

# **A CDF "Layer 0" Pixel Option**

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# Motivation

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*"An important limitation to the reconstruction of tracks, and therefore secondary vertices using the SVX is the ability of the detector and reconstruction algorithms to correctly resolve nearby tracks in the dense core of jets."*

**- CDF/ANAL/TOP/CDFR/2568 (1994)**

- Particles separated in  $r-\phi$  by a distance of order strip pitch *not resolved*
  - separation in  $z$  could be of order 1 mm
- The extra track moves the charge centroid
- Leads to degradation in 20-30% of tracks
- Could affect almost 35% of B and  $B_c$  tracks in Layer 0
- Leads to spurious impact parameter measurements

# Concept

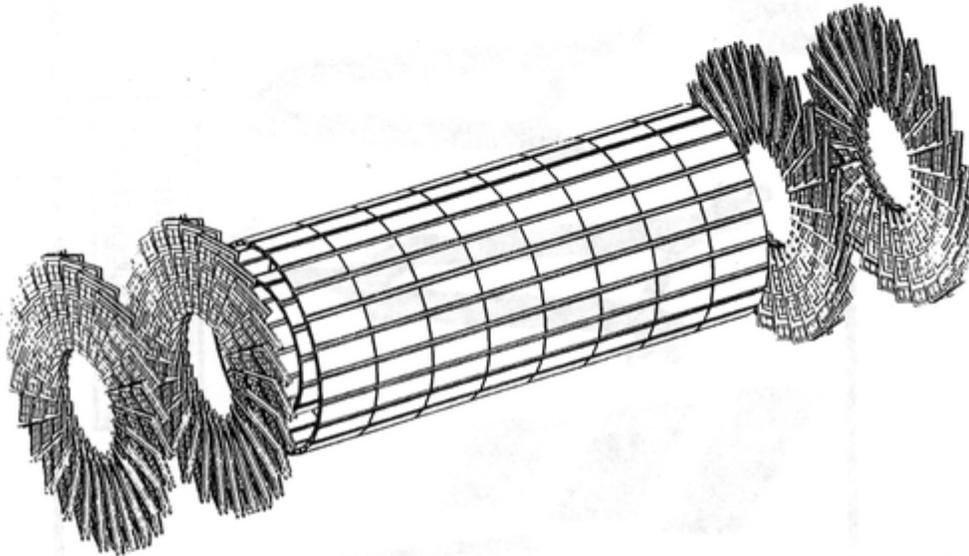
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- **Introduce a pixel "Layer 0" ( $\approx 2.5\text{-}3$  cm radius)**

- Work in conjunction with an inner layer of strips featuring
  - Minimum mass
  - Minimum complexity close to the beam pipe
- Choose pixel size small enough to resolve tracks in jets
- Pixel z measurement complements the single sided inner layer
- Pixels provide unambiguous space points
  - Powerful tool for pattern recognition
- Mass constraint not quite so tight as for the innermost layer
- Integrate mechanically with inner strip layer
  - Draw on CMS and ATLAS barrel mechanical designs
  - CMS design shown in sketches on next three slides

# CMS Module Layout

## CMS PIXEL SYSTEM



precise impact parameter in  $r\phi$  &  $z$

0.2cm 11.0cm

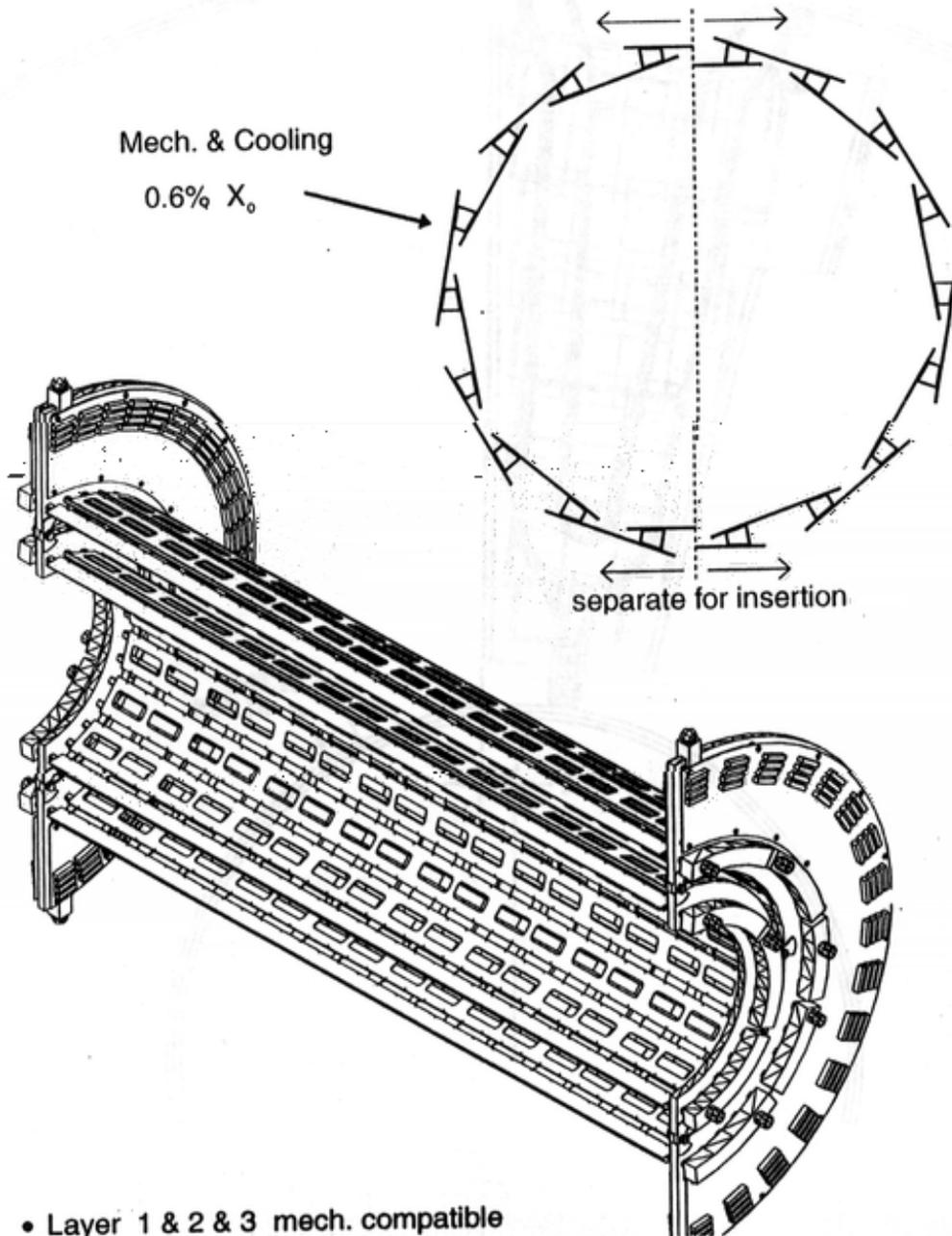
high Lumi

$/\text{cm}^2$

- 3D - tracking points
- $\sigma(z) \sim \sigma(r\phi) \sim 15\mu\text{m}$  for pre
- LAYERS:  $r = 4.3\text{cm}$  7  
Low Lum
- replace layers after  $6 \times 10^{14}$
- all 3 layers compatible

# CMS Barrel Mechanical Support

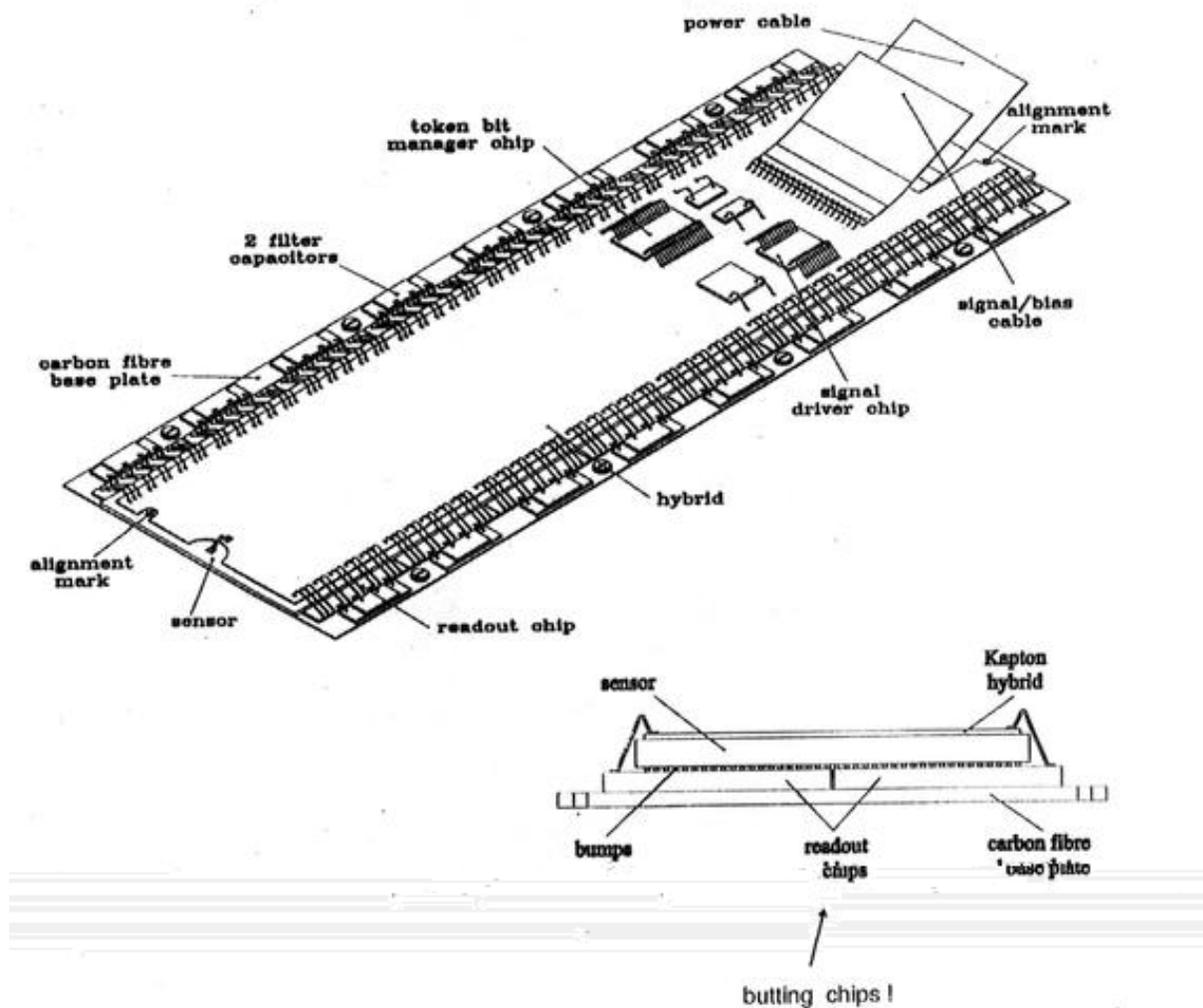
## CMS PIXEL BARREL



# CMS Barrel Detector Module

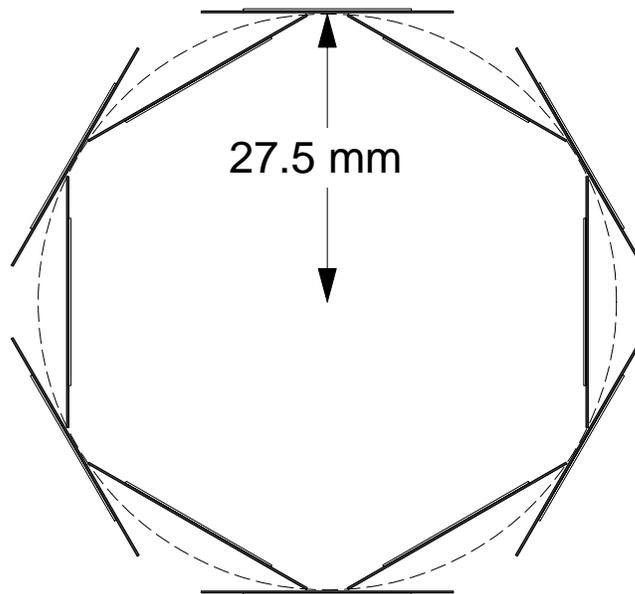
## BARREL PIXEL MODULE

- Silicon sensor  $16 \times 64\text{mm}^2$ ,  $250\ \mu\text{m}$  thick,  $150\ \mu\text{m}$  square pixels
- 16 Readout chips ( $52 \times 53$  pixel) ---> ~44k pixel ---> 2.4 Watt
- ~ 1 %  $X_0$



# Scope of Design

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- **Estimate scope using "straw man" design with CMS-like detector modules**
  - Atlas modules similar
    - FPIX modules half as wide with single row of chips
  - CMS estimates 1.5%  $X_0$  per layer incl. supports and cooling
  - Sensor modules are 16x64 mm<sup>2</sup> with 16 readout chips
  - A 12-sided design integrates with rest of SVX geometry
  - Length of barrel depends on luminous region size
    - 12 modules would cover 76.8 cm length
  - With 12 12-sided modules, have 144 sensors, 2304 readouts
  - Approx. 10% of CMS barrel system (rough estimate)