

ILC Status

Scientific Progress
Political Progress

K. Yokoya

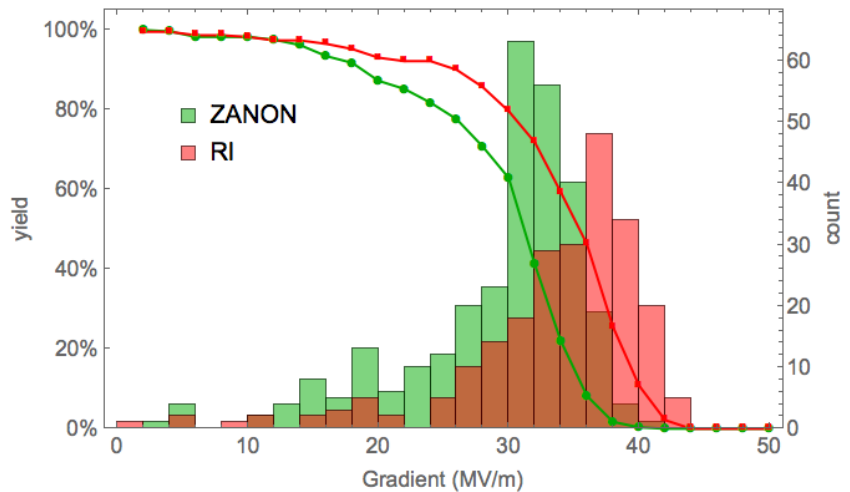
2015.9.2 POSIPOL, Daresbury

Scientific Progress

- R&D Progress
 - XFEL cavity/cryomodule
 - KEK-STF
 - KEK-ATF2
 - Positron
- Design change / Site-specific Design
 - Change Requests

XFEL Results: Extrapolation to ILC - VT

- ILC TDR assumed VT acceptance > 28MV/m (XFEL >20 MV/m)
 - Average of 35 MV/m (XFEL 26 MV/m)
 - Assumed first-pass yield: 75%
 - 25% cavities retreated to give final yield of 90% >28 MV/m (35 MV/m average)
 - 10% over-production assumed in value estimate



Cavities	522	(88%)
Tests	522	(63%)

	Tests	Average	RMS	Yield@20	Yield@26	Yield@28
ZANON	291	29.3	6.8	87%	78%	71%
RI	231	33.6	7.	93%	90%	86%
All	522	31.2	7.2	90%	83%	77%

RI results only (ILC recipe)		ILC TDR (assumed)	XFEL	
			max	usable
First-pass	Yield >28 MV/m	75%	86%	53%
	Average >28 MV/m	35 MV/m	36 MV/m	33.5 MV/m
First+Second pass	Yield >28 MV/m	90%	92%	80% *
	Average >28 MV/m	35 MV/m	36 MV/m	33 MV/m

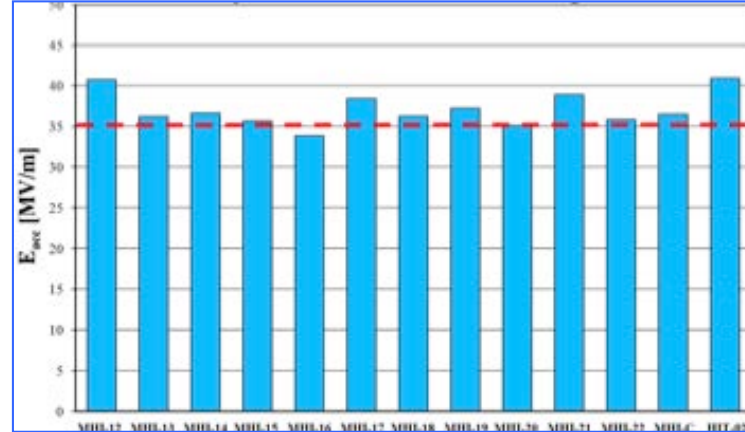
* based on re-treatment model using XFEL data

✓ but close! ✗

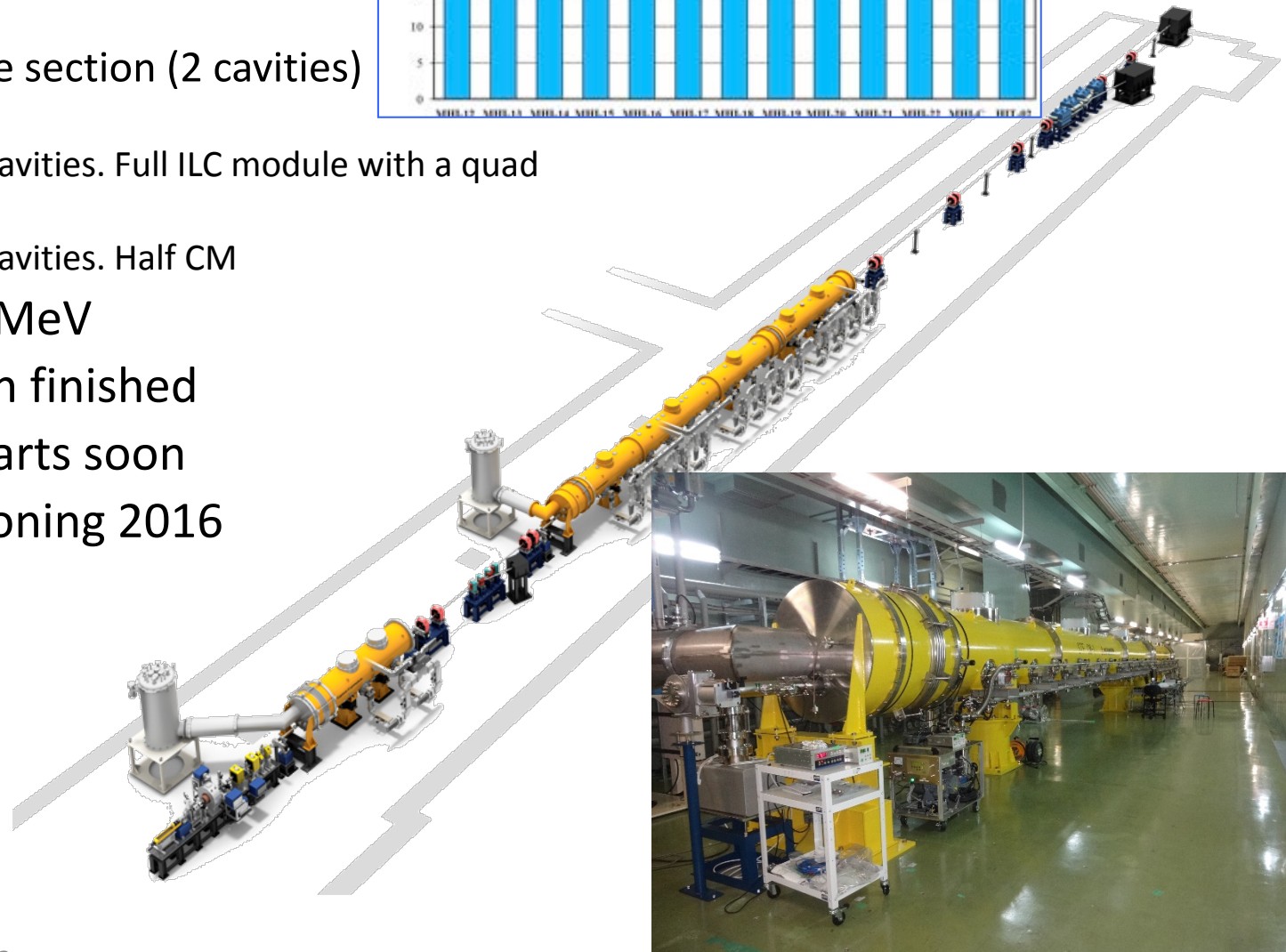
N.Walker, Apr.2015

KEK-STF

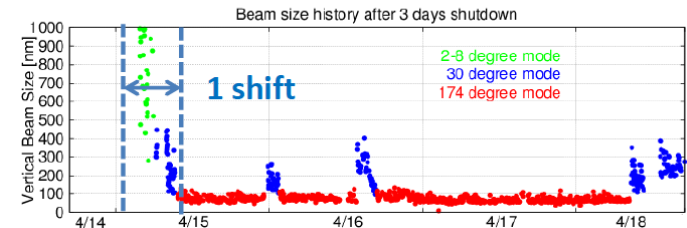
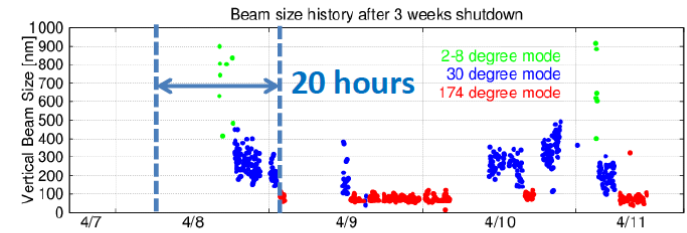
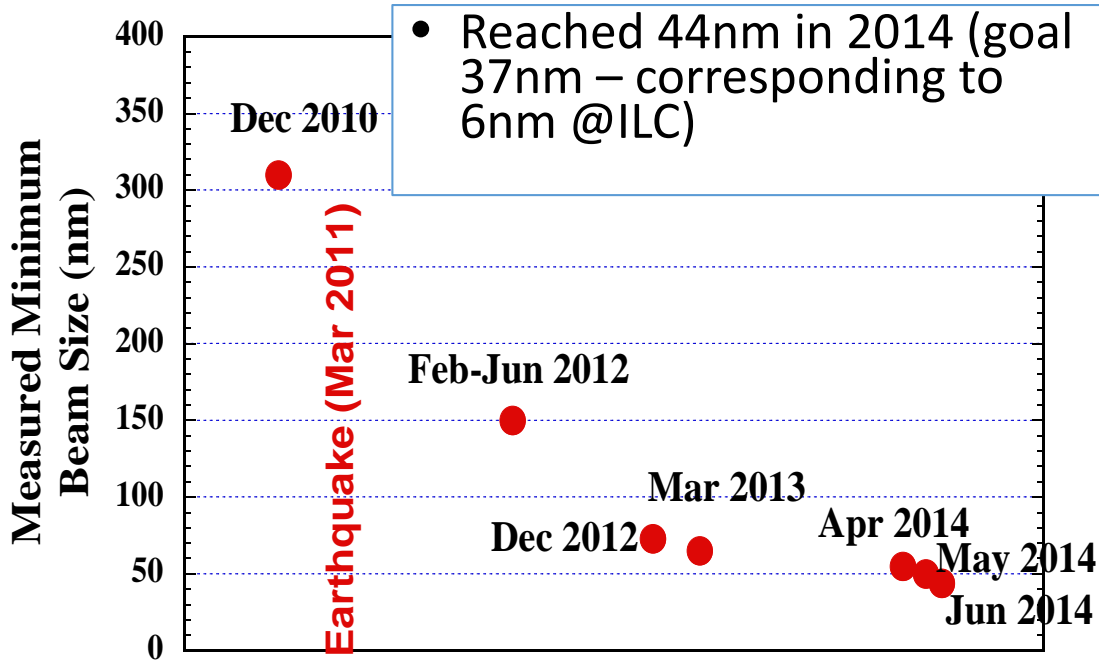
- Consisting of
 - RF-gun
 - Capture section (2 cavities)
 - CM1
 - 8 cavities. Full ILC module with a quad
 - CM2a
 - 4 cavities. Half CM
- Up to 420MeV
- Installation finished
- Cooling starts soon
- Commissioning 2016



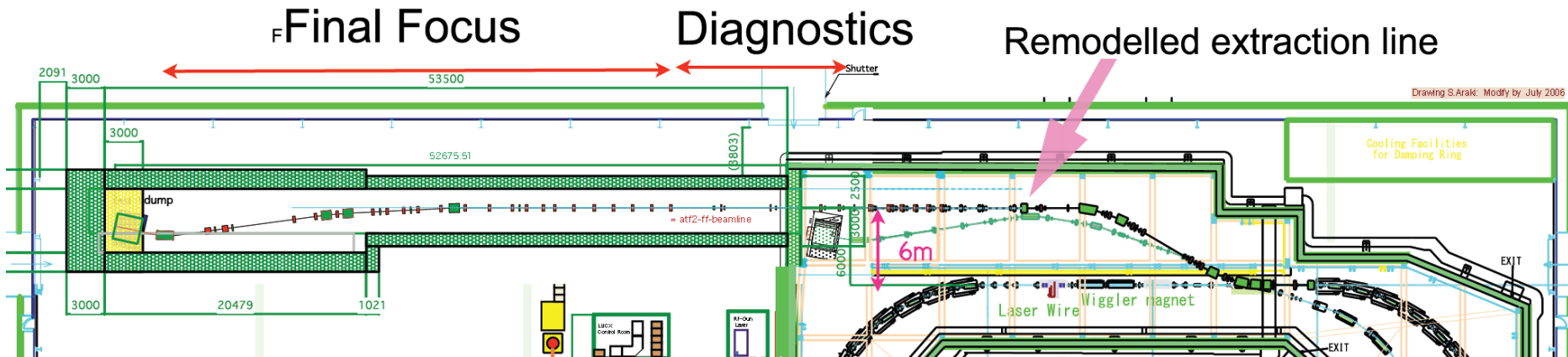
Vertical tests
>90%
>35MV/m



KEK-ATF2



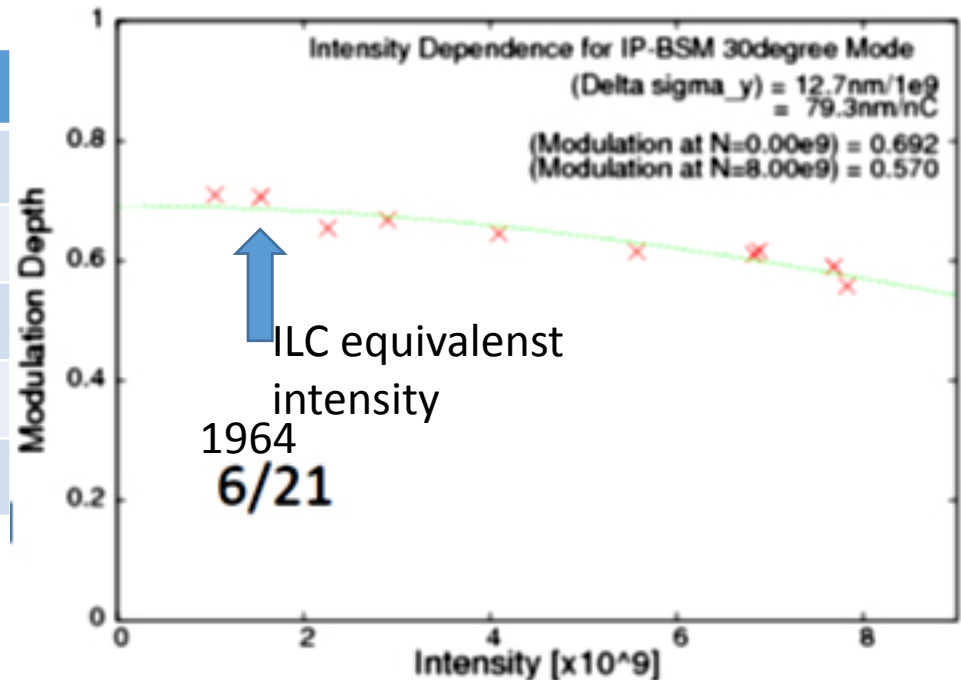
Quick tuning in ~20 hrs



Intensity Dependence of the Beam Size

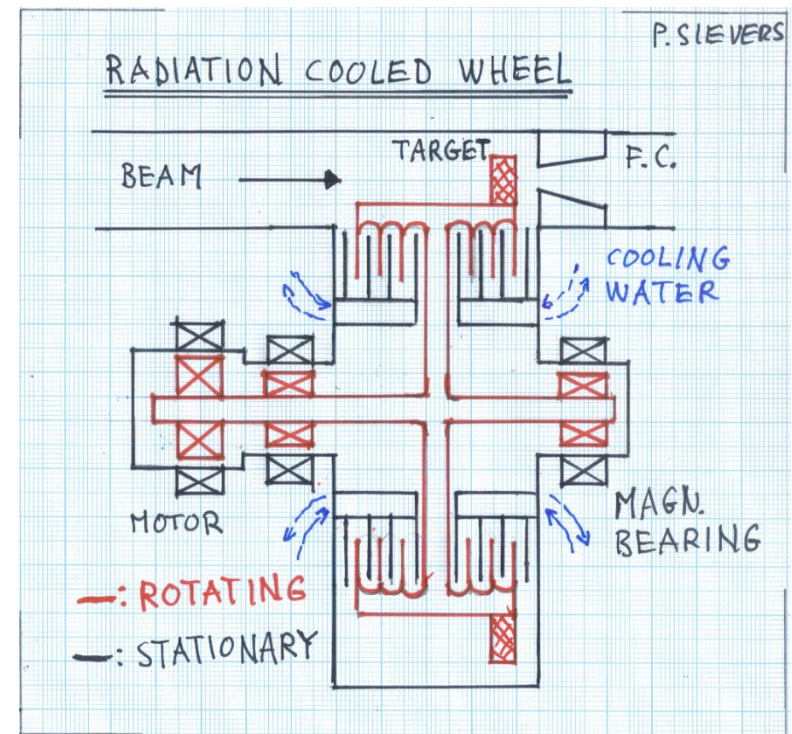
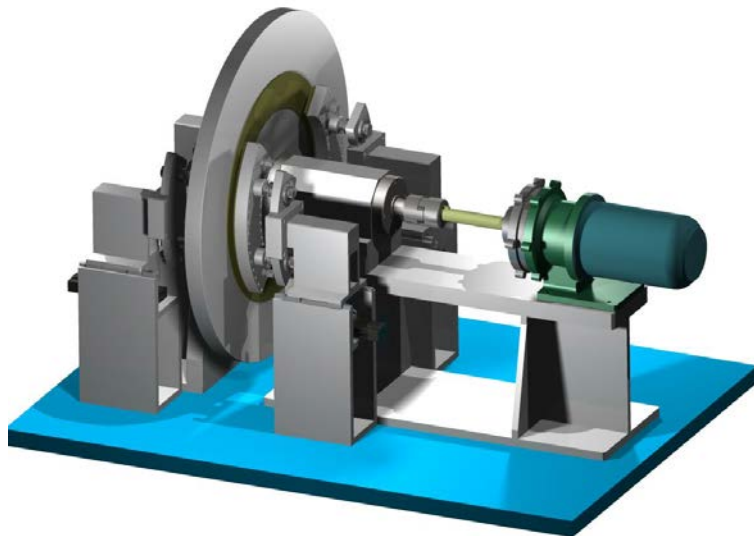
- ATF2 beam size strongly depends on the beam intensity
- Already visible at $N \sim 3 \times 10^9$
- ILC design $N = 2 \times 10^{10}$
- But ILC beam size is much less sensitive to the intensity (more than 1 order of magnitude)

	ATF2	ILC500GeV	ILC/ATF
Energy	1.3GeV	250GeV	0.0052
Bunch length	7mm	0.3mm	~ 0.5
Emittance	12pm	0.07pm	13.1
Beta	$241 \text{ m}^{1/2}$	$557 \text{ m}^{1/2}$	2.31
total			0.078



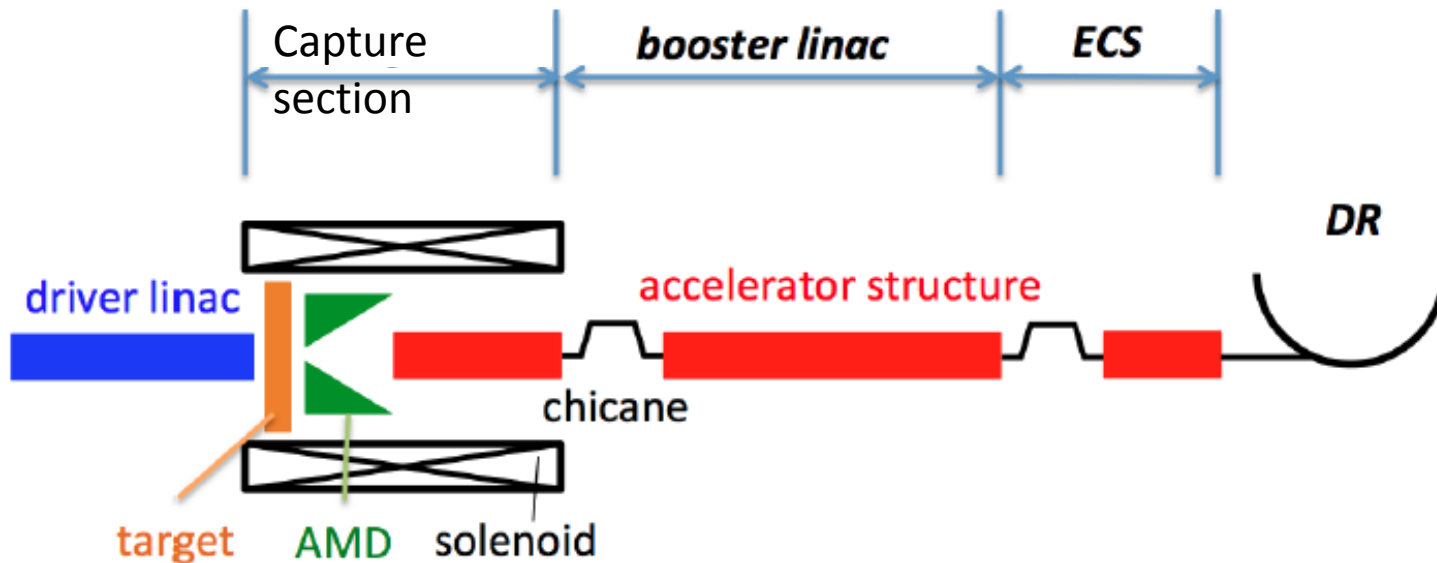
Positron

- Positron target is the only item that requires substantial technology progress
- Rotating target for the undulator (baseline) scheme
 - Problem: rapidly rotating wheel in vacuum
 - 2 solutions under study
 - Sliding contact cooling
 - Radiation cooling



Positron (continued)

- Backup scheme in detailed study
 - Conventional (electron-driven)
 - 6GeV electron
 - All normal-conducting
- Cannot decide now

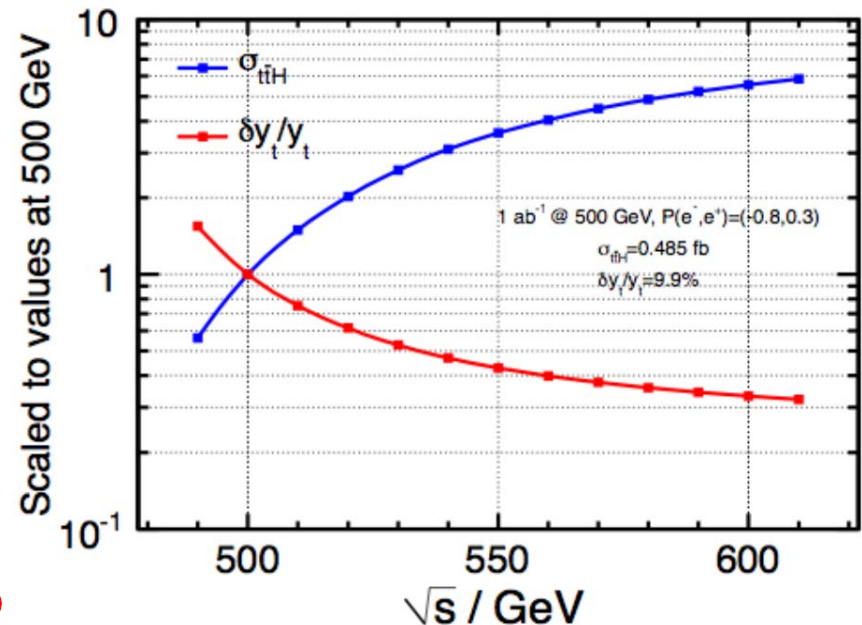
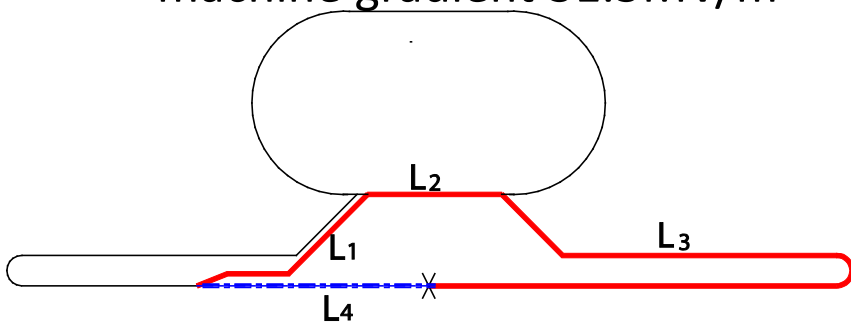


Design Changes since TDR

- CR2: Equal L^* for SiD and ILD
- CR3: Vertical shaft access for detector hall
- CR4: ML tunnel extension by 2 x 1.5km
- CR5: Correction of the luminosity params etc.
- CR6: Add BPM downstream of QD0
- CR7: Adoption of mountain-site design for all
- CR8: TDR lattice 2015a
- Other expected changes
 - ML tunnel shielding thickness
 - Location of cryogenics (mostly to under ground)
 - Tunnel compatible with e-driven positron source

ML tunnel extension by 2 x 1.5km

- TDR geometry does not satisfy $(L_1 + L_2 + L_3) - L_4 = n \times C_{DR}$, but $(L_1 + L_2 + L_3) - L_4 = 9 \times C_{DR} + 294\text{m}$
- This can be solved by slightly lengthen C_{DR} , but a better solution is to extend the main linacs by 1.5km (14%) each.
- This is too expensive, but to extend only the tunnel to prepare for the future extension is realistic.
- 2 merits:
 - Max energy may be extended beyond 500GeV (Note: threshold of $e^+ e^- \rightarrow t t H$ at $E_{CM}=475\text{GeV}$)
 - More margin from the accelerator side for the machine gradient 31.5MV/m



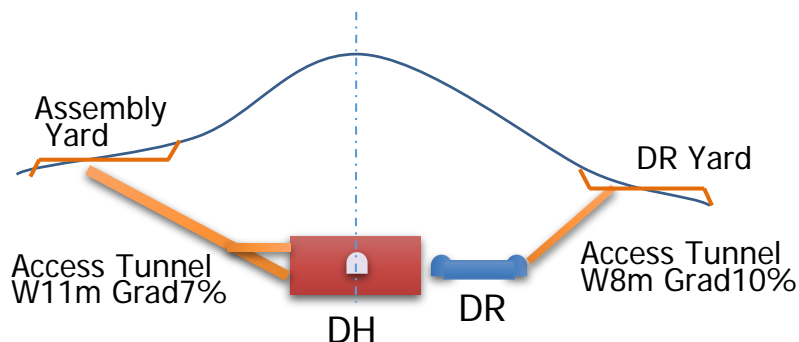
Detector Hall (DH) with Vertical shaft

(An example of site-specific design)

- TDR written with generic (mountain) site in mind
- But IP in Kitakami site turned out to be not too deep

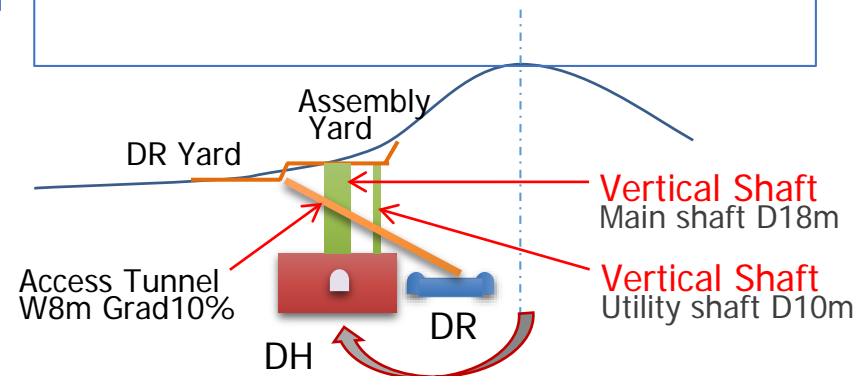
TDR

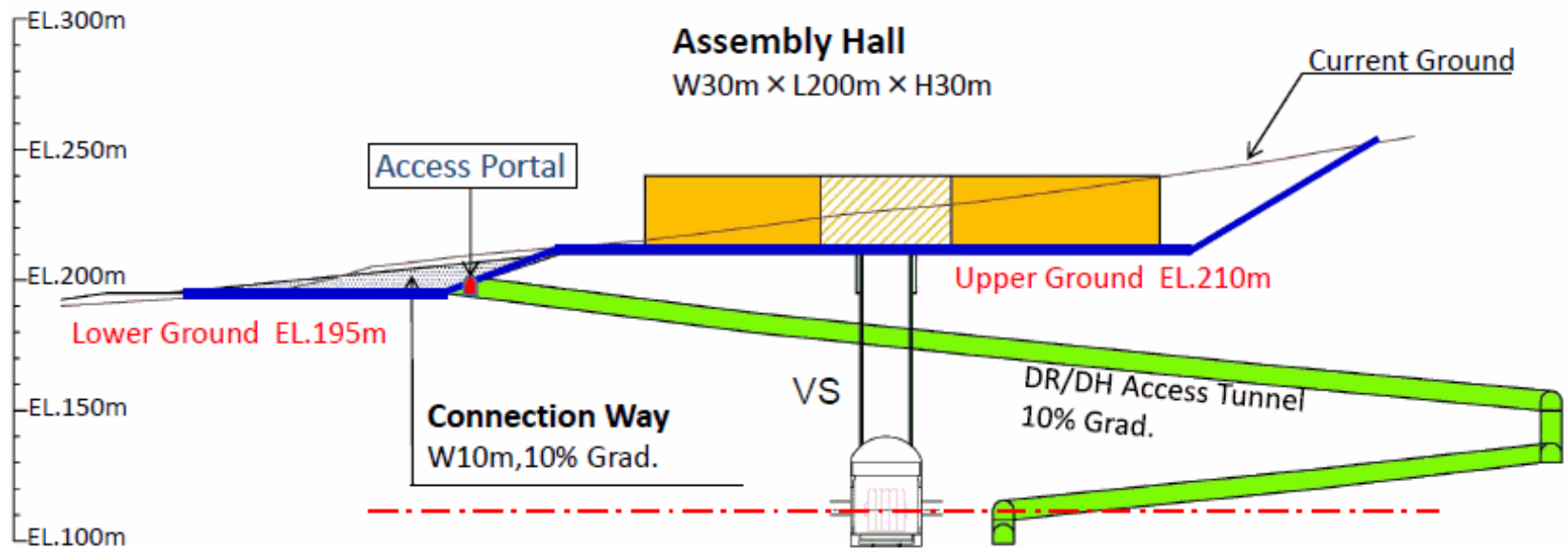
- Access to DH --- horizontal tunnel
- Transport --- special long trailer
- Assembly --- underground



New Baseline

- Access to DH --- vertical shaft
- Transport --- gantry crane
- Assembly --- surface building





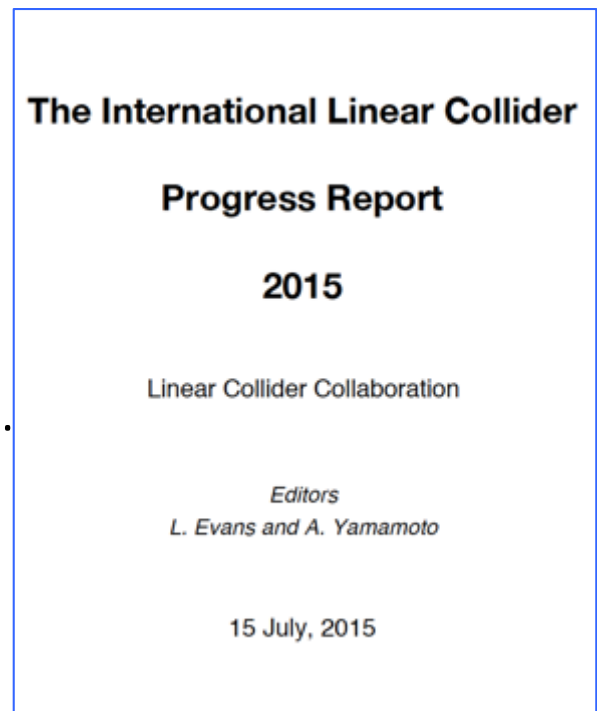
Longitudinal section

LCC-ILC Progress Report, after TDR

prior to the commissioned survey 2015

- It contains the LCC-ILC technical progress after TDR, respecting:
 - *Civil engineering studies*
 - *Accelerator hardware design/development updates*
 - *Accelerator system layout updates*
 - *Integration/test facilities to be prepared for “hub-laboratory functioning”*
 - *Project Implementation plan*
 - *Further preparatory work*
 - *Summary*
- To be a useful document for preparing the survey and/or evaluation on the ILC activities.
- *Recognition by LCB and registration of the report at each laboratory will be much appreciated.*

A.Yamamoto



Political Progress

- SCJ (Science Council of Japan) report (Sep.2013)
- MEXT (Ministry of Education, Culture, Sport, Science, Technology of Japan) response
 - Task force
 - Advisory Panel
 - Working groups
 - Commissioned surveys
- Congress (Federation of Diet Members)
- Industries (AAA)

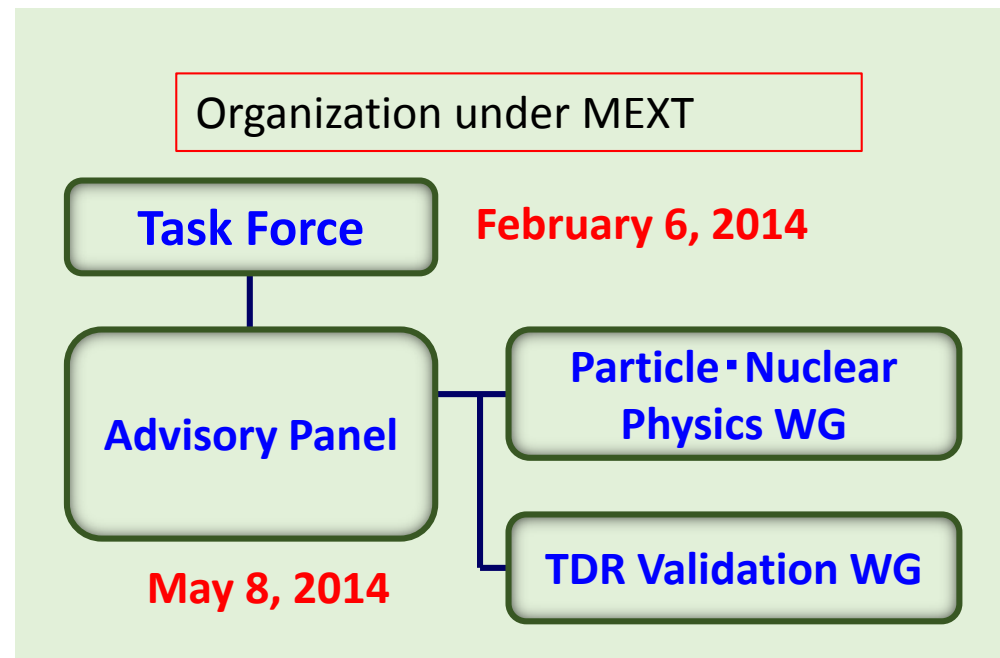
SCJ Report (Sep.2013)

Conclusion from the academic side

- SCJ (Science Council of Japan) issued “Remarks on the International Linear Collider Project”
http://www.scj.go.jp/ja/info/kohyo/pdf/Report%20on%20ILC_Executive%20Summary.pdf
- We **recognize the scientific merit** of the project in elementary particle physics.
- However,...in light of the huge investment necessary for the project, **a clearer and more convincing explanation for the ILC project, including the relation with the LHC**, is desirable.
- It is too early to approve the project at the present time...We recommend to the government to **approve funding for further necessary investigations to evaluate whether to go ahead with the ILC project** and to **proceed with intensive investigations and discussions for two or three years, including experts in other fields and relevant government agencies**
- It is necessary **to have discussions** with the research institutes and the responsible funding authorities of key countries and regions involved **outside of Japan**, and to obtain clear understanding of the expected **sharing of the financial burden**.

Response of MEXT

- Based on the recommendation of SCJ Sep.2013, MEXT set up an internal (within MEXT) task force in Feb.2014.
- Under the task force, “Advisory Panel”, consisting of science experts, was formed in May 2014.
 - Conclusion by Mar.2016, but might be later
- Advisory Panel set up 2 working groups:
 - ✓ Elementary particle physics and nuclear physics working group
 - ✓ TDR-validation working group
- MEXT also asked a commissioned survey
→ next page



MEXT survey

- In 2014 MEXT commissioned “Survey of spin-off effects of the ILC project from technical and economic aspects and research trends in elementary particle physics and nuclear physics including necessary technologies in the world” (国際リニアコライダー(ILC)計画に関する技術的・経済的波及効果及び世界各国における素粒子・原子核物理学分野における技術面を含む研究動向に関する調査分析)
- Done by NRI (Nomura Research Institute 野村総合研究所)
- Also reported in Apr.2015 meeting of Advisory Panel
- “the ILC project will in the end generate domestic demand worth JPY 2.10 trillion and lead to production worth JPY 4.46 trillion”

Activities of the Advisory Panel and WGs

Particle&Nuclear Physics WG		TDR Validation WG	
1 st Advisory Panel Meeting (14/5/08)			
6/24	Status and prospect for particle physics	6/30	Overall: Technology & cost
7/9	Strategies at EU and Ams	7/28	SRF technology & cost
8/27	Cosmic ray and astrophysics ILC science objects	9/8	SRF cost continued CFS technology & cost
9/22	Flavor and neutrino physics ILC science objects	11/4	ILC construction cost all
10/21	Summary discussion for a report		
2 nd Advisory Panel Meeting (14/11/14)			
1/8	Experience from SSC ILC Science objectives	1/26	Beam technology Human resources
2/17		3/2	Summary
3/30	Summary discussion for the report		
3 rd Advisory Panel Meeting (15/4/31)			
4 th Advisory Panel Meeting (15/6/25)			

Advisory Panel and Working Groups

- 2 WGs had 6-8 meetings each by early 2015 and wrote interim reports to the Advisory Panel
- NRI reported the spin-off survey results to the Advisory Panel
- Advisory Panel discussed on the WG reports and the survey report in the 3rd meeting in Apr.2015 and summarized the interim results in “**Summary of the International Linear Collider (ILC) Advisory Panel’s Discussions to Date**” (Not the final report)

Advisory Panel's Summary

- Recommendation 1: The ILC project requires huge investment that is so huge that a single country cannot cover, thus it is indispensable to share the cost internationally. From the viewpoint that the huge investments in new science projects must be weighed based upon the scientific merit of the project, a **clear vision on the discovery potential of new particles as well as that of precision measurements of the Higgs boson and the top quark** has to be shown so as to bring about novel development that goes beyond the Standard Model of the particle physics.
- Recommendation 2: **Since the specifications of the performance and the scientific achievements of the ILC are considered to be designed based on the results of LHC experiments, which are planned to be executed through the end of 2017, it is necessary to closely monitor, analyze and examine the development of LHC experiments.** Furthermore, it is necessary to clarify how to solve technical issues and how to mitigate cost risk associated with the project.
- Recommendation 3: While presenting the total project plan, including not only the plan for the accelerator and related facilities but also the plan for other infrastructure as well as efforts pointed out in Recommendations 1 & 2, **it is important to have general understanding on the project by the public and science communities.**

Advisory Panel's Summary (continued)

- International collaboration
 - The ILC project is an international project requiring enormous investment. It is necessary to conduct the project with **support not only by a single country but also by international collaboration.**
 - The cost should be shared in such kind of international collaboration. It is important to **confirm the willingness of each participating country to cover a reasonable part of the project cost.**
 - The European and American particle physics community expects Japan to proceed with the ILC project in line with their strategies. However, current plans and budget of their countries do not explicitly define the ILC project. **It is necessary to proceed based on worldwide attitudes to the ILC project.**
 - It should be noted that the ILC project will **lose international momentum** if decisions on the ILC project implementation are not made in a **timely manner.**

Advisory Panel's Summary (continued)

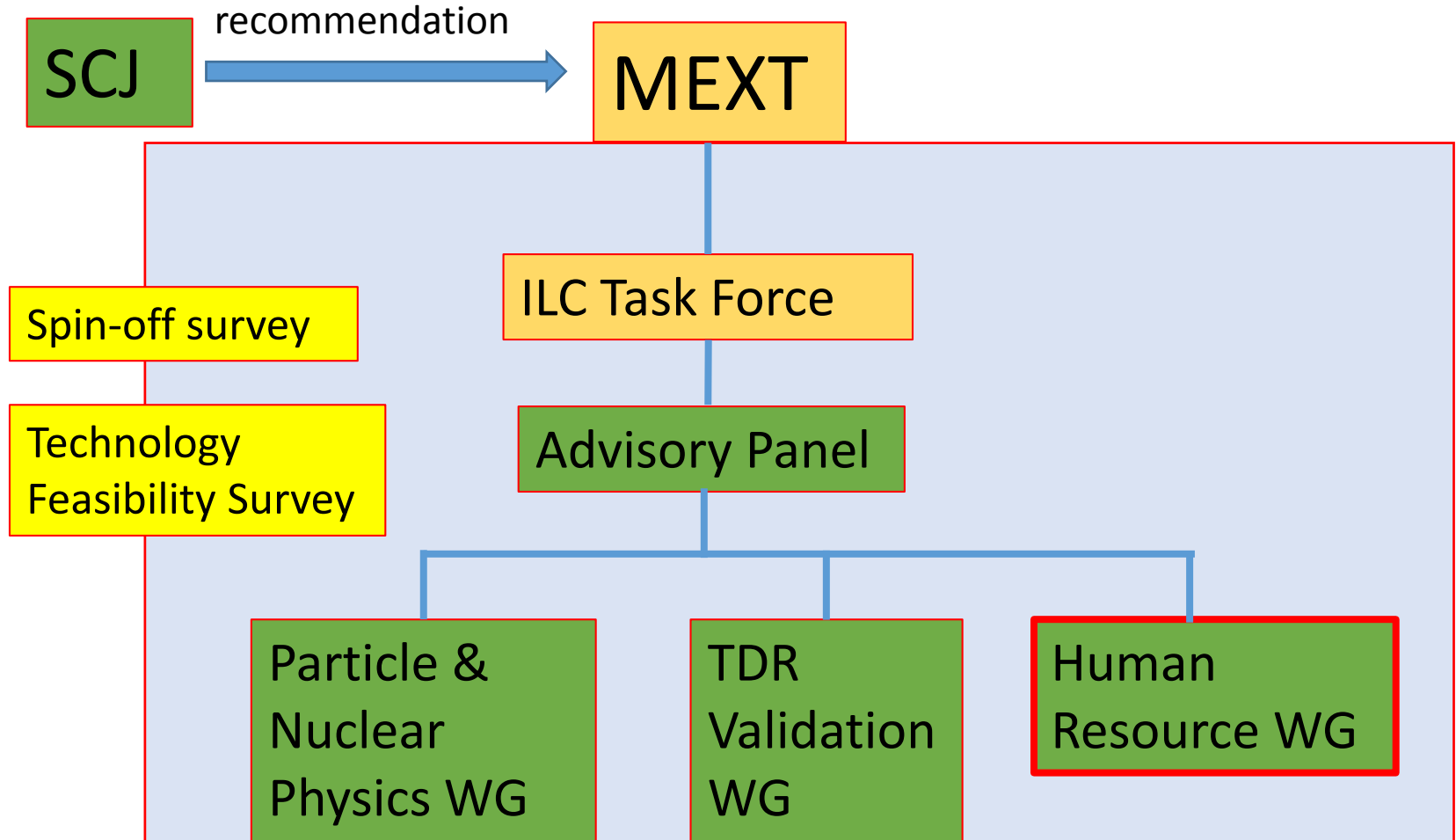
- Future prospects of the investigation
 - We will set up **another working group** to investigate the issue of necessary **human resources and their cultivation**.
 - We will commission **another survey** using an external research agency in order to understand the **world trends in technology issues** related to accelerator construction, and in approaches to **reduce the production cost** of accelerators.
- The opinions in the Advisory Panel Summary are basically identical to those of the SCJ
 - Essential difference is that Advisory Panel is under MEXT
 - Now MEXT will start to act according to this report

New Commissioned Survey

- Based on the recommendation of the Advisory Panel, MEXT asked a survey on the technical feasibility and technological issues in accelerator construction (Not an official translation) (国際リニアコライダー(ILC)計画に関する技術的実現可能性及び加速器製作における技術的課題等に関する調査分析)
 - Hearing at domestic/foreign labs and industries
 - Report deadline Feb.1.2016
- Tender of NRI (Nomura Research Institute) was accepted
 - First meeting on Jul.23.2015
 - Hearing at KEK: early September
- Visits to Europe/US institutes and industries being planned in September and November
 - **Must be prepared**

New Working Group

- Based on the recommendation of the Advisory Panel, a new WG was formed under the Advisory Panel: “Human Resource Working Group”



Federation of Diet Members for ILC

- Since 2006 in LDP, since 2008 non-partisan
- Now about 250 members
- Frequent meetings (almost every month)



2015/9/7 LFC15 Yokoya



AAA (Advanced Accelerator Association)

- Established 2008. Collab between industries and academies
- 100 companies, 40 universities and institutions,
- <http://aaa-sentan.org>
- Frequent meetings and symposiums
- Held Tokyo Event (with LCC) in Apr.2015
 - At Tokyo U and Hotel New Otani
 - Diet members, ambassadors/diplomats from many countries, leading scientists



2015/9/7 LFC15 Yokoya



Government-to-government discussions

- Apr.30 2013 at Washington DC:
Symposium on Advanced Science and Technology centered on the ILC
 - MEXT Minister, Secretary of Energy US, Federation of Diet Members of Japan for ILC
- Jan.2014, MEXT Minister met with Dr.Monitz (Secretary of Energy) at Washington DC
- July 2014, Federation of Diet Members visited Washington
- Apr.2015, Federation of Diet Members visited Washington



2nd US Visit by Giren



1st US Visit by Giren 27

Government-to-government discussions

- July 2014 at Geneva: talks with officials in Europe and US
 - MEXT deputy minister, DG for Research and Innovation of EU, CERN DG, Director of HEP-US, and officials from Germany, France, UK, Italy, Spain.
- Visits by Diet Members to Asia and Europe being planned in Winter 2015

Preparation in KEK side

- Epoch: LHC results ~2017 (Advisory Panel summary)
- ILC community must be ready by that time
- Pre-phase
- “Green Sign” from the government
 - “Green sign” : The government decides to start official negotiation with foreign governments, foreseeing the approval
- 4 year plan, after “Green Sign” before construction start, is being considered
 - May expect more budget in this period than now
 - **Required human resources and budget** being considered
- KEK-PIP (Project Implementation Planning) discussion starting

Summary

- MEXT-level investigation in Japan for ILC is going on, following the recommendation of SCJ. Advisory panel says that official discussion with foreign countries is indispensable and that LHC results ~2017 should be taken into account.
- Federation of Diet Members for ILC, industries (AAA) and local governments strongly support ILC
- Understanding by higher level of Japanese government is in progress
- Diplomatic discussion between Japan and US governments in progress. Collaboration framework on science and technology including ILC being established.
- Will be expanded to Europe and Asia
- Voices from physicist side essential for pushing the governments