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Pixel Geometry

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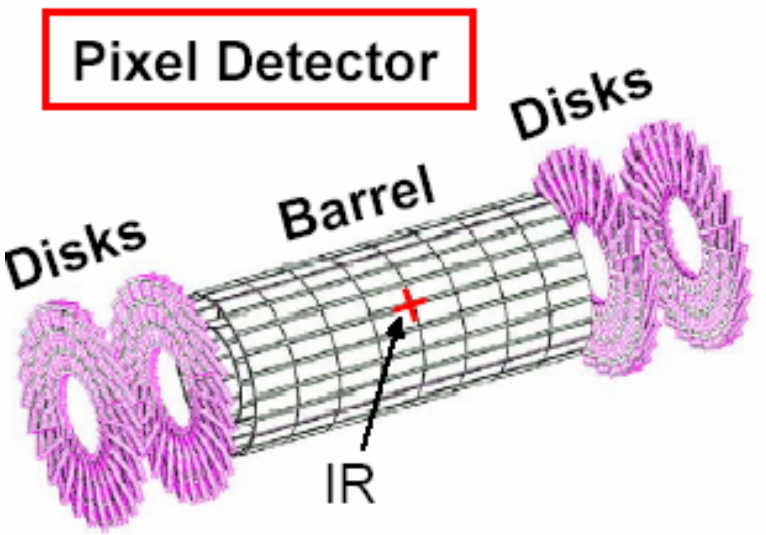
Pixel Detector

- **Barrels:** ***Barrel Pixels***
  - *3 layers*

- **Endcaps/Disks:** ***Forward Pixels (FPix)***
  - *2 disks on either side (upgraded to 3 disks later)*



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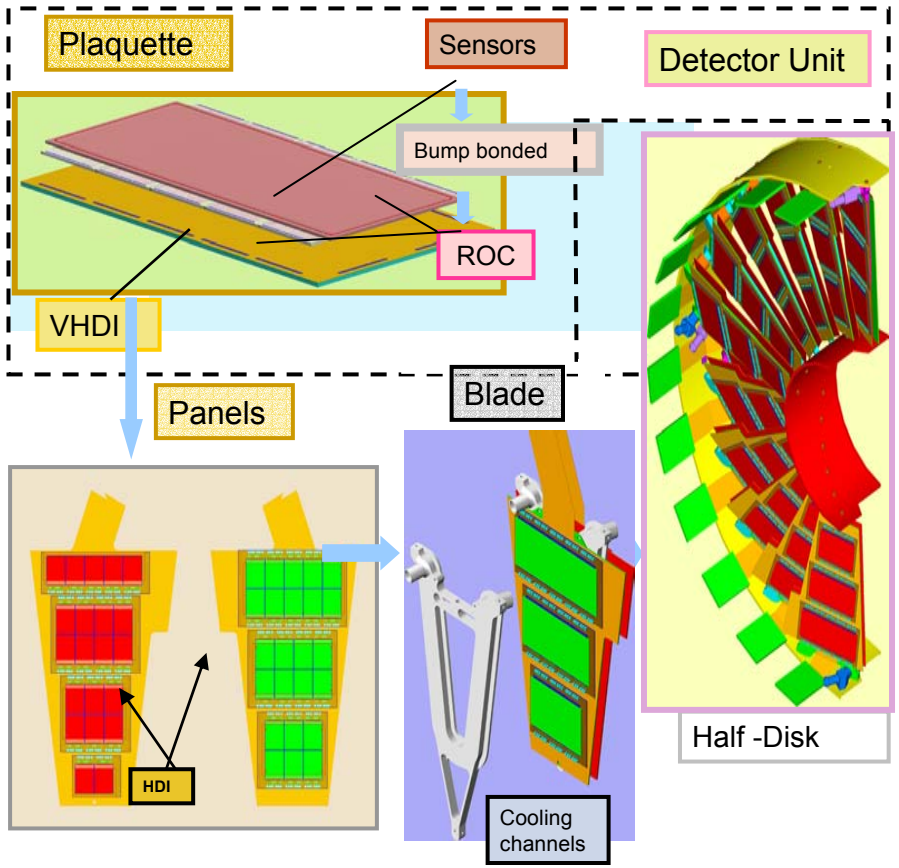
Barrel Pixel Status

- Changes made to barrel geometry for CMSSW
  - Half modules
  - Correct module cooling attachments
- Plans
  - Run IGUANA with CMSSW
  - Run simhits access in CMSSW

Structure of FPix Disks

- **Each disk includes 24 wedge shaped blades**
  - Turbine like geometry
  - Each blade is rotated 20^0 around their radial symmetry axis to increase charge sharing among pixels
- **Each blade has a set of 45 readout chips (ROC)**
  - 5 different types
    1x5, 2x5, 2x4, 2x3, 1x2
  - ROCs+ Sensors+VHDI= PLAQUETTES
  - Arranged in 7 different arrays on the two sides of the blade



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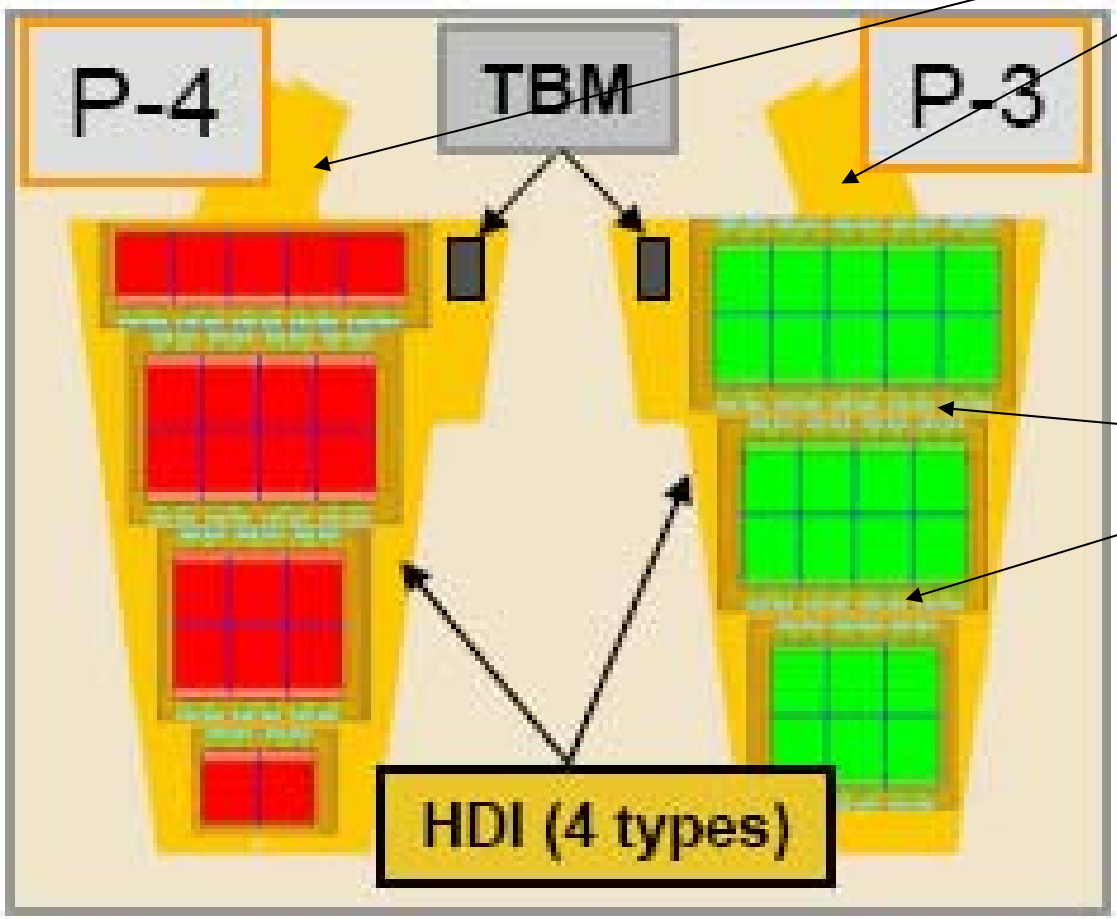
Panels

- 8 different types of Panels
  - 1L, 2L, 3L, 4L
  - 1R, 2R, 3R, 4R
- The difference is in position of TBM and “pigtails” (see next slide)
- Describe only two types of panels: L and R
- Geometry description exists for these two types
- L-type panels have 3 plaquettes on them
- R-type panels have 4 plaquettes on them

Panels



No geometry description for this part between plaquettes

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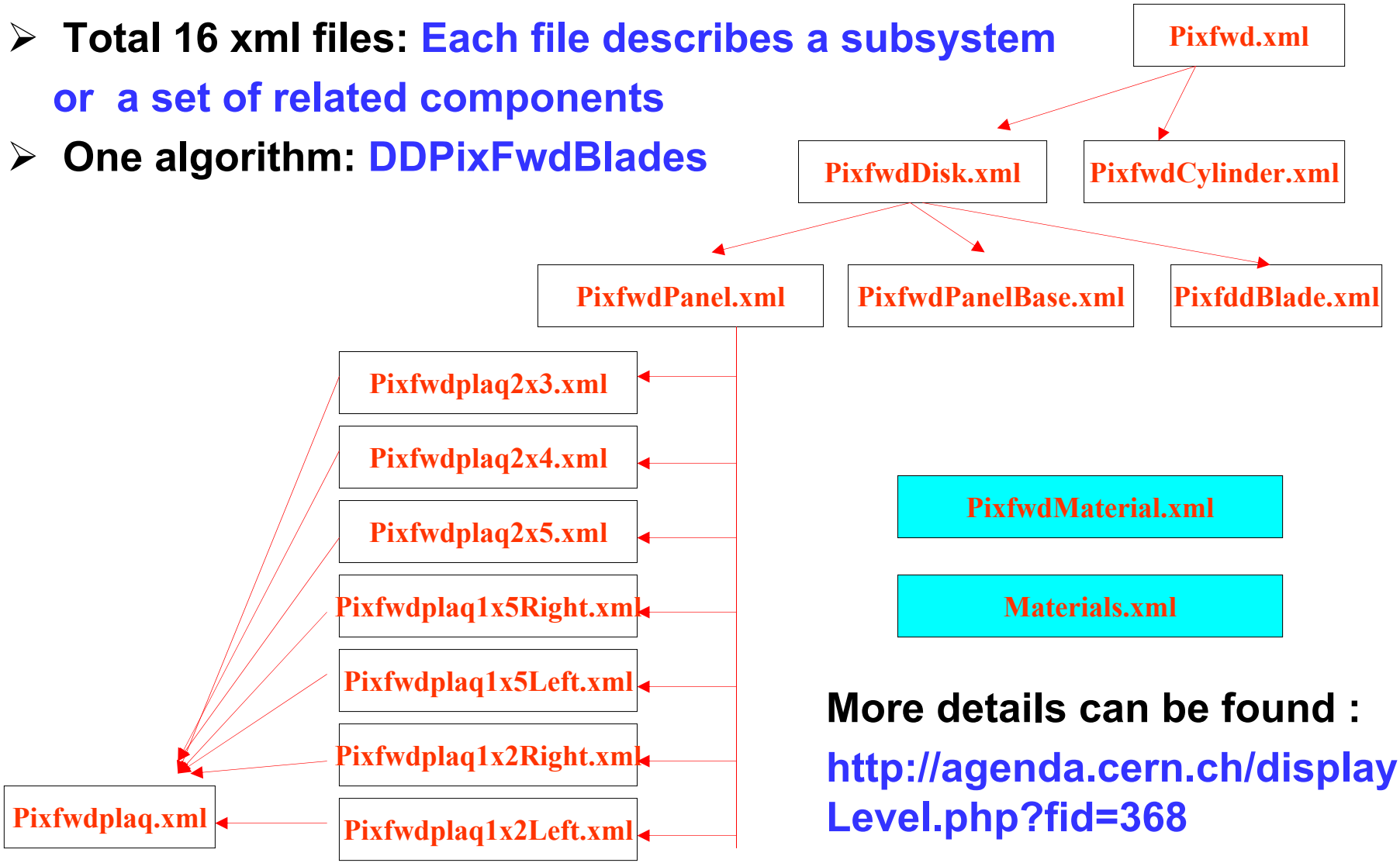
FPIX Geometry

- The New Geometry Description is written in the XML Schema based on the Detector Description Language (DDL)
- Make it very flexible and easily extendable (critical since the design of some components is not final)
- The Geometry Description has been done and put into the CVS (Version of 2.01.01)

  http://cmsdoc.cern.ch/swdev/viewcvs/viewcvs.cgi/CMSSW/Geometry/TrackerCommonData/data/?cvsroot=CMSSW

Structure of FPix Geometry

- Total 16 xml files: Each file describes a subsystem or a set of related components
- One algorithm: DDPixFwdBlades

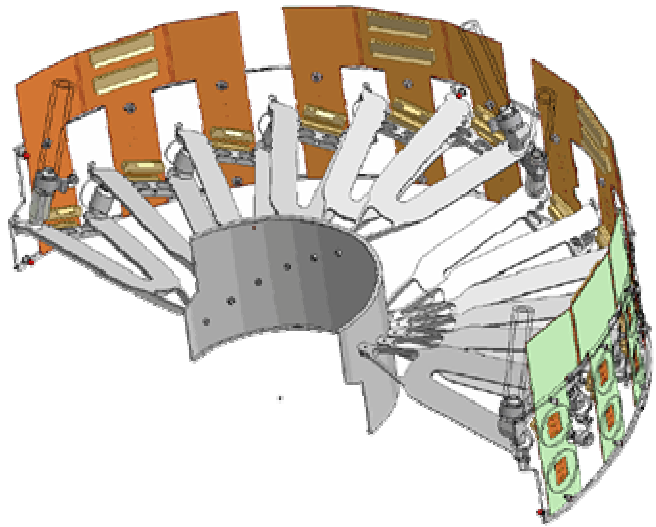


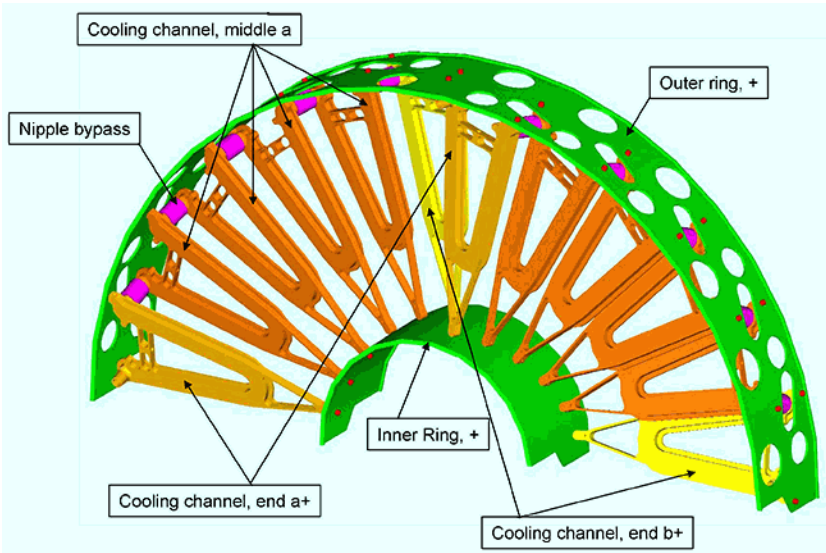
More details can be found :

http://agenda.cern.ch/displayLevel.php?fid=368

Design not yet complete

- **Adapter boards, Support and Cooling, Service cables and cylinders….**
  - Many complex shapes
  - The design is not yet final
  - Implemented simplified preliminary version
  - Not critical for the zero-approximation geometry
  - need better drawings (we're in contact with engineers)





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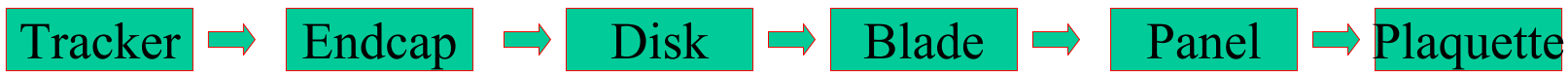
Numbering Scheme

- The goal of Numbering Scheme is to assign one 32-bit unique integer number(DetUnitId) to each sensor which can produce hits when particles pass through
- From this DetUnitId , identify which Endcap, disk, blade, panel and plaquette the hits come from
- Active volume structure is not expected to change, so we have worked out the Numbering Scheme based on the current Geometry description



- For each sub-system of the Tracker, DetUnitId is a 32-bits unsigned integer

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Coordinates

- The implementation of Numbering Scheme is Based on the global position (Z , Phi, R)
  - Endcap: #1 in Z-negative side, #2 in Z-positive side (Z)
  - Disk: #1 closest to IP, #3 furthest (Z)
  - Blade: #1 starting from phi=0, increasing with (Phi)
  - Panel: #0 (increasing Z), #1 (decreasing Z) panel (Z)
  - Plaquette: #1 closest to IP and working out in (R)

R is the distance from the center of the Plaquette to Beam line

Proposed Scheme

- The four most significant bits identify the large-scale detector: Tracker, Ecal, Hcal, Muon
- The next three bits identify Tracker sub-detector

  Barrel pixel , Forward pixel, TIB, TOB, TID, TEC

Component	Valid Values	Number of bits
Subdetector ID	" "	4
Barrel/forward pixel	1/2	2
Endcap (±Z)	1/2	2
Disk	1,2,3	2
Blade	1→ 24	5
Left/Right Panel	0/1	1
Plaquette	1, 2, 3, 4	3

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Preliminary Simulation Results

- Current Simulation work is using the new Geometry Definition
  - There are total of 6 disks
- Look at the hit occupancy in both global frame and local frame to check if all pixels work well
- This work is done using CMSSW_0_3_0_pre6

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Global Coordinates

- Definition of Global coordinate System
  - Y is vertical
  - X is horizontal and points inward to the center of the LHC ring
  - Z is aligned with the beam
  - The center is Interaction Point

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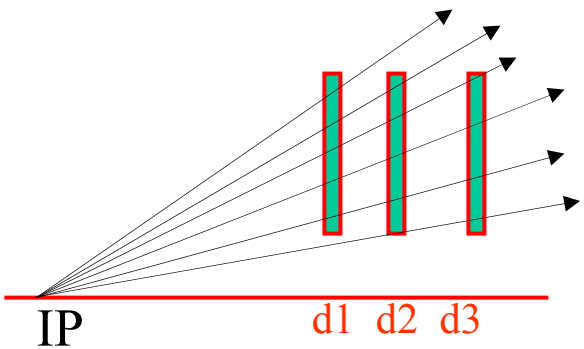
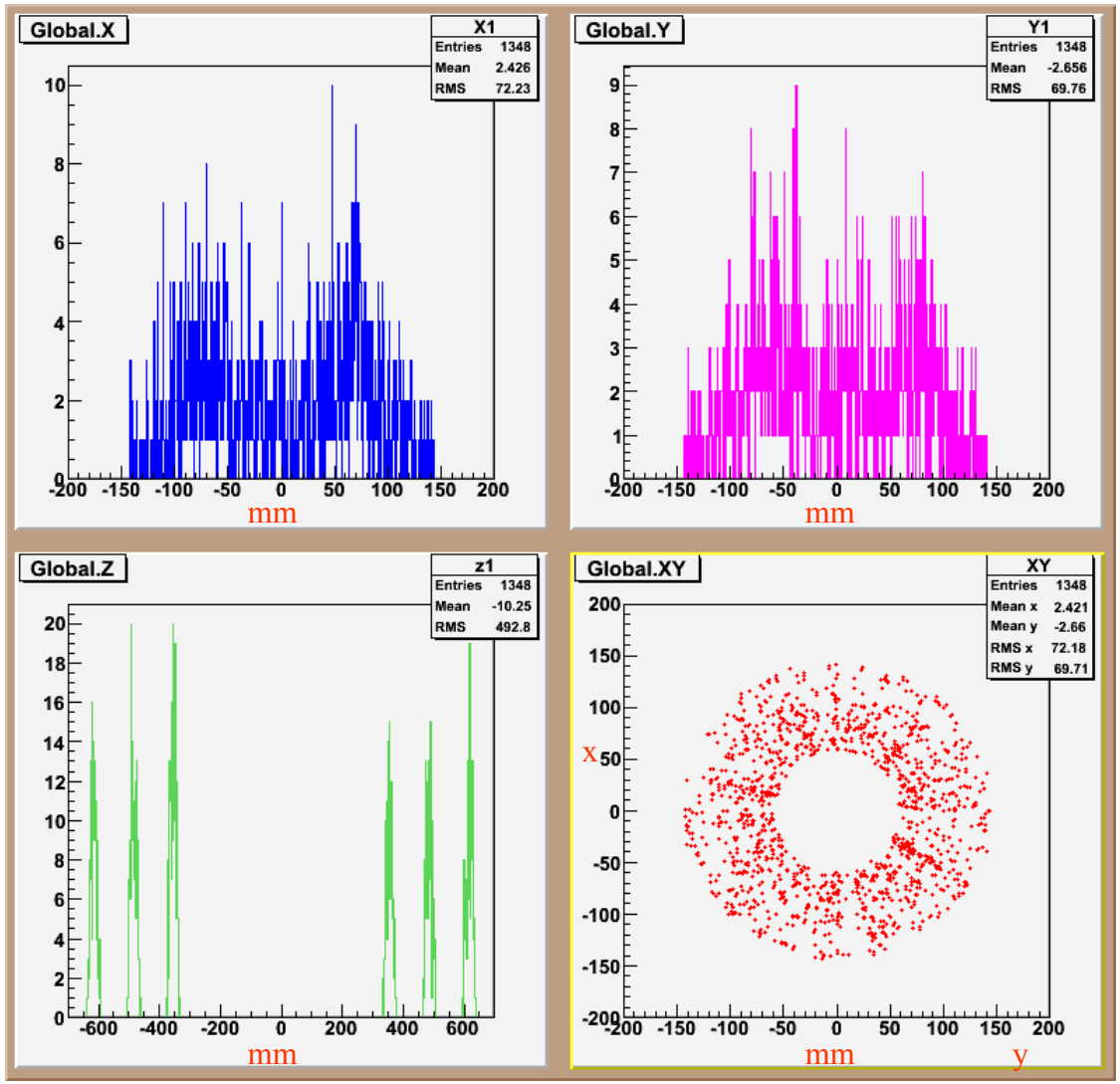
Global Coordinates

- **Features**
  - Particle Gun
  - 1000 events
  - Pion plus
  - 20 GeV
  - |eta|<3
  - 0< Phi < 360
- **It looks good!!**





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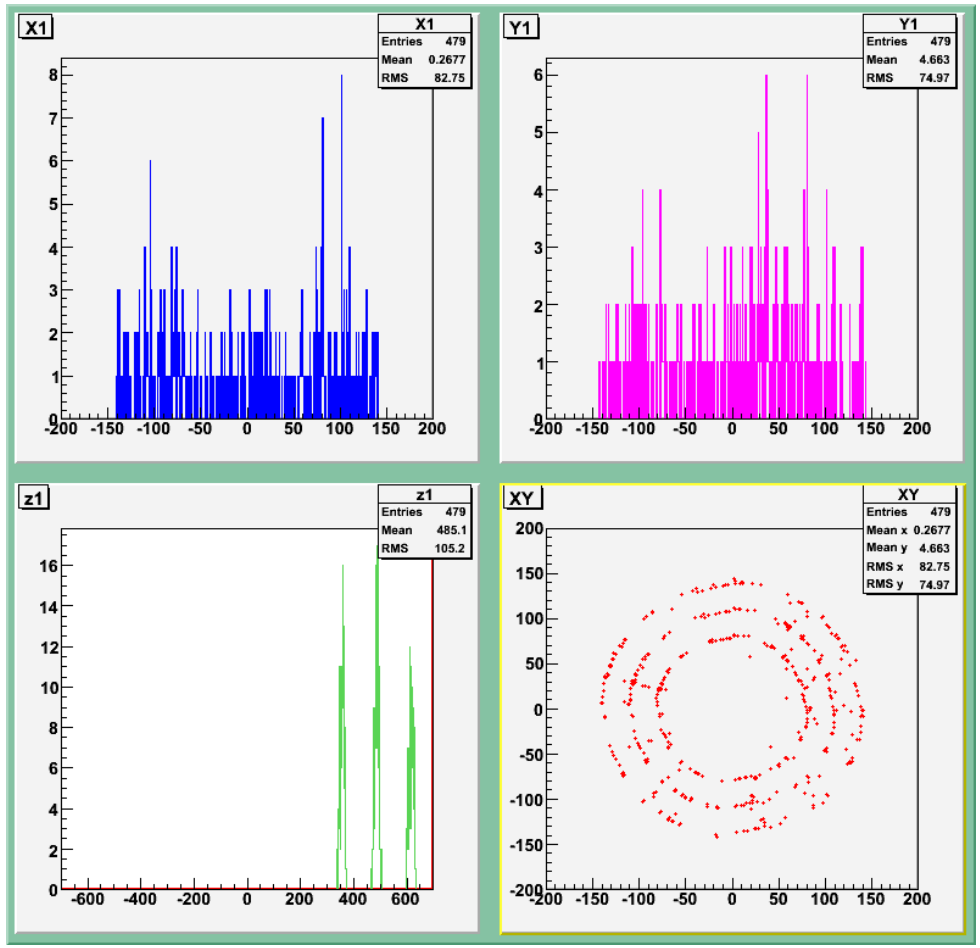
Global Coordinates

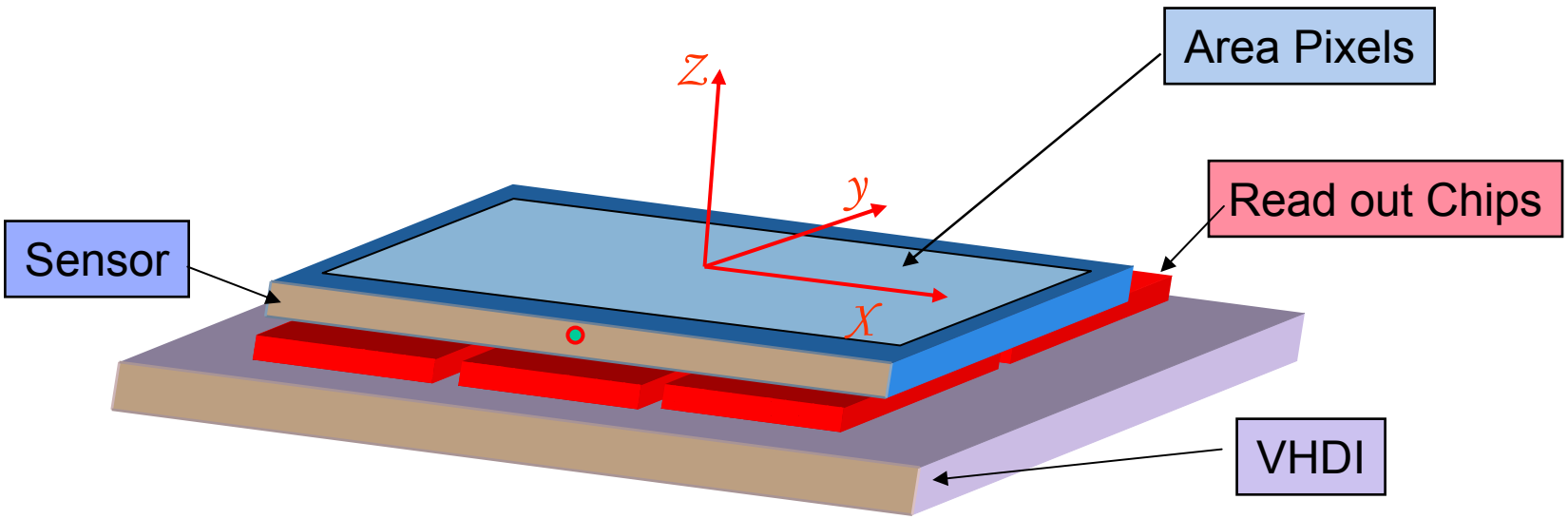
- Particle Gun
- 100 events
- Pion plus
- 20 Gev
- Eta = 2.2
- 0< Phi < 360

The average number of hits is 4.79 per track



Local Coordinates

- X is along the length of the Sensor (2 to 5 ROC chips)
- Y is along the width of the Sensor (1 to 2 ROC chips)
- Z is along the thickness of the Sensor and perpendicular to the pixel plane, and the positive Z is the direction in which pixel lies
- The center is the geometric center of the Sensor



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Local Coordinates

- Hits are generated in the middle of the sensor in Z
- All of Hits are saved into ROOT files
- The information of the hit
  - DetUnitID
  - EnergyLoss
  - Tof
  - Momentum
  - Particle Type
  - Tracker ID
  - Process Type
  - Entry Point
  - Phi at Entry
  - Theta at Entry
  - Segment= ExitPoint – EntryPoint

So, we can calculate the position of the hit:

HitPiont = EntryPoint + Segment/2

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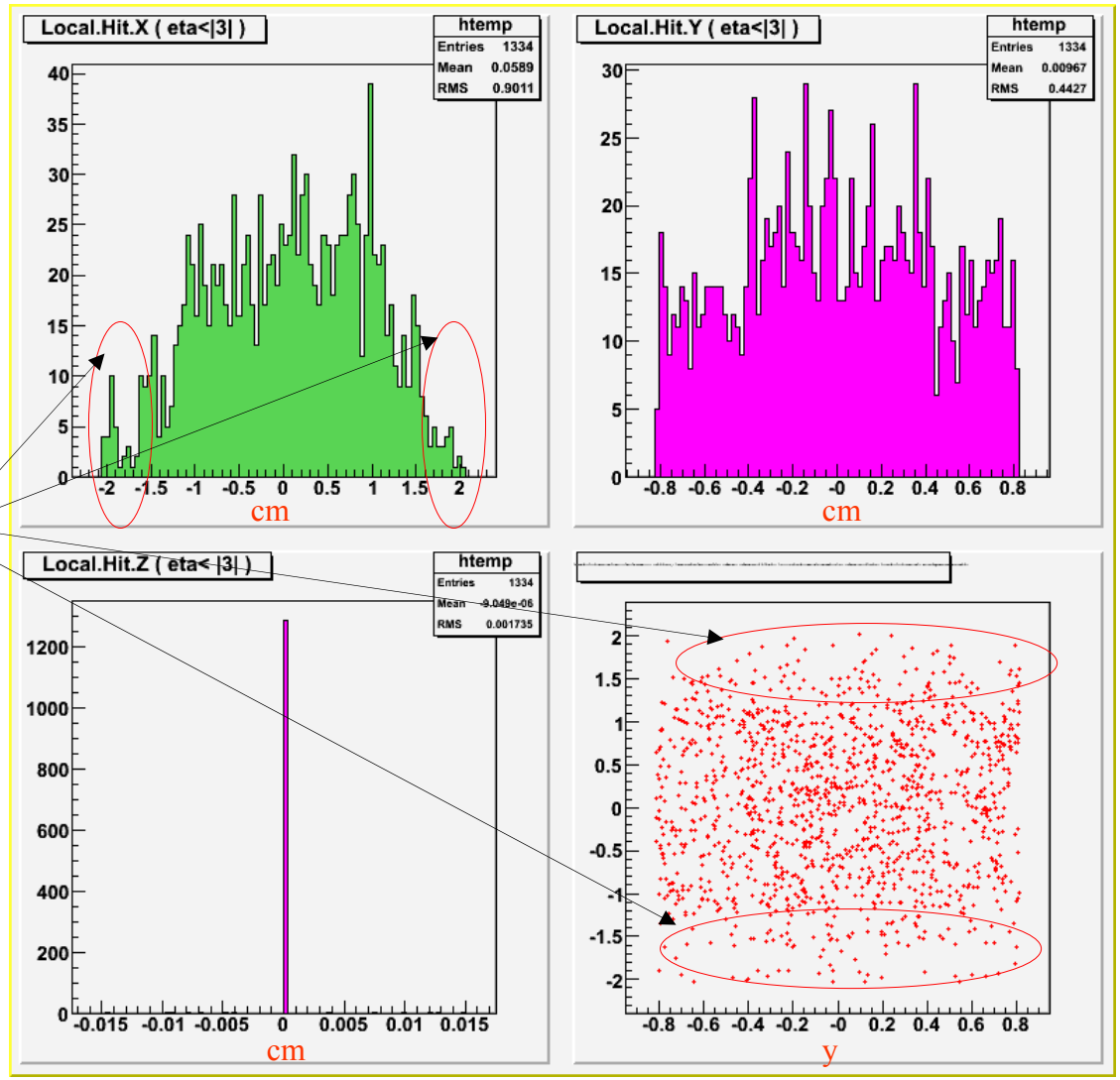
Local Coordinates

The contributions to these four areas are from the hits on the ROCs that are on the sides of 1x5 and 2x5 plaquettes



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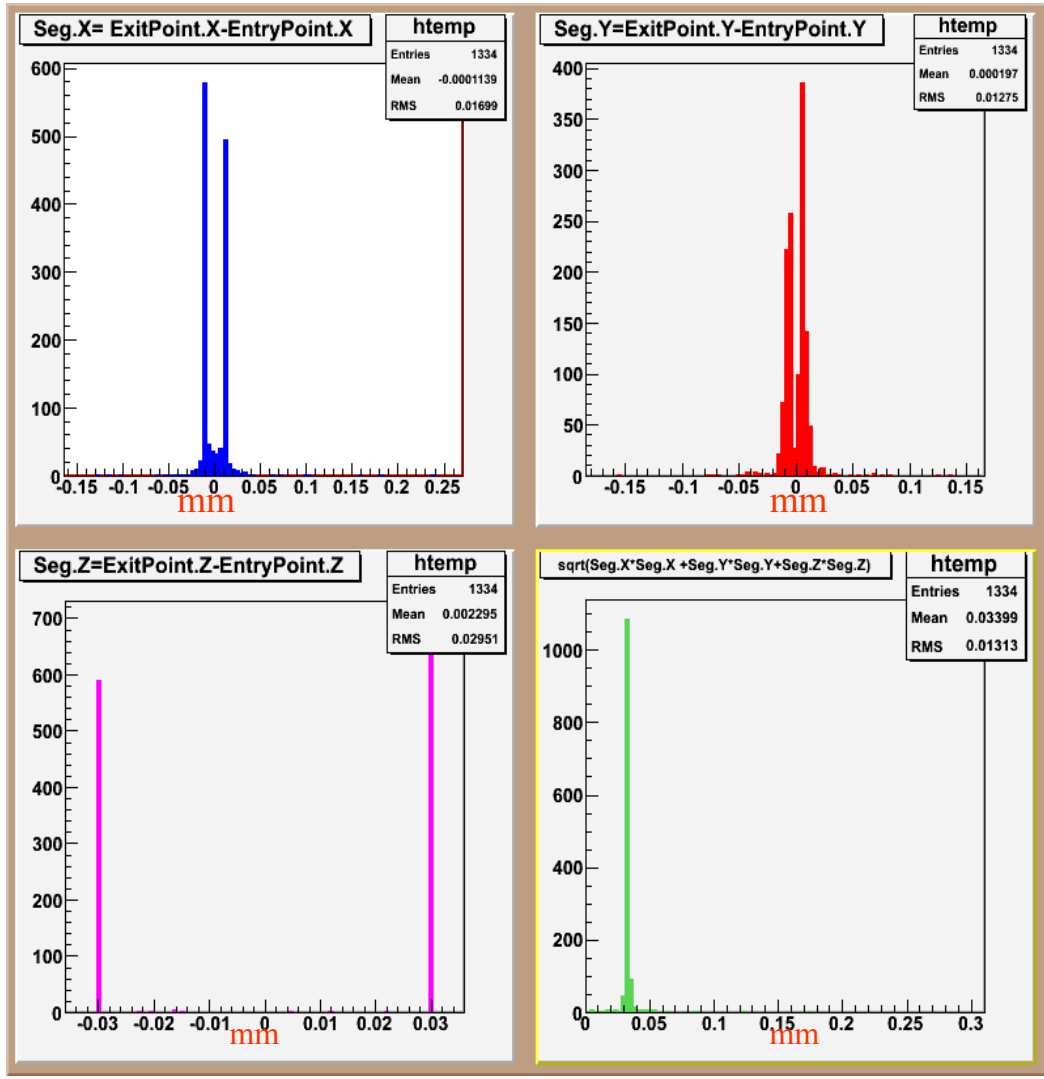
Local Coordinates

- The Segment refers to the distance the particle passes through the sensor
- Segment =

  ExitPoint- EntryPoint



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Next steps

- Position resolution
- Energy resolution
- Charge sharing
- Hit efficiency

Breakout session on Thursday

11-12:30, 14:00-15:00, 1-EAST

- Xingtao will give a talk and discuss
  - Validation of the new Geometry
  - Implementation of digitization
  - Change Geometry according to the need of the FPix 2007 FPIX installation

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Manpower

- Neeti Parashar (Coordinator)
- Dmitry Onoprienko – Kansas State Univ
- Victoria Martin – Northwestern
- Xingtao Huang – Puerto Rico Univ
- Vesna Cuplov – Purdue Univ Calumet (new)

- Thanks to all who helped us get started
- Many have expressed interest in this effort