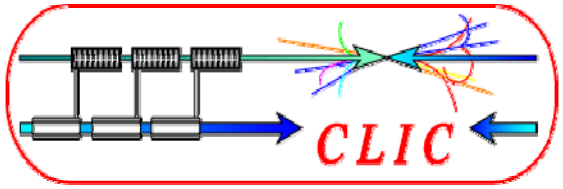
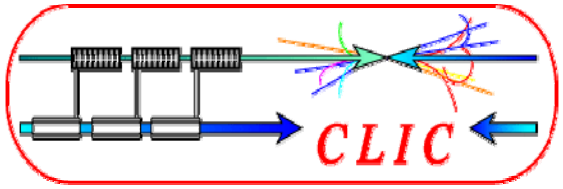


CLIC physics/detector studies

status + plans



CLIC links, workshops and time-line

CLIC website:

http://clic-study.web.cern.ch/CLIC-Study/

CLIC07 workshop, October 2007

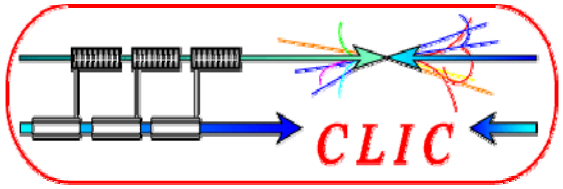
http://cern.ch/CLIC07Workshop

CLIC08 workshop, October 14-17 2008

http://project-clic08-workshop.web.cern.ch/project-clic08-workshop/

CLIC CDR foreseen for 2010

CLIC TDR foreseen for 2014



Detector Specifications

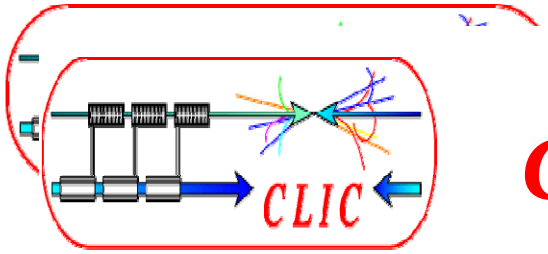
hep-ph/0412251 ; CERN-2004-005

Detector	CLIC
Vertexing	$15\mu m \oplus \frac{35\mu m GeV/c}{p \sin^{3/2}\theta}$ $15\mu m \oplus \frac{35\mu m GeV/c}{p \sin^{5/2}\theta}$
Solenoidal Field	$B = 4\ T$
Tracking	$\frac{\delta p_t}{p_t^2} = 5. \times 10^{-5}$
E.m. Calorimeter	$\frac{\delta E}{E(GeV)} = 0.10 \frac{1}{\sqrt{E}} \oplus 0.01$
Had. Calorimeter	$\frac{\delta E}{E\ (GeV)} = 0.40 \frac{1}{\sqrt{E}} \oplus 0.04$
μ Detector	Instrumented Fe yoke $\frac{\delta p}{p} \simeq 30\%$ at 100 GeV/c
Energy Flow	$\frac{\delta E}{E\ (GeV)} \simeq 0.3 \frac{1}{\sqrt{E}}$
Acceptance	$\lvert\cos\theta\rvert < 0.98$
mask	120 mrad
beampipe	3 cm
small angle tagger	$\theta_{min} = 40$ mrad

CLIC Report 2004:
Starting point: the TESLA TDR detector adapted to CLIC environment

-Based on previous CLIC parameters

Conclusions:
-No significant differences required between TESLA and CLIC detector
- Greater need for time-stamping of events



CLIC-ILC Collaboration?

- **Following visit of Barry @ CERN (Nov 07)**

  http://www.linearcollider.org/newsline/archive/2007/20071213.html

Independently of US/UK financial crisis,

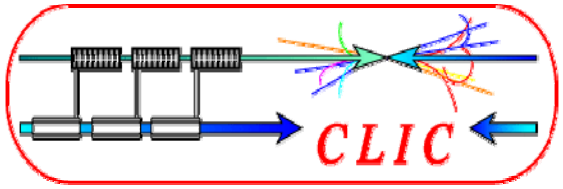
but even more desirable now

- **CLIC-ILC Collaboration meeting (Feb 08)**

  http://indico.cern.ch/conferenceDisplay.py?confId=27435

- **GDE/ACFA Meeting at Sendai/Japan (March 08)**

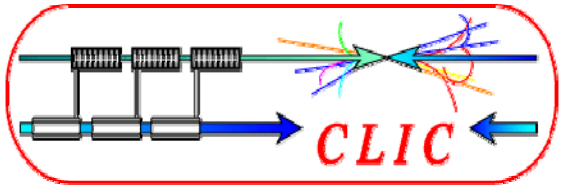
  http://www.awa.tohoku.ac.jp/TILC08/



ILC-CLIC working groups

ILC-CLIC working groups	
Topic	Conveners
Civil Engineering and Conventional Facilities (CFS)	Claude Hauviller (CERN), John Osborne (CERN), Vic Kuchler (FNAL)
Beam Delivery Systems and Machine Detector Interface	Brett Parker (BNL), Daniel Schulte (CERN) , Andrei Seryi (SLAC), Emmanuel Tsesmelis (CERN)
Detectors	Lucie Linssen (CERN), Francois Richard (LAL), Dieter Schlatter (CERN), Sakue Yamada (KEK)
Cost & Schedule	John Carwardine (ANL), Katy Foraz (CERN), Peter Garbincius (FNAL), Tetsuo Shidara (KEK), Sylvain Weisz (CERN)
Beam Dynamics	Andrea Latina (FNAL), Kiyoshi Kubo (KEK), Daniel Schulte (CERN), Nick Walker (DESY)

First working group meeting was held on 13/5/2008

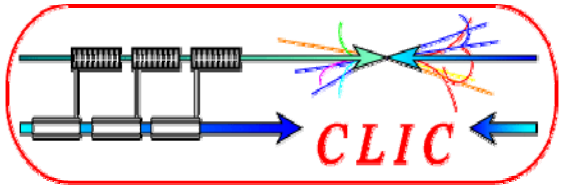


Topics for CLIC-ILC physics/detector

Extracted from 8 Feb 08 meeting summary:

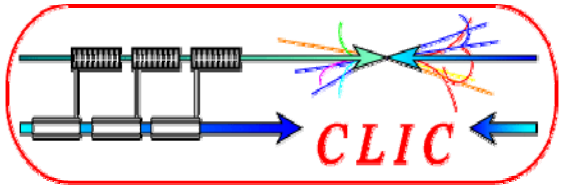
1) Define a CLIC detector concept at 3 TeV.
(update of 2004 CLIC Study) based on ILC detector concepts.

2) Detector simulations
- Simulation tools to be used by ILC and CLIC (WWS software panel)
- Validation ILC detector options for CLIC at high energy, different time structure and different backgrounds
- 1 TeV benchmark studies to provide overlap
- compare performance using defined benchmark physics processes (e.g. WW/ZZ separation)



Work plan

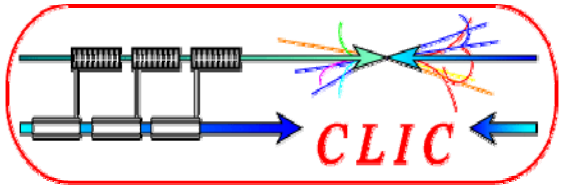
- **Preparation for the CLIC CDR 2010**
  - Physics motivations/simulations
  - Perform simulation studies to define a valuable CLIC detector concept
    - Based on ILC detector concepts and tools
  - Detailed implementation of the CLIC forward regions, including the assessment of the main engineering aspects
  - Provide overlap with ILC detector studies for comparison (0.5 TeV or 1 TeV?)
  - Identify critical areas for detector R&D, which are not yet covered by R&D for ILC



CERN team

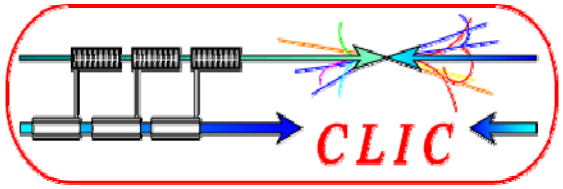
CERN has now allocated some (minimal) resources for the CLIC detector/physics studies.

- 1 Doctoral student, 1 Fellow, 1 PDSA (2009)
- Part time availability of several staff members
- Resources (subsistence) to pay for visitors for the CLIC simulations

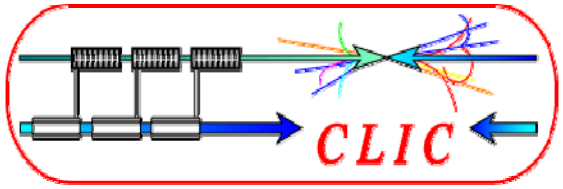


- CLIC physics/detector studies are starting again
- Many similarities with ILC detector studies
- Good exchange and collaboration with ILC experts is fundamental …..
- Your participation is most welcome

Let’s get started



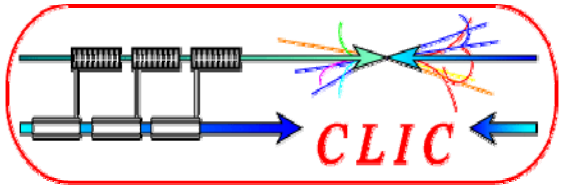
Spare slides



CLIC main parameters

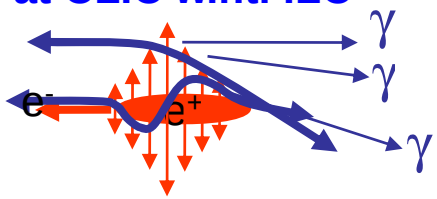
http://clic-meeting.web.cern.ch/clic-meeting/clictable2007.html

Center-of-mass energy	3 TeV
Peak Luminosity	$7 \cdot 10^{34}$ cm^{-2} s^{-1}
Peak luminosity (in 1% of energy)	$2 \cdot 10^{34}$ cm^{-2} s^{-1}
Repetition rate	50 Hz
Loaded accelerating gradient	100 MV/m
Main linac RF frequency	12 GHz
Overall two-linac length	42 km
Bunch charge	$3.72 \cdot 10^{9}$
Bunch separation	0.5 ns
Beam pulse duration	156 ns
Beam power/beam	14 MWatts
Hor./vert. normalized emittance	660 / 20 nm rad
Hor./vert. IP beam size bef. pinch	40 / ~1 nm
Total site length	48 km
Total power consumption	322 MW

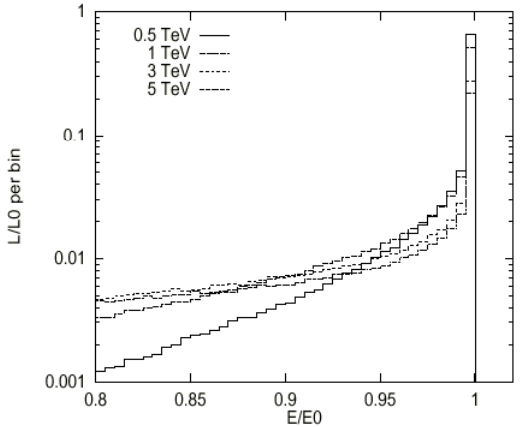


Luminosity and Background Values

3x more energy loss due to beamstrahlung at CLIC w.r.t. ILC



unavoidable at Linear Colliders in general: small beam sizes -> large beamstrahlung



CLIcC luminosity spectrum

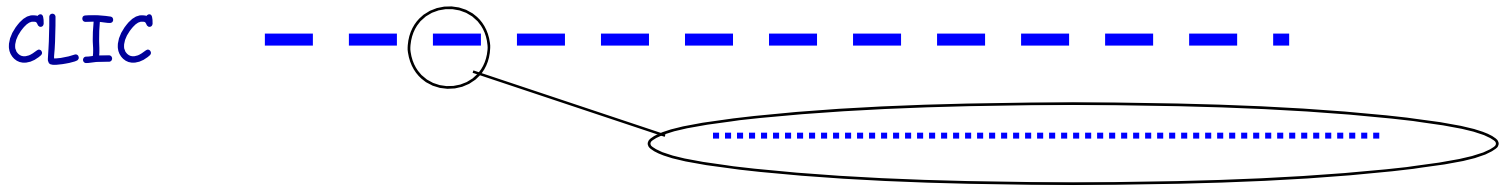
		CLIC	CLIC	CLIC	ILC	NLC
E_{cms}	$[TeV]$	0.5	1.0	3.0	0.5	0.5
f_{rep}	[Hz]	100	50	50	5	120
N	$[10^9]$	3.7	3.7	3.7	20	7.5
ϵ_y	$[nm]$	20	20	20	40	40
L_{total}	$10^{34}cm^{-2}s^{-1}$	2.2	2.2	5.9	2.0	2.0
$L_{0.01}$	$10^{34}cm^{-2}s^{-1}$	1.4	1.1	2.0	1.45	1.28
n_γ		1.2	1.5	2.2	1.30	1.26
$\Delta E/E$		0.08	0.15	0.29	0.024	0.046
N_{coh}	10^5	0.03	37.0	3.8×10^3	—	—
E_{coh}	$10^3 TeV$	0.5	1080	2.6×10^5	—	—
n_{incoh}	10^6	0.05	0.12	0.3	0.1	n.a.
E_{incoh}	$[10^6 GeV]$	0.28	2.0	22.4	0.2	n.a.
$n_\perp$		12.5	17.1	45	28	12
n_{had}		0.14	0.56	2.7	0.12	0.1

- Target is to have about one beamstrahlung photon per beam particle
  - similar effect to initial state radiation

  $\Rightarrow$ average energy loss is larger in CLIC than ILC
- Note: shorter bunches increase the photon energy but not the number

Time structure of the beam

Train repetition rate 50 (100) Hz



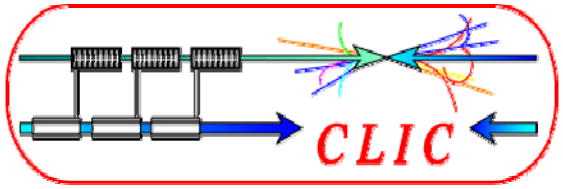
1 train = 312 bunches 0.5 nsec apart

ILC

⇒ 5 Hz 1 train ~2820 bunches ~337 ns apart

Experimenting at CLIC similar to the "NLC"

Time stamping!



Major revision of CLIC parameters made 2007

(final parameter optimization still ongoing)

Basic changes

30 GHz -> 12 GHz RF frequency

close to old NLC frequency (11.424 GHz)

easier to adapt NLC work and experience

lower frequency allows more relaxed alignment tolerances

150 MV/m -> 100 MV/m

reduces breakdown rate and surface damages in RF accelerating structures

50 km long LINAC allows 2 x 1.5 TeV = 3 TeV CM energy (was 5 TeV)

0.5 ns bunch spacing, 312 bunches (= 156 ns bunch trains), 50 Hz (3 TeV)

optimized for maximum luminosity

was subject of various changes in the past: 0.667 ns -> 0.267 ns -> 0.667 ns -> 0.5 ns

Aim for feasibility and conceptual design report in 2010