Introduction to the 6th CLIC Advisory Committee meeting (02-04/02/11)

CLIC Advisory CommitteE

(ACE)

CLIC progress and perspectives
Follow-up from last ACE meeting

J.P.Delahaye/CERN
for the CLIC Study team and CLIC Collaboration

Organisation

- This room reserved for the Committee up to Friday pm
- Coffee breaks here (Committee and Speakers)
- Lunches in CERN Main Cafeteria (tickets provided to Committee)
- Dinner to-morrow in Glass Box (Main Cafeteria): (Committee and Speakers)
- Report on ACE's findings and recommendations by ACE chairman to: CLIC team on Friday pm Feb 04
- Report on ACE's findings and recommendations by ACE chairman to: Collaboration Board on Monday am Feb 07

•Any organisational or administrative issues: **Alexia (161220)**

Specific to this ACE meeting

The 6th ACE meeting will focus on:

1)The status and progress of the ongoing CLIC R&D activities on technical subjects whose final results are expected beyond 2011.
2) The R&D program and the correspondent planning for the post CDR phase of the project.

In particular, a few critical technical systems corresponding to ACE's specific concerns (Damping Ring) and systems with major investments envisaged in the post CDR phase (Two-Beam modules, CTF3 upgrade and new drive beam facility) will be treated in detail.

The ACE is asked to provide comments on:

1) Relevance of the R&D issues.
2) Validity of the program to address such issues.

ACE6 agenda
(organised by R.Corsini)

http://indico.cern.ch/conferenceDisplay.py?confId=115921

- This morning: Follow-up of ACE5, specially damping ring issues (Yannis) and feasibility status towards CDR

  Next CLIC phase: Steinar (LC study leader)
- This pm: Two Beam Module issues

  Visit of two beam module test stand to-morrow lunch
- To-morrow am: CTF3 and +
- To-morrow pm: CLIC Drive Beam injector issues
- Friday am: additional info on request

5th ACE meeting (02-04/02/10)

The 5th ACE meeting will focus on the technical progress towards the CDR design and the status of the R&D program needed to demonstrate CLIC feasibility in support of the CDR.

The ACE is asked to comment on:

i) the layout and schedule for the CDR

ii) the schedule of the CLIC feasibility demonstrations and timing of the CDR

iii) the technical and/or design status of the following subjects drawn from the "list of CLIC critical issues":

- **ACE report**: Recommendations to CLIC team:
  http://indico.cern.ch/conferenceDisplay.py?confId=81094
- **Presentation Tor to CLIC/CTF3 collaboration Board:**
  http://indico.cern.ch/conferenceDisplay.py?confId=82576

ACE5 recommendations on Feasibility issues

JPD
This
presentation

S.Stapnes
02/02 am

- Clarify the context of "technical feasibility of CLIC concept" *upfront*, in CDR i.e. what it is, and what it is not.
- CLIC group should quantify and qualify -
  - What has been demonstrated wrt what is needed at CLIC.
  - What is planned to do at the TDR stage with goals, deliverable, milestones and budget for all significant parts of it.
  - (How the outcome from activities during the TD stage would relate to the launch of the project.)
- CLIC group should offer the explanations in reasonable details for the above sub-bullets in the CDR, besides the design description of CLIC which is already planned in the outline for CDR.

ACE5 recommendations on Main Beam Accelerator Structures

R.Corsini
02/02 am

- Should go full steam ahead with RF testing of the acc structures in pipeline, with emphasis on TD24.
  - Take advantage of any chances for further schedule optimization.
  - Try to make some statement on the struc life time on the basis of available data.

W.Wuensch
02/02 pm

- Besides the ongoing work toward CDR,
  - Testing of more accelerator structures highly recommended in the future to enhance confidence in the statistical and technical sense.
  - Clarify implications of difference in the current testing environment (i.e. absence of beam, beam-loading) wrt actual CLIC operational conditions, to pre-avoid confusion in the community.
  - Address lifetime issues.
  - Validated HOM damping performance.
- CERN efforts on its own infrastructure (fab + testing) strongly encouraged.

ACE5 recommendations on Drive Beam Decelerator Structure

- **Toward completion of CDR**
  - ON/OFF operation has to be demonstrated (with the new scheme; integrated reflector)
  - HOM will not be immediately measured and remains to be an outstanding concern.
  - Ditto for damage and lifetime aspects in a recirculator-aided setting.

JPD for I.Syratchev

- **Ultimate goal has to be remembered:**
  DB-driven test all features with a 100 A beam .

R.Corsini
E.Jensen
S.Doebert
03/02 am

ACE5 concerns on Damping Ring

- Space charge tune shift (0.2) very large,
- 2GHz RF system seems very hard. No detailed calc or sim seem available.
- Beam pipe diameter very small (10mm).
- Bunch length very short (1mm).
- HOM power studies not available.
- [illegible] gap in the ring might cause a lot of difficulties for [illegible] system and RF and beam stability requirements.
- [illegible]ynchronous phase spread due to the gap transient is missing.
- No studies made on single and multi bunch instabilities.
- Feedback requirements missing.
- Longitudinal dynamics (with RF cavities) has to be checked.

Y.Papaphilippou
02/02 am

- **Committee feels that not enough data presented to judge the DR feasibility.**
  - DR is one of the major performance drivers for any LCs.

ACE5 Global Recommendations for / beyond CDR

S.Doebert
03/02 am

- **Highly desirable to make concentrated efforts on the CTF3-TBL demo test**
  - With the goal of showing the probe beam acceleration
  - Before the CERN council meeting (June 2011)
- **For sake of CDR presentation**
  - Understand the audience (Council, Community around CERN, Community in the world, Community outside HEP)
  - Do not be shy about the progress and accomplishment.
  - Yet, be open and forthcoming about remaining issues.
  - Be quantitative, whenever possible.
  - Also, use tables to compare the specs, goals, achievements, projections, whenever possible.

H.Schmickler
to authors

- **The feasibility of many of the critical components for CLIC has been demonstrated in the sense of an existence proof**
  - What is less well developed is the feasibility of systems and the systems-integration
  - These issues must be addressed in TDR-phase

S.Stapnes
03/02 am

ACE5 Recommendations on next phase

- **Develop a plan for the TDR phase that is focused on laying the groundwork for approval of CLIC construction**
  - The committee supports including prototype development and testing as well as significant R&D items, in particular, realistic testing of the two-beam acceleration structures with 100 Amps and 240 ns.

S.Stapnes
02/02 am

- **Construction of the full drive beam linac (2 GeV) could be part of "CLIC-Zero" as a first phase of CLIC construction.**
  - CLIC-Zero would be only opportunity for the many systems-level demonstration of the CLIC concept.
  - Important to think of a possible physics justifications for CLIC-zero.

Discussion
introduced
&
moderated
R.Corsini
03/02 pm

World-wide CLIC&CTF3 Collaboration

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

CLIC multi-lateral collaboration
41 Institutes from 21 countries
Chairman:K.Peach, Spokesperson:RCorsini

New member from ACE5

ACAS (Australia)
Aarhus University (Denmark)
Ankara University (Turkey)
Argonne National Laboratory (USA)
Athens University (Greece)
BINP (Russia)
CERN
CIEMAT (Spain)
Cockcroft Institute (UK)
ETHZurich (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)

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. University of Catalonia (Spain)
PSI (Switzerland)
RAL (UK)
RRCAT / Indore (India)
SLAC (USA)
Thrace University (Greece)
Tsinghua University (China)
University of Oslo (Norway)
Uppsala University (Sweden)
UCSC SCIPP (USA)

Extending CLIC /ILC Collaboration

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

- **Common working groups on technical subjects with strong synergy between CLIC & ILC (co-chaired):**

  Physics & Detectors, Beam Delivery System (BDS) & Machine Detector Interface (MDI), Civil Engineering & Conventional Facilities, Positron Generation, Damping Rings, Beam Dynamics, Cost & Schedule

- **Joint Working Groups on Linear Collider General Issues (Accelerator & Detectors)**

  reporting to ILCSC and CLIC Collaboration Board

  Final report end 2012, preliminary report by PL to CB on 07/02/11

IWLC2010 workshop (18-22/10/2010 @ CERN)
Joint CLIC & ILC (Accelerator and Detectors)
https://espace.cern.ch/LC2010/default.aspx
- 500 participants

9 Accelerator WG + 13 Physics@Detectors WG

CLIC design update

- **Baseline review**
  - Proposals of WGs in December 2009
  - Presented to ACE by G.Geschonke in Feb 2010
  - Recommendations of dedicated teams for critical proposals
  - Approved by CASC after final review in March 2010: https://edms.cern.ch/document/1115567/1

- **Lots of detailed studies in preparation of CDR**

  in the framework of the various WGs reporting to oversight committees:

  http://clic-study.org/structure/CLIC-organisation.htm

CLIC main parameters

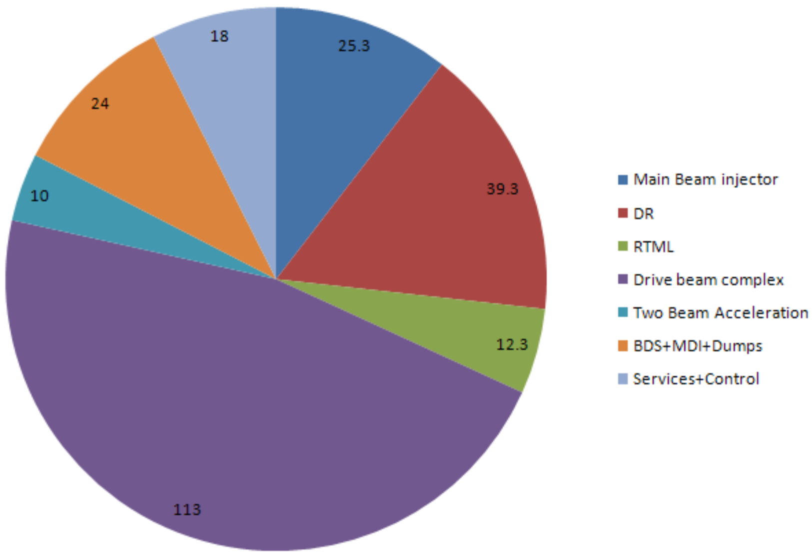
http://cdsweb.cern.ch/record/1132079?ln=fr http://clic-meeting.web.cern.ch/clic-meeting/clictable2007.html

Center-of-mass energy	CLIC 500 GeV		CLIC 3 TeV	
Beam parameters	Relaxed	Nominal	Relaxed	Nominal
Accelerating structure	502		G	
Total (Peak 1%) luminosity	$8.8(5.8)\cdot10^{33}$	$2.3(1.4)\cdot10^{3}$	$7.3(3.5)\cdot10^{33}$	$5.9(2.0)\cdot10^{34}$
Repetition rate (Hz)	50			
Loaded accel. gradient MV/m	80		100	
Main linac RF frequency GHz	12			
Bunch charge10^{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($10^{-6}/10^{-9}$)	7.5/40	4.8/25	7.5/40	0.66/20
Hor/Vert FF focusing (mm)	4/0.4	4 / 0.1	4/0.4	4 / 0.1
Hor./vert. IP beam size (nm)	248 / 5.7	202 / 2.3	101/3.3	40 / 1
Hadronic events/crossing at IP	0.07	0.19	0.28	2.7
Coherent pairs at IP	10	100	$2.5\ 10^{7}$	$3.8\ 10^{8}$
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~~ 241		~~415~~ 568	

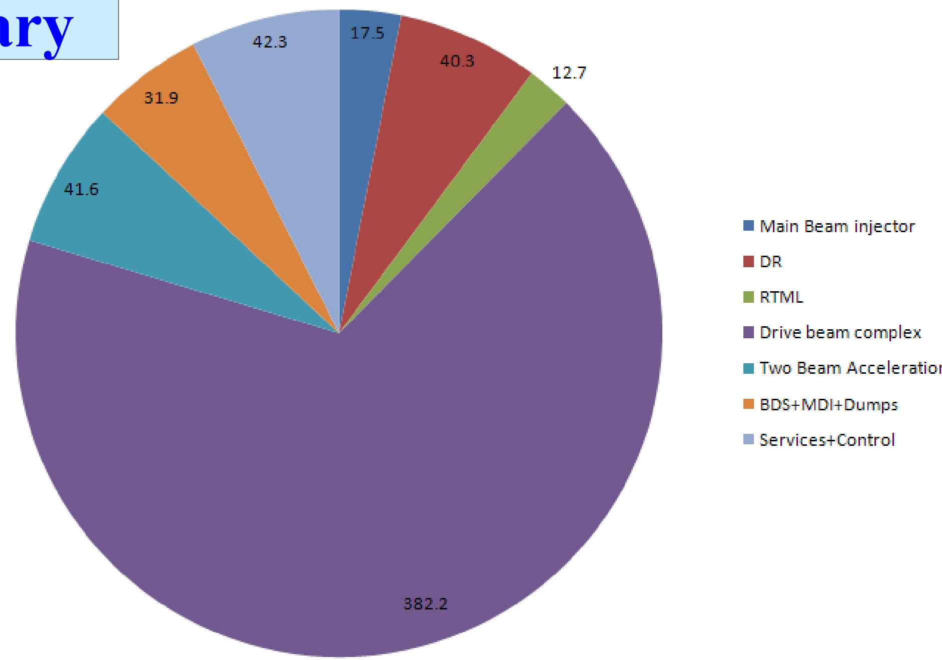
CLIC power

JB.Jeanneret Preliminary

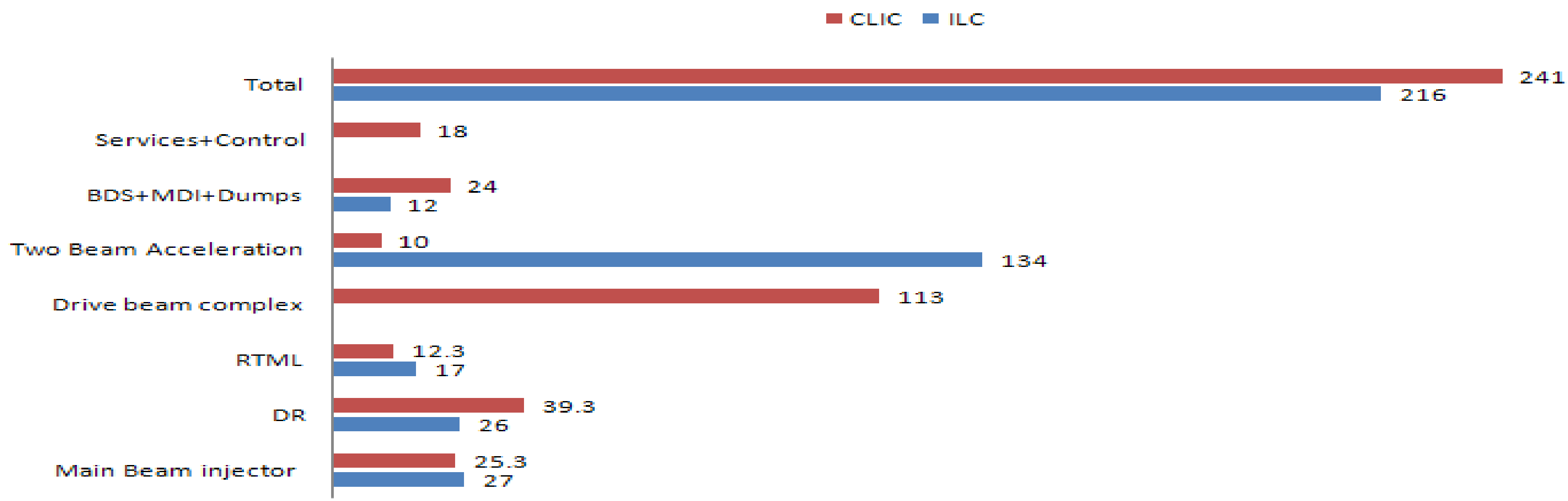
CLIC 500 GeV = 241 MW



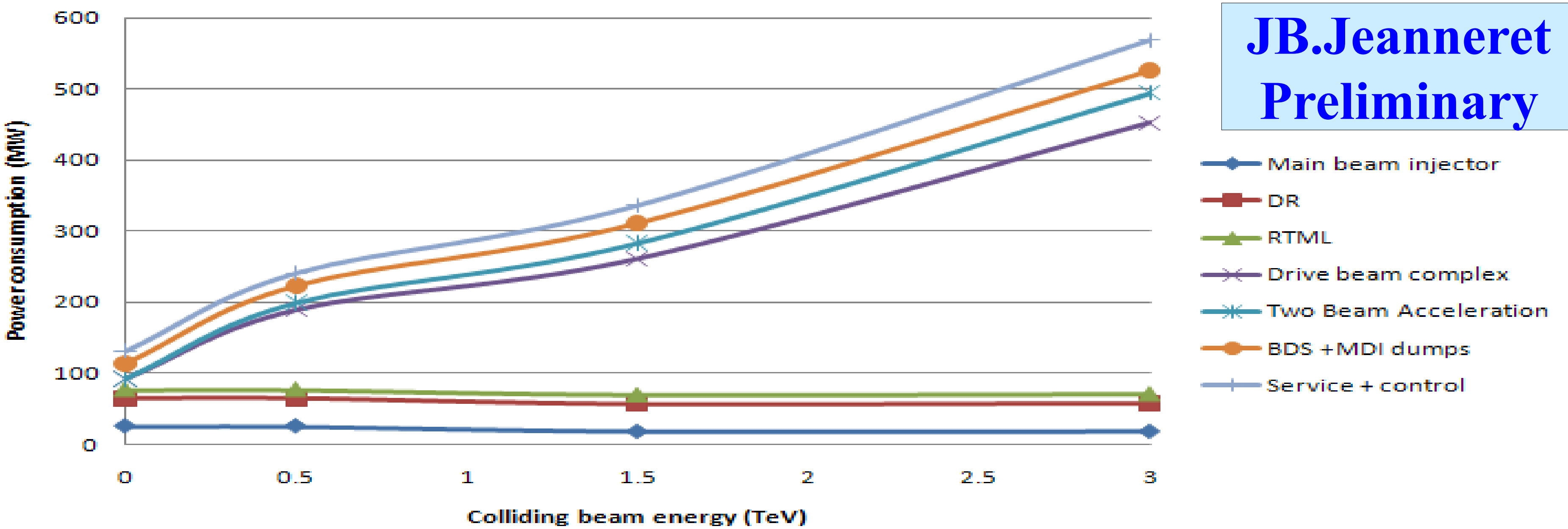
CLIC 3 TeV = 568 MW



LC 500 GeV power repartition

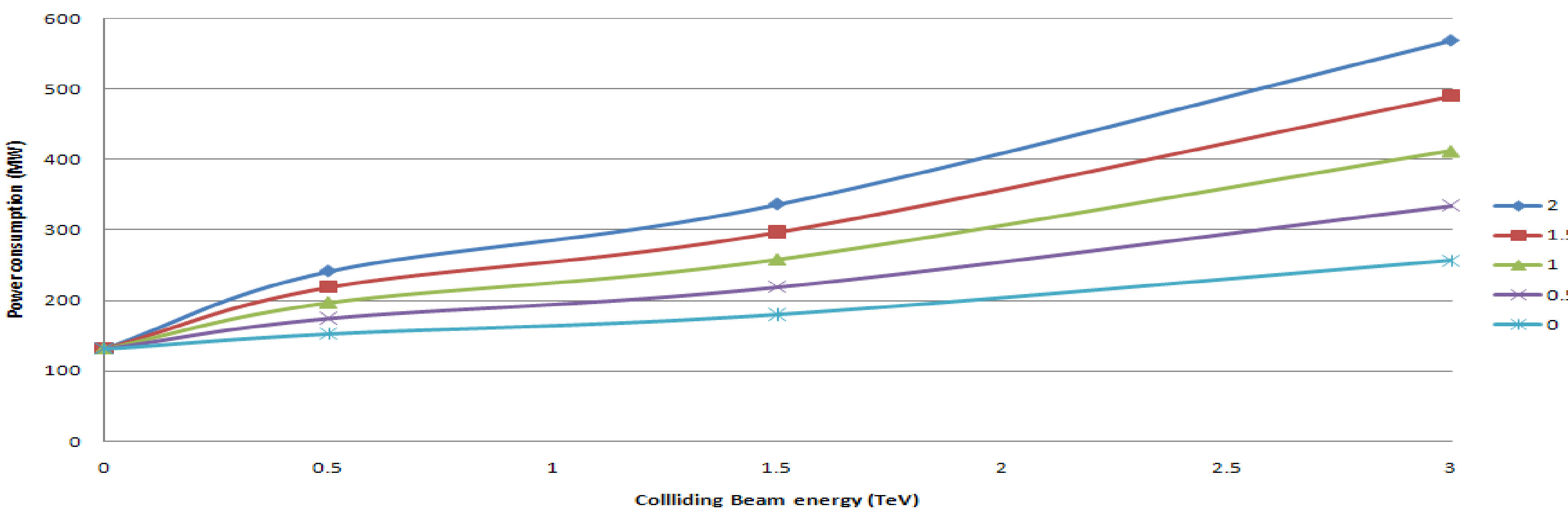


CLIC power repartition by systems versus beam energy

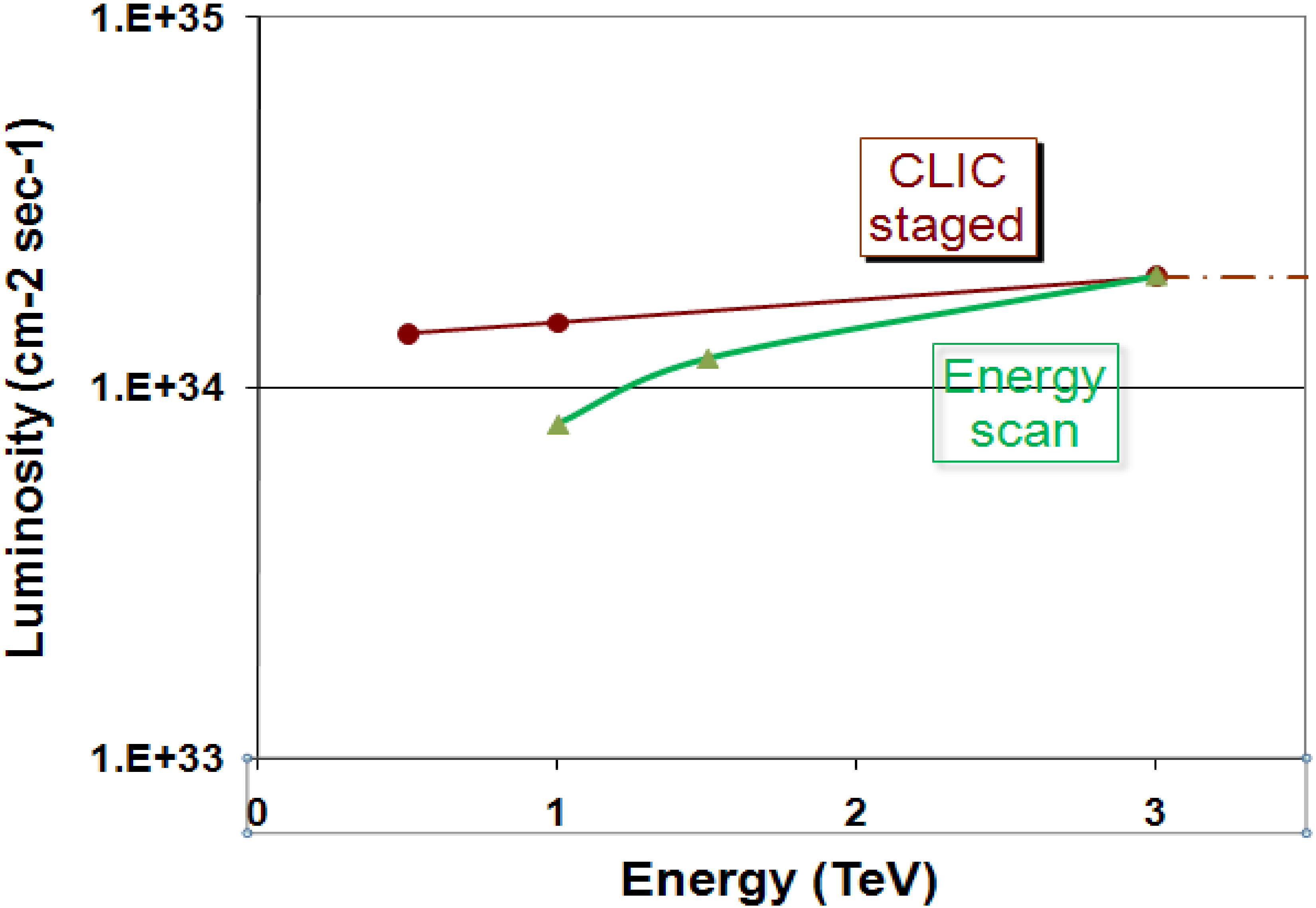


JB.Jeanneret
Preliminary

CLIC power versus beam energy
for various luminosities (10^34)



CLIC performances and energy scan

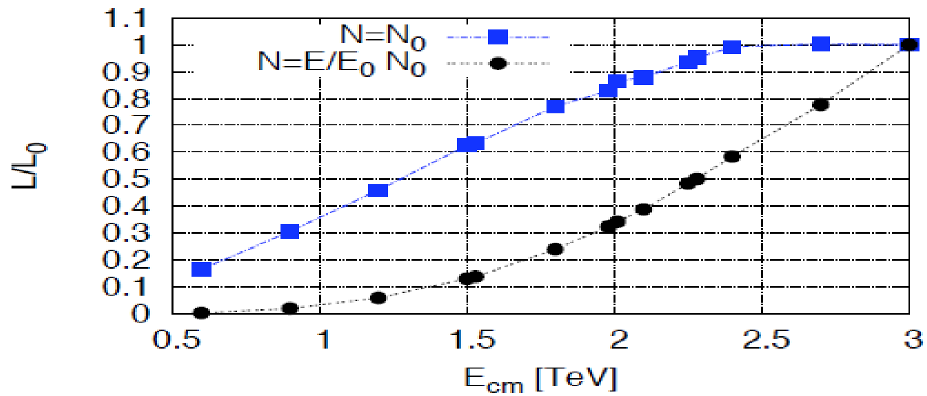


Energy scan strategy and performance

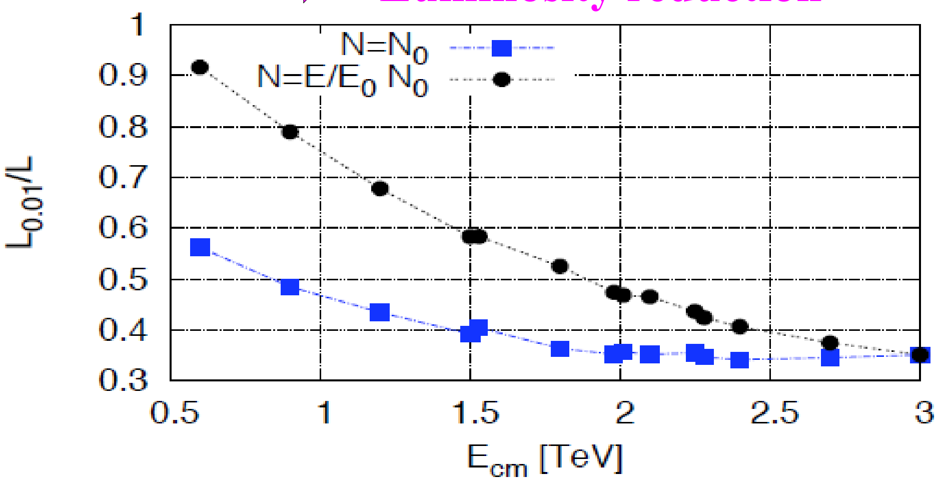
D.Schulte

Beam collision energy (E) adjustment by accelerating gradient (G) tuning

Charge per bunch N proportional to

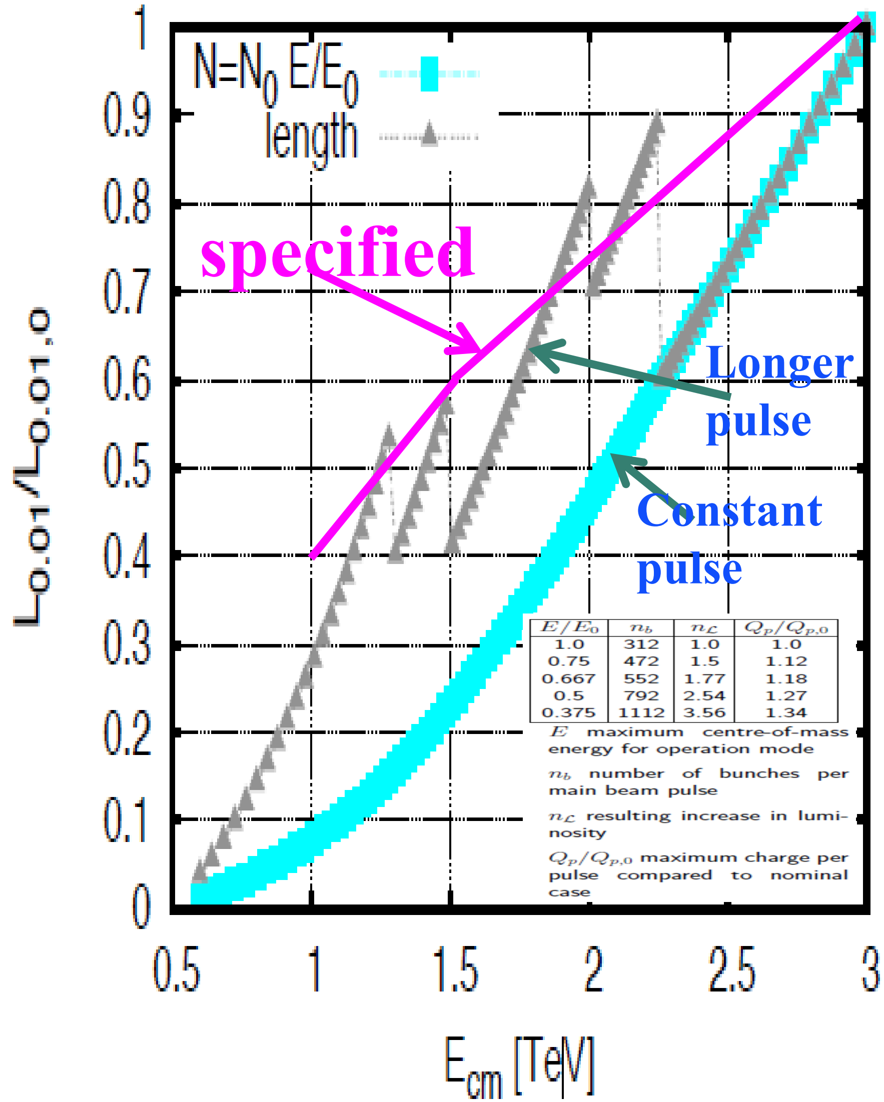


→ Luminosity reduction



→ Better energy spectrum

Luminosity recovery by longer beam pulse compatible with reduced gradient in RF



E/E_0	n_b	$n_{\mathcal{L}}$	$Q_p/Q_{p,0}$
1.0	312	1.0	1.0
0.75	472	1.5	1.12
0.667	552	1.77	1.18
0.5	792	2.54	1.27
0.375	1112	3.56	1.34

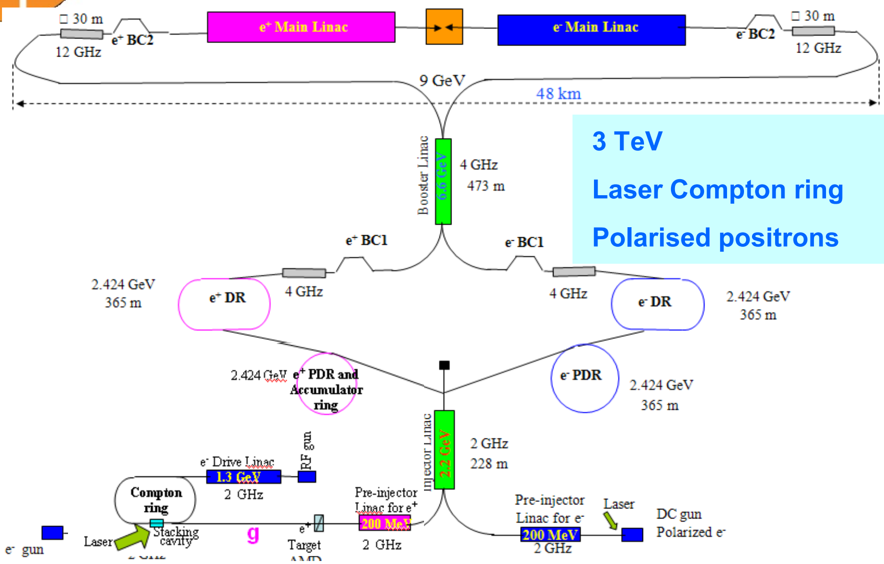
E maximum centre-of-mass energy for operation mode

n_b number of bunches per main beam pulse

$n_{\mathcal{L}}$ resulting increase in luminosity

$Q_p/Q_{p,0}$ maximum charge per pulse compared to nominal case

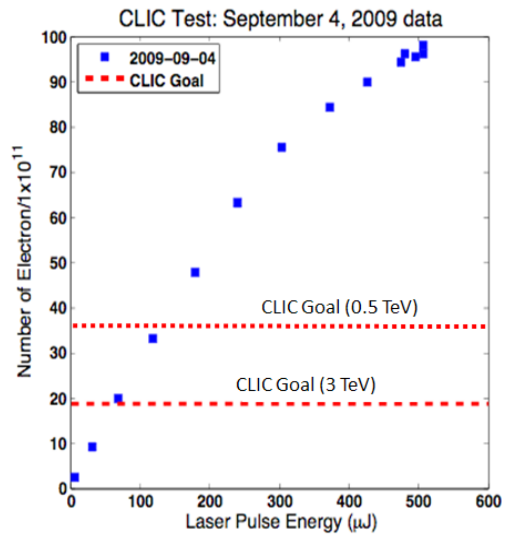
Progress on Main Beam Injector Sources



3 TeV

Laser Compton ring

Polarised positrons



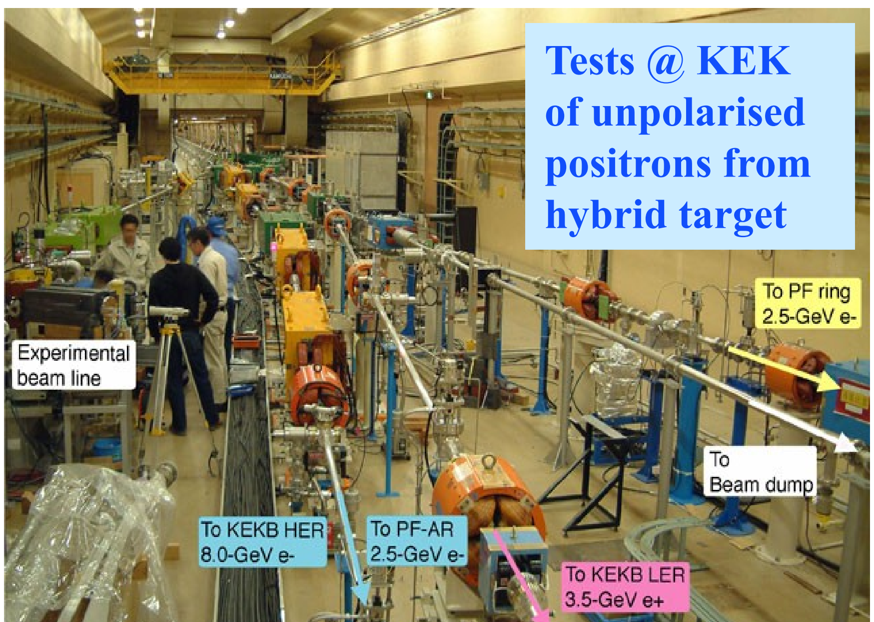
L.Rinolfi

The total charge produced is a
factor 3 above CLIC required 0.5 TeV
factor 5 above CLIC required 3 TeV

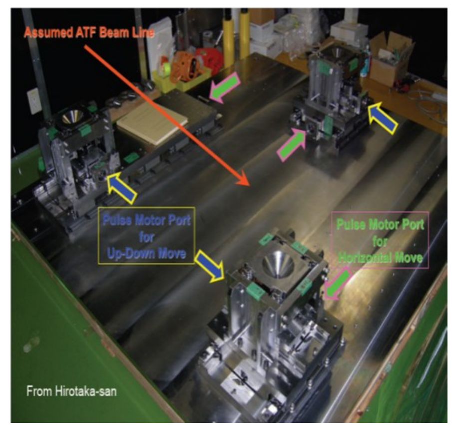
QE ~ 0.7 %

Measured polarization ~ 82 %

Tests @ SLAC of polarised electrons



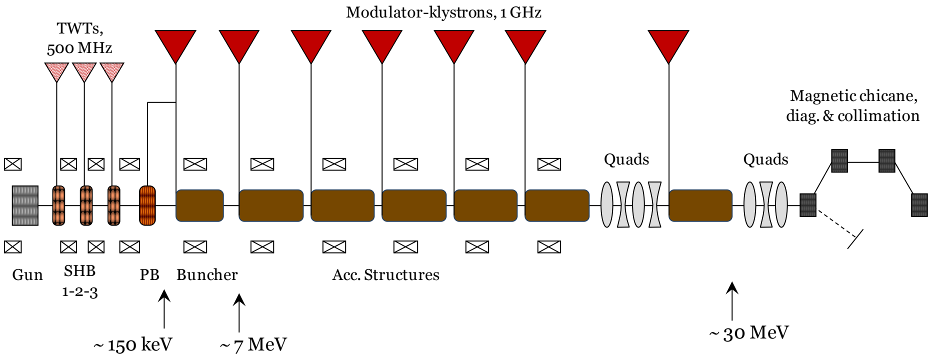
Tests @ KEK of unpolarised positrons from hybrid target

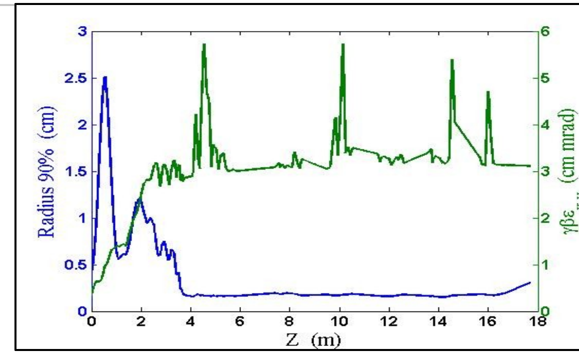


Tests @ KEK of Optical cavity using Compton backscattering for ILC and CLIC polarized e^+ (Collaboration CERN/LAL/KEK)

Progress in Drive Beam Complex design

Drive beam injector design





Parameter	Unit	Simulations	CLIC
Energy	MeV	53.2	50
Bunch charge	nC	8.16	8.4
Bunch length (rms)	mm	2.83	3 (@ 50 MeV)
Energy spread (rms)	MeV	0.45 (@53 MeV)	< 0.50 (@ 50 MeV)
Horizontal normalized emittance (rms)	µm rad	32.9	≤ 100
Vertical normalized emittance (rms)	µm rad	28.7	≤ 100
Satellites population	%	4.9	As less as possible

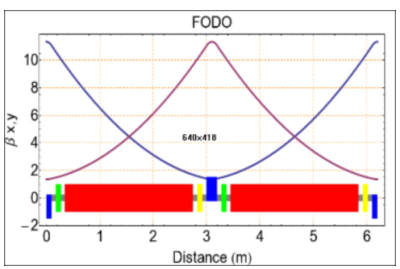
A.Vivoli

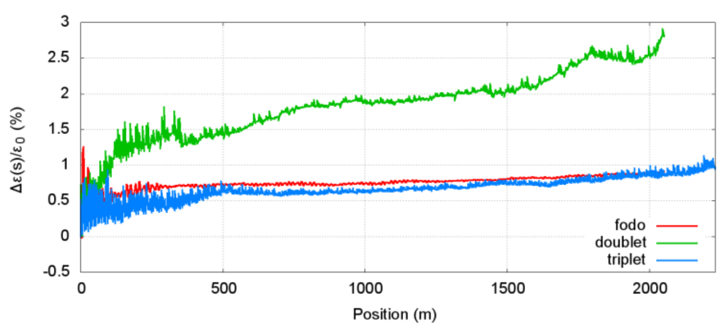
S.Bettoni

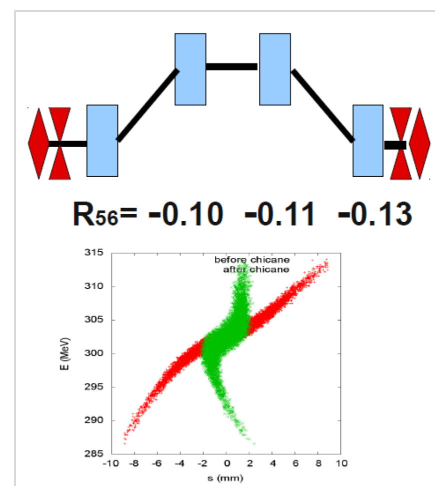
Conceptual design, beam dynamics simulations

Beam performances well within specs

Drive Beam linac design & simulations – including compressors







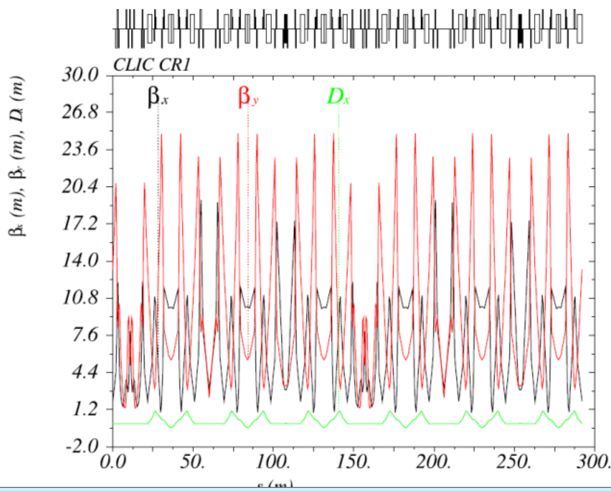
A. Aksoy

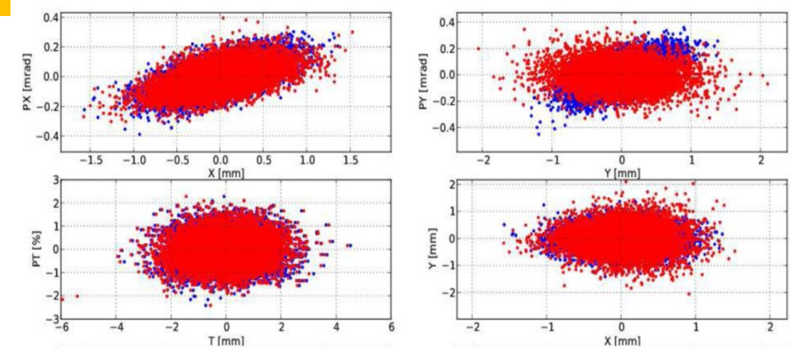
Lattice, beam dynamics, transverse and longitudinal stability studies

Stability ensured, tolerances defined for phase and energy errors

Progress in Drive Beam Complex design, cont'd

Drive beam Combiner Rings





Layout, optics, beam dynamics simulations

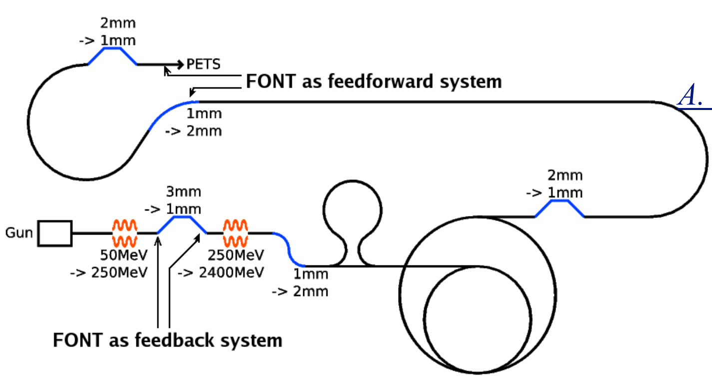
Chromatic corrections, control of emittance growth

Summary Emittance Growth

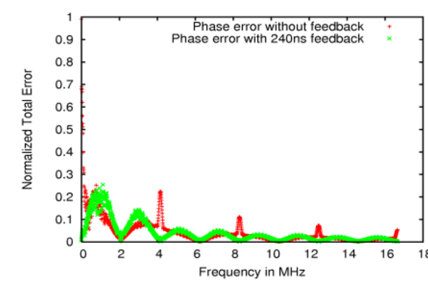
No sextupoles,
$\epsilon_{X,Init}=26.0 \rightarrow \epsilon_{X,End} = 62.8$ nm rad.
$\epsilon_{Y,Init}=26.0 \rightarrow \epsilon_{Y,End} = 35.9$ nm rad.
$\sigma_{l,Init}= 1\ 10^{-3} \rightarrow \sigma_{l,End}=1.27\ 10^{-3}$ m.
Chromaticity and higher order dispersion corrected,
$\epsilon_{X,Init}=26.0 \rightarrow \epsilon_{X,End} = 28.3$ nm rad.
$\epsilon_{Y,Init}=26.0 \rightarrow \epsilon_{Y,End} = 35.9$ nm rad.
$\sigma_{l,Init}= 1\ 10^{-3} \rightarrow \sigma_{l,End}=1.01\ 10^{-3}$ m.

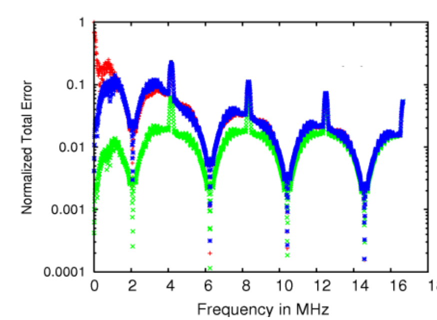
P. Skowronski, J. Barranco, C.Biscari

Drive beam charge and phase jitter control, feedbacks and feed-forward



A. Gerbershagen





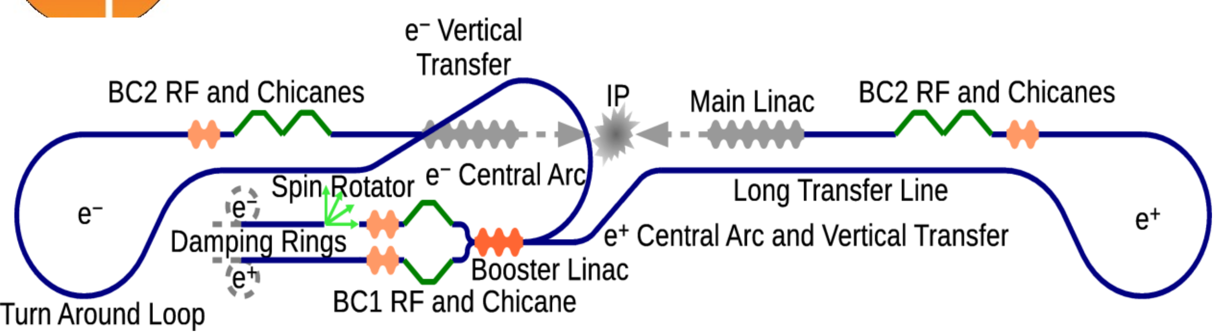
Analysis of charge error propagation, feedback & feed-forward simulation

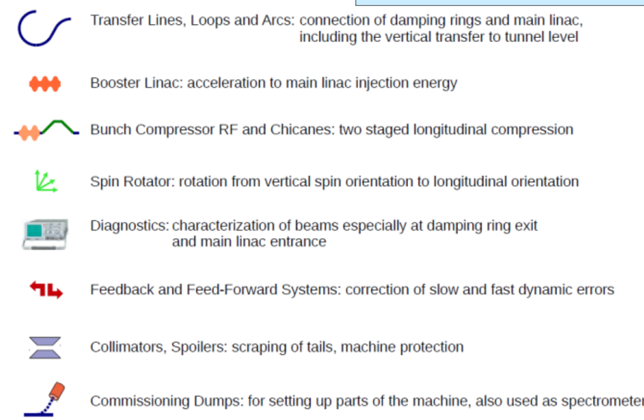
Good performance with 240ns feedback, residual errors corrected with high-bandwidth feed-forward

A. Gerbershagen

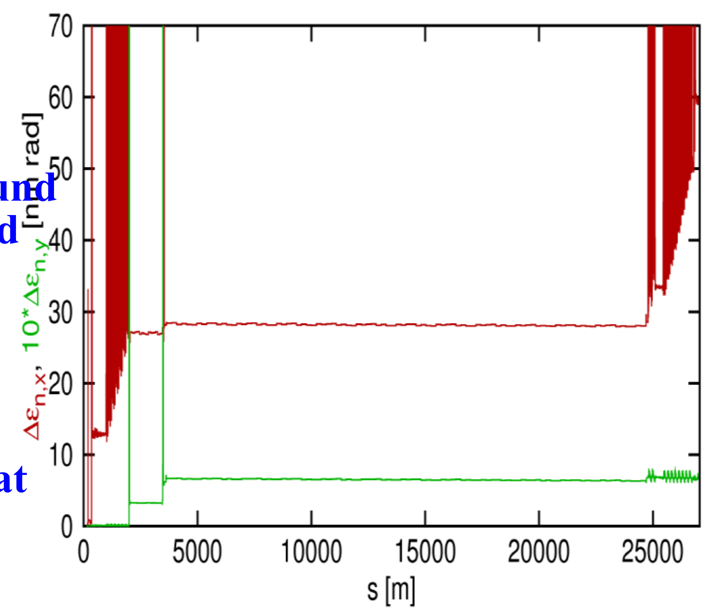
Progress in CLIC RTML design

F.Stulle



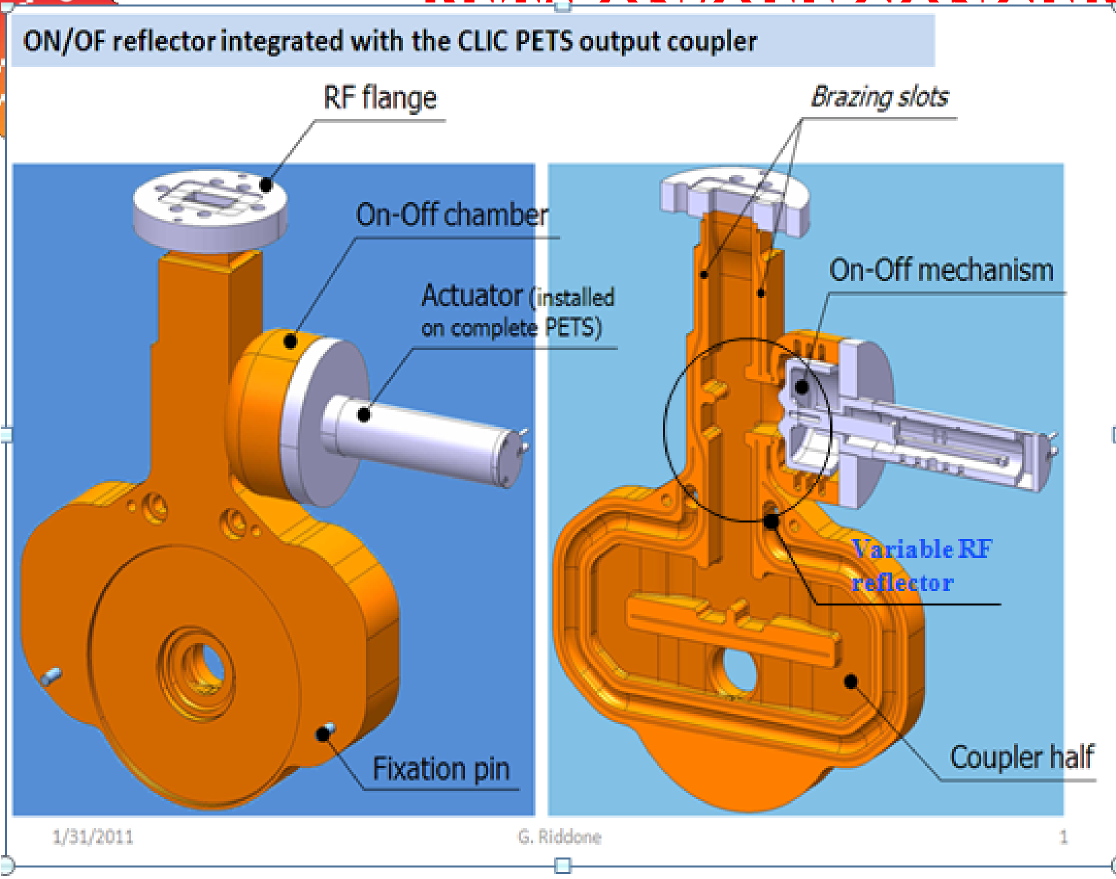


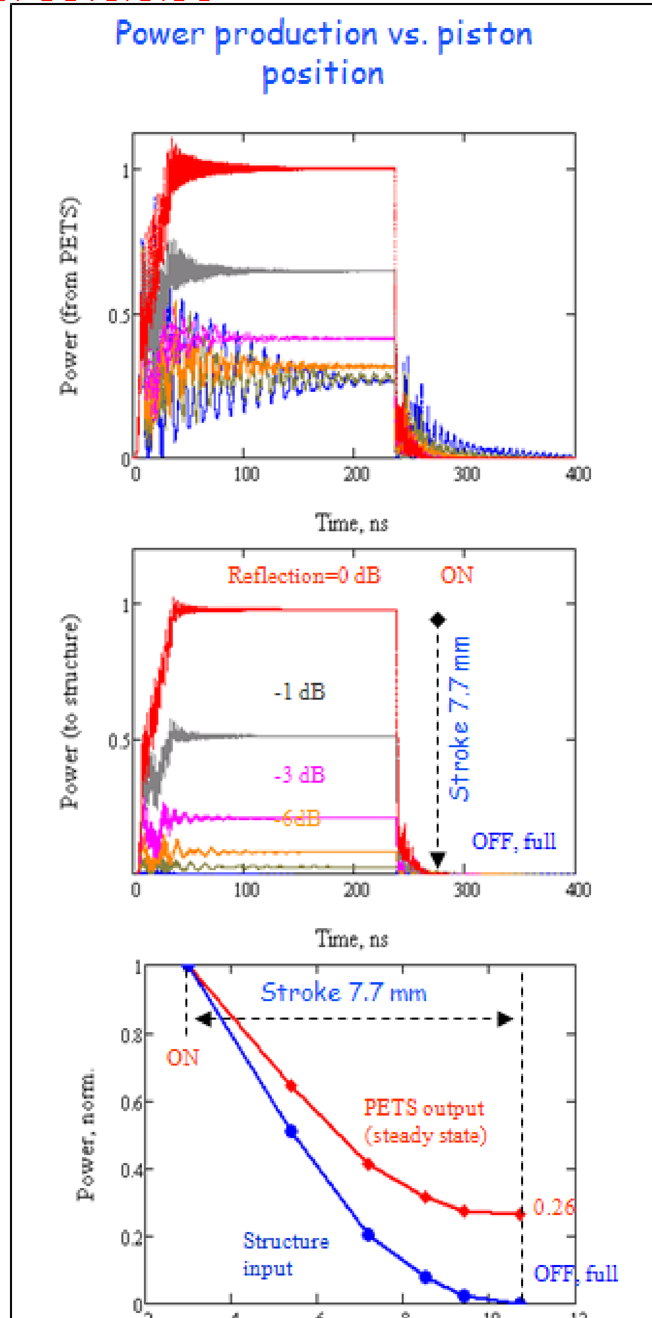
- Lattices are complete including the e- spin rotator.
- Good performance including incoherent synchrotron radiation, coherent synchrotron radiation and single bunch wakes.
- Static misalignment along RTML (Booster linac, turn around loops with specifications ~1 μm range for 1-to-1 steering and in the ~100 μm range for dispersion free steering.
- Ground motion not really be an issue.
- Dynamic magnetic stray for the long transfer line with specification below 10 nT (~0.1 nT for periodic stray fields at betatron wavelength).
- Tolerances for incoming beam properties, RF phases and amplitudes : partially tight but not too far from what has already been shown in accelerators, e.g. 0.08 deg @ 2 GHz BC1 RF phase stability.
- The RTML studies are considered sufficient for the CDR.



Growth of normalized emittances $\epsilon_{n,x}$ (red), $\epsilon_{n,y}$ (green) with single bunch wakes, ISR and CSR

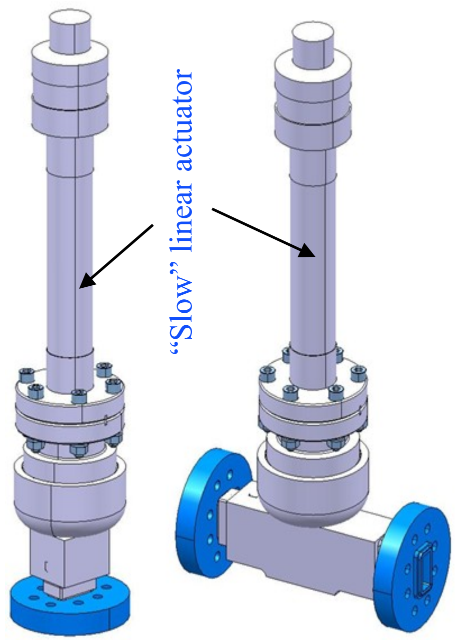
Increasing applications of high field X band structures





1. The RF power production level is manipulated by changing the external reflection combined with internal RF anti-phase re-circulation in the PETS.
2. The reflection depends on position of the piston in the short circuited port of the 3dB splitter.
3. By RF design the ON/OFF mechanism provides at any position less electric field concentration than in the PETS itself.

Prototypes for TBTS PETS



Variable RF short circuit

Variable RF reflector

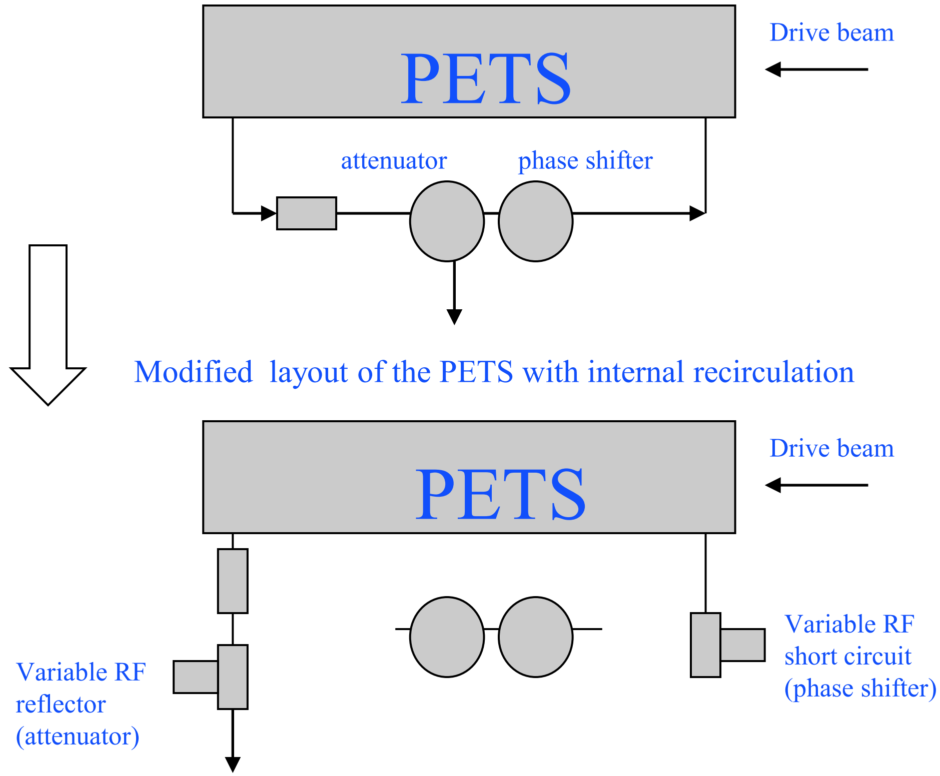
Engineering design completed in September 2010
Tendering until December 2010

Fabrication of two units by beginning of March 2011

Installation on TBTS during summer for tests with beam

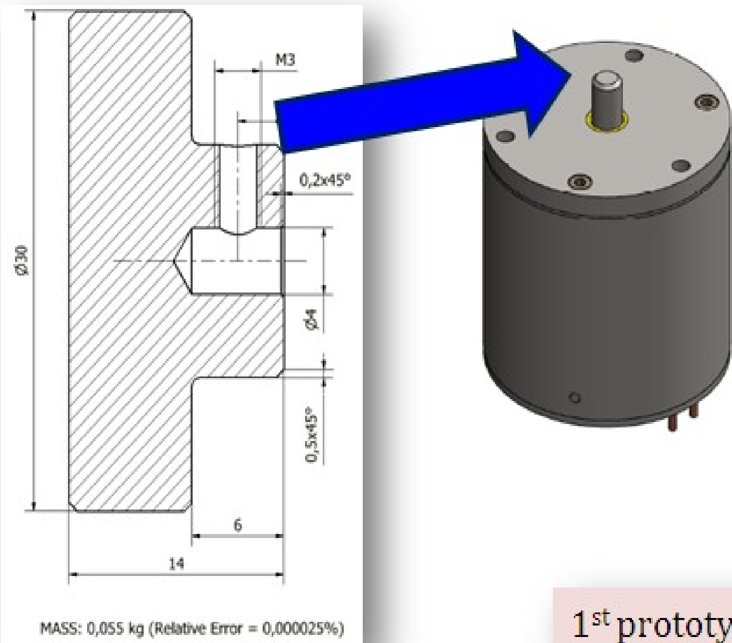
ON/OFF mechanism testing program

Present layout of the PETS with external recirculation

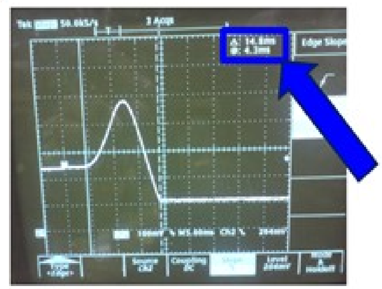


1. **During summer shout down 2011, the PETS external recirculation loop will be replaced by the CLIC type variable reflector and operate with internal re-circulation. To demonstrate termination of the CLIC nominal RF power production CTF3 should provide high (25 A) current.**
2. **The new layout will allow operation in amplification mode (low current), similar to the operation with external re-circulation.**

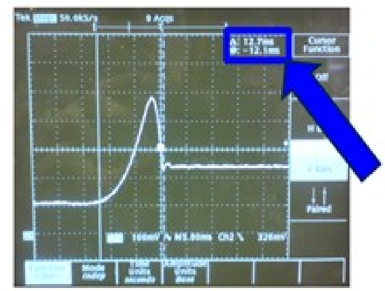
Development and validation of the fast (20 msec) linear actuator (10 mm linear stroke). Prototype from MMT



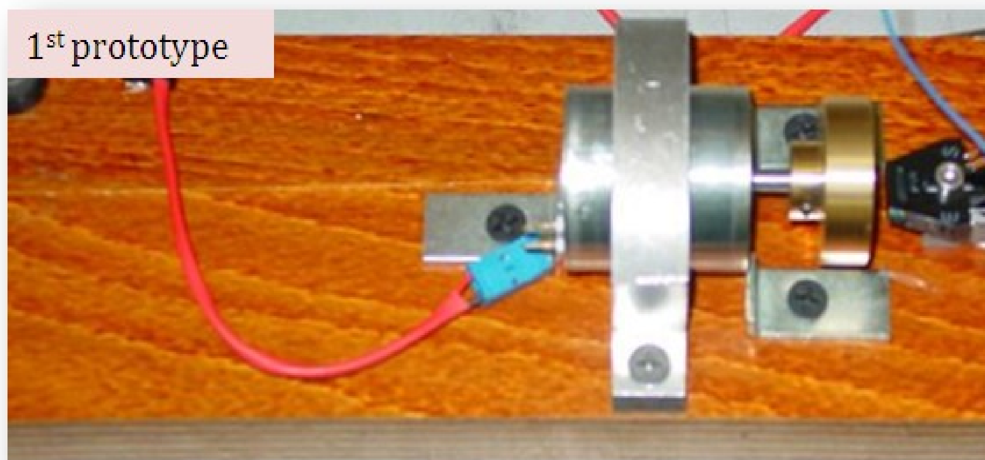
- 55 g weight is fixed on one end of actuator axis
- (f=1Hz, U=20,6 V) → 3600*24*7=604800 cycles performed



14,8 ms

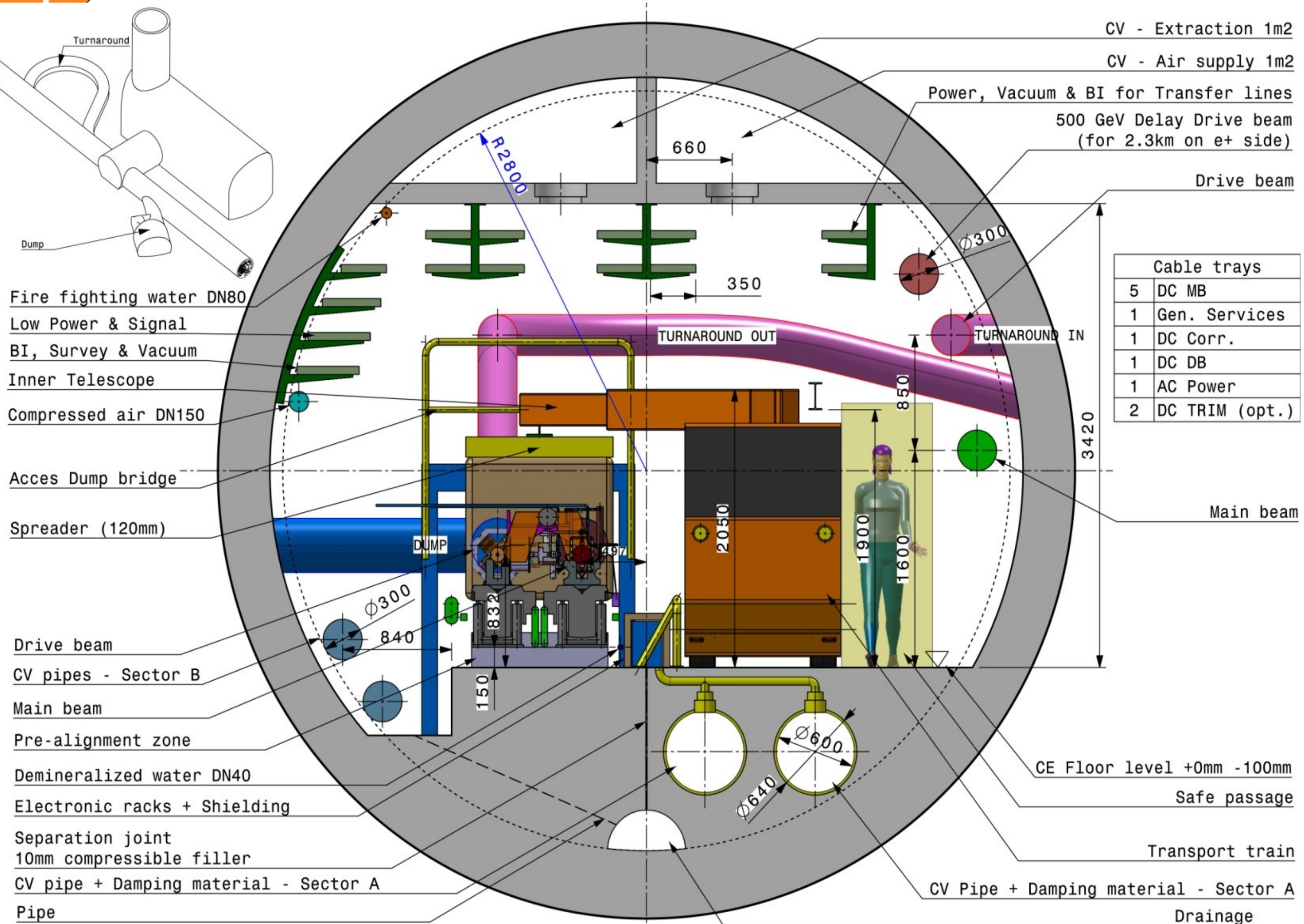


12,7 ms



2nd prototype with less vibrations and less power consumption under testing

Tunnel integration &"Conventional Facilities"



CLIC - Typical Cross Section - Diameter 5600mm - Junction with Turnaround - 1:25

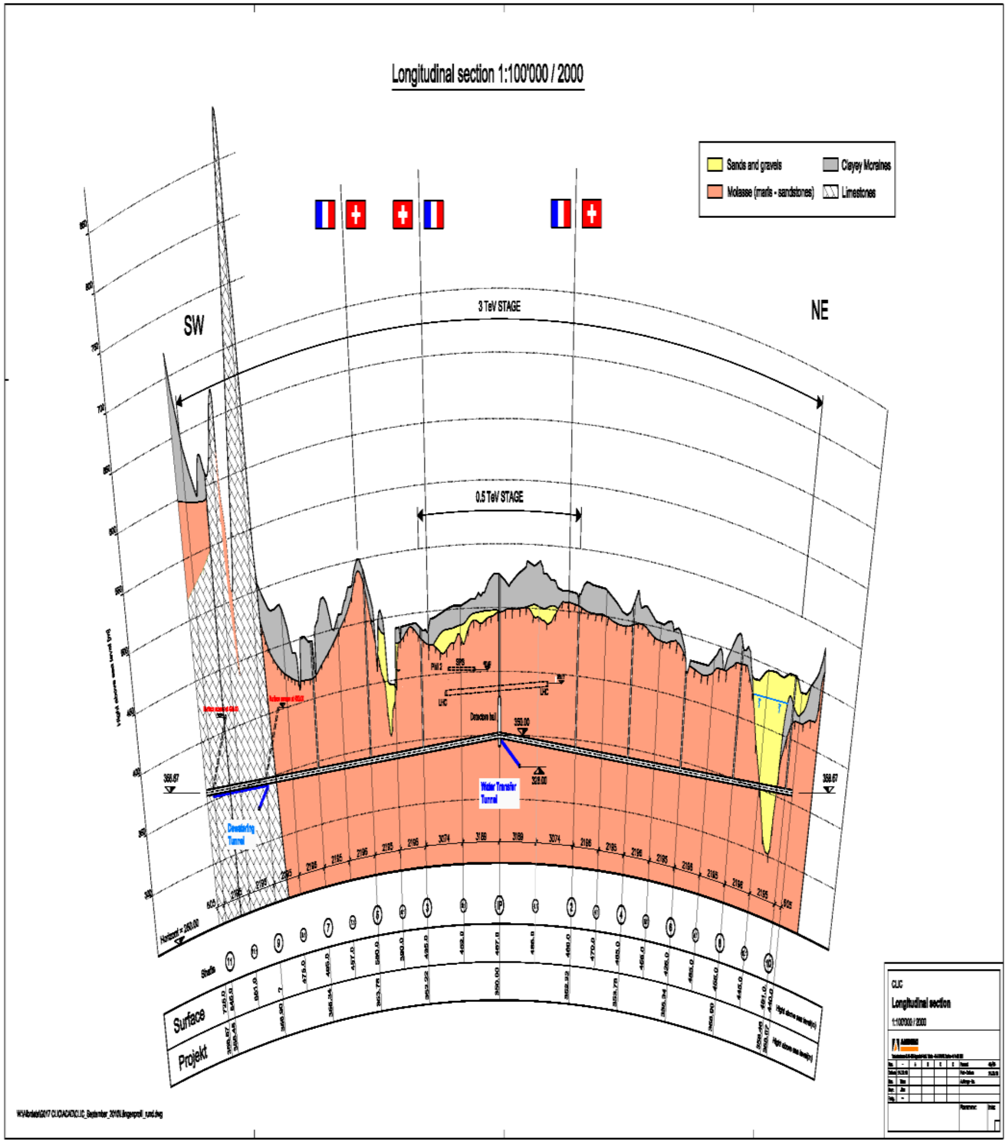
Typical tunnel diameter increased from 4.5m to 5.6m internal diameter

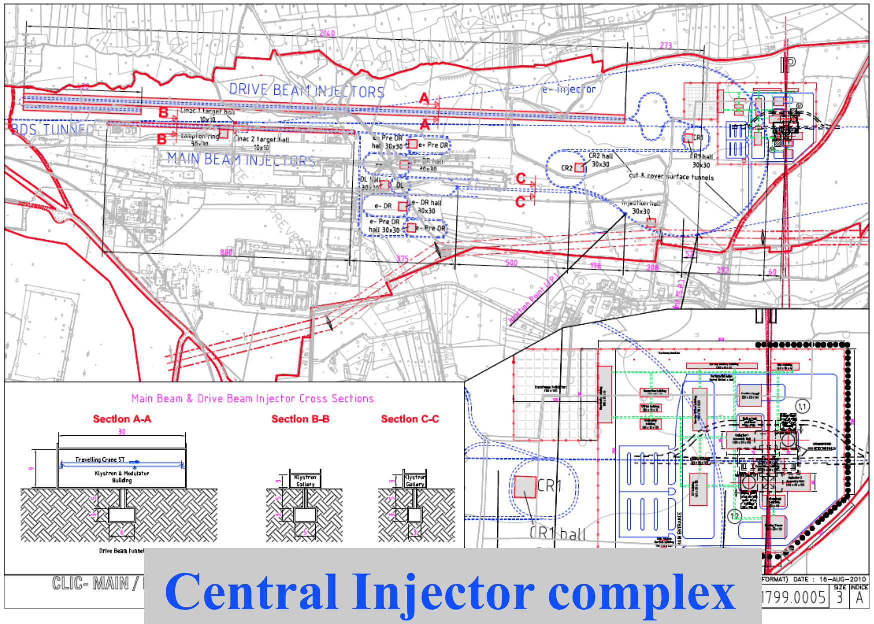
- **'standard' metro diameter in Europe**
- **More space needed for power converters and other services = bigger tunnel**
- **CV pipes now isolated via compressible filler**
- **Transversal ventilation adopted for CDR**

J.Osborne

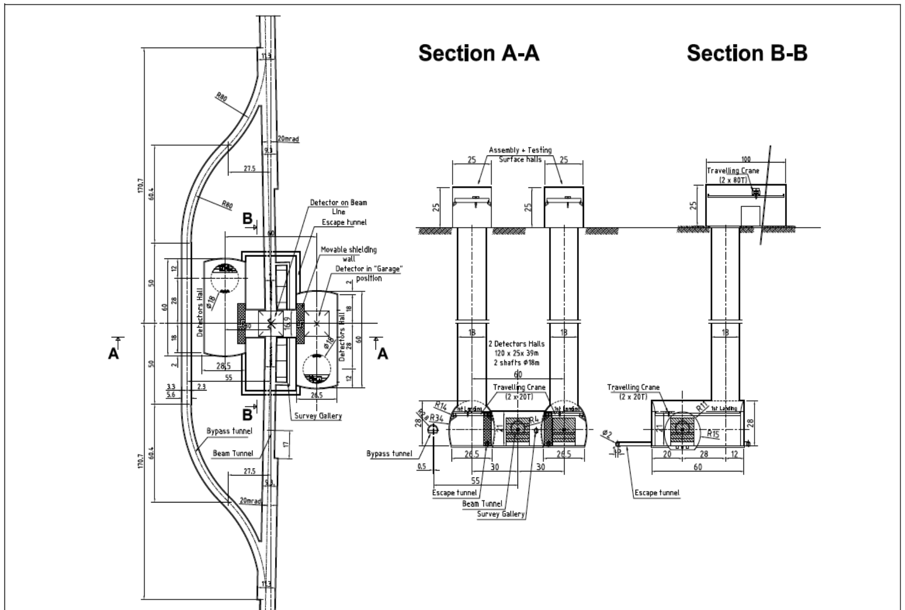
CLIC @ ACE 02-02-11

Tunnel implementation (laser straight)





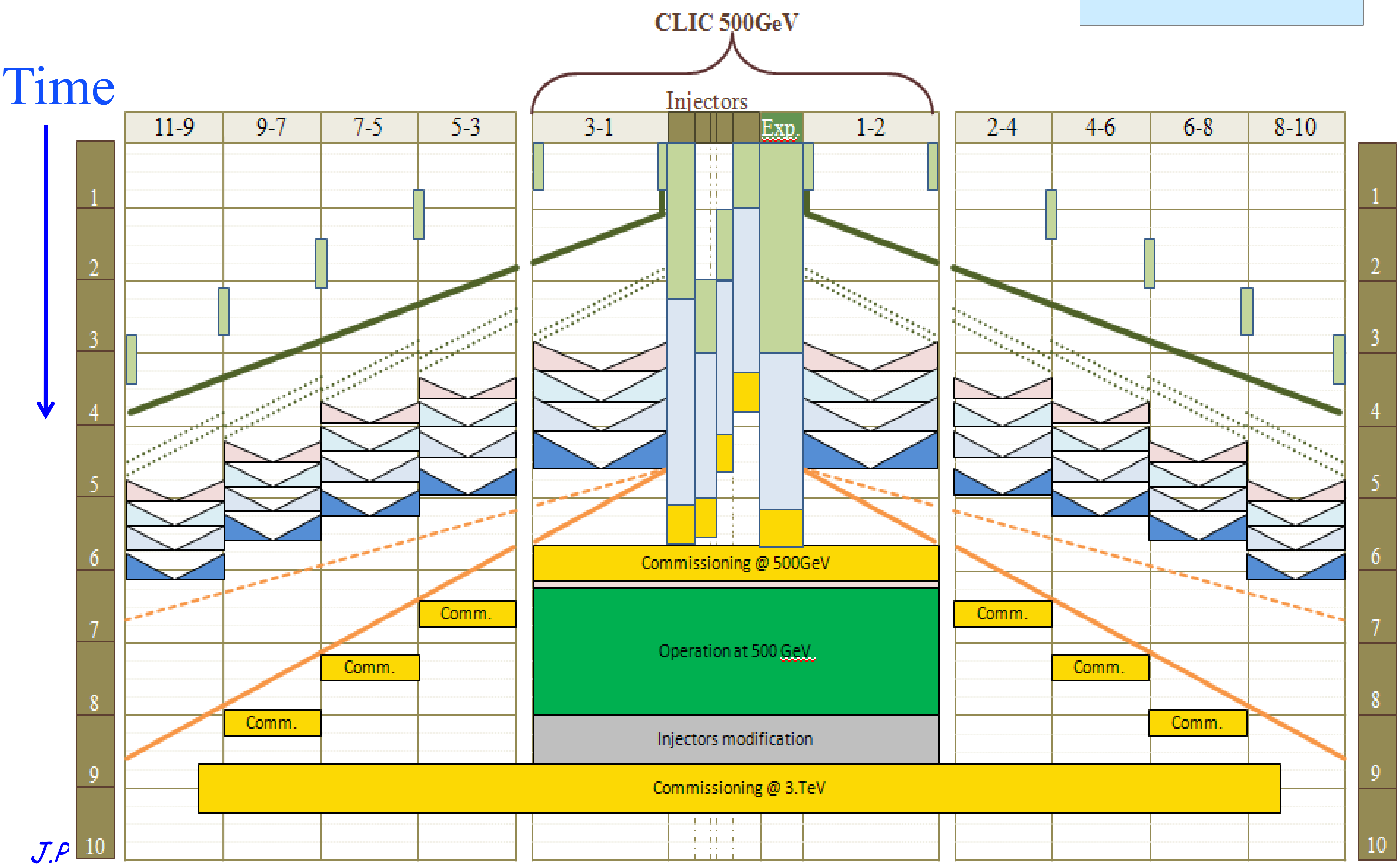
Central Injector complex



Central MDI & Interaction Region

General Construction and installation Schedule derived from LHC experience

K.Foraz



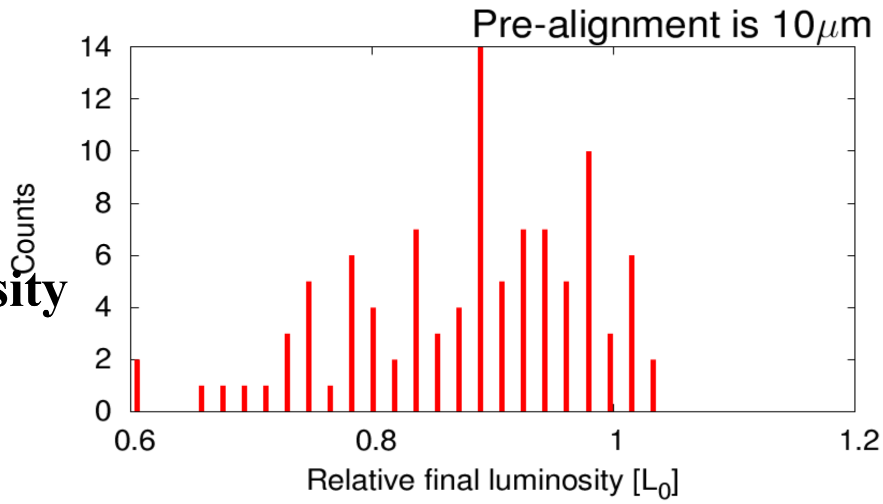
Progress on the CLIC BDS

R.Tomas

- Write-up of the CDR: BDS CDR chapter
- Consolidation of the 500 GeV BDS
- Consolidation of the L*=6m 3 TeV FFS
- Consolidation of the collimation system:
  CLIC note on collimation
- Tuning of the FFS
- Commissioning of ATF2 (BBA & tuning)

Status of tuning in 2010 with l = 3.5m*

80% probability to reach 80% of the luminosity
In 18000 iterations (*design lumi=1.3L0*)

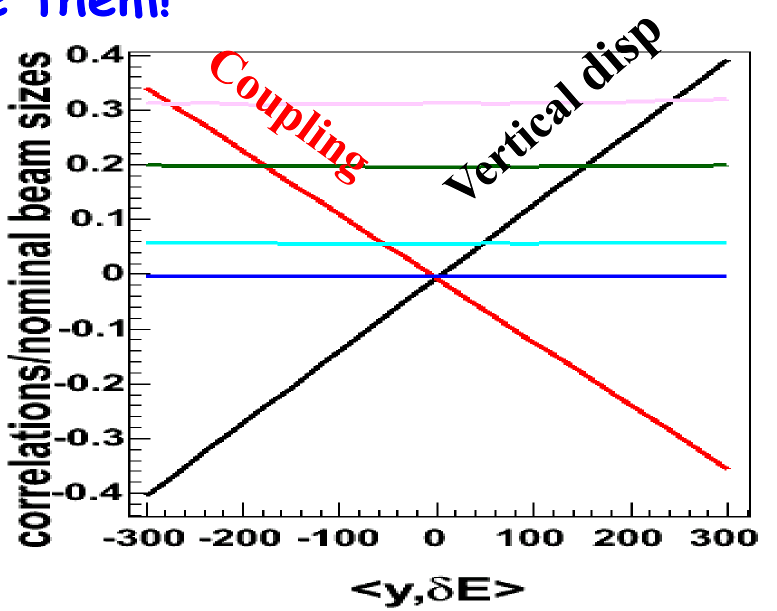


Progress on tuning FFS with l=3.5m*

E.Marin

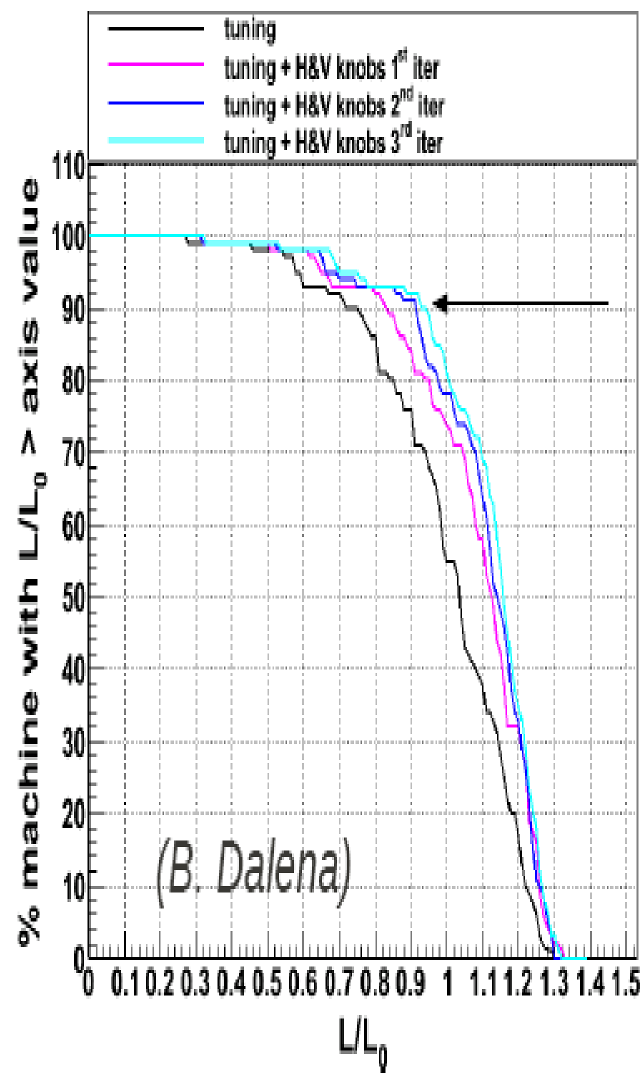
Designing knobs

- Knobs are combinations of the FFS sextupole H&V transverse displacements
- They are built to target relevant aberrations in an orthogonal way
- We have not managed to build orthogonal knobs yet but still we use them!



Vertical dispersion knob

Systematic use of (not ideal) knobs



Two iterations of H&V knobs enough to reach 90% probability of 90% lumi !!! (goal is reached!)

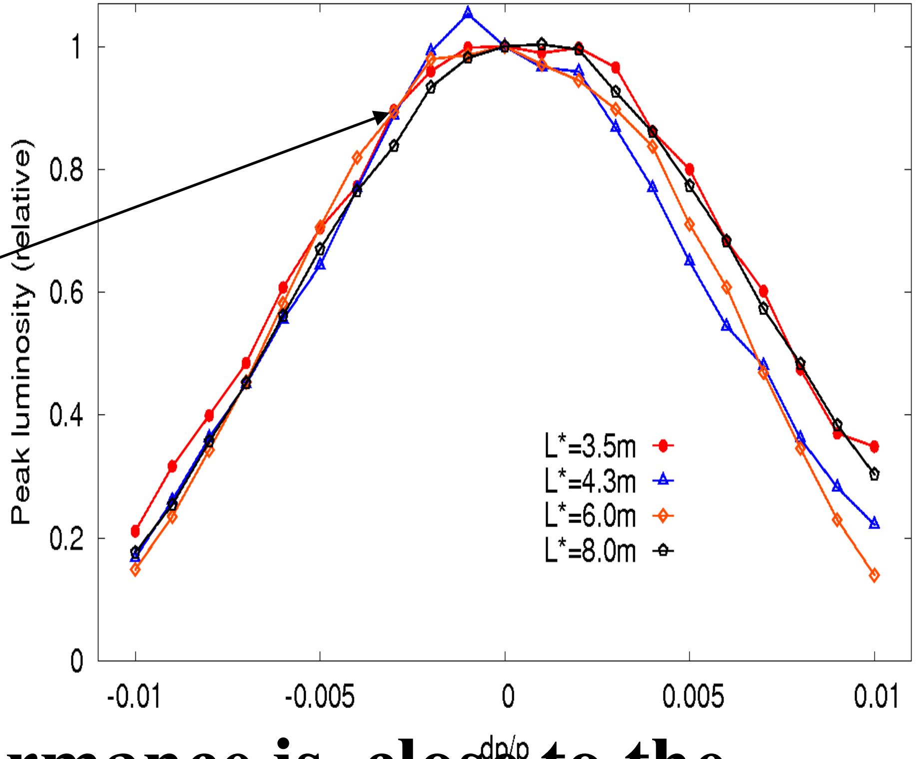
Still to improve: # of iterations by improving the initial "brute force" tuning

G.Zamudio

The L=6m FFS*

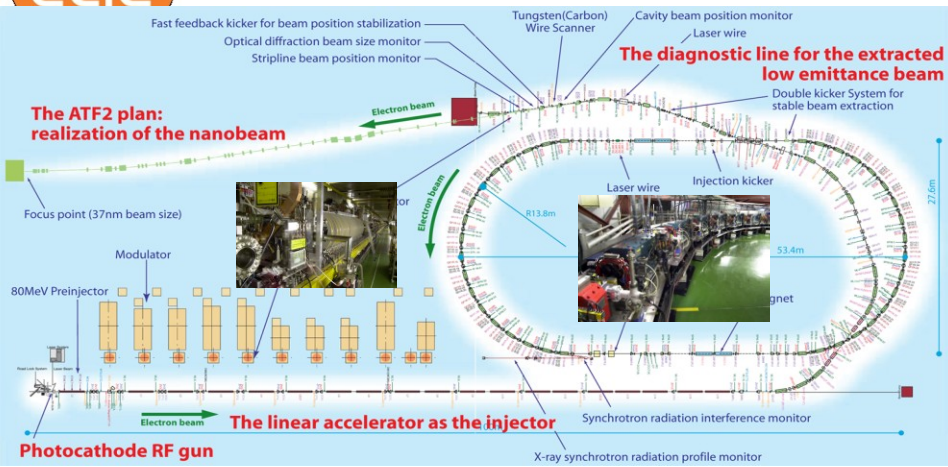
- Lumi=1.1Lo (larger than design but lower than for L*=3.5m)
- Bandwidth is similar
- Tuning 8μm prealign.: 80% prob. to reach 90% of Lo (without knobs!)

E bandwidths of all CLIC FFS



The L*=6m FFS performance is close to the current L*=3.5m. With a bit more effort we might be able to move QD0 out of the detector!

Fruitful collaboration with ATF/KEK

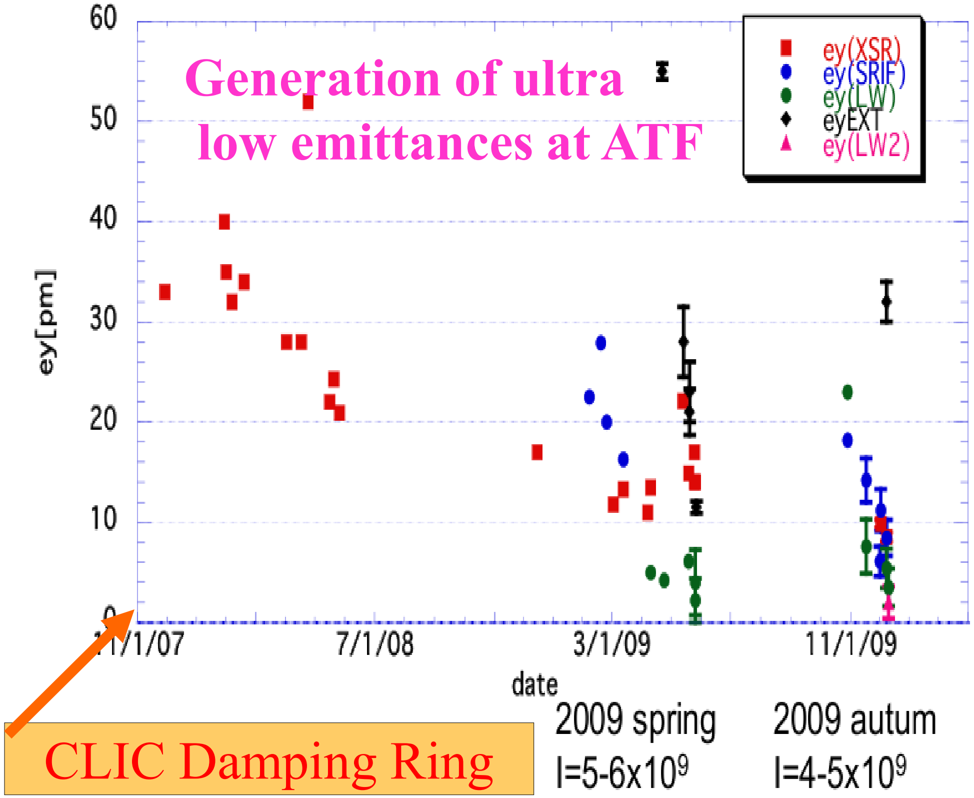


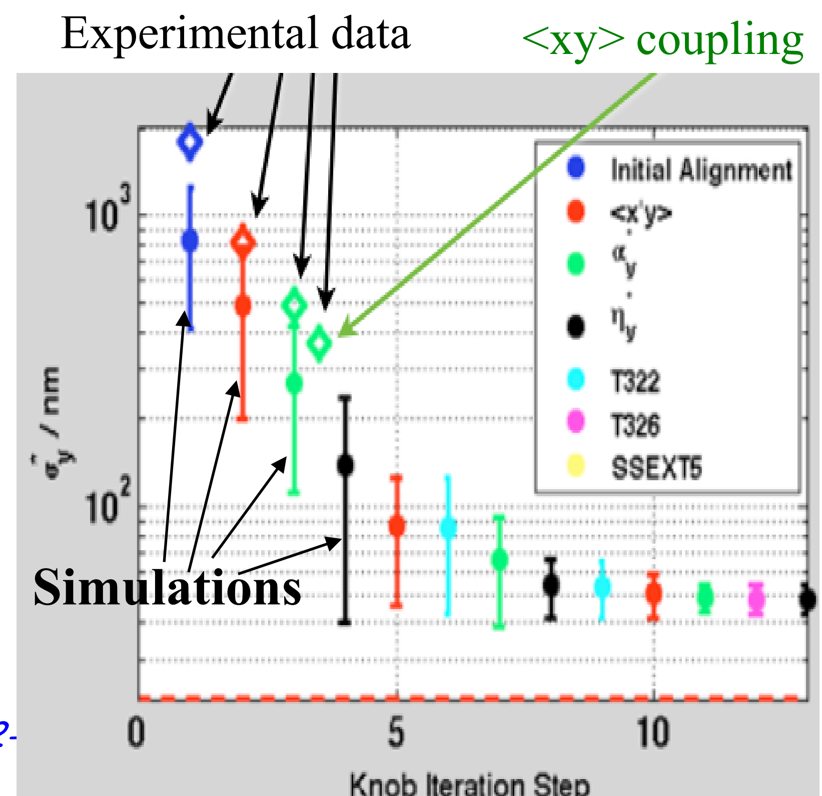
ATF2 commissioning - Dec 2010

- ATF2 & ATF2 ultra-low β* successes are critical for CLIC
- CERN contributes 2 "commissioners":

  E. Marin & Y. Renier
- Dec. run: 300nm were reached with a MAPCLASS-optimized lattice

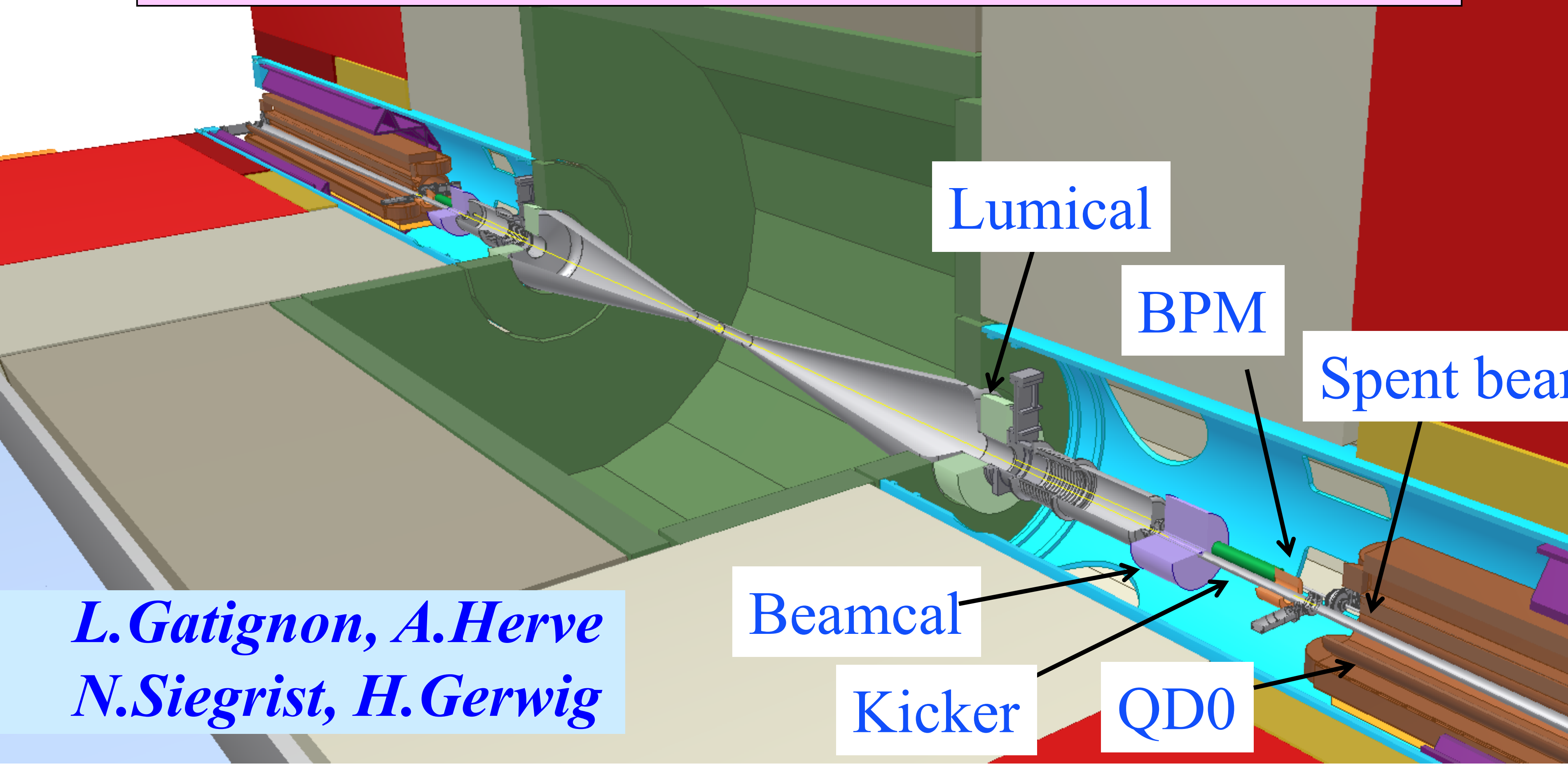
Simulations set good expectations for next run





Machine Detector Interface

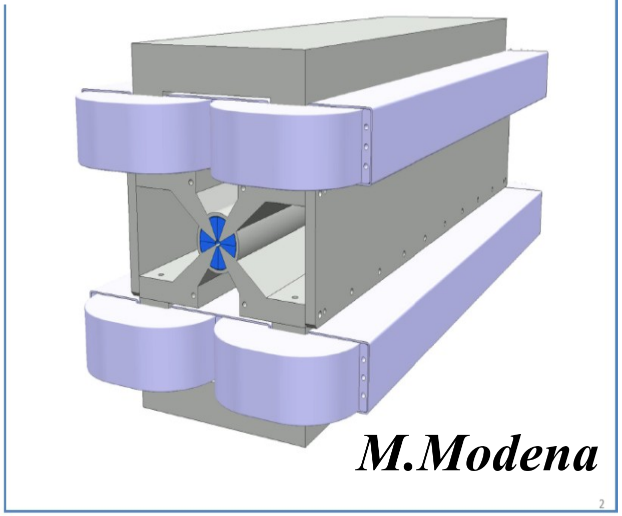
Improved Final Doublet Support (stabilisation 0.15 nm)
Integration into detector (Push pull mode)
Intra-beam feedback



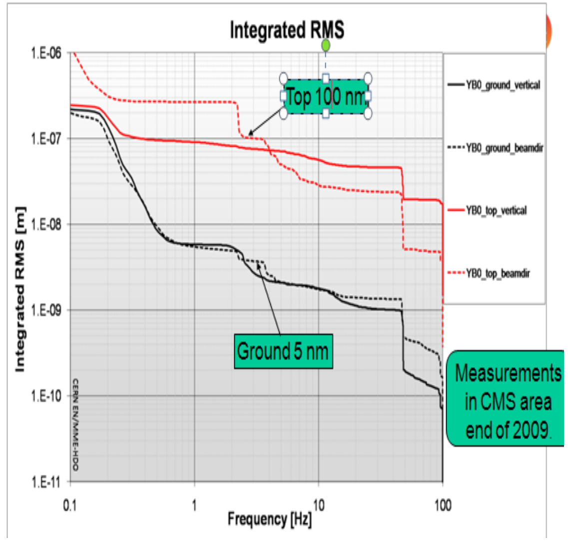
L.Gatignon, A.Herve
N.Siegrist, H.Gerwig

Final doublet integration & stabilisation

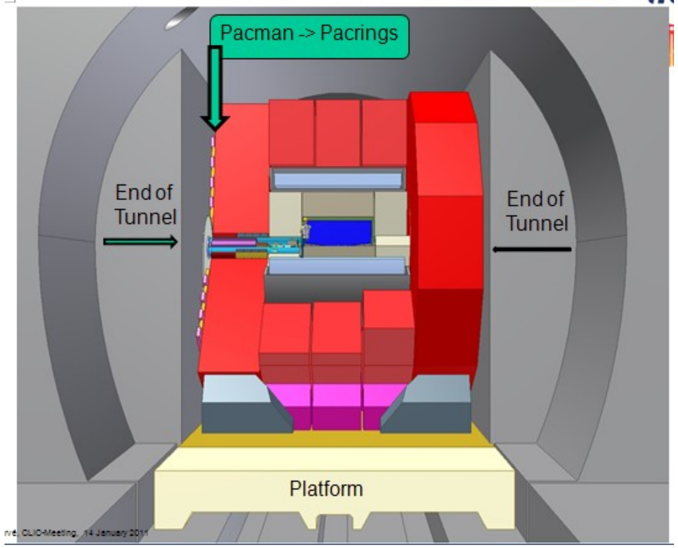
Hybrid QD0 permanent magnet stabilised with coils mounted independent of yoke



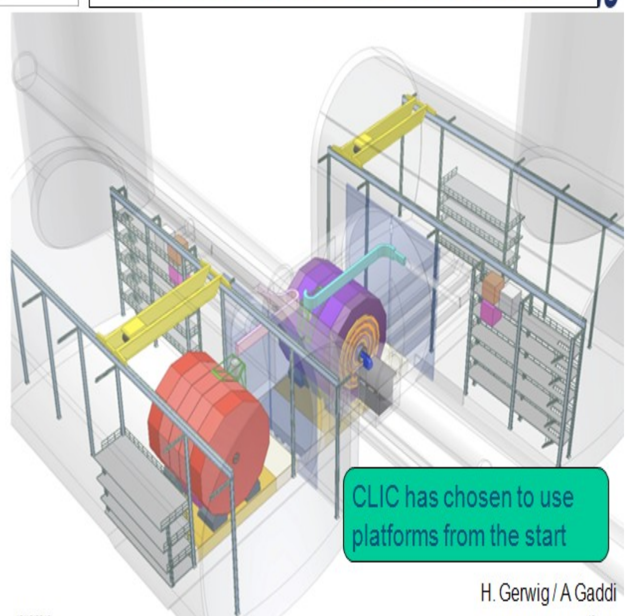
2-Decouple the QD0 support from the experiment



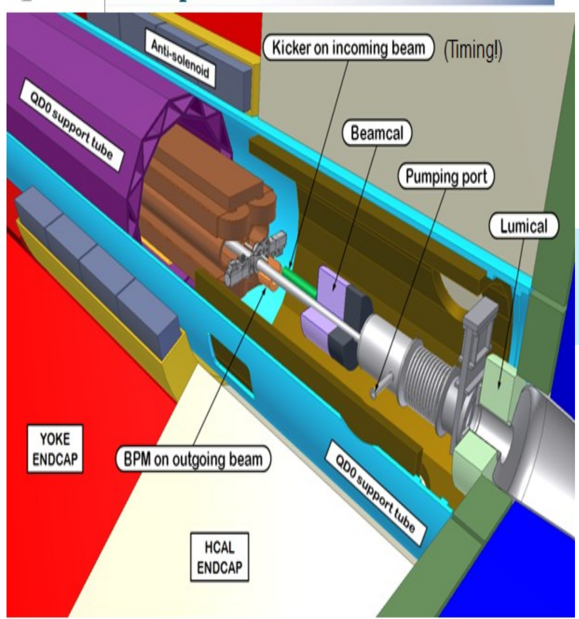
Minimize the length of the support tube



Push-Pull for CLIC detectors



5-Adopt the solution of a double tube

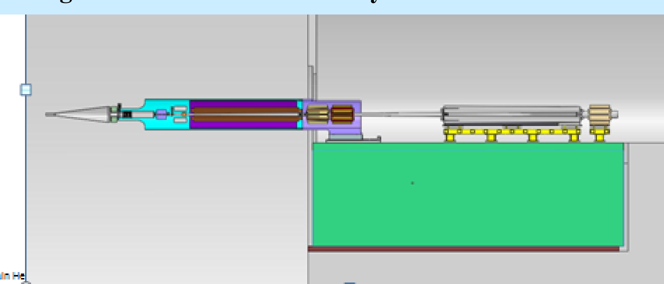


4-Support the QD0 and QF1 from a Pre-Isolator

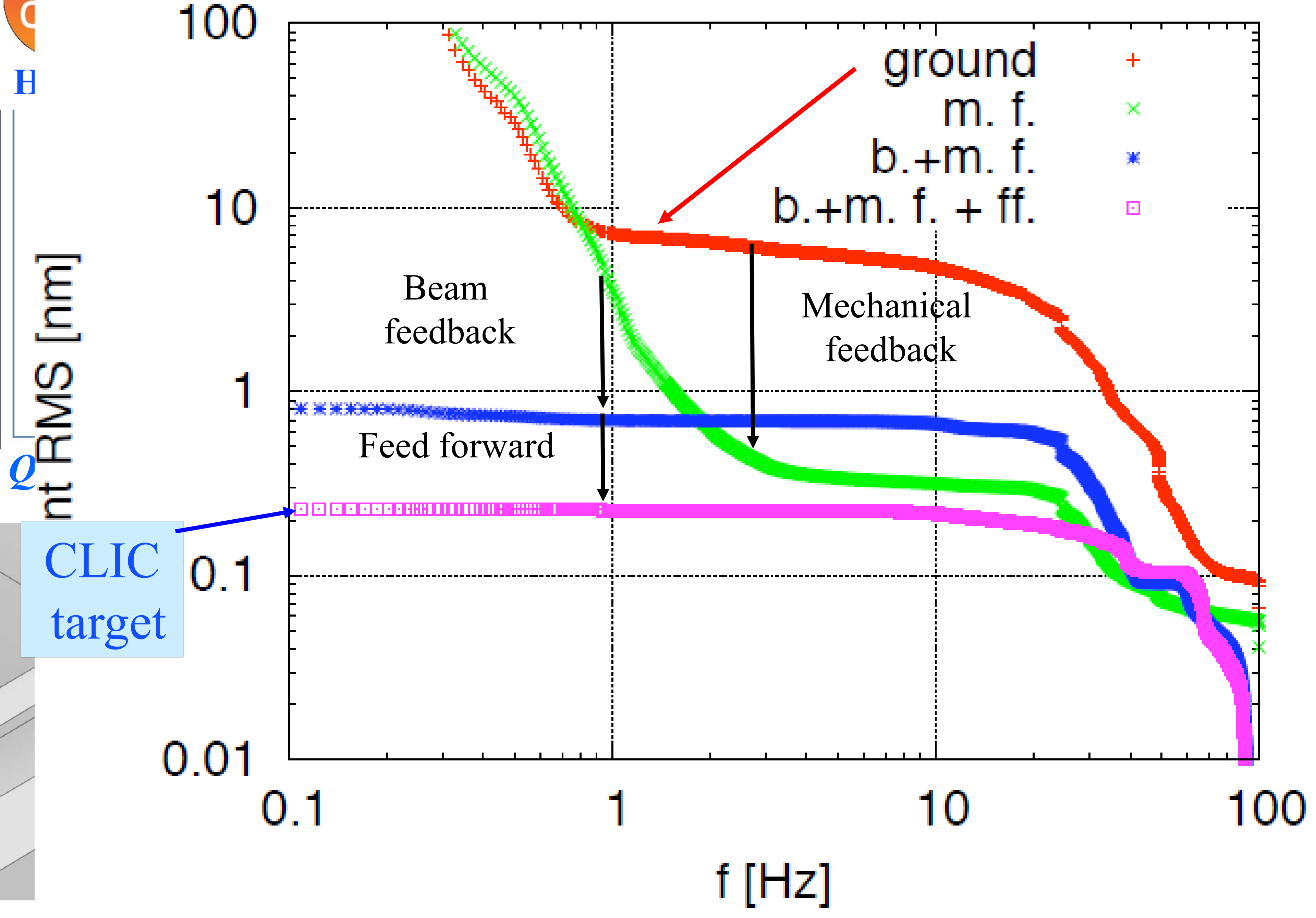
(Andrea Gaddi et al. / CERN)

- The idea is to decouple and stabilize the support of QD0 and QF1.
- It must be connected to the active pre-alignment system to correct or low freq. (< 1 Hz) movements.

Concrete mass of ~ 80 tons mounted on calibrated springs.
Eigenfrequency ~ 1 Hz.
Designed to reduce vibrations by a factor of ~ 30.



Final doublet stabilisation



CLIC issues as discussed at ACE5

Critical issues?

Every parameters or system above the present state of the art
Overall list of critical issues (Risk Register) under:

https://edms.cern.ch/nav/CERN-0000060014/AB-003093

Critical Issues classified in three categories:

1. **CLIC design and technology feasibility**
   - **Not feasible or never done before**
   - **Feasible with parameters leading to a dramatic (?) consequences on performance reduction or cost increase**
2. **Performance**
   - **Feasible with parameters leading to a substantial (?) reduction of CLIC performance**
3. **Cost & Power**
   - **Feasible with parameters leading to a substantial (?) increase of CLIC cost or power consumption**

Dramatic: order of magnitude ? **Substantial: a few?**

CLIC strategy

- **Address feasibility issues during CDR phase (2004-11)**
  - For each feasibility issue build and test (at least one) equipment or system and demonstrate parameters close enough to nominal such that:
    - It is shown to be feasible
    - The nominal performance is not reduced by a large factor
    - The cost or power are not increased by a large a large factor
    - If factor is still substantial, feasibility issue classified in performance or cost or power issue

- **Address performance, cost & power issues during post CDR phase (2012-2016):**
  - For each performance and cost issue build and test a large enough number of equipments or systems for long enough time and demonstrate parameters close enough to nominal and a yield large enough such that:
    - The nominal performance is not reduced (negligeable)
    - The cost and the power are not increased (negligeable)
    - longevity is long enough
  - Provide margin for solid and flexible design

CLIC Accelerator Feasibility Issues @ ACE6
Delay of critical studies by CTF3 fire

System	Item	Feasibility Issue	Unit	Nominal	Achieved	How	Feasibilit	Comments
Two Beam Acceleration	Drive beam generation	Fully loaded accel effic	%	97	95	CTF3	✓	Novel scheme fully demonstrated in CTF3 in spite of lower current since beam dynamics more sensitive than nominal due to lower energy (250MeV/2Gev)
		Freq&Current multipl	-	2*3*4	2*4	CTF3	✓	
		Combined beam current (12 GHz)	A	4.5*24=100	3.5*8=28	CTF3	✓	
		Combined pulse length (12 GHz)	nsec	240	140	CTF3	✓	
		Intensity stability	1.E-03	0.75	< 0.6	CTF3	2011	End of DBA. To be demonstrated for combined beam
		Drive beam linac RF phase	Deg (1GHZ)	0.05	0.035	CTF3, XFEL	✓	Achieved in CTF3, XFEL design
	Beam Driven RF power generation	PETS RF Power	MW	130	>130	TBTS/SLAC	✓	BD rate at nominal power and pulse lenght, measured on Klystron driven PETS. Beam driven tests under way in CTF3
		PETS Pulse length	ns	170	>170	TBTS/SLAC	✓	
		PETS Breakdown rate	/m	< 1·10-7	≤ 2.4 10-7	TBTS/SLAC	✓	
		PETS ON/OFF	-	@ 50Hz	-	CTF3/TBTS	2011	Prototype under fabrication for tests with beam
		Drive beam to RF efficiency	%	90%	-	CTF3/TBL	2012	TBL with 8 (16) PETS in 2011(12) for 30(50%) efficiency. Benchmark beam simulation for safe extrapolation of high efficiency at high drive beam
		RF pulse shape control	%	< 0.1%	-	CTF3/TBTS	2011-2012	
	Accelerating Structures (CAS)	Structure Acc field	MV/m	100	100	CTF3 Test Stand, SLAC, KEK	✓	Nominal performances of 3 structures without damping. 2 structure with damping features reached 85 MV/m at nominal BR still under RF conditionning. Two nominal structures with high efficiency under
		Structure Flat Top Pulse length	ns	170	170		✓	
		Structure Breakdown rate	/m	< 3·10-7	5·10-5(D)		2011	
		Rf to beam transfer efficiency	%	27	15		2011	
	Two Beam Acceleration	Power production and probe beam acceleration in Two beam	MV/m - ns	100 - 170	106 - <130	TBTS	2011	Power production in Two Beam Test Stand (TBTS); Probe beam acceleration by TwoBeamTestStand(TBT
		Drive to main beam timing	psec	0.05	-	CTF3	2012	
		Main to main beam timing	psec	0.07	-	XFEL	2012	
Ultra low	Ultra low Emittances	Emitttance generation H/V	nm	500/5	3000/12	ATF, NSLS/SLS + simulation	✓	Relax emittances achieved in ATF
		Emittance preservation: Blow-up	nm	160/15	160/15		2011-12	Simulation + alignment/stability
	Alignment	Main Linac components	microns	15	10 (princ.)	Mod.Test Bench	2011	Principle demonstrated in CTF2, to be adapted to long distances and integrated in Two Beam Module in
		Final-Doublet	microns	2 to 8			2011	
	Vertical stabilisation	Quad Main Linac	nm>1 Hz	1.5	0.13 (principle)	Stabilisation Test Bench	2011-12	Adaptation to quad prototype and detector environment in 2010. Integrated in Two Beam Module with beam till 2012.
		Final Doublet (with feedbacks)	nm>4 Hz	0.2				
Operation and Machine Protection System (MPS)		72MW@2.4GeV 13MW@1.5TeV				CTF3 simulations	2011-12	Report integrating LHC experience under preparation

R.Corsini Exp. results

S.Doebert

W.Wuensch

F.Tecker

D.Schulte

H.Mainaud

K.Artoos

J.P.

Operation & Machine Protection System

- **Issues:** **Main beam: 2*14 MW @ 1.5 TeV (50Hz)**

  Drive Beams: 2*70 MW @ 2.4 GeV (50Hz)

- **Protection strate**y construction (2 ms)

  stem (from LHC)

M.Jonker

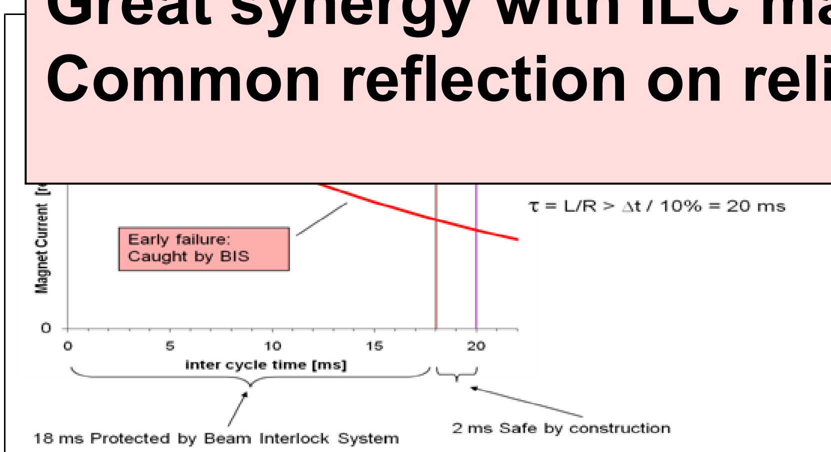
Safe by construction

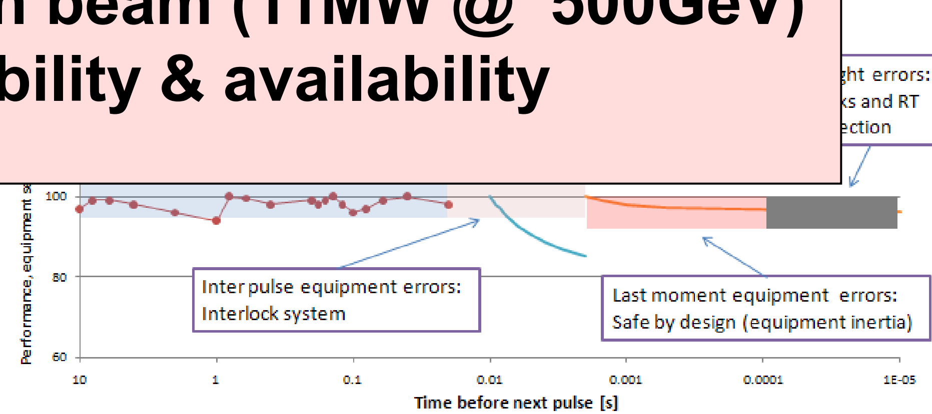
Machine Protection Timeline

Coverin
Remain v

Studies: a
Same prin

Taking advantage of LHC experience !
Great synergy with ILC main beam (11MW @ 500GeV)
Common reflection on reliability & availability





Conceptual Design Report:
New strategy towards European Strategy for HEP

3 volumes:

- 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 demandin
  - Application to 500 GeV as first stage and intermediate energy range
  - No cost figures (peer review postponed)
- Vol 2: The CLIC physics and detectors (L.Linssen)
- Vol 3: CLIC study summary
  - Comprehensive summary of vol1 and 2 findings for European Strategy
  - Staging scenario up to energy compatible with LHC Physics
  - Including cost issues and cost drivers for R&D mitigation in next phase
  - Proposing objectives and work plan of post CDR phase

Schedule:

Mid April 2011: Vol1, Contributions by individual Authors
mid July 2011: Vol1, Reviewed for consistency by Editorial Board
mid Sept 2011: Vol1, Completed and Processed
Dec 2011: Vol 1 presented @ SPC for comments
March 2012: Final Vol 1 and 2 + Vol3 to European Strategy

Layout of Volume 1 on Accelerator

1) Overview of the CLIC concept; Details on CLIC feasibility demonstration

2) Accelerator Physics description of the Main Beam Complex

3) Accelerator Physics description of the Drive Beam Complex

3TeV

4) Preliminary design of a 500 GeV and intermediate energy stages

5) Detailed description of the accelerator components ⟺ Specifications

6) Civil Engineering and Services

7) CLIC technologies demonstrated in CTF3

8) Construction and Operational Scenarios

9) Energy Scanning

CDR website with skeleton and present contributions:

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

Contribution/Authors by CLIC collaborators

- **International. editorial board:**

N.Phinney (SLAC), N.Toge (KEK), P.Lebrun(CERN), H.Schmickler(CERN)

- **Processing (Latex):**

M.Draper(CERN), D.Manglunki (CERN), H.Schmickler (CERN)

- **Author-list management:**

A.Augier(CERN), M.Draper (CERN)

-**authors:**

i) responsible author: responsible for submission in time
ii) contributing author: active contribution to write-up
iii) supporting author: "signing-up" through a web-portal as CDR author

CLIC Tentative Schedule

Delay of CDR (fire in CTF3 Klystron gallery)
Post CDR phase reviewed following Medium Term Plan

CTF3 Modulator (before-after fire)

Final CLIC CDR and proposal next phase @ European Strategy

European Strategy for Particle Physics @ CERN Council

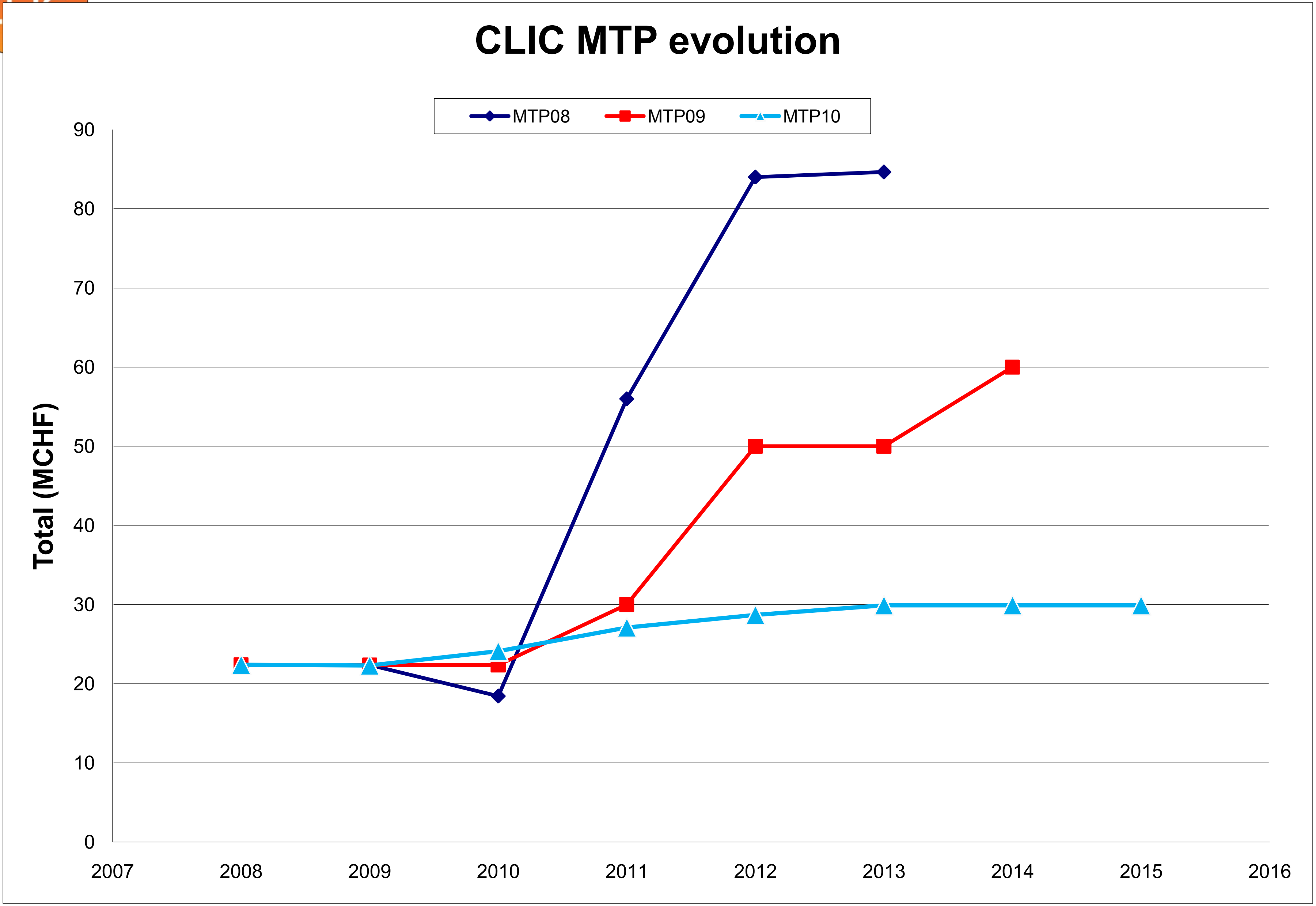
	2010	2011	2012	2013	2014	2015	2016	2017	2018
Feasibility issues (Accelerator&Detector)	■	■							
Conceptual design & preliminary cost estimation	■	■							
Engineering, industrialisation & cost optimisation			■	■	■	■	■	■	?
Project Preparation			■	■	■	■	■		
Project Implementation								■	?

Draft Conceptual Design Report(CDR) (Acc.&Det.) to SPC

Project Implementation Plan (PIP) and proposal for next phase

Conclusion

- 2011 critical and transition year!
- CLIC concept and Feasibility studies described in CDR towards European Strategy by the end of 2011 …and early 2012.
- Exploration of multi-TeV energy range up to 3 TeV
- Design optimized at 3 TeV (most demanding) and R&D focused on corresponding feasibility issues
  - Findings on performances and limitations by technology risks, power and cost
  - Staging scenario with parameters range compatible with LHC Physics and affordable power
- Strong R&D on risk, performance, power and cost issues required during post CDR phase
- Linear Colliders (including CLIC) in excellent hands (Steinar and CLIC team) for the future.


CLIC MTP evolution
MTP08
MTP09
MTP10
Total (MCHF)
0
10
20
30
40
50
60
70
80
90
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016

CLIC Budget (M & P)

MTP 2010 revised vs MTP 2010 presented