Report for TCMB on Nov.14,2017

Shin MICHIZONO

- Machine/ Physics reports from LCC to LCB
- Presentation at LCB
- ICFA statement / LCB conclusion report
- Scientist summary from Geoffrey TAYLOR (next ICFA chair)
- Recent topics at Japan (reported on last face-to-face TCMB)

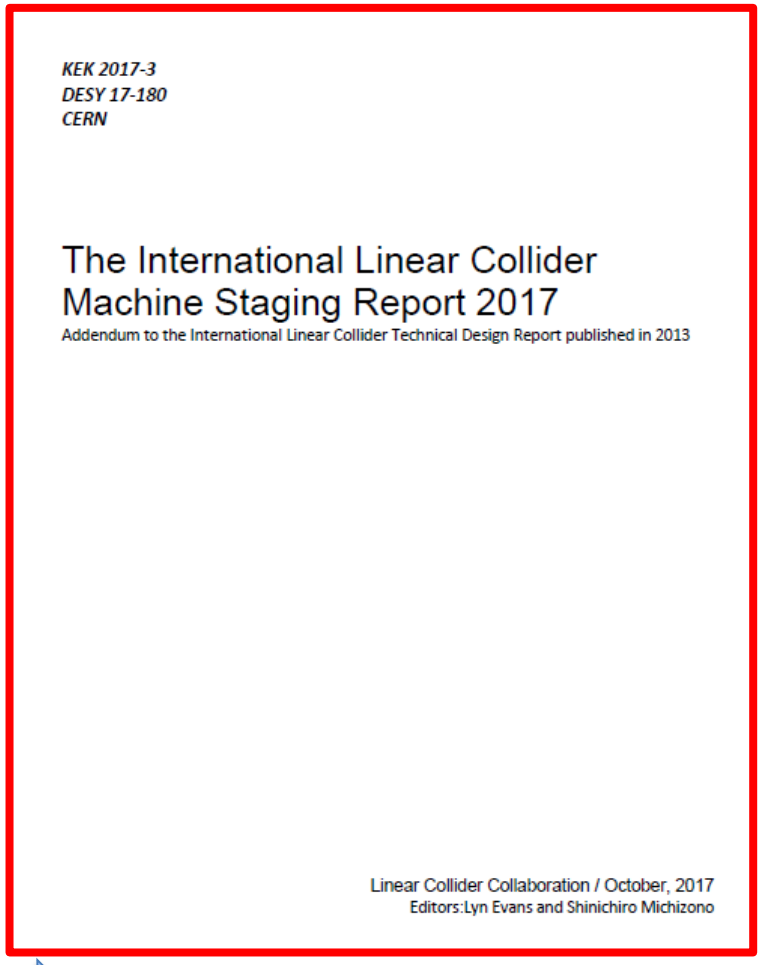
Recent status

- LCB on August 9,2017: ILC staging report
- Internal cost review on Sep. 26, 2017: Positron, Lumi. @250GeV, SRF R&D
- (machine, physics reports submission to LCB/ICFA)
- LCB on Nov. 7: ILC staging discussion
  Indico: https://indico.fnal.gov/event/15545/
- ICFA on Nov. 7: ILC staging discussion
  http://icfa.fnal.gov/statements/
  - ICFA statement:
    http://icfa.fnal.gov/wp-content/uploads/ICFA-Statement-Nov2017.pdf
  - LCB Conclusion Report:
    http://icfa.fnal.gov/wp-content/uploads/LCB-Short-Conclusion-Nov2017.pdf
- ICFA on Nov. 9: “Scientist Summary” by Geoffrey TAYLOR (next ICFA chair)
  Indico: https://meetings.triumf.ca/indico/event/9/timetable/#20171109.detailed

Machine/Physics report

https://arxiv.org/abs/1711.00568

https://arxiv.org/abs/1710.07621



KEK 2017-3
DESY 17-180
CERN

The International Linear Collider
Machine Staging Report 2017

Addendum to the International Linear Collider Technical Design Report published in 2013

Linear Collider Collaboration / October, 2017
Editors:Lyn Evans and Shinichiro Michizono

DESY-17-155
KEK Preprint 2017-31
LAL 17-059
SLAC–PUB–17161
October 2017

Physics Case for the 250 GeV Stage
of the International Linear Collider

LCC Physics Working Group

Keisuke Fujii[1], Christophe Grojean[2,3], Michael E. Peskin[4] (Conveners); Tim Barklow[4], Yuanning Gao[5], Shinya Kanemura[6], Hyungdo Kim[7], Jenny List[2], Mihoko Nojiri[1,8], Maxim Perelstein[9], Roman Pöschl[10], Jürgen Reuter[2], Frank Simon[11], Tomohiko Tanabe[12], James D. Wells[13], Jaehoon Yu[14]; Mikael Berggren[2], Moritz Habermehl[2], Sunghoon Jung[7], Robert Karl[2], Tomohisa Ogawa[1], Junping Tian[12]; James Brau[15], Hitoshi Murayama[8,16,17] (ex officio)

ABSTRACT

The International Linear Collider is now proposed with a staged machine design, with the first stage at 250 GeV with a luminosity goal of 2 ab^{-1}. In this paper, we review the physics expectations for this machine. These include precision measurements of Higgs boson couplings, searches for exotic Higgs decays, other searches for particles that decay with zero or small visible energy, and measurements of e^+e^- annihilation to W^+W^- and 2-fermion states with improved sensitivity. A summary table gives projections for the achievable levels of precision based on the latest full simulation studies.

I reported on last face-to-face TCMB on Oct.26.

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ICFA

SPONSORED BY THE PARTICLES AND FIELDS COMMISSION OF IUPAP

ABOUT | MEETINGS | PANELS | STATEMENTS | LINEAR COLLIDER

http://icfa.fnal.gov/meetings/

Meetings

The **12th ICFA Seminar** and, **LCB and 80th ICFA Meeting** will be held in Ottawa, Canada, Nov. 6-9, 2017.

The **79th ICFA meeting** will be held at LP2017 in Guangzhou, China, on August 9, 2017.

The **78th ICFA meeting** was held in Valencia 16-17 February 2017. You can find the Summary of the meeting here.

Summary of the 77th Meeting of ICFA – @ICHEP 2016, Chicago, August 7, 2016

Summary of the 76th Meeting of ICFA — J-PARC, Japan 25-26 February 2016

Agenda and Transparencies from the ICFA Seminar — IHEP, Beijing, 27-30 October 2014

LCB/ICFA Meetings, Ottawa

Tuesday, November 7, 2017 from **18:30** to **21:35** (Canada/Eastern)
at **National Arts Centre, Ottawa, Ontario, Canada (Le Salon)**

Description ZOOM:

https://fnal.zoom.us/j/369284362?pwd=jwwhvL3xdHmZyJEM2d0r0g
Password: icfaOttawa

Or Telephone :
US: +1 646 558 8656 or +1 669 900 6833
Meeting ID: 369 284 362
International numbers available: https://fnal.zoom.us/zoomconference?m=HcFDnDYziGqej293FJiYCGwuxdgB0dKr

Tuesday, November 7, 2017

18:30 - 20:30 LCB Session (with Buffet Dinner), Chair: Prof. Tatsuya Nakada

18:30 **Introduction** *5'*
Speaker: Prof. Tatsuya Nakada (EPFL)

18:35 **Final report on the ILC 250 GeV cost** *15'*
Speaker: Prof. Shinichiro MICHIZONO (KEK)
Material: **Slides**

18:50 **Final report on the LCC 250 GeV physics study** *15'*
Speaker: Michael Peskin (SLAC)
Material: **Slides**

19:05 **Latest News from Japan, Community and Government** *15'*
Speaker: Sachio Komamiya (The University of Tokyo)
Material: **Slides**

19:20 **LCWS2017 Report** *10'*

19:30 **Discussion on further work by LCB** *10'*
Speaker: Prof. Tatsuya Nakada (EPFL)

19:40 **Formulating the final LCB conclusions to report to ICFA** *30'*
Speaker: Prof. Tatsuya Nakada (EPFL)

20:10 **ILC budget** *10'*

20:20 **Plan for the next meeting** *10'*
Speaker: Prof. Tatsuya Nakada (EPFL)

https://indico.fnal.gov/event/15545/

Final report on the ILC 250 GeV cost

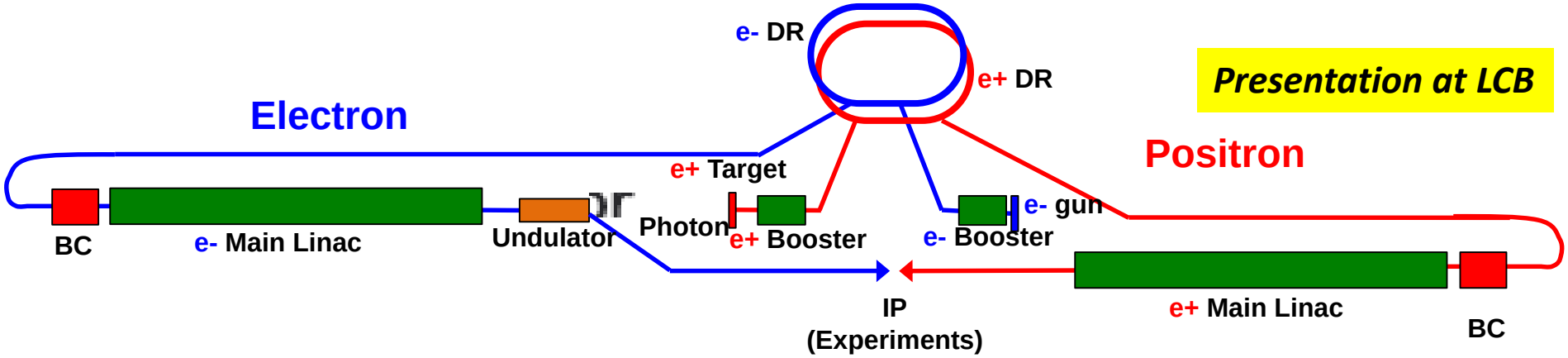
Presentation at LCB

KEK/LCC

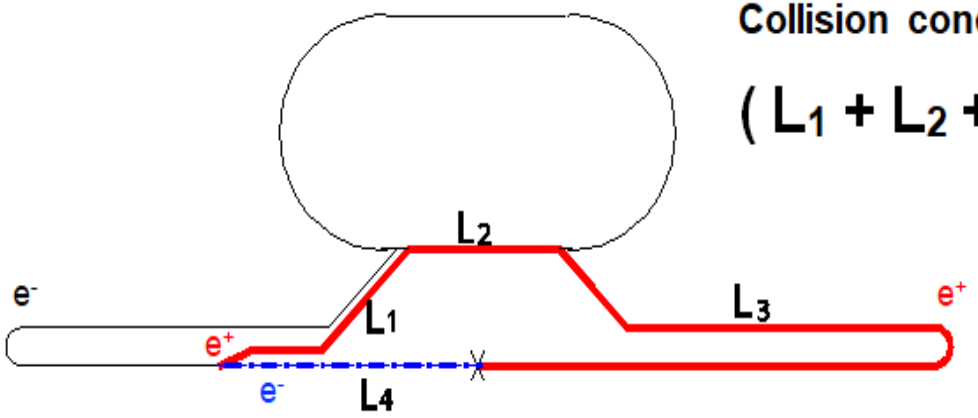
Shin MICHIZONO

- *Positron production options*
- *Variants of the baseline (Options A/B/C)*
- *SRF R&D and resulting cost reduction*
- *Improvement of Luminosity*
- *Cost estimate for ILC 250 GeV*

ILC Undulator-based e+ Source



-Positrons can be generated by increasing the undulator length from 147 m to 231 m.
-This longer undulator source of positrons is the new baseline for the ILC250GeV staging.
-Electrons lose ~3 GeV in the undulator and this is compensated by the main electron linac.
-Collision condition constraint should be satisfied at Undulator source.



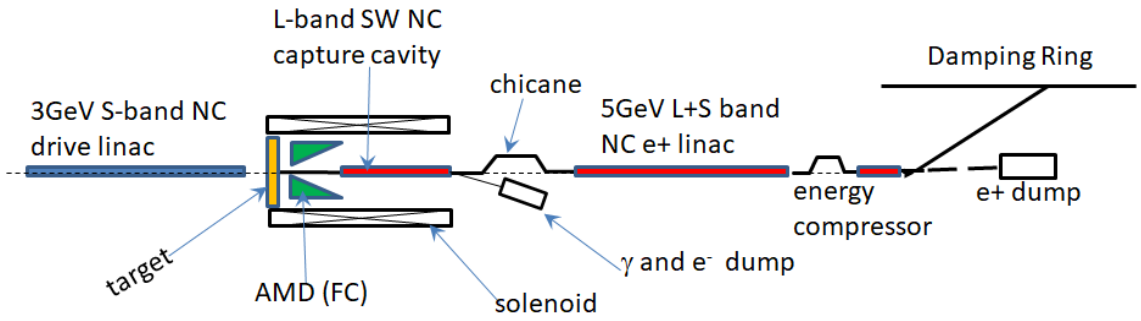
Collision condition

$$(L_1 + L_2 + L_3) - L_4 = n \times C_{DR}$$

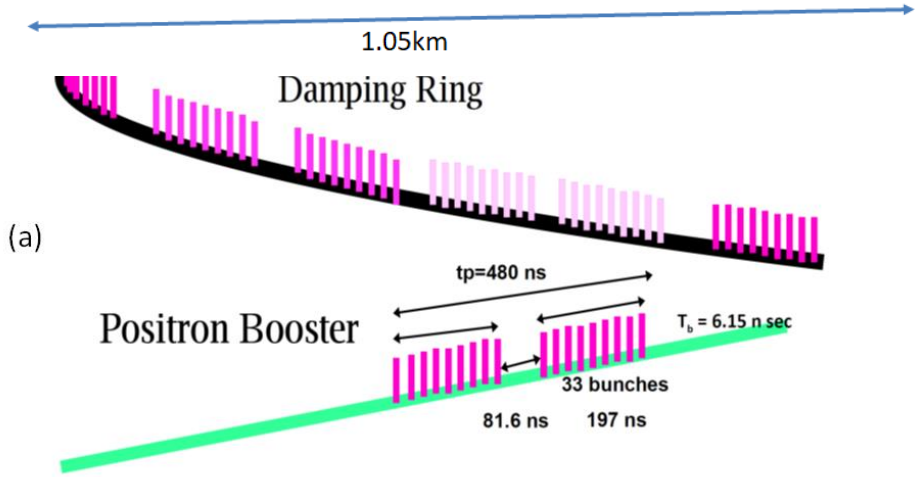
n = integer

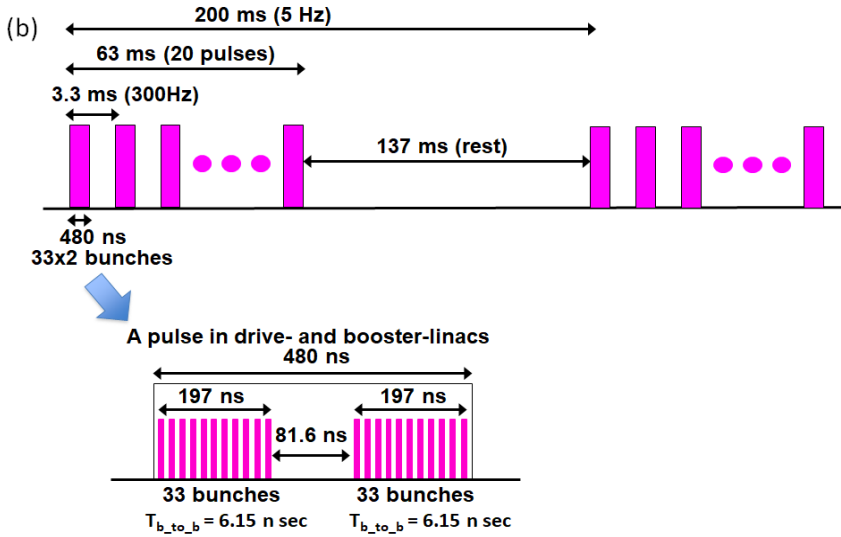
L_3 (e^+ ML/RTML) has to be adjusted.

E-driven ILC Positron Source



Presentation at LCB





-Different electron bunch patterns will be used (from undulator system).
-Beam pulses with ~480 ns duration (including ~66 bunches) will be accelerated in the normal conducting linacs.
-The linacs will operate at 20 pulses every 200 ms, with inter-pulse intervals of 3.3 ms.
-The remaining 137 ms will be reserved for damping of positrons in the damping ring.

Cost comparison and Luminosity upgrade

-No cost difference between accelerator components for the undulator and e-driven.
-Some cost reduction (of the order of a few ten's of MILCU*) associated with the e-driven system is expected, if the space for the timing constraint in the undualtor scheme is omitted.

Presentation at LCB

-The undulator source will still be considered as the baseline source of positrons.
-However, an e-driven source of positrons can be adopted initially for ILC250 GeV and be replaced by undulator in future upgrades, depending on the technical maturity, because the e-driven source is safer for achieving design luminosity at low electron energies (~125 GeV) and has the big advantage that positron beam commissioning can be done without needing the full electron linac and damping ring.

-The basic change in the luminosity upgrade is the increase in the number of bunches from 1,312 to 2,625.
-In the case of the e-driven, one more positron damping ring is required because beam-loading compensation is difficult to realize with a 3-ns-wide bunch spacing.
-The driving beam linac should be extended from 3 GeV to 4.8 GeV and the modulators of the driving linac and booster should be reinforced owing to longer beam pulse durations.

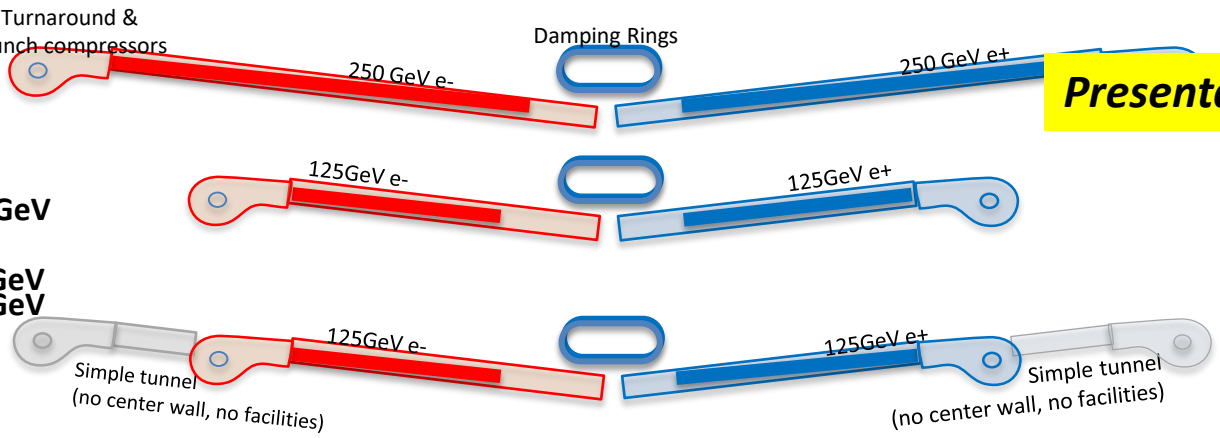
*The reference currency (the "ILCU") is the United States dollar (USD) as of January, 2012.

Options for ILC250GeV

TDR update:

renamed

Options A, A': 250 GeV tunnel
Options B, B': 350 GeV tunnel
Options C, C': 500 GeV tunnel



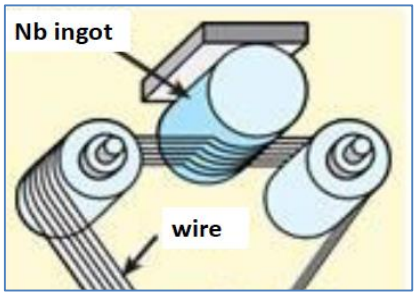
Presentation at LCB

-Collision timing constraint is included.
-Energy reach margin is considered
(1) Module margin: 2.5% (3.1 GeV in each linac) to reach the target energy.
(2) Availability margin: 3% (3 RF units) for a cryomodule trip.
(3) Space margin: allow for more cryomodules to be installed in the future.
At all times, 0.5% is required to compensate for cavity phase offset.
Total energy balance is 2% (=1.5%+0.5%) @TDR and 6% (=2.5%+3%+0.5%) @ILC250GeV.

Options	Gradient [MV/m]	E_{CM} [GeV]	Total E_{CM} Margin	n	Space margin	Reserved tunnel	Total tunnel
TDR update	31.5	500	2%	10	1,473 m	0 m	33.5 km
Option A		250	6%	6	583 m	0 m	20.5 km
Option B				6&8		3,238 m	27 km
Option C				6&10		6,477 m	33.5 km
Option A'	35			6	1,049 m	0 m	20.5 km
Option B'				6&8		3,238 m	27 km
Option C'				6&10		6,477 m	33.5 km

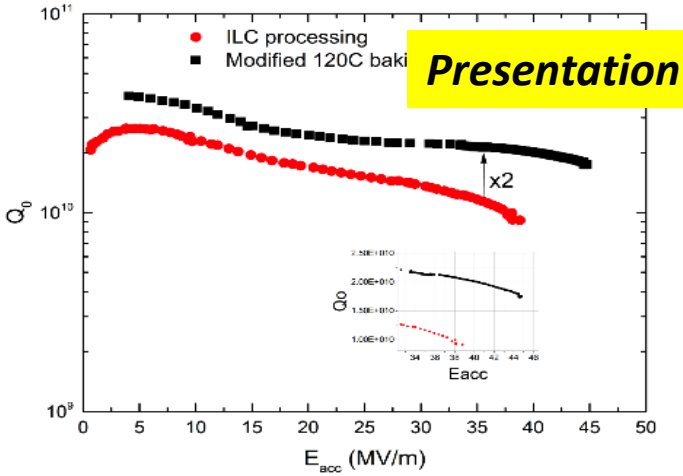
cost reduction R&D

Preparation of niobium materials (processing for sheet fabrication and piping)



Direct slicing from ingot material

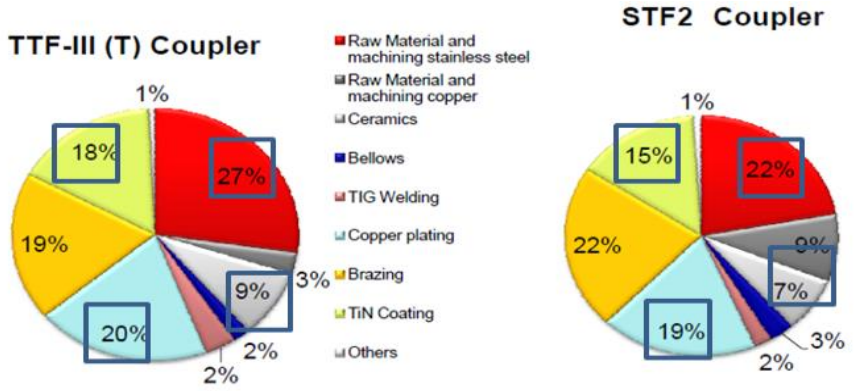
SRF cavity fabrication to ensure a high gradient and high Q (N-infusion)



Presentation at LCB

New treatment to improve performance

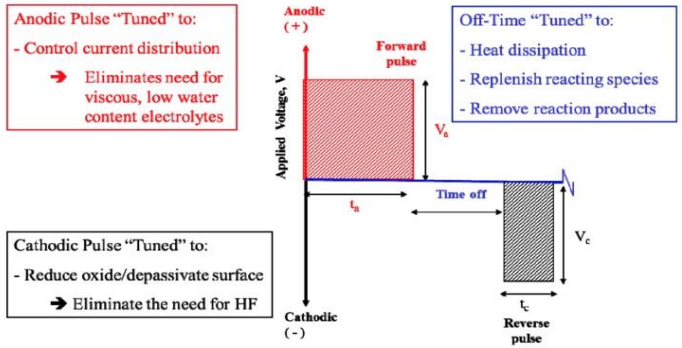
Power input coupler fabrication



TTF-III (T) : Toshiba modifying version

Material (incl. coating) and Cu plating optimization

Cavity chemical treatment



HF free chemical treatment

Total ~6% reduction at ILC250GeV

Improvement of Luminosity

Presentation at LCB

ILC TDR is optimized for 500GeV CM.
Luminosity is re-optimized at 250GeV CM.
The luminosity is proportional to P_B/E x $(\delta_{BS} / \varepsilon_{ny})^{½}$
where P_B is the beam power, δ_{BS} the loss of energy associated with beamstrahlung, and ε_{ny} the normalized vertical emittance.
To increase P_B is costly and to decrease ε_{ny} requires tighter alignment tolerance of the main linac.
Therefore, we choose to accept a larger δ_{BS}, which is still small (~1%) at 250 GeV.
The best way to increase δ_{BS} is to reduce the horizontal beam size at the IP by reducing the horizontal normalized emittance ε_{nx}.
This is achieved by slightly changing the design of the damping rings (using longer dipole magnets in the arcs).
The resulting luminosity is 1.35 × 10^{34} /cm^2/s at 250 GeV, ***a factor 1.65 higher than that for the TDR***.

Results of cost estimate

The cost estimate is carried out with the ILCU (USD as of January, 2012).
RF unit cost and other unit cost is calculated from TDR.
The staging cost is obtained by subtracting the decreased number of units.
Reduced volume production effect and price fluctuation from 2012 are ignored because these depend on the different components.
Options A'/B'/C' include the effect the cost reduction R&D.

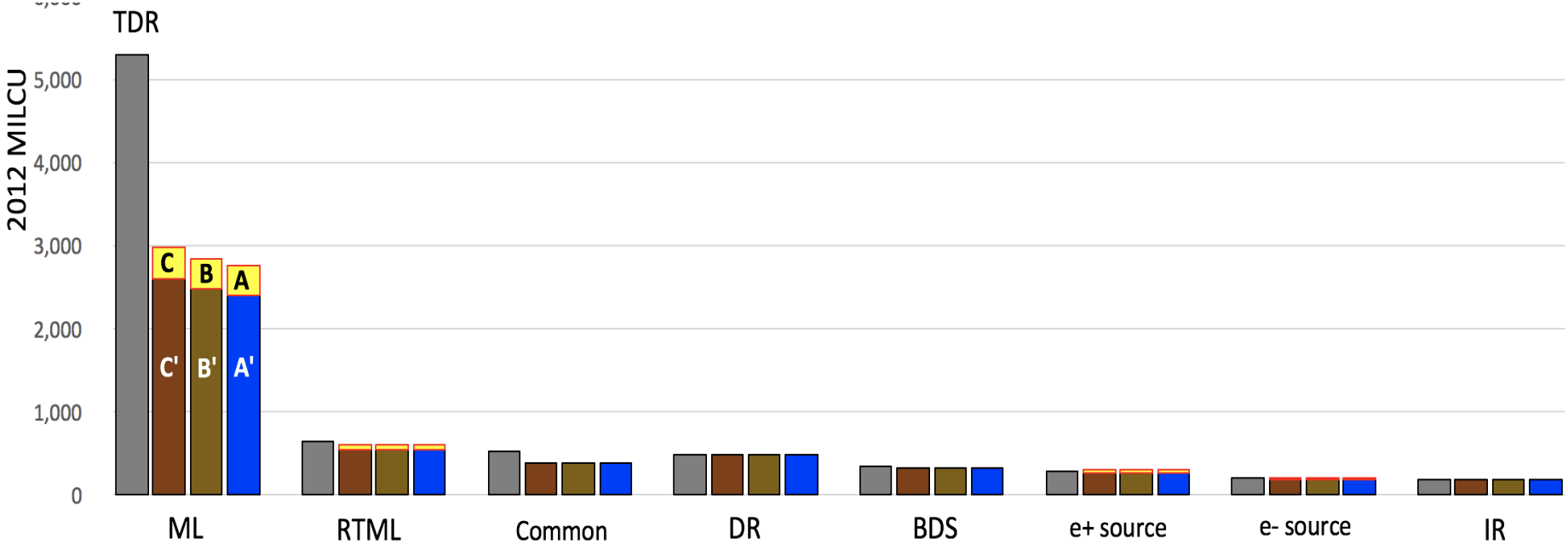
Presentation at LCB

	e+/e- collision [GeV]	Tunnel Space for [GeV]	Value Total (MILCU)	Reduction [%]
TDR	250/250	500	7,980	0
TDR update	250/250	500	7,950	-0.4
Option A	125/125	250	5,260	-34
Option B	125/125	350	5,350	-33
Option C	125/125	500	5,470	-31.5
Option A'	125/125	250	4,780	-40
Option B'	125/125	350	4,870	-39
Option C'	125/125	500	4,990	-37.5

Results of cost estimate

Presentation at LCB

The Value estimates broken down by the area systems.
The cost reduction from the TDR is mainly coming from the main linac owing to the smaller SRF system and shorter tunnel length.
The difference from Option A to A' results from the cost reduction R&D.
Simple and empty tunnels are added to the upstream side in the case of Options B and C (B' and C'), resulting in the cost difference between Options A, B, and C.
"Common" consists of common parts in the ILC laboratory, such as the main campus, the main AC power station, general computing system (laboratory networking, e-mail system, business computers etc.), accelerator installation and control systems.
These costs are saved due to the reduction of human resources and ML energy



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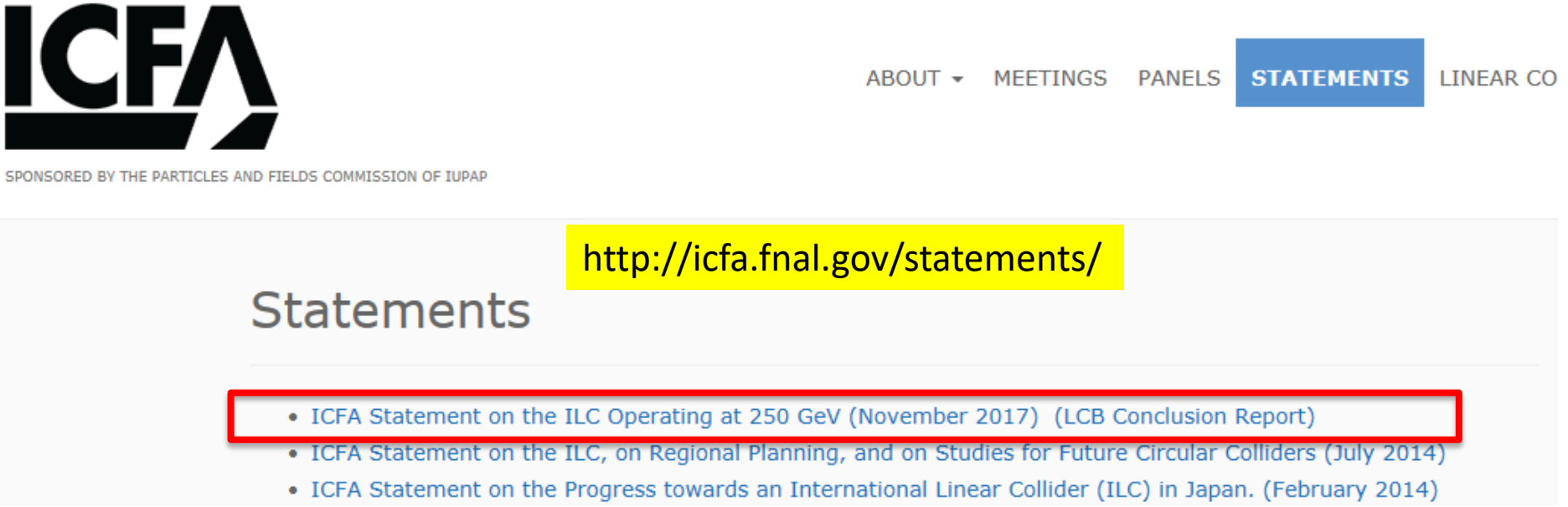
ICFA statement / LCB conclusion report



ICFA Statement on the ILC Operating at 250 GeV as a Higgs Boson Factory

The discovery of a Higgs boson in 2012 at the Large Hadron Collider (LHC) at CERN is one of the most significant recent breakthroughs in science and marks a major step forward in fundamental physics. Precision studies of the Higgs boson will further deepen our understanding of the most fundamental laws of matter and its interactions.

The International Linear Collider (ILC) operating at 250 GeV center-of-mass energy will provide excellent science from precision studies of the Higgs boson. Therefore, ICFA considers the ILC a key science project complementary to the LHC and its upgrade.

ICFA welcomes the efforts by the Linear Collider Collaboration on cost reductions for the ILC, which indicate that up to 40% cost reduction relative to the 2013 Technical Design Report (500 GeV ILC) is possible for a 250 GeV collider.

ICFA emphasizes the extendibility of the ILC to higher energies and notes that there is large discovery potential with important additional measurements accessible at energies beyond 250 GeV.

ICFA thus supports the conclusions of the Linear Collider Board (LCB) in their report presented at this meeting and very strongly encourages Japan to realize the ILC in a timely fashion as a Higgs boson factory with a center-of-mass energy of 250 GeV as an international project[1], led by Japanese initiative.

[1] In the LCB report the European XFEL and FAIR are mentioned as recent examples for international projects.

Ottawa, November 2017

http://icfa.fnal.gov/wp-content/uploads/ICFA-Statement-Nov2017.pdf

Conclusions on the 250 GeV ILC as a Higgs Factory proposed by the Japanese HEP community
- Short Summary -

http://icfa.fnal.gov/wp-content/uploads/LCB-Short-Conclusion-Nov2017.pdf

Linear Collider Board

8 November 2017, Rev 1

Physics studies by the Linear Collider Collaboration Physics and Detector Group [1], and the Japanese Association of High Energy Physicists (JAHEP) [2] show a compelling physics case for constructing an ILC at 250 GeV centre of mass energy as a Higgs factory. The cost of such a machine is estimated to be lower by up to 40% compared to the originally proposed ILC at 500 GeV [3]. The acceleration technology of the ILC is now well established thanks to the experience gained from the successful construction of the European XFEL in Hamburg. One of the unique features of a linear collider is the capability to increase the operating energy by improving the acceleration technology and/or extending the tunnel length. For these reasons, the Linear Collider Board strongly supports the JAHEP proposal [4] to construct the ILC at 250 GeV in Japan and encourages the Japanese government to give the proposal serious consideration for a timely decision.

In recent examples of similar international projects[1], the host country made the majority contribution. A natural expectation would be that the cost for the civil construction and other infrastructure is the responsibility of the host country, while the accelerator construction should be shared appropriately. A clear expression of interest to host the machine under these principles would enable Japan to start negotiations with international partners. It would also allow members of the international community to initiate meaningful discussions with their own governments on possible contributions.

References

[1] K. Fujii et. al. (Linear Collider Collaboration), "Physics Case for the 250 GeV Stage of the International Linear Collider", DESY-17-155 / KEK Preprint 2017-31 / LAL 17-059 / SLAC-PUB-17161, arXiv:1710.07621 [hep-ex].

[1] Recent examples in the field close to the ILC are European XFEL and FAIR in Germany.

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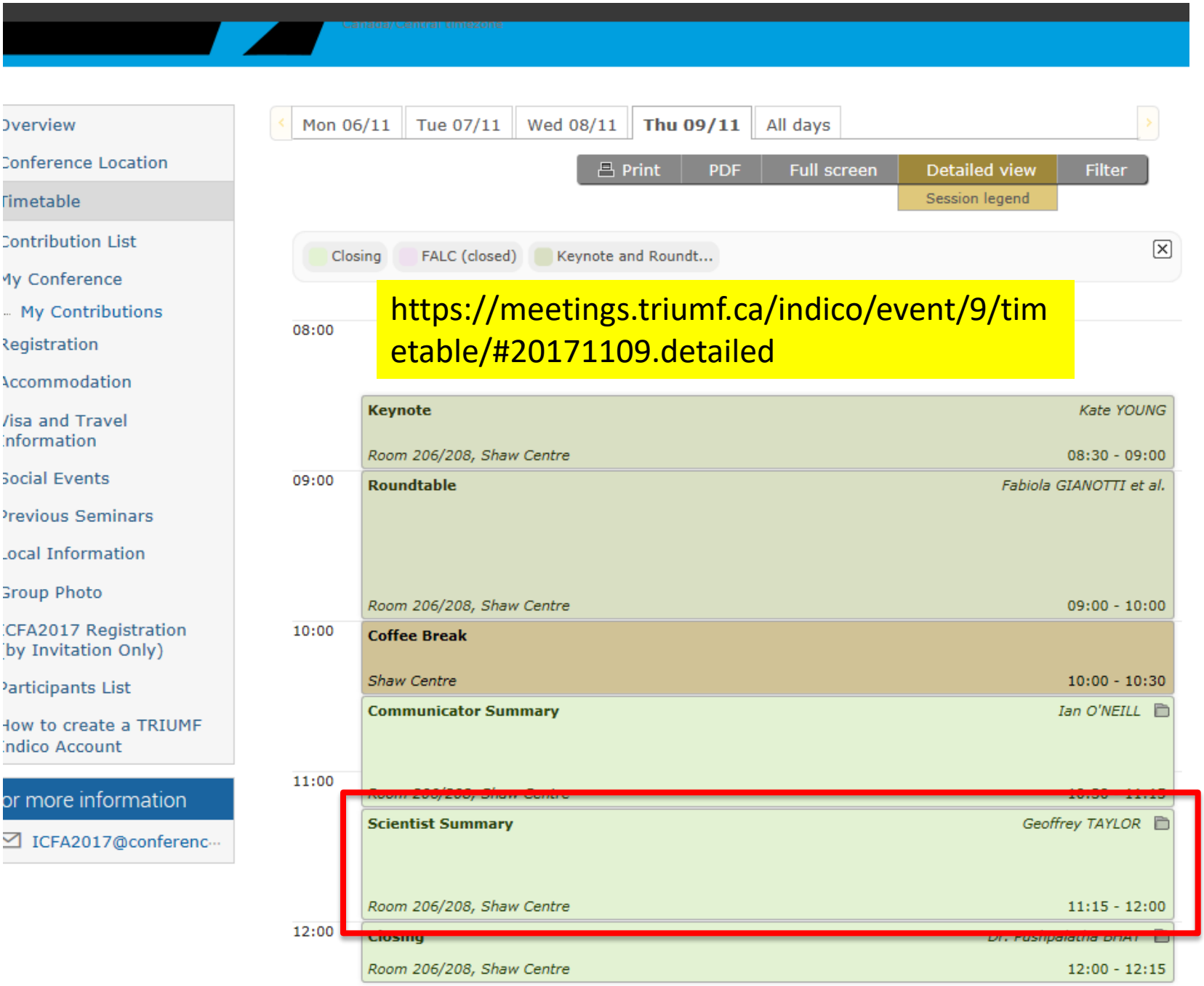
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09:00
10:00
11:00
12:00
Keynote
Kate YOUNG
Room 206/208, Shaw Centre
08:30 - 09:00
Roundtable
Fabiola GIANOTTI et al.
Room 206/208, Shaw Centre
09:00 - 10:00
Coffee Break
Shaw Centre
10:00 - 10:30
Communicator Summary
Ian O'NEILL
Scientist Summary
Geoffrey TAYLOR
Room 206/208, Shaw Centre
11:15 - 12:00
Room 206/208, Shaw Centre
12:00 - 12:15

GEOFFREY TAYLOR, ICFA CHAIR-ELECT

SCIENTIST SUMMARY
ICFA SEMINAR OTTAWA 2017

Geoffrey Taylor, CoEPP, The University of Melbourne

CoEPP
ARC Centre of Excellence for Particle Physics at the Terascale

ILC – READY FOR APPROVAL?

- Many reports demonstrating advanced status of
  - Physics Motivation
  - Machine Design
  - Experiment Concepts and Technology
- But the price tag close to O(10^{10})
  - ILC250 (with Upgrade capacity)
  - Major cost reduction.
  - Higgs Factory - excellent first stage for ILC

ICFA/LCB CHAIR – TATSUYA NAKADA PRESENTATION

Reporting on LCB meeting on 9 August 2017 in Guangzhou

"... PHYSICS STUDIES BY THE LCC PHYSICS AND DETECTOR GROUP AND THE JAHEP MAKE IT CLEAR THAT THERE IS A COMPELLING PHYSICS CASE FOR THE ILC BUILT AT 250 GEV. AND THE COST OF SUCH MACHINE IS AT A LEVEL OF SOME OF THE EXISTING LARGE INTERNATIONAL SCIENTIFIC FACILITIES.

FOR THESE REASONS, THE LCB STRONGLY SUPPORTS THE JAHEP CONCLUSION TO PROMPTLY CONSTRUCT THE ILC AT 250 GEV IN JAPAN AND ENCOURAGES THE JAPANESE GOVERNMENT TO GIVE THEIR PROPOSAL VERY SERIOUS CONSIDERATION WITH A FAVOURABLE CONCLUSION..."

THE ILC IS WELL ESTABLISHED

- NLC, JLC, …from before 1990!
- OECD - GSF conclusion 2002!
- ILC-GDE Director (2005-2013), Barry Barish, in the meantime has built LIGO and Advanced LIGO, found gravity waves and been awarded the Nobel prize !
- The Cost Reduction strategy has been successful.
  - Maintain capacity to upgrade to 350-380 GeV
  - But seek approval now, for commencement of ILC250
  - Clear guidance needed for upcoming European Strategy and P5 deliberations

Time to move!

ICFA STATEMENT ON THE ILC OPERATING AT 250 GEV AS A HIGGS BOSON FACTORY

The discovery of a Higgs boson in 2012 at the Large Hadron Collider (LHC) at CERN is one of the most significant recent breakthroughs in science and marks a major step forward in fundamental physics. Precision studies of the Higgs boson will further deepen our understanding of the most fundamental laws of matter and its interactions.

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ICFA emphasises the extendibility of the ILC to higher energies and notes that there is large discovery potential with important additional measurements accessible at energies beyond 250 GeV.

ICFA thus supports the conclusions of the Linear Collider Board (LCB) in their report presented at this meeting and very strongly encourages Japan to realize the ILC in a timely fashion as a Higgs boson factory with a center-of-mass energy of 250 GeV as an international project[1] , led by Japanese initiative.

1 In the LCB report the European XFEL and FAIR are mentioned as recent examples for international projects.

Ottawa, November 2017

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Recent topics

1. MEXT survey of the cost reduction R&D by new technology
   In this fiscal year, KEK get a contract about "survey of cost reduction R&D" from MEXT.
   We will survey and make some study about cost reduction (like N-infusion) by this budget.
   The cost reduction session during LCWS2017 is helpful to this survey.
   The external advisory committee will check the survey and next advisory committee will be held on Nov.20. We will report R&Ds of Nb material, N-infusion, input coupler, and normal conducting linear collider (CLIC).
2. KEK's re-estimate of staging cost at 2017 base
   After the endorsement of staging at ICFA seminar, we expect that MEXT advisory panel will be held to estimate the staging on the end of January or early Feburary.
   Since we will be probably asked the staging cost (when we will build ILC in Japan not 2012 but 2017 base) at the panel , KEK has just started the re-estimate of the staging on 2017 base in two months (before the coming advisory panel).
   Of course it is impossible to gather the new cost like GDE era, the accelerator will re-estimate the typical items.
   Nb material, Nb cavity, input coupler, klystron In addition, we will check the items not included in TDR.