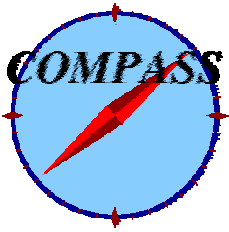




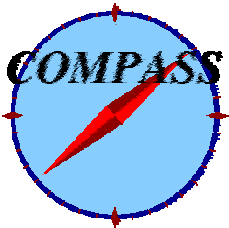
COMPASS

Status and Outlook



Plan of the talk

- Physics motivations
- Experimental apparatus
- Detector performances
 - Highlights (not all detectors!)
- 2001 run
- Conclusions and outlook



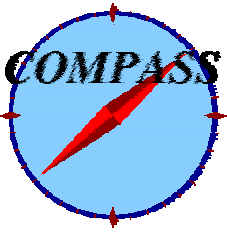
COMPASS programme

Nucleon structure

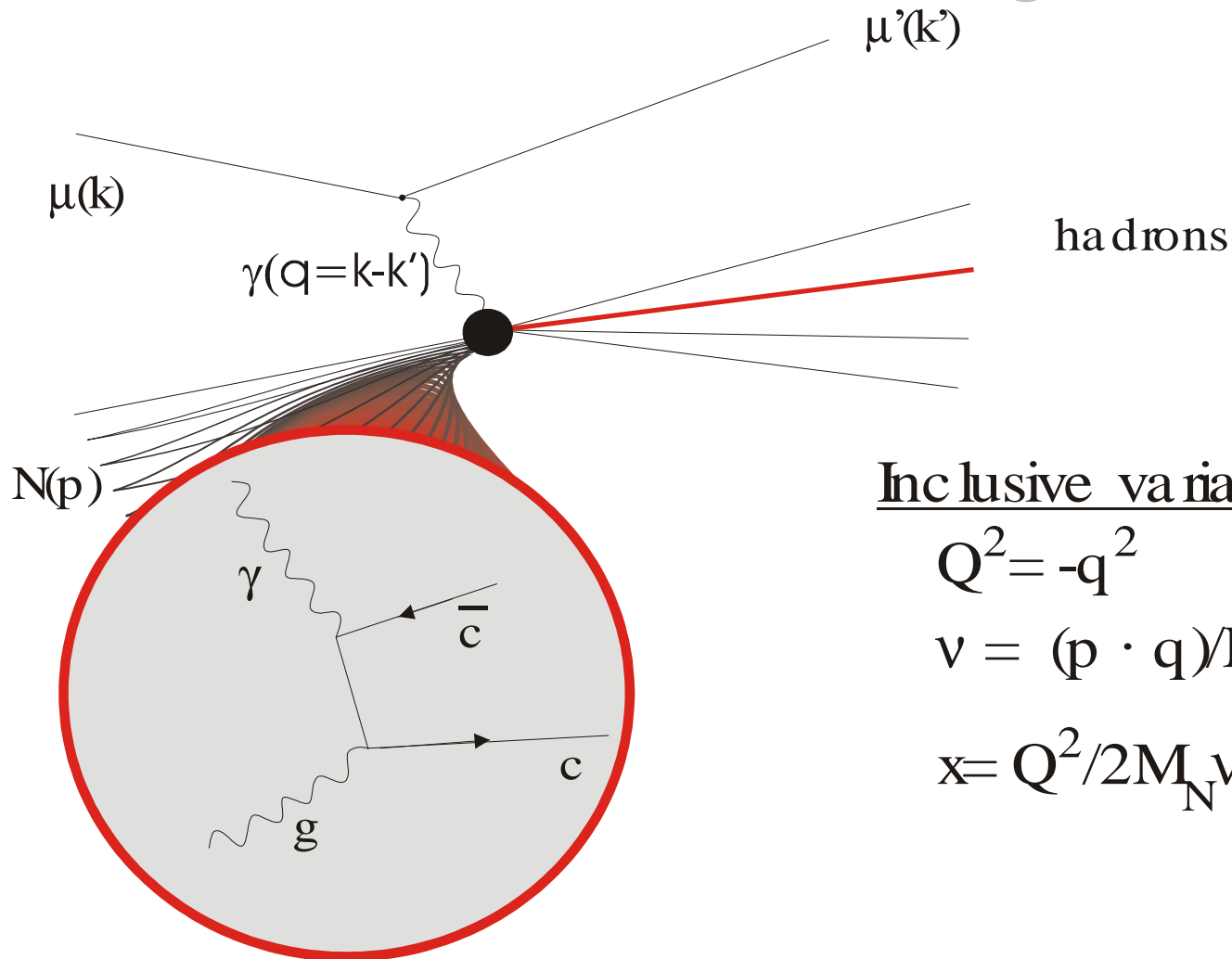
- Gluon polarisation $\Delta G(x)$
- Flavour-dependent helicity functions $\Delta q(x)$
- Transverse-spin distribution functions $\Delta_T q(x)$
- Spin-dependent fragmentation (ΔD_q^Λ)

Spectroscopy

- Primakov reactions
 - Polarizability of π and K
- Glueballs and hybrids
- Charmed mesons and baryons
 - Semileptonic decays
 - HQET
 - Observe double-charmed baryons



Semi Inclusive Deep-Inelastic Scattering

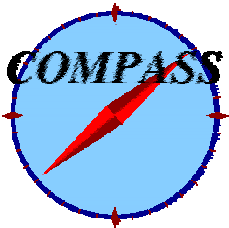


Inclusive variables

$$Q^2 = -q^2$$

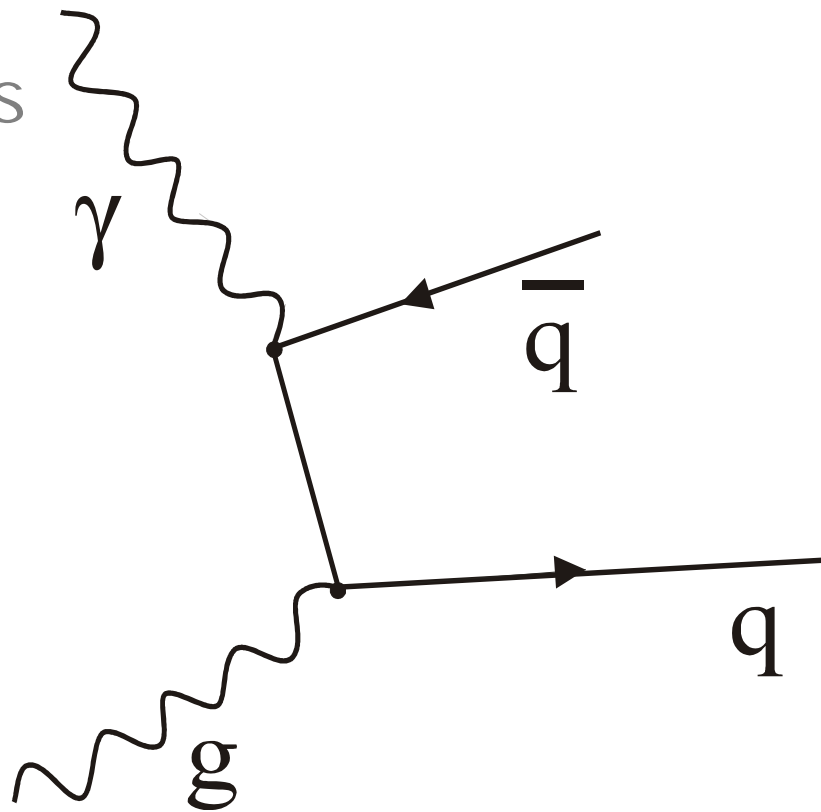
$$v = (\mathbf{p} \cdot \mathbf{q})/M_N$$

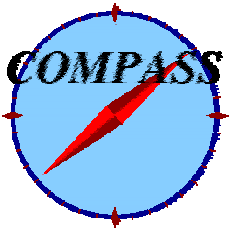
$$x = Q^2/2M_N v$$



ΔG measurements

- Single out γg fusion graphs
 - Heavy quark lines ($c\bar{c}$)
 - High transverse momentum
- Experimentally:
 - DIS + D^0 (e.g. via $\rightarrow\pi^+K^-$)
 - DIS + D^{+*} ($\rightarrow\pi^+D^0$)
 - DIS with high Pt hadrons
- Asymmetries measure ΔG
 - $A \rightarrow D A_{\gamma N} \sim D A_{\gamma g} \Delta G/G$





COMPASS experiment

Complex apparatus to allow a wide range of measurements

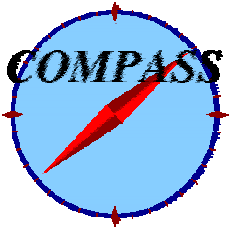
μ beams and polarised nucleon targets

hadron beams (up to 300 GeV energy)

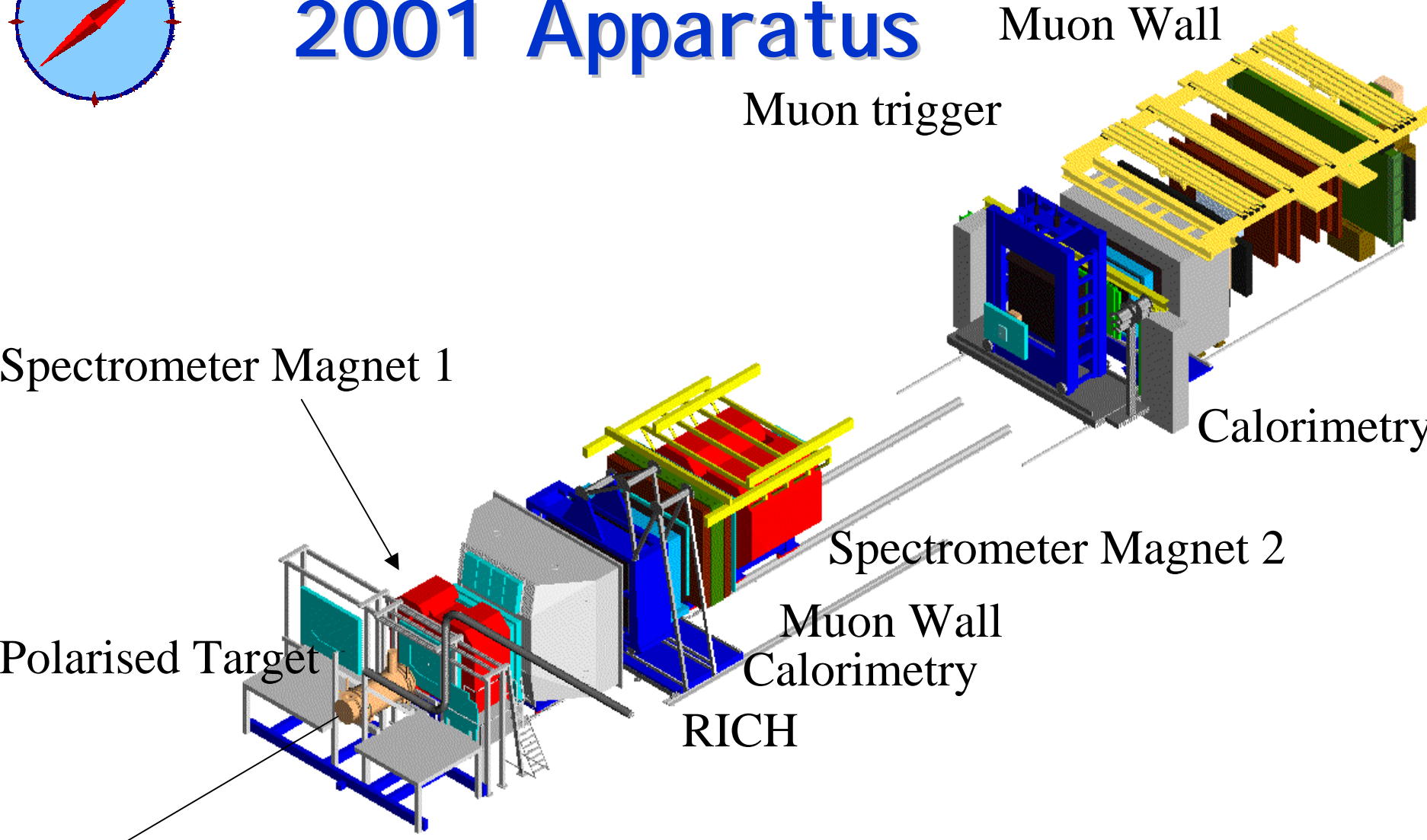
Large dynamical range (angles and momenta)

Particle identification

High-rate capabilities



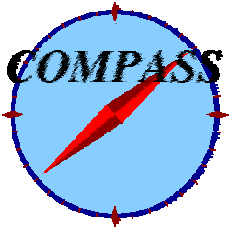
2001 Apparatus



SPS 160 GeV μ beam

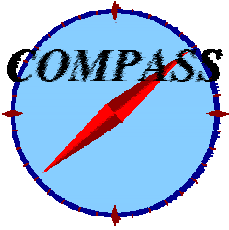
26 February 2002

Massimo Lamanna CERN-I NFN Trieste

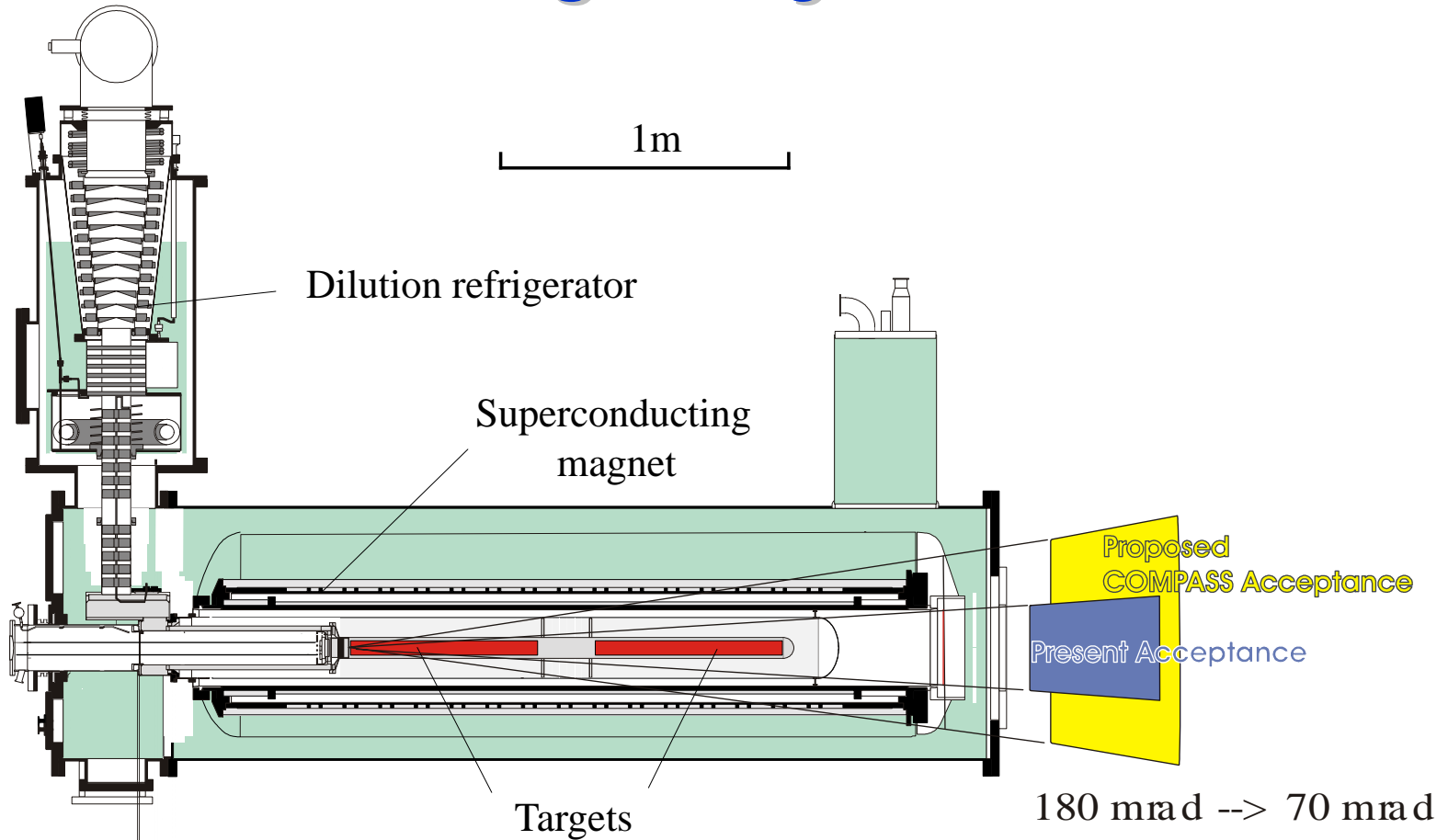


Detectors 2001 DAQ

- All types of detectors on the floor
- Many systems fully commissioned
- Many novel detectors operated in nominal conditions ($2 \cdot 10^8 \mu/s$)
- Tracking: half of the channels
- RI CH fully equipped
- The target is hosted in the SMC magnet



Target system



${}^6\text{LiD}$ Target

Two-cell target solid target (2X60 cm) with opposite polarisation

2.5 T solenoid field

${}^3\text{He}$ - ${}^4\text{He}$ dilution refrigerator (T~50mK)

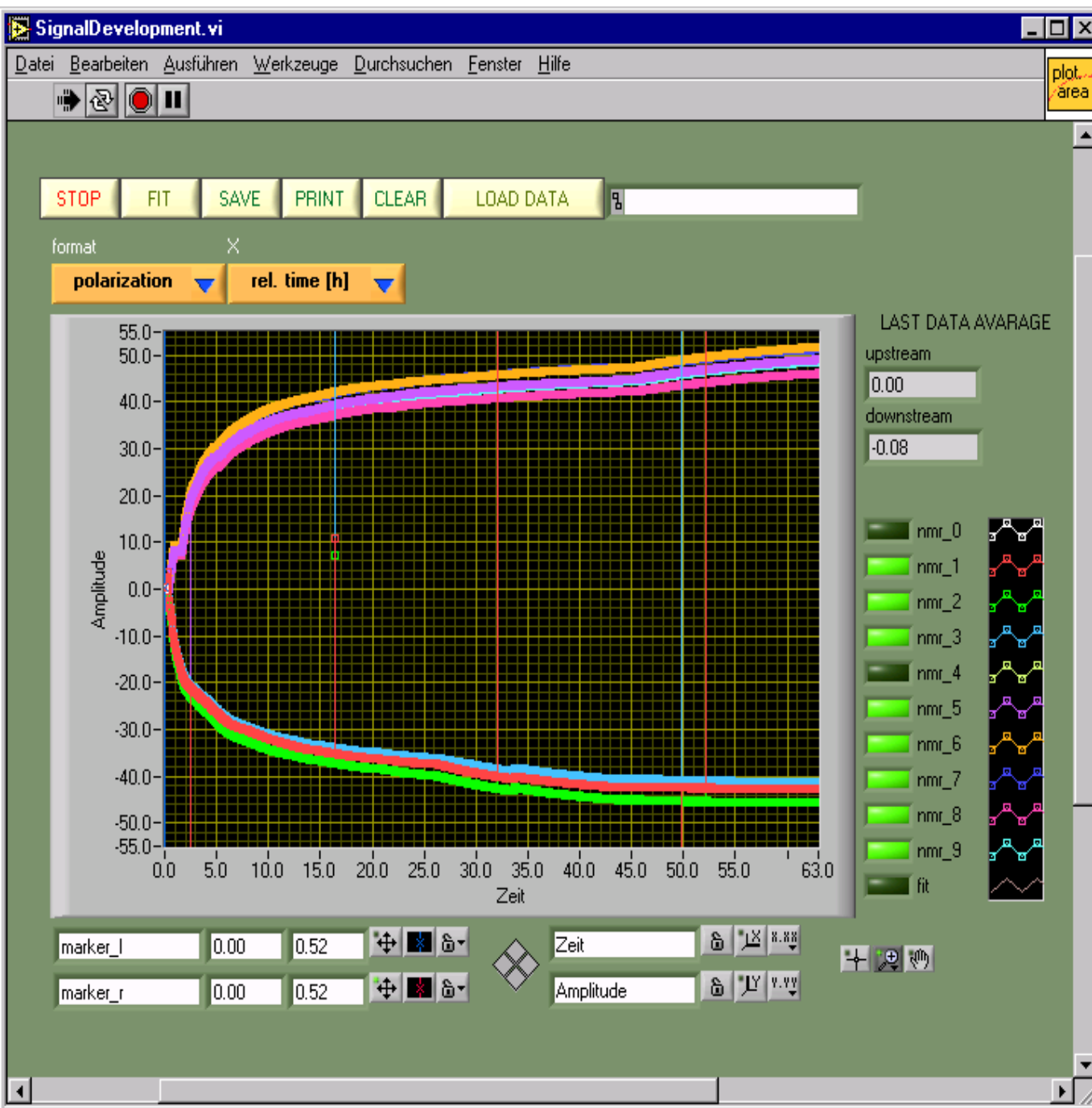
Dynamic Nuclear Polarization

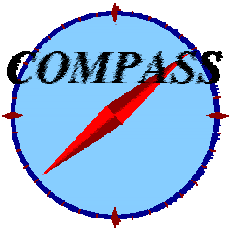
Dilution factor ~50%

Preliminary P values

Pups = -43% (max -48%)

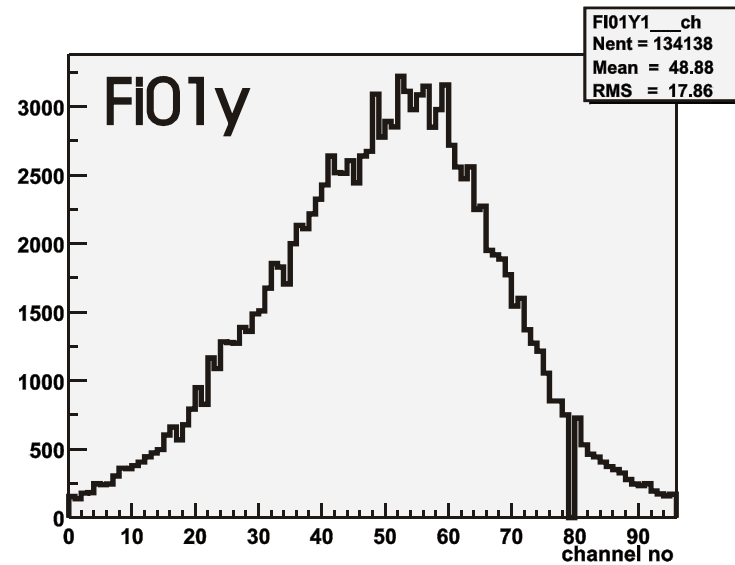
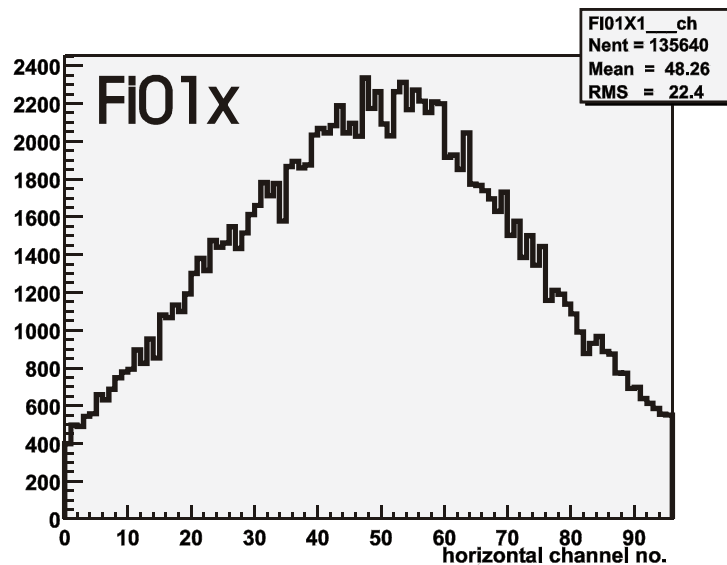
Pdws = +48% (max 55%)

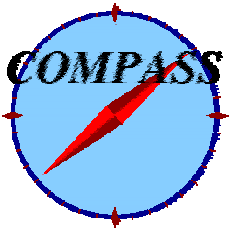




SciFi

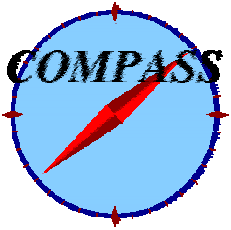
- Full set installed (beam area, small-angle scattered muon: 5x5 cm² cross section, fibre diameter 0.5-0.7 mm)
- 8 stations (total of 18 coordinates)



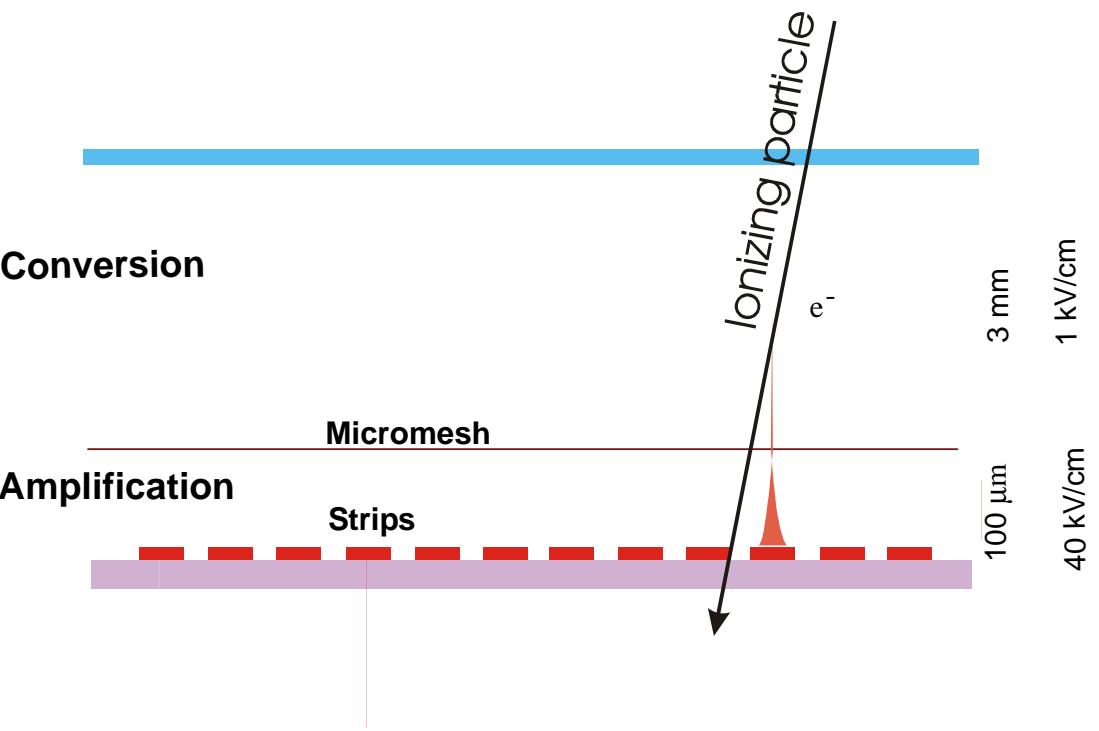


MicroMegas

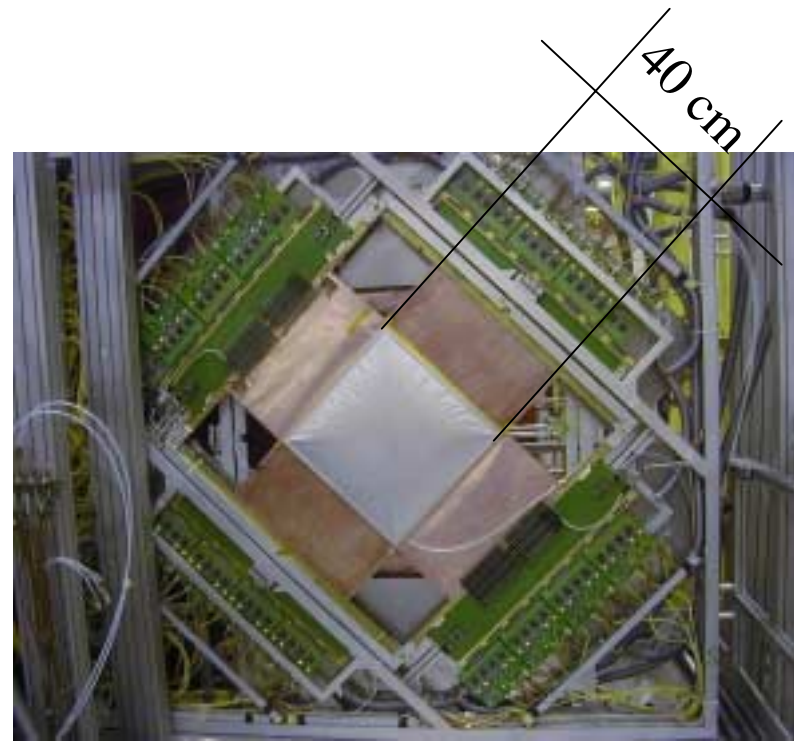
- Tracking in the first spectrometer
 - High rate gaseous detector
 - High precision ($< \sim 70 \mu\text{m}$)
 - High fluxes (before first dipole)
 - Very good efficiency

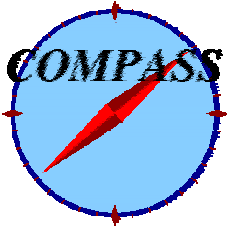


MicroMegas



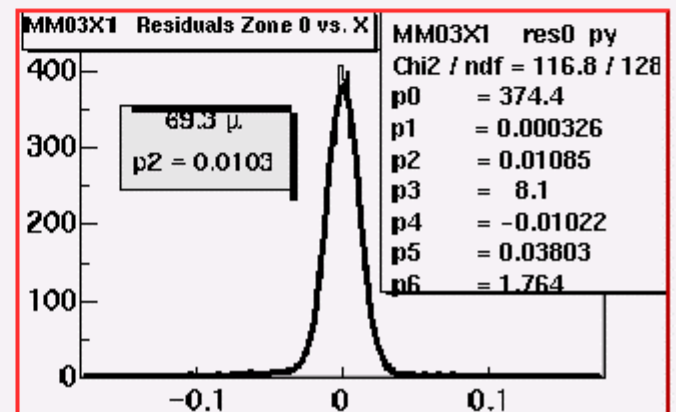
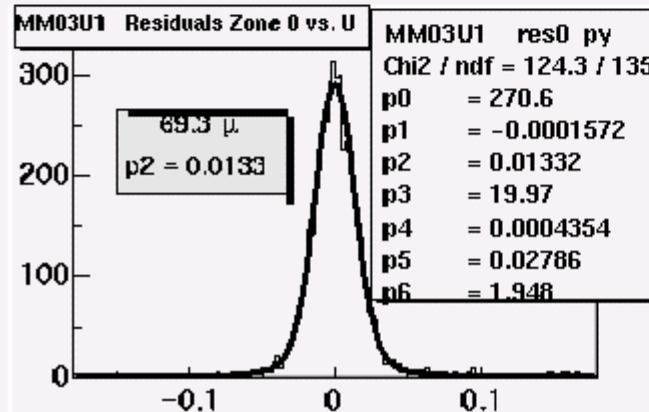
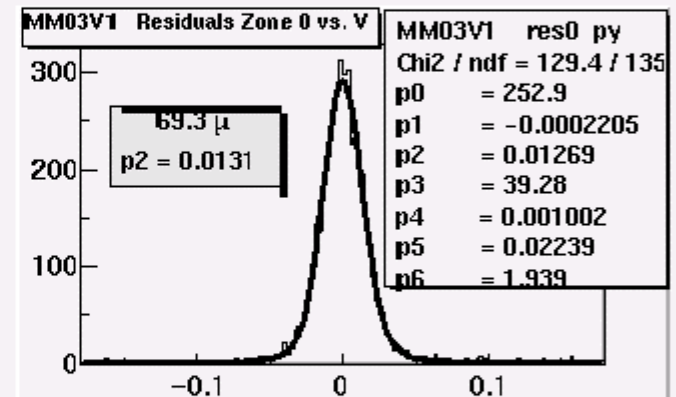
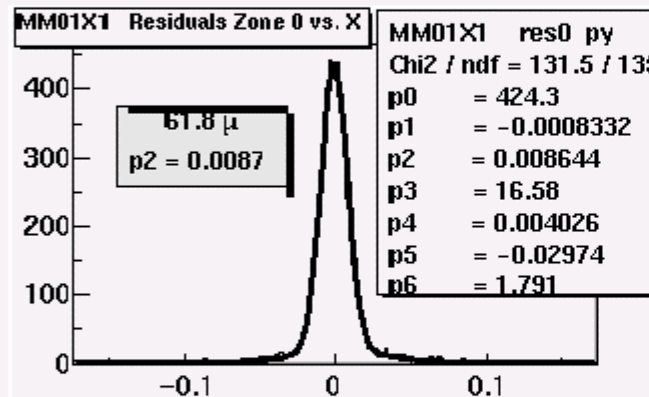
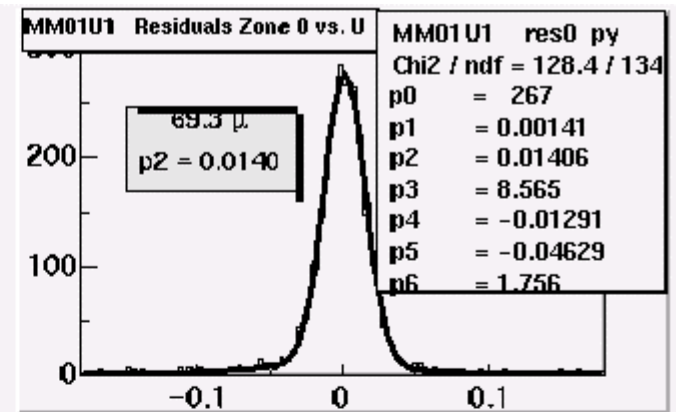
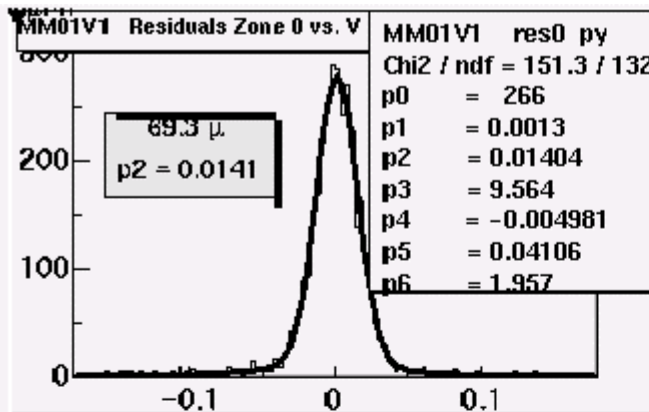
Novel gaseous detector

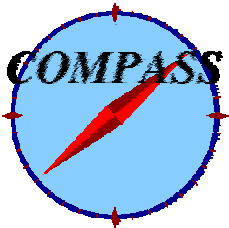




Micromegas resolution

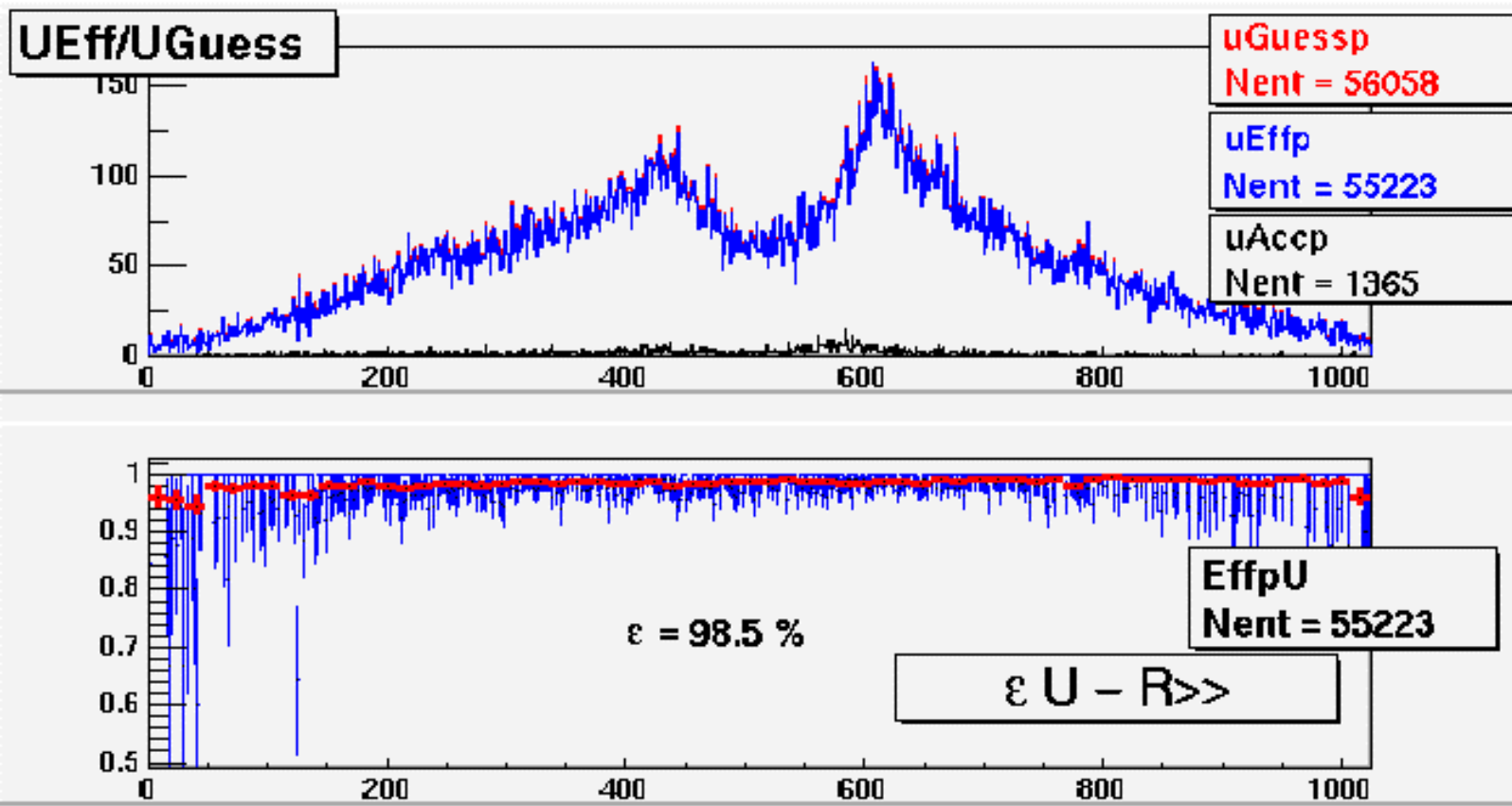
preliminary

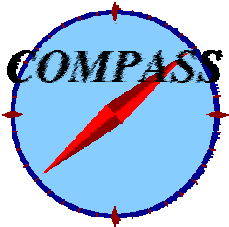




MicroMegas efficiency

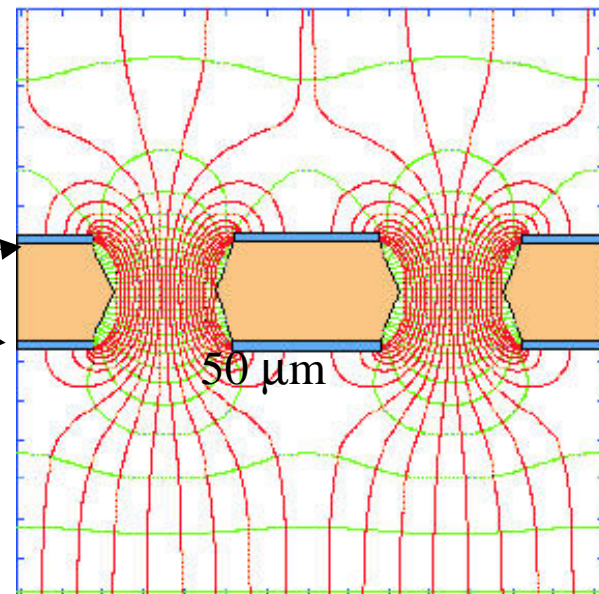
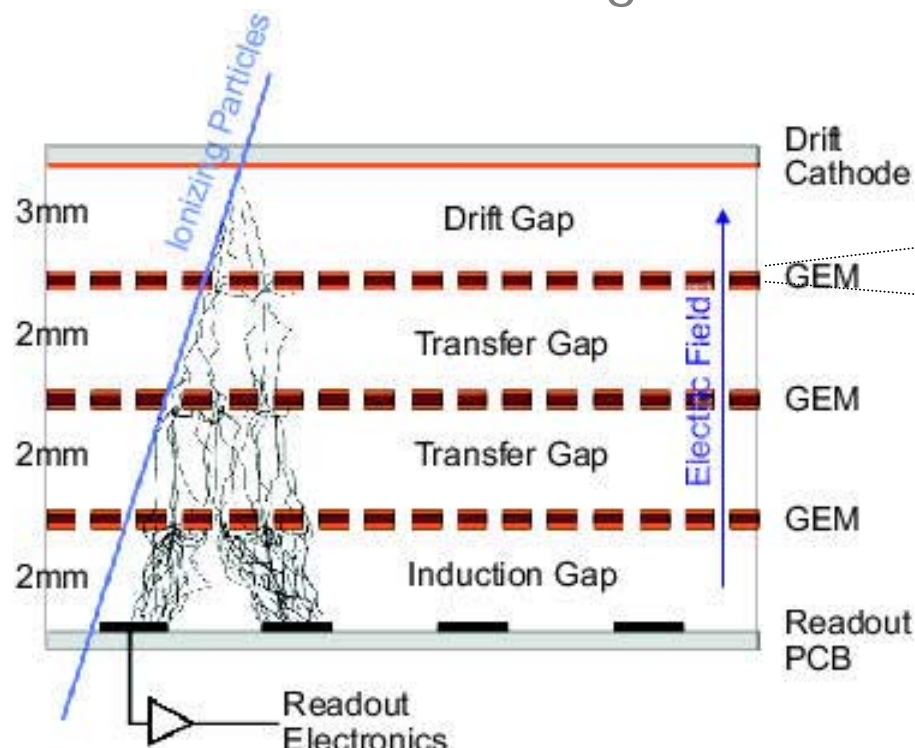
preliminary

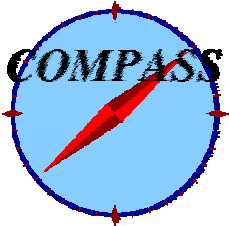




GEMs

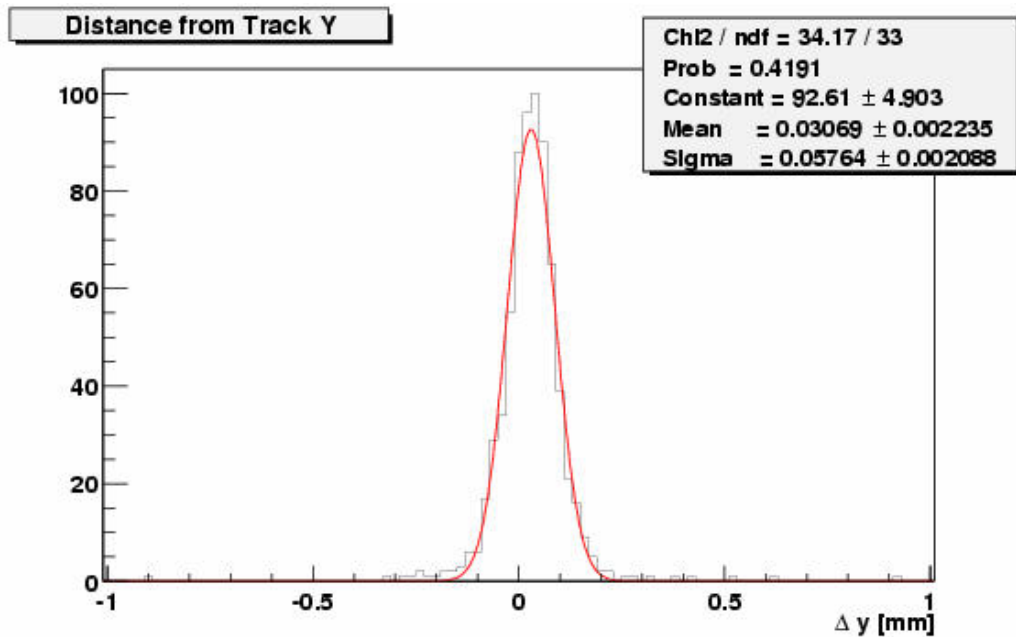
- High rate gaseous detector
- High precision ($< \sim 70 \mu\text{m}$)
- Small area tracking in SM1 and SM2



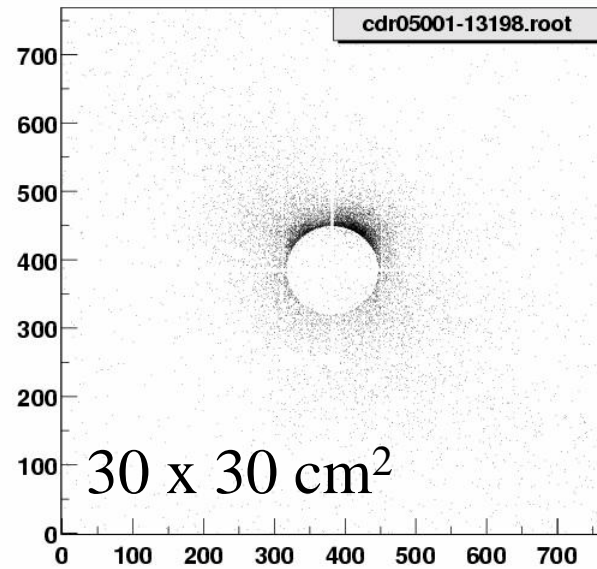


GEMs

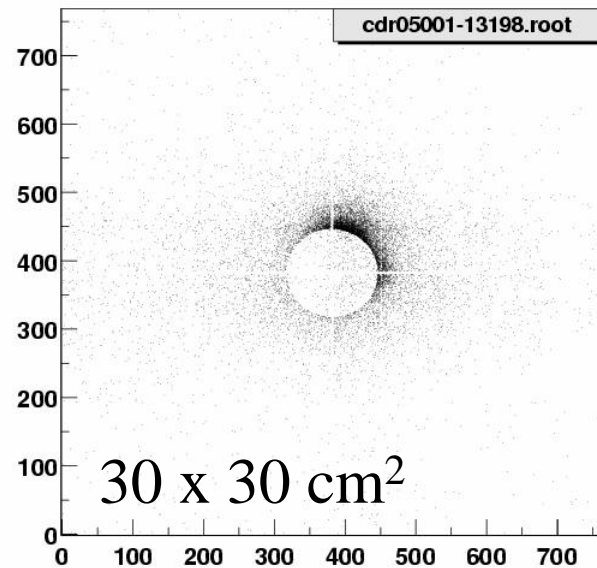
- Measured resolution $\sim 60 \mu\text{m}$



GM01UV Hit map



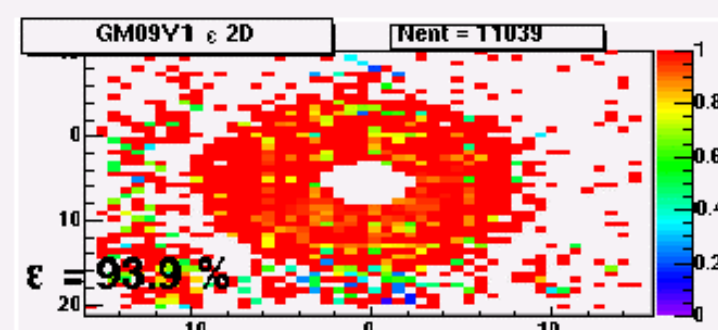
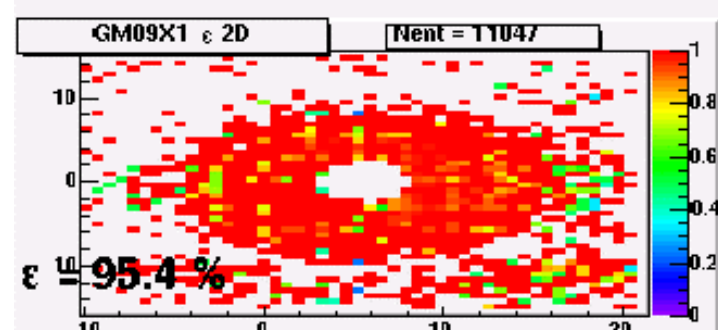
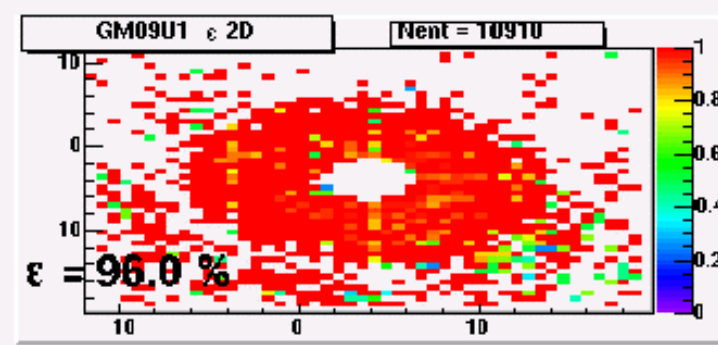
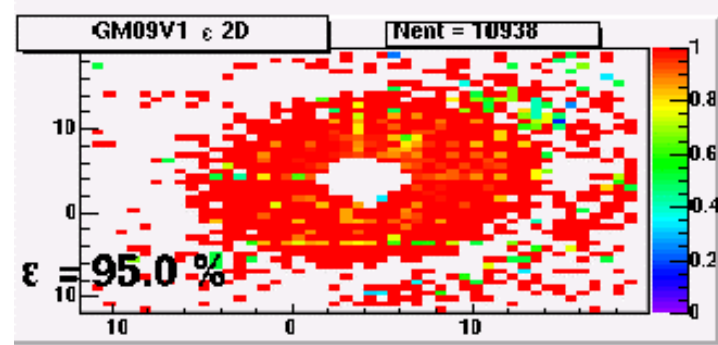
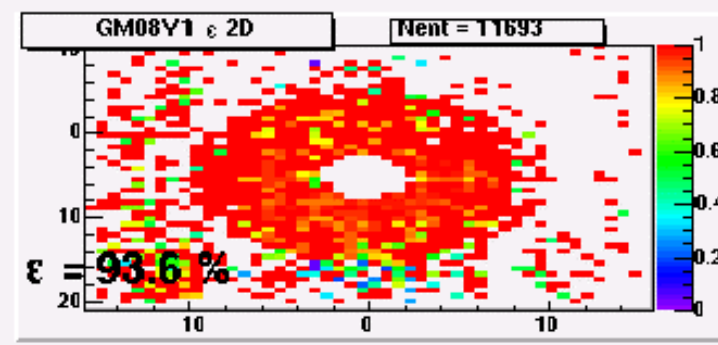
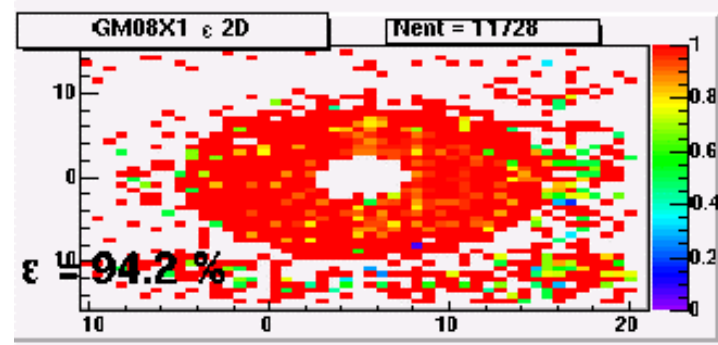
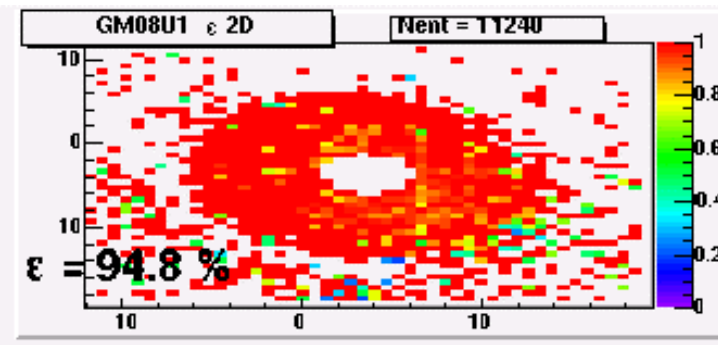
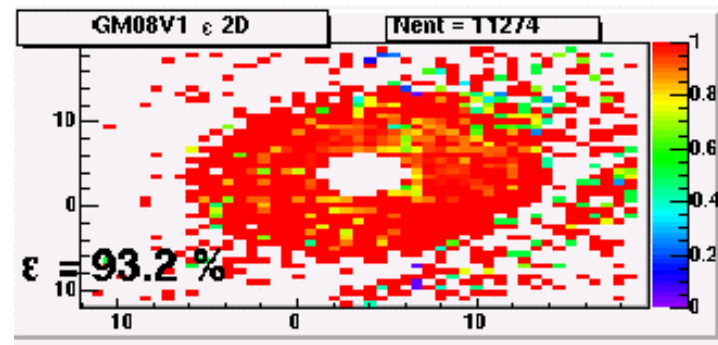
GM01XY Hit map

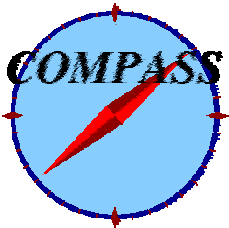




GEMs efficiency maps

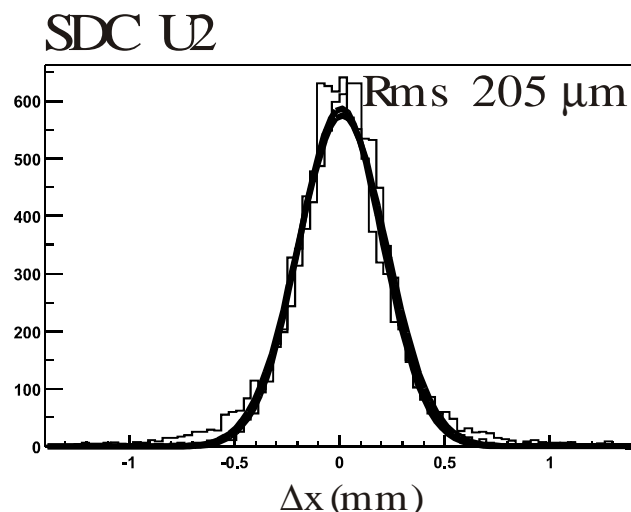
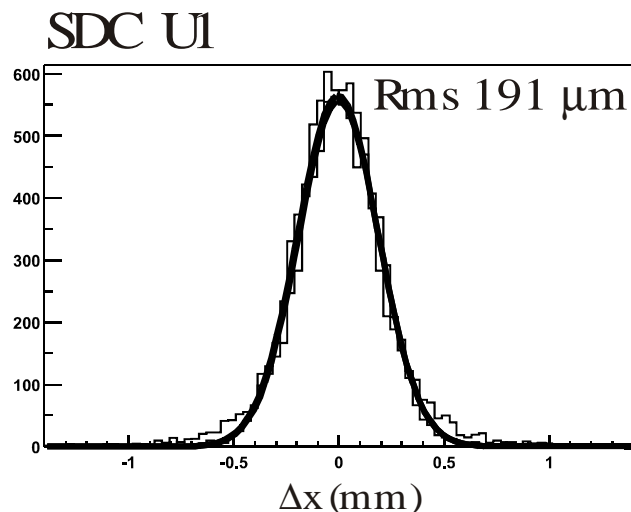
preliminary

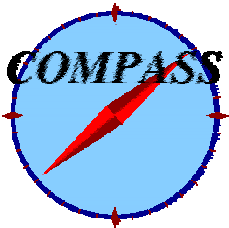




Drift Chambers (SDC)

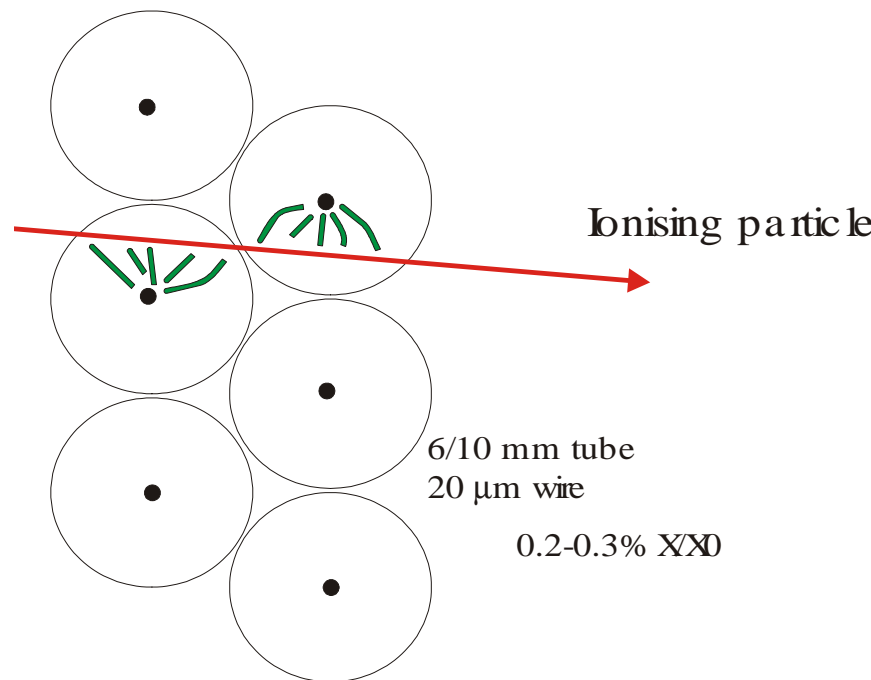
- Large area of SM1 tracking
- 1 chamber (3 in 2002)
- Each chamber provides 8 coordinates with resolution $\sim 175 \mu\text{m}$

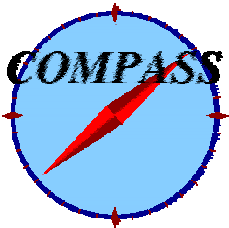




STRAWs

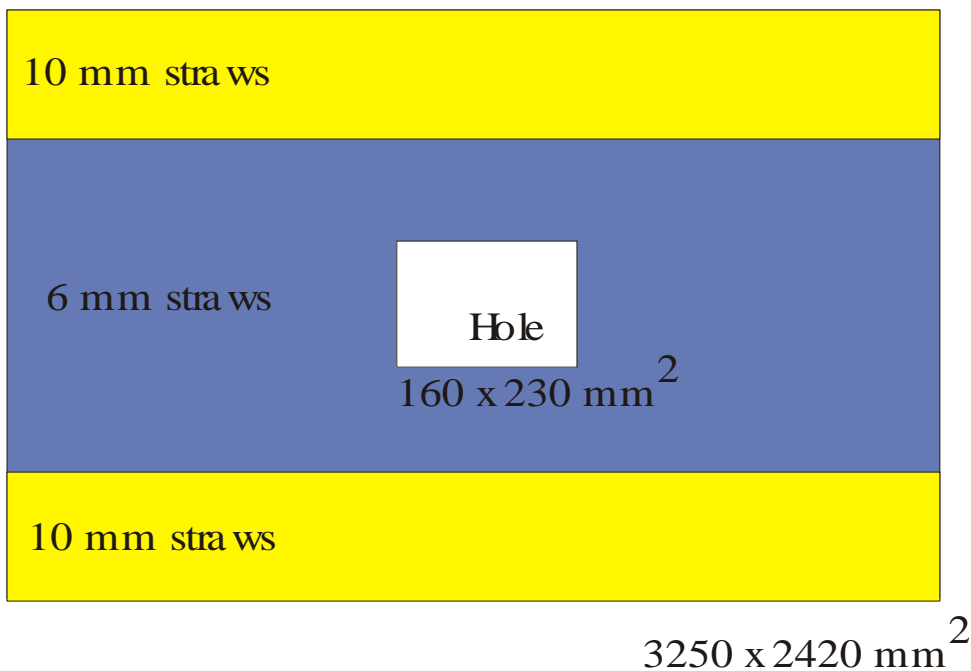
- Drift tubes (STRAW tubes) arranged in “double layers” to provide high resolution (150-200 μm) after SM1
- Very large area ($\sim 8 \text{ m}^2$)
- Low material budget
- First modules could be installed and operated (4 “double layers”). Basic principle demonstrated: 10 double layers are expected in 2002





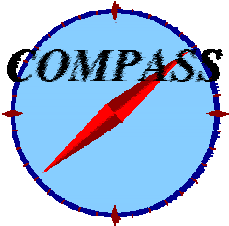
STRAWs

Typical dimensions



Installation of a double layer

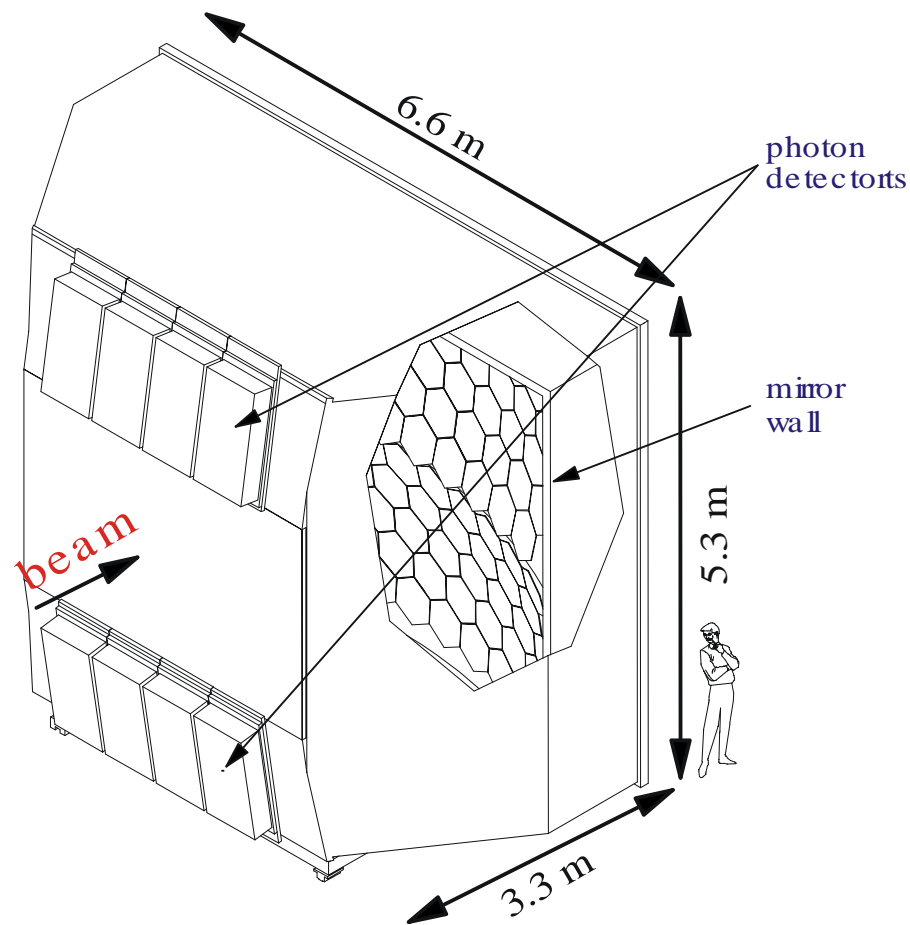




RICH

Ring Imaging Cherenkov

- 90 m³ (3 m C₄F₁₀)
- 120 mirrors (3.3 m focal length)
- Over 20 m² UV detectors
 - MWPC CsI photon-sensitive cathods
 - 8x8 mm² pads
- 83k channels
- p/K/ π separation up to 60 GeV



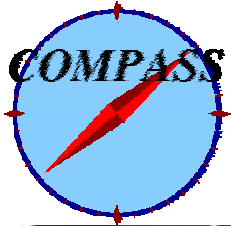


Vessel



26 February 2002

Massimo Lamanna CERN-I NFN Trieste

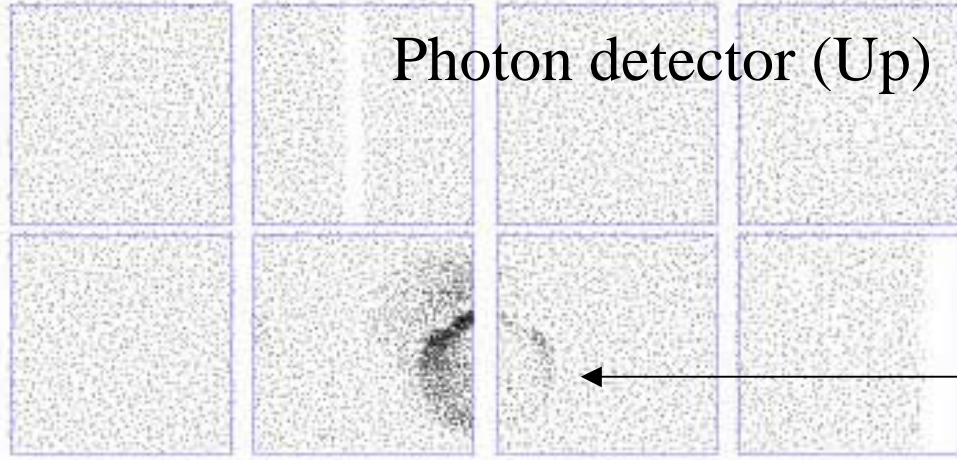
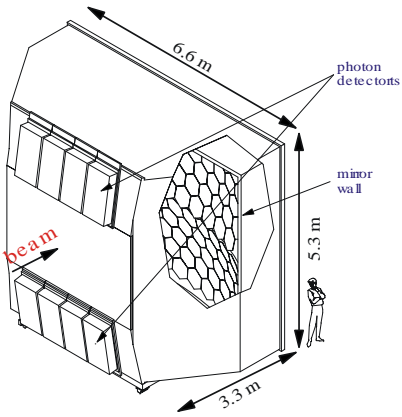


Mirrors and photon detectors

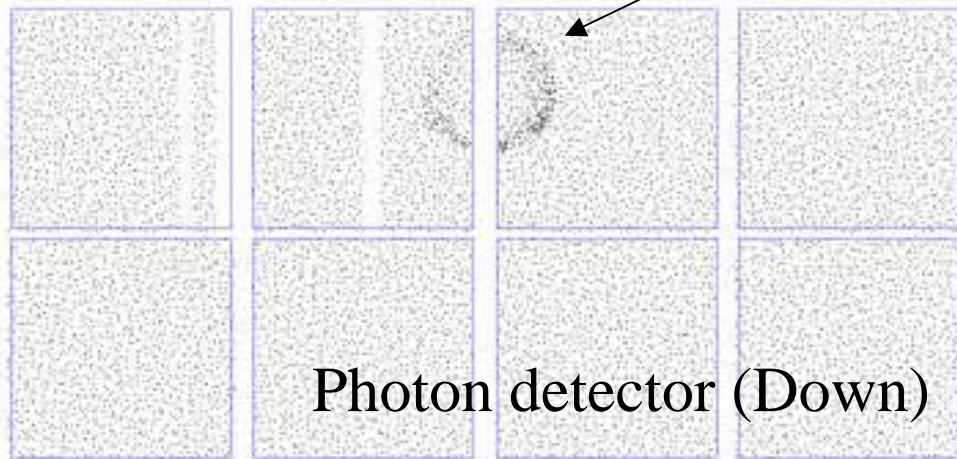




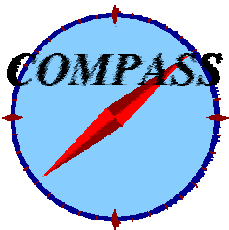
RICH



Beam halo

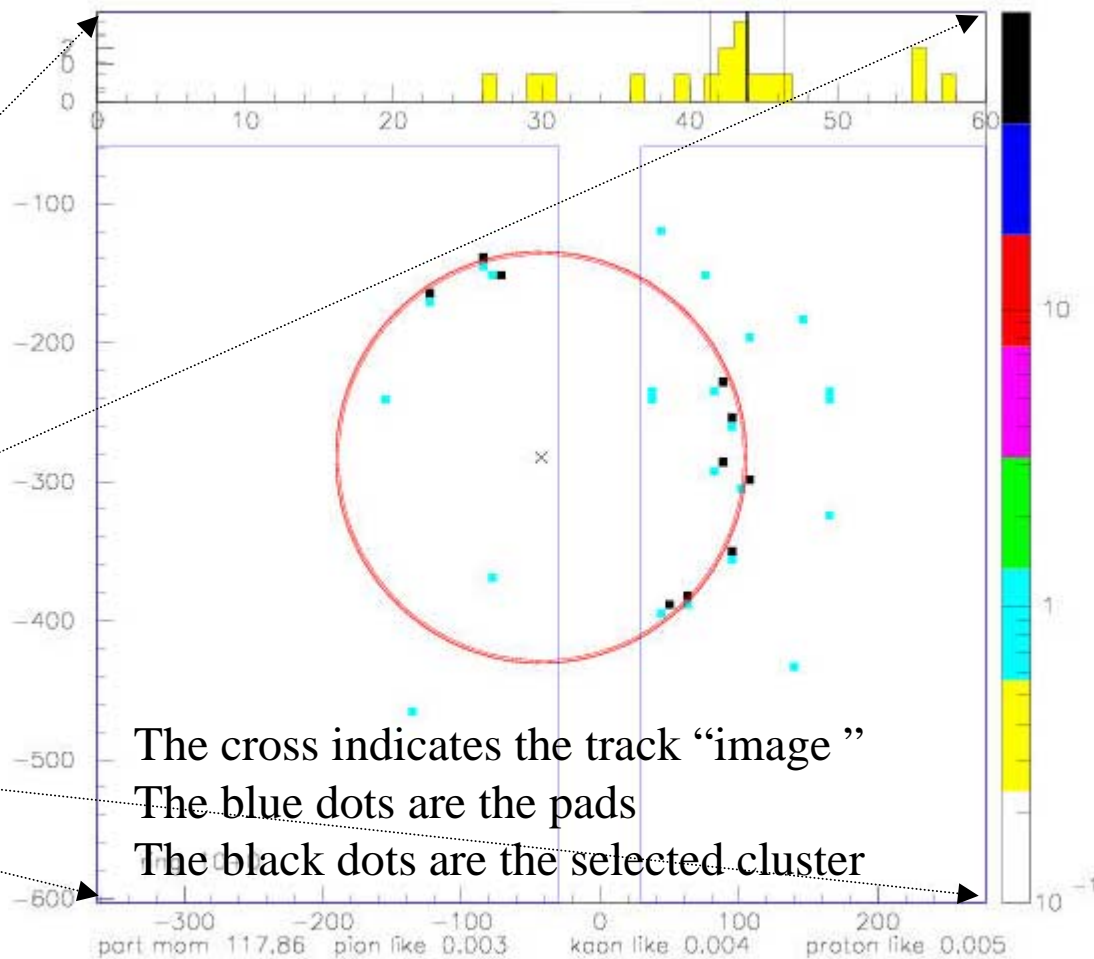
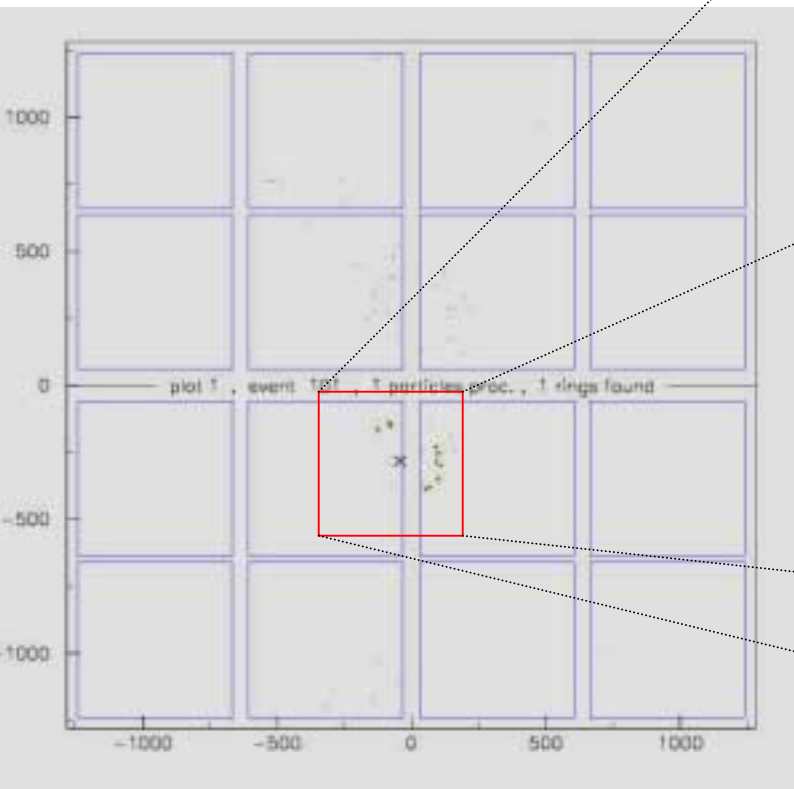


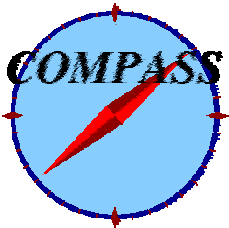
“Online” event superposition



RICH

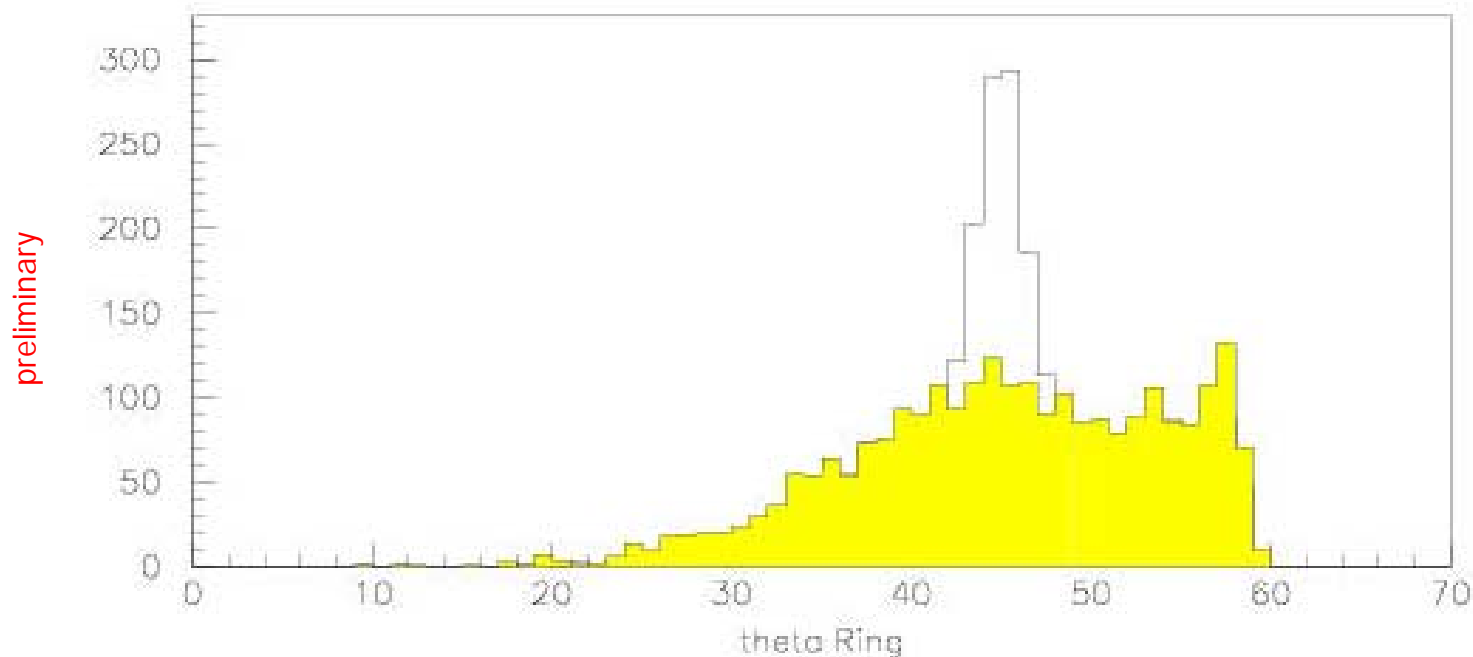
“Ring event”

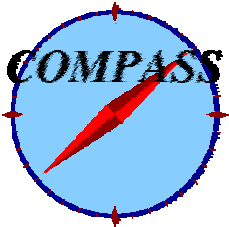




RICH

Cherenkov angle of photons on the Rich
Superimposed (yellow) out of time signals





DAQ + ONLINE

Layered architecture

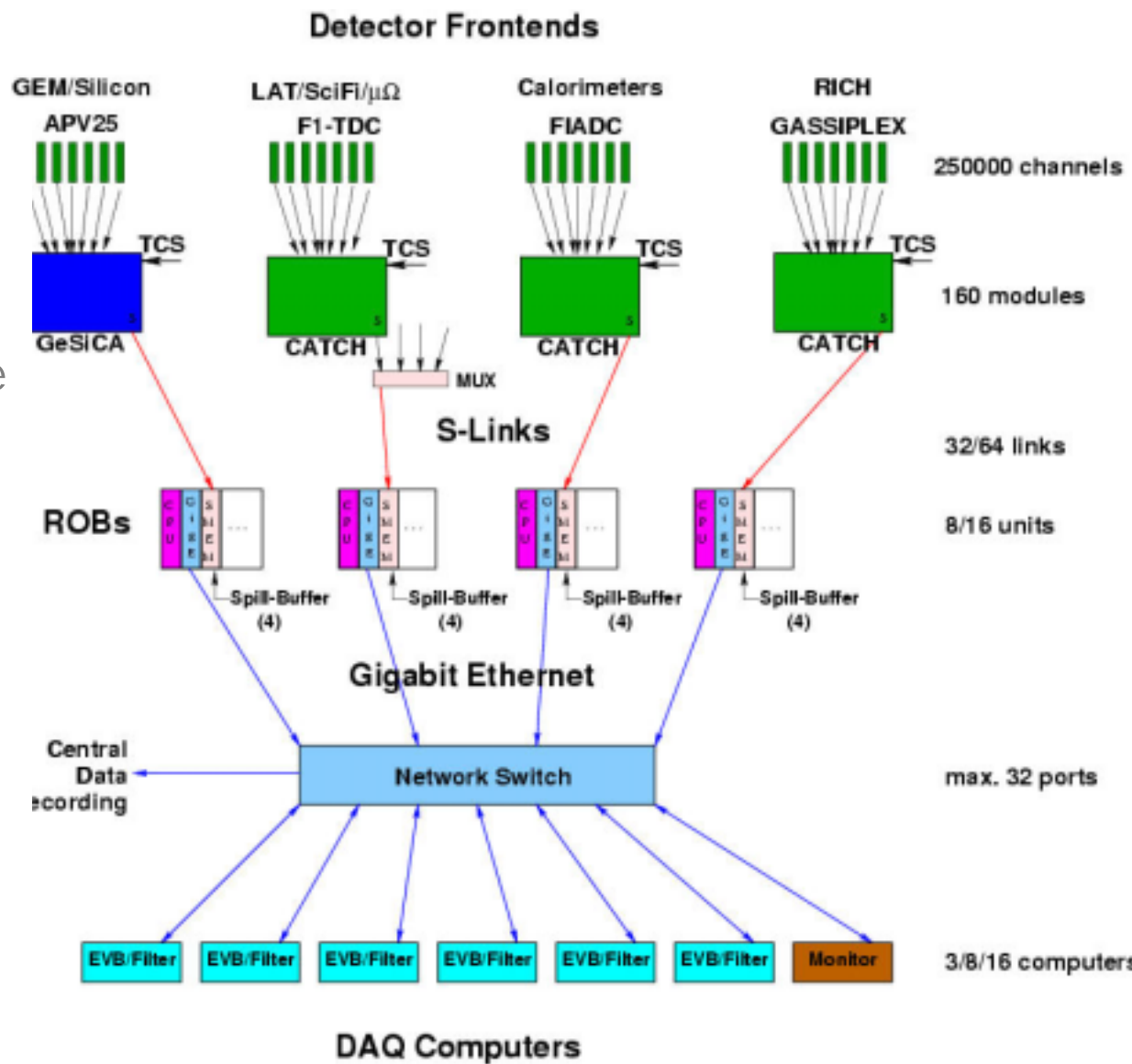
- Front end
- Read-out buffers
- Event building stage
- Recording

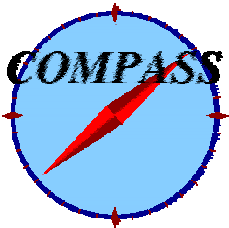
Hardware:

- Custom COMPASS solutions
- Mainstream PC and networking

Software

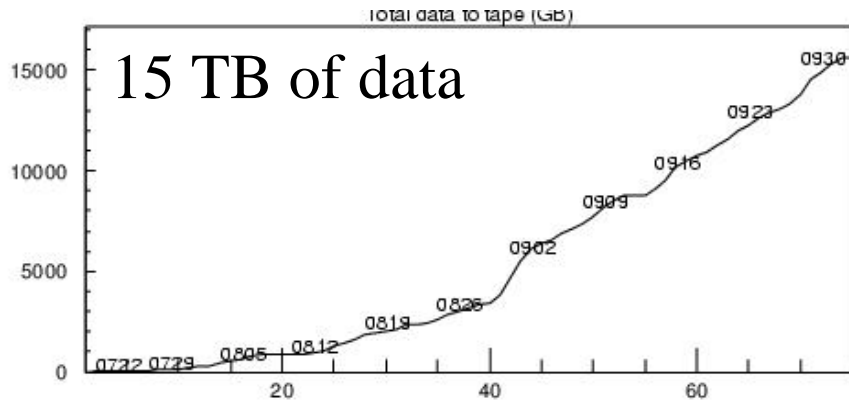
- ALICE DATE
- ROOT (COOL)



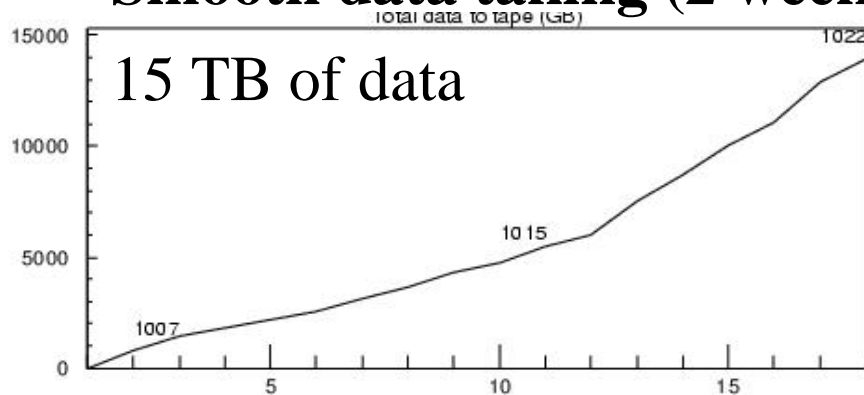


Data Recording: 2001 data taking

Beg. Jul → Beg. Oct



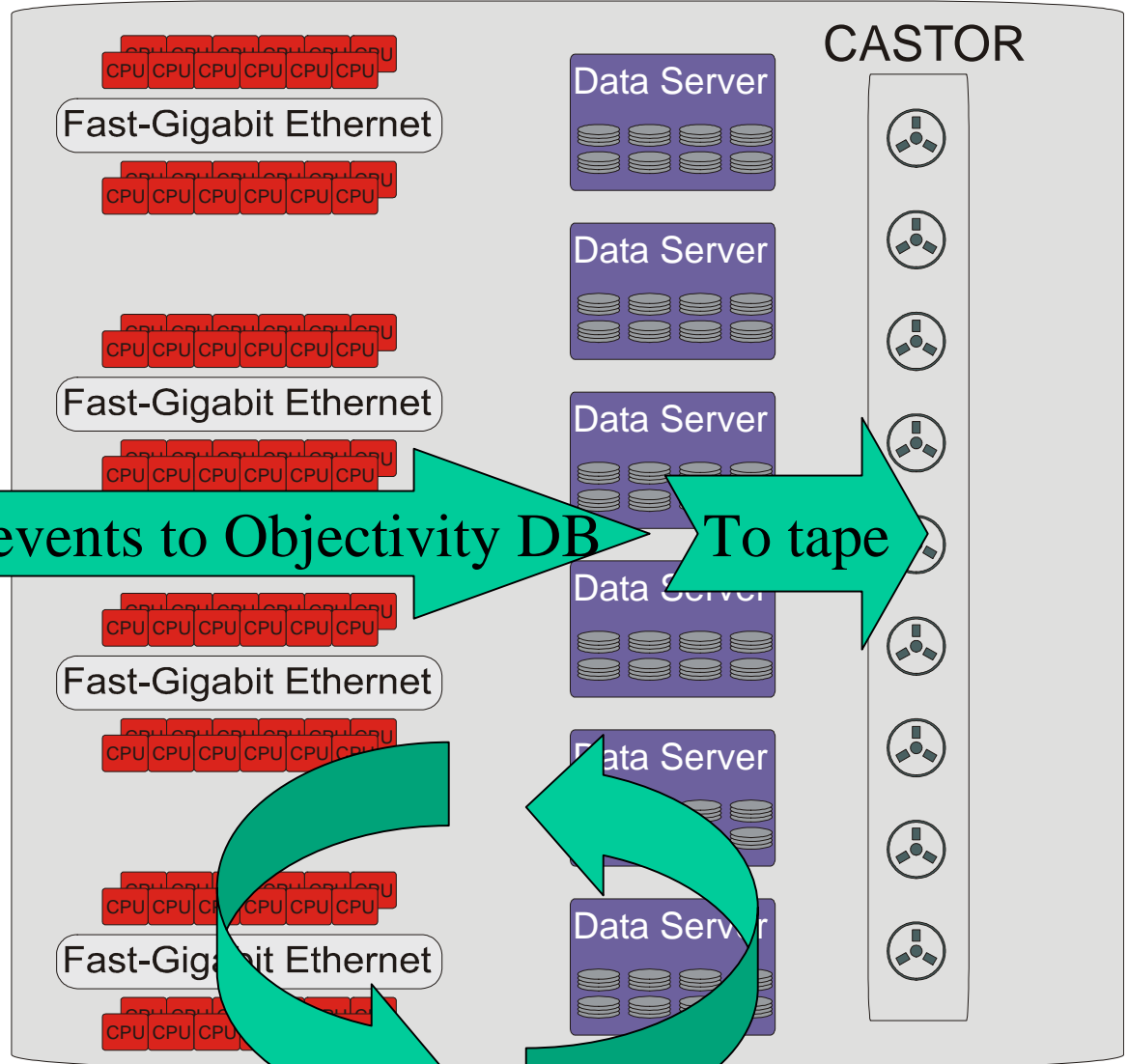
Smooth data taking (2 weeks)



- Setting up period
 - New detectors put in place and commissioned
 - On-line system fully commissioned
 - First look to the data
- Two week "smooth data taking"
 - Event size close to nominal (30 kB)
 - Event rate close to nominal (35 MB/s)



CCF

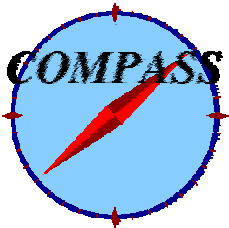


Online Computers

Long-distance Gigabit Ethernet

On-line events to Objectivity DB To tape

200 CPUs
35 MB/s input rate
300 TB/year

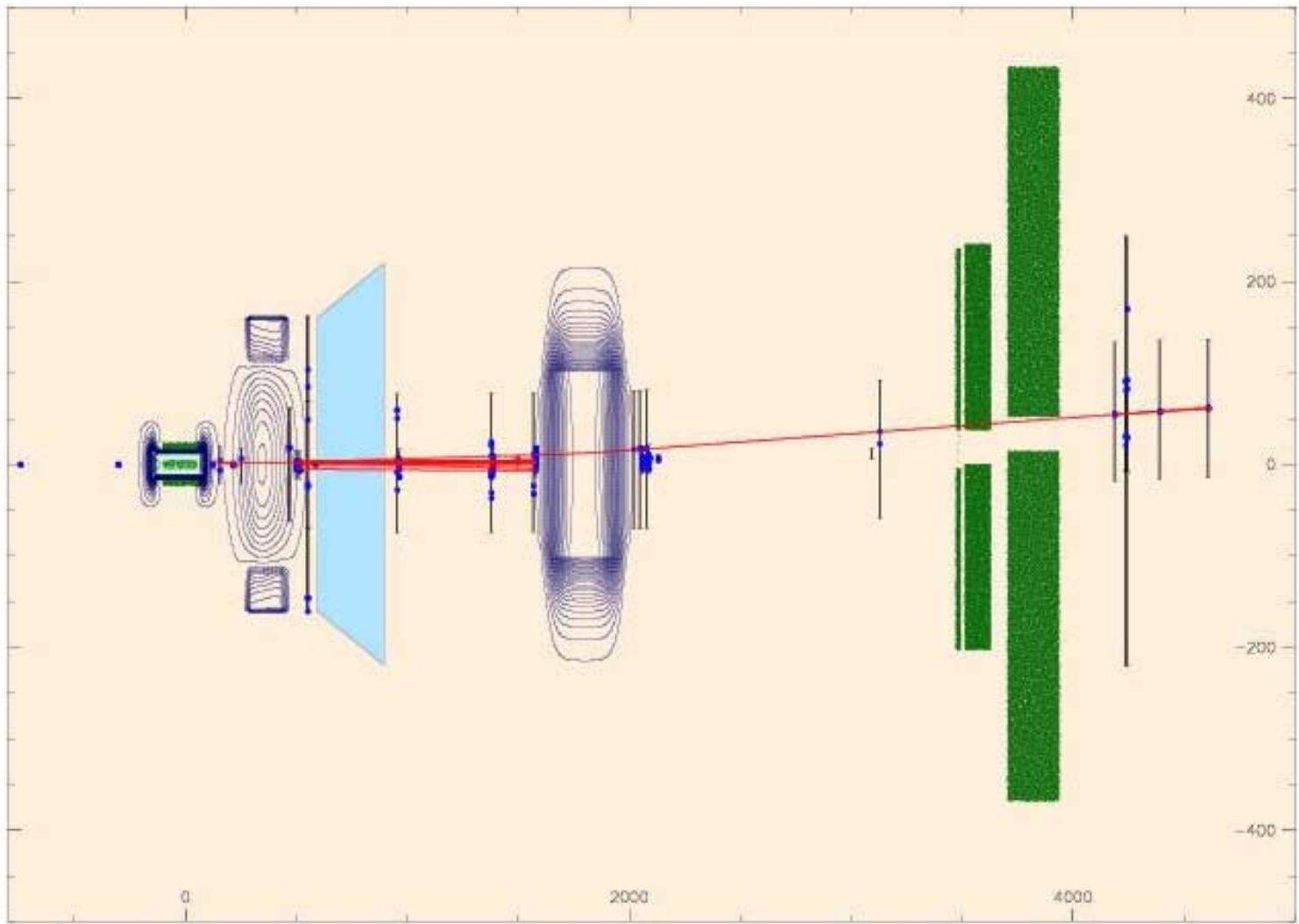


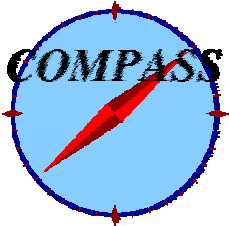
CORAL

- First extensive use of the reconstruction program on real data
 - CORAL: new C++ reconstruction framework
 - Tracking packages:
 - Traffic
 - Recon
 - Dico
 - RI CH
 - Calorimeter
 - ...



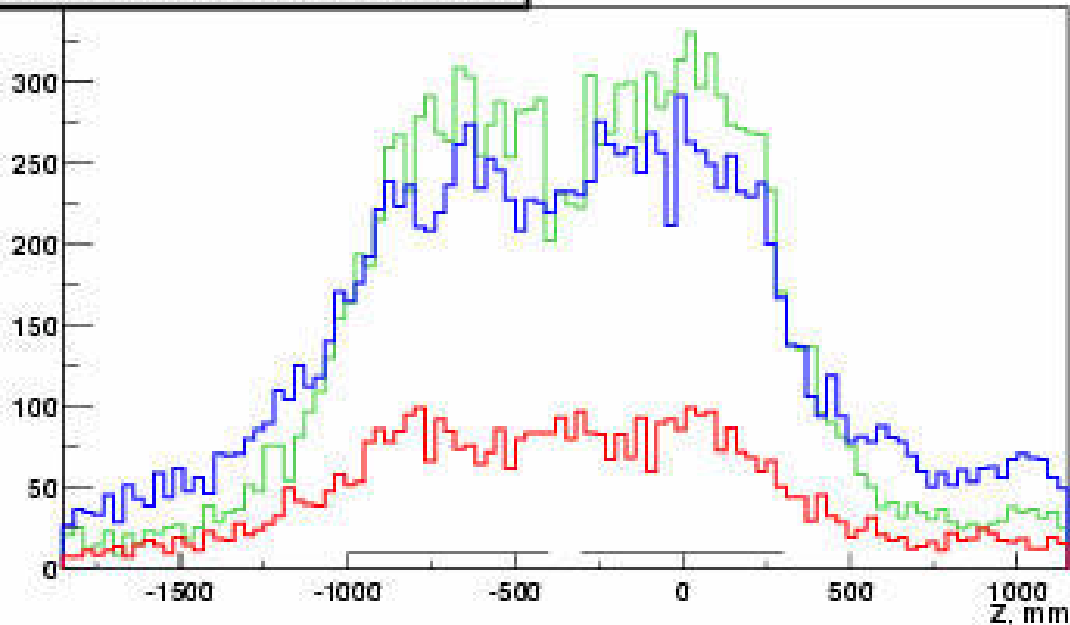
2001 events





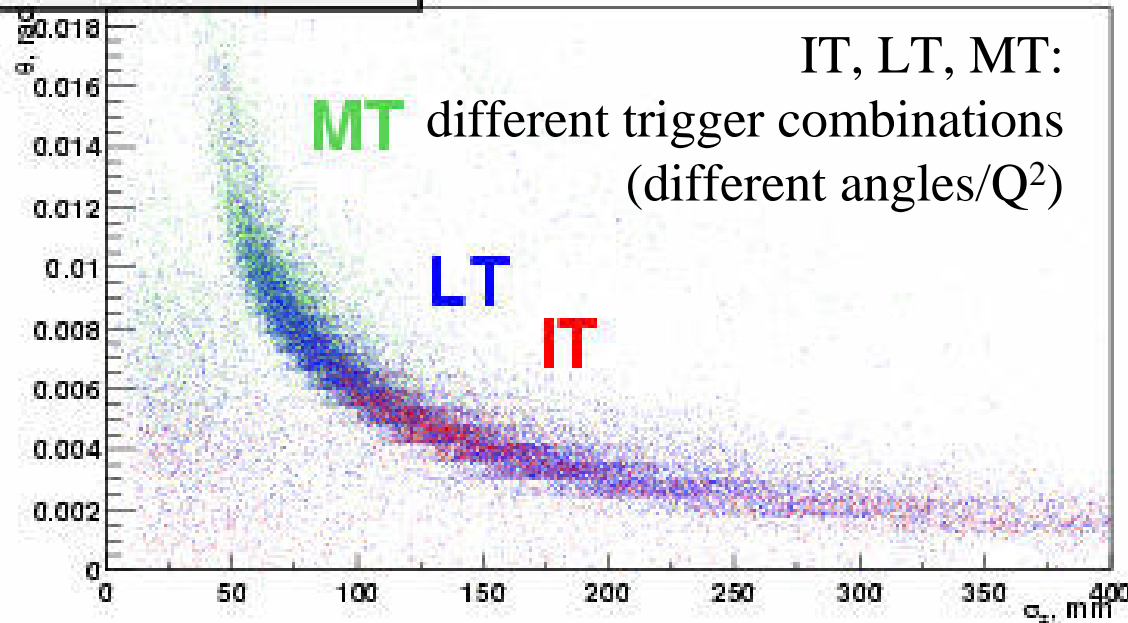
Muon vertex (primary vertex)

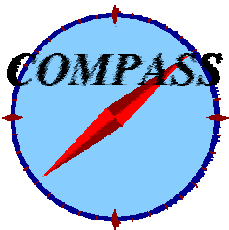
Vertex distribution along z



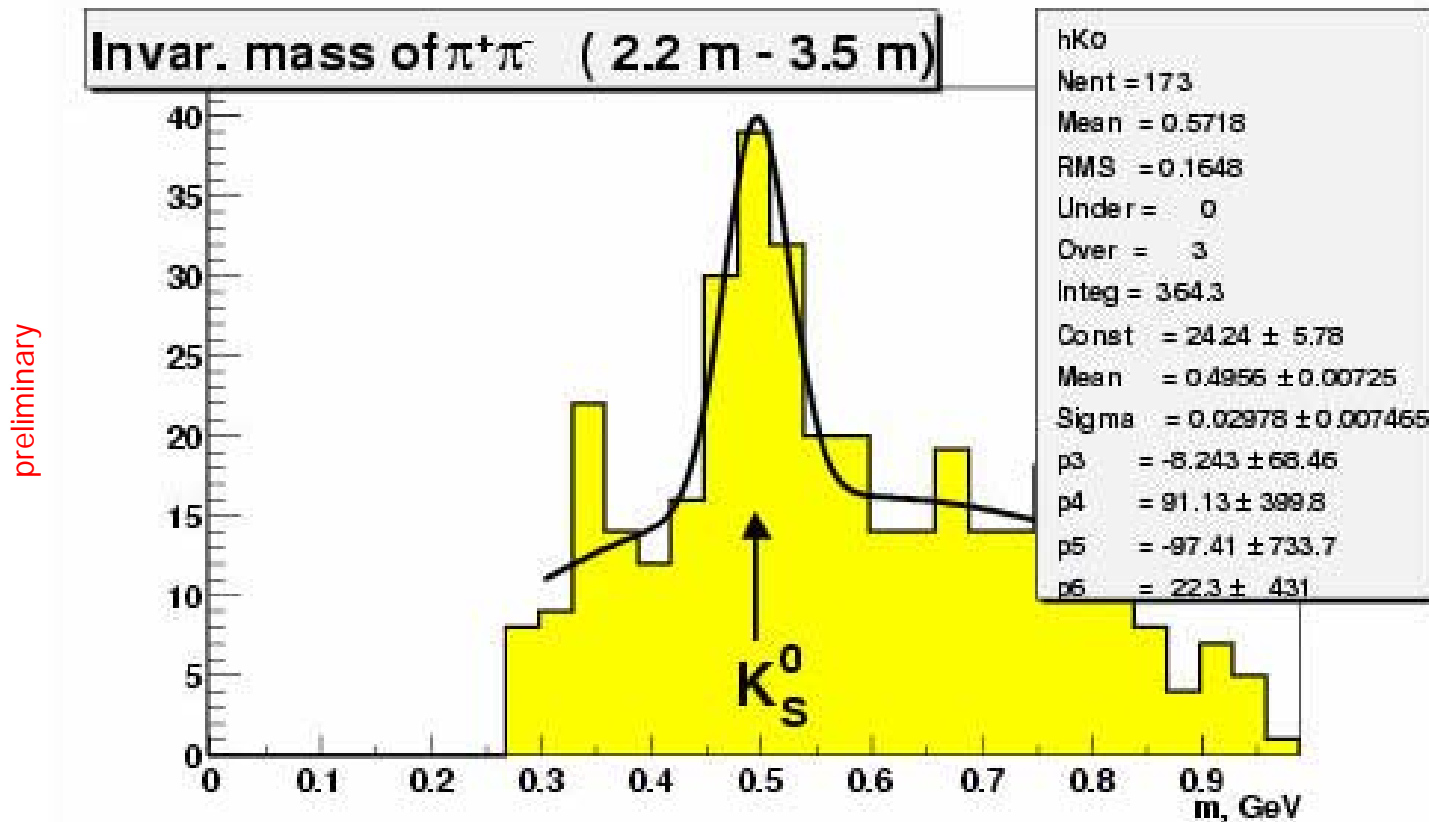
preliminary

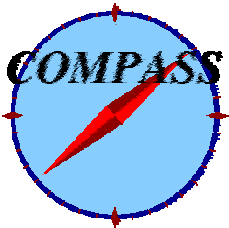
σ_z vs θ





Vertex \rightarrow invariant mass





Conclusions and outlook

- Successful 2001 pilot run
 - All detectors tested in realistic environment
- Excellent perspectives for 2002
 - This is our “initial setup”
 - Complete the first phase of the tracking
 - Measure $\Delta G!!!$
 - Room for upgrades and further evolution