ATF status and plans for 2017

Nobuhiro Terunuma, KEK

19th ATF2 project meeting/TB meeting
March 15th 2017, CERN

Changes on the ATF/ATF2 operation

- **Significant amount of US contributions on ATF/ATF2 program**
  - **FNAL**
    - **DR bpm readout system;** from front-end to DAQ
  - **SLAC**
    - **manpower;** Glen White, Douglas McCormic,...
    - **Flight simulator with multi-OTR;** emittance measurement, Dispersion Correction
    - **BPM readout system; ext-stripline and CBPM**
    - **ATF2 magnet PS, magnet movers and final doublet magnets**
    - **Injection/extraction kicker system**

      Provided by SLAC. Spares for maintenance are under the process of shipping and will be delivered by the end of March, but no future support will be expected.
- **Remote maintenance becomes difficult. Possible longer recovery time to fix a failure by ourselves.**

Risks on the ATF operation

- **Long shutdown may happen in the case of expensive failures.**
  - KEK faces very tight budget.
  - Decisions will depend on how the ATF is important to move forward the ILC project.

- **Possible failures (beam-operation stoppers) are ...**
  - **LINAC RF klystrons**
    - **Highly required! No spare at present.**
    - It is on the top of the list for the supplementary budget.
  - **Bigger Power Supplies**
    - Septum magnets (3000A x 4), Dipoles (**DR**, BT, EXT)
  - **Cooling water facilities**
    - LINAC (RF, Magnet), DR (RF, Mag, Vac), ATF2 (Mag)

Planning of the 2017 beam weeks

- **Background**
  - In 2016, discussions for the **cost reduction of ILC** has been started.
    - **SRF cost reduction R&D initiated by MEXT and DOE**
    - **Realistic staging scenarios to bring the cost of the first stage down.**
  - **SRF cost reduction R&D needs an equipment to be prepared in 2017** for the timely approach within 2 years to contribute the ILC decision. Supplemental funds by MEXT for this R&D are expecting from 2018.
  - The cost of this equipment should be shared by all running ILC programs and **resulted 20% budget reduction in FY2017.**

ILC technical status

Shin MICHIZONO (KEK)

- *ILC overview*
- *Recent R&D results at KEK*
- *Scope of the ILC R&D*
  - *US-Japan Cost reduction R&D*
  - *CERN-KEK collaboration*
- *Staging*

SCJ → Recommendation in 2013 → **MEXT**

Ministry of Education, Culture, Sports, Science, and Technology

ILC Taskforce
formed in 2013

Commissioned Survey by MEXT, contracted w/NRI (in 2014, and 2015)

ILC Advisory Panel**
(Academic Experts Committee)
in JFY 2014 ~ ______

Particle & Nuclear **Phys.** Working Group
in 2014 ~ 2015

TDR Validation Working Group
in 2014 ~ 2015

Human Resource Working Group
in 2015-2016

On July 7,2016

- -Cost reduction study with new technology → US-Japan cost-reduction R&D
- -Feasibility study with current technology → Positron: international collaboration; Beam-dump: CERN-KEK

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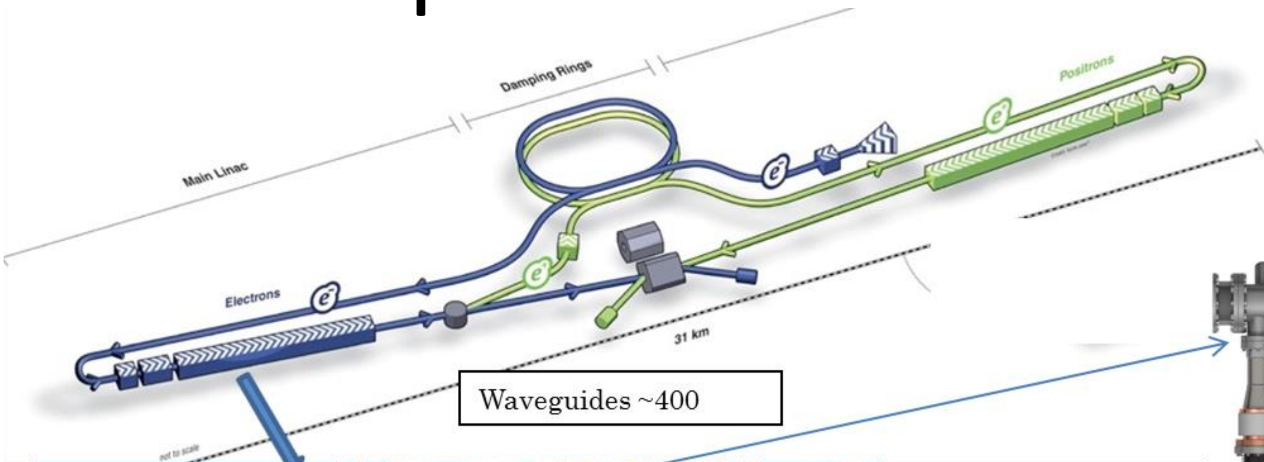
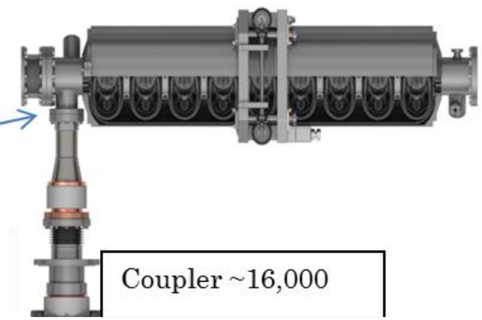
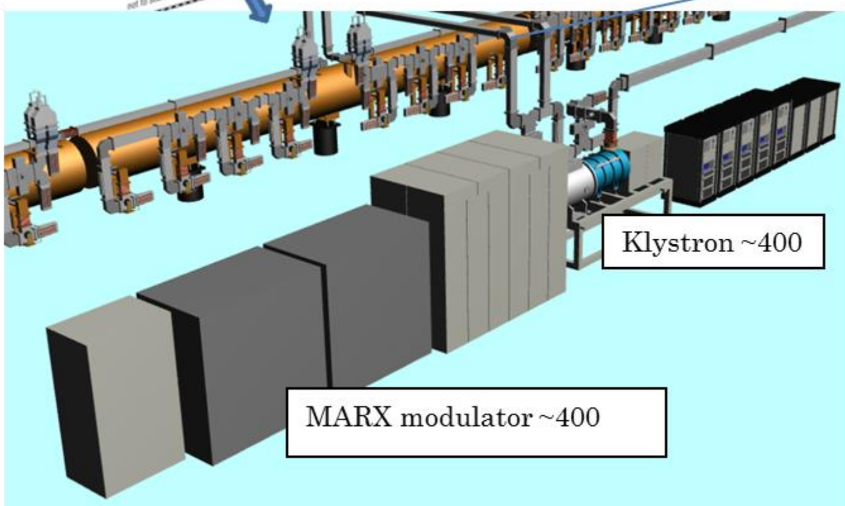
US-Japan cost reduction R&D







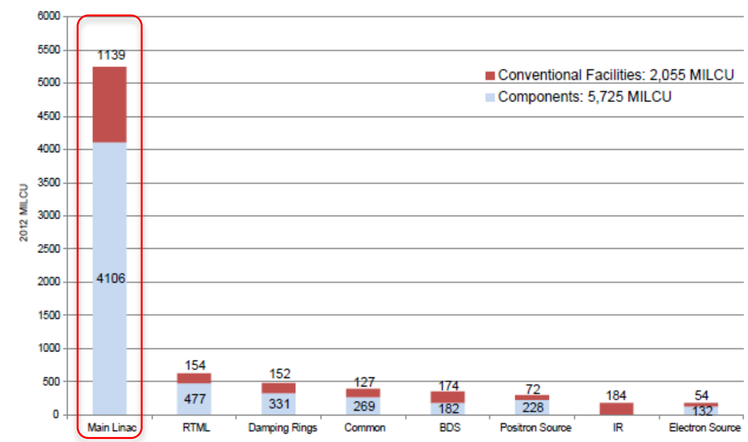


Figure 15.8. Distribution of the ILC value estimate by system and common infrastructure, in ILC Units. The numbers give the TDR estimate for each system in MILCU.

The ILC is the electron-positron collider of ~30 km linac.
The main fraction of the construction cost is coming from main linac (ML).
Thus we focused into ML (superconducting RF technology)

US-JAPAN cost reduction R&D

Short-term R&D (2–3 years)

A-1. Niobium material preparation

- with new processing for sheeting and piping

A-2. SRF cavity fabrication for high gradient and high Q

- with a new surface process recipe provided by Fermilab

A-3. Power input coupler fabrication

- with new-ceramic window (w/o additional coating)

A-4. Cavity chemical treatment

- with vertical configuration and new chemical

A-1. Niobium material preparation (with new processing for sheeting and piping)

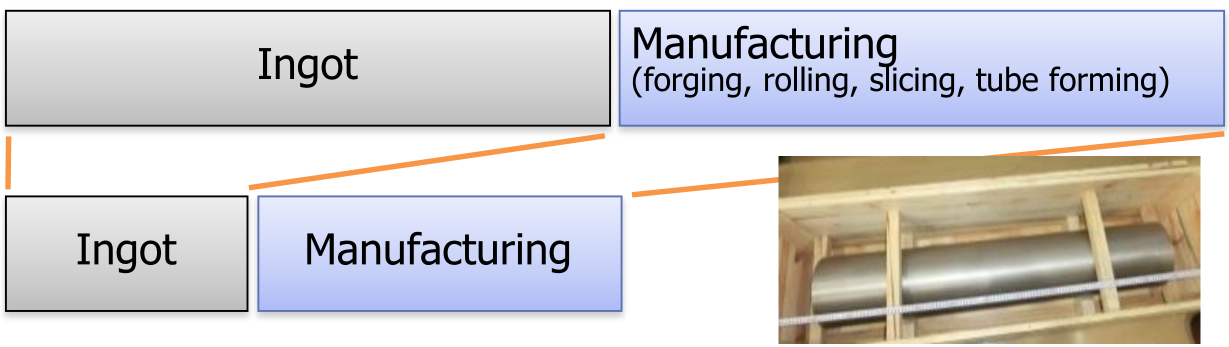
<u>Motivation</u>

Niobium material cost for fabricating SRF cavity cell and end-groups is relatively high.
If the ingot purity and manufacturing method for each part is optimized precisely as well as satisfying the ILC specification shown in the TDR, the cost will be reduced significantly.

<u>Approach</u>

- Optimize the ingot purity with a lower residual resistivity ratio (RRR) with accepting specific residual content.
- Simplify the manufacturing method such as forging, rolling, slicing and tube forming with small loss.

Total, **50% off**



Niobium ingot

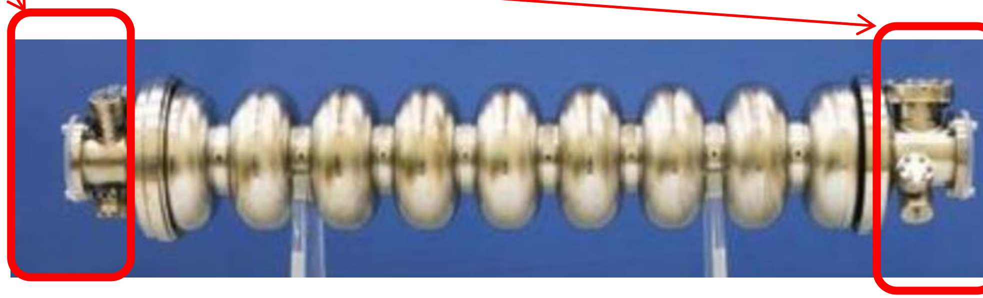
R&D plan for Nb material

JFY2017:

- Production of total 4 three-cell cavities
  - High Ta medium RRR（100～200）material
  - High Ta high RRR（200～300）material
- Evaluation of these cavities from the view points of material cost, chemical cost, etc.
- Selection of the material

JFY2018,2019:

- Production of 8 nine-cell cavities (satisfying the high pressure regulation)
- Material optimization of end-group (including HOM coupler)
- Chemical processing, vertical test

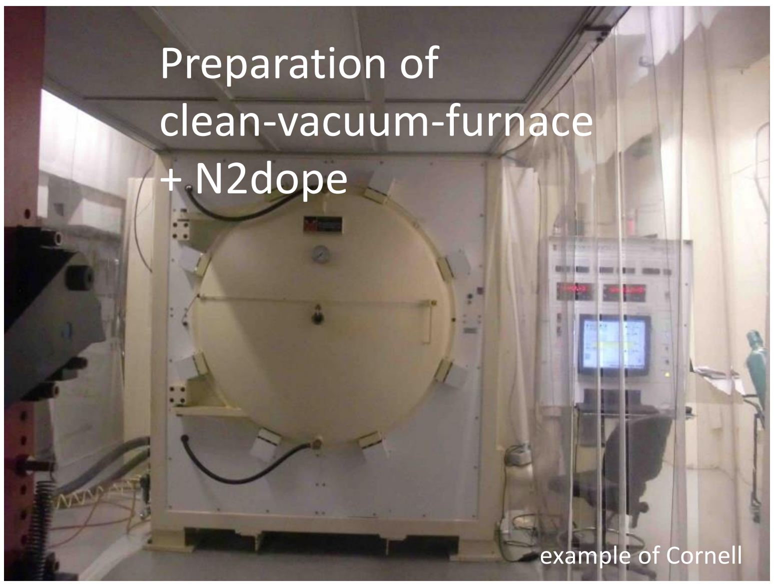


Schedule

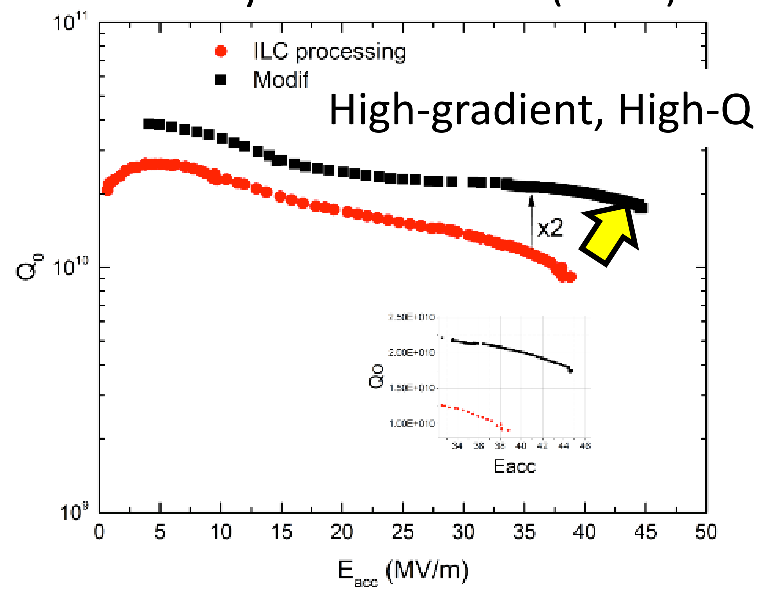
	2016	2017	2018	2019
KEK Masashi Yamanaka	Feasibility study using 4x3-cell cavities (ongoing)		Preparing materials / Manufacture 8x9-cell cavities	Evaluation (Vertical&Horizontal tests)

A-2. SRF cavity fabrication for high gradient and high Q (with a new surface process provided by Fermilab)

- High Q cavity enables the decrease in number of cryogenics leading to the cost reduction.
- FNAL researcher (A. Grassellino) found the new cavity preparation recipe having high Q and high gradient.
- Demonstrate N2-infusion (High-gradient and High-Q) technology with 9-cell-cavities.



By A. Grassellino (FNAL)



R&D plan for High-Q High-G

JFY2016:
- Single-cell KEK-cavity processing at FNAL (done)
- Q-measurement (with residual magnetic field dependence) at FNAL (done)
- Q measurement at KEK (to confirm the measurement system configuration)

JFY2017:
- New single-cell cavity production
- Processing at small vacuum furnace
- Procurement of new vacuum furnace for 9-cell cavity

JFY2018:
- High-Q High-G processing to 3 nine-cell cavity
- Production of 8 nine-cell cavities

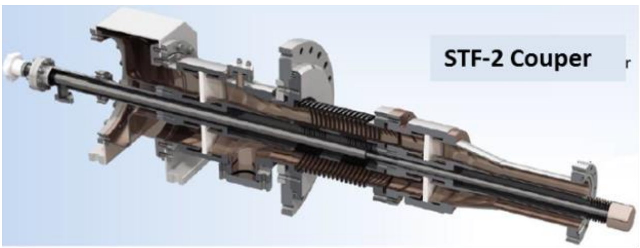
JFY2019 :
- Performance test
- Preparation of the installation to STF-2

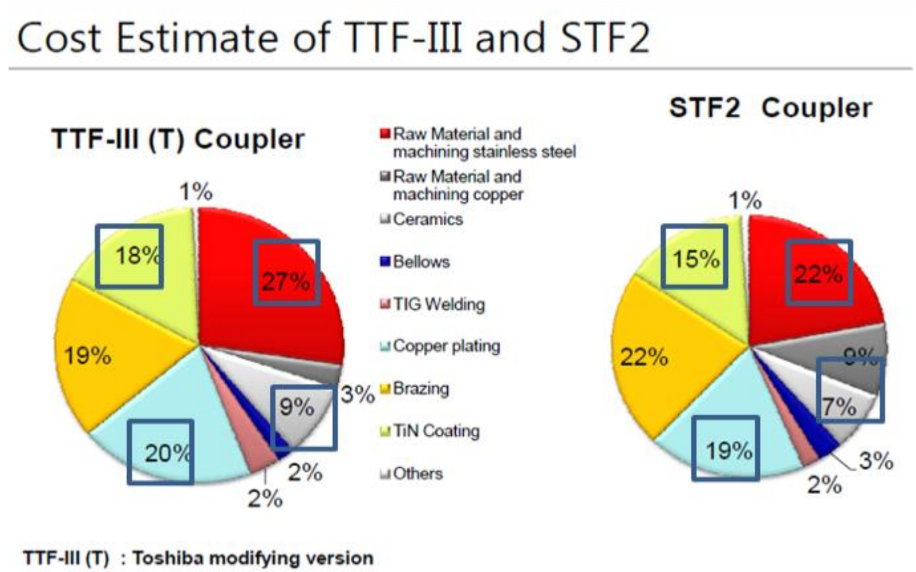
	2016	2017	2018	2019
KEK Hitoshi HAYANO	FNAL process Preparation of vacuum furnace	1 cell processing Preparation of vacuum furnace	Performance test 3-9cell performance 8 - 9cell cavities fabrication	Preparation for cyromodule Performace test

A-3. Power input coupler fabrication

- By innovating the ceramic window material, we will try to make the coupler without additional surface treatment on the ceramic leading to the cost reduction.

- Material cost (including Cu plating) in cavity input coupler is rather high. We will review the materials and Cu plating procedure.



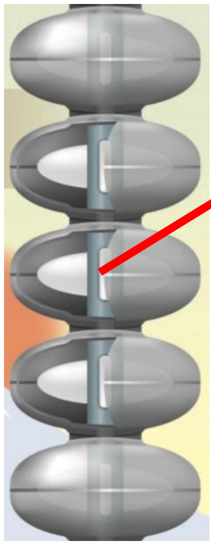


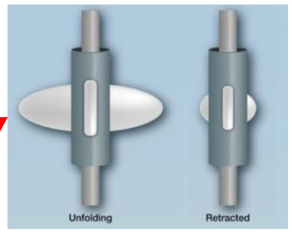
Schedule

	2016	2017	2018	2019
KEK E. Kako Y. Yamamoto	Evauation of ceramic (on going)	Design Collaboration with FNAL	Manufacturing High power test	#2 Manufacturing High power test Manufacturing For cyromodule

A-4. Cavity chemical treatment

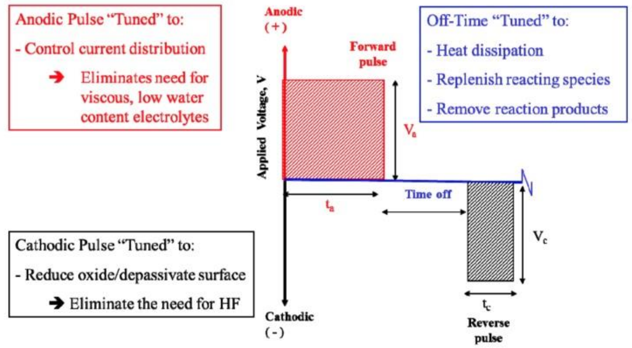
The change of the SC-cavity chemical treatment, from horizontal EP and sulfuric acid + HF (TDR) to vertical EP (VEP) + non-HF solution + bipolar EP.





VEP
with wing-cathode

+



Bipolar EP
using non-HF solution

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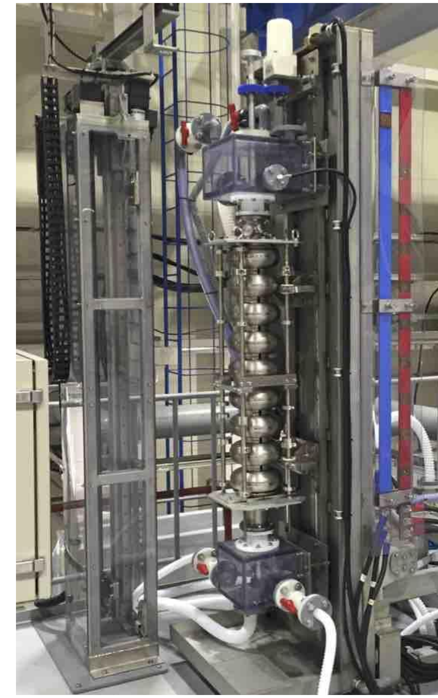

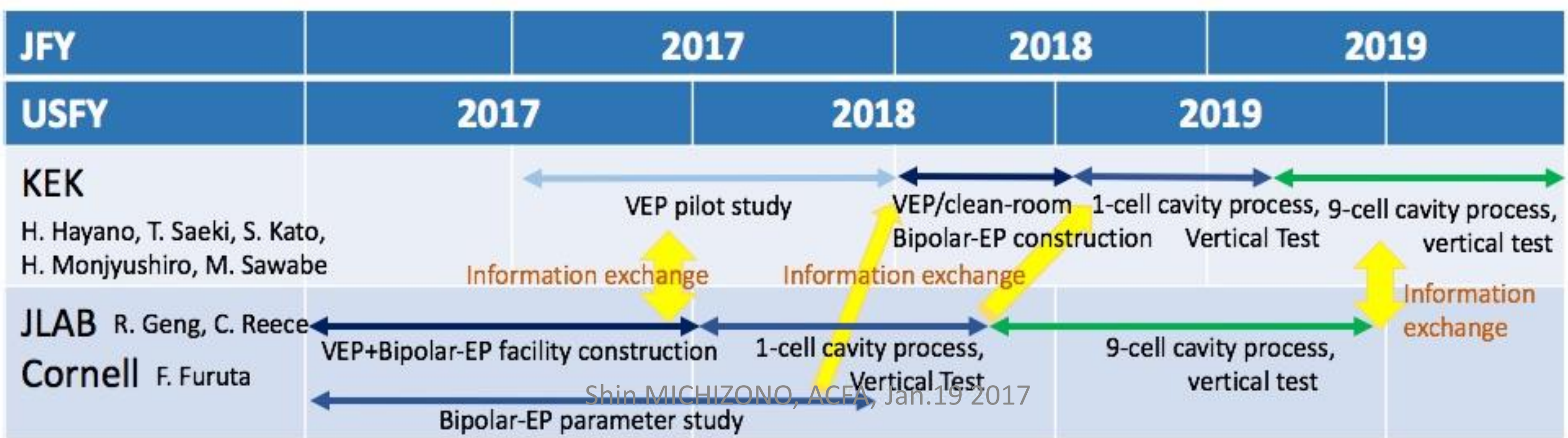

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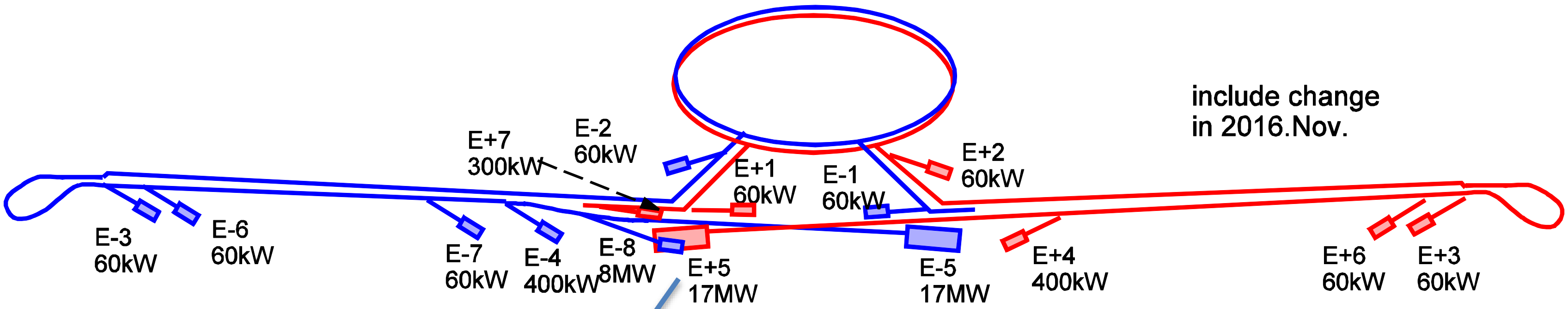
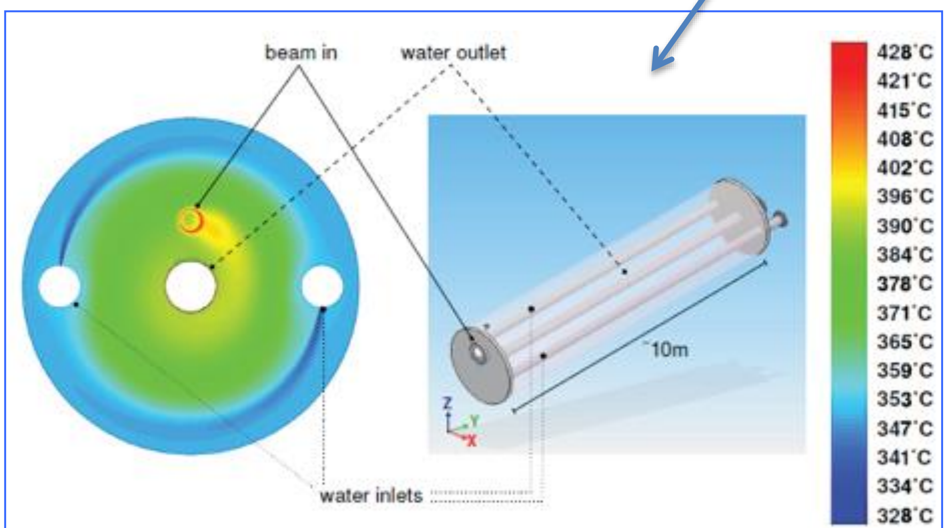
CERN and KEK Collaboration for LCs

- Nano-beam technology
  - Nano-beam size and the stability as a common subject for ILC and CLIC, using ATF,
- SCRF technology
  - Cavity fabrication/forming technology, such as electro-hydro forming
  - Cryomodule integration and the industrialization study
  - Input-power couplers and tuners, as a common subject
  - Cryogenic engineering, specially on He inventory management including emergency
  - RF technology, including high-efficiency Klystron
- Civil engineering
  - Central region design, specially based on the CMS site experience,
  - Optimization of acc. layout and access, using Tunnel Optimization Tool (TOT) originally developed for Future Circular Collider Study at CERN.
- Radiation Safety and Acc. Tunnel Design
  - Radiation safety design with optimization of the central wall thickness.
- Beam Dump design study
  - 18 MW beam dump design engineering study as a common subject for CLIC and ILC.

ILC Beam Dump Design of 18 MW with common features with CLIC





Electron/positron energy:	500 GeV
Number of electrons/positrons per Bunch:	2×10^{10}
Number of bunches per train:	2820
Duration of the bunch train:	0.95 ms
Beam size:	σ_x=2.42 mm and σ_y=0.27 mm
Energy in one bunch train:	4.5 MJ
Number of bunch trains per second:	4
Beam power (average):	18 MW
Beam power (peak):	4.5 GW
Beam sweep radius:	6 cm
Beam sweep frequency	~1 kHz

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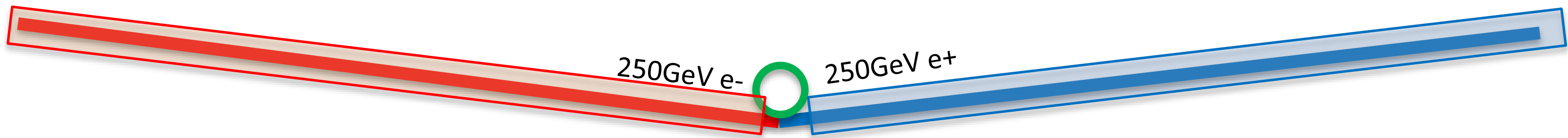
LCWS2016
By Lyn Evans

Cost reduction

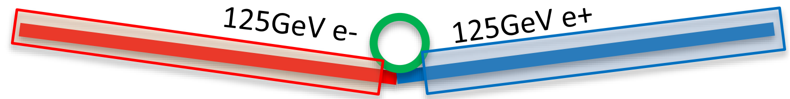
- All of these measures will reduce the cost by 10-20%, but that is not enough for a realistic project funding.
- The beauty of a linear collider is that it can be staged.
- Serious discussions must now start on realistic staging scenarios to bring the cost of the first stage down.

Examples of 250GeV & 500GeV ILC

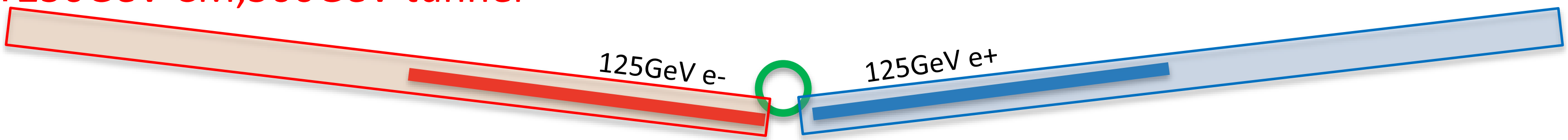
TDR 500GeV CM



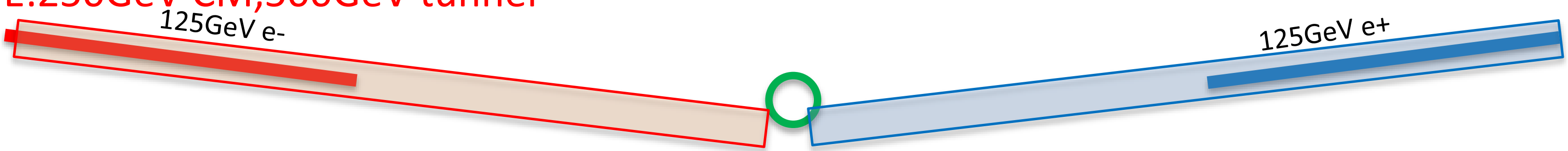
Option C：250GeV CM



Option D：250GeV CM,500GeV tunnel



Option E:250GeV CM,500GeV tunnel

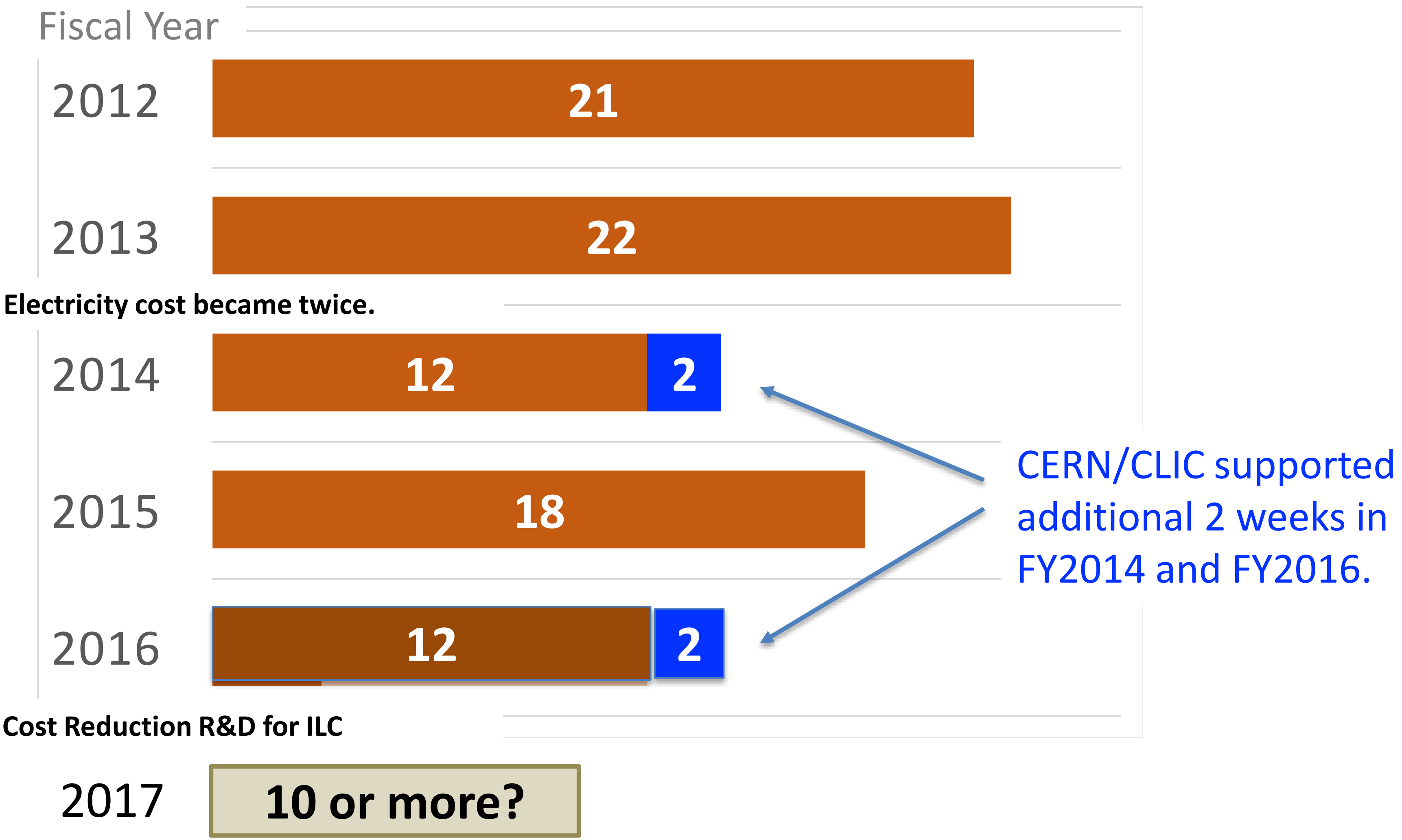


These configurations will be considered in the working groups at LCC.

Planning of the 2017 beam weeks

- **Impact on the ATF operation**
  - Electricity expenses are under the assessment by the KEK executive board.
  - We had submitted an annual plan of electricity to the board and requested to have the same number of beam weeks as FY2016, i.e., 12 weeks. (not include the CERN's support)
  - If we need to apply 20% of reduction on the electricity budget, it results only 10 weeks operation.
  - We are expecting a conclusion of the executive board by the end of this month.
  - Even if it still needs more discussion, we schedule the beam operation before summer. It should be in a range of guarantee then 4 or 5 weeks.
  - Draft of schedule will be discussed at the end of this talk.

Number of ATF beam weeks



Candidate of ATF beam weeks to be discussed

FY2017

10 week candidates (green) | extra candidates (yellow) | 2017/03/05 Nobuhiro Terunuma

April

Su	Mo	Tu	We	Th	Fr	Sa
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

May

Su	Mo	Tu	We	Th	Fr	Sa
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

5/14-19 IPAC17

June

Su	Mo	Tu	We	Th	Fr	Sa
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

6/26-30 AWLC17

July

Su	Mo	Tu	We	Th	Fr	Sa
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

August

Su	Mo	Tu	We	Th	Fr	Sa
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

September

Su	Mo	Tu	We	Th	Fr	Sa
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

October

Su	Mo	Tu	We	Th	Fr	Sa
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

LCWS17 23-27 or 30-11/3

November

Su	Mo	Tu	We	Th	Fr	Sa
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

December

Su	Mo	Tu	We	Th	Fr	Sa
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

January

Su	Mo	Tu	We	Th	Fr	Sa
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

February

Su	Mo	Tu	We	Th	Fr	Sa
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28			

March

Su	Mo	Tu	We	Th	Fr	Sa
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31