CLIC08 Workshop

CERN, 14-17 October 2008

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CLIC'08 is an Accelerator and Physics Workshop which follows the very successful 1st Workshop of this kind held at CERN in Oct 2007.

The Aims of CLIC08 are:

- Review the R&D towards CLIC Feasibility Demonstration and Conceptual Design Report in 2010. This includes Items of ILC-CLIC Common Interest as defined in the recently established ILC-CLIC Collaboration.
- Identify the R&D, Facilities and Engineering Efforts needed in the period after 2010 to progress from a Conceptual Design to a Technical Design.
- Address Particle Physics and Detector Issues of a Multi-TeV Linear Collider.

Welcome

Participants: 215 (registered) from 57 Inst. of 18 countries

- China: Tsinghua University
- Finland: Helsinki Univ, HIP
- France: CEA Saclay, LAL, IPNL-IN2P3, IRFU-SPP, LAPP, LPHNE
- Germany: Bonn Univ., DESY, Forschungszentrum Karlsruhe, Greifswald Univ., MaxPlanck Inst.
- Greece: Nat Tech Univ., NTU Athens
- India: BARC-RRCAT, Ravishankar Shukla Univ
- Italy: LNF-INFN
- Japan: KEK
- Norway: Univ of Oslo
- Pakistan: NCP, Air Univ.
- Poland: Inst of Nucl Phys
- *Russia: BINP, JINR, SINP-MSU*
- *Spain: CIEMAT, IFIC, Catalonia Univ., UPC Univ*
- *Sweden: MAX-Lab, Uppsala Univ.*
- *Switzerland: EPFL, ETH, PSI*
- *Turkey: Ankara Univ., TAEA*
- *United-Kingdom: ASTeC, Birmingham Univ., Cockcroft Inst., Euclid TechLab, Manchester Univ., RHUL, JAI, Oxford Univ., RAL, Lancaster Univ., STFC*
- *United-States: ANL, Colorado Univ., Cornell Univ., LBNL, FERMILAB, SLAC, NASA Inspires*

CLIC/CTF3 Multi-Lateral Collaboration of Volunteer Institutes

27 institutes involving 17 funding agencies from 15 countries

Organized as a Physics Detector Collaboration

Collab. Board: Chair: M.Calvetti/INFN; Spokesperson: G.Geschonke/CERN

MoU with addenda describing specific contribution (& resources)

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

Members (full responsibility of work packages and providing corresponding resources):

- **CERN members with additional voluntary contributions:**

CERN, Finland (HIP), France (IRFU, LAL, LAPP), Italy (LNF), Norway (Oslo U.), Spain (CIEMAT, UPC, IFIC), Sweden (Uppsala), Switzerland (PSI), UK (Cockcroft, JAI, RHUL)

- **CERN non members with voluntary contributions:**

India (RRCAT), Japan (KEK), Pakistan (NCP), Russia (BINP, IAP, JINR), Turkey (Ankara U., Gazi U.), Ukraine (IAP), USA (NWU, SLAC, JLAB)

MoU under discussion: China (IHEP, Tsinghua Univ.), Iran (IPM),

World-wide CLIC / CTF3 collaboration

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

24 members representing 27 institutes involving 17 funding agencies of 15 countries

Ankara University (Turkey)
BINP (Russia)
CERN
CIEMAT (Spain)
Cockcroft Institute (UK)
Gazi Universities (Turkey)
IRFU/Saclay (France)

Helsinki Institute of Physics (Finland)
IAP (Russia)
IAP NASU (Ukraine)
Instituto de Fisica Corpuscular (Spain)
INFN / LNF (Italy)
J.Adams Institute, (UK)

JINR (Russia)
JLAB (USA)
KEK (Japan)
LAL/Orsay (France)
LAPP/ESIA (France)
NCP (Pakistan)
North-West. Univ. Illinois (USA)

Oslo University (norway)
PSI (Switzerland),
Polytech. University of Catalonia (Spain)
RRCAT-Indore (India)
Royal Holloway, Univ. London, (UK)
SLAC (USA)
Uppsala University (Sweden)

CLIC/CTF3 Collaboration
Welcome to recent new members

- **Cockcroft Institute/UK**
  - Accelerating Structures + Crab cavities
  - CTF3 operation
  - Damping Ring design
  - Positron sources
  - Beam diagnostics

- **Oslo/Norway**
  - Beam dynamics and PETS tests in TBL

- **KEK/Japan**
  - Fabrication and Tests of Accelerating Structures

- **IAP/Ukraine**
  - RF breakdown (simulations and theoretical studies)

Fruitful CLIC /ILC Collaboration

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

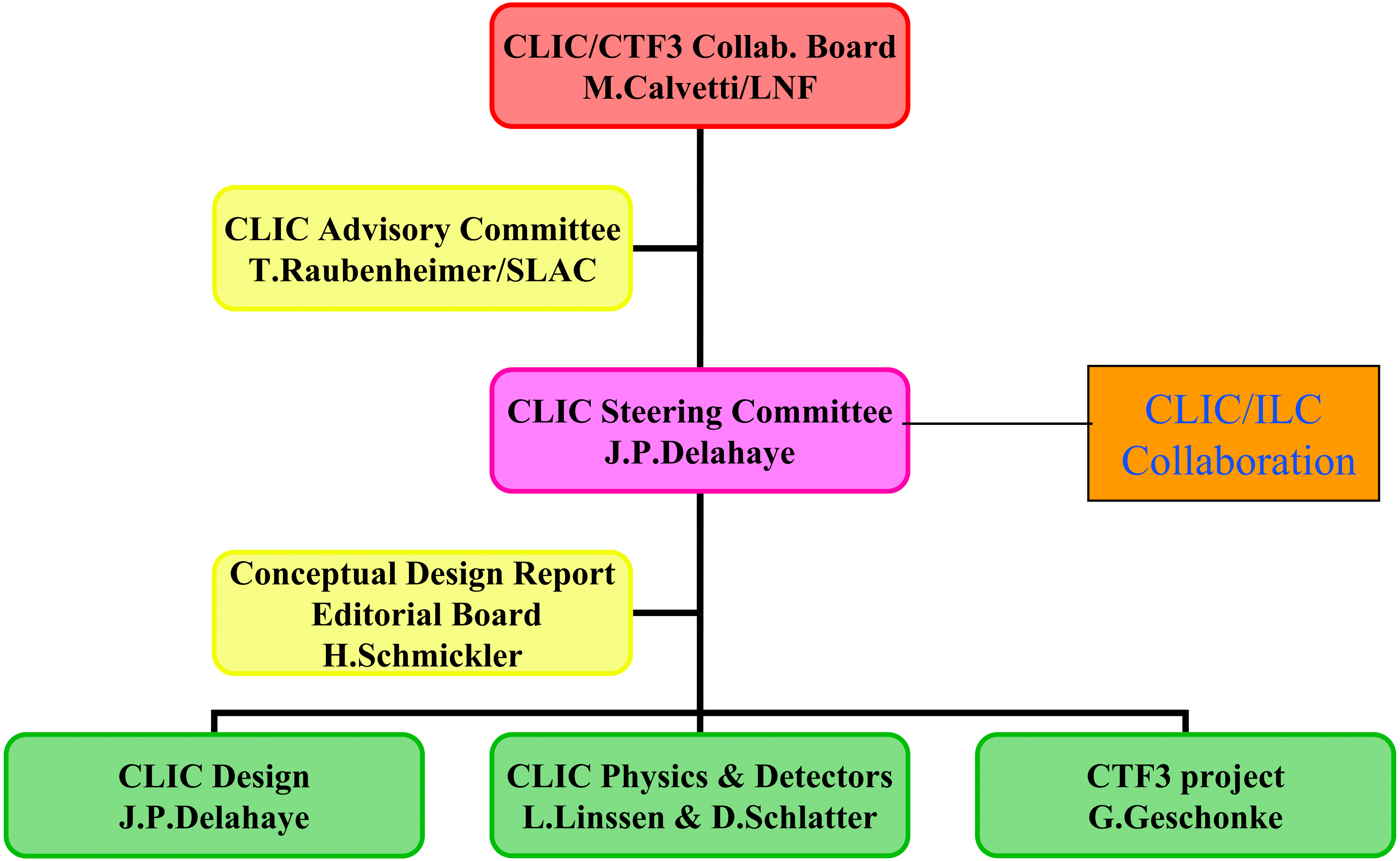
- Focusing on subjects with strong synergy between CLIC & ILC

Developed next by the
ILC Project Manager, M.Ross

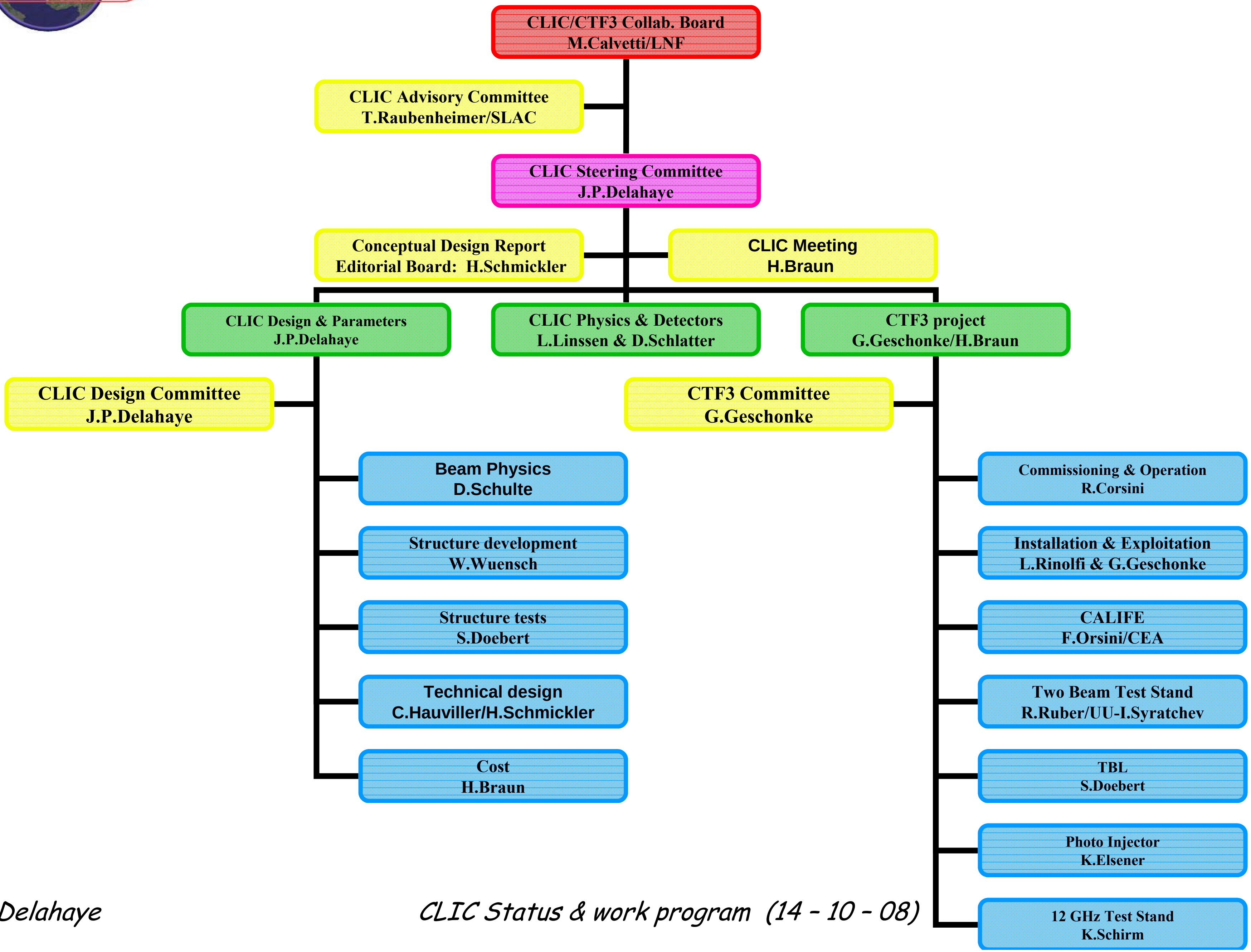
- making the best use of the available resources
- adopting systems as similar as possible
- identifying and understanding the differences due to technology and energy (technical, cost….)
- developing common knowledge of both designs and technologies on status, advantages, issues and prospects for the best use of future HEP
- preparing together the future evaluation of the two technologies by the Linear Collider Community made up of CLIC & ILC experts

CLIC organizational Chart

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



CLIC Chart



CLIC/CTF3 Collab. Board
M.Calvetti/LNF
CLIC Advisory Committee
T.Raubenheimer/SLAC
CLIC Steering Committee
J.P.Delahaye
Conceptual Design Report
Editorial Board: H.Schmickler
CLIC Meeting
H.Braun
CLIC Design & Parameters
J.P.Delahaye
CLIC Physics & Detectors
L.Linssen & D.Schlatter
CTF3 project
G.Geschonke/H.Braun
CLIC Design Committee
J.P.Delahaye
CTF3 Committee
G.Geschonke
Beam Physics
D.Schulte
Structure development
W.Wuensch
Structure tests
S.Doebert
Technical design
C.Hauviller/H.Schmickler
Cost
H.Braun
Commissioning & Operation
R.Corsini
Installation & Exploitation
L.Rinolfi & G.Geschonke
CALIFE
F.Orsini/CEA
Two Beam Test Stand
R.Ruber/UU-I.Syratchev
TBL
S.Doebert
Photo Injector
K.Elsener
12 GHz Test Stand
K.Schirm

CLIC Site and Documentation

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

- **CLIC Committees and Working Groups reflecting the CLIC organization:**
  http://clic-study.web.cern.ch/CLIC-Study/Mtgs_Wkg_Grp.htm

- **Documentation on EDMS:**
  https://edms.cern.ch/cedar/plsql/navigation.go_to_tree?cookie=7682580&p_top_id=1724490942

CLIC major activities and milestones up to 2010

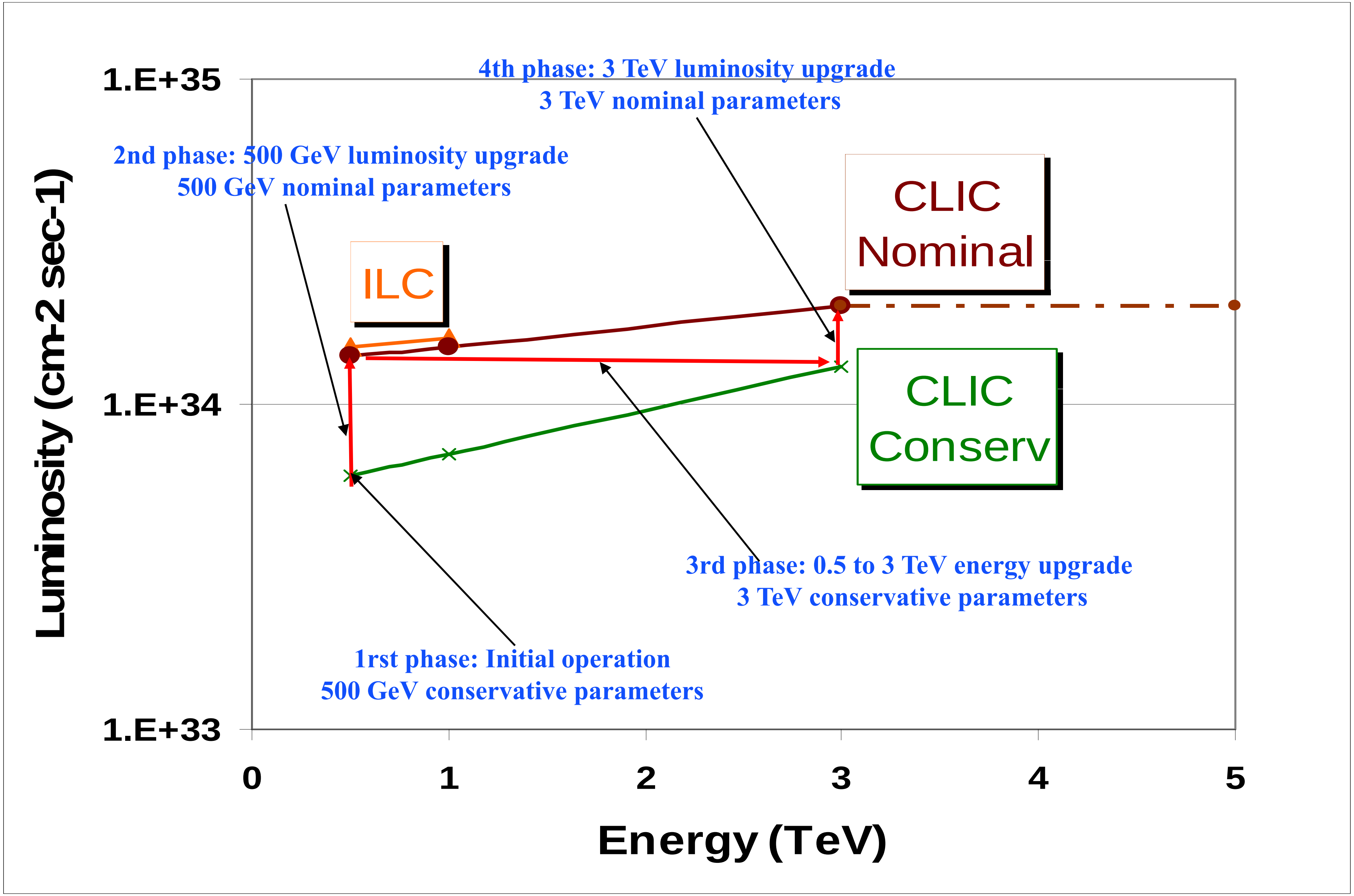
- **Demonstrate feasibility of CLIC technology**
  - Address all feasibility issues
- **Design of a linear Collider based on CLIC technology**
  http://clic-study.web.cern.ch/CLIC-Study/Design.htm
- **Estimation of its cost (capital investment & operation)**
- **CLIC Physics study and detector development**
  http://clic-meeting.web.cern.ch/clic-meeting/CLIC_Phy_Study_Website/

  M.Battaglia
- **Conceptual Design Report to be published in 2010** including
  - Physics, Accelerator and Detectors
  - R&D on critical issues and results of feasibility study,
  - Preliminary performance and cost estimation

  H.Schmickler

CLIC Parameters and upgrade scenario

http://cdsweb.cern.ch/record/1132079/files/CERN-OPEN-2008-021.pdf



CLIC main parameters

http://cdsweb.cern.ch/record/1132079?ln=fr   http://clic-meeting.web.cern.ch/clic-meeting/clictable2007.html

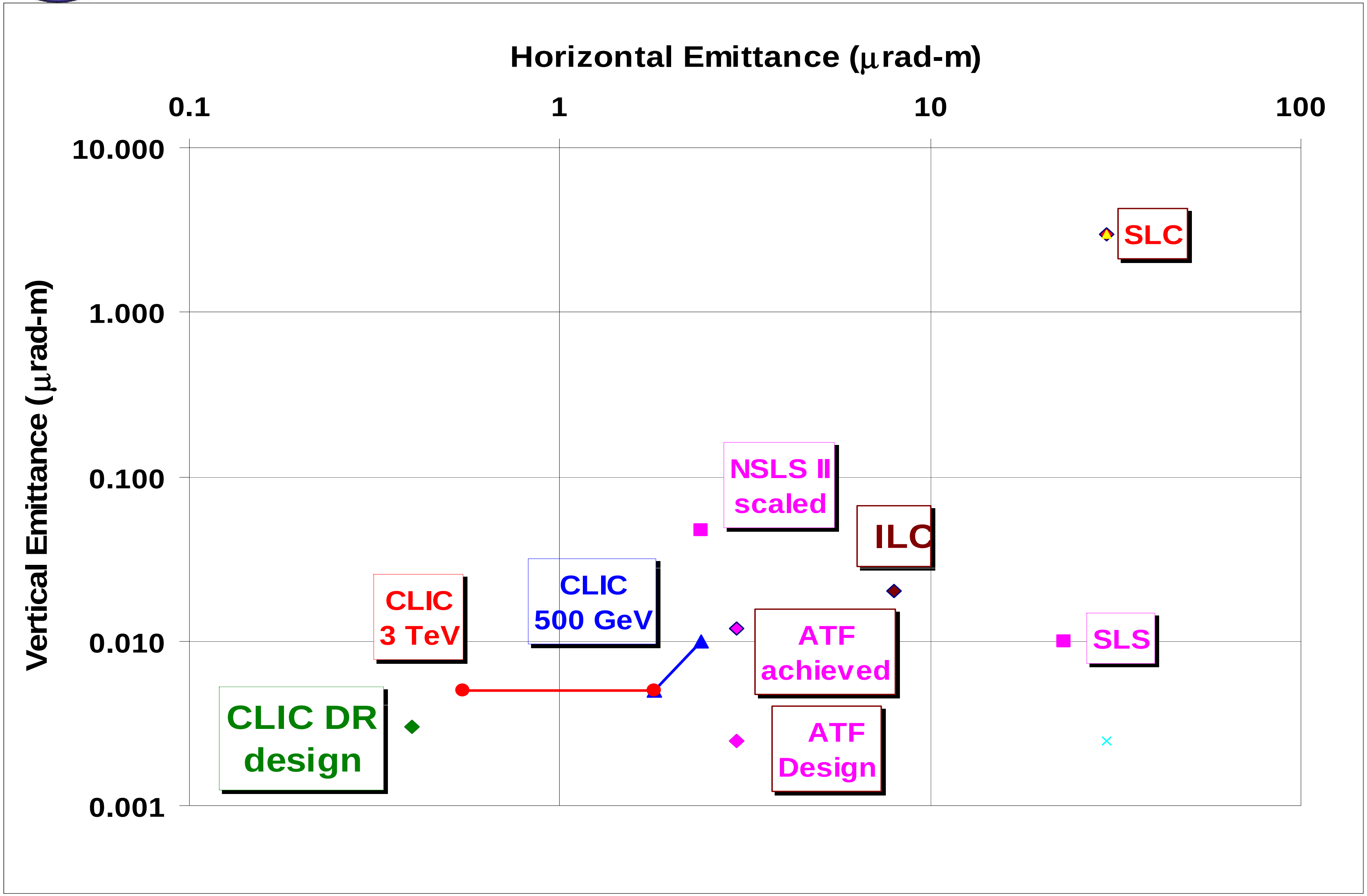
Center-of-mass energy	CLIC 500 G		CLIC 3 TeV	
Beam parameters	Conservative	Nominal	Conservative	Nominal
Accelerating structure	502		G	
Total (Peak 1%) luminosity	$0.9(0.6)\cdot10^{34}$	$2.3(1.4)\cdot10^{34}$	$2.7(1.3)\cdot10^{34}$	$5.9(2.0)\cdot10^{34}$
Repetition rate (Hz)	50			
Loaded accel. gradient MV/m	80		100	
Main linac RF frequency GHz	12			
Bunch charge 10^9	6.8		3.72	
Bunch separation (ns)	0.5			
Beam pulse duration (ns)	177		156	
Beam power/beam MWatts	4.9		14	
Hor./vert. norm. emitt ($10^{-6}/10^{-9}$)	3/40	2.4/25	2.4/20	0.66/20
Hor/Vert FF focusing (mm)	10/0.4	8 / 0.1		4 / 0.1
Hor./vert. IP beam size (nm)	248 / 5.7	202 / 2.3	83 / 1.1	40 / 1
Hadronic events/crossing at IP	0.07	0.19	0.75	2.7
Coherent pairs at IP	10	100	$5.\ 10^7$	$3.8\ 10^8$
BDS length (km)	1.87		2.75	
Total site length km	13.0		48.3	
Wall plug to beam transfert eff	7.5%		6.8%	
Total power consumption MW	129.4		415	

LC 500 GeV Main parameters

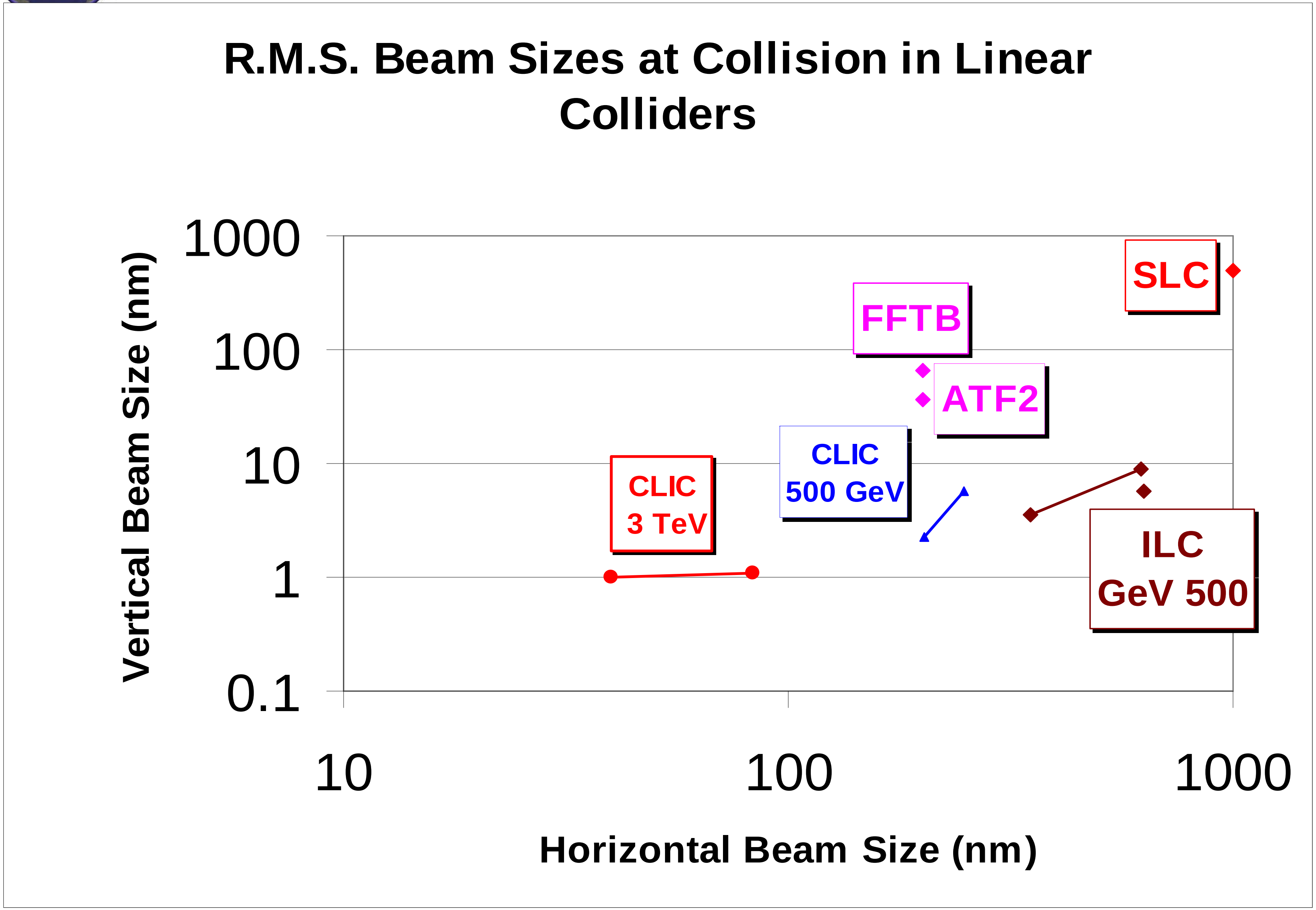
http://clic-meeting.web.cern.ch/clic-meeting/ComparisonTable.html

Center-of-mass energy	NLC 500 GeV	ILC 500 GeV	CLIC 500 G Conservativ	CLIC 500 G Nominal
Total (Peak 1%) luminosity	$2.0(1.3)\cdot10^{34}$	$2.0(1.5)\cdot10^{34}$	$0.9(0.6)\cdot10^{34}$	$2.3(1.4)\cdot10^{34}$
Repetition rate (Hz)	120	5	50	
Loaded accel. gradient MV/m	50	33.5	80	
Main linac RF frequency GHz	11.4	1.3 (SC)	12	
Bunch charge10^9	7.5	20	6.8	
Bunch separation ns	1.4	176	0.5	
Beam pulse duration (ns)	400	1000	177	
Beam power/linac (MWatts)	6.9	10.2	4.9	
Hor./vert. norm. emitt ($10^{-6}/10^{-9}$)	3.6/40	10/40	3 / 40	2.4 / 25
Hor/Vert FF focusing (mm)	8/0.11	20/0.4	10/0.4	8/0.1
Hor./vert. IP beam size (nm)	243/3	640/5.7	248 / 5.7	202/ 2.3
Soft Hadronic event at IP	0.10	0.12	0.07	0.19
Coherent pairs/crossing at IP	10?	10?	10	100
BDS length (km)	3.5 (1 TeV)	2.23 (1 TeV)	1.87	
Total site length (km)	18	31	13.0	
Wall plug to beam transfer eff.	7.1%	9.4%	7.5%	
Total power consumption MW	195	216	129.4	

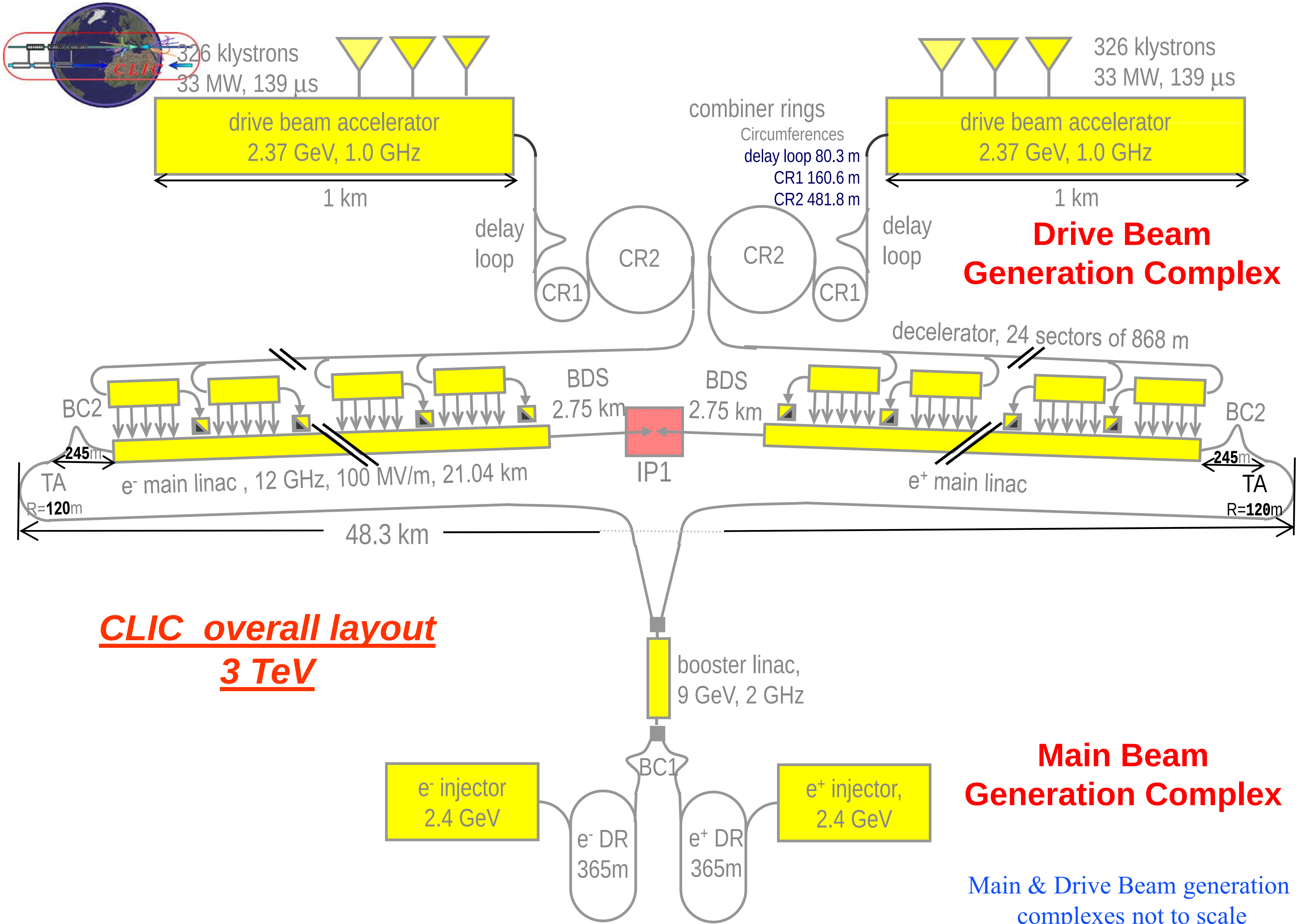
Beam emittances at Damping Rings

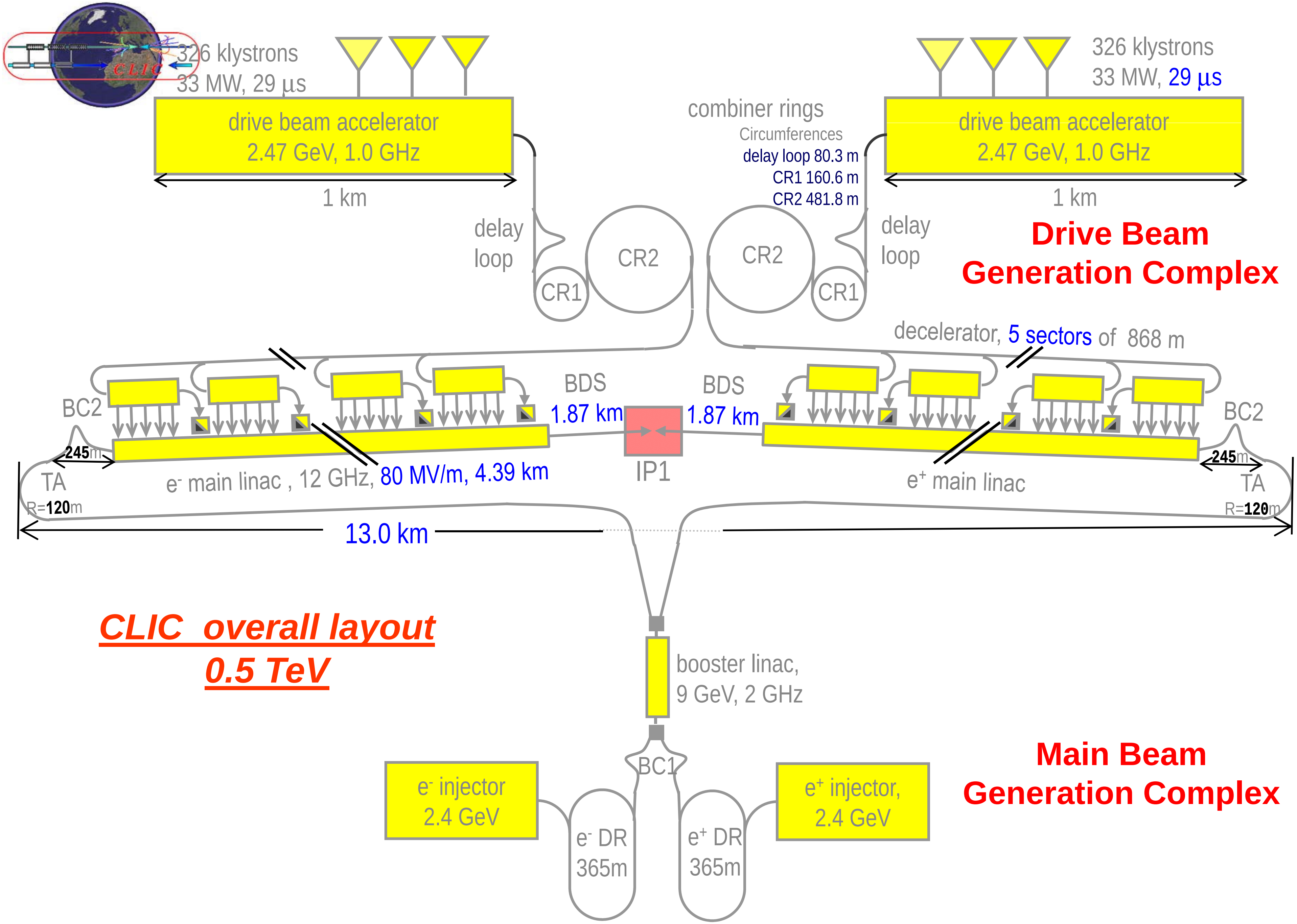


Beam sizes at Collisions



CLIC overall layout 3 TeV





CLIC overall layout
0.5 TeV

CLIC critical issues
R&D strategy and schedule

Updated from the Technical Review Committee (TRC) (2003)

Overall list available under: https://edms.cern.ch/document/918791

Presented by H.Schmickler

Issues classified in three categories:

- **critical for CLIC design and technology feasibility**

  Fully addressed by 2010 by specific R&D with results in Conceptual Design Report (CDR) with Preliminary Performance & Cost

- **critical for performance**
- **critical for cost**

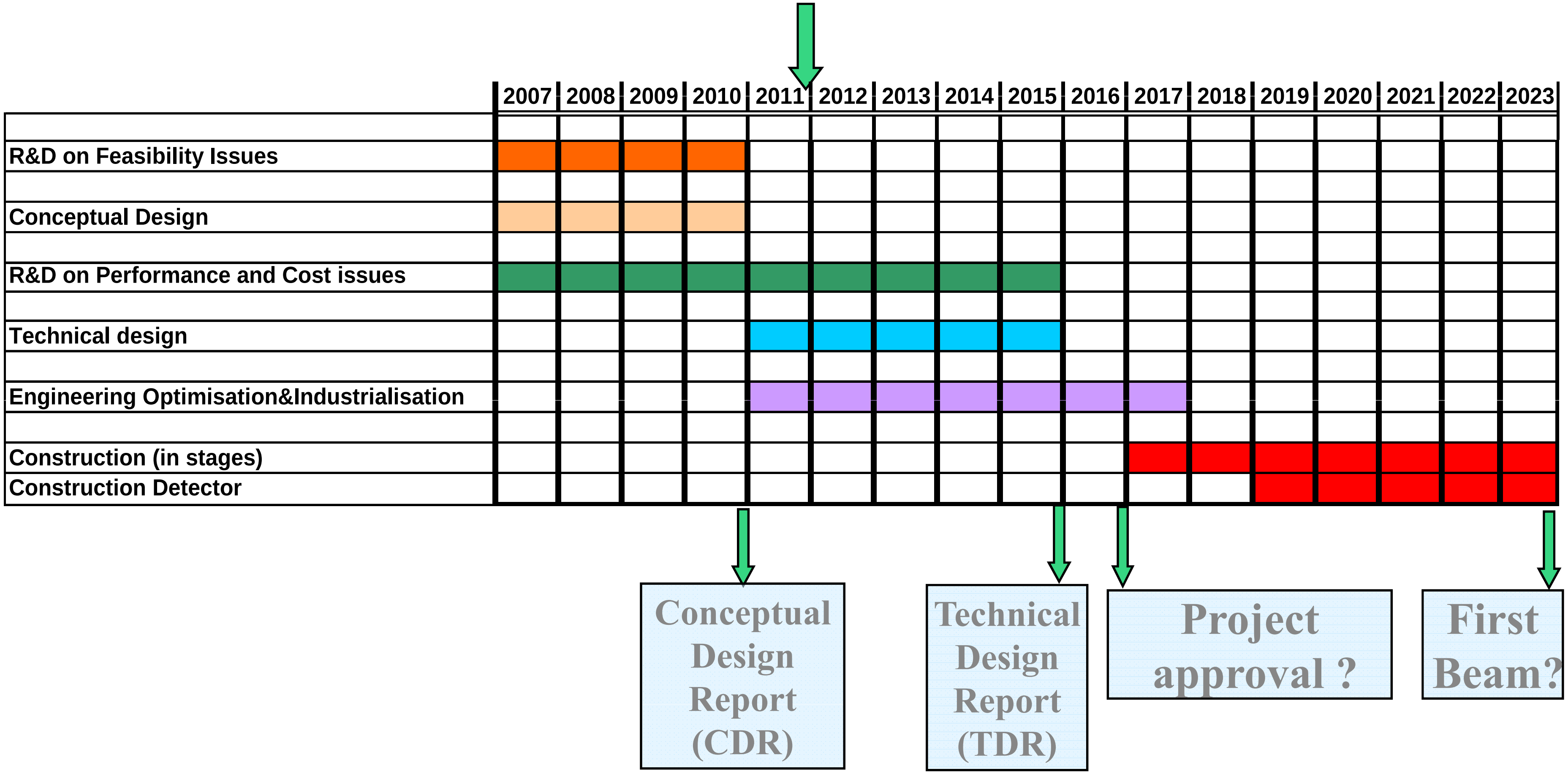
  Both being addressed now by specific R&D to be completed before 2015 with results in Technical Design Report (TDR) with Consolidated Performance & Cost

CLIC feasibility issues

	SYSTEMS (level n)	Critical parameters	Feasibility issue	Performance issue	Cost issue
Structures	**<u>Main beam acceleration structures</u>** **Demonstrate nominal CLIC structures with damping features at the design gradient, with design pulse length and breakdown rate .**	**100 MV/m** **240 ns** **3·10-7 BR/(pulse*m)**	**X**	**X**	**X**
Structures	**<u>Decelerator structures</u>** **Demonstrate nominal PETS with damping features at design power, with design pulse length, breakdown rate on/off capability**	**136 MW** **240 ns**	**X**		**X**
Drive Beam	**<u>Validation of drive Beam</u>** **- production** **- phase stability , potential feedbacks** **- MPS appropriate for beam power**	**0.2 degrees phase stability at 12 GHz**	**X**	**X**	
Two Beam	**Test of a relevant linac sub-unit with both beams**	**NA**	**X**		
Beam Physics	**- Preservation of low emittances (main linac + RTML)**	**Absolute blow-up** **Hor: 160nradm** **Vert: 15 nradm**	**X**	**X**	
Stabilization	**Main Linac and BDS Stabilization**	**Main Linac : 1 nm vert (>1 Hz)** **BDS: 0.15…1 nm vert (>4 Hz) depending on implementation of final doublet girder**	**X**	**X**	**X**
Operation and reliability	**Commissioning strategy** **Staging of commissioning and construction** **MTBF, MTTR** **Machine protection**	**Handling of drive beam power of 72 MW**	**X**	**X**	**X**

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 with staged construction starting with the lowest energy required by Physics



CLIC critical issues addressed in Operational or Test Facilities

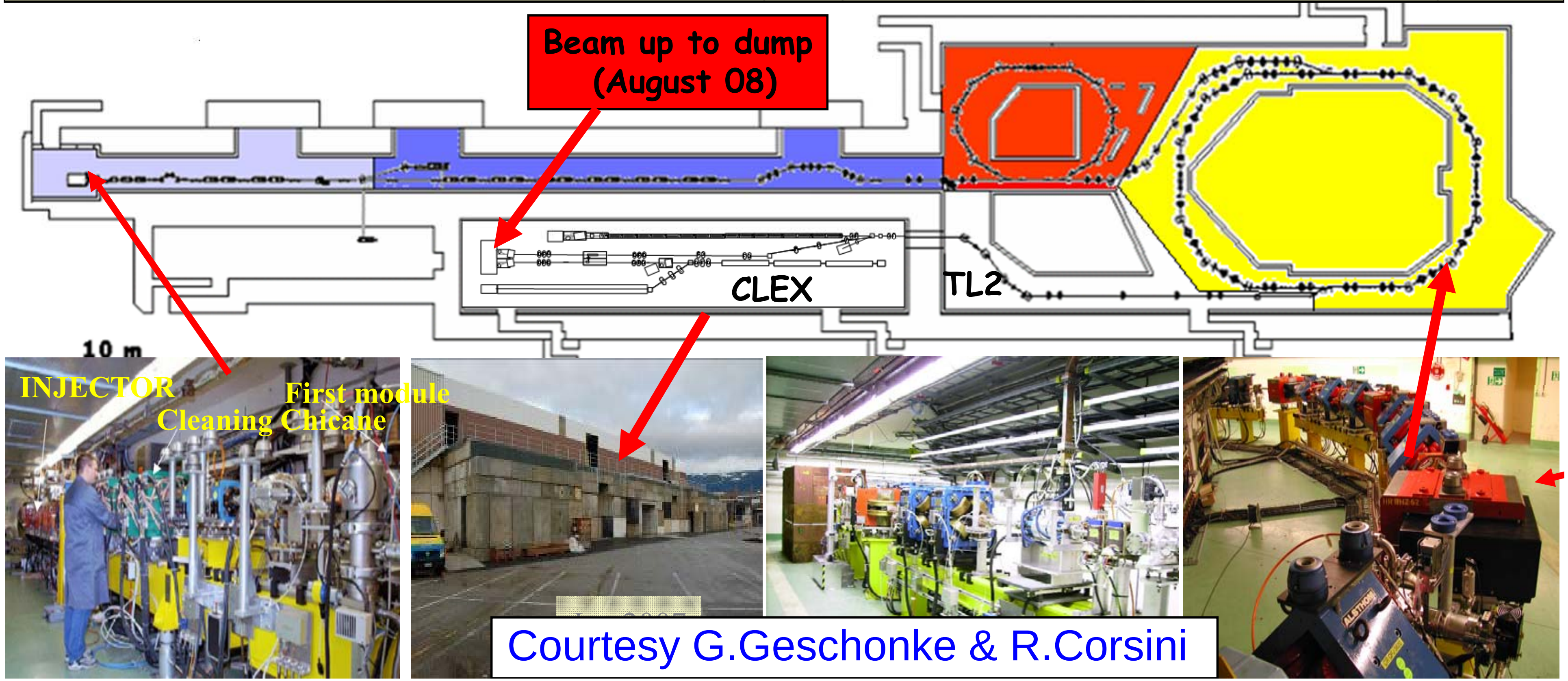
	SYSTEMS (level n)	Critical parameters	Crucial design choice or fesibility	Performance issue	Cost issue	Relevant Facilities (also valid for ILC)
Structures	Main beam acceleration structures Demonstrate nominal CLIC structures with damping features at the design gradient, with design pulse length and breakdown rate .	100 MV/m 240 ns 3·10-7 BR/(pulse*m)	X	X	X	CTF2&3 (2005-2010) Test Stand (2009-2010) SLAC/NLCTA SLAC/ASTA KEK/NEXTEF
	Decelerator structures Demonstrate nominal PETS with damping features at	136 MW				CTF3 (2005-2010) CTF3/TBTS (2008-2010) 2010)
Drive Beam	- MPS appropriate for beam power					10) 2010) LCLS
Two Beam	Test of a relevant linac sub-unit with both beams	NA	X			CTF3/TBTS (2008-2010)
Beam physics	Ultra-low emittances - Generation of low-emittances (damping rings)	Hor:500 nradm Vert: 5 nradm		X		ATF (2008-10): 3000/12 CESRTA:Electron Cloud NSLSII: Hor 2000nradm SLS: Vert 10nm
	- Preservation of low emittances (main linac + RTML)	Absolute blow-up Hor: 160nradm Vert: 15 nradm	X	X		Beam simulations LCLS SCSS
	- Beam focusing to small dimensions (BDS)	Hor: 40 nm Vert: 1 nm		X		ATF2 (2006-2012) Hor: 200 nm Vert: 36 (20) nm

Presented by N.Toge

Addressed in Linear Collider Test Facilities WG

All major CLIC technology key issues addressed in CLIC Test Facility (CTF3)

- **Demonstrate Drive Beam generation**
  (fully loaded acceleration, beam intensity and bunch frequency multiplication x8)
- **Demonstrate RF Power Production and test Power Structures**
- **Demonstrate Two Beam Acceleration and test Accelerating Structures**
- **Operational Experience (reliability) by continuous operation (10m/year)**

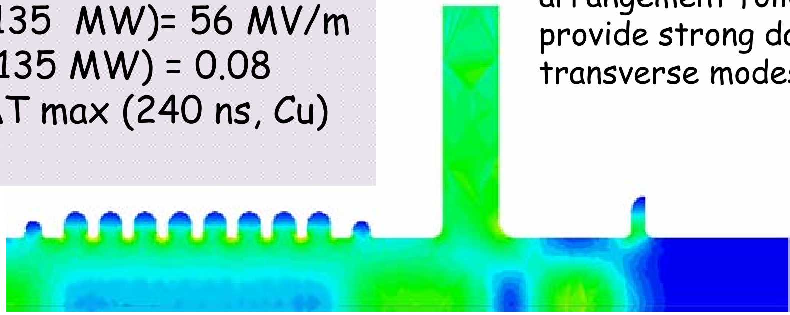


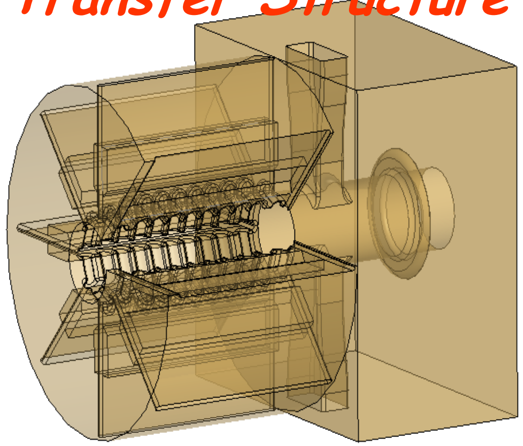
Courtesy G.Geschonke & R.Corsini

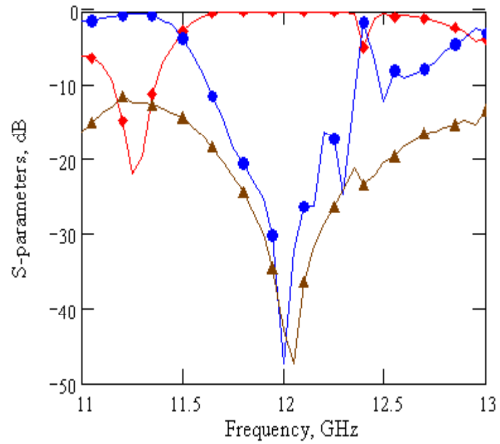
PETS parameters:
- Aperture = 23 mm
- Period = 6.253 mm (90^0/cell)
- Iris thickness = 2 mm
- R/Q = 2258 Ω
- V group= 0.453
- Q = 7200
- P/C = 13.4
- E surf. (135 MW)= 56 MV/m
- H surf. (135 MW) = 0.08 MA/m   (ΔT max (240 ns, Cu) = 1.8 C^0)

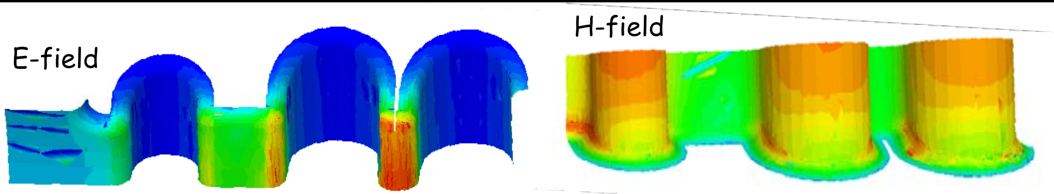
CLIC Power Extraction and Transfer Structure (PETS)

In its final configuration, PETS comprises eight octants separated by the damping slots. Each of the slots is equipped with HOM damping loads. This arrangement follows the need to provide strong damping of the transverse modes.





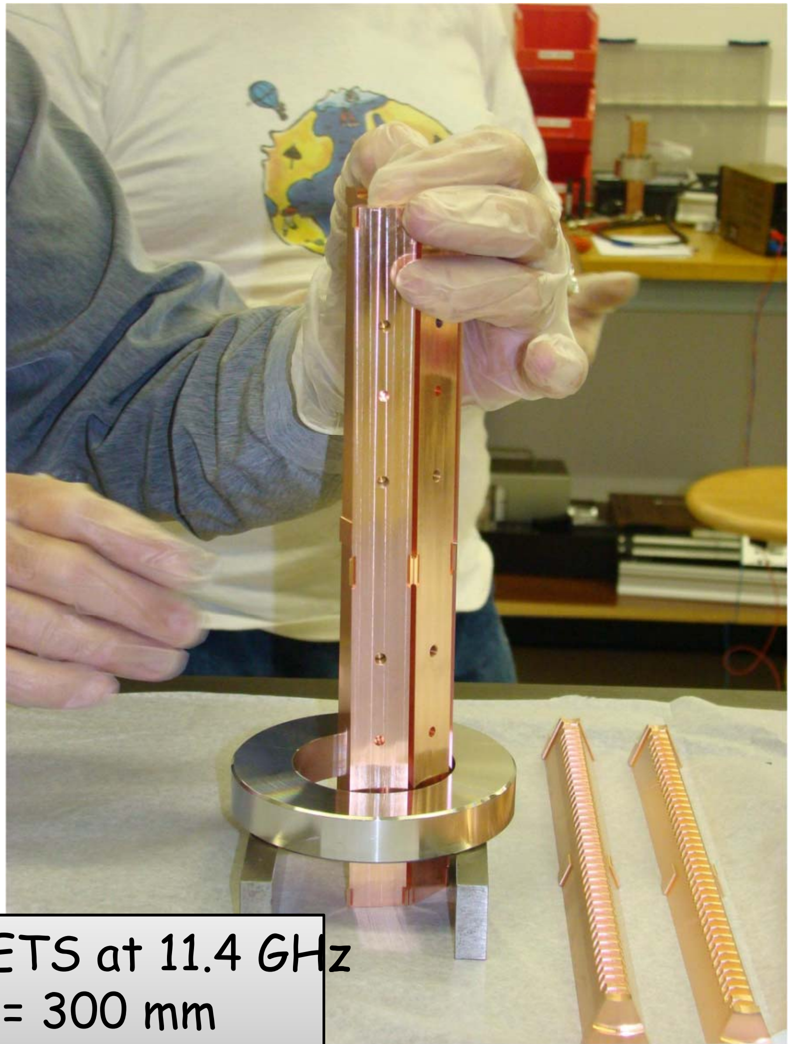




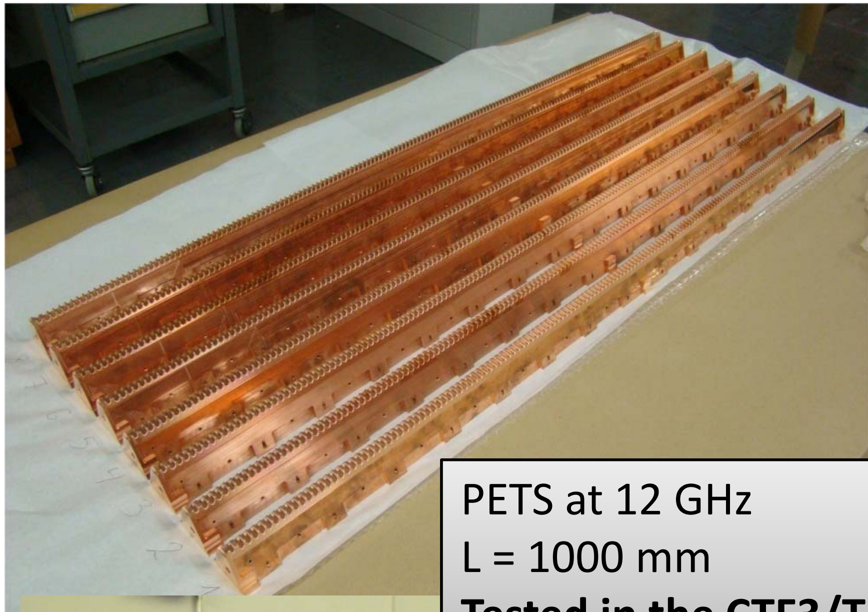
To reduce the surface field concentration in the presence of the damping slot, the special profiling of the iris was adopted.

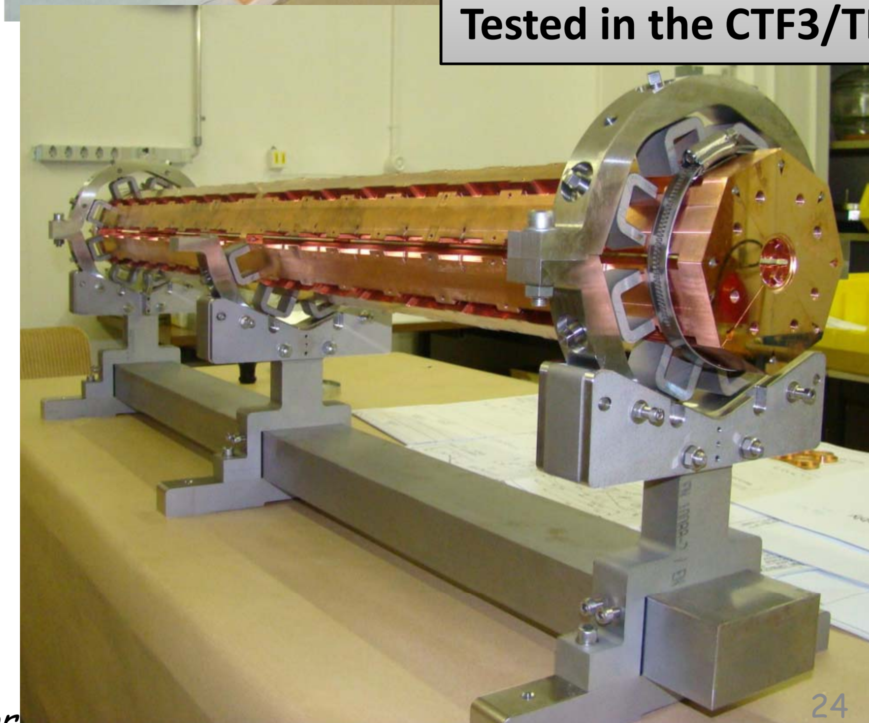
Courtesy I. Syratchev

Power Extraction & Transfer Structure (PETS)

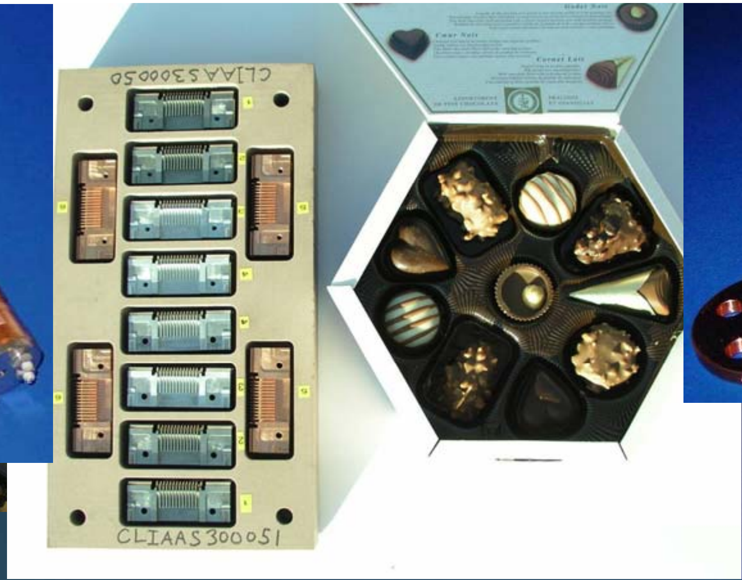


PETS at 11.4 GHz
L = 300 mm
Tested at SLAC

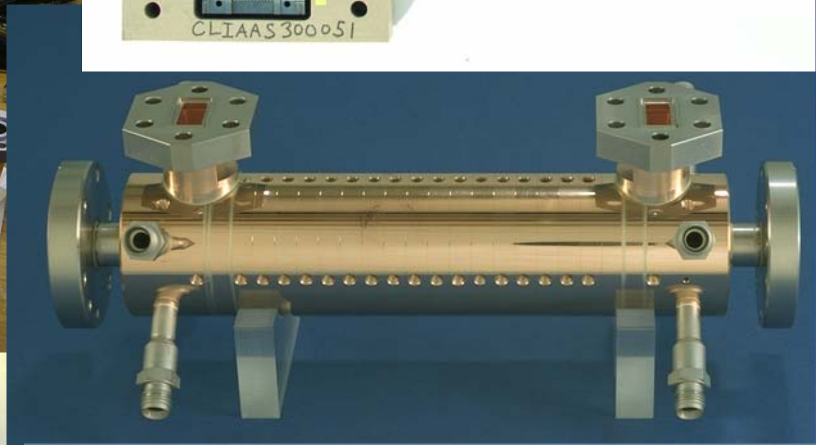
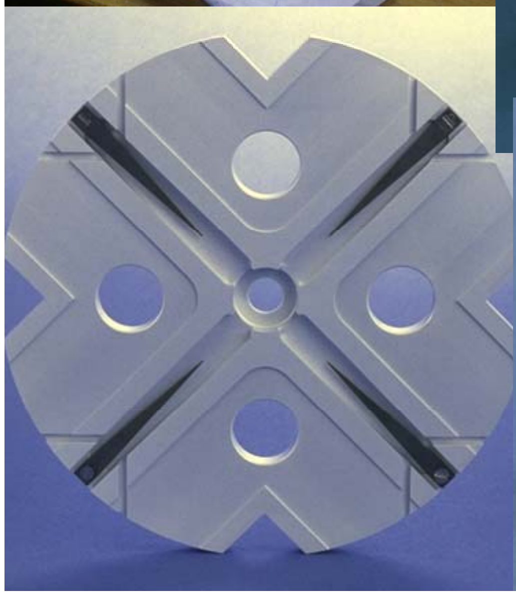
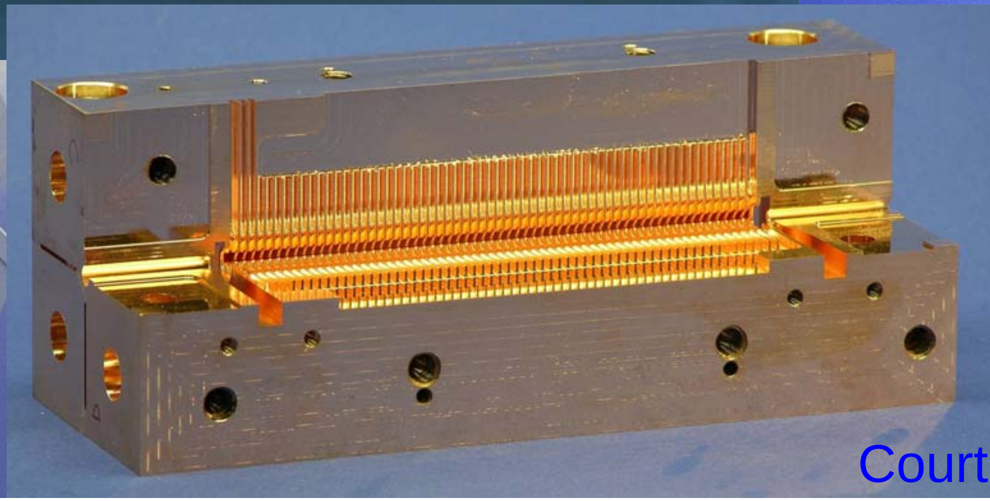




PETS at 12 GHz
L = 1000 mm
Tested in the CTF3/TBTS



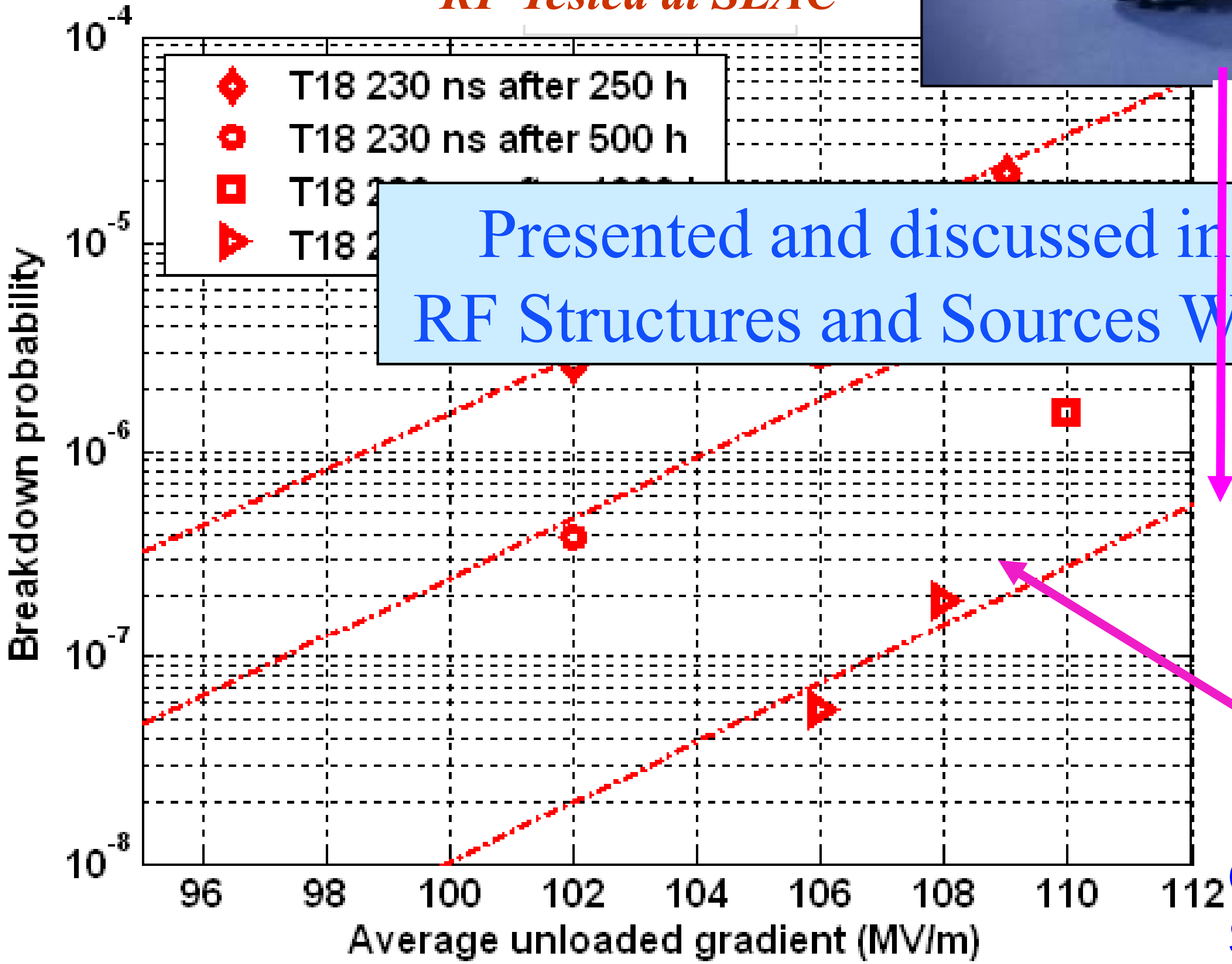
Testing Accelerating Structures

Courtesy W.Wuensch

Nominal Structure Performance demonstrated

A shining example of fruitful collaboration:

T18_VG2.4_disk: *Designed at CERN,*
(without damping) *Built at KEK,*
RF Tested at SLAC



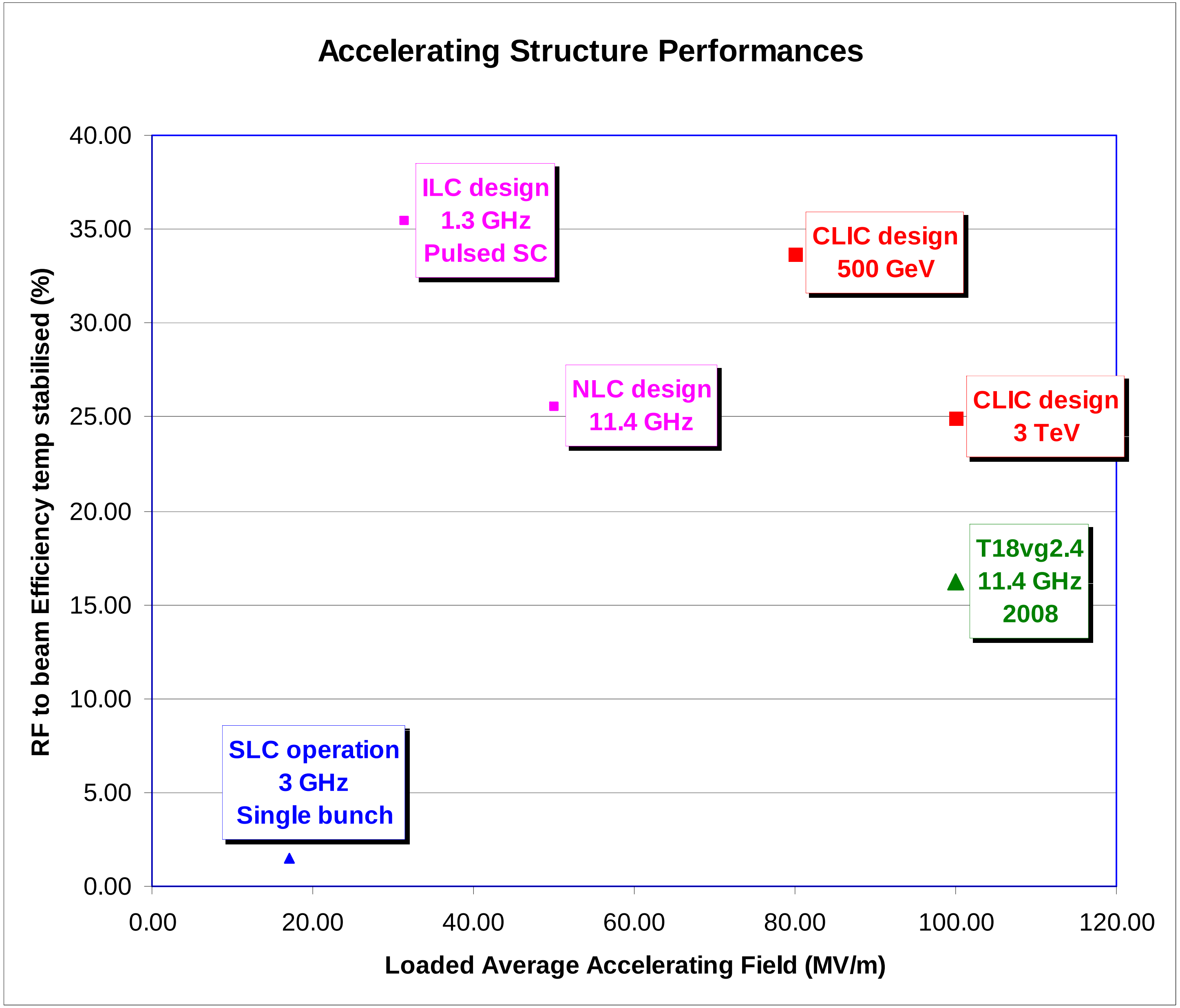
Presented and discussed in
RF Structures and Sources WG

provement by
conditionning

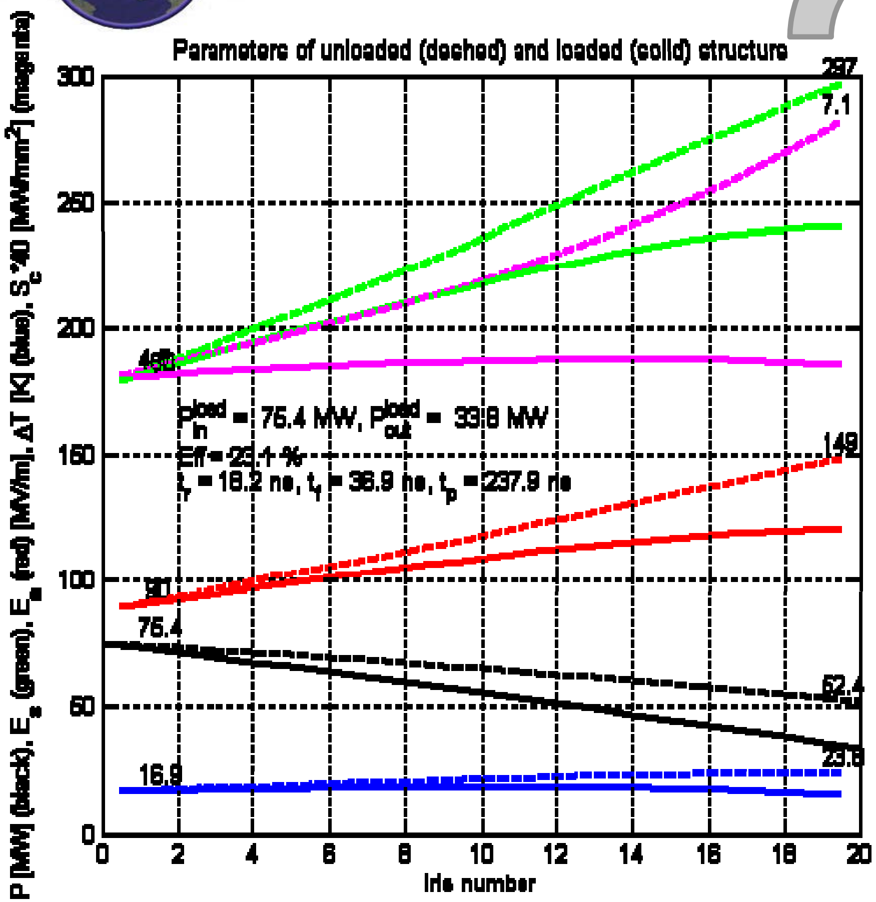
CLIC nominal

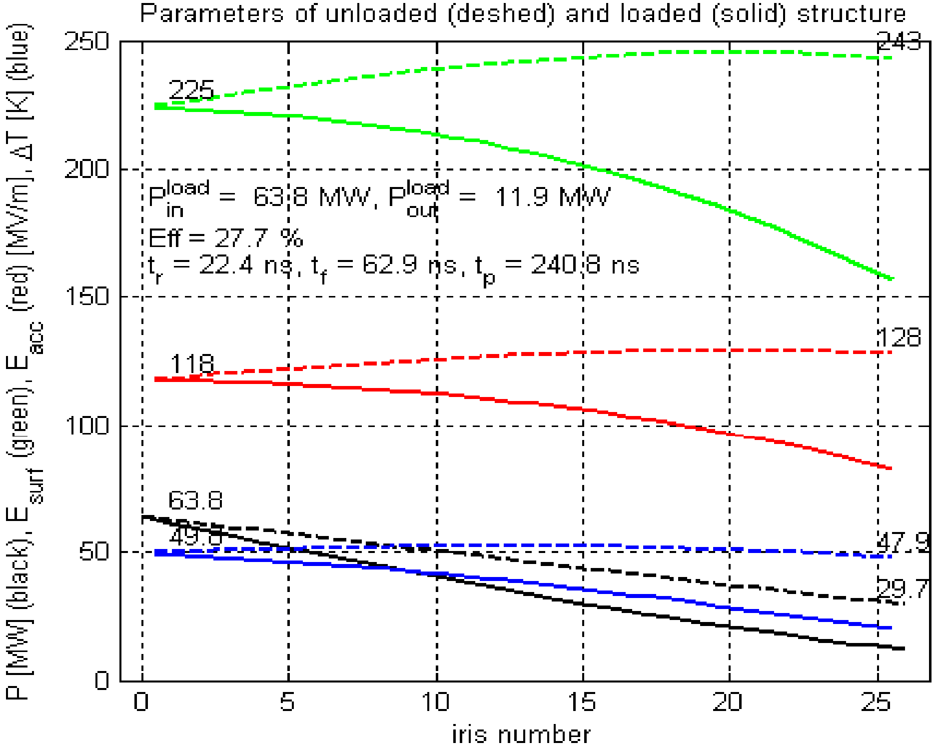
Courtesy W.Wuensch &
S.Doebert

Rf to beam transfer efficiency
(including power for temperature stabilisation)

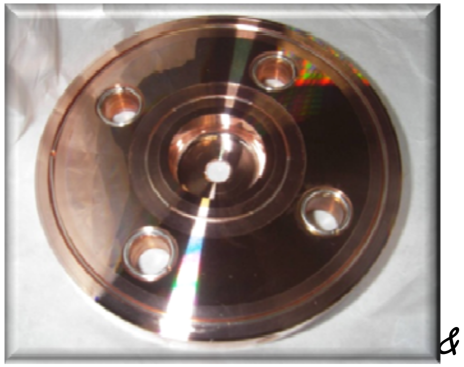


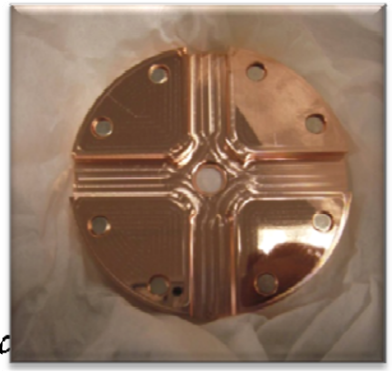
Achieved results to prototype CLIC structure





T18 test structure





CLIC prototype

The path to the CLIC full-structure feasibility demonstration

Move from achieved result with simplified structure to fully equipped, higher efficiency structure

Courtesy W.Wuensch

Supporting tests:
Quadrant fabrication
CD10
Choke mode CD10

TD18

Add damping

Move to design iris range

T18
tested to 105 MV/m, 230 ns, $2x10^{-7}$/(mxpulse)

Move to design iris range and add damping

CLIC_G with damping, full prototype

Move to design iris range

Add damping

CLIC_G undamped

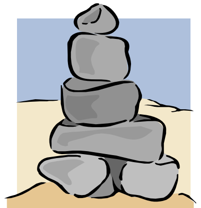
Supporting tests:
C10 series
T23

Today

early 2009

late 2009

Mile stones and decision points

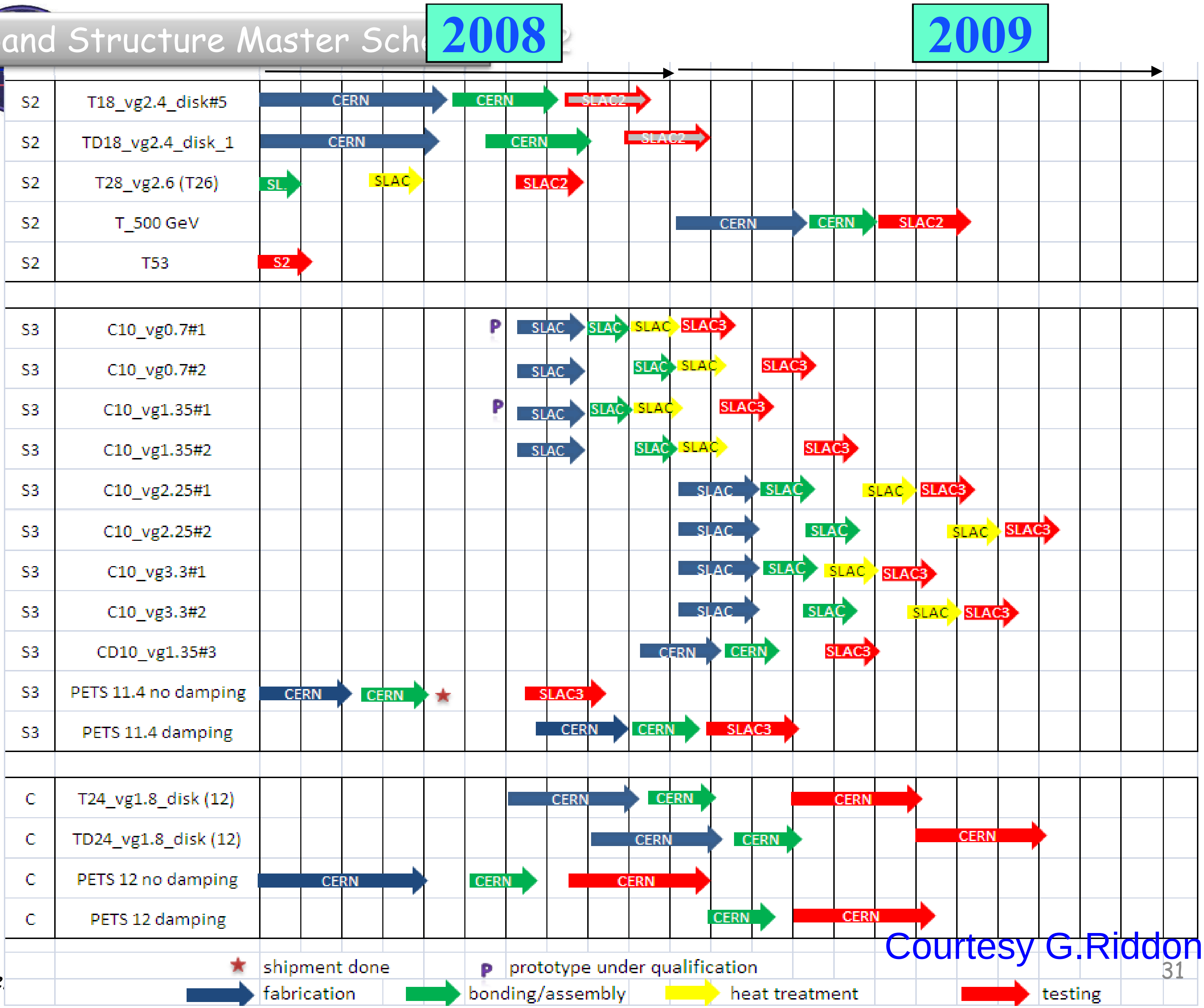


- 100 MV/m average gradient for CLIC pulse length with good breakdown rate and acceptable efficiency > 10 % but no damping yet
- Similar performance with damping
- Similar performance, damping, better efficiency 'CLIC prototype structure T24vg1.7'
- Fully featured structure HOM loads and s-BPM's integrated (ASSET test ?)

- Review manufacturing technology, optimization strategy, baseline geometry, rf parameters
- Review damping options and parameter optimization

Courtesy S.Doebert

X-band Structure Master Sch



Courtesy G.Riddone

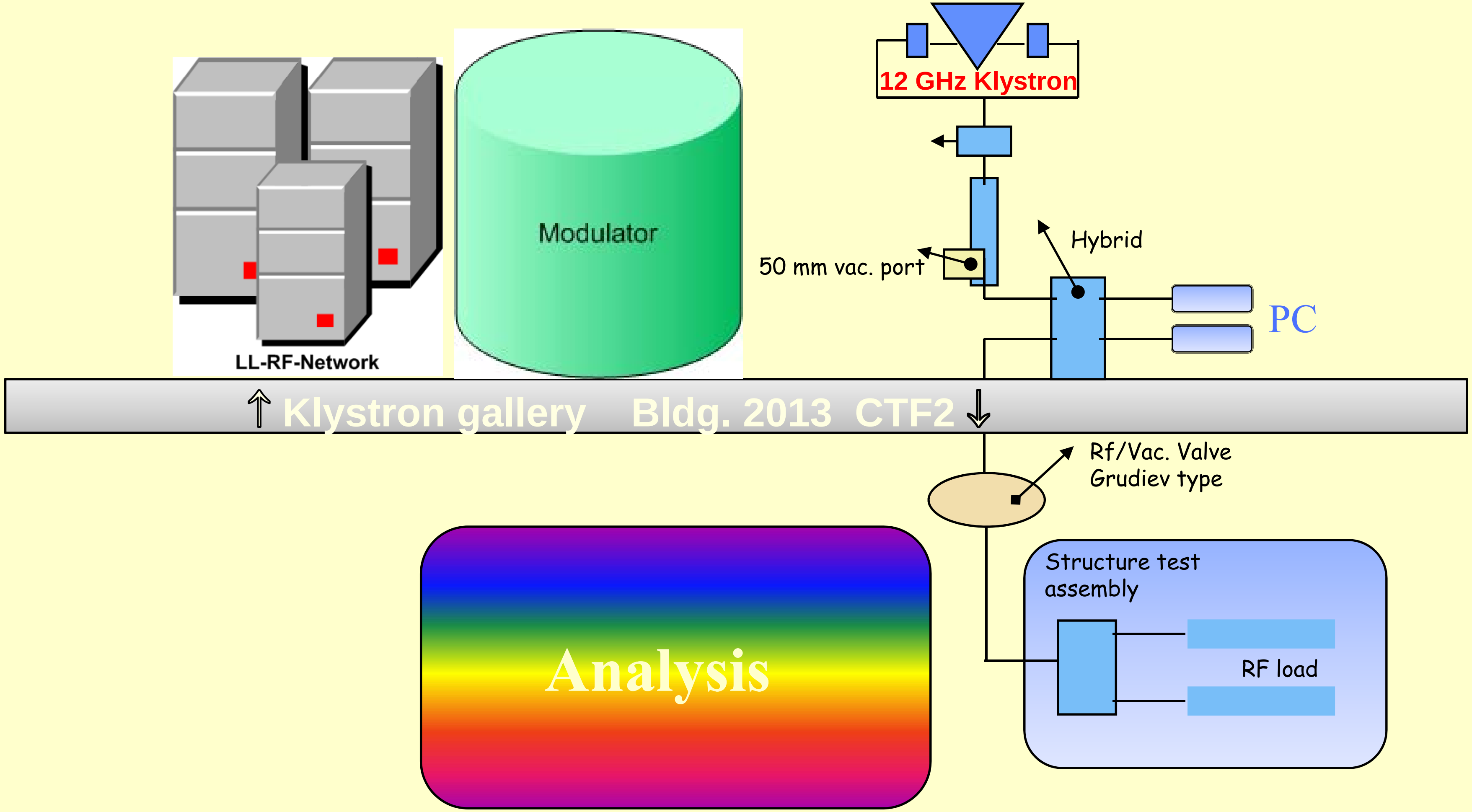
Structure testing program

Courtesy S.Doebert

		2008						2009						
		Jul	Aug	Sept	Oct	Nov	Dez	Jan	Feb	Mar	Apr	May	Jun	Jul
Facility	Structure													
SLAC Station 1	T18_vg2.4_disk[1]													
11.4 GHz	TD18_vg2.4_quad[1]													
	TD18_vg2.4_disk[1]													
SLAC Station 2	T28_vg2.9													
	T18_vg2.4_disk[5]													
	T24vg1.7_disk													
SLAC ASTA	PETS 11.4													
	C10vg0.7[1													
	C10vg1.3[1													
	C10vg3.3[1													
	C10vg2.2_t													
KEK NEXTEF														
	T18_vg2.4_disk[2]													
	T18_vg2.4_disk[3]													
	TD18_vg2.4_quad[2]													
	TD18_vg2.4_disk[2]													
CLEX 12 GHz														
	Pets 12 GHz													
	Pets [2] 12 GHz													
	T24_vg1.7_disk													
	TD24_vg1.7_disk													
30 GHz CTF3														
	C30_vg2.6													
	C30_vg2_TM02													
	C30_vg4.7_sb													
	T28_30 GHz													

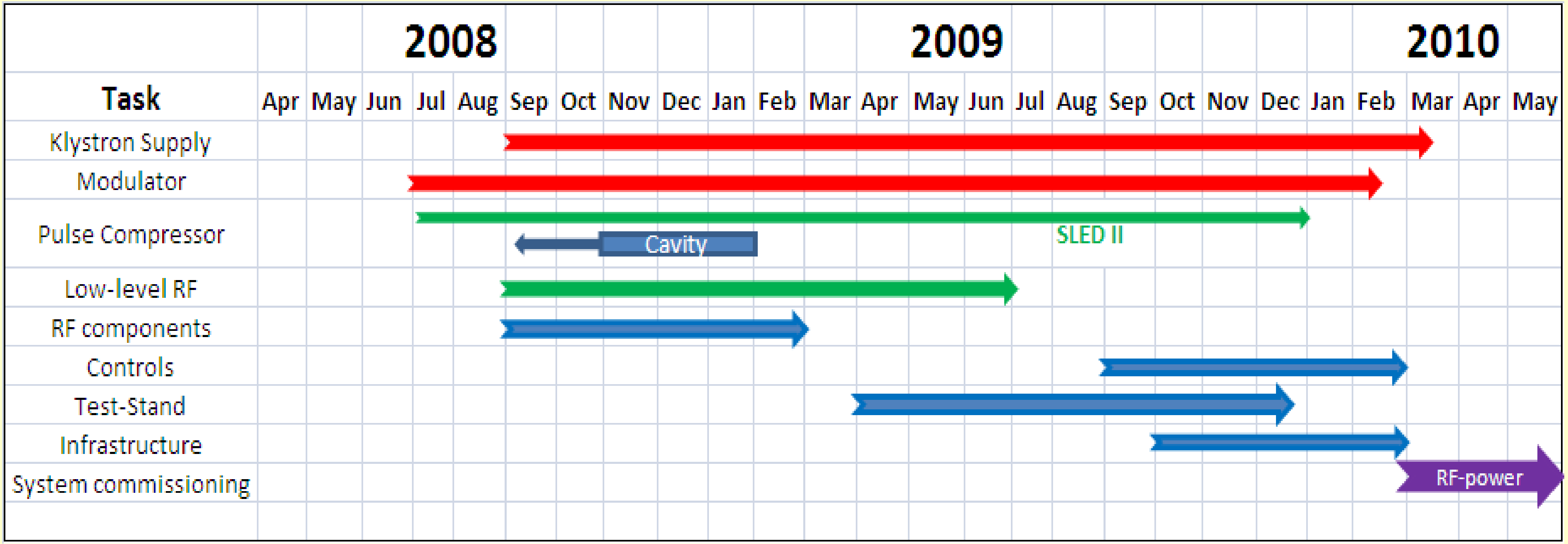
Presented and discussed in
RF Structures and Sources WG

12 GHz Test-Stand at CERN



Courtesy :K Schirm & G. McMonagle

12 GHz Test-Stand Schedule (In-kind contribution of CEA/France)



Optimum Structure at 500 GeV adapted to beam parameters and energy

Case	3TeV nominal	500 GeV nom structure	500 GeV optim structure
Structure	CLIC G	CLIC G	CLIC 502
Average accelerating gradient: $<E_a>$ [MV/m]	100	80	80
Average iris radius/wavelength: $<a>/\lambda$	0.11	0.11	0.145
Input/Output iris radii: $a_{1,2}$ [mm]	3.15, 2.35	3.15, 2.35	3.97, 3.28
Input/Output iris thickness: $d_{1,2}$ [mm]	1.67, 1.00	1.67, 1.00	2.08, 1.67
N. of reg. cells, str. length: N_c, l [mm]	24, 229	24, 229	19, 231
Bunch separation: N_s [rf cycles]	6	6	6
Luminosity per bunch X-ing: $L_{b\times}$ [m^{-2}[illegible]	[illegible]	[illegible]	[illegible]
Bunch population: N	[illegible]	[illegible]	[illegible]
Number of bunches in a train: N_b	[illegible]	[illegible]	[illegible]
Pulse length: τ_p [ns]	[illegible]	[illegible]	[illegible]
Input power per structure: P_{in} [MW]	63.8	42.1	74.2
$P_{in}/Ct^{P}{}_{p}{}^{1/3}$[MW/mm ns$^{1/3}$]	18	16	17
Max. surface field: E_{surf}^{max} [MV/m]	245	200	250
Max. temperature rise: ΔT^{max} [K]	53	50	56
Efficiency: η [%]	27.7	37.4	39.6
Figure of merit: $\eta L_{b\times}/N$ [a.u.]	9.1	1.8	3.3
Repetition frequency: f_{rep}[Hz]	50.0	50.0	50.0
RF input power: P_l [MW/linac]	50.4	13.9	12.2
Total AC power: Pt [MW]	389	200	192
Luminosity : L_1[10^{34}cm^{-2}s^{-1}]	2.03	0.62	1.00

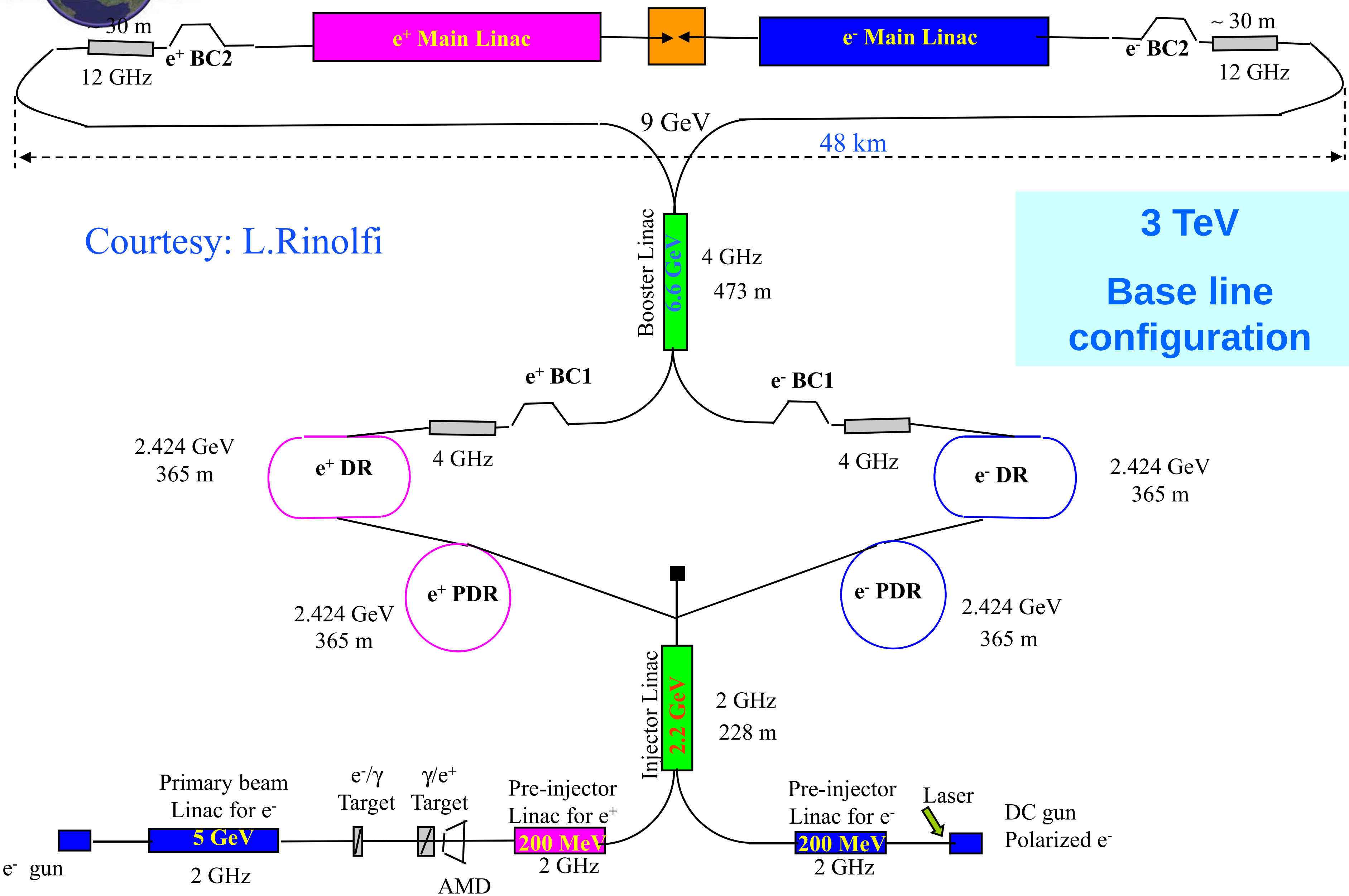
Presented and discussed in RF Structures and Sources WG

500 GeV design based on optimum 502 structure:

- Reduced accelerator field (80 MV/m)
- Larger iris diameter and dimensions
- Similar RF structure ...han at 3 TeV
- ...r pulse length
- ...ent RF to beam efficiency (39.6%)
- Modules and drive beam sectors identical to 3 TeV
- Double charge per bunch 6.8 10^9

Courtesy: A.Grudiev

The CLIC Injector complex in 2008

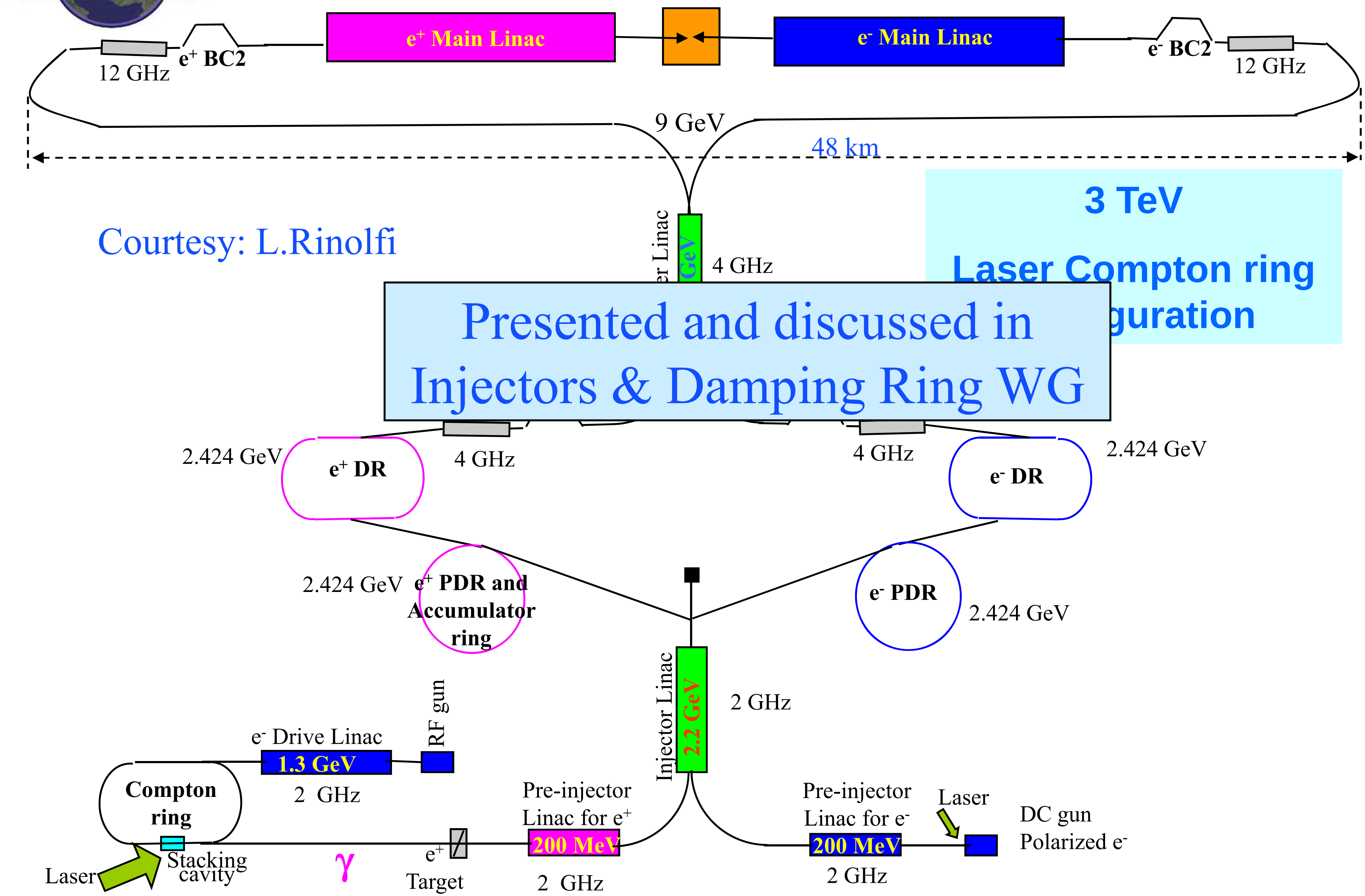


Courtesy: L.Rinolfi

3 TeV

Base line configuration

The CLIC Injector complex (Compton)



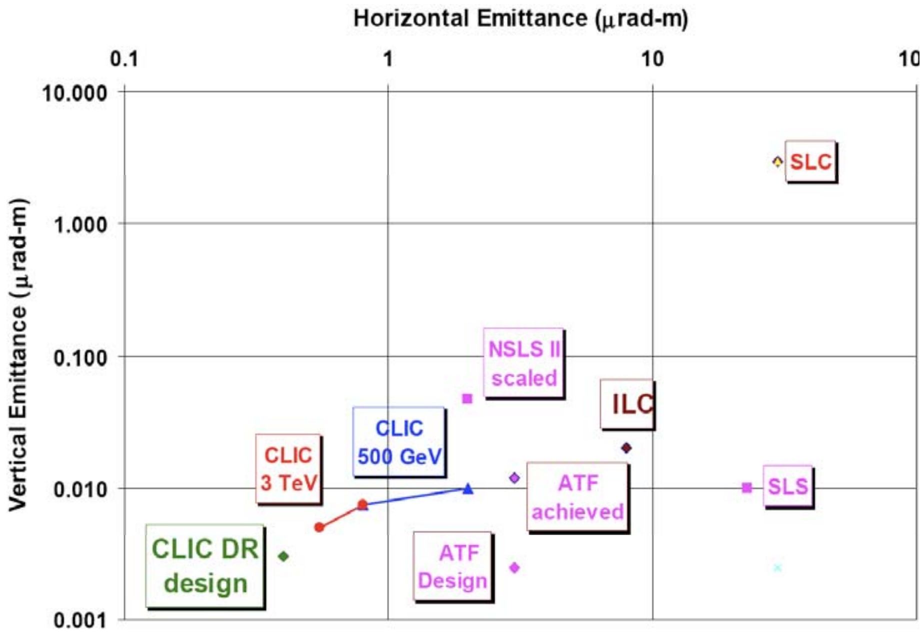
Courtesy: L.Rinolfi

3 TeV

Laser Compton ring ...guration

Presented and discussed in Injectors & Damping Ring WG

Damping ring design



PARAMETER	NLC	CLIC (3TeV)
bunch population (10^9)	7.5	4.1
bunch spacing [ns]	1.4	0.5
number of bunches/train	192	316
number of trains	3	1
Repetition rate [Hz]	120	50
Extracted hor. normalized emittance [nm]	2370	<550
Extracted ver. normalized emittance [nm]	<30	<5
Extracted long. normalized emittance [keV.m]	10.9	<5
Injected hor. normalized emittance [μm]	150	63
Injected ver. normalized emittance [μm]	150	1.5
Injected long. normalized emittance [keV.m]	13.18	1240

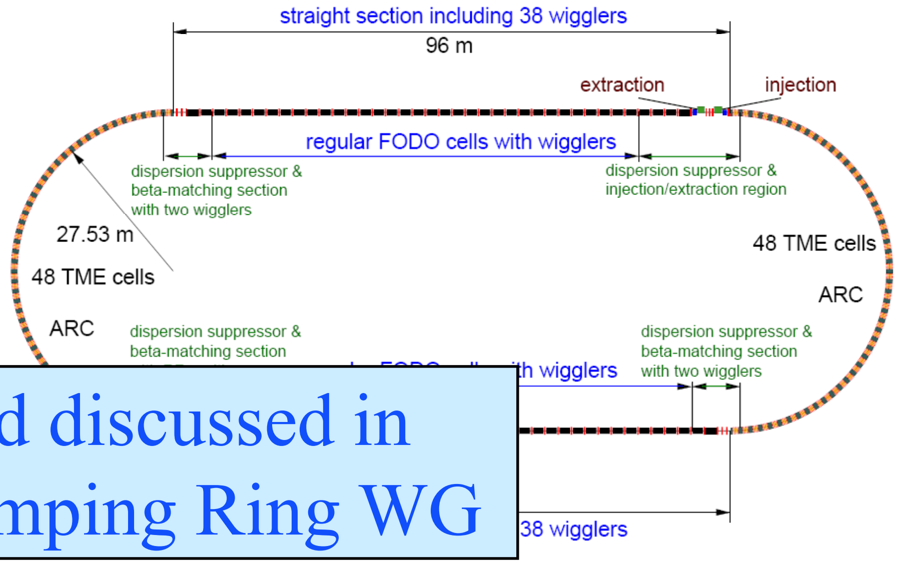
Courtesy: Y.Papaphilipou

- Present CLIC DR design for **3TeV** achieves goals for transverse emittances with a 20%-30% margin (**380nm** horizontal and **4.1nm** vertical)
- Conservative DR output emittances (**2.4μm** horizontal, **10nm** vertical) for CLIC @ **500GeV** scaled from operational or approved light source projects (NSLSII, SLS)
- Route to lower emittances to be defined

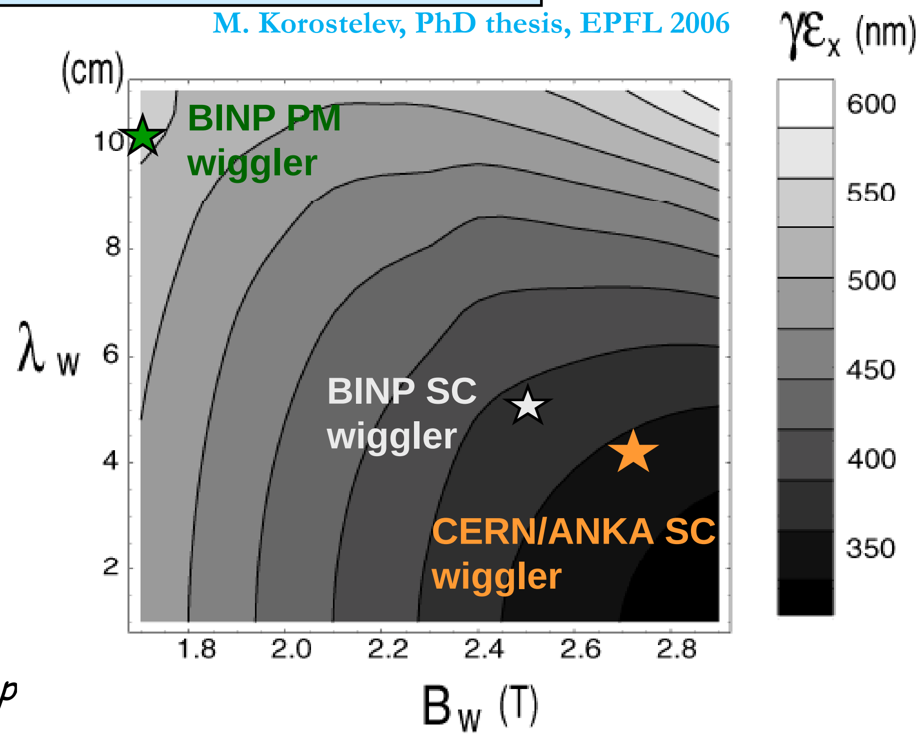
CLIC damping rings

- Two **365.2m** long rings of racetrack shape @ **2.424GeV**
- Arcs filled with **TME cells** and straights with **2m-long superconducting** damping wigglers (**2.5T**, **5cm** period)
- Output emittance st
IBS
- Issues to be address
    - Lattice optimization (magnet design, non-linear dynamics)
    - Superconducting wiggler design progress (NbTi/Nb_3Sn, radiation absorption)
    - Collective effects (e^- cloud, IBS)
    - RF system considerations
    - ILC/CLIC DR common issues
    - Pre-damping ring design (positron stacking)

Presented and discussed in Injectors & Damping Ring WG



M. Korostelev, PhD thesis, EPFL 2006



Beam emittance preservation
Beam Dynamics, alignment and stability

Emittance blow-up from Damping Ring to BDS limited:
- **in Horizontal to 30% from 500 nrad**
- **in Vertical to 300% from 5 nrad**

Pre-
Beam
S

Magnet	Horiz.	Vert.
		1.3 nm
		5to1 nm

s

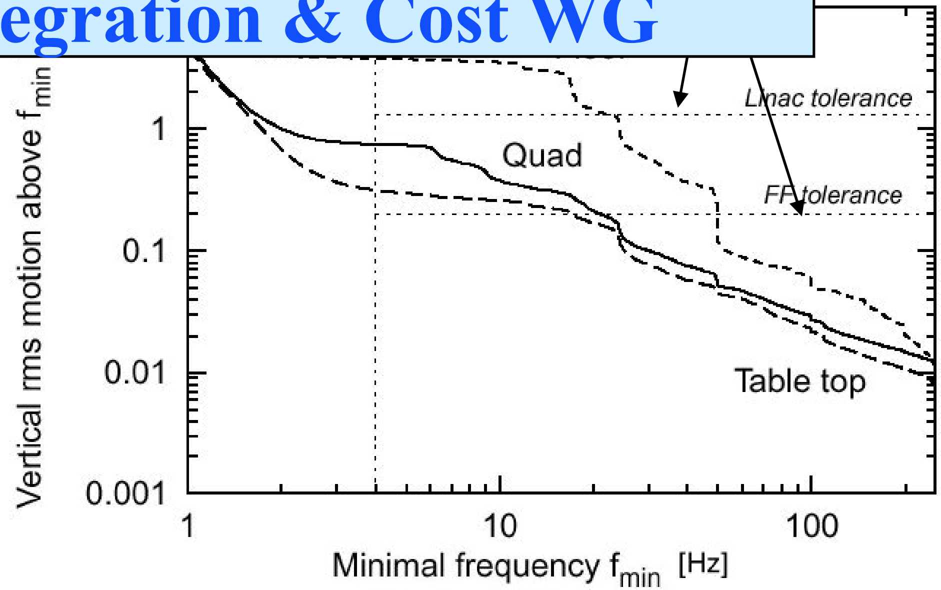
Presented and discussed in
Main & Drive Beam Dynamics WG
and
Technical issues, Integration & Cost WG

Achieved stability

on CERN vibration test stand

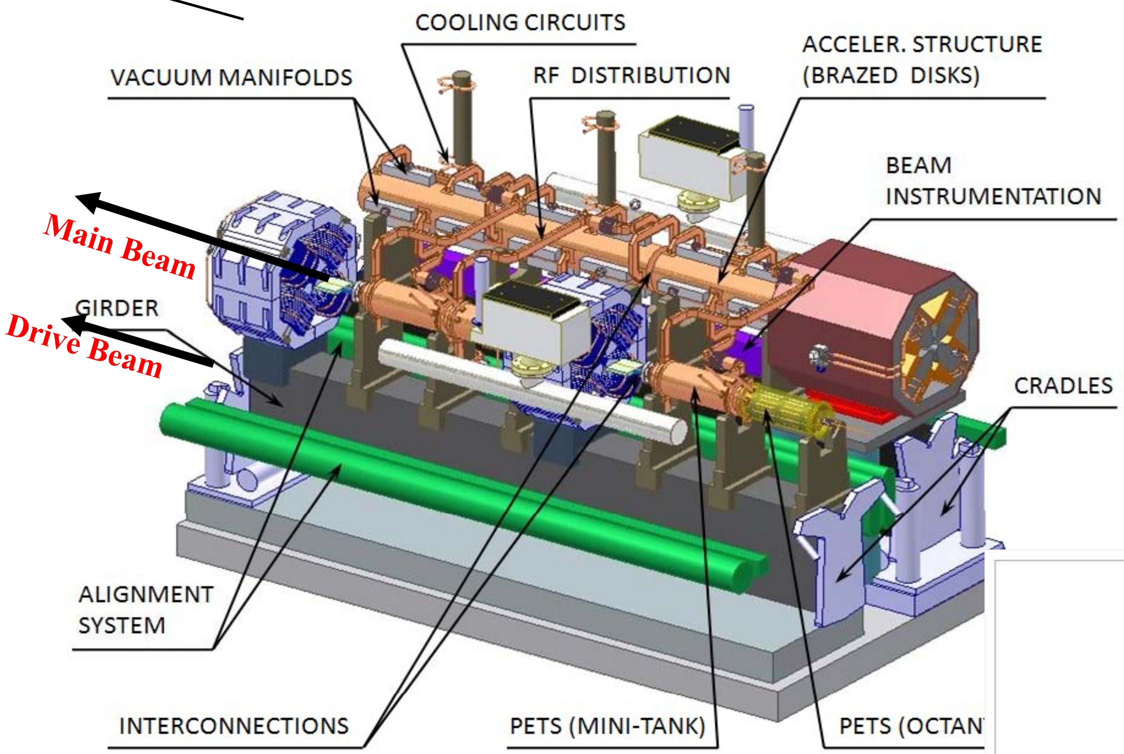
Test made in noisy environment, active damping reduced vibrations by a factor about 20, to rms residual amplitudes of:

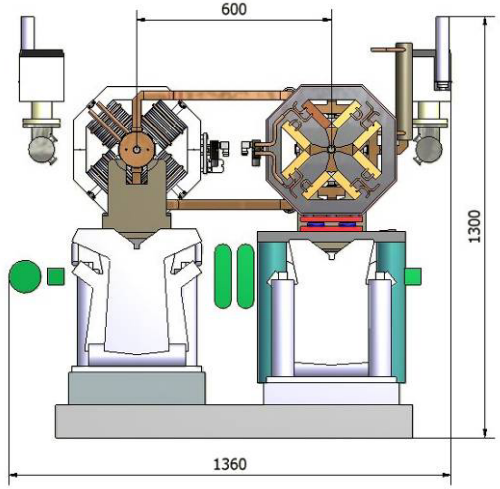
Vert.	0.9 ± 0.1 nm
	1.3 ± 0.2 nm with cooling water
Horiz.	0.4 ± 0.1 nm

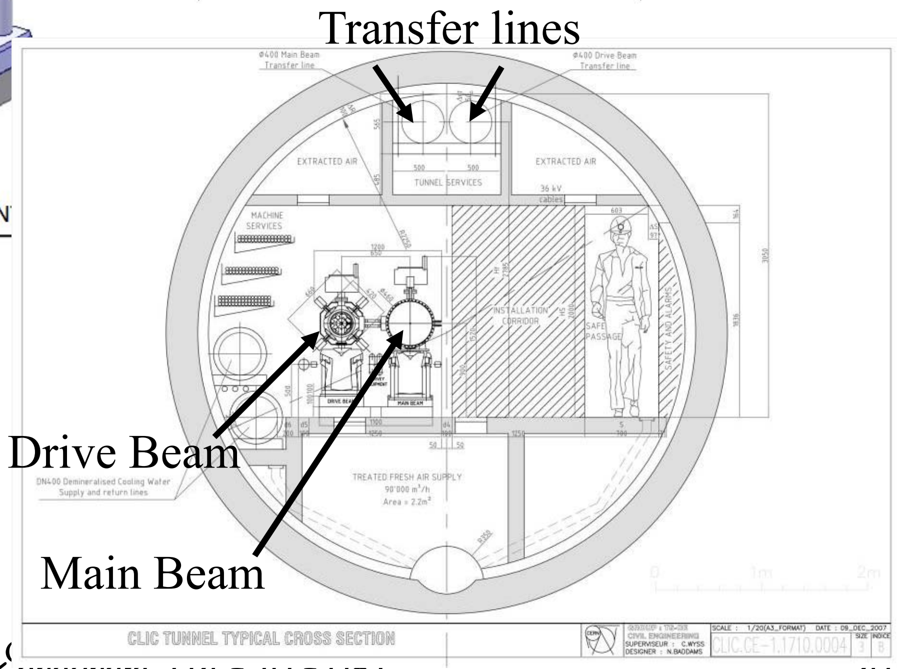


CLIC Accelerating Module

Courtesy: G.Riddone







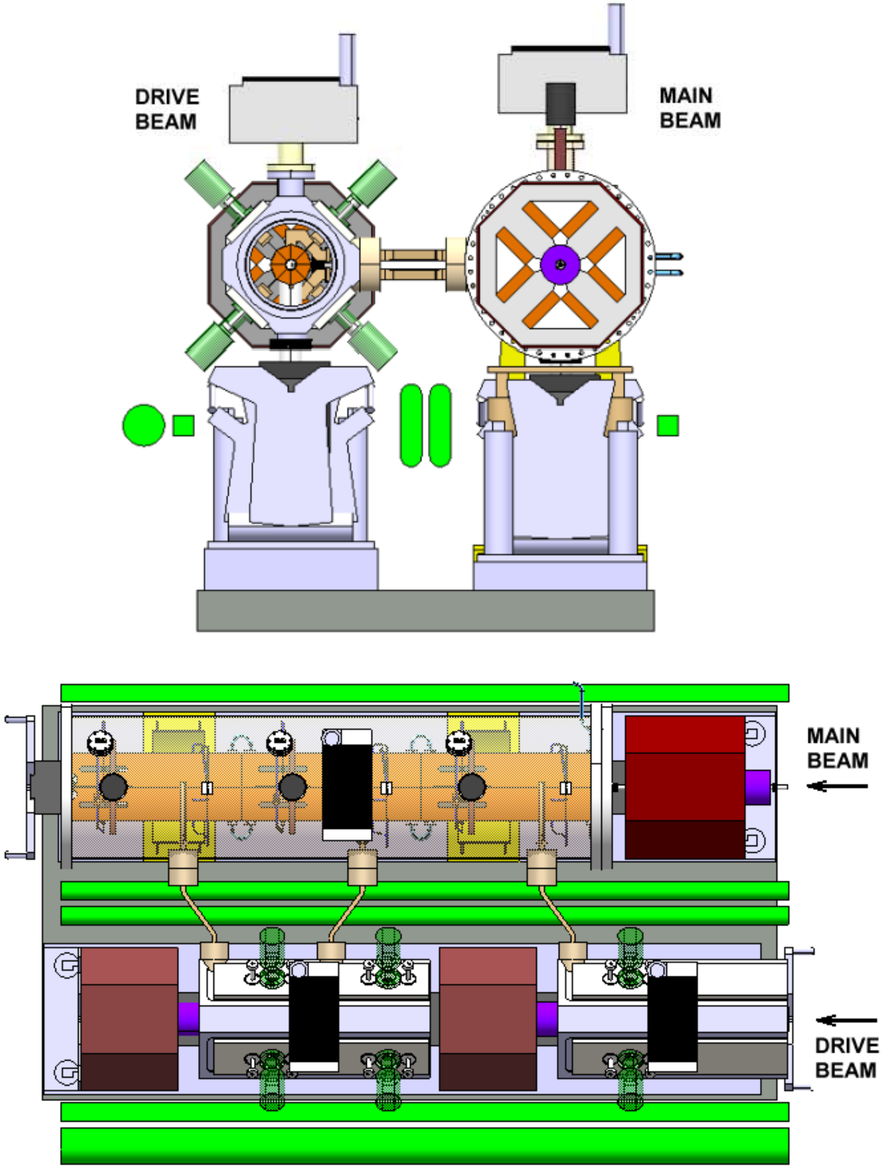
20760 modules (2 meters long)

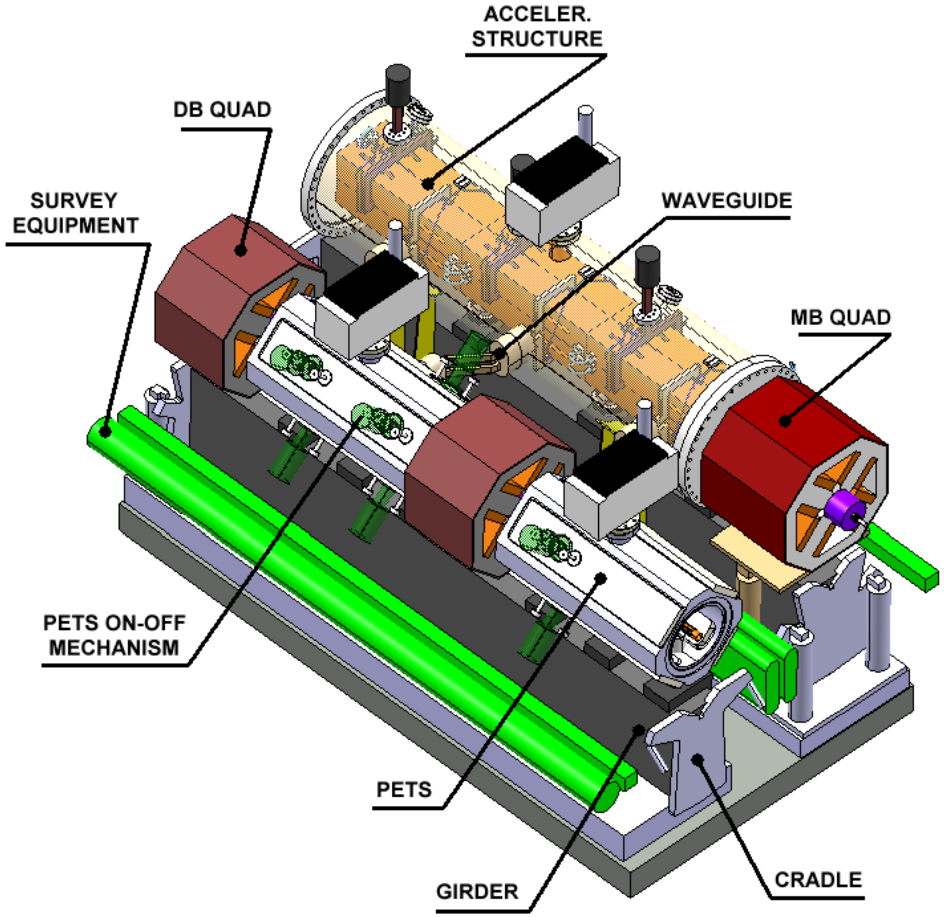
71460 power production structures PETS (drive beam)

143010 accelerating structures

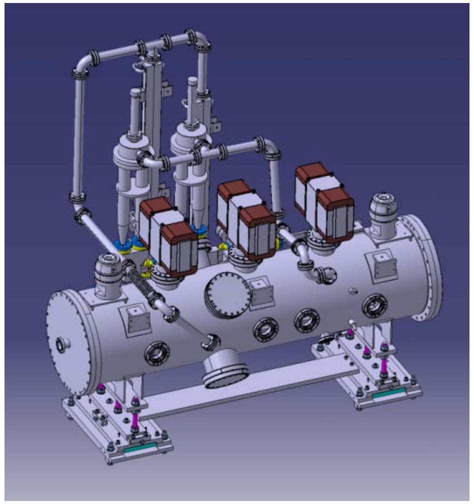
(main beam)

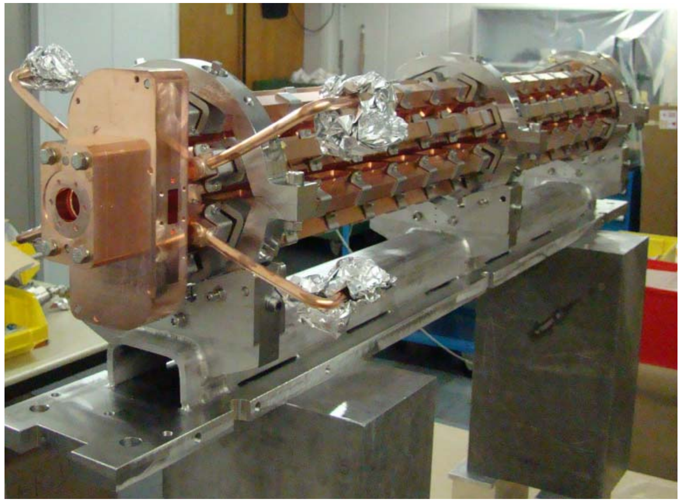
CLIC Standard Two Beam Module





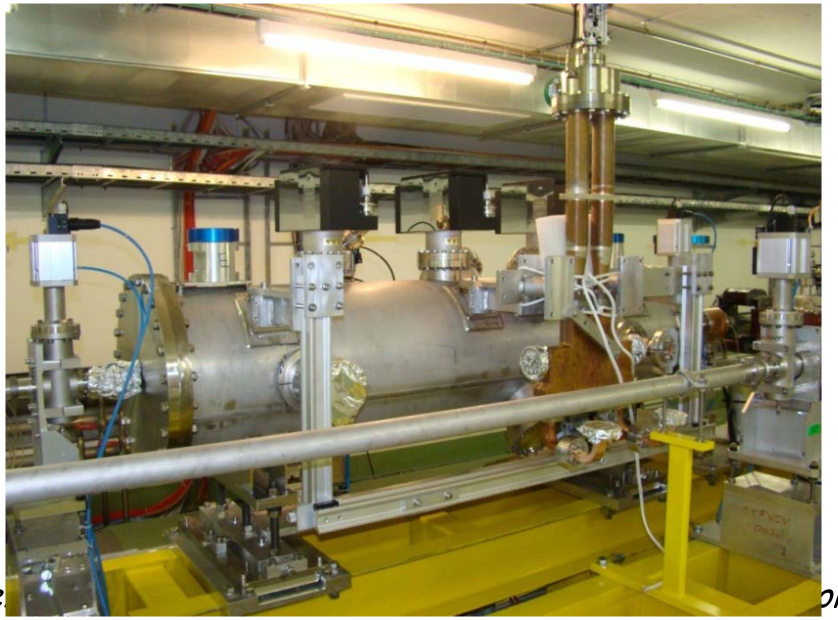
Power Extraction Structure test (PETS) in CTF3

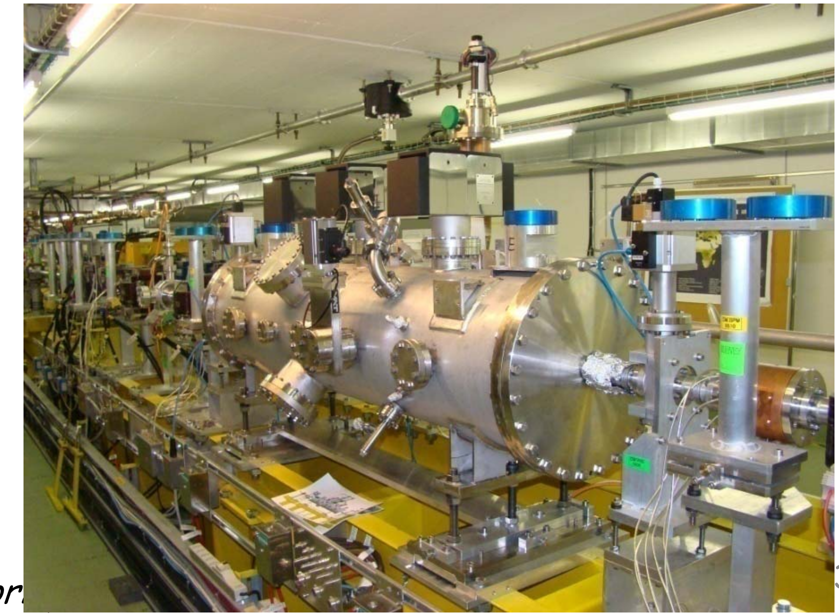




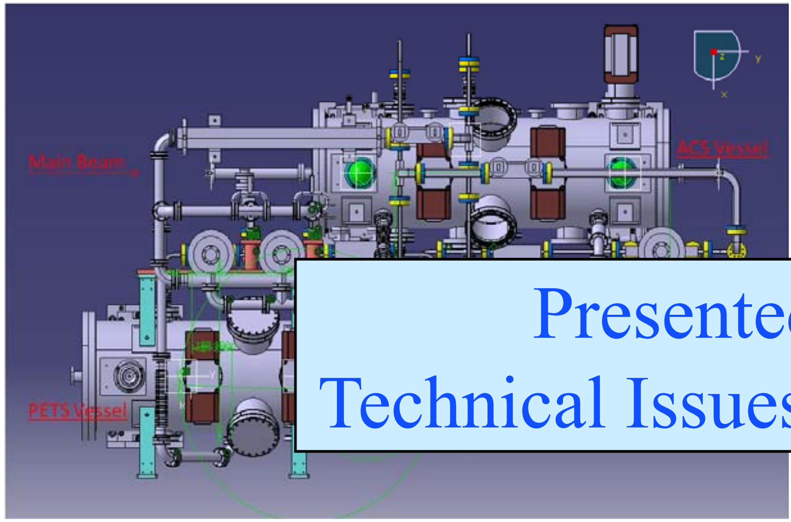
PETS installation in tank successful
(**collaboration with Pakistan – NPC Islamabad**)

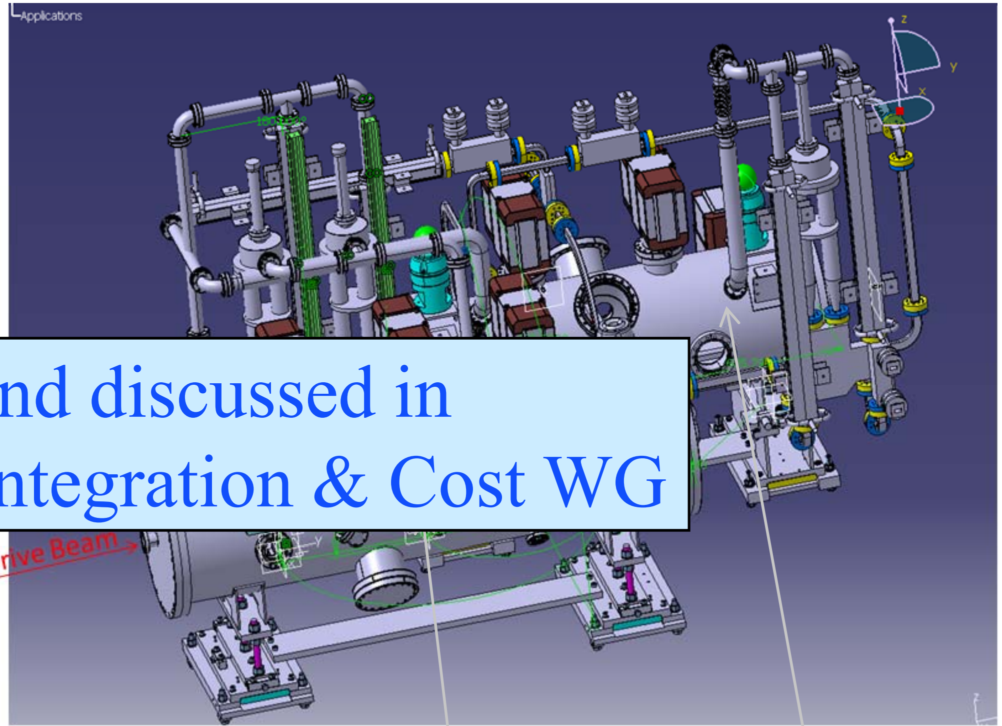
PETS installation in CLEX under way



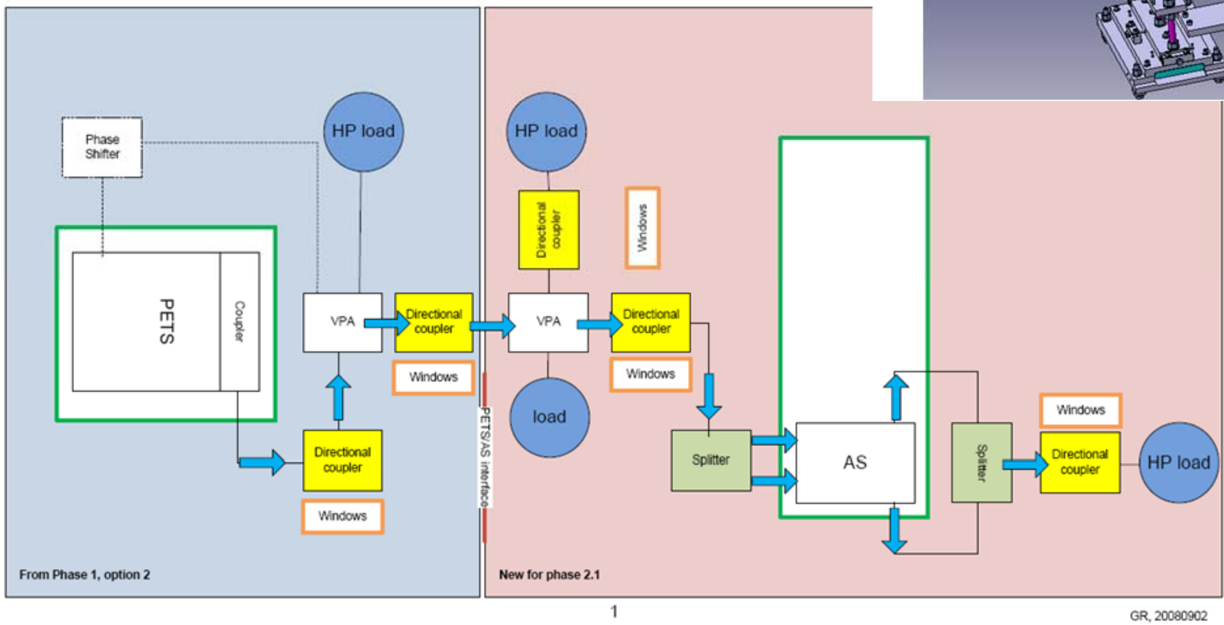


Two Beam Test Stand (TBTS) in CTF3





Presented and discussed in
Technical Issues, Integration & Cost WG



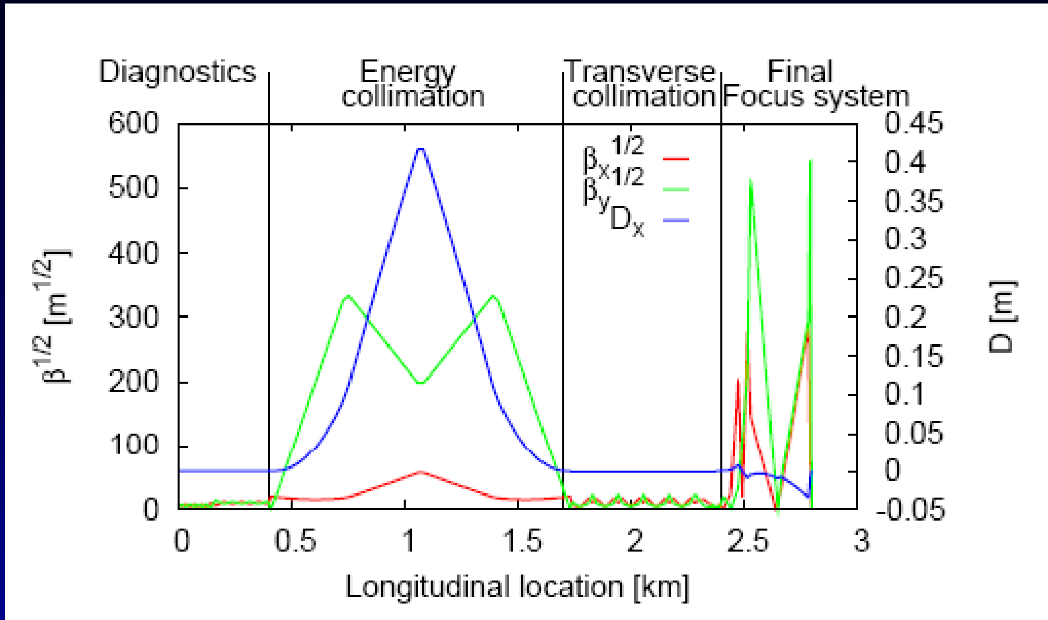
PETS

Accelerating structure

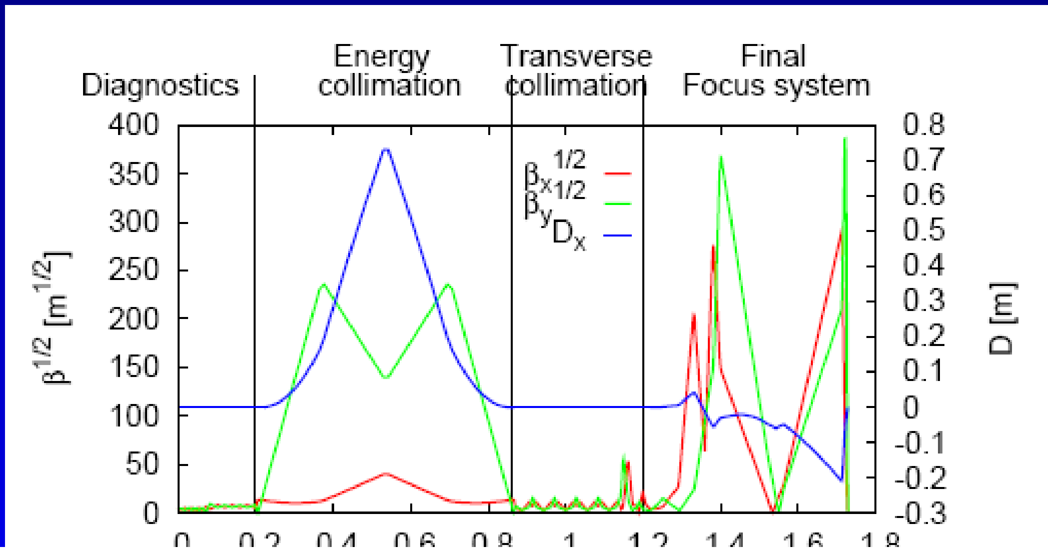
The CLIC BDS

Courtesy: R.Tomas Garcia

3 TeV



500 GeV



The CLIC BDS hot topics

Courtesy: R.Tomas Garcia

- Collimation: collimator survival, collimator wakefields, lattice design.
- BDS global alignment and stabilization
- FFS design and L*: 3.5m, 4.3m, ?
- FFS tuning strategies need improvement
- ATF2 ultra-low betas proposal to address CLIC-like chromaticities and tuning problems
- Polarization measurement inclusion and its impact in the lattice

Presented and discussed in BDS & MDI WG

Beam Instrumentation

Instrument	How many?
Intensity	356
Position	45008
Beam Size / Emittance/Energyspread	784
Energy	205
EnergySpread	205
BunchLength	302
BeamLoss	0
Beam Halo	0
Beam Phase	96

Drive Beam

➡ 46956 devices

Instrument	*How many?*
Intensity	229
Position	8126
Beam Size / Emittance/Energy spread	203
Energy	73
Energy Spread	20
BunchLength	10
BeamLoss	1
Beam Halo	0
Beam Phase	1
BeamPolarization	35
Luminosity	10
Wakefield monitor	142816

Main Beam

➡ 151524 devices

List Critical Beam Diagnostics

All instruments are mandatory for machine performance optimization

<u>Feasibility issues:</u>

- Need to study the Machine Protection System for both the Drive and Main beams and to develop a Beam loss monitoring system along the CLIC Linac (both beams)

-Very tight requireme 40-75microns short bunch length ar

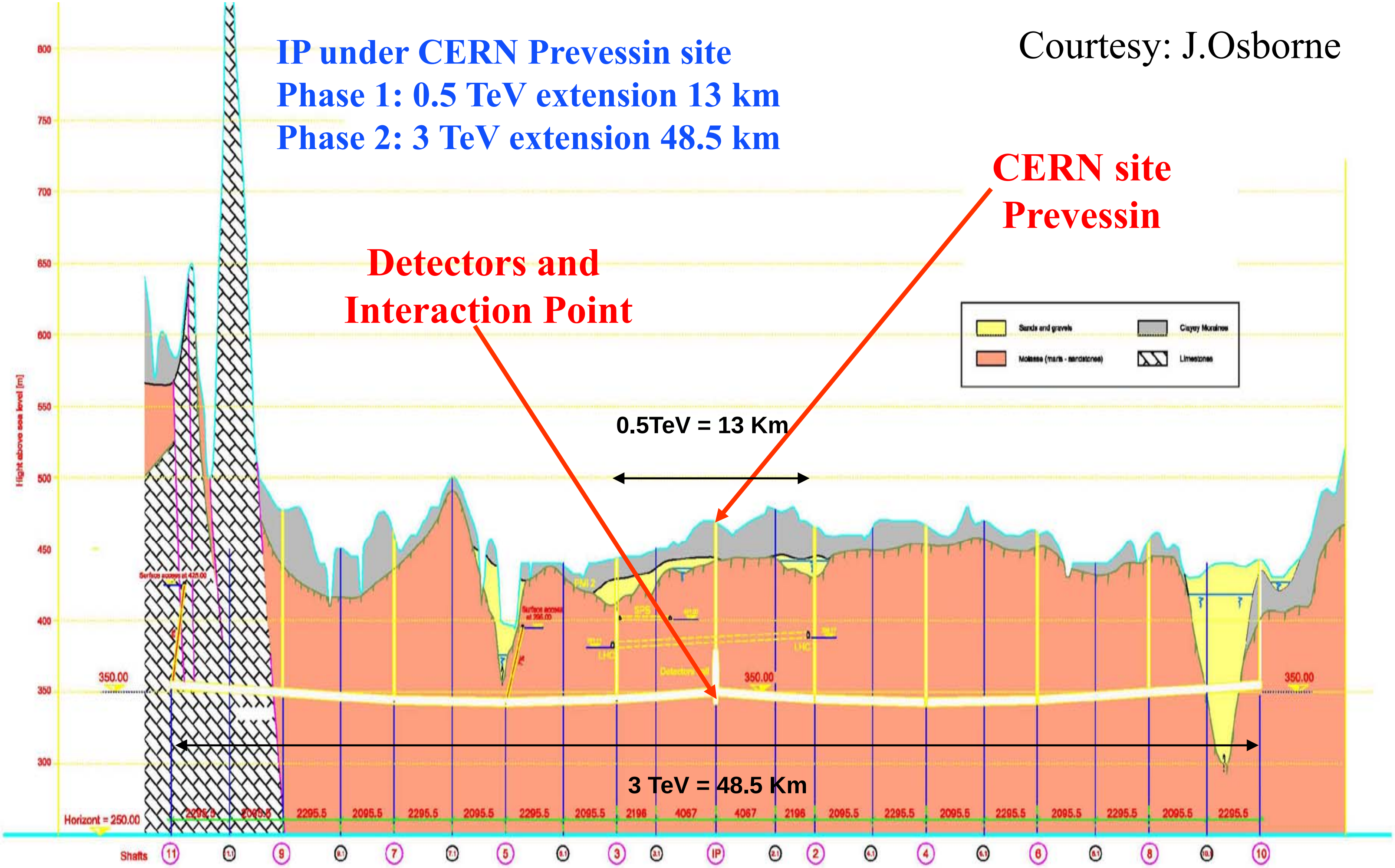
- Reliability, availabilit on of roughly 5000 high resolution (50nm) BPMs, 150000 wakefield monitors with 5µm resolution and 40000 BPMs for the Drive Beam decelerators

- Beam synchronization implies a very precise phase measurement (0.1deg at 12GHz) with an adequate feedforward system and a stability of the Drive Beam energy and intensity of 3.10^{-5}

Presented and discussed in Instrumentation WG

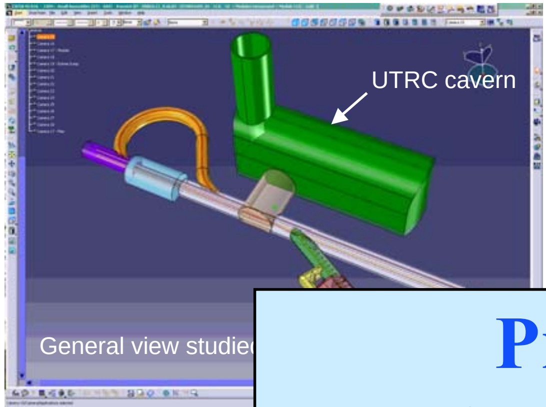
Longitudinal section of a laser straight Linear Collider on CERN site–

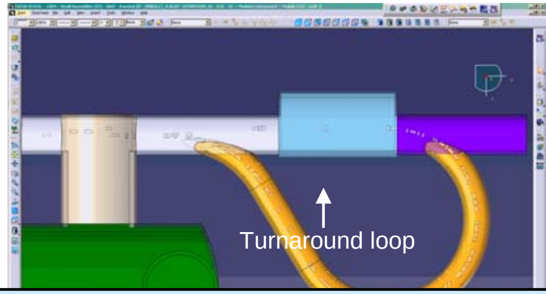
Courtesy: J.Osborne

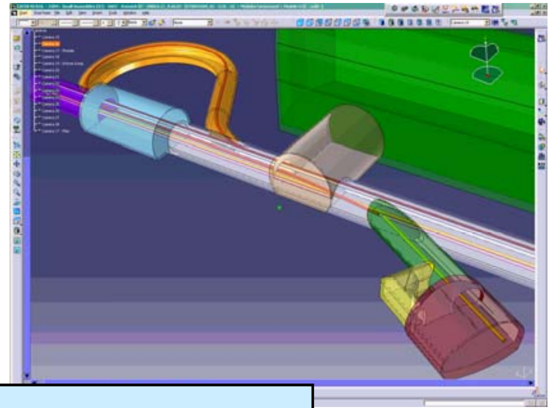


Civil Engineering and Services (CES) :

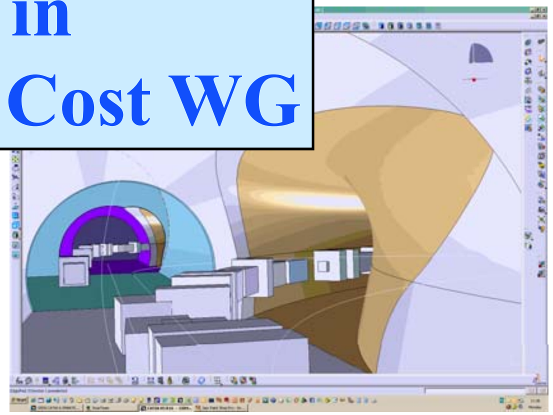
Key Issues for CLIC08 Workshop



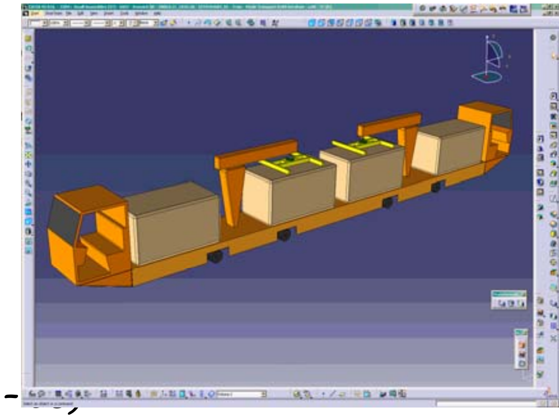




Presented and discussed in Technical Issues, Integration & Cost WG



- •Tunnel Layout and Cross Section
- •Transport of the CLIC modules and elements
- •Cooling and Ventilation in the tunnel
- •ILC Collaboration for CES issues :
    - •Safety issues for underground structures
    - •ILC underground layouts
    - •The Dubna proposal for ILC



Courtesy: J.Osborne

CONCLUSION

- CLIC design (3 TeV and 500 GeV) and R&D addressing all CLIC technology feasibility issues on schedule for completion of Conceptual Design Report (TDR) by 2010 including:
    - Concept of accelerator and detector
    - R&D on critical issues and results of feasibility
    - Preliminary performance and cost
- R&D on complementary issues related to Performance and Cost to be completed and reported in a Technical Design Report with consolidated performance and cost by 2015
- A lot still to be done before the CLIC technology is mature enough to be considered for a future Linear Collider
    - Perspectives beyond 2010 in presentation of H.Braun
- CLIC/CTF3 multi-lateral collaboration strong of 27 institutes from 15 countries extremely efficient and fruitful
    - Importance of CLIC/ILC collaboration
- Your participation before, during and after the workshop warmly welcome and appreciated

Welcome to reinforce or join the CLIC collaboration

CLIC08 workshop (Chairman: H.Braun)

In the series of yearly CLIC workshop

Building-up and follow-up of very successful CLIC07

http://indico.cern.ch/conferenceDisplay.py?confId=17870

CLIC'08 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 aiming at:

- **Review the R&D towards CLIC Feasibility Demonstration and Conceptual Design Report in 2010 including items of CLIC-ILC Common Interest as defined in the CLIC-ILC Collaboration.**
- **Identify the R&D, Facilities and Engineering Efforts needed in the period after 2010 to progress from a Conceptual Design to a Technical Design.**
- **Address Particle Physics and Detector Issues of a Multi-TeV Linear Collider.**

CLIC'08 program outline

Tuesday 14, morning
registration

Tuesday afternoon
Plenary talks
Presentation of WG programs
19:00 Workshop Cocktail in "Globe of Science and Innovation"

Wednesday 15
Work, work, work
18:00 evening session on Plasma Wakefield acceleration, organized by Andrei Seriy

Thursday 16
Work, work, work
19:00 Workshop dinner, Main building , Restaurant 1

Friday morning
WG summaries in plenary & closing remarks

Working group	1st Convener	2nd Convener
Injectors and damping rings	Susanna Giuducci / LNF susanna.guiducci@lnf.infn.it	Louis Rinolfi / CERN Louis.Rinolfi@cern.ch
Main & drive beam dynamics	Catherina Biscari / LNF caterina.biscari@lnf.infn.it	Daniel Schulte/ CERN Daniel.Schulte@cern.ch
Instrumentation	Grahame Blair / JAI blair@pp.rhul.ac.uk	Thibaut Lefevre / CERN Thibaut.Lefevre@cern.ch
RF structures and sources	Chris Adolphsen / SLAC star@slac.stanford.edu	Walter Wuensch / CERN Walter.Wuensch@cern.ch
Technical Issues, Integration & Cost	Roger Ruber / Uppsala Roger.Ruber@cern.ch	Germana Riddone / CERN Germana.Riddone@cern.ch
Beam delivery system & Machine detector interface	Andrei Seryi / SLAC seryi@slac.stanford.edu	Rogelio Tomas /CERN Rogelio.Tomas@cern.ch
Linear collider test facilities	Toshiaki Tauchi / KEK toshiaki.tauchi@kek.jp	Roberto Corsini / CERN Roberto.Corsini@cern.ch
Physics & Detectors	Yannis Karyotakis karyotakis@lapp.in2p3.fr	Albert de Roeck /CERN Albert.de.Roeck@cern.ch
Plasma Wakefield Accelerator special evening session, October 15	Andrei Seryi / SLAC seryi@slac.stanford.edu	NA

New !