CTF3 in CLIC perspective

- Welcome
- CLIC study: Evolution from last year
- CLIC/CTF3 collaboration as Physics Detector Experiment
  - CTF3 considered as Physics Experiment (Grey Book)
- Extension of the Collaboration:
  - CLIC Workshop (Oct 07)
  - CLIC– ILC collaboration
- CLIC Advisory CommitteE (ACE)
- Main progress in 2007
  - CLIC parameters (adaptation to 12GHz - 100MV/m)
  - Progress on Structures
- Perspectives: Plans and schedule

CTF3 multi-lateral Collaboration

Organized as a Physics Detector Collaboration

18 members represent. 23 institutes involving 16 funding agencies from 13 countries

http://clic-meeting.web.cern.ch/clic-meeting/CTF3_Coordination_Mtg/Table_MoU.htm

Chairperson: M.Calvetti/INFN; Spokesperson: G.Geschonke/CERN

MoU with addenda describing specific contribution

Countries	Funding Agencies	Laboratory	Representatives & Advisorsy	MoU _ Addenda
CERN	CERN	CERN	J-P. Delahaye, G. Geschonke	Link to pdf
FINLAND		Helsinki Inst of Phys (HIP)	D.O. Riska, K. Österberg	Link to pdf
FRANCE	CEA/DSM-Saclay	DAPNIA	G. Fioni, J. Zinn-Justin	Link to pdf
	CNRS/IN2P3	LAL, LURE	G. Wormser	Link to pdf
		LAPP	Y. Kariotakis	
INDIA*	Indian DAE	RRCAT, Indore	V. Sahni, P. Shrivastava	Link to pdf Add. T1 pdf Add. M2 pdf
ITALY	INFN	LNF	M. Calvetti, A. Ghigo	Link to pdf
PAKISTAN		National Centre for Physics (NCP)	H. Hoorani, S. Ahmad	Link to pdf
RUSSIA		Budker Inst (BINP)	A. Skrinski	Link to pdf - Draft Amendt pdf
		IAP	A.G. Litvak	Link to pdf
	Dubna	JINR	V. Samoilov	Link to pdf
SPAIN	Ministry of Education & Science (MEC)	CIEMAT, UPC, IFIC	J. Fuster, L. Garcia-Tabares	Link to pdf
SWEDEN	Swedish Research Council	Uppsala Univ and Svedberg Lab (TSL)	T. Ekelof, V. Ziemann	Link to pdf
	Wallenberg Foundation			Link to pdf
SWITZERLAND		Paul Scherrer Inst (PSI)	L. Rivkin, T. Garvey	Link to pdf
TURKEY		Ankara Univ & Gazi Univ	A.K. Ciftçi	Link to pdf
UNITED-KINGDOM	STFC	J. Adams Institute for Accelerator Science	G. Blair, K. Peach	Link to pdf
USA	DOE	Northwestern Univ Illinois (NWU)	M. Velasco	Link to pdf
		SLAC	R. Ruth, S. Tantawi	Link to pdf

CTF3 collaboration observers

Discussion with possible future collaboration partners:

Countries	Funding Agencies	Laboratory	Representatives & Advisors	MoU _Addenda
IRAN		Inst for Theoretical Phys and Math (IPM)	H. Arfaei	
UNITED-KINGDOM	STFC	RAL	G. Hirst, H. Hutchinson	
		Cockcroft Institute	S. Chattopadhyay, J. Dainton	
UNITED-STATES	DOE	Jefferson Laboratory (JLAB)	A. Hutton	

Present collaboration with RAL on Laser development for PHIN in EU FP6 CARE

CLIC World wide collaboration

Ankara University (Turkey)
Berlin Tech. Univ. (Germany)
BINP (Russia)
CERN
CIEMAT (Spain)
DAPNIA/Saclay (France)
Department of Atomic Energy (India)
Finnish Industry (Finland)
Helsinki Institute of Physics (Finland)
IAP (Russia)
Instituto de Fisica Corpuscular (Spain)
INFN / LNF (Italy)
JASRI (Japan)
JINR (Russia)
KEK (Japan)
LAL/Orsay (France)
LAPP/ESIA (France)
LLBL/LBL (USA)
North-West. Univ. Illinois (USA)
Polytech. University of Catalonia (Spain)
RAL (England)
SLAC (USA)
Svedberg Laboratory (Sweden)
Uppsala University (Sweden)


CLIC
ELAN
CERN
CERN, 16-18 October 2007
CLIC'07 provides a forum to review all aspects related to the Accelerator, Detector and Particle Physics of a Multi-TeV Linear Collider based on the CLIC technology.
It is open to any interested Accelerator and Physics expert already part or not of the CLIC/CTF3 collaboration.
The workshop will address in particular:
• Present status and future plans of the CLIC study
• CLIC physics case and detector issues
• The Test Facility CTF3 used to address major CLIC technology issues
• The ongoing CLIC R&D, future plans (including FP7 proposals) and open issues
• The CLIC related collaborative efforts
Program Advisory Committee
• M. Besançon
• G. Blair
• M. Calvetti
• S. Chattopadhyay
• T. Ekelof
• A. Faus-Golfe
• L. Garcia
• T. Higo
• H. Hoorani
• Y. Karyotakis
• E. Levitchev
• K. Osterberg
• M. Poelker
• L. Rivkin
• V.C. Sahni
• G.D. Shirkov
• S. Tantawi
• M. Velasco
• G. Wormser
Local Organising Committee
• H.H. Braun (Chair)
• R. Corsini
• J-P. Delahaye
• J. Ellis
• S. Escaffre
• G. Geschonke
• A. de Roeck
• W.D. Schlatter
• D. Schulte
• W. Wuensch
CLIC Workshop 07
The CLIC workshop will be held at CERN in the Main Auditorium, Main building, 1st Floor

CLIC

Welcome

Participants: 200 (registered) from 49 Inst. of 19 countries

- China: Tsinghua University
- Finland: Helsinski Univ.- HIP
- France: CNRS/IN2P3/LAL-LAPP LPNHE-LPSC, THALES, CEA DAPNIA
- Germany: DESY-ANKA/FZK
- Greece: Athens NTU-IASA-PATRAS
- India: BARC-RRCAT
- Iran: IPM
- Italy: INFN/LNF-Napoly Fed.II
- Japan: KEK
- Norway: NTNU
- Pakistan: NCP
- Russia: IAP—BINP-JINR
- Spain: CIEMAT-IFIC-UPC
- Sweden: Uppsala Univ.
- Switzerland: CERN-ETHZ-IPP-PSI
- Turkey: Ankara U-Dumlupinar U TOBB Univ Eco&Tech
- UK: COCKROFT-J.ADAMS-Lancaster Univ-Oxford-RHUL
- Ukraine: IAP-NAS
- USA: LBNL-Northwestern U.-TJNAF-OHMEGA-Oklahoma Univ-SLAC

CLIC07 workshop

(Chairman: H.Braun)

- CLIC'07 provides a forum to review all aspects related to the Accelerator, Detector and Particle Physics of a Multi-TeV Linear Collider based on the CLIC technology.

- The workshop will address in particular:
  - **Present status and future plans of the CLIC study**
  - **CLIC physics case and detector issues**
  - **The Test Facility CTF3 used to address major CLIC technology issues**
  - **The ongoing CLIC R&D, future plans (including FP7 proposals) and open issues**
  - **The CLIC related collaborative efforts**

  - ***Agenda and slides (plenary and working groups)***

http://indico.cern.ch/conferenceOtherViews.py?view=standard&confId=17870

CLIC07 Conclusion

(M.Calvetti/ CLIC Collab. Board chairman)

CLIC technology the ONLY possible scheme to extend linear collider beam energy into Multi-TeV energy range

- **Very promising results BUT CLIC technology not mature yet**
- **novel Ideas and Challenging R&D in world-wide collaboration**

Nevertheless CLIC Conceptual Design with cost estimate by 2010

Your participation to the CLIC study during and after the workshop warmly welcome and appreciated

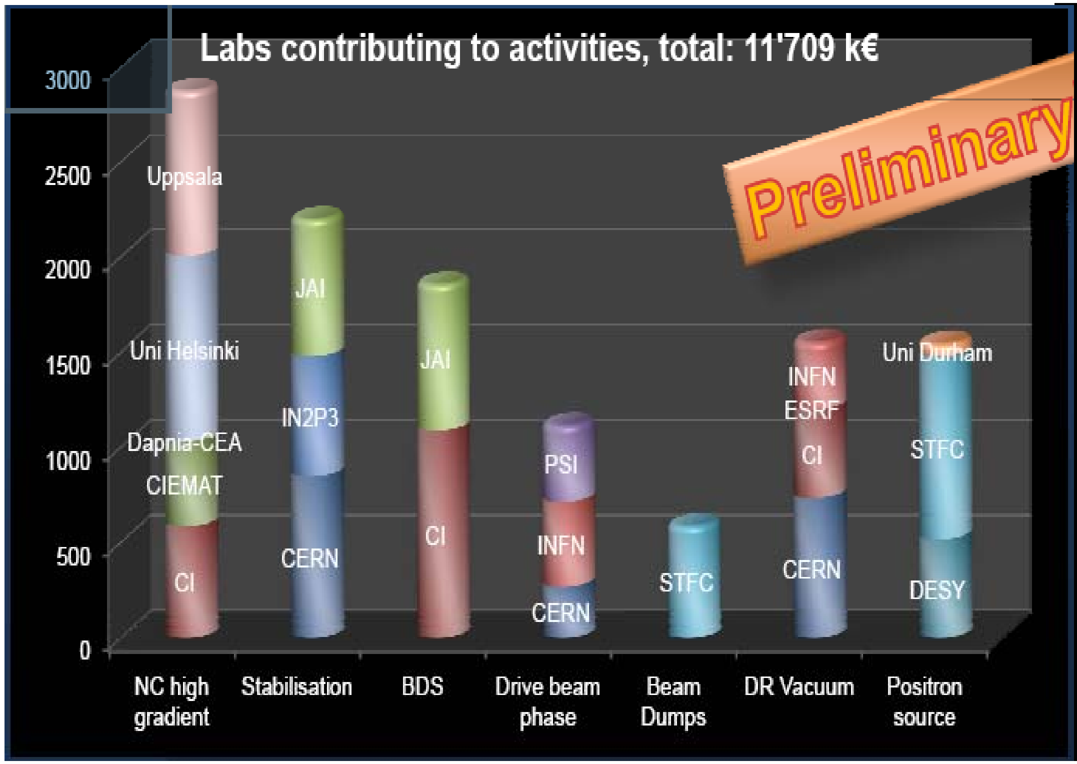
CTF3 technical meeting on 21-23/01/08

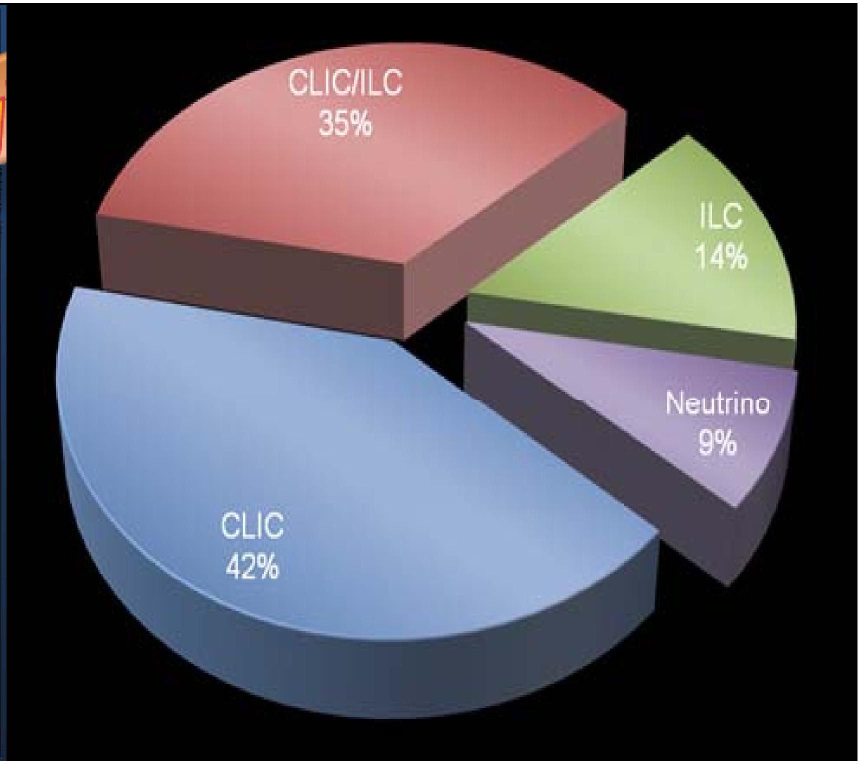
CLIC08 Workshop on 14-17/10/08

EU FP6 & FP7

- FP6: 2004 -2008
  - Coordinated Accelerator R&D in Europe (CARE): JRA = PHIN
  - EUROTEV Design Study: Design of CLIC & ILC common issues

- FP7: 2009-2013
  - Integrated Activity: CARE2
    - JRA:"NC Linear Collider" about CLIC & ILC common issues





CLIC /ILC Collaboration

- Constructive exchange of view with B.Barish during his visit at CERN in Nov 07

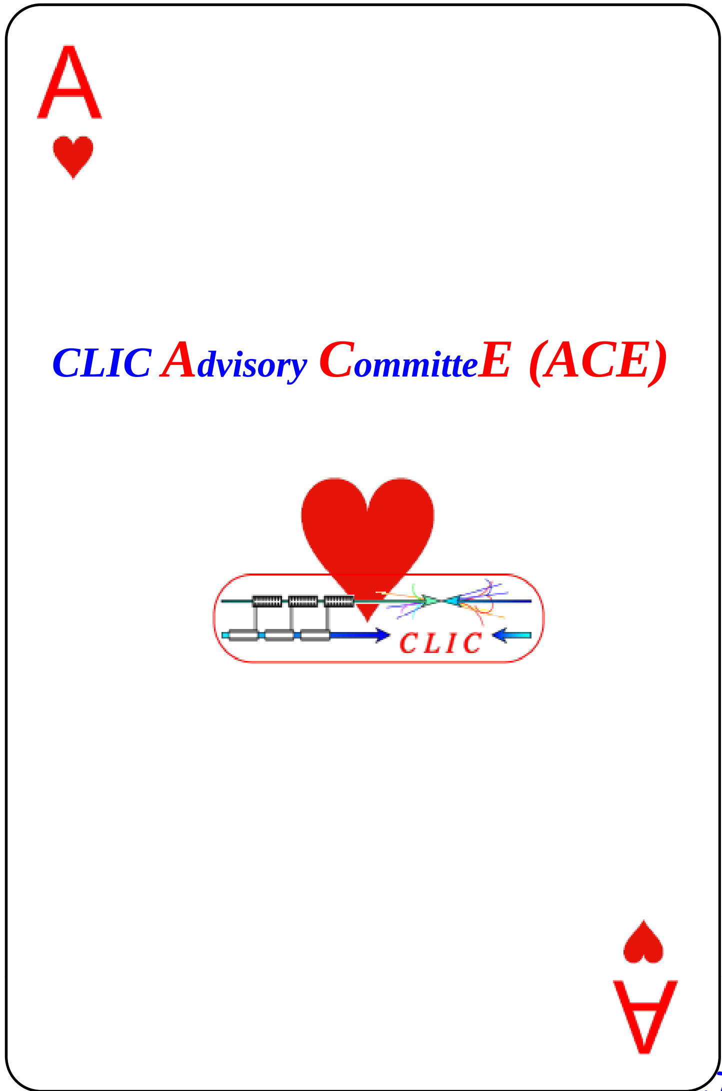
  http://www.linearcollider.org/cms/?pid=1000465

- Collaboration meeting with ILC Project managers and specific experts on 08/02/08 at CERN for collaboration on subjects with strong synergy between CLIC and ILC:

  1) Civil Engineering and Conventional Facilities
  2) Beam Delivery Systems & Machine Detector Interf.
  3) Detectors
  4) Cost & Schedule
  5) Beam dynamics & Beam Simulations

CLIC Advisory Committee

http://clic-meeting.web.cern.ch/clic-meeting/2007/CLIC_ACE/index.htm



- **Members:**
  - L.Evans/CERN
  - M.Huening/DESY
  - A.Mosnier/CEA
  - P.Raimondi/ INFN
  - T.Raubenheimer/SLAC (Chair)
  - V.Shiltsev/FNAL
  - T.Shintake/Riken
  - N.Toge/KEK
- **Kick off & first meeting on 20-24/06/07:**
  - Overview of CLIC study & CTF3
  - Finding& recommendations reported to:
    - CLIC/CTF3 collaboration board (24/06/07)
    - SPC (Sept 07)
- **Second meeting on 16-18/01/08**
  - Focused on RF Structures
  - Finding& recommendations to be reported to CLIC/CTF3 collab board (24/01/08)

- **Mandate** *(Link)*

A CLIC Study Advisory Committee is being set up with the following mandate:

- Assess the scope of the CLIC study and the technical choices for optimum performance and cost.
- Assess the work programme aiming at a demonstration of the main CLIC feasibility issues and the preparation of a Conceptual Design Report by 2010.
- Identify technical difficulties or risks of the study.
- Check the compatibility of the available resources with the work programme.
- Monitor the progress.

Organisation

The SAC acts as an advisory committee reporting to the CERN DG and the CTF3 Collaboration Board.

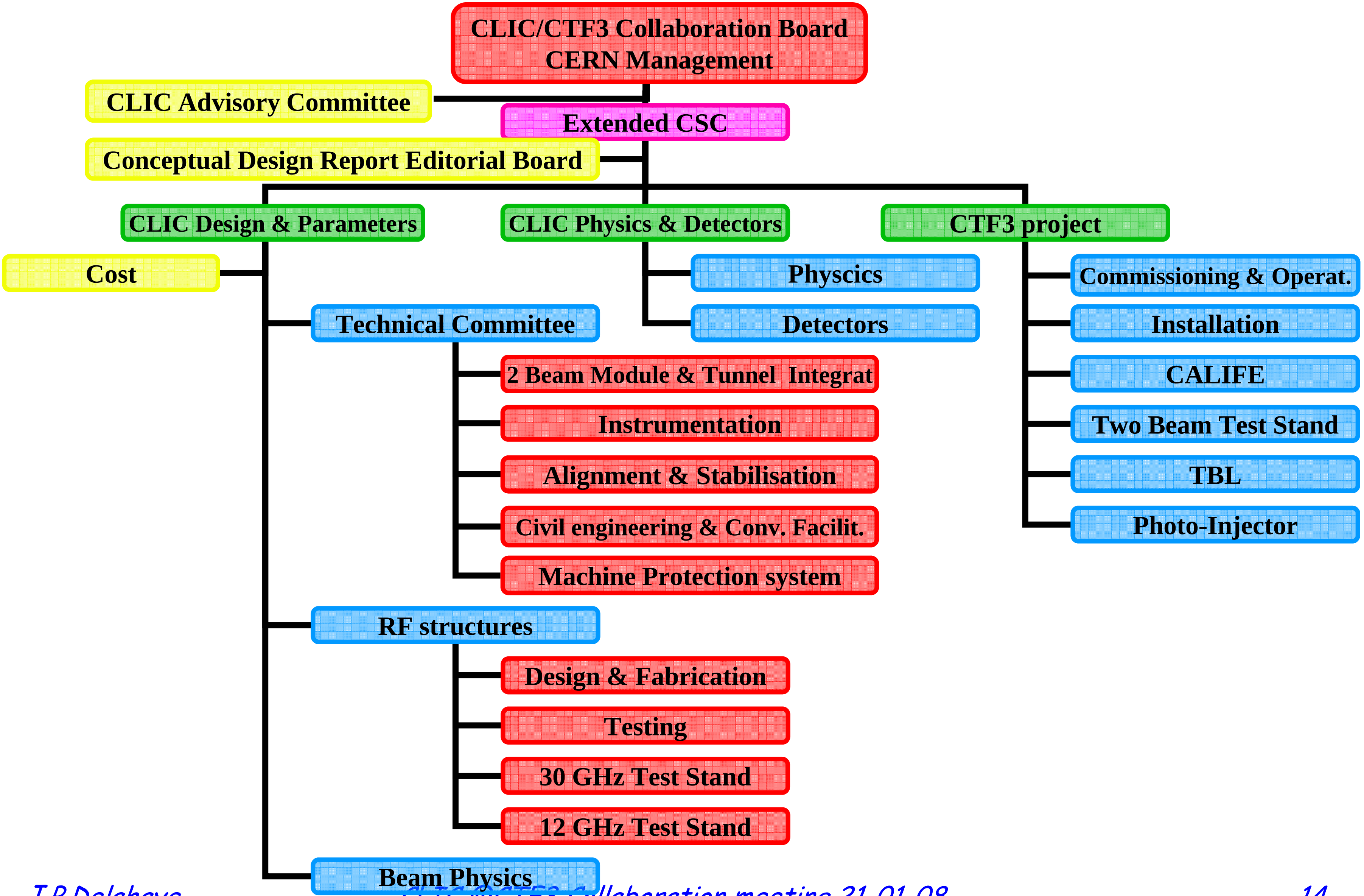
It meets at least once a year and provides a written report including recommendations at the latest two weeks after the meeting.

Members are nominated for three years.

Final Comments (18/01/08)

- Very impressed with CLIC effort
  - Large amount of progress over the last decade and last 6 months
  - Has the potential to offer a real path to multi-TeV e+/e- LC
  - Enthusiasm of the group is very refreshing!
  - Great to see younger people engaged!
- CTF3 will address many of the critical issues
  - Need to understand limitations of CTF3 and what has to happen next in the testing / construction program
- Like to have the next meeting focused on beam dynamics and subsystem designs
  - Dates TBD but probably early summer
- Everybody gave excellent presentations
  - Thanks to all participants

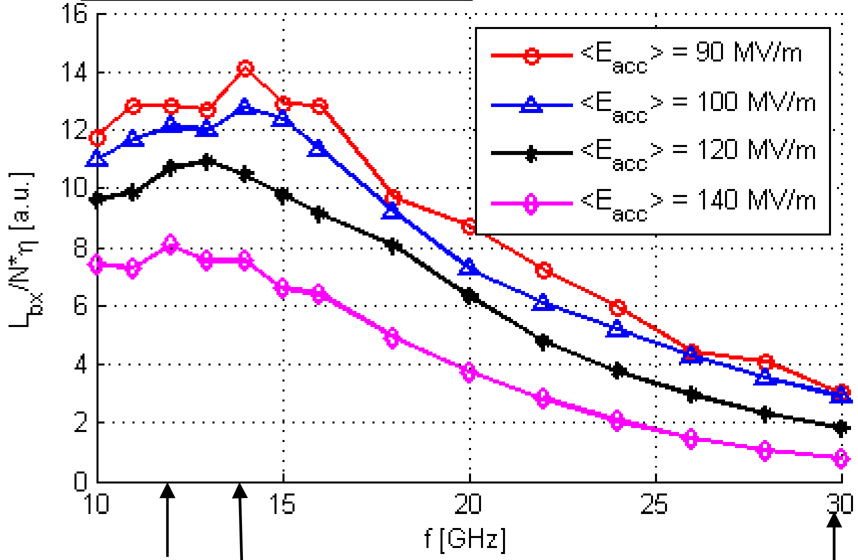
CLIC Organisational Chart



CLIC performances (FoM) and cost optimisation as function of RF frequency

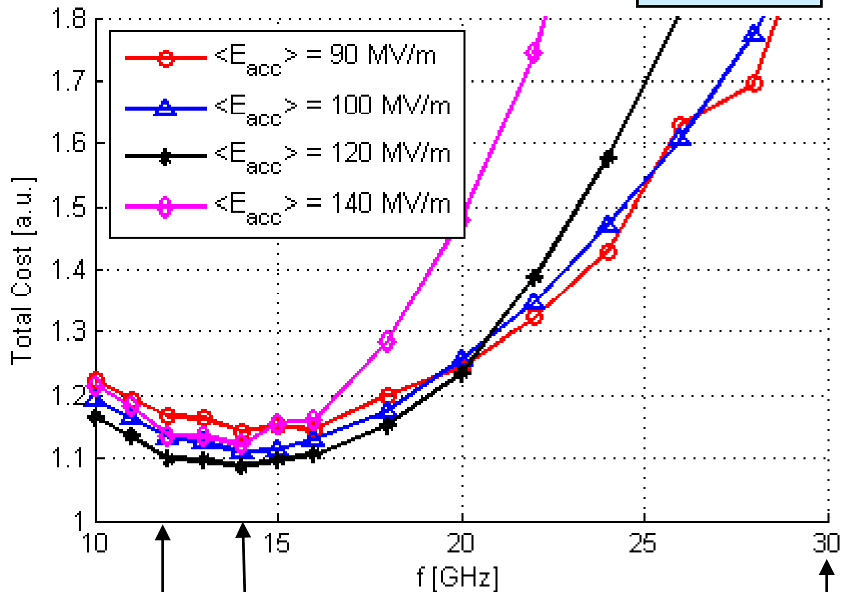
E_{cms} = 3 TeV $L_{(1\%)} = 2.0\ 10^{34}\ cm^{-2}s^{-1}$

Performance



New   Optimum   Previous

Cost



New   Optimum   Previous

- **Maximum Performance around 14 GHz**
- **Flat cost variation in 10 to 16 GHz frequency range with a minimum around 14 GHz**

SLAC MEMORANDUM

Date: March 29, 2007

To: Jean-Pierre Delahaye (jean-pierre.delahaye@cern.ch)

CC: Sami Tantawi, Ronald Ruth, Chris Pearson, Chris Adolphsen

From: Persis S. Drell

Re: CERN and CLIC Collaboration

With the recent change of the CLIC linac frequency to 12 GHz, we anticipate a growing collaboration between our two laboratories on high gradient research. Not only do we welcome this, but believe the resulting synergy is necessary for the future developments of accelerators and related technologies.

Our work on high gradient research is done under the auspices of the US High-Gradient Research Collaboration for future colliders. This effort at SLAC is managed by Sami Tantawi, who is also the spokesman for the national collaboration. Under this umbrella we are increasing our capabilities to serve users and collaborators. Collaborators can utilize the SLAC facilities in three ways:

1. Take advantage of the world-class design capabilities and manufacturing facilities to have accelerator structures, rf components, and rf sources (klystrons) designed and built. In particular, our extensive expertise for X-band systems will help ensure a successful design and implementation.

2. SLAC can provide reusable input power couplers and compatible flanges so you need only worry about the design of the accelerator structure "proper."

3. Finally, SLAC can offer high-power rf testing at 11.424 GHz.

For collaborative efforts, including pulsed heating research, manufacturing of accelerator structures, rf components, klystrons, modifying existing 11.424 GHz components to work at 12 GHz, and acquiring reusable couplers, please contact Sami directly. He will organize the work with others including Chris Pearson, the head of the klystron department, which is the prime manufacturing facility for these components.

For the time being, the NLCTA infrastructure is the best place for testing CERN-manufactured accelerator structures at 11.424 GHz. For this, as usual, please contact Chris Adolphsen directly, who will make the appropriate arrangements. On the timescale of summer 2007 we will have dedicated test stands in the Klystron Test Lab capable of 11.424 GHz testing. We anticipate these new test stands will offer faster turn around and

Collaboration with SLAC

- Structure fabrication
- Structure (Accel & PETS) tests on Test Facilities (NLCTA)
- Providing design of RF components
- Developing and fabricating X band components: (Klystrons)

SLAC collaboration on Klystrons

STANFORD UNIVERSITY

STANFORD LINEAR ACCELERATOR CENTER
PERSIS S. DRELL
ACTING DIRECTOR

November 7, 2007

Dr. Jean-Pierre Delahaye
CERN, AB Department
CH-1211 Geneva 23
SWITZERLAND

Dear Dr. Delahaye:

Thank you for your recent letter of October 19, 2007 concerning CERN's need for a high power klystron at 12 GHz. Because the development of such a klystron complements SLAC's current research on high gradient accelerators and rf power sources, we are enthusiastic about the possibility of collaborating with CERN on such a project and are prepared to make available to CERN the SLAC resources necessary to make this effort a success.

The 12 GHz klystron would be a natural project under the proposed SLAC-CERN Memorandum of Understanding (MOU) on High Gradient Research for Future Linear Colliders. With U.S. DOE approval, SLAC could establish with CERN an implementing agreement under the MOU that would allow for the contemplated CERN financial sponsorship of this klystron project.

Our klystron department, in conjunction with our financial analysts, has established an estimated production cost for this klystron of $540k. The cost estimate is based on the following assumptions:

- SLAC can make a production run of at least 3 klystrons.
  (Thus, other labs must commit to taking tubes CERN does not require.)
- Potential technical issues regarding the specification are resolved.
  (Reference email from Pearson to McMonagle, 7/24/07. I am informed that there appear to be no significant problems.)
- The MOU and a formal implementing agreement are concluded soon so work can start within a reasonable time frame.

Decision by Finance Committee (Dec 07) to order SLAC :

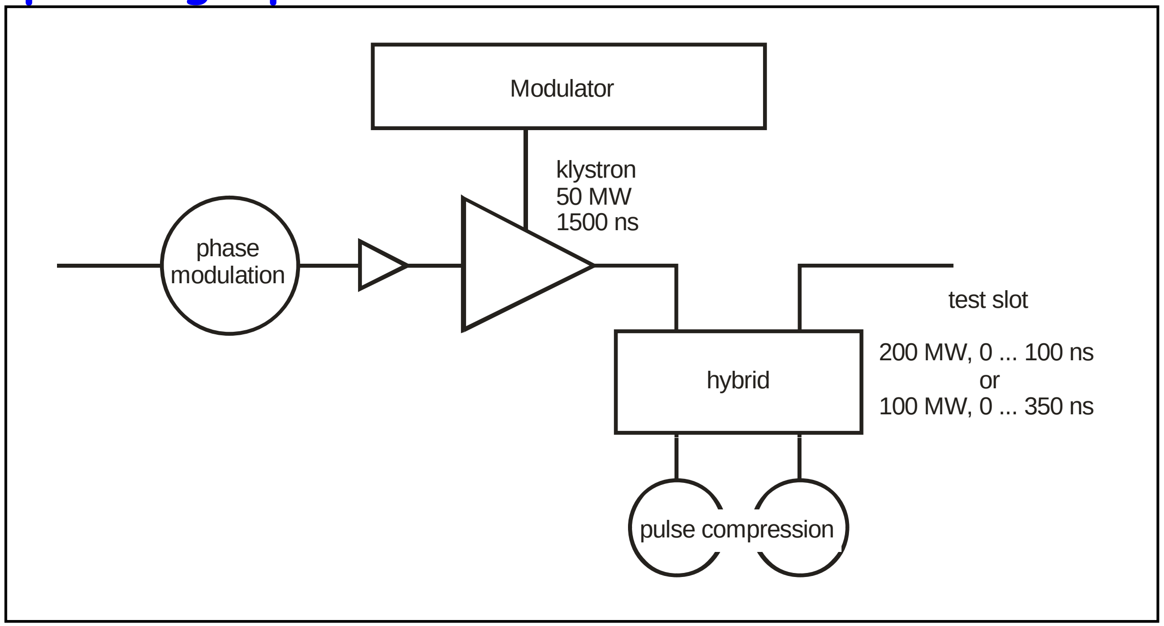
- Devel of 12 GHz Klystron (50 MW, 1.5 µs, 50 Hz)
- Fab. 1 Klystron for CERN
- Offer based on 3 Klystrons (PSI, Trieste, LNF)
- Availability Spring 09

A 12 GHz stand alone power source @ CER

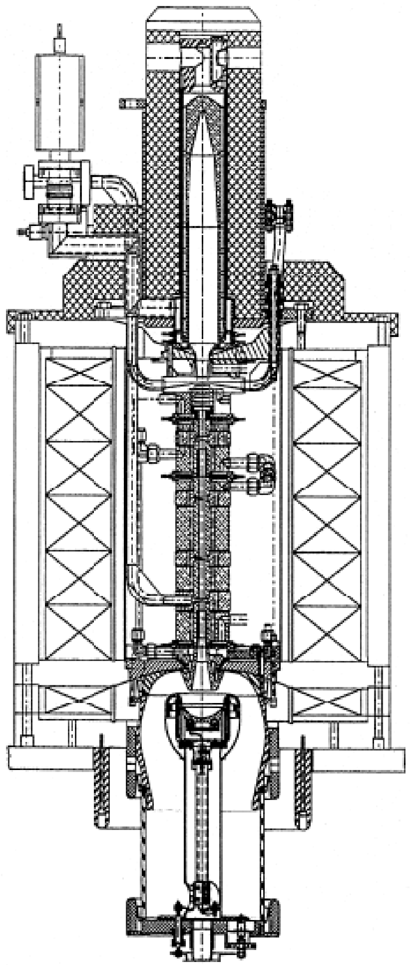
12 GHz power source: common interest with PSI, INFN-Frascati & Trieste

In parallel with power tests in CLEX

Operating April 09



- Independent 24/7 testing with fast turn around
- Variable pulse length
- High repetition rate
- Easier to operate



Derived from NLC 11.4 GHz klystron

US High Gradient Research

US collaborative effort of interested US institutes

Initiated by "DOE interested in collaborating with CERN on long range accelerator and technology R&D of importance to the CLIC approach"

Laboratories (ANL, LBNL, NRL,SLAC), Universities (MIT, Maryland), Business associates,

Spokesperson: S.Tantawi/SLAC

Governance with CERN participation (E.Jensen)

Workshop at SLAC on 21-23/01/08:

The US contribution towards a multi-TeV e+/e- machine:

A scientific approach to developping High Gradient Acceleration

- Study and selection of proposals by interested laboratories
- Proposal for funding by DOE (possibly SBIR)

Work plan for the US collaboration on High Gradient research for a Multi-TeV Linear Collider

- Making the best use of existing SLAC RF power equipment for Accelerating Structure tests
- Building up on wide expertise and long-term R&D on warm structures at SLAC and KEK

Collaboration with KEK

CLIC

DRAFT Version 7
ICA-JP-???

Agreement on Collaborative Work

between

The European Organization for Nuclear Research
CERN CH-1211 Genève 23
Switzerland
(in the following called "CERN")

and

High Energy Accelerator Research Organization
1-1 Oho, Tsukuba-shi, Ibaraki-ken 305-0801
Japan
(in the following called "KEK")

2007

Appendix 2 to Agreement on Collaborative Work (V3)

Collaboration on
Fabrication and Tests of High-Gradient X-Band Accelerating Structures

1. Personnel of the Collaboration:

KEK: Yukihide Kamiya, Director of Accelerator Laboratory of KEK
Toshiyasu Higo, Accelerator Laboratory of KEK
Shigeki Fukuda, Accelerator Laboratory of KEK
CERN: Jean-Pierre Delahaye, Accelerators and Beams Department
Walter Wuensch, Accelerators and Beams Department

2. Time schedule:

From September, 2007 until December, 2010.

3. Scope of the Collaboration:

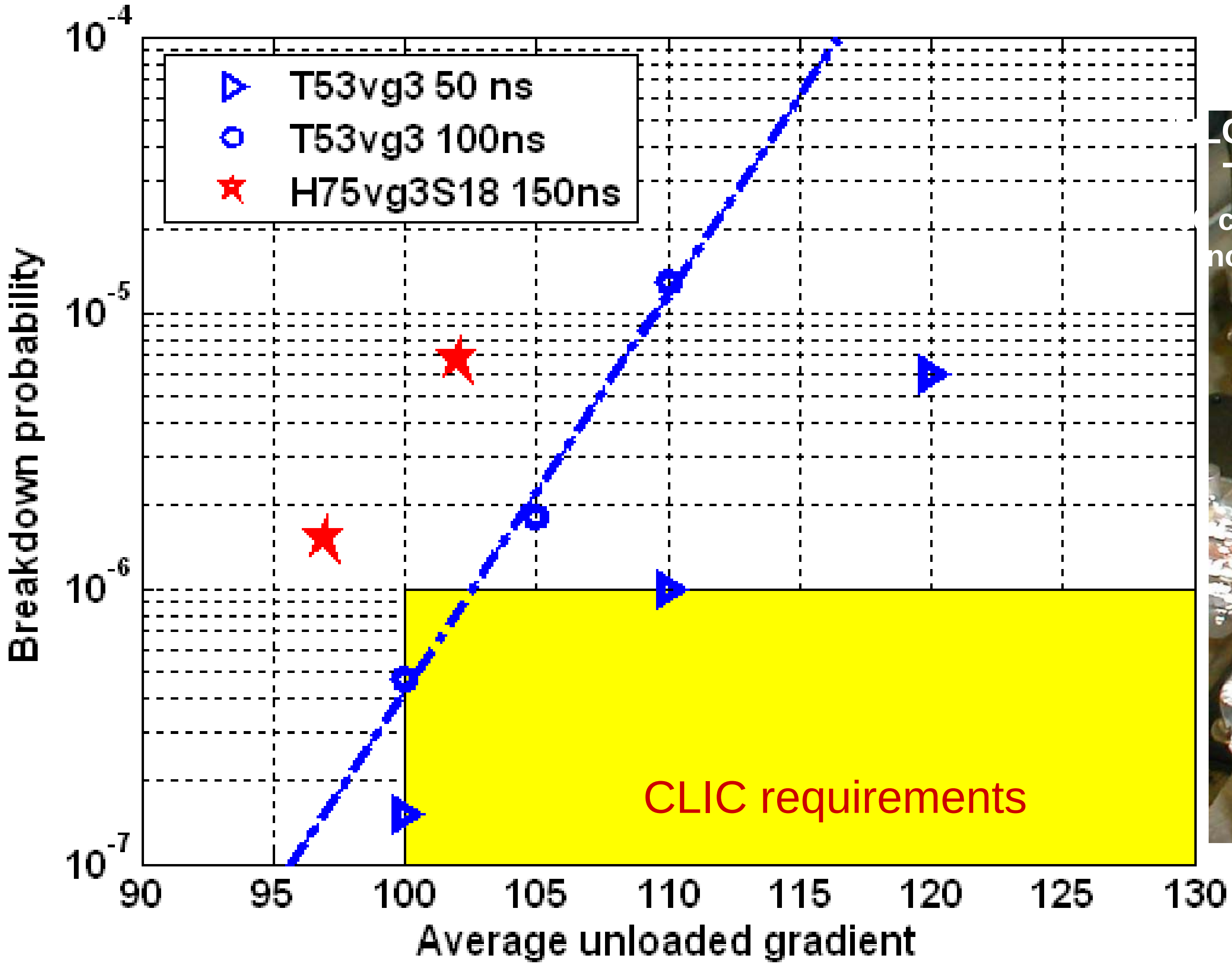
3.1 Test of high-field structures:
KEK utilizes the Nextef (X-band test facility) at KEK for this collaboration. CERN staff will visit KEK to help prepare the system to suit the Compact Linear Collider (CLIC) study. KEK expects to conduct a test of at least one CLIC structure in 2007. KEK will pursue the tests in a concerted manner with SLAC and CERN.

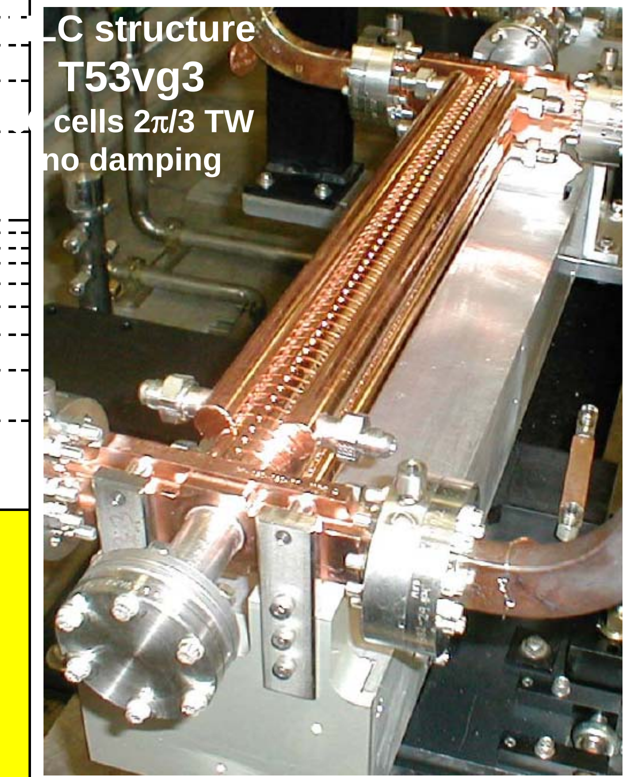
3.2 Fabrication of high-field test structures:
Test structures will be made by CERN, SLAC and KEK. The actual division of work will be decided by discussion among these three laboratories. KEK will focus in 2007 on the fabrication of "CLIC_vg1" structures composed of disks.

3.3 Fabrication of CLIC structures:
KEK starts studying the fabrication of a quadrant of a CLIC structure in 2007. If this is successful, KEK will make a high-power-ready CLIC structure in 2008.

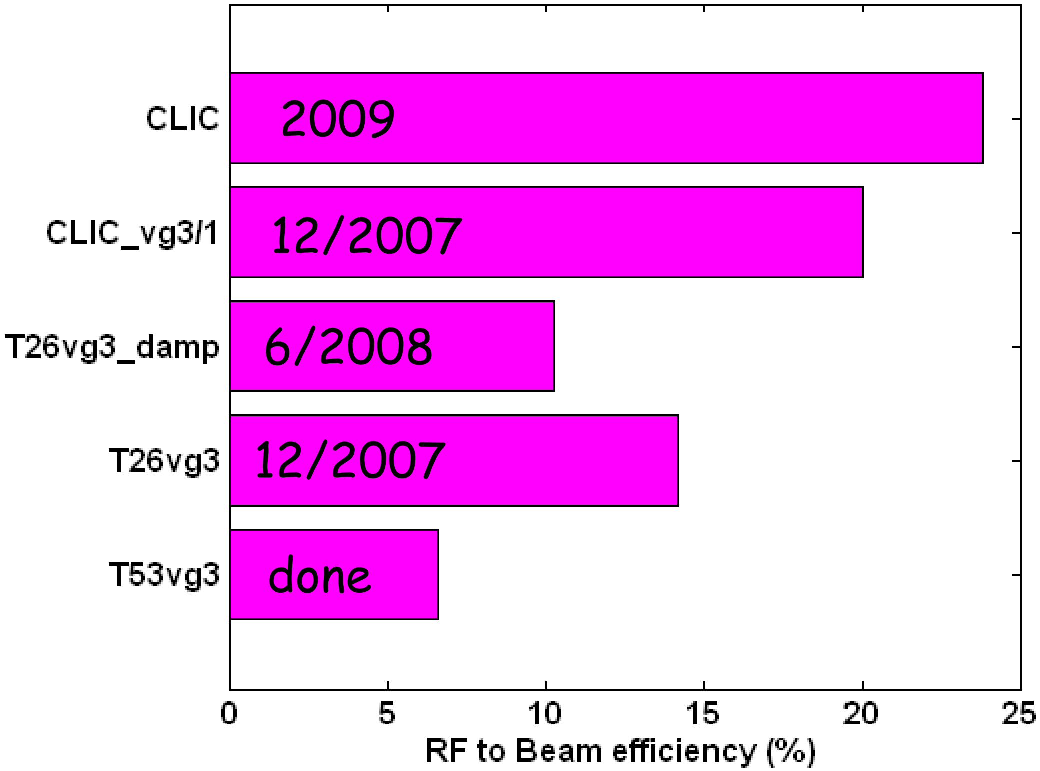
3.4 Future studies:
Further possible structure fabrications and tests will be defined by common agreement between CERN and KEK based on the outcomes of the initial tests.

Recent High-Power test results @ SLAC (11.4 GHz)





RF to Beam Efficiency milestones



P = 65 MW; 297 ns ⇔ nb = 311

P = 70 MW; 295 ns ⇔ nb = 359

P = 111 MW; 102 ns ⇔ nb = 66

P = 102 MW; 113 ns ⇔ nb = 93

P = 134 MW; 104 ns ⇔ nb = 27

100 MV/m loaded, 10^{-6} break down rate, qb=4*10^{9},
6 rf period bunch spacing, P*pl/C = 18 Wue

2008 RF Structure Test Program

CLIC

CERN

KEK

SLAC

		2007		2008										
		Nov	Dez	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov
Facility	Structure													
CTF3 30 GHz	NDS4_vg2.5_thick													
	C30_vg4.7_quad													
	C30_vg2.6													
	C30_vg8.2													
	C30_vg2_TM02													
	HDS11_vg2													
	C30_vg4.7_sb													
CLEX 12 GHz	Pets 12 GHz													
	T18_vg2.4_disk													
NEXTEF 11.4 GHz	KX03													
	Old CLIC vg1.1													
	T18_vg2.4_disk[2]													
	T18_vg2.4_disk[3]													
	TD18_vg2.4_quad[2]													
	TD18_vg2.4_disk[2]													
SLAC Station 1	TD18_vg2.4_quad[1]													
11.4 GHz	C10vg0.7[1]													
	C10vg1.3[1]													
	C10vg3.3[1]													
	C10vg2.2_thick[1]													
	HXD11 Cu big grains													
SLAC Station 2	T28_vg2.9													
	C10vg0.7[2]													
	C10vg1.3[2]													
	C10vg3.3[2]													
	C10vg2.2_thick[2]													
	T53vg3MC													
SLAC Station 3	T18_vg2.4_disk[1]													
	T18_vg2.4_disk[4]													
	PETS 11.4 GHz													
	TD18_vg2.4_disk[1]													

12 GHz Structure Tests Flow Chart

CLIC

2007

TD18_vg2.4_quad
T28_vg2.9
T18_vg2.4_disk

2008

CLICvg1
geometry OK

CLICvg1
geometry not OK

Disks OK

Quads OK
+Damp

TD18_vg2.4_disk
(T18_vg2.4_quad)

TD28_vg2.9

Damping
Not OK

2009

Input from break down R&D

CLIC prototype quads damped

?

CLIC prototype disks damped

CLIC prototype TD28 like

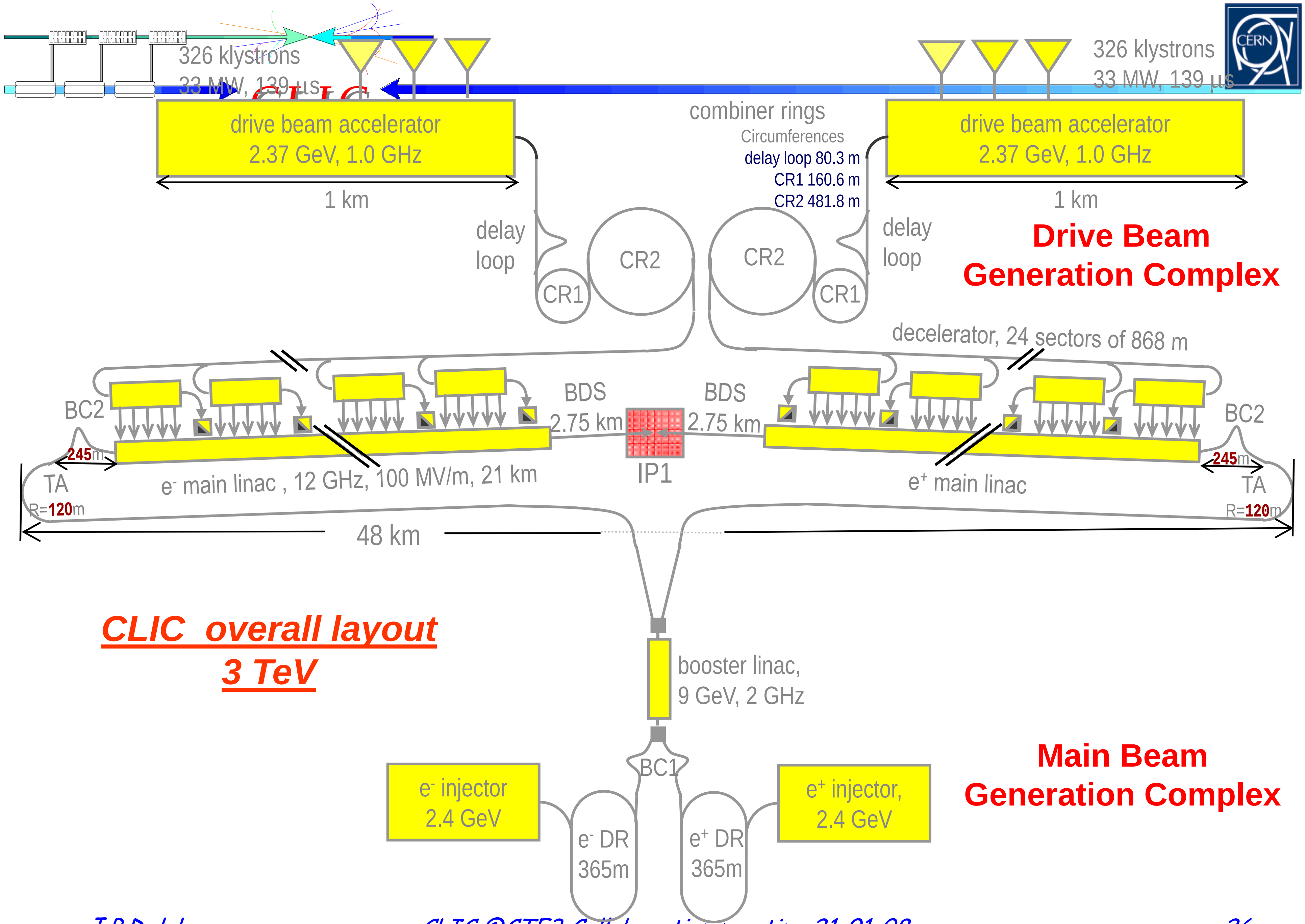
2010

Go towards more extreme structures

Evolution of CLIC parameters @ 3 TeV

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

Parameter	Symbol	2006	2007	Unit
Center of mass energy	E_{cm}	3000	3000	GeV
Luminosity	L	6.5	5.9	10^{34} cm^{-2} s^{-1}
Luminosity (in 1% of energy)	$L_{99\%}$	3.3	2	10^{34} cm^{-2} s^{-1}
Main Linac RF Frequency	f_{RF}	30	12	**GHz**
Loaded Accelerating Gradient	G	150	100	**MV/m**
Two linac length	l_{linac}	28	41.7	km
Linac repetition rate	f_{rep}	150	50	Hz
No. of particles / bunch	N_b	2.56	3.72	10^9
No. of bunches / pulse	k_b	220	312	-
Bunch separation	Δt_b	0.267	0.5	ns
RF pulse duration	τ_t	69.7	241	ns
Beam power / beam	P_b	20.3	14	MW
Transverse horizontal/vertical emittance	?e_x / ?e_y	660/10	660/20	nm rad
Horiz./Vertical IP beam size before pinch	s^*_{x}/ s^*_{y}	60/07	40/1	nm
Beamstrahlung energy loss	d_B	16	29	%
Hadronic events / crossing	N_{hadron}	0.73	3.23	-
Wall-plug power to beam efficiency	$?_{wp-rf}$	9.7	8.8	%
Total site AC power	P_{tot}	418	322	**MW**
Overall site length	l_{tot}	33.2	47.9	**km**



CLIC overall layout 3 TeV

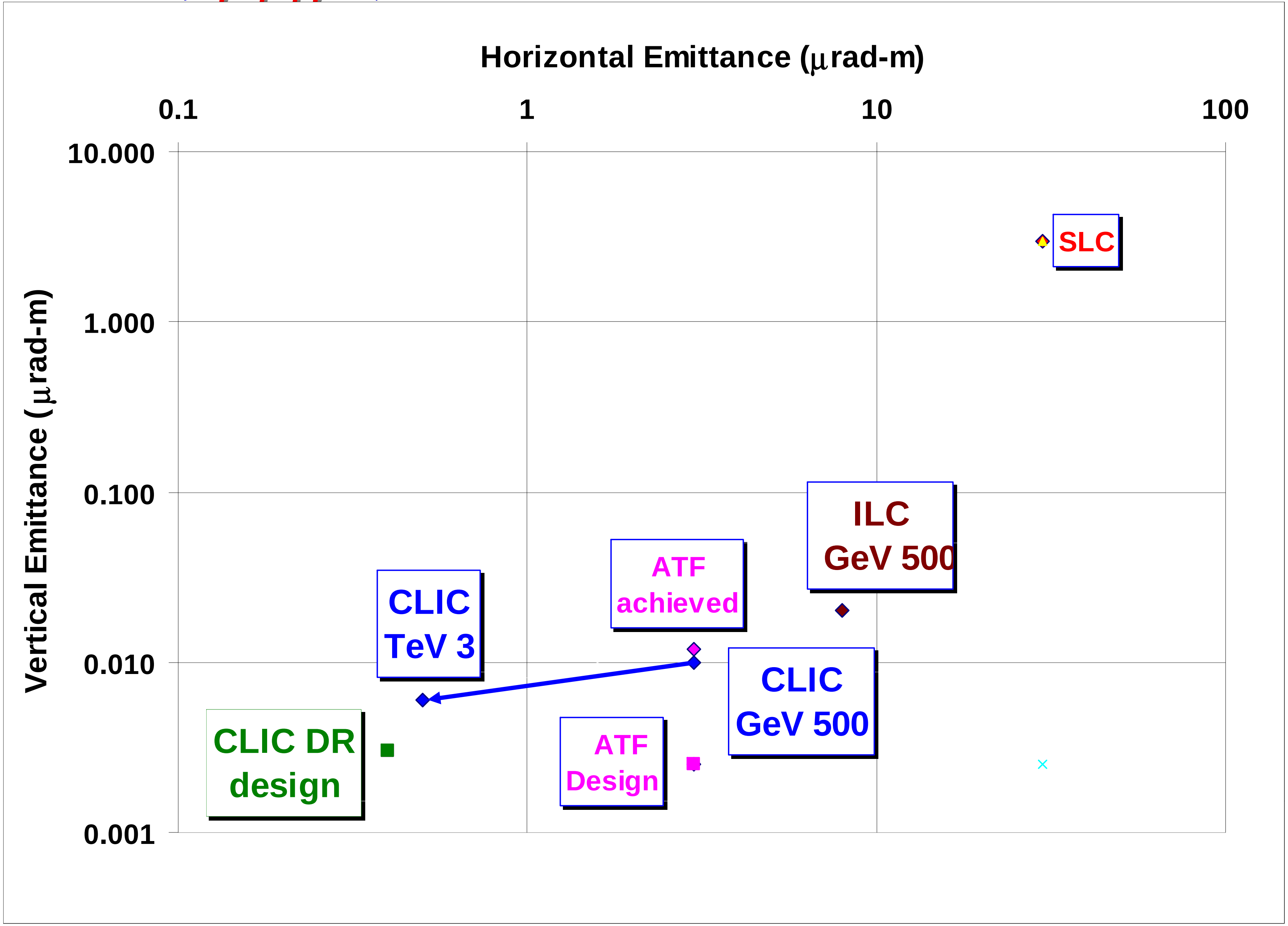
CLIC & LC parameters @ 500 GeV

CLIC

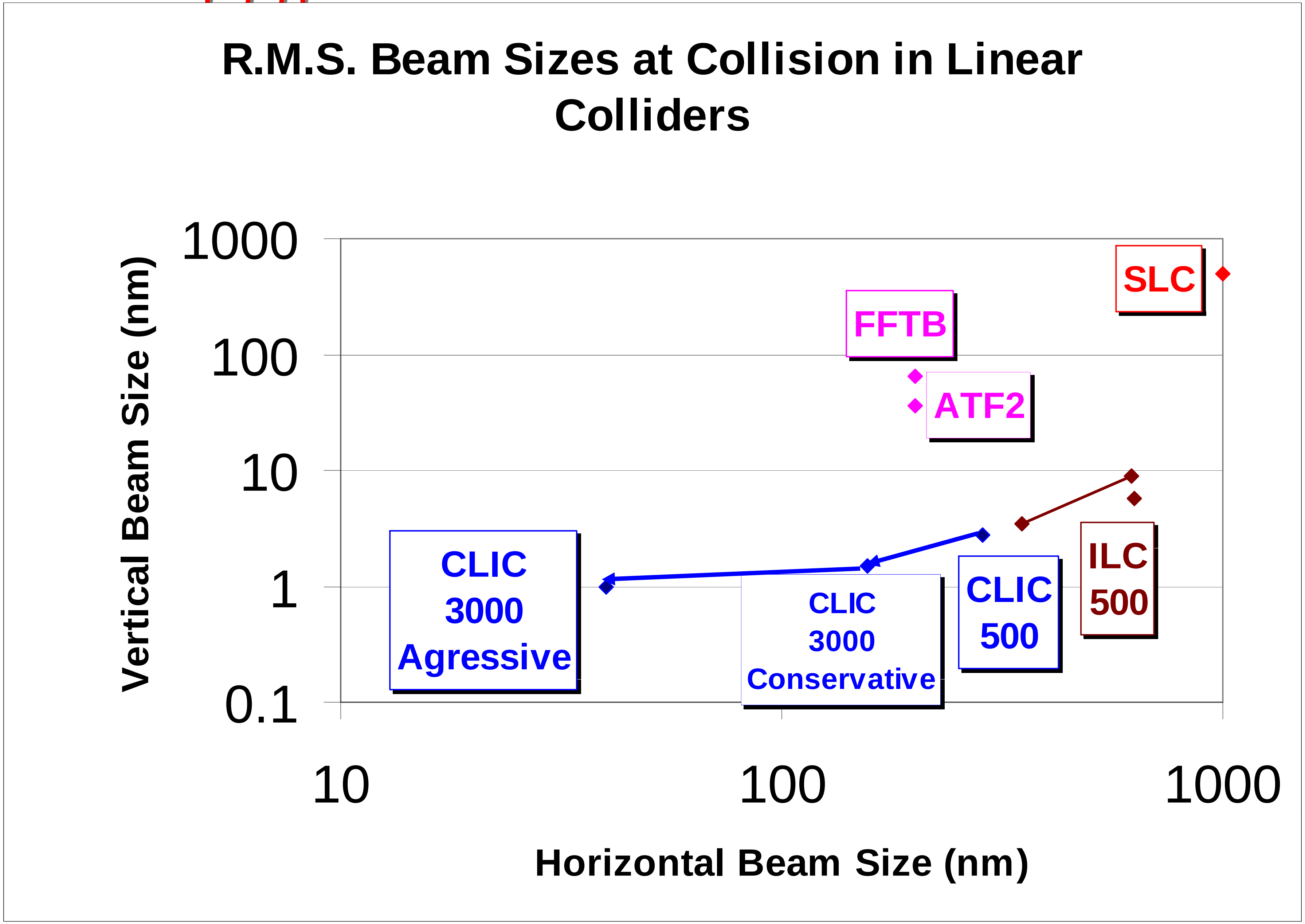
http://clic-meeting.web.cern.ch/clic-meeting/ComparisonTable.html

Parameter	Symbol	CLIC	CLIC	CLIC	ILC	NLC	Unit
Center of mass energy	E_{cm}	3000	1000	**500**	**500**	**500**	GeV
Main Linac RF Frequency	f_{RF}	12	12	**12**	**1.3**	**11.4**	GHz
Luminosity	**L**	**5.9**	**2.25**	**2.24**	**2**	**2**	**10^{34} cm^{-2} s^{-1}**
Luminosity (in 1% of energy)	$L_{99\%}$	2	1.08	**1.36**			10^{34} cm^{-2} s^{-1}
Accelerating gradient (unloaded)	**G_{acc}**	**100**	**100**	**100**	**30**	**50**	**MV/m**
Linac repetition rate	f_{rep}	50	50	**100**	**5**	**120**	Hz
No. of particles / bunch	N_b	3.72	3.72	**3.72**	**20**	**7.5**	10^9
No. of bunches / pulse	k_b	312	312	**312**	**2670**	**192**	
No. of drive beam sectors / linac	N_{unit}	24	8	**4**	-	-	-
Overall two linac length	l_{linac}	41.7	13.9	**6.9**	**22**	**14**	km
Proposed site length	**l_{tot}**	**47.9**	**19.5**	**12**	**31**	**19**	**km**
DB Pulse length (total train)	τ_t	139	46	**23**	-	-	µs
Beam power / beam	P_b	14	4.6	**4.6**	**10.8**	**6.9**	MW
Wall-plug power to beam efficiency	$\eta_{wp\text{-}rf}$	8.7	6.1	**6.1**	**9.4**	**7.1**	%
Total site AC power	**P_{tot}**	**322**	**~150**	**~150**	**230**	**195**	**MW**
Transverse horizontal emittance	$\gamma\varepsilon_x$	**660**	**660**	**660**	**10000**	**3600**	nm rad
Transverse vertical emittance	$\gamma\varepsilon_y$	**20**	**20**	**20**	**40**	**40**	nm rad
Nominal horizontal IP beta function	β^*_x	4	20	**15**	**20**	**8**	mm
Nominal vertical IP beta function	β^*_y	0.09	0.1	**0.1**	**0.4**	**0.11**	mm
Horizontal IP beam size before pinch	σ^*_x	**40**		**142**	**640**	**243**	nm
Vertical IP beam size before pinch	σ^*_y	**1**		**2**	**5.7**	**3**	nm
Beamstrahlung energy loss	δ_B	29	11	**7**	**2.4**	**5.4**	%
No. of photons / electron	n_γ	2.2	1.2	**1.1**	**1.32**	**1.3**	-
No. of pairs (p_T^{min}=20MeV/c, Î$_{,min}$=0.2)	N_{pairs}	45	17.1	**11.5**			-
No. of coherent pairs	N_{coh}	38	0.07	**0.0001**			10^7
No. of incoherent pairs	N_{incoh}	0.44	0.09	**0.05**			10^5
Hadronic events / crossing	N_{hadron}	3.23	0.29	**0.1**			-

Beam emittances at Damping Rings

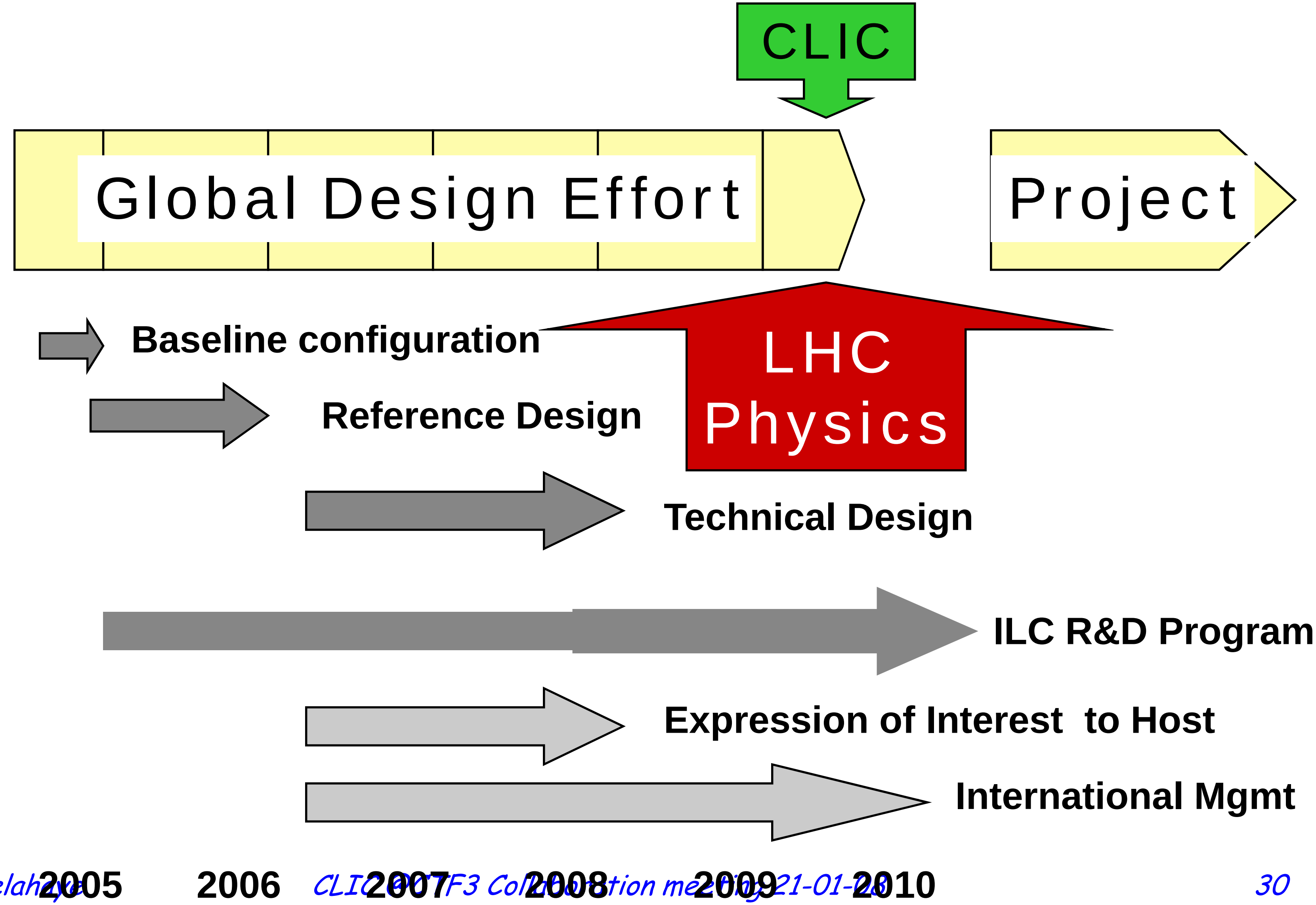


Beam sizes at Collisions



The ILC Plan and Schedule

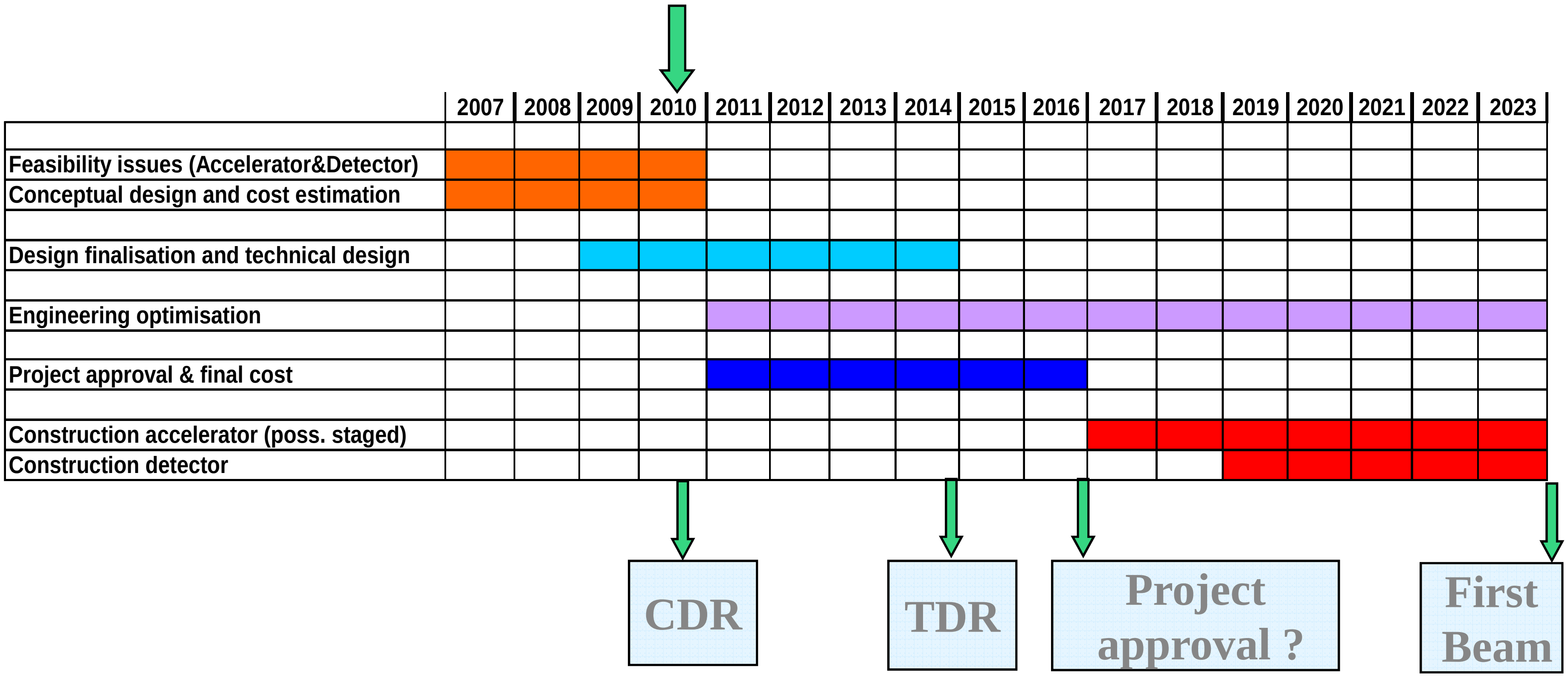
(B.Barish/CERN/SPC 050913)



Tentative long-term CLIC scenario

Shortest, Success Oriented, Technically Limited Schedule

Technology evaluation and Physics assessment based on LHC results for a possible decision on Linear Collider funding with staged construction starting with the lowest energy required by Physics



Prospects for Scientific Activities over the Period 2012 - 2016

CERN DG to Staff (16/01/08)

To be decided in 2010-2011 in light of first physics results from LHC, and designed and R&D results from the previous years. This programme could most probably comprise:

- An LHC luminosity increase requiring a new injector (SPL and PS).

  The total cost of the investment over 6 years (2011-2016: 1000-1200 MCHF + a staff of 200-300 per year. Total budget: ~200-250 MCHF per year.

- Preparation of a Technical Design for the CLIC programme, for a possible construction decision in 2016 after the LHC upgrade (depending on the ILC future).
  Total CERN M + P contribution + ~250 MCHF + 1000-1200 FTE over 6 years.

- Enhanced infrastructure consolidation: 30 MCHF + 40 FTEs from 2011.

NB: Over the period 2012-2016. Effective participation of CERN in another large programme (ILC or a neutrino factory) will not be possible within the expected resources if positive decisions taken on LHC upgrade and CLIC Technical Design. This situation could totally change *if none of the above programmes is approved* or if a new, more ambitious level of activities and support is envisaged in the European framework

Conclusion

- CLIC attractive design & promising performances already achieved
  - 3TeV consistent parameters based on Performance & Cost optimisation
  - Staged approach at low energy with conservative parameters (ATF)
  - 12 GHz frequency makes best use of avail X expert. & power facil.
  - Progress on structures strongly rely on tests at SLAC/KEK
- Well defined program to develop a Conceptual Design of a Multi-TeV Linear Collider based on CLIC technology and demonstrate its feasibility by 2010:
  - Completion and commissioning of CTF3 test facility to demonstrate CLIC RF power production and Two-Beam-Acceleration schemes
  - Use of CTF3 as RF power source to test RF components with nominal parameters
- Presently under schedule thanks to the efficient and motivated world-wide multi-lateral collaboration of volunteer institutes

23 institutes from 11 countries

Further extension following CLIC workshop (16/10/07 & Oct 08)

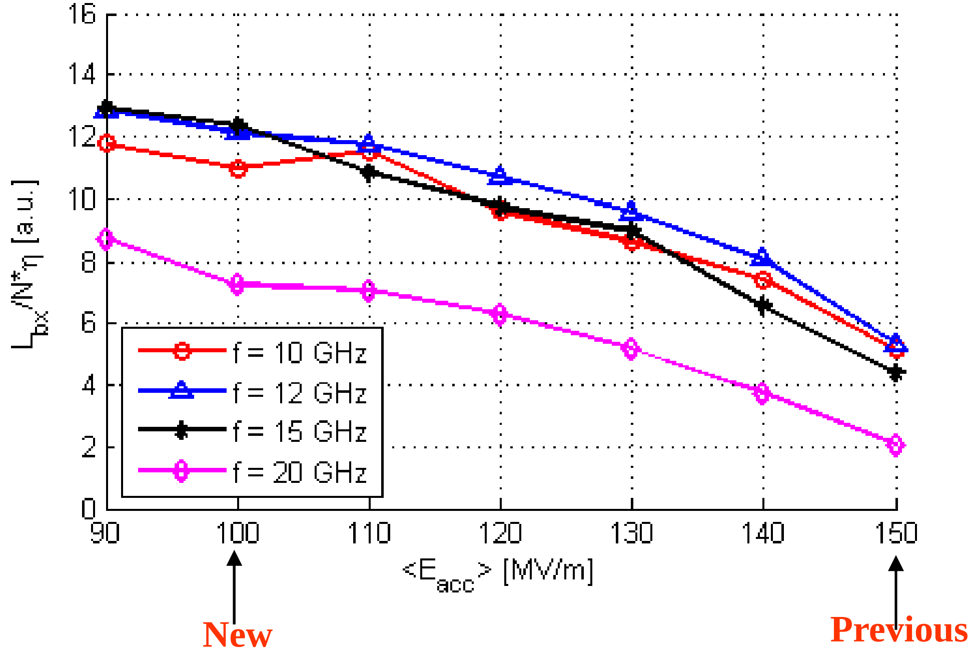
CTF3 Collaboration board on 24/01/08

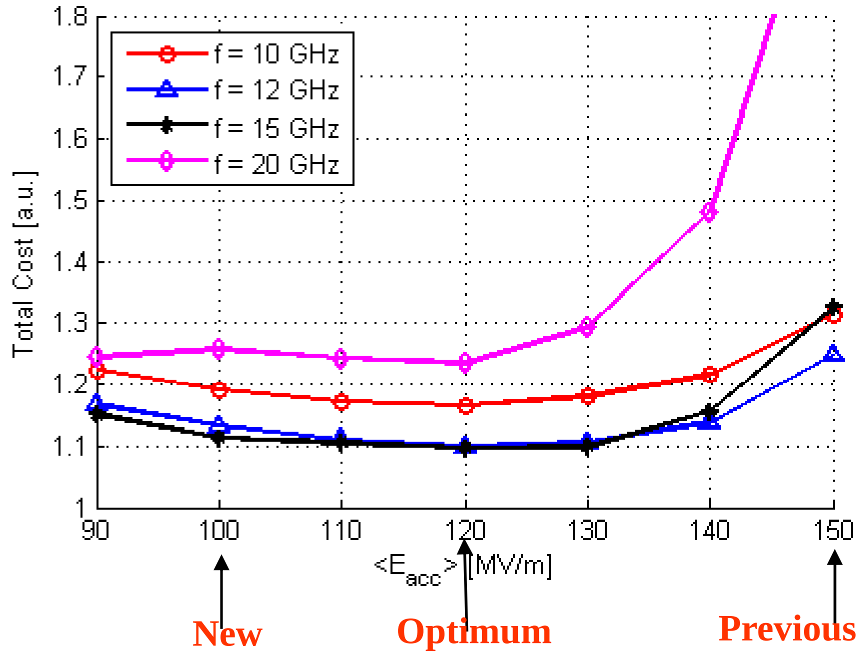
- Recommendations Advisory CommitteE (ACE) extremely useful

CTF3 key issue of the CLIC feasibility demonstration

CLIC performances (FoM) and cost (relative) variation as a function of the accelerating gradient

E_{cms} = 3 TeV $L_{(1\%)}$ = 2.0 10^{34} $cm^{-2}s^{-1}$





- **Performances increasing with lower accelerating gradient (mainly due to higher efficiency)**
- **Flat cost variation in 100 to 130 MV/m with a minimum around 120 MV/m**

The beauty of 12 GHz

- Corresponds to maximum Performance and minimum Cost
- Gradient of 100 MV/m nearly achieved with short pulse in naked structures (structure design with strong damping still to be adapted)
- Very close to the NLC and JLC frequency: 11.4 GHz
  - Takes advantage of all developments (structures, RF power sources, beam dynamics) made during many years at SLAC and KEK
  - Profit from low(er than 30 GHz) frequency for easier fabrication (tolerances, vacuum), relaxed requirements (alignment, timing, etc…),
  - High gradients achievable with short RF pulse provided by CLIC TBA RF power source (not possible with NLC Klystrons)
- RF power generation and frequency multiplication with single stage combination
  - Possibly drive beam linac at 1.33 GHz (with possible synergy with ILC MBK developments at 1.3 GHz) and multiplication by 9 (3*3) instead 36
- Easy adaptation of CTF3 (multiplication factor by 8 instead of 10)
- Stand alone power sources available: No gyroklystron necessary
  - Makes the best use of developments and equipments at SLAC and KEK
- Common and complementary study with SLAC and KEK
  - Share and distribute the studies and tests

CLIC/ILC collaboration

Participation to: ILC Reference Design (2004-2008)

ILC Engineering Design (2008-2010)

Preparation of ILC Construction of New Infrastructure (CNI)

ILC-HiGrade

Proposal full title: *International Linear Collider and High Gradient Superconducting RF-Cavities*

Proposal acronym: *ILC-HiGrade*

Type of funding scheme: *Combination of Collaborative Project and Coordination and Support Actions*

Work programme topics addressed: *INFRA-2007-2.2.1.33*

Name of the coordinating person: *Dr. Eckhard Elsen*

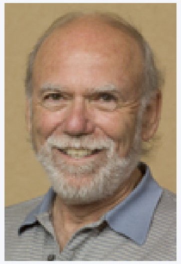
Table 1a - List of participants in the proposal

Participant no.	Participant organisation name	Country
1 (Coordinator)	DESY – Deutsches Elektronen-Synchrotron (DESY)	Germany
2	CEA – Commissariat á l'Energie Atomique	France
3	CERN – European Organization for Nuclear Research	Switzerland
4	CNRS/IN2P3 – Centre National de la Recherche Scientifique	France
5	INFN – Istituto Nazionale di Fisica Nucleare	Italy
6	UOXF.DL – The Chancellor, Masters and Scholars of the University of Oxford	UK

CLIC/ILC collaboration (ILC newsline)

Director's Corner

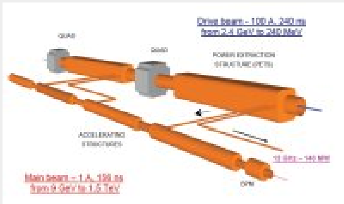
13 December 2007



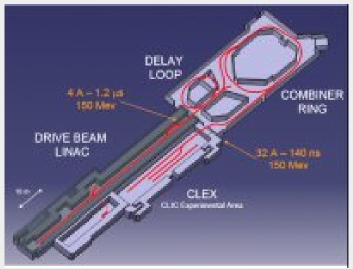
Barry Barish

A more integrated approach toward an energy frontier lepton collider

All of particle physics is poised for the impending first explorations of the trillion-electronvolt (TeV) energy scale at CERN's Large Hadron Collider. Within the next couple of years, the LHC will lead the way in opening up this new frontier for particle physics. The early results should help us determine what is required of a complementary lepton collider, in order to best address the new physics. The combination of the two explorers, as we have seen in past generations of colliders, will enable us to fully exploit the science of this new energy regime. Based on a great deal of information from both theory and experiment, we have very good reason to expect that a 500 billion-electronvolt (GeV) electron-positron collider, upgradeable to 1 TeV, will be the right match. This has given us strong motivation to develop the design for a collider like the ILC. Nevertheless, we must be prepared for what to do if LHC discoveries point strongly to the need for higher energies, maybe a multi-TeV lepton collider?



CLIC Two Beam Linear Accelerator Concept



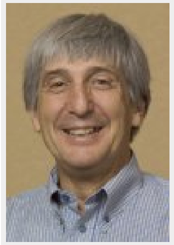
A schematic of the CLIC Test Faciity (CTF3) at CERN

Even though the precision tests of the standard model strongly indicate rich physics within the scope of the ILC, the question of what energy will be required for a lepton collider is not a new one. In any case, results from LHC will soon inform us, and R&D toward achieving higher energies has been pursued for some time. Two approaches are under study. One involves an alternative design for a linear electron-positron collider, and the other is the possibility of developing a muon collider. Both efforts are based on very clever ideas, but ones that are very hard to implement and will require significant advances in accelerator physics before a major facility can be undertaken. The muon collider offers a way to make intense neutrino beams. The technical advances needed however, especially in terms of beam cooling, make the time scale for realising a multi-TeV muon collider very long and the feasibility uncertain. The other possibility, a variant of an electron-positron collider that could potentially provide higher gradients, has been under study at CERN, known as the Compact Linear Collider or CLIC.

The main technical feature of CLIC is the two-beam acceleration scheme. The radiofrequency power for the main linac is extracted from a secondary, low-energy, high-intensity electron beam running parallel to the main linac (instead of using klystrons). The power is extracted from the beam by special extraction and transfer structures. For a 3-TeV collider

There are many technical challenges that must be solved to make this scheme viable. In fact, an R&D programme has been underway for more than 20 years now to develop this technology. Yet the basic feasibility still needs to be established. Recently, efforts to demonstrate feasibility received increased attention at CERN with a goal to prove the technology by roughly 2010, a similar timescale for achieving initial LHC results and the ILC *Engineering Design Report*.

The main goals of the CLIC R&D programme are to demonstrate drive beam generation (fully loaded acceleration, bunch frequency multiplication), to test CLIC accelerating structures and to test power production structures (PETS) in a test facility called CTF3 that is under development at CERN. The CLIC group recently lowered the main linac RF frequency from 30 GHz to 12 GHz, reduced the accelerating field from 150 MV/m (Megavolts per metre) to 100 MV/m and changed the resulting length for a 3-TeV machine from 34 km to 48 km. These changes are in response to the many problems they encountered at the higher frequencies.



Jean-Pierre Delahaye, CERN CLIC Study Group Leader

Although the work to develop the ILC design and the R&D to demonstrate CLIC feasibility has little in common technically, there are close relations between the two groups. This is especially the case because Jean-Pierre Delahaye, the CLIC Study Group Leader, is an active and important member of the ILC Global Design Effort.

For some time now, I have been coming to view that the ILC and CLIC efforts should be more closely integrated. Beyond the feasibility tests for CLIC, their emerging work will involve physics studies, detector concepts and a first-order design of the rest of the accelerator complex. For this work, CLIC faces many of the same issues we are dealing with for the ILC, with some significant differences due to the different technology and energy. Nevertheless, to best accomplish the work for both projects and to be best able to evaluate alternative approaches to the lepton collider, like a warm machine or CLIC, we should do all we can to integrate these R&D and design efforts.

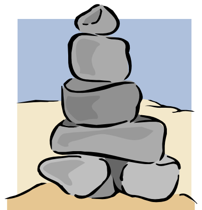
When I visited CERN last month, I had the opportunity to have a meeting with the CLIC Extended Steering Committee, including CERN Global Design Effort members. I suggested that joint work between the ILC and CLIC could have benefits for both efforts. They responded positively, and a number of specific areas have been identified where both groups could benefit. It is clear that the timescale for a machine like CLIC, even if feasible, is much later than the ILC. So the reason to consider CLIC is for energy reach, if required.

Following my visit to CERN, I discussed these joint efforts with the GDE Executive Committee, and we agreed to the general idea. As a result, the GDE Project Managers will explore specific areas of collaboration with CLIC. An exchange of ideas has begun by email, and a meeting is now planned at CERN for February 2008 to explore specific areas of cooperation.

I am hopeful that closer relations will be forged between the two groups. Our ultimate goal is to develop a lepton collider that will complement LHC physics, and I believe closer integration with CLIC will further our goal of realising a linear collider -- whatever LHC physics tell us.

-- Barry Barish

Milestones and decision points



- 100 MV/m average gradient for CLIC pulse length with good breakdown rate and acceptable efficiency > 10 %
- Similar performance with damping
- Similar performance, damping, better efficiency 'CLIC prototype structure'
- Fully featured structure HOM loads and s-BPM's integrated (ASSET test ?)

- 06/2008: Review manufacturing technology, optimization strategy, baseline geometry, rf parameters
- 12/2008: Review damping options and parameter optimization