Report from Linear Collider Collaboration

95th Plenary ECFA

Brian Foster

(Uni Hamburg/DESY/Oxford)

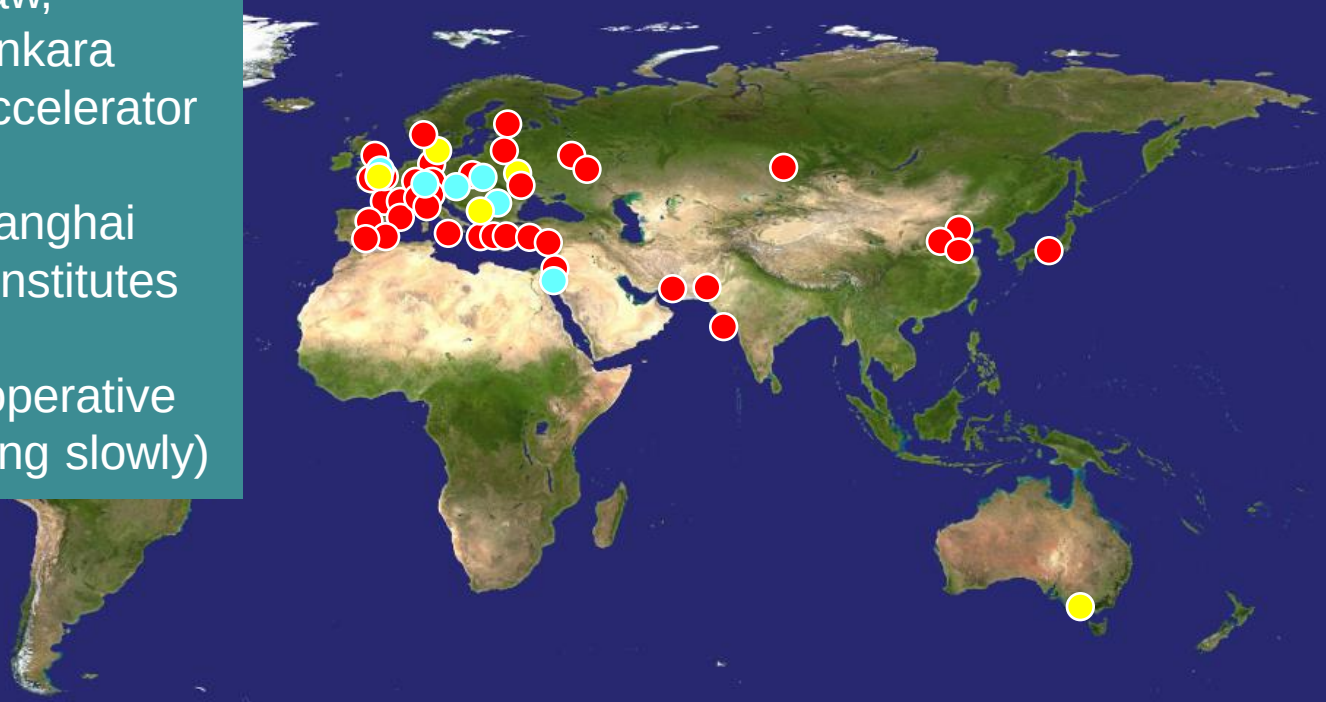
24/7/14

Collaboration

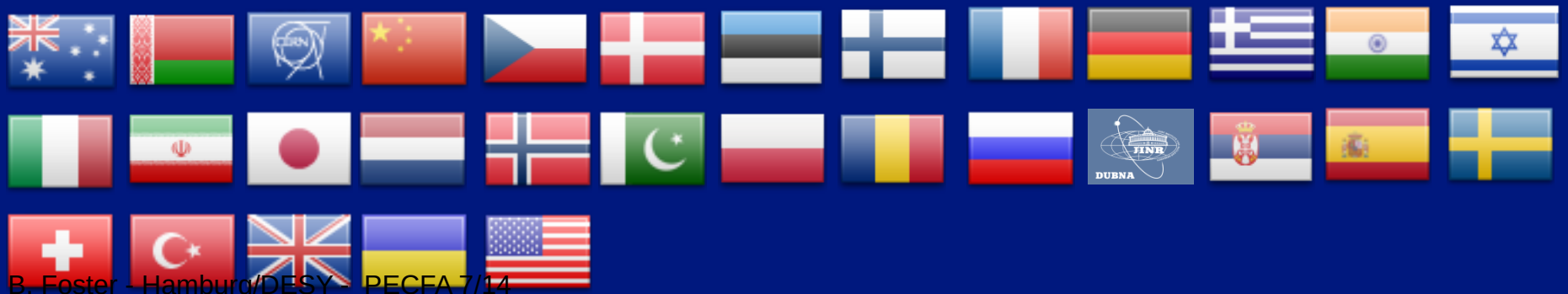
Seven new collaboration partners joined in 2013 (The Hebrew University Jerusalem, Vinca Belgrade, ALBA/CELLS, Tartu University, NCBJ Warsaw, Shandong University, Ankara University Institute of Accelerator Technologies (IAT)).
In 2014 two (SINAP Shanghai and IPM Tehran) more institutes

Detector collaboration operative with 23 institutes (growing slowly)

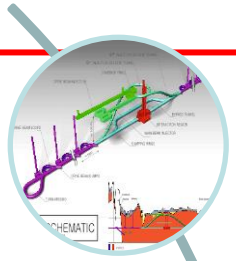
ntries – over 70 Institutes



- Detector collaboration
- Accelerator + Detector collaboration



Main activities



Parameters, Design and Implementation

- Integrated Baseline Design and Parameters
- Feedback Design, Background, Pola
- Machine Protection & Operational S
- Electron and positron sources
- Damping Rings
- Ring-To-Main-Linac
- Main Linac - Two-Beam Acceleratio
- Beam Delivery System
- Machine-Detector Interface (M
- Drive Beam Complex
- Cost, power, schedule, stages

Re-optimise for cost and power, ~360 GeV initial stage for Higgs, folding in technology progress.

The other activities illustrated by a few slides in the following:

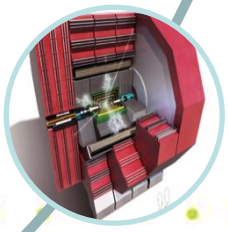
- Novel RF unit developments (high efficiency)
- Creation and Operation of x-band High power Testing Facilities
- Basic High Gradient R&D

Experimental verification

- Drive Beam phase feed-forward and feedbacks
- Two-Beam module string, test with beam
- Drive-beam front end including modulator development and injector
- Modulator development, magnet converters
- Drive Beam Photo Injector
- Low emittance ring tests
- Accelerator Beam System Tests (ATF and FACET, others)

Technical Developments

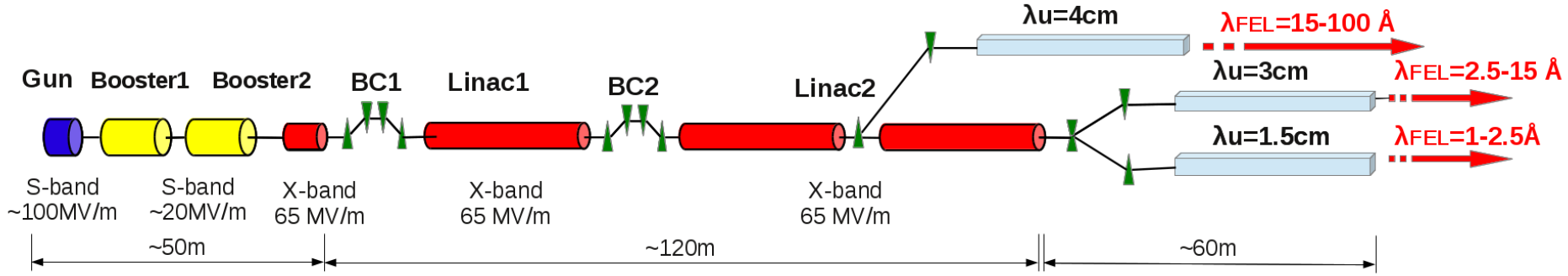
- Damping Rings Superconducting Wiggler
- Survey & Alignment
- Quadrupole Stability
- Warm Magnet Prototypes
- Beam Instrumentation and Control
- Two-Beam module development
- Beam Intercepting Devices
- Controls
- Vacuum Systems



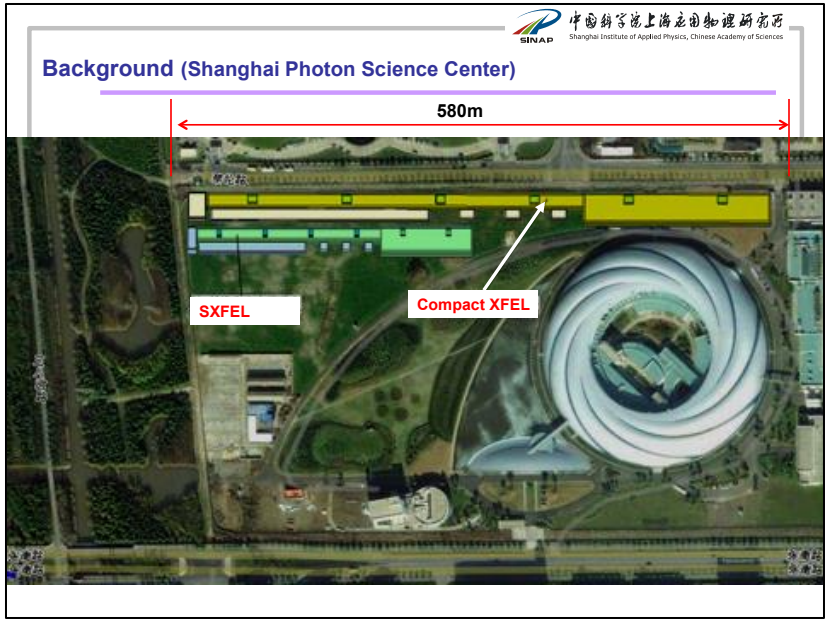
Detector and Physics

- Physics studies and benchmarking
- Detector optimisation
- Technical developments

Xband facilities - FELs



- X-band technology appears interesting for compact, relatively low cost FELs
  - **Logical step after S-band and C-band**
  - **Example similar to SwissFEL: E=6 GeV, Ne=0.25 nC, s_z=8mm**
- Use of X-band in other projects (as FELs) will support industrialisation, Xband development, system developments
  - **They will be klystron-based, additional synergy with klystron-based first energy stage**
- Started to collaborate on use of X-band in FELs
  - **Australian Light Source, Turkish Accelerator Centre, Elettra, SINAP, Cockcroft Institute, TU Athens, U. Oslo, Uppsala University, CERN**
- Share common work between partners
  - **Cost model and optimisation**
  - **Beam dynamics, e.g. beam-based alignment**
  - **Accelerator systems, e.g. alignment, instrumentation…**
- Define common standard solutions
  - **Common RF component design, -> industry standard**
  - **High repetition rate klystrons (500Hz soon to be ordered for CLIC)**



Great potential for collaboration

CLIC detector&physics

Recent progress

- Good progress wit studies

- Improved combine (mostly thanks to H

- Comprehensive CLI summer

- Starting a new set

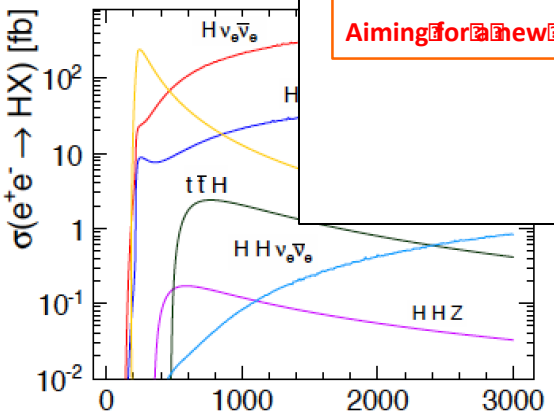
Recent progress
Detector Optimisation

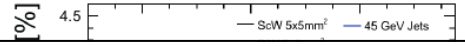
New WG on detect

Many ongoing activ

- Tracking radius working hypoth
- PFA-based ECAL
- Vertex detector tagging
- Study of reduce
- Shielding study end cap
- .....

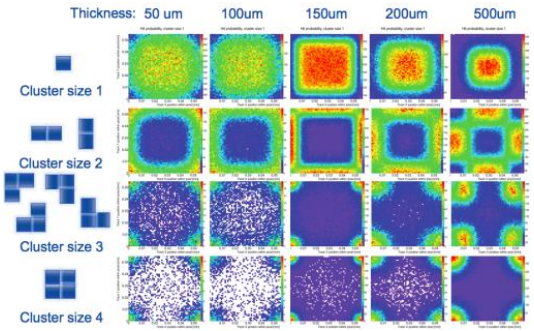
Aiming for a new d



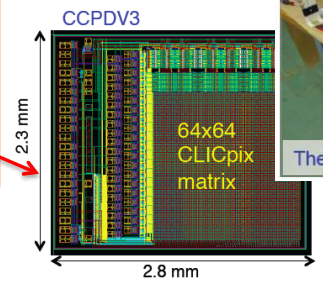


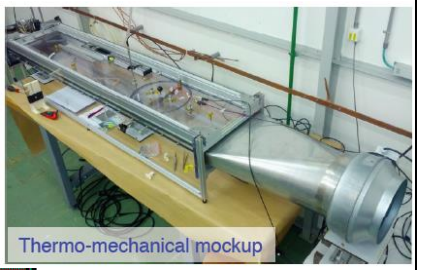
Recent progress
Vertex Detector Technology

- Two functioning ASICs (for R&D): CLICpix and Timepix3
- Successful beam tests with thin (≥50 µm) sensors and Timepix chips
- Purchase order for CLICpix-compatible silicon sensor in preparation.
- Low-mass power pulsing scheme tested in laboratory set-up
- Ongoing engineering studies: design, simulations and tests on light supports, air cooling and resulting vibrations
- Functioning active sensor in HV-CMOS for AC coupling to ASICs (coupling tests ongoing)



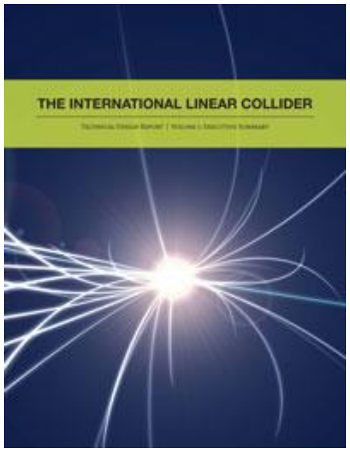
Cluster sizes in beam tests

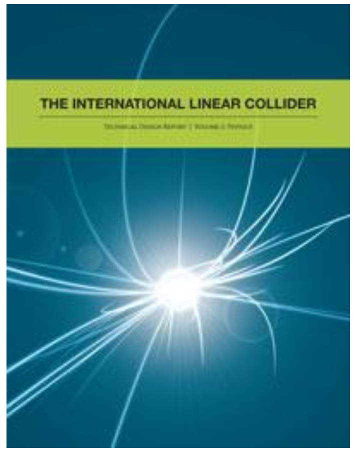


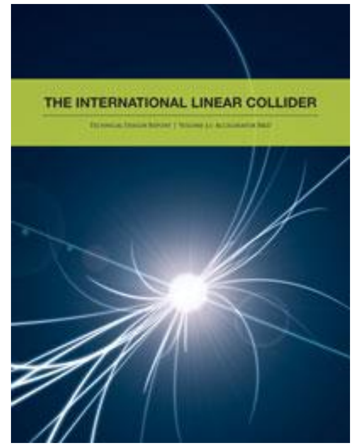


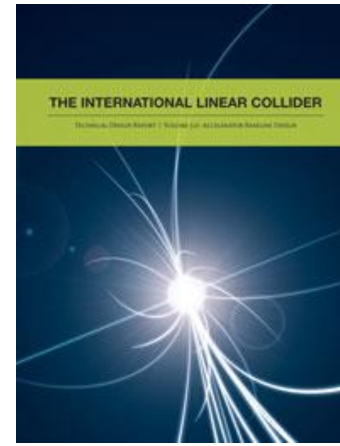
ILC - Introduction

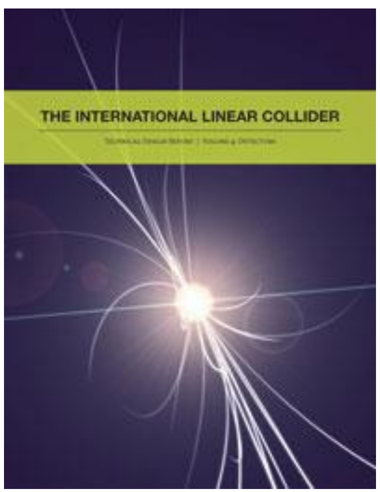
- On June 12th, 2013 ILC TDR was published in Worldwide Event.









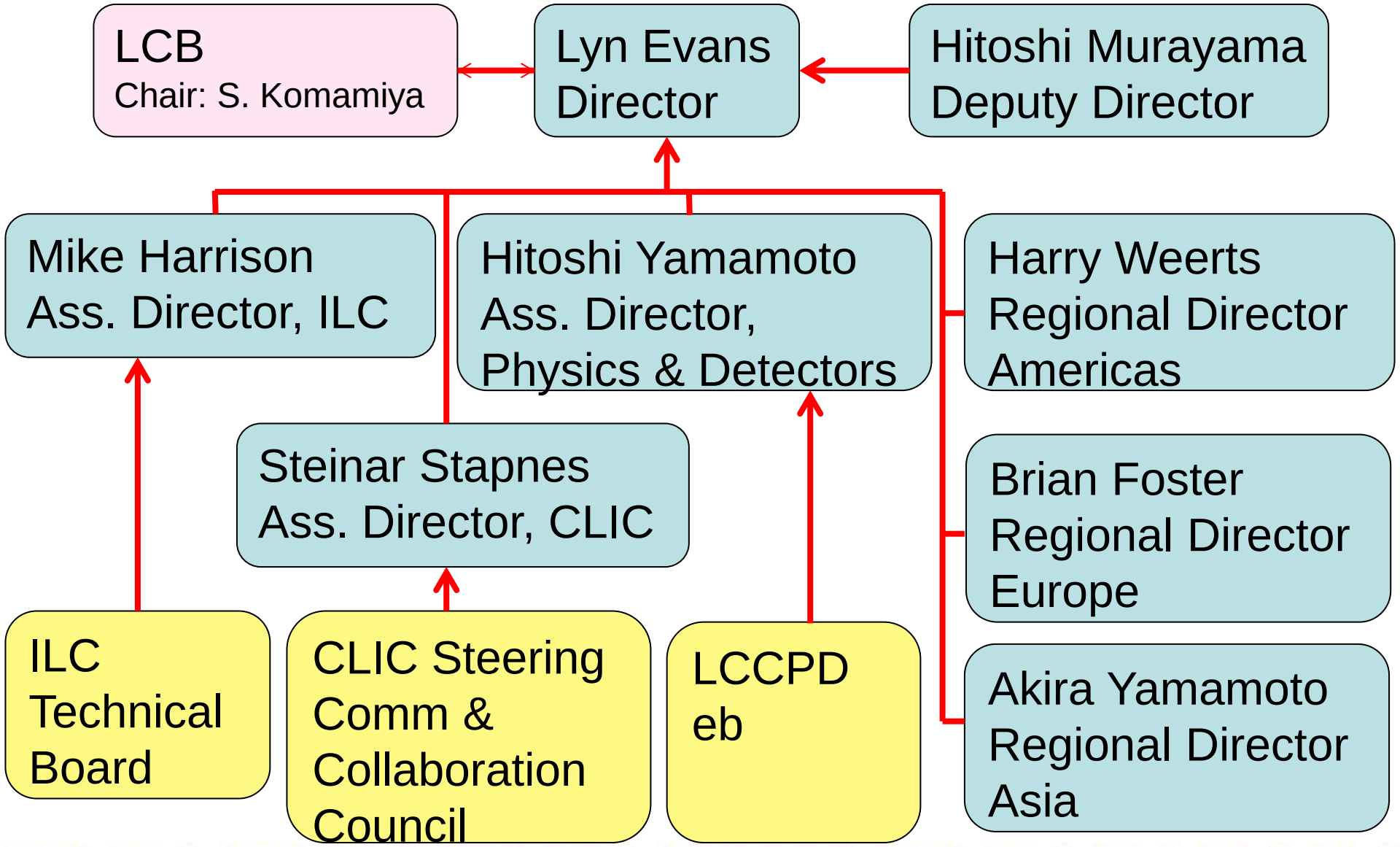


World-wide Event

- On June 12th, 2013 ILC TDR was published in Worldwide Event.

- End of major phase in ILC development – now what?

LCC Directorate



Recent Developments on ILC

LCC-ILC Director: M. Harrison, Deputies: N. Walker and H. Hayano *KEK LC Project Office Head: A. Yamamoto

Sub-Group	Global Leader Deputy/Contact p.	KEK-Leader* Deputy	Sub-Group	Global Leader Deputy/Contact P.	KEK-Leader* Deputy
Acc. Design Integr.	N. Walker (DESY) K. Yokoya(KEK)	K. Yokoya	SRF	H. Hayano (KEK) C. Ginsburg (Fermi), E. Montesinos (CERN)	H. Hayano Y. Yamamoto
Sources (e-, e+)	W. Gai (ANL) M. Kuriki (Hiroshima U.)	J. Urakawa T. Omori	RF Power & Cntl	S. Michizono (KEK) TBD (AMs , EU)	Michizono T. Matsumoto
Damping Ring	D. Rubin (Cornell) N. Terunuma (KEK)	N. Terunuma	Cryogenics (incl. HP gas issues)	H. Nakai: KEK T. Peterson (Fermi), D. Delikaris (CERN)	H. Nakai Cryog. Center
RTML	S. Kuroda (KEK) A. Latina (CERN)	S. Kuroda	CFS	A. Enomoto (KEK) V. Kuchler (Fermi), J. Osborne (CERN),	A. Enomoto M. Miyahara
Main Linac (incl. B. Compr. & B. Dynamics)	N. Solyak (Fermi) K. Kubo (KEK)	K. Kubo	Radiation Safety	T. Sanami (KEK) TBD (AMs, EU)	T. Sanami T. Sanuki
BDS	G. White (SLAC), R. Tomas (Cern) T. Okugi (KEK)	T. Okugi	Electrical Support (Power Supply etc.)	TBD	TBD
MDI	K. Buesser (DESY) T. Tauchi (KEK)	T. Tauchi	Mechanical S. (Vac. & others)	TBD	TBD
			Domestic Program, Hub Lab. Facilities	TBD	H. Hayano T. Saeki

Recent Developments on ILC

Lyn Evans meets Prime Minister Abe one year ago

Japanese Sites for ILC

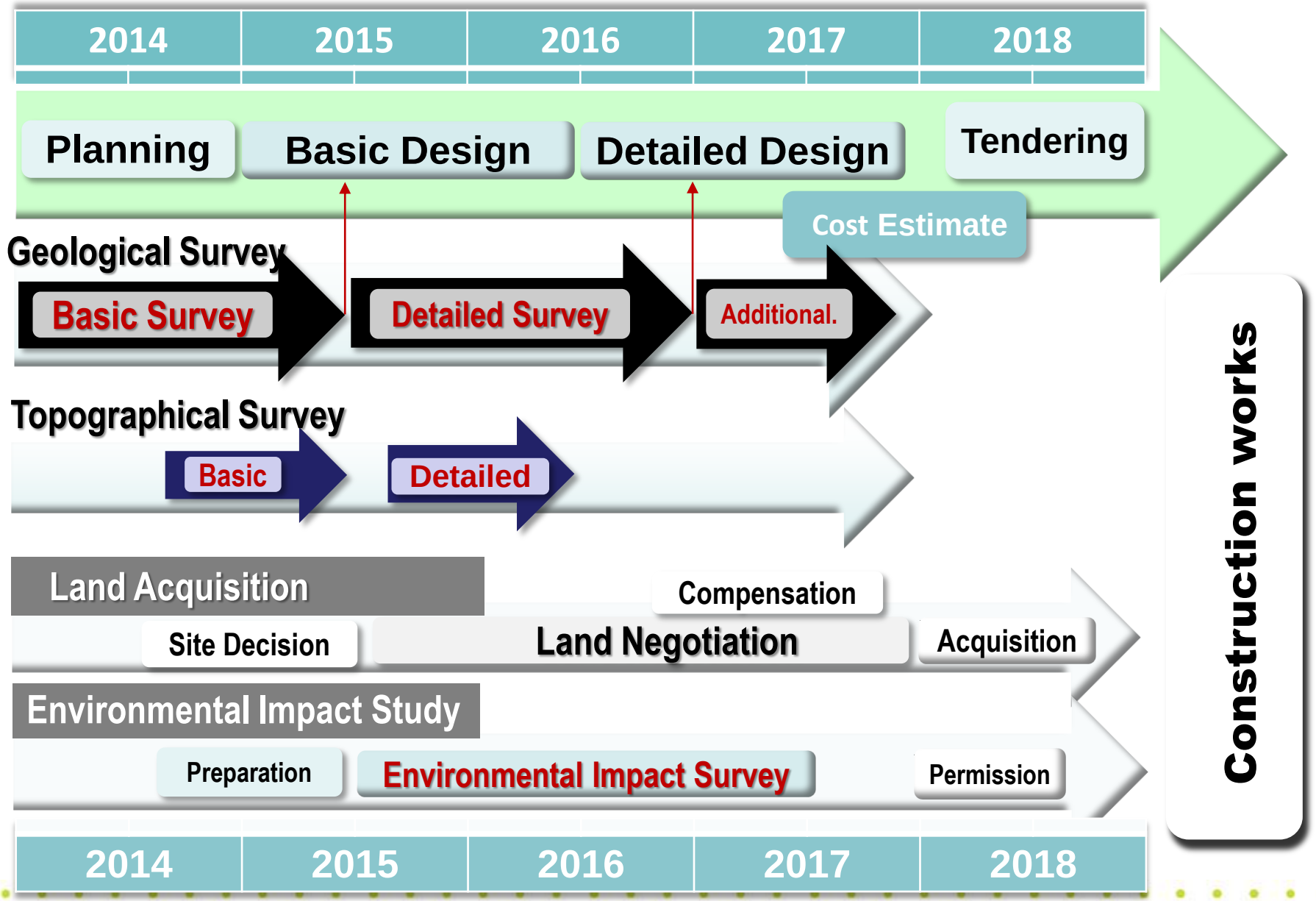
Japanese Sites for ILC

- LCC Directorate/CF&S official site visits taken place.

Japanese Site

Japanese Site

Site-specific work plan

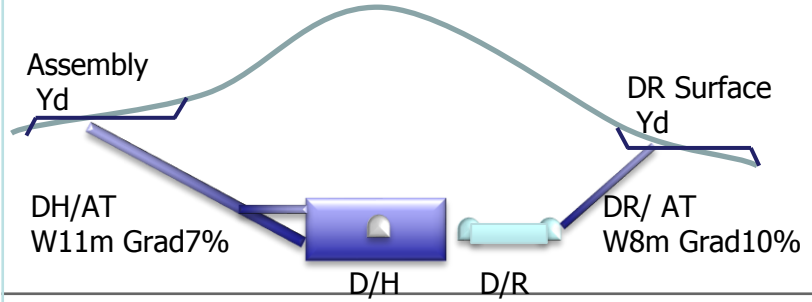


Collaboration broadening

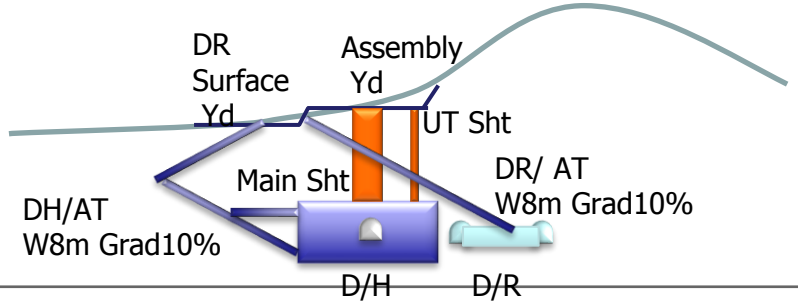
Category	Work-base	Specific subject	Global Collaboration w/
Positron Source		Positron source	PosiPol Collaboration
Nano Beam	ATF	37 nm beam 2 nm stability	ATF collaboration
SCRF Cavity Integration	STF	Power Input Coupler Tuner He-Vessel	CERN-DESY-KEK CEA-Fermi/SLAC-KEK DESY-KEK (WS at CERN? Autumn. 2014)
CM integration	STF, ILC	Conduction-cooled SC Quadrupole	Fermilab-KEK
Cryogenics	ILC	Cryog. Underground He inventry High p. Gas Safety	CERN-Fermilab-KEK (WS at CERN, 18 June)
CFS	ILC	CFS design prep.	CERN-Fermilab-KEK
Radiation Safety	ILC	ML radiation shield	SLAC-DESY-CERN-KEK

Detector Hall Evolution

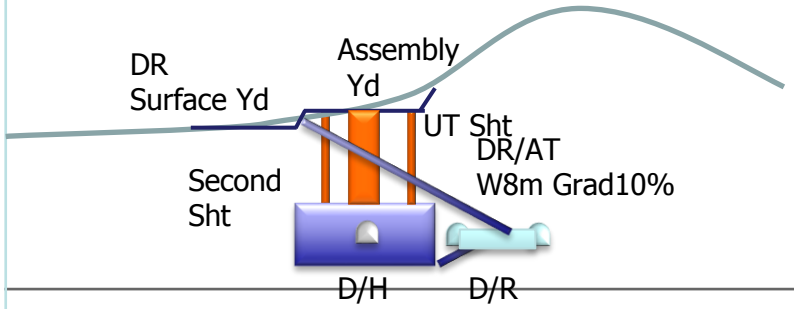
Baseline (TDR)



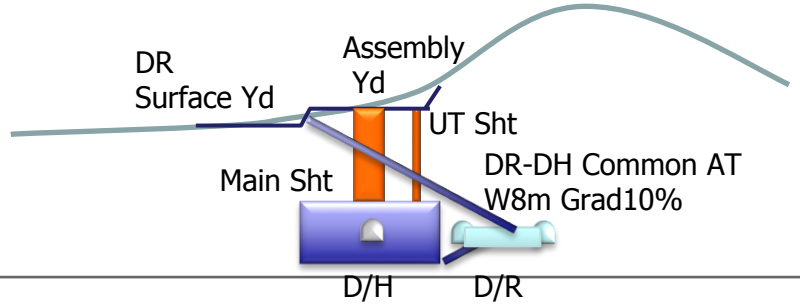
Hybrid - A (ADI-CFS Joint Meeting)



2 Vertical Shafts (SiD Proposal)



Hybrid - A′ (KEK-CFS Proposal)

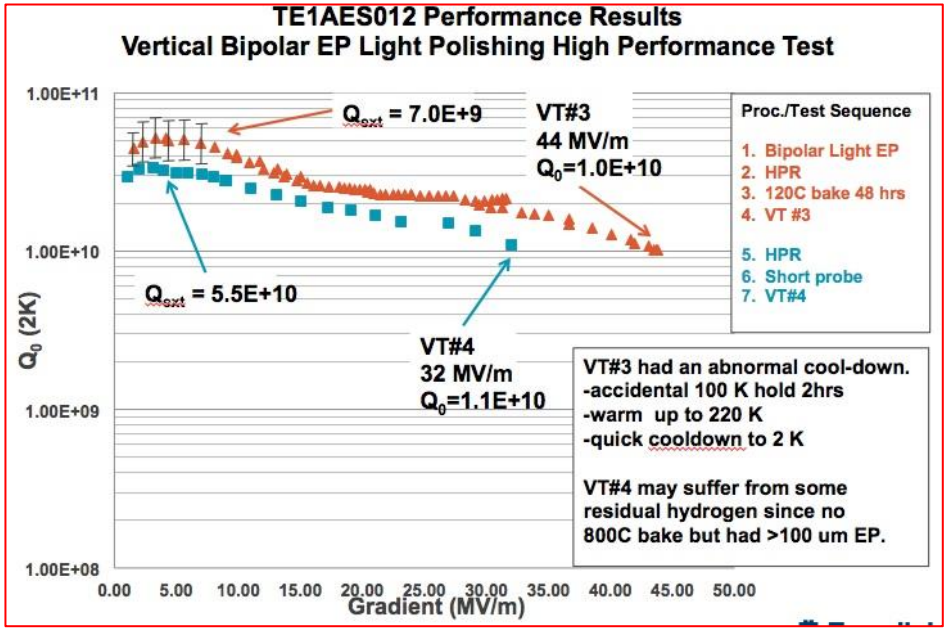


Converge in September ? – CFS/MDI meeting

From Miyahara at al

Technology optimisation

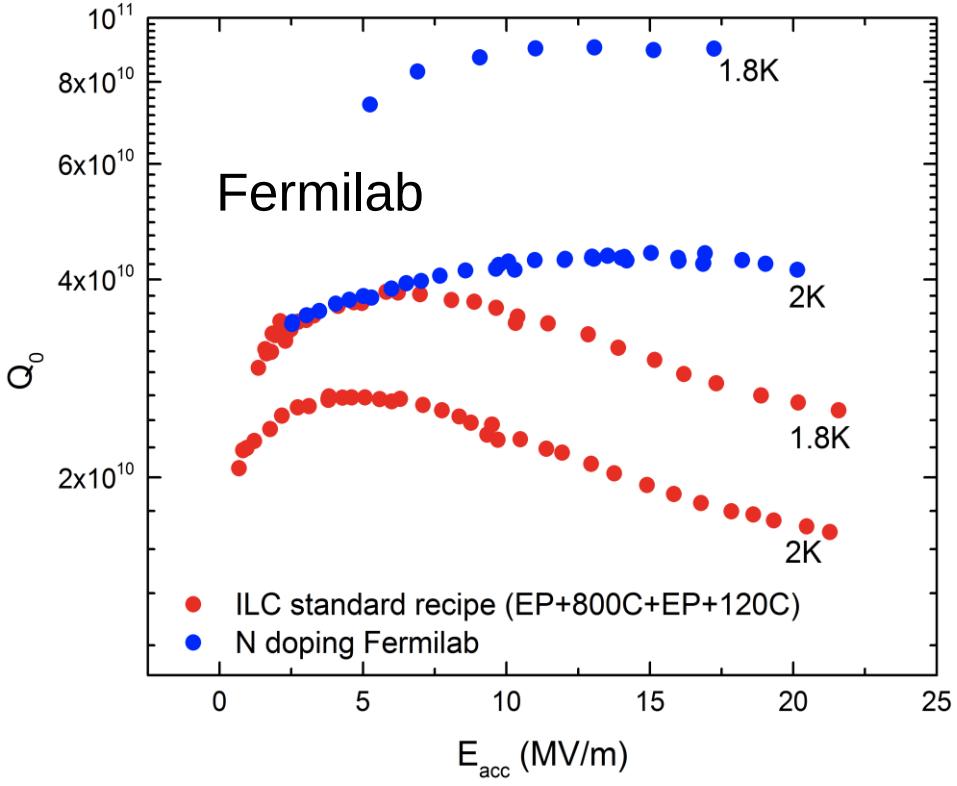
Vertical EP - Saclay

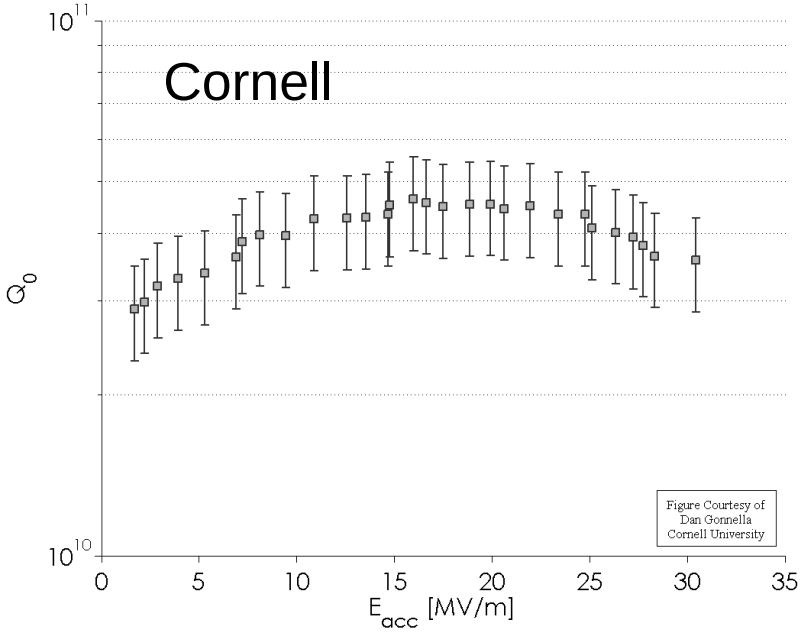


Bi-polar EP – Faraday Technology Co

Barrel Polishing DESY – No EP ?

Technology optimisation – N_2



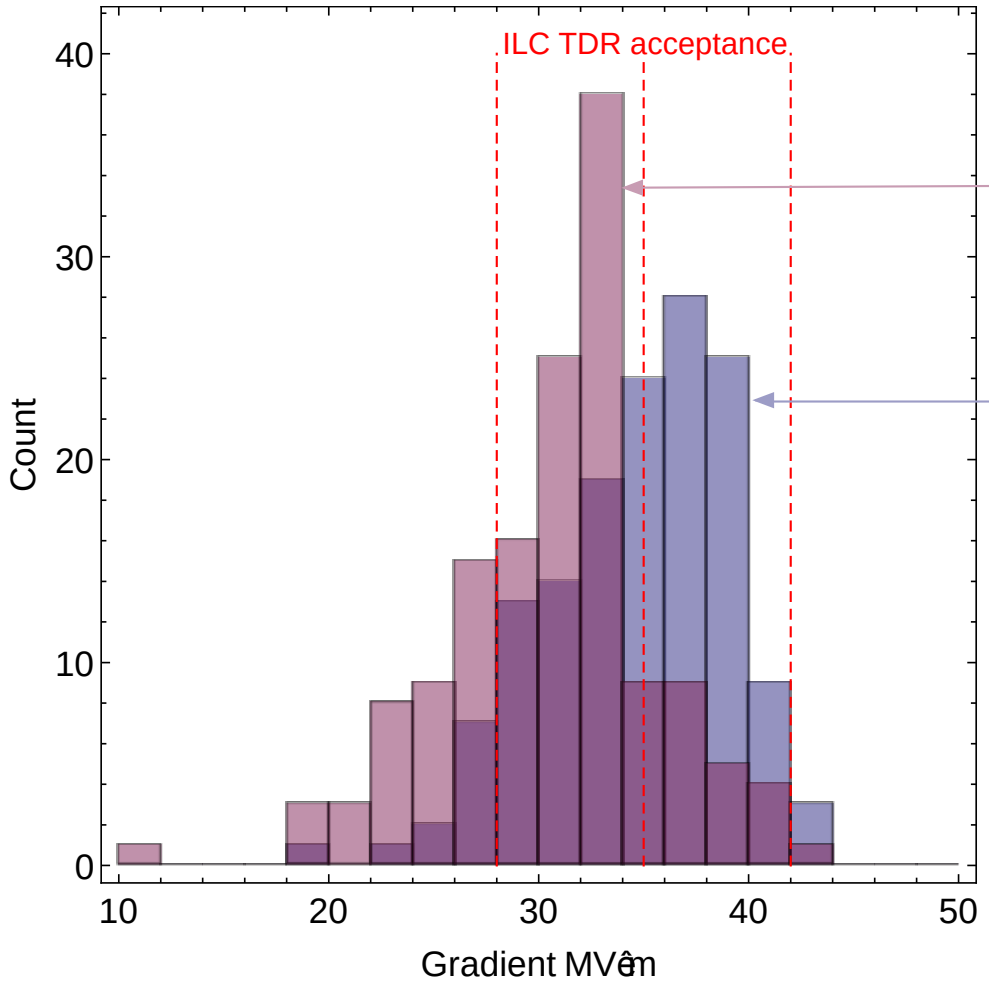


- Higher Q via nitrogen doping surface processing
- High Q via efficient flux expulsion cooling
- No high gradient yet

Industrial production - XFEL

European XFEL

ENLIGHTENING SCIENCE

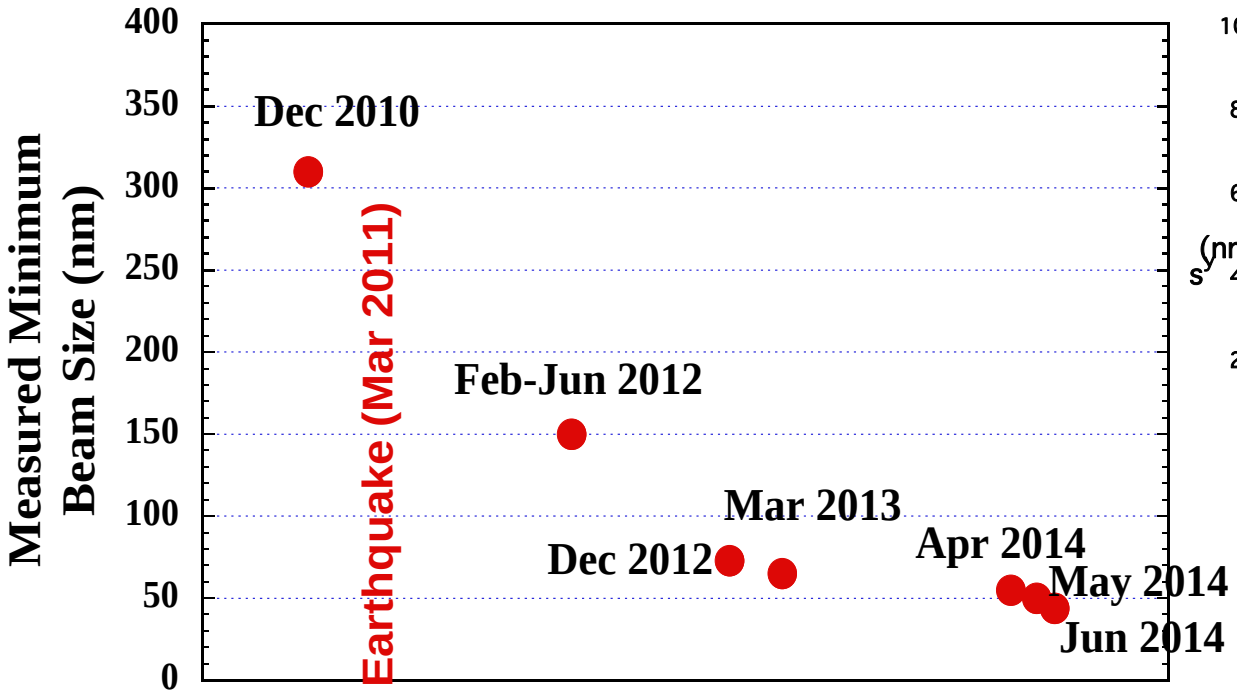


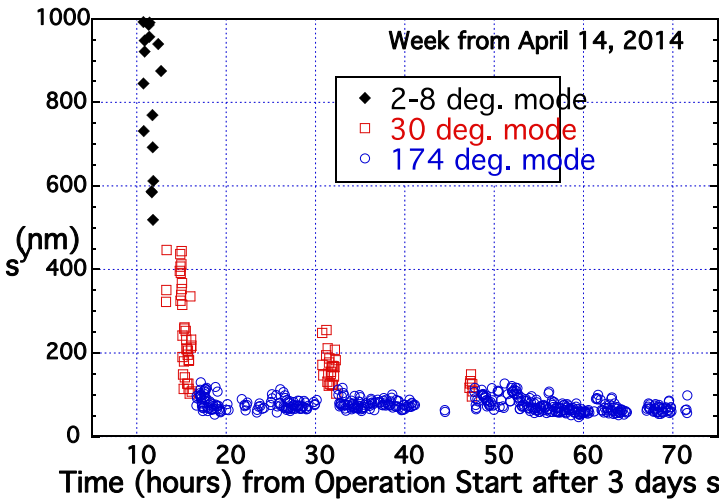
XFEL usable gradient (FE limited)

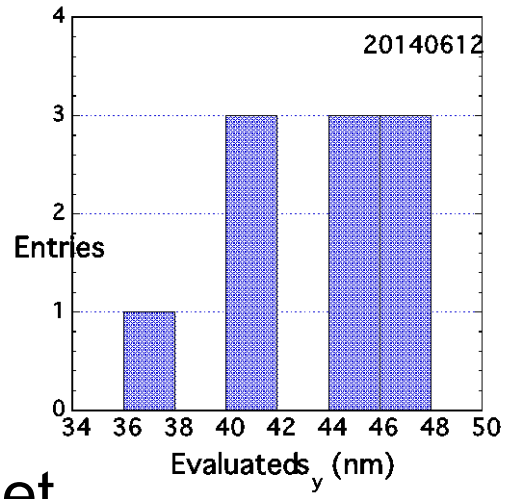
Maximum field

XFEL industrial production following ILC baseline process

ATF2 beam-size success







Currently 45± 3 nm

Field quality improvements, orbit stabilisation through feedback, shorted turn in 6-pole magnet, beam size monitor improvements

ILC Political Developments

- **Talk of Chair of Diet ILC Federation, ex-MEXT Minister**

Mr Kawamura, @ LCWS in Tokyo, 12.13

While not a member of the government, he is a very senior figure in LDP and is known to have the ear of the Prime Minister Mr Abe:

1) "We are aware that people are usually worried that an increase of academic budget in one field may mean a decrease in other fields. … We shall arrange a dedicated budget to accommodate its much wider implications. It is the responsibility of the government to carry this out."

2) "The Department of Education has requested the Department of Finance to provide an ILC investigation fund of 50 million yen in next year's budget. … once it has been approved, we members of the house will have achieved one of the most important milestones of recent years."

ILC Political Developments

- **Talk of Chair of Diet ILC Federation, Mr Kawamura**

3)“The Technical Design Report of ILC was issued in December 2012 (sic)…I would again like to express my appreciation of this effort. I understand that it is now the turn of politicians to respond to this effort, and to construct a worldwide partnership to realize this project.

4) “I think that most Diet members' knowledge of physics is at high school students’ level. If you allow me, let me take the liberty of pointing out that the understanding of political dynamics by most particle physicists is also at high school students’ level. If physicists and politicians collaborate by using each other's area of expertise, it is certain that we can accelerate the realization of the ILC project.”

ILC Political Developments

- The MEXT Minister has visited the US Secretary of Energy in January; ILC was discussed at the meeting. In February he sent the Secretary of Energy a letter following up that discussion in which he proposes inter-governmental discussion of the ILC project. A similar letter was subsequently sent to DG – designated by Council as European contact - cc EU Commission.

- The MEXT Deputy Minister was in Europe in February and July and has had dinner meetings with the DG of CERN and Robert-Jan Smits, the Director of the EC Directorate of Research and Technology. The purpose of the meeting was to discuss ILC and the next steps. At the second meeting, representatives of funding authorities of major European countries and the USA also attended. All agreed that the meetings were very useful and further meetings are scheduled to follow.

ILC Political Developments

- Lyn Evans visited the Indian Chief Science Advisor and the Head of the AEA in January. Lyn + some LCC members visited China in June and had very useful discussions.

- MEXT has set up a committee of “wise persons” who are charged with addressing the major questions brought up in the Science Council of Japan Report. They are looking at issues such as the physics case, the translation of the costing into Japanese accounting, availability of expert staff to build ILC, etc. This is mostly an internal Japanese exercise to give MEXT reassurance in language it understands – there is LCC input. It is due to report before end of Japan Fiscal 2015 – less than 2 years from now.

Most Recent Developments

- A delegation from the LCC (Lyn, BF and Harry Weerts; Hitoshi Murayama translated) met the leadership of the Diet Federation for the ILC – contains > 1/5 of all Diet members, independent of party. Kawamura-san, (chair), Shionoya-san, director general of the federation.

Kosaka-san and Hori-san all attended. Each of these is very influential; all are ex-senior Ministers.

Most Recent Developments

- It was an unusually frank & constructive meeting; much of the discussion centered on Europe. Several important initiatives were agreed, including a letter from the Diet members to CERN DG and from MEXT – both have now been received.
- ILC was discussed again at ICFA meeting in Valencia, particularly in the context of Chinese proposal for a circular machine, starting with e^+e^- at 250 GeV and then moving to high-energy pp. Important statement agreed: "ICFA endorses the particle physics strategic plans produced in Europe, Asia and the United States and the globally aligned priorities contained therein. Here, ICFA reaffirms its support of the ILC, which is in a mature state of technical development and offers unprecedented opportunities for precision studies of the newly discovered Higgs boson. In addition, ICFA continues to encourage international studies of circular colliders, with an ultimate goal of proton-proton collisions at energies much higher than those of the LHC."

European activities

- In last 12 months, BF has visited European funding agencies – France, Italy, Germany, UK – to discuss ILC, situation in Japan and European involvement over the next few years.

- BF attended annual CERN/EU meeting at CERN on 25.9. Attended by R-J Smit, DG of Directorate Research at EC. ILC was explicit item on Agenda.

- BF described current situation and R-JS responded at length. Discussion was animated. EC is clearly interested in ILC and wishes to follow closely. Agreement to set up “contact group” to maintain close contact over ILC. Met in February - maintaining regular interchange ~ monthly.

Summary and Outlook

- There is a great deal of activity, although much of it is necessarily behind the scenes.
- A single site has now been selected and the political process has momentum.
- The SCJ report is being responded to by MEXT, including consideration by an expert group.
- Ministerial-level meetings have begun – still in a very early stage.
- In Europe we are discussing way forward with national funding authorities and EU.
- The next 2 – 3 years will be decisive…..