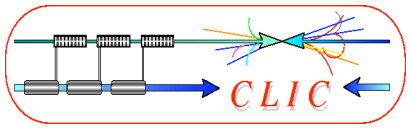
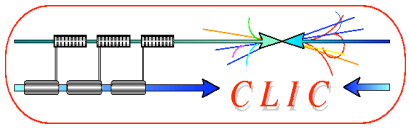


ILC-CLIC collaboration on physics/detector



Physics/detector context

Many years of investment in ILC:

- physics/detector simulations, hardware R&D
- detector concepts

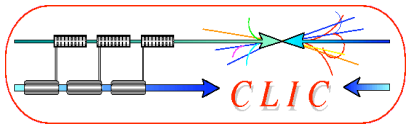
CLIC physics/detector studies:

- simulations studies for the 2004 report
- re-start simulation studies in 2008
- official **Linear Collider Detector (LCD) project** at CERN as of 2009

Important to establish *one* Linear Collider Physics community

Therefore, in a concerted effort with the individual concepts, LCD@CERN works towards describing the possible changes/upgrades to the ILC concepts to make them compatible with multi-TeV energies and CLIC beam conditions.

In preparation for the CLIC conceptual design report (CDR), end 2010



ILC-CLIC collaboration

LCD@CERN collaborates with linear collider (ILC) groups:

- ILC detector concepts **(LCD members signed LoI's)**
  - **ILD**
  - **SiD**
  - **4th** concept
- Technology collaborations **(formal agreements with CERN LCD)**
  - **LC-TPC** (TPC development, using MPGD)
  - **CALICE** (calorimetry R&D based on Particle Flow Analysis)
  - **FCAL** (forward calorimetry at linear collider)
- European project **(CERN is member)**
  - **EUDET**

www.cern.ch/lcd

CERN/SPC/921
CERN/FC/5347
CERN/2847
Original: English
2 June 2009

ORGANISATION EUROPÉENNE POUR LA RECHERCHE NUCLÉAIRE
CERN EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

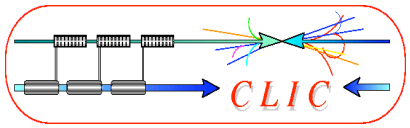
Action to be taken		*Voting procedure*
For discussion	**SCIENTIFIC POLICY COMMITTEE** 260th Meeting **15 June 2009**	—
For recommendation to Council	**FINANCE COMMITTEE** 325th Meeting **17 June 2009**	Chapter I and II: Simple majority of Member States represented and voting (abstentions are not counted) and 70% of the contributions of the Member States represented and present for the voting (abstentions are counted as votes against) and at least 51% of the contributions of all Member States Chapter IV: Two-thirds majority of Member States represented and voting (abstentions are not counted) and 70% of the contributions of the Member States represented and present for the voting (abstentions are counted as votes against) and at least 51% of the contributions of all Member States
For approval	**COUNCIL** 151st Session **18 June 2009**	Chapter I and II: Simple majority of Member States represented and voting (abstentions are not counted) Chapter IV: Two-thirds majority of Member States represented and voting (abstentions are not counted)

Medium-Term Plan for the period 2010-2014 and Draft Budget of the Organization for the fifty-sixth financial year 2010

GENEVA, June 2009

Linear collider detectors: This constitutes a new heading for CERN's participation in the detector R&D specific to a future linear collider.

(Foreseen budget allows for simulation studies and several hardware R&D activities)



Collaboration examples

Just for illustration, a few examples of collaboration:

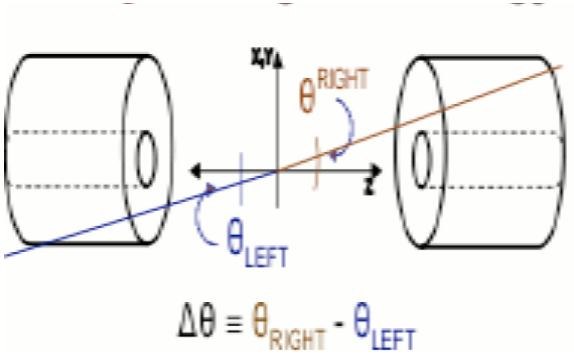
- FCAL: lumical studies for 3TeV
- LC-TPC: electronics developments
- CALICE/ILD: HCAL particle flow simulations
- SiD: sharing of software and HCAL studies

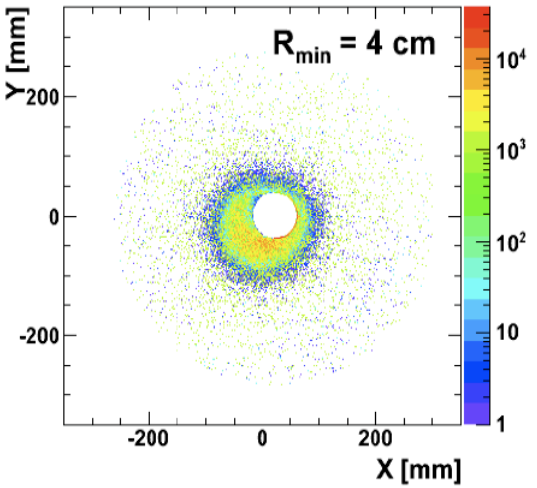
FCAL collab => Lumical study at 3 TeV

Iftach Sadeh, Tel Aviv univ.

e.g. LUMICAL, measuring luminosity

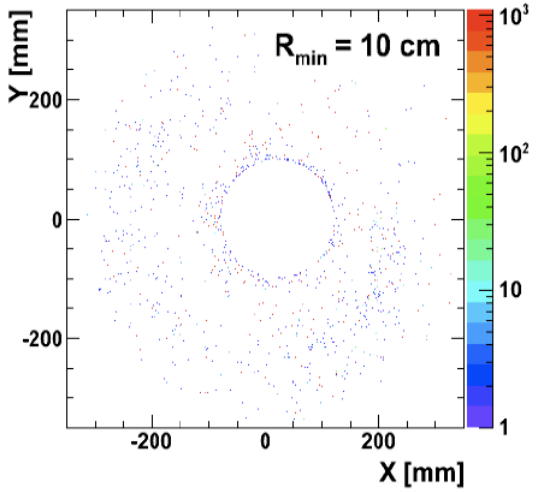
Using BhaBha scattering



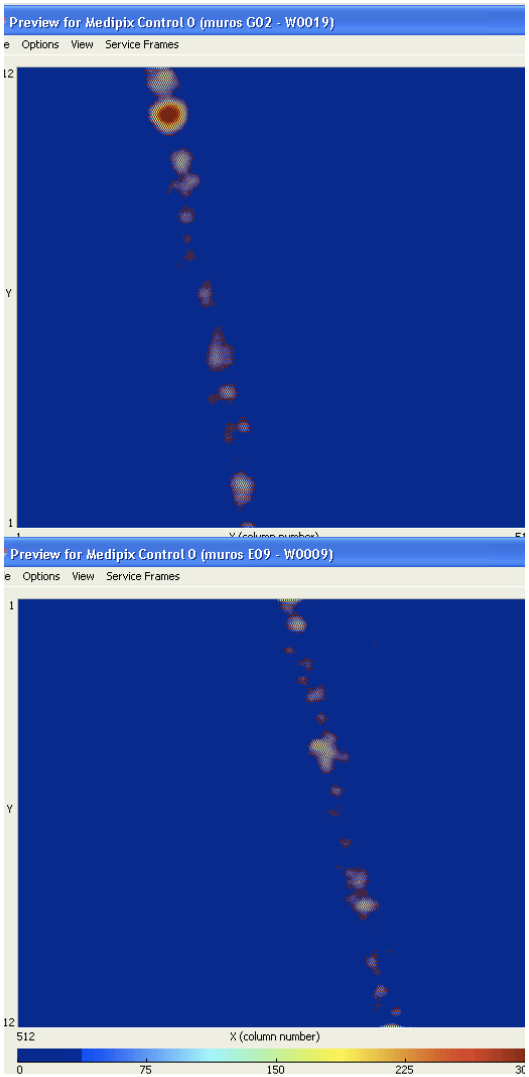


Full simulation of LUMICAL at 3 TeV, adaptation of detector geometry and opening angle.

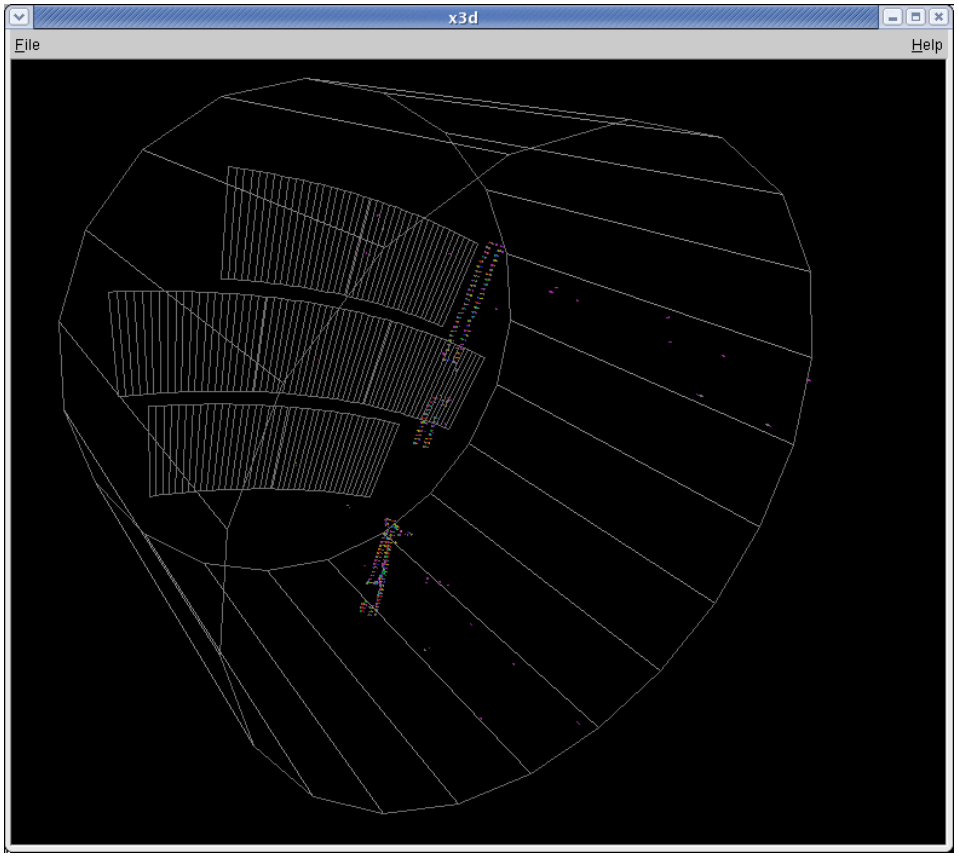
Simulation of back-scattering from the front-face of LUMICAL



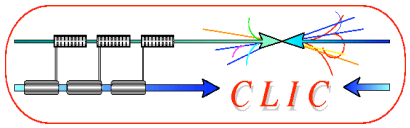
LC-TPC collaboration example: use of Timepix and S-ALTRO electronics at DESY test beam



Online TPC event display: GEM + **Timepix** (55 µm pixels)



Online TPC event display: GEM + 3000 **S-ALTRO** electronics channels



CALICE/ILD collab. example: assessment of Pandora PFA at 3 TeV

Mark Thomson CLIC08
ILD detector description

★Particle flow gives much better performance at "low" energies
- very promising for ILC

What about at CLiC ?

★PFA perf. degrades with energy

★For 500 GeV jets, current alg. and ILD concept:

$$\sigma_E/E \approx 85\%/\sqrt{E/\mathrm{GeV}}$$

★Crank up field, HCAL depth…

$$\sigma_E/E \approx 65\%/\sqrt{E/\mathrm{GeV}}$$

★Algorithm not tuned for very high energy jets, so can probably do significantly better

rms90 — PandoraPFA v03-β

E_{JET}	$\sigma_E/E = \alpha/\sqrt{E_{jj}}$ $\lvert\cos\theta\rvert<0.7$	σ_E/E_j
45 GeV	23.8 %	3.5 %
100 GeV	29.1 %	2.9 %
180 GeV	37.7 %	2.8 %
250 GeV	45.6 %	2.9 %
500 GeV	84.1 %	3.7 %
500 GeV	64.3 %	3.0 %

63 layer HCAL (8 λ_I)
B = 5.0 Tesla

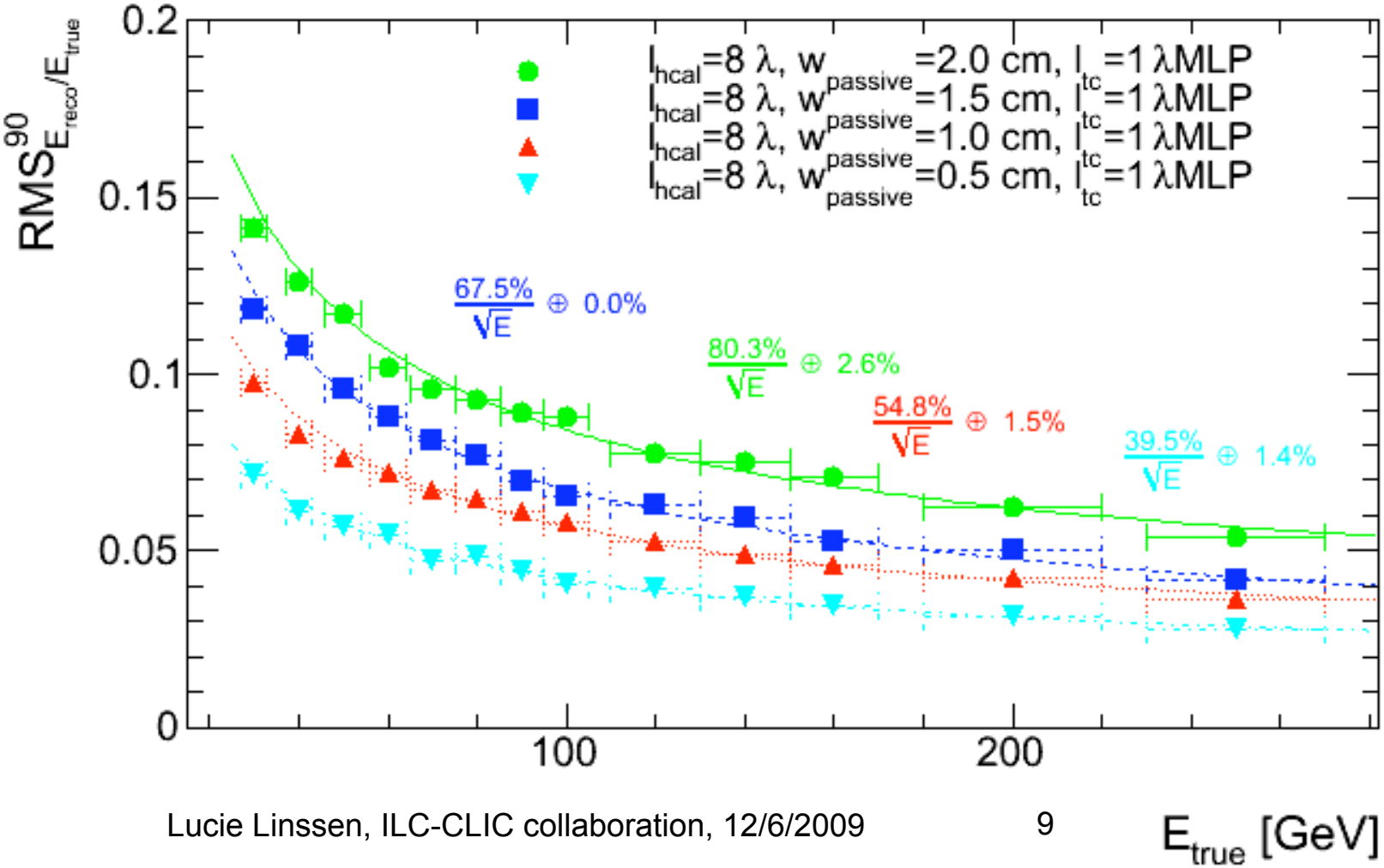
Conclude: for 500 GeV jets, PFA reconstruction not ruled out

SiD collab: use of SiD software to simulate dense calorimetry

Peter Speckmayer / Christian Grefe

Tungsten – Scintillator calorimeter

Conventional Calorimetry, resolution for **8λ**

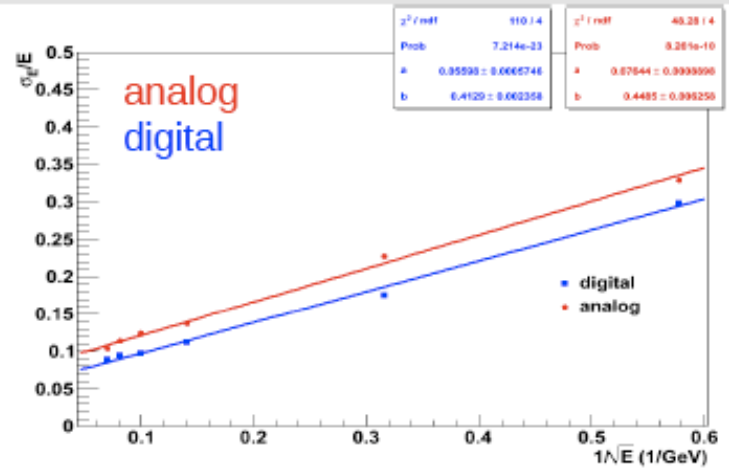


SiD collab: DHCAL simulation with different absorbers

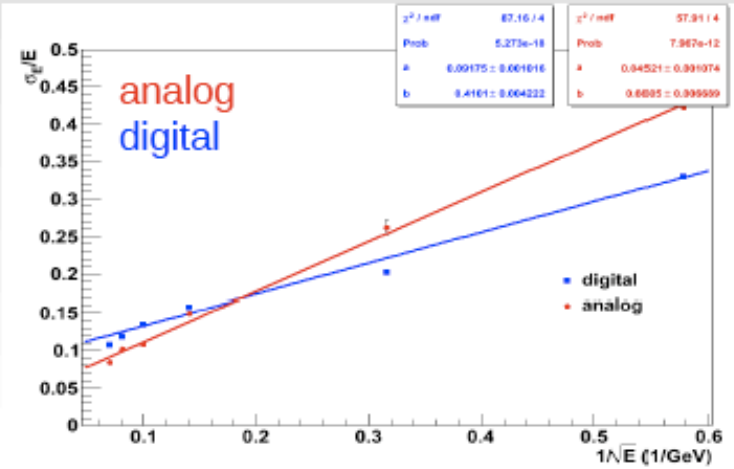
Energy resolution vs pion energy

Jan Blaha, LAPP

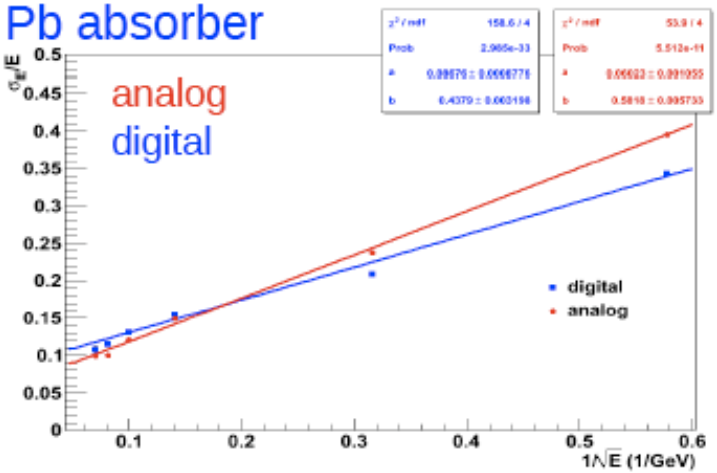
Fe absorber



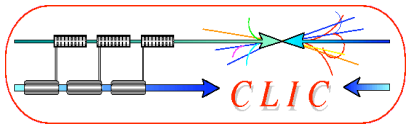
W absorber



Pb absorber



Abs	Readout	Constant (%)	Stochastic (%)
Fe	Digital	5.60 ± 0.06	41.29 ± 0.24
	Analog	7.64 ± 0.09	44.85 ± 0.63
W	Digital	9.18 ± 0.10	41.01 ± 0.42
	Analog	4.52 ± 0.12	66.05 ± 0.68
Pb	Digital	8.68 ± 0.09	43.79 ± 0.32
	Analog	6.02 ± 0.11	58.18 ± 0.58



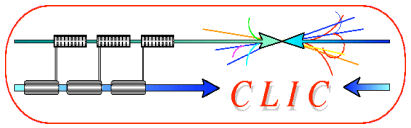
ILC-CLIC collaboration

•Collaboration with ILC physics/detector activities works out very well

- •However, collaboration is not easy with countries which currently suffer from lack of funding for LC. Good will is there.
- •For CLIC detector studies, we would like to establish more contact with the Asian groups

•The ILC-CLIC collaboration profits both ILC and CLIC. Examples of CERN's contribution to ILC detectors:

- •EUDET project
- •Engineering, conventional facilities, CE studies
- •Core software development (as a result of recent workshop at CERN, involving all ILC concepts)
- •CERN testbeams and infrastructures



ILC-CLIC collaboration, suggestions and outlook

•Horizontal technology collaborations are very useful. There would be room for similar new collaborations on e.g.:

- •Developments for large **solenoid coil**
- •Calorimetry ***concept*** studies based on **dual-readout**

•Creation of a framework for formalising LC-related R&D for European groups:

- •In view of improving funding prospects for university groups

•Encourage ILC concepts to assess physics at higher energies (1 TeV, 3 TeV)

- •Will raise awareness that most parts of the concepts have extended scope at the multi-TeV scale

•Following the CLIC CDR (end 2010), one could consider "Addenda to the current concept LoI's" describing the physics potential and detector changes required to run at CLIC conditions. This would represent a considerable effort by the concepts.