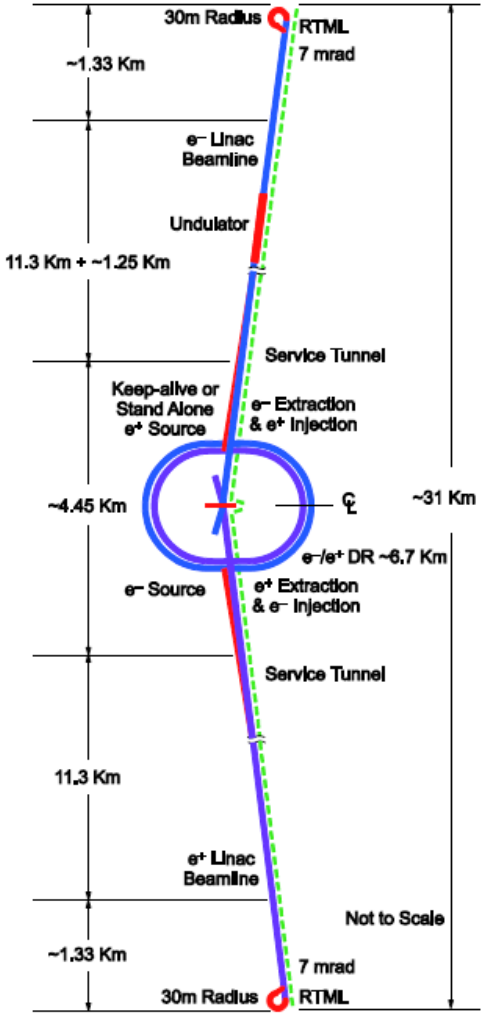
International Linear Collider Status Update

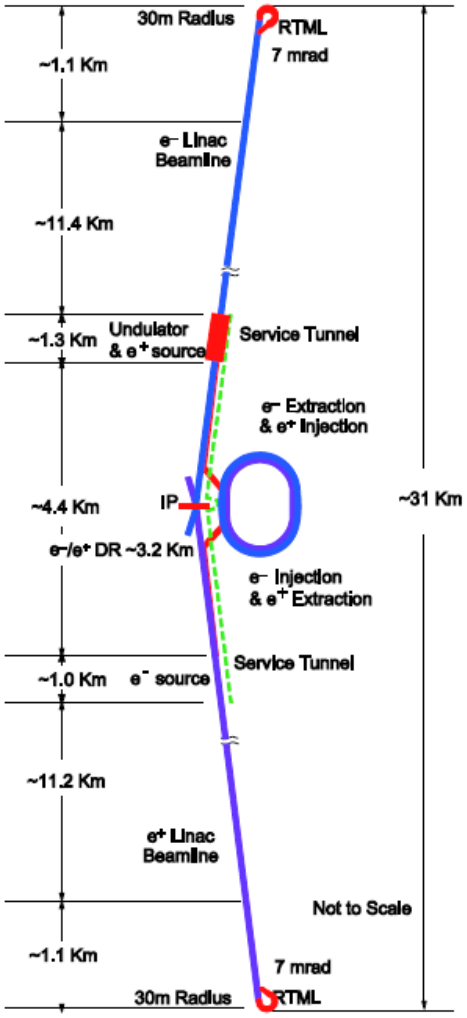
- The R&D Program 2007 – 2012
  - Machine Design
  - System tests
  - SRF Status
  - The Technical Design Report
- Asia/Europe Linear Collider Activities
- Beyond 2012

Proposed Design changes for TDR

RDR



2012 Baseline



- **Single Tunnel for main linac**
- **Move positron source to end of linac *****
- **Reduce number of bunches factor of two (lower power) ****
- **Reduce size of damping rings (3.2km)**
- **Integrate central region**
- **Single stage bunch compressor**
- **Improved low energy performance**

Nominal Cost reduction ~11%

Beam Delivery System tests – ATF2 KEK

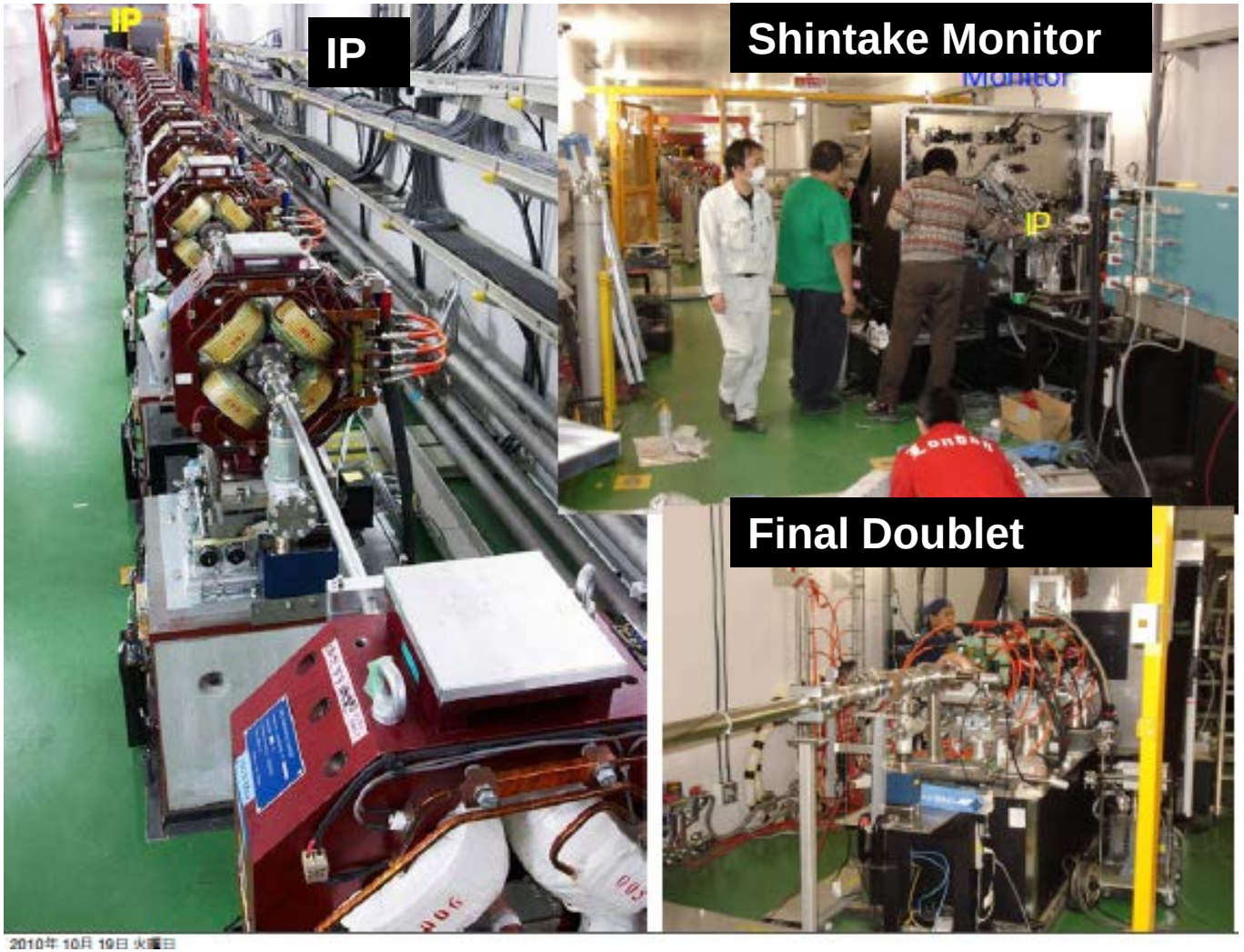
schedule impacted by earthquake ~ 1 year delay

Includes:

Beam Delivery optics and tuning

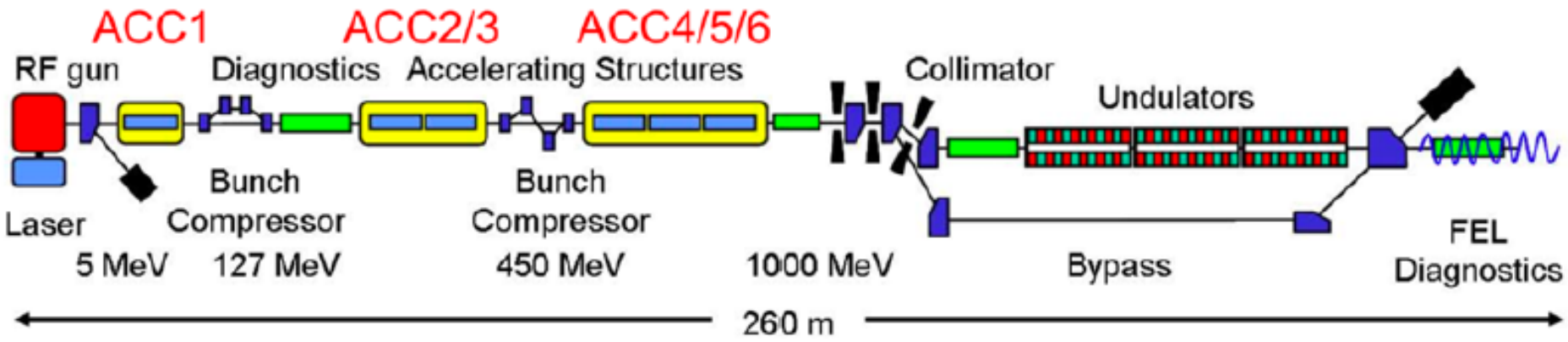
Beam stability feedback systems

IP instrumentation



TTF/FLASH 9mA Experiment

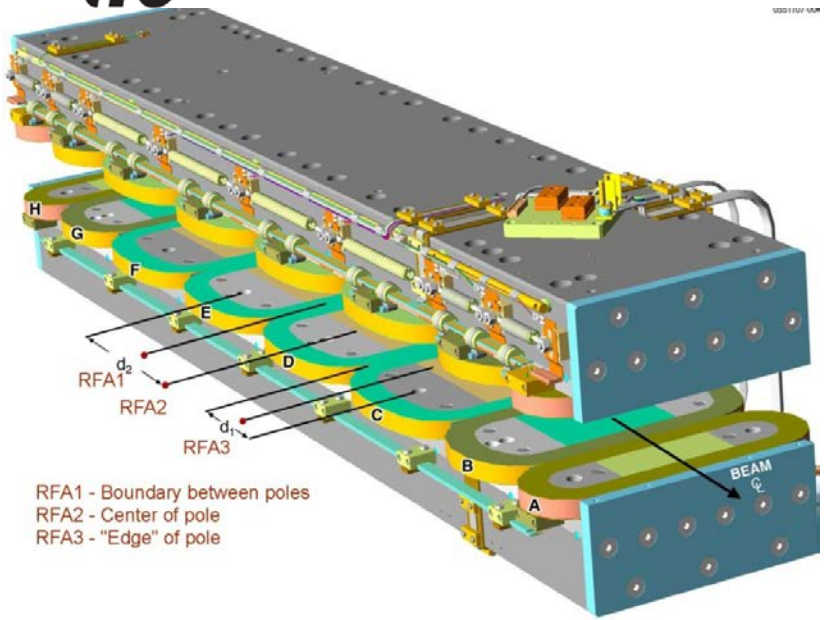
Full beam-loading long pulse operation → "S2"

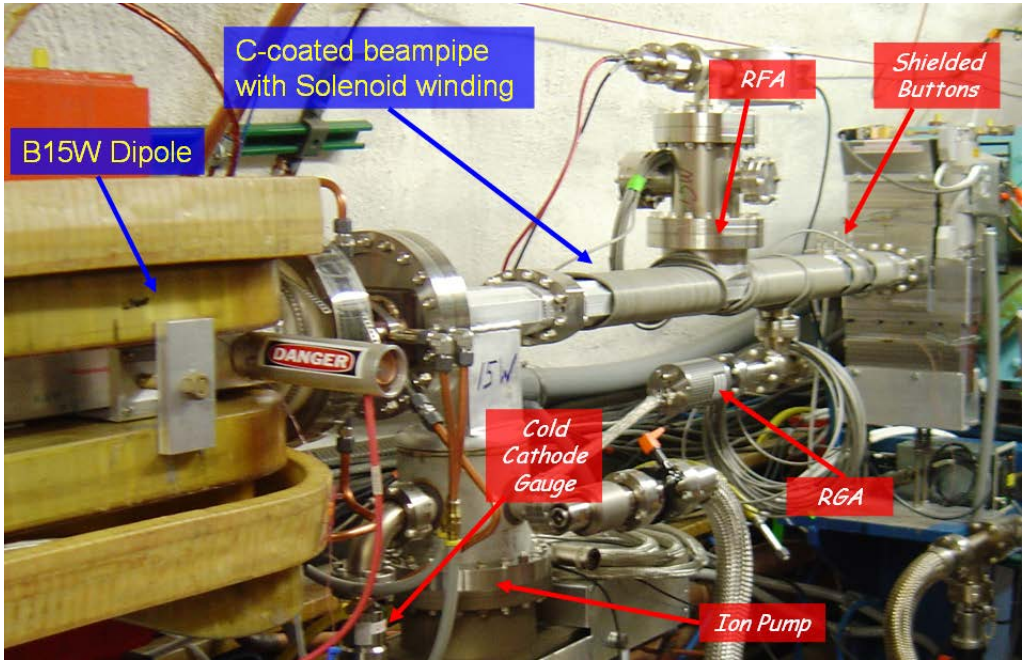


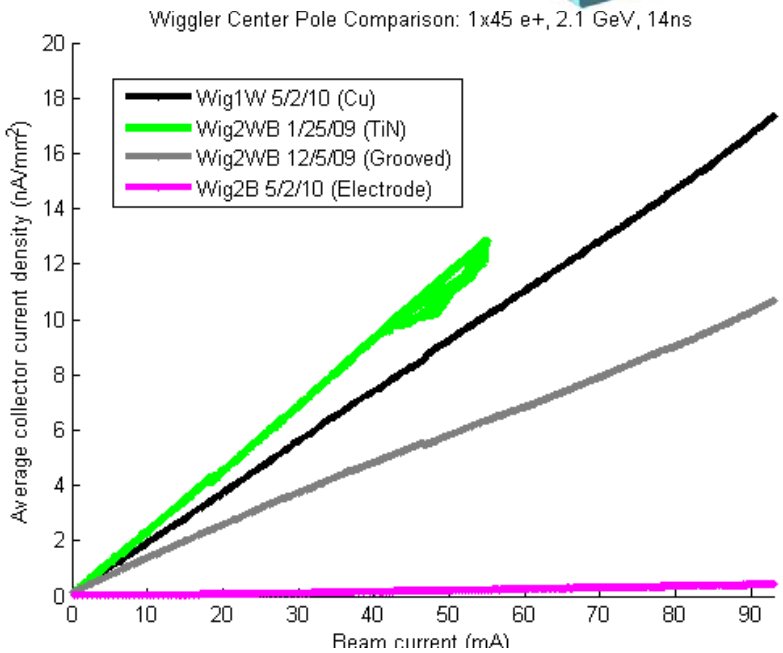
		XFEL	ILC	FLASH design	9mA studies
Bunch charge	nC	1	3.2	1	3
# bunches		3250	2625	7200*	2400
Pulse length	μs	650	970	800	800
Current	mA	5	9	9	9

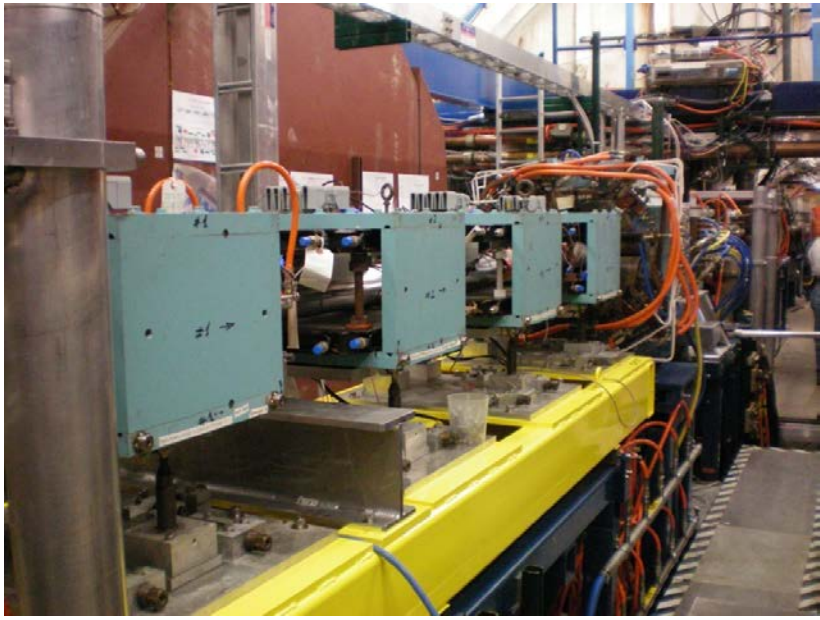
- Stable 800 bunches, 3 nC at 1MHz (800 μs pulse) for over 15 hours (uninterrupted)
- Several hours ~1600 bunches, ~2.5 nC at 3MHz (530 μs pulse)
- >2200 bunches @ 3nC (3MHz) for short periods

Cornell CesrTA – Electron Cloud R&D









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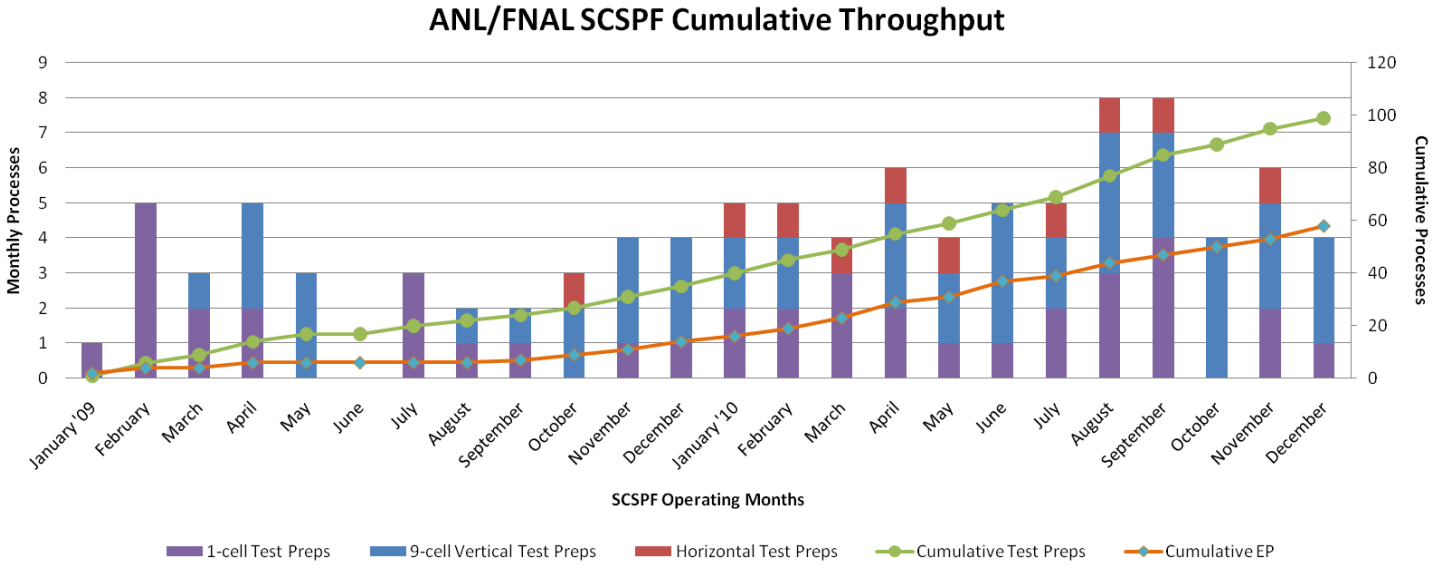
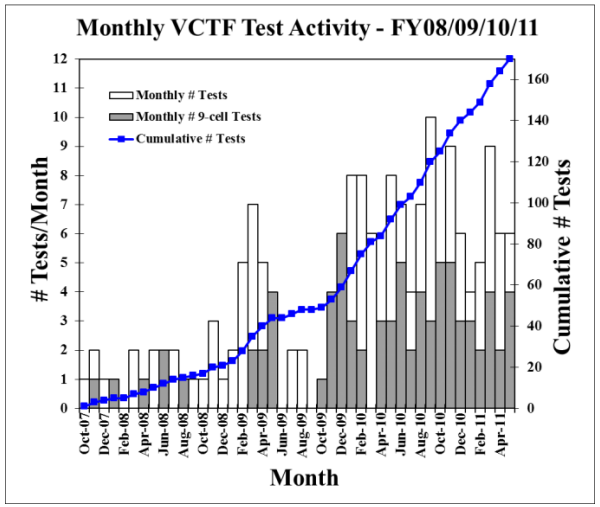
SRF 1300 MHz cavity status – US only

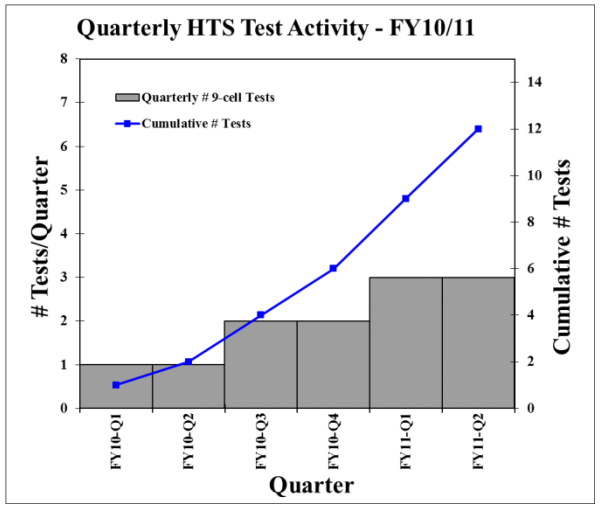
# ordered	90
# received	50
# processed	41
# vertically tested	38
# dressed	18
# horizontally tested	11
# cryomodule 2 qualified	8

- Full suite of facilities in use
- New vendors being developed
- SRF technology has potential uses well beyond the ILC program

Facility Throughput

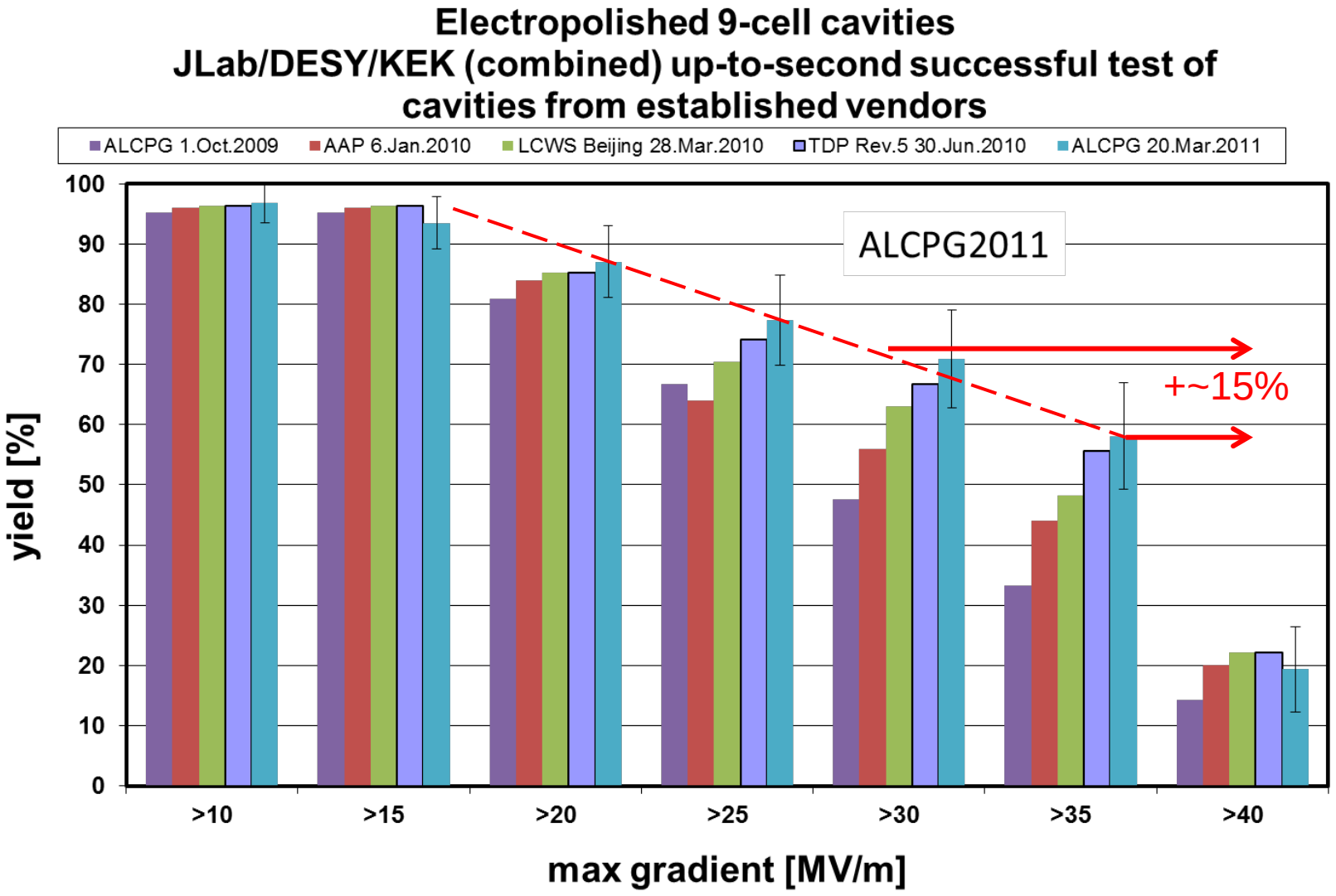






Steady and improving throughput from SCSPF, VTS, and HTS

Gradient Range Yield Gain

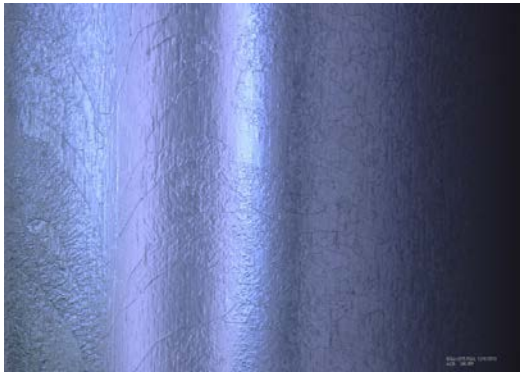


R&D Cavity Processing

Single-cell with mirror-like finish

9-cell pit repair

Before CBP



After CBP and 40 microns EP
Pit completely removed

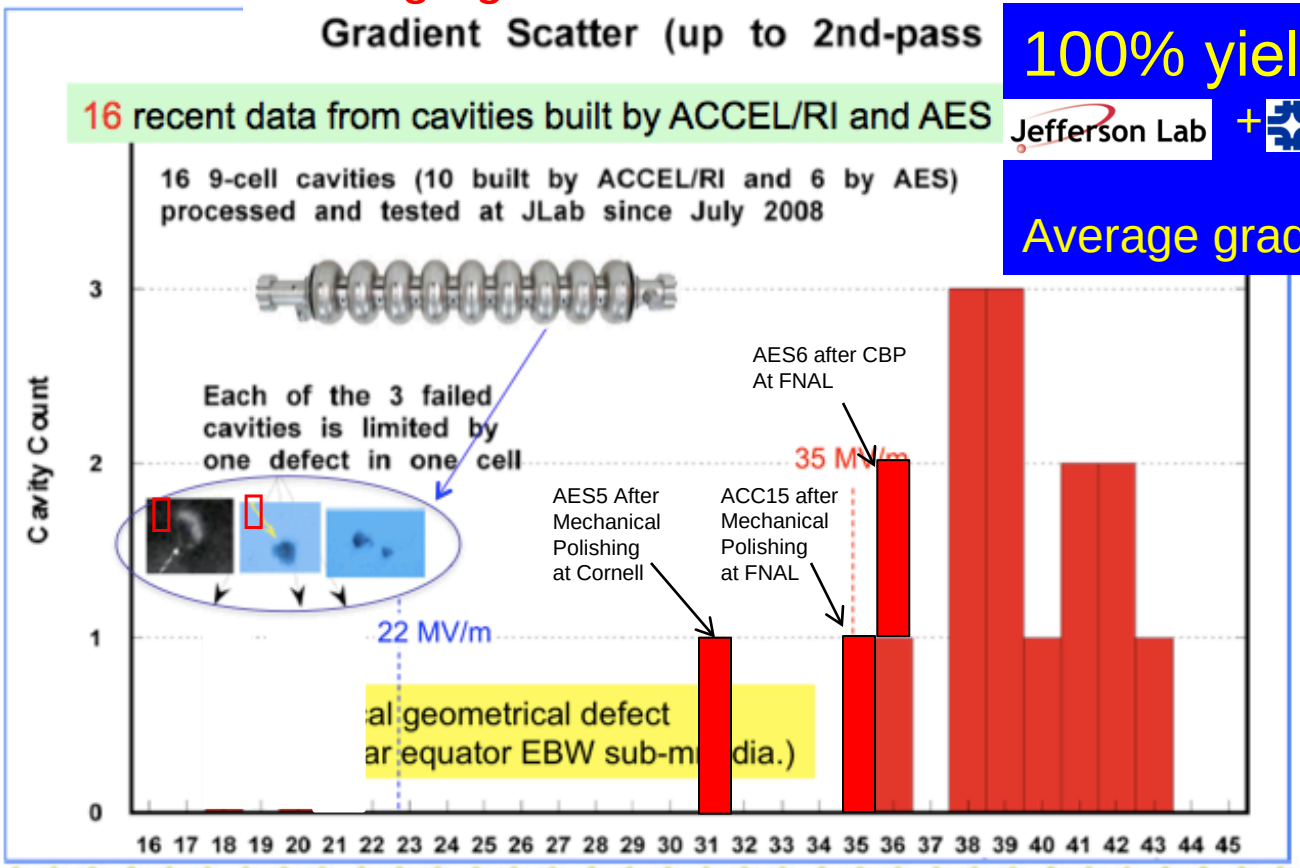
Effective gradient yield improvement if a 2nd pass RT/P is allowed 16 9-cell cavities based on recent results from US ART groups

94%

Yield at 35 MV/m achieved at JLab

R. Geng

Average gradient 39 MV/m



100% yield at ≥31 MV/m

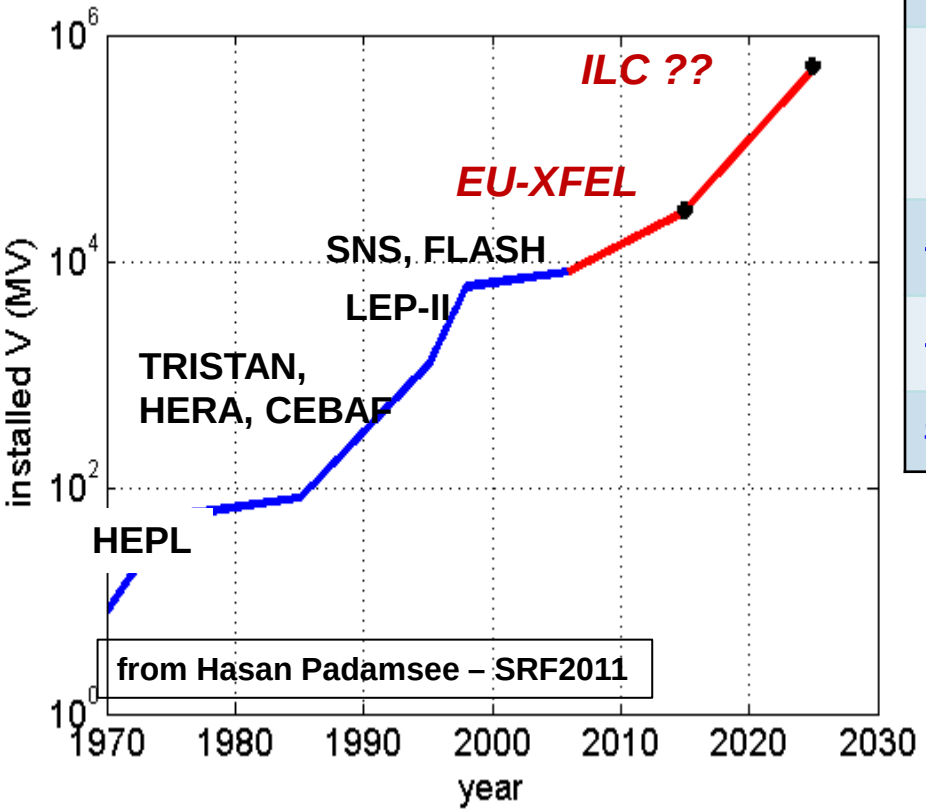
Jefferson Lab + Fermilab +

Cornell University

Average gradient 39 MV/m

An ILC challenge – the scale of the SRF

Global Installed Voltage (β=1)



SRF for ILC Main Linac	Value
C.M. Energy	500 GeV
Beam Rep. rate	5 Hz
Pulse duration	1 ms
beam current	9 mA
Av. field gradient	**31.5 MV/m +/- 20%**
# 9-cell cavities	**14,560**
# cryomodules	**1,680**
# RF units (10 MW Kly)	**560**

E.ZANON S.p.A.

research instruments

Energy Advanced Systems, Inc.

2 Europe
3 Americas
4 Asia

To be Qualified:
Niowave

Our Tech

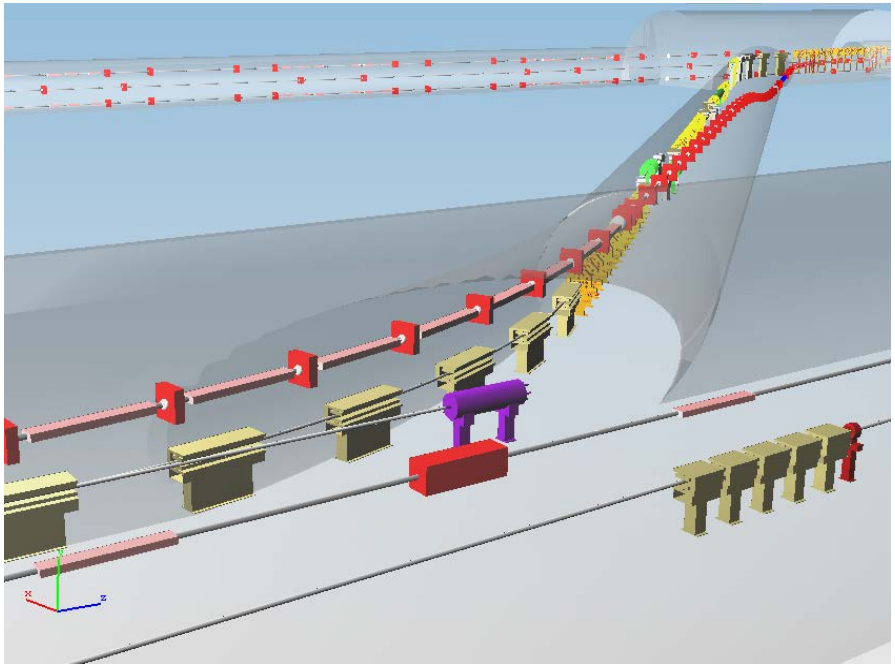
To be
Toshi
Hitach
Ningx

EU-XFEL (at DESY):

- **European companies to make 800 cavities in next few years**
  - **(600 contracted for delivery before 2014)**
- **100 cryomodules to be assembled at Saclay**

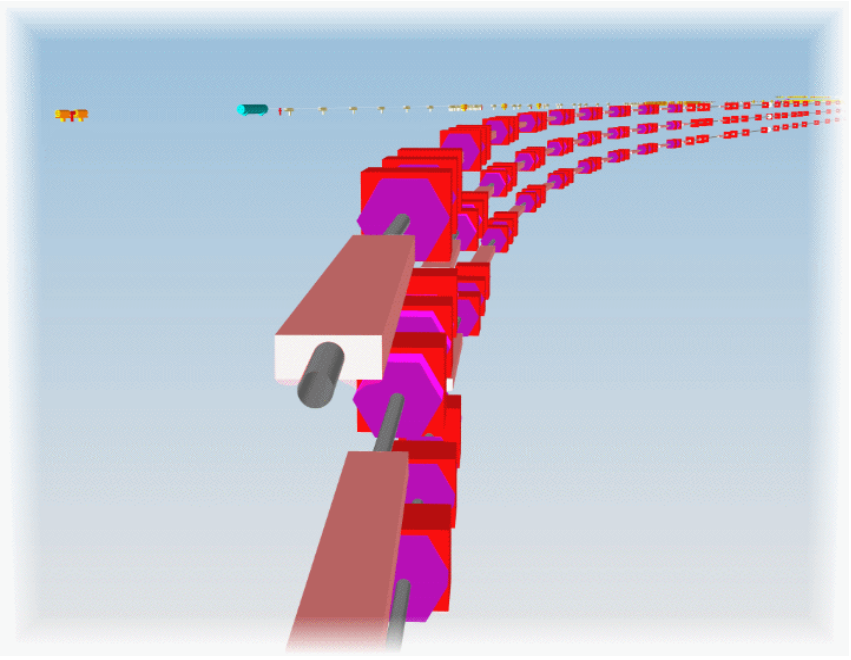
Design Integration

- **Lattice integration** of different technical areas and **design integration** of different systems: Check interfaces and avoid collisions
- **Vision sharing**: Optimize contributions to overall performance and identify needs and opportunities for collaboration



Collision checks in crowded areas

Tunnel model: J. Osborne, CERN
PS and dump line: N. Collomb, STFC Daresbury
RTML and BDS lattices: N. Solyak, D. Angel-Kalin
Lattice visualization and Integration: B. List, DESY



Accelerator and CF&S Integration

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Based on tunnel cross section by Vic Kuchler, FNAL
DR lattice: D. Rubin, Cornell
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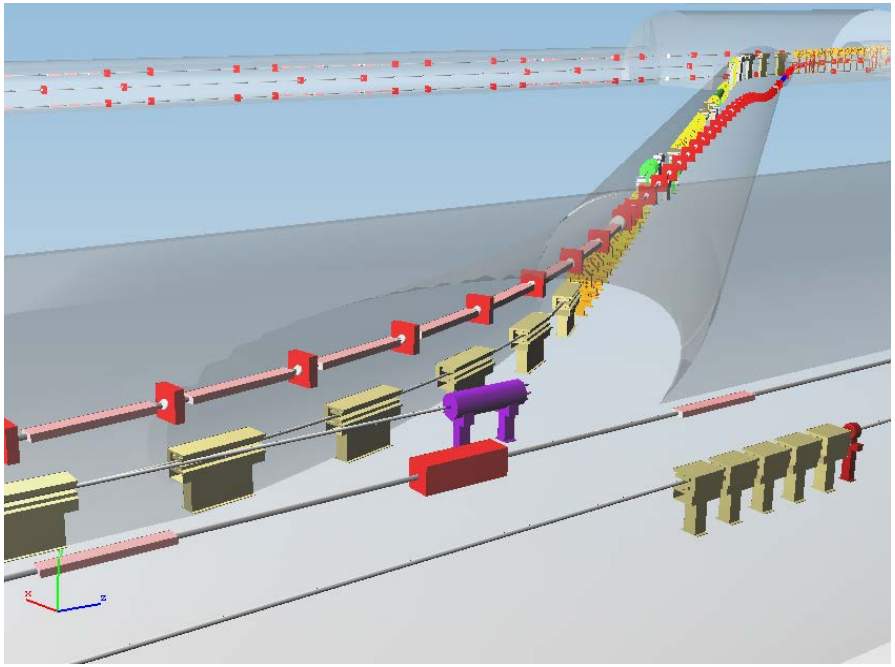

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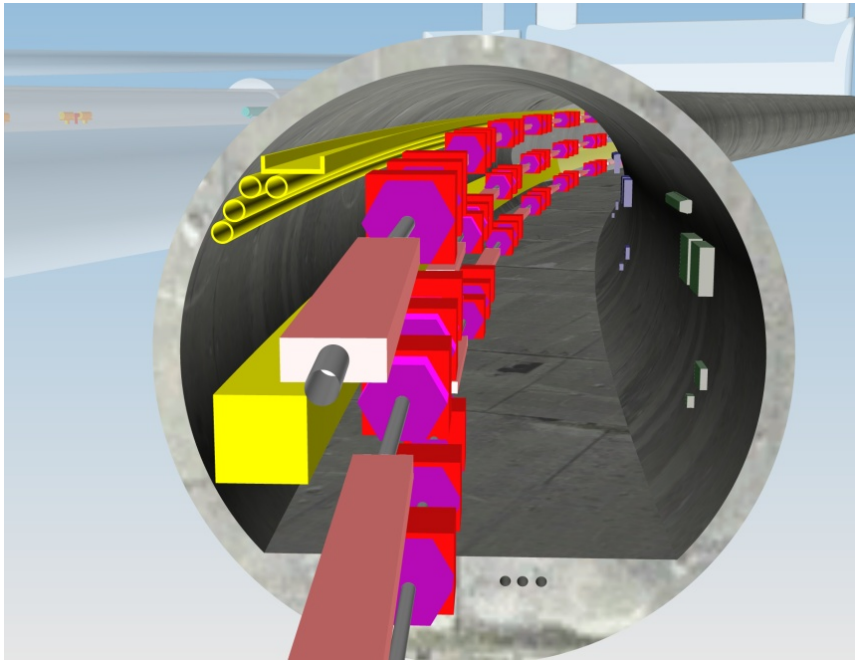

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The Technical Design Report

Final Reference design presented to ILCSC & ICFA in August 2007. The technical design report will be of similar scale and be available electronically by the end of 2012, paper version mid-2013

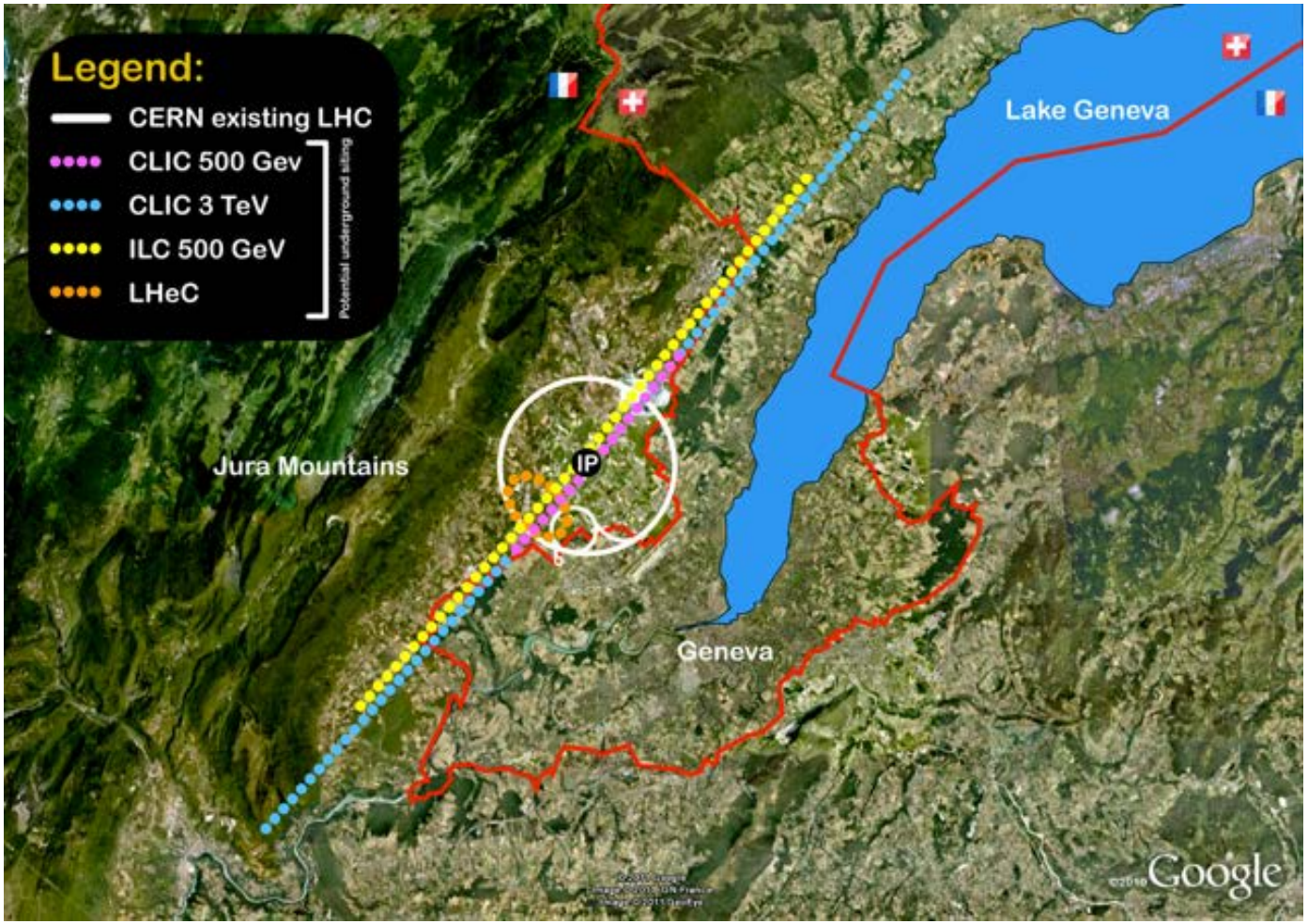
The accelerator technical design report will include:

- the new technical baseline design,
- the results of the (risk mitigating) R&D program,
- project implementation planning,
- a new cost estimate done globally in a purchasing power parity metric,

There will also be a Detector/Physics volume

EU (a.k.a. CERN) Linear Collider

CERN looking at both linear colliders and LHC options for their next big project



CERN Linear Collider approach - CLIC

Drive Beam Generation Complex

e⁻ main linac, 12 GHz, 100 MV/m, 21.02 km

e⁺ main linac

booster linac, 6.14 GeV

e⁻ injector, 2.86 GeV

e⁻ PDR 398 m

e⁻ DR 493 m

e⁺ DR 493 m

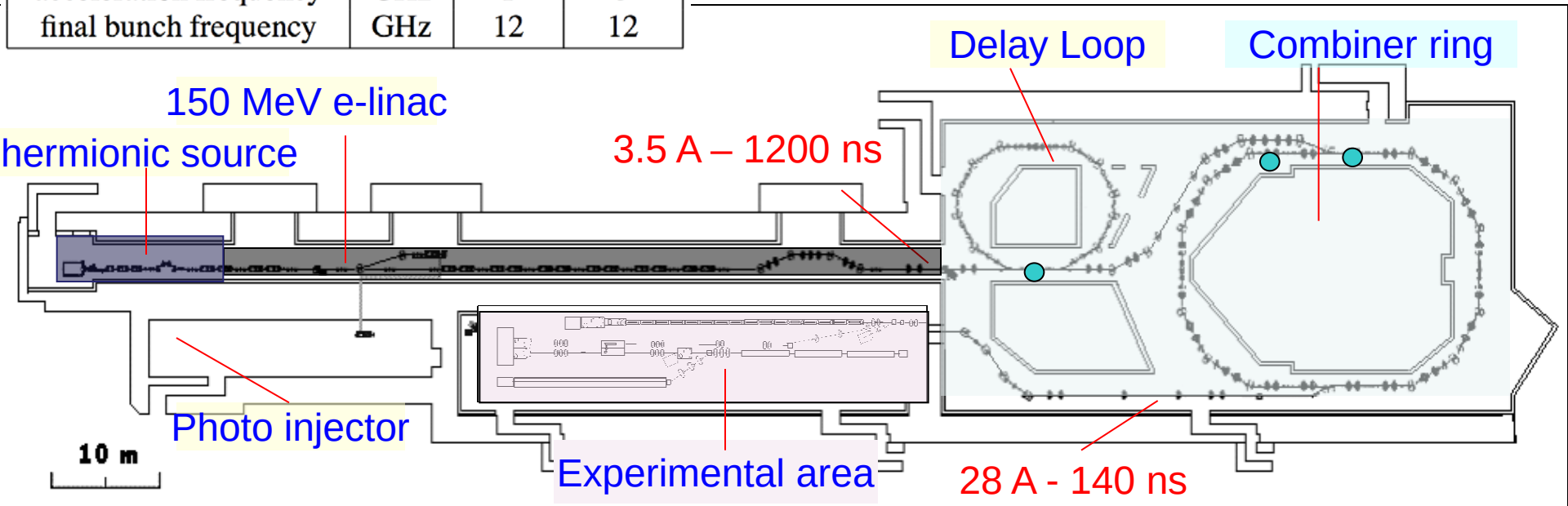
PDR 398 m

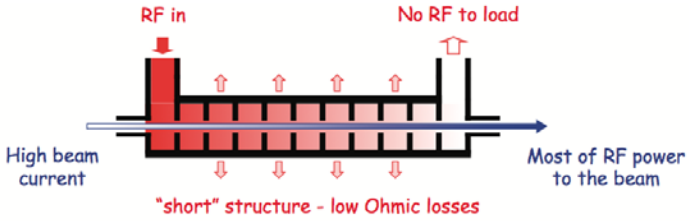
Main Beam Generation Complex

CLIC Test Facility (CTF3)

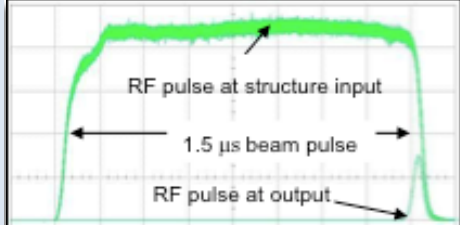
parameter	unit	CLIC	CTF3
accelerated current	A	4.2	3.5
combined current	A	101	28
final energy	MeV	2400	≈ 120
accelerated pulse length	μs	140	1.2
final pulse length	ns	240	140
acceleration frequency	GHz	1	3
final bunch frequency	GHz	12	12

Recycled infrastructure
- made it affordable
- causes lots of headaches

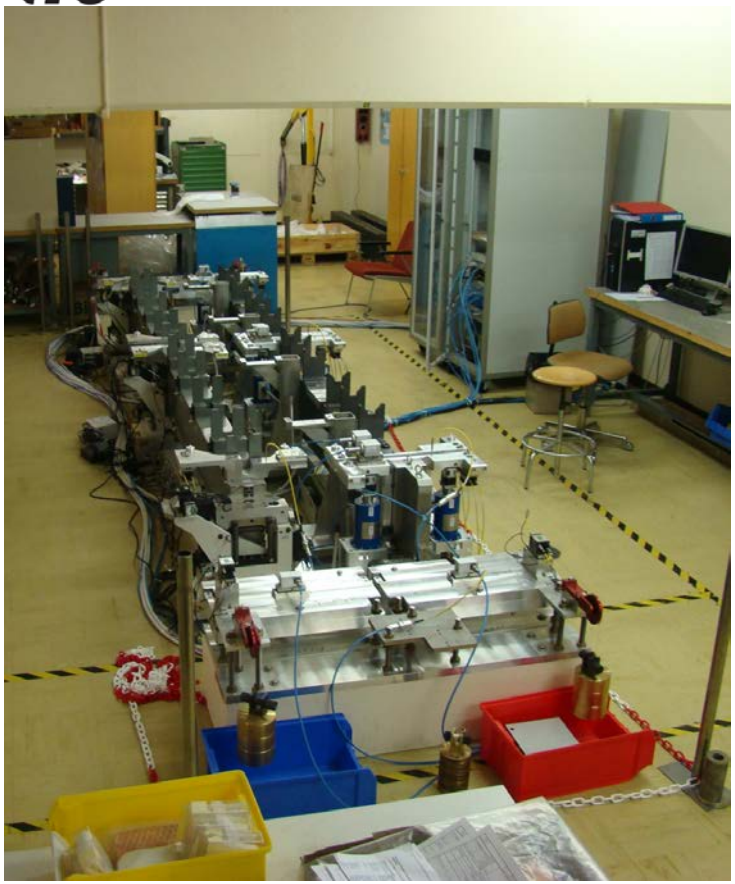




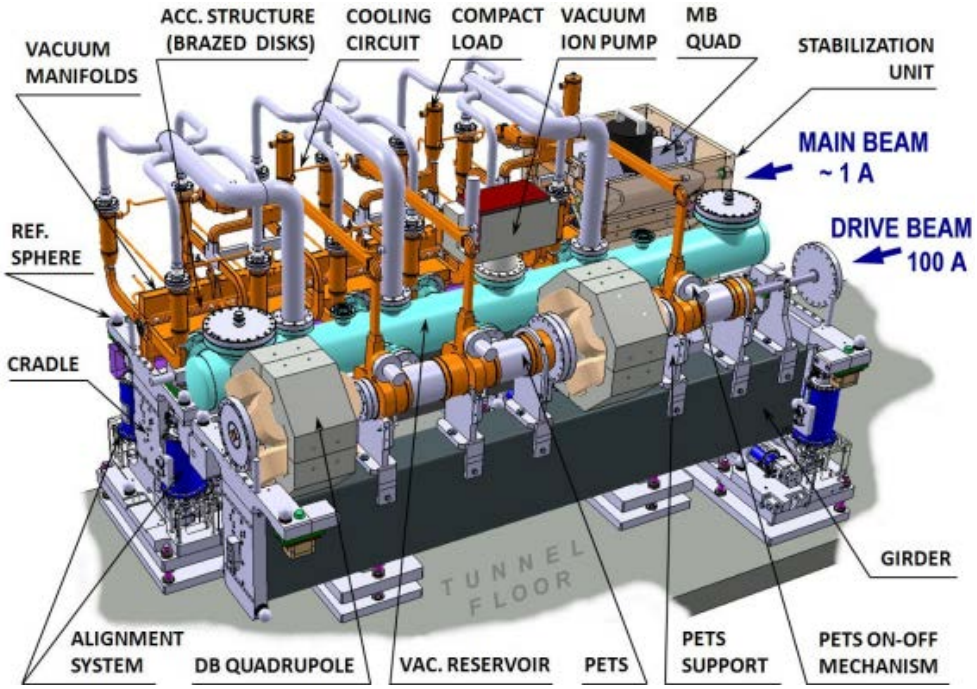
High current, full-loaded linac operation
- 95 % RF to beam efficiency measured
- No instabilities

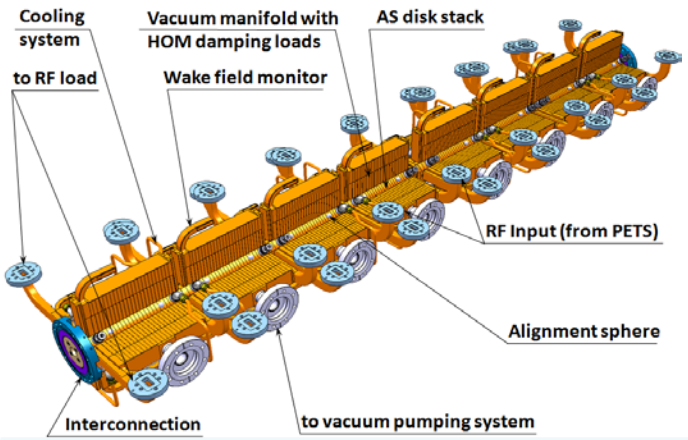


Two-beam Module Development



Installation and validation of first two prototype modules under way



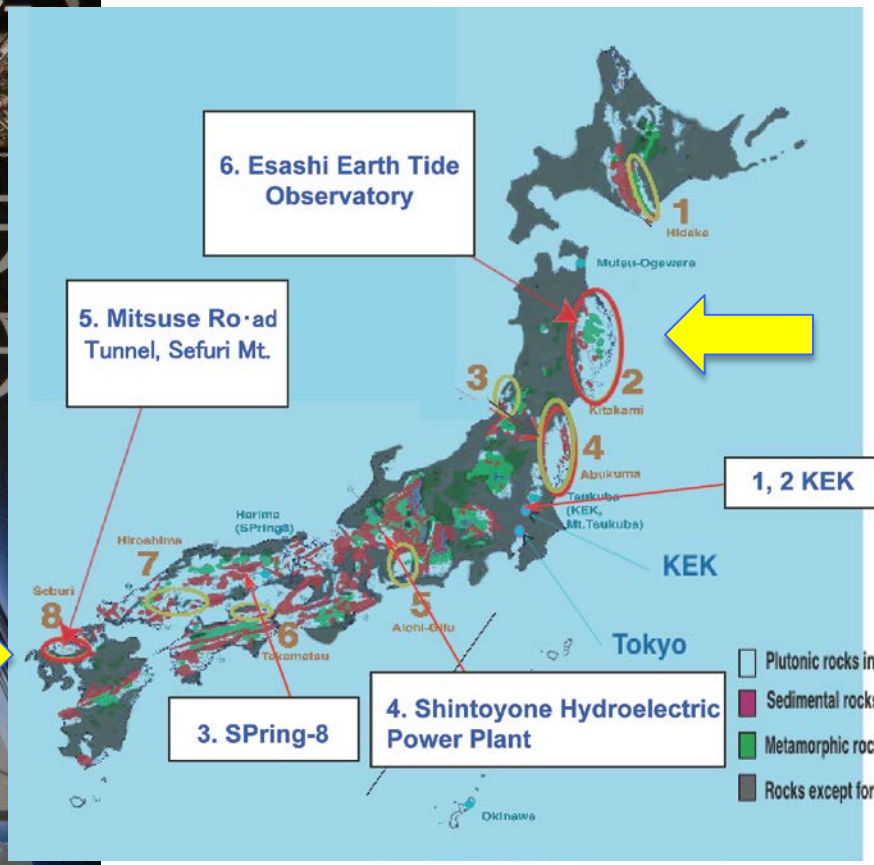


Stack of 8 ac. structures under assembly

Structure design modified slightly TD26

G. Riddone et al

Japan - Tohoku Site



Japan – LC Activities

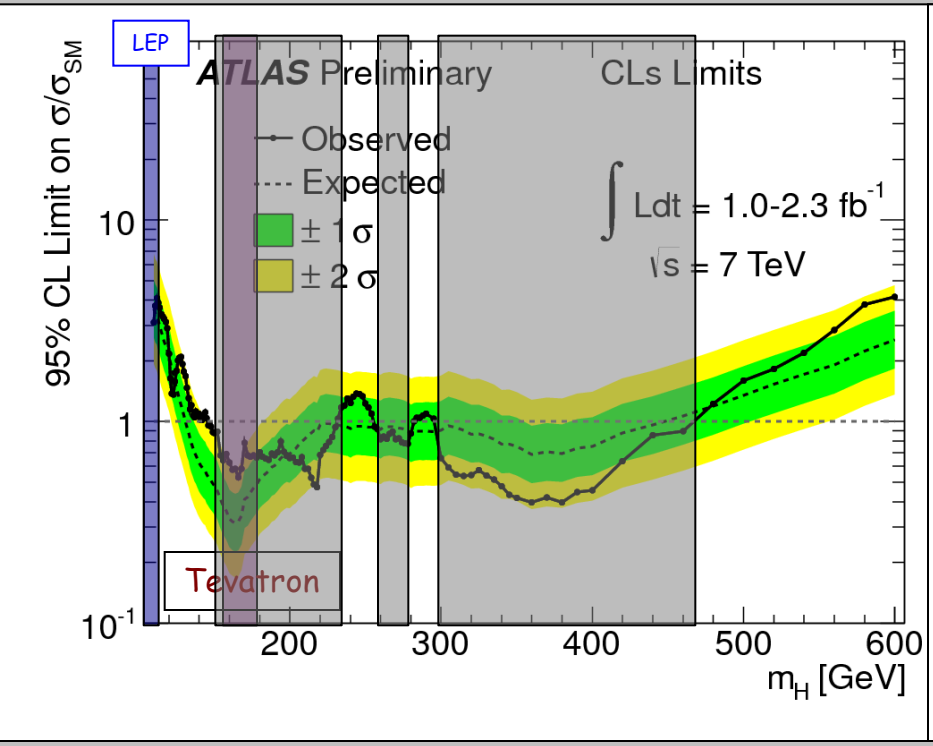
Progress (other than GDE items):

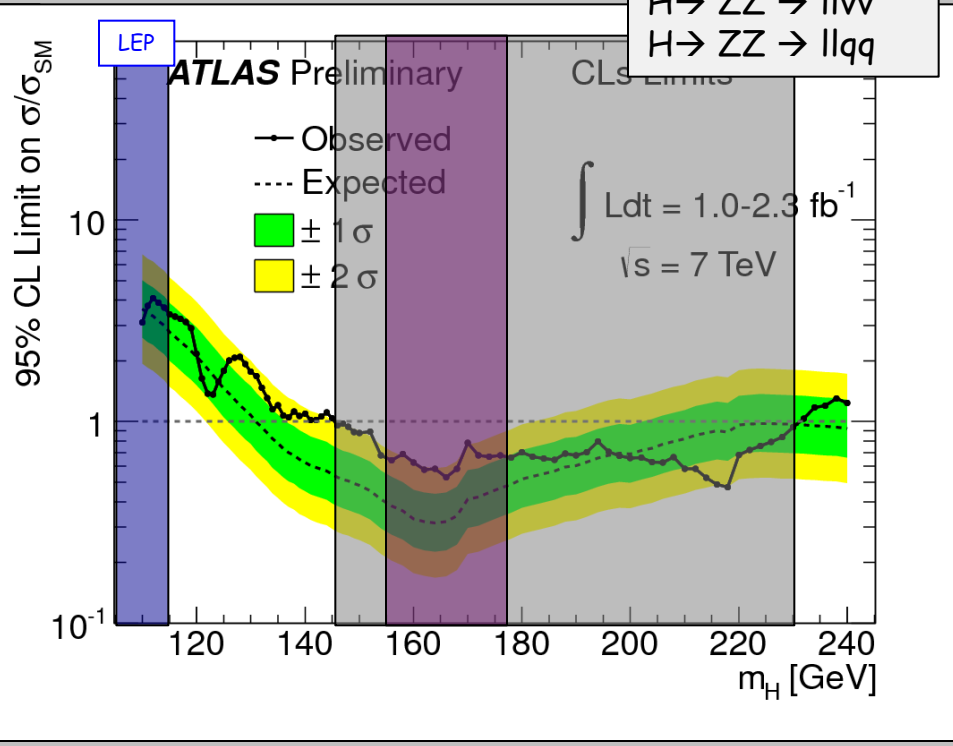
- Kyushu candidate-site study
  - Interim report given to KEK-LC/CFS on July 26,
- Tohoku candidate-site study
  - Interim report given to KEK-LC/CFS on Sept. 1,
- Council for Science and Technology
  - Discussion on ILC in a meeting held, Sept. 1
- Support from the AAA consortium (political, industrial & scientific)
- Thinking about how to industrialize SRF

LHC Status

Higgs Search All channels together → combined constraints

H→γγ
H→ ττ
W/ZH→ lbb+X
H→ WW(*)→ lνlν
H→ ZZ(*) → 4l
H→ ZZ → llνν
H→ ZZ → llqq



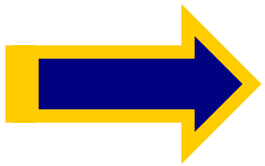


Excluded by ATLAS at 95% CL : 146-466 GeV, except 232-256, 282-296 GeV
Expected if no signal at 95% CL : 131-447 GeV

- LHC provides first direct exclusion (95% CL) of a large mass range until now unexplored
- The best-motivated low-mass region (EW fit: m_H < 161 GeV 95% CL) still open to exploration
- Data are within ±2σ of expectation for no signal over full m_H range → no significant excess

Summary of Higgs Prospects

SM Higgs Search Prospects (Mass in GeV)			
ATLAS + CMS ≈ 2 x CMS	95% CL exclusion	3 σ sensitivity	5 σ sensitivity
1 fb^{-1}	120 - 530	135 - 475	152 - 175
2 fb^{-1}	114 - 585	120 - 545	140 - 200
5 fb^{-1}	114 - 600	114 - 600	128 - 482
10 fb^{-1}	114 - 600	114 - 600	117 - 535



Higgs Boson, if it exists between masses of (114 - 600 GeV) will either be discovered or ruled out before the end of 2012

LHC Status

- Operations at 7 Tev will continue for one more year which will result in 10-15 fm-1. The luminosity will increase but at a much slower rate.

- LHC will stop for ~16 months to repair the interconnects to allow higher energy operations (~13+ Tev). There still appears to be interconnect issues with contact resistance; this time involving bypass diodes.

- Data taking will resume ~2015 and another 2 year run will start

Post 2012

LHC 7-TeV run ends

The ILC TDR (and CLIC CDR) is available

Particle Physics Community needs to:

- follow LHC (and Tevatron) results
- interpret these results
- Update the LC physics case (if there is one)
- adjust the energy and luminosity correspondingly (both up or down)

The European Particle Physics strategy (5-year plan) will be announced in early 2013.

The GDE mandate expires at the end CY12 (as does ILCSC)

- A new Linear Collider collaboration will be needed to continue the global program

The LHC input to a Linear Collider

Will the on-going LHC run produce enough physics results to motivate a linear collider by the end of 2012 ? – probably not

Will there be any guidance on an appropriate energy scale for a linear collider ? – nothing definitive but early indications are possible

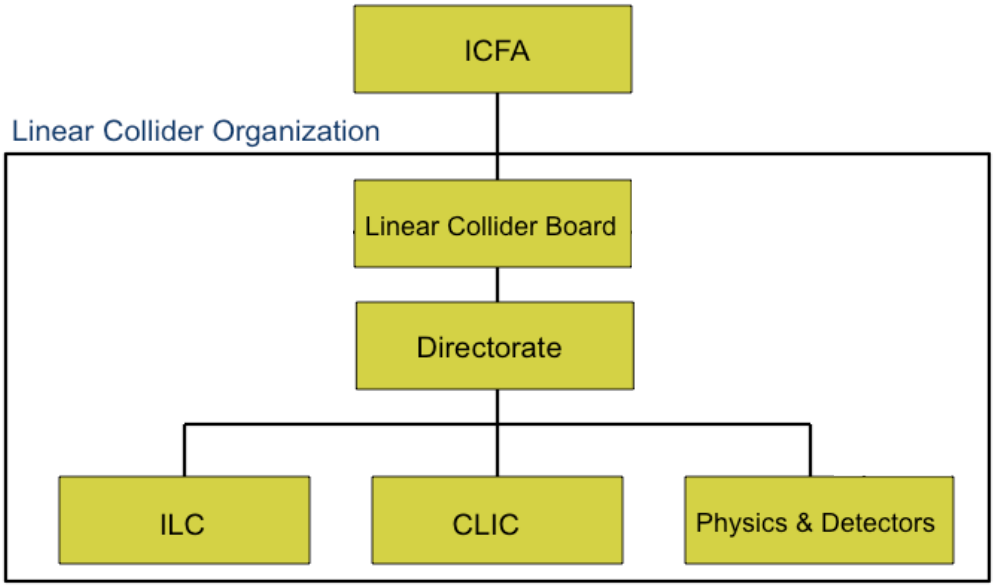
Will the on-going run be able to rule out new physics below 1 Tev (i.e. is a linear collider the machine to build ?) – possibly

It is likely that the 2015/16 LHC run will be needed to really understand what new physics is emerging in this energy regime

Linear Collider Organization post 2012

- Challenges now in implementation of the parts/boxes, and developing further the connections between them

- Several adaptions needed for CLIC – to be discussed in CB 4.11:
  - It is compatible with CLIC CB model
  - Representation in Directorate
  - Further development of combined activities
  - Detector/Physics organisation



Rolf Hauer – The CERN DG at ICFA

We need to define the most appropriate organizational form for global projects NOW and need to be open and inventive (scientists, funding agencies, politicians. . .)

Mandatory to have accelerator laboratories in all regions as partners in accelerator development / construction / commissiong / exploitation

Planning and execution of HEP projects today need global partnership for *global, regional and national* projects

in other words: for the whole program

CERN is changing to permit global projects (non-EU membership, associate membership, off-site projects)

US ILC Program 2013-15

- A proposal was sent to OHEP by the US LC steering group (Grannis) for a 3-year R&D program covering:
  - SRF value engineering
  - cavity gradient increases
  - cryomodule production (1 per year) leading to Fermilab (NML) systems tests
  - selected R&D topics (e.g. positrons, positron polarization, IP quad cold test, ….)
  - small core team within the global LC organization (other energies/luminosities)

  $15-18M /year, continue virtual lab structure.