

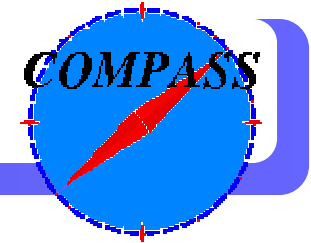
# COMPASS NA58 Status Report

G. Mallot/CERN

On Behalf of the Compass Collaboration

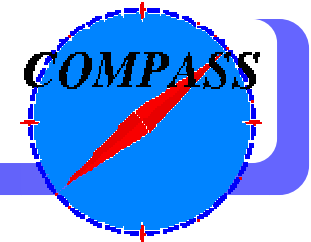
SPSC May 13, 2003

# Contents



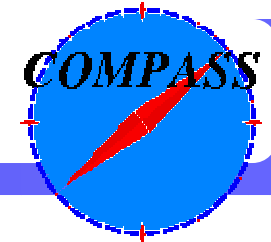
- Spectrometer and data taking
- First results from analysis
- Bottlenecks
  - Rich efficiency
  - Reconstruction and computing
  - beam time
- 2004 muon & hadron runs

# 2002 Run



- 2001 about 30 % of detector channels installed
- 2002 initial layout completely installed, except:
  - 6/15 straw planes (delivered in autumn 2002),
  - polarised target magnet
- equipment beyond initial layout:
  - large area tracking: SDC3, MW1&2 (r/o), W45,
  - large area trigger hodoscopes (large  $Q^2$ ),
  - additional MWPC, SciFi planes,
  - ECALs partly installed
- data taking: 57 day long., 19 days transv.

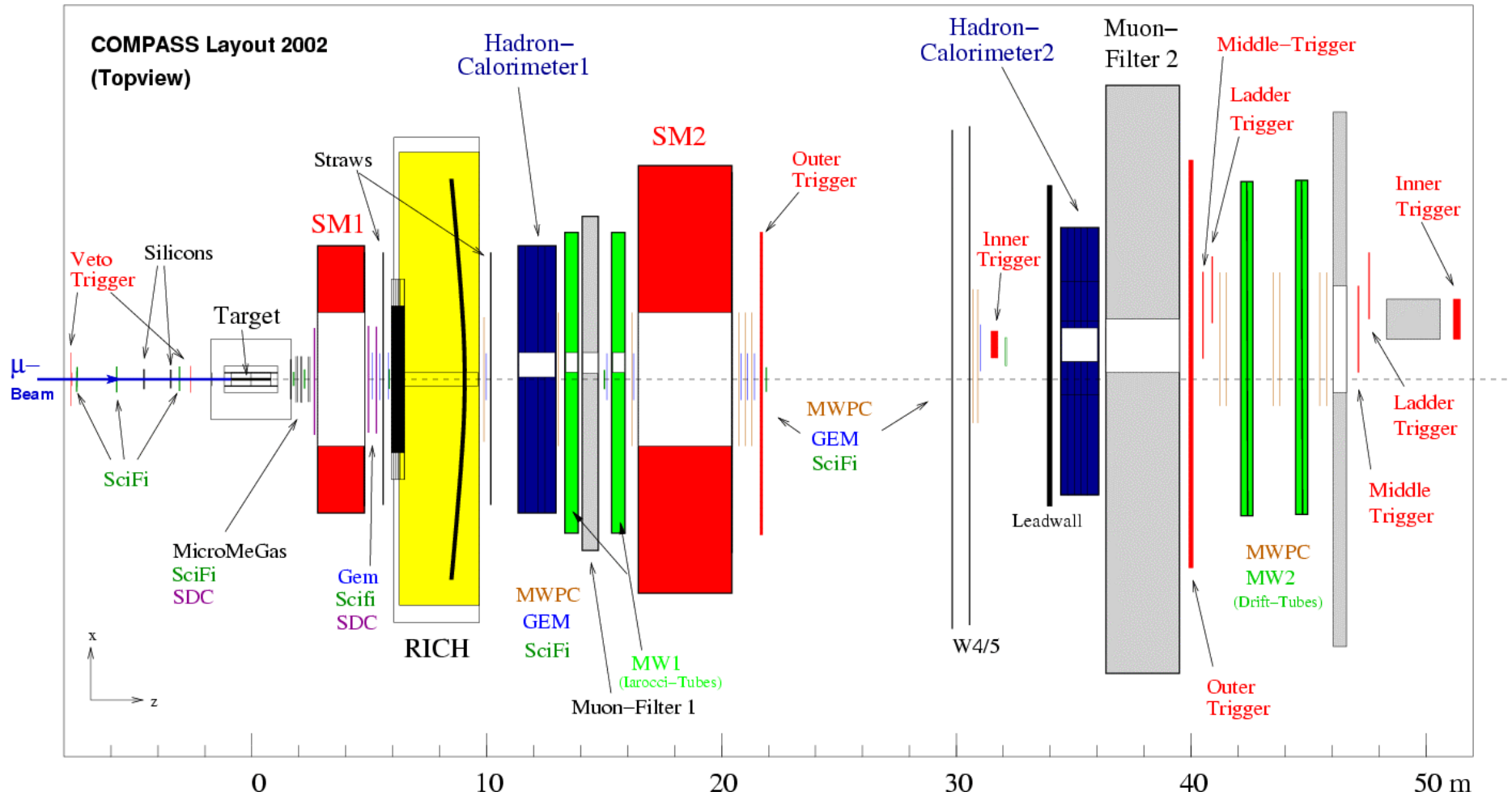
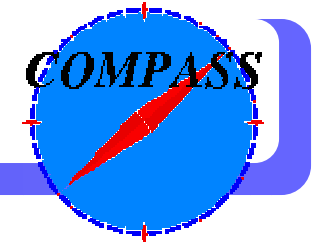
# W45 drift chambers



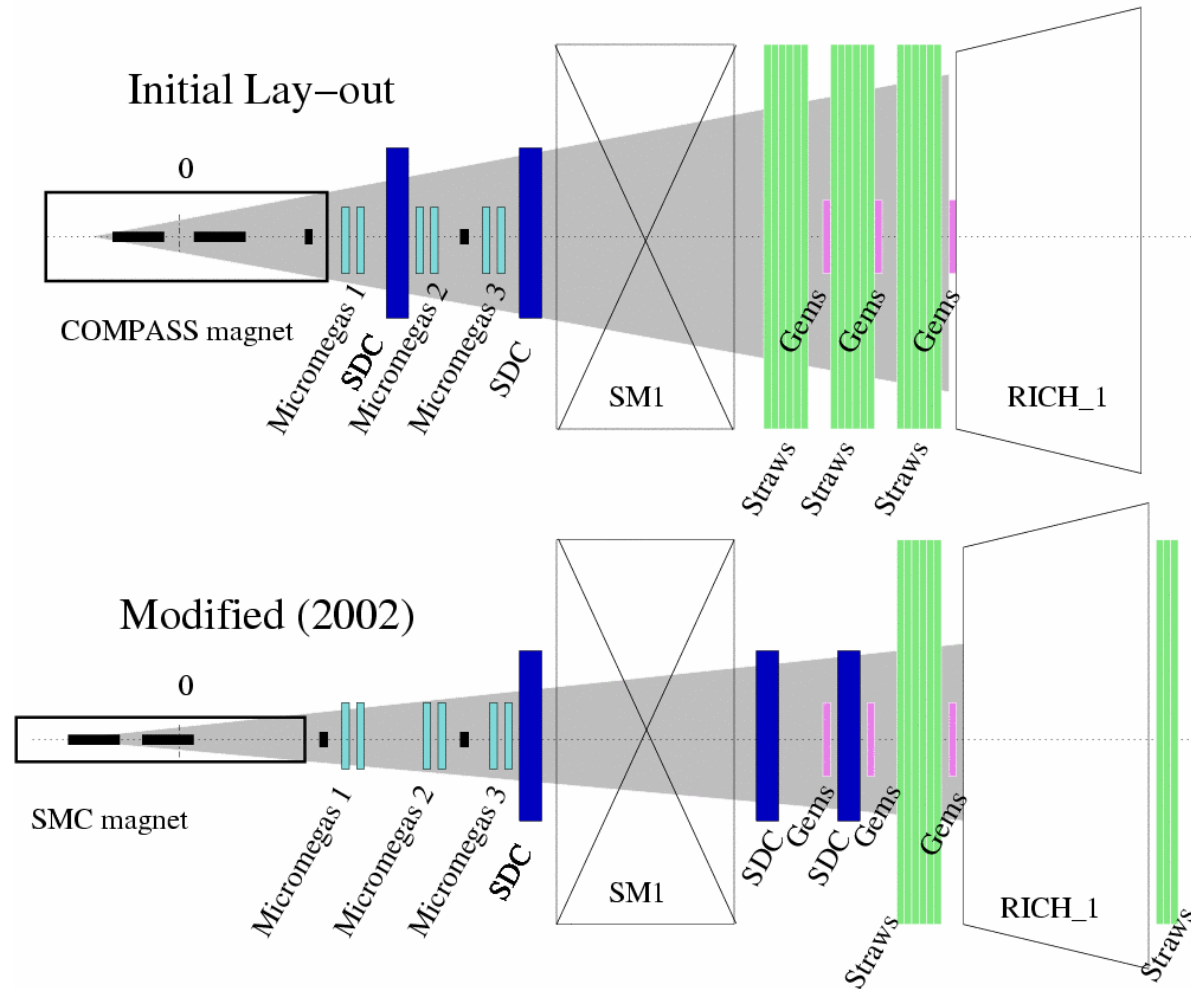
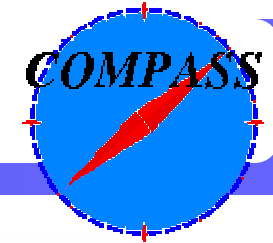
- 40 mm drift cell
- 50 cm diameter central dead zone
- 5.2 x 2.4 m<sup>2</sup>
- in 2002: 2x4 planes
- in 2003: additional 2x4 planes with new 1 m dead zone



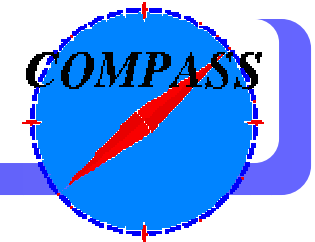
# Spectrometer 2002



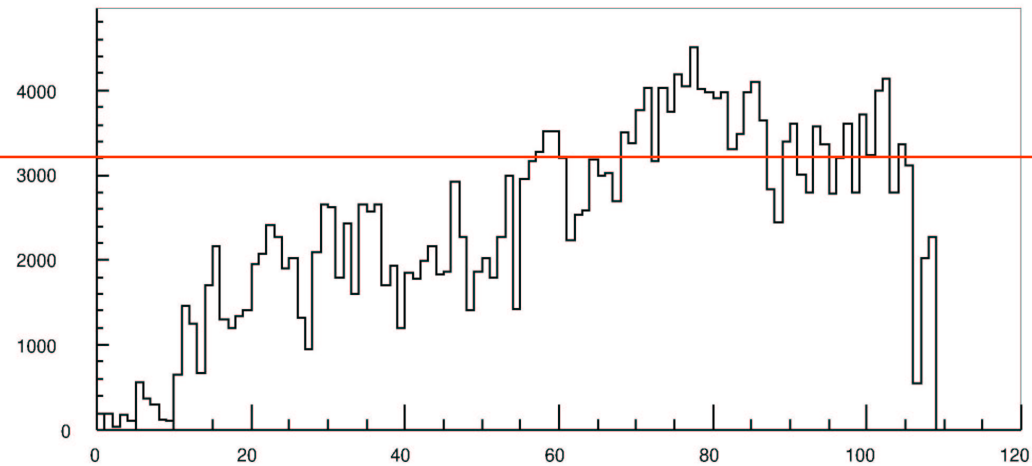
# Modification to LAS



# Central Data Recording

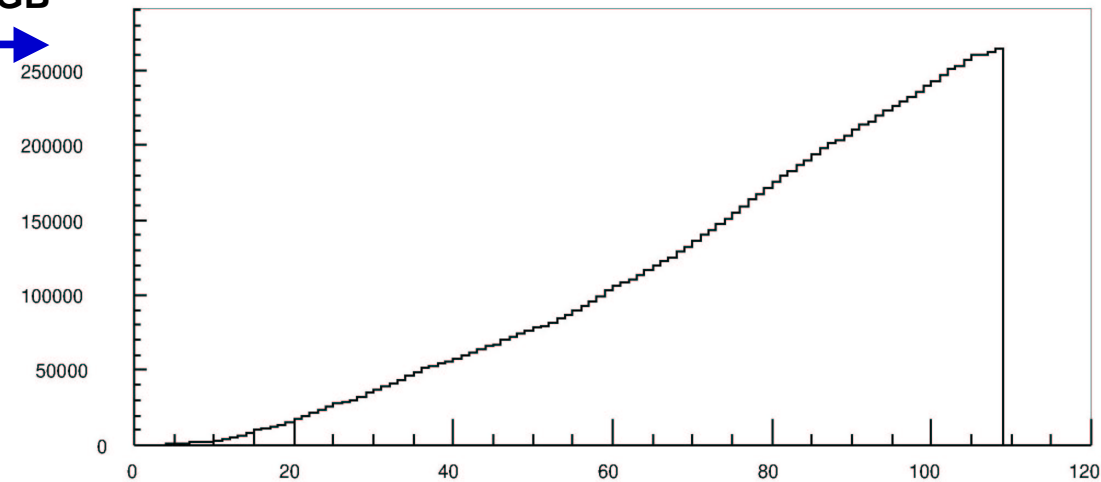


*Design value (35MB/s)*



*260 TByte in ~100 days*  
*5 billion events*

GB →

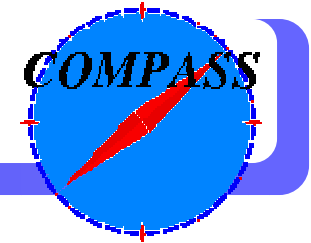


*Compare to BaBar:*  
*1TByte/day*  
*662 TByte in 1999-2002*

May 27

Sep 18

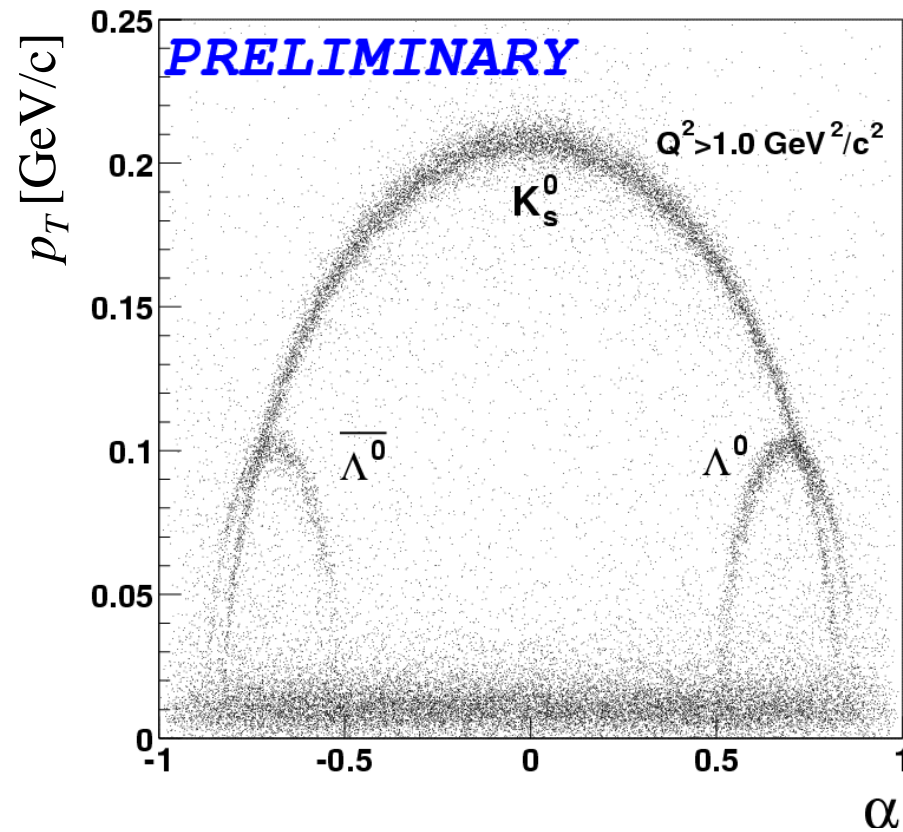
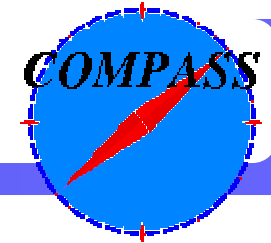
# First Analysis Results



- $\Lambda$  and  $\bar{\Lambda}$  hyperon production
- Vector meson production  $\rho$ ,  $\phi$  and  $J/\psi$
- $\Delta G/G$  from high- $p_T$  hadron pairs
- Flavour decomposition of pol. PDF
- Transversity and Collins asymmetry



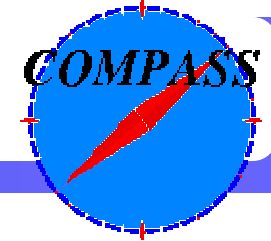
# Lambda production



Armenteros-Podolanski

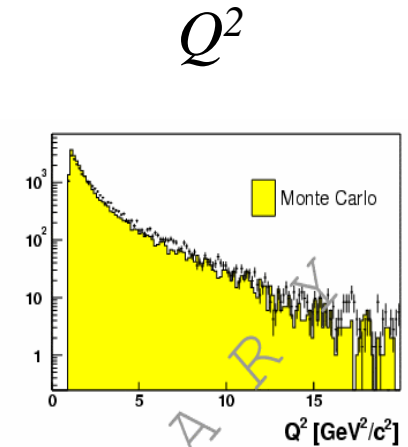
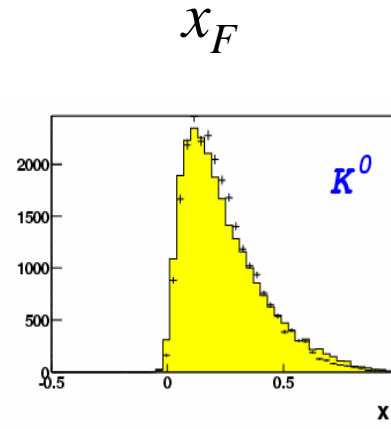
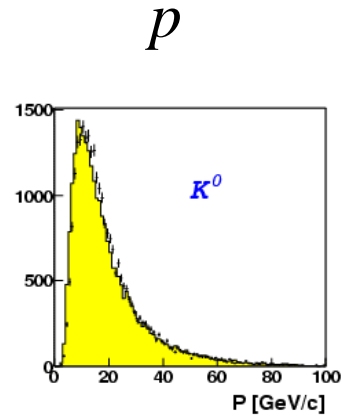
$$\alpha = \frac{P_L^+ - P_L^-}{P_L^+ + P_L^-}$$

# Lambda data vs MC

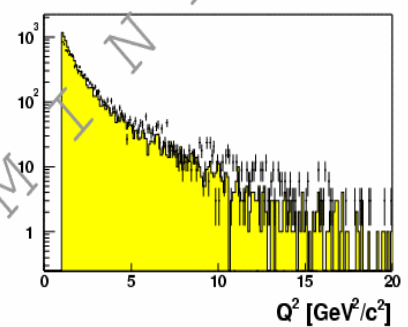
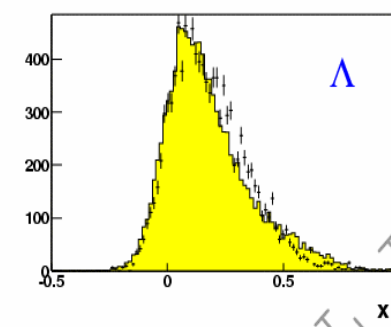
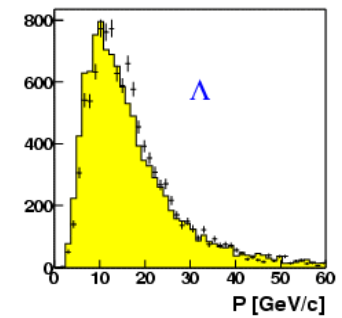


Data
Monte Carlo

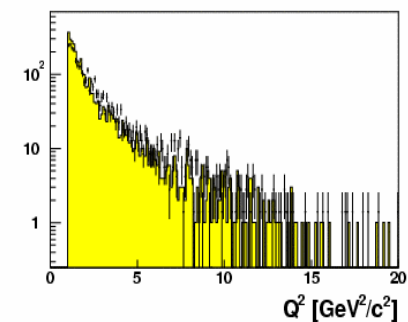
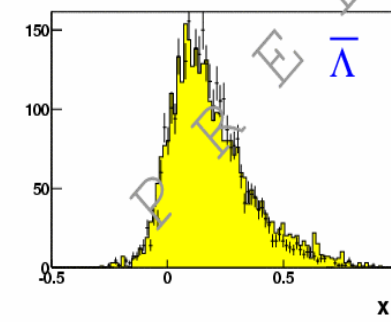
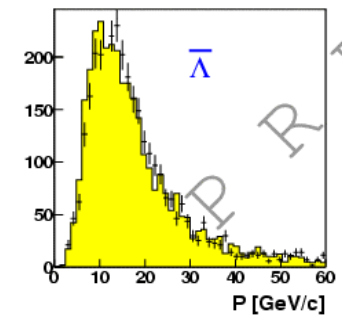
$K^0$



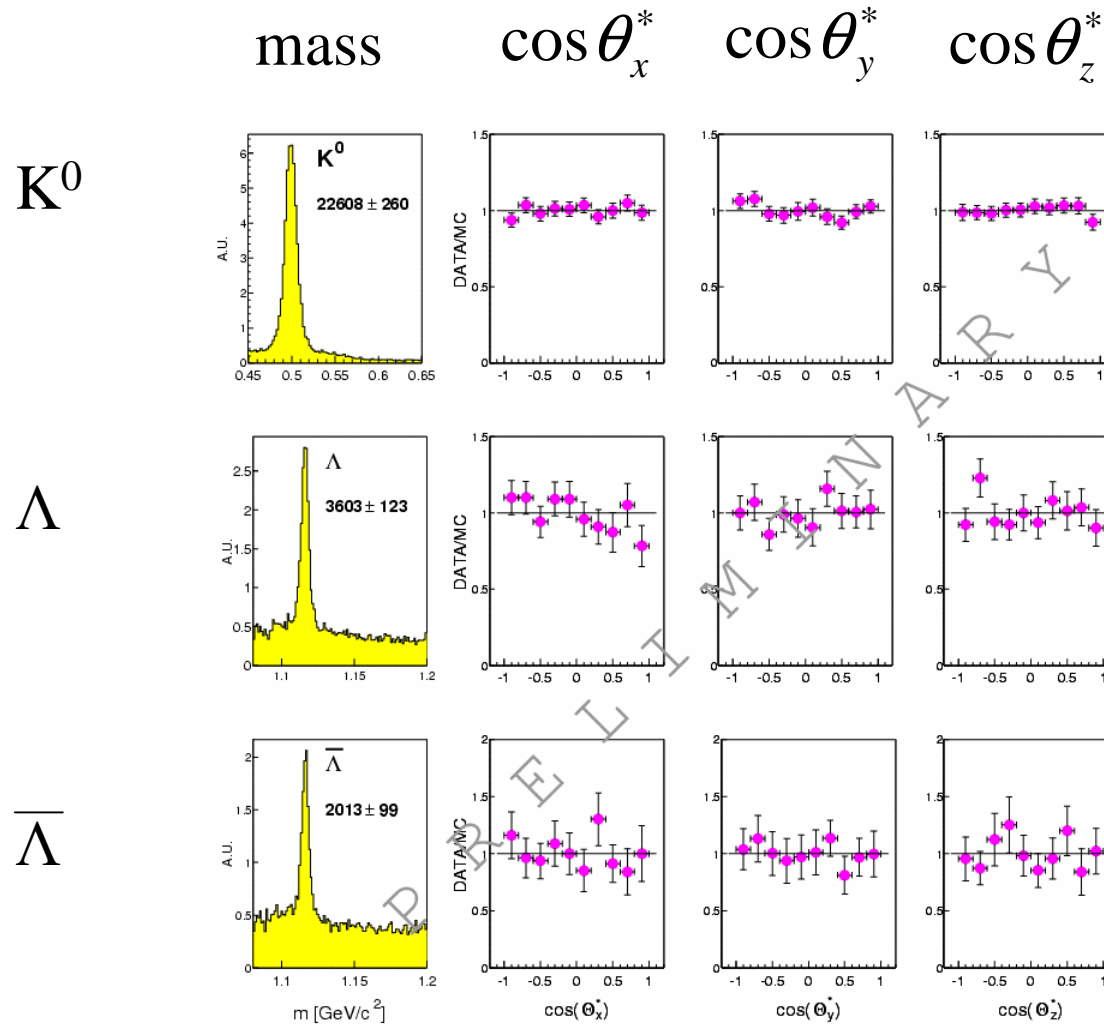
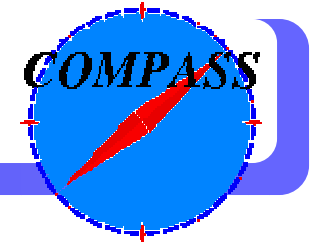
$\Lambda$



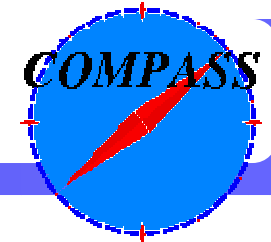
$\bar{\Lambda}$



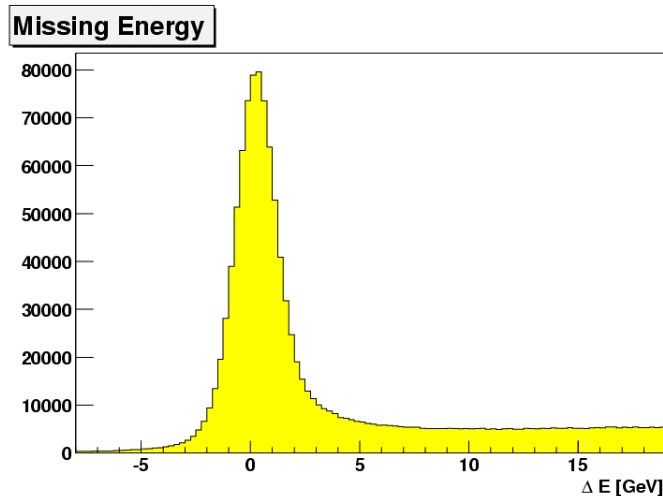
# Lambda polarization?



# Exclusive $\rho$ and $\phi$ production

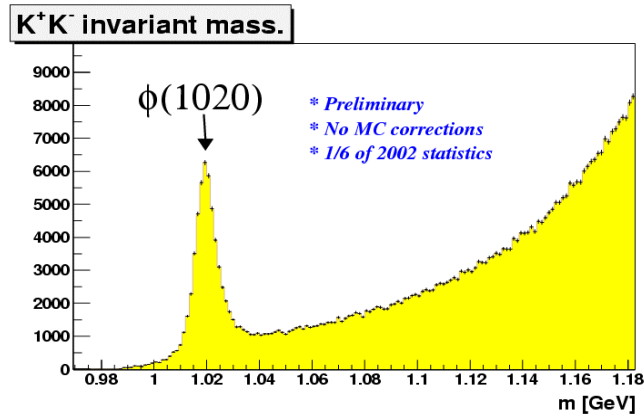
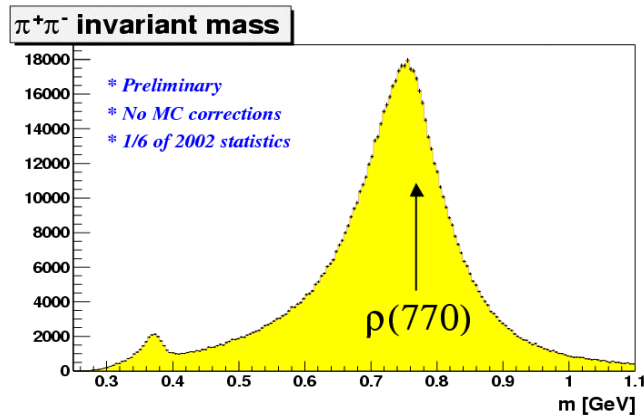
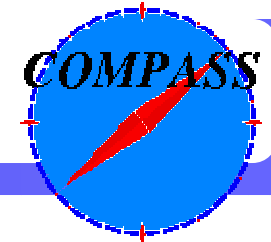


meson	mass cut	statistics (1/6 of 2002)
$\rho^0$	$0.5 < m_{\pi\pi} < 1 \text{ GeV}$	$1.3 \cdot 10^6$
$\phi$	$ m_{KK} - m_\phi  < 9 \text{ MeV}$	$42 \cdot 10^3$



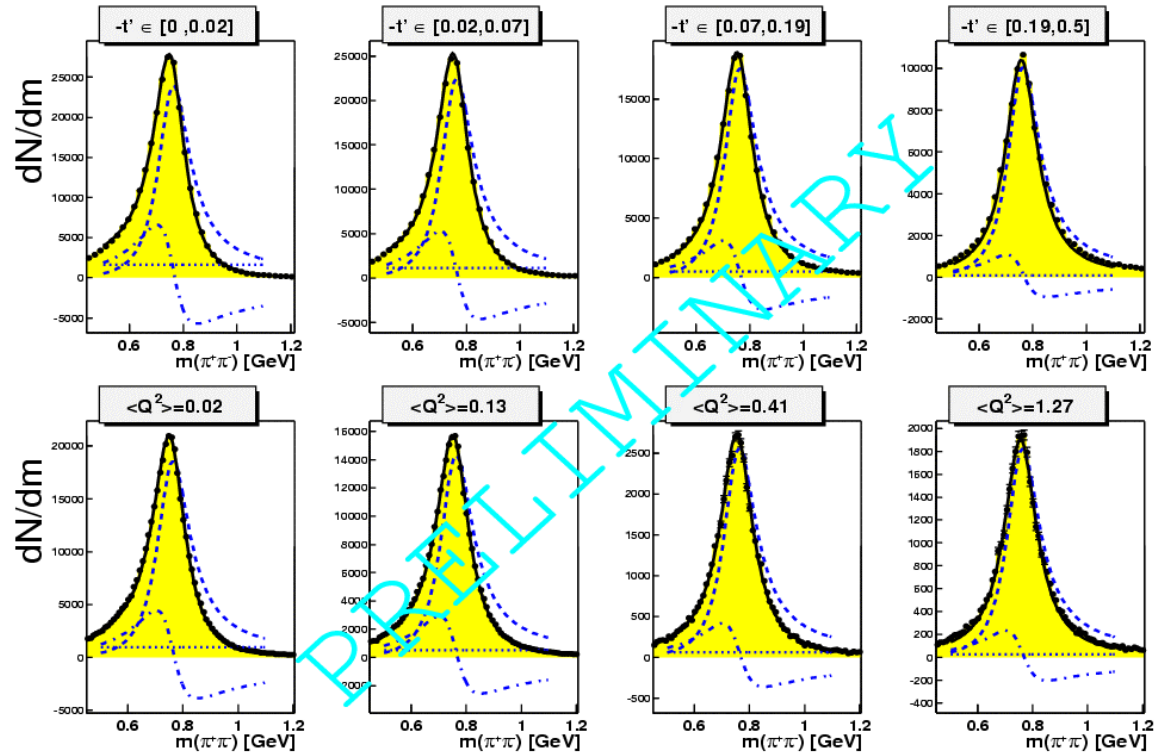
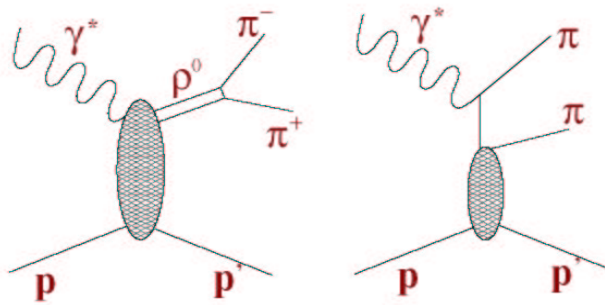
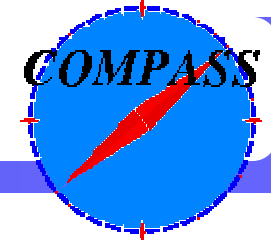
- $|t'| < 0.5 \text{ GeV}^2$
- $7.5 < W < 16 \text{ GeV}$
- $Q^2 > 10^{-3} \text{ GeV}^2$

# Invariant masses



- 16 % of total statistics (2002)
- no MC corrections yet

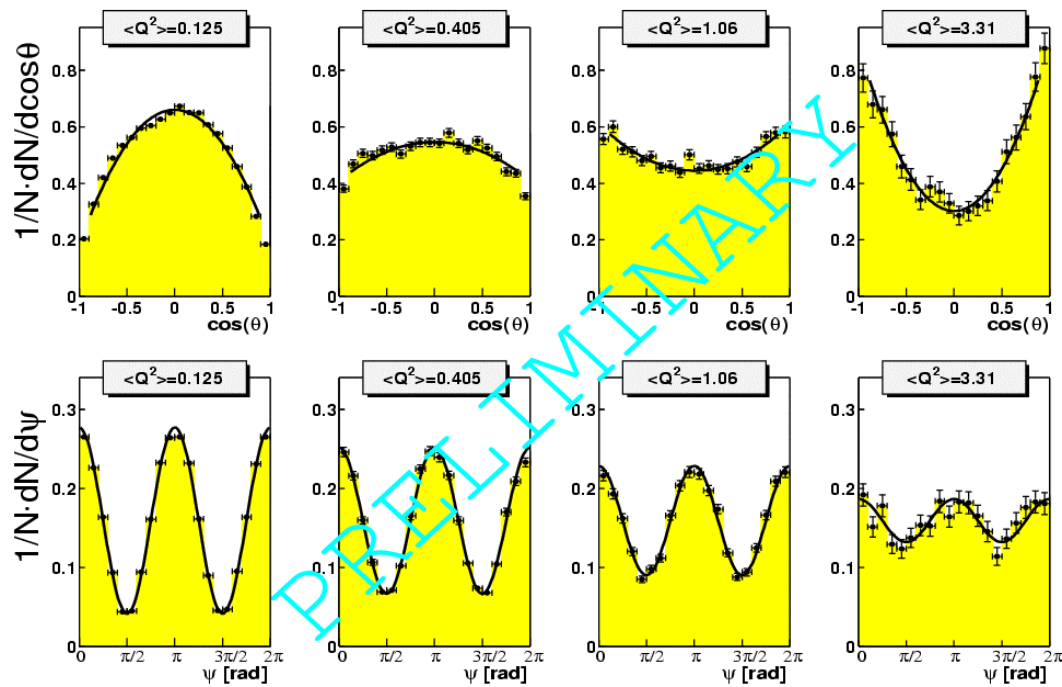
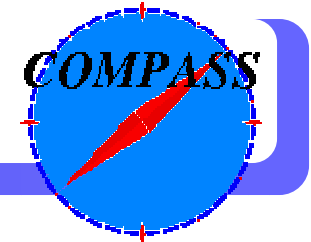
# Interference of $\rho^0$ and $\pi\pi$



- Söding parametrization
- No accept. corr.

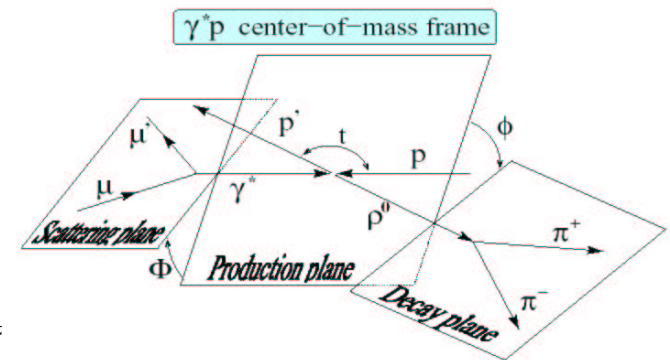
$Q^2, -t'$

# Angular distributions

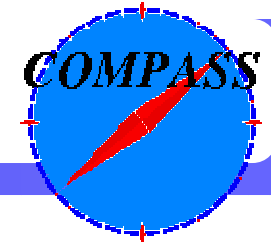


$$p_T > 0.15 \text{ GeV}$$

$$Q^2 > 0.05 \text{ GeV}^2$$

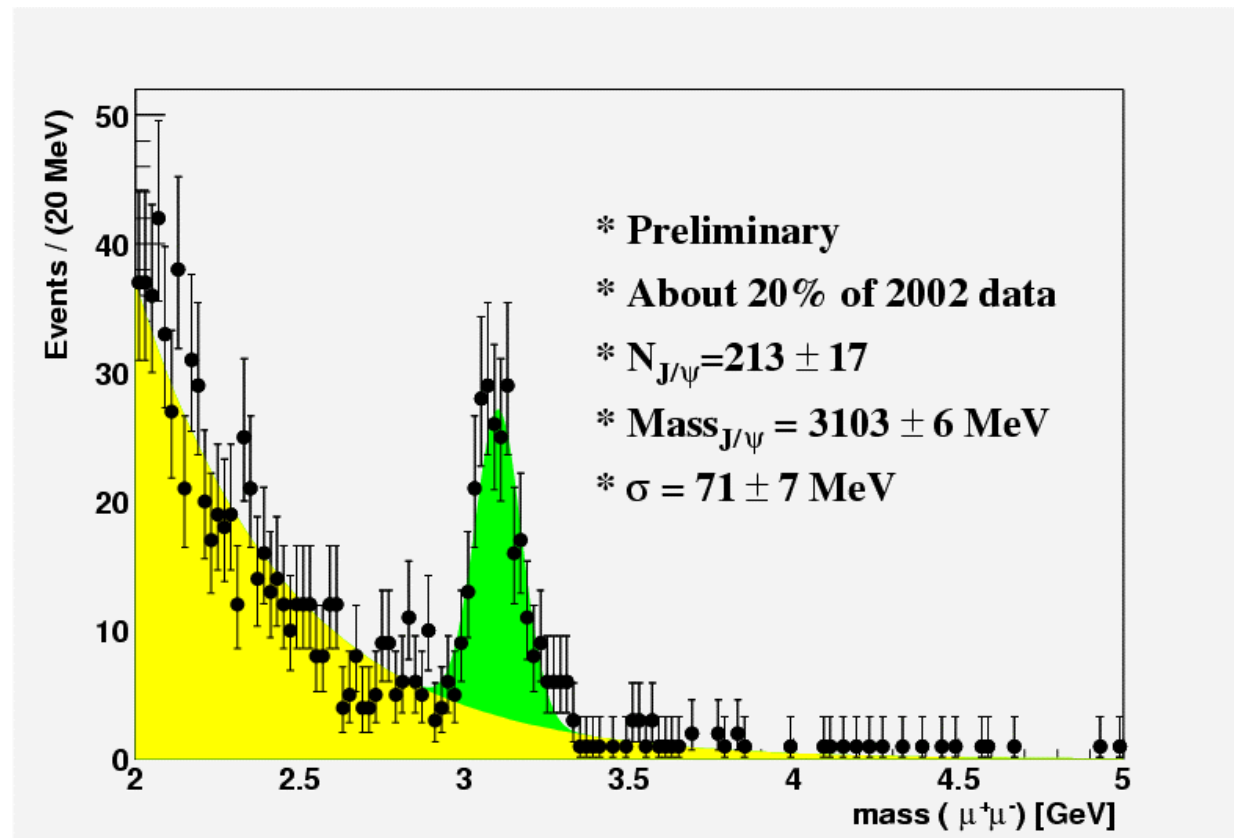


# J/ $\psi$ production



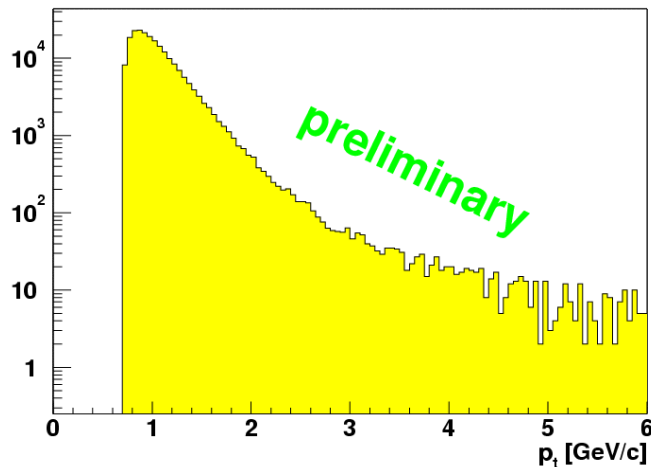
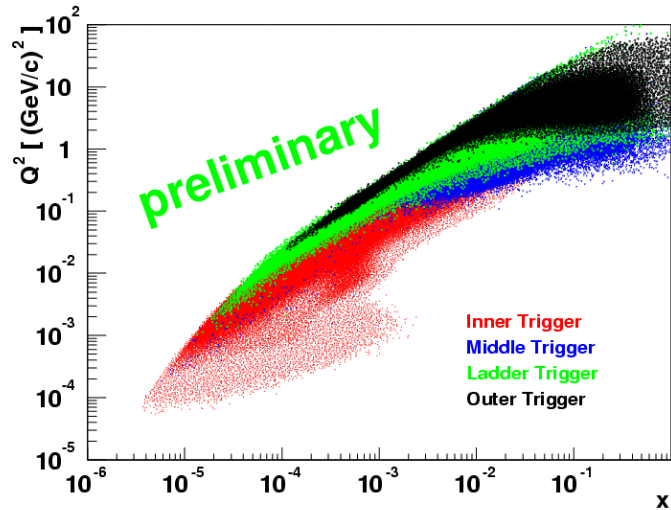
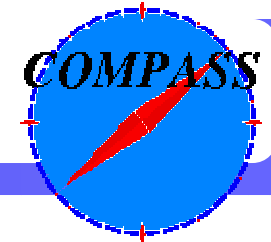
$$J/\psi \Rightarrow \mu^+ \mu^-$$

- First look
- mainly elastic



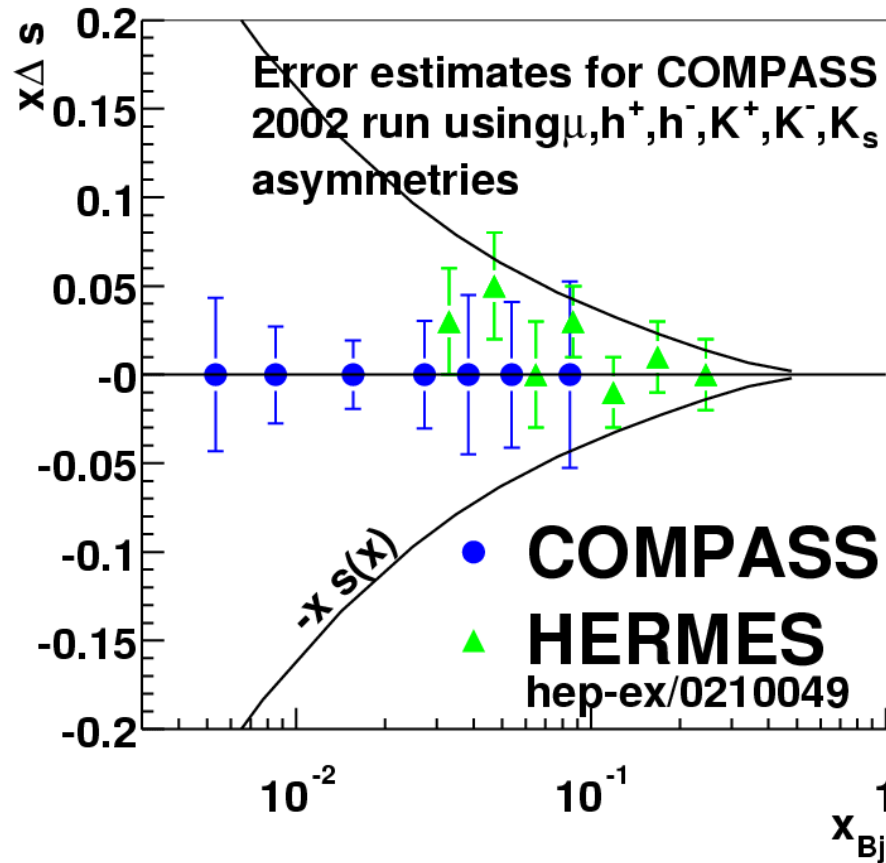
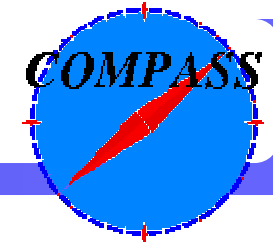


# High- $p_T$ hadron pairs



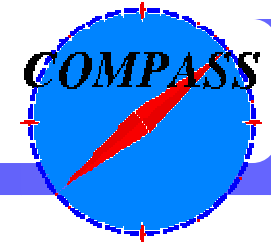
- large statistics
- theoretical uncertainties for  $Q^2 < 1 \text{ GeV}^2$ , resolved photon contributions need theory work
- For  $Q^2 > 1 \text{ GeV}^2$  from 2002 run expect 17k events and  $\delta(\Delta g/g) \sim 0.31$
- All  $Q^2$ : 160k events !!!

# Flavour separation $\Delta q$

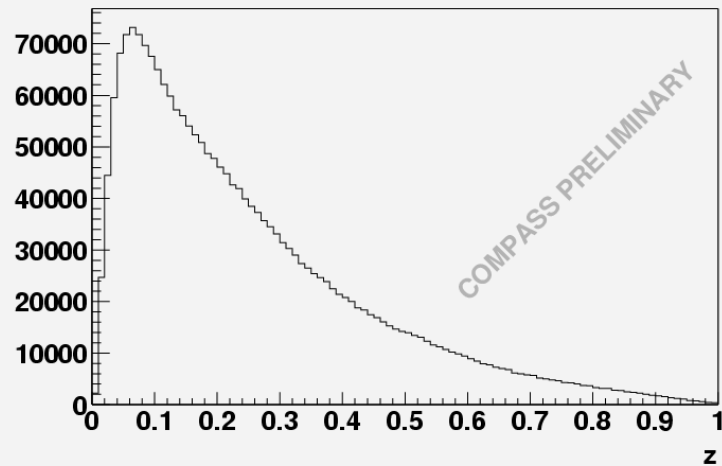


Looks very promising in particular for  $\Delta s$  !

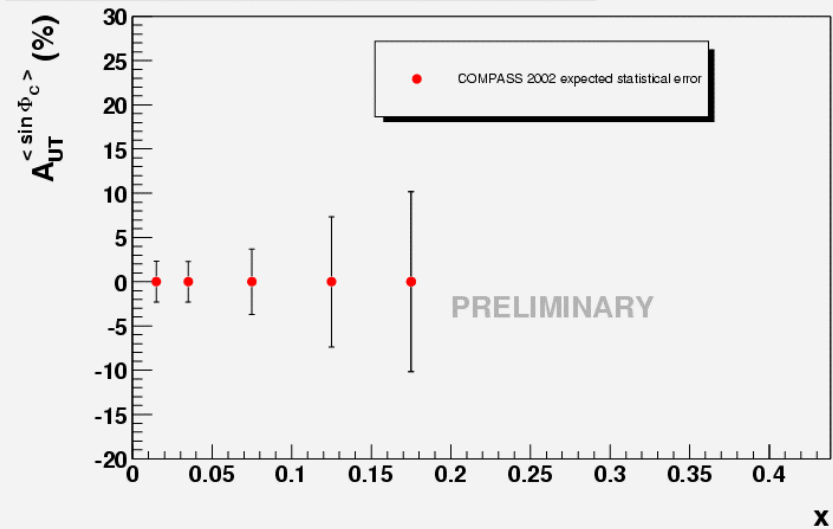
# Collins asymmetry



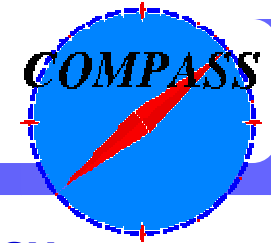
Distribution of  $z$  for leading hadron



The Collins asymmetry  $A_{UT}^{\langle \sin \phi_c \rangle}$  for positive leading hadron

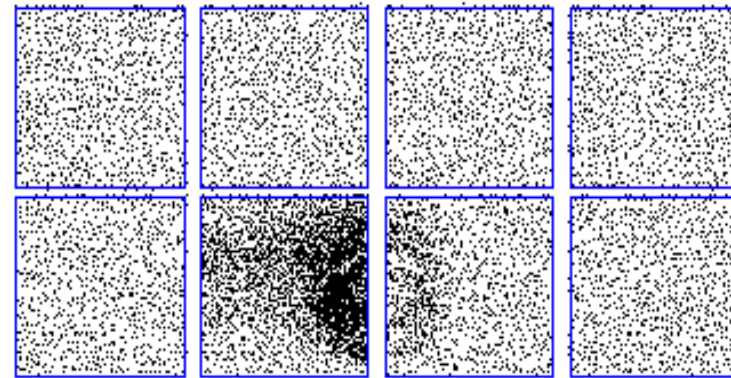


# RICH-1 Performance

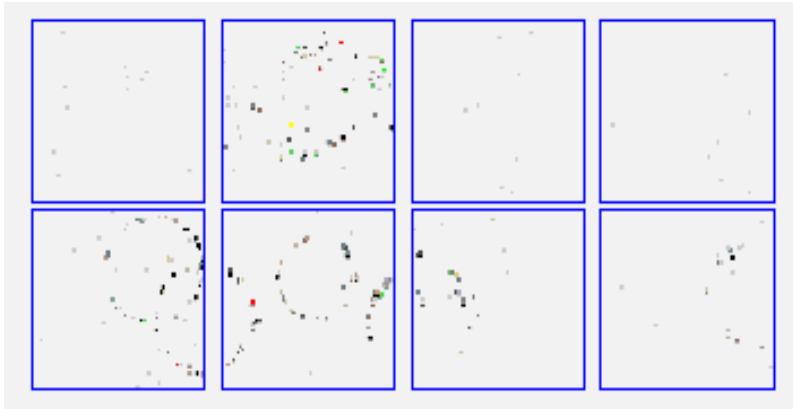


upper detector set

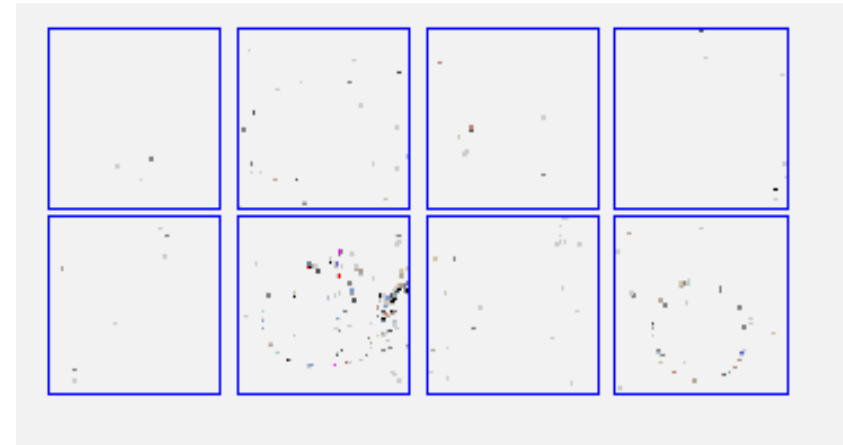
**cumulative event display**



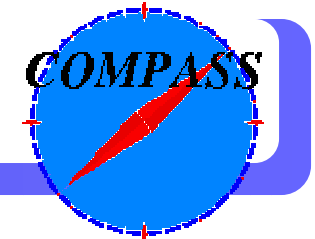
**single event, low intensity**  
80 %  $C_4 F_{10}$ , 2050V



**single event, nominal intensity**  
64 %  $C_4 F_{10}$ , 2000V



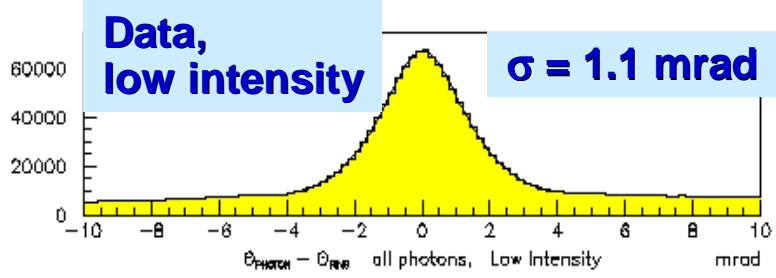
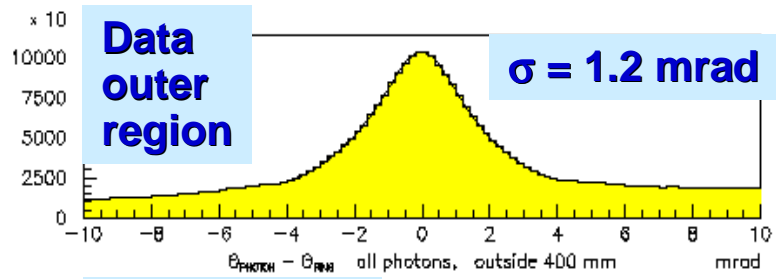
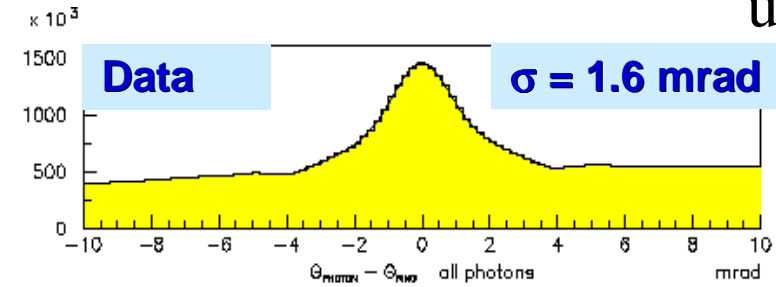
# RICH-1 Cherenkov angles



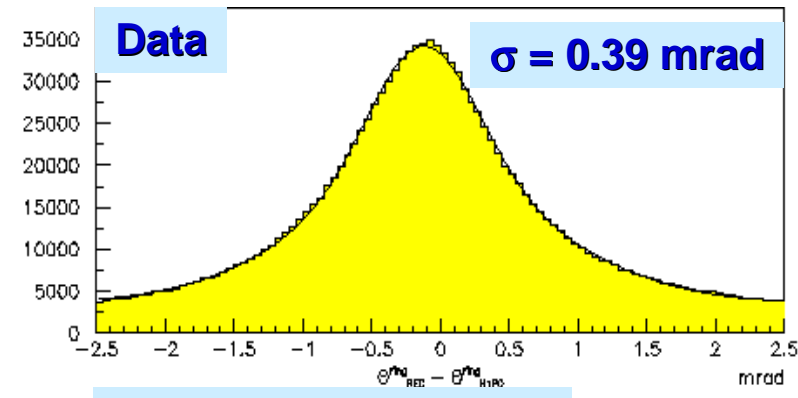
## Single Photon

Present understanding

## Ring



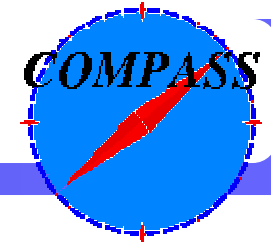
**Monte Carlo:  $\sigma = 0.8 \text{ mrad}$**



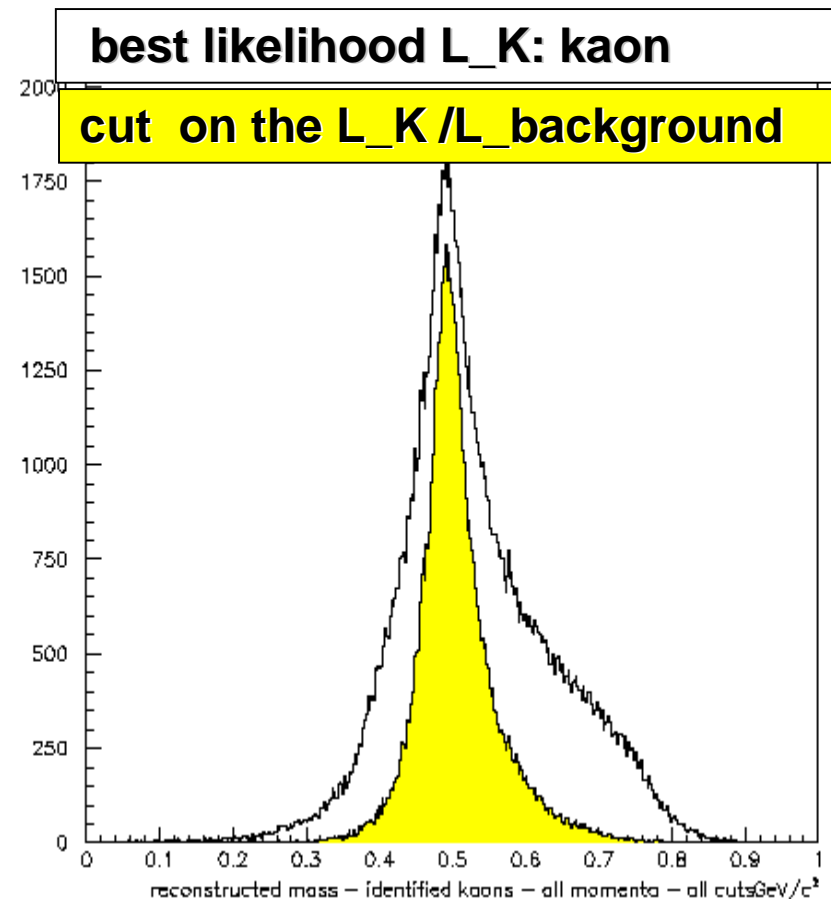
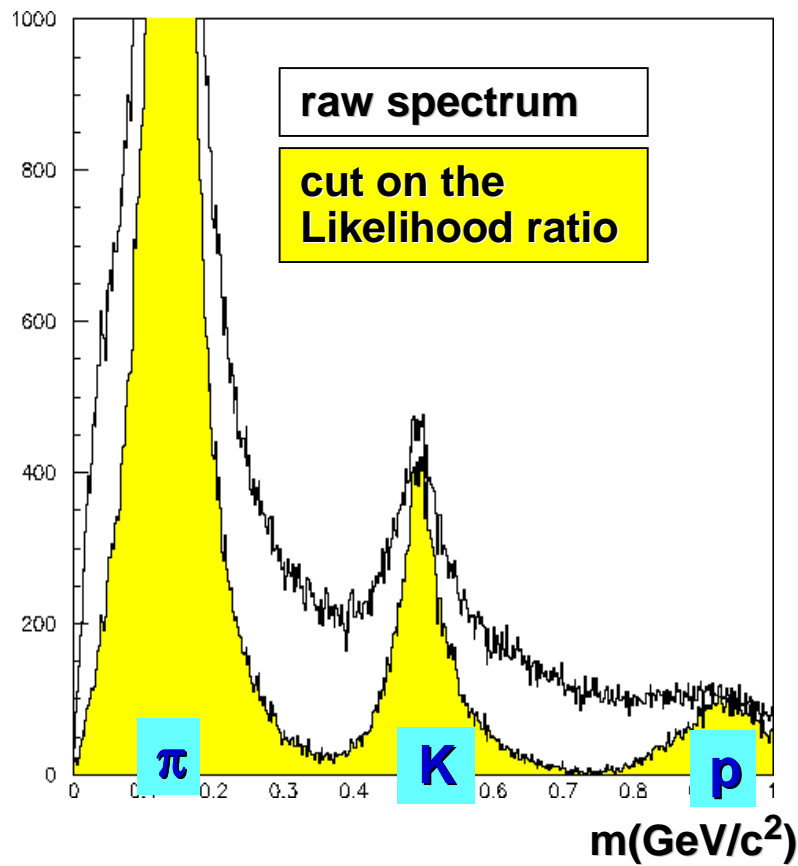
**$\langle n \rangle = 15 \text{ photons}$**

**$\langle n \rangle = 25 \text{ photons}$   
 $\sigma = 0.23 \text{ mrad}$**

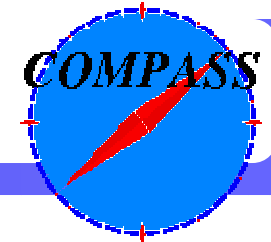
# RICH-1 mass spectrum



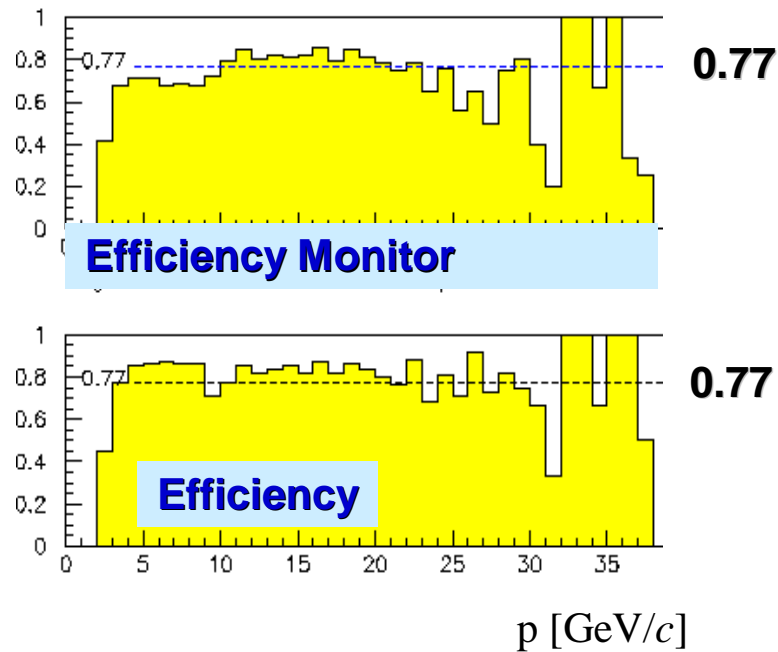
$8 < p < 38 \text{ GeV}/c$



# RICH-1 efficiency

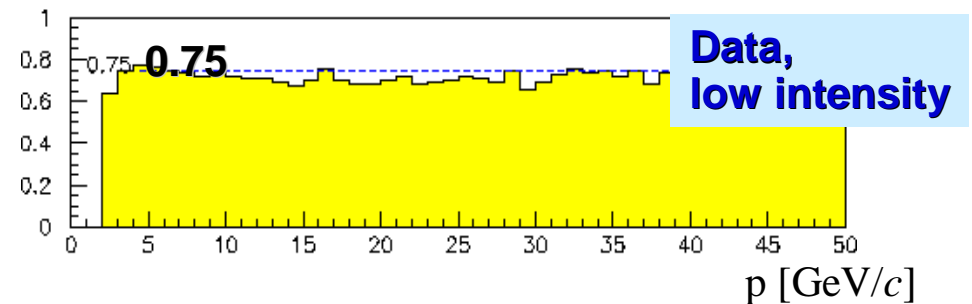
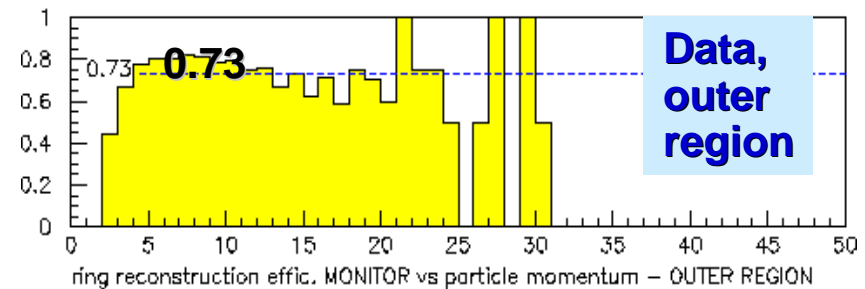
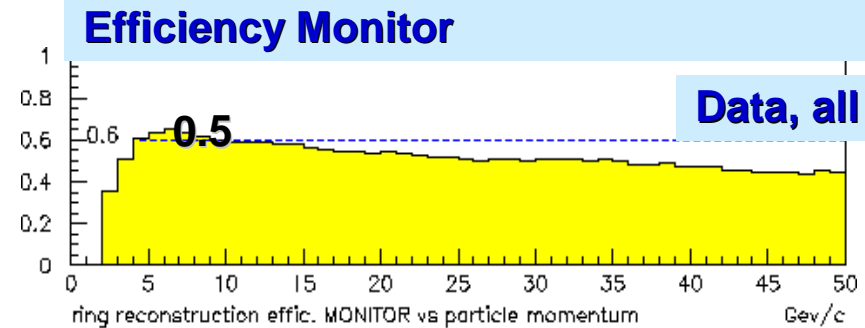


## Monte Carlo

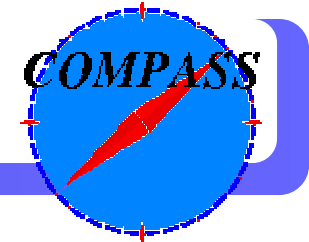


note: estimates include particles below threshold

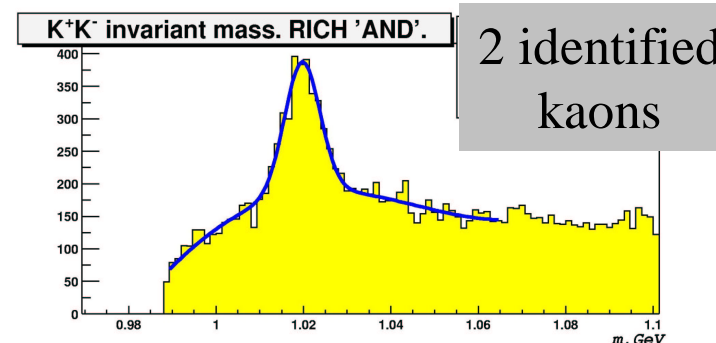
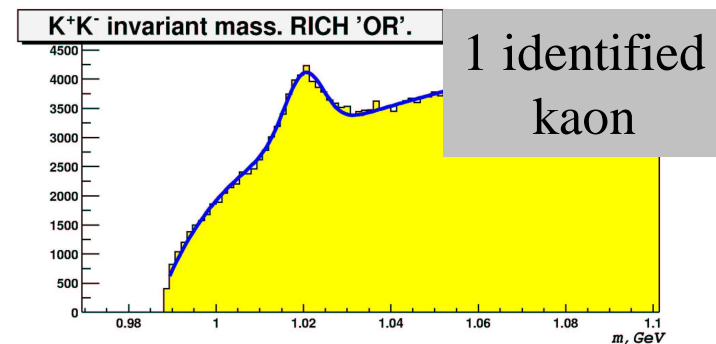
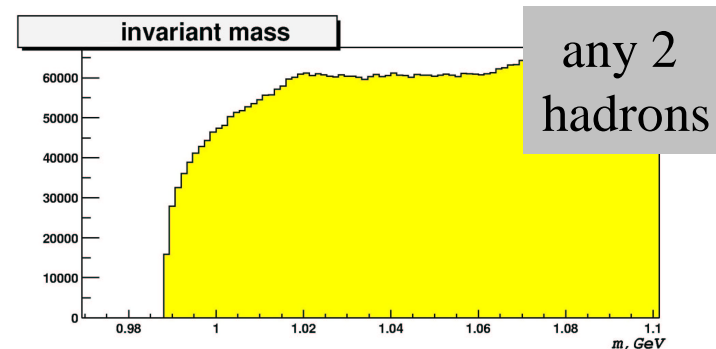
## Data



# RICH-1 efficiency

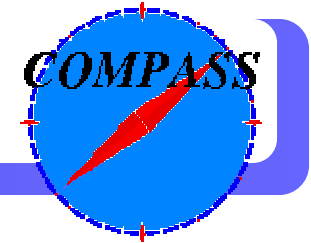


- from:  $\varphi \rightarrow K^+ K^-$
- determine effy as function of  $p$
- input for  $D^0$  Monte Carlo
- evaluate efficiency for kaon identification from  $D^0$  decay
- present result about: 0.35
- note:
  - positive kaon identification
  - previous value of 0.5 includes background
  - In 2003: better chambers.



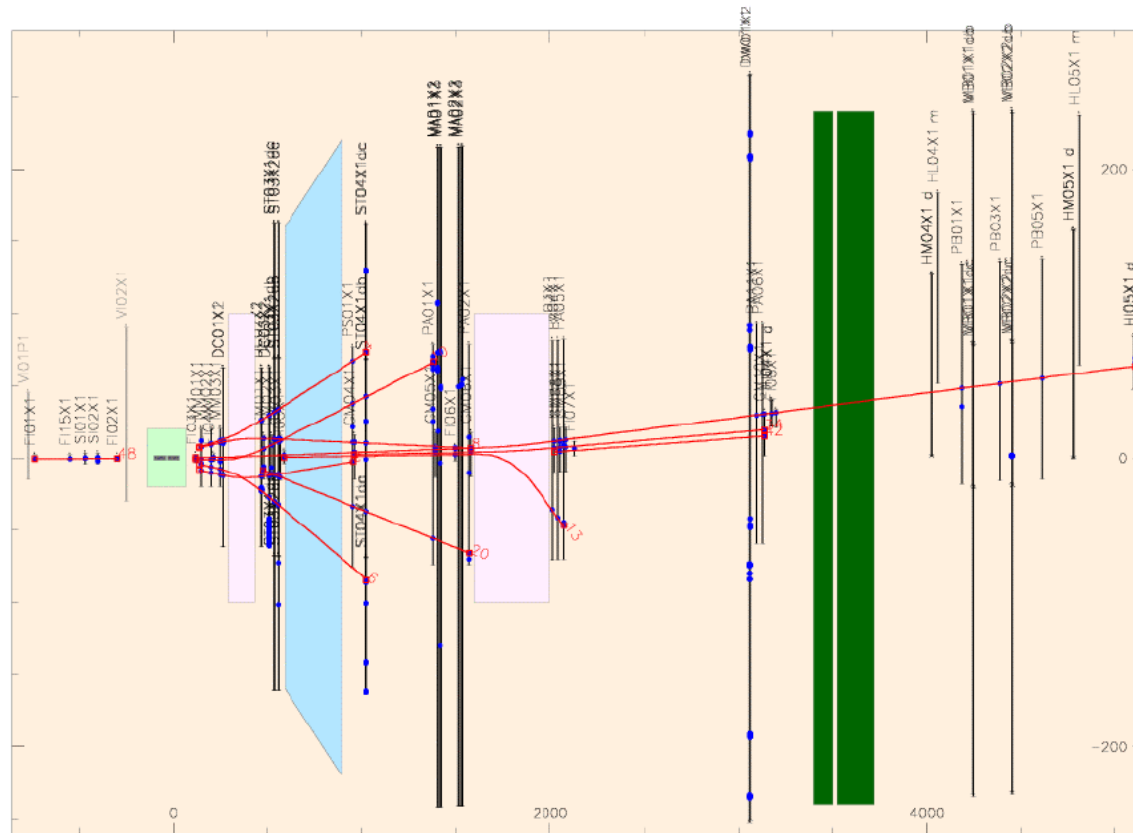


# Reconstruction

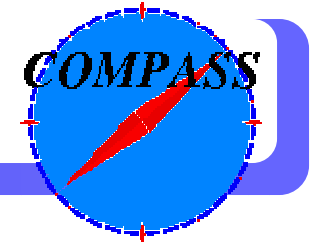


Projection 0.0 deg.

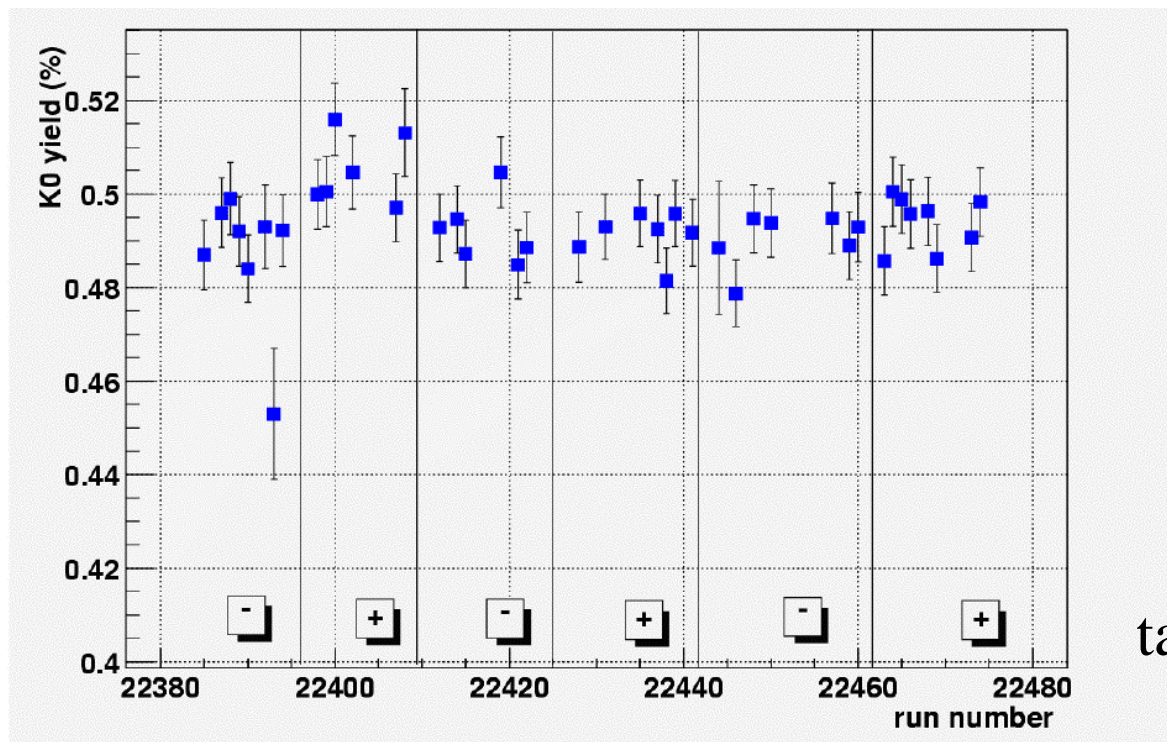
Run 22385 Event 84939982 ( 81, 5326) Trigger(s) 0 Nhits 910



# Reconstruction stability



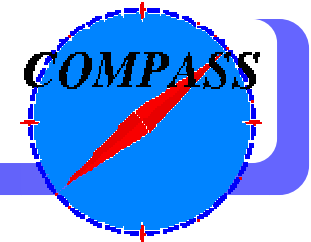
$K^0$  yield as function of run number



zero suppression

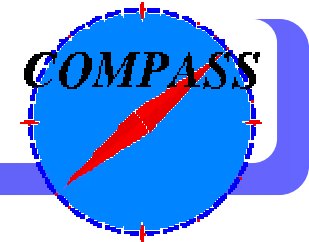
target polarisation

# Reconstruction



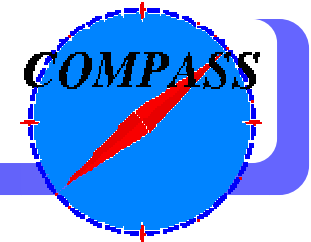
- We are still learning to understand the spectrometer
- Reconstructed today: about 30 % of longitudinal data reconstructed, 15 % analysed
- About 50 % of transverse data, to be repeated
- Still long preparation times (alignment, calibration, code improvements)
- Lost about two months due to data base migration from Objectivity to Oracle
- AND...

# Bottleneck: Computing



- Reconstruction time / event:
    - 1.17 NCU (real time 700 ms, depending on machine)
  - Coco time request for 2003:
    - Based on completion of reconstruction in 4 months
    - Request 105k Si2k
    - Granted only 60k Si2k
    - Effectively get less than 50 Si2k
  - Reconstruction time **doubles!**
  - Further **degradation** due to losses when waiting for staging and due to job crashed
- ➔ Need the full requested CPU power

# Bottleneck: beam time

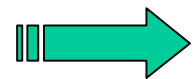
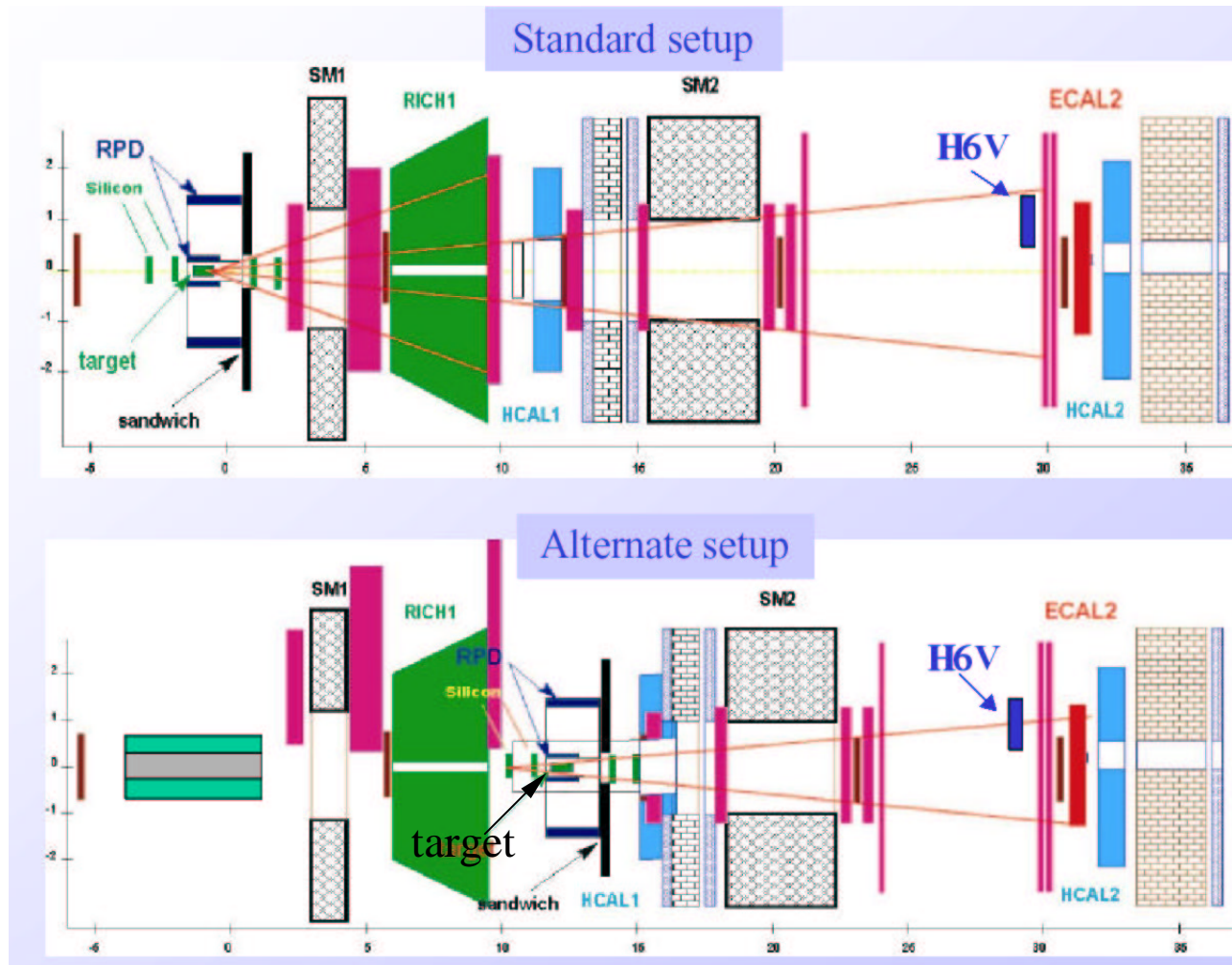
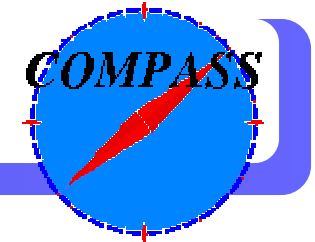


- The COMPASS proposal is based on **150 days** SPS proton operation / year
- In 2002 we got 98 days in 2003 only 78 days!
- Considering a set-up time of only 2 weeks this corresponds to a reduction to **55 % !**

To obtain a meaningful physics results we need a long 2004 run and a compensation for the time lost in 2003

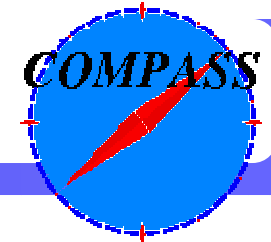
Need result **before 2005** (competition at RHIC and maybe at SLAC)

# Pilot hadron run 2004



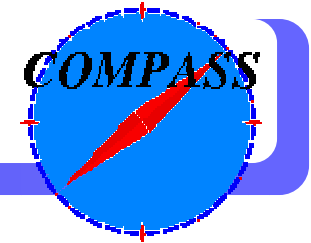
$\pi$ , 190 GeV

# Pilot hadron run in 2004



- Pilot run for **hadron programme**
- Must take place **before the 2005** shutdown
- Originally planned for 2003, but shifted due to further reduction of beam time (PS problem)
- 4 weeks in 2004, 190 GeV pions
- New **alternate set-up** maximizing ECAL coverage as long as ECAL1 not ready, minimize risks: **keep PT in place**
- Need 2 weeks for change over, request to **schedule SPS break** or LHC tests during this time
- Need a **long 2004 running period**, order of 20 weeks
- **See presentation by S. Paul, SPSC Feb. 2003**

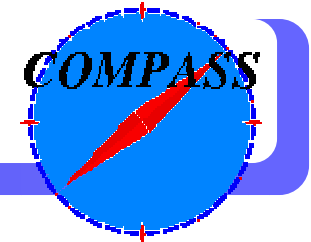
# Completion of spectrometer



- Workshop in Sept. 2002, see S. Paul SPSC Feb 2003
- Preparation of MoU for 2005 – 2010 in progress
- Equipment partly funded, requests being made
- Rich physics potential as laid out in original proposal
- Prospects for new topics (e.g. DVCS, GPD) being studied
- Excellent perspectives for the future



# Conclusions



- 2002 run was most successful
- COMPASS is in production mode
- Reconstruction advanced, to be fine tuned
- Need full requested computing resources
- Beam time is a limiting factor
- Completion of spectrometer under way for 2005-2010