Conclusion ALCW2018

- 1st June 2018, Fukuoka Japan
- Waseda Univercity Sachio Komamiya

Steinar, Phil et al., I do not forget CLIC !

2013 - 2019 Development Phase

Development of a Project Plan for a staged CLIC implementation in line with LHC results; technical developments with industry, performance studies for accelerator parts and systems, detector technology demonstrators

2020 - 2025 Preparation Phase

Finalisation of implementation parameters, preparation for industrial procurement, Drive Beam Facility and other system verifications, Technical Proposal of the experiment, site authorisation

2026 - 2034 Construction Phase

Construction of the first CLIC accelerator stage compatible with implementation of further stages; construction of the experiment; hardware commissioning

2019 - 2020 Decisions

Update of the European Strategy for Particle Physics; decision towards a next CERN project at the energy frontier (e.g. CLIC, FCC)

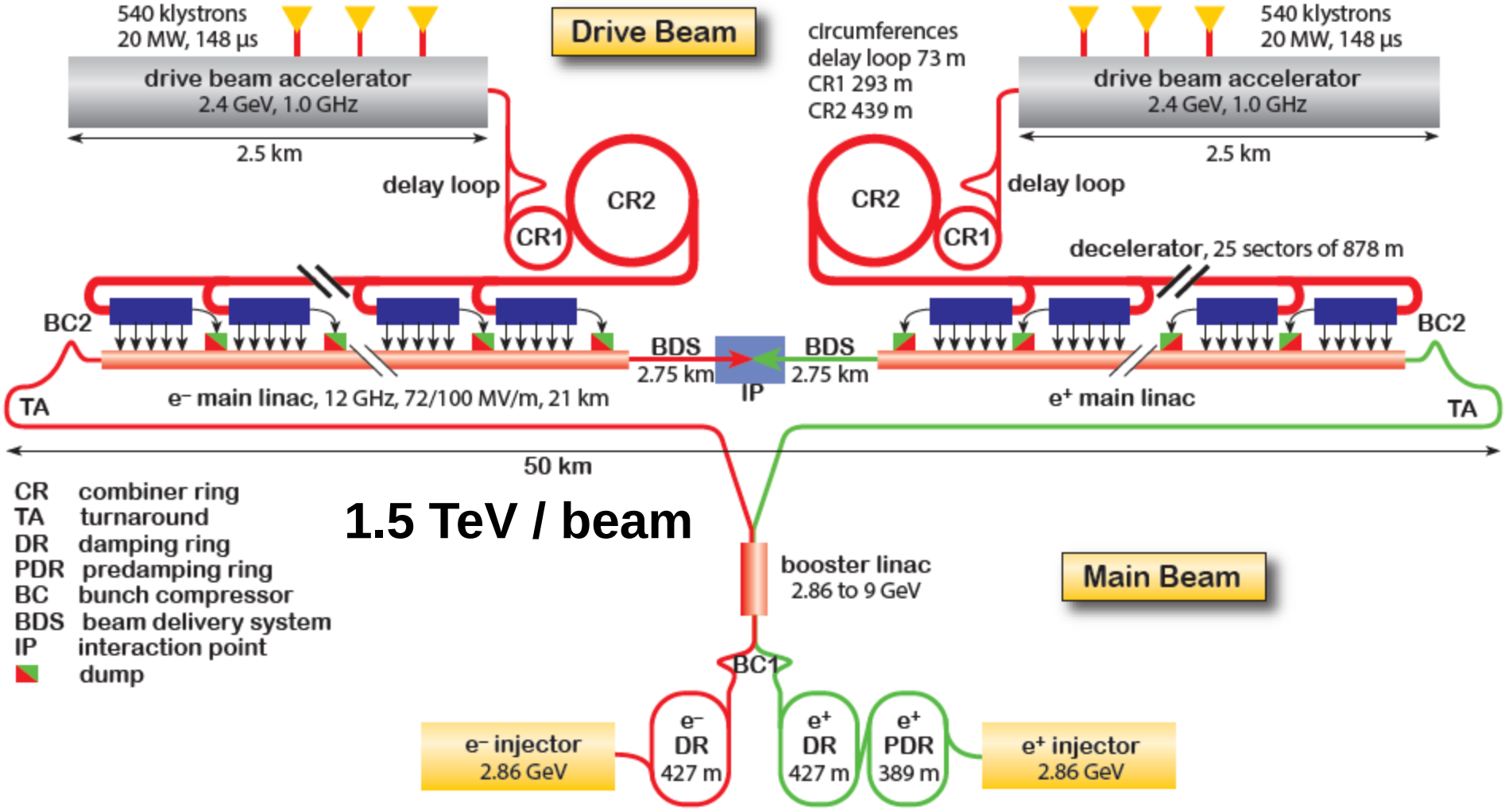
2025 Construction Start

Ready for construction; start of excavations

2035 First Beams

Getting ready for data taking by the time the LHC programme reaches completion

CLIC layout (3 TeV)



X-band technology

Eindhoven	Compact Compton source - 100 MeV	6 MW	Design and procurement
CERN	CLEAR - 50 MeV (from Xbox-1)	50 MW	Design and preparation
Frascati	XFEL, injector to plasma - 1 GeV	4(8)x50 MW	CDR
Collaboration	CompactLight - 6 GeV		Design Study
CERN	LDMX - 3.5 GeV	24x50 MW	Proposal under discussion
Groningen	1.4 GEV XFEL Accelerator - 1.4 GeV		NL roadmap
CERN	CLIC - 380 GeV	5000x50 MW	CDR

CERN	XBox-1	50 MW, 12 GHz	Operational (later to CLEAR)
	Xbox-2	50 MW, 12 GHz	Operational
	XBox-3	4x6 MW, 12 GHz	Operational
KEK	NEXTEF	2x50 MW	Operational
Tsinghua	Later energy upgrade for Compton	50 MW, 12 GHz	Commissioning
Trieste	CTF	45 MW, 3 GHz	Operational
Valencia		2x10 MW, 3 GHz	Commissioning
Frascati		50 MW, 12 GHz	Procurement
Shanghai		50 MW, 12 GHz	Procurement
Melbourne, ALS		2x6 MW, 12 GHz	Proposal submission
SLAC	NLCTA		Operational (I think)

Trieste	Linearizer for Fermi	50 MW	Operational
PSI	Linearizer for SwissFEL	50 MW	Operational
	Deflector for SwissFEL	50 MW	Design and procurement
DESY	Deflector for FLASHforward	6 MW	Design and procurement
	Deflector for FLASH2	6 MW	Design and procurement
	Deflector for Sinbad	tbd	Planning
SINAP	Linearizer for soft X-ray FEL	6 MW	Operational
	Deflectors for soft X-ray FEL	2x50 MW	Procurement
Daresbury	Linearizer	6 MW	Design and procurement
Tsinghua	Linearizer for Compton source	6 MW	Planning
SLAC	LCWS linearizer		Operational
	LCWS deflector	50 MW	Operational

Beyond being a collaboration for CLIC, many groups have their own X-band facilities and components (see overview)

Left: EU Design Study for X-Band FELs 2018-2020:
http://compact-light.web.cern.ch

In the CLIC preparation phase:
Take advantage of the widespread use of electron linacs, and rapidly increasing use of X-band → increase collaboration

We have closely monitored the LHC Run-II results and analyze the development of the LHC experiments as asked by the ILC Advisory Panel of the MEXT.

(1) Neither new particles nor new phenomena have been discovered at the LHC Run-II, so far.

⇒ Scientific significance of the precise measurements of the Higgs Boson increases.

(2) Due to the application of the Effective Field Theory Higgs couplings to other elementary particles can be precisely determined at 250 GeV ILC alone (+LHC results).

⇒ ILC is redefined as a Higgs Factory at the maximum HZ cross section point of Ecm = 250 GeV.

As a result, cost of the ILC significantly reduced.
(length ~ 30 km ⇒ ~ 20 km)
together with the new developments in SCRF technology.
(N2 infusion etc.)
⇒ ~ 60 % of the cost in the TDR of 500 GeV

We all know that the largest merit of the linear collider is its potential capability of energy upgrade.
In the future the Ecm can be increased by extending the length of linac or using higher gradient cavities.

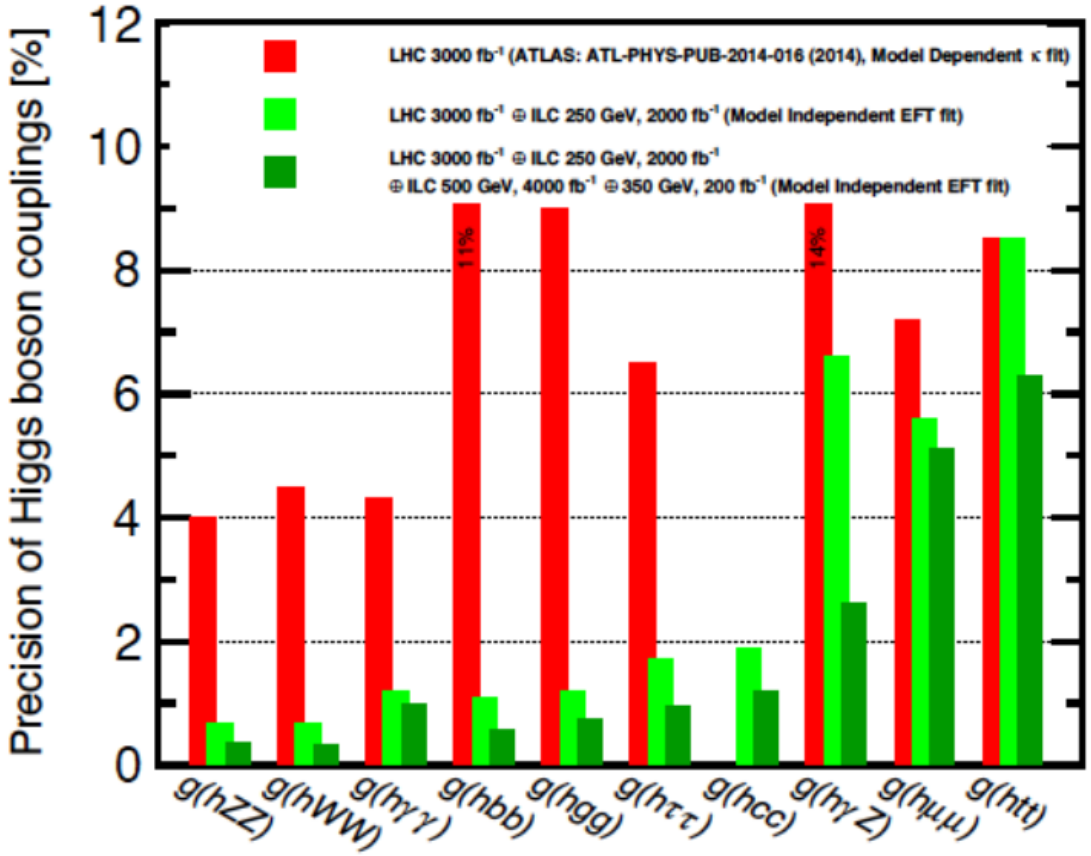
However, it is premature to talk about the upgrade now.
Please be patient. (LEP-I ⇒ LEP-II, LHC ⇒HL-LHC, HE-LHC)

LCC revisit the LHC Run-II physics

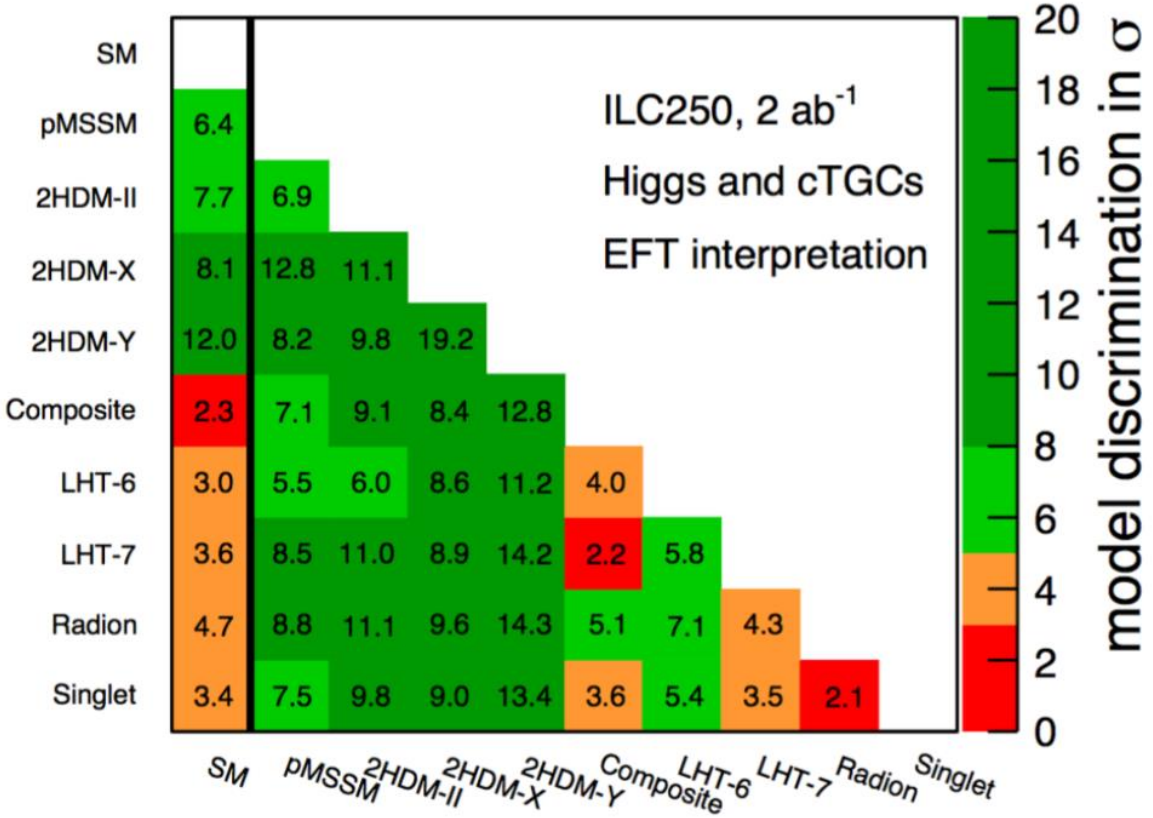
- Compelling physics case as a Higgs factory.

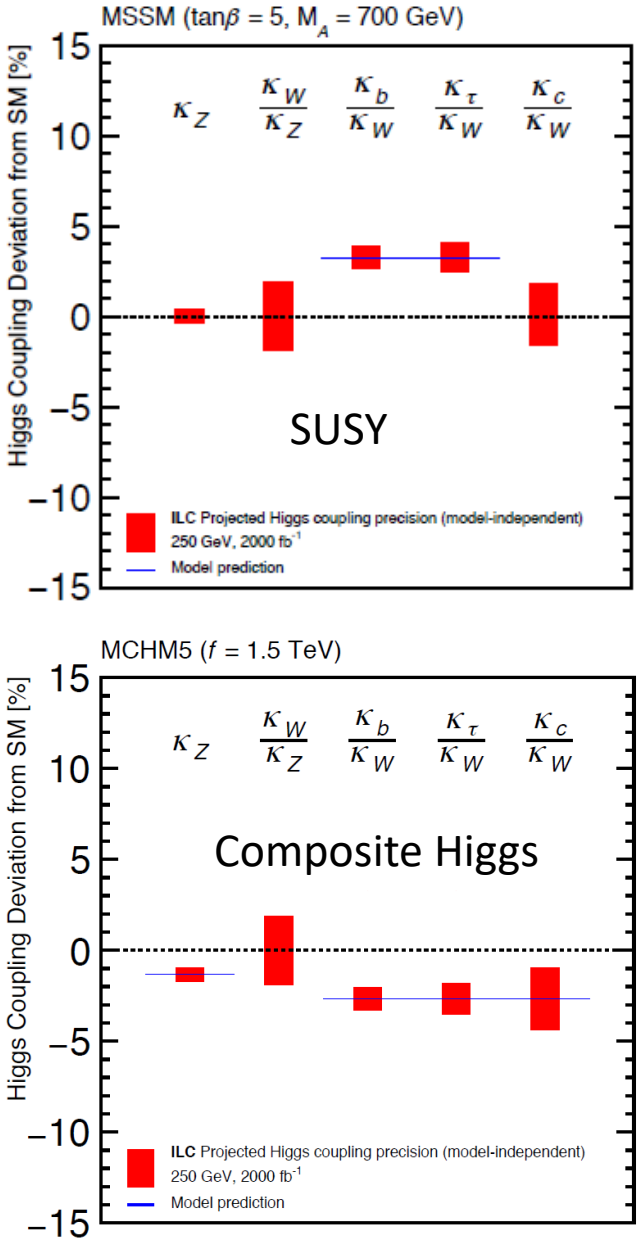
Effective Field Theory

With a new theoretical framework, expectations for the Higgs coupling measurements improved significantly.



Once a deviation from the Standard Model prediction in the couplings are seen, types of new physics could be differentiated from the deviation pattern





◎Significance of model discrimination
◎For Models which cannot be directly discovered at LHC
◎Most of the models can be discriminated by 3 σ or more.

Results of the full EFT analysis should be better than these ones.

Experiments at ILC is multi-purpose.
Not just for Higgs precise measurements

Standard Model Studies

EW Gauge sector
- Running α
- Precise measurements of W,Z-bosons
- $e^+e^- \rightarrow bb, cc, ee, \mu\mu, \tau\tau, WW, ZZ, \gamma Z, \gamma\gamma, \gamma X$
  + higher order processes

Deep understanding of the detector performances by studying the SM processes.

Perturbative QCD
- Running α_s
- Higher order QCD
- Radiative return (s-dependence cross section)

Non-perturbative QCD ～Hadron Physics
- Smooth connection of perturbative QCD with non-perturbative QCD
- Fragmentation-Hadronization
  - Meson production mechanism
  - Baryon production mechanism

Clean environment without hadrons in the initial state ⇒ Helping hadron collider physics

Beyond the SM

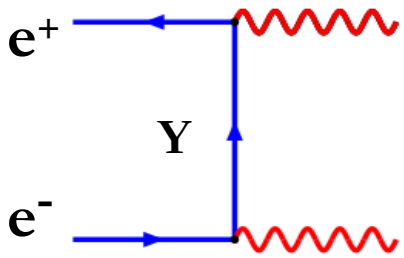
Virtual effects

s-channel new heavy particle X

$e^+e^- \rightarrow X \rightarrow ff$

$e^+e^- \rightarrow X \rightarrow WW, ZZ$

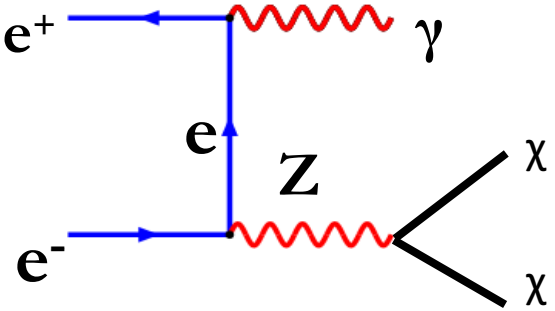
t-channel new heavy particle Y with electron flavor



Loop effects

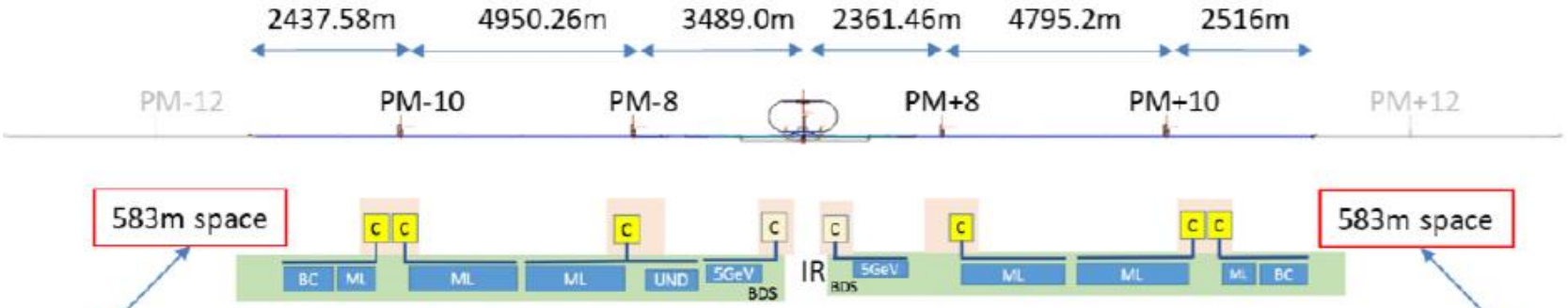
Light Dark Matter χ

$e^+e^- \rightarrow \gamma\chi\chi$ single γ, $ZH \rightarrow Z+\chi\chi$



- Substantial cost reduction compared to the original 500 GeV ILC.

TDR based 250 GeV main linac configuration



	BC				e+inj	Ecm=250GeV	e-inj				BC	
module space margin for option C, 31.5MV/m	51	90	189	189	24	module space	24	180	189	90	51	module space margin for option C, 31.5MV/m
	51	45	189	189	24	cryomodules	24	180	189	45	51	
	17	10	42	42	8	RF unit	8	40	42	10	17	
e^- 134.8GeV =	10.0	12.8	53.5	53.5	5.0	E gain (GeV)	5.0	51.0	53.5	12.8	10.0	= e^+ 132.3GeV +5.8%margin

Total tunnel length = 20549.5m (20.5km)

Compared to the ILC TDR 500 GeV machine

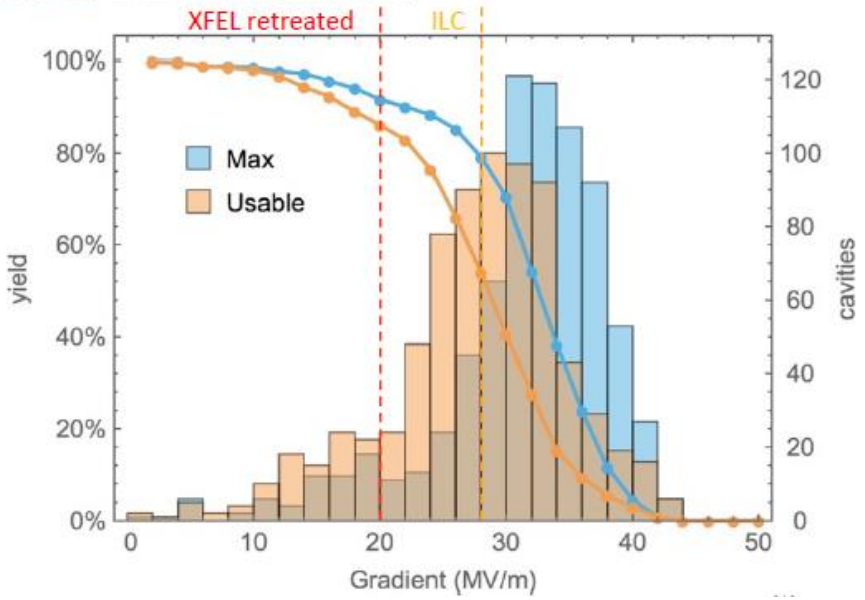
- Up to 40% reduction for the construction cost, predominantly due to the number of the main linac components needed.
- Up to 25% reduction for the human resources due to less assembly, installation and testing work.
- Up to 25% reduction for the operation due to less electricity consumption.

The numbers for human resources and operation cost are not the final values.
I hope they can reduce more. (Michizono)

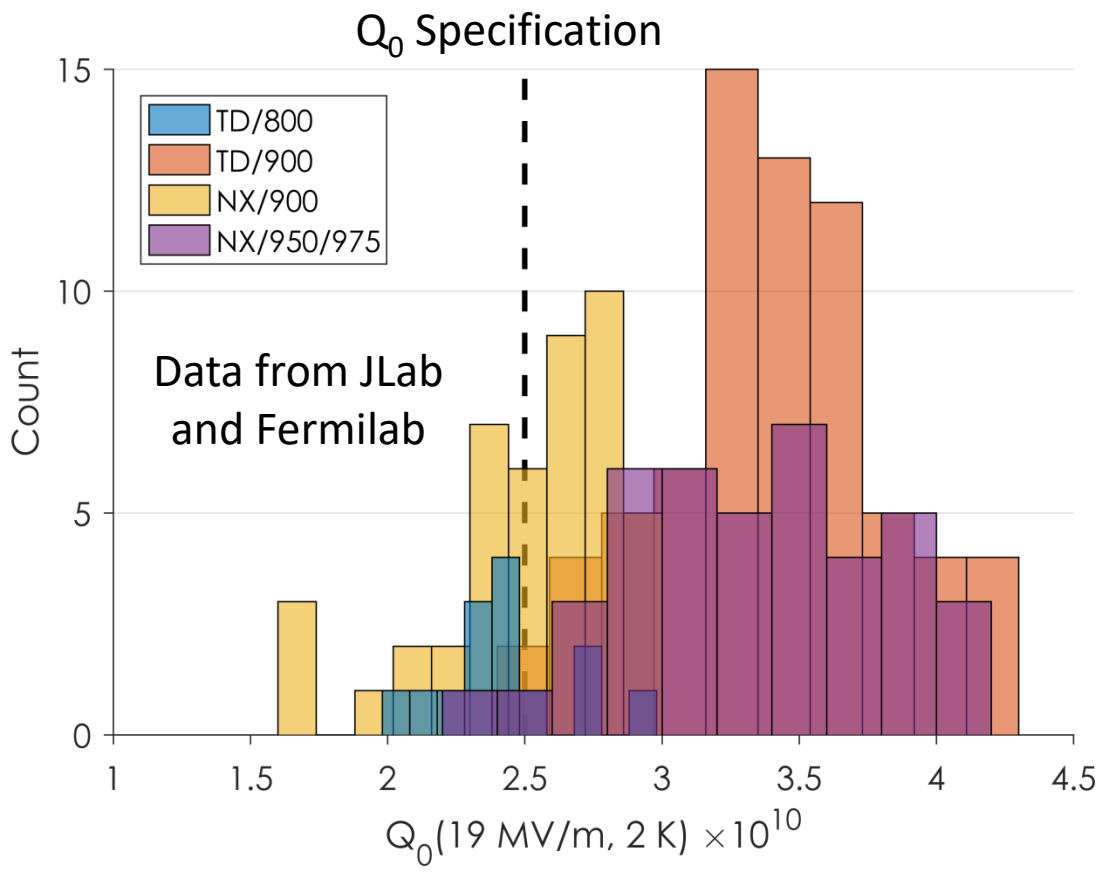
- Technology is mature, thanks to the European XFEL.

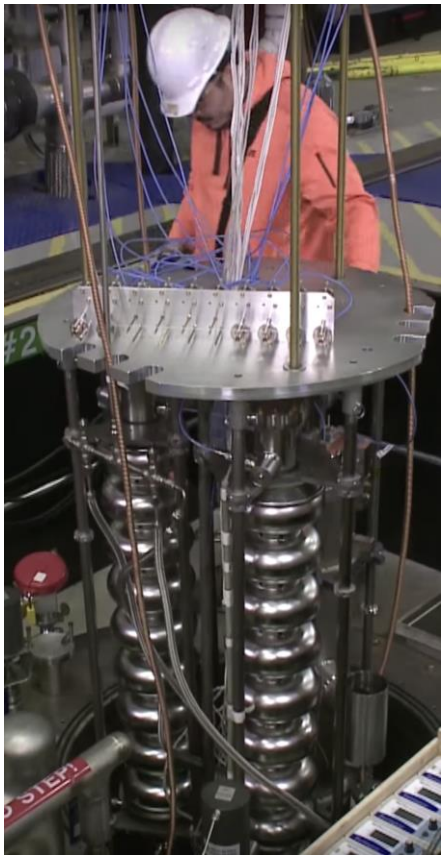
European XFEL is a 10% prototype for the ILC 250 GeV

	XFEL	ILC250
Nr of cryomodules	100	~900
Nr of cavities	800	~8500
Nr of Klystrons/ Modulators/LLRF	26	~300



LCLS-II Production Cavities – Vertical Test

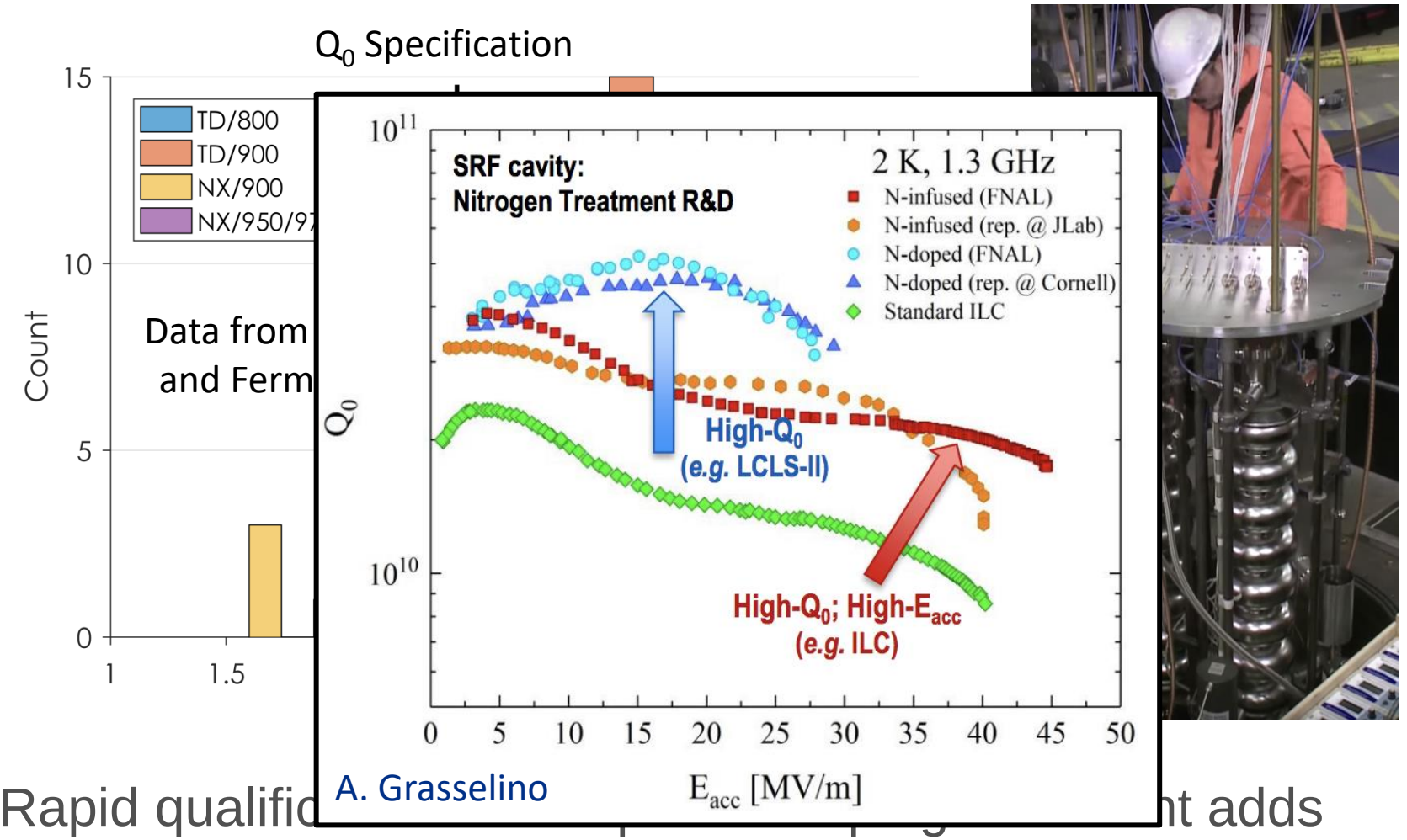




- Rapid qualification of complex N-doping treatment adds confidence in vendor capability to handle advanced cavity processing techniques, important for ILC cost reduction efforts

Plot from D. Gonnella et al., TTC Milan

LCLS-II Production Cavities – Vertical Test



- Rapid qualific … nt adds confidence in vendor capability to handle advanced cavity processing techniques, important for ILC cost reduction efforts

Plot from D. Gonnella et al., TTC Milan

PHYSICS TODAY 71, Toni Feder 25.3.2018

Japan tests the water for hosting International Linear Collider

Bid now or bust: The high energy physics community is gearing up to plan its future facilities.

Nigel Lockyer :

"Higgs Boson is the unique particle. It's only the fundamental spin-zero particle we have observed. Mixing with a new particle could show up by making precise measurements of Higgs properties, and deviations could related to dark matter, cosmic inflation, or extra-dimensions. **You would be nuts not to study the heck out of the Higgs**."

Joachim Mnich:

"The ILC concept relies on technology that has been proven. It has been tested in a large scale facility, and industry knows how to make it."

Hitoshi Murayama:

"Once a tunnel is in place, the machine can be upgraded either by lengthening it or by developing better technologies. It's premature to talk about the way to ramp up."

Michael Peskin:

"But the lower energy is a good start. High energy physics machine costs billions, so you have to be patient."

Halina Abramowiticz:

“If Japan doesn’t clearly indicate a desire to host the ILC by the end of 2018, it would be irrelevant in the discussion of the future. And that has tremendous implications. For example, geenlighting the ILC could shift the focus of research at the High Luminosity LHC to the high energy end of proton-proton interactions, which is a `whole different ballgame’ from studying the Higgs Boson with the LHC.”

Proponents believe the timing for the ILC could be propitious.

Nigel Lockyer:

“In the US, the Deep Underground Neutrino Experiment should be up and running by 2026, so the big money in the US high- energy program starts to free up. And CERN will have finished the LHC high- luminosity upgrade but not yet started with magnets for an energy upgrade. There is a global window of opportunity. The best-case scenario for the ILC would see it completed in the early 2030s.”

Hitoshi Murayama:

“No doubt infrastructure is lacking for foreigners living in Japan. But the infrastructure would be build up if project goes ahead.”

Nigel Lockyer:

“With high-energy projects so costly and rare, any global facility that gets realized will attract physicists and accelerator scientists. Build and people will come.”

Satoru Yamashita:

The important thing is to keep pushing at all the levels.

Lyn Evans:

“What’s needed is a move from neutrality. Things are slow and opaque in Japan. It’s a diode. We give information in, but get nothing out. The same thing happened with discussion of contribution from Japan to the LHC.” he recalls.

“Suddenly, out of the blue one came.”

We try to work very hard, so that the same thing happens also for this time !

European Particle Physics Strategy *Update*

European Strategy Update

2017 | 2018 | 2019 | 2020

Jan.2018
Call for proposals for venues for Open Symposium and Strategy Drafting Session
(deadline May 15, 2018)

Febr.2018
Call for scientific input

March.2018
Call for nominations of PPG & ESG members

June.2018
Council decision on venues and dates

Sept.2018
Council to launch the Strategy Update process & establish the PPG and ESG

organisation & input preparation by community

Dec.2018
Closing submission community input
(deadline Dec 18, 2018)

***2nd half of* May.2019**
Open Symposium
4 days

Sept.2019
Physics Briefing Book available

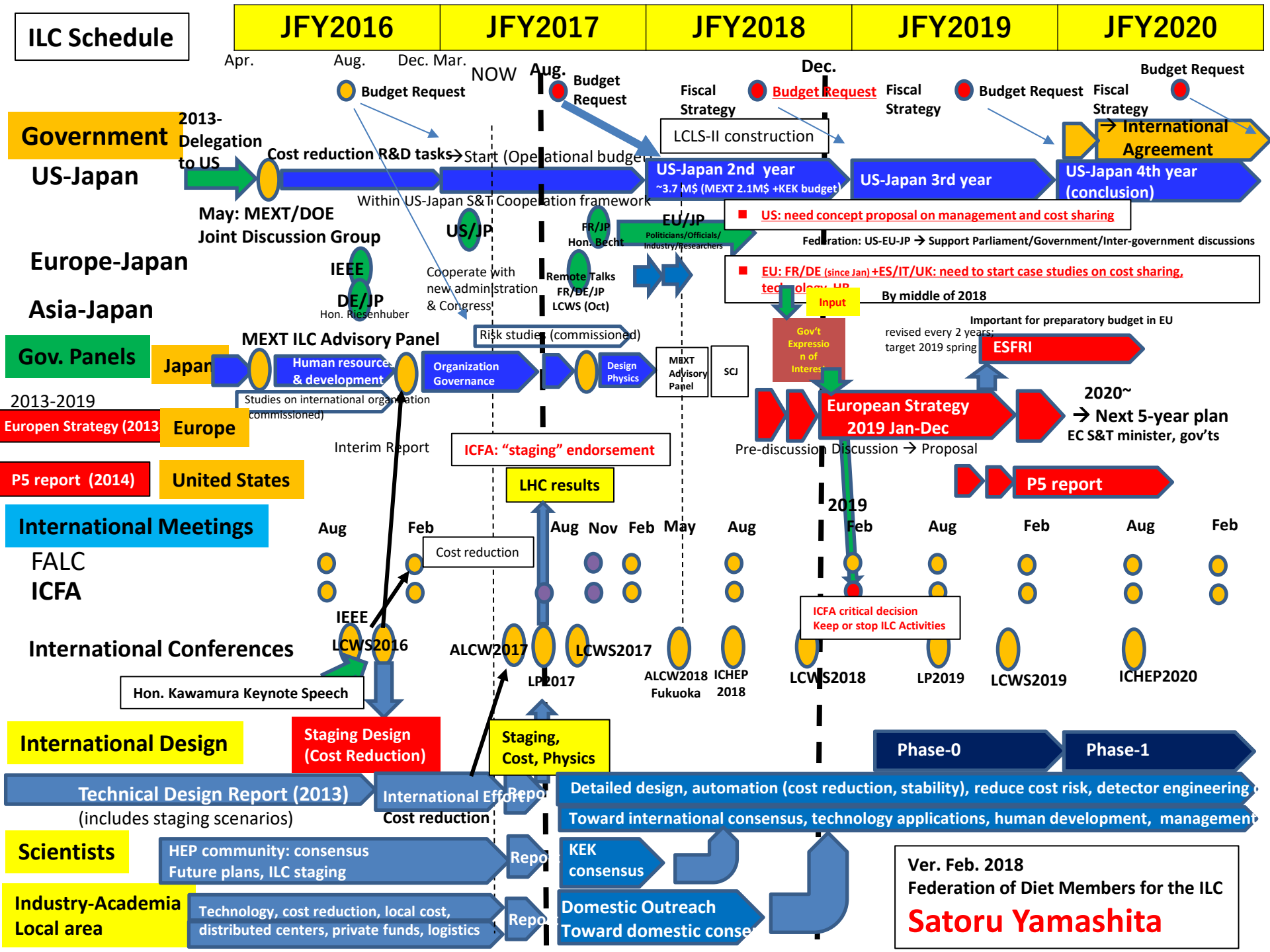
consultation & consensus building

***2nd half of* Jan.2020**
Strategy Update Drafting Session
one week

March.2020
Strategy Update submitted to Council

May.2020
Council to approve Strategy Update

Physics results appearing after May 2019 will be taken into account in the process


ILC Schedule
JFY2016
JFY2017
JFY2018
JFY2019
JFY2020
Apr.
Aug.
Dec. Mar.
NOW
Aug.
Dec.
Budget Request
Budget Request
Budget Request
Budget Request
Budget Request
Fiscal Strategy
Fiscal Strategy
Fiscal Strategy
Government
US-Japan
Europe-Japan
Asia-Japan
2013- Delegation to US
Cost reduction R&D tasks→Start (Operational budget)
LCLS-II construction
→ International Agreement
US-Japan 2nd year
~3.7 M$ (MEXT 2.1M$ +KEK budget)
US-Japan 3rd year
US-Japan 4th year (conclusion)
Within US-Japan S&T Cooperation framework
May: MEXT/DOE Joint Discussion Group
US/JP
FR/JP Hon. Becht
EU/JP
Politicians/Officials/ Industry/Researchers
US: need concept proposal on management and cost sharing
Federation: US-EU-JP → Support Parliament/Government/Inter-government discussions
IEEE
DE/JP
Hon. Riesenhuber
Cooperate with new administration & Congress
Remote Talks FR/DE/JP LCWS (Oct)
EU: FR/DE (since Jan) +ES/IT/UK: need to start case studies on cost sharing, technology, HR
By middle of 2018
Input
Gov. Panels
Japan
MEXT ILC Advisory Panel
Risk studies (commissioned)
Human resource & development
Organization Governance
Design Physics
MEXT Advisory Panel
SCJ
Gov't Expression of Interest
Important for preparatory budget in EU
revised every 2 years; target 2019 spring
ESFRI
2013-2019
Studies on international organization commissioned)
Europen Strategy (2013)
Europe
European Strategy 2019 Jan-Dec
2020~
→ Next 5-year plan
EC S&T minister, gov'ts
Interim Report
ICFA: "staging" endorsement
Pre-discussion Discussion → Proposal
P5 report (2014)
United States
LHC results
P5 report
2019
International Meetings
Aug
Feb
Aug
Nov
Feb
May
Aug
Feb
Aug
Feb
Aug
Feb
FALC
ICFA
Cost reduction
ICFA critical decision
Keep or stop ILC Activities
IEEE
International Conferences
LCWS2016
ALCW2017
LCWS2017
LP2017
ALCW2018 Fukuoka
ICHEP 2018
LCWS2018
LP2019
LCWS2019
ICHEP2020
Hon. Kawamura Keynote Speech
International Design
Staging Design (Cost Reduction)
Staging, Cost, Physics
Phase-0
Phase-1
Technical Design Report (2013)
(includes staging scenarios)
International Effort
Cost reduction
Detailed design, automation (cost reduction, stability), reduce cost risk, detector engineering
Toward international consensus, technology applications, human development, management
Scientists
HEP community: consensus
Future plans, ILC staging
KEK consensus
Industry-Academia
Local area
Technology, cost reduction, local cost, distributed centers, private funds, logistics
Domestic Outreach
Toward domestic conse
Ver. Feb. 2018
Federation of Diet Members for the ILC
Satoru Yamashita

KEK
High Energy Accelerator Research Organization

Okada's Summary

- The next half a year is a critical time for realizing the ILC in Japan.
- We need to work together to push the project in various ways coherently.

- ✓ Stand behind the 250 GeV ILC plan as a worldwide HEP community
- ✓ Make the ILC Advisory Panel in MEXT/ Science Council of Japan (SCJ) understand the importance of the project for a positive outcome
- ✓ Cooperate with Federation of Diet members, the industrial sector (AAA), local sectors to promote the project
- ✓ Obtain general understanding by the public and scientific communities
- ✓ Facilitate discussions between governments and funding agencies. This could go in parallel with the process of the ILC Advisory Panel/SCJ

My Summary:

The Fukuoka Statement is very well-received.

Physics : By examining physics results at LHC Run-II, validation of physics significance at 250 GeV is completed by LCC, JAHEP and the Physics Working Group under the ILC Advisory Panel of the MEXT. The reports (physics and TDR validation) are delivered to the Panel meeting yesterday.

Technology: Extensive SCRF technology developments specially at Euro-XFEL and LCLS-II make it from "matured stage" to "robust stage". The industrial sessions of this Workshop was well attended and very enthusiastic.

Politics: Members of the Diet Alliance are trying to get the way for the ILC financing. In the same time, they are watching for a chances to effectively push the Prime Minister's office to take positive reactions for the ILC.

Finally,

We sincerely thank the local organizers of this workshop lead by Professor Kiyotomo Kawagoe for their preparations and excellent hospitality.

Kyushu University staff: Prof. Taikan Suehara, Prof. Tamaki Yoshioka, and Ms. Toyomura

+18 graduate students (Kyushu, Tokyo, Shinshu, Iwate, KEK, Oregon) + LOC members

We will meet at the LCWS2018 in Arlington Texas from 22nd to 26th October 2018.

I hope we can feel that the traffic light goes from yellow to green by the next meeting.

Statement on "Towards the realization of the International Linear Collider, an update"

31 May 2018, Fukuoka

Scientists who gathered for the Linear Collider Workshop in Tokyo in 2015 issued a statement confirming their strong support for the scientific justification for a prompt realization of the International Linear Collider (ILC). The Linear Collider Collaboration (LCC) and the worldwide participants at the 2018 Asian Linear Collider Workshop (ALCW2018) in Fukuoka, Japan, reconfirm the scientific importance of the ILC. We are closer to the realization of the project, but it is now in a critical phase.

(1) Results to date from the CERN Large Hadron Collider indicate that we are at a crossroads in our quest to uncover the origin and history of the Universe. We now know that precision measurements, in particular of the properties of the Higgs boson, are an essential next step to advance our understanding. Precise measurements in electron-positron interactions at a center of mass energy of 250 GeV at the ILC will deliver a leap in our scientific knowledge and, together with future results from the LHC and SuperKEKB, will propel us toward the ultimate theory of particle physics and a deep understanding of the Universe itself.

(2) We have been preparing for the ILC for many years, in collaboration with industries and in discussion with governments worldwide. The ILC is now the most mature and realizable electron-positron collider project, and offers the energy expandability of a linear collider. The successful operation of the European XFEL in Hamburg and recent advances in the superconducting R&D in Fermilab near Chicago and other laboratories, together with a cost reduction by changing the initial center of mass energy to 250 GeV, increases the ILC technical and financial feasibility whilst maintaining the physics potential of the machine at this energy. The superconducting technology being developed for the ILC has a great impact on industrial and medical applications of accelerators. We deeply appreciate the evaluation process by the Japanese government for the proposal based on the new ILC design.

(3) The ILC can only be realized as an international project, and a nation who wishes to host the project should lead the international negotiations. A positive message from the Japanese government expressing readiness to initiate these discussions this year is critically important because work on the update of the European Strategy for Particle Physics, including collaboration in the ILC construction, will start early next year. This update will have a large impact outside Europe on the future of high energy physics projects worldwide. While we will strongly present the scientific case for the ILC in these discussions, it is now essential to hear a positive message from the Japanese government in a timely manner.

Lyn Evans

LCC Director

For scientists from LCC and ALCW2018