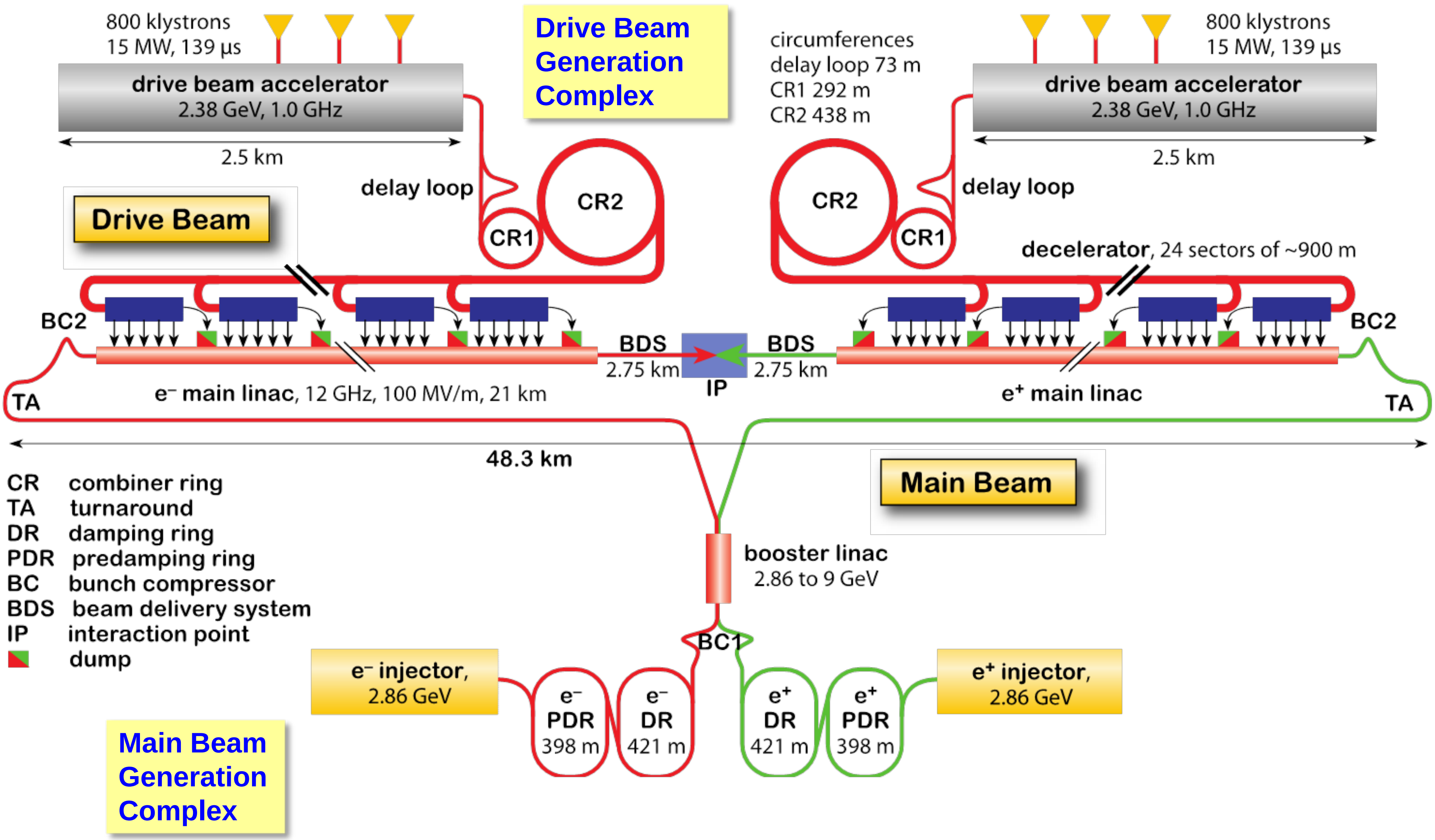
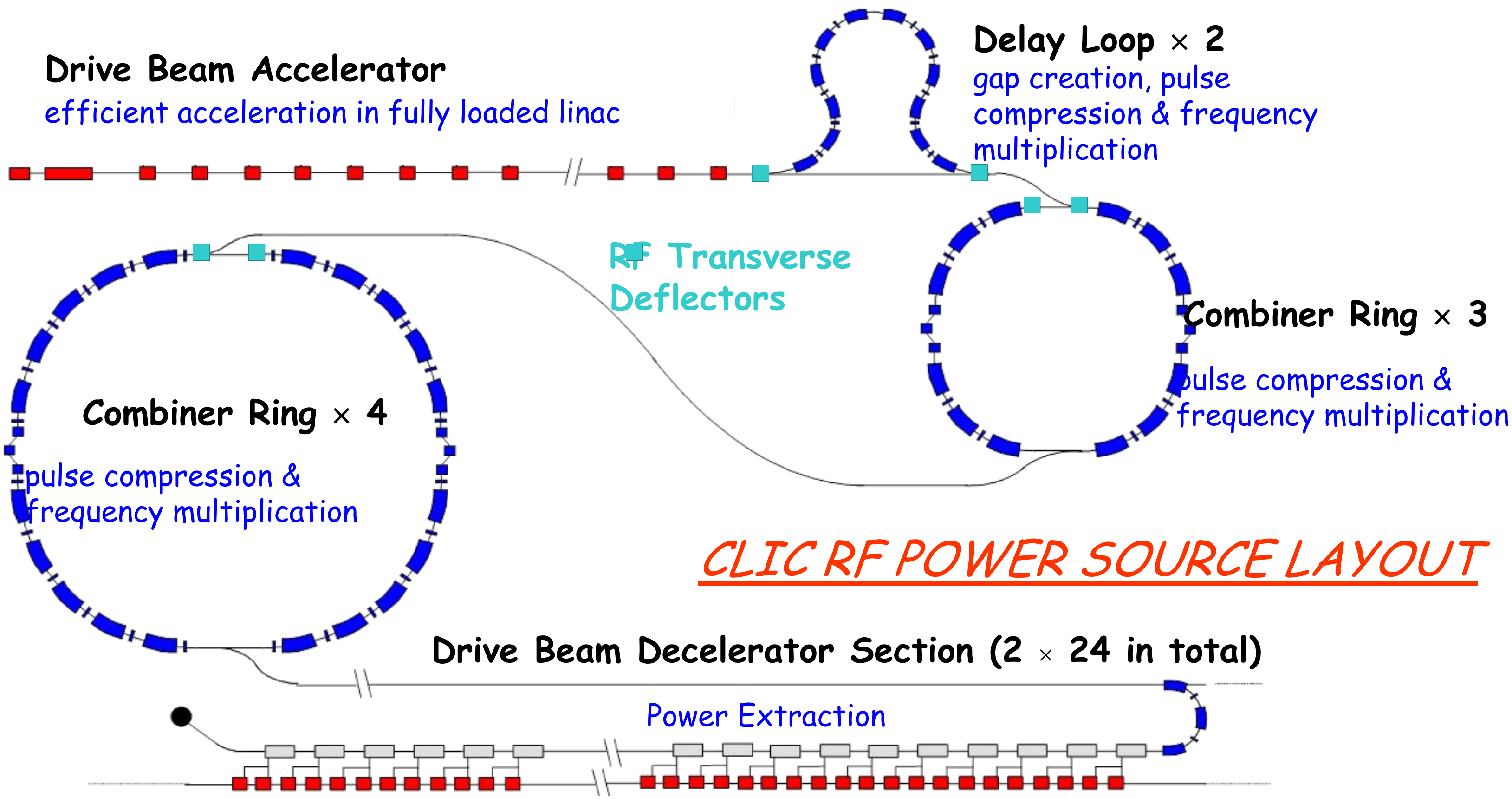
CLIC status and plans

- Accelerator studies and status
- Detectors at CLIC
- Physics scope and Implementation studies
- Program 2012-16 and beyond
- Summary

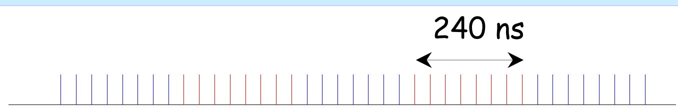
CLIC Layout at 3 TeV



CLIC Power Source Concept

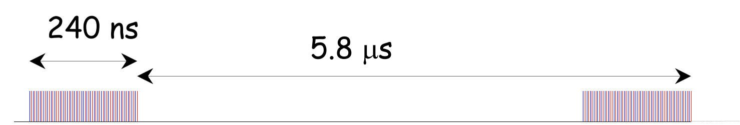


Drive beam time structure - initial



140 μs train length - 24 × 24 sub-pulses
4.2 A - 2.4 GeV – 60 cm between bunches

Drive beam time structure - final



24 pulses – 101 A – 2.5 cm between bunches

Current CLIC&CTF3 Collaboration

CLIC multi-lateral collaboration - 44 Institutes from 22 countries

ACAS (Australia)
Aarhus University (Denmark)
Ankara University (Turkey)
Argonne National Laboratory (USA)
Athens University (Greece)
BINP (Russia)
CERN
CIEMAT (Spain)
Cockcroft Institute (UK)
ETH Zurich (Switzerland)
FNAL (USA)
Gazi Universities (Turkey)
Helsinki Institute of Physics (Finland)
IAP (Russia)
IAP NASU (Ukraine)
IHEP (China)
INFN / LNF (Italy)
Instituto de Fisica Corpuscular (Spain)
IRFU / Saclay (France)
Jefferson Lab (USA)
John Adams Institute/Oxford (UK)
Joint Institute for Power and Nuclear Research SOSNY /Minsk (Belarus)
John Adams Institute/RHUL (UK)
JINR (Russia)
Karlsruhe University (Germany)
KEK (Japan)
LAL / Orsay (France)
LAPP / ESIA (France)
NIKHEF/Amsterdam (Netherland)
NCP (Pakistan)
North-West. Univ. Illinois (USA)
Patras University (Greece)
Polytech. Univ. of Catalonia (Spain)
PSI (Switzerland)
RAL (UK)
RRCAT / Indore (India)
SLAC (USA)
Sincrotrone Trieste/ELETTRA (Italy)
Thrace University (Greece)
Tsinghua University (China)
University of Oslo (Norway)
University of Vigo (Spain)
Uppsala University (Sweden)
UCSC SCIPP (USA)

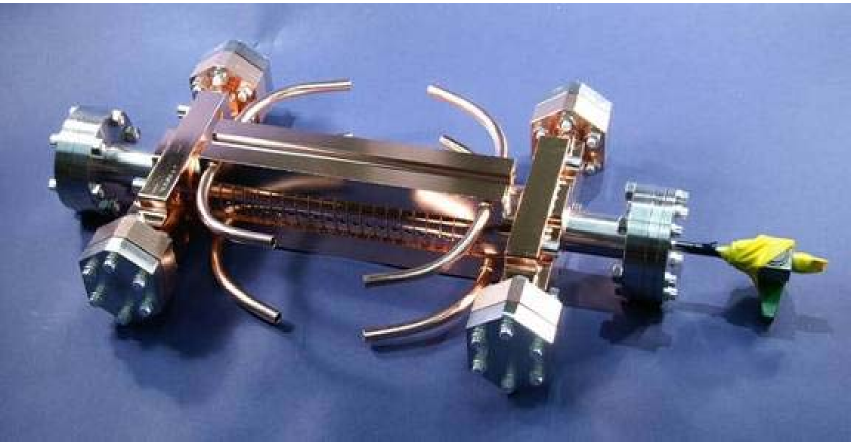
CLIC Main Parameters

parameter	symbol		
centre of mass energy	E_{cm} [GeV]	500	3000
luminosity	$\mathcal{L}$ $[10^{34}\ cm^{-2}s^{-1}]$	2.3	5.9
luminosity in peak	$\mathcal{L}_{0.01}$ $[10^{34}\ cm^{-2}s^{-1}]$	1.4	2
gradient	G [MV/m]	80	100
site length	[km]	13	48.3
charge per bunch	N $[10^9]$	6.8	3.72
bunch length	σ_z [μm]	72	44
IP beam size	σ_x/σ_y [nm]	200/2.26	40/1
norm. emittance	ϵ_x/ϵ_y [nm]	2400/25	660/20
bunches per pulse	n_b	354	312
distance between bunches	Δ_b [ns]	0.5	0.5
repetition rate	f_r [Hz]	50	50
est. power cons.	P_{wall} [MW]	271	582

Key Design Issues

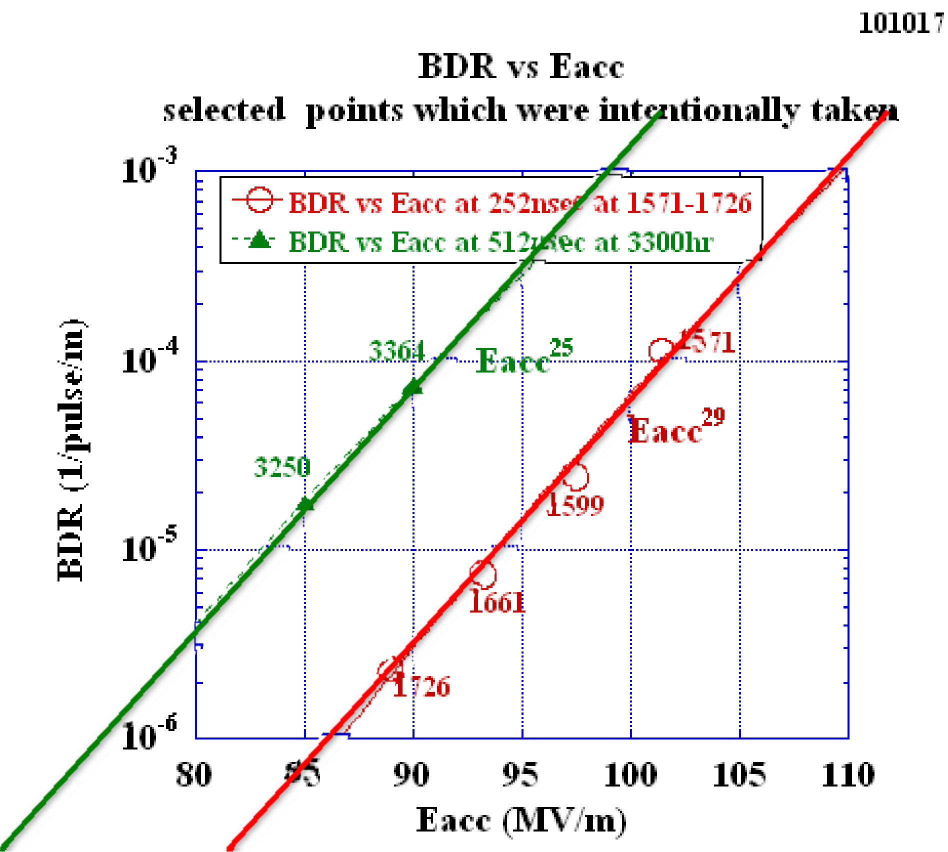
Main linac gradient	– Accelerating structure
Drive beam scheme	– Drive beam generation – PETS (power extraction and transfer structures) – Two beam acceleration – Drive beam deceleration
Luminosity	– Main beam emittance generation, preservation and focusing – Alignment and stabilisation
Operation and Machine Protection System (robustness)	
Detector (experimental conditions)	

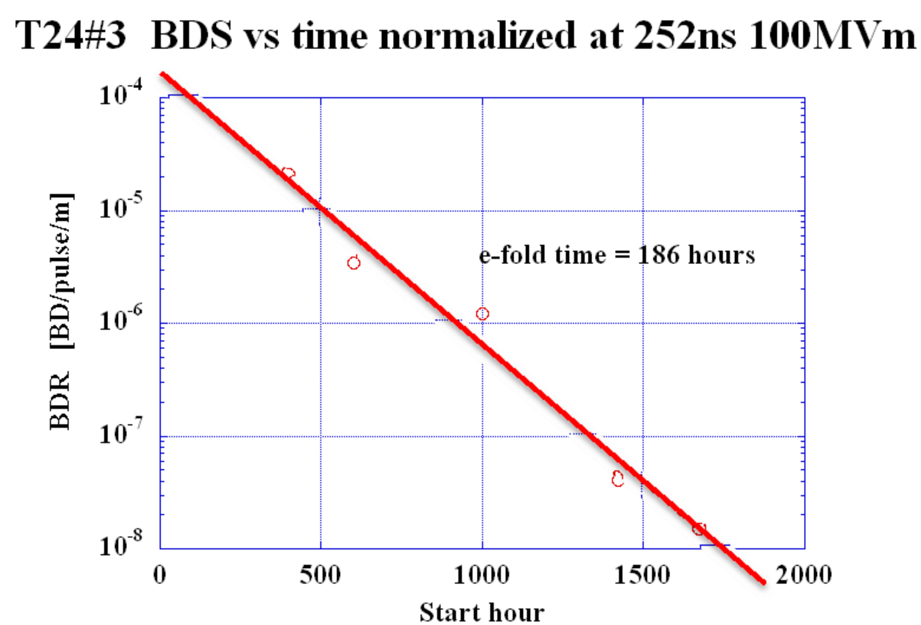
Accelerating Structure



- Require <1% probability of even a single break down in any structure
  - p ≤ $3 \times 10^{-7} m^{-1} pulse^{-1}$

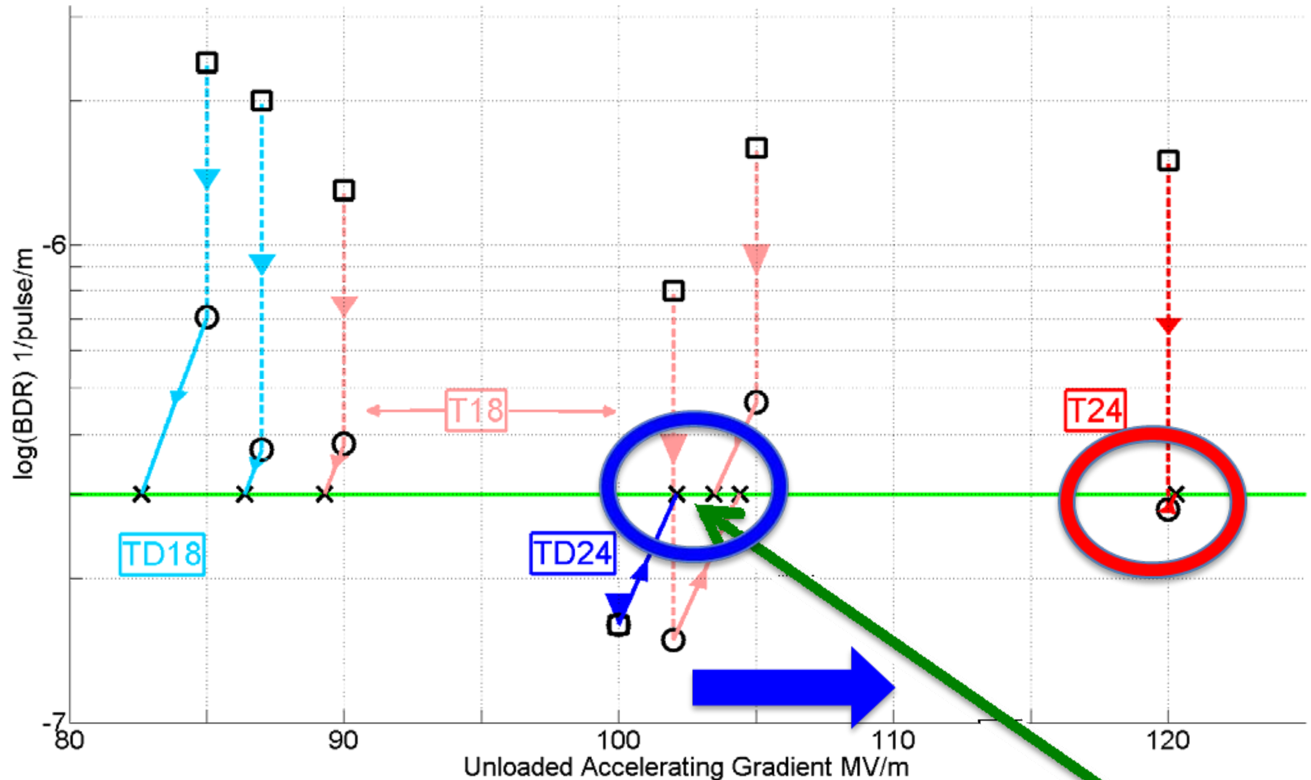
- Design based on empirical constraints





Achieved Gradient

Tests at KEK and SLAC



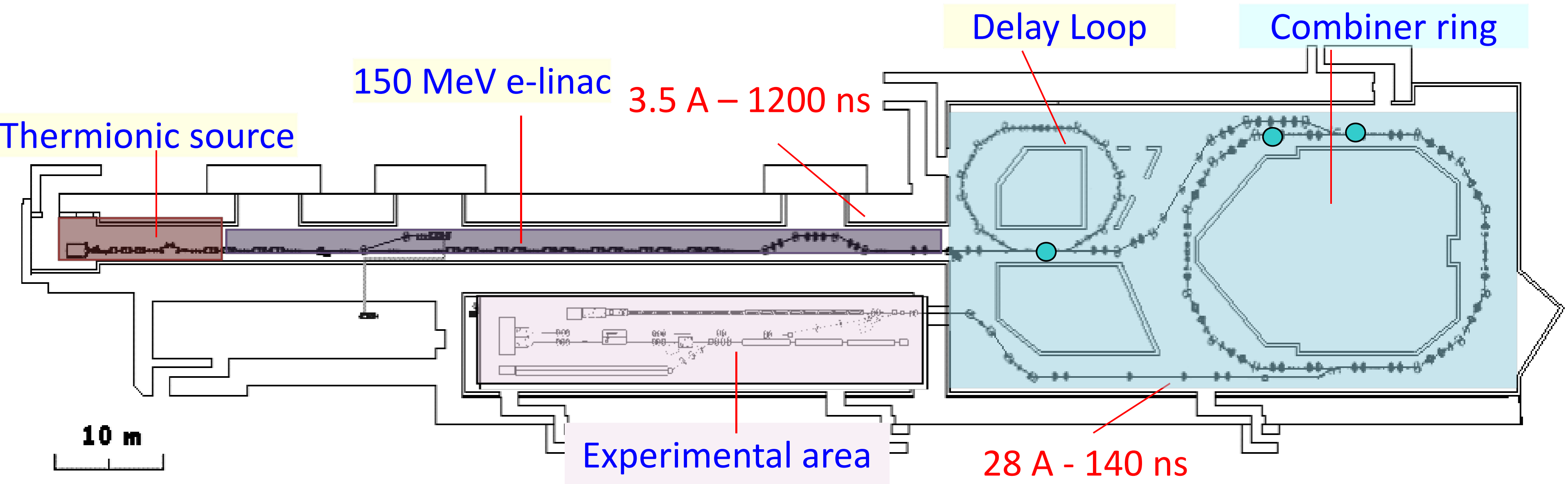
Measurements scaled according to

$$p \propto G^{30}\tau^{5}$$

Unloaded 103MV/m
Expected with beam loading 86-103 MV/m

	Simple early design to get started	More efficient fully optimised structure
No damping waveguides	T18	T24
Damping waveguides	TD18	TD24 = CLIC goal

CLIC Test Facility (CTF3)



parameter	unit	CLIC	CTF3
accelerated current	A	4.2	3.5
combined current	A	101	28
final energy	MeV	2400	≈ 120
accelerated pulse length	μs	140	1.2
final pulse length	ns	240	140
acceleration frequency	GHz	1	3
final bunch frequency	GHz	12	12

Recycled infrastructure
- made it affordable
- causes lots of headache

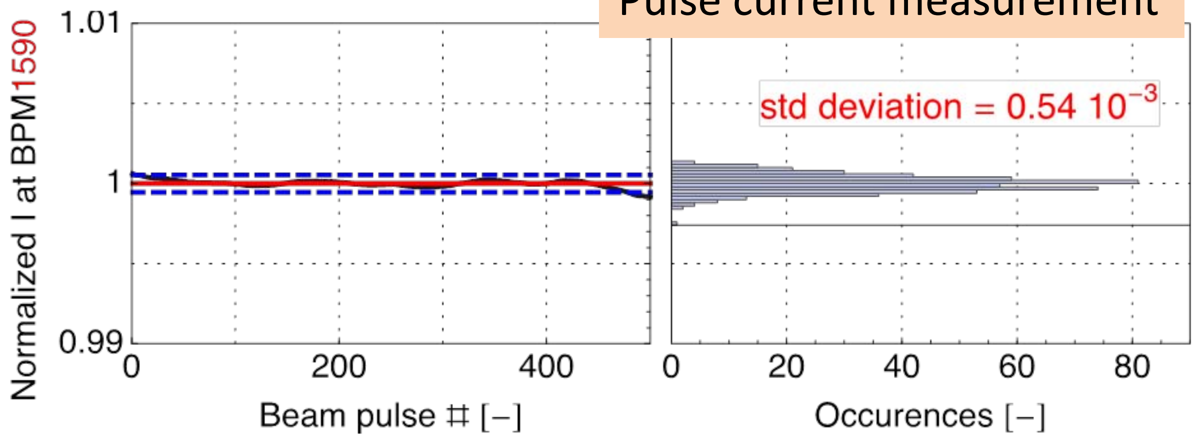
Drive Beam Linac

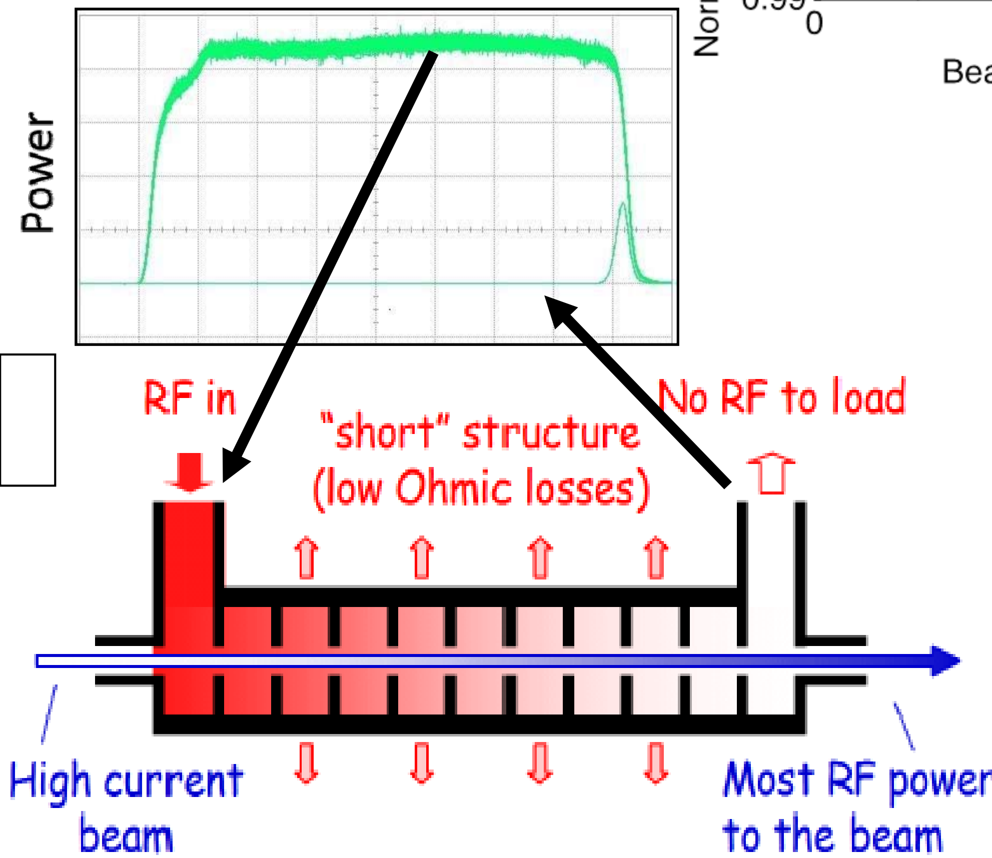
95.3% RF to beam efficiency

No instabilities

Phase switch works OK

Pulse current measurement





Parameter	CLIC goal	CTF3 measured at end of linac
Transverse emittance	100µm	50-60µm
Pulse current	7.5e-4	5.4e-4

Drive Beam Combination

29 A reached, routinely 25A

Significant increase of transverse emittance

Current jitter increases to O(0.1%-1%)

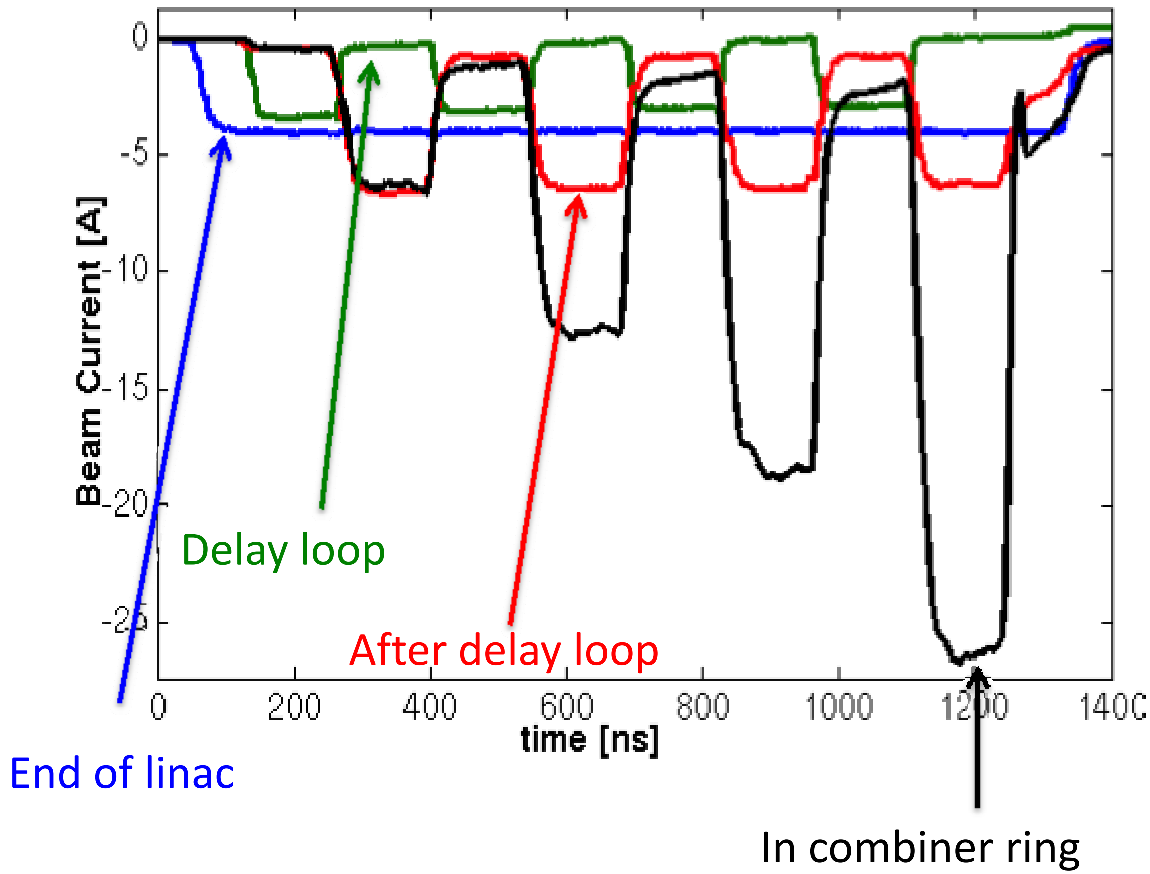
Focus has been on current

- will now further improve beam quality

CTF3 specific issues need to be addressed and limits identified

- RF pulse compression
- Beam energy in combiner ring is 5% of that in CLIC
- Geometric emittance 20 times larger
- …
- …

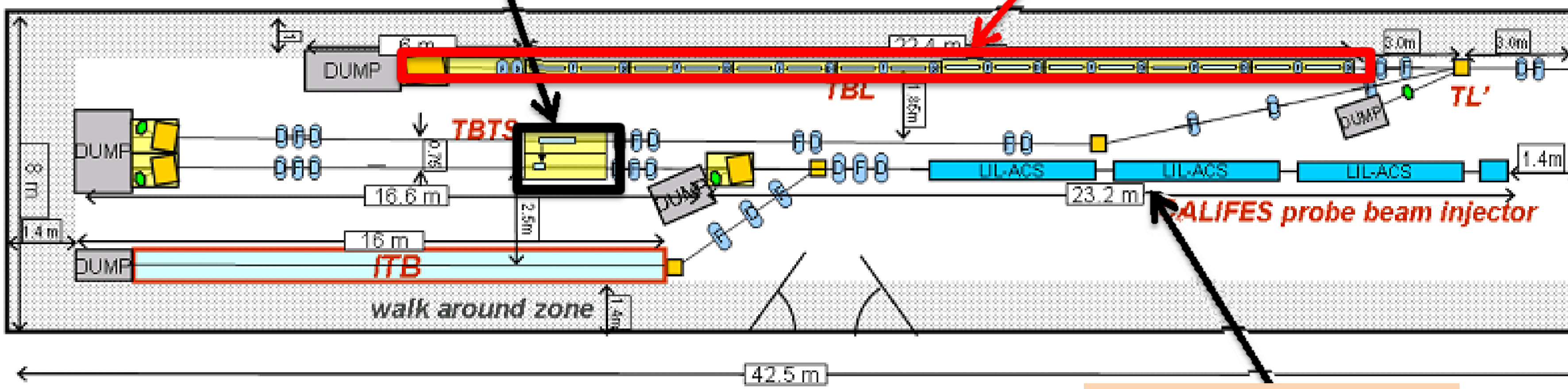
Current measurement in CTF3



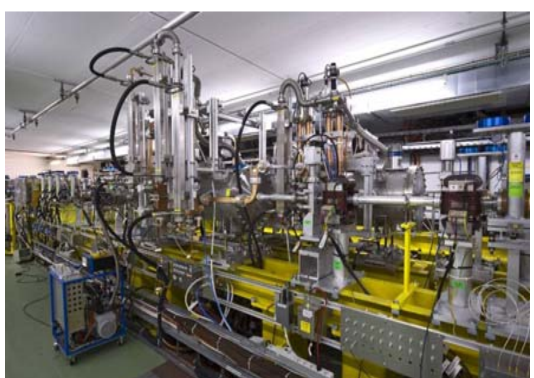
Drive Beam Deceleration and Module: CLEX

TBTS (two-beam test stand)
- power transfer to main beam
- module design

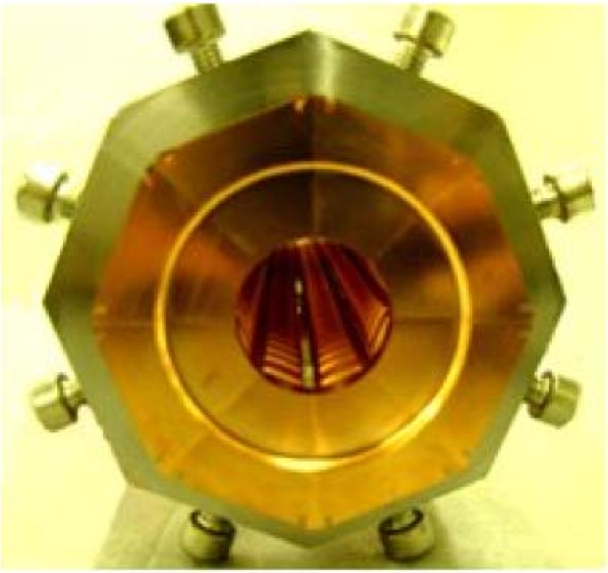
TBL (test beam line)
- drive beam stability during deceleration

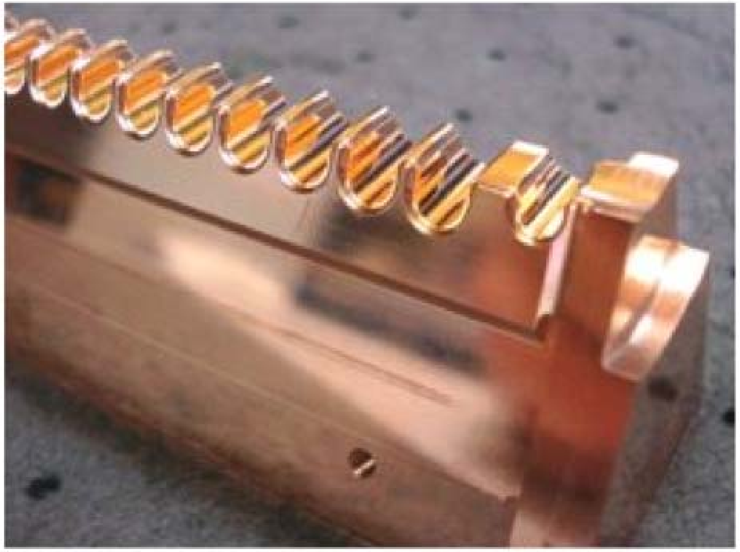


Main beam injector



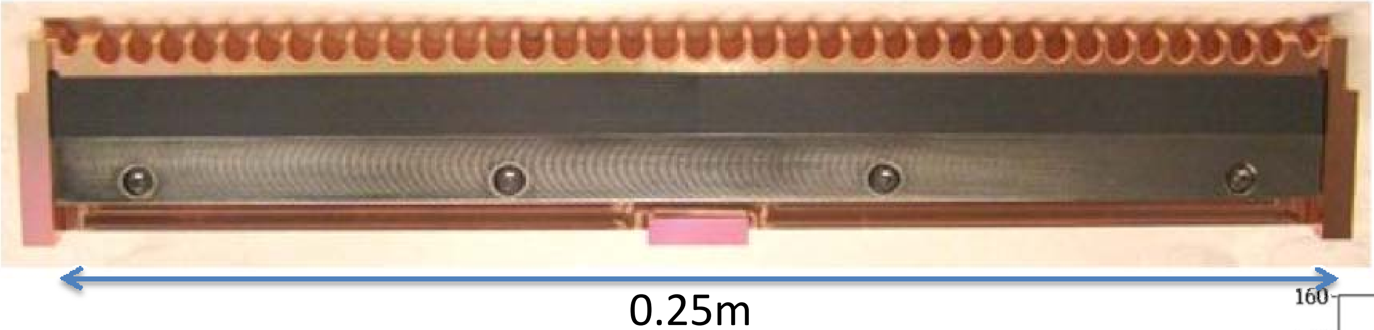
PETS





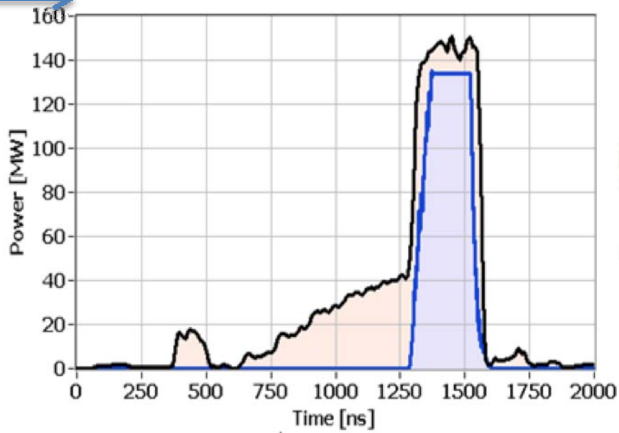
Designed with more margin than accelerating structures

P_{out}≈130MW

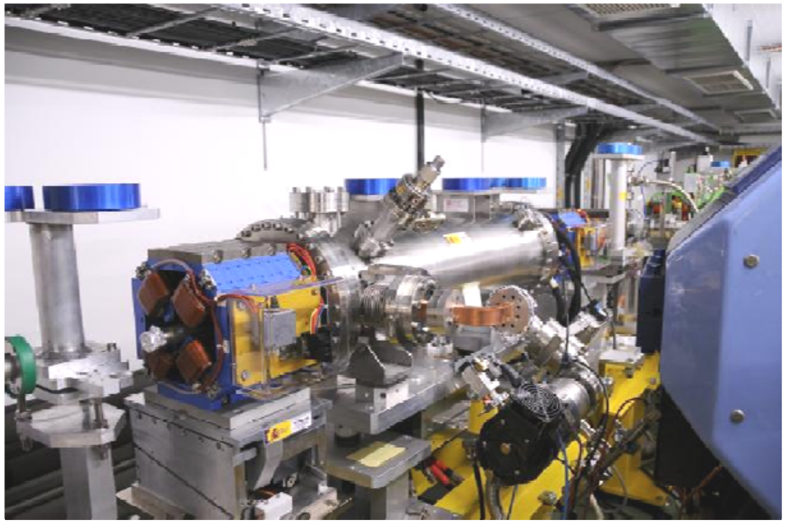


Measurements at SLAC:
No breakdown last O(8 10^6 pulses)
-> P consistent with p≤10^{-7}/m/pulse

Pulse used for measurement and nominal pulse (blue)



TBL: Drive Beam Deceleration



9 out of 16 PETS installed

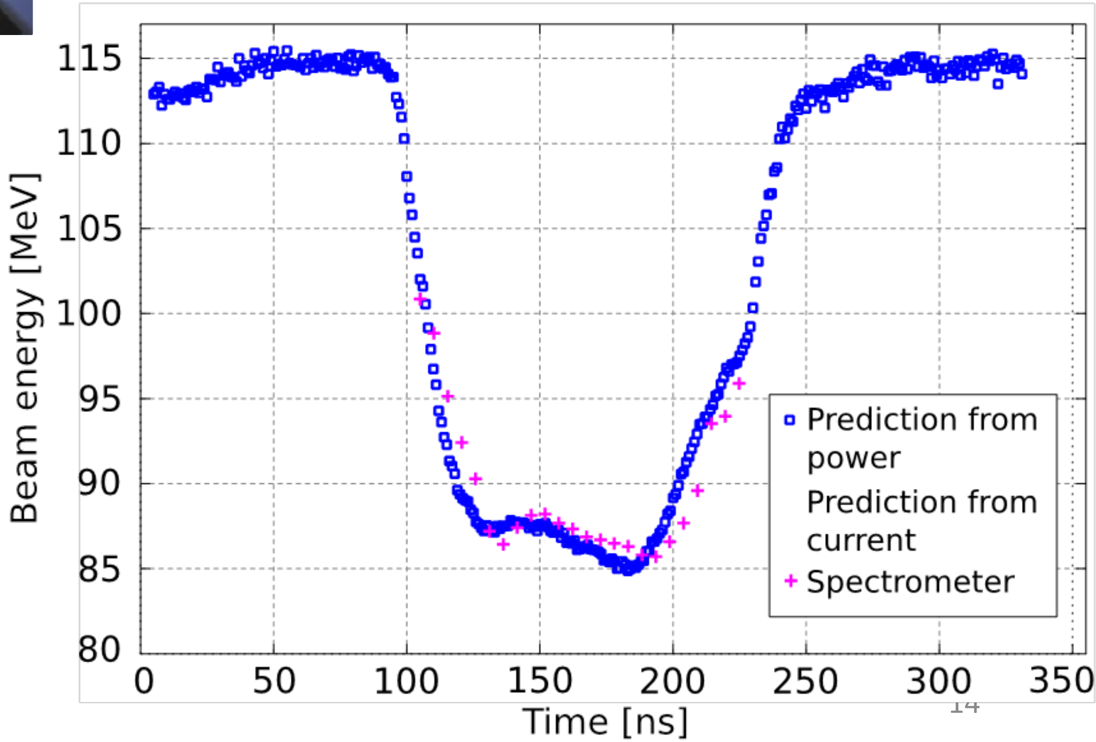
Rest will come this year

~26% deceleration

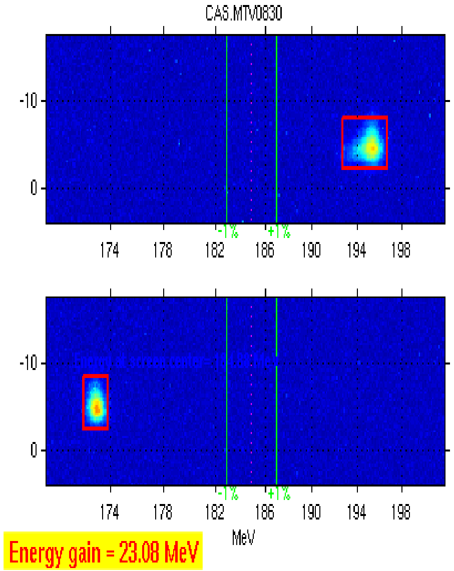
Final goal is 50% deceleration

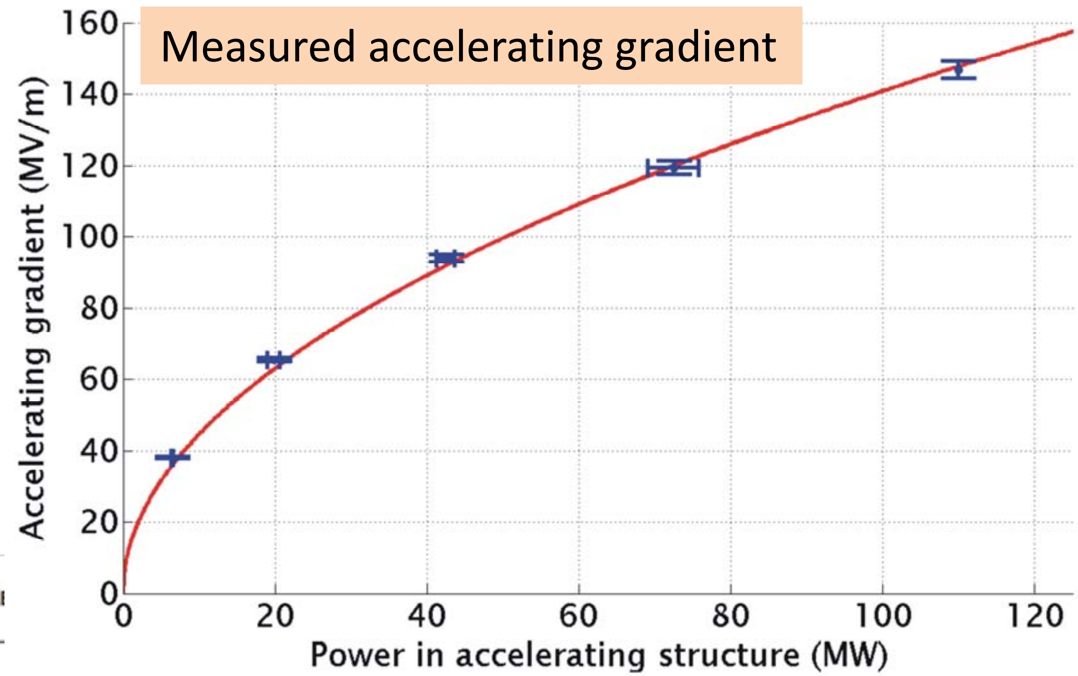
Measured in TBL:
Up to 21A current
- optics understood
- no losses in TBL

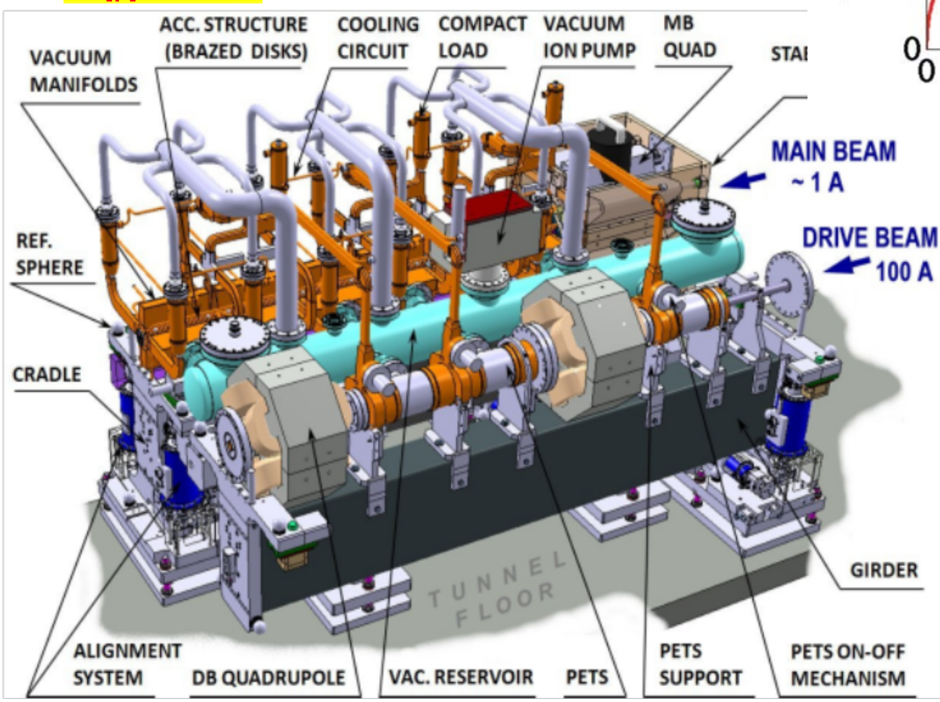
Good agreement
- power production
- beam current
- beam deceleration



TBTS: Two Beam Acceleration







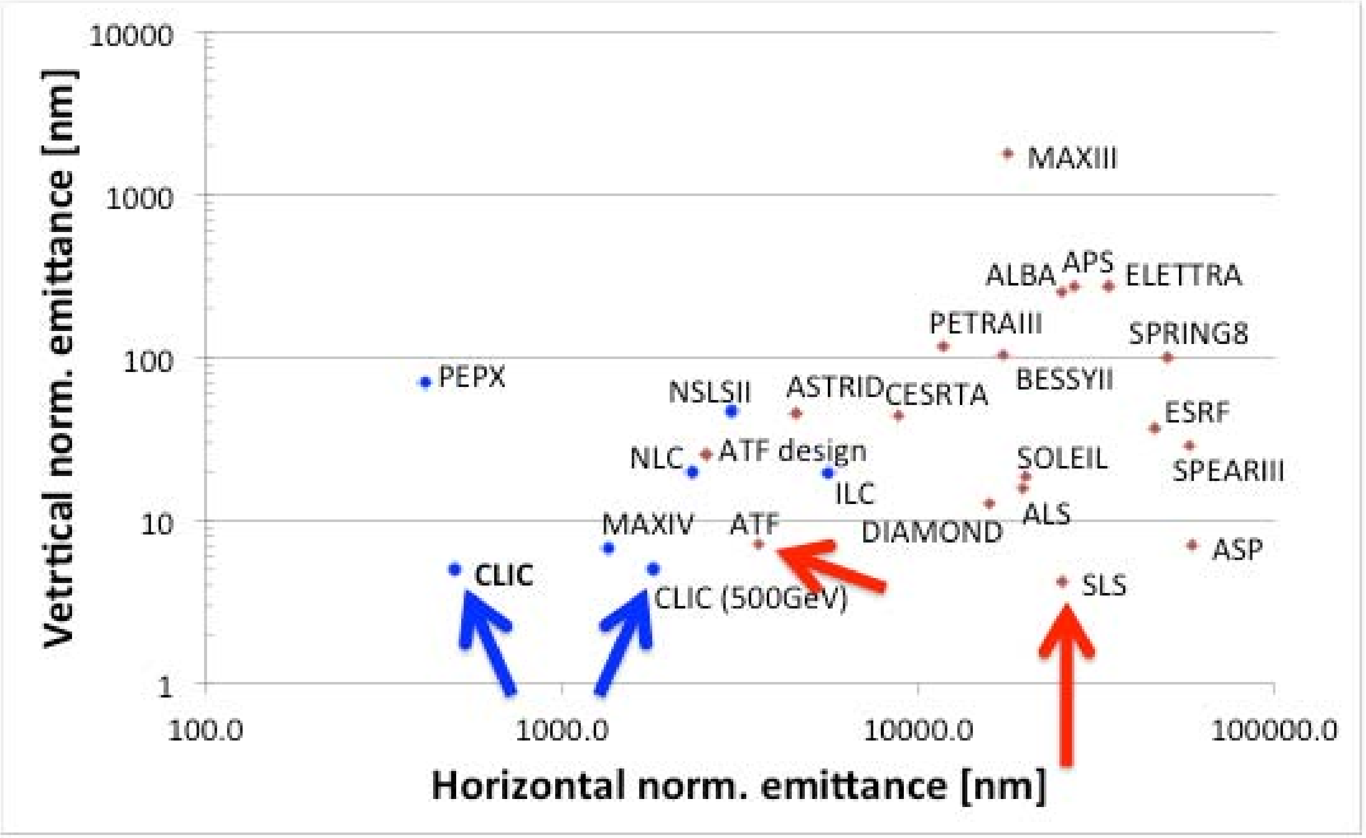
Maximum gradient 145 MV/m

Consistency between
- produced power
- drive beam current
- test beam acceleration

Emittance Generation

Many design issues addressed

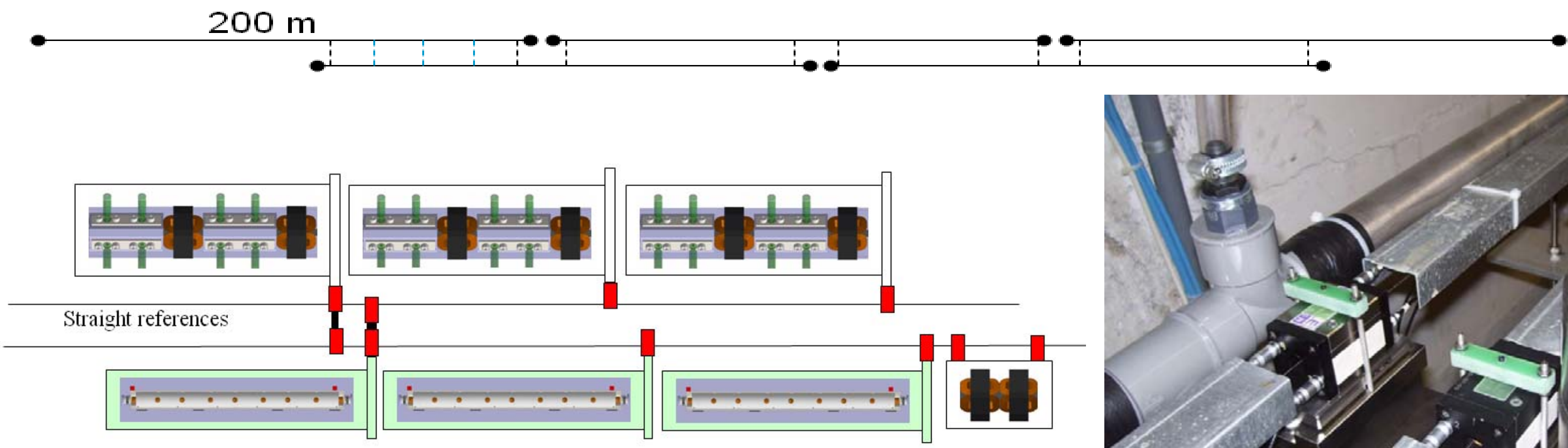
- lattice design
- dynamic aperture
- tolerances
- intra-beam scattering
- space charge
- wigglers
- RF system
- vacuum
- electron cloud
- kickers

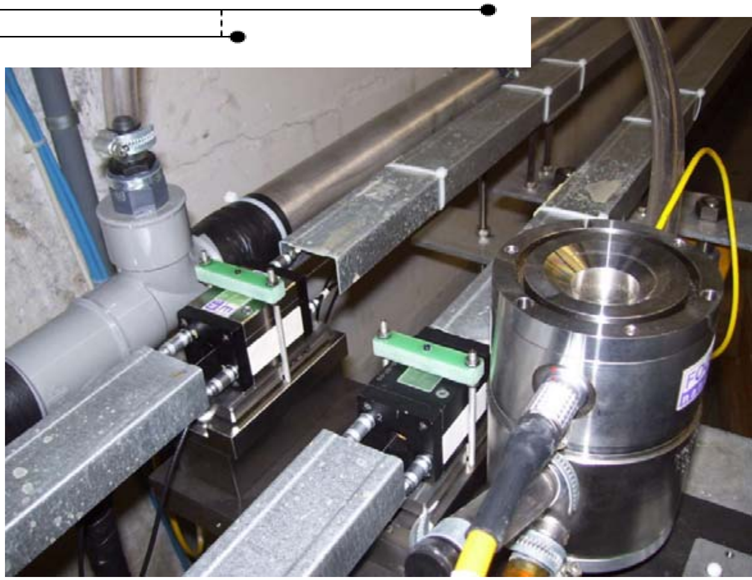


CLIC @3 TeV would achieve 1/3 of luminosity with ATF performance (3800nm/15nm@4e9)

Damping ring design is consistent with target performance

Pre-alignment System

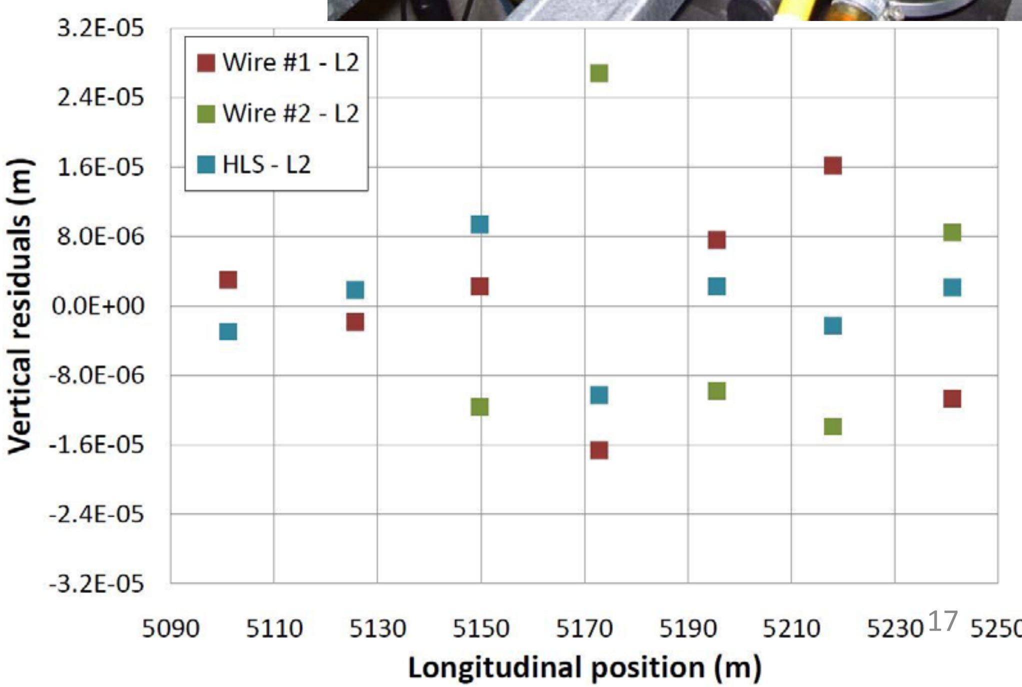




• Required accuracy of reference point is 10µm

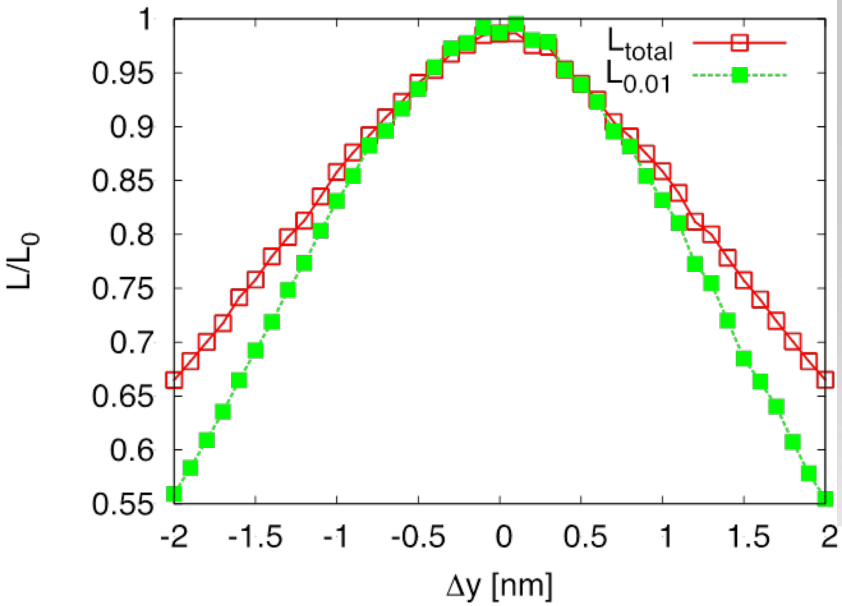
• Test of prototype shows
  • vertical RMS error of 11µm
  • i.e. accuracy is approx. 13.5µm

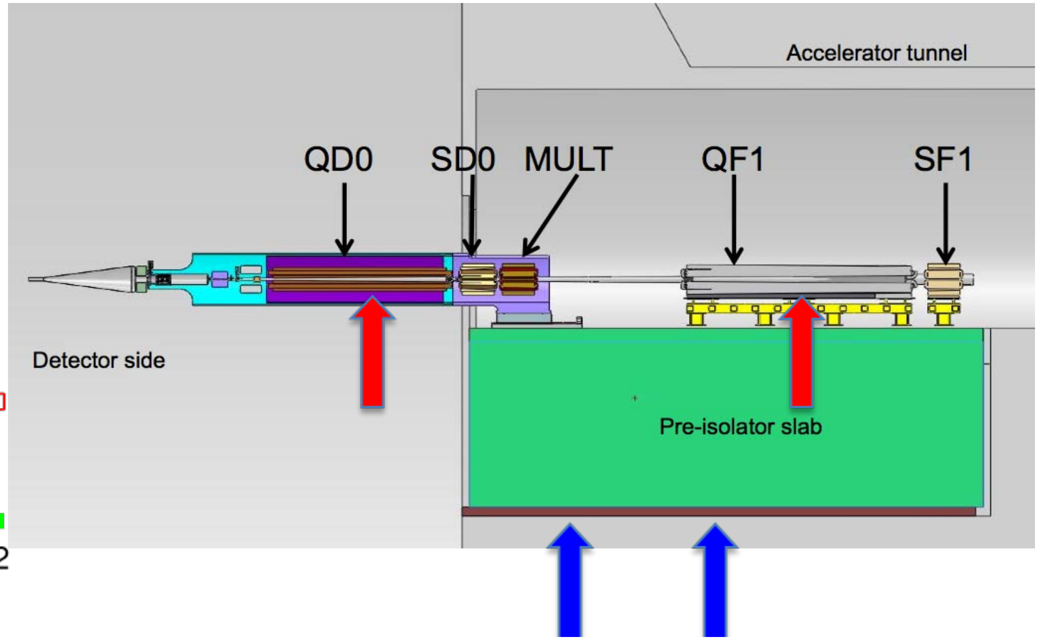
• Improvement path identified



D. Schulte

Ground Motion and Its Mitigation

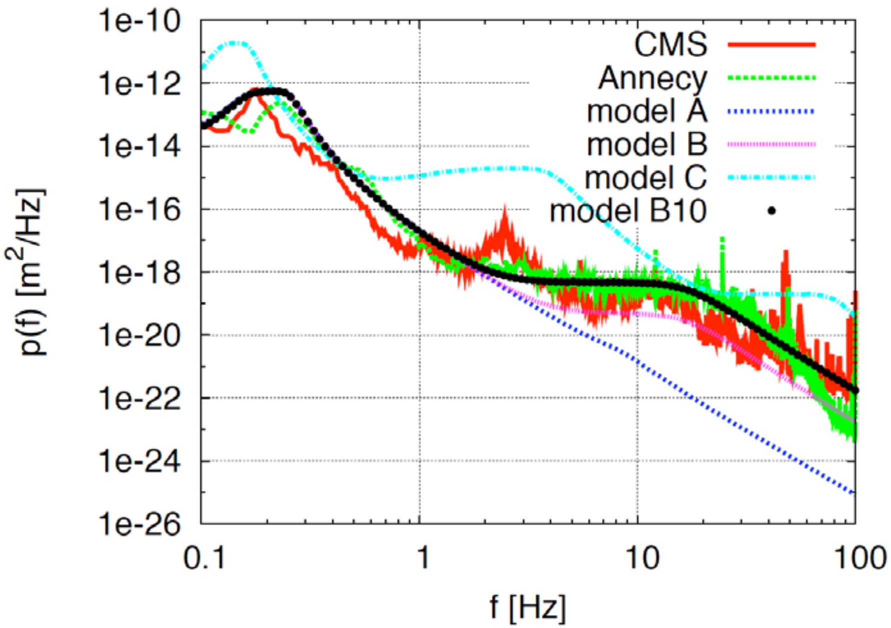




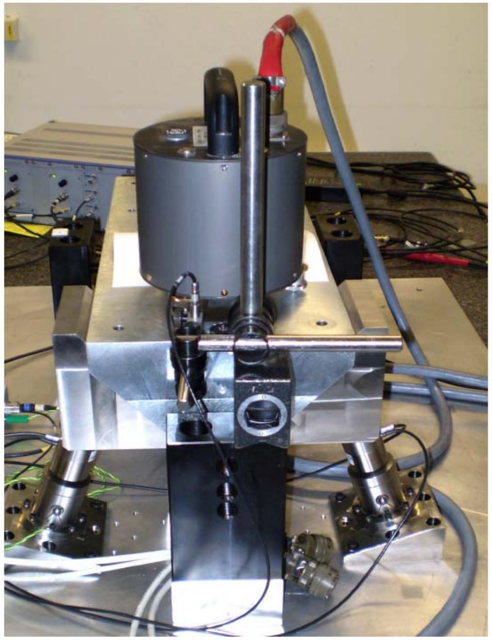
Natural ground motion can impact the luminosity

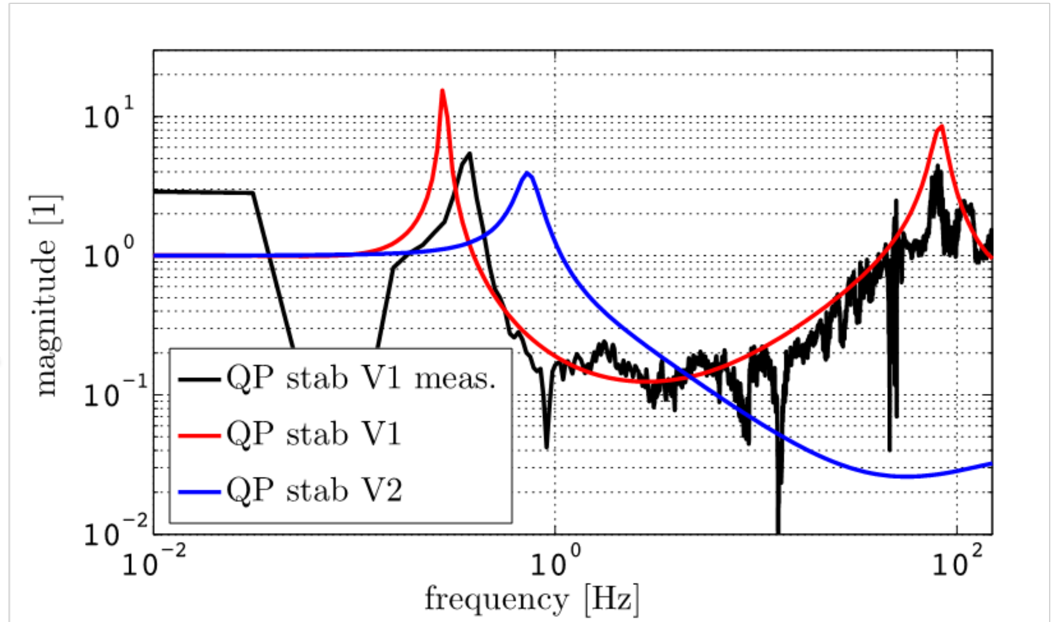
- typical quadrupole jitter tolerance O(1nm) in main linac and O(0.1nm) in final doublet

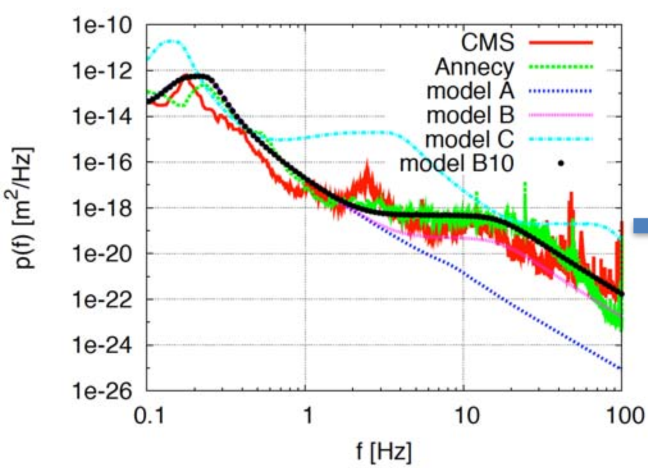
-> develop stabilisation for beam guiding magnets



Active Stabilisation Results







Code

Machine model
Beam-based feedback

Luminosity achieved/lost [%]

	B10
No stab.	53%/68%
Current stab.	108%/13%
Future stab.	118%/3%

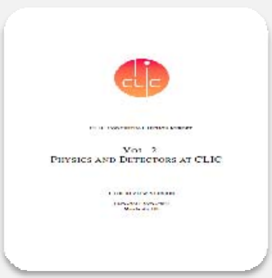
Close to/better than target

The CLIC CDRs

Vol 1: The CLIC accelerator and site facilities (H.Schmickler)

- CLIC concept with exploration over multi-TeV energy range up to 3 TeV
- Feasibility study of CLIC parameters optimized at 3 TeV (most demanding)
- Consider also 500 GeV, and intermediate energy range
- Complete, final editing ongoing, presented in the SPC In March 2012 (Daniel Schulte)

http://project-clic-cdr.web.cern.ch/project-CLIC-CDR/



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- Physics at a multi-TeV CLIC machine can be measured with high precision, despite challenging background conditions
- External review procedure in October 2011
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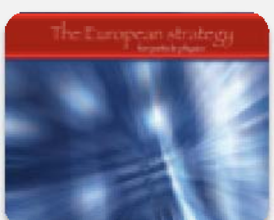
http://lcd.web.cern.ch/LCD/CDR/CDR.html#Overview



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- Summer 2012: Ready for the European Strategy Open Meeting

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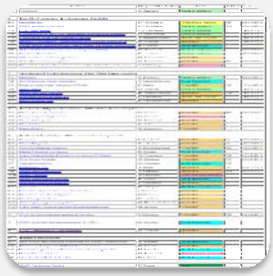

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CLIC machine environment

	CLIC at 500 GeV	CLIC at 3 TeV
L ($cm^{-2}s^{-1}$)	2.3×10^{34}	5.9×10^{34}
BX separation	0.5 ns	0.5 ns
#BX / train	354	312
Train duration (ns)	177	156
Rep. rate	50 Hz	50 Hz
σ_x / σ_y (nm)	≈ 200 / 2.3	≈ 45 / 1
σ_z (μm)	72	44

Drives timing requirements for CLIC detector

Simplified view:

Pair background

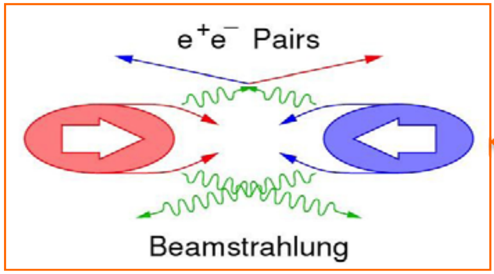
- Design issue

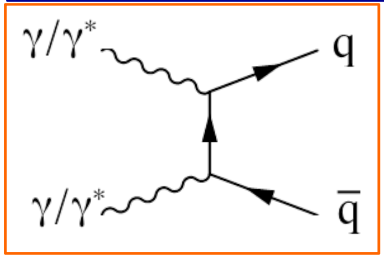
γγ → hadrons

- Impacts on the physics
- Needs suppression in data

Beam related background:

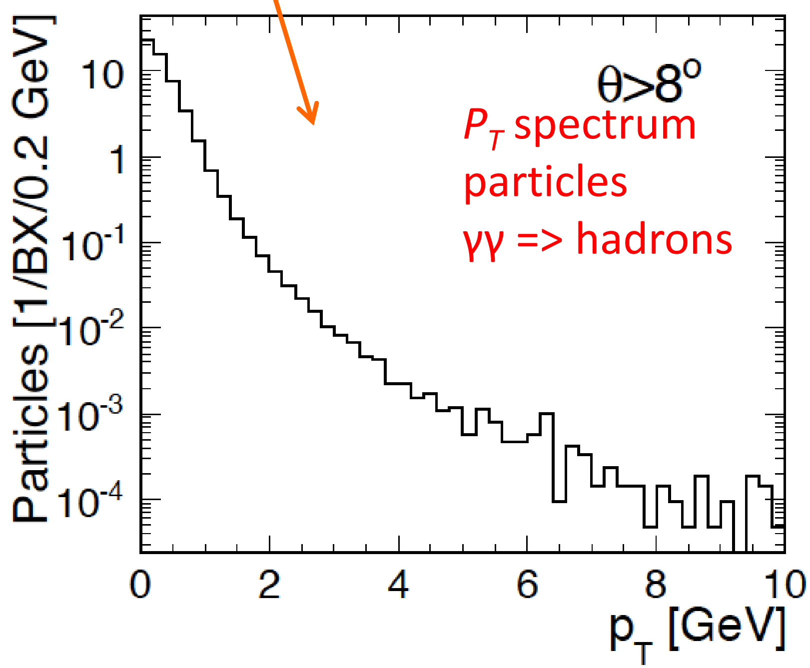
- Small beam profile at IP leads to very high E-field
  - **Beamsstrahlung**
    - Pair-background
    - γγ to hadrons

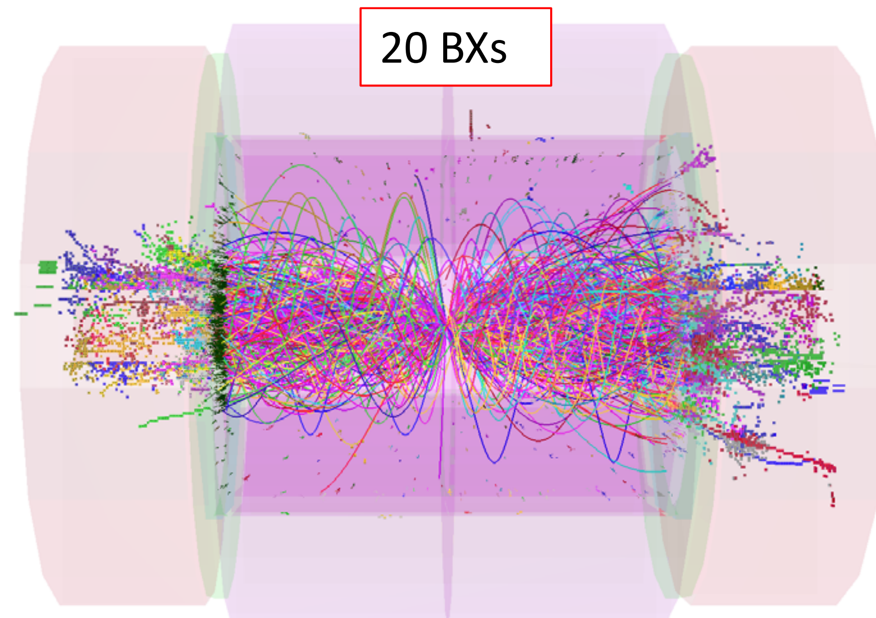




impact of $\gamma\gamma \rightarrow$ hadrons

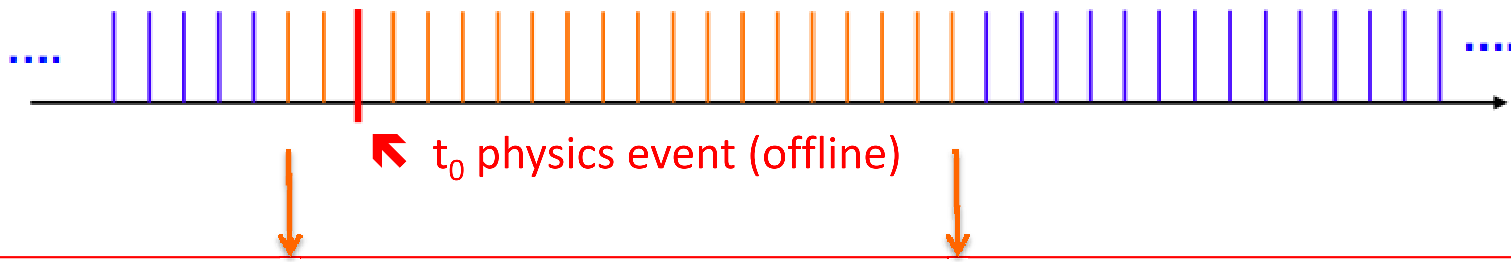
- Dominating background in calorimeters and central tracker, “mini-jets”
- At 3 TeV, average 3.2 events per BX (approximately 5 tracks per event)
- For entire bunch-train (312 BXs)
  - 5000 tracks giving total track momentum : 7.3 TeV
  - Total calorimetric energy (ECAL + HCAL) : 19 TeV
- Mostly low p_T particles



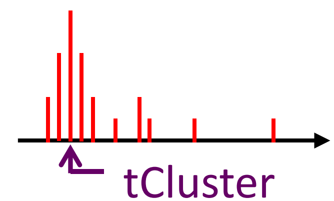


background suppression at CLIC

Triggerless readout of full train



- **Full event reconstruction + PFA analysis with background overlaid**
  - => physics objects with precise p_T and cluster time information
  - Time corrected for shower development and TOF
- **Then apply cluster-based timing cuts**
  - Cuts depend on particle-type, p_T and detector region
  - Allows to protect high-p_T physics objects



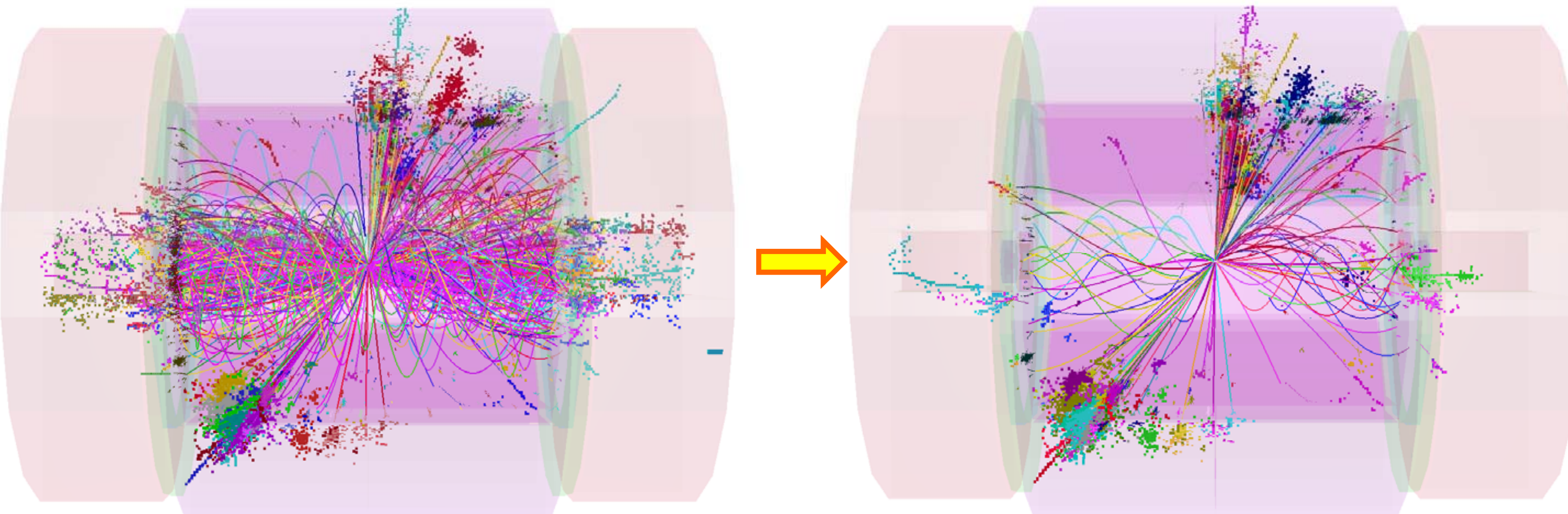
+

- **Use well-adapted jet clustering algorithms**
  - Making use of LHC experience (FastJet)

combined p_T and timing cuts

1.2 TeV

100 GeV



$$e^+e^- \rightarrow H^+H^- \rightarrow t\bar{b}b\bar{t} \rightarrow 8 \text{ jets}$$

1.2 TeV background in reconstruction time window

100 GeV background after tight cuts

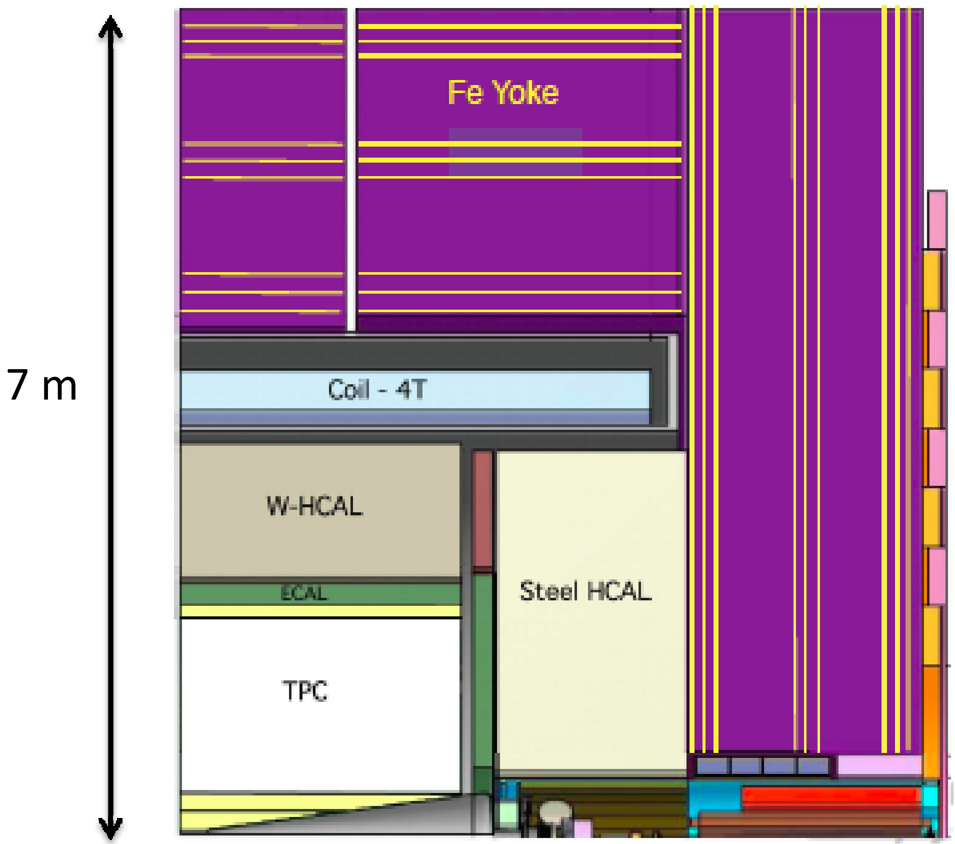
CLIC_ILD and CLIC_SiD

Two general-purpose CLIC detector concepts

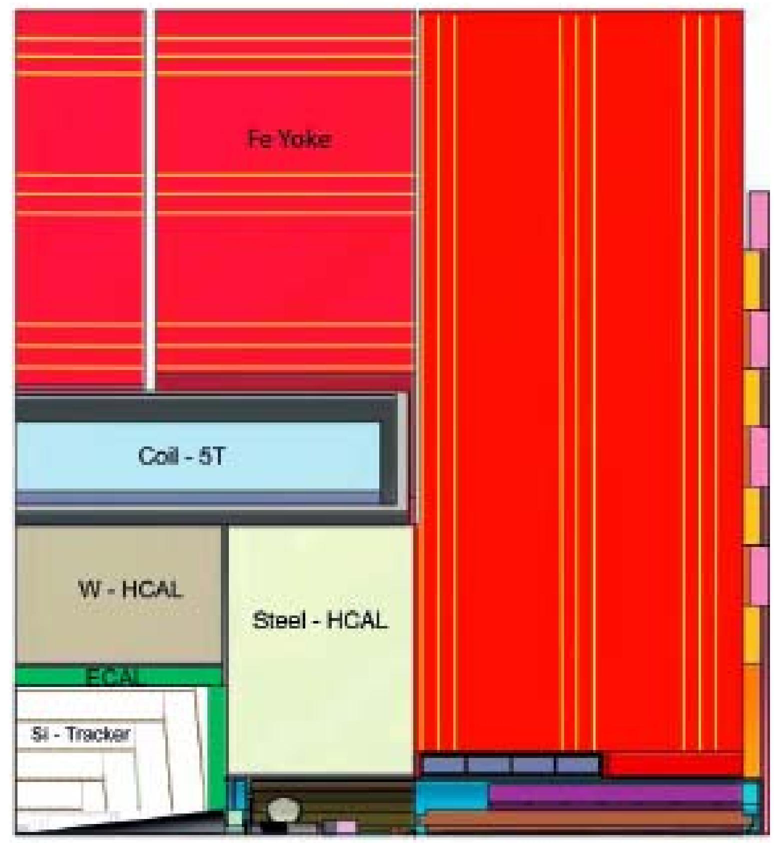
Based in initial ILC concepts (ILD and SiD)

Optimised and adapted to CLIC conditions

CLIC_ILD



CLIC_SiD



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- External review procedure in October 2011
- Completed and ready for print end 2011, presented in SPC in December 2011 (Lucie Linssen)

http://lcd.web.cern.ch/LCD/CDR/CDR.html#Overview

Vol 3: "CLIC study summary" (S.Stapnes)

- Summary and available for the European Strategy process, including possible implementation stages for a CLIC machine as well as costing and cost-drives
- Proposing objectives and work plan of post CDR phase (2012-16)
- Summer 2012: Ready for the European Strategy Open Meeting

- Main information page: http://clic-study.org/accelerator/CLIC-ConceptDesignRep.php

CLIC physics potential

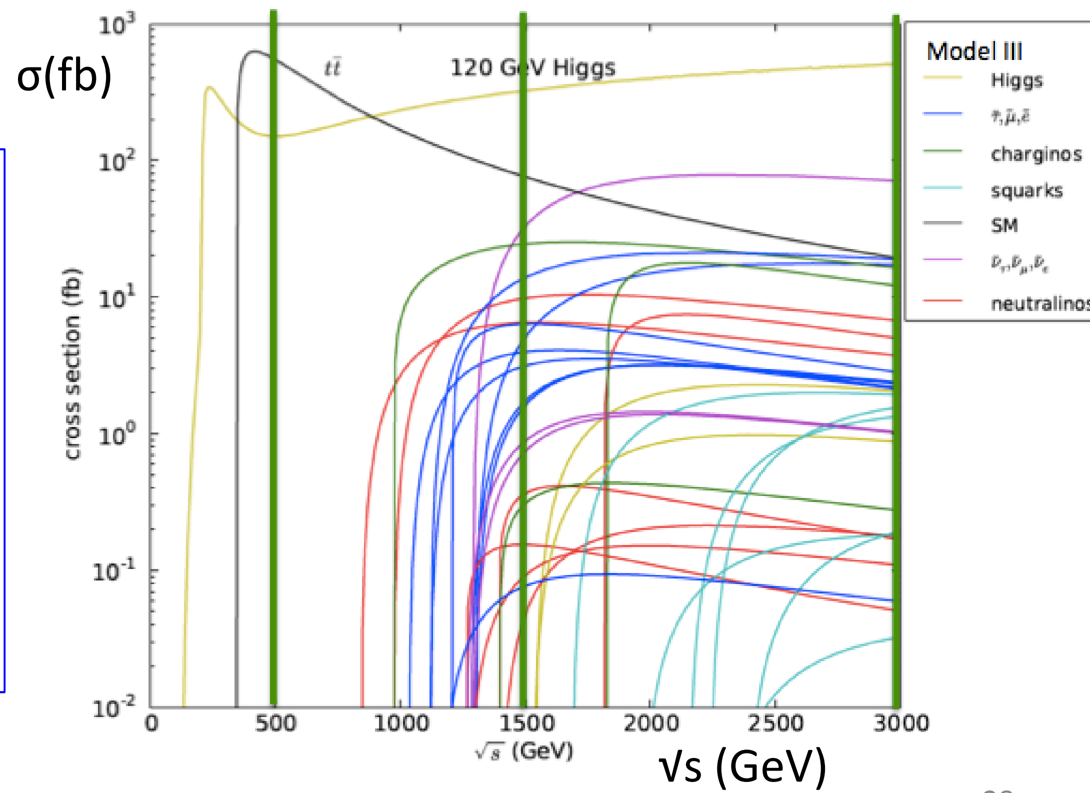
CLIC physics potential is complementary to LHC

Beyond LHC discovery reach:

- e+e- collisions give access to additional physics processes
  - weakly interacting states (e.g. slepton, chargino, neutralino searches)
  - more clean conditions than in LHC
- Defined initial state + more precise measurements

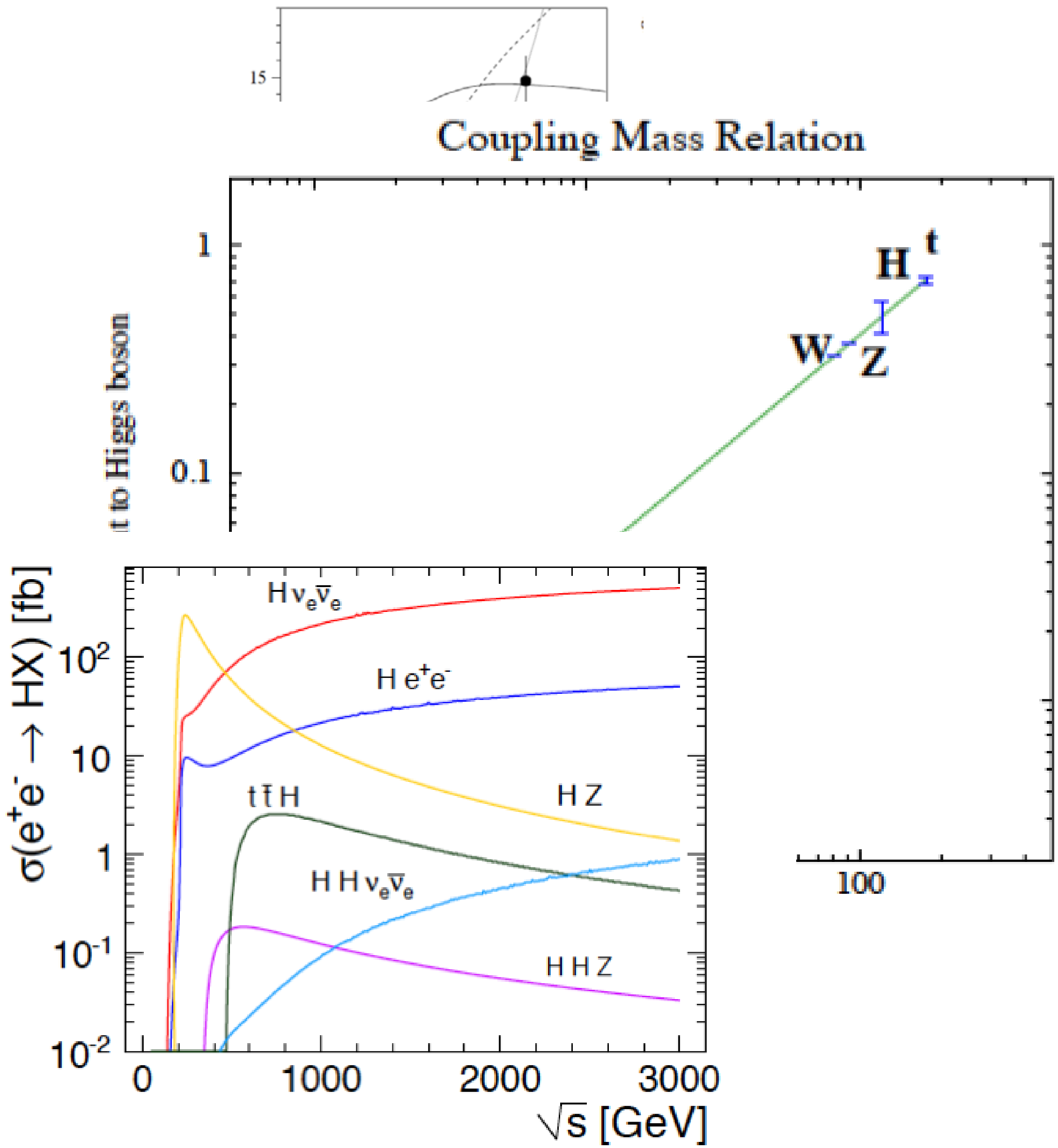
Examples highlighted in the CDR

- Higgs physics (SM and non-SM)
- Top
- SUSY
- Higgs strong interactions
- New Z' sector
- Contact interactions
- Extra dimensions
- ….



Higgs – 120 GeV in this case

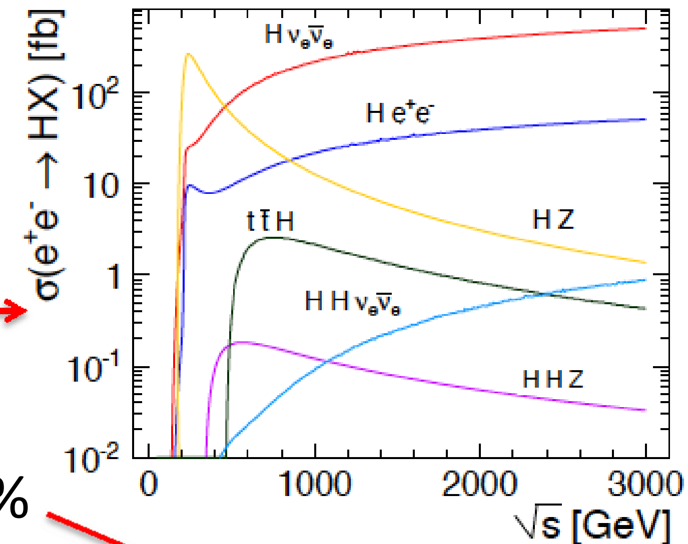
- Precision measurements from ILC RDR and CLIC CDR (volume 2 in both cases)
- 20 fb^{-1} per point for spin measurements
- Couplings (in this plot): 300 GeV and 500 fb^{-1} for b, τ, e, W, Z and 500 GeV for H (self-coupling), 700 GeV for top
- Higgs self coupling error reduced to 12% if running at 1 TeV (1 ab^{-1})
- CLIC studies compatible, has focused on running at 3 TeV (large WW fusion cross-section) and 2 ab^{-1} leading to reduced statistical errors and access to difficult cases as coupling to muons (23% error)
- Note that these measurements are "not theory dependent" and provide an absolute measure (important for BSM scenarios)
- To be compared – at some point - to LHC at 1-2 ab^{-1} and dedicated triggers, analyses and upgrades, which can cover some of the same measurements



SM Higgs

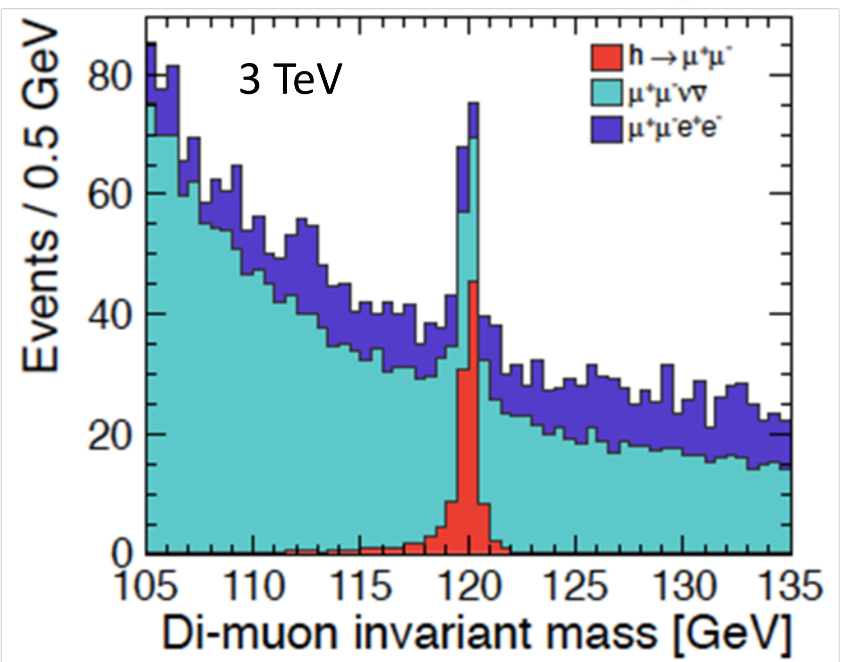
Standard model Higgs (example 120 GeV)

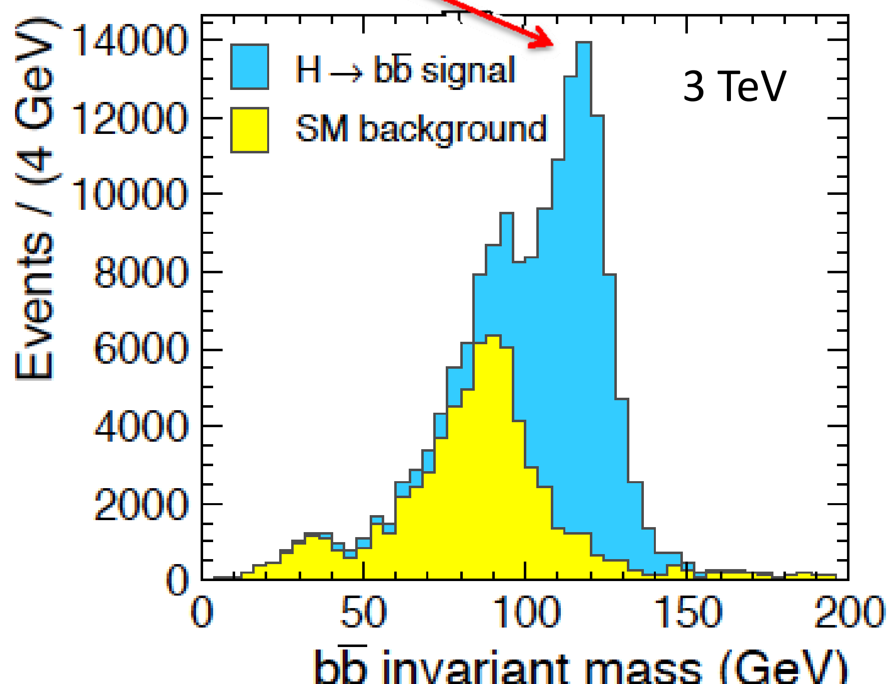
CLIC √s range give access to a wealth of Higgs studies



$\sigma(h \rightarrow \mu^+\mu^-) \rightarrow \pm 15\%$

$\sigma(h \rightarrow b\bar{b}) \rightarrow \pm 0.2\%$





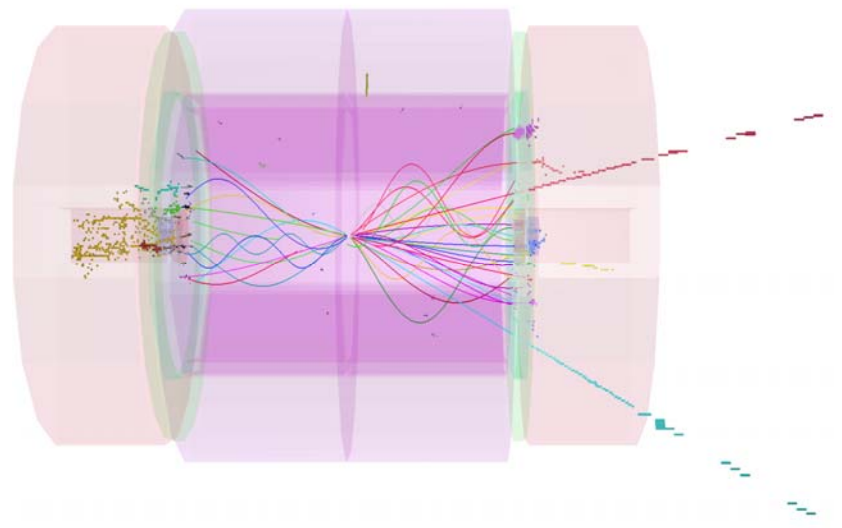
slepton production

Slepton production at CLIC very clean

SUSY "*model II*": slepton masses ~ 1 TeV

Channels studied include

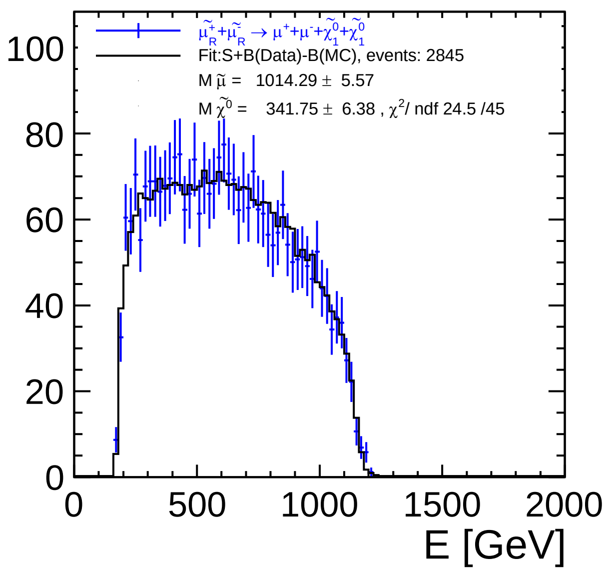
- $e^+e^- \rightarrow \tilde{\mu}_R^+\tilde{\mu}_R^- \rightarrow \mu^+\mu^-\ \tilde{\chi}_1^0\ \tilde{\chi}_1^0$
- $e^+e^- \rightarrow \tilde{e}_R^+\tilde{e}_R^- \rightarrow e^+e^-\ \tilde{\chi}_1^0\ \tilde{\chi}_1^0$
- $e^+e^- \rightarrow \tilde{\nu}_e\tilde{\nu}_e \rightarrow e^+e^- W^+W^-\ \tilde{\chi}_1^0\ \tilde{\chi}_1^0$



Leptons and missing energy

Masses from analysis of endpoints of energy spectra

e.g. smuon production



All channels combined

$$m(\tilde{\mu}_R)\ :\ \pm 5.6\ \text{GeV}$$
$$m(\tilde{e}_R)\ :\ \pm 2.8\ \text{GeV}$$
$$m(\tilde{\nu}_e)\ :\ \pm 3.9\ \text{GeV}$$
$$m(\tilde{\chi}_1^0)\ :\ \pm 3.0\ \text{GeV}$$
$$m(\tilde{\chi}_1^\pm)\ :\ \pm 3.7\ \text{GeV}$$

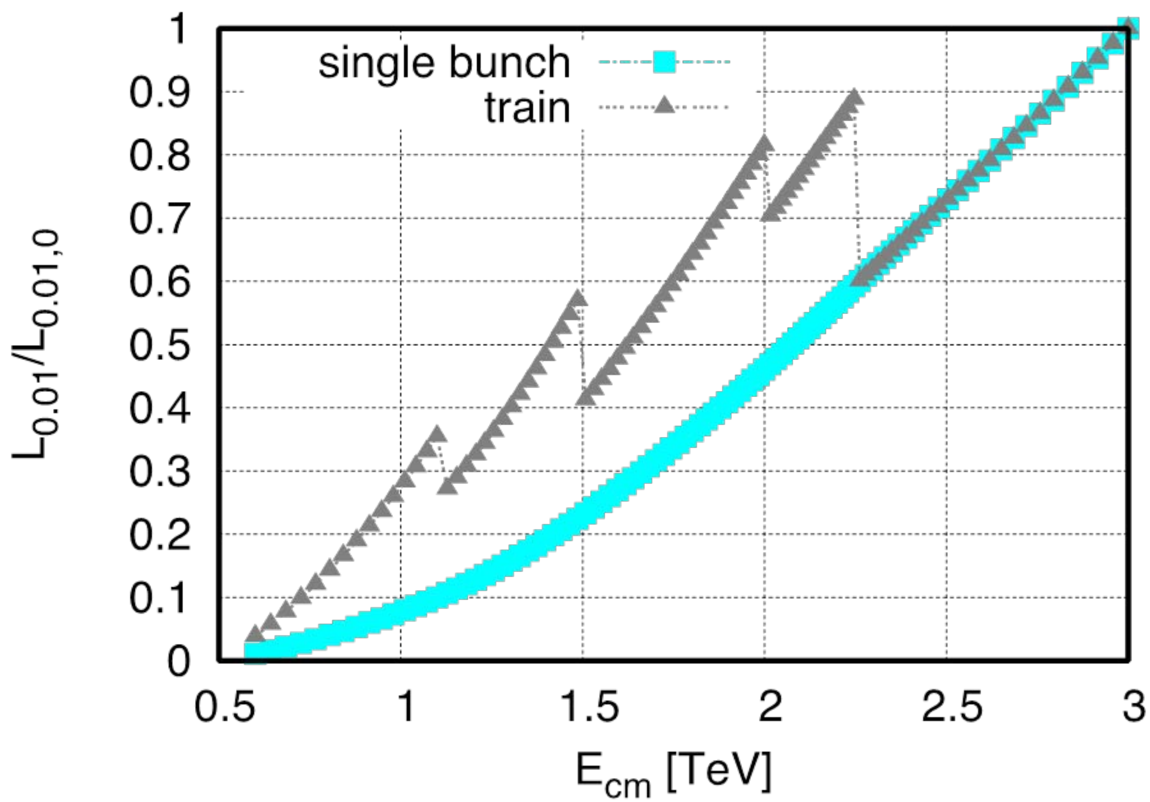
Energy Flexibility

Need to operate at
Lower than nominal energy

Concept developed

• based on reduced main and drive beam current but longer pulses

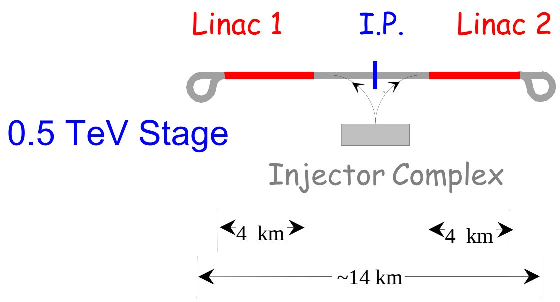
• can cover factor 3 in energy

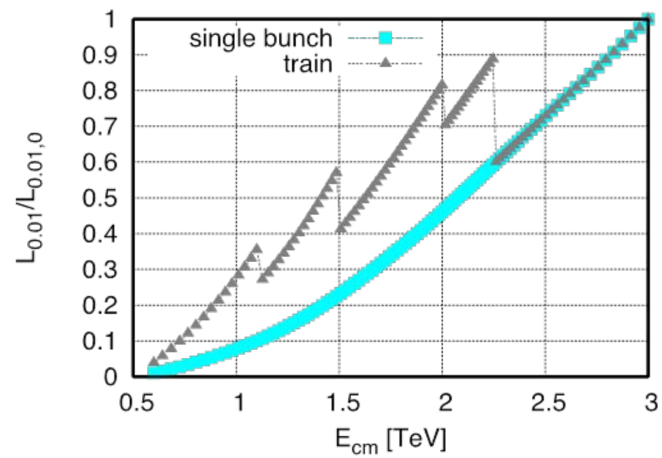


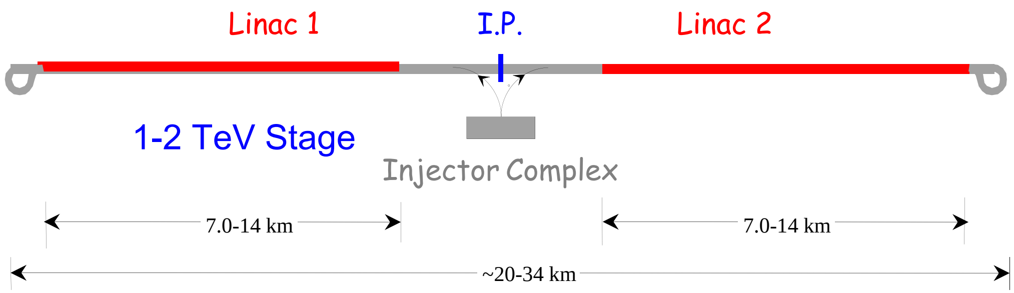
CLIC Implementation – in stages?

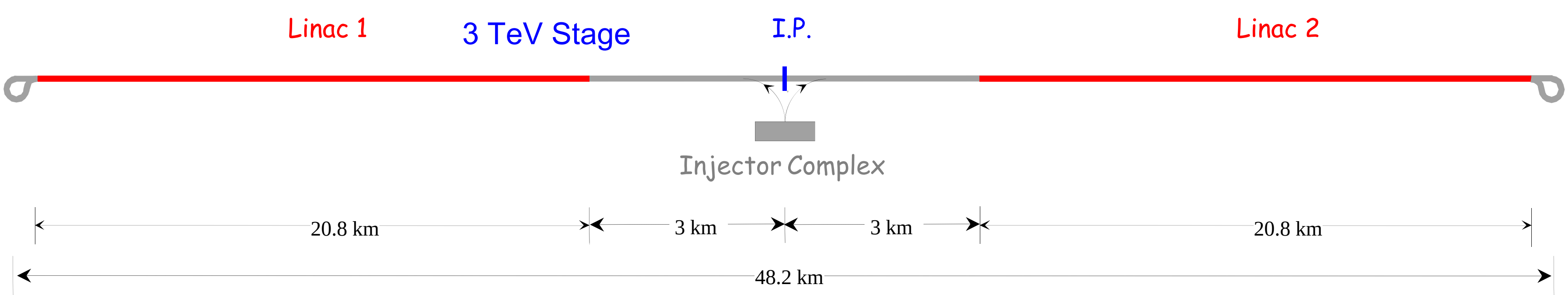
CLIC two-beam scheme compatible with energy staging to provide the optimal machine for a large energy range

Lower energy machine can run most of the time during the construction of the next stage. Physics results will determine the energies of the stages

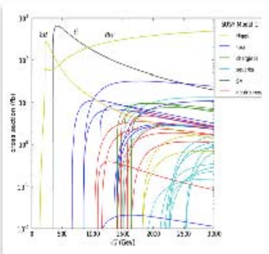








Implementation issues

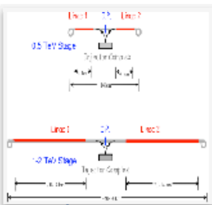


Physics - how do we build the optimal machine given a physics scenario (partly seen at LHC ?):

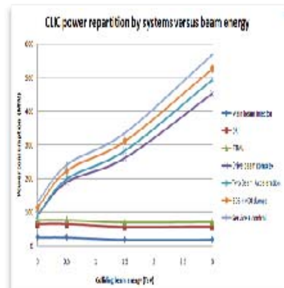
Understand the benefits of running close to thresholds versus at highest energy, and distribution of luminosities as function of energy

Construction scenario (and approval scenario):

Explore how we in practice will do the tunneling and productions/installation/movement of parts in a multistage approach ? Environmental impact study

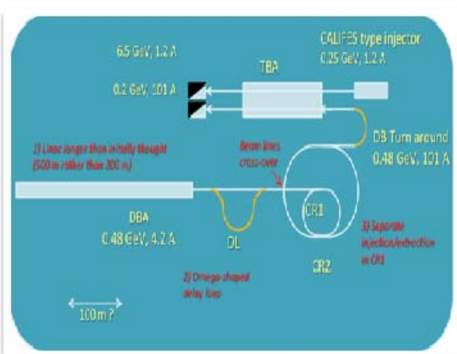


Costs - Initial machine plus energy upgrade: External cost review 21-22.2.2012, costs will be discussed in volume 3 of the CDR



Power and energy development.

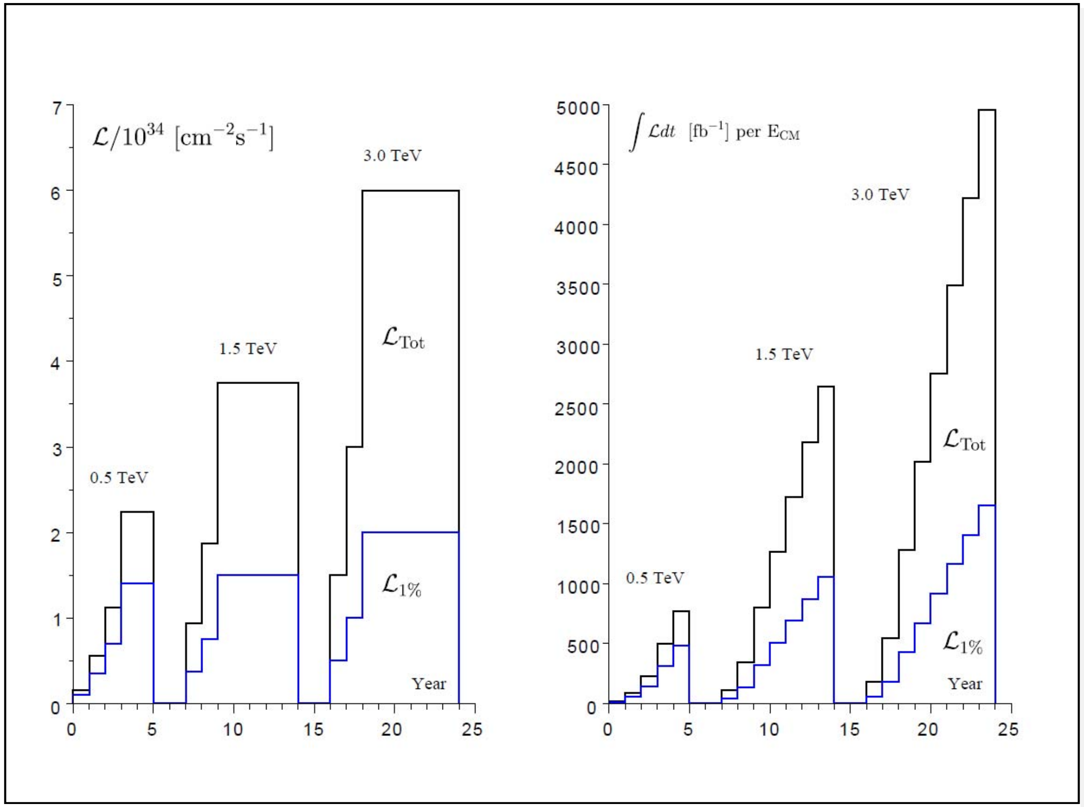
Have started to work on energy estimates (not only max power at max luminosity and the highest energy) based on running scenarios and power on/off/standby estimates



Timescale/lifecycle for project re-defined: Buildup of drive beam (CLIC zero), stage one – physics, more stages/extensions

Parameters: energy steps and scans, inst. and int. luminosities, commissioning and lum. ramp up times.

A possible energy/luminosity scenario

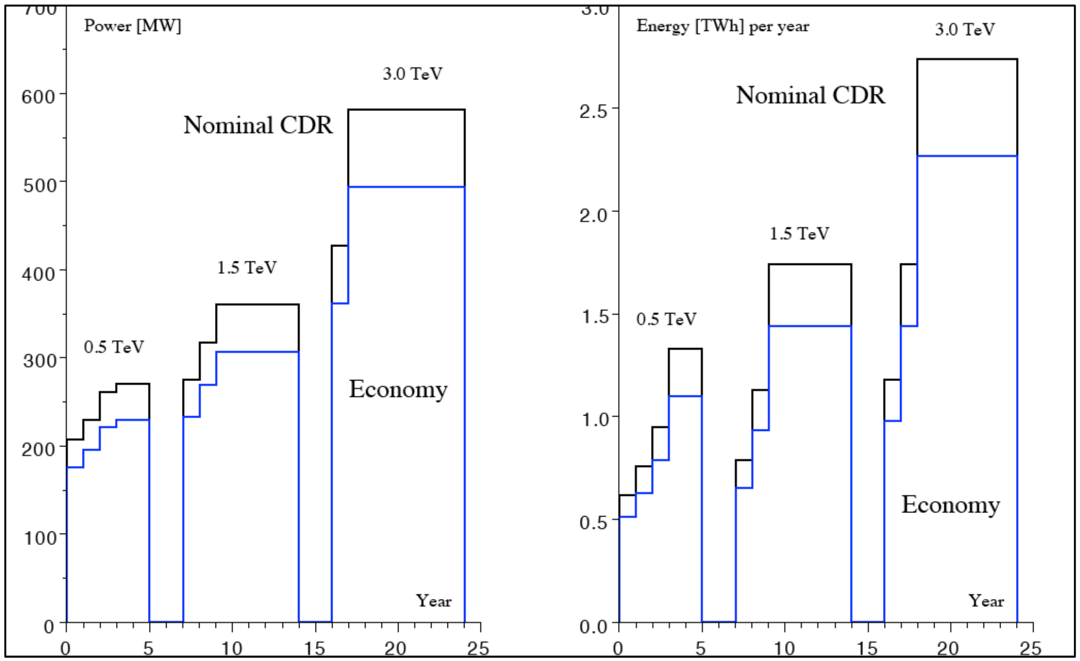


With a model (see figure for one example) for energies and luminosities, and assumptions about running scenarios (see below), one can extract power and energy estimates as function of time (next slide).

For each value of CM energy:

- 177 days/year of beam time
- 188 days/year of scheduled and fault stops
- First year
  - 59 days of injector and one-by-one sector commissioning
  - 59 days of main linac commissioning, one linac at a time
  - 59 days of luminosity operation
  - Quoted power : average over the three periods
  - All along : 50% of downtime
- Second year
  - 88 days with one linac at a time and 30 % of downtime
  - 88 days without downtime
  - Quoted power : average over the two periods
- Third year
  - Still only one e+ target at 0.5 TeV, like for years 1 & 2
  - Nominal at 1.5 and 3 TeV
- Power during stops (scheduled, fault, downtime) :
  - (40 MW, 45 MW, 60 MW) at (0.5, 1.5, 3) TeV, respectively

Power/energy



Other models can be envisaged (this is one out of many), and one should also keep in mind that reducing the instantaneous luminosity at the highest energies reduced both power and yearly energy, and finer energy scans might well be needed within one stage

The possible « economy » (see blue curves):

Sobriety

- Reduced current density in normal-conducting magnets
- Reduction of heat loads to HVAC
- Re-optimization of accelerating gradient with different objective function

Efficiency

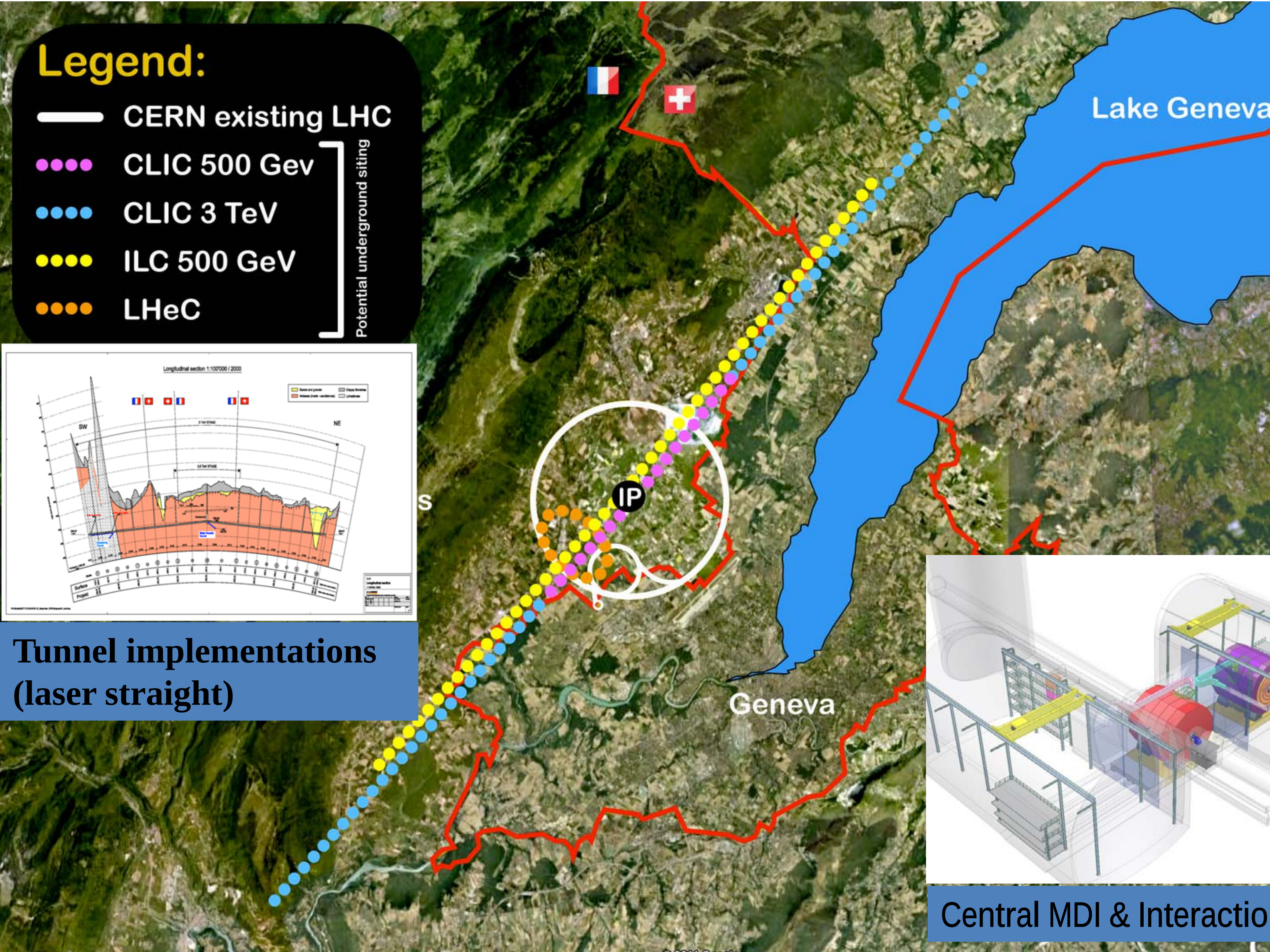
- Grid-to-RF power conversion
- Permanent or super-ferric superconducting magnets

Energy management

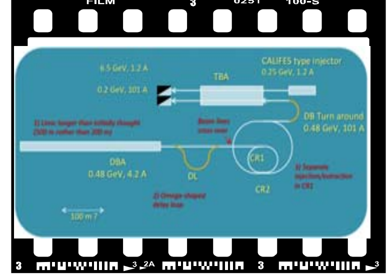
- Low-power configurations in case of beam interruption
- Modulation of scheduled operation to match electricity demand: Seasonal and Daily
- Power quality specifications

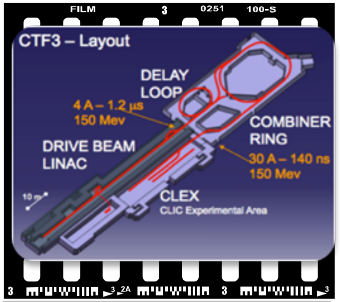
Waste heat recovery

- Possibilities of heat rejection at higher temperature
- Waste heat valorization by concomitant needs, e.g. residential heating, absorption cooling


Legend:
CERN existing LHC
CLIC 500 Gev
CLIC 3 TeV
ILC 500 GeV
LHeC
Potential underground siting
Lake Geneva
IP
Geneva
Longitudinal section 1:100'000 / 2000
SW
NE
Tunnel implementations (laser straight)
Central MDI & Interactio

CLIC project time-line





Final CLIC CDR and feasibility established, also input for the Eur. Strategy Update

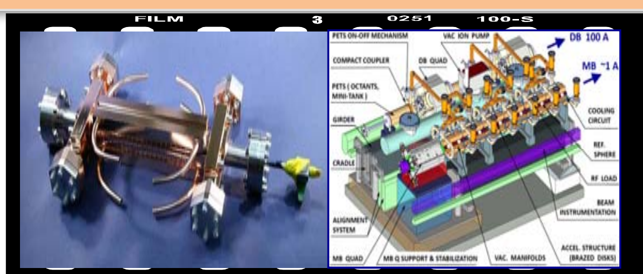
From 2016 – Project Implementation phase, including an initial project to lay the grounds for full construction:

- CLIC 0 – a significant part of the drive beam facility: prototypes of hardware components at real frequency, final validation of drive beam quality/main beam emittance preservation, facility for reception tests – and part of the final project)
- Finalization of the CLIC technical design, taking into account the results of technical studies done in the previous phase, and final energy staging scenario based on the LHC Physics results, which should be fully available by the time
- Further industrialization and pre-series production of large series components for validation facilities
- Other system studies addressing luminosity issues (emittance conservation) …
- Environmental Impact Study

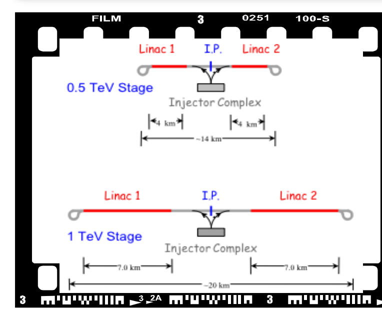
2004 - 2012	2012 - 2016	2016 – 2022	~ 2020 onwards

2011-2016 – Goal: Develop a project implementation plan for a Linear Collider:

- Addressing the key physics goals as emerging from the LHC data
- With a well-defined scope (i.e. technical implementation and operation model, energy and luminosity), cost and schedule
- With a solid technical basis for the key elements of the machine and detector
- Including the necessary preparation for siting the machine
- Within a project governance structure as defined with international partners



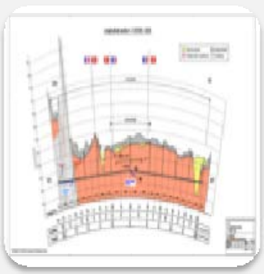
CLIC project construction – in stages, making use of CLIC 0



The objectives and plans for 2012-16

In order to achieve the overall goal for 2016 the follow four primary objectives for 2012—16 can defined:

- These are to be addressed by activities (studies, working groups, task forces) or work-packages (technical developments, prototyping and tests of single components or larger systems at various places)



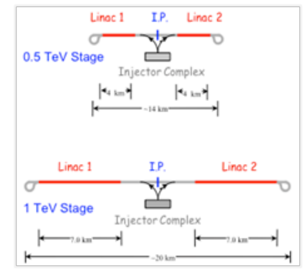
Define the scope, strategy and cost of the project implementation.

Main input:

The evolution of the physics findings at LHC and other relevant data

Findings from the CDR and further studies, in particular concerning minimization of the technical risks, cost, power as well as the site implementation.

A Governance Model as developed with partners.

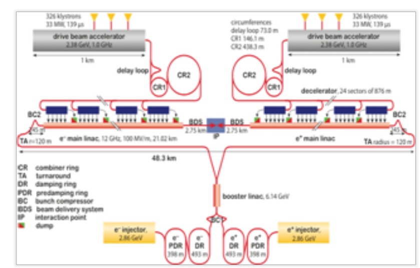


parameter	symbol		
centre of mass energy	E_{cm} [GeV]	500	3000
luminosity	$\mathcal{L}$ [10^{34} cm^{-2}s^{-1}]	2.3	5.9
luminosity in peak	$\mathcal{L}_{0.01}$ [10^{34} cm^{-2}s^{-1}]	1.4	2
gradient	G [MV/m]	80	100
site length	[km]	13	48.3
charge per bunch	N [10^9]	6.8	3.72
bunch length	σ_z [μm]	70	44
IP beam size	σ_x/σ_y [nm]	200/2.26	40/1
norm. emittance	ϵ_x/ϵ_y [nm]	2400/25	660/20
bunches per pulse	n_b	354	312
distance between bunches	Δ_b [ns]	0.5	0.5
repetition rate	f_r [Hz]	50	50
est. power cons.	P_{wall} [MW]	240	560

Define and keep an up-to-date optimized overall baseline design that can achieve the scope within a reasonable schedule, budget and risk.

Beyond beam line design, the energy and luminosity of the machine, key studies will address stability and alignment, timing and phasing, stray fields and dynamic vacuum including collective effects.

Other studies will address failure modes and operation issues.

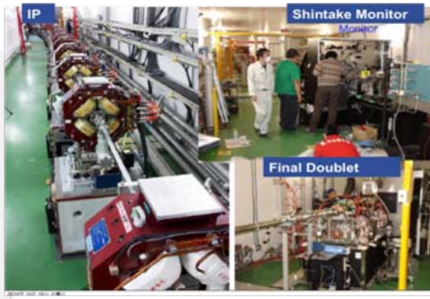


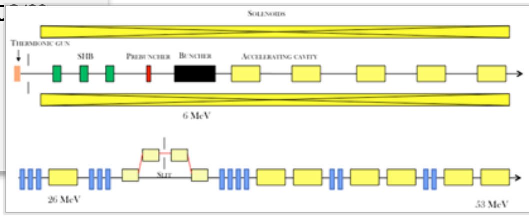
The objectives and plans for 2012-16

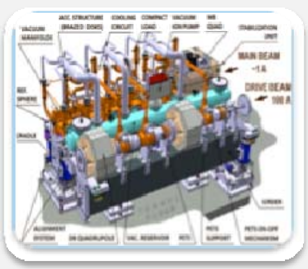
Identify and carry out system tests and programs to address the key performance and operation goals and mitigate risks associated to the project implementation.

The priorities are the measurements in: CTF3+, ATF and related to the CLIC zero Injector addressing the issues of drive-beam stability, RF power generation and two beam acceleration, as well as the beam delivery system.

Technical work-packages and studies addressing system performance parameters



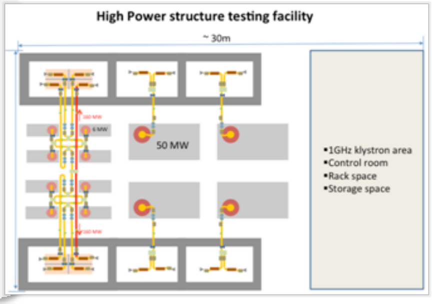




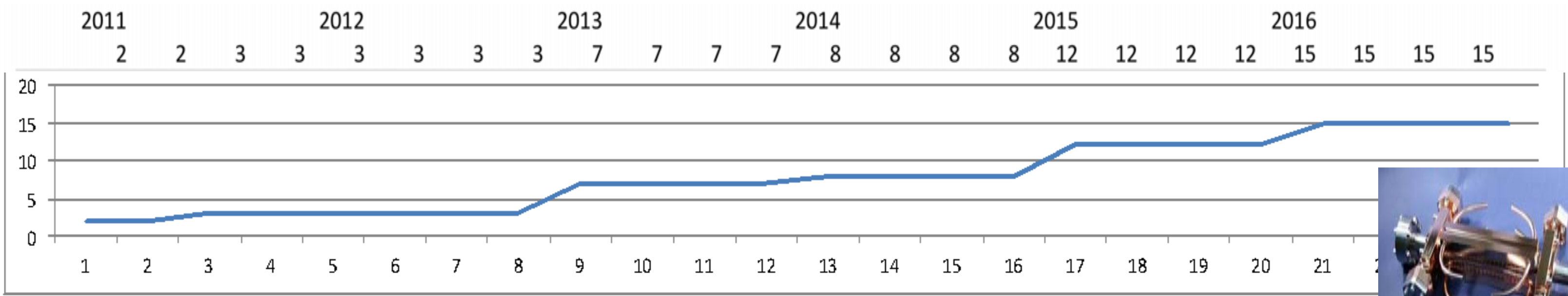
Develop the technical design basis. i.e. move toward a technical design for crucial items of the machine and detectors, the MD interface, and the site.

Priorities are the modulators/klystrons, module/structure development including testing facilities, and site studies.

Technical work-packages providing input and interacting with all points above



number of rf ports



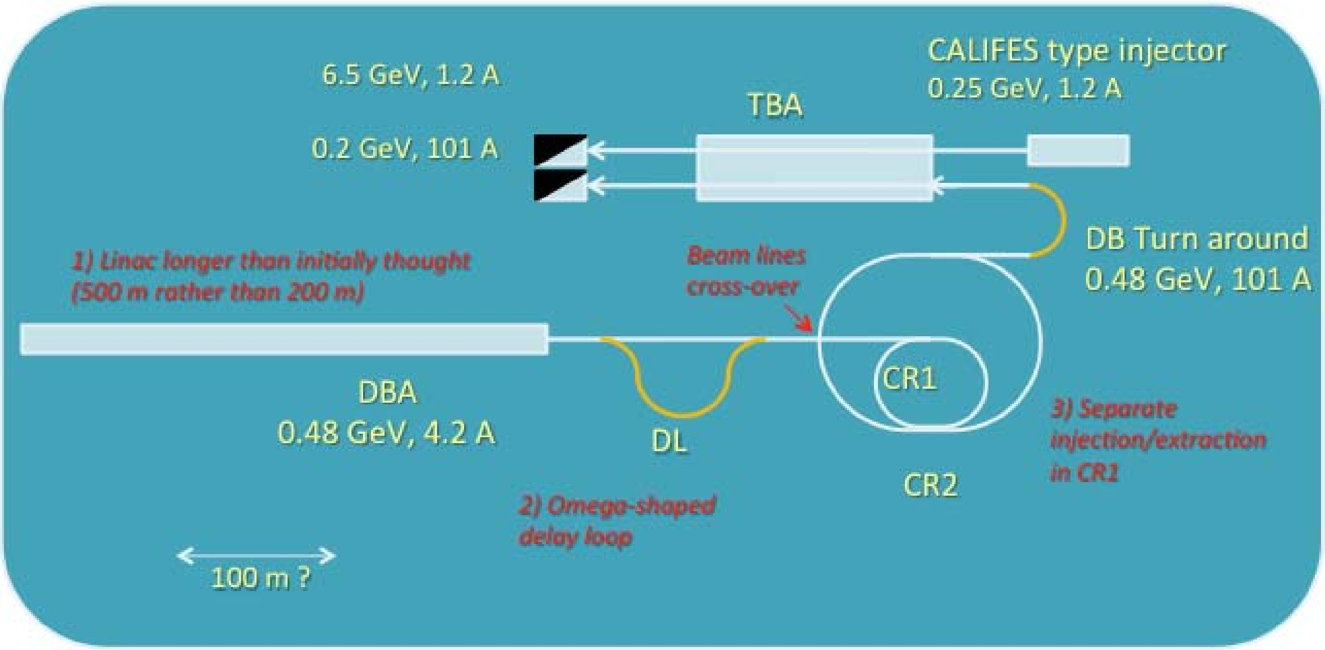
Work-packages and responsibilities

	Name	Name	WP Holder	Collaboration input
General		CLIC General	S. Stapnes	
Parameters and design Daniel Schulte	CD-BASE	Integrated Baseline Design and Parameters	D. Schulte	
	CD-SIM	Integrated Modelling and Performance Studies	A. Latina	
	CD-LUMI	Feedback Design	D. Schulte (interim)	
	CD-OP	Machine Protection & Operational Scenarios	M. Jonker	
	CD-BCKG	Background	D. Schulte (interim)	
	CD-POL	Polarization	-	
	CD-ESRC	Main beam electron source	S. Doebert	29 submissions of ongoing or planned contributions to these work-packages from collaborators outside CERN
	CD-PSRC	Main beam positron source		
	CD-DR	Damping Rings	Y. Papaphilippou	
	CD-RTML	Ring-To-Main-Linac	A. Latina	
	CD-ML	Main Linac - Two-Beam Acceleration	D. Schulte (placeholder)	
	CD-BDS			
	CD-MD			
	CD-DRV			
Experimental verification Roberto Corsini	CTF3-0			
	CTF3-0			
	CTF3-0			
	CTF3-0			ckages from
	CLIC0-0			
	CLIC0-0			
	BTS-00			
	BTS-00			
Technical Developments Hermann Schmickler	CTC-WI			
	CTC-SU			
	CTC-QU			
	CTC-TB			
	CTC-WI			
	CTC-BD			
	CTC-PC			ckages from
	CTC-CO			
	CTC-RF			
	CTC-EP			
	CTC-VA			
	CTC-MI			
	CTC-BT	Beam Transport Equipment	M. Barnes	
	CTC-MME	Creation of a "CLIC technology center@CERN"	F.Bertinelli	
X-band Technologies Walter Wuensch	RF-DESIGN	X-band Rf structure Design	A.Grudiev, I. Syratchev	
	PRODUCTION	X-band Rf structure Production	G.Riddone	20 submissions of ongoing or planned contributions to these work-packages from collaborators outside CERN
	TESTING	X-band Rf structure High Power Testing	S.Doebert	
	TEST AREAS	Creation and Operation of x-band High power Testing Facilities	E.Jensen (placeholder)	
	HIGH-GRADIENT	Basic High Gradient R&D	S.Calatroni	
Implementation studies Philippe Lebrun	IS-CES	Civil Engineering & Services	J. Osborne	
	IS-PIP	Project Implementation Studies	P.Lebrun	

The programme combines the resources of collaborators inside the current collaboration, plus several new ones – and also involves around 20 CERN groups:

- Have ~75 submitted descriptions of ongoing or planned efforts linked to these work-packages 2012-16 from groups outside CERN (result of CLIC working meeting 3-4.11: https://indico.cern.ch/conferenceOtherViews.py?view=standard&confId=156004 (still open for more interests)
- Description of contributions, link-persons, planned personnel and material resources at home and at CERN for the period

System test and initial step for CLIC



parameter	unit	CLIC	CTF3
accelerated current	A	4.2	3.5
combined current	A	101	28
final energy	MeV	2400	≈ 120
accelerated pulse length	μs	140	1.2
final pulse length	ns	240	140
acceleration frequency	GHz	1	3
final bunch frequency	GHz	12	12

Objectives beyond 2016:

- Final components at some scale
- Full currents
- Needed for initial phase of project (receptions and conditioning of final modules before installation)

Tentative beam parameters

Drive beam (TBA entrance)

Energy	480	MeV	
Emittance, norm. rms	≤ 150	um	
Energy spread, rms	~ 1 %		
Bunch length, rms	1	mm	(3.6 ps)
Bunch charge	8.4	nC	
Pulse Current	101	A	(4.2 A in DBA)
Pulse length	244	ns	(~ 6 us in DBA, option for full pulse length – 140 us)
Rep. Rate	50	Hz	

Probe beam (end of TBA)

Energy	6.5 – 6.75	GeV	(250 to 500 MeV injector exit, 6.25 GeV acceleration)
Emittance, norm. rms	1 – 20	um	(both horizontal and vertical)
Energy spread, rms	0.1 – 1 %		
Bunch length, rms	~ 0.5	mm	(1.8 ps – may changed by adding a bunch compressor)
Bunch charge	0.2 - 1	nC	
Pulse Current	0.4 – 2	A	
Pulse length	up to 156 ns		(possibility of single bunch)
Rep. Rate	up to 50	Hz	

Summary

- Technical progress on accelerator and detectors good (CDRs will be substantial documents addressing most of the key issues for the project – at the level possible at this time)
  - Results for the accelerator feasibility studies are good and the progress continues
  - The detector and physics studies show the capabilities for doing physics at CLIC at high energies
  - A staged implementation provides a good basis for a practical implementation and a long term and exiting physics programme
- Plans for 2012-16 well underway for CLIC, and organization also ok – the Collaboration provides crucial work and support in a number of development areas
- Plans 2016-2020(2) require more resources (for example for a larger CLIC drive beam facility)

- Open Project Meetings (on WEBEX or EVO): https://indico.cern.ch/categoryDisplay.py?categId=3589
- Next collaboration meeting May 9-11: https://indico.cern.ch/conferenceDisplay.py?confId=178209

- Thanks to the CLIC collaboration for the slides and work presented, and in particular Daniel Schulte and Lucie Linssen's slides from recent CERN presentations