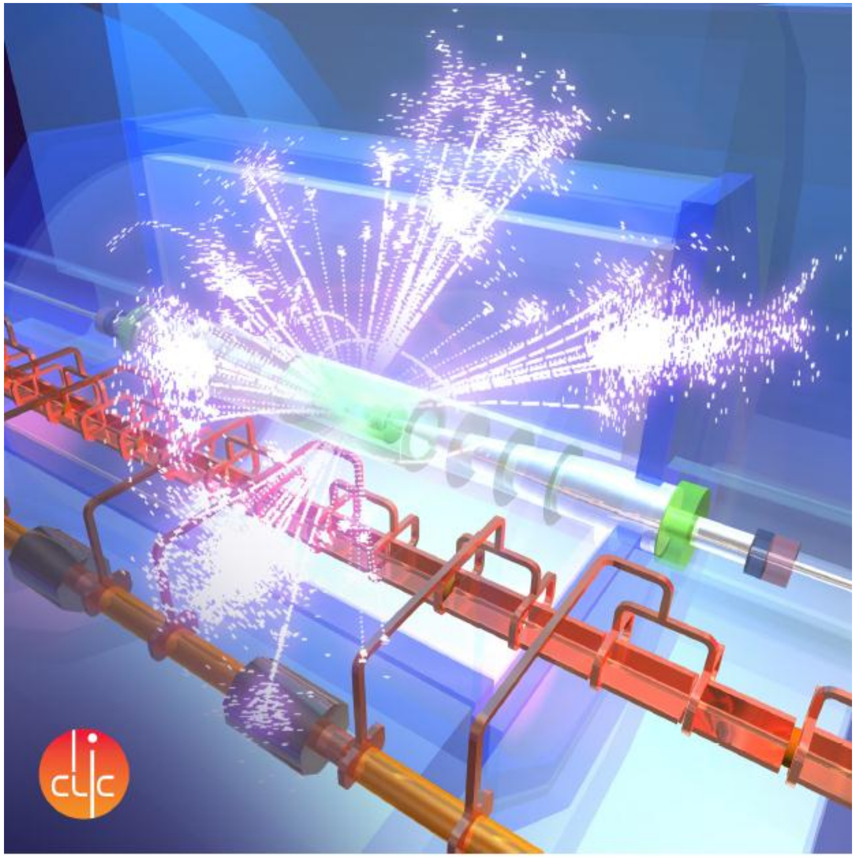
CLIC detector & physics "work plans"



Lucie Linssen, CERN

on behalf of the CLIC detector and physics study

Priority list of activities ?

Difficult to make a list of activities for the a full experiment and its physics motivation !

The work for CLIC is placed in the context of all Linear Collider detector and physics studies, and a lot of relevant work is going on in many places.

Many (but not all !) of the Institutes joining the MoC are connected to both ILC and CLIC. They often want their work to be of profit to both ILC and CLIC.

However, some of the studies are CLIC-specific.

Quite an extensive work-list was written in CDR Vol 2, chapter 11.
http://arxiv.org/abs/1202.5940v1
It is still quite valid.

Globally speaking, one can see it as => next slide

plans for the phase 2013-2016

Further exploration of the physics potential

- Complete picture of Higgs prospects at ~350 GeV, ~1.4 TeV, ~3 TeV
- Discovery reach for BSM physics
- Sensitivity to BSM through high-precision measurements

⇐ cf. LHC results

⇒ Drives the CLIC staging strategy

Detector Optimisation studies

- Optimisation studies linked to physics (e.g aspect ratio, forward region coverage);
- Interplay between occupancies and reconstruction;
- Interplay between technology R&D and simulation models.

Technology demonstrators

- Many common developments with ILC
- Complemented with CLIC requirements

CLIC benchmark analysis plans

Studies towards paper on **Higgs studies** at CLIC at 350 GeV, 1.4 TeV and 3 TeV.
To be ready by (hopefully) LC2013 @ DESY

- Simultaneous extraction of H -> bb, H -> cc and H -> gg at 350 GeV and 1.4 TeV
- H -> τ τ at 350 GeV and 1.4 TeV
- H -> WW* at 350 GeV and 1.4 TeV (and 3 TeV?)
  - At 1.4 TeV potential for absolute Higgs to W coupling
- ZZ fusion at 1.4 TeV (and 3 TeV?)
  - Ratio of the ZZH to WWH couplings
  - Potential for other coupling measurements
- Higgs -> γγ and Zγ at 1.4 TeV
- Higgs -> μμ at 1.4 TeV
- ttHiggs at 1.4 TeV
- Higgs self-coupling at 1.4 TeV and 3 TeV (ongoing)
- Longitudinal WW scattering at 1.4 TeV (and 3 TeV?) (also for the Higgs paper)

work-assignments mostly already made

Other ongoing analysis on **BSM physics**:

- Generic search for dark matter at 1.4 and 3 TeV
- Composite Higgs at 3 TeV?

CLIC physics potential

Important to stay in pace LHC results !

Work together with ILC (and other e^+e^- colliders ?)

Work together with other options for future high-energy frontier machine at CERN:

- Collaborate with LH-LHC and HE-LHC studies
- Involving experimental groups and theory

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For some short-term physics objectives, see e.g. plans for the CLIC Snowmass physics input.

Table 10.1
CDR
Vol. 2

Table 10.1: Overview of readout details for the various subdetectors of the CLIC_ILD detector concept. Occupancies and data volumes are for a full bunch train and include charge sharing between pixels/strips. Safety factors of five and two are applied to the rates of the incoherent pairs and the $\gamma\gamma \rightarrow$ hadrons, respectively; except for the TPC, for which no safety factors have been applied. Occupancies averaged over entire subdetectors are compared to the maximum values obtained for the regions with the highest backgrounds.

	time stamping resolution [ns]	time sampling period [ns]	cell size [mm^2]	number of channels [10^6]	average to maximum occupancy [%]	number of bits per hit [bit]	data volume [Mbyte]
VTX barrel	~ 5	10	0.02×0.02	945	< 1.5 - 1.9	32	56
VTX endcap	~ 5	10	0.02×0.02	895	< 2.0 - 2.8	32	72
FTD pixels	~ 5	10	0.02×0.02	1570	0.1 - 1.0	32	6.3
FTD strips	~ 5	10 - 25	0.05×100	1.6	160 - 290	16	48
SIT	~ 5	10 - 25	0.05×90	1.0	100 - 174	16	30
SET	~ 5	10 - 25	0.05×438	5.0	17 - 17	16	150
ETD	~ 5	10 - 25	0.05×300	4.0	38 - 77	16	120
TPC	–[a]	25	1×6	3[b]	5 - 32	24	500
ECAL barrel	1	25	5×5	69.5	< 3	16	2090
ECAL endcap	1	25	5×5	43.2	60 - 150	16	1300
HCAL barrel	1	25	30×30	6.9	< 5	16	210
HCAL endcap	1	25	30×30	1.8	120 - 5200	16	54
HCAL rings	1	25	30×30	0.2	< 5	16	6.0
LumiCal	5	10	5×5	0.2	600 - 6000	32	28
BeamCal	5	10	8×8	0.1	15600[c]	32	15
MUON barrel	1	25	30×30	1.4	0.01 - 0.05	24	< 0.01
MUON endcap	1	25	30×30	2.4	0.12 - 10	24	< 0.01

[a] By combining with different subdetectors in offline reconstruction 2 ns will be achieved.
[b] The 3D TPC reads out 1000 voxels per channel for each bunch train.
[c] All cells measure a signal for each bunch crossing.

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CDR
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Drives some of the detector optimisation

+

technology development needs

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other detector optimisation

Forward region acceptance

- Final focus QD0 inside or outside the detector ?
- Understand requirements for forward coverage
  - Use suitable physics processes as a gauge
    - Triple Higgs study + ?? + ??

CLIC vertex detector layout and flavour tagging

- Detailed detector optimisation, linked to the vertex detector R&D
- E.g. spiraling disks
- Transition from pixels to strixels/strips
- Material distribution in agreement with hardware R&D
- Use "flavour tagging as a gauge" (not only impact parameter)

Cost-effective ECAL study

See: http://indico.cern.ch/categoryDisplay.py?categId=4379
CLIC detector model used, but applies directly to ILC and CLIC

Link between superconducting coil technology and HCAL leakage

- Choice for thin aluminium-based conductor stems from CMS, which has a "thin" HCAL and CMS was not built for PFA
- CLIC proposes a deep HCAL and PFA
- How "thick" do we allow the coil to be and how does this link to new superconductor technologies on the market ?

other

Core software development

- Common for Linear Collider (+AIDA)

CLIC-related electronics readout

- Precise timing (10 ns for vertex/tracking, 1 ns for calorimeter), multi-hit capability in 156 ns
- Power delivery and power pulsing

R&D objectives: 2013-2016

R&D => technology demonstrators

Implementation examples ***demonstrating the required functionality***

Vertex detector

Demonstration module, meeting requirements of high precision, 10 ns time stamp and ultra-low mass

Main tracker

Demonstration modules, including manageable occupancies in the event reconstruction

Calorimeters

Demonstration modules, technological prototypes + addressing control of cost

Electronics

Demonstrators, in particular in view of power pulsing

Magnet systems

Demonstrators of conductor technology, safety systems and moveable service lines

Engineering and detector integration

Engineering design and detector integration harmonized with hardware R&D demonstrators

Challenging and interesting detector technologies
Considered feasible in a 5-year R&D program