FUTURE

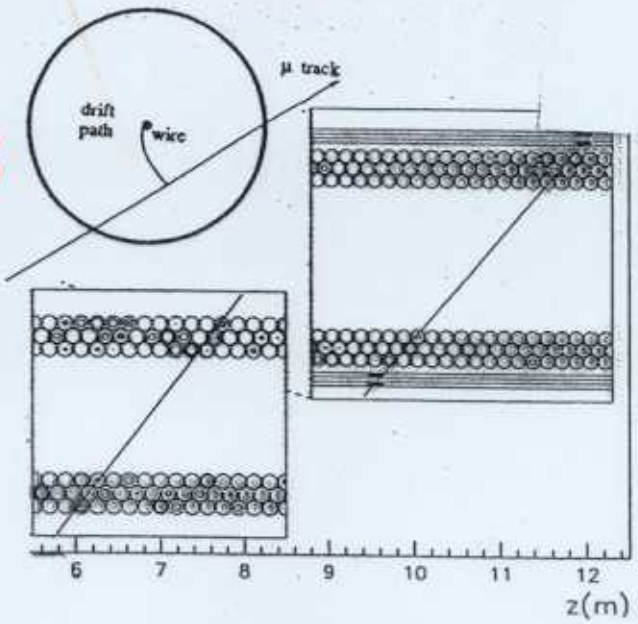
II

Why?

DRIFT GAS DETECTORS
still DOMINATE!

ATLAS

371 488 TUBES
770m^3 at 3 bar
Ar:CH_4:N_2
CO_2



CMS
191 440 WIRES
500m^3 at 1 bar
Ar:CO_2 ?

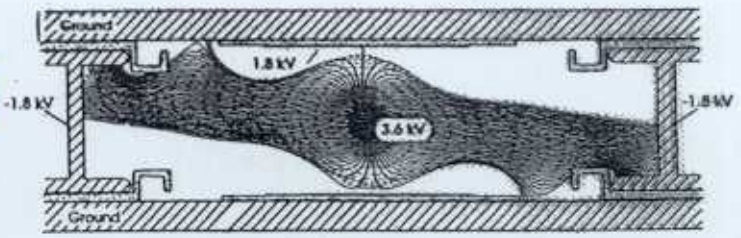
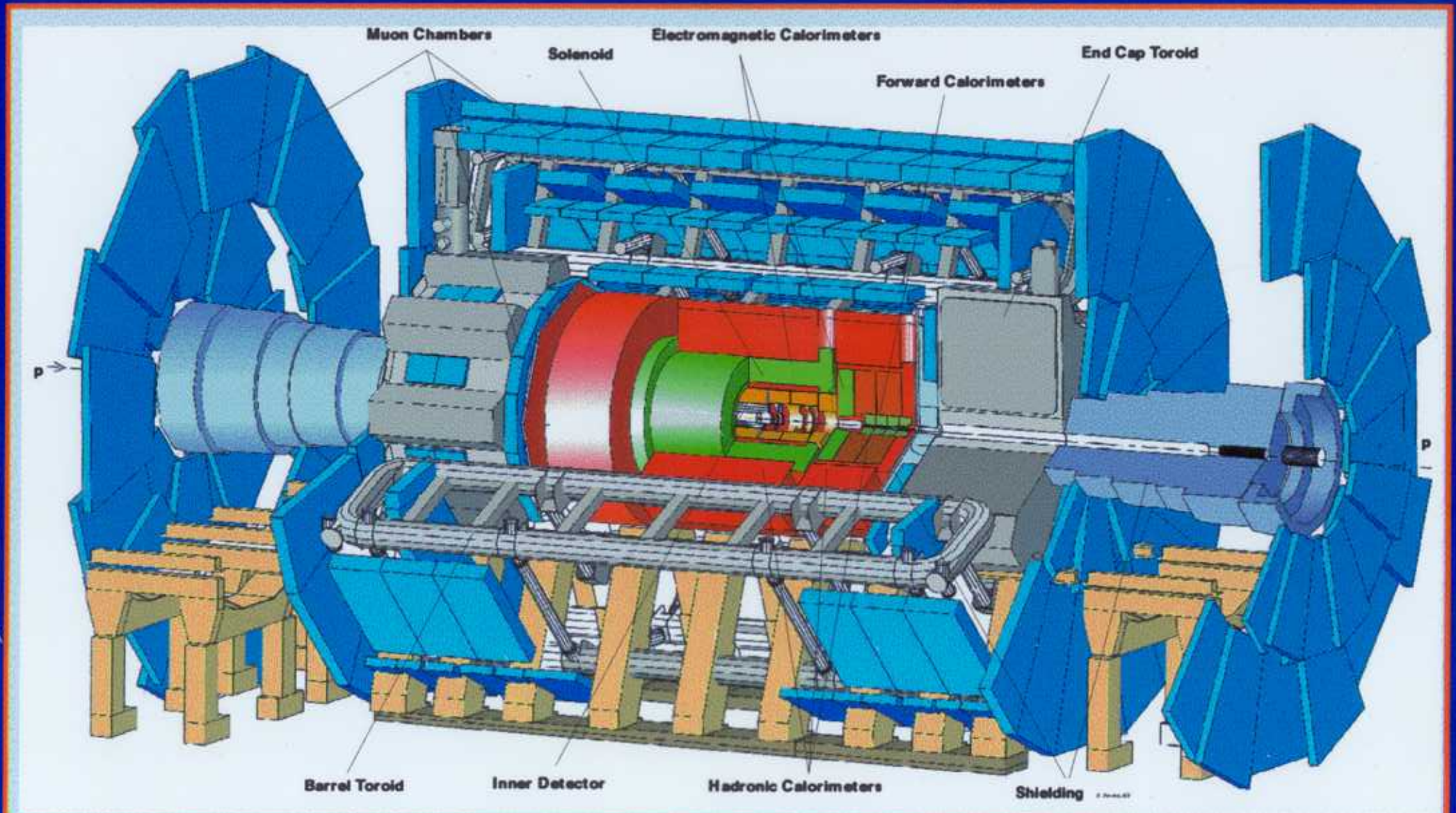


Fig. 3.9.2: The drift cell of the CMS barrel muon detector under the influence of a magnetic field of 0.45 T parallel to the anode wires. The drift gas is Ar (85%) CO_2(15%).

Barbar,Blast,LHC-b He:Isobutane..

ATLAS
A Toroidal LHC Apparatus



ATLAS - Muon

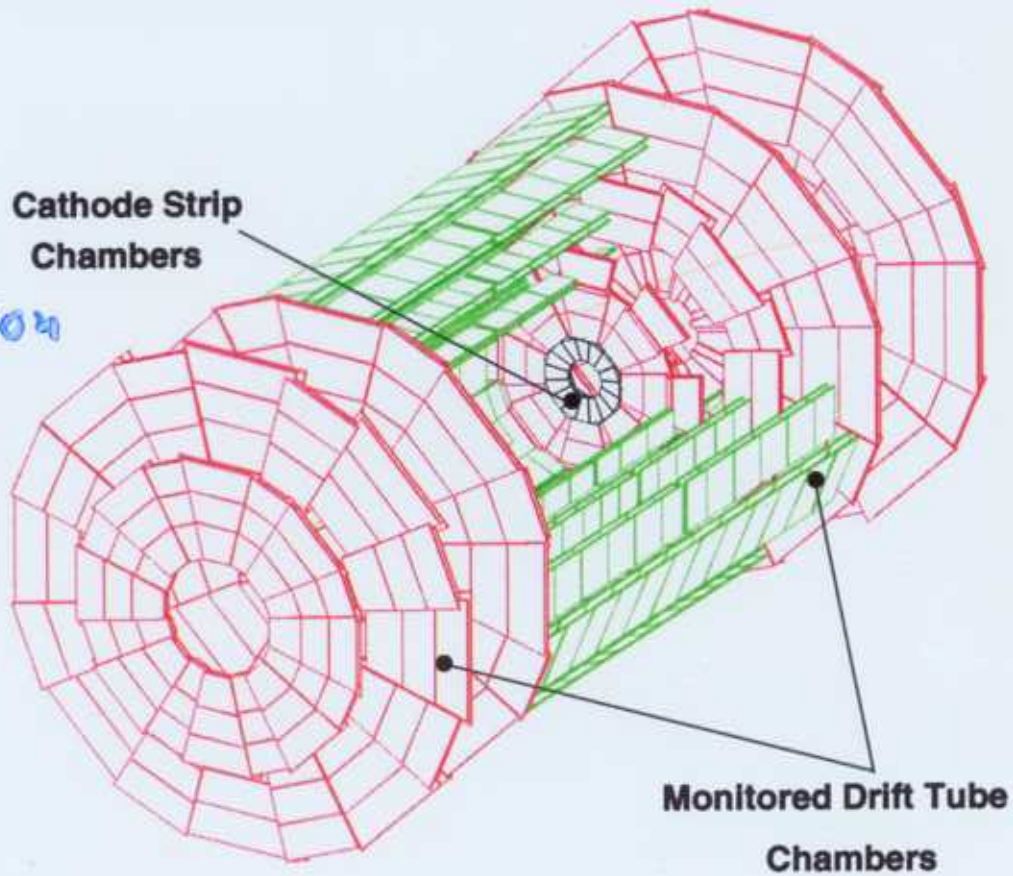
Precision Chambers

Monitored Drift Tube (MDT) chambers are used.

371 k tubes

3 bar, small diffusion

- single cell resolution of better than 80 μm;
- precise mechanics;
- multiple track sampling;
- low occupancy.



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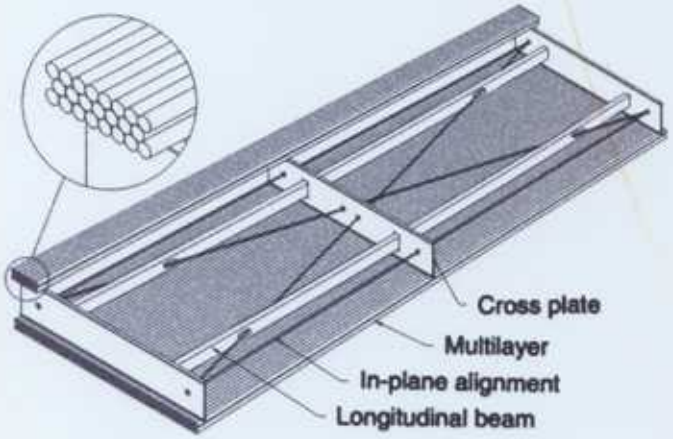
ATLAS

Monitored Drift Tubes

The MDT chambers are made of two multilayers of pressurized aluminium drift tubes separated by a 50 to 320 mm high spacer and support structure . The latter comprises an in-plane alignment system which monitors chamber deformations.



A multilayer consists of three (or four) layers of dense-packed drift tubes. Each tube determines the vertical distance between a charged particle track and the wire from the arrival time of the first ionization electrons.

Parameters:

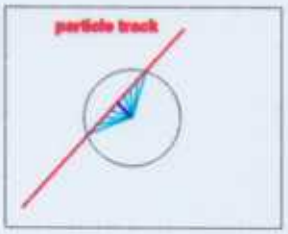
- Tubes:
  outer diameter: 30 mm
  wall thickness: 0.4 mm
- Wire: 50 µm W-Re (gold-plated)
- 370.000 channels

Operating conditions: ageing

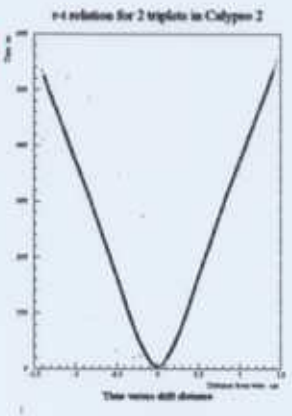
- Ar:N_2:CH_4 (91:4:5)
- gas pressure: 3 bar (absolute)
- HV: 3.25 kV (gas gain: $2 \cdot 10^4$)

Performance:

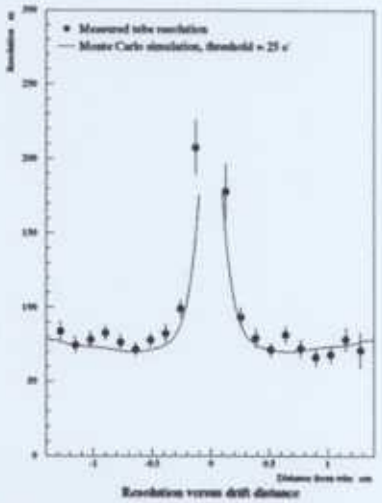
- efficiency: > 99 %
- streamer fraction: < 0.1%
- max drift time = 480 ns
- $\langle\sigma\rangle$ = 80 µm (single tube)



When a charged particle traverses the tube, the gas along its passage is ionized and the electrons drift towards the central wire.



The relation between time and distance is deriv ed from overdetermined track fits ('autocalibration').



Test beam results from Pavia/ Rome prototype chamber

y02K167

DOE

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Optimization of drift gases for accuracy in pressurized drift tubes

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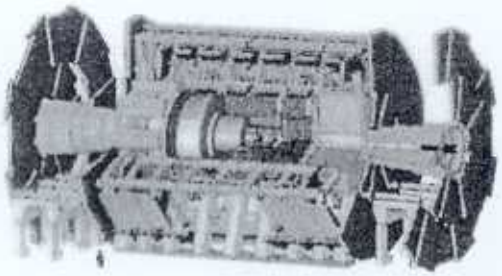
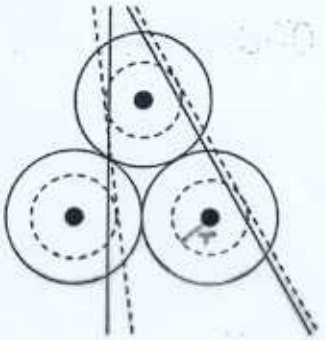
Laboratory of Nuclear Science, Massachusetts Institute of Technology, Cambridge, MA 02139, USA

Submitted to the MIT Department of Physics in partial fulfillment of the requirements for the degree of Bachelor of Science in Physics

June 2000

ATLAS

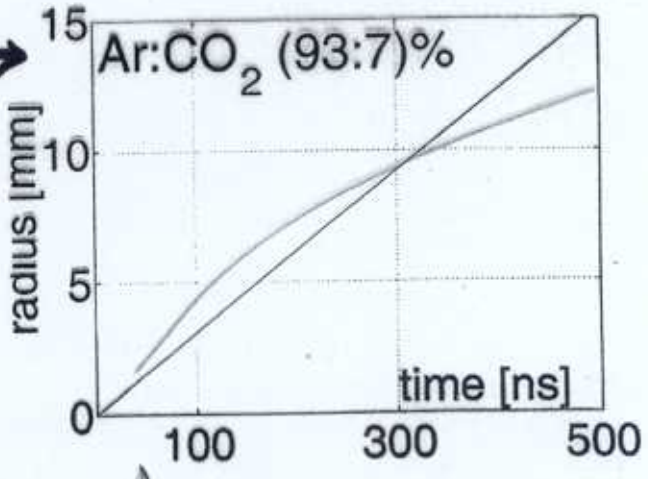




$E \propto \frac{1}{r}$

$r - t$

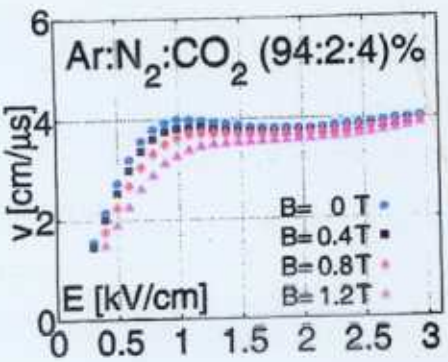
Original Gas aged, now →

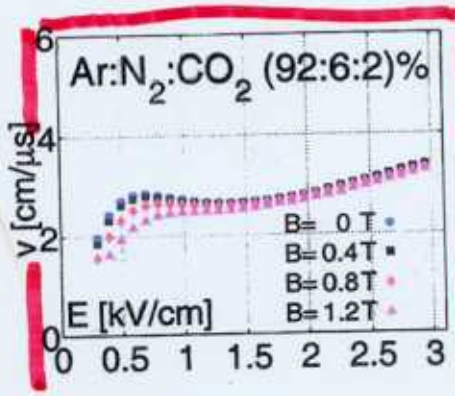


↑ LARGE CORRECTIONS!

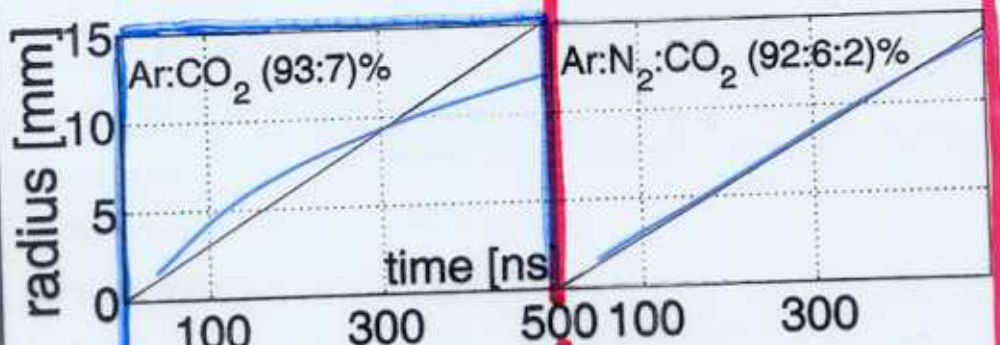
Space-time Relation

Results for a better space-time relation





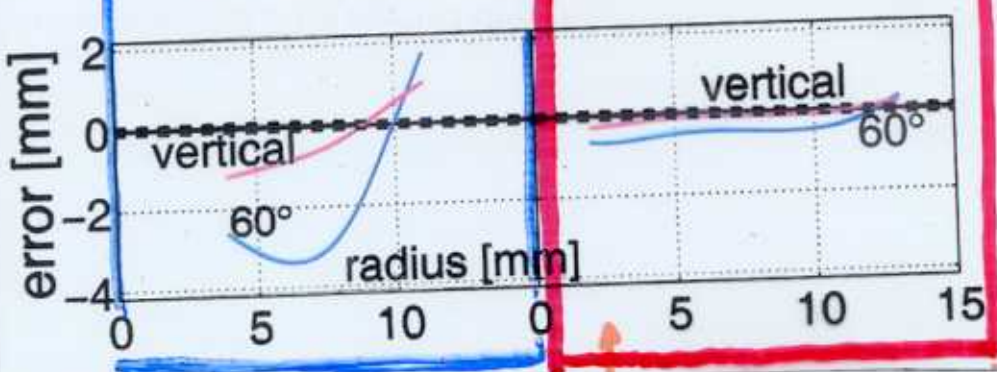
$E \sim \frac{1}{r}$



~ linear

corrections

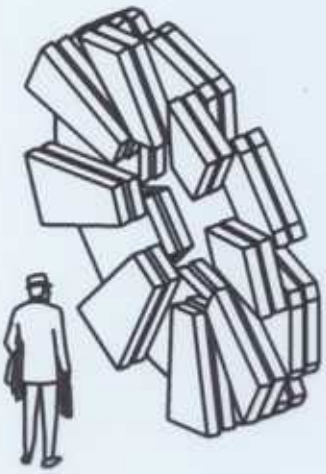
Reconstruction ~~Errors~~



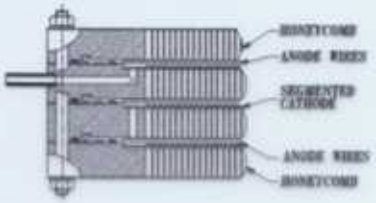
smaller corrections

ATLAS

Cathode Strip Chambers



CSCs are multiwire proportional chambers. The precise position measurement is achieved by determining the centre of gravity of the charge induced on the cathode strips arranged perpendicular to the wires. The 2nd coordinate is obtained by reading either the anode wires or additional strips parallel to the wires.



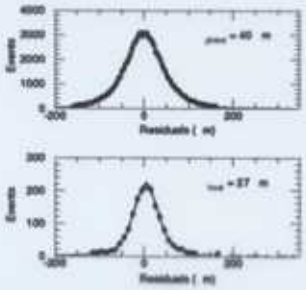
Each chamber contains three wire planes.

Parameters:

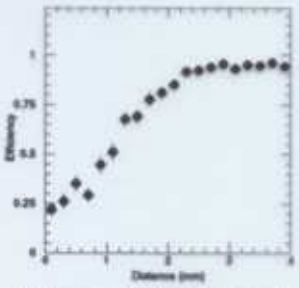
- Typical size: 1 x 1 m^2
- 64.000 channels

Operating conditions:

- Ar:CO_2 :CF_4 (30:50:20)
- HV: 3.2 kV



Global and local resolution as measured in a test beam



Measured double track resolution as a function of track distance

Performance:

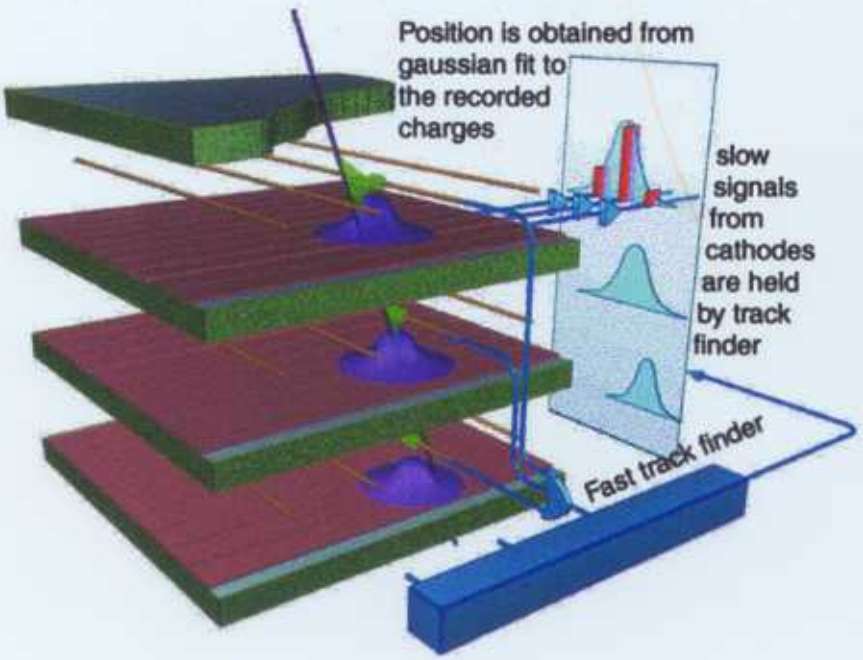
- high rate capability (max. drift time: 25 ns)
- high granularity (strip pitch: 5 mm)
- spatial resolution: $\langle\sigma\rangle$ = 60 μm
- double track efficiency: 95% at 2mm

View of a prototype CSC in the M2 test beam at CERN

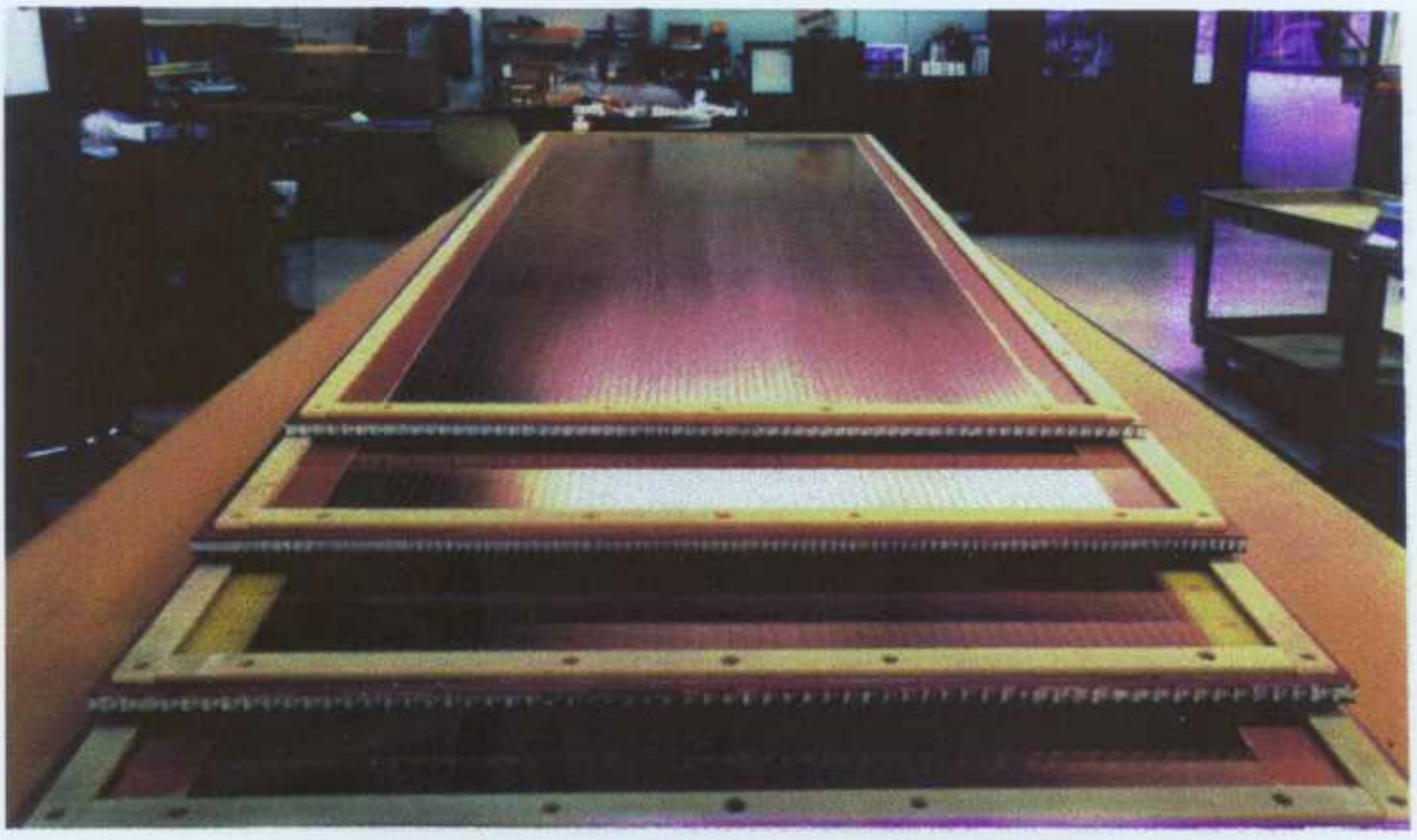
Construction:

Chambers will be built in the USA and Russia.

Forward CMS
Cathode Strip Chambers



The electrons are collected by the wire, whereas a cloud of positive ions moving away from the wire toward the cathode induces charge on the perpendicular cathode.



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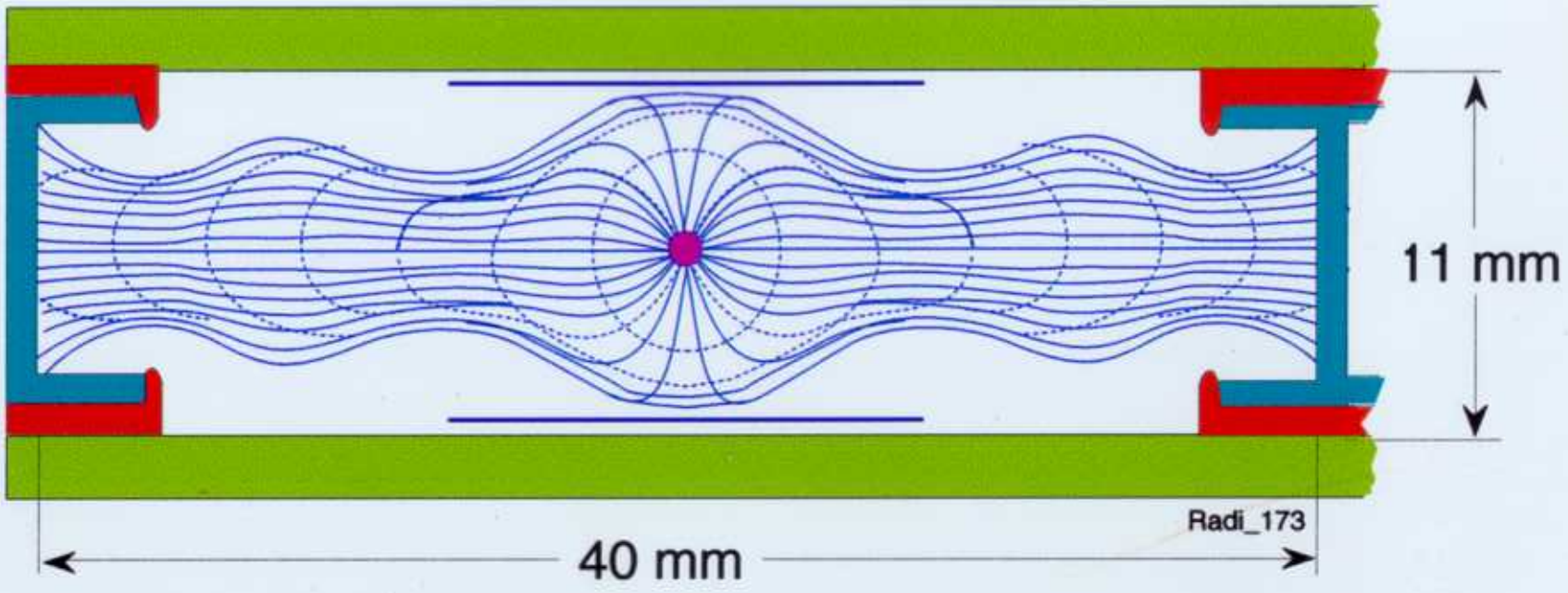
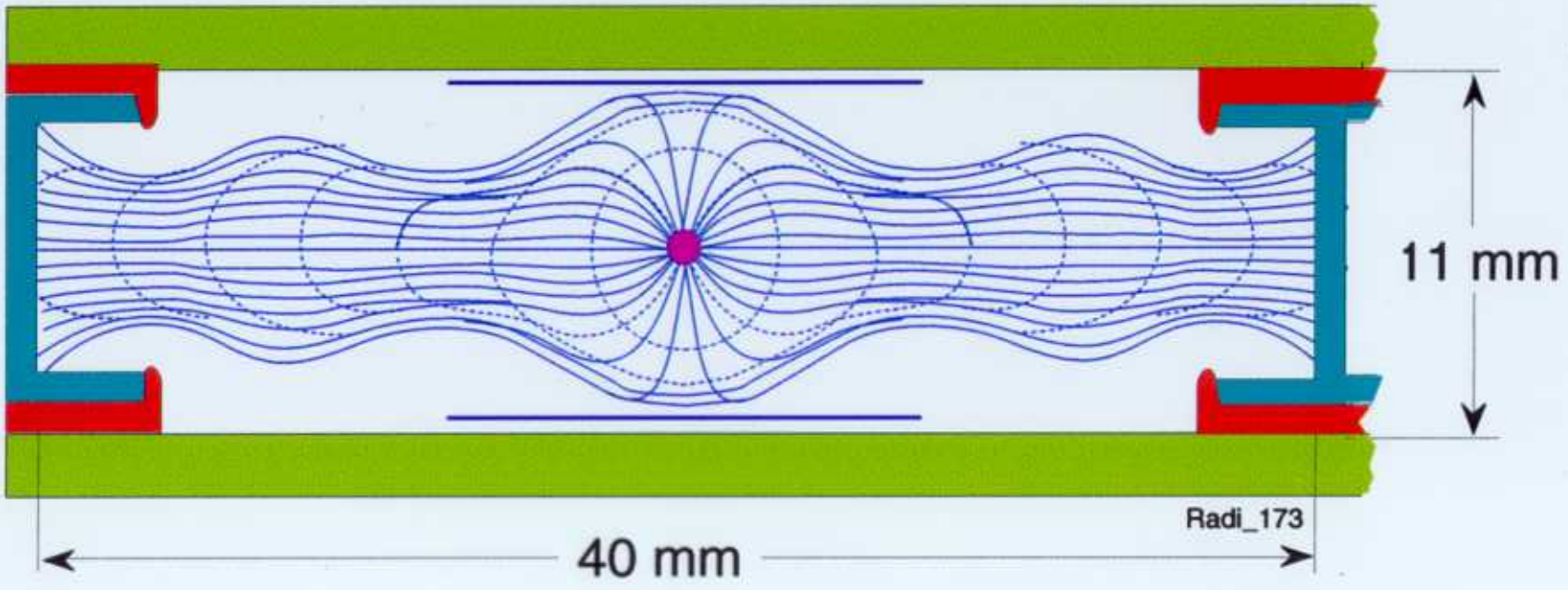
CMS

Drift cells, B = 0





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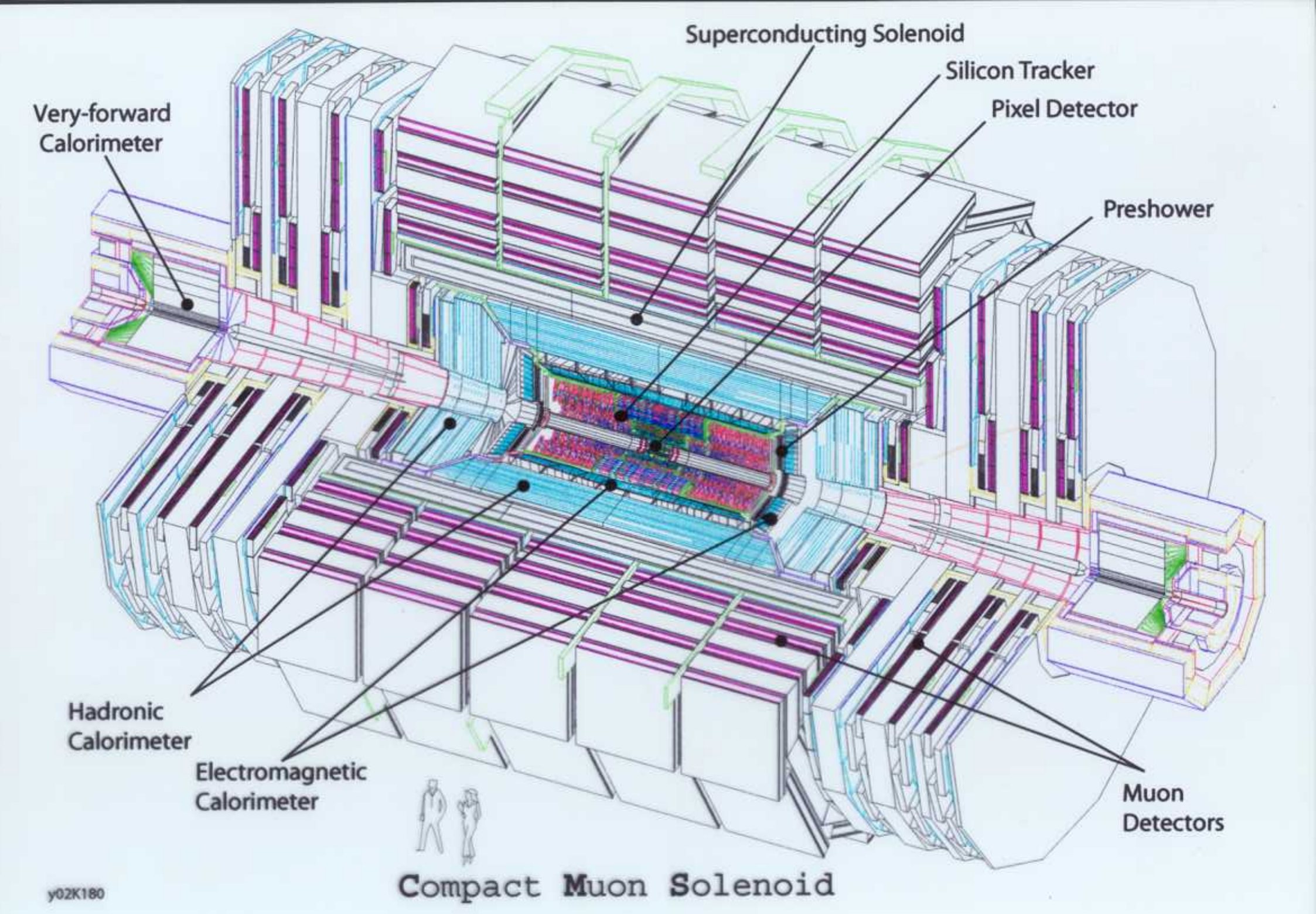
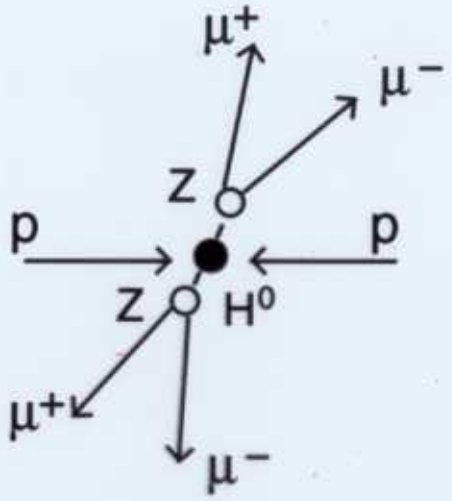
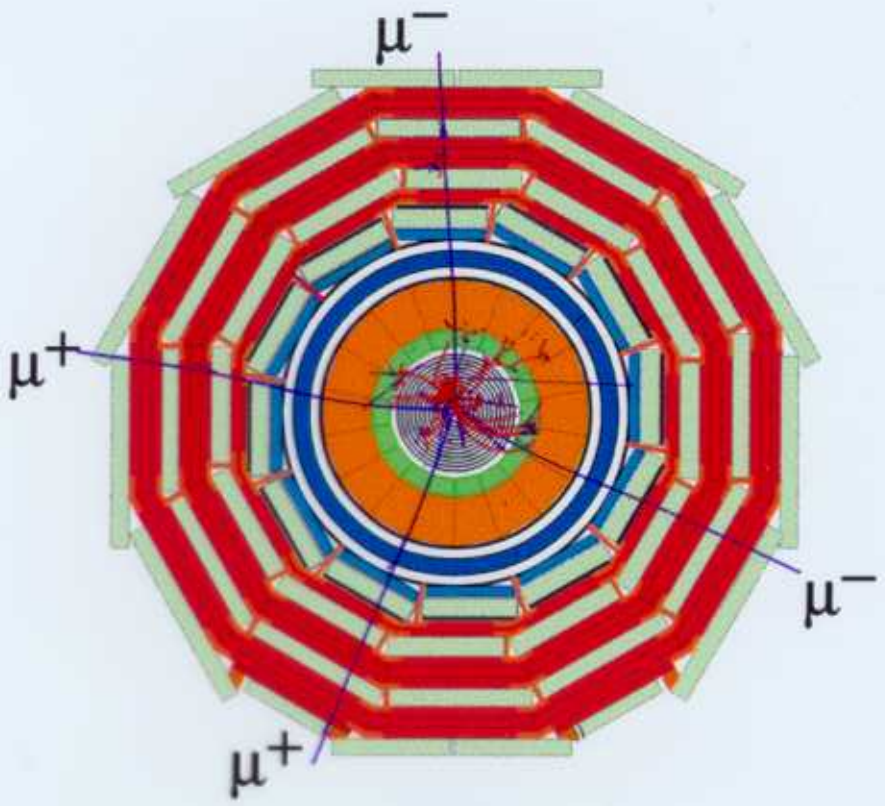

Superconducting Solenoid
Silicon Tracker
Pixel Detector
Very-forward Calorimeter
Preshower
Hadronic Calorimeter
Electromagnetic Calorimeter
Muon Detectors
Compact Muon Solenoid
y02K180

Physics

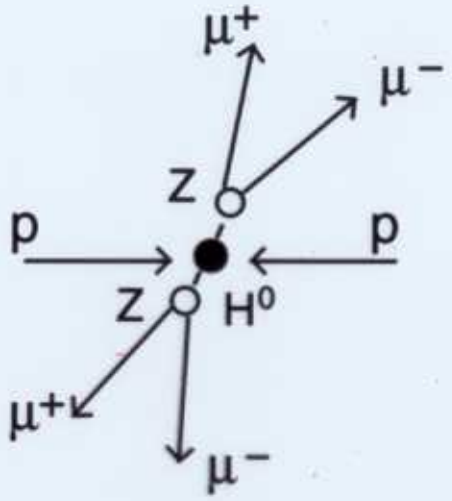


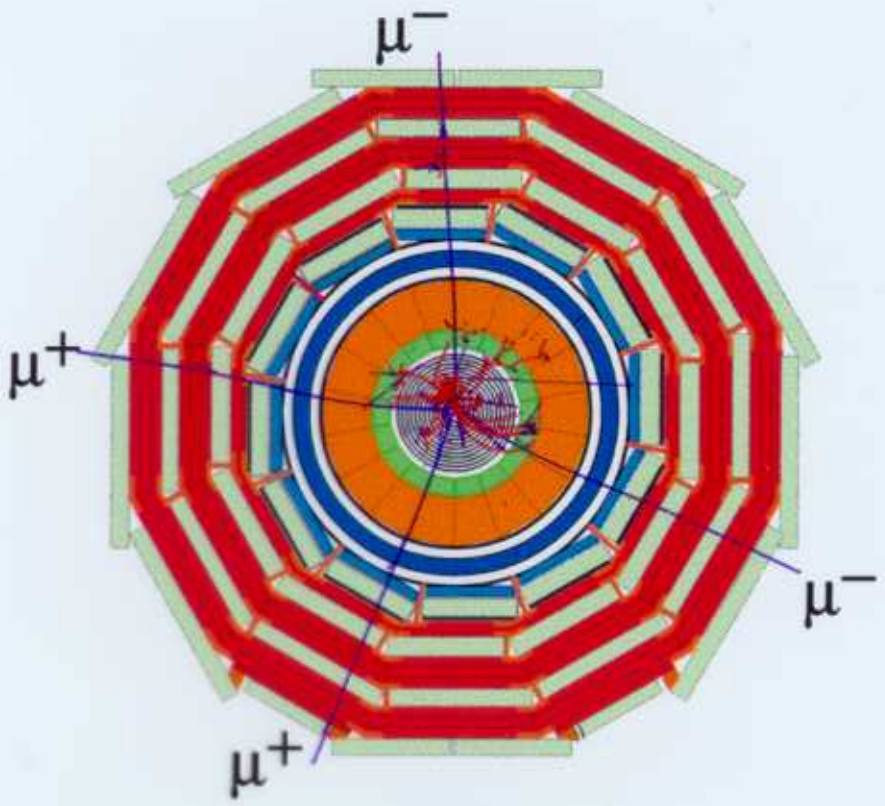


CMS

$$p\,p \rightarrow H^0 \rightarrow Z\,Z \begin{cases} \hookrightarrow \mu^+\,\mu^- \\ \hookrightarrow \mu^+\,\mu^- \end{cases}$$

Physics





CMS

$$p\,p \rightarrow H^0 \rightarrow Z\,Z \begin{cases} \hookrightarrow \mu^+\,\mu^- \\ \hookrightarrow \mu^+\,\mu^- \end{cases}$$