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SiD Optimzation Studies

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The SiD Detector

SiD Rationale

A compact, cost-constrained detector designed to make precision measurements and be sensitive to a wide range of new phenomena

Design Choices

- Robust silicon vertex and tracking detectors with excellent momentum resolution
- Time-stamping for single bunch crossings
- Highly granular calorimeters optimized for Particle Flow
- Compact design with 5T field
- Iron flux return / muon identifier is part of the SiD self-shielding
- The detector is designed for rapid push-pull operation

Detector Optimization

The optimization studies are aimed at

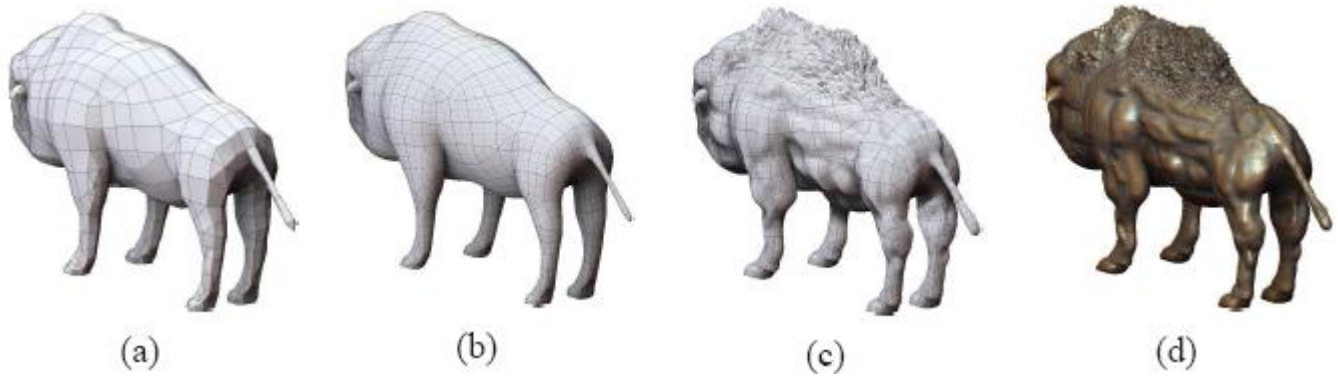
→ Improving the physics performance

→ Reducing the risk during construction or operation

→ Both, financial and technical risk

By using better engineering and better technology

We're fleshing out the detailed face of SiD, but we are not looking to change its identity



Some Examples of Opportunities in SiD

- SiD has a tracking detector that is resilient against increased background
  - Signatures with long-lived secondaries, few 100 ns lifetime
- SiD has a tracking ECal
  - We should extend track reconstruction to include mip stubs
  - → V0 reconstruction
  - → Dark photons
- SiD has an excellent Vertex Detector
  - Single-bunch time stamping, small radius of the innermost vtx layer
  - → b- and c-tagging should clearly benefit
  - → tau-vtx reconstruction?
- And of course, if you want to try new technologies in SiD, we'd also like to hear from you
  - Pixel tracker, MAPS ECAL, Scintillator HCAL, …

Or, if you like challenges

- SiD has a limited number of tracker hits
  - Resilience against losing a layer?
  - Particle ID in the silicon?
  - What about low-pt tracks, vtx charge?
- SiD has a compact radius
  - Compensation for leakage at higher energies by analyzing shower profile
  - Particle ID in the calorimeter, fractal dimensions
  - Confusion term in shower reconstruction
  - → Effect of transverse, lateral segmentation?
  - → Can statistical approaches compensate, at least for some signatures?

Studies Overview

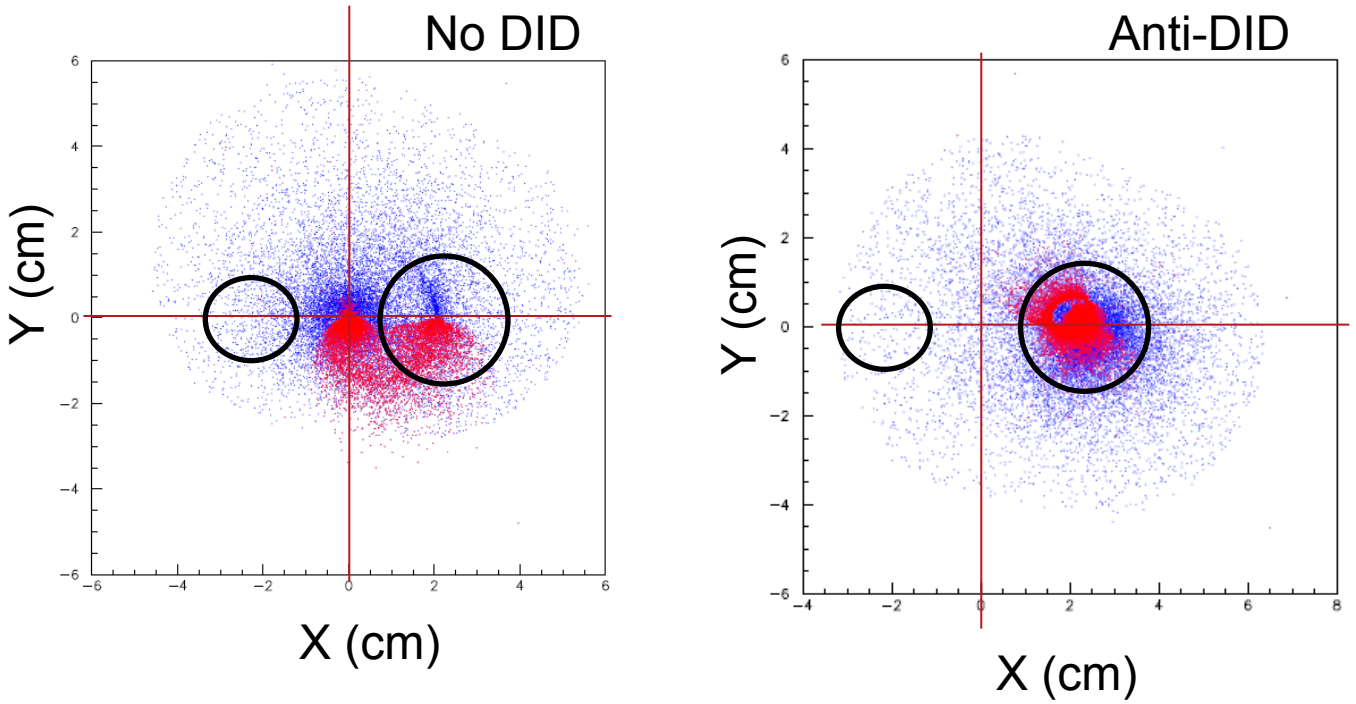
- Detector optimization group meets frequently, but not regularly
- The group is now partially supported by a US-Japan project "Acceleration of ILC detector studies by a distributed computing between US and Japan"
  - Money for storage and CPU, and for travel from Japan to the US
  - For ILD and SiD
- Past and future studies
  - Number of layers in the ECAL (SLAC summer student)
  - Tracking studies with different vtx layout (ANL student)
  - Planned: Neutron flux from beam dump (DESY)

Recent Accomplishments

- GuineaPig pair background production industrialized (DESY)
  - 1 train completely simulated in different sidloi3 variants
- Forward layout now in line with engineering models (UCSC)
- BeamCal now centered on the outgoing beam pipe (UCSC)
- Engineering Drawings updated with 30º angle of the iron, based on studies of the fringe field (SLAC)
- Anti-DID vs. no anti-DID studies revived (SLAC, UCSC)
- Studies of occupancies with different layouts, with/without anti-DID (UCSC, DESY)
  - Results at this workshop

T. Maruyama, 2011-03 LCWS@UO

SLAC

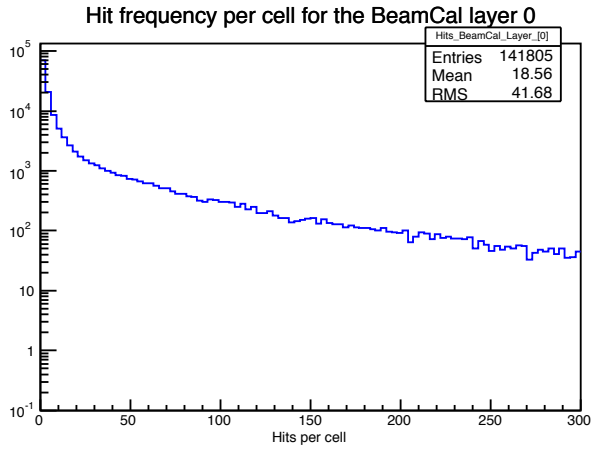


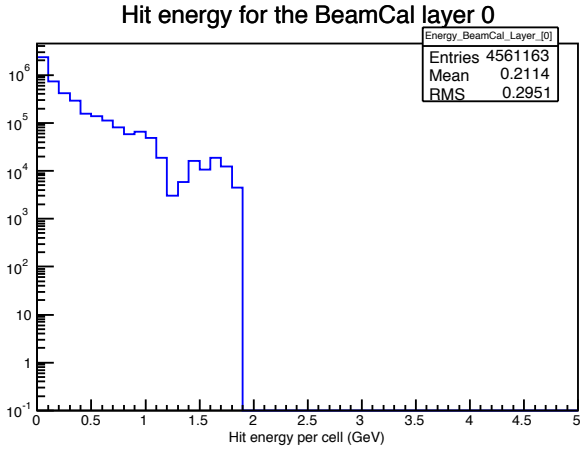
Tom Markiewicz, SLAC

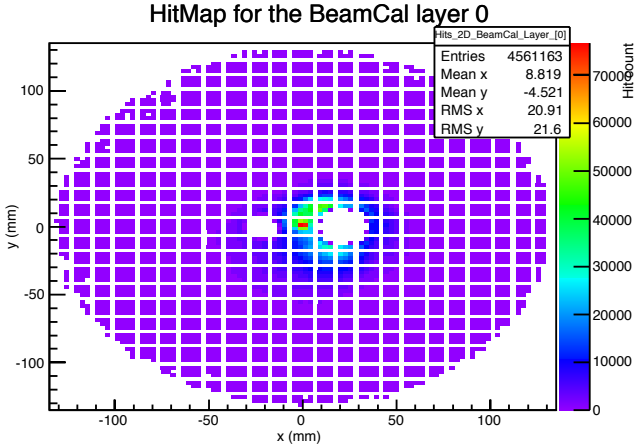
	500GeV RDR	500GeV TF	500GeV NO TF
NO-DID Energy (TeV)	20.9	58.8	45.3
Anti-DID Energy (TeV)	12.0	38.2	29.1
Anti-DID radiation (Mrad/year)	100	160	120

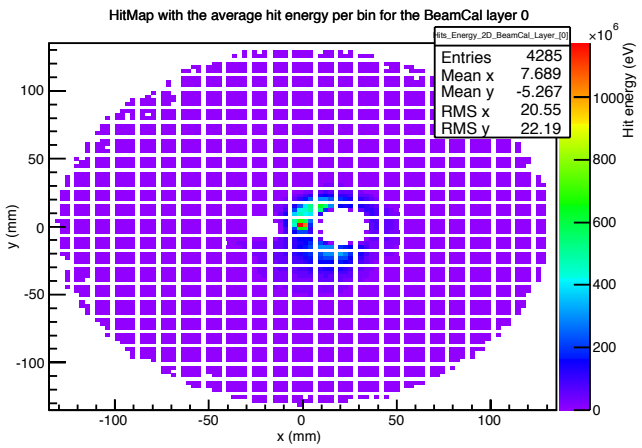
GuineaPig Pairs in the BeamCal

- Studies at DESY









Variants currently under study

- Currently looking at different variants of sidloi3
  - BeamCal changed position and orientation
  - Technical limitations prevent us from turning this into a complete detector
    - Tracking region, which keeps track of secondaries, overlaps with lumi cal
- Sidloi3
  - With and without anti-DID
- Changed orientation of the beam cal
  - With and without anti-did
  - Changed layout around and between the beam pipes

Several ways to get involved

- Join the meetings
  - https://agenda.linearcollider.org/category/219/
- Send us an email: To me directly
  - Or to the spokespeople
- Talk to us at the workshops

Some suggestions to get started: Studies on DBD samples

- Performance of existing Particle ID in your favorite channel
- Energy resolution in different physics channels
  - Usual plots are shown to benchmark PFA, not (necessarily) the detector
- Relevance of energy leakage of the calorimeters to physic studies
  - What kind of channels suffer
  - Can we recover?

Summary

- The detector optimization studies for SiD are continuously gaining momentum
- We are starting to make progress on some important questions
- There are still many opportunities to influence the design of SiD with your work
  - Technology choices
  - Some details of the engineering layout
  - Reconstruction tools
- A lot more work is needed before we can start with the TDR
  - Our infrastructure needs some love to enable new groups to become productive
  - Discussions in the second session this morning