ILC-CLIC Collaboration

Physics and Detectors

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PAC meeting Taipei, May 20 2011

Thanks to:
T. Behnke, N. Graf, J. Jaros, L. Linssen all those whom I used their slides

LHC situation and Physics expectations, 2011-2012

Lyn Evans at ALCPG 2011 in Eugene:

Luminosity target of 10^{32} $cm^{-2}s^{-1}$ for 2010 has been reached.

The 2011 run:

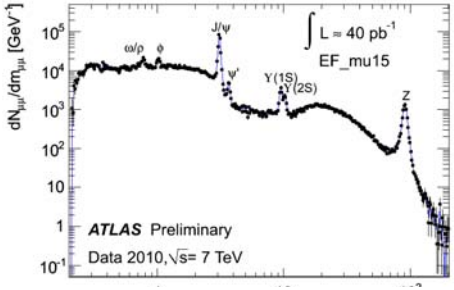
In 2011 peak luminosities up to 10^{33} $cm^{-2}s^{-1}$ can be expected.

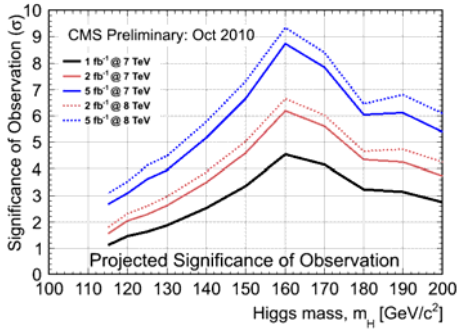
Peak luminosity and bunch configuration will depend on e-cloud effects.

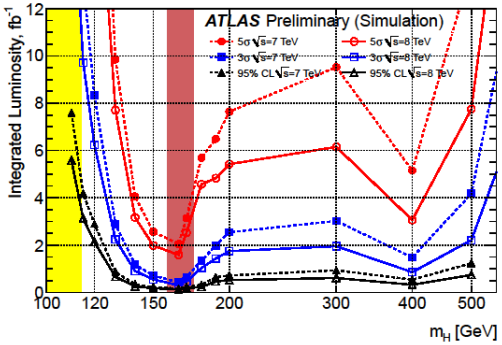
3-4 fb^{-1} is within reach.

The LHC will run in 2012

A reasonable target is 10 fb^{-1} by the end of 2012 (per experiment)







ALCPG 2011 Eugene:

P. Kumar Mal

Higgs Discovery

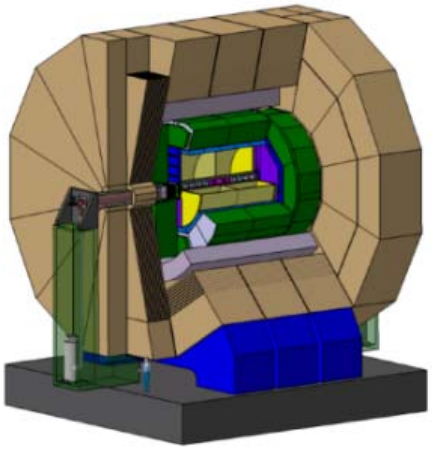
√s=7 TeV

ATLAS + CMS ≈ 2 x CMS	95% CL exclusion	3σ sensitivity	5σ sensitivity	
1 fb^{-1}	120 - 530	135 - 475	152 - 175	
2 fb^{-1}	114 - 585	120 - 545	140 - 200	
5 fb^{-1}	114 - 600	114 - 600	128 - 482	2011
10 fb^{-1}	114 - 600	114 - 600	117 - 535	2012

If the SM Higgs exists, we'll know its mass soon

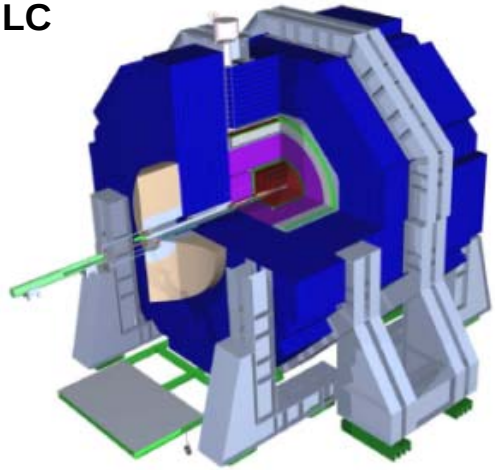
ALCPG 2011 Eugene: S. Dawson

Detector Concepts



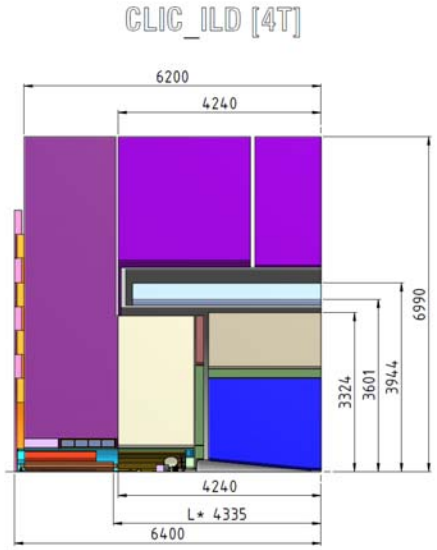
Two validated detector concepts for the ILC

ILD **SiD**



With ILC-CLIC cooperation

CLIC_SiD and CLIC_ILD concepts

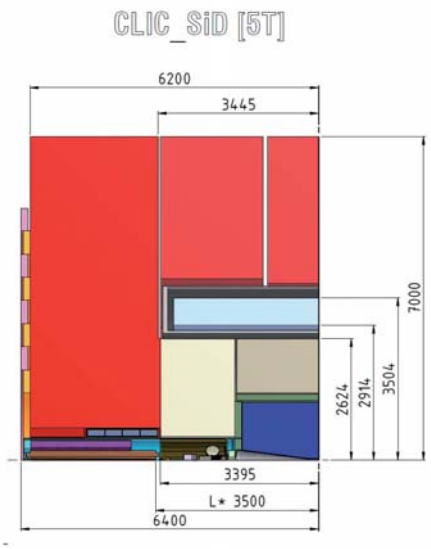


- Need to cover the physics potential of the full energy range, including 0,5-1,0 Tev (higher energies, shorter bunch spacing, harsher backgrounds)

- Not full new concepts but modifications to ILC and SiD:

    - Vtx. 2,5-3,0 cm,
    - HCAL 7,5 λ,
    - B=4-5 T
    - Redesign FWD region

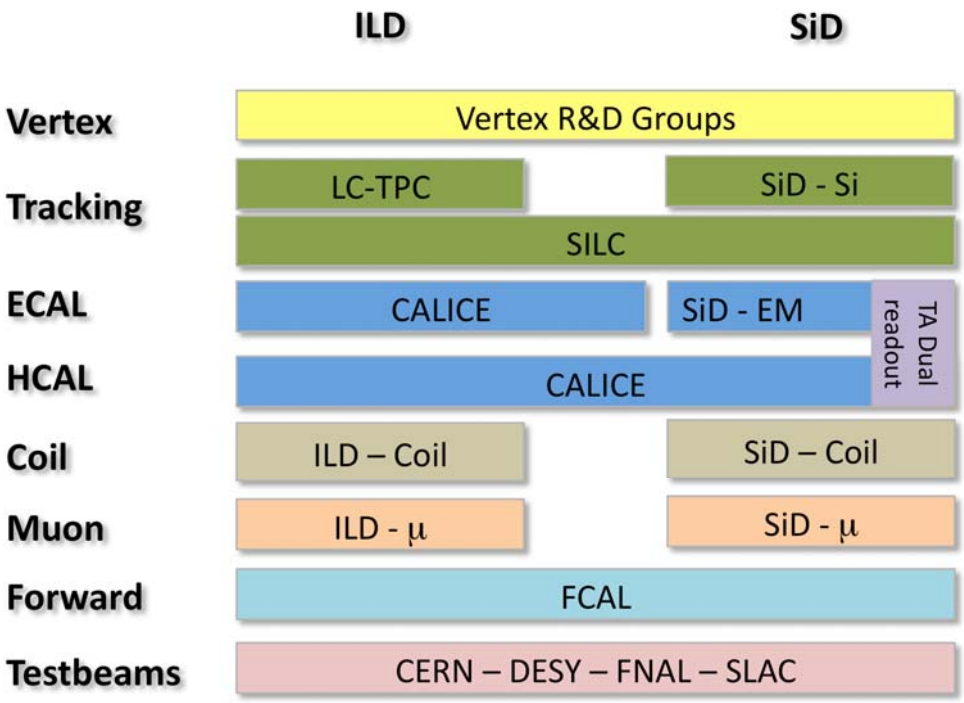
- Tracking and ECAL unchanged



Detector R&D Organization

ALCPG 2011, Eugene by M. Demarteau

- The matrix of detector R&D is quite convoluted

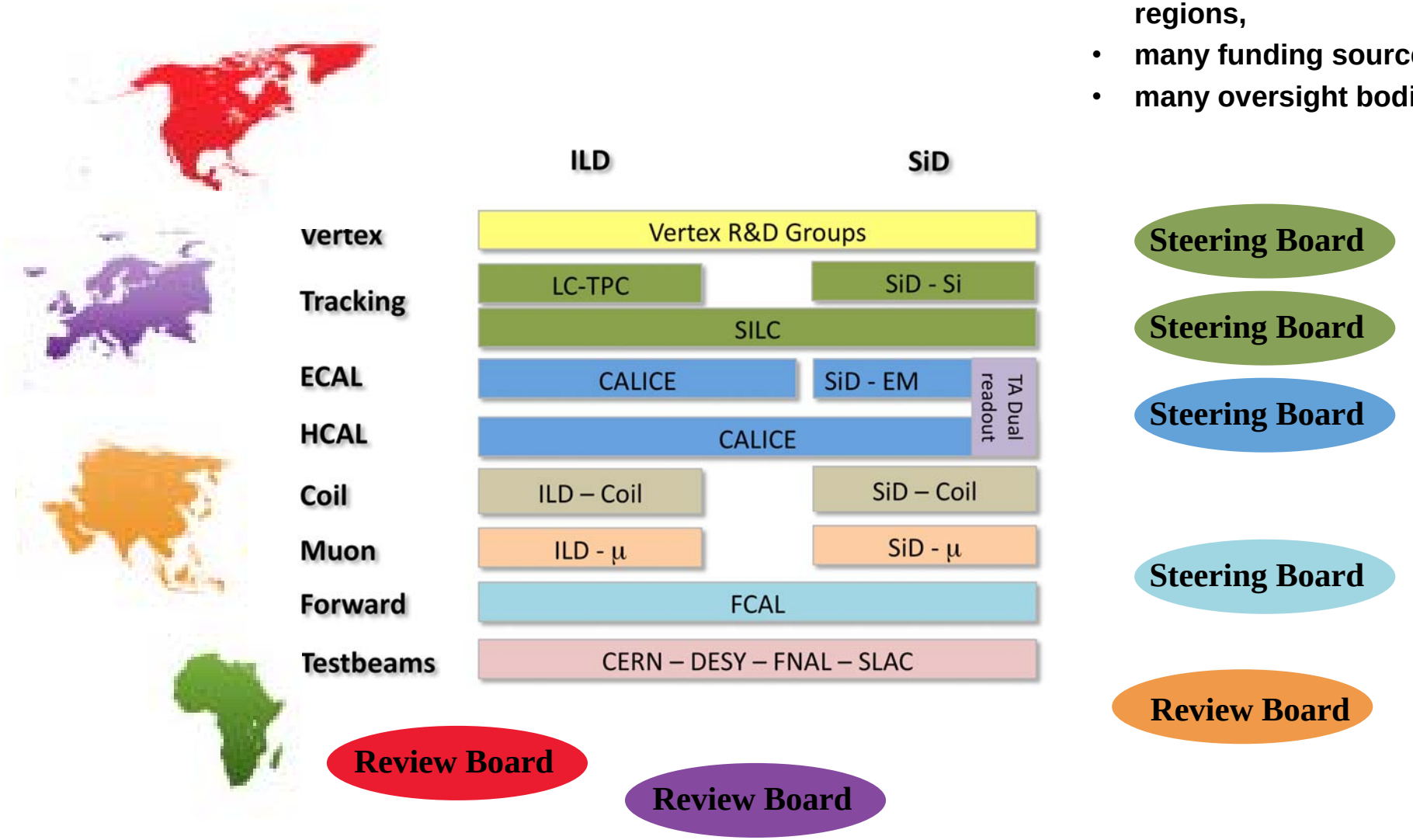


- Control held by R&D collaborations, but even that is very limited

Detector R&D Organization

ALCPG 2011, Eugene by M. Demarteau

- **R&D based in many regions,**
- **many funding sources,**
- **many oversight bodies**

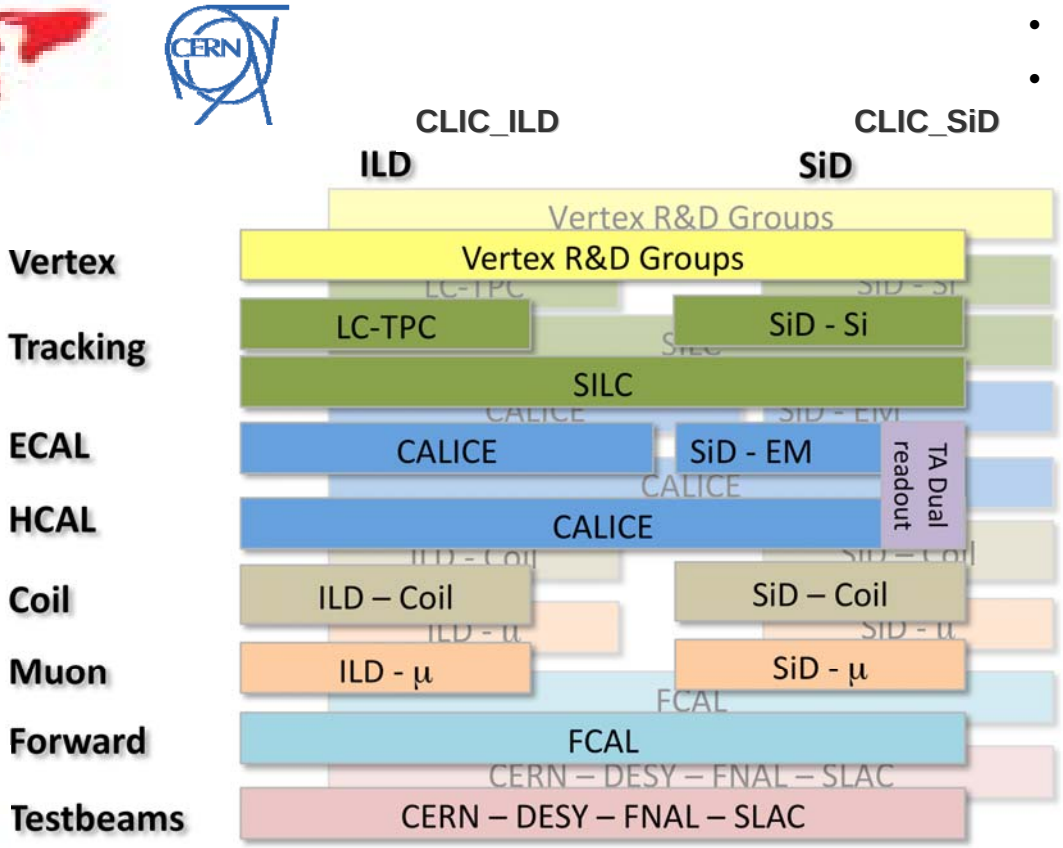


Detector R&D Organization

ALCPG 2011, Eugene by M. Demarteau

It works !!

- **R&D based in many regions,**
- **many funding sources,**
- **many oversight bodies**



Steering Board

Steering Board

Steering Board

Steering Board

Review Board

Review Board

Review Board

CLIC adds an "extra dimension"

CERN LCD project is formally member of:

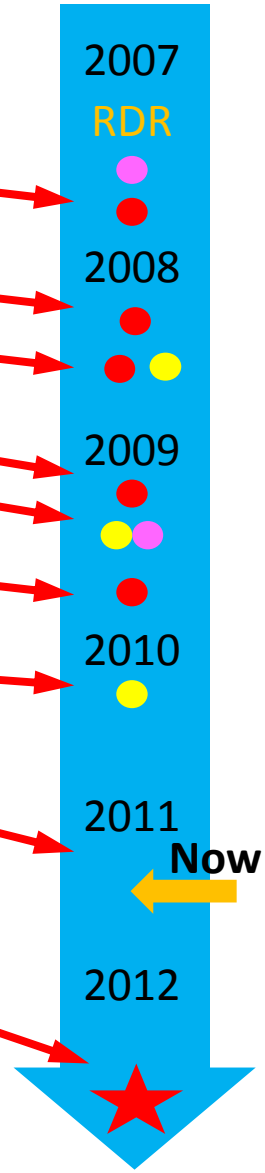
CALICE, LC-TPC, FCAL, EUDET, AIDA

Several are members of SiD and ILD

Detector R&D Timeline: ILC

ALCPG 2011, Sakue Yamada

- Oct. 2007: **Call for LOIs was made by ILCSC**
- Jan. 2008: Detector management was formed
- Mar. 2008: IDAG formed, 3 LOI groups known
- Mar. 2009: 3 LOIs submitted
- **Summer 09: IDAG recom. for validation and ILCSC's approval**
- Oct 2009: Work plan of the validated groups
- Mar:2010: IDAG began monitoring the progress
- **End 2010: Interim report (still being prepared)**
- **End 2012: Detailed Baseline Design Report and updated physics case for ILC**



To define: How to continue after 2012

Detector R&D Timeline: CLIC

ALCPG 2011, Konrad Elsener & Lucie Linssen

- **End Aug. 2011:** Concept Design Report Volume 2, Physics and Detector for 3 TeV CLIC machine
- **Oct. 2011:** add to the previous study a staged energy approach with intermediate energies in the 1.5-2.0 TeV range
- **Mid Oct. 2011:** Internal review (probably 18-20 Oct.)
- **Dec. 2011:** Report to the CERN Scientific Policy Committee (SPC)
- **Mid 2012:** Executive Summary as input for European Strategy Update in 2012

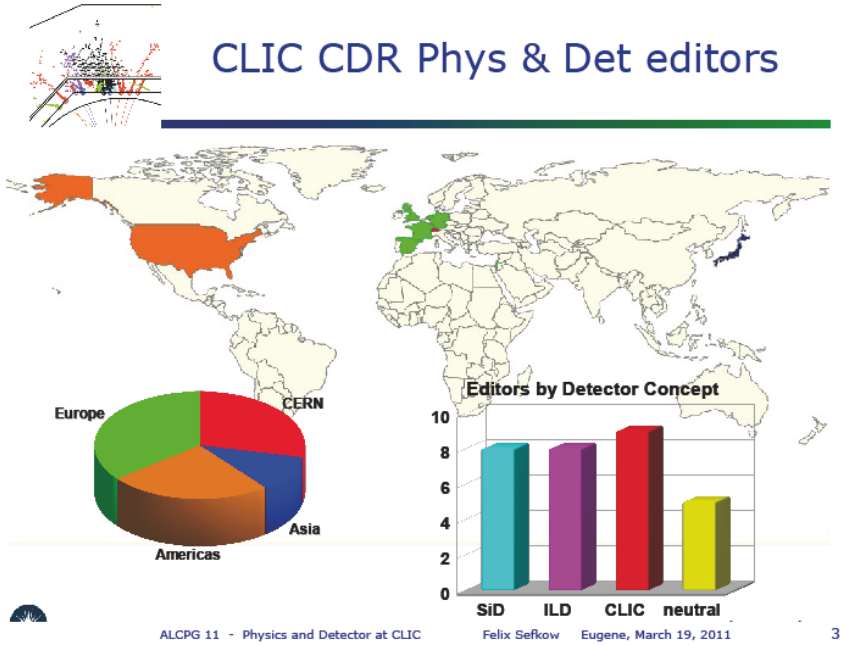
Set up CLIC timeline after 2012. Define plans for the period up to 2016 (Project Preparation Phase), and also for the years after (Project Implementation Phase).

ILC – CLIC Cooperation

A working group to cooperate and discuss synergies between ILC and CLIC in Physics and Detectors.

M. Demarteau, J. Fuster, L. Linssen, F. Sefkow, M. Stanitzky, M. Thomson, S. Yamada (chair)

(http://indico.cern.ch/categoryDisplay.py?categId=3018)



Both Communities have committed to cooperate elaborating:

- **the CLIC CDR (first, 2011)**
- **the ILC DBD (later, 2012)**

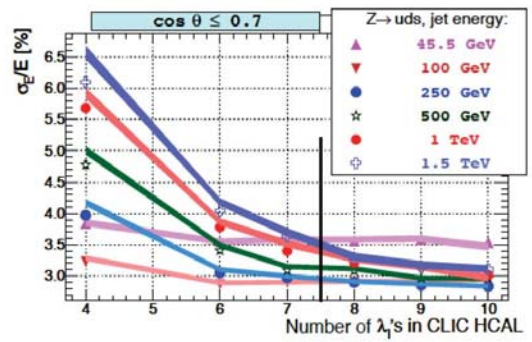
ALCPG 2011, Felix Sefkow

List of Cooperative tasks (Oct. 2010)

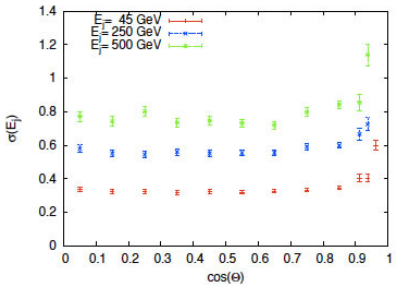
Core Software development

Core software Mokka/Marlin	Improvements to the geometry descriptions in Mokka/Marlin (involving mostly members of CERN, DESY, LLR)
Pandora_PFA_new	New Pandora architecture allows use of Pandora in ILD and SiD (SLAC, N. Graf). Participation in the re-write of Pandora, in particular the photon clustering algoritm (Cambridge univ, with help from CERN). The SiD version (interface) is called SLiCPandora.
Pandora_PFA_new	Assesment of performance of Pandora PFA new in jet reconstruction (Barklow), PFO lepton-id
GRID production tools	Setting up of automatic GRID production tools and file database for Mokka/Marlin and for SLIC/LCSim (using the LHCb DIRAC framework)
TPC pattern recognition and track reconstruction	Development of improved TPC pattern recognition and track reconstruction with the aim of providing parametrisations which can be used in the ILD TPC tracking
Hadronisation in Geant4	Study and improvements to the hadronisation models in Geant4

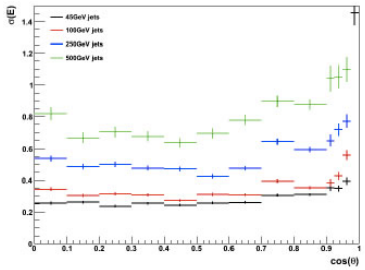
Pandora based optimization



CLIC SID

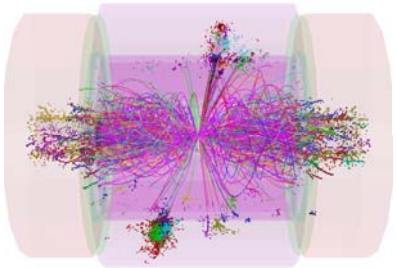


CLIC ILD (J.M.)



Work on overlay of background and physics

Overlay of incoherent pairs and gg=> hadron events	Work on overlay of background and physics events, gaining experience that is also of use for ILC
Forward region background studies	Detailed forward region simulations with study of backscattered particles in Mokka/Marlin
Muon background from machine	Study of (horizontal) muon background from the machine and its rejection in the tracking/calo codes



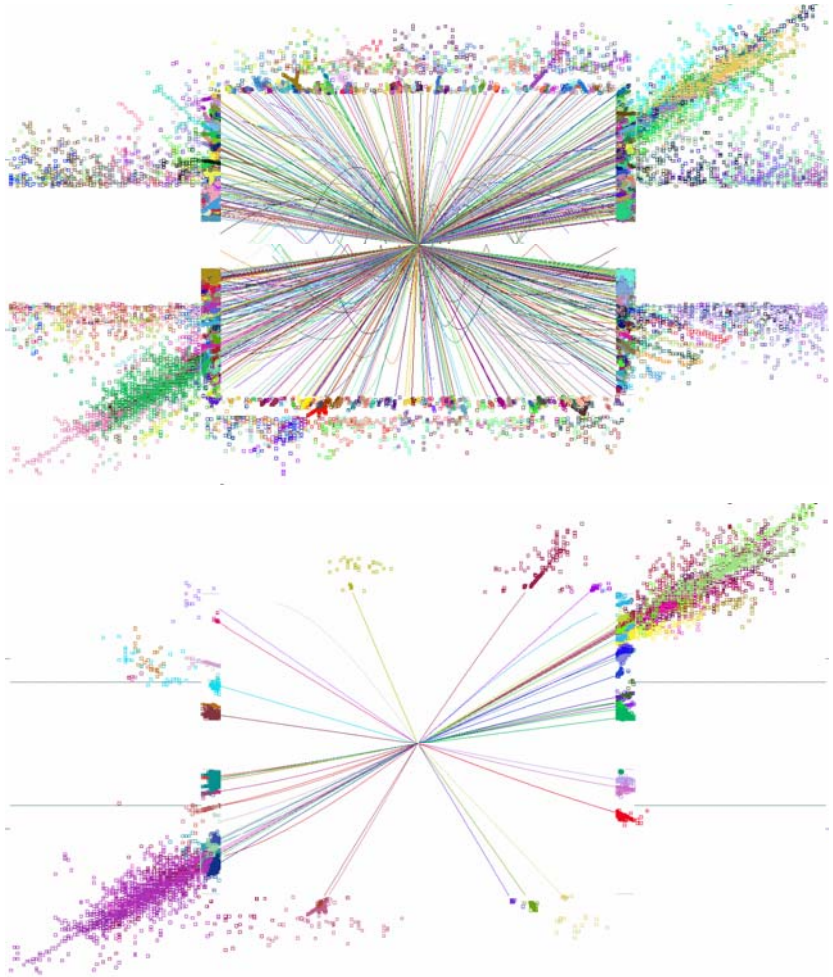
List of Cooperative tasks (Oct. 2010)

Assessment of high energies, with clear interest for future 1 TeV ILC work

SiD tracking at high energies	Assesment of SiD tracking at high energies and with background overlay
Muon id and muon optimisation	Study of muon-id, dramatic energy loss by muons, hadron shower leakage
Tau finder	Development of a tau finder and tau reconstruction (currently in Marlin, but can extend to SiD software)
SiD and ILD detector adaptations for higher energies	For the CLIC study, the ILD and SiD concepts are adapted to higher energies (and of course also to CLIC background conditions). These adaptations will provide useful input to define 1 TeV detector strategies for the ILC.
Optimisation of physics observables	For the CLIC study we work on the optimisation of physics observables at 3 TeV. The corresponding adaptations to the various codes will serve the ILC as well.

Engineering studies

Vibration studies, forward region quadrupole suspension	Vibration studies at LHC locations, study of QD0 suspension including FEA and design, corresponding opening scenarios (this is partly CLIC-specific, due to the severe CLIC requirements)
Push-pull studies and requirements for experimental area	Push-pull studies and requirements for experimental area and its services
Solenoid magnet studies	Solenoid magnet (4T and 5T) caluculations and design parameters
Solenoid services	Studies of solenoid services and quench protection compatible with push-pull



Z->uds @ 1TeV + 60BX gg->hadrons before and after timing cuts on PFOs

List of Cooperative tasks (Oct. 2010)

Electronics developments

TPC pad readout	Development of TPC pad readout electronics, based on S-Altro (microelectronics) design
TPC pixel readout	Design of pixel chip for TPC readout (Timepix2 chip)
Microelectronics support	Microelectronics support, training, foundry services, design reviewing for LC community

HCAL R&D

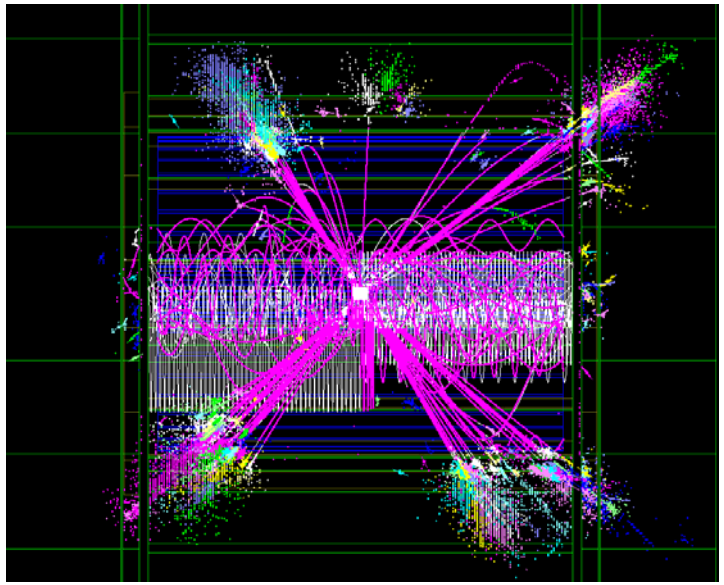
Tungsten-based HCAL studies within CALICE	Preparation of beam tests of a large HCAL prototype, based on Tungsten absorbers and various CALICE active media

FCAL

Beamcal and lumical simulation models	Setting up and maintenance of Mokka/Marlin/Geant4 simulation model of Beamcal and Lumical; software support for ILC FCAL members

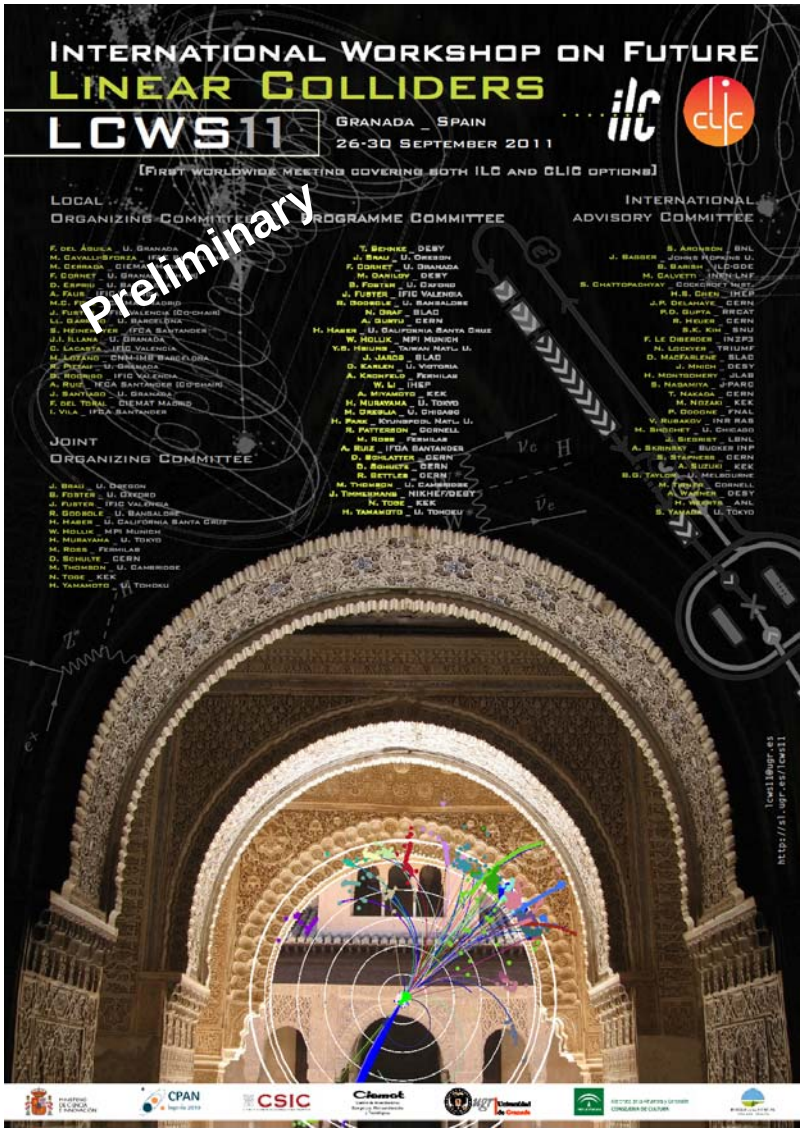
Benchmarks

e+e −> $h\nu_e\nu_e$ e+e −> H^+H^- e+e −> H^0A^0 e+e −> $q_R\bar{q}_R$ e+e −> $\ell^+\ell^-$, ℓ = e, μ e+e −> $\chi^+_i\chi^-_j$; $\chi^0_i\chi^0_j$ e+e −> $t\bar{t}$ (0,5 TeV)	Cambridge (chair), CERN, MPI Munich, LAPP, UCSC, Prague, Barcelona, SLAC, RAL, DESY



HA→bbbb (CLiC_ILD)

Joint Organization of Linear Collider Workshops



Conclusions concerning future Linear Collider workshops
IWLC-2010 Workshop at Geneva 18-22, Geneva

Conclusions drawn at the meeting of 19/10/2010 among ILC GDE executive committee, ILC RD, regional contact persons for ILC physics and detectors studies, CLIC steering committee, CERN management, ILC-CLIC working group on general issues for detector cooperation

• Following recommendations from WWS, there will be each year one global International Workshop on the Linear Collider and one regional Linear Collider workshop.

• Both types of workshops will rotate over the three regions.

• The annual International Workshop on the Linear Collider will be fully common between ILC and CLIC, both for the accelerators and for the physics/detectors.

• It is essential that both the accelerator and physics/detector communities from both ILC and CLIC be fully involved in the organisation of these future workshops. Therefore an organizing committee reflecting this composition should be set up.

• Concerning the regional workshops these will remain focused on ILC for the accelerator part. In the physics and detector domain, there is naturally a broader overlap between the ILC and CLIC studies, which therefore translates into an enlarged coverage at the regional workshops.

• Other topical meetings and workshops can be organised as needed.

ILC – CLIC Cooperation Summary

- End of 2012 is a time when:
  - LHC results at 7 TeV will be available with ~ 10 fb^{-1} per experiment.
  - Tevatron data will also be well understood/final.
  - Among other issues, the existence or absence of SM Higgs should be known.
- ILC and CLIC activities show an excellent progress and are working hard towards reaching the maximum amount of useful information for 2012 discussions
- A common coordination ILC-CLIC working group exists and cooperation is developping very positively:
  - CDR (CLIC) document which will ready by the end of 2011, and
  - DBD (ILC) documents which will ready by the end of 2012
- Common cooperative tasks are identified and a good motivation from groups is shown
- Finishing all documents, CDR and DBD, by 2012 in due time is “the milestone” in order to be ready for the scientific discussion which will happen by the end of 2012 (2013 ?)
- Main worry to get this goal is the lack of resources which is being experimented. Of special harm is the loss of active groups with long tradition in the project and high level of expertise. Strong support from all panels (like PAC), committees, labs, etc.. is urgently needed/required to overcome this situation
- Future LC workshops will be jointly organized by both communities, ILC and CLIC

End of 2012 (2013 ?) is an important date

best knowledge possible is crucial