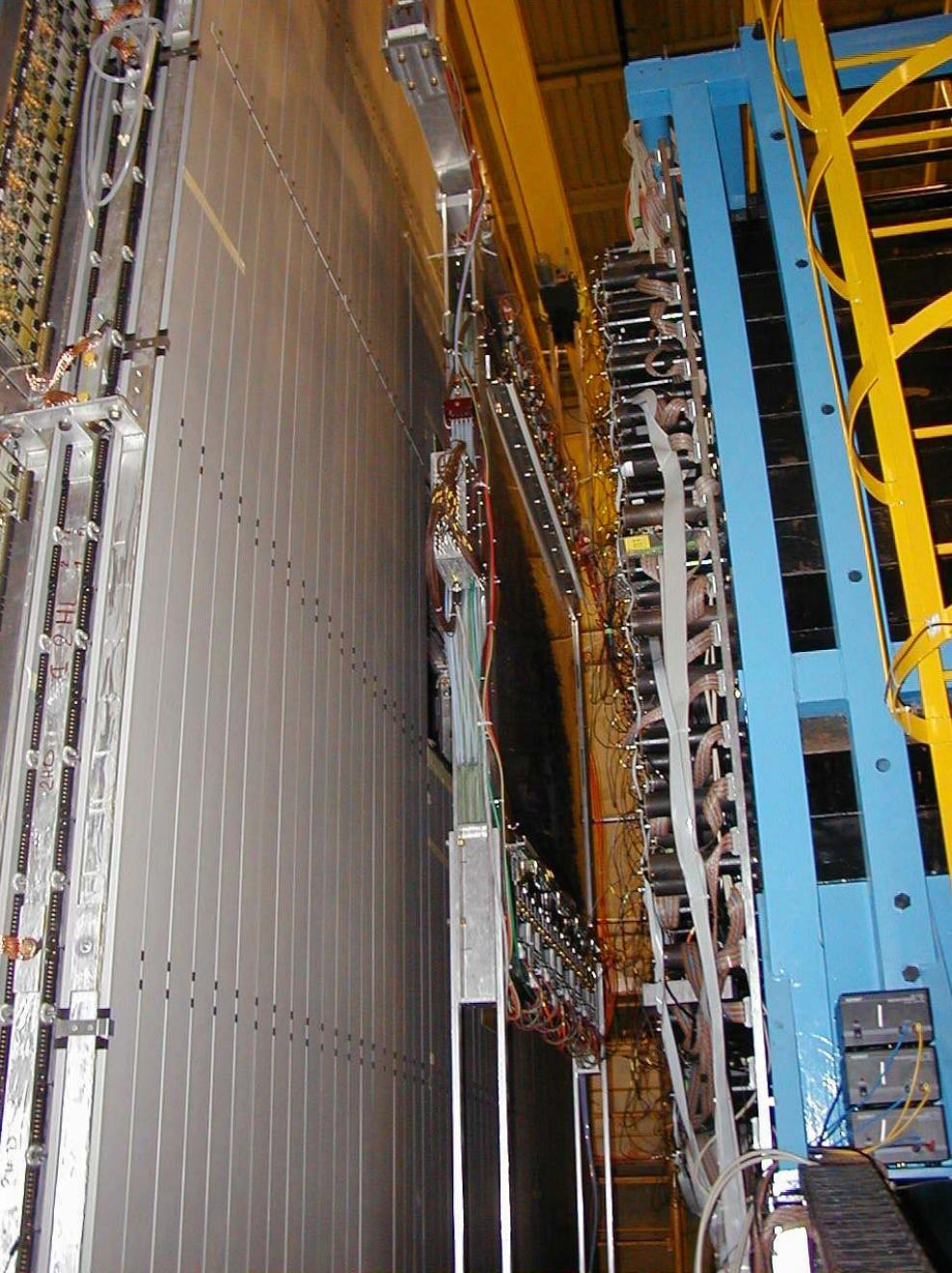




Muon Wall 1

and

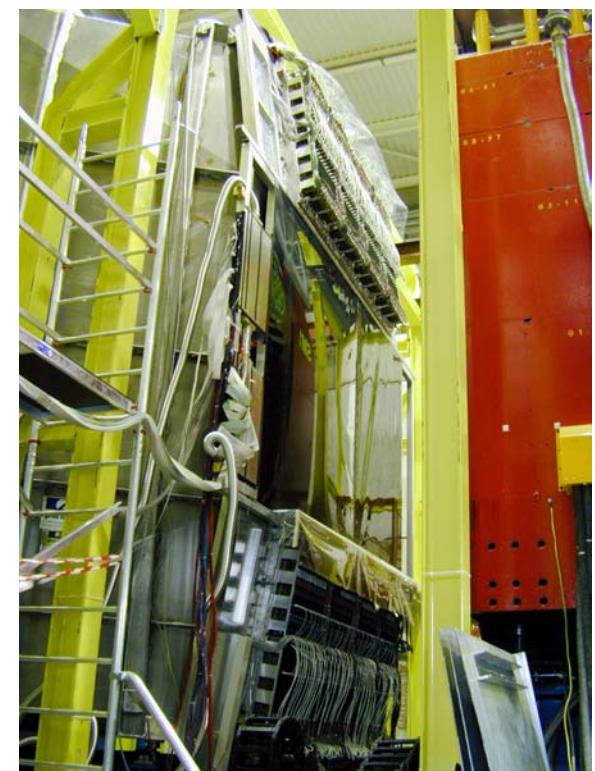
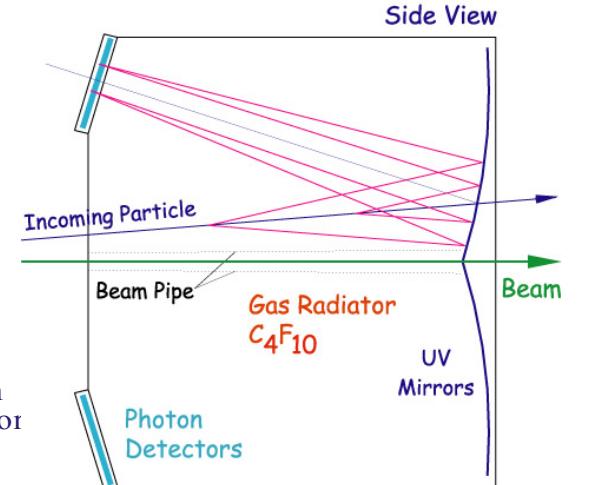
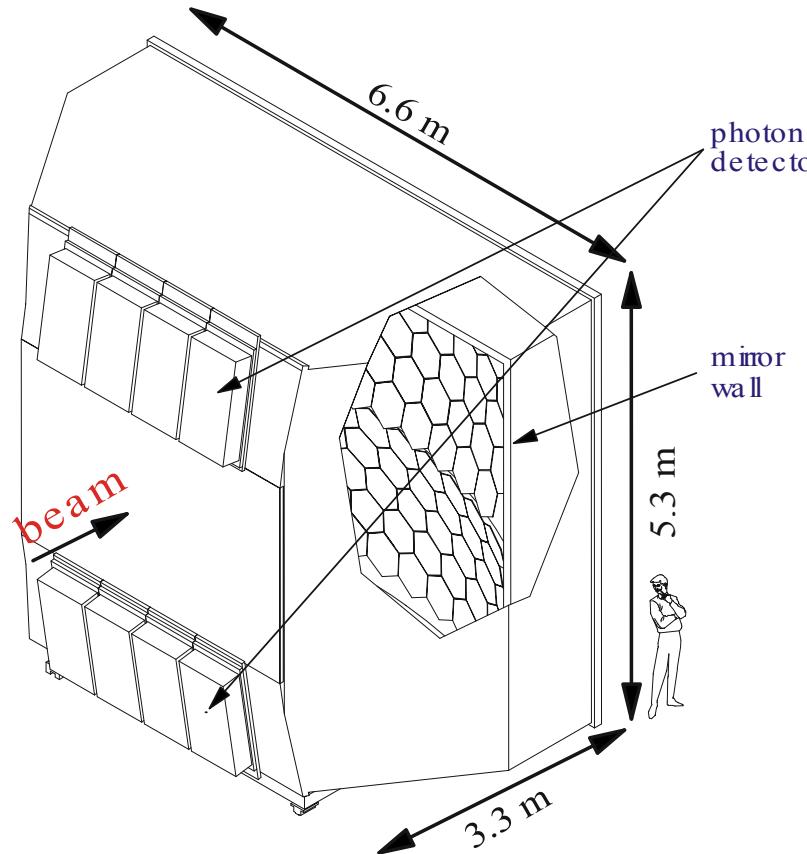
Muon Wall 2





RICH 1

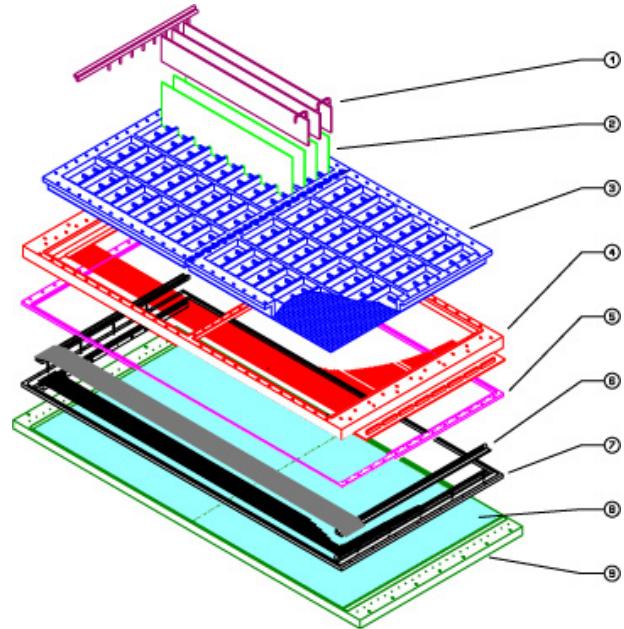
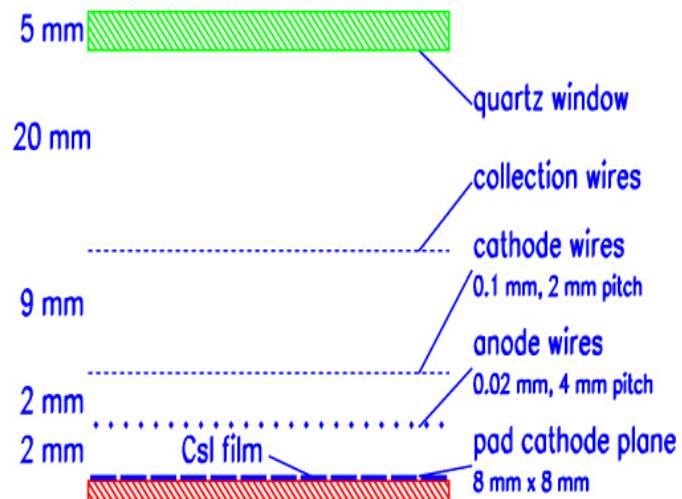
- Radiator: 3 m C_4F_{10}
- Vessel volume: 90 m^3
- 116 mirrors
- Focal length = 3 m
- 5.3 m^2 UV detectors:
 - MWPC with CsI photo-sensitive cathodes
 - 8x8 mm^2 pads
- 84k channels
- 10 bits ADC r/o
- Local thr. comparison and 0 suppression



$6 \text{ eV} < E_\gamma < 7.5 \text{ eV} \Rightarrow \text{high gas purity}$

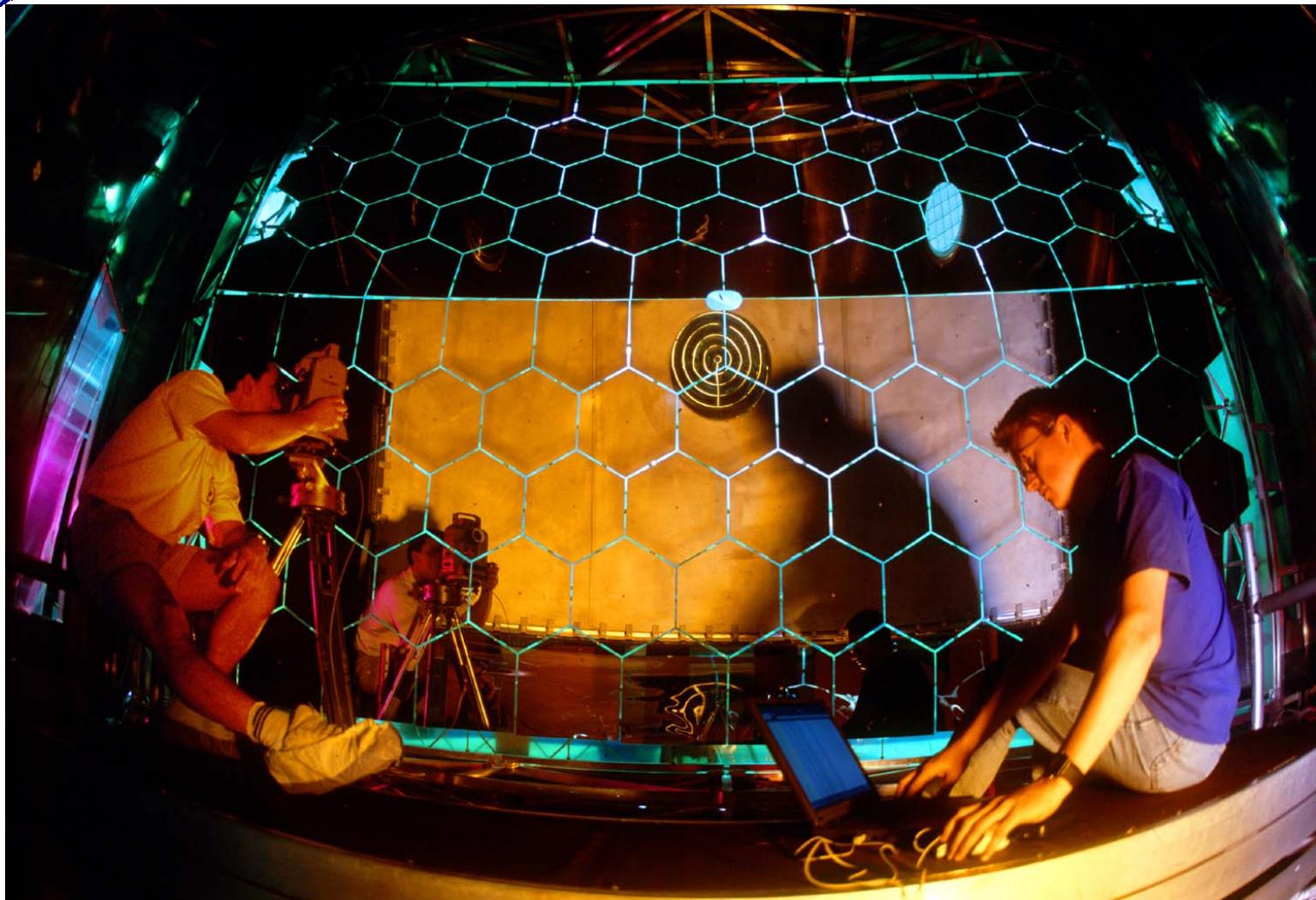


Photon Detectors





RICH Mirrors



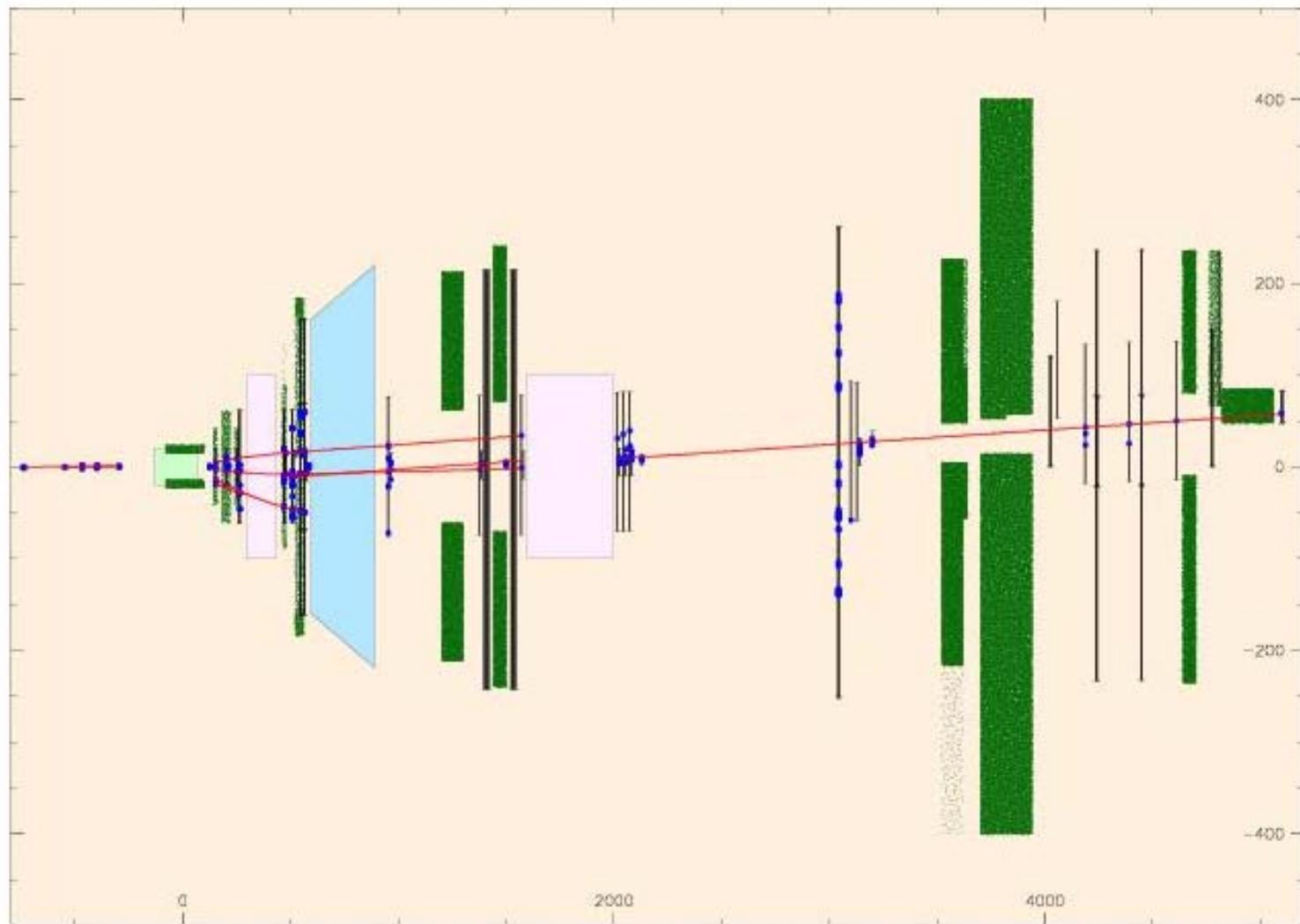


Comparison with Initial lay-out

Detector	In. Lay-out	2001 run	2002 run
Target	${}^6\text{LiD}$	${}^6\text{LiD}$	${}^6\text{LiD}$
Solenoid	COMPASS	SMC	SMC
BMS	4	4	4
Scint. Fibers	18	18	21
Silicon	4	2	4
GEM	20	14	20
Micromegas	12	6	12
Drift Chambers	16	8	24
Straws	15	4	9
MWPC	30	30	34
Large DC	0	0	8
Muon Walls	100%	10%	100%
HCAL	100%	10%	100%
RICH mirrors	118	118	118
RICH PDs	8	8	8
RICH radiator	100%	50%	100%
DAQ	100%	50%	100%



On-line event display





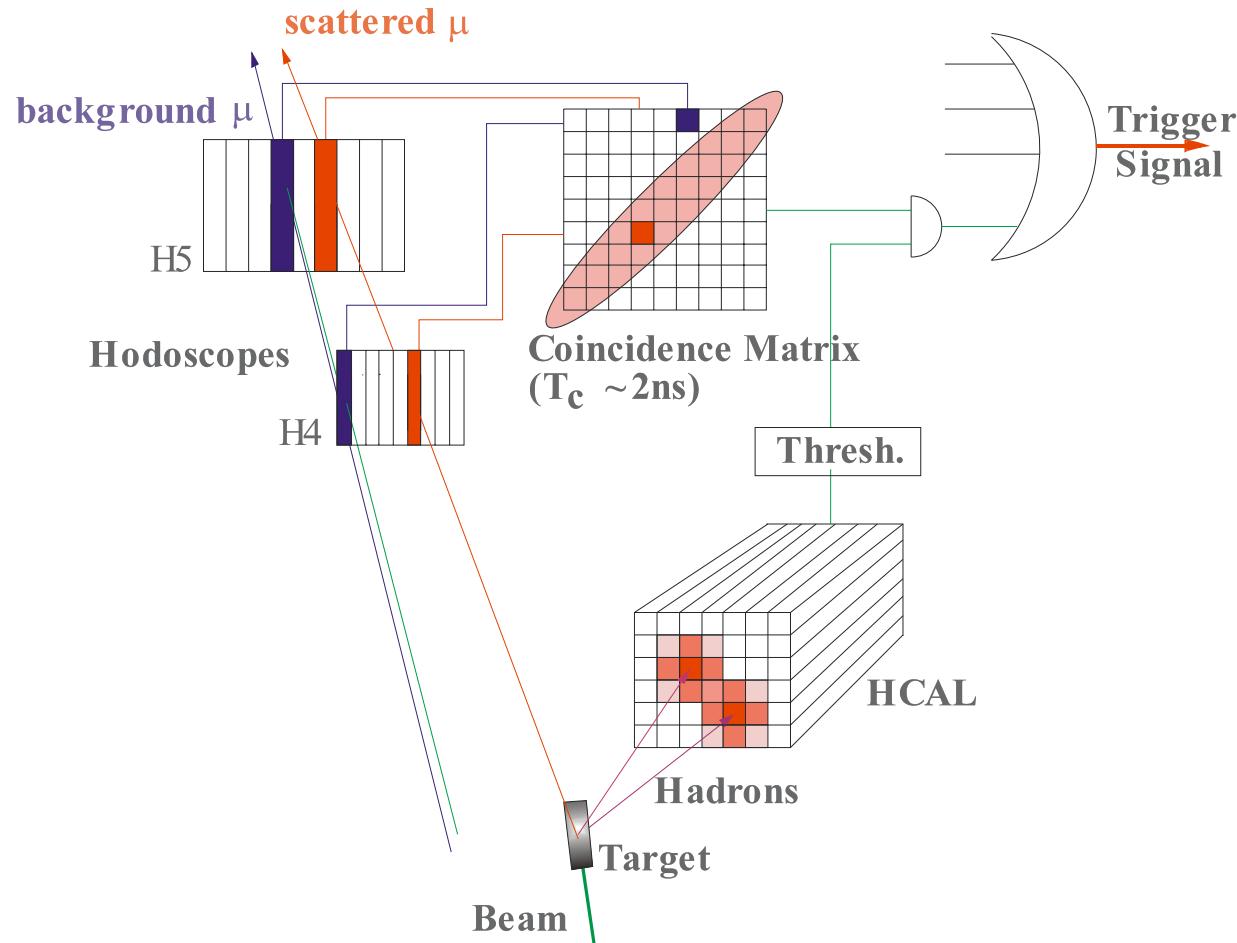
RICH Event Display



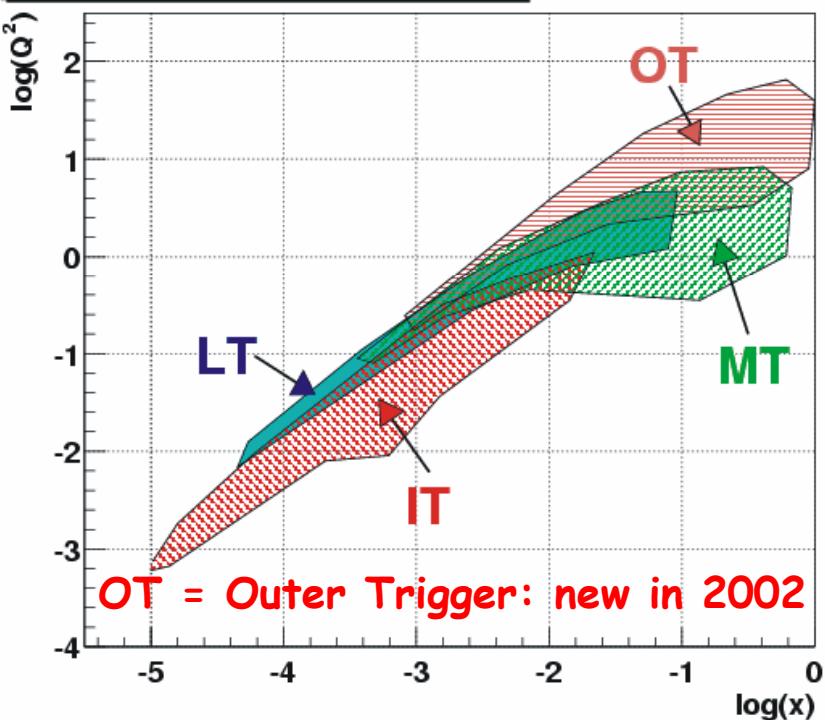


Trigger concept

Trigger: $(H4 * H5) * (HCAL1 \vee HCAL2)$



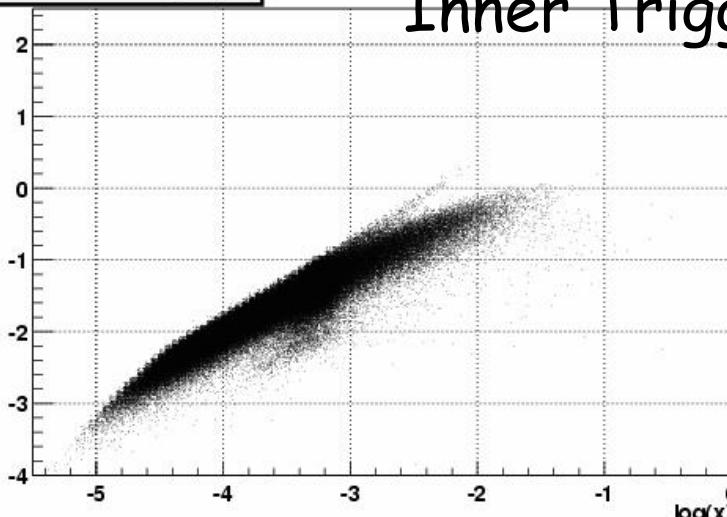
Kinematic ranges for IT, LT, MT, OT



Trigger coverage

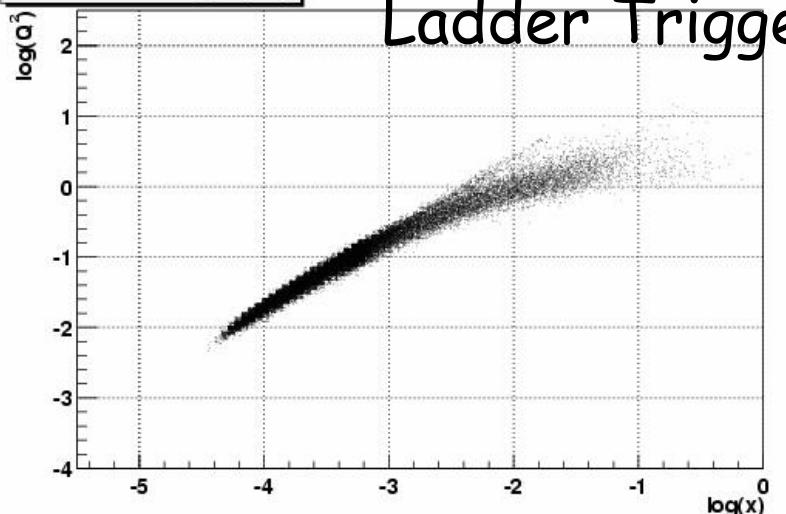
Kinematic range (IT)

Inner Trigger



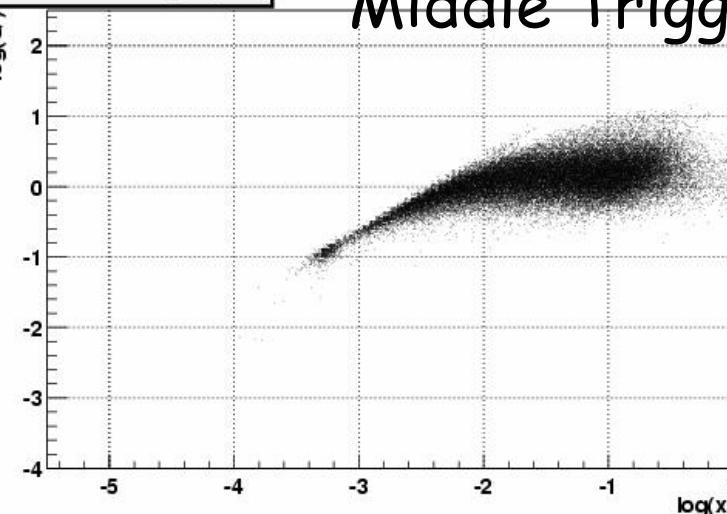
Kinematic range (LT)

Ladder Trigger



Kinematic range (MT)

Middle Trigger





ONLINE and DAQ

Layered architecture

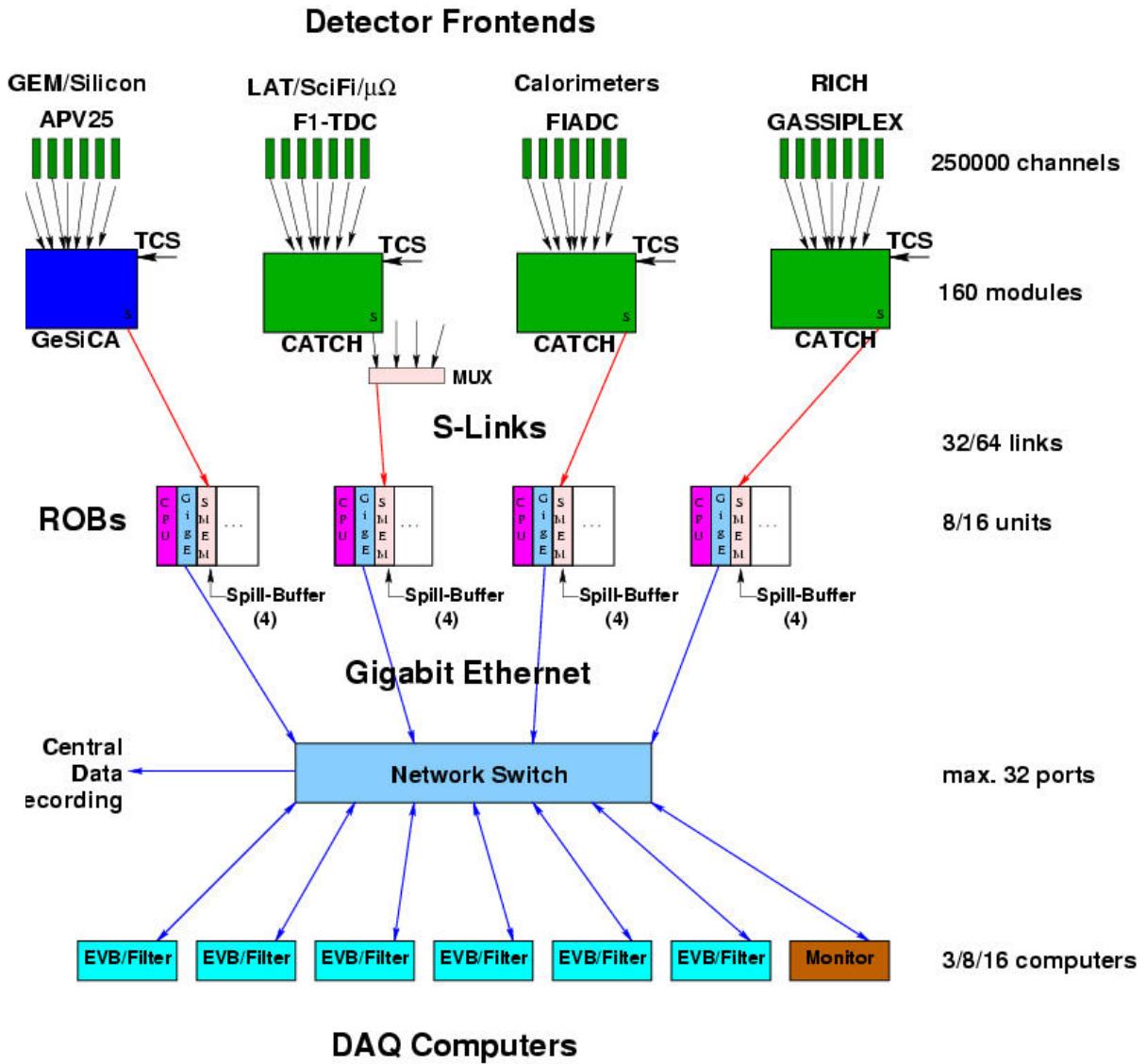
- Front end
- Read-out buffers
- Event building stage
- Recording

Hardware:

- Custom COMPASS solutions
- Mainstream PC and networking

Software

- ALICE DATE
- ROOT (COOOL)

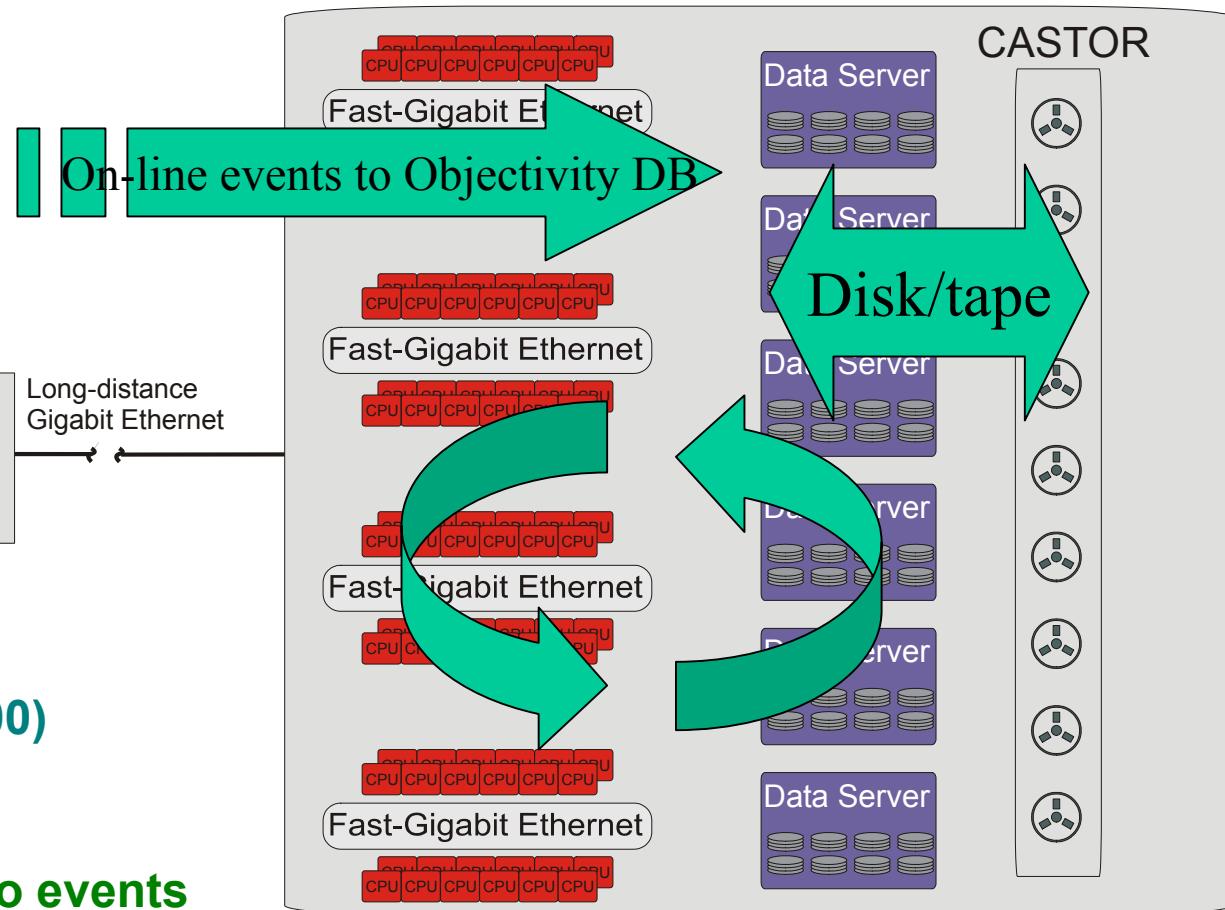
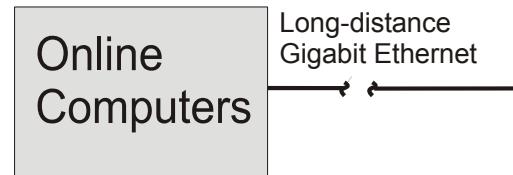




COMPASS Computing Farm

200 CPUs

35 MB/s input rate
300 TB/year



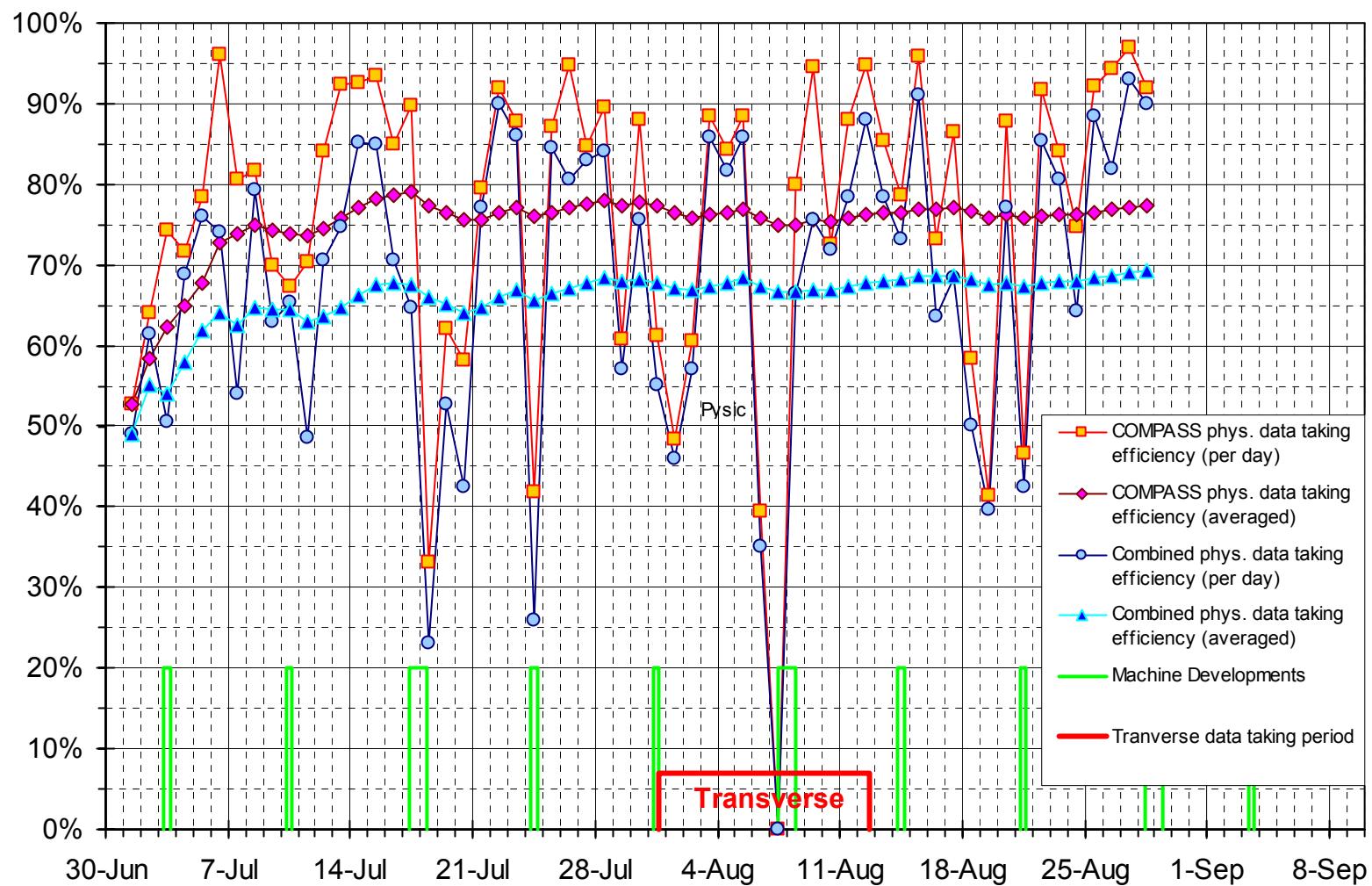
Use of CASTOR (since 2000)

Use of Objectivity/DB

- Farm parallel access to events
- DST production
- RAW-DST connection without data duplication

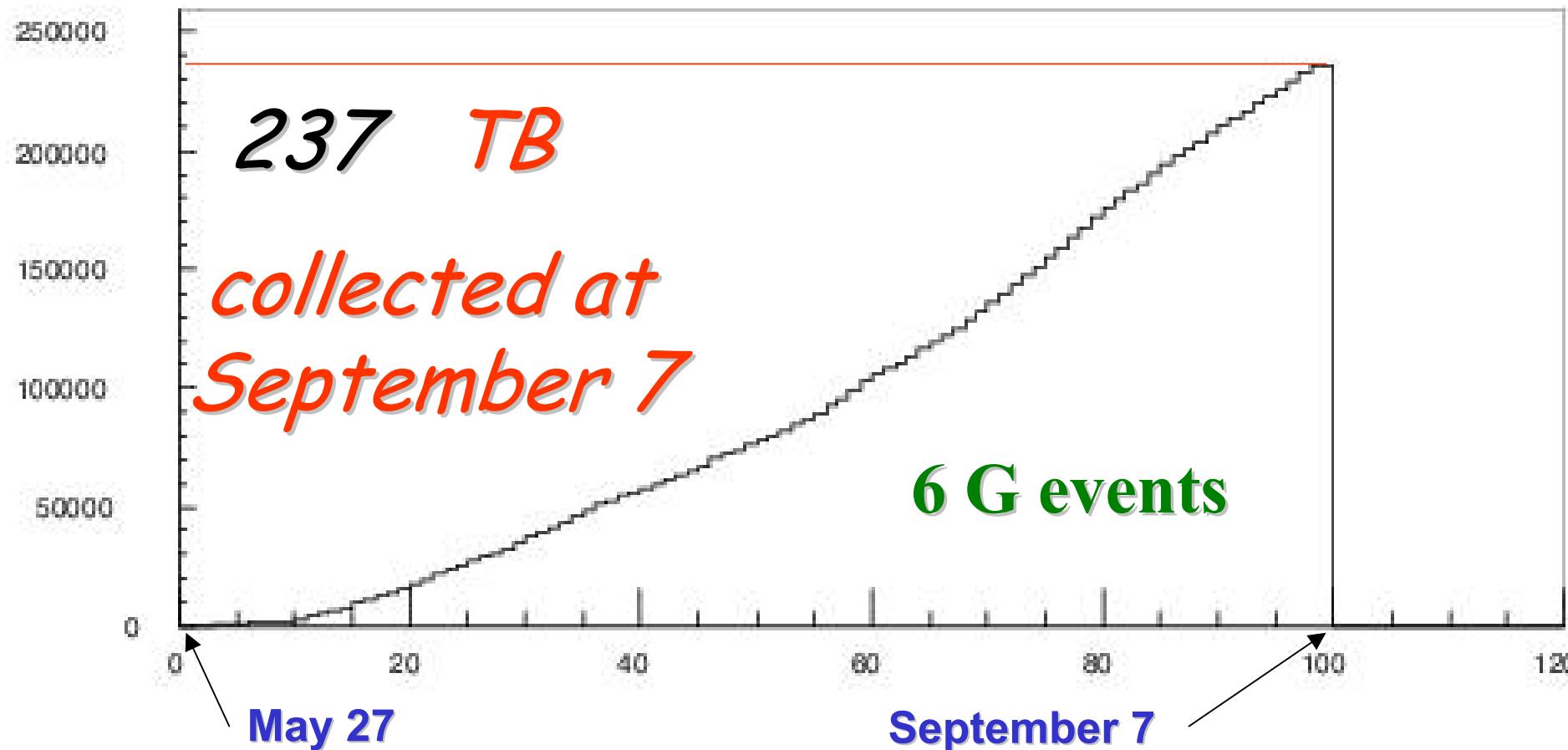


COMPASS physics data taking efficiency



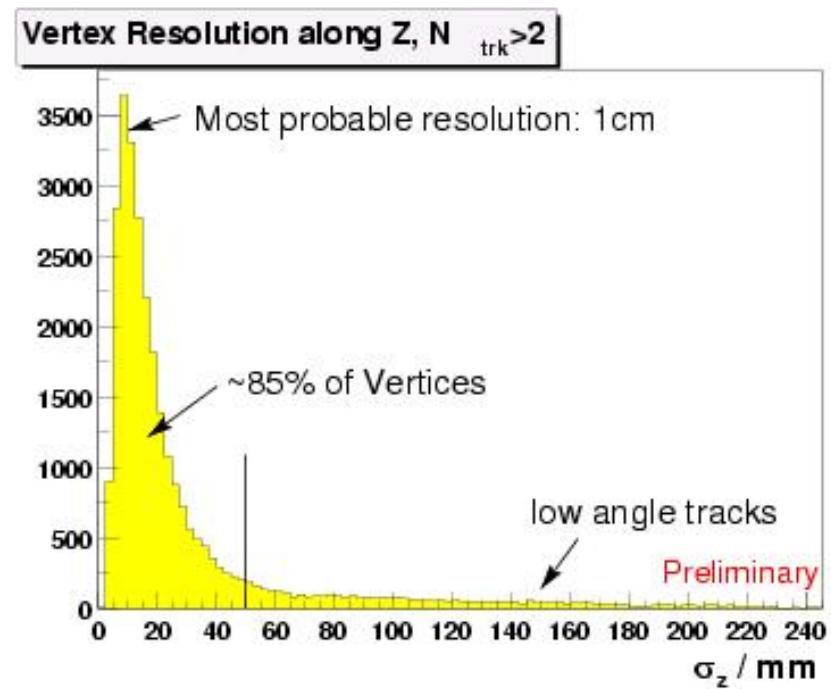
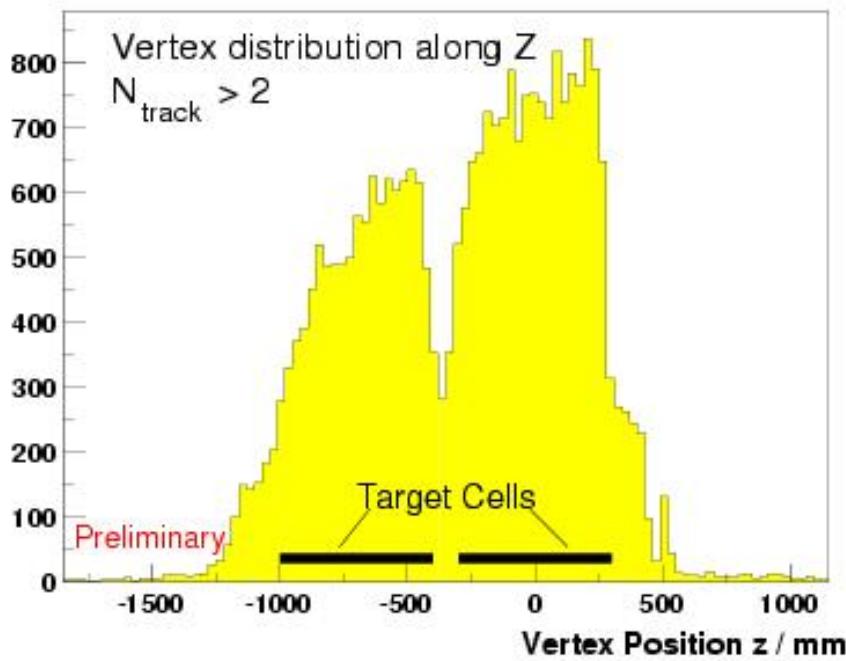


Data on Tape





Primary vertex reconstruction



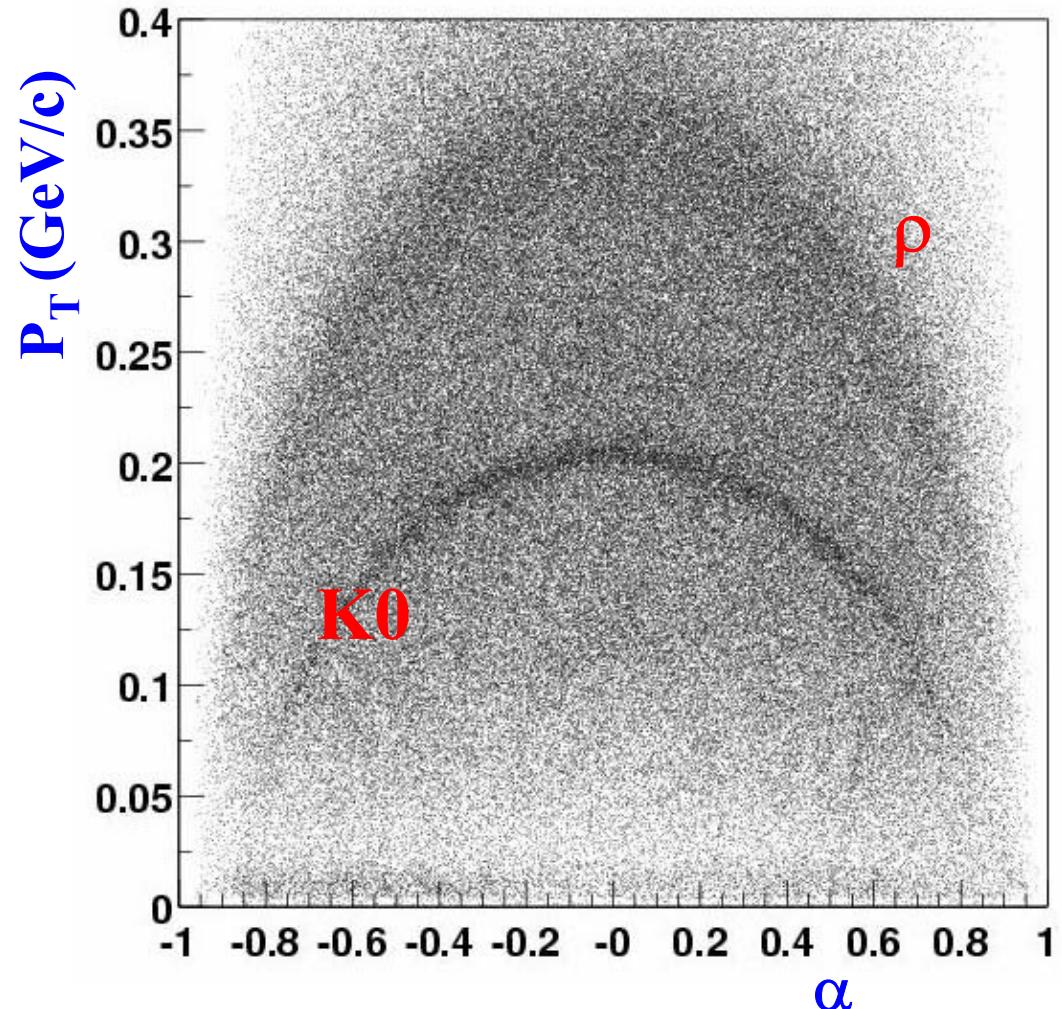


Secondary vertices

From 2001 data:

Armenteros plot
of the VO_s
reconstructed
in the target region

$$\alpha = \frac{p_L^+ - p_L^-}{p_L^+ + p_L^-}$$





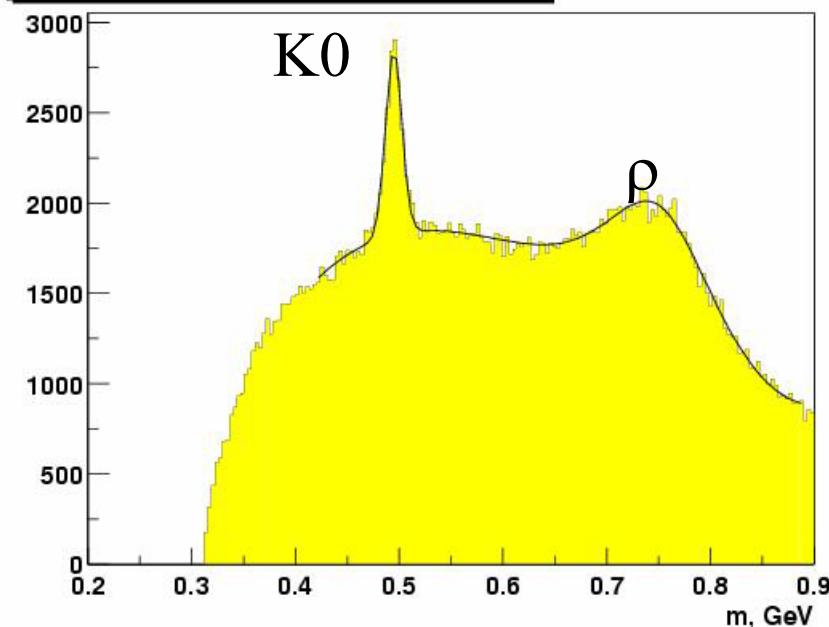
K^0 and ρ

From 2001 data:

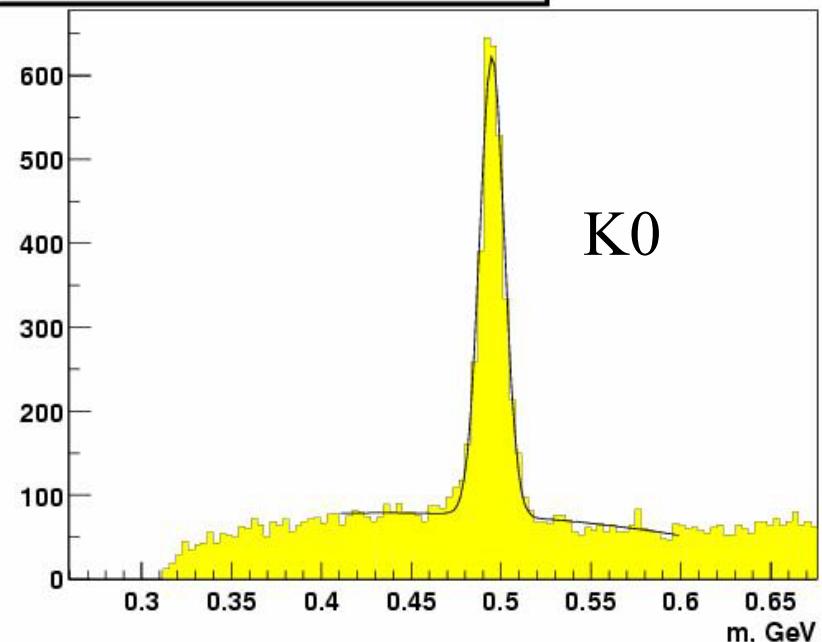
V0 outside the target

V0 from the target region

$\pi^+\pi^-$ invariant mass. $Z > -350\text{mm}$



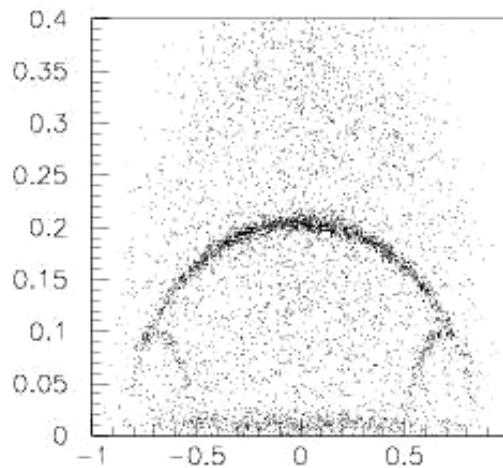
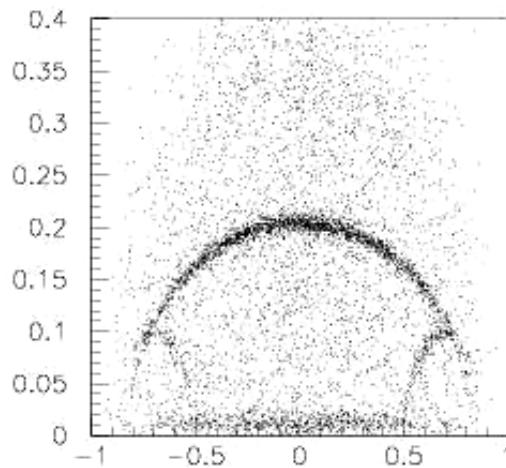
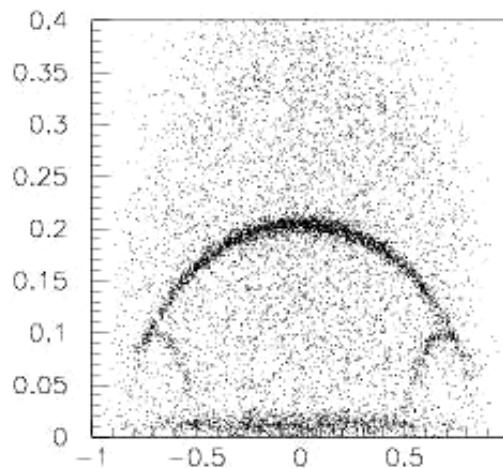
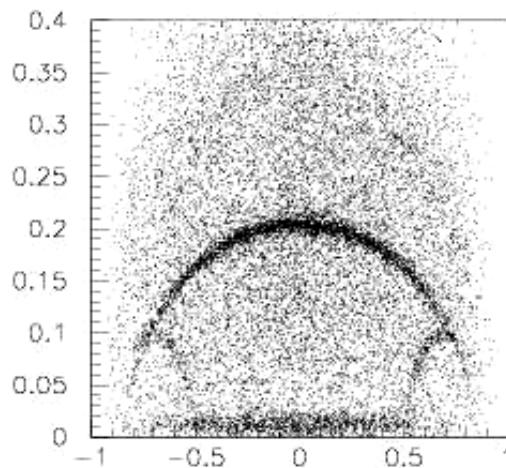
$\pi^+\pi^-$ invariant mass. $Z > 450\text{mm}$



K^0 mass resolution ≈ 6 MeV
(close to the value from the simulations)



Lambda



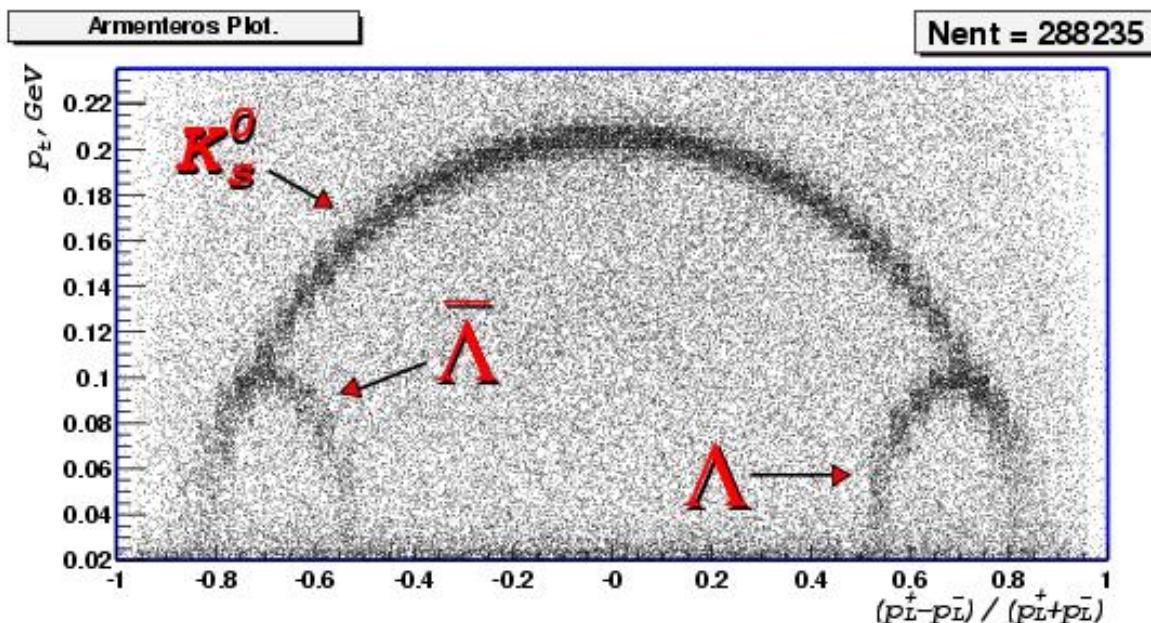
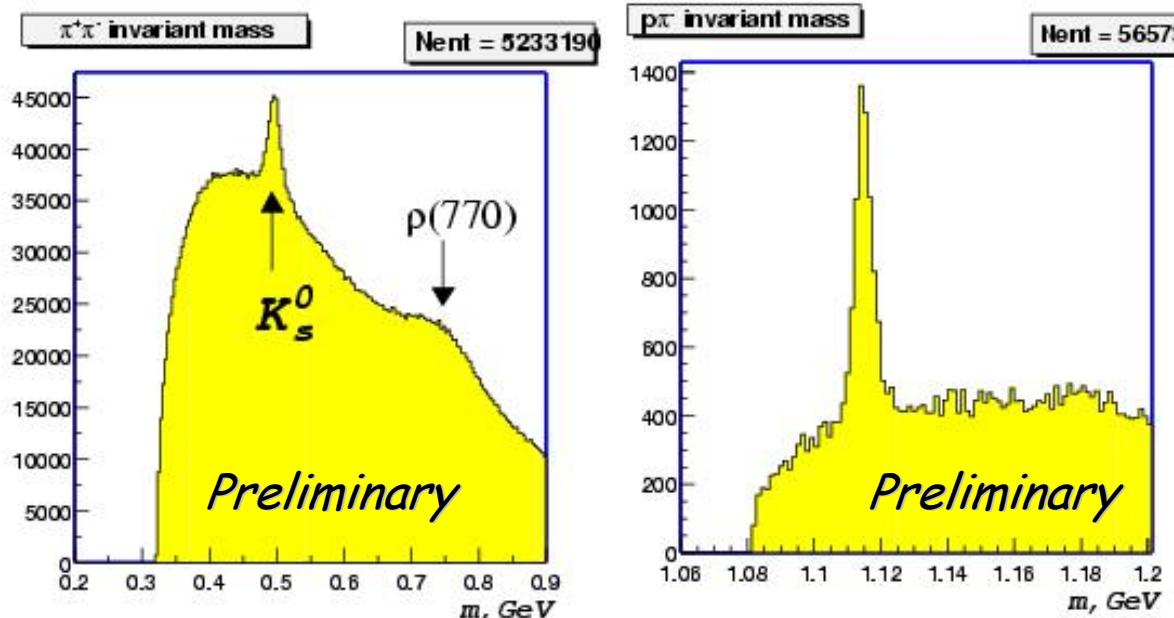
2001 data

Armenteros plots
outside the target
volume

$Z_{v0} > 10$ cm, 20 cm,
 30 cm, and 40 cm
from the target edge



New Results



K^0
and Λ

2002

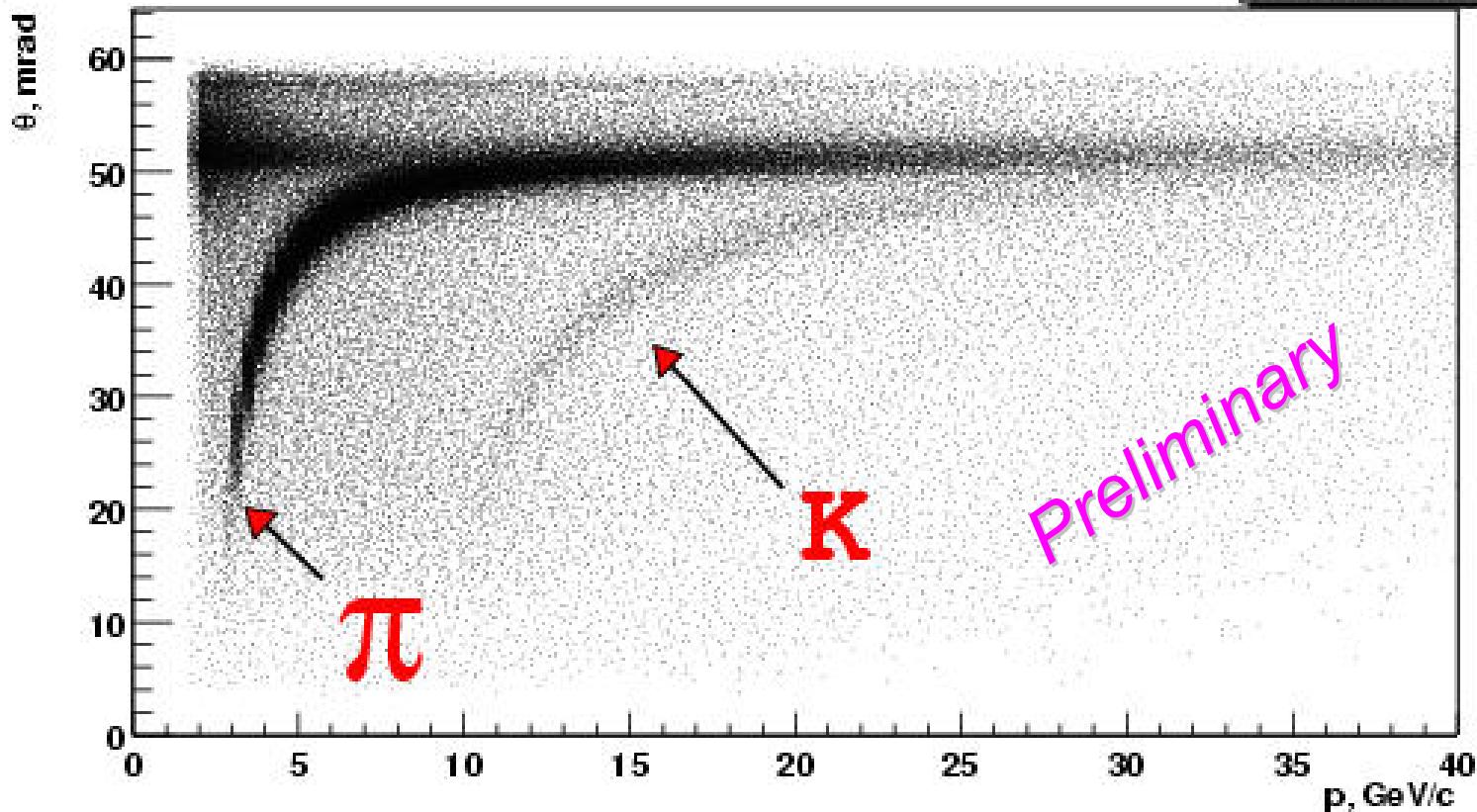
data



RICH 1 performances

Cherenkov θ

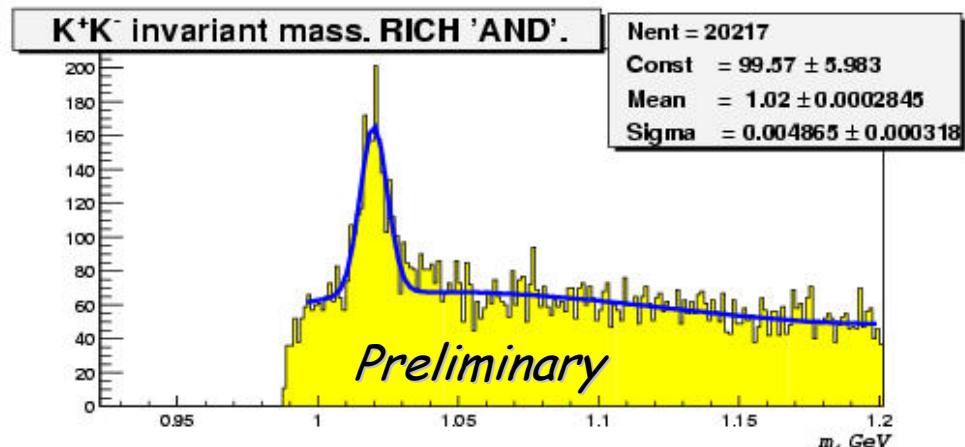
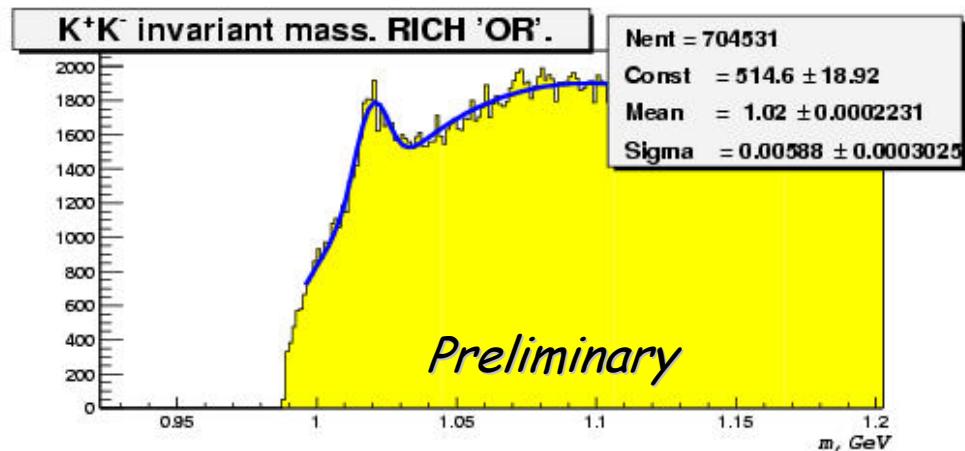
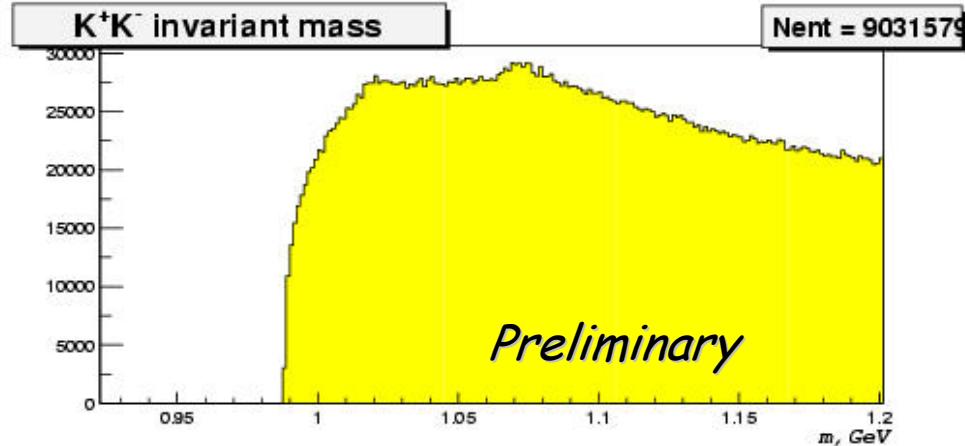
N_{ent} = 4522146





2002 data

*Including
the RICH
in the
analysis*

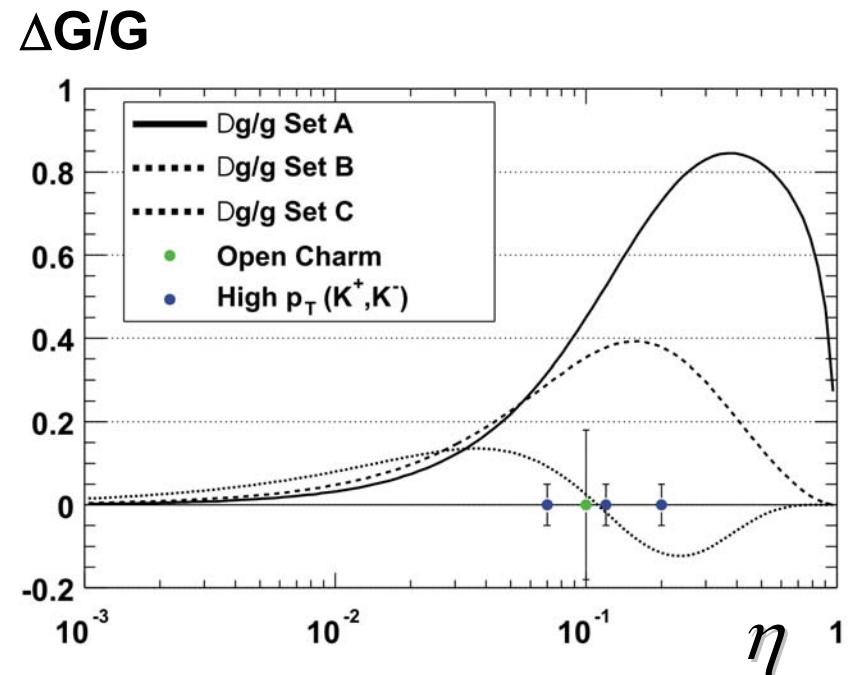




Projected results

Statistical accuracy after 80 days of ${}^6\text{LiD}$ data taking
with 160 GeV muons and SMC magnet

- Open Charm Production
 - low systematic error
 - 16k reconstructed charm events
 $\rightarrow d(DG/G)_{st} \sim 0.18$
 - one data point at $\langle h \rangle \sim 0.1$
- High p_T hadron pairs
 - Compton background
 - low statistical error
 - $\langle h \rangle$ reconstructed: three data points $0.04 < h < 0.2$





CONCLUSIONS

**COMPASS COMMISSIONED AN
OUTSTANDING APPARATUS**

~100 DAYS OF μ RUN IN 2002

DATA LOOK GOOD

PHYSICS SIGNALS ARE COMING OUT OF THE ANALYSIS

**EXCELLENT PERSPECTIVES FOR THE
PRESENT PHYSICS PROGRAM**