# The CLIC project

- Overall context of a multi-TeV e+e- machine
  - Strategies and implementation
- Brief physics reminders
- CLIC concept and CDR status
  - recall main achievements
- Status and plans towards 2018
  - some of the recent developments
- A final slide

…. much more in later talks this week

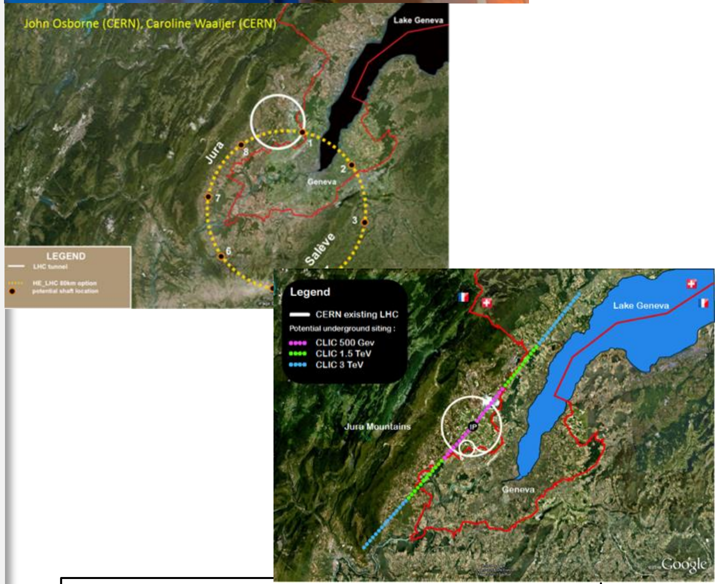
# The context of the LC projects - strategies

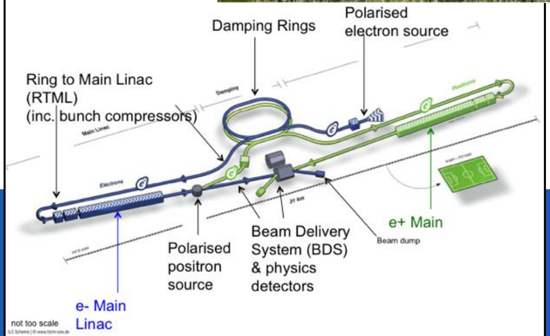
European Strategy priorities related to the Energy Frontier:

- LHC and LHC luminosity upgrades (until ~2030)
  - Higgs and Beyond the Standard Model physics in long term programme
- BSM – does it show up at LHC at 14 TeV, 2015 onwards ?
  - What are the best machines to access such physics directly post-LHC …. prepare main options the next years towards next strategy update (~2018)
  - Two main alternatives considered; higher energy hadrons (Future Circular Collider), or highest possible energy e+e- with CLIC
- ILC in Japan, a possibility for exploring the Higgs in detail, starting at 250 GeV
  - If implemented a comprehensive programme that can in particular can map out the Higgs sector

At CERN: In accordance with this, pursue three connected LC activities in the period towards 2017-18 (when LHC results at nominal energy are becoming mature):

- CLIC as option for the energy frontier (accelerator, det&phys studies) – with links to FCC where appropriate
- ILC project development - towards a construction project
- Common activities wherever possible

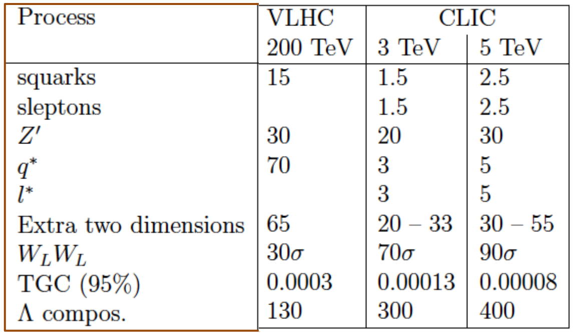




# CLIC for the energy frontier

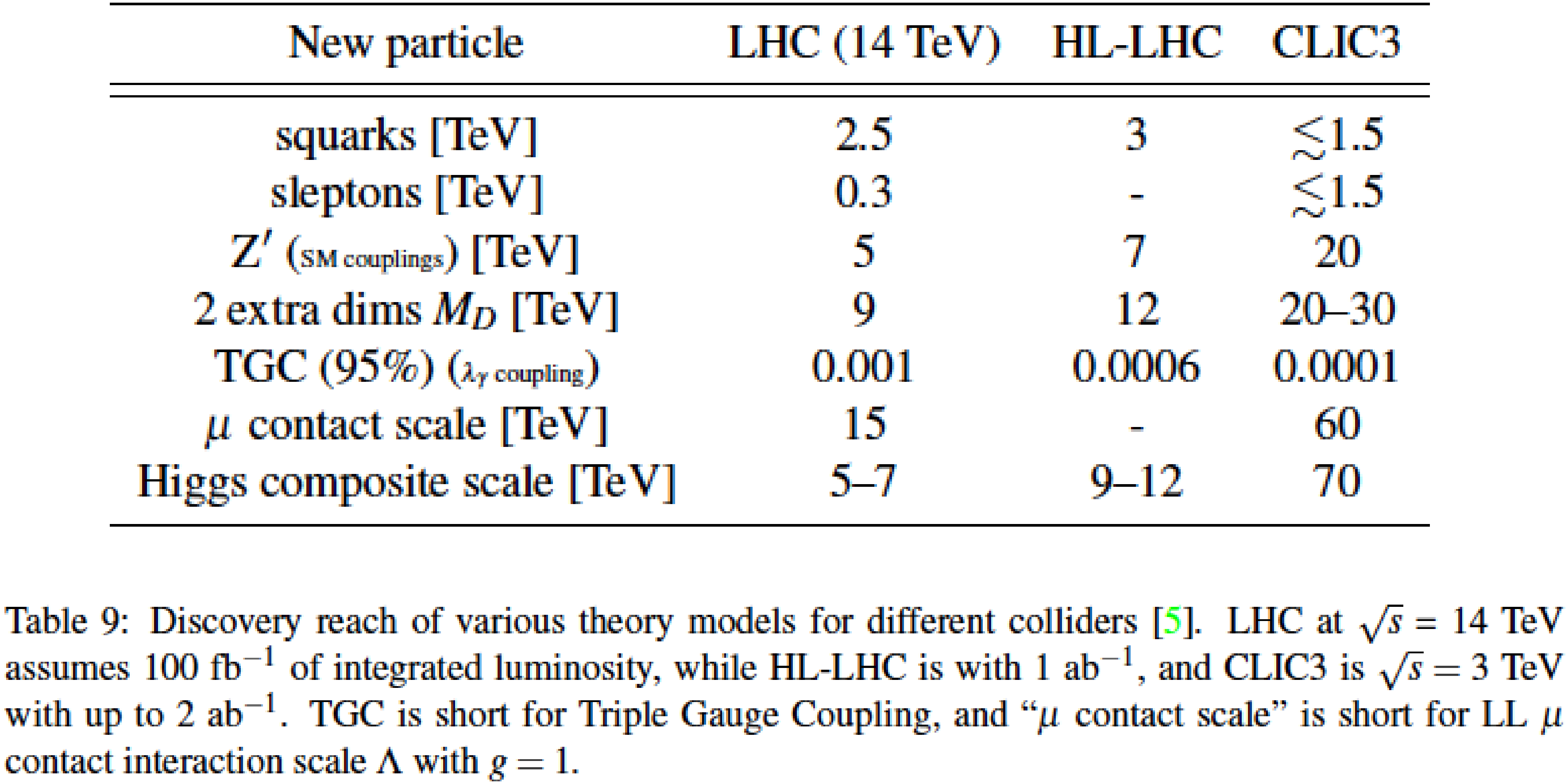
**Goal for the next European Strategy update (2018): Present a CLIC project that is a “credible” option for CERN beyond 2030:**

- Physics studies updated taking into account LHC-14 TeV (assume the physics case will be there for an energy frontier machine – i.e. focus beyond the Higgs)
- Physics after LHC programme completion (2030 +)
- Initial costs and upgrade costs for 2nd and 3rd stage in reasonable agreement with one could hope based on CERN resources with additional international help – considering a 20-30 year perspective
- Common/combined or coordinated studies with various of high energy hadron rings FCC, in particular related to CE, conv.system, costs, power, schedules, resources, some technical studies, physics studies (very little done in the last decade – see fig. right from 2001)



| Process | VLHC | CLIC | |
|---|---|---|---|
| | 200 TeV | 3 TeV | 5 TeV |
| squarks | 15 | 1.5 | 2.5 |
| sleptons | | 1.5 | 2.5 |
| $Z'$ | 30 | 20 | 30 |
| $q^*$ | 70 | 3 | 5 |
| $l^*$ | | 3 | 5 |
| Extra two dimensions | 65 | 20 – 33 | 30 – 55 |
| $W_L W_L$ | $30\sigma$ | $70\sigma$ | $90\sigma$ |
| TGC (95%) | 0.0003 | 0.00013 | 0.00008 |
| $\Lambda$ compos. | 130 | 300 | 400 |

# CLIC reach for New Physics



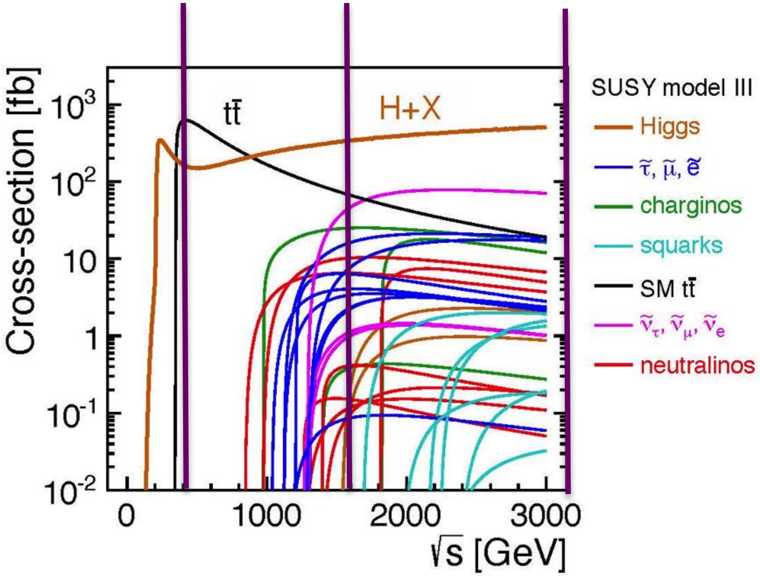
| New particle | LHC (14 TeV) | HL-LHC | CLIC3 |
|---|---|---|---|
| squarks [TeV] | 2.5 | 3 | $\lesssim 1.5$ |
| sleptons [TeV] | 0.3 | - | $\lesssim 1.5$ |
| $Z'$ (SM couplings) [TeV] | 5 | 7 | 20 |
| 2 extra dims $M_D$ [TeV] | 9 | 12 | 20–30 |
| TGC (95%) ($\lambda_\gamma$ coupling) | 0.001 | 0.0006 | 0.0001 |
| $\mu$ contact scale [TeV] | 15 | - | 60 |
| Higgs composite scale [TeV] | 5–7 | 9–12 | 70 |

Table 9: Discovery reach of various theory models for different colliders [5]. LHC at $\sqrt{s}$ = 14 TeV assumes 100 $\text{fb}^{-1}$ of integrated luminosity, while HL-LHC is with 1 $\text{ab}^{-1}$, and CLIC3 is $\sqrt{s} = 3$ TeV with up to 2 $\text{ab}^{-1}$. TGC is short for Triple Gauge Coupling, and "$\mu$ contact scale" is short for LL $\mu$ contact interaction scale $\Lambda$ with $g = 1$.

From Lucie Linssen

# Physics at Linear Colliders from 250 GeV to 3000 GeV

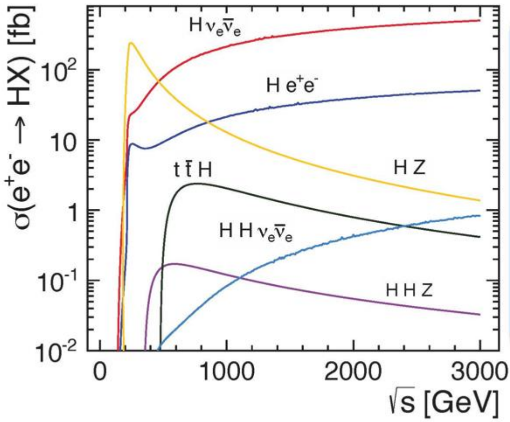
- Physics case for the Linear Collider:
  - Higgs physics (SM and non-SM)
  - Top
  - SUSY
  - Higgs strong interactions
  - New Z' sector
  - Contact interactions
  - Extra dimensions
  - …. AOP (any other physics) …



Specific challenges for CLIC studies therefore:

- Need to address Higgs-studies, including gains for measurements at higher energies
- Reach for various "new physics" (list above) options; comparative studies with HiLumi LHC, FCC …
- See talk of Andre Sailer concerning (some of) these studies

**Higgs boson Production Cross-Sections**



Several thresholds:

126 GeV Hνν, $He^+e^-$

217 GeV HZ

252 GeV HHνν

343 GeV HHZ

472 GeV Htt

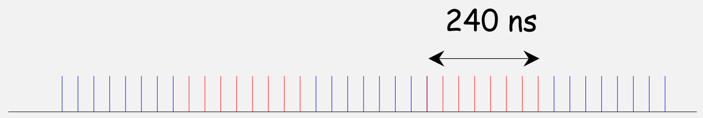
Optimization determines optimal signal to bkgd

Lebrun et al., arXiv:1209.2543

# CLIC Layout at 3 TeV

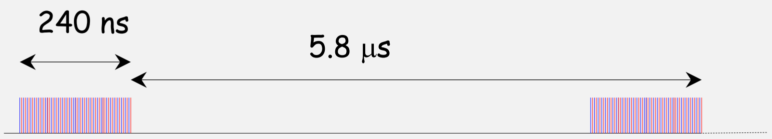
**Drive Beam Generation**

## Drive beam time structure - initial

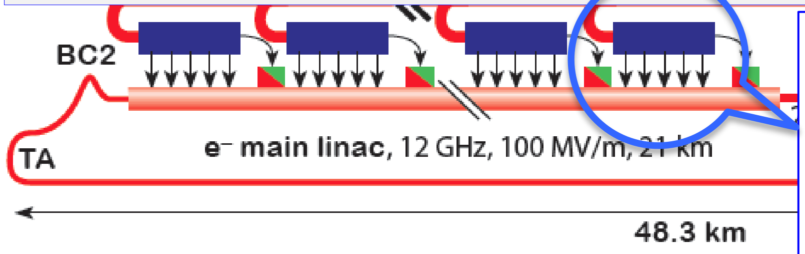


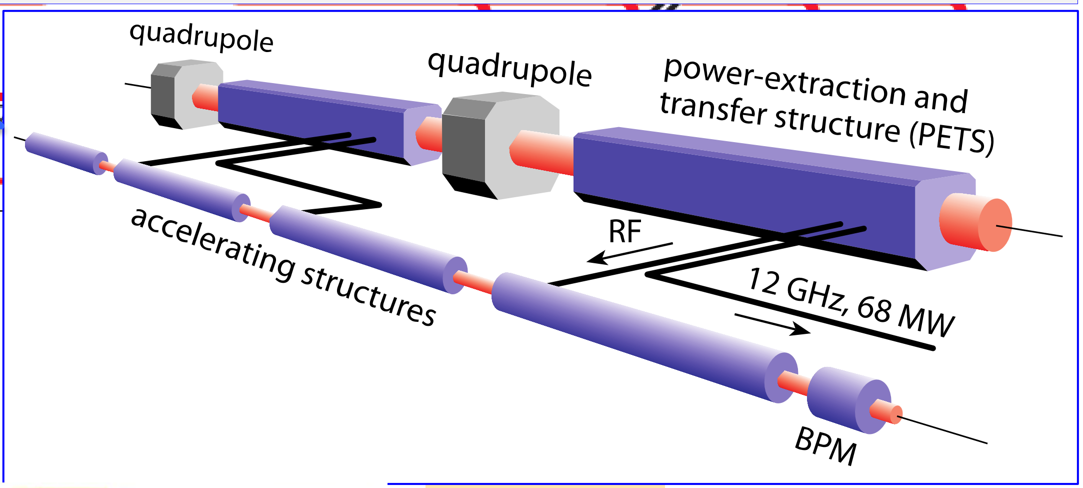
140 µs train length - 24 × 24 sub-pulses
4.2 A - 2.4 GeV – 60 cm between bunches

## Drive beam time structure - final



24 pulses – 101 A – 2.5 cm between bunches

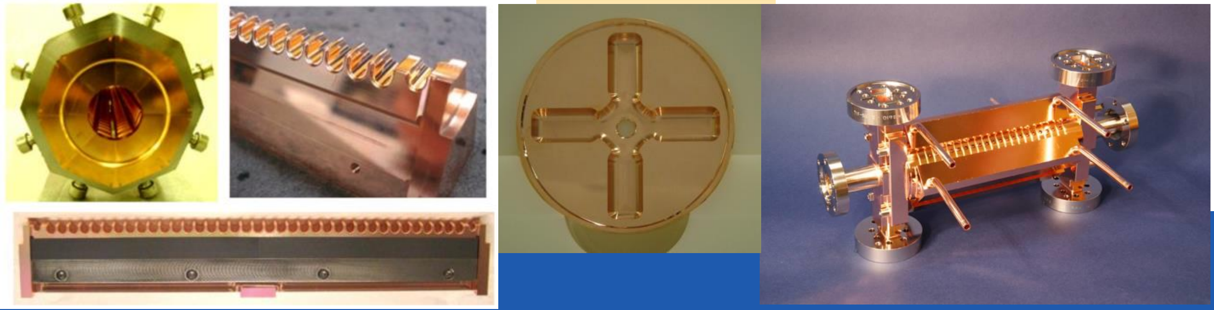




| | |
|---|---|
| CR | combiner ring |
| TA | turnaround |
| DR | damping ring |
| PDR | predamping ring |
| BC | bunch compressor |
| BDS | beam delivery system |
| IP | interaction point |
| 🟥 | dump |

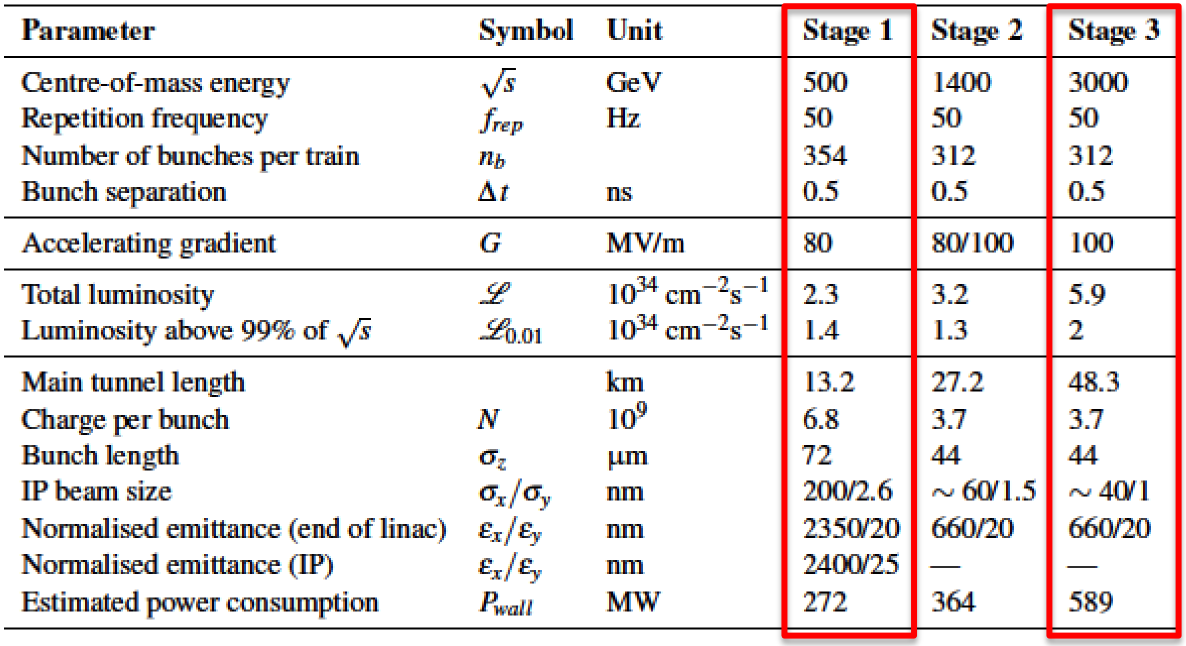
e⁻ injector,
2.86 GeV

**Main Beam Generation Complex**



# Possible CLIC stages studied

Table 1: Parameters for the CLIC energy stages of scenario A.



| Parameter | Symbol | Unit | Stage 1 | Stage 2 | Stage 3 |
|---|---|---|---|---|---|
| Centre-of-mass energy | $\sqrt{s}$ | GeV | 500 | 1400 | 3000 |
| Repetition frequency | $f_{rep}$ | Hz | 50 | 50 | 50 |
| Number of bunches per train | $n_b$ | | 354 | 312 | 312 |
| Bunch separation | $\Delta t$ | ns | 0.5 | 0.5 | 0.5 |
| Accelerating gradient | $G$ | MV/m | 80 | 80/100 | 100 |
| Total luminosity | $\mathscr{L}$ | $10^{34}$ cm$^{-2}$s$^{-1}$ | 2.3 | 3.2 | 5.9 |
| Luminosity above 99% of $\sqrt{s}$ | $\mathscr{L}_{0.01}$ | $10^{34}$ cm$^{-2}$s$^{-1}$ | 1.4 | 1.3 | 2 |
| Main tunnel length | | km | 13.2 | 27.2 | 48.3 |
| Charge per bunch | $N$ | $10^9$ | 6.8 | 3.7 | 3.7 |
| Bunch length | $\sigma_z$ | μm | 72 | 44 | 44 |
| IP beam size | $\sigma_x/\sigma_y$ | nm | 200/2.6 | ~ 60/1.5 | ~ 40/1 |
| Normalised emittance (end of linac) | $\varepsilon_x/\varepsilon_y$ | nm | 2350/20 | 660/20 | 660/20 |
| Normalised emittance (IP) | $\varepsilon_x/\varepsilon_y$ | nm | 2400/25 | — | — |
| Estimated power consumption | $P_{wall}$ | MW | 272 | 364 | 589 |

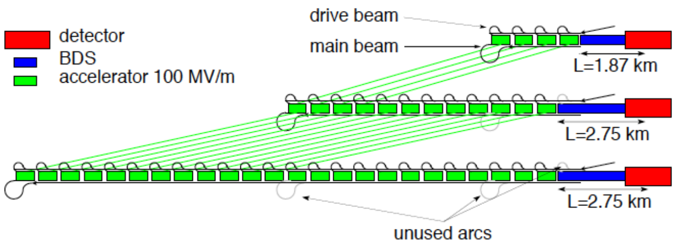
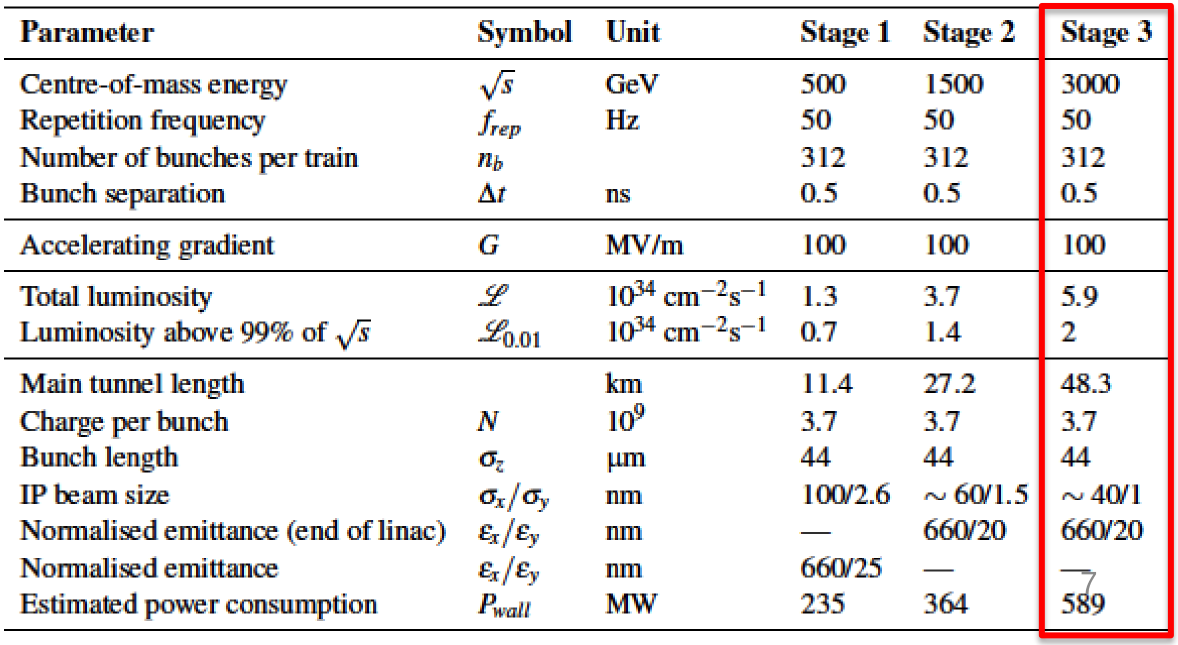


Fig. 3.6: Simplified upgrade scheme for CLIC staging scenario B.

Key features:

- High gradient (energy/length)
- Small beams (luminosity)
- Repetition rates and bunch spacing (experimental conditions)

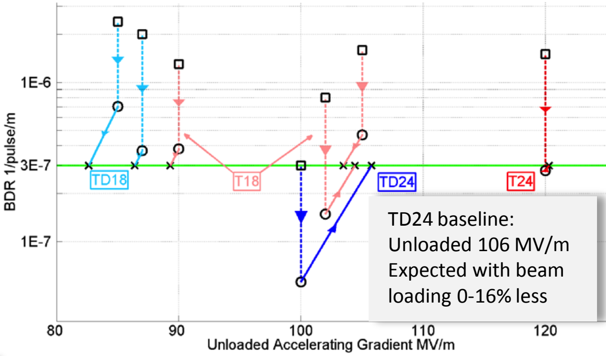
Table 2: Parameters for the CLIC energy stages of scenario B.



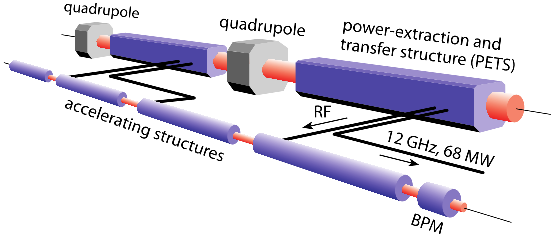
| Parameter | Symbol | Unit | Stage 1 | Stage 2 | Stage 3 |
|---|---|---|---|---|---|
| Centre-of-mass energy | $\sqrt{s}$ | GeV | 500 | 1500 | 3000 |
| Repetition frequency | $f_{rep}$ | Hz | 50 | 50 | 50 |
| Number of bunches per train | $n_b$ | | 312 | 312 | 312 |
| Bunch separation | $\Delta t$ | ns | 0.5 | 0.5 | 0.5 |
| Accelerating gradient | $G$ | MV/m | 100 | 100 | 100 |
| Total luminosity | $\mathscr{L}$ | $10^{34}$ cm$^{-2}$s$^{-1}$ | 1.3 | 3.7 | 5.9 |
| Luminosity above 99% of $\sqrt{s}$ | $\mathscr{L}_{0.01}$ | $10^{34}$ cm$^{-2}$s$^{-1}$ | 0.7 | 1.4 | 2 |
| Main tunnel length | | km | 11.4 | 27.2 | 48.3 |
| Charge per bunch | $N$ | $10^9$ | 3.7 | 3.7 | 3.7 |
| Bunch length | $\sigma_z$ | μm | 44 | 44 | 44 |
| IP beam size | $\sigma_x/\sigma_y$ | nm | 100/2.6 | ~ 60/1.5 | ~ 40/1 |
| Normalised emittance (end of linac) | $\varepsilon_x/\varepsilon_y$ | nm | — | 660/20 | 660/20 |
| Normalised emittance | $\varepsilon_x/\varepsilon_y$ | nm | 660/25 | — | — |
| Estimated power consumption | $P_{wall}$ | MW | 235 | 364 | 589 |

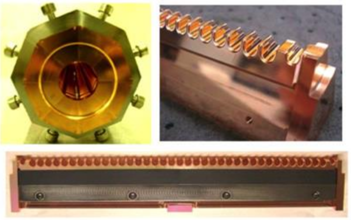
# Conclusion of the accelerator CDR studies

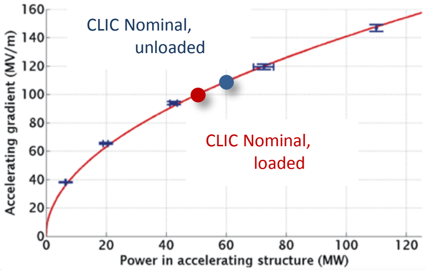
| | |
|---|---|
| Main linac gradient | – Ongoing test close to or on target<br>– Uncertainty from beam loading being tested |
| Drive beam scheme | – Generation tested, used to accelerate test beam abov specifications, deceleration as expected<br>– Improvements on operation, reliability, losses, more deceleration studies underway |



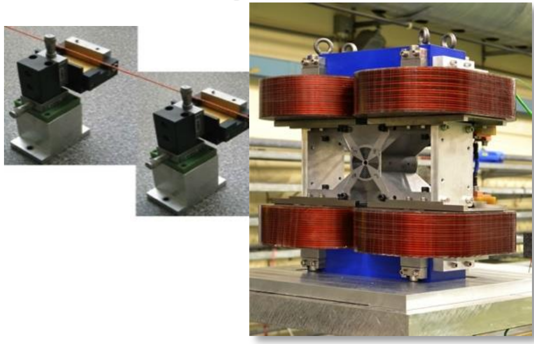
TD24 baseline:
Unloaded 106 MV/m
Expected with beam loading 0-16% less







| | |
|---|---|
| Luminosity | – Damping ring like an ambitious light source, no show stopper<br>– Alignment system principle demonstrated<br>– Stabilisation system developed, benchmarked, better system in pipeline<br>– Simulations on or close to the target |
| Operation & Machine Protection | – Start-up sequence and low energy operation defined<br>– Most critical failure studied and first reliability studies |
| Implementation | – Consistent three stage implementation scenario defined<br>– Schedules, cost and power developed and presented<br>– Site and CE studies documented |



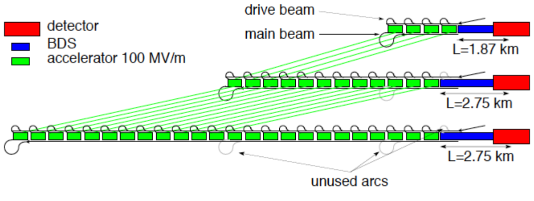
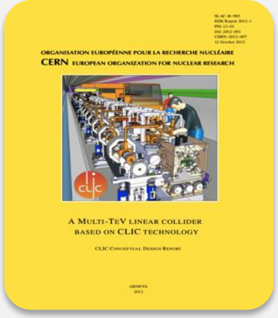


Fig. 3.6: Simplified upgrade scheme for CLIC staging scenario B.

# The CLIC CDR documents



ORGANISATION EUROPÉENNE POUR LA RECHERCHE NUCLÉAIRE
CERN EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

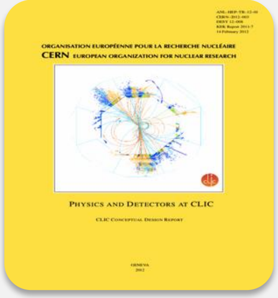
A Multi-TeV linear collider
based on CLIC technology

CLIC Conceptual Design Report

Geneva
2012

Vol 1: The CLIC accelerator and site facilities

- 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
- https://edms.cern.ch/document/1234244/



ORGANISATION EUROPÉENNE POUR LA RECHERCHE NUCLÉAIRE
CERN EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

Physics and Detectors at CLIC

CLIC Conceptual Design Report

Geneva
2012

Vol 2: Physics and detectors at CLIC

- Physics at a multi-TeV CLIC machine can be measured with high precision, despite challenging background conditions
- External review procedure in October 2011
- http://arxiv.org/pdf/1202.5940v1

ORGANISATION EUROPÉENNE POUR LA RECHERCHE NUCLÉAIRE
CERN EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

The CLIC Programme:
towards a staged $e^+e^-$ Linear Collider
exploring the Terascale
CLIC Conceptual Design Report

Geneva
2012

Vol 3: “CLIC study summary”

- 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)
- http://arxiv.org/pdf/1209.2543v1

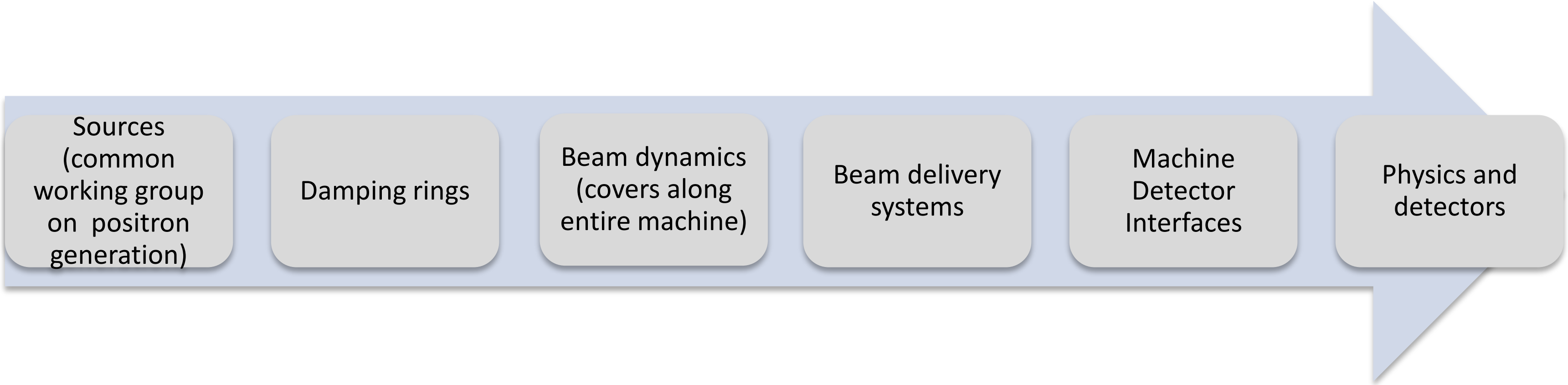
In addition a shorter overview document was submitted as input to the European Strategy update, available at: http://arxiv.org/pdf/1208.1402v1

Input documents to Snowmass 2013 has also been submitted: http://arxiv.org/abs/1305.5766 and http://arxiv.org/abs/1307.5288

# CLIC and ILC

Even though the basic acceleration technologies are different for CLIC and ILC, many areas have common challenges and potentially common solutions whenever the requirements are similar.

Among the most pronounced common activities:



- Sources (common working group on positron generation)
- Damping rings
- Beam dynamics (covers along entire machine)
- Beam delivery systems
- Machine Detector Interfaces
- Physics and detectors

# Main activities and goals for 2018

**Design and Implementation studies:**

- CDR status: not optimized except at 3 TeV and not adjusted for Higgs discovery, not optimized cost, first power/energy estimates without time for reductions, limited industrial costing, very limited reliability studies
- Baseline design and staging strategy
- Solid cost basis and more optimized power/energy (aim for 20% energy reduction)
- Proof of industry basis for key components/units, in particular those specific for CLIC
- Comprehensive reliability/robustness/uptime analysis
- Pursue increased use of X-band for other machines/applications

**System-tests:**

- CDR status: CTF3 results initial phase (as of early 2012), ATF and FACET very little, no convincing strategy for further system verification
- Complete system-tests foreseen for next phase, and comprehensive documentation of the results at CERN (CTF3) and elsewhere
- Strategy for further system verification before construction (XFEL, connected to light-sources, further drive-beam verifications) or as part of initial machine strategy.
- CDR status concerning drive-beam FE: Nothing done beyond CTF3
- Demonstrator of drive beam FE and RF power unit based on industrial capacity – will open for larger facilities beyond 2018 if necessary

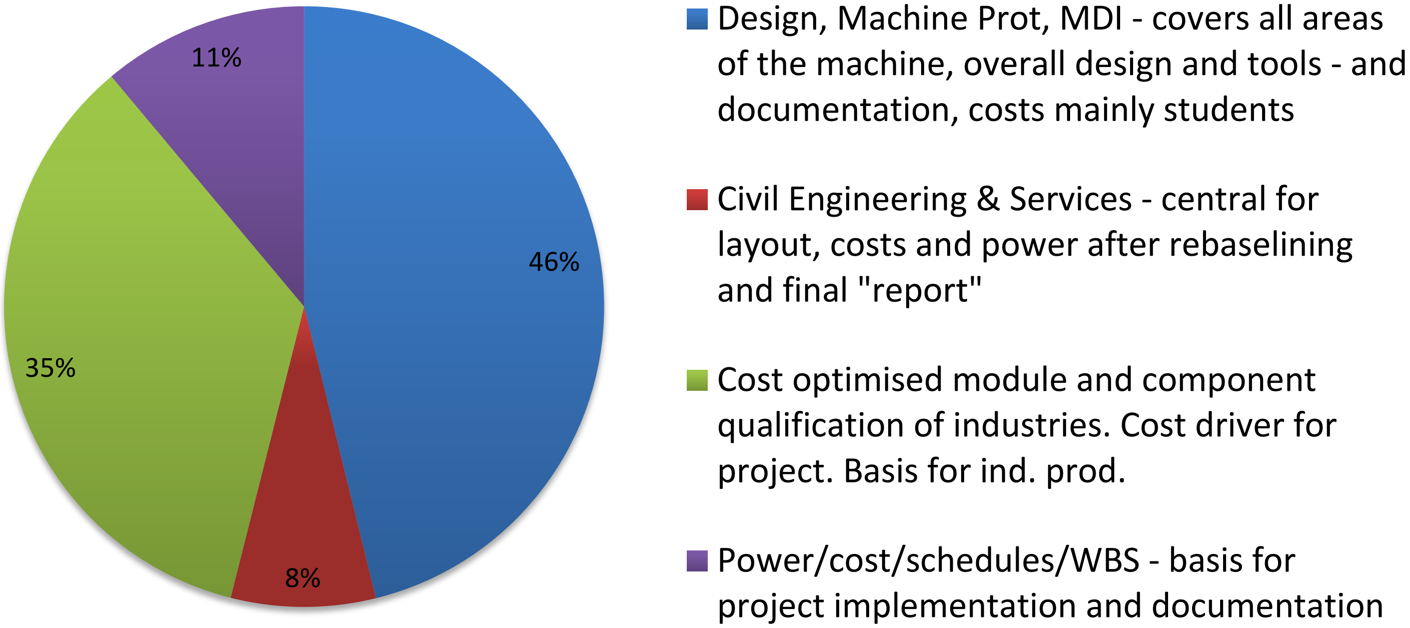
**X-band developments:**

- CDR status: Single elements demonstrated – limited by test-capacity
- Statistics for gradient and structure choice (energy reach) and other X-band elements

**Technology developments:**

- CDR status: alignment/stability partly covered, BBA assumed, wakefield mon. perf. assumed, no complete module
- Demonstration of critical elements and methods for the machine performance:
  - ✓ DR, main linac, BDS with associated instrumentation and correction methods (combination of design, simulation, system-tests and technologies)
  - ✓ Stability/alignment (locally and over distances)
  - ✓ Module including all parts

# Design and Implementation



🟦 Design, Machine Prot, MDI - covers all areas of the machine, overall design and tools - and documentation, costs mainly students

🟥 Civil Engineering & Services - central for layout, costs and power after rebaselining and final "report"

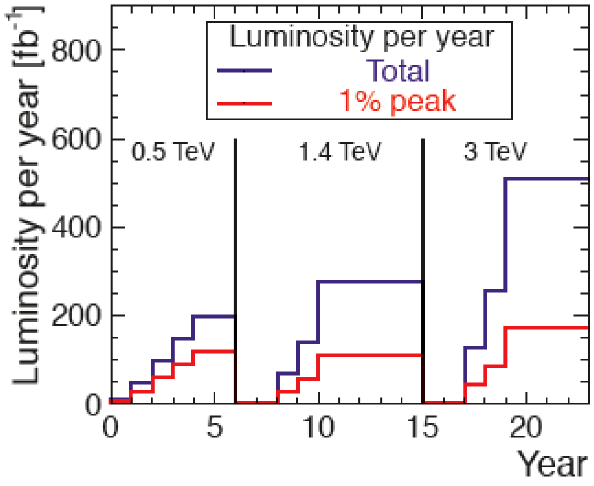
🟩 Cost optimised module and component qualification of industries. Cost driver for project. Basis for ind. prod.

🟪 Power/cost/schedules/WBS - basis for project implementation and documentation

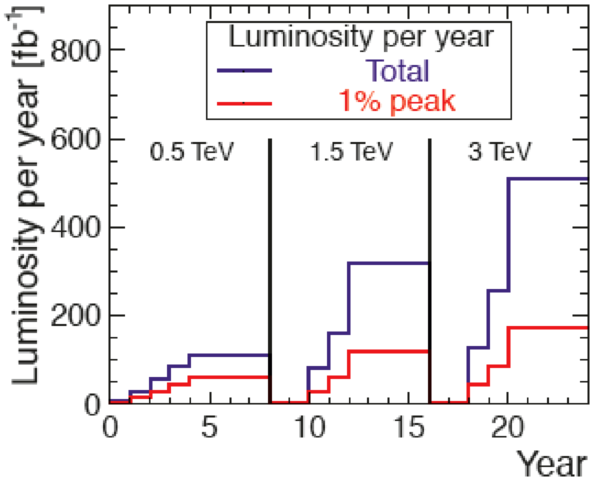
- Will comment on all of these items briefly
- Links strongly to many technical developments: design/modeling <-> technical  developments <-> tests/verification

# Possible luminosity examples – in CDR

*First stage luminosity optimised (scenario A)*



*Low entry cost (scenario B)*



Based on 200 days/year at 50% efficiency (accelerator + data taking combined)

Target figures: >600 fb$^{-1}$ at first stage, 1.5 ab$^{-1}$ at second stage,

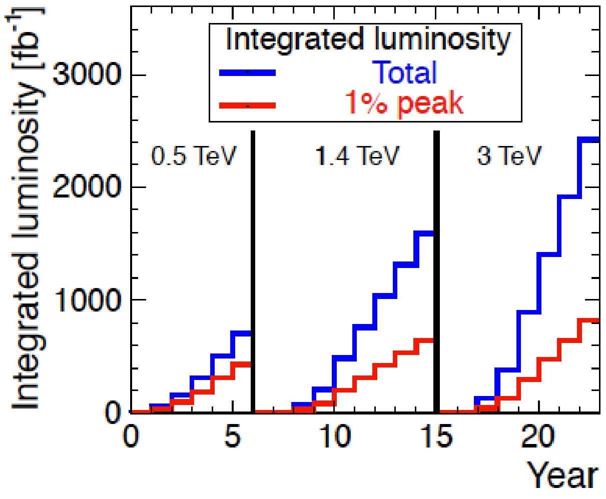


Fig. 5.2: Integrated luminosity in the scenarios
and optimised for entry costs (right). Years are
figures include luminosity ramp-up of four yea
(25%, 50%) in subsequent stages.

Ongoing process: Iterate on energy choices

- Stage optimised for ~350-375GeV for Higgs and top
- 1-2 TeV depending on physics findings, will still also do Higgs
- 3 TeV as current ultimate energy, includes more Higgs

Consider in particular the initial stages:

- Identify, review and implement cost and power/energy saving options
- Identify and carry out required R&D

Re-optimise parameters (global design)

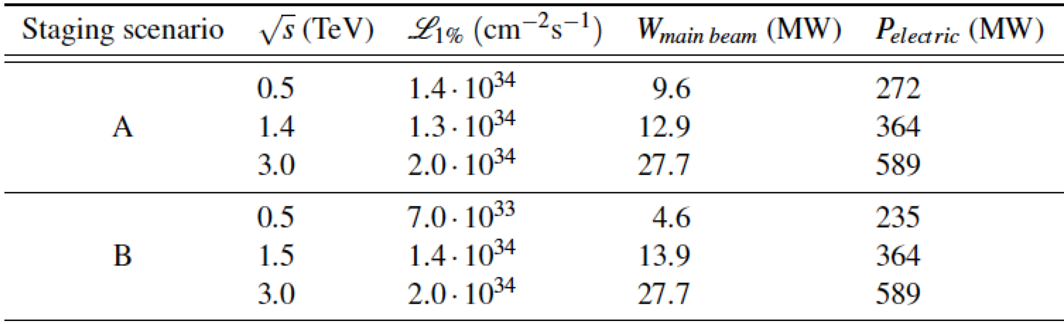
- Develop an improved cost and power/energy consumption model
- Iterations needed with saving options

# Power/energy consumption

Considering 150 days per year of normal operation at nominal power and a luminosity ramp-up in the early years at each stage of collision energy, the development of yearly energy consumption can be sketched.

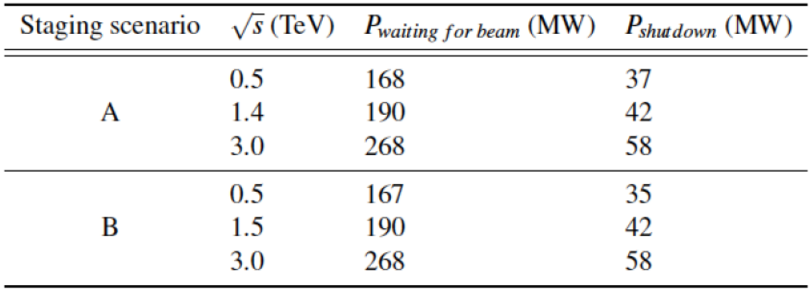
- Re-optimize parts
  - Reduced current density in normal-conducting magnets
  - Reduction of heat loads to HVAC
  - Re-optimization of accelerating gradient with different objective function
- Efficiency
  - Grid-to-RF power conversion
  - Permanent or super-ferric superconducting magnets
- Energy management
  - 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

Beyond:
Scale with inst. luminosity – i.e. running at the very end of the project lifetime might be power limited and require more time.



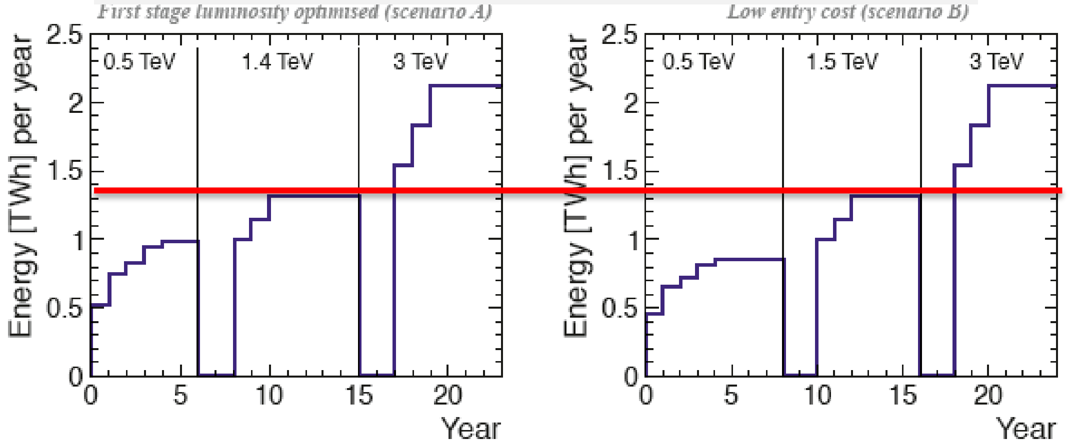
| Staging scenario | $\sqrt{s}$ (TeV) | $\mathscr{L}_{1\%}$ (cm$^{-2}$s$^{-1}$) | $W_{main\ beam}$ (MW) | $P_{electric}$ (MW) |
|---|---|---|---|---|
| A | 0.5 | $1.4 \cdot 10^{34}$ | 9.6 | 272 |
| | 1.4 | $1.3 \cdot 10^{34}$ | 12.9 | 364 |
| | 3.0 | $2.0 \cdot 10^{34}$ | 27.7 | 589 |
| B | 0.5 | $7.0 \cdot 10^{33}$ | 4.6 | 235 |
| | 1.5 | $1.4 \cdot 10^{34}$ | 13.9 | 364 |
| | 3.0 | $2.0 \cdot 10^{34}$ | 27.7 | 589 |

Table 5.2: Residual power without beams for staging scenarios A and B.

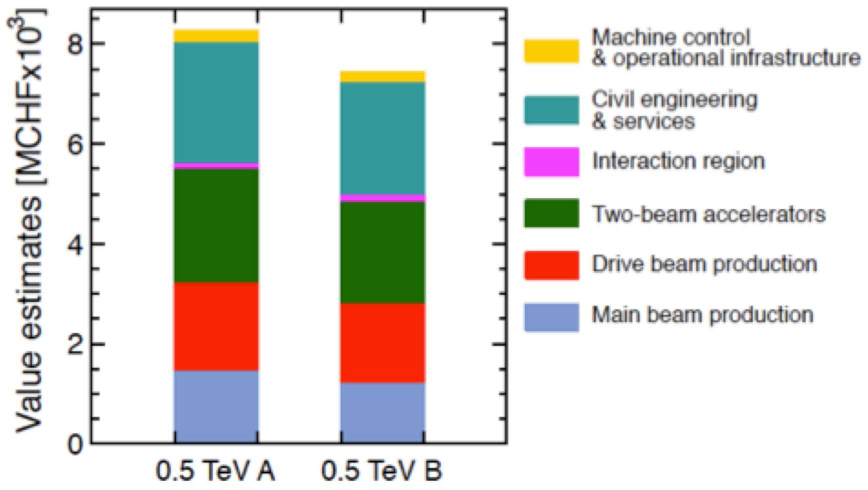


| Staging scenario | $\sqrt{s}$ (TeV) | $P_{waiting\ for\ beam}$ (MW) | $P_{shutdown}$ (MW) |
|---|---|---|---|
| A | 0.5 | 168 | 37 |
| | 1.4 | 190 | 42 |
| | 3.0 | 268 | 58 |
| B | 0.5 | 167 | 35 |
| | 1.5 | 190 | 42 |
| | 3.0 | 268 | 58 |

CERN energy consumption 2012: 1.35 TWh



# Cost/power reductions: some identified savings



First to second stage: 4 MCHF/GeV (i.e. initial costs are very significant)

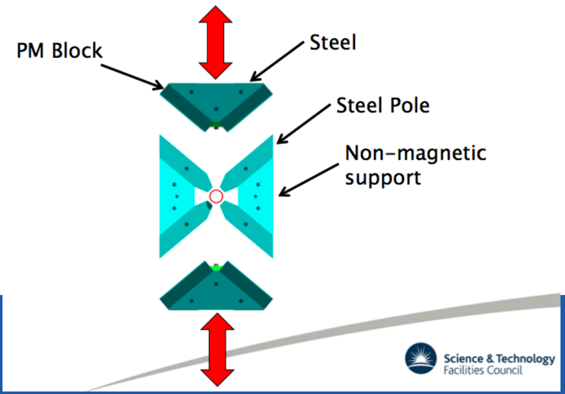
Caveats:

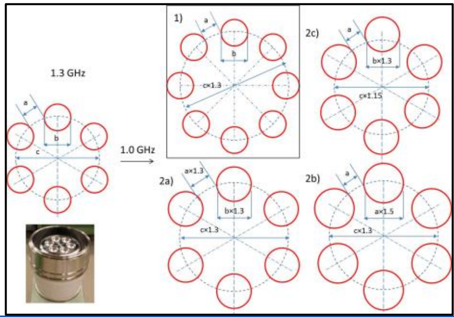
Uncertainties 20-25%

Possible savings around 10%

However – first stage not optimised (work for next phase), parameters largely defined for 3 TeV final stage

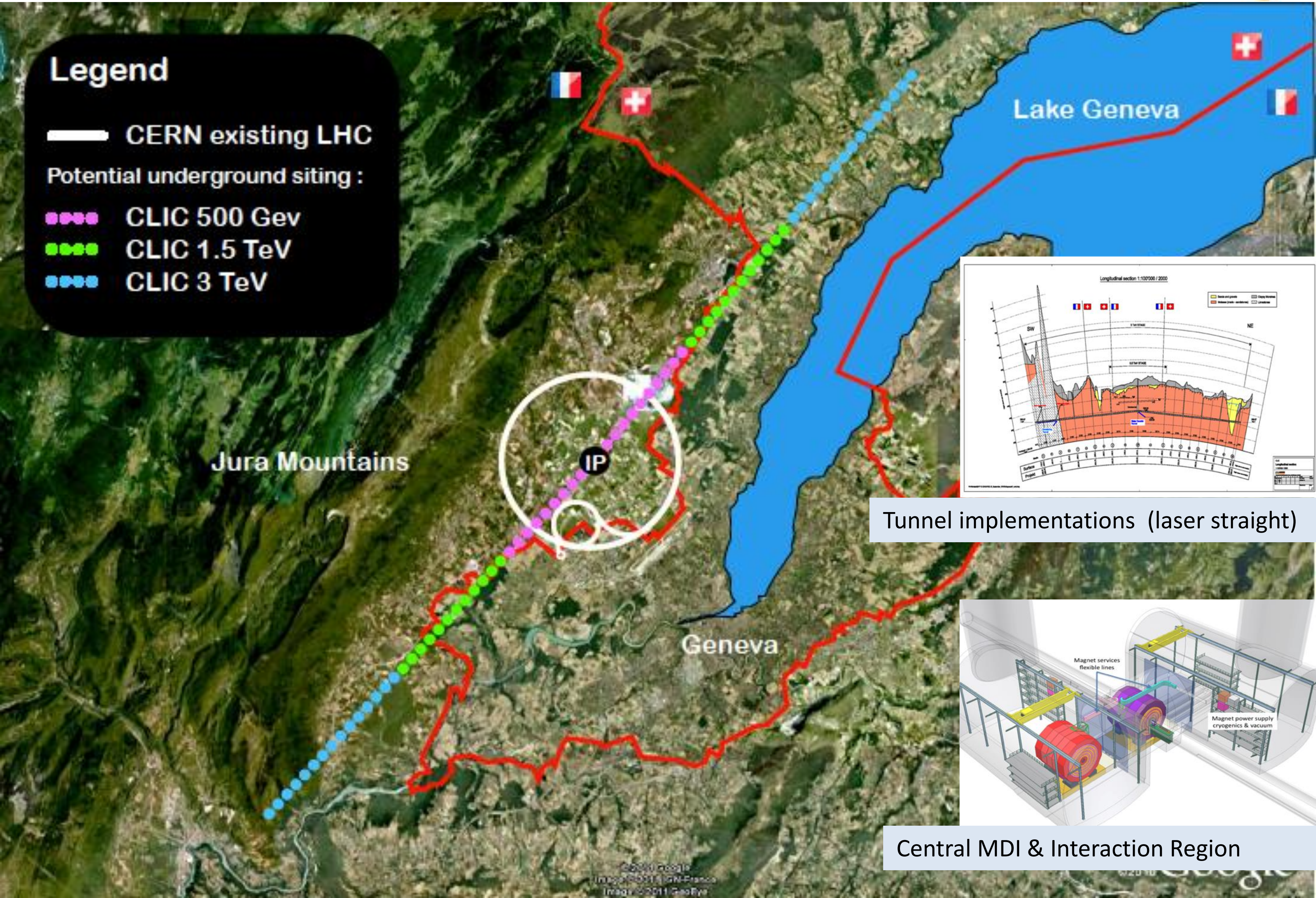
- Use of **permanent or hybrid magnets** for the drive beam (order of 50’000 magnets)
- Optimize **drive beam accelerator** klystron system
- Electron **pre-damping ring** can be removed with good electron injector
- Dimension drive beam accelerator building and infrastructure are for 3TeV**, dimension to 1.5TeV results in large saving**
- Systematic **optimization** of injector complex linacs in preparation
- Power consumption:
  - Optimize and reduce overhead estimates





L-band klystron optimization studies

# CLIC near CERN



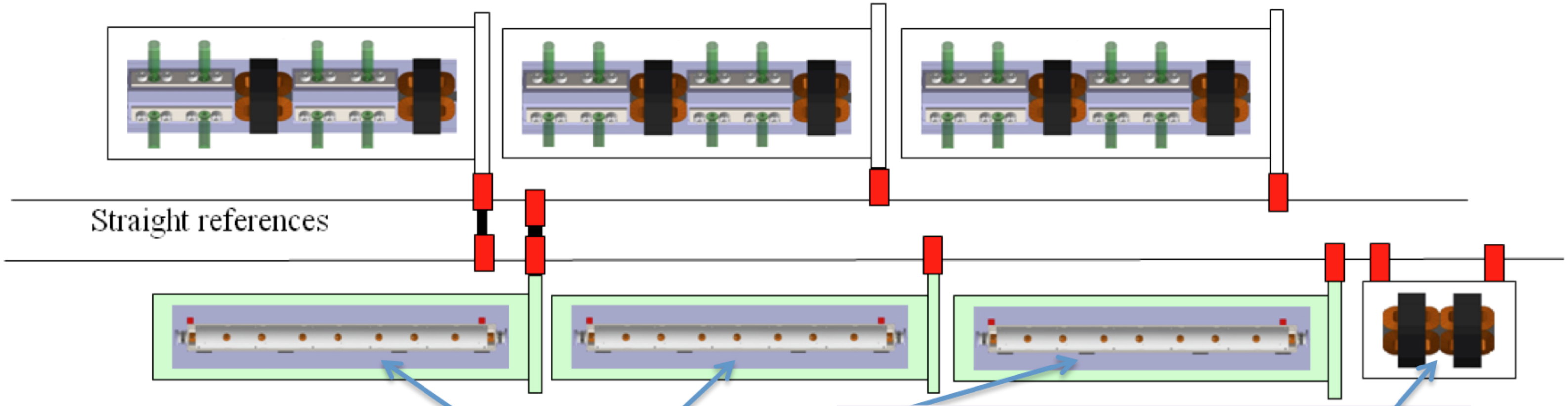
Tunnel implementations (laser straight)

Central MDI & Interaction Region

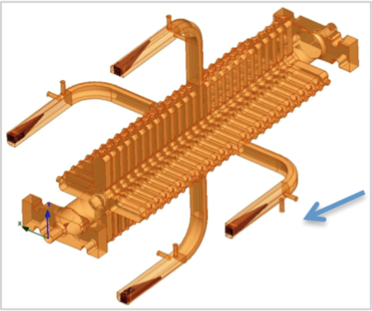
# Design/modeling -> Hardware -> Tests

Emittance preservation feasibility for LC: mainly simulation studies

Currently and next period: experimental studies of alignment methods

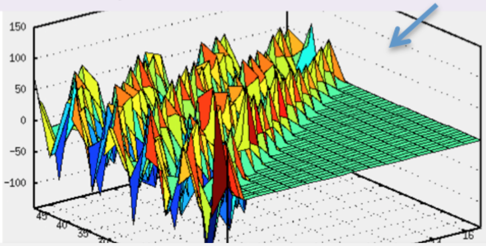


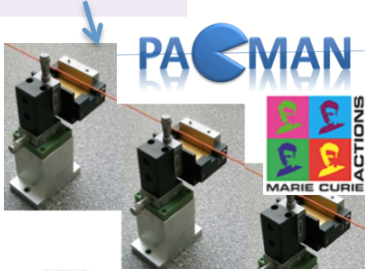
1) Pre-align BPMs+quads accuracy O(10μm) over about 200m and Stabilize quadrupole O(1nm) @ 1Hz
**Next period:** dedicated research test stand



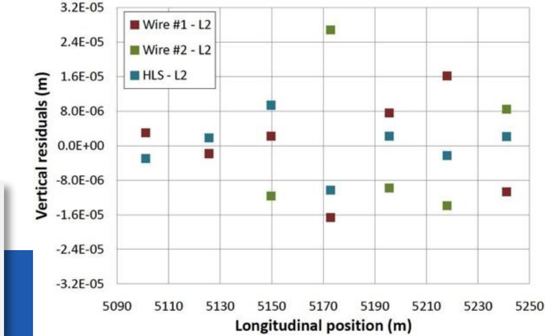
3) Use wake-field monitors accuracy O(3.5μm).
**Next period:** improved design and testing in the CLIC Test Facility.

2) Beam-based alignment
**Next period:** experimental tests at FACET

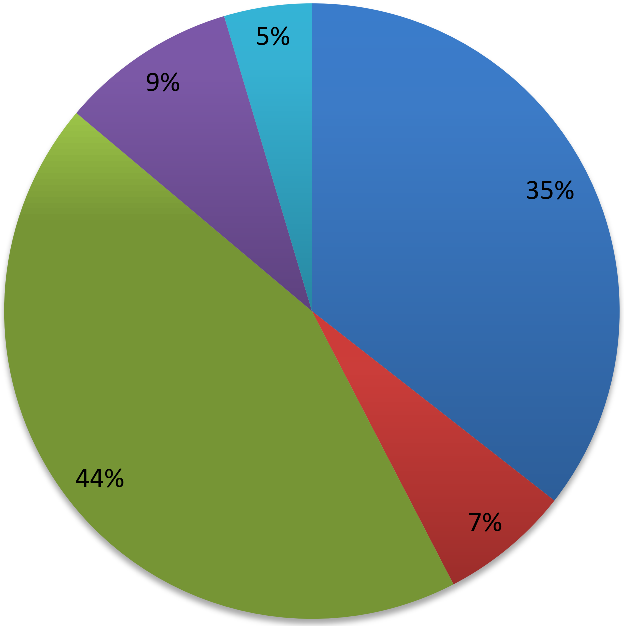




- Test of prototype shows
  - vertical RMS error of 11μm
  - i.e. accuracy is approx. 13.5μm



# System-tests at CERN and outside

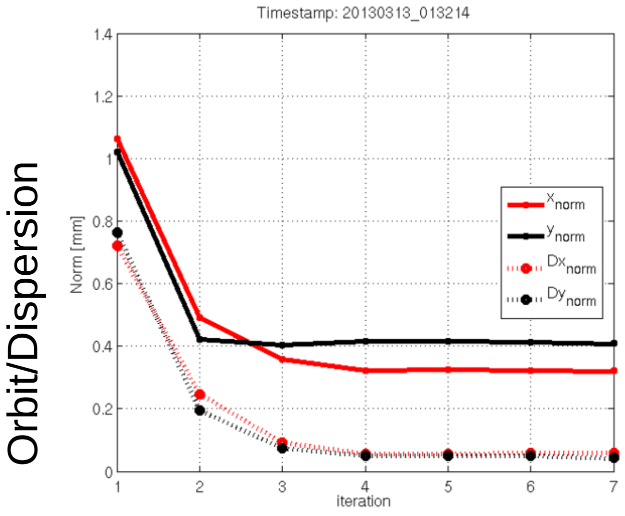


- 🟦 CTF3 Consolidation & Operation (stop planned end 2016) for the next period, studies of re-use of equip. and site
- 🟥 Drive Beam performance and feedback/forwards, drive beam decelaration and power prod., two beam mudule tests, instr. tests
- 🟩 Drive-beam front end including injector studies (critcal parts of the first part of drive beam complex and power units)
- 🟪 Modulator development, magnet converters, also to become part of Drivebeam FE system
- ■ Accelerator Beam System Tests (Low emittance ring test, ATF, FACET,…)

- Will comment mostly on CTF3 but note increased resources to development of full intensity drive-beam FE components such that we have prototypes/developments of all key part by 2018

# CLIC Beam-Based Alignment tests at FACET

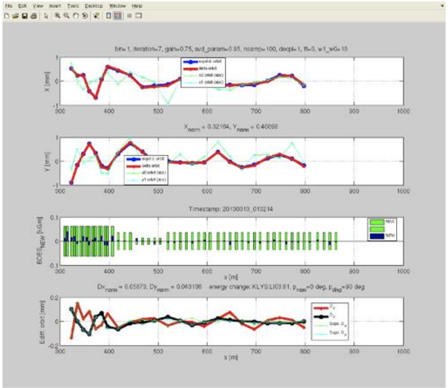
Dispersion-free Steering (DFS) proof of principle – March 2013

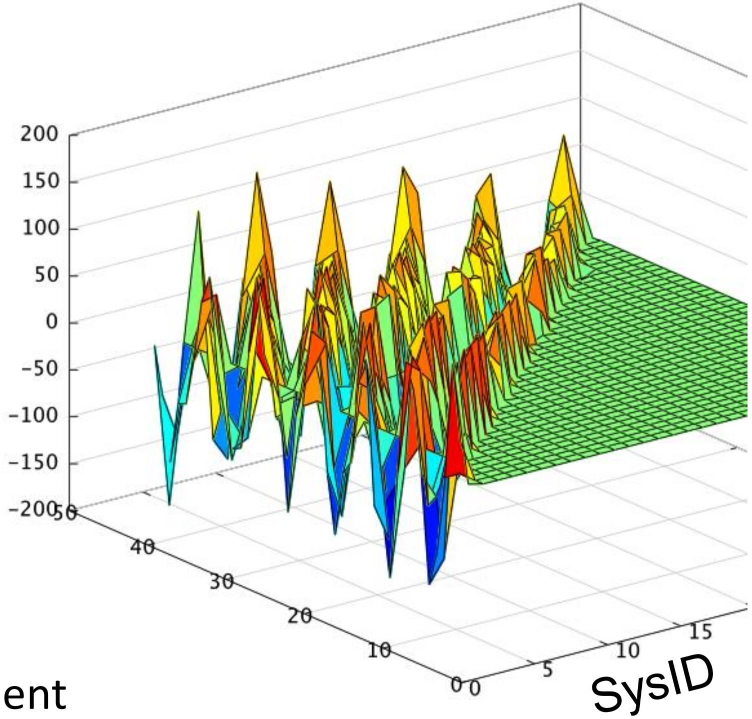


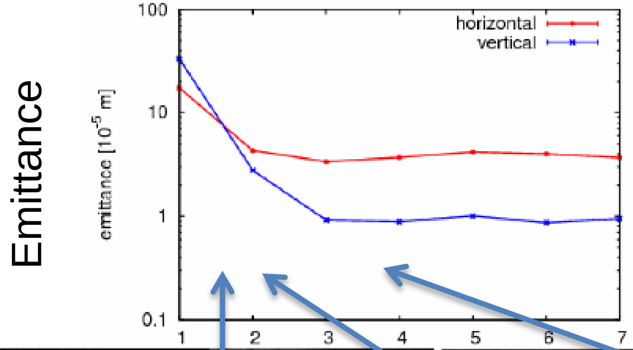
DFS correction applied to 500 meters of the SLC linac

- SysID algorithms for model reconstruction
- DFS correction with GUI
- Emittance growth is measured

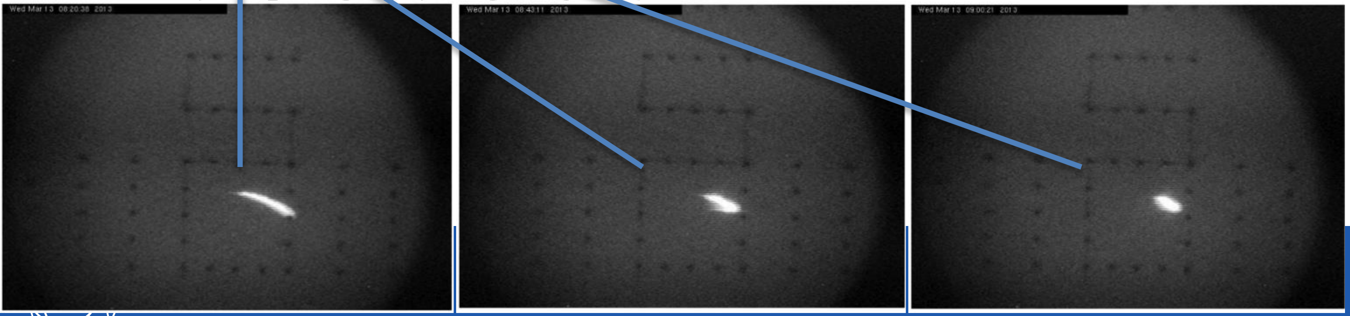
Graphic User Interface:







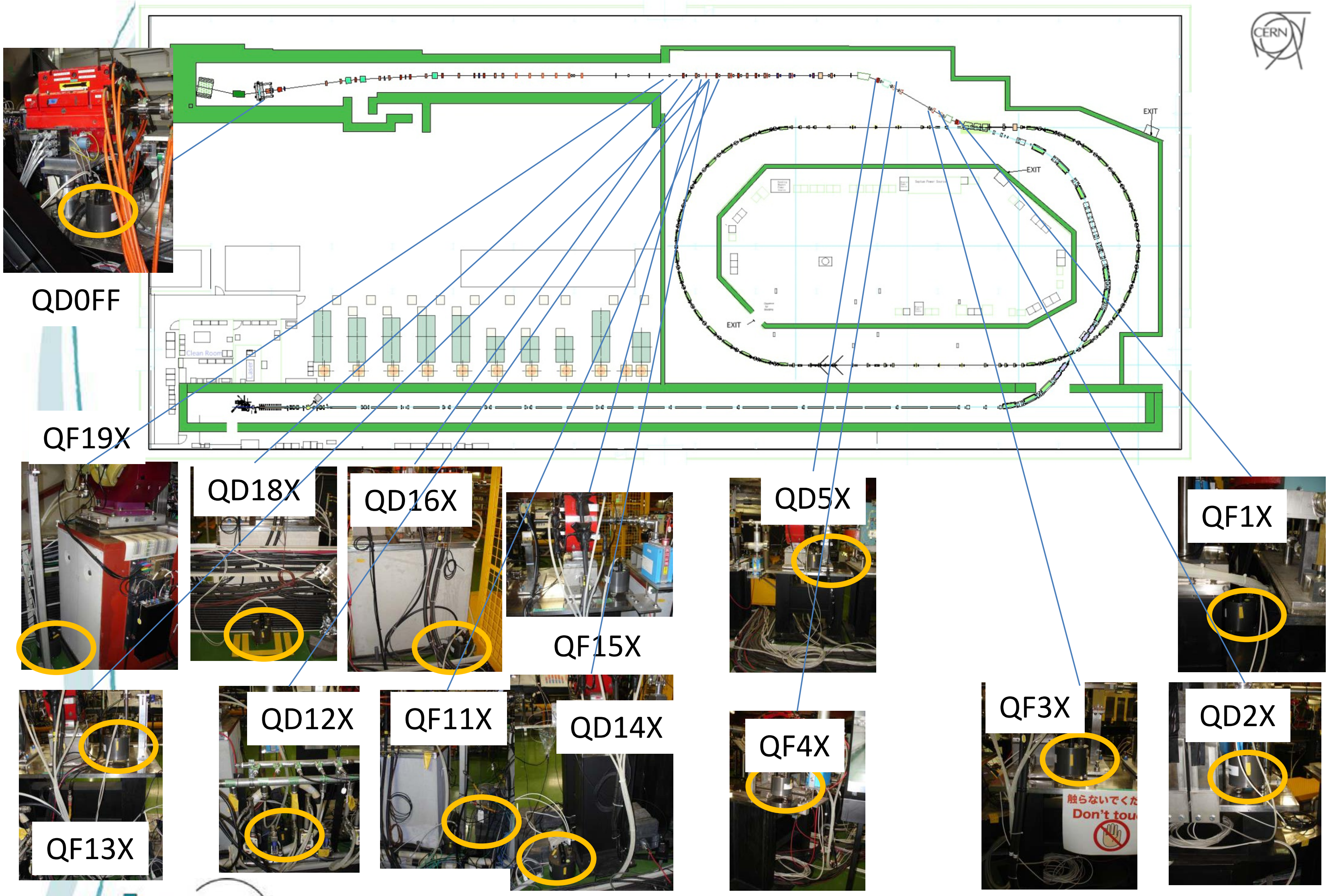
Beam profile measurement



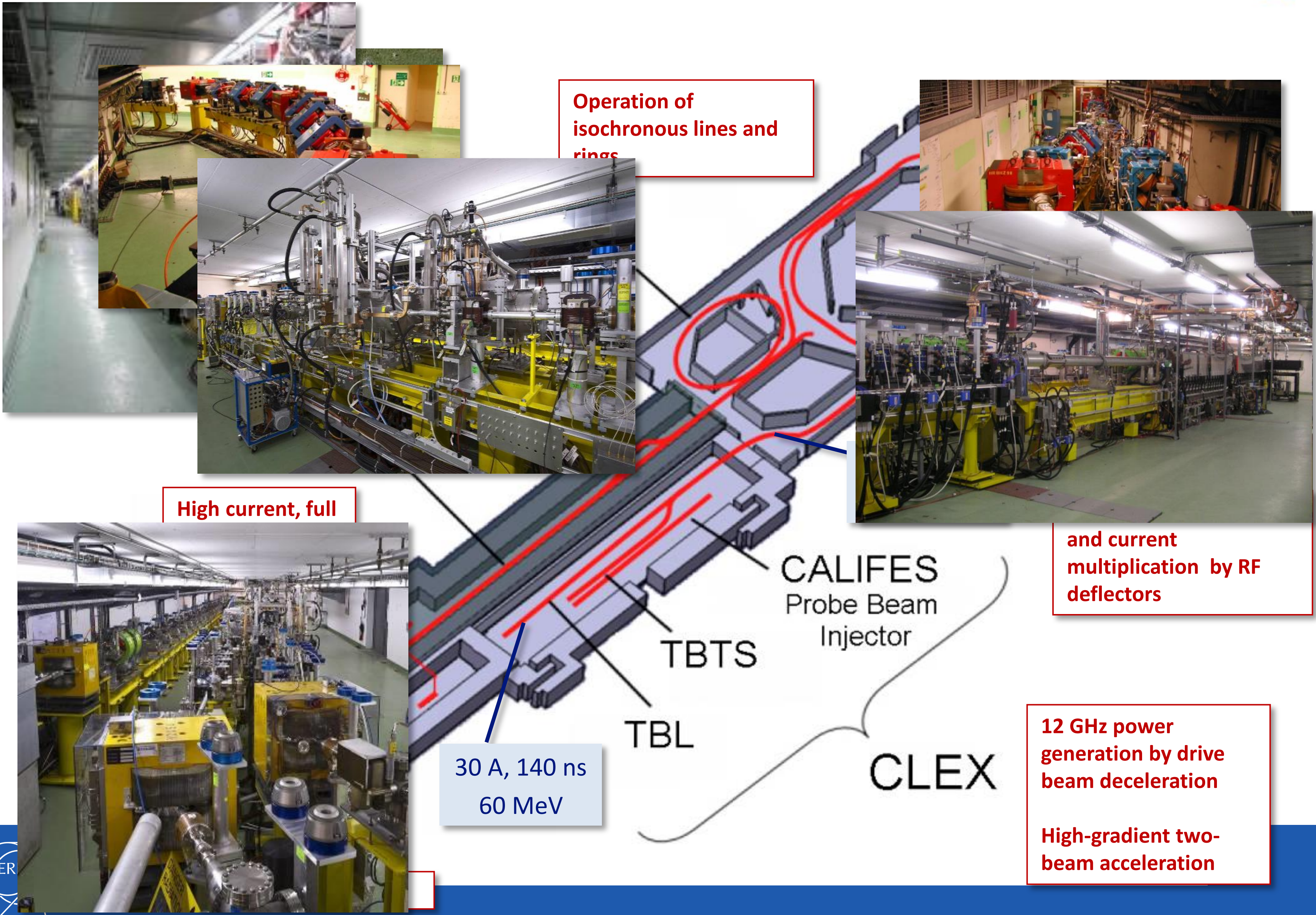
Before correction After 1 iteration After 3 iterations

Incoming oscillation/dispersion is taken out and flattened; emittance in LI11 and emittance growth significantly reduced.

# Stabilisation Experiment



# CLIC Test Facility / CTF3



Operation of isochronous lines and rings

High current, full

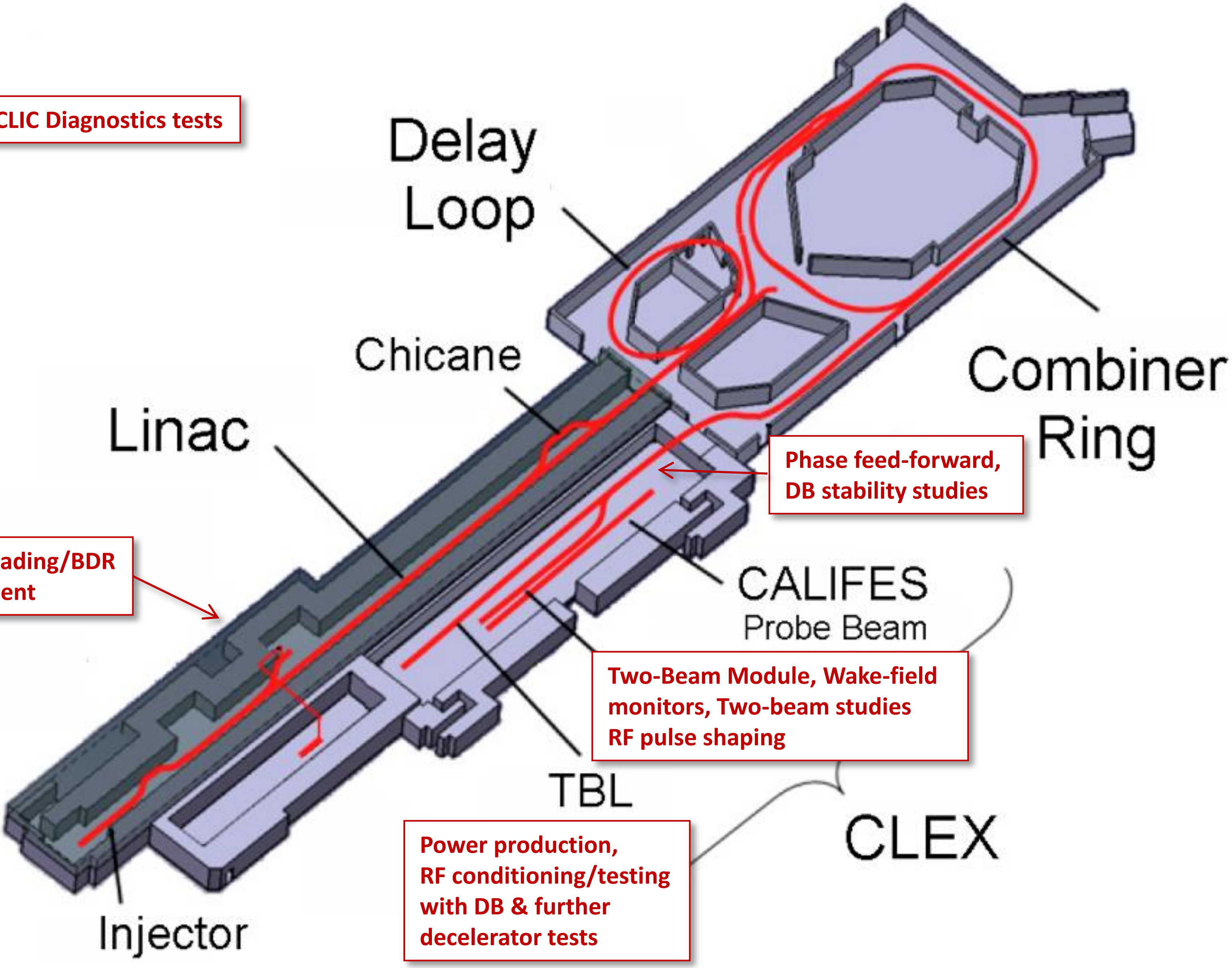
and current multiplication by RF deflectors

30 A, 140 ns
60 MeV

12 GHz power generation by drive beam deceleration

High-gradient two-beam acceleration

# CTF3 programme 2013-2016



CLIC Diagnostics tests

Phase feed-forward, DB stability studies

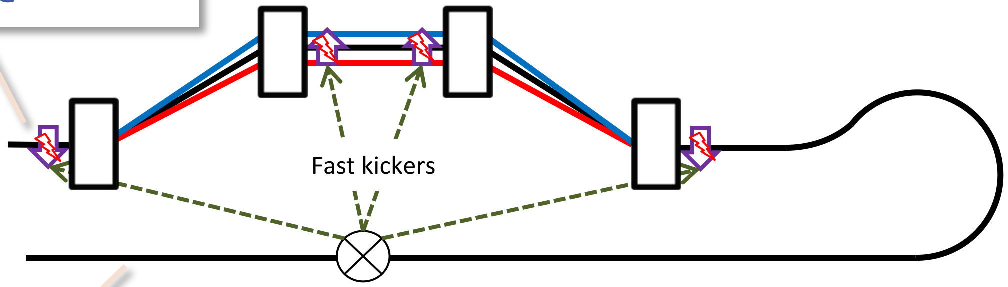
Beam loading/BDR experiment

Two-Beam Module, Wake-field monitors, Two-beam studies RF pulse shaping

Power production, RF conditioning/testing with DB & further decelerator tests

# Drive Beam phase feed-forward experiment

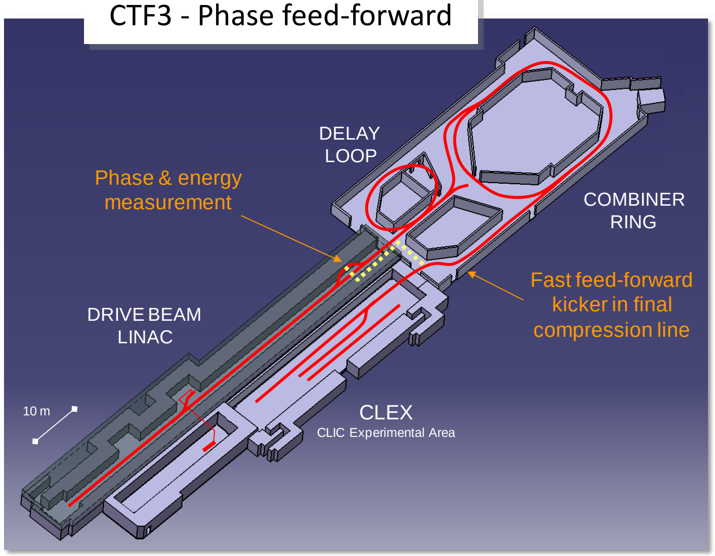
Phase stability
0.2° @ 12GHz



CLIC drive beam phase feed-forward concept

Phase stability 2.5° @ 12GHz
0.2° @ 1GHz

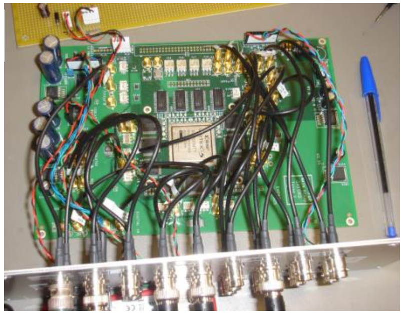
CTF3 - Phase feed-forward



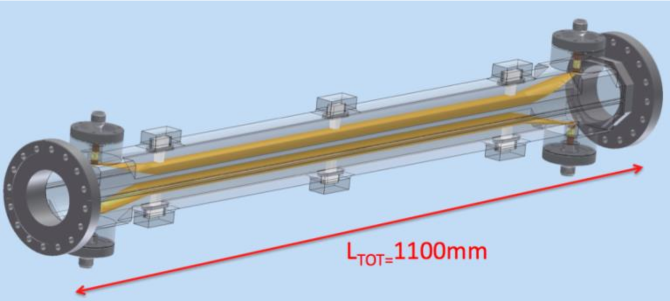
## Series of related studies:

- Measure phase and energy jitter, identify sources, devise & implement cures, extrapolate to CLIC
- Show principle of CLIC fast feed-forward

FONT5 board



Stripline kicker



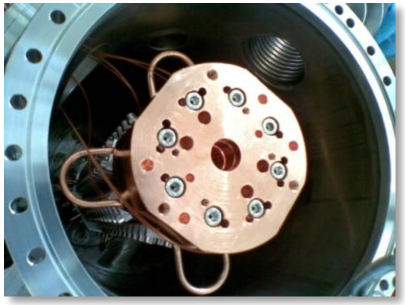
# Test Beam Line – Drivebeam deceleration

13 Power Extraction & Transfer Structures (PETS) installed and running in 2012

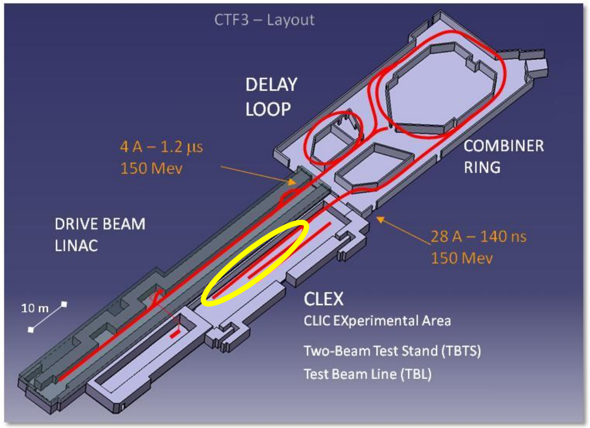
Full beam transport to end-of-line spectrometer, stable beam

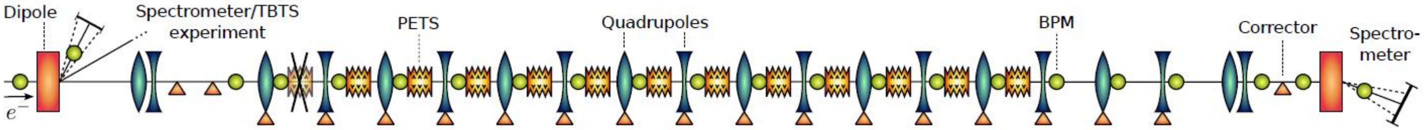
Power produced (70 MW/PETS) fully consistent with drive beam current (21 A) and measured deceleration.

More than half a GW of 12 GHz power!

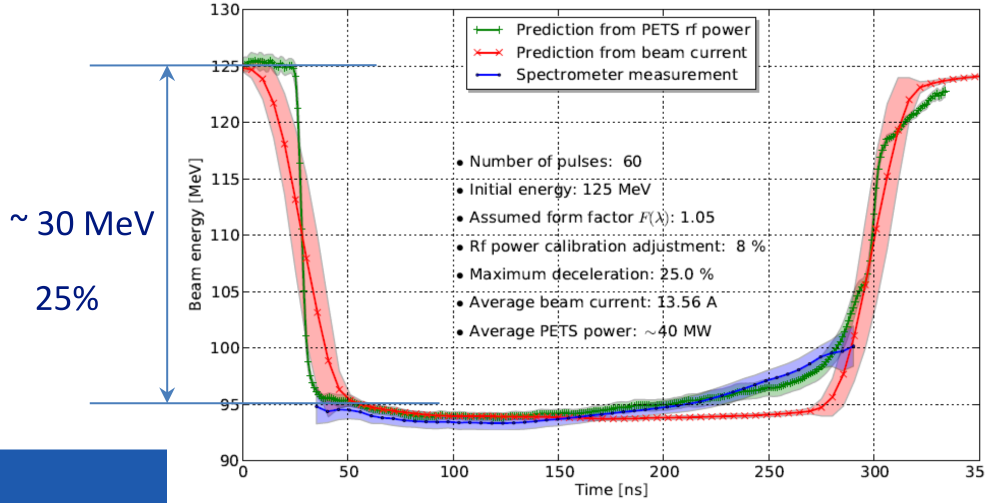


PETS tank during installation





TBL line in CLEX



Beam deceleration, measured in spectrometer and compared with expectations

# Two-Beam module into CTF3

Several mechanical complete modules are assembled, next:

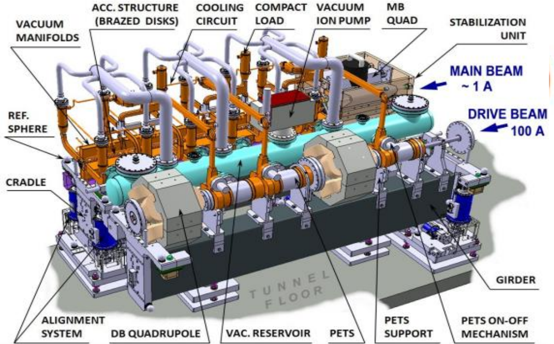
Installation and test of one full-fledged Two-Beam Module in CLEX

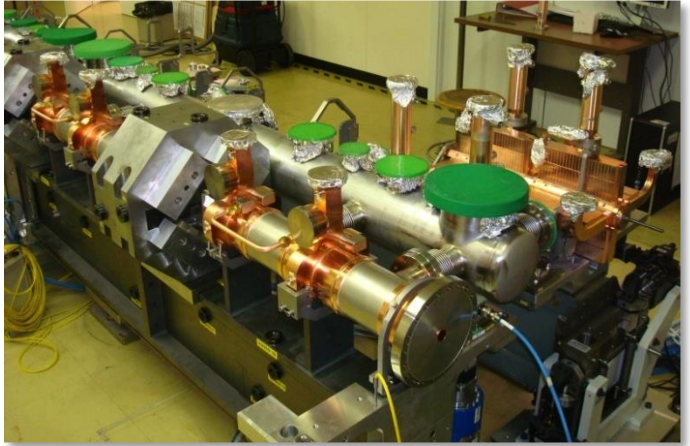
CLEX module under fabrication/assembly, installation planned for mid 2014

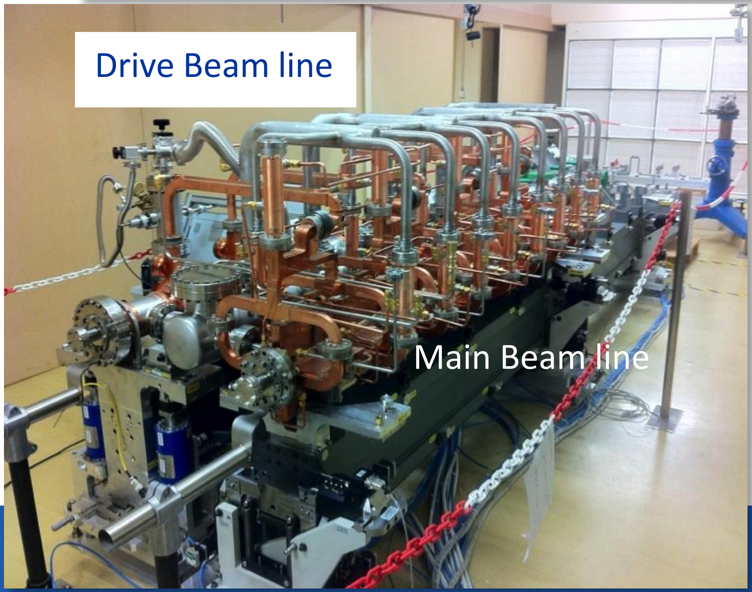
Completing the TBTS program: WF monitors, beam kicks, multi-poles…

Followed by module test program:

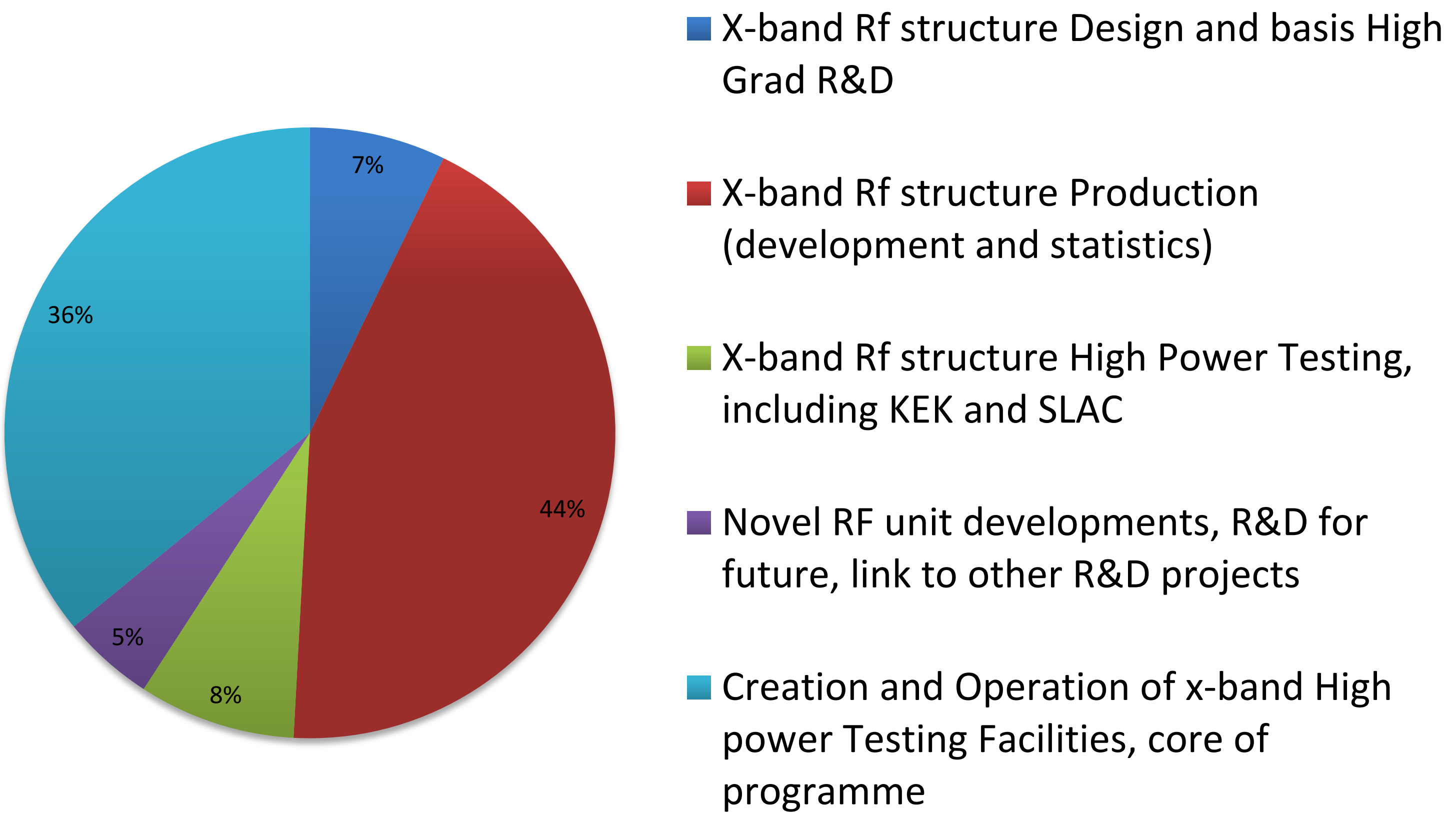
- Basic RF behaviour (system conditioning, breakdown cross talks…).
- Basic two-beam acceleration (energy gain, set-up with beam and phasing…).
- Active alignment and stabilization, in presence of radiation and EM noise.
- Alignment and fiducialization - WF monitors vs BPMs.
- Phase drifts studies (thermal effects, losses…)







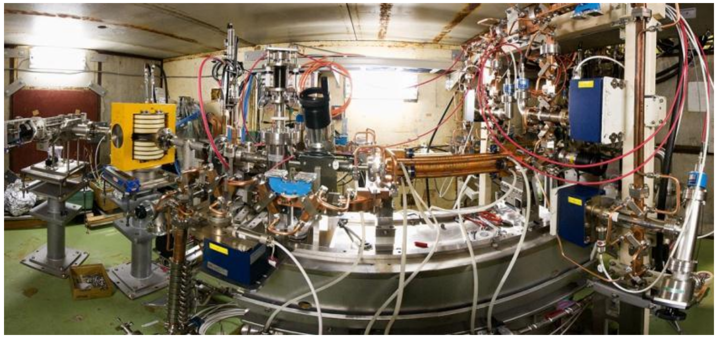
# X-band activities



- Will comment on the major resource items

Previous:
Scaled 11.4 GHz
tests at SLAC and KEK.

NEXTEF at KEK

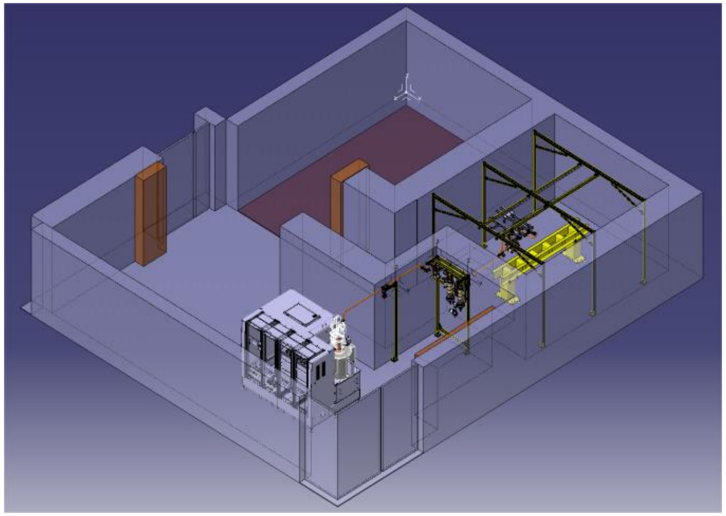


ASTA at SLAC

XBOX1 at CERN with SLAC klystron

100 MW can be provided in pulses of 250 ns, 50 Hz.
Can power two CLIC accelerating structures.

XBOX2 at CERN, industrial klystron
ready next … then XBOX3

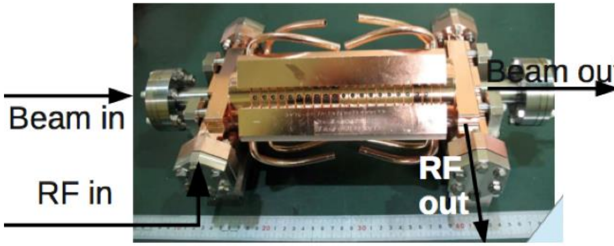


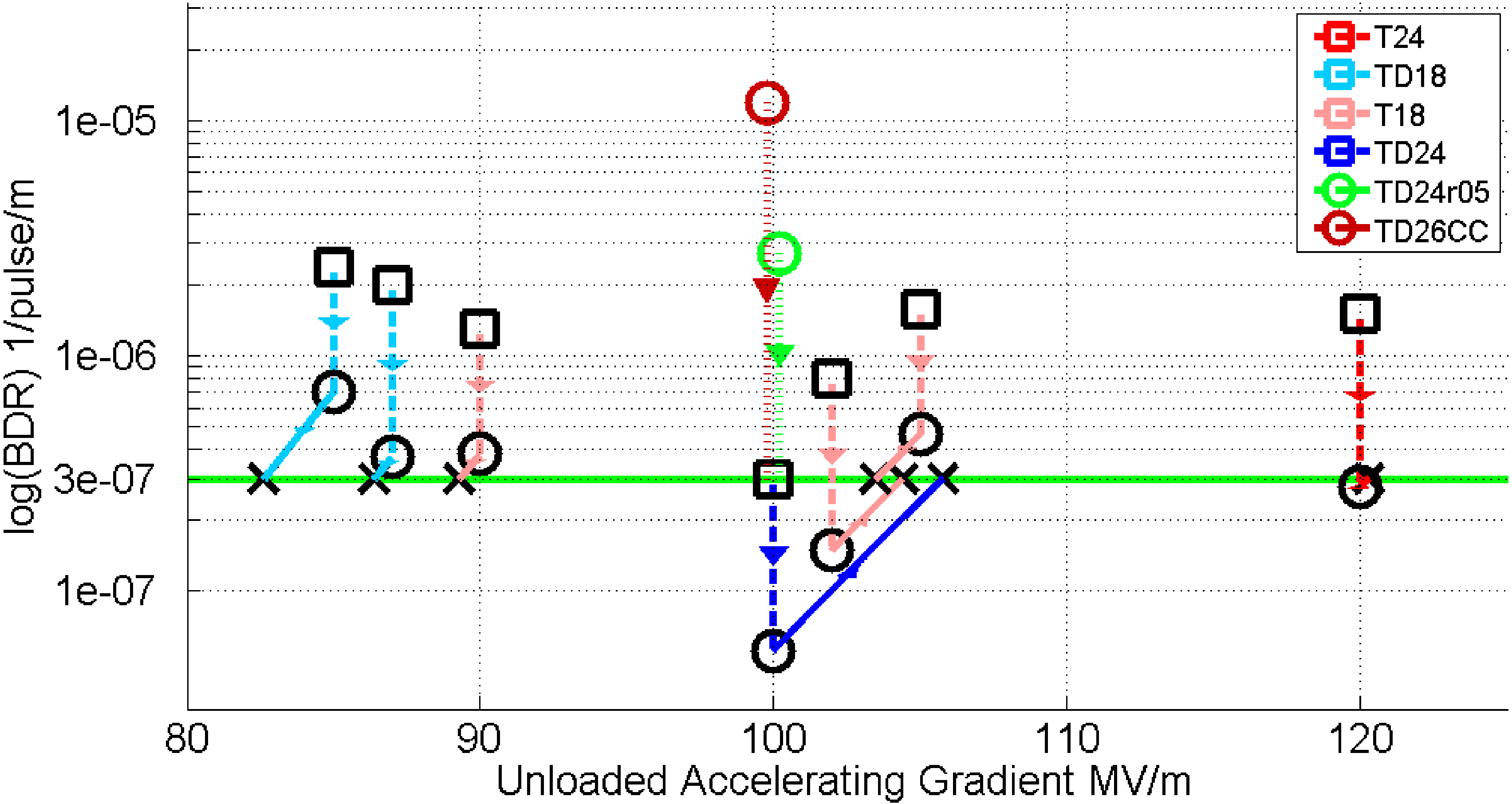
Planned capacity : power six CLIC accelerating structures

Important goal: greatly increased X-band rf test capability, at 12 GHz, at CERN

# CLIC main linac structure (12 GHz Cu TW)

- 100 MV/m gradient (loaded)
- BDR < 3 x $10^{-7}$/pulse/m
- Rf pulse length: $t_p$ = 240 ns
- Gradients depends on BDR and pulse-length, the lines represent the scaling to the correct BDR and pulse-length
- TD24 structure (blue) at 106 MV/m unloaded (expect 0-16% less with loading)





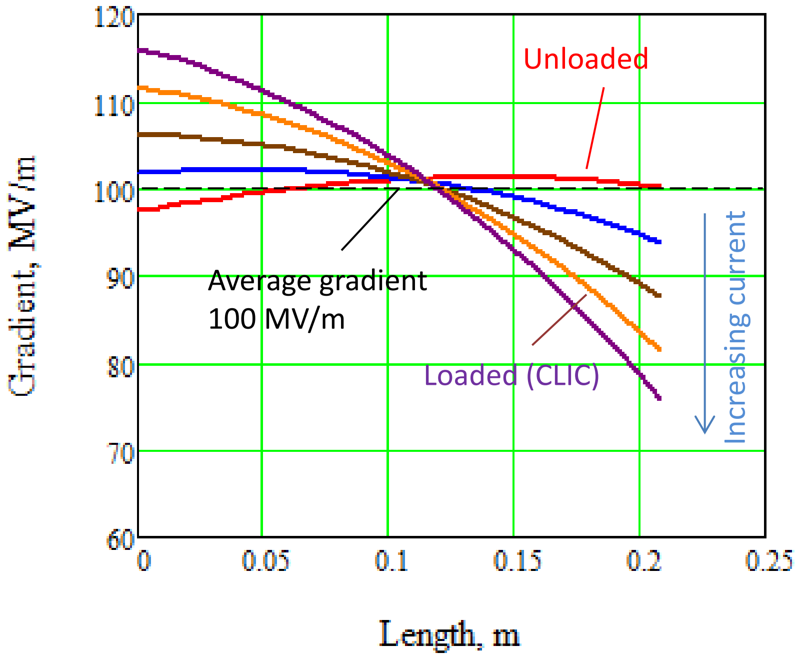
# Experiment on the effect of Beam-Loading on BD rate

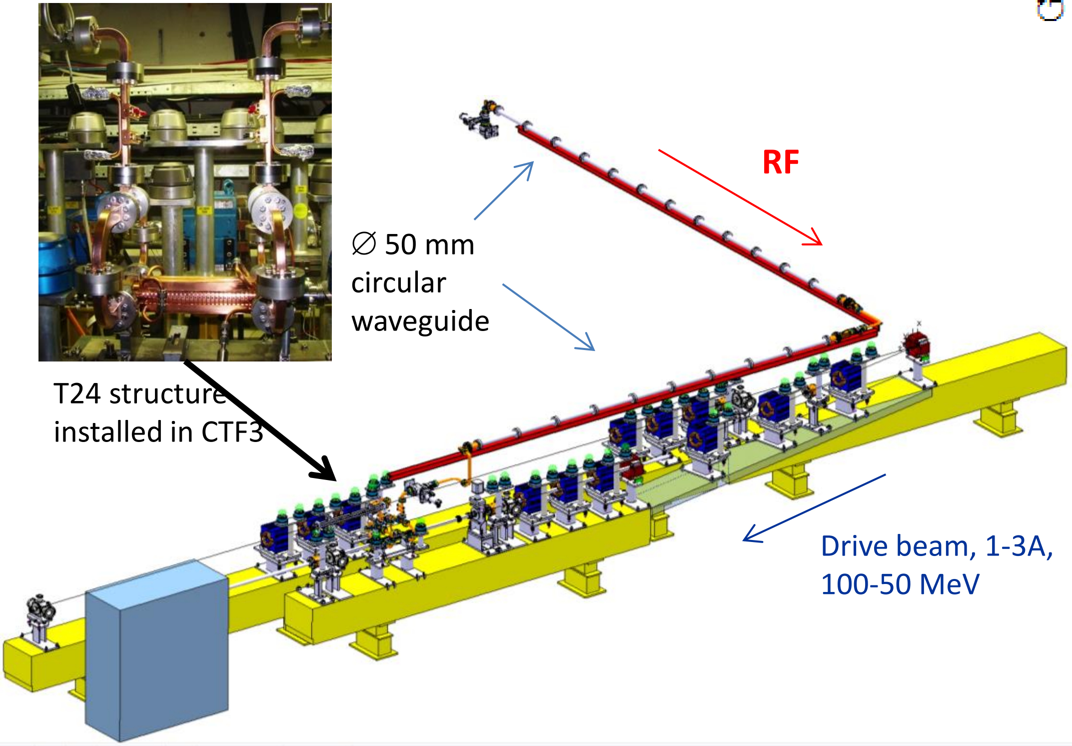
Beam loading reduces field locally in the structure
⇨ is it the break-down rate lower (or higher)?

Use CTF3 drive beam and klystron driven X-band structure

- Measure BDR with/without beam to get a direct comparison

Gradient along the structure

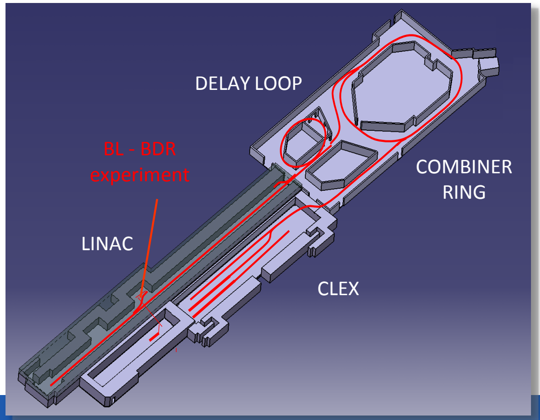




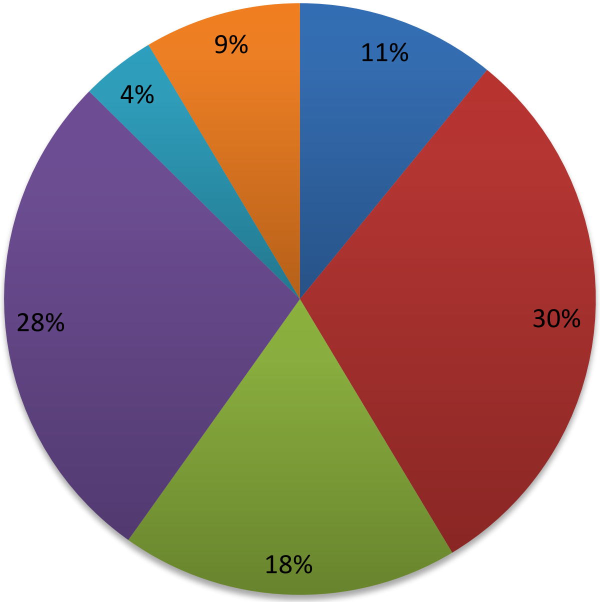
∅ 50 mm circular waveguide

T24 structure installed in CTF3

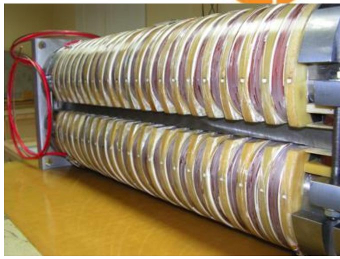
Drive beam, 1-3A, 100-50 MeV

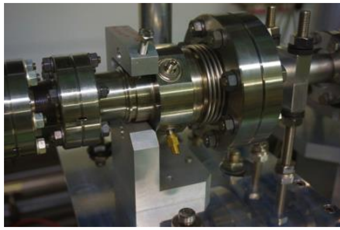


# Technology developments



- 🟦 Pulsed, SC and warm magnets: Damping Rings Superconducting Wiggler and Kicker Development
- 🟥 Survey & Alignment, Stability, Magnet development including PACMAN hardware
- 🟩 Beam Instrumentation and Control
- 🟪 Two-Beam module development, for lab and CTF3 measurements
- 🟦 Vacuum systems and studies (and finalise minor collimator studies)
- 🟧 Creation of a "CLIC technology center@CERN" - bat 156





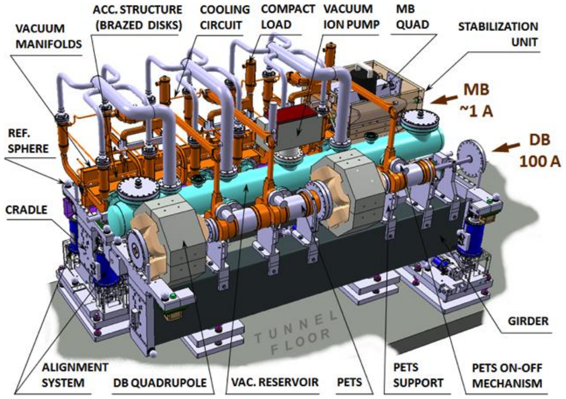
- Several of these developments already mentioned in earlier slides; providing hardware for systemtests and/or for assembled larger systems or specific studies
- Will mentioned two: PACMAC Marie Curie Network with 10 Ph.D students, and the two beam module programme

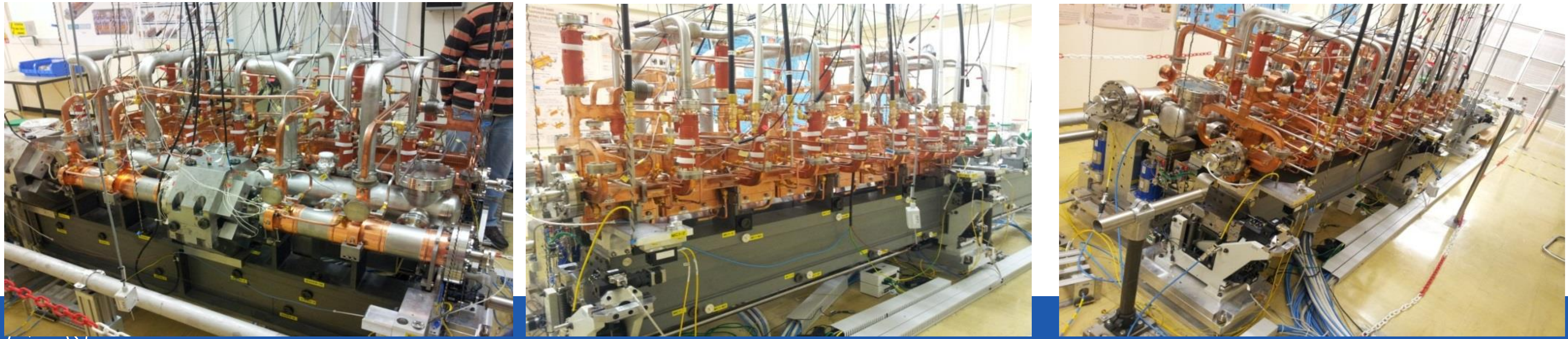
Footnote: CLIC technology centre included costs for space preparation at CERN for CLIC activities in next period

# Two beam module lab objectives

Build at least three mechanical modules for detailed tests in lab (plus one for CTF3 as mentioned)

- Integration of all technical systems
- Validation of different types of girders and movers
- Pre-alignment of girders/quadrupoles in the module environment,
- Full metrology of the module components
- Validation of interconnections and vacuum systems under different thermal loads
- Stabilization of main beam quad in the module environment
- Vibration study of all systems and identification of vibration sources
- Measurement of resonant frequencies
- Simulation of several thermal cycles and alignment verification
- Transport of the module and alignment verification



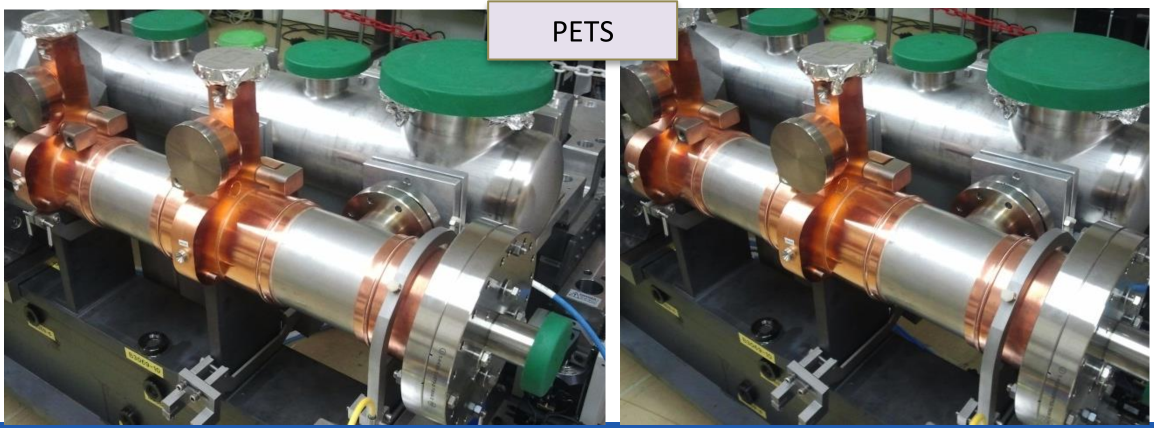


CLIC Two-Beam Module Type 0 in B169

# Fabricated RF mock-ups

8 Accelerating Structures

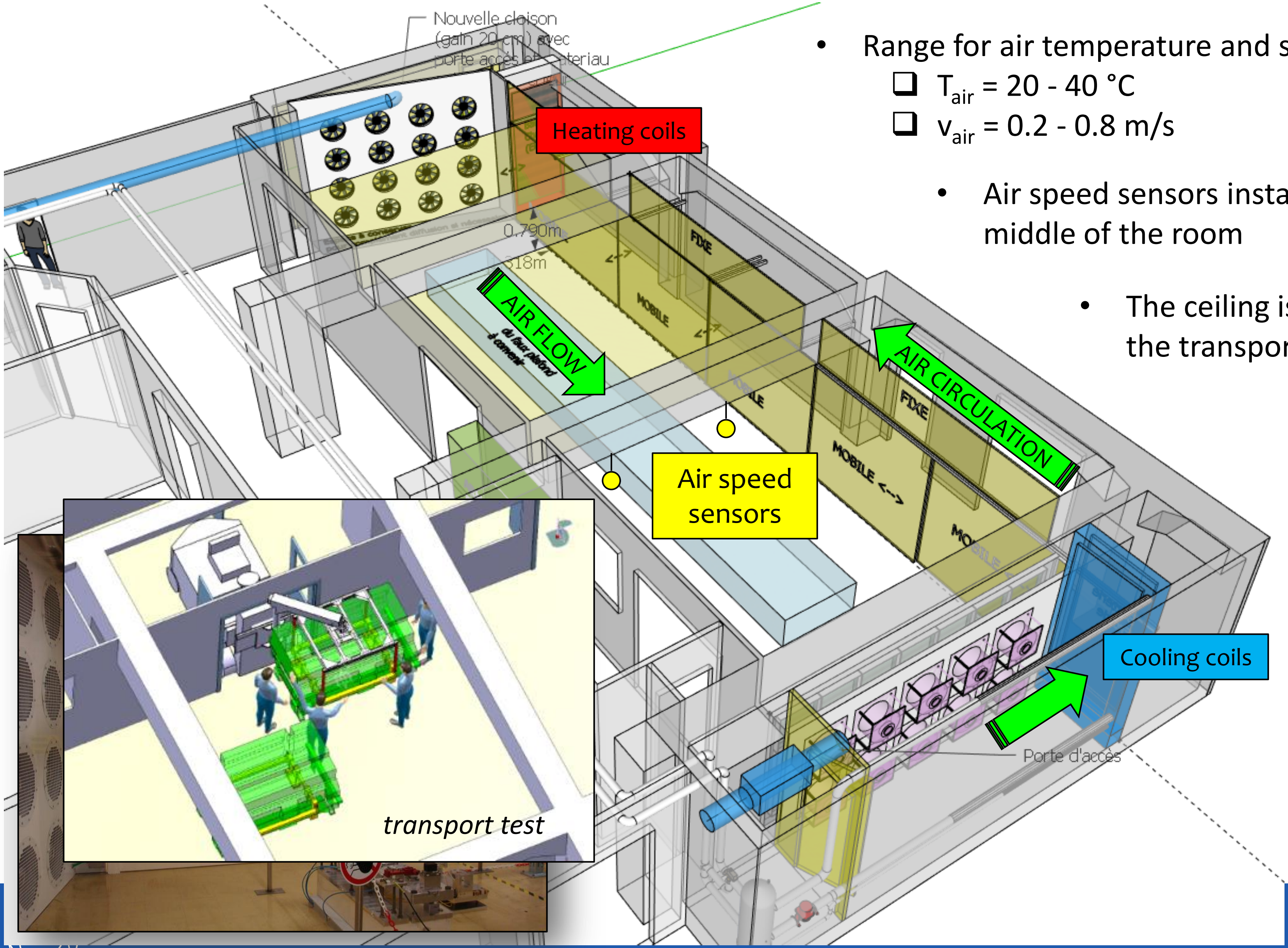
RF network



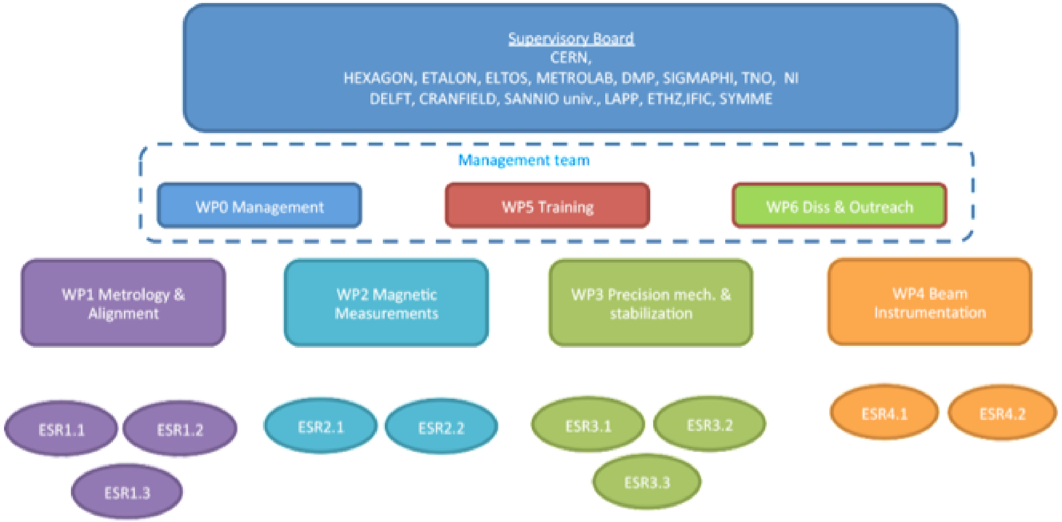
PETS

# Test-area (simulating the tunnel)

- Range for air temperature and speed:
  - ☐ $T_{air}$ = 20 - 40 °C
  - ☐ $v_{air}$ = 0.2 - 0.8 m/s
    - Air speed sensors installed in the middle of the room
      - The ceiling is movable for the transport test



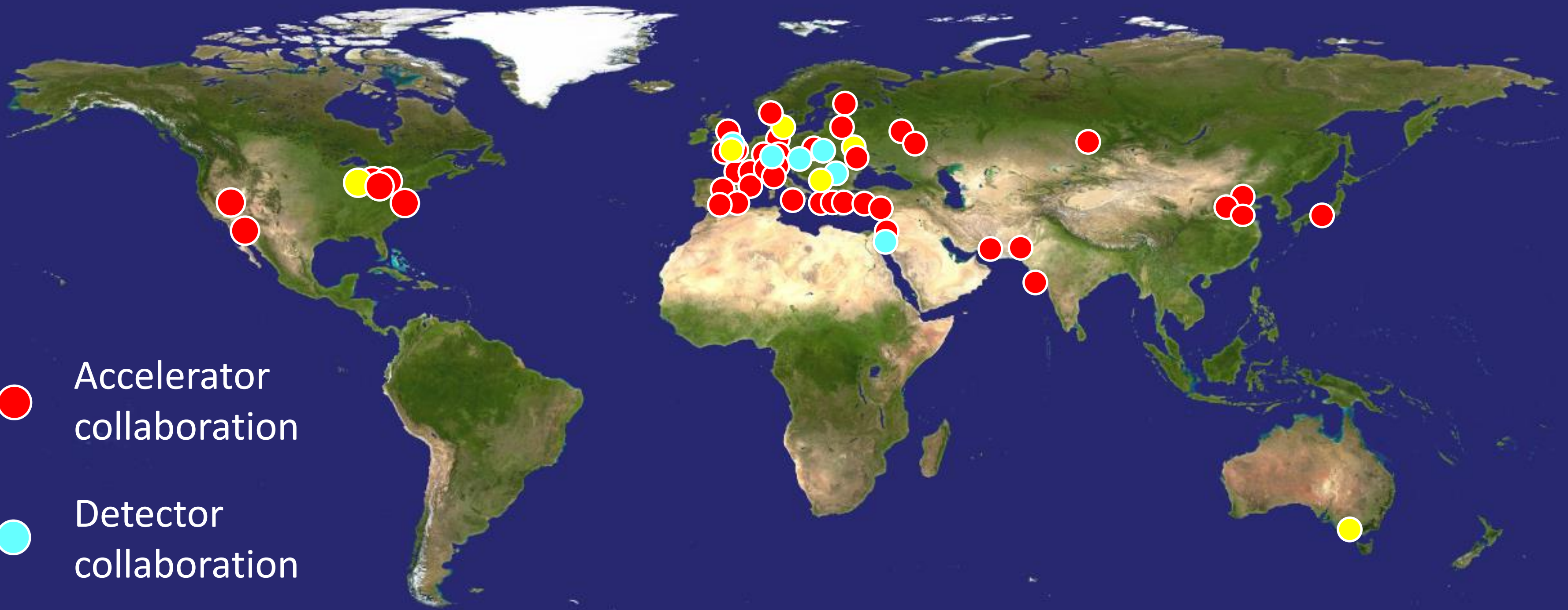
# Organization



**WP: Work Package**
**ESR: Early Stage Researcher (i.e. PhD Student position)**

# CLIC Collaboration

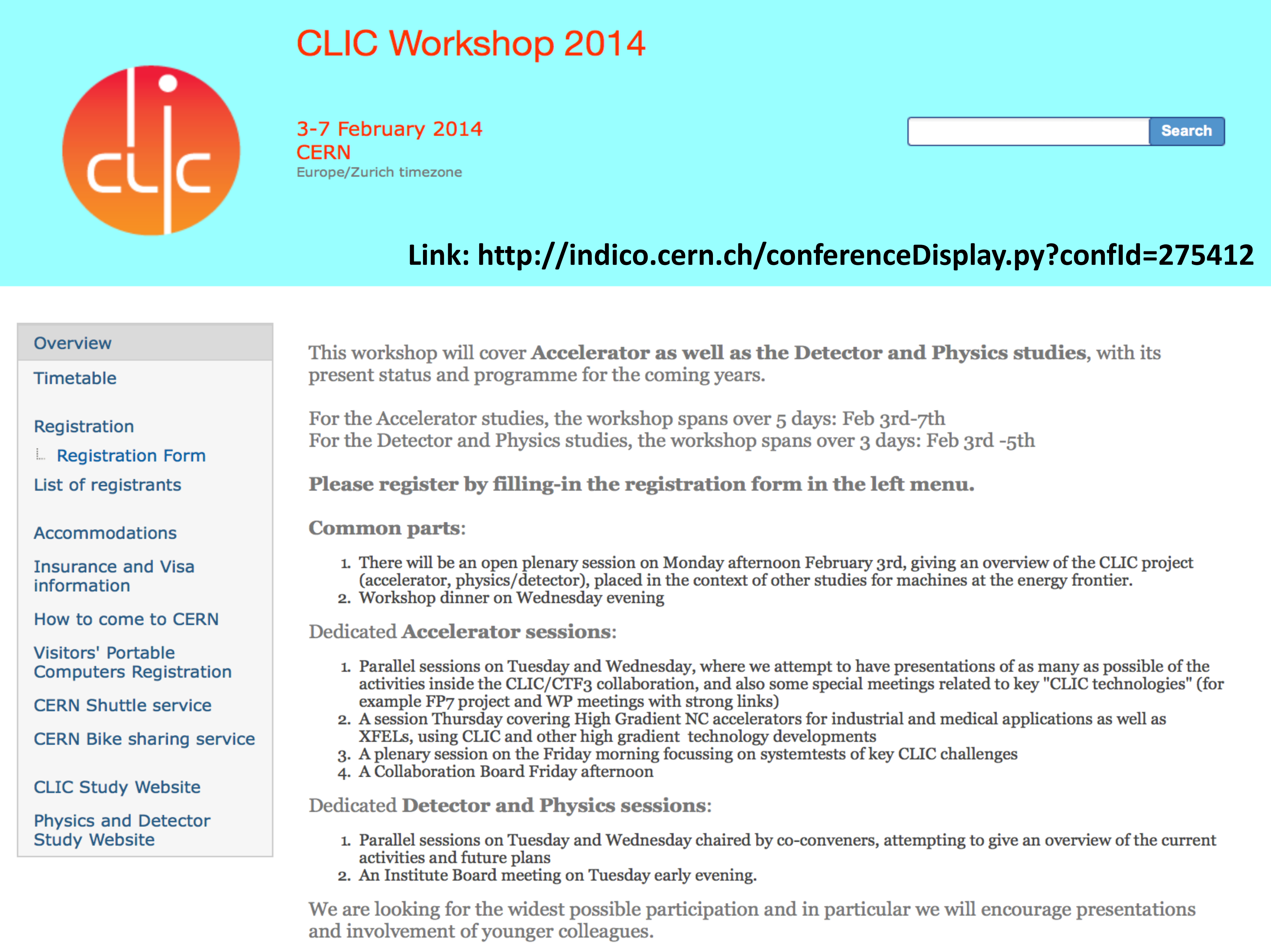
29 Countries – over 70 Institutes



● Accelerator collaboration

● Detector collaboration

● Accelerator + Detector collaboration



# CLIC Workshop 2014

3-7 February 2014
CERN
Europe/Zurich timezone

**Link: http://indico.cern.ch/conferenceDisplay.py?confId=275412**

This workshop will cover **Accelerator as well as the Detector and Physics studies**, with its present status and programme for the coming years.

For the Accelerator studies, the workshop spans over 5 days: Feb 3rd-7th
For the Detector and Physics studies, the workshop spans over 3 days: Feb 3rd -5th

**Please register by filling-in the registration form in the left menu.**

**Common parts**:

1. There will be an open plenary session on Monday afternoon February 3rd, giving an overview of the CLIC project (accelerator, physics/detector), placed in the context of other studies for machines at the energy frontier.
2. Workshop dinner on Wednesday evening

Dedicated **Accelerator sessions**:

1. Parallel sessions on Tuesday and Wednesday, where we attempt to have presentations of as many as possible of the activities inside the CLIC/CTF3 collaboration, and also some special meetings related to key "CLIC technologies" (for example FP7 project and WP meetings with strong links)
2. A session Thursday covering High Gradient NC accelerators for industrial and medical applications as well as XFELs, using CLIC and other high gradient technology developments
3. A plenary session on the Friday morning focussing on systemtests of key CLIC challenges
4. A Collaboration Board Friday afternoon

Dedicated **Detector and Physics sessions**:

1. Parallel sessions on Tuesday and Wednesday chaired by co-conveners, attempting to give an overview of the current activities and future plans
2. An Institute Board meeting on Tuesday early evening.

We are looking for the widest possible participation and in particular we will encourage presentations and involvement of younger colleagues.

# Summary

- CDR produced and feasibility demonstrated, providing input the strategy processes
- The goals and plans for 2013-18 are well defined for CLIC, focusing on the energy frontier capabilities
- Key challenges related to system specifications and performance, system tests to verify performances, technical developments of key elements, implementation studies including power and costs
  - A rebaselining of the machine stages with particular emphasis on optimising the staging of the machine, to be able react on LHC physics and possible guidance about the energy scales of new physics
  - The programme combines the resources of collaborators inside the current collaboration, plus several new ones now joining. Wherever possible common work with ILC is being implemented

- Please see more in the talks given this week from many CLIC colleagues