Very Forward Region and Beam-Beam-Background

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FCAL Collaboration Meeting

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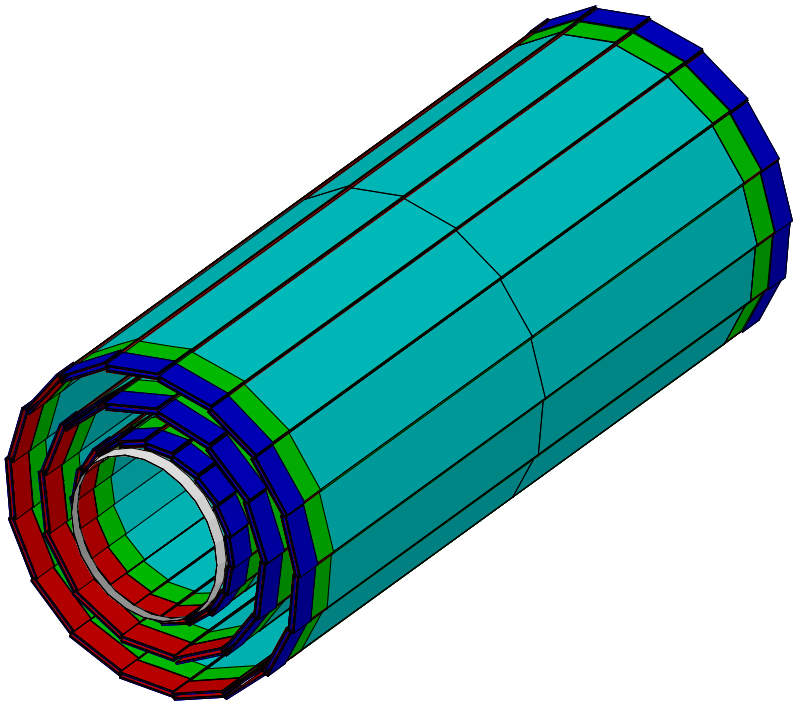
- Beam-Beam-Background Simulations
- Forward Region of a CLIC Detector
  - LumiCal, BeamCal, QD0 @ CLIC
- Background in the Vertex Detector
- Summary and Conclusions

Beam-Beam-Background

- Full Detector Simulation (Geant4, Mokka) with Beam-Beam-Background
  - Considering only incoherent Pairs: ≈$3*10^5$ /BX
  - 10 BX for some statistics
- What is the Background in the Detector?
  - Focus on the Vertex Detector
    - But must take the rest of the Detector into account

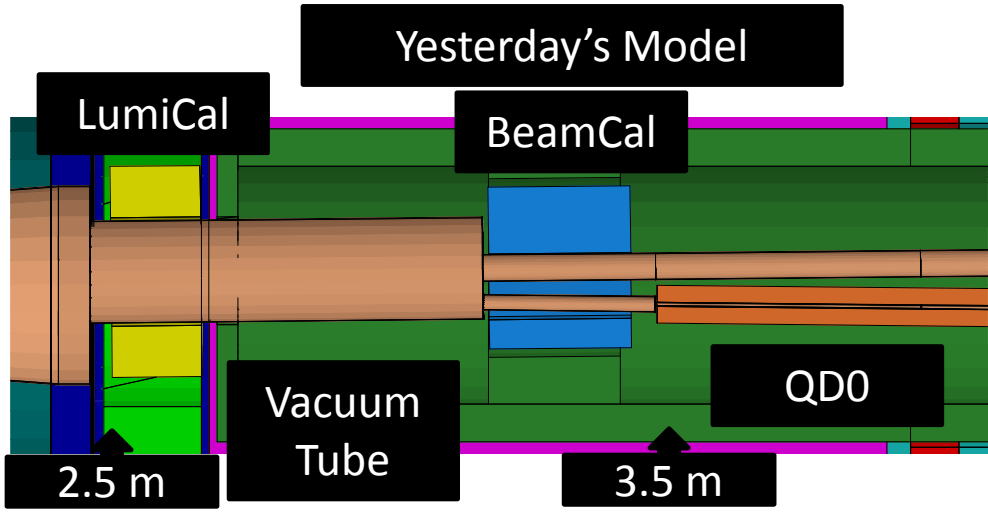
Vertex Detector

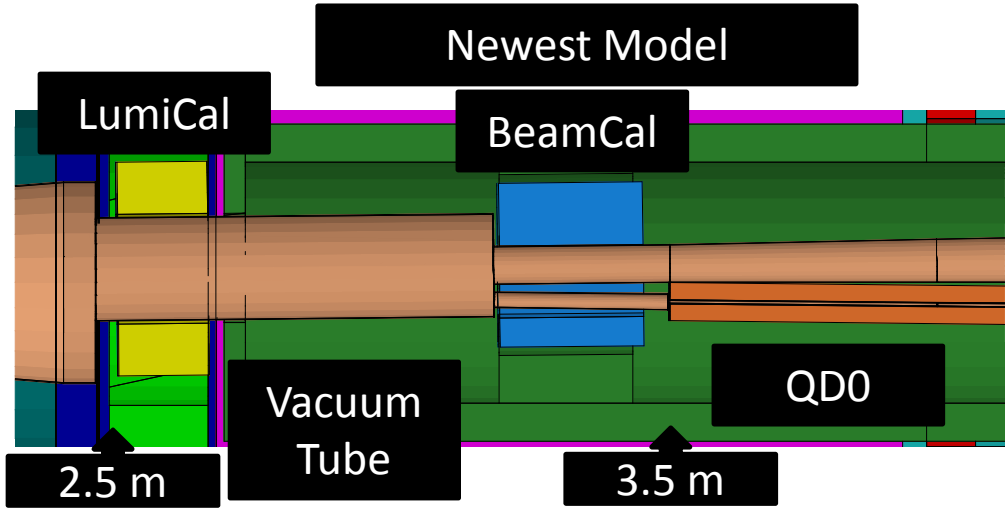
- 3 Double Layers
- In Z from -12.5 to +12.5 cm
- R = 31, 46, 60
- 50 micron Silicon
  - Threshold: 3.4 keV
- + Electronics + Support



Forward Region of a CLIC Detector

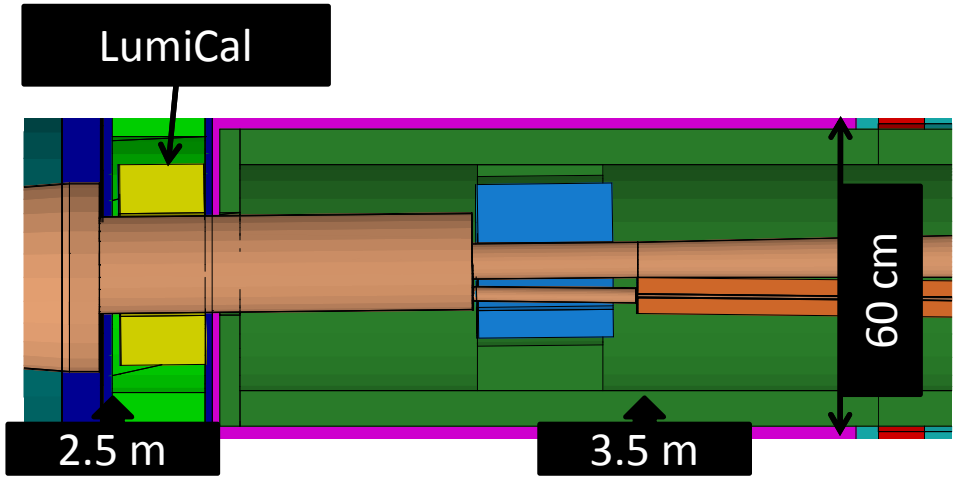
- 20 mrad crossing angle
- LumiCal >= 40 mrad
- BeamCal >= 10 mrad
  - 3.5 cm inner radius
- Conical beam pipe after BeamCal with 10 mrad opening angle
- (Present Status)

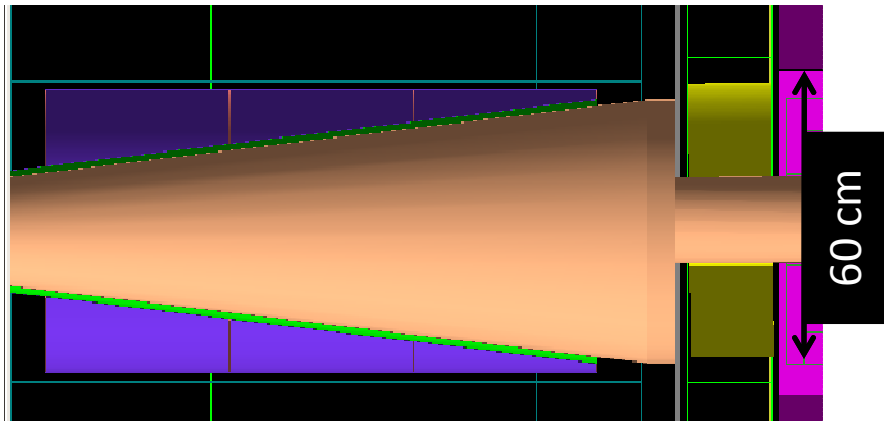




LumiCal

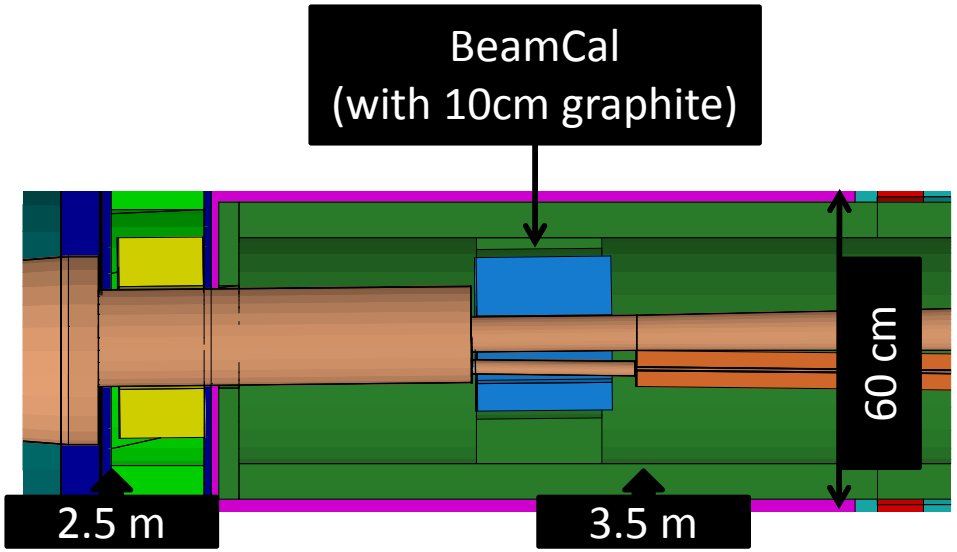
- 40 Layers Silicon-Tungsten (Si-W) Sandwich Calorimeter
- Counts Bhabha events to measure Luminosity
- Centered on Outgoing Beam axis
- Inner radius: 10 cm
  - Due to Incoherent Pairs
- No material supposed to be between LumiCal and IP
  - 35 cm radius is a bit much in this case
  - What happens, if the tracking disks cover (part of) LumiCal

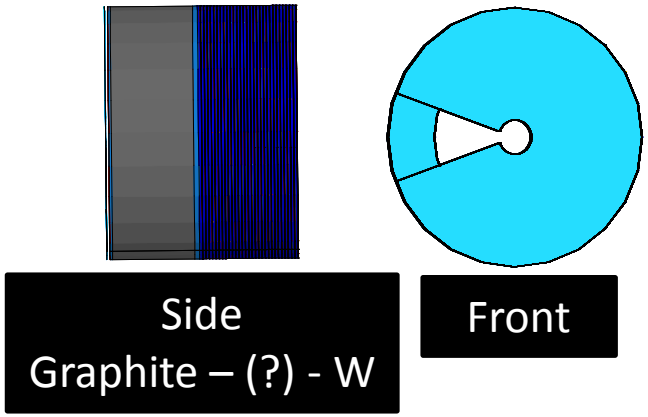




BeamCal

- (?)-Tungsten Sandwich Calorimeter
- 3.2 m from IP
- Centered on outgoing beam pipe
- Inner radius: 3.5 cm (11 mrad)
- Outer Radius: 15 cm (47 mrad)
  - Outer radius to complement LumiCal coverage
- Dump for incoherent pairs
- Collision/Luminosity Monitoring?
- Masking against back-scattering particles from post-collision line
- Electron Veto for 2-Photon events
  - Smaller inner radius desirable
  - Background from Backscatters/ Coherent Pairs

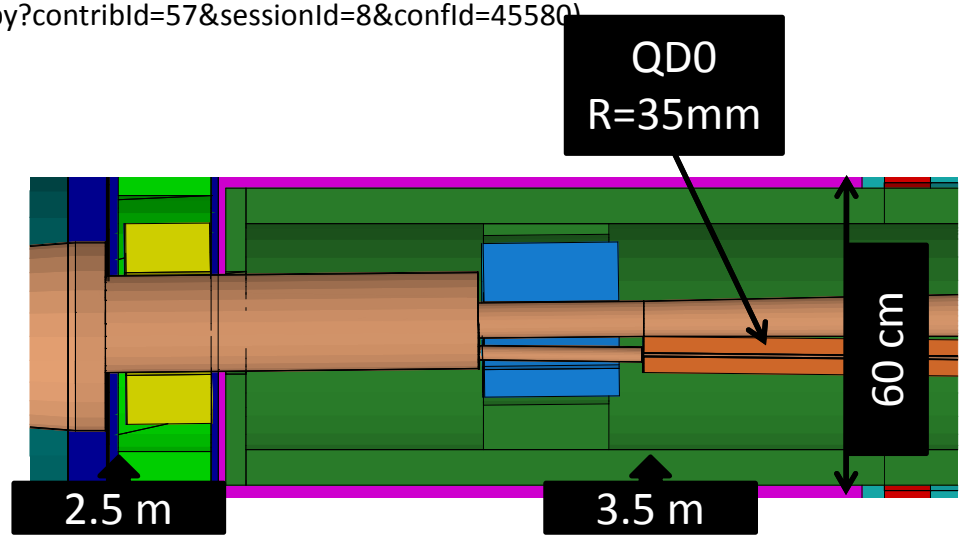


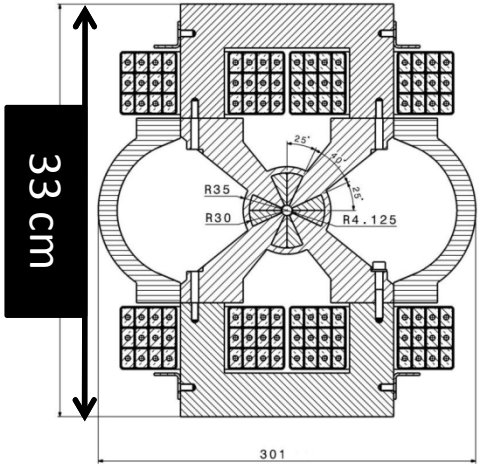


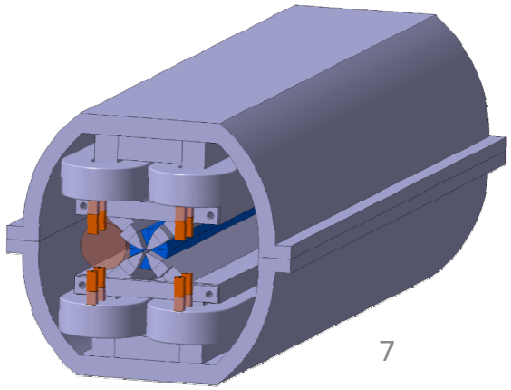
QD0

(See Talk by M. Modena CLIC09
http://indico.cern.ch/contributionDisplay.py?contribId=57&sessionId=8&confId=45580)

- QD0 Prototype
  - 33cm height
  - Should fit into forward region
- Has to be stable to ≈0.1nm
- 10 mrad space for outgoing beam pipe
- Move BeamCal Forward
  - Coils extend a little beyond Z=3.5 m
  - Allow Space for Intra-Train-Feedback

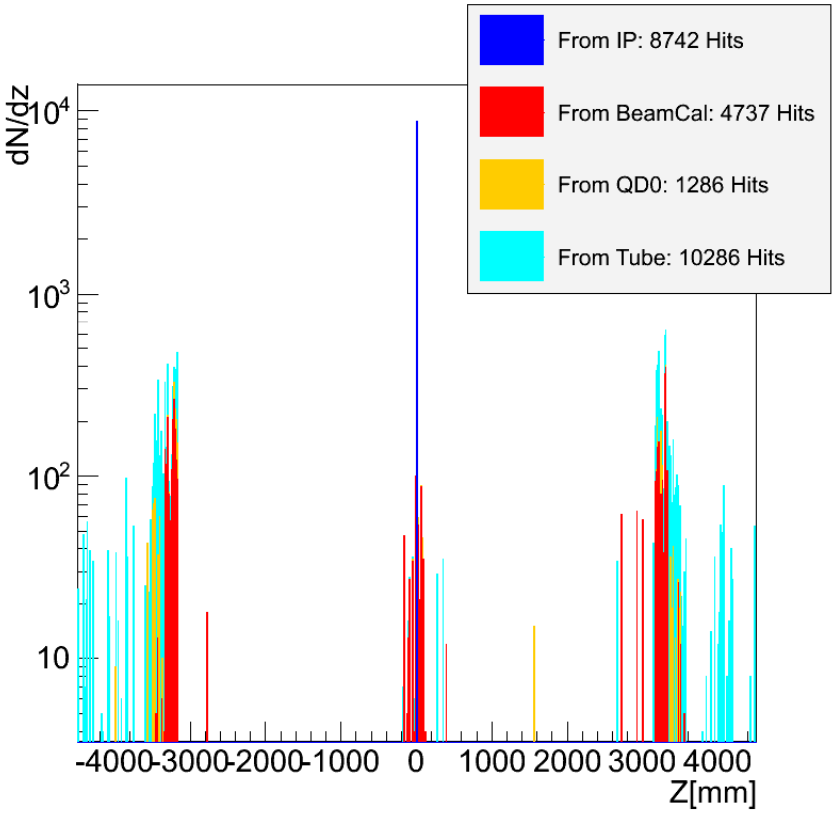






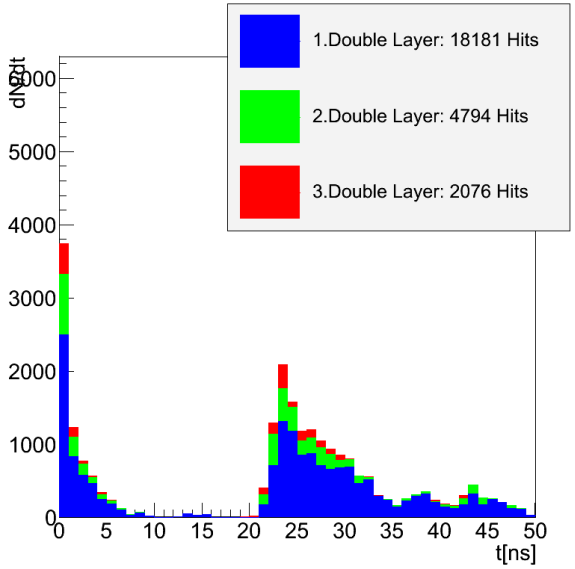
Background in the Vertex Detector (I)

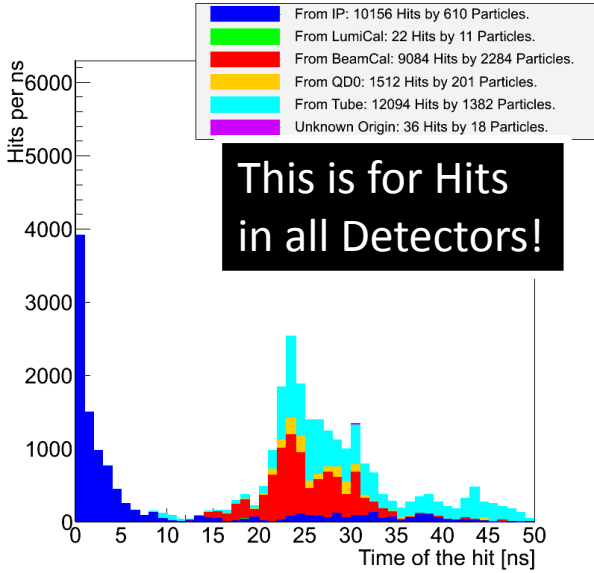
- Roughly 25k Hits in the VXD
- One third directly from IP
  - Reduce with higher B-Field
  - Larger Inner Radius
- 5k from BeamCal
  - Larger Inner Radius
- 10k from “Tube”
  - Mostly back-scattering from behind/inside BeamCal
- 0.02 Hits /mm^2 /BX



Background in the Vertex Detector (II)

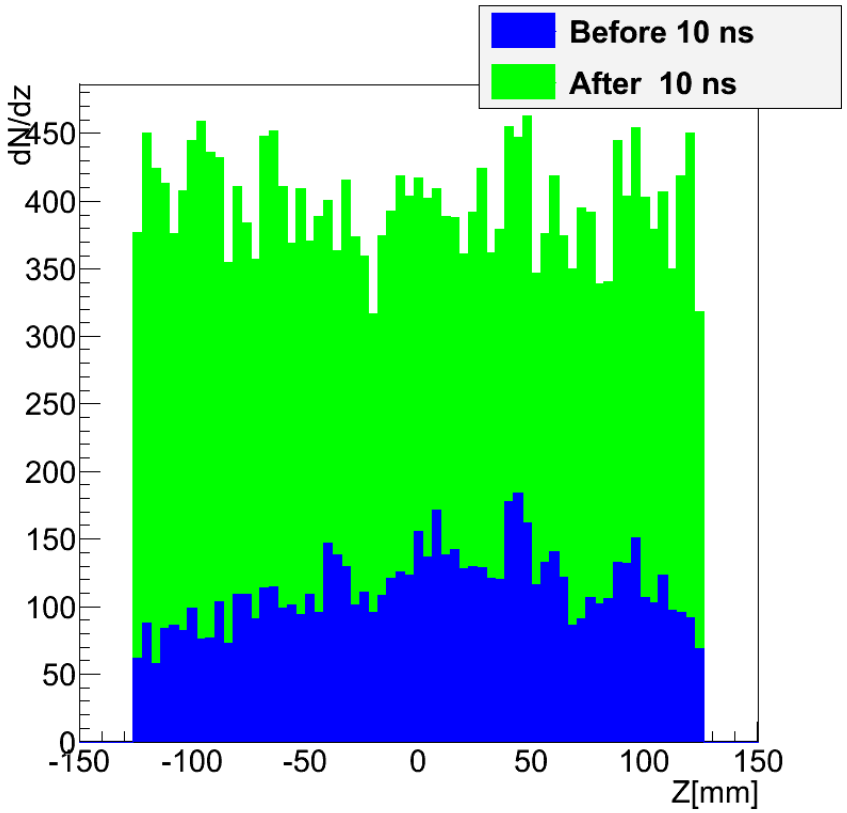
- Time separation between direct Hits and back-scattered Hits
- As expected from time of flight





Background in the Vertex Detector (III)

- Not touching $\sqrt{z}$ envelope of Incoherent Pairs
- Reduction in Length does not change hit density
  - Reduces Tracking Coverage



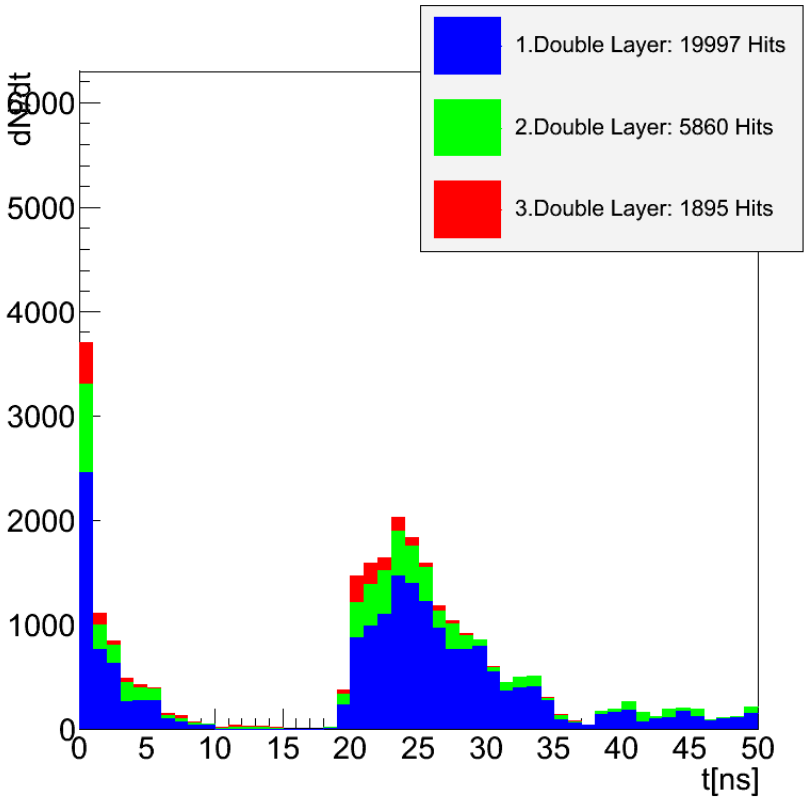
Hit Distribution along Length of VXD

Background in the Vertex Detector (IV)

- Hits in First Layer of Vertex Detector
  - 0.02 Hits per mm^2 /BX
  - 6 Hits per mm^2 /Train
  - 6 times higher than prior estimate (Barbara's Talk)
- Includes Back-scattered particles
- Particles from IP hit VXD more than 3 times
- Hits per BX similar to ILC (at smaller radius)

BeamCal closer to IP

- Work done few days ago
- Very preliminary
- Moved BeamCal 30 cm closer to IP
  - 3.2 cm inner Radius (vs. 3.5 cm)
- Larger Distance to QD0
  - Make some Space for Intra-Train-Feedback
- 10% more Hits in inner-most VXD Layer



Input from Beam Physics Team needed

- What is the expected Bunch to Bunch fluctuation in Beam-Beam-Background?
  - Expected Beam Offsets
  - Simulate Full Bunch Train
- Need this to understand Electron tagging efficiency of BeamCal
  - Not only the deposited Energy is the issue, but also the fluctuations
- Better estimation of Background in Detectors

Summary and Outlook

- Using a fairly realistic Simulation of Forward Region
- Simulated 10 BX of Incoherent Pairs
- Large background in Vertex Detector (6Hits/mm^2/Train)
- Further Studies regarding Layout of Forward Region
  - Add Intra-Train-Feedback System
  - Better Model of QD0
  - Simulate a full and realistic Bunch Train, including fluctuations