Goals for the ILD Vertex Detector 2015-20 Plans

M. Winter

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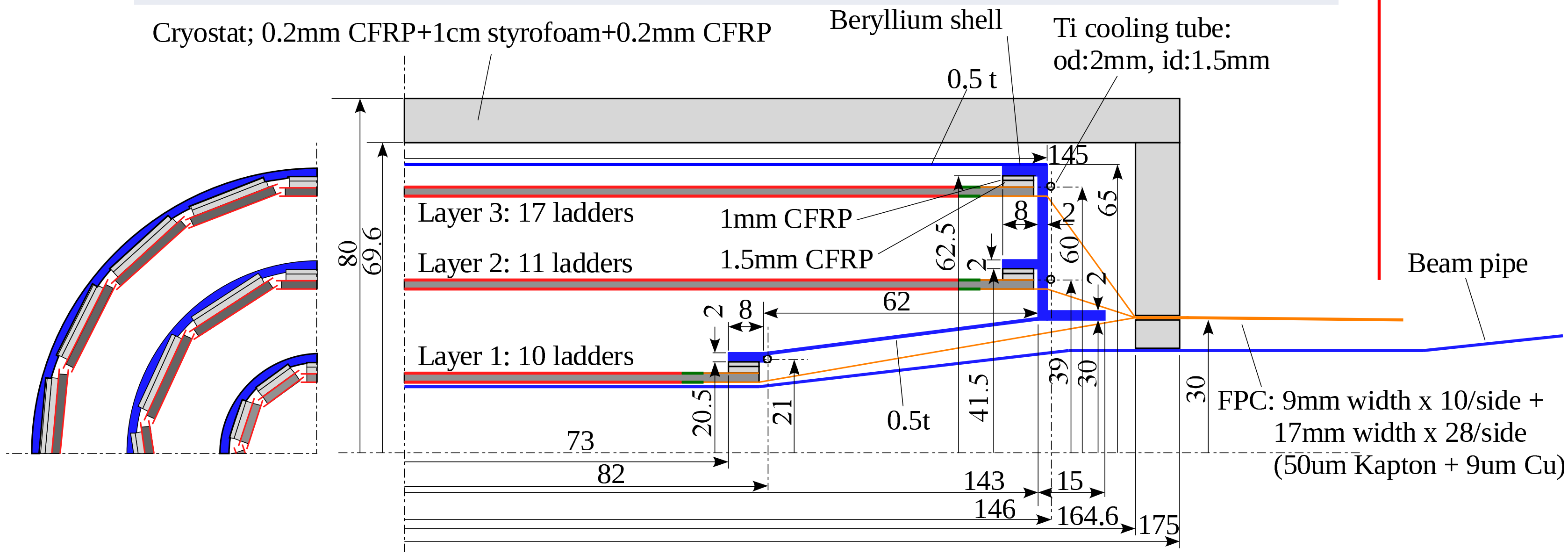
Outline

- *Introductory remarks*
- *Detector requirements*
- *Pixel technologies*
- *Detector geometry*
- *Detector operation and services*
- *Summary*

Vertex detector in DBD

- Baseline design

	R (mm)	|z| (mm)	|cosθ|	σ (μm)	Readout time (μs)
Layer 1	16	62.5	0.97	2.8	50
Layer 2	18	62.5	0.96	6	10
Layer 3	37	125	0.96	4	100
Layer 4	39	125	0.95	4	100
Layer 5	58	125	0.91	4	100
Layer 6	60	125	0.9	4	100



Introductory Remarks

- VXD REQUIREMENTS : poorly motivated quantitatively & scientifically
- VXD REQUIREMENTS : lack of strategy
  - supposed to be identical at all coll. energies (but beam BG evolves
  - do not exploit sensor technology evolution (industry !)
  - do not account for relatively easy upgrade possibilities
- REQUIREMENTS ARE NOT DRIVEN BY "DIFFICULT CASES" :
  - impact of beam background on (low p) track reconstruction
  - charm tagging
  - b-tag in top jets (?)
  - secondary vertex electrical charge determination

$\Rrightarrow$ **Calls for additional physics performance assessments vs E_{cm} as well as for more robust, E_{cm} dependent, requirements**

Pixel technologies

- TOO POOR GUIDANCE FROM REQUIREMENTS TO ELECT/CONVERGE ON $\geq$ 1 SENSOR DESIGN:

  $\Rrightarrow$ each technology **believed** satisfactory $\Rrightarrow$ which one is **best** suited ?

- FINE PIXEL RELATED QUESTIONS :

  - which added value for physics ?

    $\hookrightarrow$ charm decay, 2ry vertex charge determination, etc.

  - which limitations from occupancy due to beam BG ?

    $\hookrightarrow$ would FP be adapted to $E_{cm} \approx$ 250 GeV ? up to which E_{cm} can one use FP ?

    $\hookrightarrow$ what if one increases R(L1 & L2) by 3-4 mm ?

  - how precise can the alignment be ?

- SENSOR COMBINATION :

  - added value of bunch tagging in L2 ?

    $\hookrightarrow$ track seeding in high BG environment ?

  - added value of mixed pixel techno. & designs ?

    $\hookrightarrow$ alternatives to DBD strategy ? $\longmapsto$

	Layer 1		**Layer 2**	
	σ_{sp}	$t_{r.o.}$	σ_{sp}	$t_{r.o.}$
DBD	**2.8 μm**	**50 μs**	**6 μm**	**10 μs**
update	2.8 μm	50 μs	5 μm	8 μs
alternative	5 μm	8 μs	5 μm	8 μs

Detector Geometry

- Barrel vs Forward Disks :
  - short vs long barrel
  - impact of FTD pixel layers performances

- Double-sided vs single-sided ladders

  ⇛ **Is there an optimum for ”all” physics cases and E_{cm} values ?**

- Continuous (power pulsed) vs delayed read-out :

  ⇛ SWOT analysis needed ?

Detector Operation and Services

- POWER PULSING :
  - assess effect of PP in high magnetic field
  - maintain FP option as long as no full proof of principle is achieved

- SERVICES :
  - find a consistent solution for low mass cables and cooling implantation
  - preparation of Engineering Design may require mock-ups

Summary

- REFINE VXD REQUIREMENTS : (E_{cm} dependence. ambitious physics cases)
  - guidance for pixel technology
  - guidance for sensor designs & combinations

- SWOT ANALYSIS OF PIXEL TECHNOLOGIES AND VXD GEOMETRIES :
  - delayed vs continuous read-out $\Rrightarrow$ power pulsing in high magnetic field $\longmapsto$ alignment ?
  - added value of $\lesssim$ 1 μm resolution (vs inner radius ?)
  - long vs short barrel & connection to FTD pixel planes
  - double-sided vs single-sided ladders

- EXPLOIT RESULTS OF ABOVE TO EXTEND/REFINE ILD PHYSICS POTENTIAL

  $\Rrightarrow$ **strengthen ILC physics case**

- STUDY ISSUES OF VXD INTEGRATION $\longmapsto$ services (cables, cooling)