Silicon Detectors @ the LHC
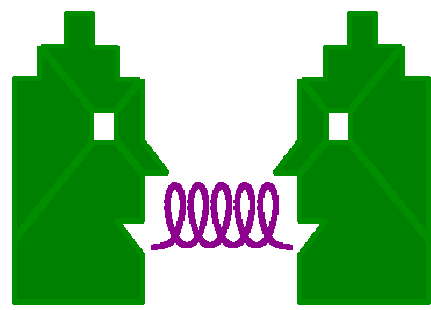
ICHEP02

Chris Parkes

ALICE	0.3 + 1.3 + 2.9 m^2	Pixels+Drift+Strips
LHCb	0.3	Strixels! + Strips (RICH)
ATLAS	2.2	Pixels + Strips
CMS	0.8 + 206 m^2	Pixels + Strips

TOTAL = 287 m^2

= 3.6 secs/m^2

Contents

- Layouts
  - x 4

    Then pick a few examples….

- Sensor Designs
  - ALICE Si Drift Detector, LHCb VELO
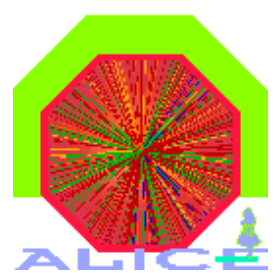 - CMS Strip Optimisation

- FE Electronics / Mechanics / Cooling
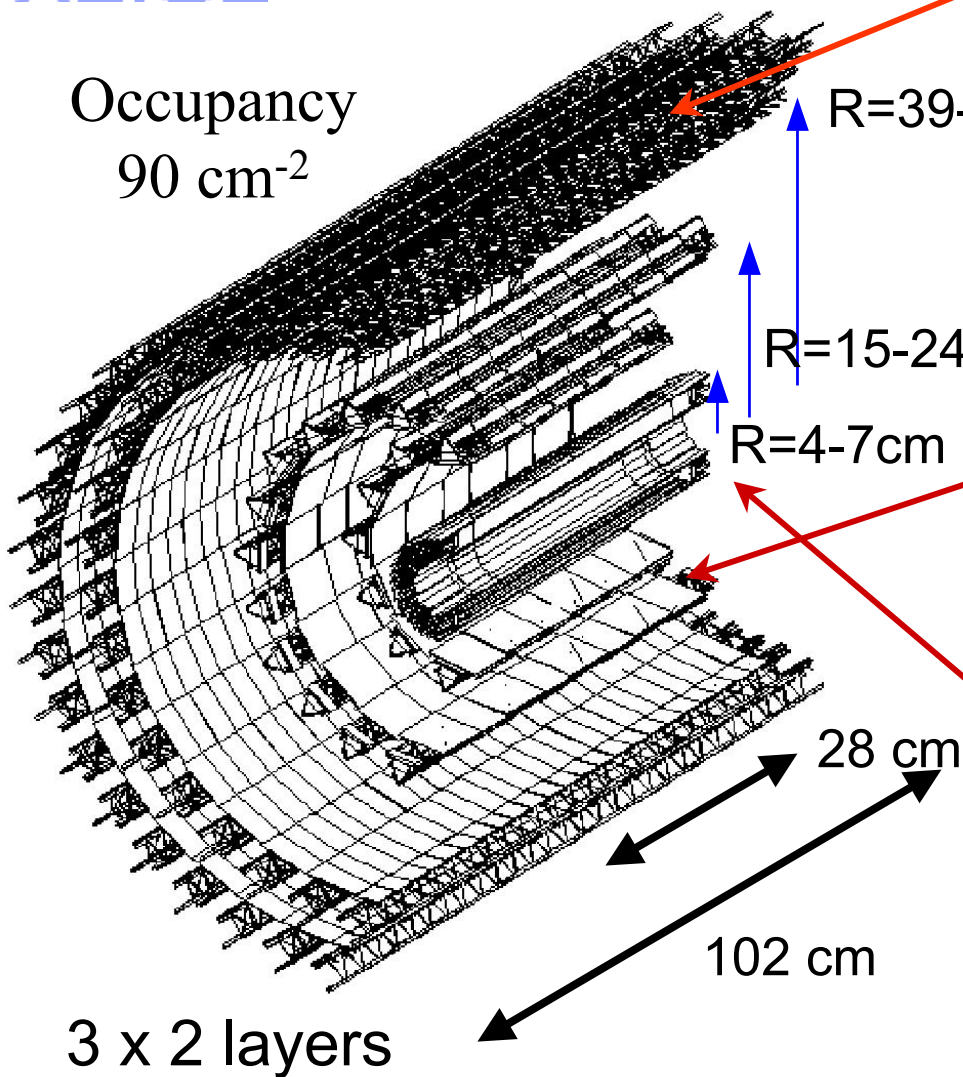 - ATLAS Pixels

- Module Assembly
  - CMS Strips

- Q/A
  - ATLAS Strips

ALICE Silicon

Double-sided Silicon Strips

R=39-43cm

Occupancy
90 cm^{-2}

2.7M 95 μm pitch stereo twist p$^+$/n$^+$ on n strips, analogue rad-tol 0.25 μm CMOS readout, 1770 modules

R=15-24cm

R=4-7cm

Silicon Drift Detectors

260 modules,
0.13M channels
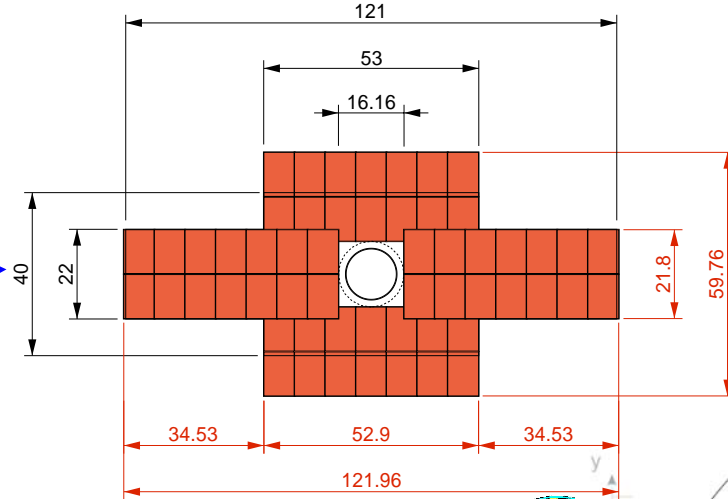p$^+$/n$^+$ on n – see later

28 cm

102 cm

Silicon Pixel Detectors

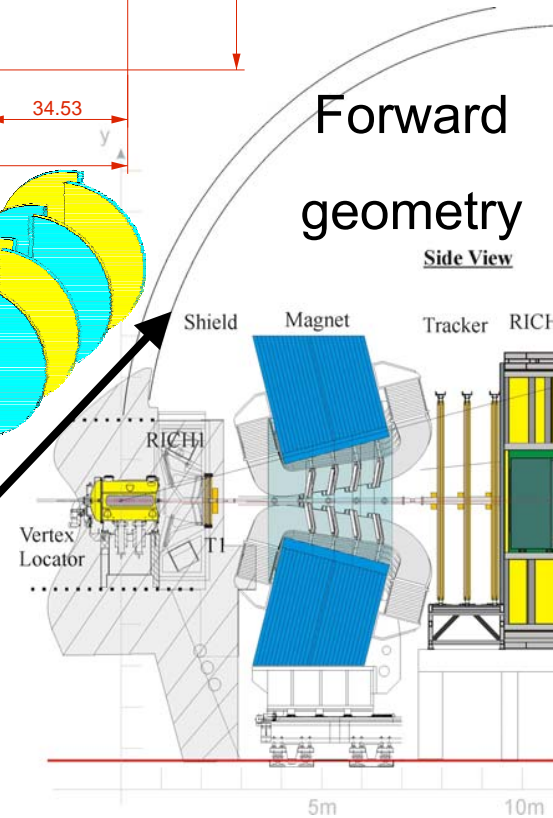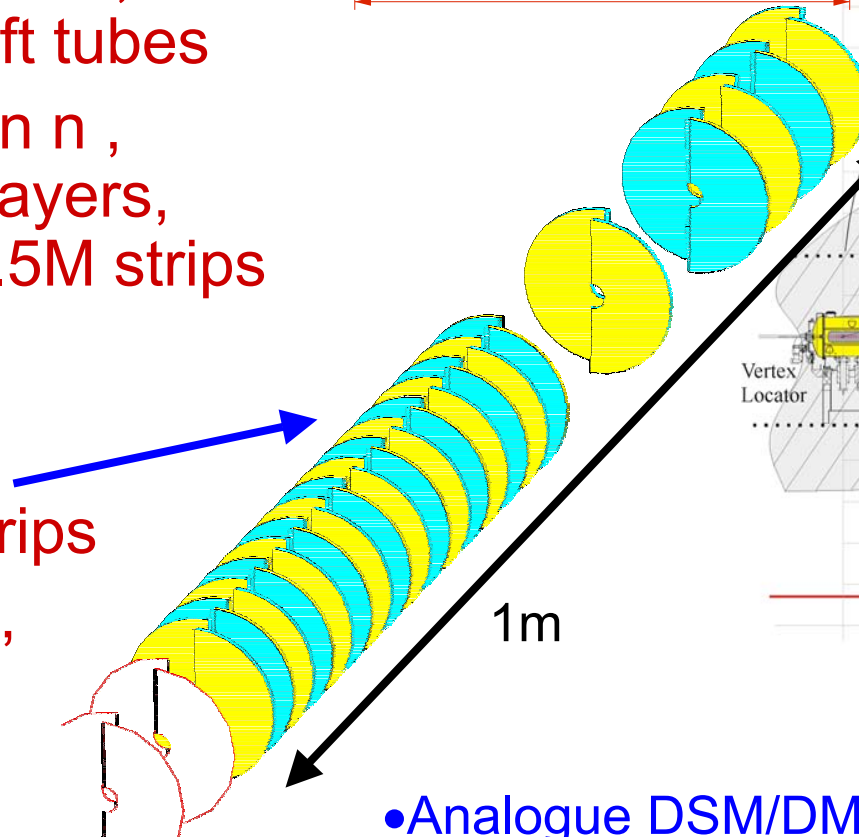9.8M 50 x 425 μm
p$^+$ on n pixels
240 modules

3 x 2 layers

• Tracker

– 4 all Si layers +

– Strips close to beam, outside straw drift tubes

– 200μm pitch p$^+$on n , stereo twist, 16 layers, 2300 sensors, 0.5M strips

Forward

geometry

Side View

Shield Magnet Tracker RICH

RICH1

Vertex
Locator

T1

5m   10m

• Vertex Locator

– n+ on n, 0.2M strips

– 8mm from beam, weird layout!!!

– see later

1m

•Analogue DSM/DMILL readout

ATLAS Inner Detector

Pixels n+ on n, 50x400 μm^2

3 layers, 8 disks, 1500 modules

r = 4.8 - 16 cm, 140 M channels,

Tracking and Vertex reconstruction

Axial magnetic field 2T

Enclosed in a thermal envelope inside the solenoid, -7^{0}C
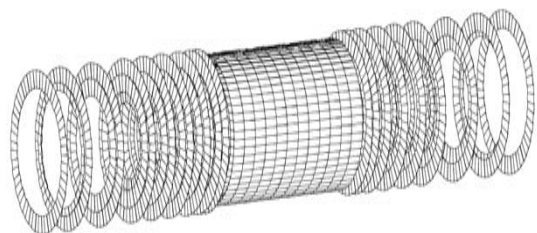
SemiConductor Tracker (SCT)

**19,300 single sided 80 μm pitch
p-on-n strip detectors
6 sensor geometries
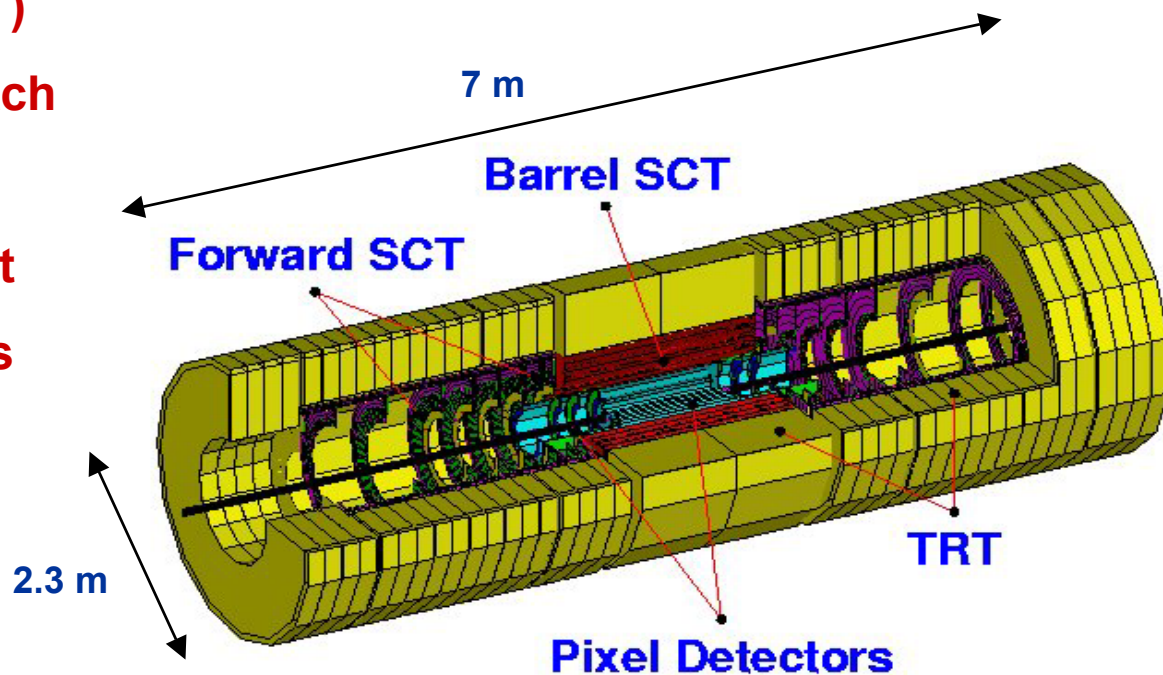Dmill BiCMOS Binary readout**

r = 27 - 52 cm, 6.3 M channels

4 Barrel cylinders (square),

2 x 9 End-cap disks (wedge)

7 m

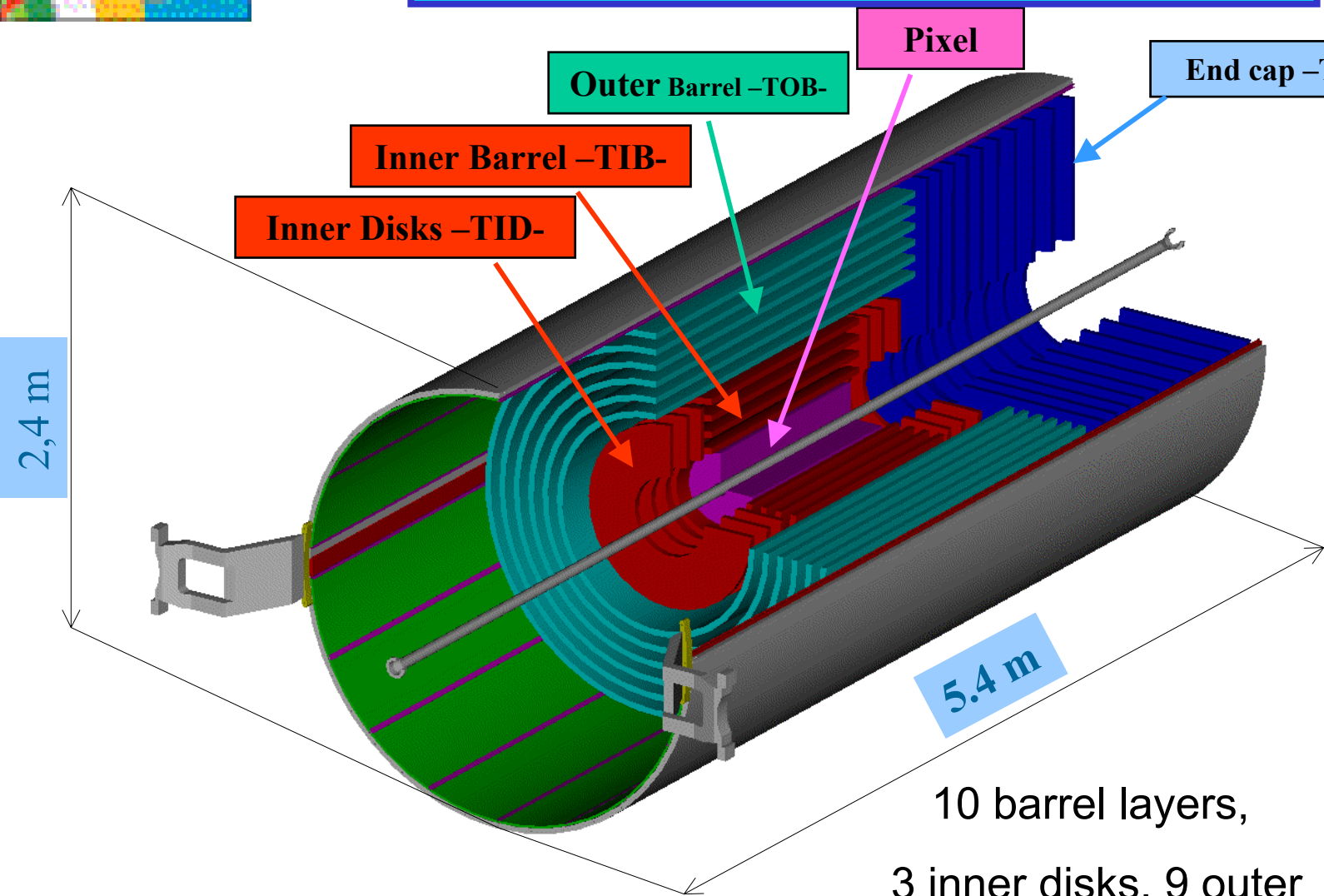**Barrel SCT**

Forward SCT

2.3 m

TRT

Pixel Detectors

Two key differences of ATLAS/CMS strips

Size: 4,000 → 15,000 modules

Strip readout: Analogue DSM chip - APV

Pixel

Outer Barrel –TOB-

Inner Barrel –TIB-

Inner Disks –TID-

End cap –T

2 Pixel Layers

R=4cm layer to be replaced by R=11cm after low lumi.

2,4 m

5.4 m

10 barrel layers,

3 inner disks, 9 outer

LHC Si Detectors   ICHEP 24th -31st July 2002   Chris Parkes