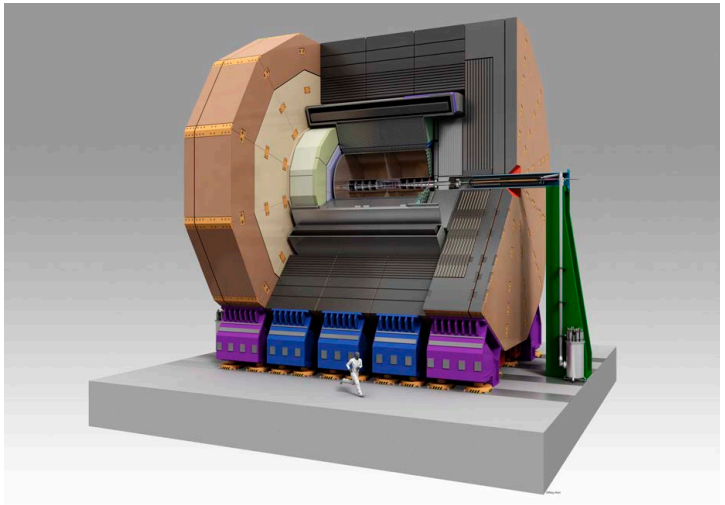


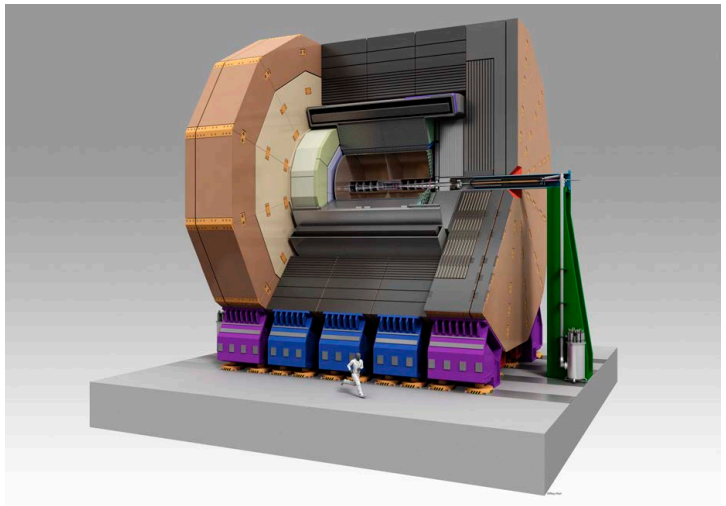
ILD Status and Plans

Tomohiko Tanabe (Tokyo)
On behalf of the ILD Concept Group

December 5, 2016

18:05-18:25 (20 min)

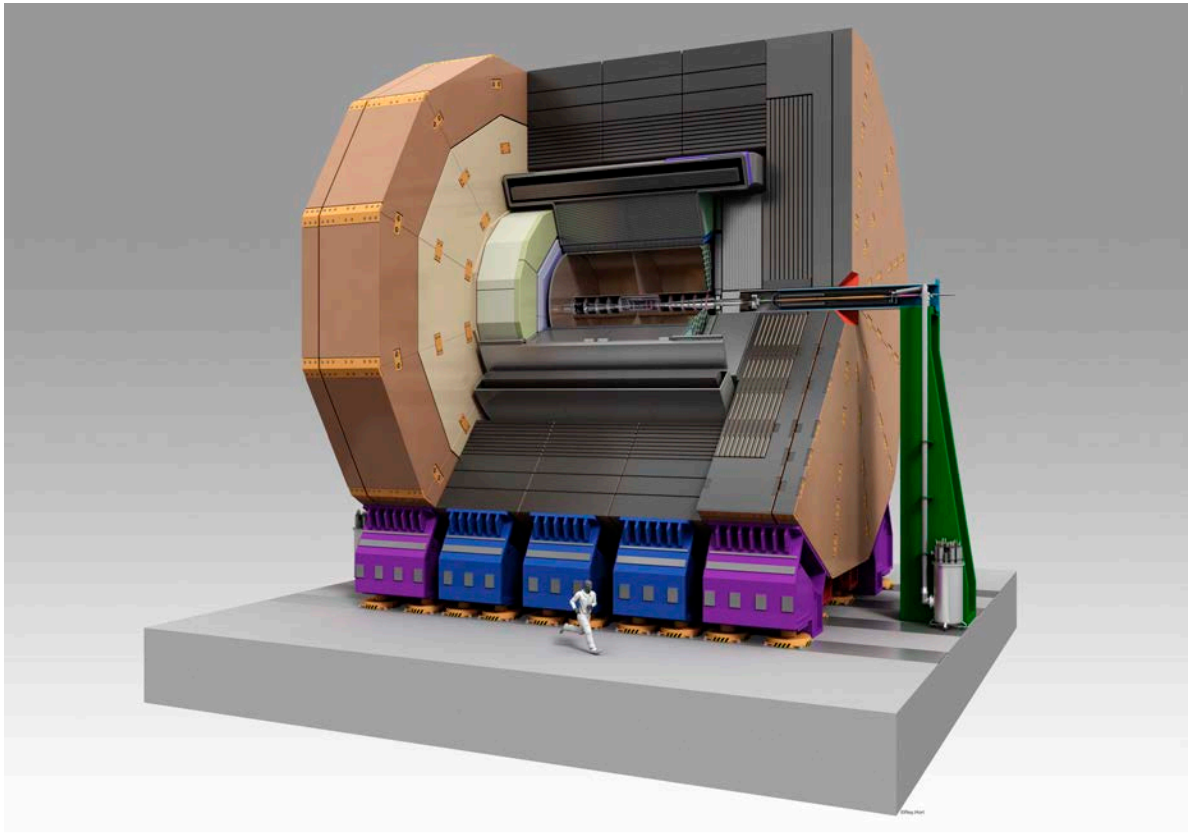
Outline



- News from ILD
- Topics on Detector Optimization
- Open Issues
- Alignment and calibration (Z running)
- Analysis highlights

ILD Concept

ILD: International Large Detector



ILD is a large multi-purpose detector for the ILC

- High precision silicon for vertex and timing
- Hybrid tracker with Silicon and TPC for robustness
- Granular calorimeters for particle flow

ILD Organization

Executive Team

Spokesperson: T. Behnke
Deputy: K. Kawagoe

Institute Assembly

70 institutions

Chair: J. Timmermans
Deputy: T. Takeshita

Chair-elect: M. Winter

Proposed by Spokesperson
Approved by Institute Assembly

Physics Coordinator
K. Fujii
(J. List)

Software/Reco. Coordinator
F. Gaede
(A. Miyamoto)

Technical Coordinator
C. Vallée
(K. Buesser)

Four members elected by Institute Assembly

H. Videau
A. Ruiz
Y. Sugimoto
G. Wilson

Publication and Speakers Bureau
t.b.n.

ILD Meeting at Oshu, 2014

ILD institutes around the world

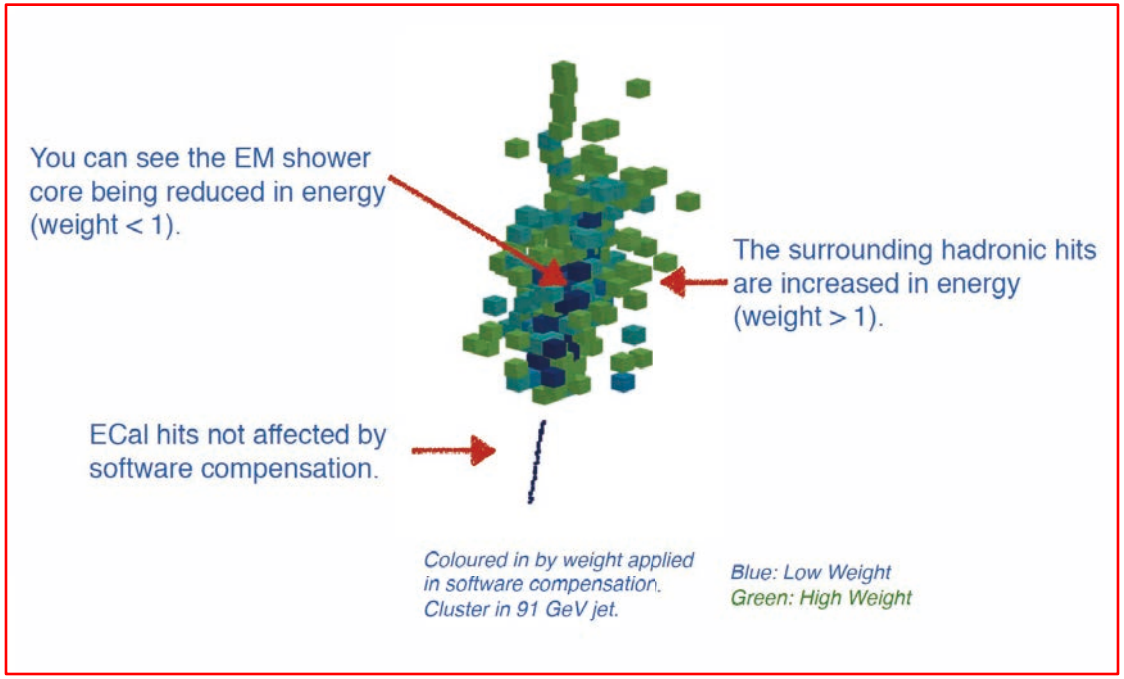
New ILD Logo

Design by **Ralf Diener**

*To be confirmed by Institute Assembly,
possibly after small optimization

Software Compensation

- Calorimeters have two components:
  - electromagnetic (EM) showers
  - hadronic showers
- Ideally, want the two components to have the same energy fraction, e/h ~1.
  - But usually (including the ILD calorimeters), e/h>1, i.e. non-compensating.
- Require additional design (thus increased $$$)
  - reduce EM response (e.g. shielding)
  - boost hadronic response (e.g. Uranium).
- Instead, use software compensation
  - event-by-event correction of e/h taking advantage of the different shower profiles and ILD's imaging calorimetry

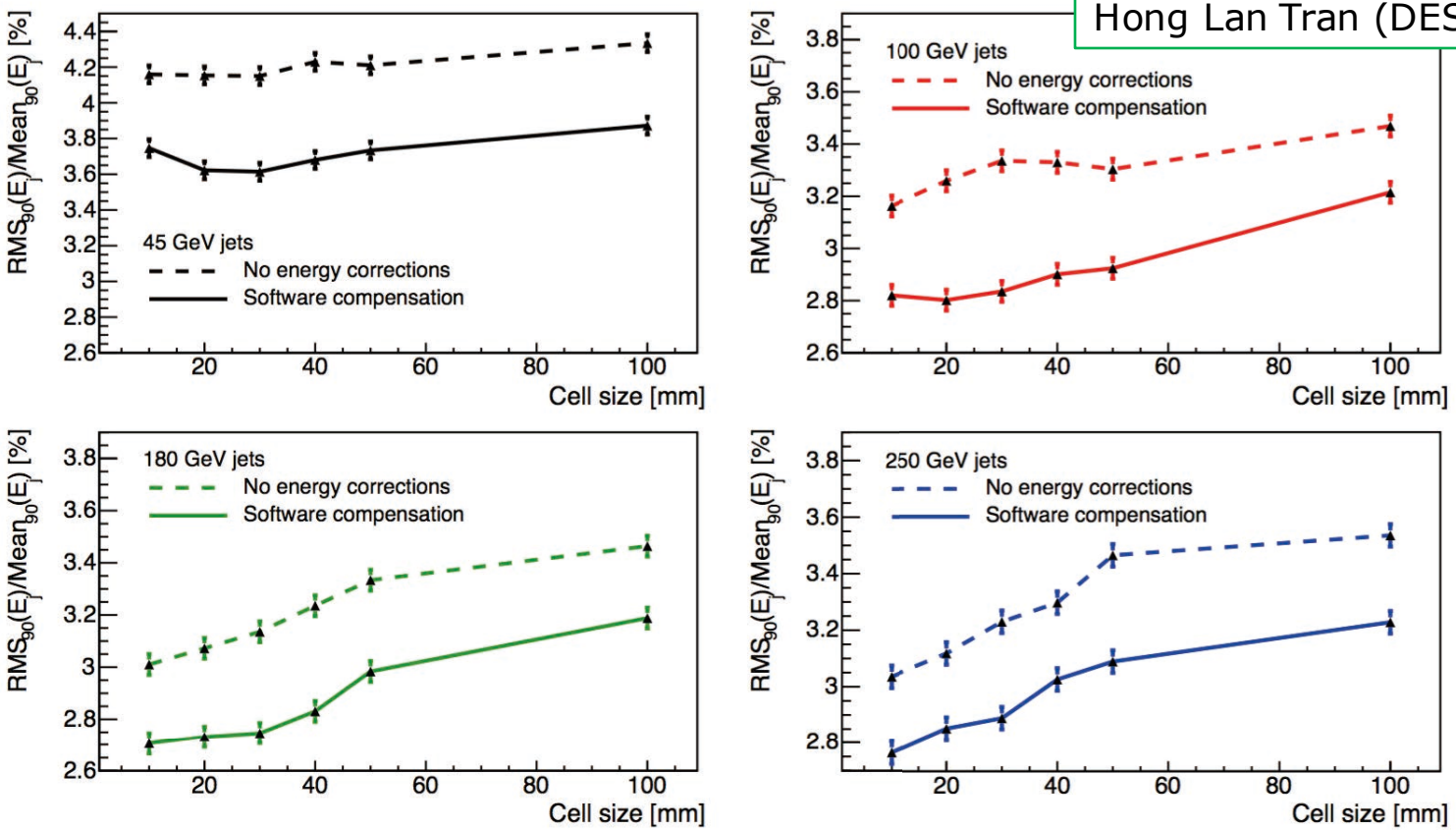


Visualization in Pandora by Steven Green (Cambridge)

Software Compensation

- Effectiveness of software compensation depends on granularity

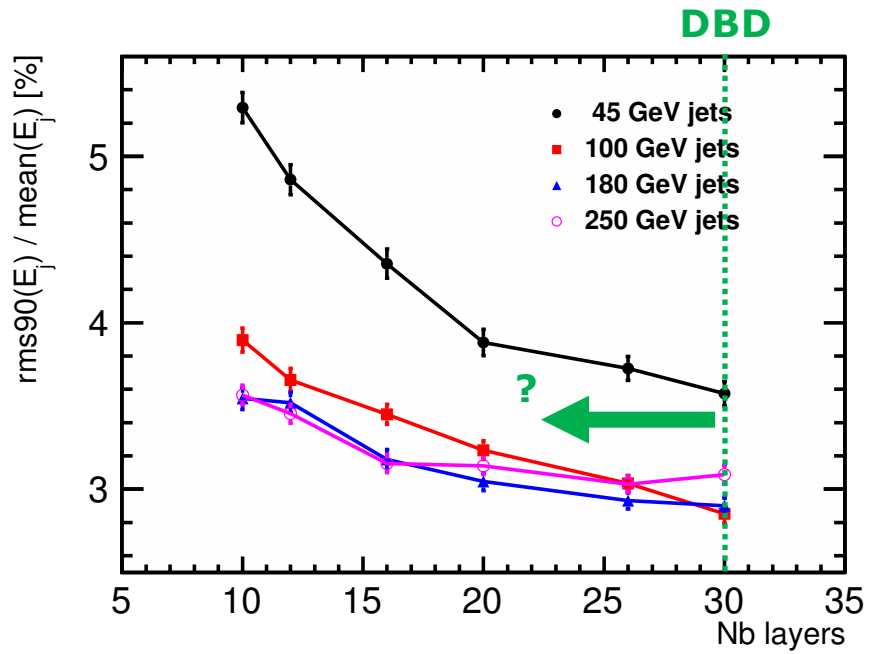
work in progress
Hong Lan Tran (DESY)



Improved understanding of jet energy resolution by introducing software compensation.
Understanding of the reconstruction is crucial for performance study.

Towards Re-optimization

- Understanding of ILD performance built on many years of study
- Consideration towards ILD re-optimization:
  - readiness in accord with expected project green light
  - improve understanding of cost vs. performance
    - overall cost profile (the smaller the better, but need to quantify the sacrifice)
    - relative cost weight with respect to other components yet to be defined (e.g. anti-DID)
- Already known at DBD, the performance degradation in terms of subdetector size.
  - For example, Jet Energy Resolution vs. Number of ECAL layers:



From ILC TDR, Vol.4

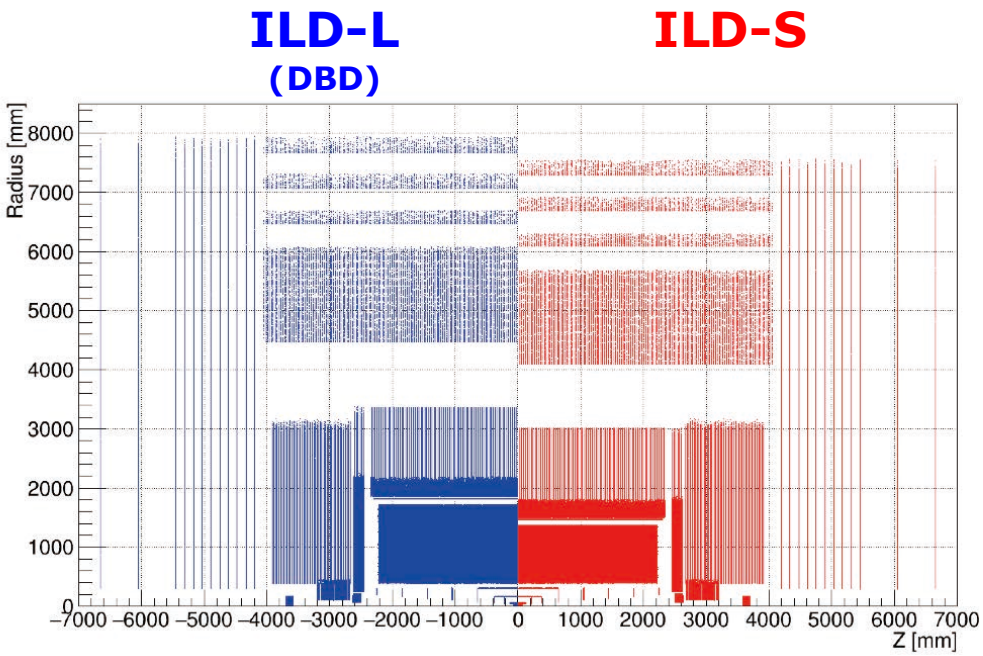
Performance of the current ILD model well-understood.
Need for re-optimization by understanding impact of a smaller detector

ILD Optimization: Models

Two ILD models have been defined:

- ILD-L: same as DBD
- ILD-S: smaller TPC, ECAL, HCAL, Coil

Detector	ILD-L (DBD)	ILD-S
B Field	3.5 T	**4 T**
VTX inner radius	1.6 cm	1.6 cm
TPC inner radius	33 cm	33 cm
TPC outer radius	180 cm	**146 cm**
TPC length (z/2)	235 cm	235 cm
Inner ECAL radius	184 cm	150 cm
Outer ECAL radius	202.5 cm	168.5 cm
Inner HCAL radius	206 cm	172 cm
Outer HCAL radius	335 cm	301 cm
Coil inner radius	344 cm	**310 cm**

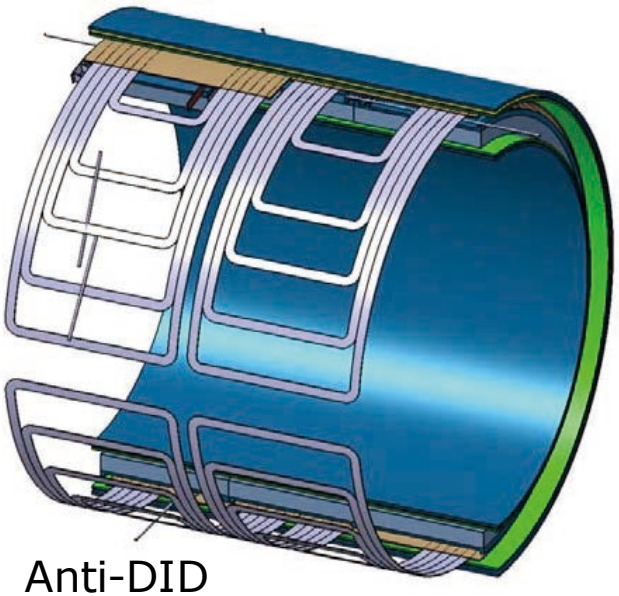


Both models are now available in the latest software (DD4hep/lcgeo).
Intense software and validation development ongoing towards simulation studies.

Detector Integrated Dipole

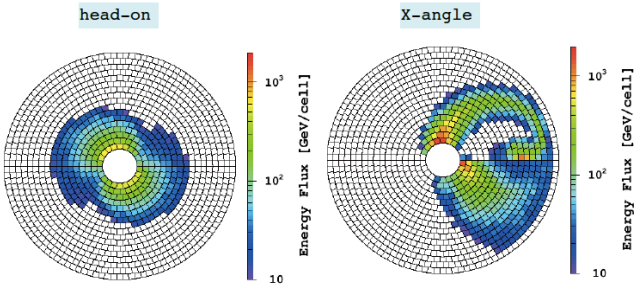
- Need to reduce soft e+e- pair backgrounds (e.g. on BeamCal)
- Realized through magnetic field along the outgoing beam
  - "Anti-DID" a conventional name
- Realized by adding dipole windings around the main solenoid

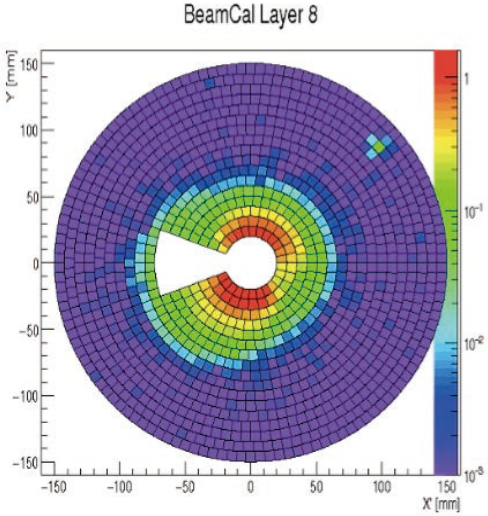
- Impact on physics:
  - Reducing BeamCal backgrounds: better hermeticity
  - Essential for physics with missing momentum (e.g. DM, SUSY)



Anti-DID
DBD version,
LC-DET-2012-081

BeamCal
w/ and w/o
Anti-DID
RDR (2005)





Current
BeamCal
design w/
Anti-DID

Anti-DID Task Force

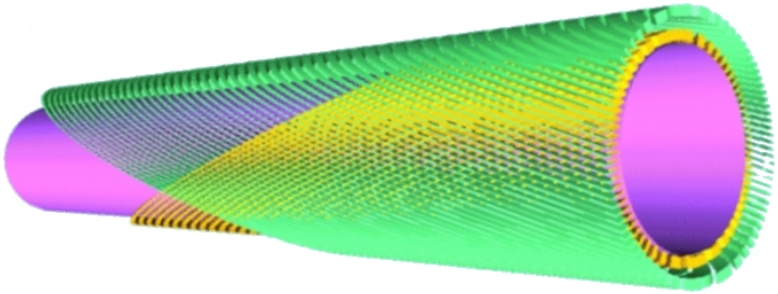
Dedicated Task Force has been setup.
Meeting on Nov. 7, 2016, at LAL.

Talks by: K. Buesser, Ch. Berriaud, U. Schneekloth, R. Settles, S. Schuwalow, J. List, A. Besson, A. Ishikawa, P. Colas, F. Gaede

Anti-DID Task Force:
Understand impact of smaller L*
Re-optimize detector design
Do we need an Anti-DID?

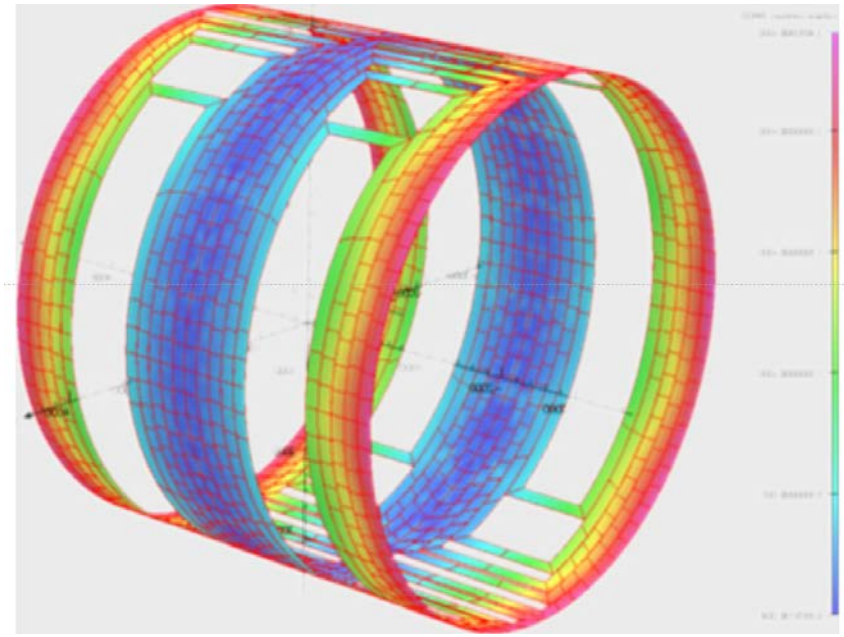
Topics discussed:

- Technical feasibility
- Background computations
- Effect on physics
- Tracker requirements
- Simulation options



Christophe Berriaud (CEA/Irfu)

Possible cheaper alternative:
Canted conical dipole via winding around the conical beam pipe
Is it compatible with the requirements?

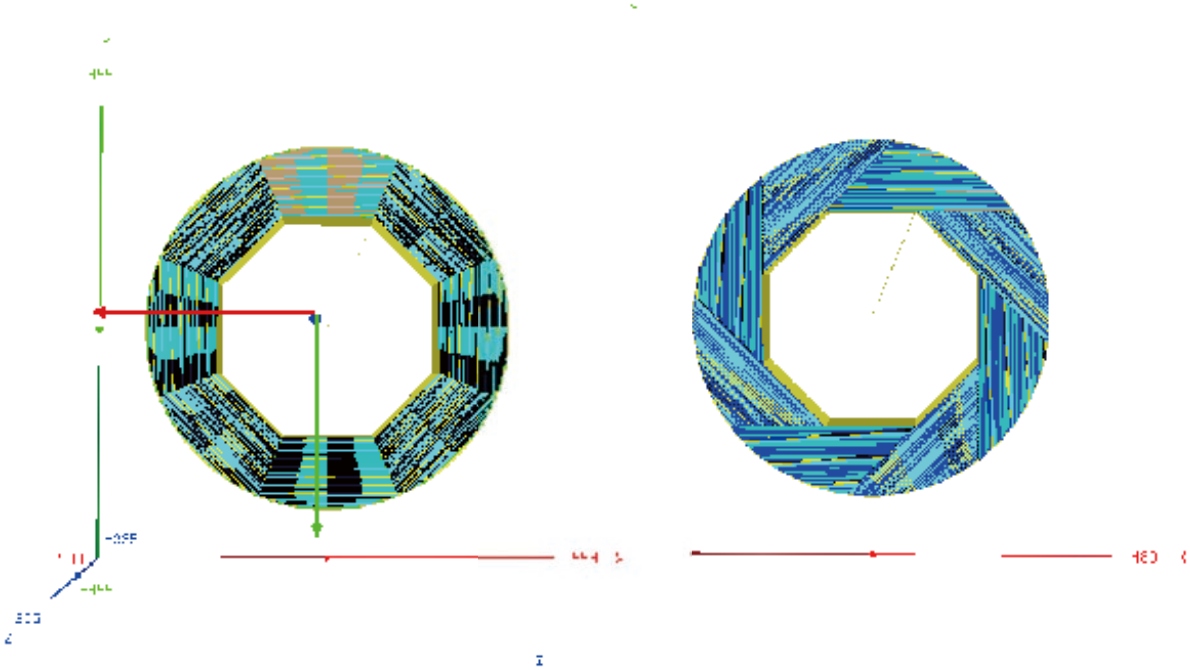


Brett Parker

Implementation of Anti-DID sophisticated winding needed, estimated cost O(5) M€
Further investigation underway

HCAL Geometry

Two geometries proposed for ILD HCAL:



"TESLA" "Videau"

HCAL Geometry Task Force

Dedicated Task Force has been setup.
Meeting on Nov. 8, 2016, at LAL
(Following the Anti-DID Task Force Meeting.)

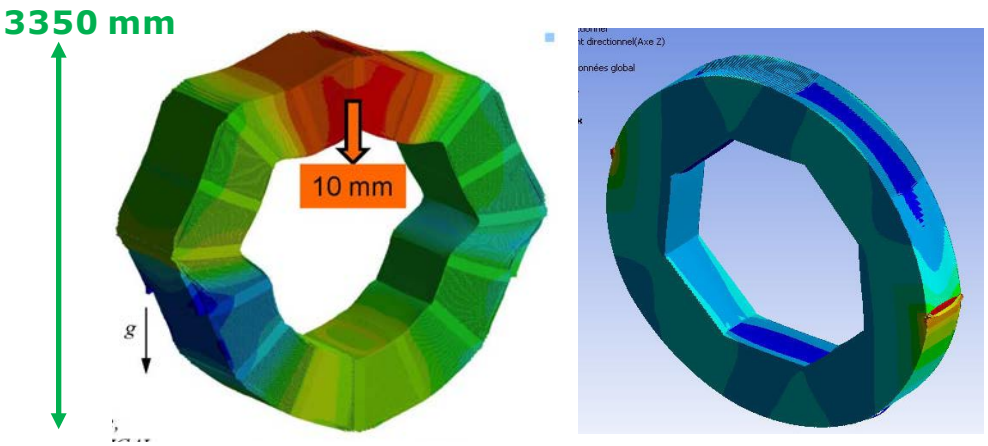
Talks by: R. Poeschl, F. Sefkow, I. Laktineh, J.C. Ianigro, K. Krueger, M. Anduze, D. Grondin, K. Buesser, F. Gaede

HCAL Geometry Task Force:
Understand pros/cons of both structures
Decide for a simulation implementation

Discussion Topics

- Mechanical stability
- Vibration behavior
- Impact on ECAL design
- Effects of cracks
- Signal paths
- Transport assembly
- Simulation options

Deformation Study
Left: TESLA, Right: Videau
*Color scale not the same



Detailed studies of the two geometries started:
Tasks have been identified, and tools are available.

On Calibration/Alignment

Aim for about 10x LHC performance

Overall strategy needed
- Physics data
- Cosmic rays
- Built-in systems
- Z-running (?)

Studies are ongoing to quantify these effects.

ILD Position on Z-running (PRELIMINARY, under discussion)
- We recognize that Z-running can be a very powerful tool to calibrate the detectors, if sufficient luminosity can be delivered.
- We recognize that Z-running of the machine needs to be well justified, therefore we are in the process of developing a complete scheme to calibrate and align our detector, with and without Z-running.
- At this moment we do not feel that we are in a position to strongly exclude nor to strongly request Z-running for ILD.
- We insist that a final decision on whether or not Z-running should be included as a possibility cannot be taken before such studies have come to a conclusion.

Please come to the dedicated ILD session for calibration/alignment
Wednesday: 10:40-12:30 @ MALIOS

Analysis Talks @LCWS16

Higgs/EW:

- "Higgs self-coupling analysis at the ILC", by C. Duerig (DESY)
- "Anomalous VVH couplings at the ILC", by T. Ogawa (KEK & Sokendai)
- "Measurement of the H-> WW* decay at 500 GeV ILD", by M. Pandurovic (U Belgrade)
- "CP measurements in Higgs -> tau tau at ILC", by D. Jeans (U Tokyo)
- "BSM search using Higgs to invisible decay at the ILC", by Y. Kato (U Tokyo)
- "A new method for Higgs mass measurement", by J. Tian (U Tokyo)
- "Model-Independent Determination of the Triple Higgs Coupling at e+e- Colliders", by T. Barklow (SLAC), (ILD-SiD-Theory collaboration)

Top/QCD:

- "An analysis of top pair creation at Ecm = 500 GeV" by Y. Sato (Tohoku)

BSM:

- "WIMP Search at the ILC" by TT, on behalf of M. Habermehl (DESY)
- "Search for Light Higgsinos with compressed mass spectrum at ILC 500 GeV" by Jacqueline Yan (KEK)
- "SUSY parameters from measurements of light higgsinos at the ILC" by S.L. Lehtinen (DESY)
- "Stau Coannihilation" by M. Berggren (DESY)

Summary and Outlook

- **ILD is built on many years of experience [DBD, 2012]**
  - Since the DBD: progress in simulation tools, start of intensive studies for re-optimization.

- **Detector optimization with two detector models**
  - Intense software development and validation
  - Simulation, reconstruction, analysis

- **Develop strategy for detector integration**
  - Calibration/alignment
  - Services
  - Engineering
  - Siting issues

- **Systematic evaluation of the ILD potential**
  - For a range of detector options and physics channels

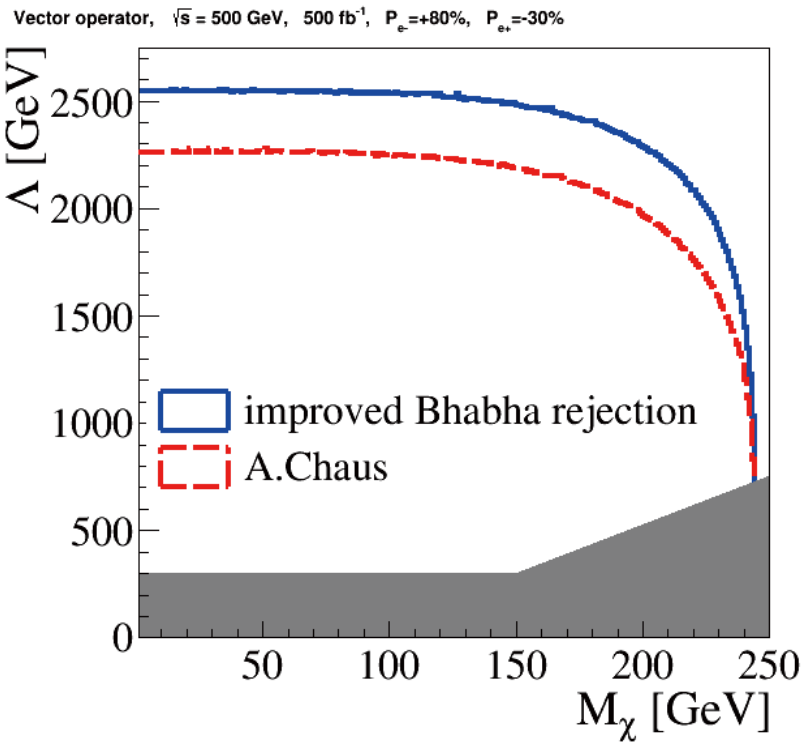
ILD continues to develop towards a collaboration in accord with the timeine of the ILC project

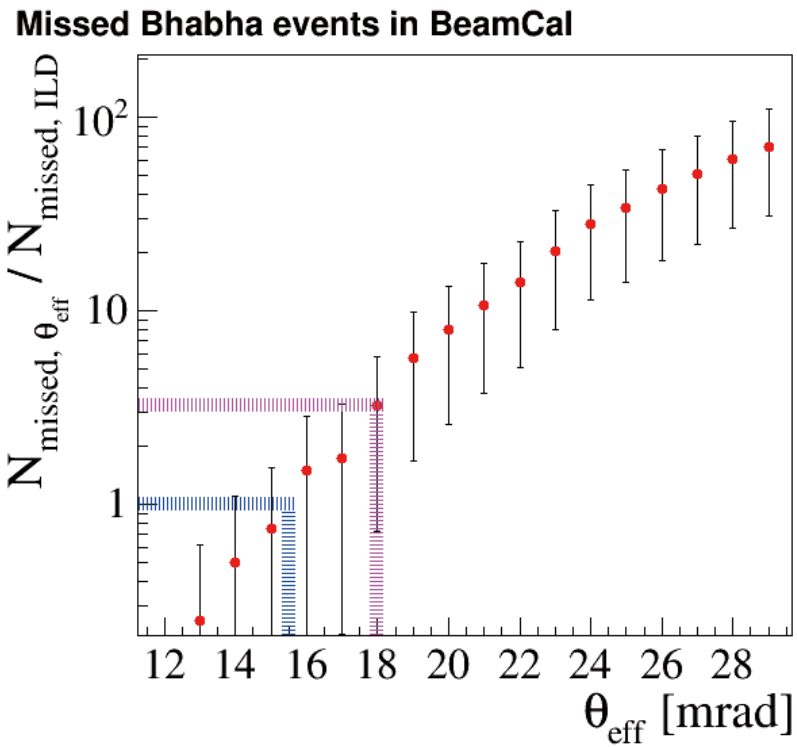
Additional Slides

Analysis Highlight

WIMP study [Habermehl]

Error bars? check with Moritz
Sample not S.I. (cuts on same sample)





Sensitivity increased with improved Bhabha rejection

Effect of angle coverage on missed Bhabha events

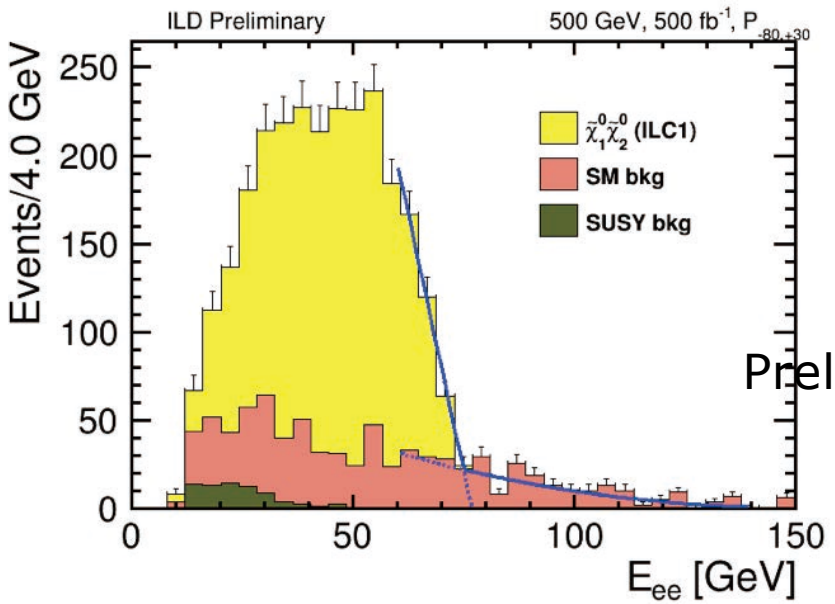
reconstruction is improved; impact on ILD optimization

Analysis Highlight

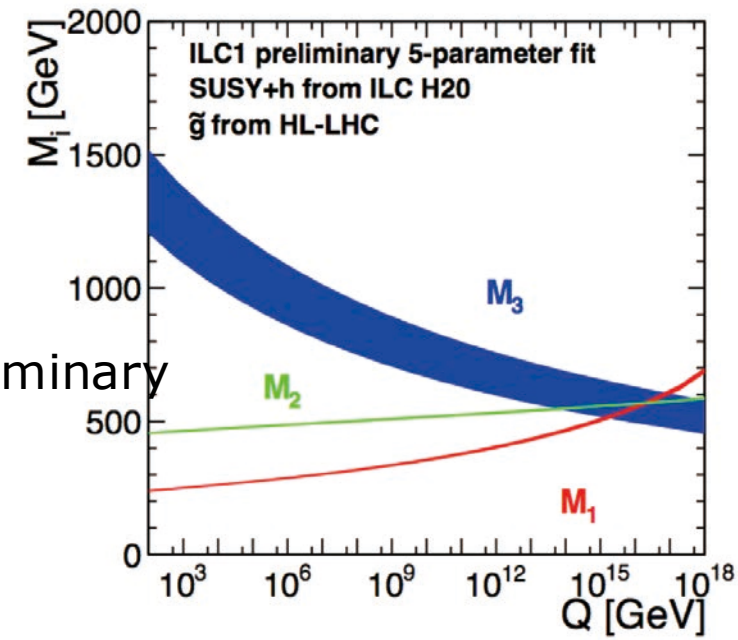
explain

Light Higgsinos in RNS models [Yan, Lehtinen]

Choice of benchmark point more "natural" O(10) GeV mass gap



Preliminary



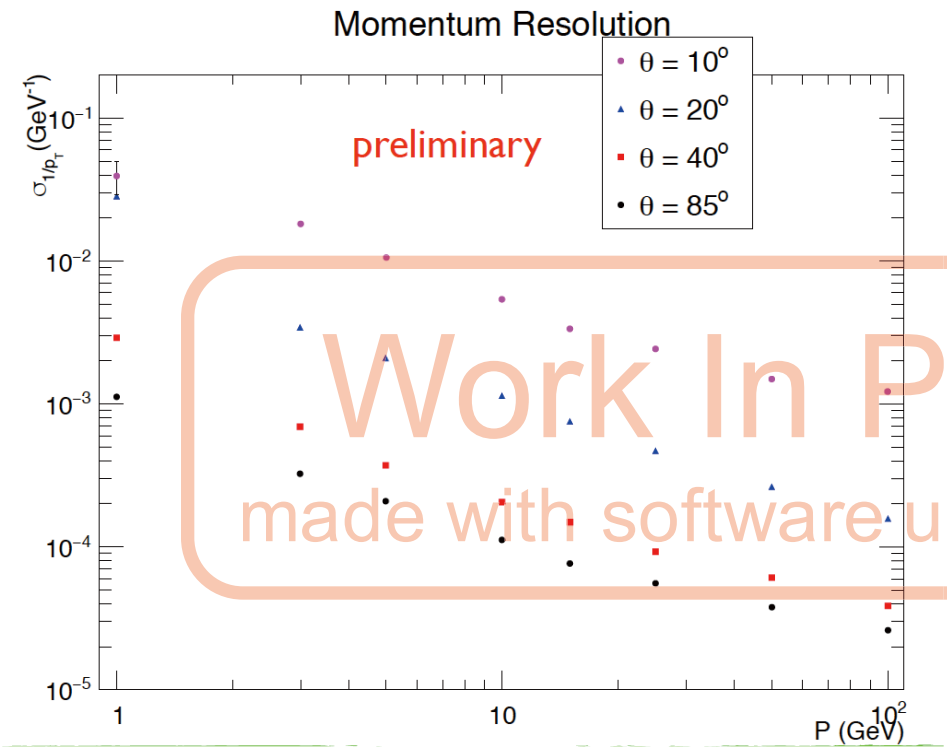
Extraction of kinematic edges
→ mass precision O(1)%

Parameter extraction & extrapolation:
Test of gaugino mass unification

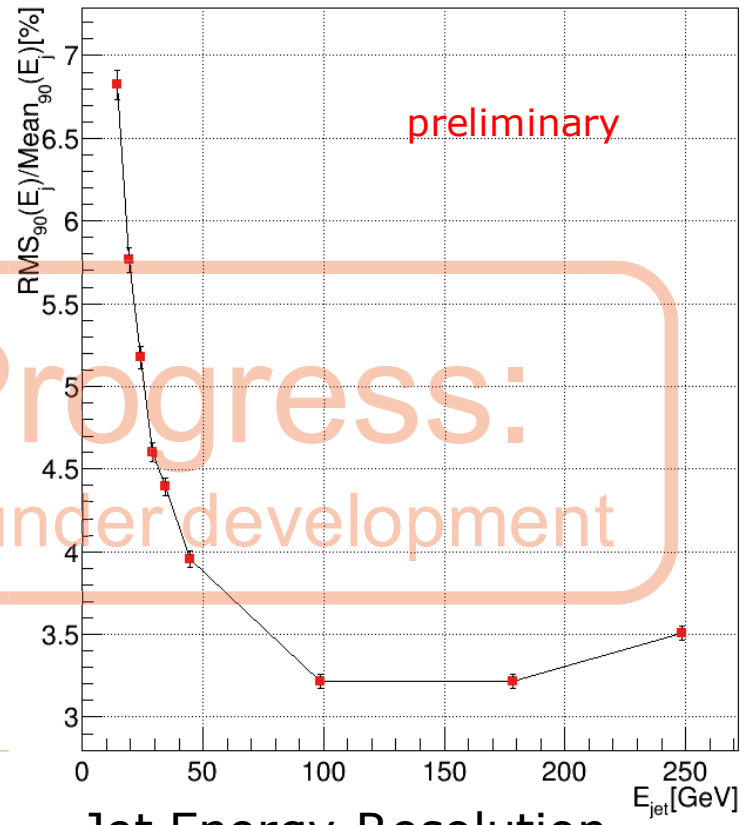
ILD-S

Performance Preview

Detailed validation ongoing for the two detector models (ILD-L and ILD-S) which are implemented in the new software (DD4hep/lcgeo).



Momentum Resolution

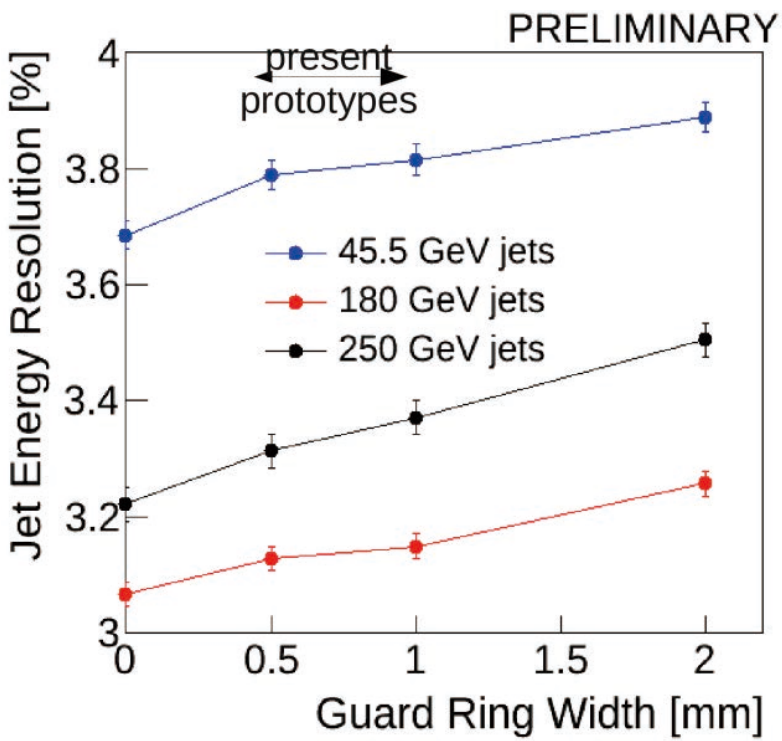


Jet Energy Resolution

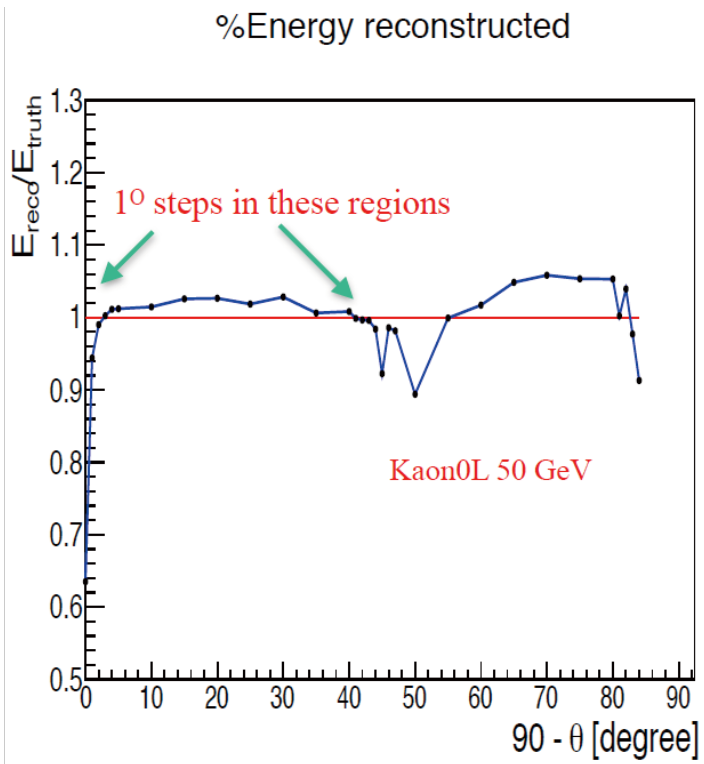
ILD is ready to start the re-optimization studies

ILD Optimization

Level of details studied:



Effect of the guard ring thickness on the Si-ECAL performance



Effect of cracks in the AHCAL

Particle Flow: Demonstration

Two-particle separation demonstrated with Data