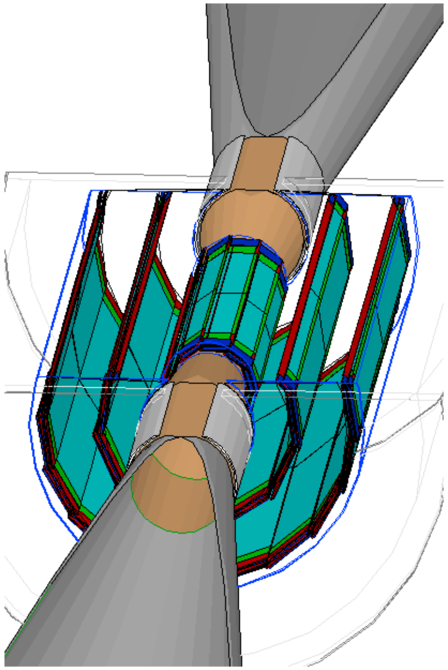
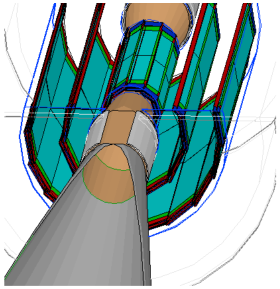


ILD vertex detector: VXD Integration

ILD inner region integration meeting, LAL, 2010 June 30

J.Baudot, for the IPHC group
baudot@in2p3.fr

- ✗ Overview
- ✗ Mechanics
- ✗ Cooling
- ✗ Cabling
- ✗ Material budget



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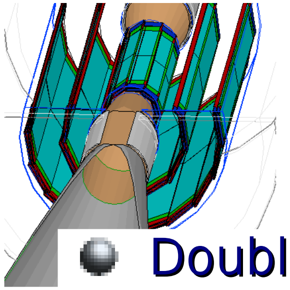
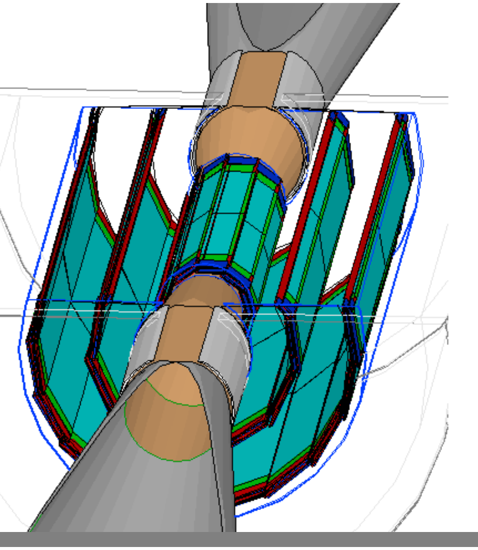


Two options for geometry

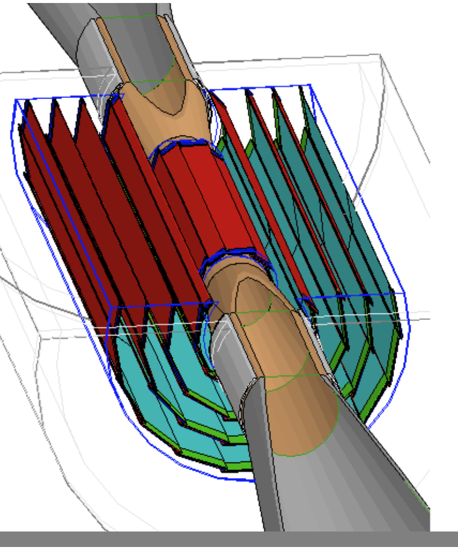
Double sided ladder

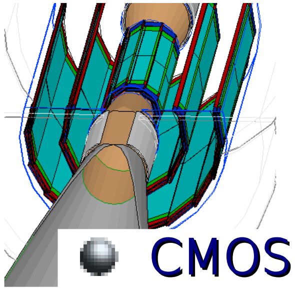
- Ladder is equipped with two layers of sensors
  - ➔ Material budget [LOI target) 0.16% X0
- 3 ladders



Single sided ladder

- Ladder is equipped with one layer of sensor
  - ➔ Material budget (LOI target) 0.11% X0
- 5 ladders





Sensor options

CMOS pixel sensors

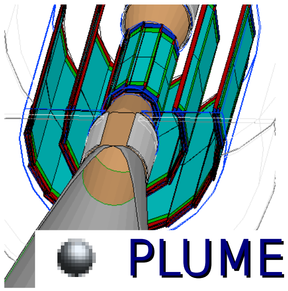
- ✗ Power dissipation ~100mW/cm^2
  - ➔ Full detectorL O(1) KW while active
  - ➔ Factor 1/50(100) for average
- ✗ Servicing required
  - ➔ ?
- ✗

CCDs

- ✗ FinePixelCCD, ISIS
- ✗ CCD to be kept at low temp
  Power dissipation ? mW/cm^2
- ✗ Servicing required

DEPFET sensors

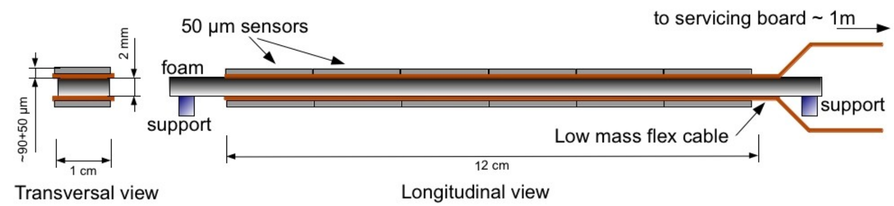
- ✗ Power dissipation ? mW/cm^2
- ✗ Servicing required



Ladder prototype

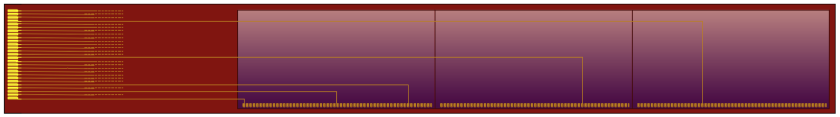
PLUME project

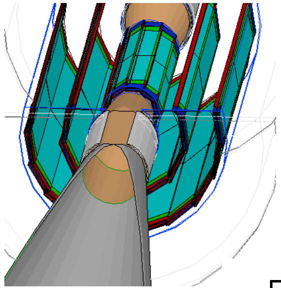
- Bristol U. DESY, IPHC, Oxford U.
- Running from 2009 to 2012
- Double sided ladder with 0.3% X0 goal
- Focus on CMOS sensors
  BUT should accommodate other technologies



SERWIETE project

- IPHC, IKFrankfurt, IMEC Leuven
  - EU-FP7, Hadron Physics 2 project
- Embedding the sensor inside kapton & metal layers
  - Benefit from ultimate CMOS thickness (20-30µm)
  - Allow very thin metal traces down to 1µm
  - Material budget for 1 module $O(0.1)$ % X0

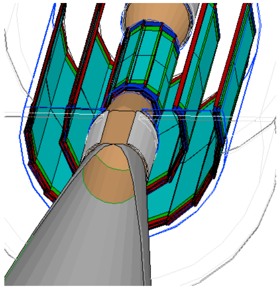




Numbers

	radius [mm]		ladder length [mm]		read-out time [μs]	
geometry	VTX-SL	VTX-DL	VTX-SL	VTX-DL	VTX-SL	VTX-DL
layer 1	15.0	16.0/18.0	125.0	125.0	25–50	25–50
layer 2	26.0	37.0/39.0	250.0	250.0	50–100	100-200
layer 3	37.0	58.0/60.0	250.0	250.0	100-200	100-200
layer 4	48.0		250.0		100-200	
layer 5	60.0		250.0		100-200	

- ~100 ladders in total
- 300-500 Mpixels



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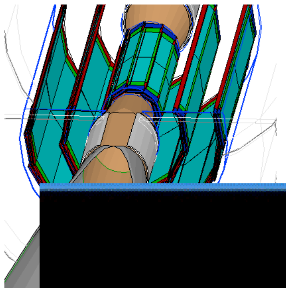
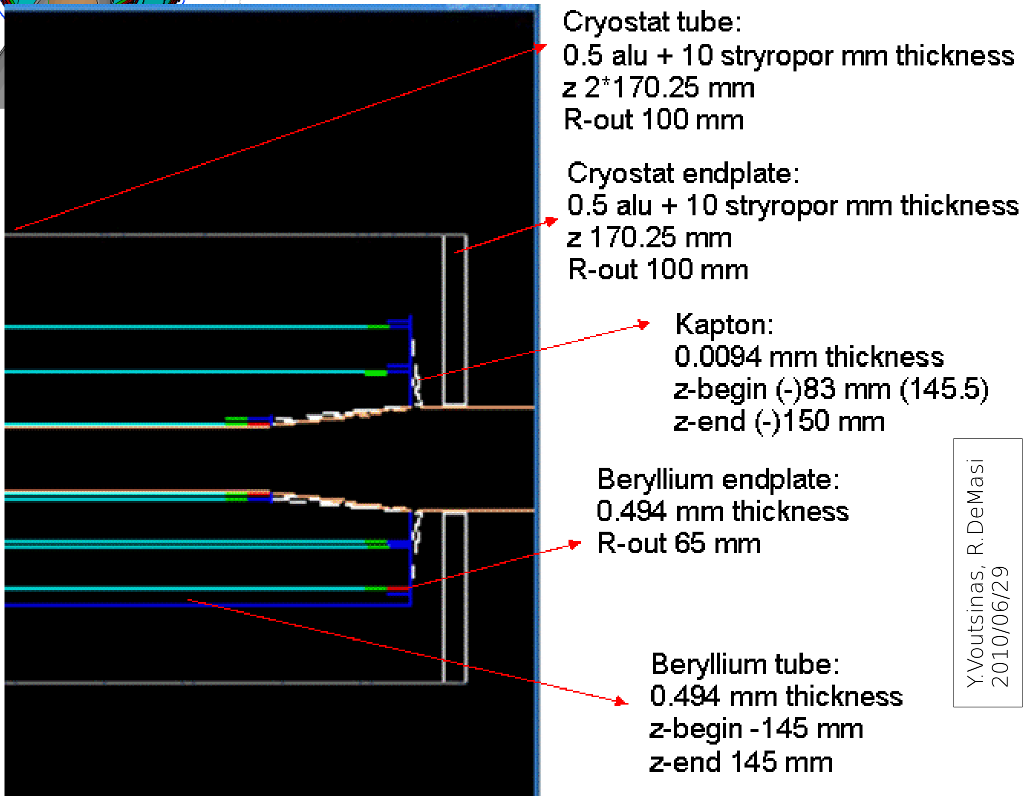
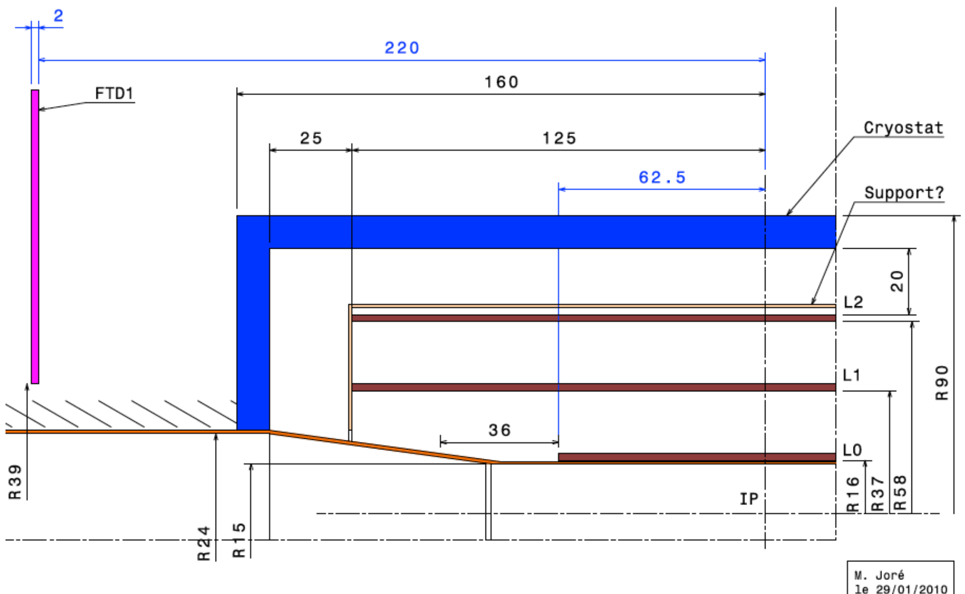


Mokka vs Mecha. model



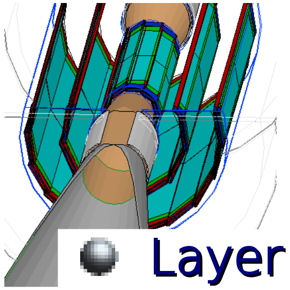


Mokka (VXD03)

- ✗ Simplistic double-sided ladder = 2xsingle-sided ladder BUT radiation length match LOI target
- ✗ Cryostat larger R(+10mm) & z (+10mm) / mecha. model

Mechanical model

- ✗ Miss ladder fixtures on support
  - ➔ Support z is -20mm / Mokka
- ✗ Miss kapton cables from ladders to pipe
- ✗ Support radius lower (-5mm) / Mokka



Supporting the VXD

Layer support

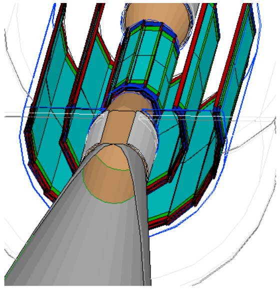
- ✗ 1^{st} layer is mounted on the beam pipe
- ✗ 2^{nd} & 3^{rd} layers mounted on the Beryllium support
- ✗ Beryllium support clamped on beam pipe
- ✗ No study on the impact of beam pipe deformation
- ✗ No technical drawing available (manpower)

Mechanical alignment

- ✗ Initial survey (<100µm) should be good enough
- ✗ <u>Note:</u> IR light go through CMOS sensors (both sides)

Mounting concept

- ✗ No detail work done



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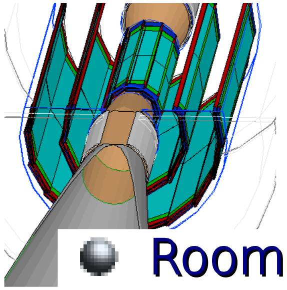


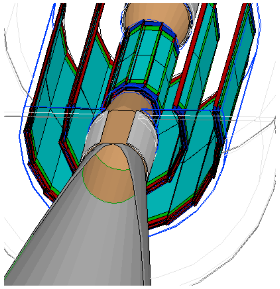
Two options

Room temperature operation

- CMOS-like sensors
- Passive cooling
  - Air flow ~ 1 m/s (for mech. Stability)
  - Sensor Temp~10-30 °C
  - Air Temp. Under study
- No real cryostat, nevertheless
  - Faraday cage needed
  - May require air separation / SIT
  - Some thickness of aluminium
- Tubes required on beam pipe
  - Diameter ? mm

Negative temperature operation

- FinePixel-CCD-like sensors
- Active cooling required
  - C02 evaporation in tubes
  - Sensor Temp~ -(5-15) °C
- Real cryostat needed
  - Backbone 0.5 mm aluminium
  - Isolation material = 10mm styropor
  - 0.15(?) % X0
- Tubes required on beam-pipe
  - ?



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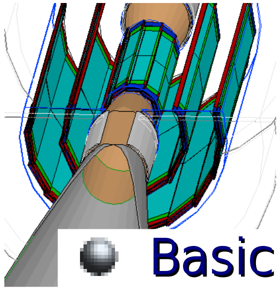

Cables

Basic option

- ✗ Flat kapton cables running from each ladder to the beam pipe
- ✗ Small patch panel on the cryostat to interconnect to other flat kapton cables running to the next larger patch pannel some meters away
- ✗ 2 such cables for each ladder
  - ➔ ~200 cables divided on the 2 end-caps
- ✗ Kapton cable ~ 50 µm thick, ~1cm wide
- ✗ After some distance (meters) conversion to long distance cables
  - ➔ How much ?
  - ➔ What kind ?