CLIC resource plan 2012-2017

Personnel & Money ; P+M

Hermann Schmickler for the CLIC steering team

Collaboration workshop, CERN, 9-11 May 2012

2011

In 2011 we were allowed to dream:

-CDR almost done, preparation for publication
- Major part of CLIC feasibility studies done
- Bottom-up elaboration of a work-program for the next 5 years

-Based on the 2009-2011 taskforce on a new program definition
-First version shown in the November 2011 workshop with the collaborators
-Many Collaboration proposals received ... Still working on detailed arrangements
-Work Plan structured in Workpackages, activities...

-Basically this work program needed 150% of available financial CERN resources and 200% of available CERN personnel

2012

Reality sets in:

- CERN resources confirmed (also in new MTP = council June 2012)
- Detailed resource loading by all involved CERN group leaders done (P)

i.e. By definition CERN “P” resources match available resources

→Started documentation in CERN APT tool (= Activity Planning Tool)

-First prioritization by CLIC study team in order to match “M” budget in a two day retreat March 2012

→ Overview of resulting program in this presentation for further discussion with collaborators

Further Outline

General directives for the program 2012-2017 (S. Stapnes)

Workpackages Structure

CLIC Design Overview
CLIC Design some details...

Experimental Verifications Overview
Experimental Verifications some details...

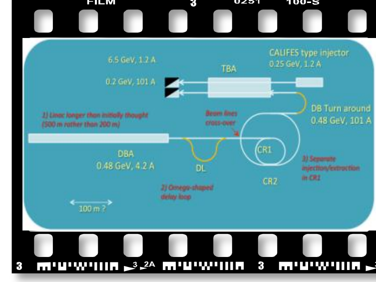
X-band RF Overview
X-band RF some details...

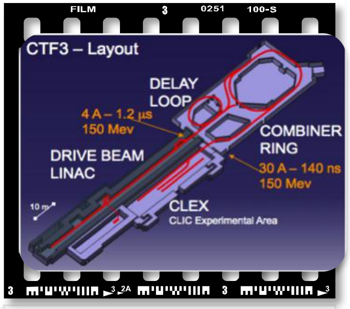
CLIC Technology Developments Overview
CLIC Technology Developments some details...

General issues and project implementation plan

Conclusions

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:

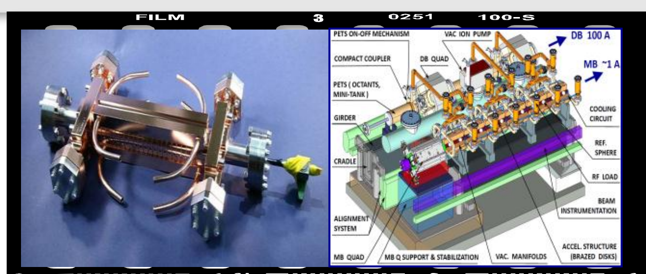
- Finalization of the CLIC technical design, taking into account the results of technical studies done in the previous phase, and final energy staging scenario based on the LHC Physics results, which should be fully available by the time
- Further industrialization and pre-series production of large series components with validation facilities
- Environmental Impact Study

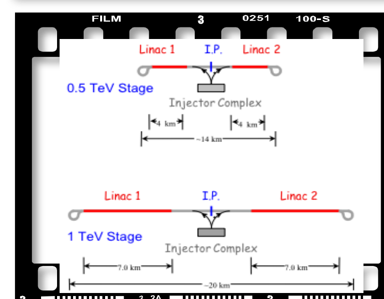
2004 - 2012	2012 - 2016	2016 – 2022	~ 2020 onwards

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

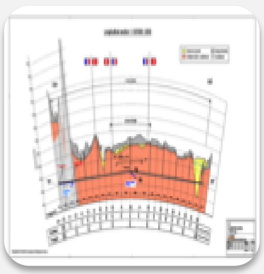




The objectives and plans for 2012-16

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)



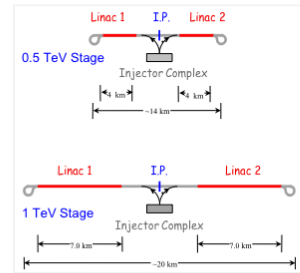
Define the scope, strategy and cost of the project implementation.

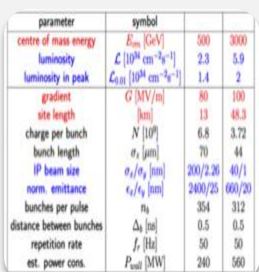
Main input:

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.



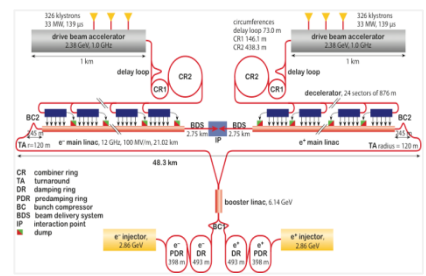


parameter	symbol		
centre of mass energy	E_{cm} [GeV]	500	3000
luminosity	$\mathcal{L}$ [10^{34} cm^{-2}s^{-1}]	2.3	5.9
luminosity in peak	$\mathcal{L}_{0.01}$ [10^{34} cm^{-2}s^{-1}]	1.4	2
gradient	G [MV/m]	80	100
site length	[km]	13	48.3
charge per bunch	N [10^9]	6.8	3.72
bunch length	σ_z [μm]	70	44
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.

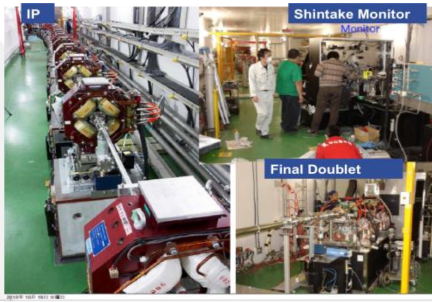


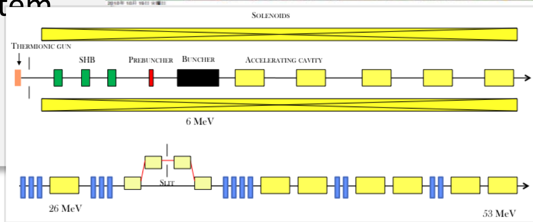
The objectives and plans for 2012-16

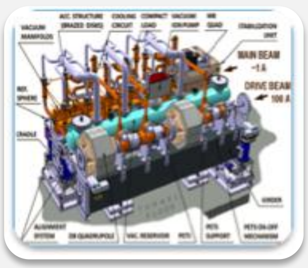
Identify and carry out system tests and programs to address the key performance and operation goals and mitigate risks associated to the project implementation.

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



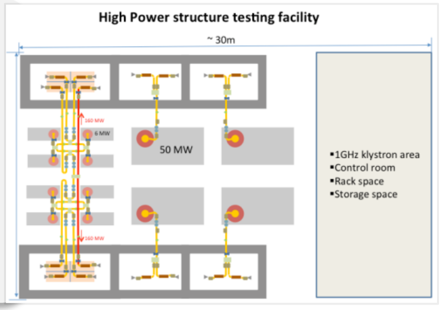




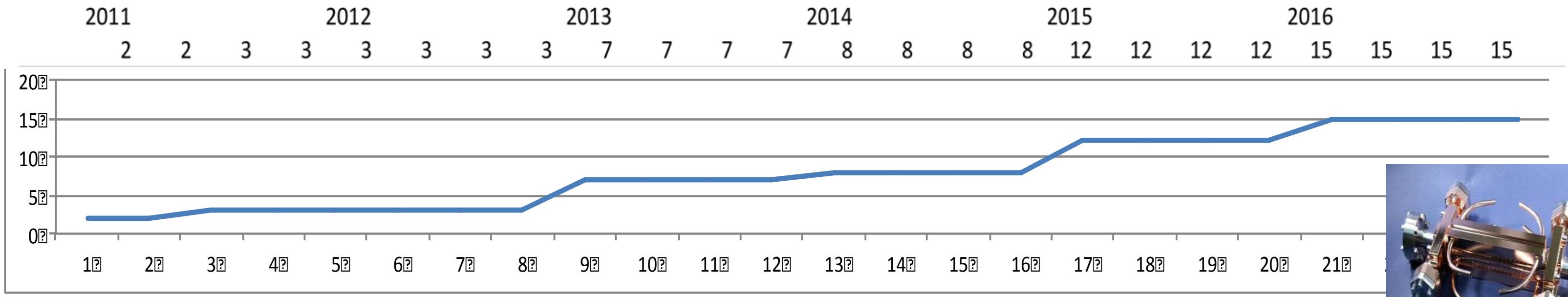
Develop the technical design basis. i.e. move toward a technical design for crucial items of the machine and detectors, the MD interface, and the site.

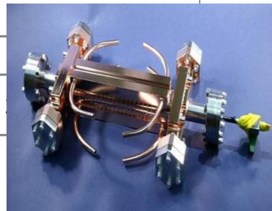
Priorities are the modulators/klystrons, module/structure development including testing facilities, and site studies.

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	CD-BASE	Integrated Baseline Design and Parameters	D. Schulte	29 submissions of ongoing or planned contributions to these work-packages from collaborators outside CERN
Daniel 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	
	CD-PSRC	Main beam positrion 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	Beam Delivery System	R. Tomas	
	CD-MDI	Machine-Detector Interface (MDI) activities	L.Gatignon	
	CD-DRV	Drive Beam Complex	B. Jeanneret	
Experimental verification	CTF3-001	CTF3 Consolidation & Upgrades	F. Tecker	10 submissions of ongoing or planned contributions to these work-packages from collaborators outside CERN
Roberto Corsini	CTF3-002	Drive Beam phase feed-forward and feedbacks	P. Skowronski	
	CTF3-003	TBL+, X-band high power RF production & structure testing	S. Doebert	
	CTF3-004	Two-Beam module string, test with beam	-	
	CLIC0-001	CLIC 0 drive-beam front end facility (including Photoinjector option)	S. Doebert	
	CLIC0-002	Drive Beam Photo Injector	S. Doebert	
	BTS-001	Accelerator Beam System Tests (ATF, Damping Rings, FACET,...)	R. Tomas	
	BTS-002	Sources Beam System Tests	-	
Technical Developments	CTC-WIG	Damping Rings Superconducting Wiggler	P. Ferracin	16 submissions of ongoing or planned contributions to these work-packages from collaborators outside CERN
Hermann Schmickler	CTC-SUR	Survey & Alignment	H. Mainaud	
	CTC-QUA	Quadrupole Stability	K. Artoos	
	CTC-TBM	Two-Beam module development	G. Riddone	
	CTC-WMP	Warm Magnet Prototypes	M. Modena	
	CTC-BDI	Beam Instrumentation	T. Lefevre	
	CTC-PCLD	Post Collision Lines and Dumps	E. Gschwendtner	
	CTC-CO	Controls	M.Draper	
	CTC-RF	RF Systems (1 GHz klystrons & DB cavities, DR RF)	E. Jensen (placeholder)	
	CTC-EPC	Powering (Modulators, magnet converters)	S. Pittet	
	CTC-VAC	Vacuum Systems	C. Garion	
	CTC-MM	Magnetic stray Fields Measurements	S. Russenschuck	
	CTC-BT	Beam Transport Equipment	M. Barnes	
	CTC-MME	Creation of a "CLIC technology center@CERN"	F.Bertinelli	
X-band Technologies	RF-DESIGN	X-band Rf structure Design	A.Grudiev, I. Syratchev	20 submissions of ongoing or planned contributions to these work-packages from collaborators outside CERN
Walter Wuensch	PRODUCTION	X-band Rf structure Production	G.Riddone	
	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	IS-CES	Civil Engineering & Services	J. Osborne	
Philippe Lebrun	IS-PIP	Project Implementation Studies	P.Lebrun	

https://indico.cern.ch/conferenceOtherViews.py?view=standard&confId=156004

List of CLIC Design Workpackages; D.Schulte et al.

Area packages

- Main beam electron source (Steffen Doebert)
- Main beam positron source (Steffen Doebert, interim)
- Damping rings (Yannis Papaphilippou)
- RTML: ring to main linac transport (Andrea Latina)
- Two-beam acceleration (D.S. interim)
- BDS: beam delivery system (Rogelio Tomas)
- MDI: machine detector interface (Lau Gatignon)
- Drive beam complex (Bernard Jeanneret)

Integrating packages

- Integrated design (D.S.)
- Simulations and integrated studies (Andrea Latina)
- Feedback design (D.S., interim)
- Machine protection and operation (Michael Jonker)
- Background (D.S., interim)
- Polarization (?)

CLIC Design Details…

• Labor intense work-packages; shortage of people and in particular shortage of leadership of work-packages. Collaborators should step in.

• Some work needs to be done on all fronts, no workpackage is an obvious candidate for a complete cut; polarization will certainly be on low profile.

• Work Objectives:

-Move from a conceptual design to a technical design
- Definition of a CLIC staged approach (following LHC results)
- Definition of all basic parameters for each stage including operational scenarios
- active participation in experimental validations
- Contribution to cost optimization and risk minimization

• prioritization process not finished; details will evolve of the next months…

Experimental Verification
R.Corsini et al.

- Present experimental program of CTF3 (feasibility issues)

- Consolidation/upgrade of CTF3 **to fully exploit its potential**:
  - Verify **stability/reliability performance** in view of CLIC requirements , improve operational experience
  - **High-power RF testing** in **presence of main beam**; demonstrate **operation of a drive -beam driven power source**
  - Test with beam CLIC **two-beam modules**

CTF3-001, CTF3-002, CTF3-003 & CTF3-004

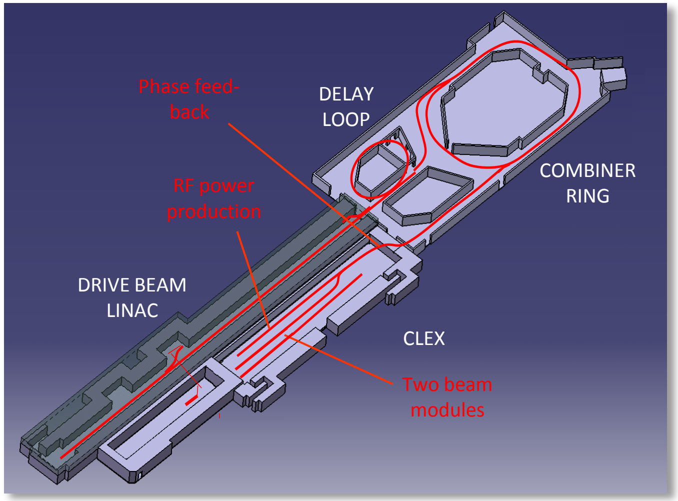
- New drive beam injector facility, at nominal CLIC parameters
  - Final proof of drive beam performances, **long-pulse, high -power operation**
  - provides a **focus for development and pre-industrialization of drive beam components** – all hardware reusable
  - **First step towards CLIC Zero**, facility for….

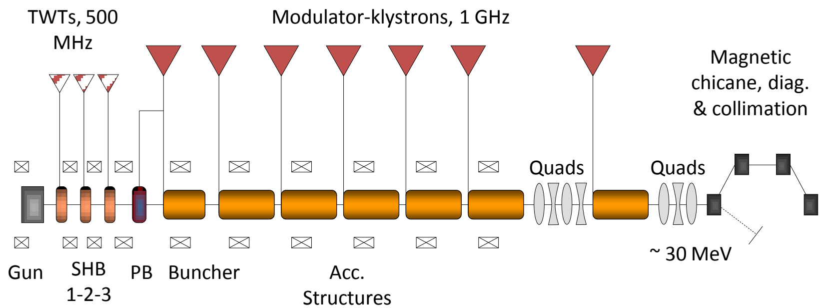
CLIC0-001 and CLIC0-002

- Pursue and intensify **experimental program in other facilities**
  - ATF II
  - CesR-TA, SLS, ATF I, ANKA…
  - Facet, Asset
  - …

BTS-001 and BTS-002

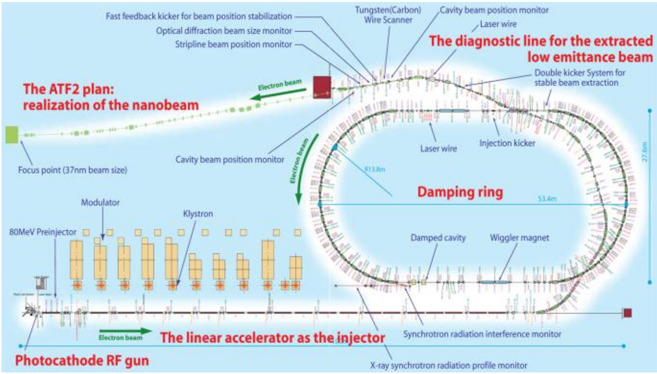
CTF3+





CLIC Drive Beam injector schematic layout

ATF - KEK

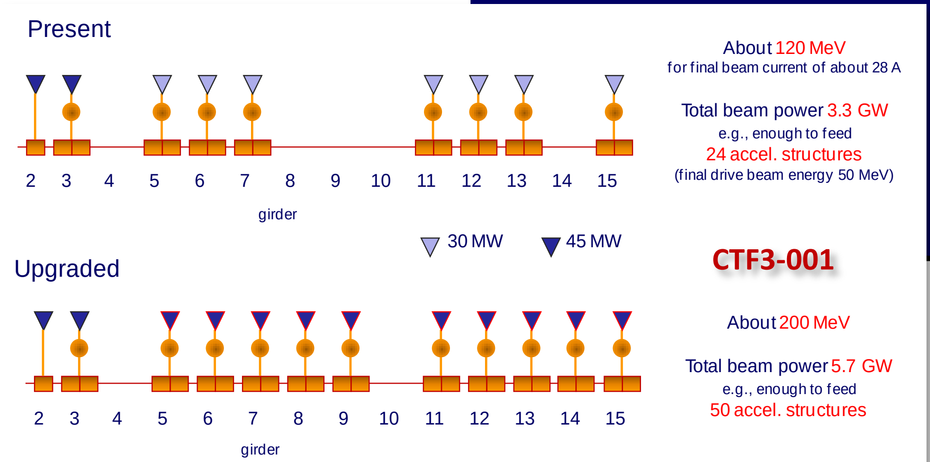


R. Corsini
CLIC work-package planning meeting
2-3 November 2011

Test facilities – CTF3+

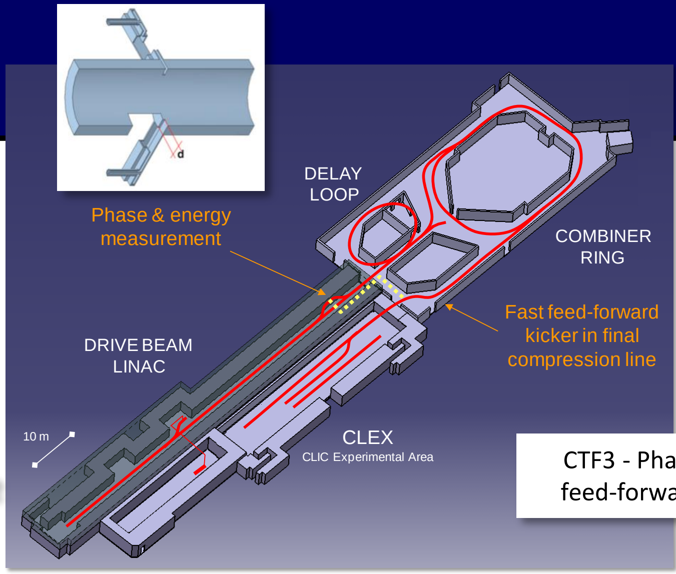
CTF3 consolidation and upgrade

- Consolidation and upgrade (higher energy, stability, reliability, rep. rate)
- Drive beam phase feed-forward experiments
- Upgrade and operate TBL as 12 GHz power production facility
- Operation with beam of a long string of CLIC two-beam modules



CTF3-001

CTF3 consolidation and upgrade

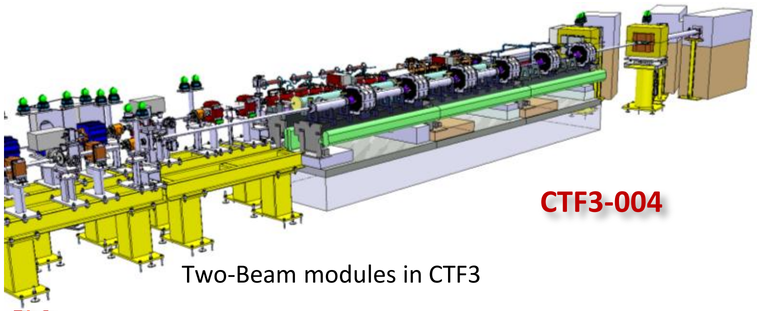


CTF3 - Phase feed-forward

CTF3-002

TBL - CLEX

CTF3-003



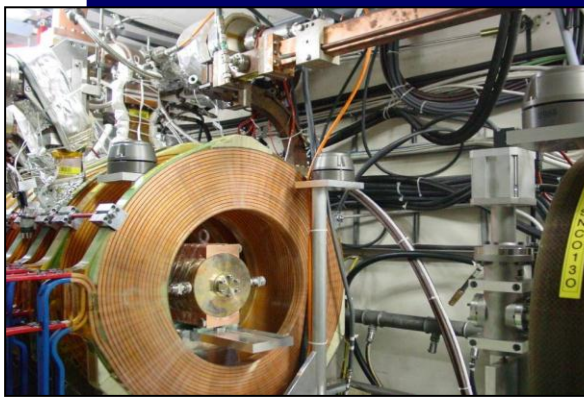
CTF3-004

Two-Beam modules in CTF3

CLIC Drive Beam Front-end

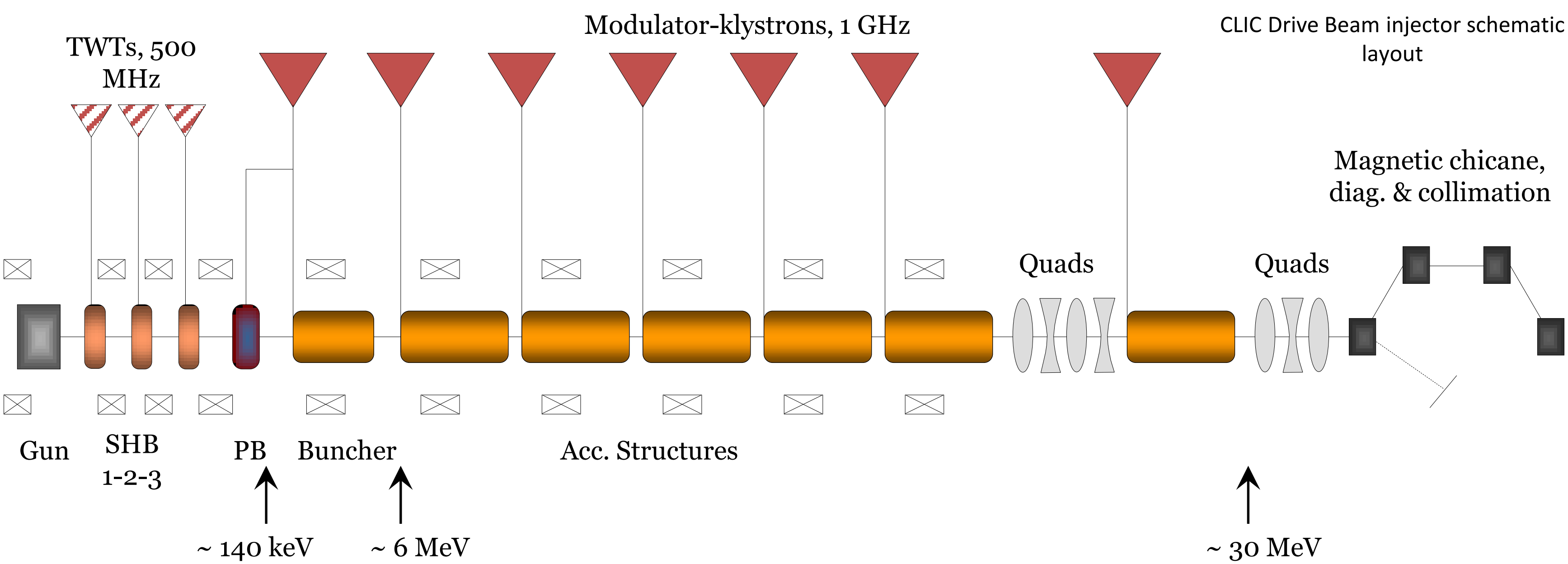
Build and commission 30 MeV Drive Beam front-end with nominal CLIC parameters

- Build and commission 30 MeV Drive Beam injector with nominal CLIC parameters
- Build and commission a few Drive Beam accelerator nominal modules
- Contribution to Technical Design of full CLIC Zero facility



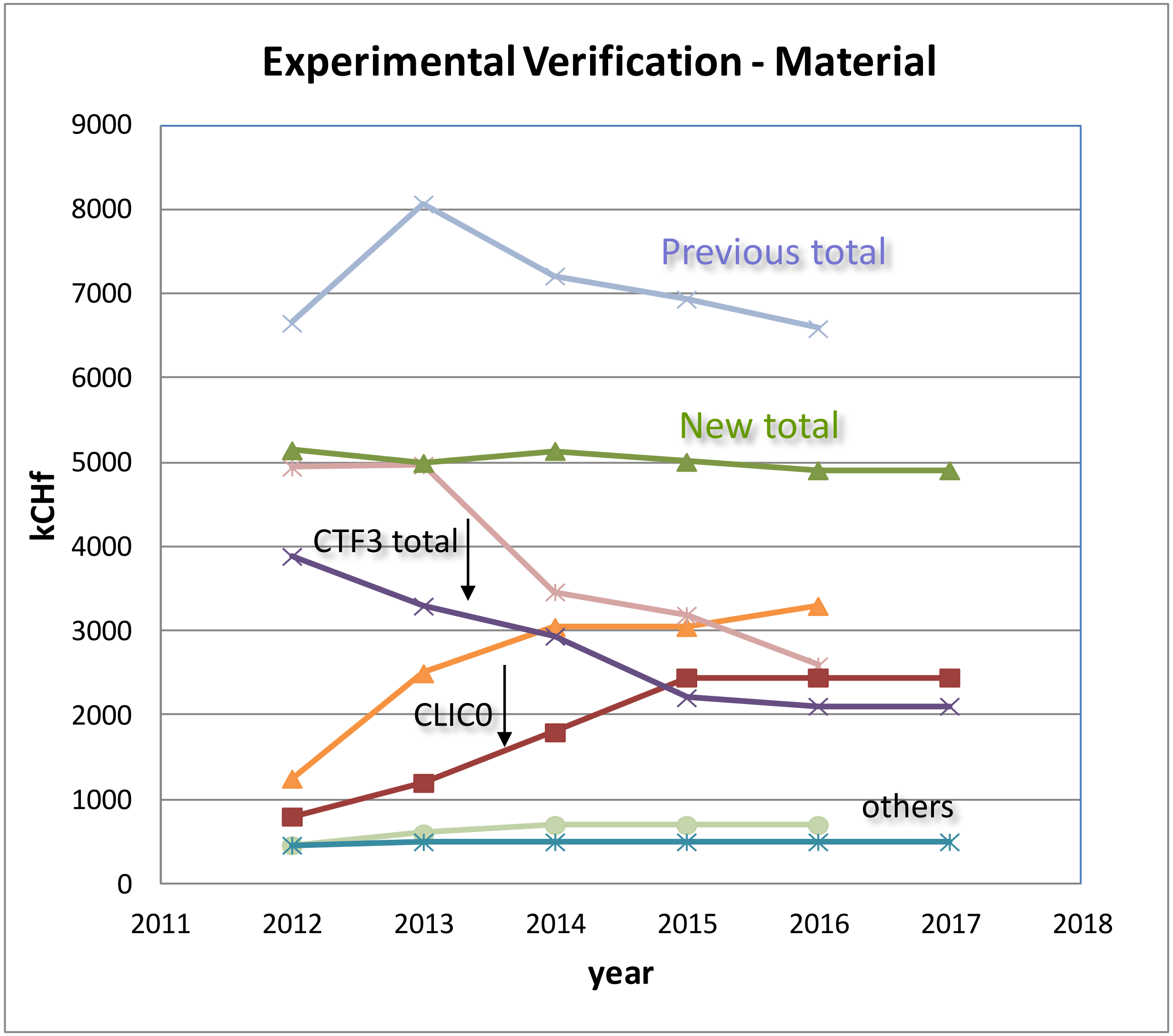
CTF3 Injector

CLIC0-001 and CLIC0-002



CLIC Drive Beam injector schematic layout

Experimental Validation Summary



- In order to make the budget fit:

- Extend to 2017
- Reduced scope whenever possible, but:
  keep CTF3 upgrades
  keep DB injector sources work
  redo design of DB injector
  full technical design report

- Assuming (in most) cases flat contribution from Collaborators, starting with September 2011 commitments
- Assume external contribution to CLIC0 (about 400 kCHF/year)

X-Band Rf work-packages; W. Wuensch et al.

		Name	WP Holder
X-band Technologies Walter Wuensch	RF-DESIGN	X-band Rf structure Design	A.Grudjev, I. Syratchev
	RF-XPROD	X-band Rf structure Production	G.Riddone
	RF-XTESTING	X-band Rf structure High Power Testing	S.Doebert
	RF-XTESTFAC	Creation and Operation of x-band High power Testing Facilities	E.Jensen (placeholder)
	RF-R&D	Basic High Gradient R&D	S.Calatroni

PETS - Easily making specifications. We need to test more often and in more realistic conditions.

Accelerating structures – Probably close enough to specifications to go forward on a baseline, which means adding all details, statistics and lifetime. Big question is what happens with beam loading. We are still learning a LOT about life at 100 MV/m and have many refinements, optimizations and alternatives to work through. So far formulated target was:
High power testing of 100 accelerating structures

RF components – Diverse zoo of components, healthy and growing.

High-power test capability – Still struggling. KEK recovered from the earthquake and has a steady, even expanding, program planned. SLAC winding down for us. CERN very promising now but still not there. CTF3 restricted to specialized system tests not high rep rate component tests. Breakthrough with new ideas on using medium power sources? Communication with collaborators ongoing?

High-gradient studies – Major elements of multi-scale picture of breakdown can now be simulated. Starting to produce direct predictions of dependencies, scaling laws and surface preparation techniques. Uncovering the effect of surface current on gradient. Specialized experimental set-ups getting closer to RF conditions.

Overall Observations x-band RF

- We're closer to testing 30 accelerating structures over the next five years, than the 100 we once spoke about. Our object has been to have statistics, long-term running, a few of prototype generations, some investment in alternative ending in "project ready" structures. We'll fall short…

- High M spending at 700 KCHF/CERNFTEyear but we buy expensive stuff.
- Contributions to test stands at collaborators are consistent with high values of KCHF/CERNFTEyear.
- 5 years*6 MCHF/year/30 structures= 1 MCHF/tested structure

- Need decisions in 2012 on X-band test stands at collaborators

- Teams will contribute to the parameter evolution of CLIC stagings and operational scenarios

CLIC technology developments workpackages; H.Schmickler et al.

		KCHF	KCHF	my	my	
WP	Title	total M	M>P	P<M	total P	work handled by
CTC-WIG	SC Wigglers	2000				P. Ferracin et al.
CTC-SUR	Survey and Alignment	5000	2130	19.6	45.4	H. Mainaud et al.
CTC-QUA	Quadrupole Stability	4950	1800	19.2	48	K. Artoos et al.
CTC-TBM	TBA module	15000	4380	64	88	G . Ridone et al.
CTC-WMP	Warm magnet prototypes	3035	960	12	36	M. Modena et al.
CTC-BDI	beam instrumentation	6990	3046	33.5	52.8	T. Lefevre et al.
CTC-DCM	Dumps, collimators, masks	1200	1020	12	13.2	V. Vlachoudis et al.
CTC-CO	Controls	1500				M. Draper et al.
CTC-RF	RF systems	9000	360	3	9	E. Jensen et al.
CTC-EPC	Powering	4000				D. Nisbet et al.
CTC-VAC	Vacuum Systems	1500				C. Garion et al.
CTC-MM	Magnetic Strayfields	500				S. Russenschuck et al.
CTC-BT	DR extraction system	600			8.8	M. Barnes et al.
CTC-MME	Creation of "In House" TechnoCenter					F. Bertinelli et al.
		55275	**13696**	**163.3**	301.2	

Some details (1/4):

- SC wiggler:
  - NbTi Technical design and construction at Budker in Novosibirsk.
  - System tests at ANKA/KIT.
  - Moderate Nb3Sn development program at CERN after LHC long shutdown1 (LS1)
- Active pre-alignment: Continuation of program on:
  - technical design and prototyping of metrology and alignment for main linac and BDS
  - cost reduction on components
  - experimental validation in TZ32, TBM assembly, CLEX and elsewhere
  - active study on laser based alternatives with collaborators
- Quad stability: Continuation of program on:
  - component procurement and validation (sensors, actuators)
  - technical designs for main linac and BDS
  - experimental validation on full scale prototypes
- TBA modules:
  - Complete design and construction of 7 modules

    4 lab modules (1-0-0-4 arrangement)

    3 CLEX modules (0-0-1 arrangement)
  - experimental program for the validation of concepts, redesign in case of problems, implementations on existing modules if possible. NO second generation of modules in hardware.
  - Cost reduction studies and follow up of changes due to energy staging

Some details (2/4):

- Warm magnet prototypes:
  - continuation of hardware realization of critical prototypes (QD0, ML quad type 4...)
  - less other prototypes in hardware, more design studies

- Beam Instrumentation: Continuation of program on:
  - prototype construction of few important components (MB BPM, DB BPM, non interceptive micrometer resolution profile monitor (X-ODR)
  - experimental validations with beam
  - contribution to programs at ATF, SLAC, CESR-TA
  - In general program stretched in time

- Dumps, Collimators, Masks:
  - small program for simulations and design studies together with collaborators on important beam intercepting devices. Priority list still to be defined.

- Controls:
  - Pilot project on module acquisition system: Constraints: Radiation level, low heat dissipation to air, small footprint, 200 acquisition channels per 2m module.

  Prototyping and testing in CLEX.
  - No activity so far on timing reference and site wide distribution (10 fs stability)

Some details (3/4):

- RF work:

  - continuation of designs for Damping Rings.
  - production of few ("low efficiency") 1 GHZ high power klystrons.

  → no ambitious R&D on high efficiency (MB-) klystrons

- Powering:

  - team has developed a nice collaborative program for the development of a high efficiency high power modulator (for above klystrons), with very demanding specs on reproducibility and jitter and with an innovative interface to the power-grid. No other R&D possible due to limitations of funds.

- Vacuum

  - wide spread program on main linac vacuum and on damping ring vacuum.

- Magnetic Stray Field measurements

  - has still not started as activity

- Beam transfer equipment

  - continuation of R&D and prototyping on pulse generator (induktive adder) and stripline kicker for damping ring extraction. Experimental verifications planned at ATF and ALBA.

Some details (4/4):

- Creation of “in House” Technology Center:

  - project of creating a CERN facility with technolgies linked to the CLIC project:

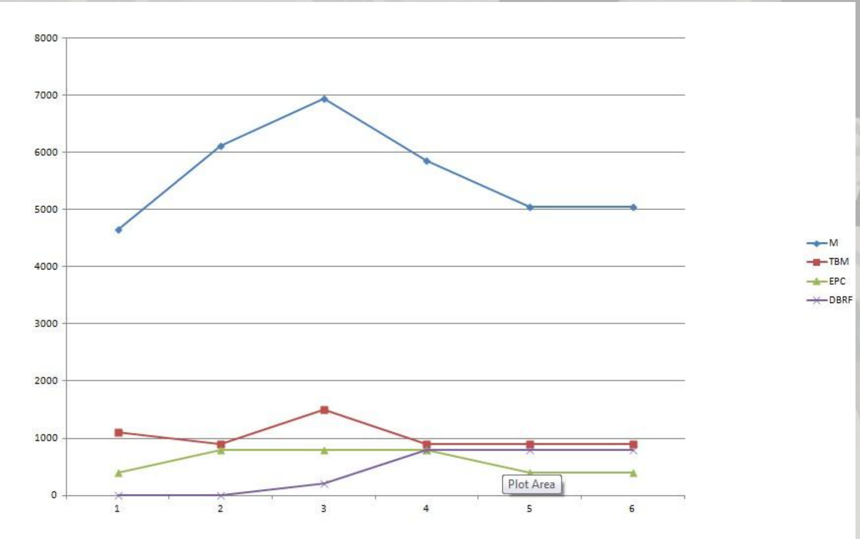
  a) He- brazing

  b) large scale metrology

  c) clean room assembly

  d) ...

- Money reserved; project is stuck due to non availability of space@CERN.



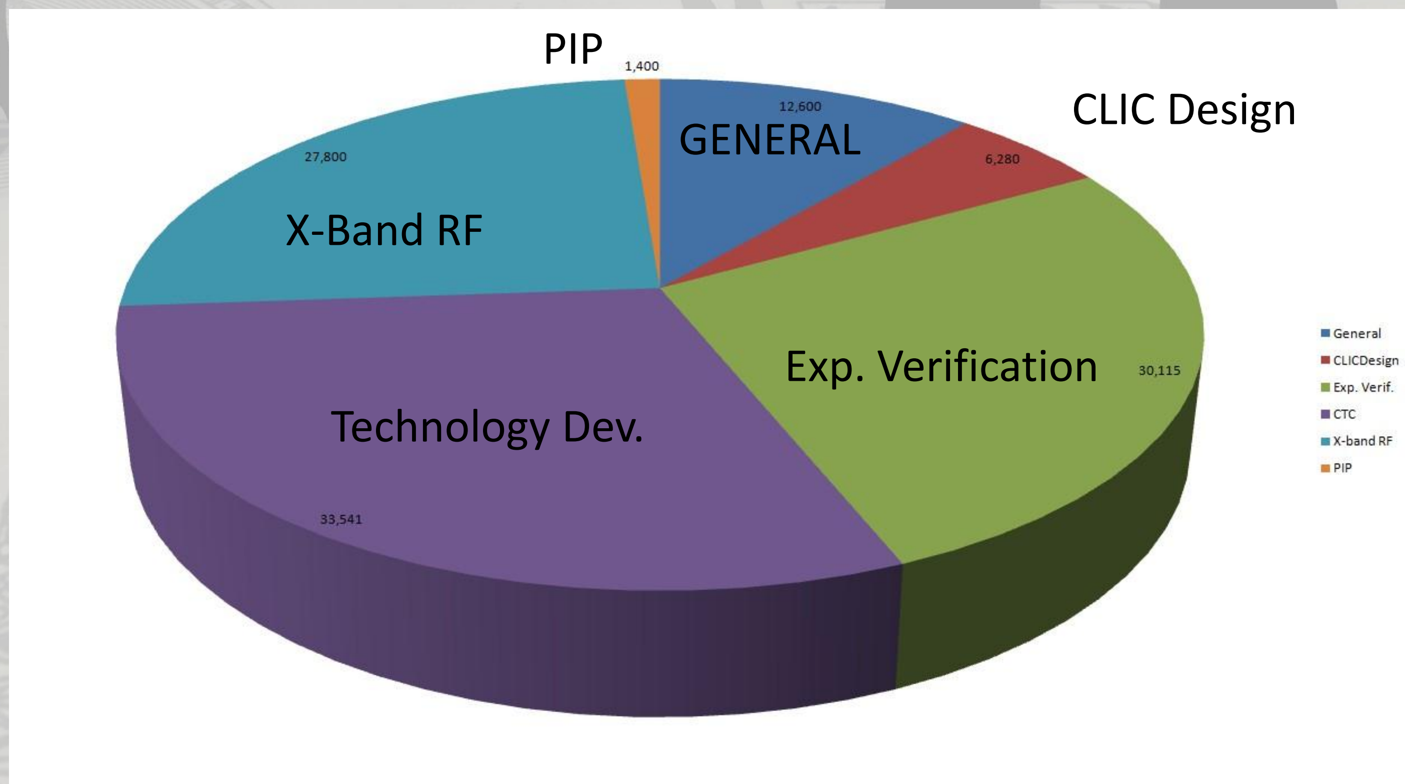
Last not least:
CLIC project implementation + CLIC "general"

- CLIC project implementation; P. Lebrun et al.
  - paper studies for a project implementation plan at CERN
  - "co-studies" with ILC

- "general" Activities; S. Stapnes et al.
  - fellows
  - CERN-UK collaboration
  - administration and travel budgets

CERN CLIC Resources Summary (2012-2017)

- About 101 MCHF in Medium term Plan (MTP)
- About 110 MCHF spending planned
- About 12 MCHF/y for CERN personnel (~ 80 FTE)
- Another 60 FTE at CERN via M>P transfer



Summary

We have arrived at a CLIC work program for 2012 – 2017 with the following assumptions:

-CERN resources kept at constant level
- CERN continues leading the collaboration, but stronger need for full responsibility in work-packages to be taken by collaborators

General assessment: No revolution, everything a little less or later.

- CERN Money assignment still “overbooked” on the 10% level in later years, but this can be refined in due time.

-Next steps:
- Detailed understanding and integration of collaborations.
  → Concrete commitments of collaborators through revised MoUs/contracts
- Full documentation in APT including data from collaborators by the end of 2012
- More concrete definition of the long term goals of the project (taskforce, European strategy process, LHC results...)
- Matching of the existing program 2012-2017 to the long term goals. This might lead to significant re-prioritization of activities.

→But we can “keep rocking” under the present program at least within the next 12 months.

→ Critical long terms investments will be delayed until firm decisions