Very Forward Region and Beam-Beam-Background

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CLIC09: MDI/Physics&Detectors

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Content

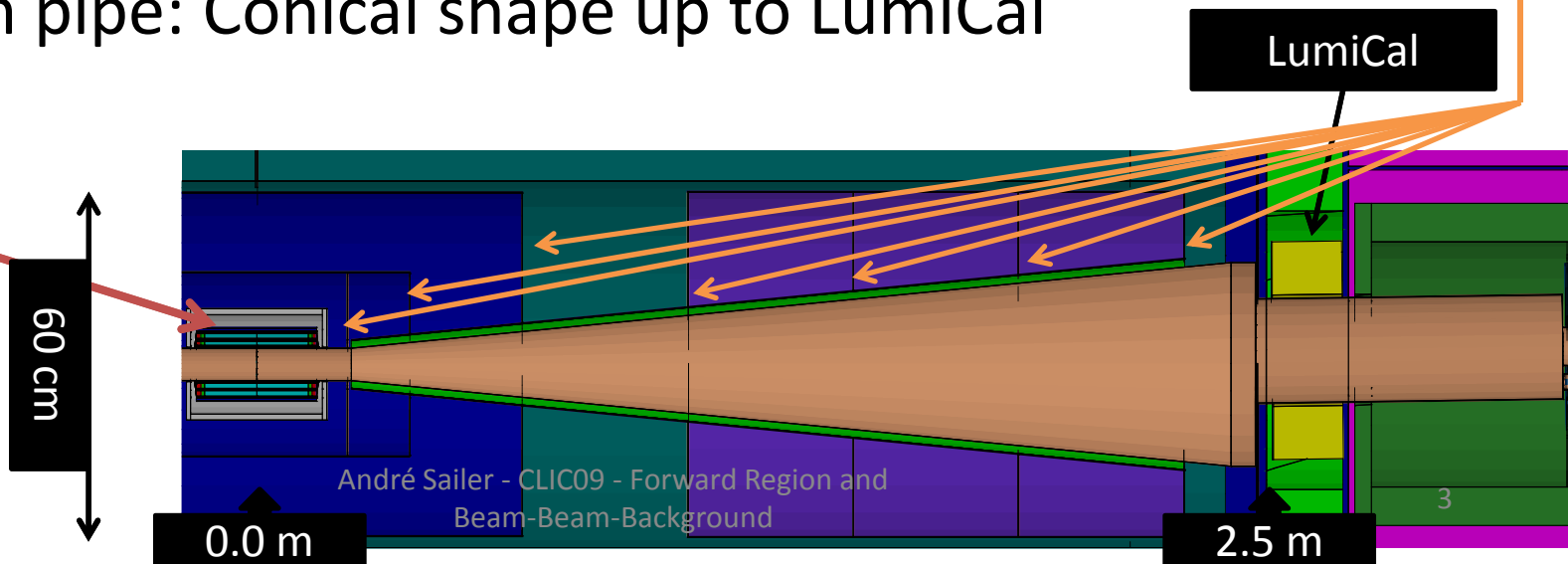
- Beam-Beam-Background Simulations
- Forward Region of a CLIC Detector
- Background in the Vertex Detector
- Summary and Conclusions

Beam-Beam-Background

- See Barbara's Talk for Beam-Beam-Effect etc.
- This Talk: 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
  - How do Changes in the Forward Region affect Background levels
  - How can Background be reduced

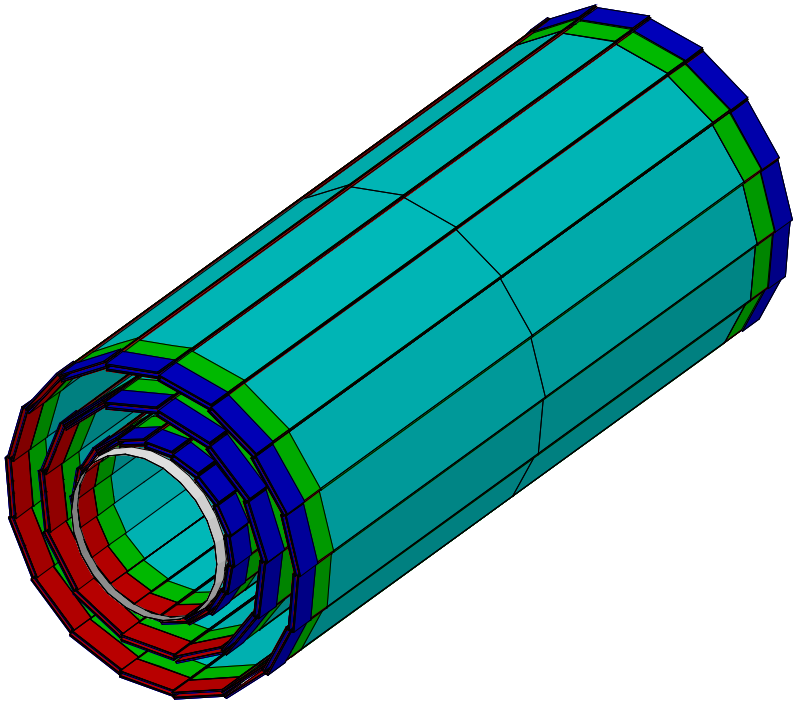
CLIC_ILD: Vertex and Forward Trackers

- Vertex Detector: 3 double Layers of Silicon Sensors
  - At: 31, 46, 60 mm Radius, each 25 cm long (Z=±12.5cm)
- Forward Tracking: 7 Disks
  - Inner Radius: Beam pipe
  - Outer Radius: ~30 cm (For last 5 Disks)
- Beam pipe: Conical shape up to LumiCal



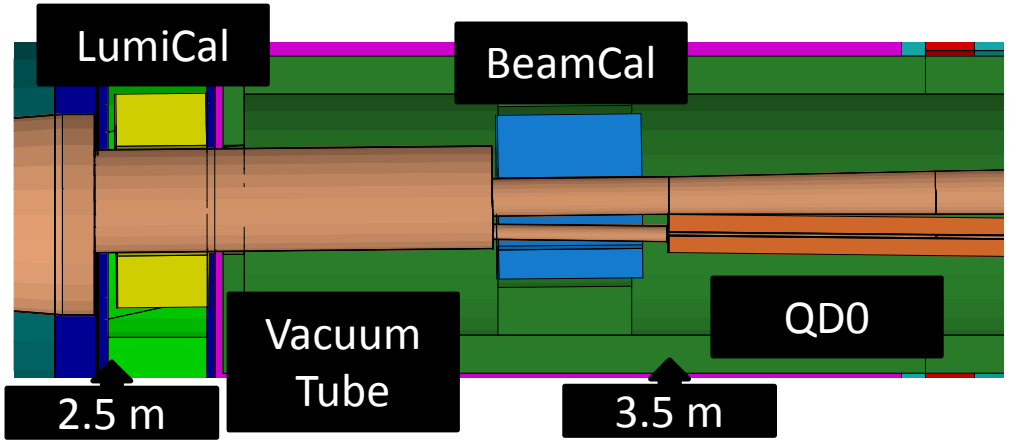
Vertex Detector

- 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



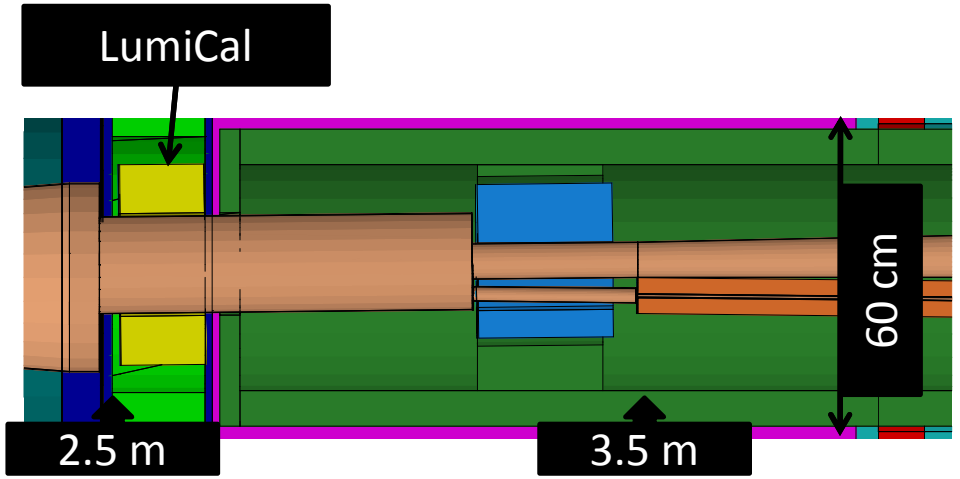
Forward Region of a CLIC Detector

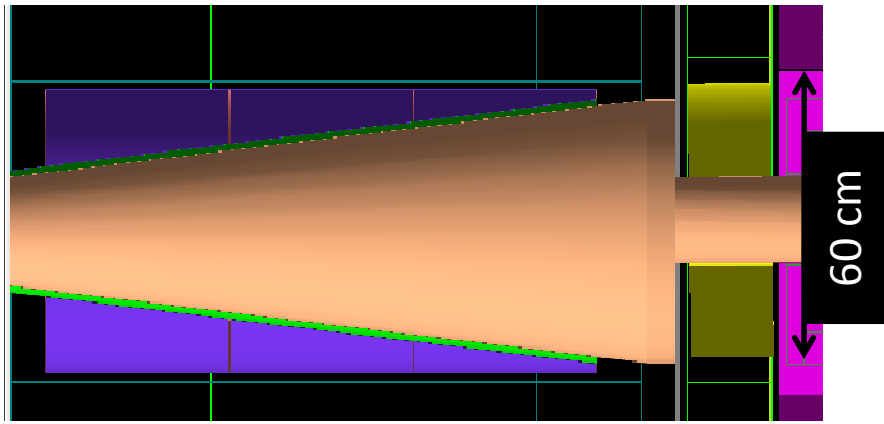
- Based on Forward Calorimetry for ILC (ILD)
- LumiCal >= 40 mrad
- BeamCal >= 10 mrad
- Changes ILC→CLIC
  - QD0 3.5 m (instead 3.9 m @ILC)
  - Larger Opening for outgoing beam (Coherent Pairs)
  - No Anti-DID, only 4T Solenoid Field
- (Present Status)



LumiCal

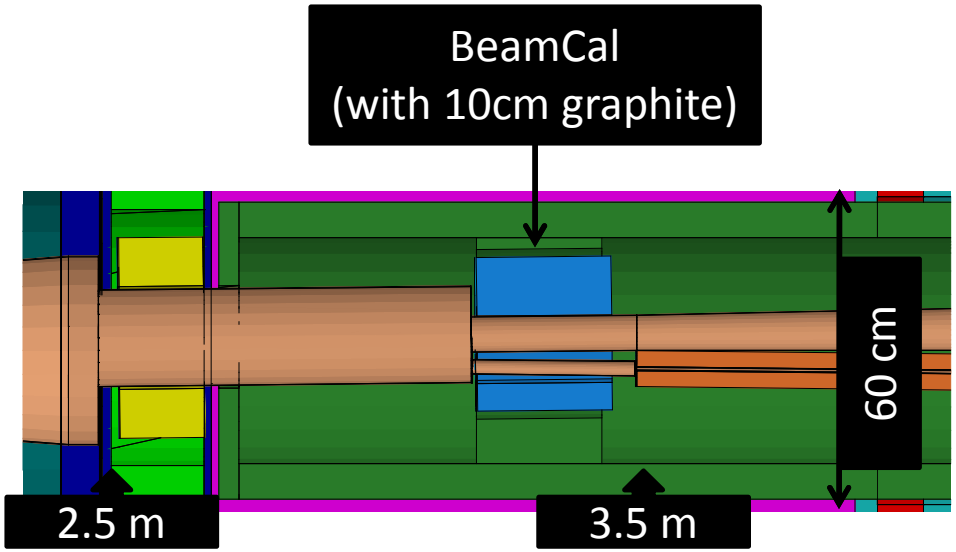
- Silicon-Tungsten (Si-W) Sandwich Calorimeter
- Counts Bhabha events to measure Luminosity
- Centered on Outgoing Beam axis
- Inner radius: 10 cm
  - Incoherent Pairs
- No material supposed to be between LumiCal and IP

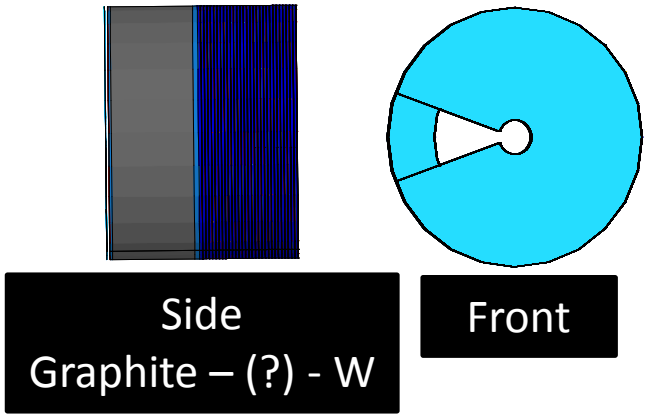




BeamCal

- (?)-Tungsten Sandwich Calorimeter
  - Centered on outgoing beam pipe
  - ≈3.5 cm inner radius
  - Outer radius to complement LumiCal coverage (≈ 20 cm)
- 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

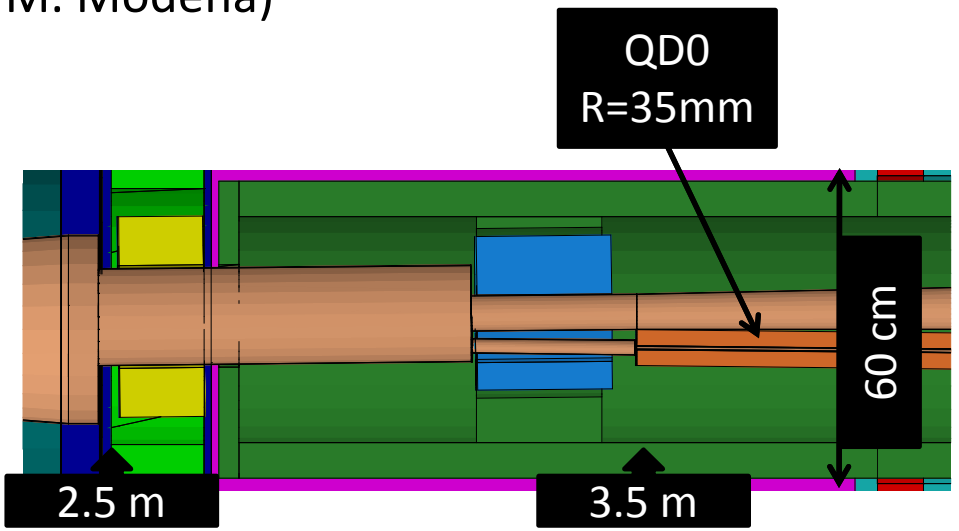


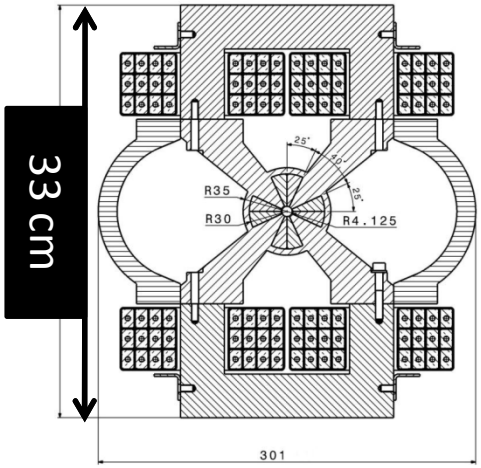


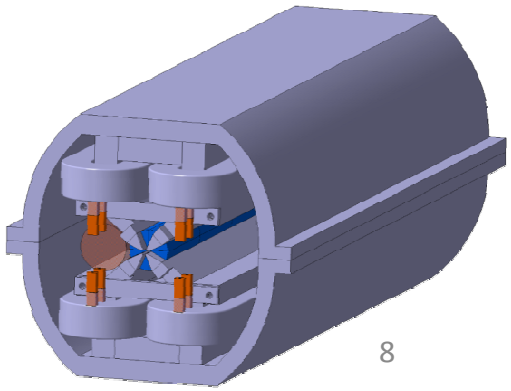
QD0

(See Talk by M. Modena)

- QD0 Prototype
  - 33cm height
  - Should fit into forward region
  - How far do the coils extend beyond 3.5 m?
  - Move BeamCal Forward
    - Allow Space for Intra-Train-Feedback

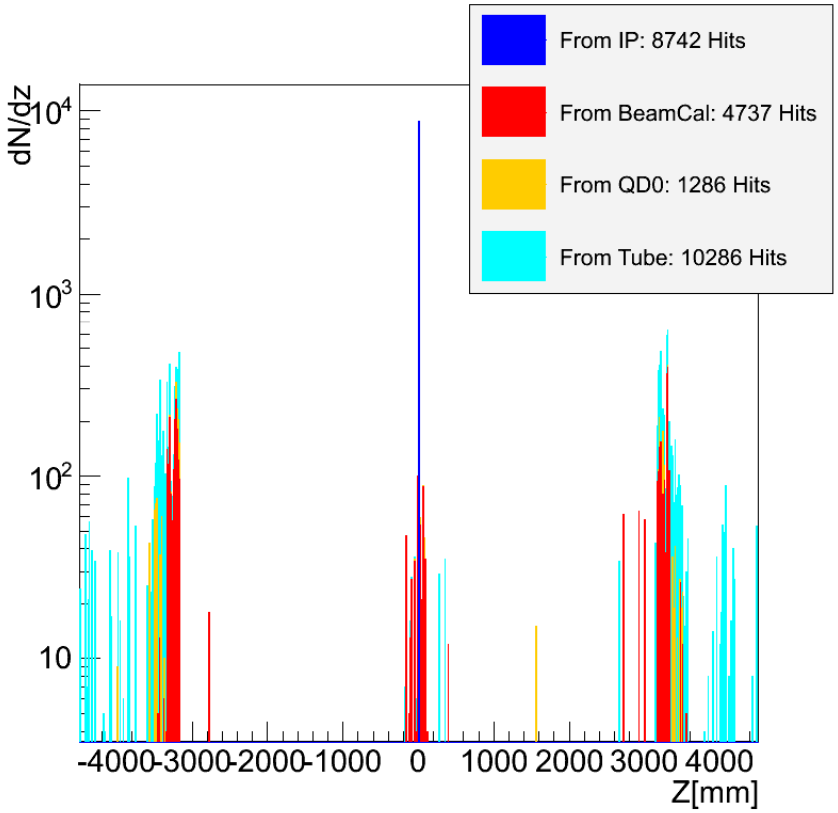






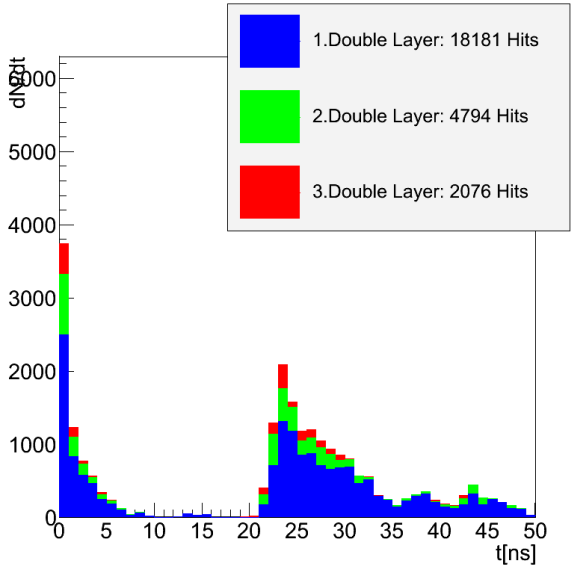
Background in the Vertex Detector (I)

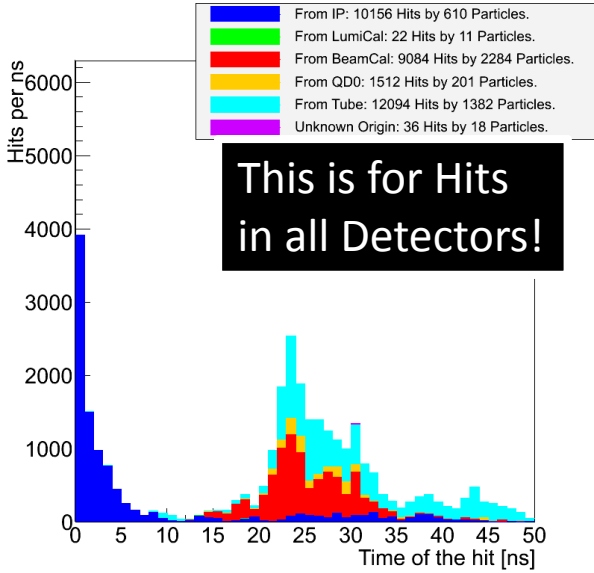
- Roughly 25k Hits in the VXD
- One third directly from IP
  - Reduce with higher B-Field
  - Larger Inner Radius
- 5k from BeamCal
  - Larger Inner Radius
- 10k from “Tube”
  - Mostly back-scattering from behind/inside BeamCal
- 0.02 Hits /mm^2 /BX



Background in the Vertex Detector (II)

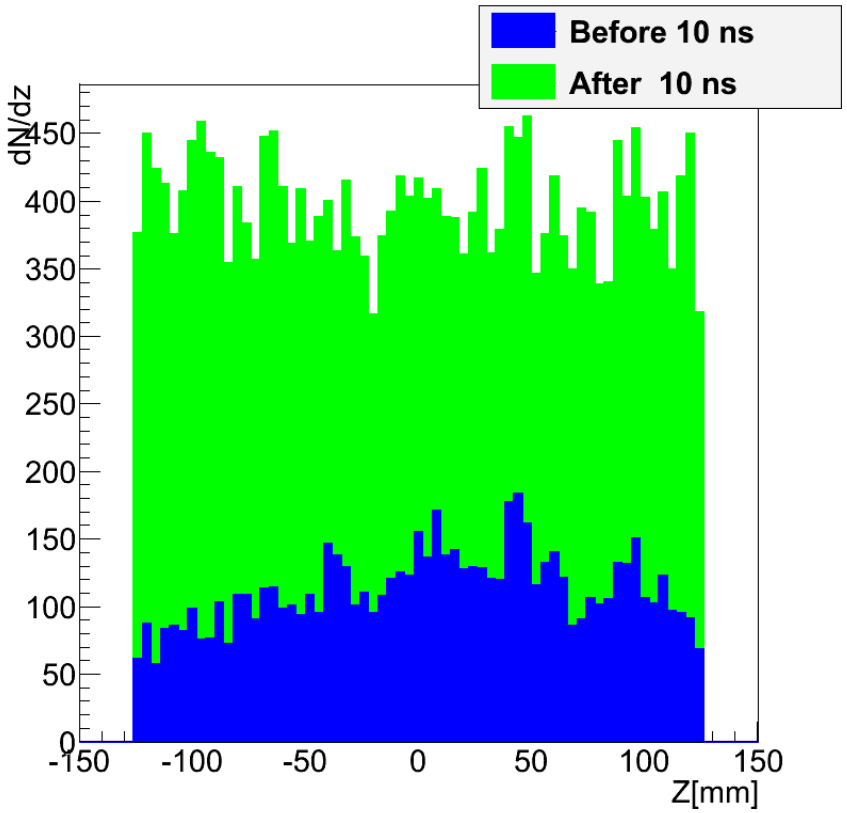
- Time separation between direct Hits and back-scattered Hits
- As expected from time of flight





Background in the Vertex Detector (III)

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



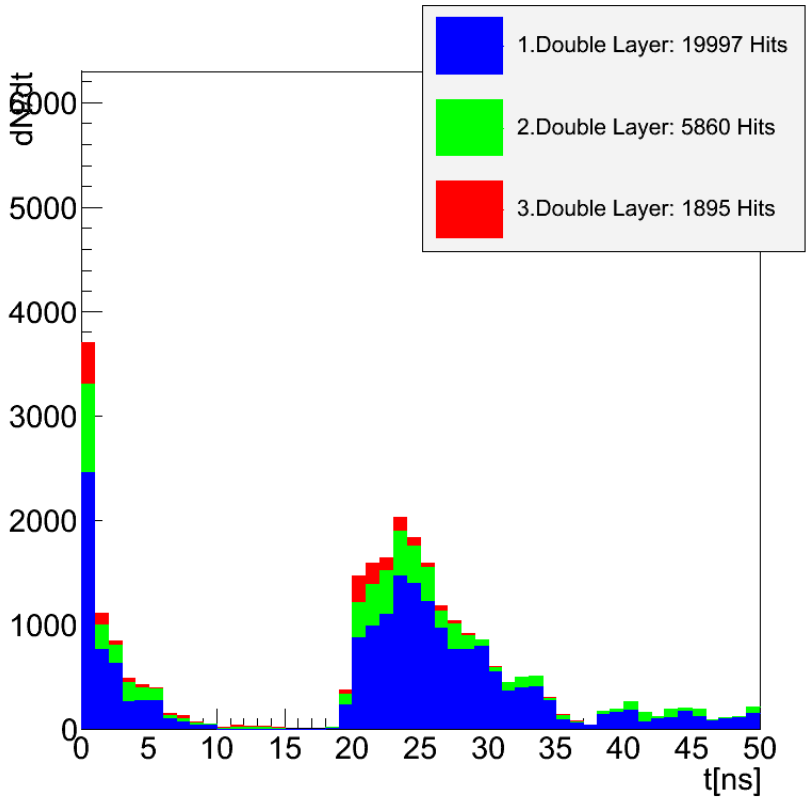
Hit Distribution along Length of VXD

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)
- Make some Space for Intra-Train-Feedback
- Larger Distance to QD0
- 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 Prototype
- Simulate a full and realistic Bunch Train, including fluctuations