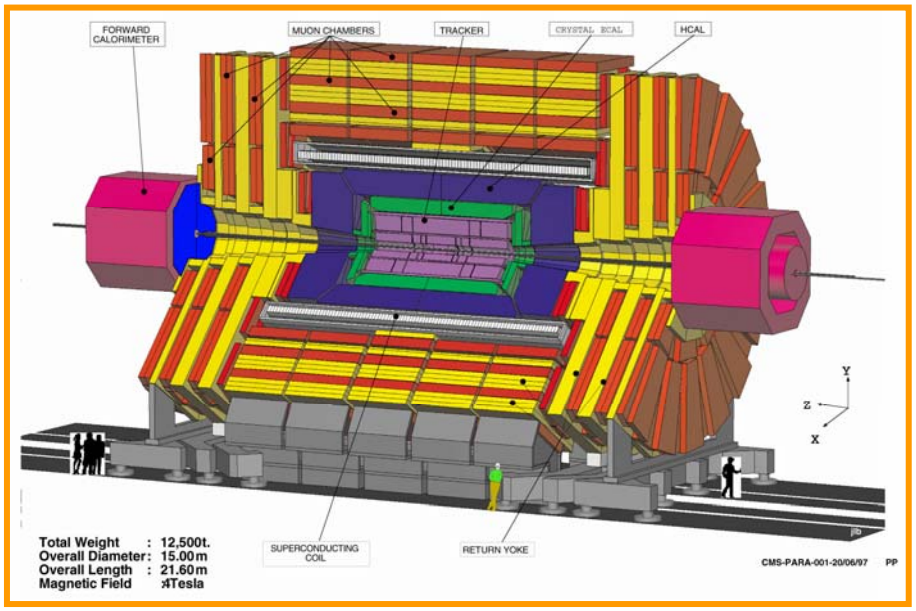
# Primer of the CMS Pixel Disks

USCMS Project Management Group




Bruno Gobbi

September 29, 2006

# Why Silicon Pixels ?

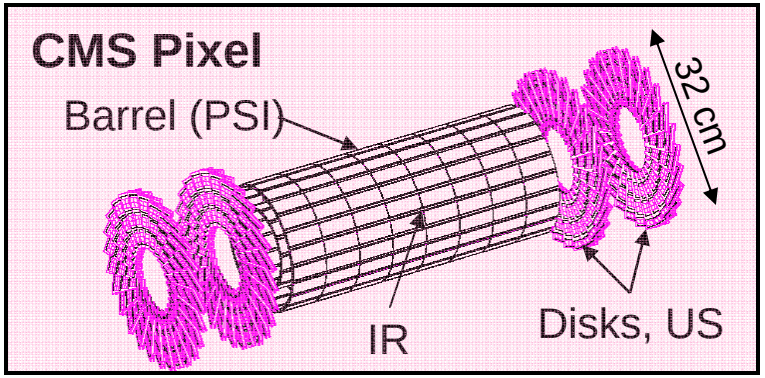
Silicon pixels are radiation hard (can record the trajectory of particles very near the interaction point of the LHC beams).

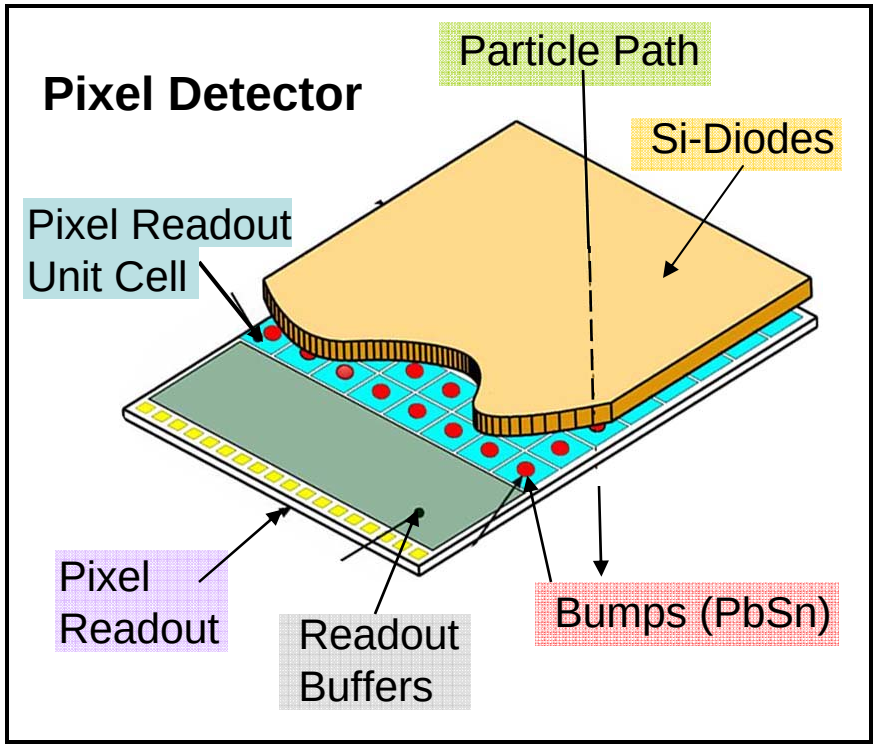
They can measure the position of tracks with an accuracy of ~10 µm.

Can identify secondary vertices, generated by the decay of particles with very short lifetimes.

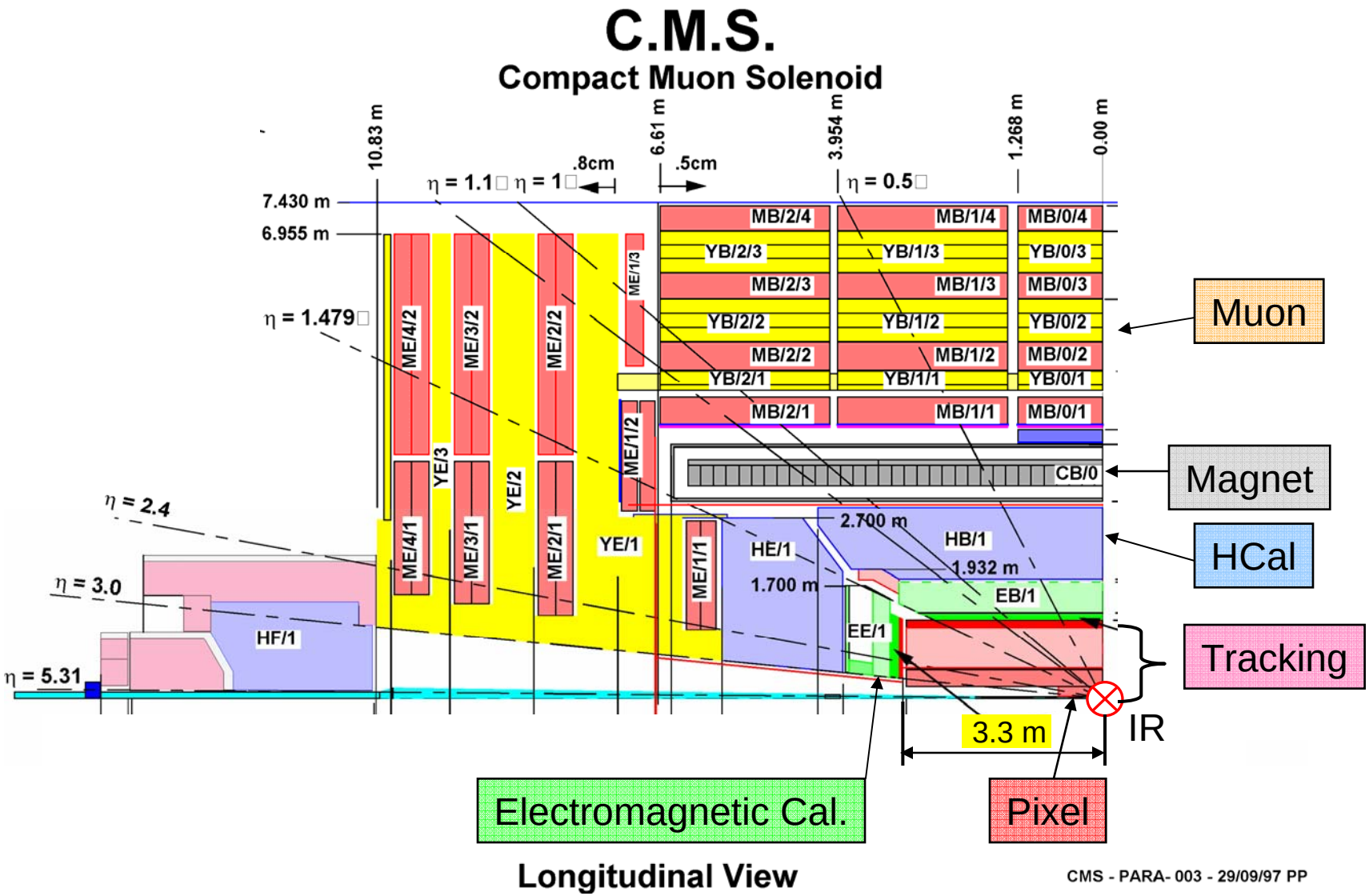
Such particles are expected to be produced at LHC energy in the decay of new states of matter.

Pixel detectors will to play a major part in new discoveries at the LHC.



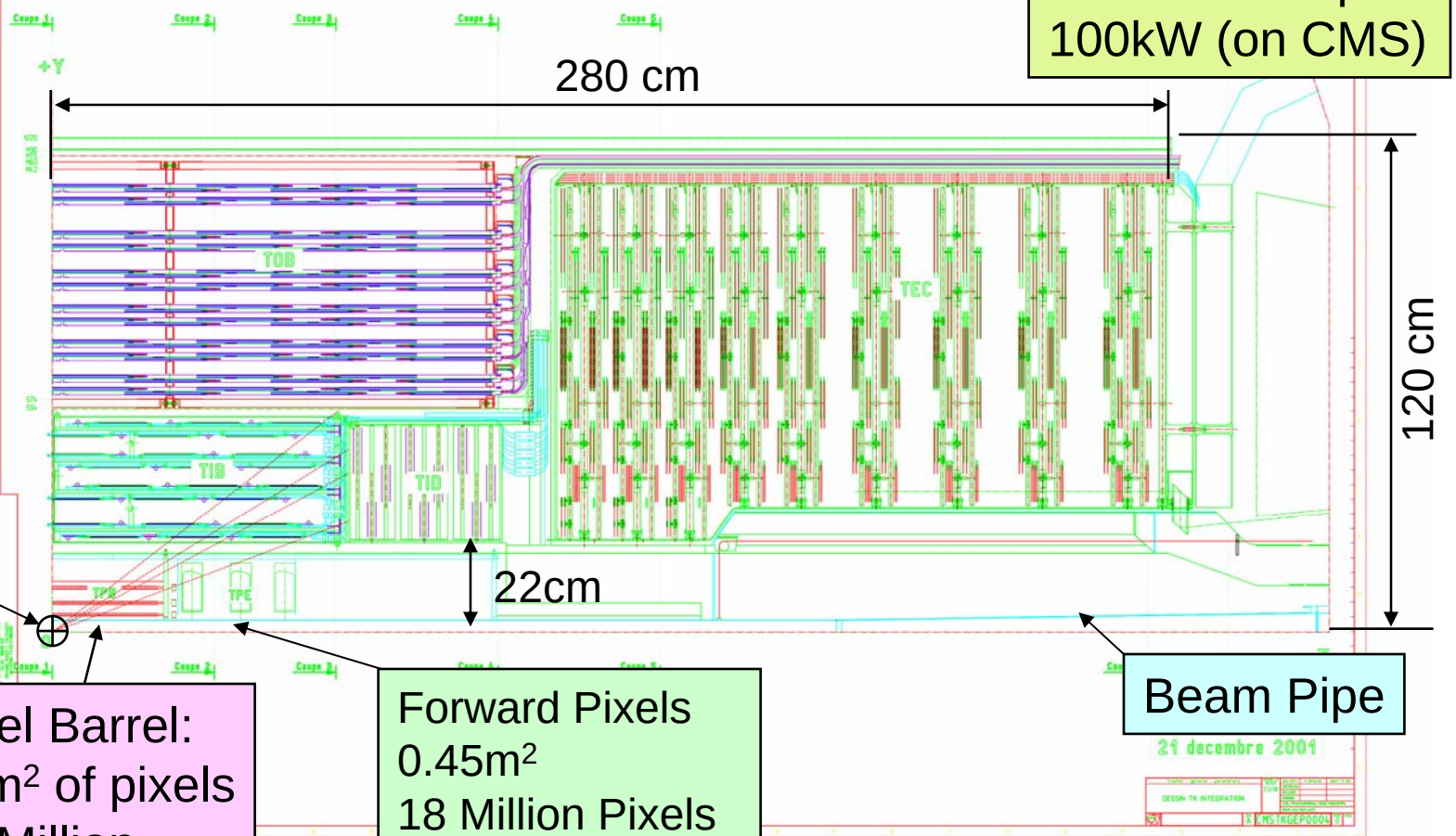



# Compact Muon Solenoid Quadrant



# CMS Tracker

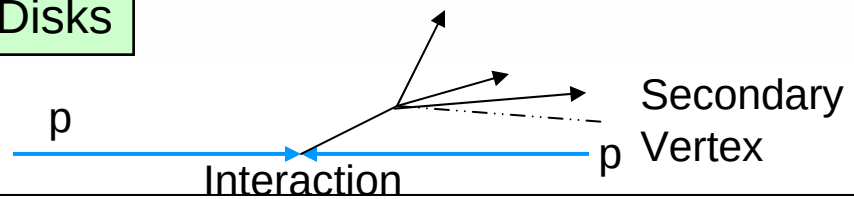
Silicon Strips:
200m$^2$ of sensors
10 Million strips
100kW (on CMS)




Pixel Barrel:
1. m$^2$ of pixels
40 Million
20 kW

Forward Pixels
0.45m$^2$
18 Million Pixels
9k Watts, 3 Disks

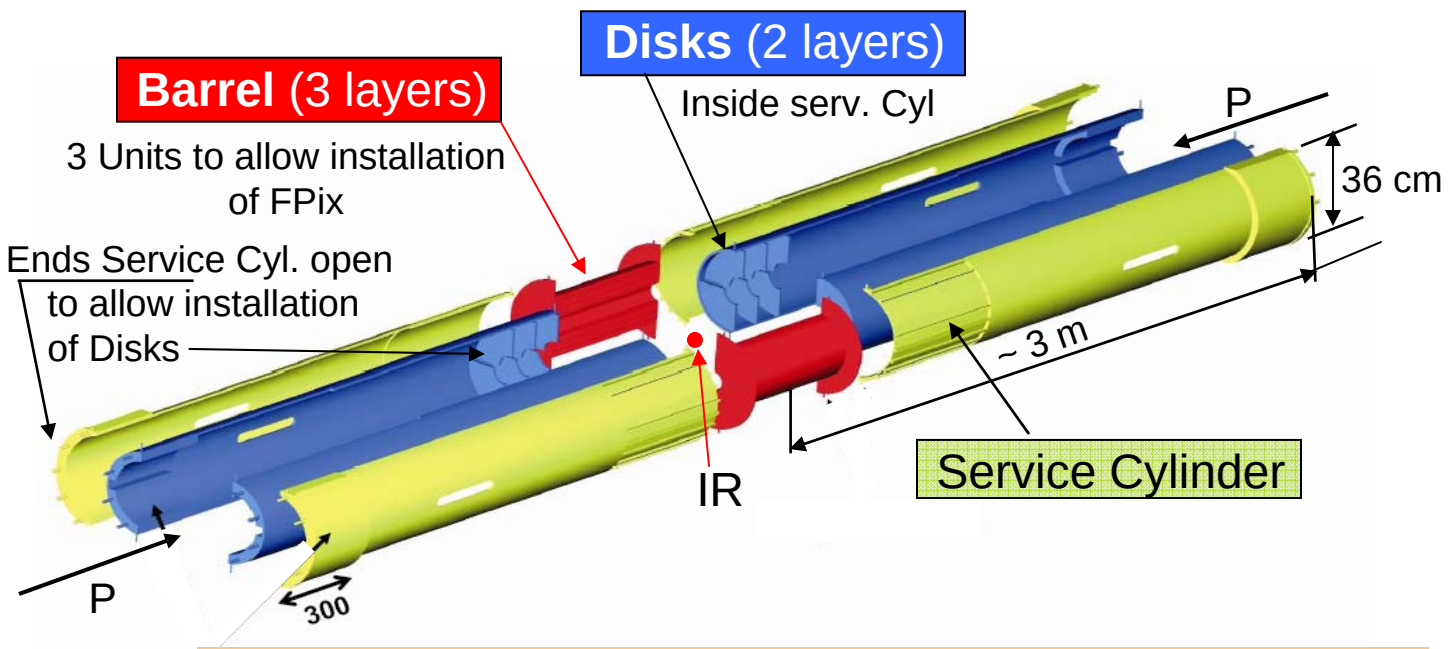
Beam Pipe



# CMS Pixels

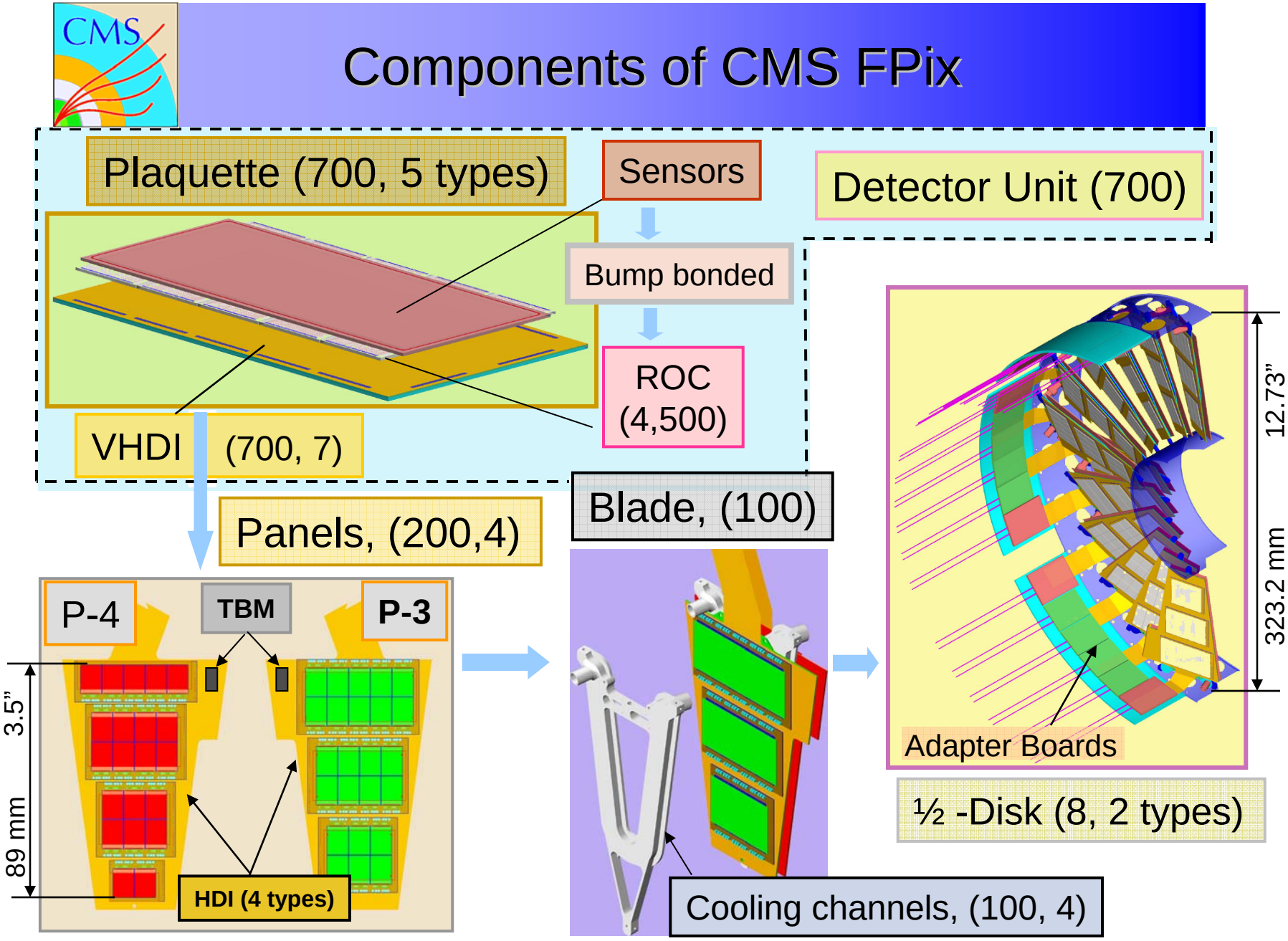
Aspects unique to the Pixel detectors are:

- Pixel Detectors are installed only after the beam pipe (held by vert. and horizontal wires) has been baked out.
- The Pixels will have to be removed when the beam pipe has to be backed out.
- During the yearly shut down, the pixel detectors will be removed from CMS and moved to the ground level for inspections and repairs.

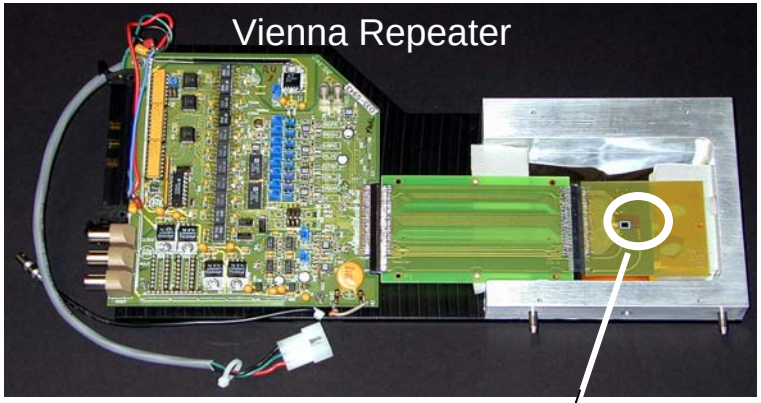



Units of **half** Cylinders because during installation the horizontal positioning wire will be removed, but not the vertical one.

# Components of CMS FPix

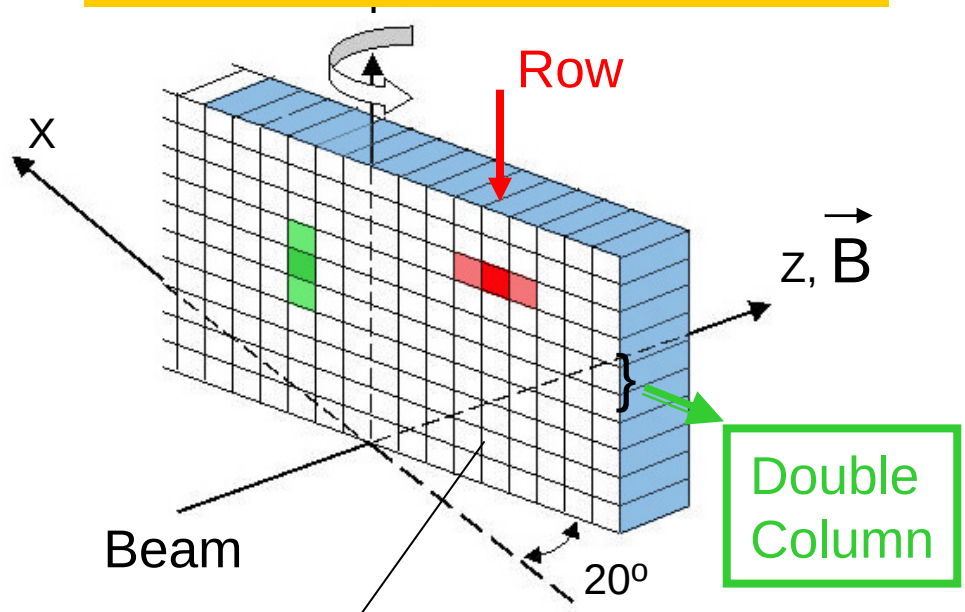


# Enhanced Resolution with Charge Sharing
# H2 Test Beam, Summer 2000



8mm

Charge Sharing by rotating the Panels by 20$^{o}$.




ROC, **PSI36**:
11 dbl col. x 30 rows
Pixels 150 x150 $\mu m^2$

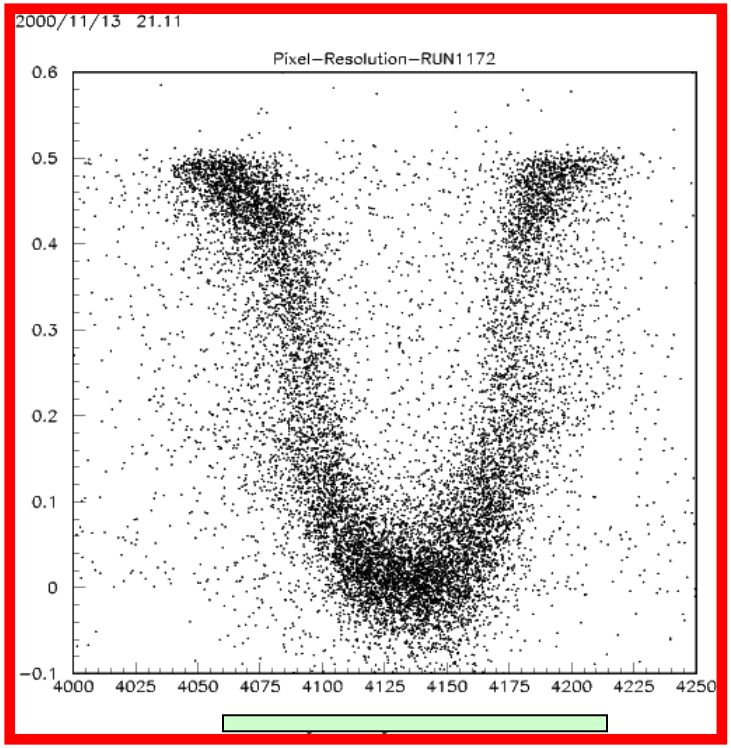
NOW: ROC, **PSI46**:
52 dbl. col. x 80 rows
Pixels 150 x 100 $\mu m^2$
4160 pixels / ROC

# Sensors rotated by $20^0$: Increase charge sharing

Pixels rotated by 20 degrees to beam

Resolution Without Charge Sharing:

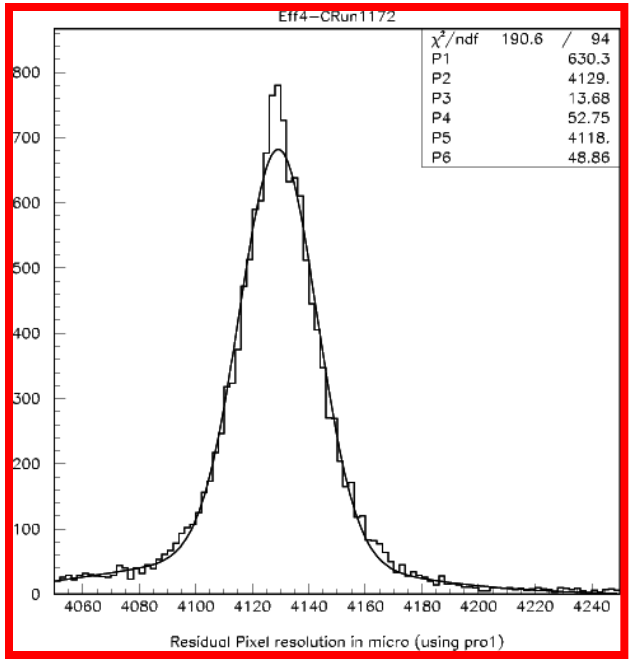
**150 μm / √12 = 43 μm**




150 μm

Charge sharing between rows

| | | |
|---|---|---|
| Pixel size | **150 μm** | **100 μm** |
| With charge sharing | **σ = 14 μm** | **→ 10 μm** |
| | **over pixel** | |

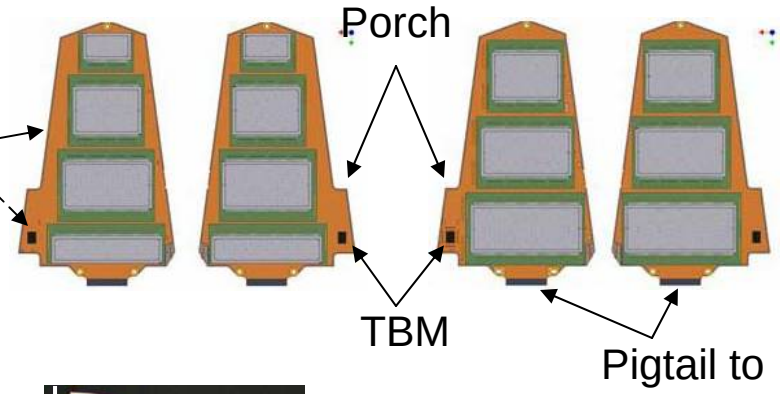



Position Resolution

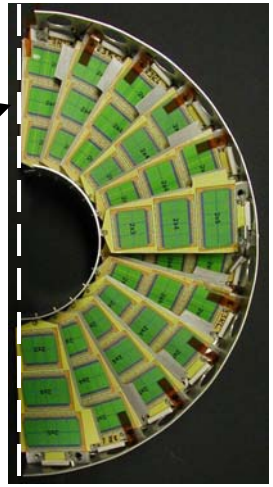
# Constraints of the Read Out and Geometry:

• The dimensions of the Pixel sensors are dictated by the size of the ROC. The geometry of the Plaquettes (how many ROCs per Plaquette) was chosen to optimize the solid angle coverage (98%).

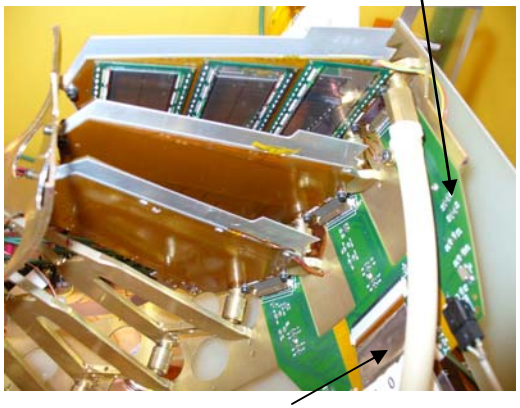
• Electronics requirements demand that the Token Bit Manager (TBM) must be mounted on the Panel rather than on the Adapter Board! Because there was no space on the original Panel, a 'Porch' was added to accommodate the TBM.




• This porch can not extend past the diameter line of the ½-Disk because of the installation constraints.

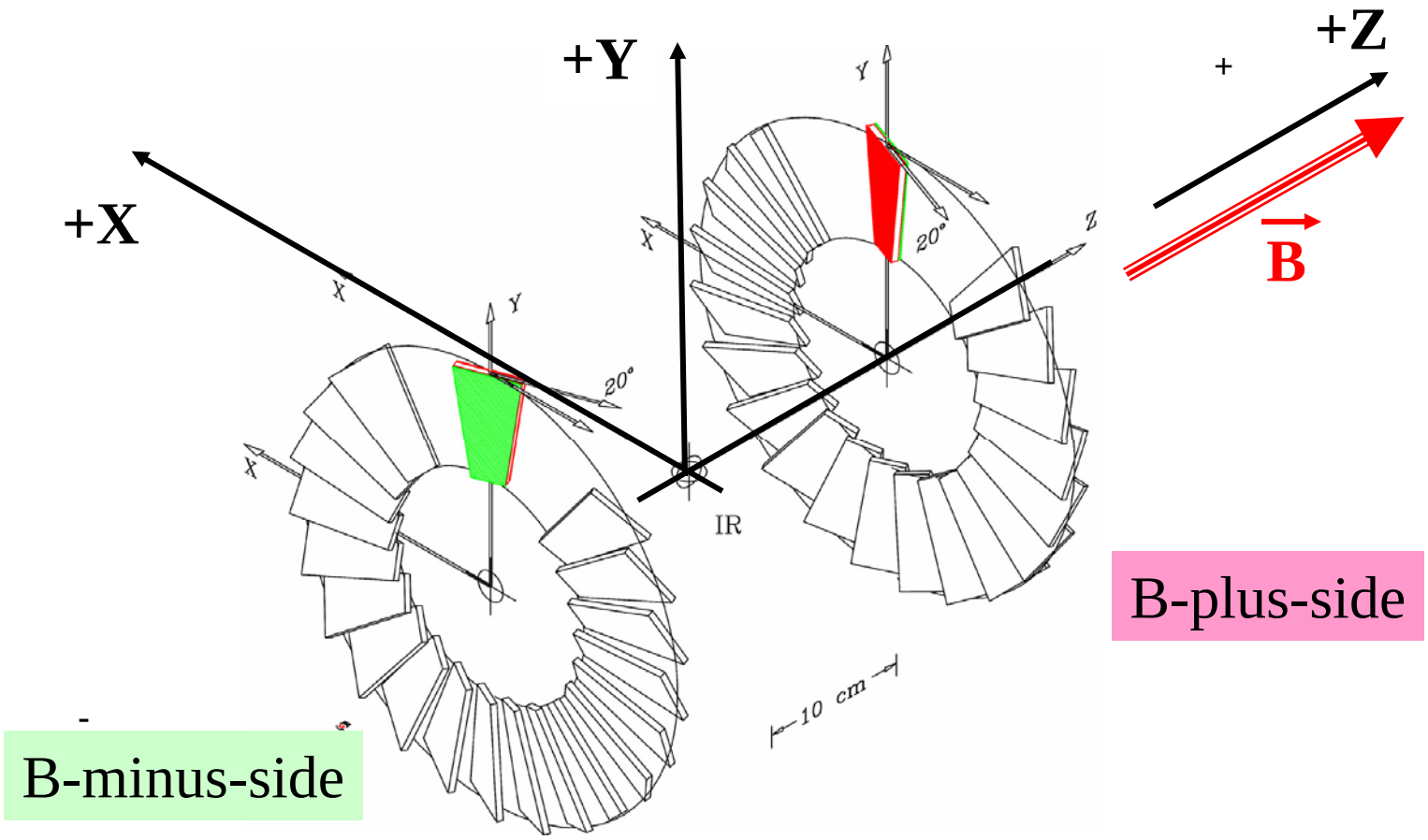


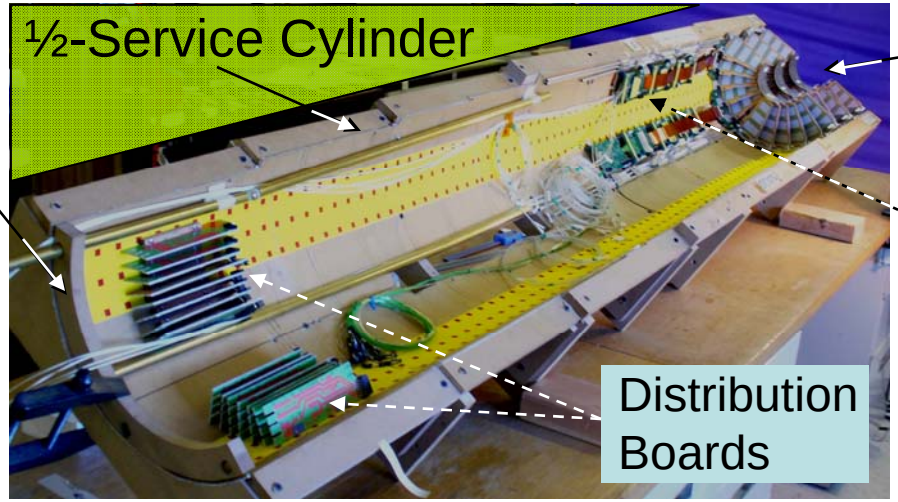
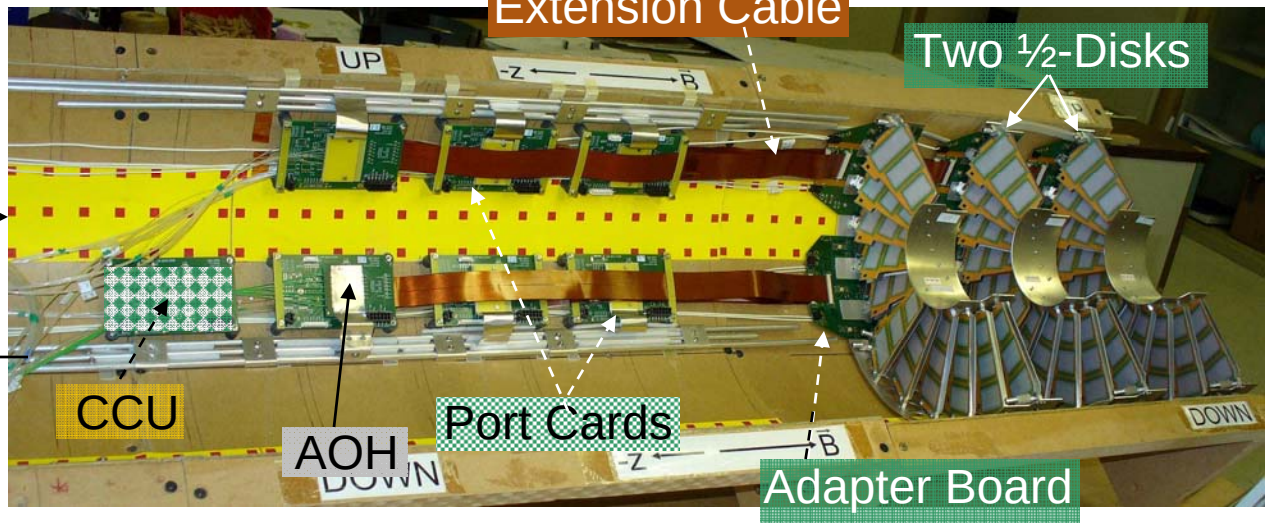
• This constraint requires four different types of Panels, two Left handed and two Right handed!



Extension Cable

# Point Symmetric Geometry of the Disks




Proposed by Martin Corden at the UCD Working Meeting on CMS Forward Pixel, Feb. 6-8, 1997

# Model ½-Service Cylinder