Steps towards a CLIC detector concept

Goal: CLIC Conceptual Design Report (mid 2010)

1. Start with SiD baseline detector concept

2. Modify for CLIC specifics:
   - Get B=5 T and 14mrad crossing approved by CLIC!
   - VDET inner (4cm?) + outer radius, 4 or 5 layers? Barrel length?
   - Additional layers for time stamping (tracker, ECAL, HCAL? Where? How many?)

3. Clarify forward region. → Andrey
   - CLIC mask from z = 1-3 m, (SiD @ 2-3 m),
     r_{outer} = 25 cm?, Θ_{min}=80mrad, Θ_{max}=120mrad, hole < 10mrad ?.
     Add 10 cm of low-Z material to reduce backscattering?
   - 1 or 2 masks (see p38, CLIC04: "In the presence of a crossing angle… part of the vertex detector cannot be protected to prevent backscattering through the hole of the mask)

Cont.: Steps towards CLIC detector concept

- LumCal 36mrad – 113mrad?
- BeamCal < 46mrad
- GamCal 5mrad
- Extra BPM and kicker, where? (Daniel)
- Extra magnets (DID) needed to remove background from forward calorimeters?
- CLIC beam pipe layout, r(z)?

4. MDI in general (supports, services, etc)

5. Verify tracker layout, 5 axial layers ok? SiD material assumptions?

6. Verify Pixel detector layout; push layers to larger radii?
7. B-field, provide field map to study effect on beams

Questions for later

1. One concept for both low and high E or two versions? Start with detector for E=0.5 TeV and upgrade later to 3 TeV?
2. Effect of muons from collimators on sub-detectors
3. Consider a TPC à la ILD
4. Consider alternative calorimeter (dual read-out?) → Lucie
5. Reconstruction of E_{cms} spectrum (see Daniel's presentation)
6. Cost estimate
7. What else?

End

SiD Starting Point
Details & Dimensions

Flux return / muon
R_{in} = 333 cm
R_{out} = 645 cm

Solenoid: 5 T; R_{in} = 250 cm

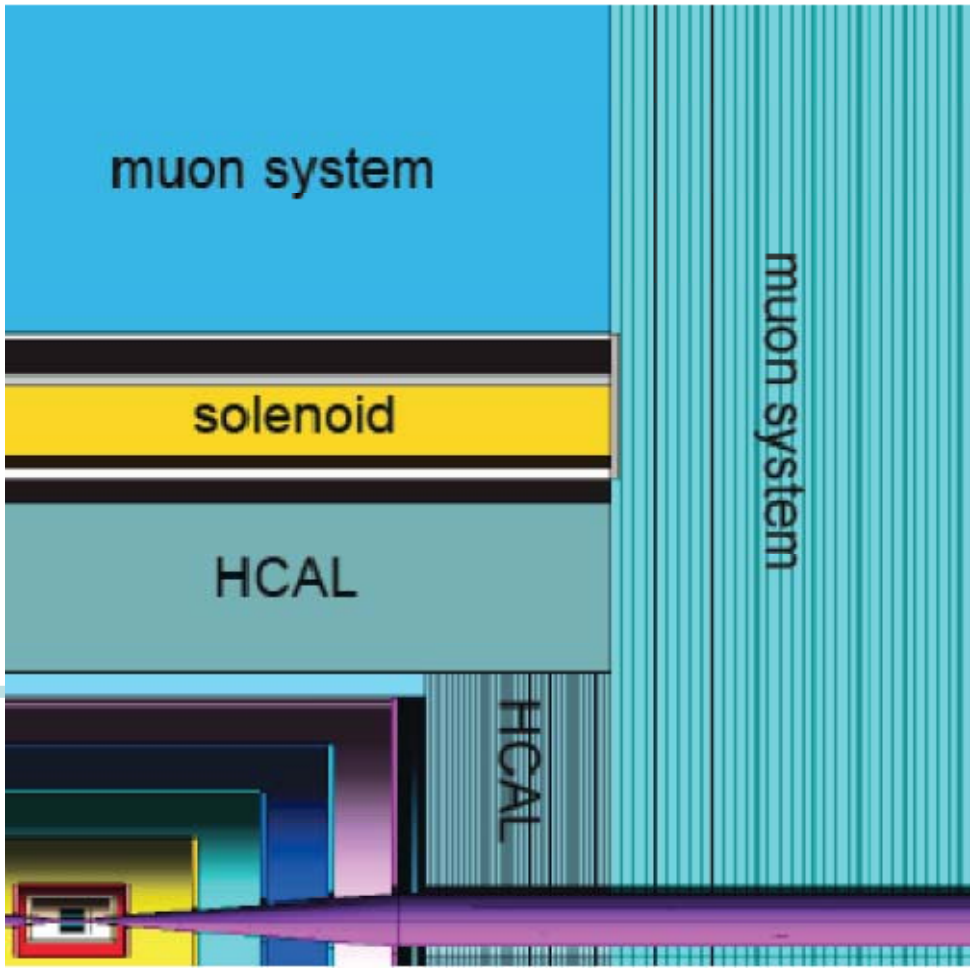
PFA

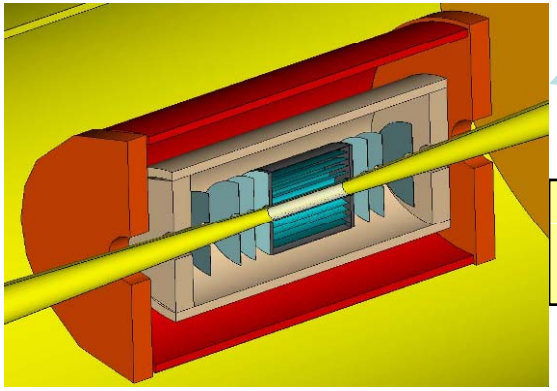
HCAL Fe: 34 layers; R_{in} = 138 cm

EMCAL Si / W: 30 layers R_{in} = 125 cm

Si

Si tracking: 5 layers; R_{in} = 18 cm



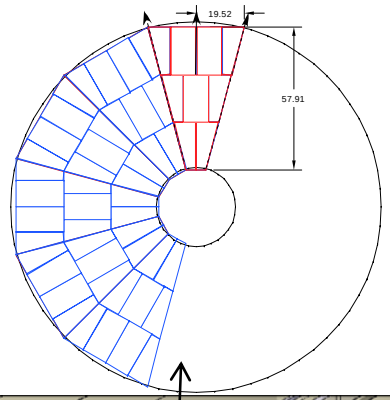


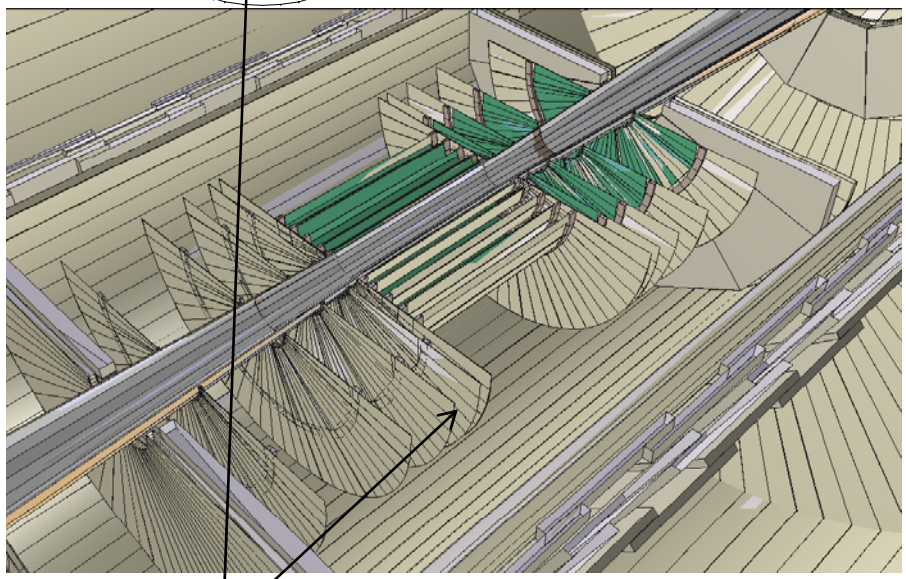
Vertex detector:
5 barrels, 4 disks; R_{in} = 1.4 cm

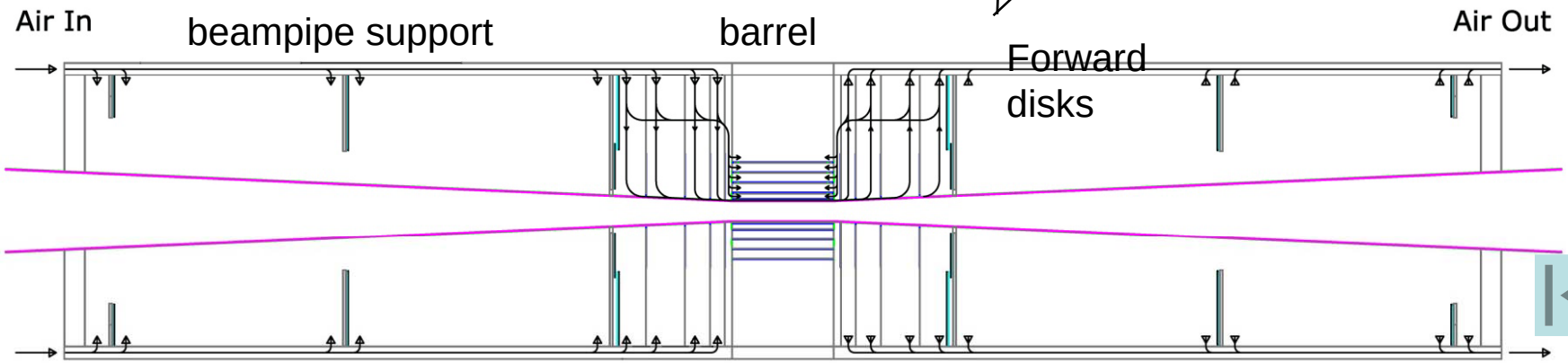
SiD Vertex Detector

SiD Vertex concept is based on short (12 cm) barrels followed by disks

- Detailed mechanical design including carbon fiber support cylinder and services
- 5T field allows small inner radius
- Sensor technologies considered
  - CCD, DEPFET, CMOS, 3D
  - Final detector can be a mix defined by power consumption and performance







SiD tracker

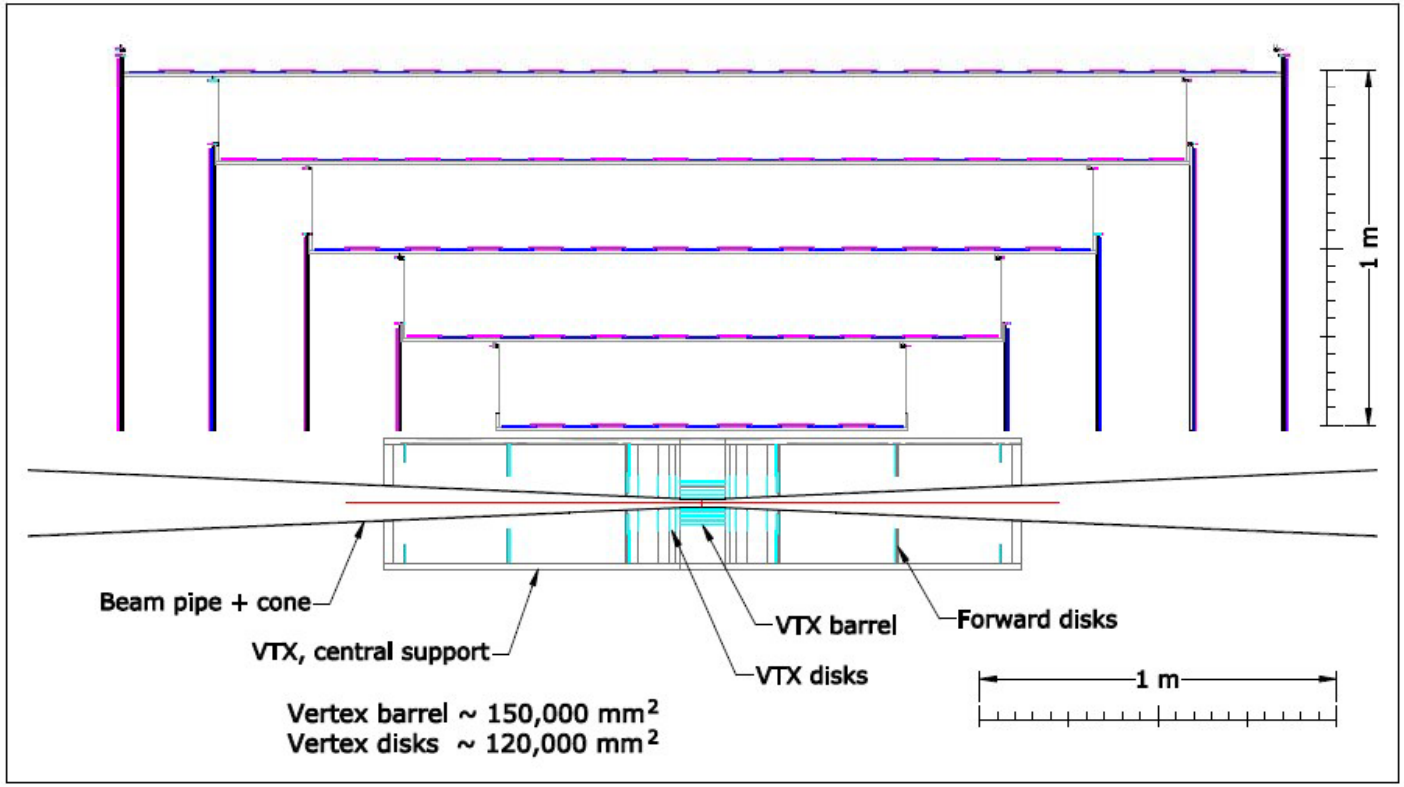
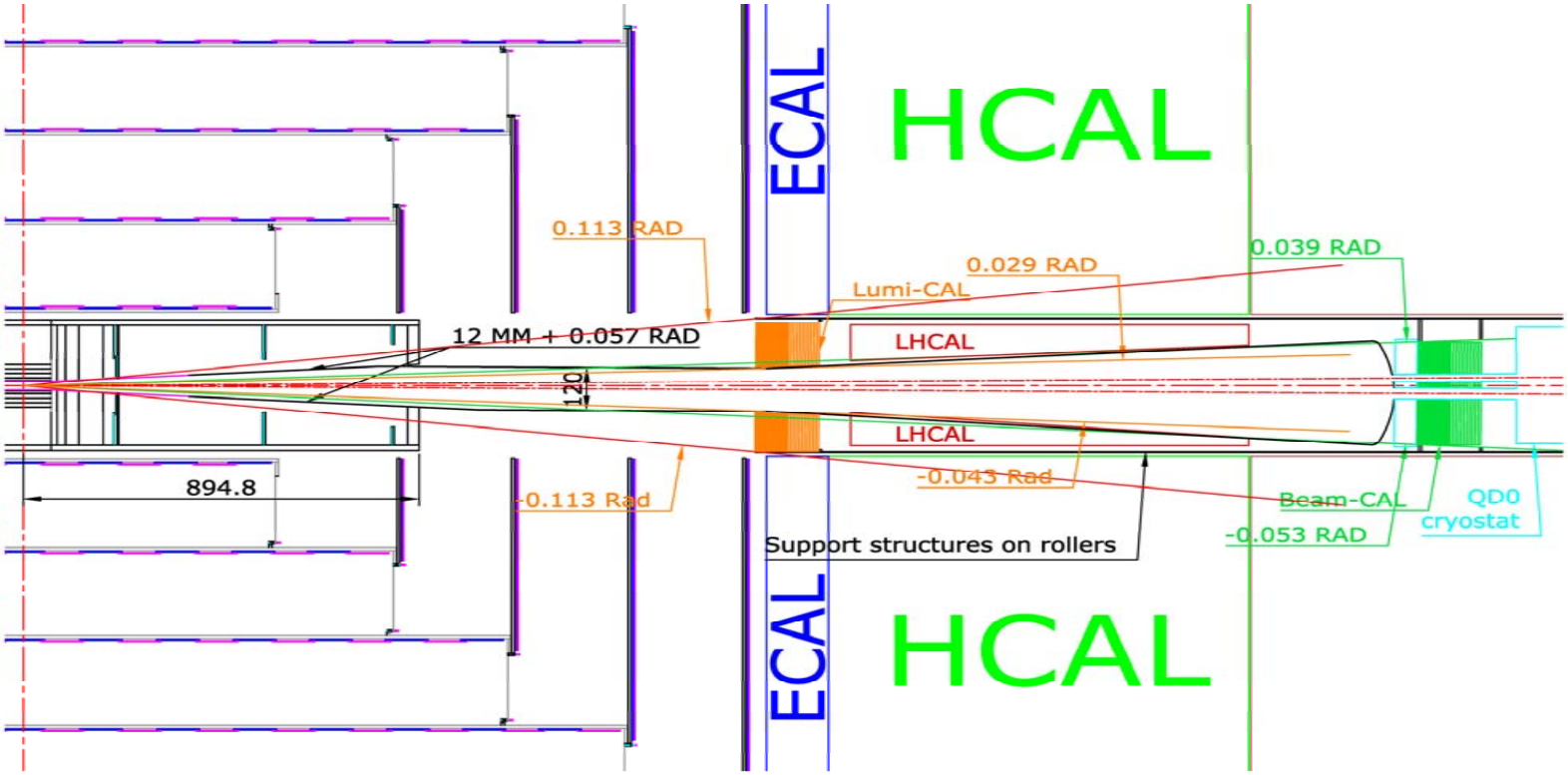


FIGURE 3.2. Mechanical concept for supporting the SiD vertex detector barrel and endcaps, tracker forward disks, and the beam pipe

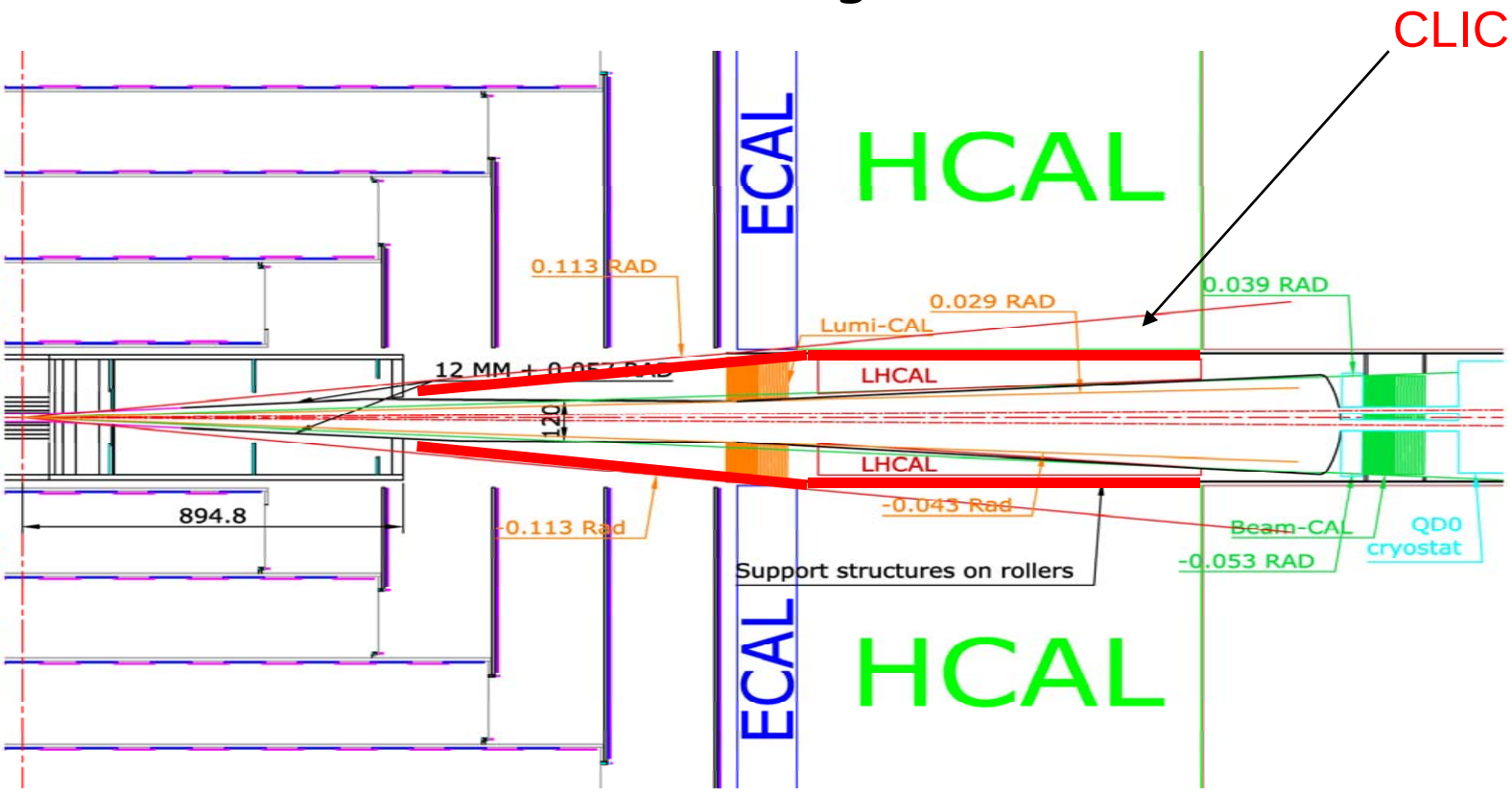
SiD Forward region



In close cooperation with FCAL collaboration

LumiCal inner edge	≈36mrad about outgoing
LumiCal outer edge	≈113mrad about 0mrad
LumiCal fiducial	≈46-86mrad about outgoing
BeamCal outer edge	≈46mrad about outgoing
LumiCal	$30X_0$ Si-W
BeamCal	$30X_0$ rad-hard Si,diamond....

Forward region



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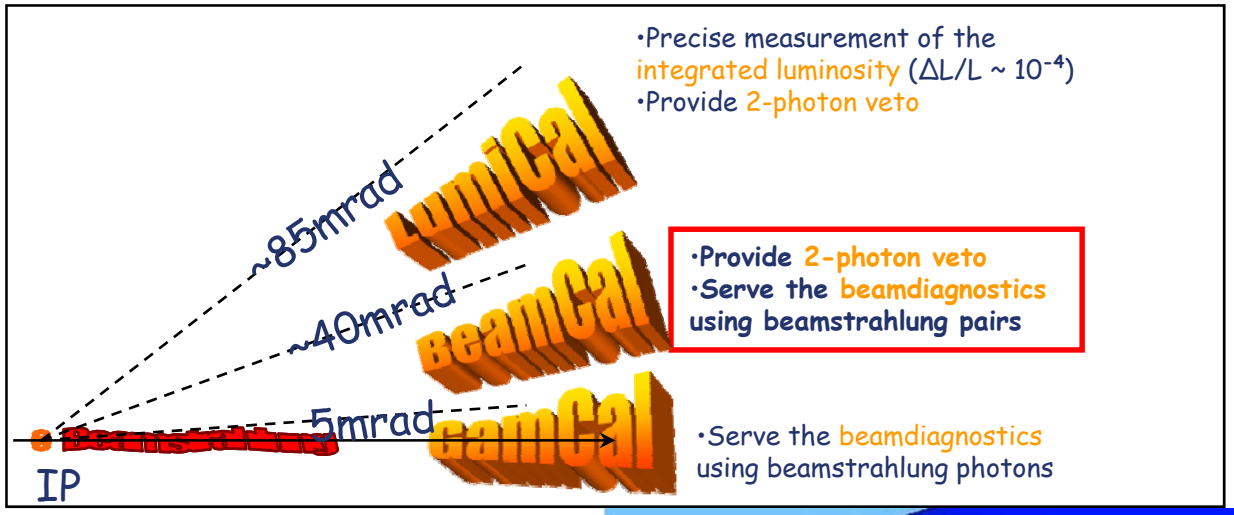
The Design



•Precise measurement of the integrated luminosity ($\Delta L/L \sim 10^{-4}$)
•Provide 2-photon veto

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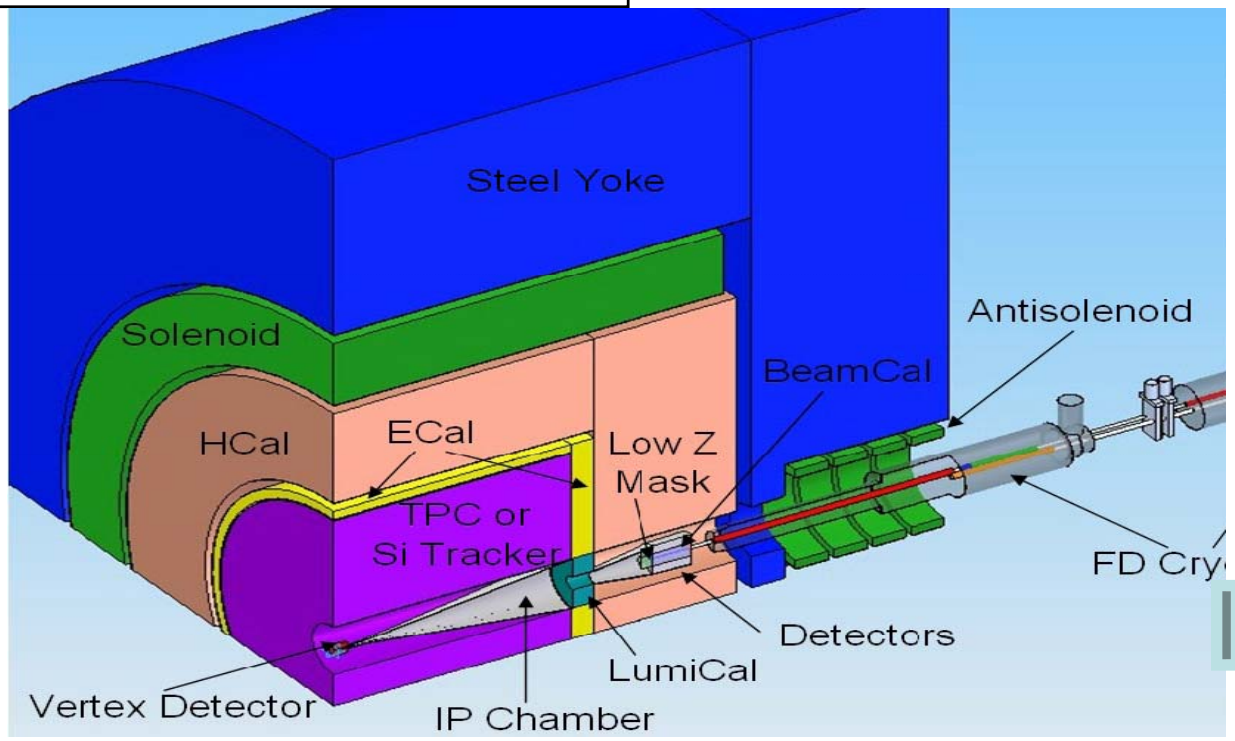
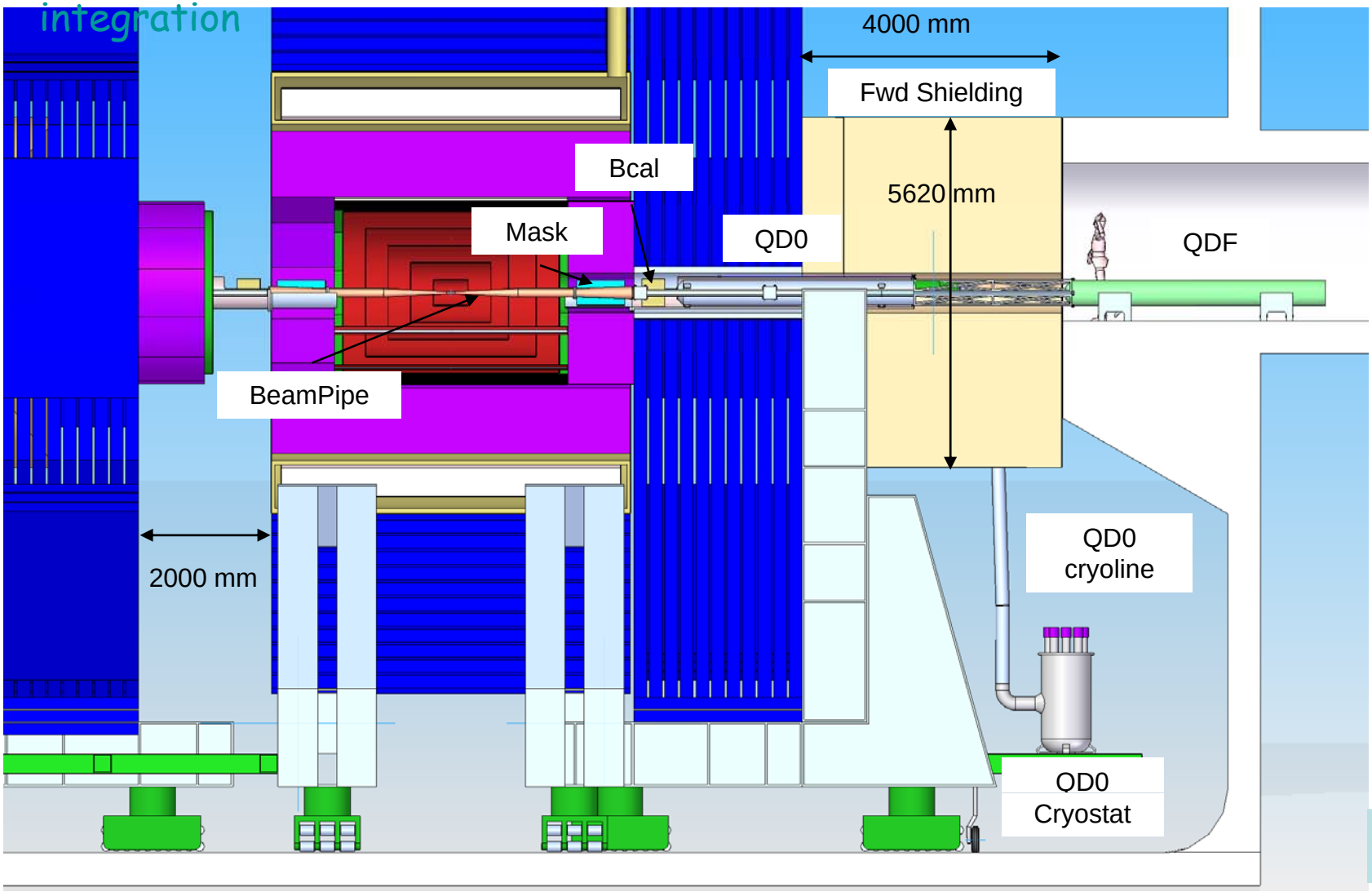
•Serve the beamdiagnostics using beamstrahlung pairs

•Serve the beamdiagnostics using beamstrahlung photons



Machine-Detector Interface

The first step is to translate the parameters in an engineering model, formulating technical solutions, clearances and components integration

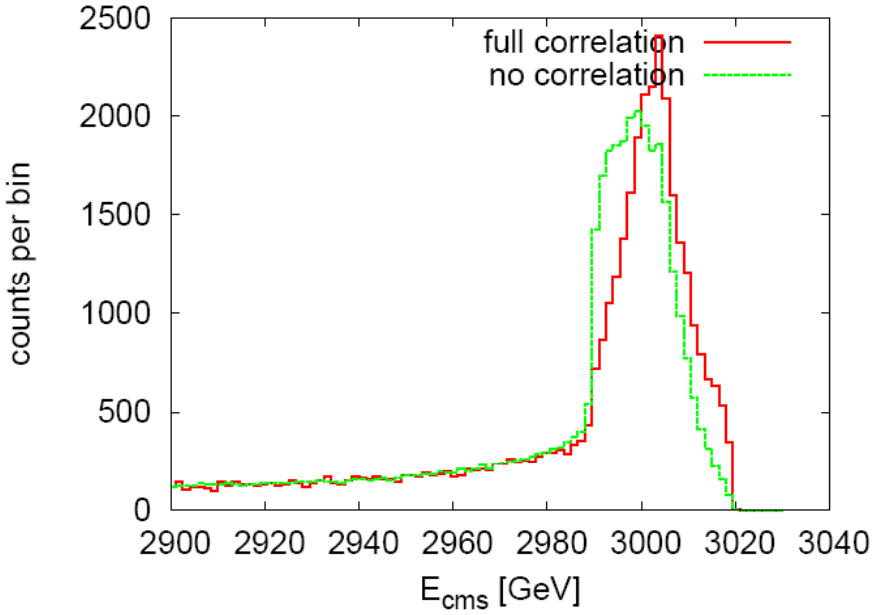


Luminosity Spectrum Reconstruction

- Luminosity Spectrum reconstruction is a challenging task
- One proposed method is to measure Bhabha angles

$$p_{\perp,1} = -p_{\perp,2} \quad \Rightarrow \quad \frac{p_1}{p_2} = \frac{\sin\theta_2}{\sin\theta_1}$$

- Initial transverse momenta could be different
  - is noticeable in ILC
  - ⇒ needs to be studied for CLIC



- Need model to seperate the beams
- Simple test remix colliding beam particle energies
  - ⇒ different spectrum
  - ⇒ correlations are important

⇒ Further study needed