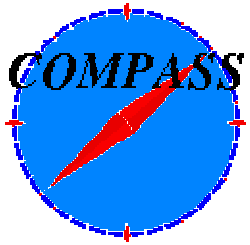
Completion of the Spectrometer



- History
- The initial layout
- Hadron set-up: production of exotics
- EM Calorimetry
- A look to the various programmes
  - Polarisability of Kaons and pions
  - Exclusive meson production and DVCS
  - Double Charm set-up
- RICH-II
- RICH wall tracking detector
- Further tracking options
- Conclusions

G.K. Mallot CERN/EP

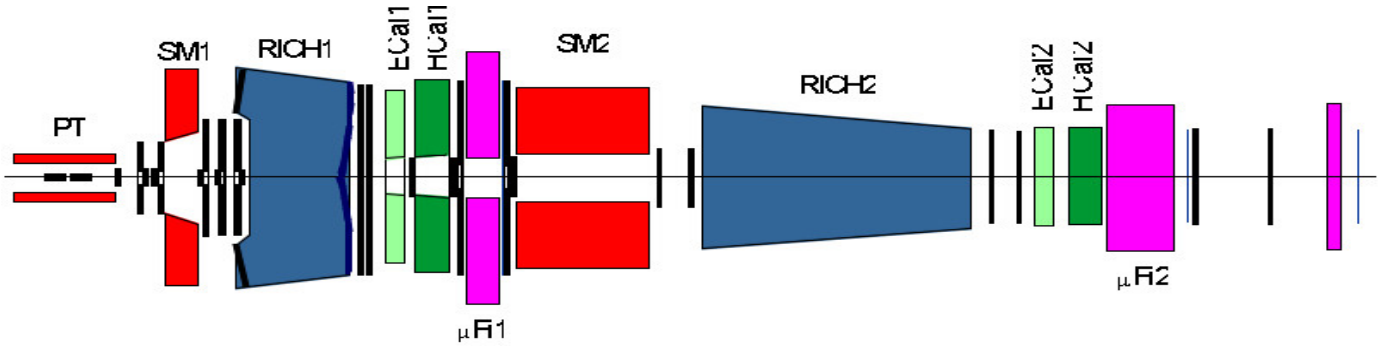
History

- **1996** Mar: proposal for full COMPASS
  - muon and hadron programme
- **1997** Feb: conditional approval
- **1998** adaptation to available resources
  - Jul: approval of reduced 'initial layout'
  - Sep: MoU for initial layout,
    omitting commitments for:
    - Large area tracking and triggering
    - Rich II
    - EM calorimetry
    - Full-scale DAQ

    Goal remains the complete spectrometer

COMPASS initial layout

full layout

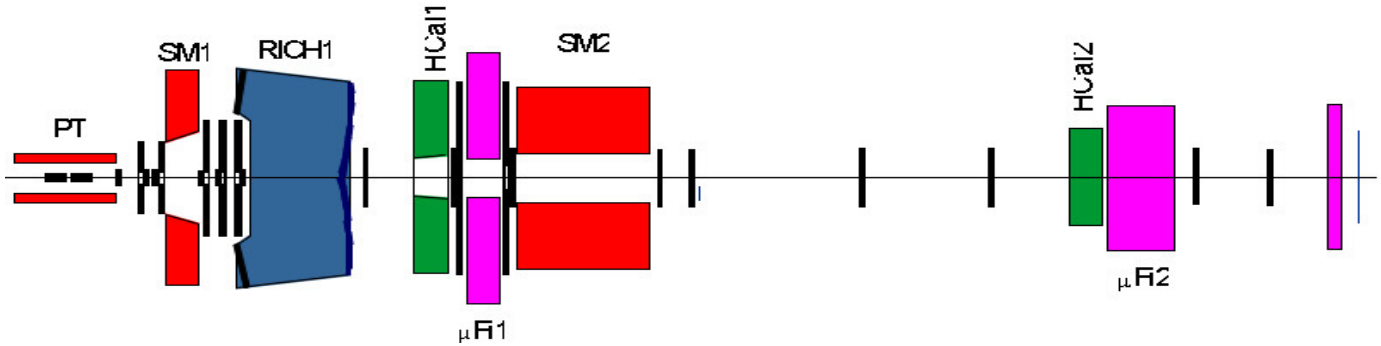


beam

Large angle spectrometer

Small angle spectrometer

initial layout



Physics with initial layout

Missing detectors	Related physics
Large area tracking	High-Q^2 DIS
Rich II	PID only up to 30 – 40 GeV/c
EM Calorimetry, reduced DAQ	Basically no hadron program, apart from semi-leptonic decays

Status of initial layout

Essentially completed

S. Dalla Torre

to do:

- RICH-I
  - 3/8 photon detectors to be fixed for 2003
- Straw detectors
  - 9 of 15 installed and working
  - 5 ready to be shipped mid October 2002
  - 1 to be fixed for 2003
- Polarised target magnet
  - using SMC magnet
  - good performance, limited acceptance

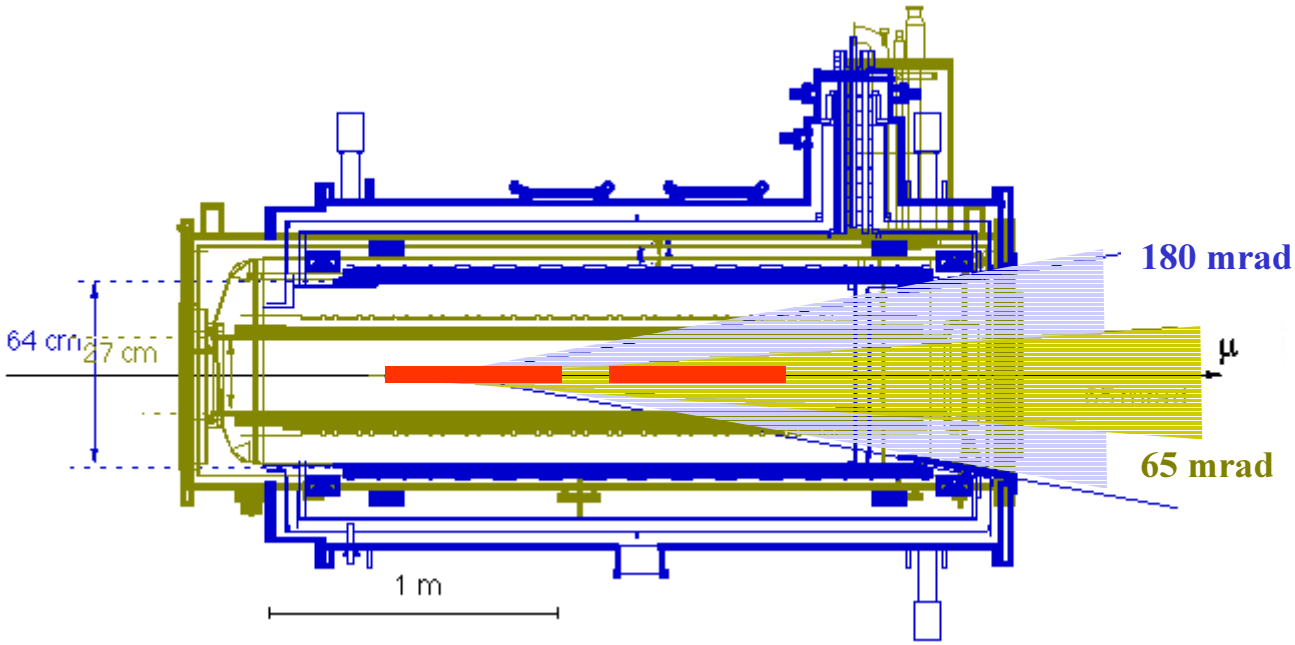
PT Magnet

- Apart from acceptance same specification as SMC magnet
- Construction not satisfactory
- Original contract with OIS terminated amicably
- New contract being negotiated with different company
- Presently magnet being inspected
- Idea: build new coils
- Earliest ready for 2004 run, likely later

PT magnet acceptances

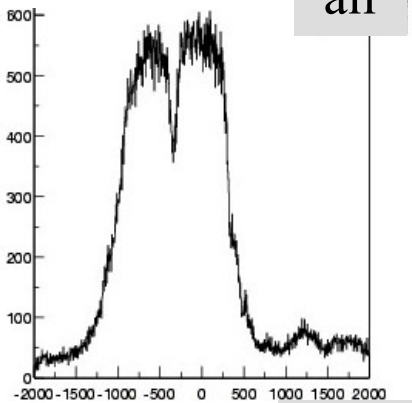
COMPASS magnet

SMC magnet

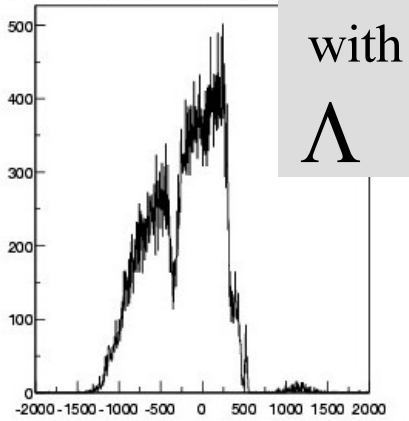


preliminary

all



with Λ



Initial layout ++

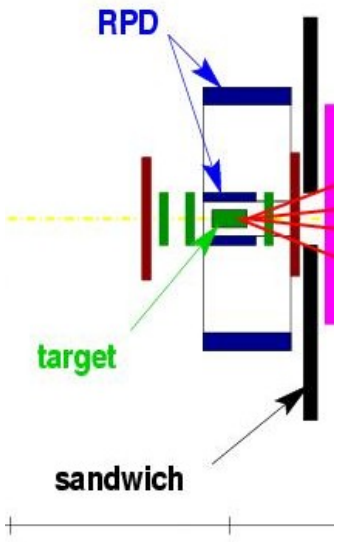
- GAMS 2000 lead glass blocks
- ECAL 1 frame
- Large area tracking
  - Trigger hodoscopes
  - Muonwall 1
  - Muonwall 2
  - SMC W45 chamber
    8 views, performance to be studied
- 3rd Saclay drift chamber
  - Replacing missing straw, 98 % acceptance for SMC magnet
- Extra fibres and MWPCs

Production of Exotics

S. Donskov
V. Dorofeev
M. Moinester

e.g.: $pp \Rightarrow \eta\eta \Rightarrow 4\gamma$

- Existing (to be refurbished):
  - Liquid hydrogen target, 40 cm
  - Recoil Proton detector RPD
- Essential: EM calorimetry, options:
  - ECAL1+GAMS (≡ ECAL2 ')
  - ECAL1+ECAL2
  - Additional wide angle Detector



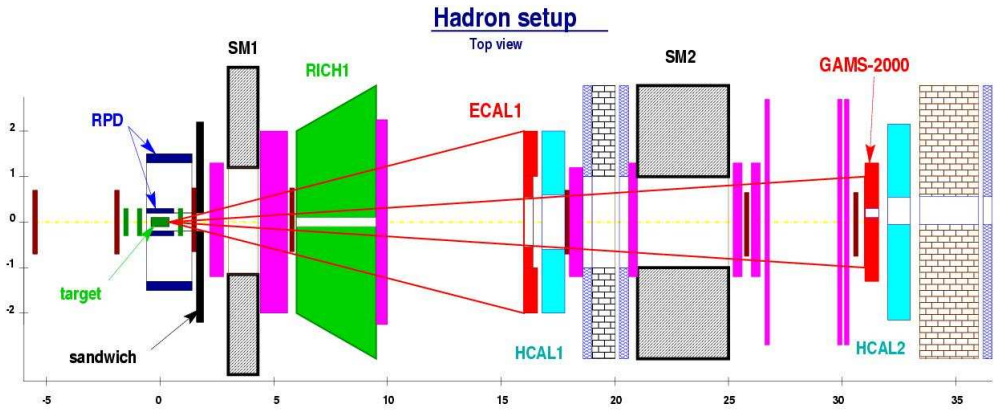
EM Calorimetry

ECAL1 + GAMS

geometrical

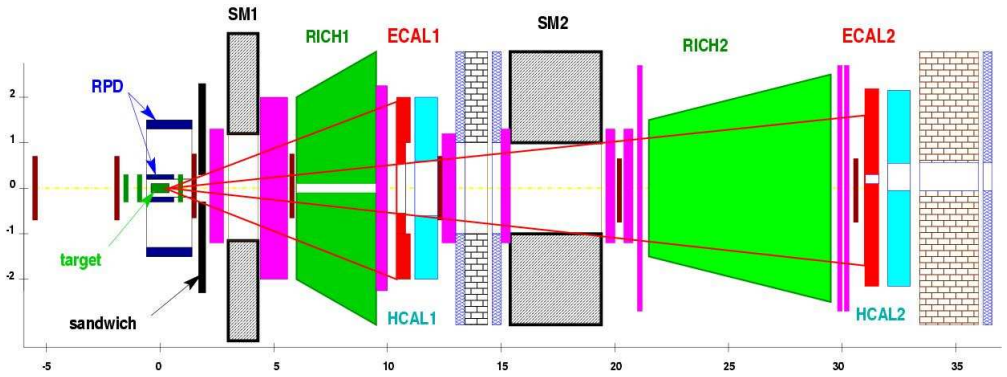
γ-acceptance 18 %

for $\eta\eta(4\gamma)$



ECAL1 + ECAL2

γ-acceptance 36 %



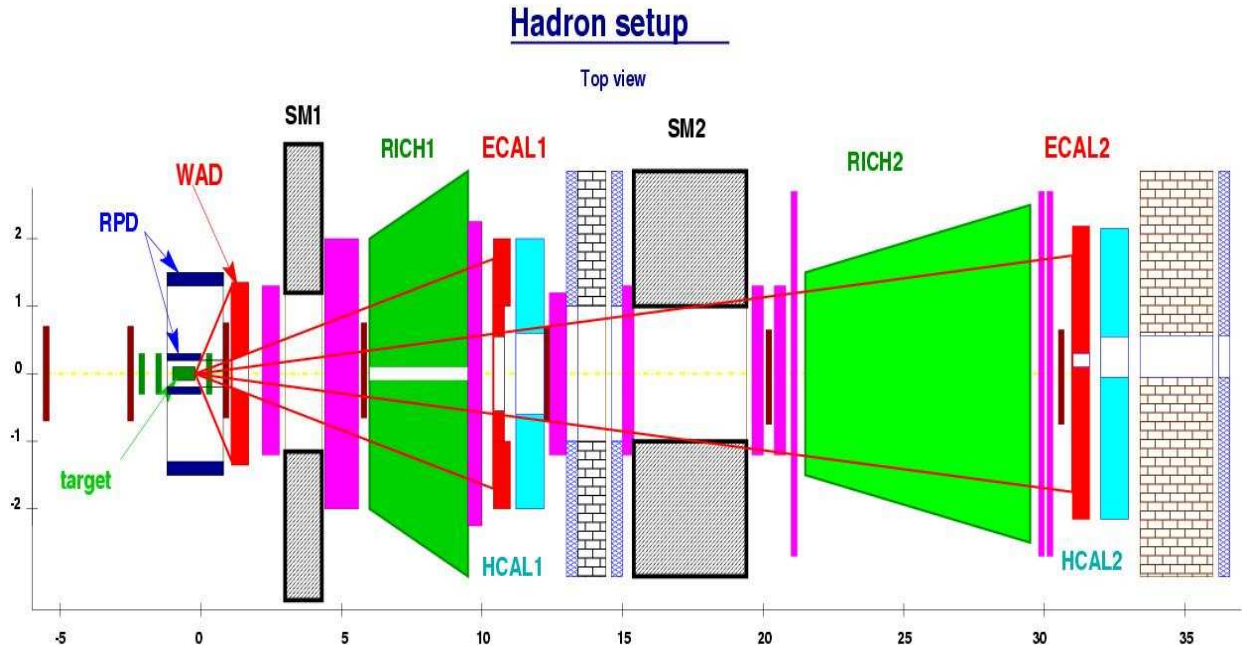
EM Calorimetry

ECAL1 + ECAL+

WAD

γ-acceptance 95 %

$\eta\eta(4\gamma)$



ECAL 1&2

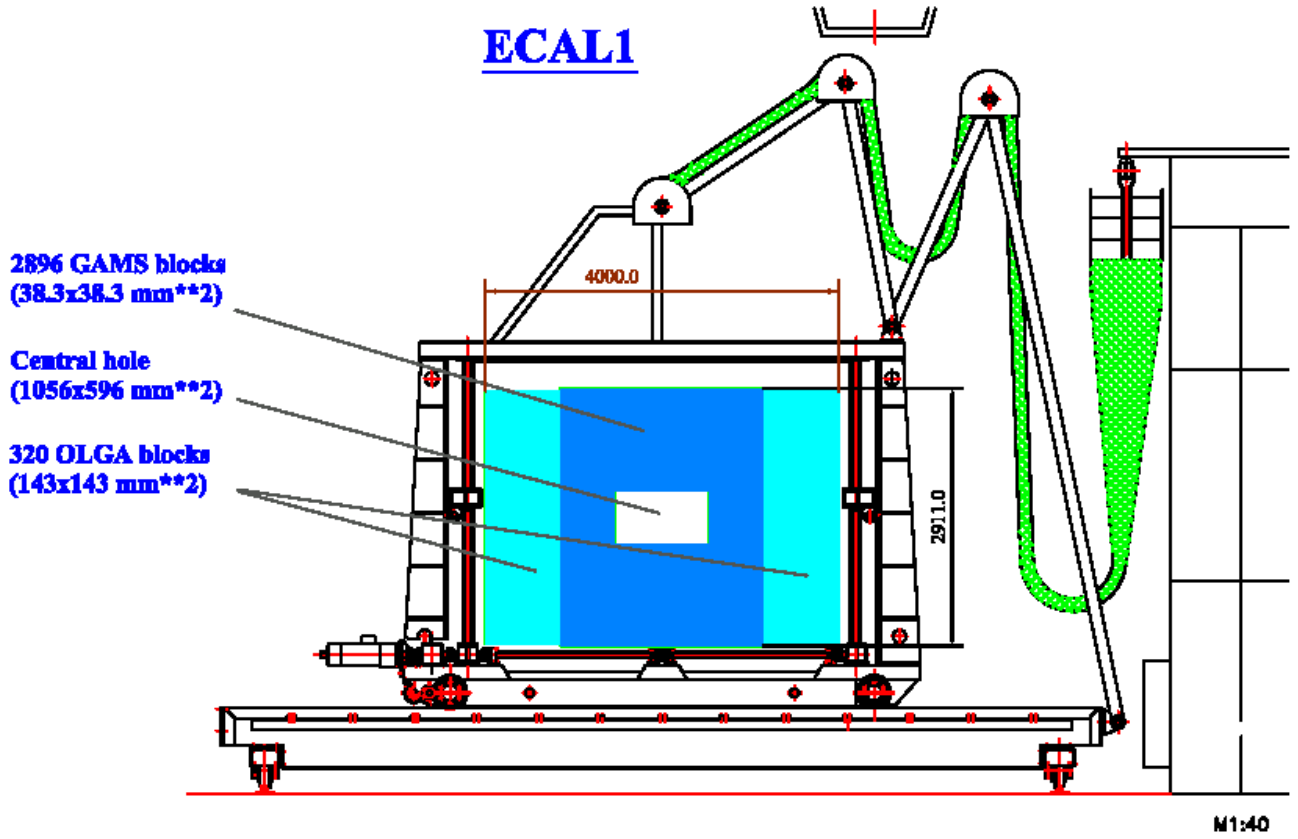
- ECAL1
  - Frame installed
  - Cassette under construction
  - Operational 2004
- ECAL2
  - Design finished
  - Construction to be clarified
  - Operational 2006

- ADC readout

FIADC: Fast integration, about 3000 channels existing of 8000, cables needed!

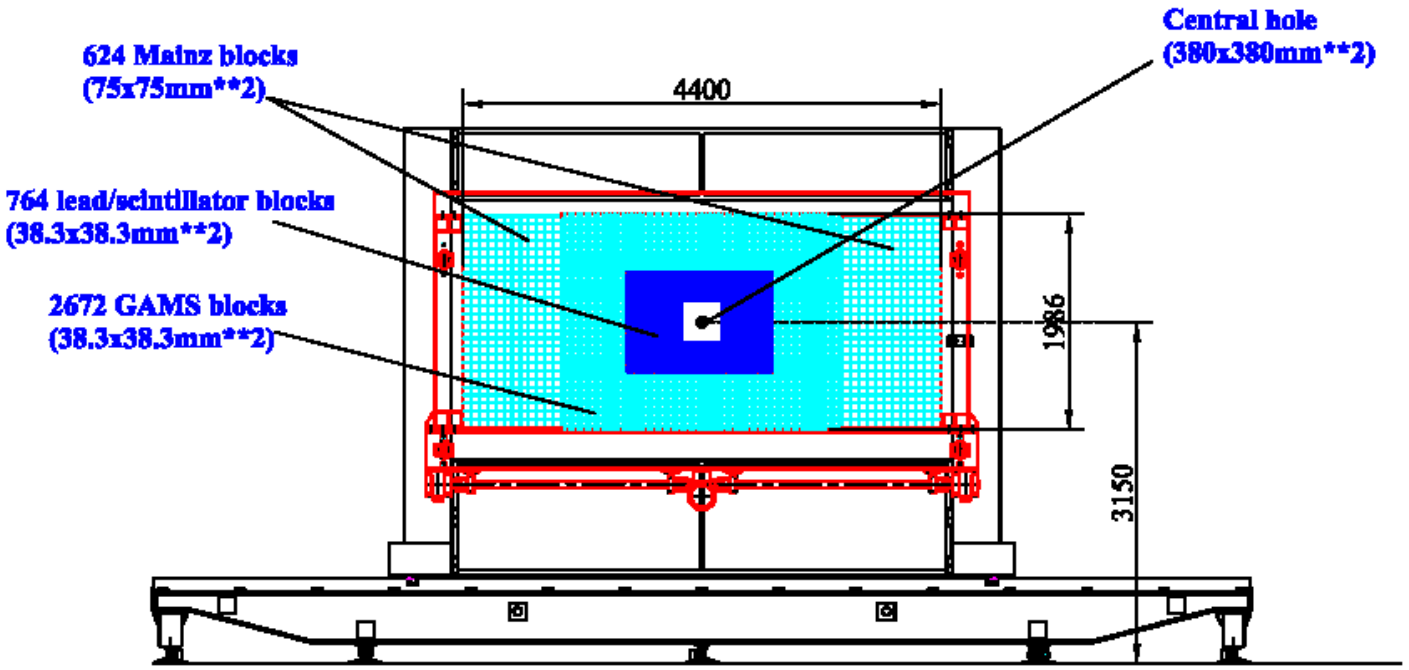
SADC: Sampling ADC, design ongoing

ECAL 1


ECAL1
2896 GAMS blocks
(38.3x38.3 mm**2)
Central hole
(1056x596 mm**2)
320 OLGA blocks
(143x143 mm**2)
4000.0
2911.0
M1:40

ECAL1 frame

ECAL2

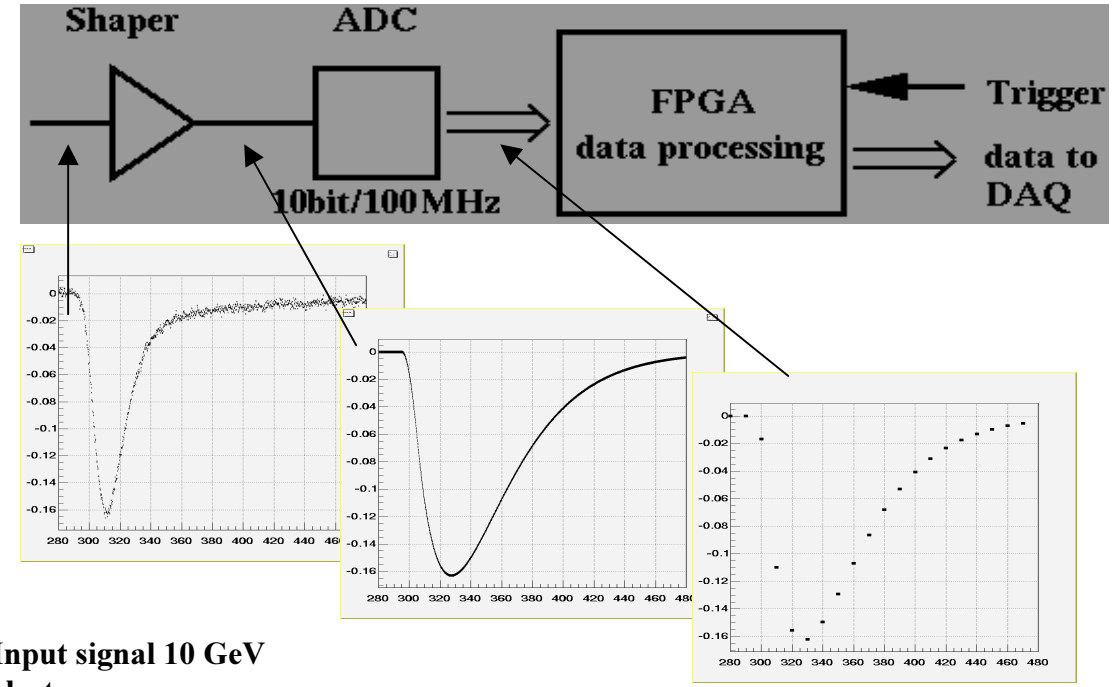

ECAL2
624 Mainz blocks
(75x75mm**2)
764 lead/scintillator blocks
(38.3x38.3mm**2)
2672 GAMS blocks
(38.3x38.3mm**2)
Central hole
(380x380mm**2)
4400
1986
3150

ECAL Sampling ADC

Konorov

- SHAPER
  - Stretching and smoothing
  - optimized for lead glass signals
- ADC
  - 100 MHz sampling
  - 10 bit resolution
- FPGA
  - Data compression
  - Signal fitting
  - ➨ Amplitude and Time

Simplified diagram of single channel ADC



Input signal 10 GeV electron

Reshaped signal

Digitized signal

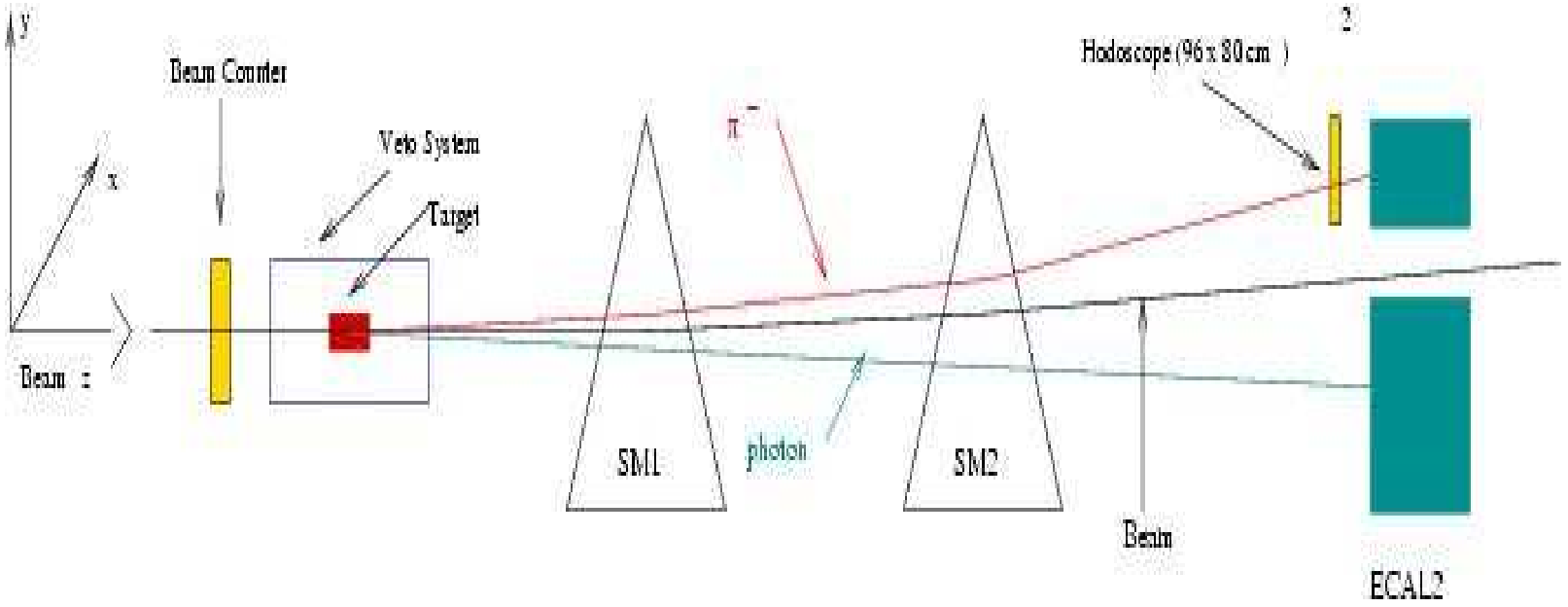
SADC cont.

- **Advantages**
  - elimination of long signal cables
  - very good time resolution 1-2 ns
  - rejection or correction of pileup events
- **Status and plans**
  - The design is being simulated and optimized
  - Full prototype test in summer 2003
  - Production in 2003 – 2004

Polarisability of K and π

- **Kaon and pion beams**
- **Pb target, target veto**
- **EM calorimetry**

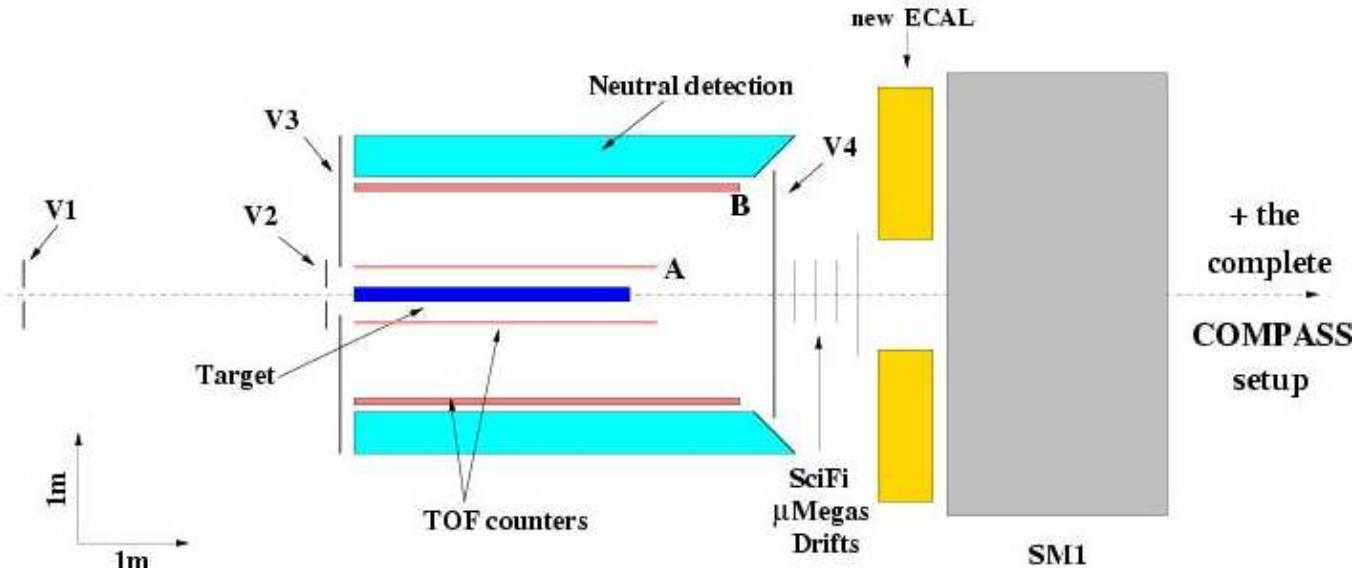
➡ Colantoni



Exclusive mesons and DVCS

$\rho^0 \Rightarrow \pi^+ + \pi^-$ $\pi^0 \Rightarrow \gamma\gamma$ $\mu p \Rightarrow \mu' p' + \gamma$ ➡ d'Hose

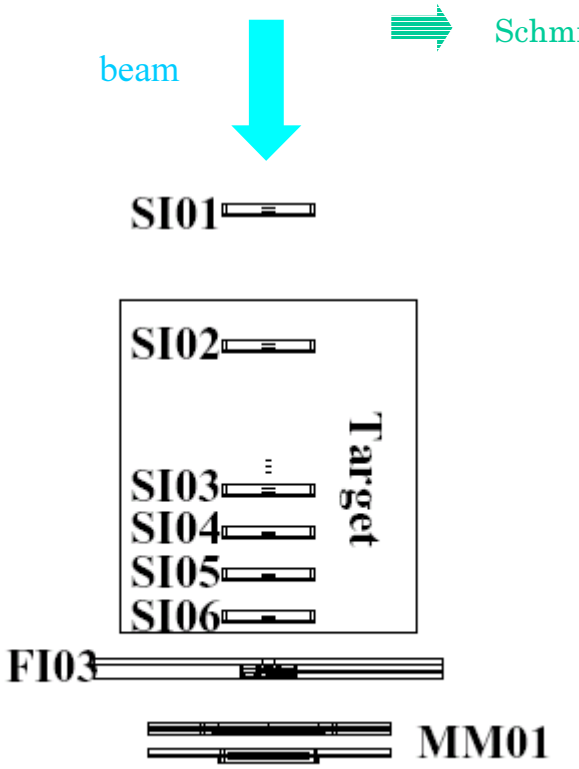
- muon beam needs long liquid hydrogen target
- Recoil proton detector
- maybe same wide angle ECAL as for exotics



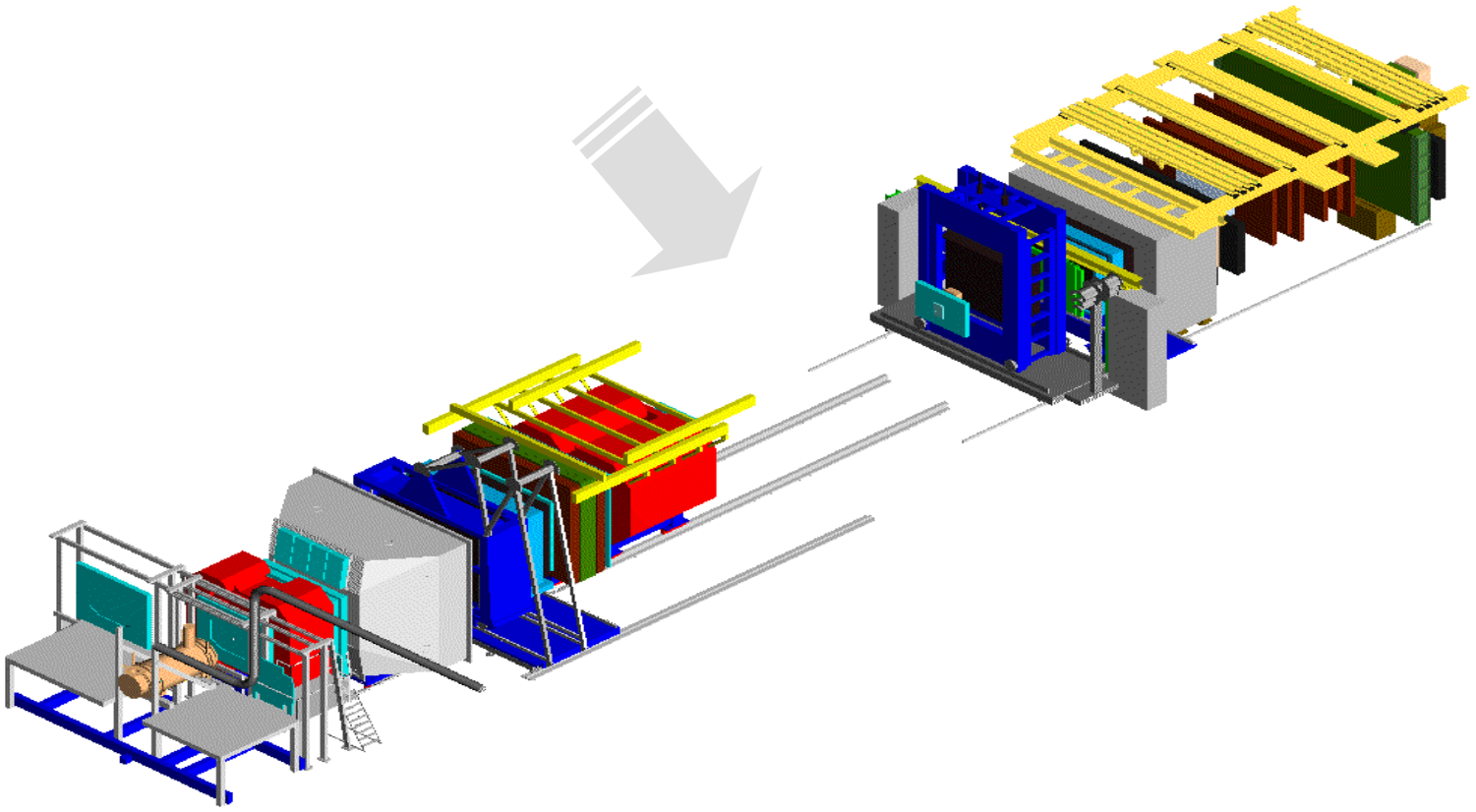
Double Charm target set-up

- Production of double charm hadrons

- Proton beam 280 GeV
- Pack of silicon detector for decay vertices
- DAQ upgrade
- Second level trigger/filter farm indispensible



Space for RICH-II

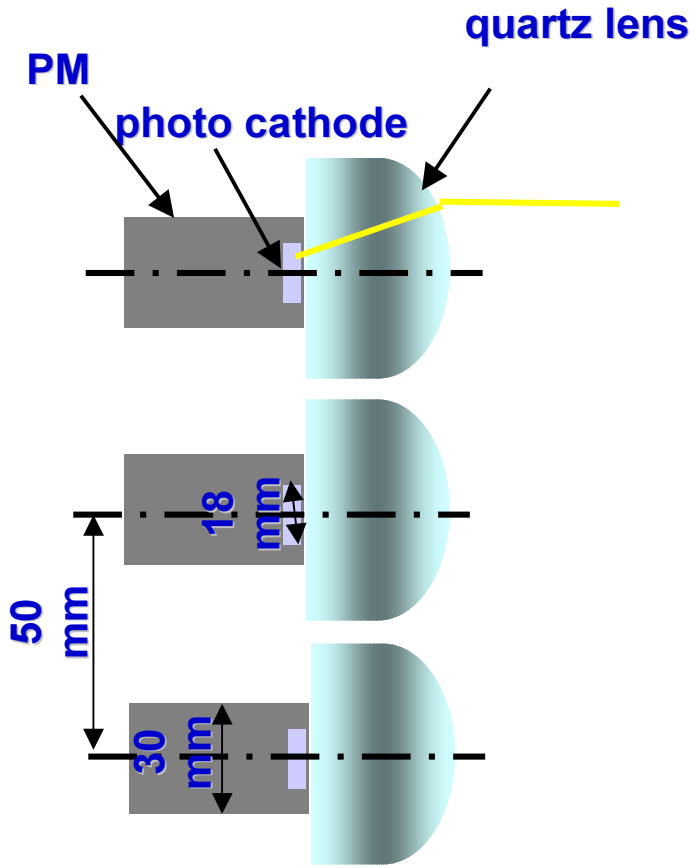


RICH-II

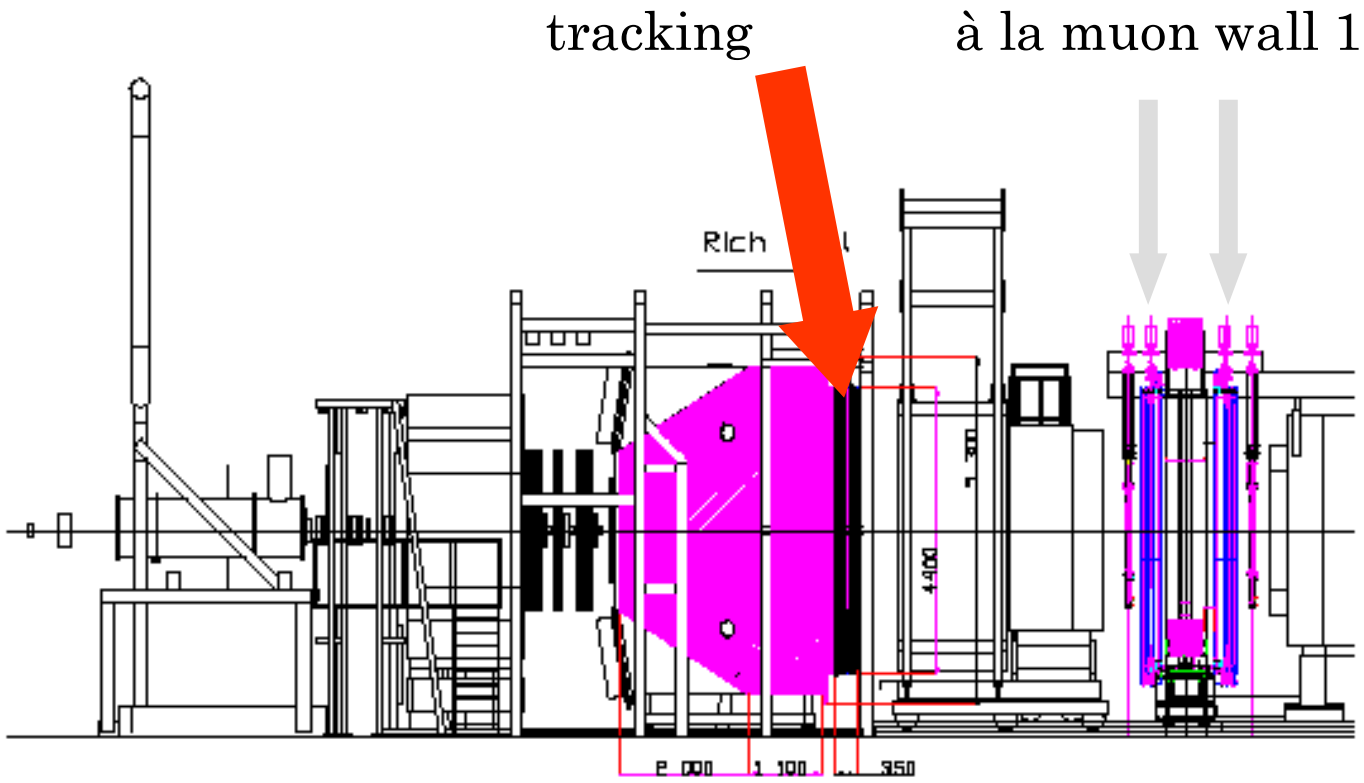
- baseline proposal (under discussion):
  - π/K separation 30 – 120 GeV/c as in proposal
  - covers up central region and high momentum region,
    where RICH-I is weaker (e.g. beam pipe)
  - use photons in visible and near UV ($\lambda > 200$ nm)
    RICH-I operates in $\lambda < 200$ nm (CsI), less photons
  - keep resolution unchanged $\sigma_{\gamma,\vartheta} \cdot \sqrt{n_\gamma} \propto \mathrm{cost}$
  - can release spacial (angular) resolution
  - option: multi-anode PM: HAMAMATSU H6568-03
    already about 100 in COMPASS (SciFi)

RICH-II photon detection

- fast RICH, less pile-up
  - 10 ns vs 1 μs RICH-I
- reasonably simple
  - could be achieved for 2007
- large number of γ per ring
- readout
  - 1120 PMs per 2.8 m^2
  - 18000 channels
  - effective pitch: ~ 11 mm

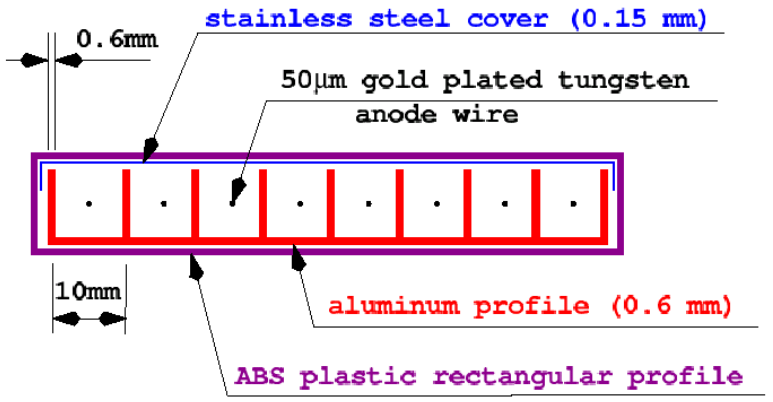


Rich Wall Detector



Rich Wall

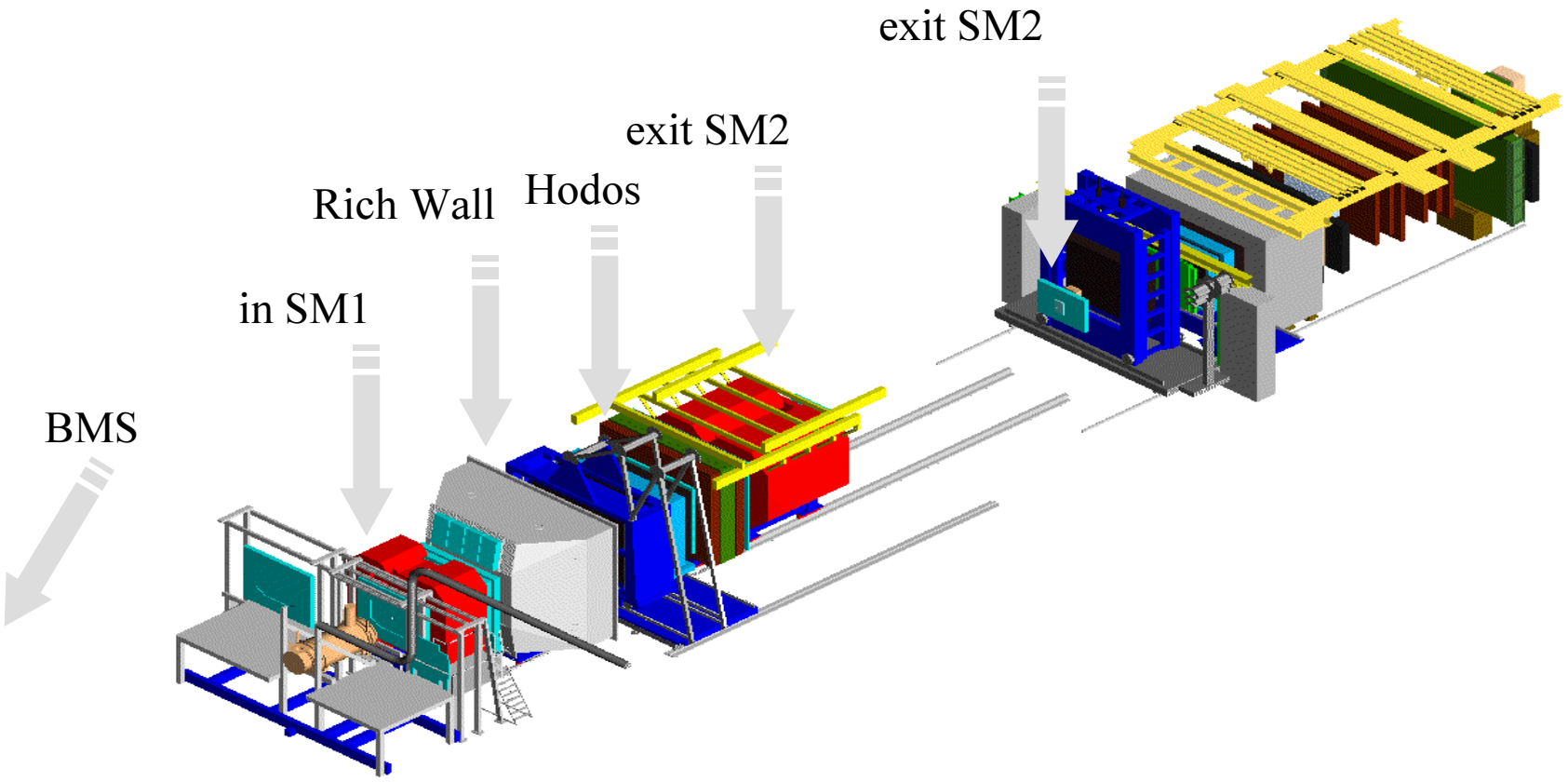
- Improvement of Cherenkov ring resolution
- Improvement of momentum resolution
- Similar technique as muon wall 1
- Eight planes of 5.3x4.3 m^2
- Ready for 2004, if approved in 2002



Further tracking options

- Strengthening of beam momentum reconstruction in BMS
  - two more planes (currently 4 planes, 92 % efficiency)
- Chamber in first spectrometer magnet
  - to improve pattern recognition and resolution
  - Larger tracking downstream of magnet SM2
- New large Q^2 hodoscopes in muon wall 1
  - presently calorimetric trigger only
- Larger tracking downstream of magnet SM2
  - current trackers smaller than aperture
- Replacing old SMC large-area drift chambers
  - 2002 performance to be understood

Further tracking options



Conclusion

- Projects of various maturity
- A must: EM calorimetry and DAQ filter
- Important: RICH-II and more tracking
- Planning for completion has started
- Still open for good suggestions AND ….
  ….. new collaborators