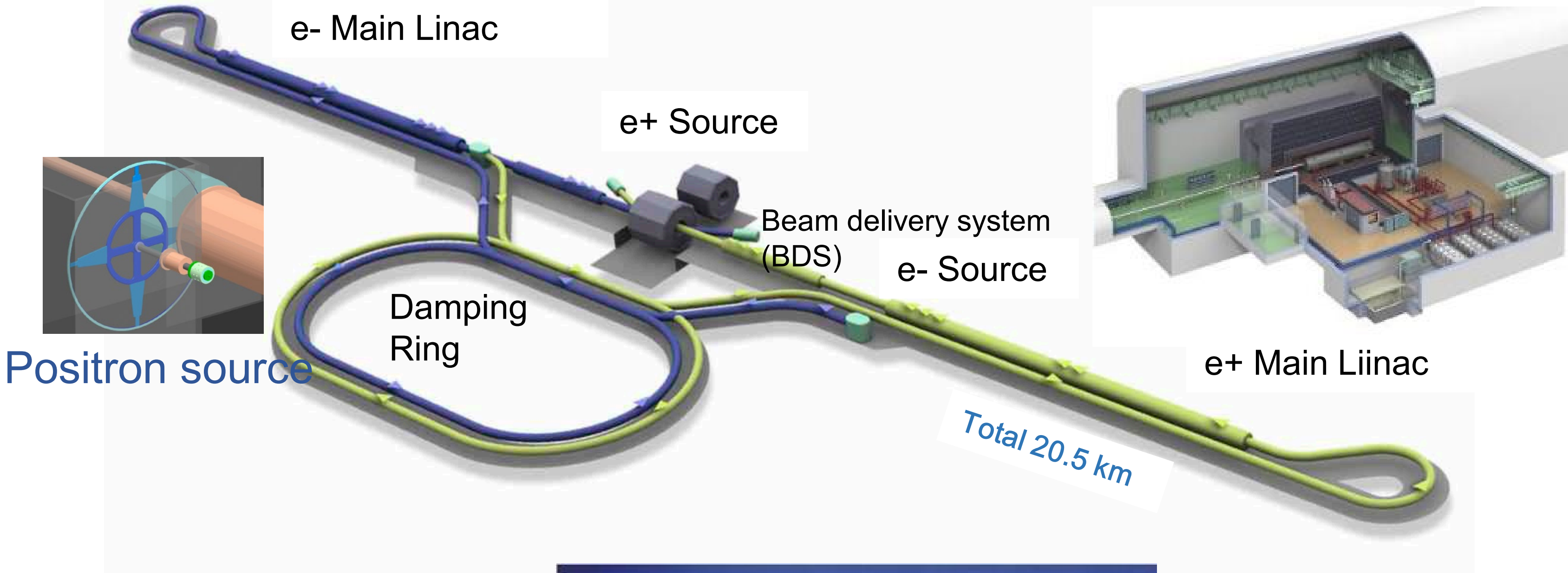
Status of ILC Global Activities / KEK

KEK / IDT-WG2
Shin MICHIZONO (KEK)

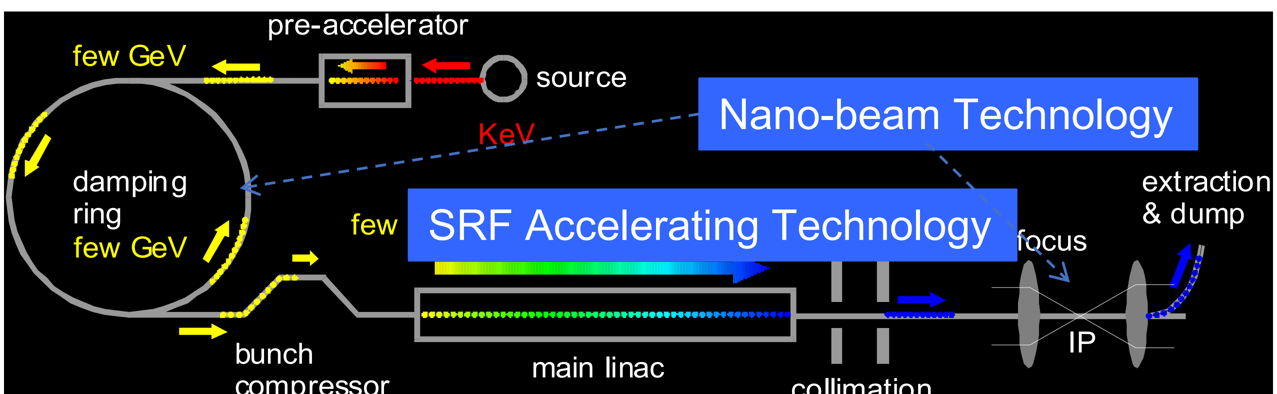
- ✓ ILC accelerator
- ✓ ILC international collaboration
- ✓ Technology level
  - ✓ SRF
  - ✓ Positron source
  - ✓ Damping ring
  - ✓ Final focus
  - ✓ Beam dump
- ✓ Technical preparation at Pre-lab
  - ✓ WP-1/2
- ✓ Civil/Safety/Environment
- ✓ Summary

250GeV ILC



8,000 cavities

Key Technologies

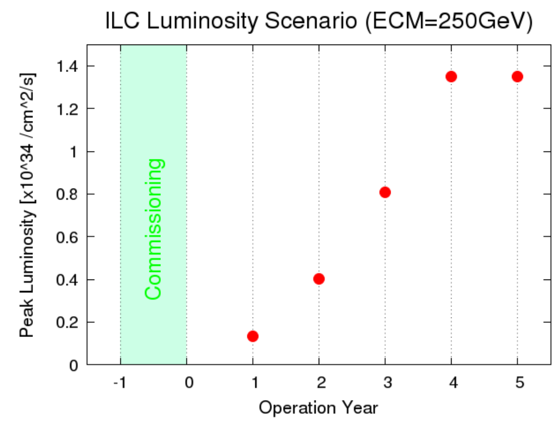


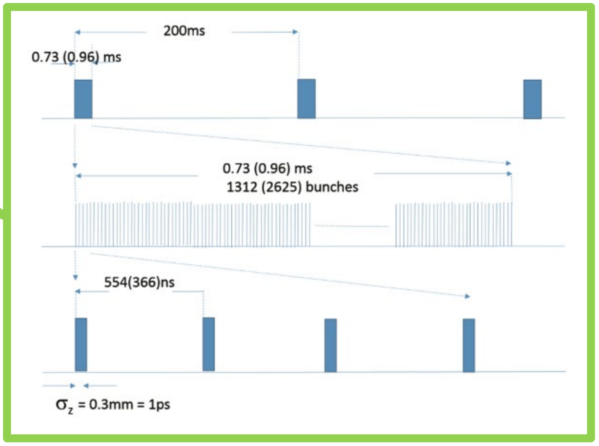
Item	Parameters
C.M. Energy	250 GeV
Length	20km
Luminosity	1.35 x10^{34} $cm^{-2}s^{-1}$
Repetition	5 Hz
Beam Pulse Period	0.73 ms
Beam Current	5.8 mA (in pulse)
Beam size (y) at FF	7.7 nm@250GeV
SRF Cavity G. Q_0	31.5 MV/m (35 MV/m) Q_0 = 1x10^{10}

ILC machine parameters

ILC	electron/positron	ILC250
Beam Energy	GeV	125 (e-) and 125 (e+)
Peak Luminosity (10^34)	cm-2 s-1	1.35
Int. Luminosity	ab-1/yr	0.24*
Beam dE/E at IP		0.188% (e-), 0.150% (e+)
Transv. Beam sizes at IP x/y	nm	515/7.66
Rms bunch length /	cm	0.03 (σ_z)
beta*	mm	bx*=13mm, by*=0.41mm
Crossing angle	mrad	14
Rep./Rev. frequency	Hz	5
Bunch spacing	ns	554
# of bunches		1,312
Length/Circumference	km	20.5
Facility site power	MW	111
Cost (value) range	$B US	~5 (tunnel and accelerator)
Timescale till operations	years	(~1) + 4(prep.) + 9(construction)

** 5,000-hour operation at peak luminosity*





Potential for upgrades

The ILC can be upgraded to higher energy and luminosity.

			Z-Pole [4]			Higgs [2,5]		500GeV [1*]		TeV [1*]	
			Baseline	Lum. Up	Baseline	Lum. Up	L Up.10Hz	Baseline	Lum. Up	case B	
Center-of-Mass Energy	E_{CM}	GeV	91.2	91.2	250	250	250	500	500	1000	Energy
Beam Energy	E_{beam}	GeV	45.6	45.6	125	125	125	250	250	500	
Collision rate	f_{col}	Hz	3.7	3.7	5	5	10	5	5	4	
Pluse interval in electron main linac		ms	135	135	200	200	100	200	200	200	
Number of bunches	n_b		1312	2625	1312	2625	2625	1312	2625	2450	
Bunch population	N	10^{10}	2	2	2	2	2	2	2	1.737	
Bunch separation	Δt_b	ns	554	554	554	366	366	554	366	366	
Beam current		mA	5.79	5.79	5.79	8.75	8.75	5.79	8.75	7.60	
Average beam power at IP (2 beams)	P_B	MW	1.42	2.84	5.26	10.5	21.0	10.5	21.0	27.3	
RMS bunch length at ML & IP	σ_z	mm	0.41	0.41	0.30	0.30	0.30	0.30	0.30	0.225	
Emittance at IP (x)	$\gamma\epsilon^*_x$	μm	6.2	6.2	5.0	5.0	5.0	10.0	10.0	10.0	
Emittance at IP (y)	$\gamma\epsilon^*_y$	nm	48.5	48.5	35.0	35.0	35.0	35.0	35.0	30.0	
Beam size at IP (x)	σ^*_x	μm	1.118	1.118	0.515	0.515	0.515	0.474	0.474	0.335	
Beam size at IP (y)	σ^*_y	nm	14.56	14.56	7.66	7.66	7.66	5.86	5.86	2.66	
Luminosity	L	$10^{34}/cm^2/s$	0.205	0.410	1.35	2.70	5.40	1.79	3.60	5.11	Lumi.
Luminosity enhancement factor	H_D		2.16	2.16	2.55	2.55	2.55	2.38	2.39	1.93	
Luminosity at top 1%	$L_{0.01}/L$	%	99.0	99.0	74	74	74	58	58	45	
Number of beamstrahlung photons	n_g		0.841	0.841	1.91	1.91	1.91	1.82	1.82	2.05	
Beamstrahlung energy loss	δ_{BS}	%	0.157	0.157	2.62	2.62	2.62	4.5	4.5	10.5	
AC power [6]	Psite	MW			111	138	198	173	215	300	
Site length	Lsite	km	20.5	20.5	20.5	20.5	20.5	31	31	40	

ILC construction/operation cost

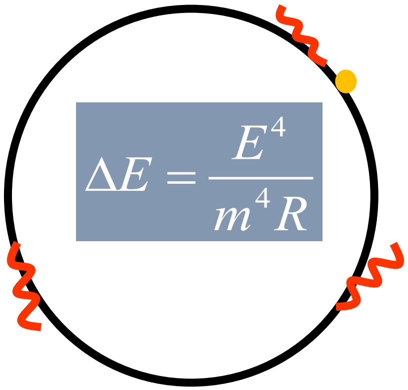
ILC accelerator (including tunnel) construction cost is ~5 B$.

	TDR: ILC500 [B ILCU] (Estimated by GDE)	ILC250 [B ILCU]* (Estimated by LCC)	Conversion to: [B JPY] (Reported to MEXT/SCJ)
Accelerator Construction: sum	**n/a**	**n/a**	**635.0 ~ 702.8**
Value: sub-sum	7.98	4.78 ~ 5.26	515.2 ~ 583.0
Tunnel & building	1.46	1.01	111.0 ~ 129.0
Accelerator & utility	6.52	3.77 ~ 4.24	404.2 ~ 454.0
Labor: Human Resource	22.9 M person-hours (13.5 K person-years)	17.2 M person-hours (10.1 K person-years)	119.8
Detector Construction: sum	**n/a**	**n/a**	**100.5**
Value: Detectors (SiD+ILD)	0.315+0.392	0.315+0.392	76.6
Labor: Human Resource (SiD + ILD)	748+1,400 person-years	748+1,400 person-years	23.9
Operation/year (Acc.) : sum	**n/a**	**n/a**	**36.6 ~ 39.2**
Value: Utilities/Maintenance	0.390	0.290 ~ 0.316	29.0 ~ 31.6
Labor: Human Resource	850 FTE	638 FTE	7.6
Others (Acc. Preparation)	**n/a**	**n/a**	**23.3**
Uncertainty	**25%**	**25%**	**25%**
Contingency	**10%**	**10%**	**10%**
Decommission	**n/a**	**n/a**	**Equiv. to 2-year op. cost**

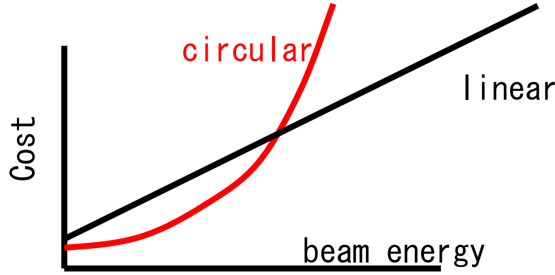
*1 ILCU= 1 US$ in 2012 prices

Main advantages

- A linear accelerator is more advantageous for accelerating electron and/or positron beams to higher energies.
- The spin of the electron and/or positron beam can be maintained during the acceleration and collision. This can help significantly improve measurement precision.
- The small surface resistance of the SRF accelerating structure (cavity) made of Nb enables the efficient power transfer from the AC power source to the beam.
- Further energy efficiency improvements are considered as part of the of Green ILC concept, which aims to establish a sustainable laboratory.



Circulating beam loses energy by synchrotron radiation.
Linear collider can extend its collision energy by longer tunnel/ higher gradient.



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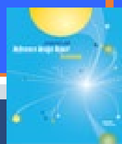
Brief History of ILC Collaboration

international development team

2004 '06 '07 '08 '09 '10 '11 '12 '13 '14 '15 '16 '17 '18 '19 '20 '21

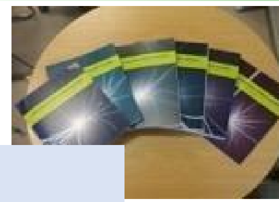
RDR | ILC-GDE | TDR | LCC



Technology selection

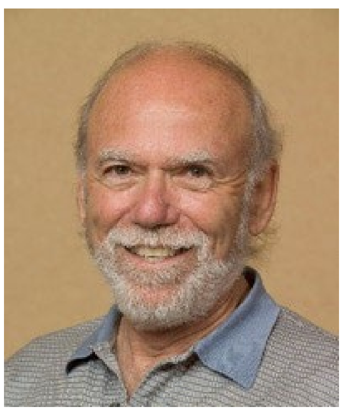
ILC technical design

TDR:
49 countries
392 institutions
>2400 researchers

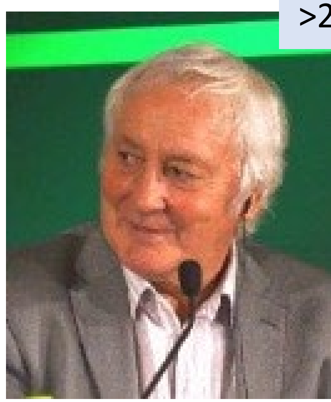


International ***D***evelopment ***T***eam

IDT chair
Tatsuya Nakada (EPFL)



Barry Barish
GDE director
(the Nobel Prize winner
for physics in 2017)



Lyn Evans
LCC director
(former LHC project manager)

LHC

European XFEL

LCLS-II

IDT organization

ICFA

ILC International Development Team

Executive Board

Americas Liaison	Andrew Lankford (UC Irvine)
Working Group 2 Chair	Shinichiro Michizono (KEK)
Working Group 3 Chair	Hitoshi Murayama (UC Berkeley/U. Tokyo)
Executive Board Chair and Working Group 1 Chair	Tatsuya Nakada (EPFL)
KEK Liaison	Yasuhiro Okada (KEK)
Europe Liaison	Steinar Stapnes (CERN)
Asia-Pacific Liaison	Geoffrey Taylor (U. Melbourne)

Working Group 1
Pre-Lab Setup

Working Group 2
Accelerator

Working Group 3
Physics & Detectors

From IDT to Pre-Lab, ILC construction

IDT is formed under ICFA. KEK serves as its host.

Stage 1 International Development Team (~1.5 years)

ILC Pre-Lab. is established by MOU's among the laboratories.

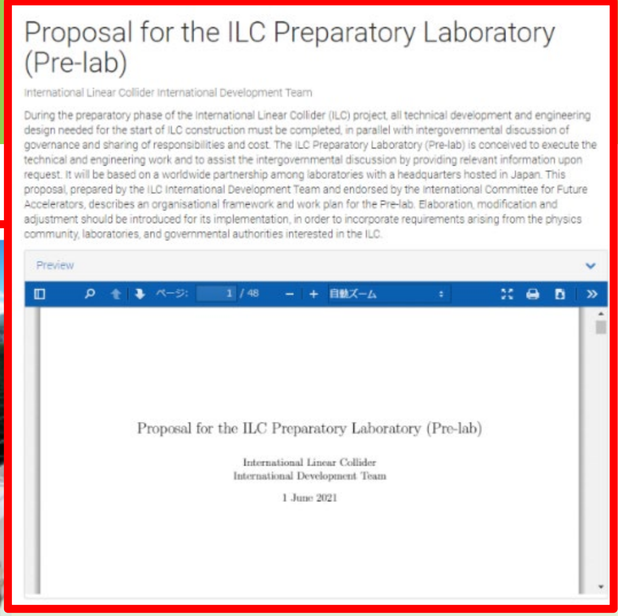
Stage 2 ILC Pre-Laboratory (4 years)

ILC Lab. is established by governmental agreement.

Stage 3 ILC Laboratory (10 years for construction)

Stage 4 Experiment at ILC!

Pre-lab proposal



Proposal for the ILC Preparatory Laboratory (Pre-lab)

International Linear Collider International Development Team

During the preparatory phase of the International Linear Collider (ILC) project, all technical development and engineering design needed for the start of ILC construction must be completed, in parallel with intergovernmental discussion of governance and sharing of responsibilities and cost. The ILC Preparatory Laboratory (Pre-lab) is conceived to execute the technical and engineering work and to assist the intergovernmental discussion by providing relevant information upon request. It will be based on a worldwide partnership among laboratories with a headquarters hosted in Japan. This proposal, prepared by the ILC International Development Team and endorsed by the International Committee for Future Accelerators, describes an organisational framework and work plan for the Pre-lab. Elaboration, modification and adjustment should be introduced for its implementation, in order to incorporate requirements arising from the physics community, laboratories, and governmental authorities interested in the ILC.

Preview

ページ: 1 / 48 自動ズーム

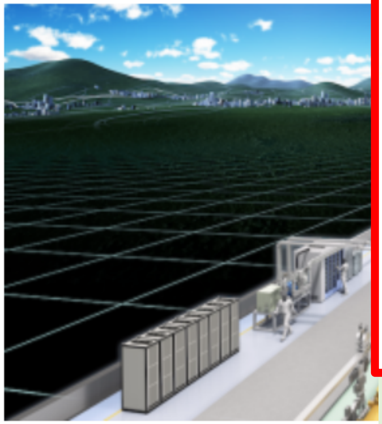
Proposal for the ILC Preparatory Laboratory (Pre-lab)

International Linear Collider
International Development Team

1 June 2021

Full text of Pre-lab proposal:
https://zenodo.org/record/4884744

ILC newsline June 1,2021
https://newsline.linearcollider.org/2021/06/01/ilc-preparatory-laboratory-proposal-released/



Artist's impression of the ILC. Im

The ILC International Development Team (IDT) was established by the International Committee for Future Accelerator (ICFA) in August 2020, to prepare the ILC Preparatory Laboratory (Pre-lab) that would complete the technical development and engineering preparation for the International Linear Collider project to be ready for construction. During the same period, governmental authorities of interested nations are expected to forge an agreement on the sharing of the cost and responsibilities for the construction and operation of the ILC facility and on the organisational structure and governance of the ILC Laboratory.

After ten months of work, the IDT has achieved the first major milestone of completing the ILC Pre-lab proposal, which outlines the organisational framework, an implementation model and work plan of the Pre-lab. Three working groups were the key players and an impressive number of people have been contributing to this effort. Working Group 1 worked on the mandate, governance model, organisational structure and Pre-lab start-up procedure. Working Group 2 identified necessary technical development and engineering preparation work for the ILC accelerator and site construction. Working Group 3 discussed a strategy for developing the compelling ILC physics programme. Then the Executive Board took the responsibility of compiling the document. It was very encouraging to see the growing number of participants in those activities.

The IDT activity now enters the next phase of implementing the steps for establishing the Pre-lab along the lines described in the proposal. The plan for the accelerator technical development and engineering preparation work needs to be further elaborated and people and laboratories with interest and expertise in the work must be identified. The physics community needs encouragement and support for further exploring the physics potential of the ILC and converging towards concrete designs of experiments. Discussion on the Pre-lab start-up process must be initiated among the world key laboratories.

An equally crucial factor now is to understand what kind of process is needed to achieve the establishment of the Pre-lab. Unlike the ILC itself, the Pre-lab activities will be driven at the level of laboratories rather than having a direct involvement of governmental authorities. For the managements of interested laboratories to engage seriously in the discussion of responsibility sharing for the Pre-lab activities, however, a signal from the Japanese government indicating its interest in hosting the ILC and supporting the Pre-lab would be required. In parallel, we will make further effort to gain more support for the ILC worldwide.

We will continue to do our best for the swift realisation of the Pre-lab. Exciting times are head of us all.

Timeline

Now we are at pre-preparation phase (waiting for the preparation phase).
Four years preparation (@ILC Pre-Lab) and ~10 years construction (@ ILC Lab.).

	IDT	ILC Pre-Lab				ILC Lab.										
	PP	P1	P2	P3	P4	1	2	3	4	5	6	7	8	9	10	Phys. Exp.
Preparation CE/Utility, Survey, Design Acc. Industrialization prep.																
Construction																
Civil Eng.																
Building, Utilities																
Acc. Systems																
Installation																
Commissioning																
Physics Exp.																

Technical preparation

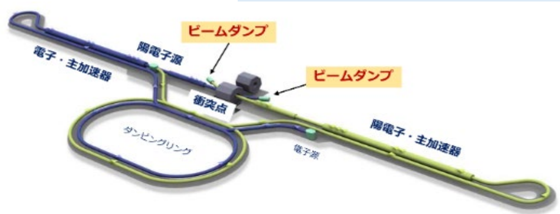
IDT-WG2 summarized the technical preparation as work packages (WPs) in the technical preparation document.

Actual cavity /CM manufacturing

ILC Pre-lab

- ***SRF*** ~41MILCU 285 FTE-yr
  - WP-1 Cavity production
  - WP-2 Cryomodule assembly
  - WP-3 Crab cavity
- ***e- source*** ~2.5MILCU, 6 FTE-yr
  - WP-4 Electron source
- ***e+ source*** ~6MILCU, 15FTE-yr
  - ***Undulator scheme***
    - WP-5 Undulator
    - WP-6 Rotating target
    - WP-7 Magnetic focusing
  - ***e-Driven scheme***
    - WP-8 Rotating target
    - WP-9 Magnetic focusing
    - WP-10 Capture cavity
    - WP-11 Target replacement
- ***DR*** ~2.5MILCU, 30FTE-yr
  - WP-12 System design
  - WP-13 Collective effect
  - WP-14 Injection/extraction
- ***BDS*** ~2MILCU, 16FTE-yr
  - WP-15 Final focus
  - WP-16 Final doublet
- ***Dump*** ~3MILCU, 12FTE-yr
  - WP-17 Main dump
  - WP-18 Photon dump

For detail,
http://doi.org/10.5281/ zenodo.4742018



SRF technology is energy-efficient, and its applications are increasing around the world.
These WPs will contribute to the promotion of SRF accelerators in each region.

- The technical preparation document was reviewed by the international review committee (chair:Tor Raubenheimer (SLAC)).
- The total global cost of the project is about 60 MILCU* and about 360 FTE-year. (This does not include the cost of the infrastructure for the WPs.)
- The cost will be shared internationally as in-kind contribution.

1MILCU=1M$(2012)

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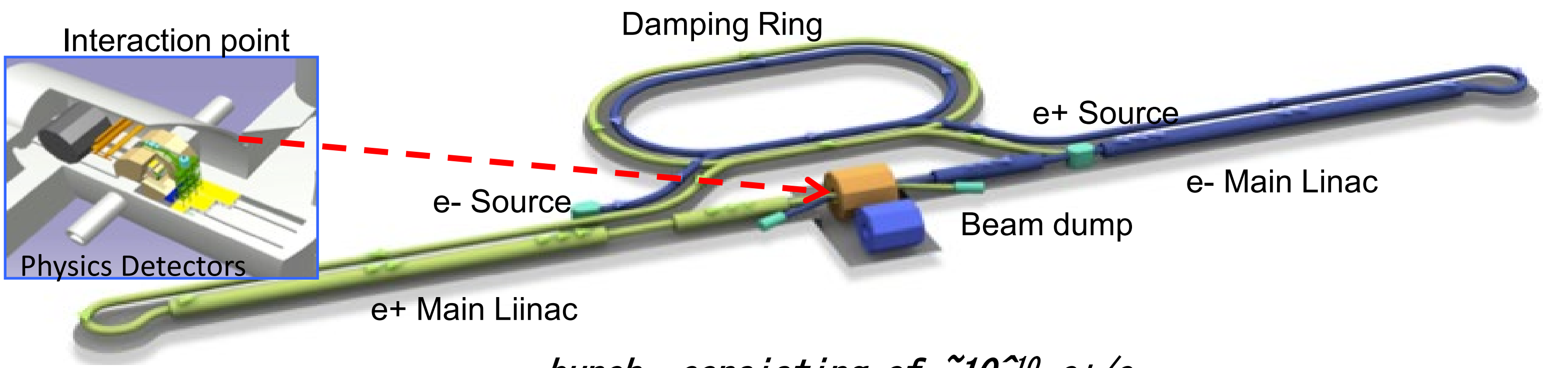
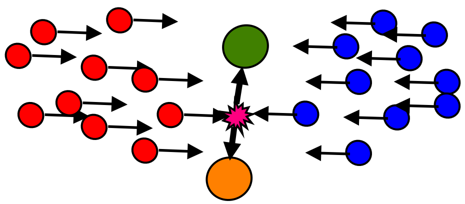
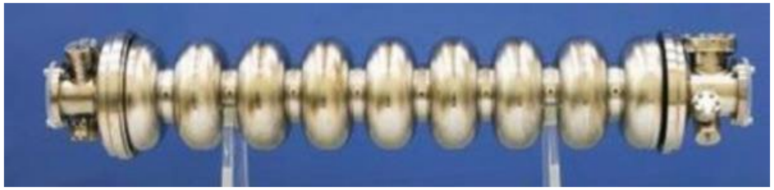
Area systems of the ILC



bunch, consisting of ~10^10 e+/e-



- Creating particles *Sources*
  - polarized elections/positrons
- High quality beams *Damping ring*
  - Low emittance beams
    - Small beam size (small beam spread)
    - Parallel beam (small momentum spread)
- Acceleration *Main linac*
  - superconducting radio frequency (SRF)
- Getting them collided *Final focus*
  - nano-meter beams
- Go to *Beam dumps*



ILC Technology level

Since the publication of the conceptual design report (RDR) in 2007 and the Technical Design Report (TDR) in 2013, the technical development has been progressing steadily toward the start of construction.

Status	(RDR) (TDR)	2021	(EDR)*	ILC construction
SRF cavity, CM	~2017 Technology development ->Model work-> Prototype	2018~2021 High performance and cost reduction of cavities	International mass production, and transfer demonstration	
SRF Linac	Model work: small-scale models, partial/component models.	European XFEL user operation		
e- source	~2017 Tech. Design->Tech. Development->Tech. Demonstration		Tech. confirmation	
e+ source Undulator scheme	~2017 Tech. Design->Tech. Development	2018~2021 Tech. Demonstration	Target and magnetic focusing	
e+ source e-driven scheme	~2017 Tech. Design->Tech. Developmen	2018~2021 Tech. Demonstration	Target and capture cavity	
DR	~2017 Design->Tech. Development-> Tech. demonstration achieved at KEK ATF		Kicker	
Final focus	~2017 Design->Tech. Development->Tech. demonstration achieved at KEK ATF		Stable op.	
Dump	~2017 Tech. Design->Tech. Development	2018~2021 Facility design	Remote handling	

: ~2017
: 2018~2021
: Pre-lab

*EDR:Detailed Engineering Design Report required to start construction.

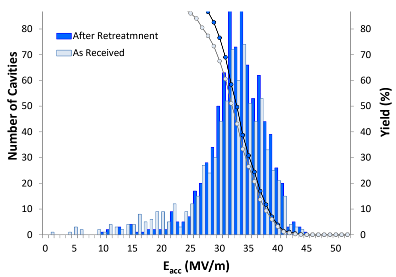
Progress in SRF

~ 2017	2018 ~ 2021	Pre-lab

Cavity

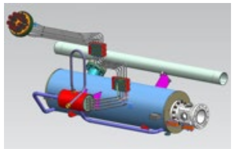
Yield evaluation of cavities based on TDR

The mass production of European XFEL has reached ≥ 83% of the ILC specification yield (90%).



Cryomodule

Eng. design



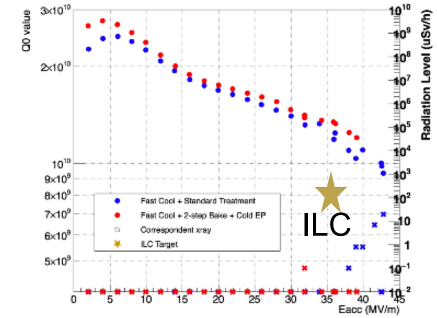
Euro-XFEL Operation (Europe)
~800 cavities/
~100 Modules

LCLS-II Construction (USA)
~280 cavities/
~35 Modules

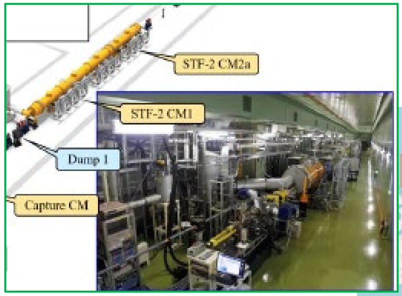
Realized through international cooperation and procurement

High performance and cost reduction

high performance with new surface treatment, etc.



Module assembly

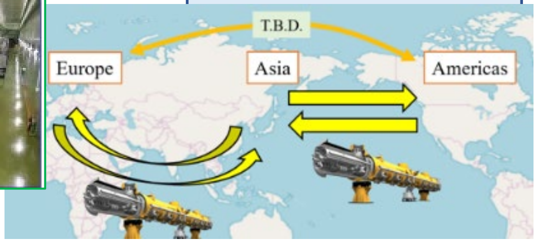


Accelerator performance verification at KEK-STF2

~41 M$,285 FTE-yr

Cavity manufacturing, performance demonstration (Yield demonstration in three areas)

Demonstration of cryomodule assembly, transfer, and performance

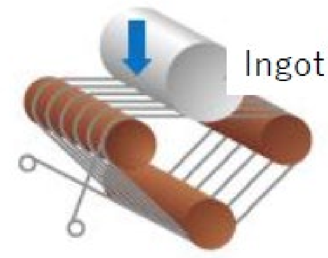


International Cooperation in SRF

2018-2021:

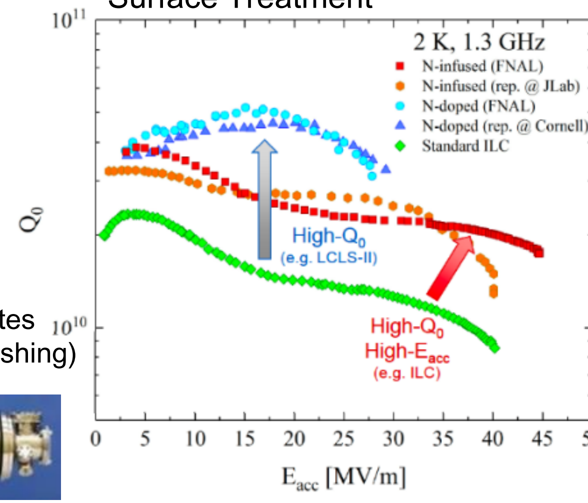
- Achieve stable electric field E > 35 MV/m through US-Japan cooperation
  - Improvement of Nb material manufacturing process and properties (FG, MG, LG)
  - Improvement of surface treatment technology
    - Low temperature (10-20C) EP Two-step baking (75C and 120C) Optimization of cooling speed (flux expulsion)
- Cavity manufacturing efficiency improvement and dust prevention work automation Europe-Japan cooperation
- KEK-STFdemonstrated the beam acceleration at 33 MV/m
- High Gradient Cryomodule (HGC, FNAL) (in progress)
  - Aim to demonstrate 38 MV/m

Cost reduction by direct slicing materials

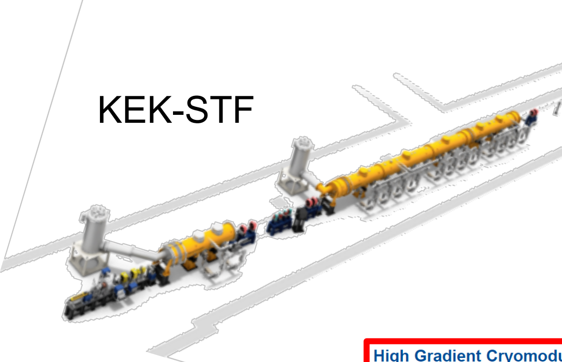


Direct slice from ingot (eliminates the rolling and mechanical polishing)

Improving Performance through Surface Treatment

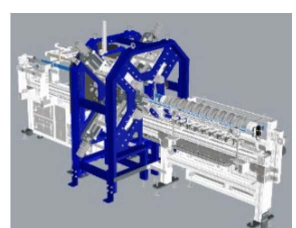


KEK-STF

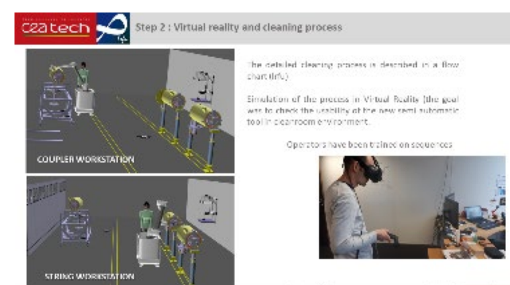


HGC (FNAL) aiming for performance beyond ILC specifications (in progress)

Improving efficiency in cavity manufacturing



Automation of Dust Prevention Work



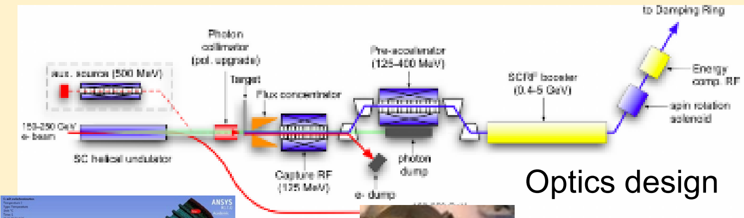
Plan A:Undulator scheme
Plan B:e-driven scheme (same tunnel)
Plan C:e-driven scheme (extra tunnel)

Progress in positron source

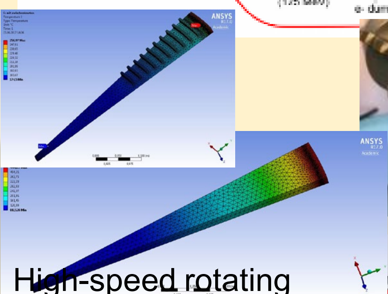
~ 2017 tech. design | 2018 ~ 2021 tech. verification | Pre-lab

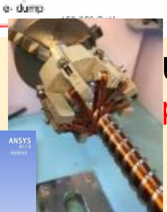
Undulator scheme to obtain polarization

1.5 M$ 10FTE-yr



Optics design



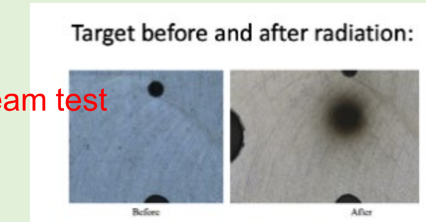


Undulator prototype

Photon dump design

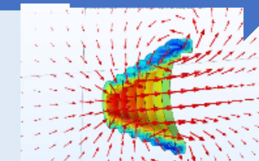
High-speed rotating positron target, Technology Design

Ti target beam test



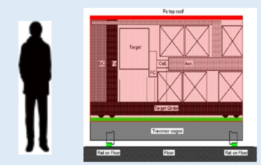
Practical Operation of Superconducting Helical Undulator (APS)

Long undulator operation at European XFEL



Pulse solenoid design

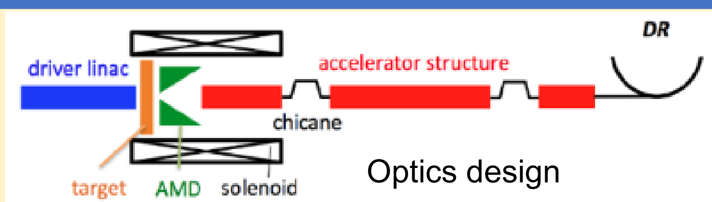
Next Steps:
evaluate both schemes by international cooperation



Target maintenance

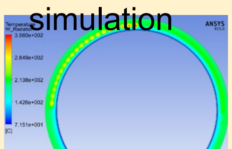
Conventional e-Driven

4.4 M$, 5FTE-yr

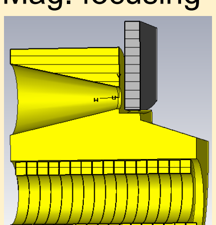


Optics design

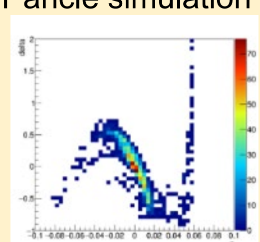
Target thermal simulation

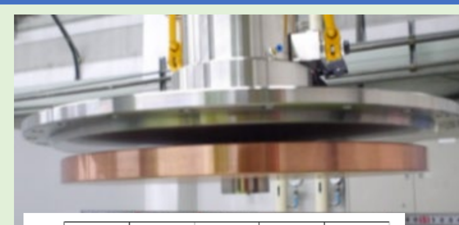


Mag. focusing

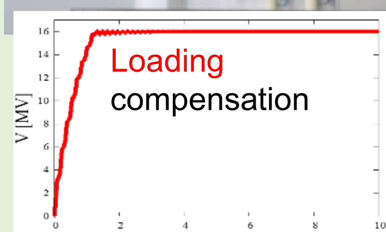


Paricle simulation



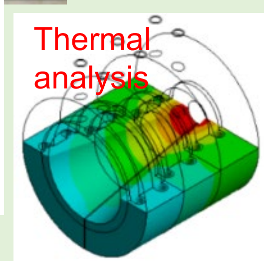


Target Prototyping Vacuum characteristics Testing

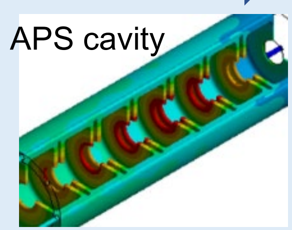


Loading compensation

Thermal analysis



APS cavity



RF stability test

Technology selection

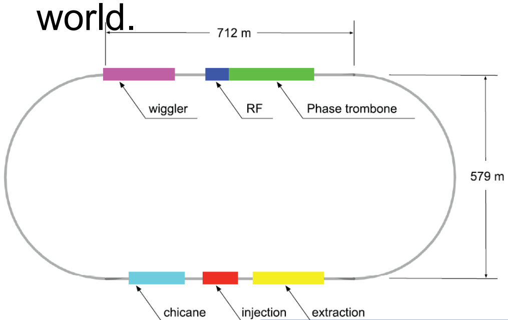
Progress in DR

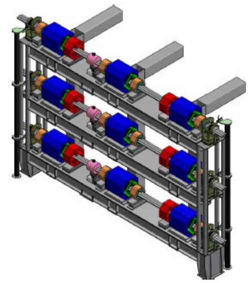
~ 2017	2018 ~ 2021	Pre-lab

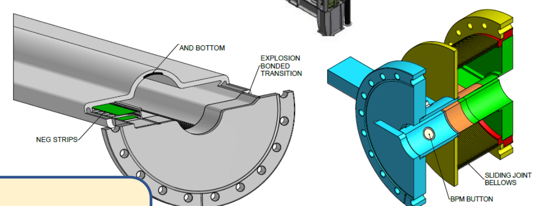
DR

Eng. design

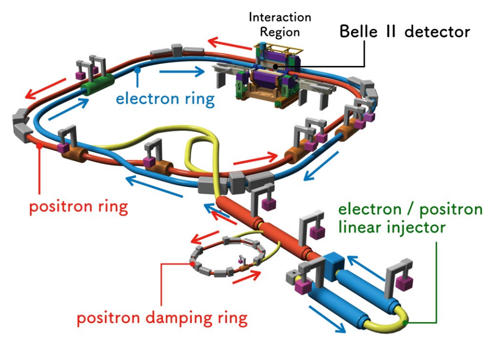
Design based on experience with circular accelerators around the world.



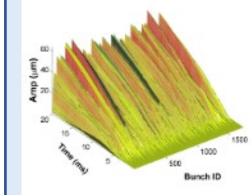




Technology is maturing in the latest ring accelerators such as SuperKEKB



~2.5 M$,30 FTE-yr



CBETA Fixed field

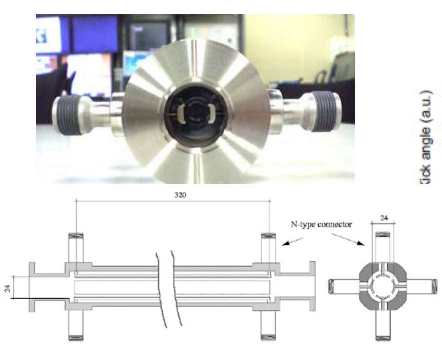
QUAPEVA (Soleil) Factor of 2 tuning

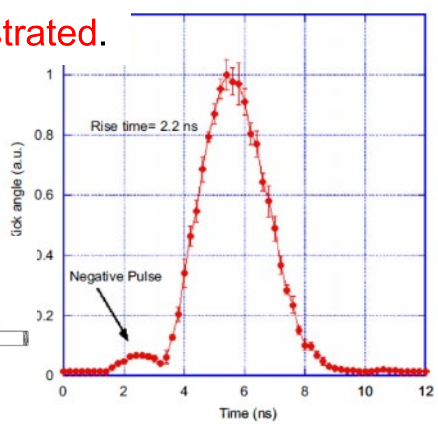
Final design

Inj./Ext.

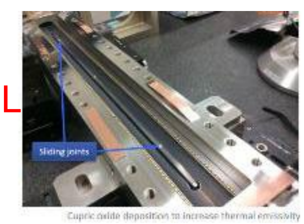
Eng. Design
Equipment verification

Beam extraction demonstrated.

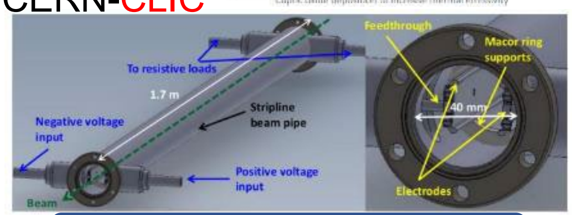




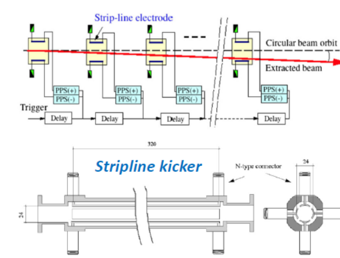
LBNL



CERN-CLIC



Fast kicker technology



Stable op.

Progress in final focus

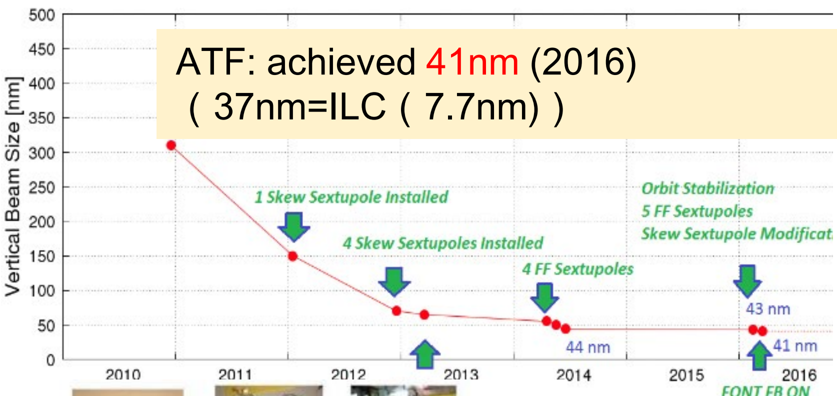
~ 2017	2018 ~ 2021	Pre-lab

Tech. design completed
Spec. almost achieved

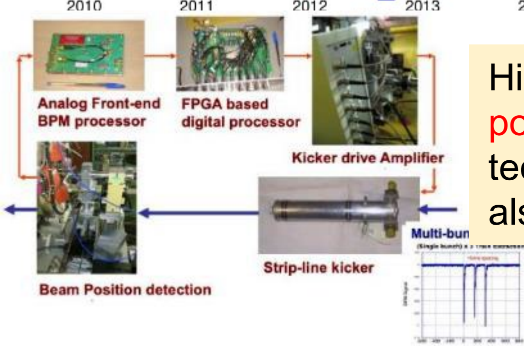
Wakefield effect

~2M$, 16FTE-yr

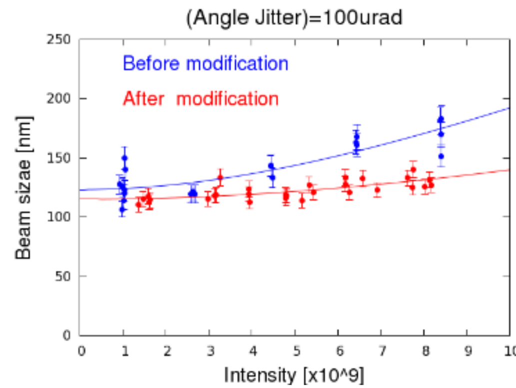
Detailed design
Stable operation
demonstration



ATF: achieved 41nm (2016)
(37nm=ILC (7.7nm))



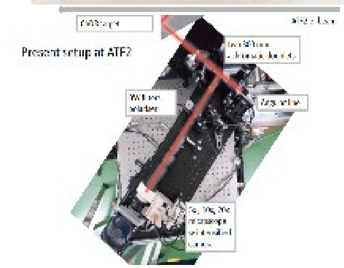
High-speed beam position control technology was also demonstrated.



Wakefield effect was evaluated at ATF.
-confirm no serious problem at ILC
-demonstrate a technique to reduce the wakefield effect

ATF International Review (Committee)*
-The committee highly evaluated the achievements of ATF so far.
-The committee pointed out the importance of continuing research to contribute to the detailed design of the ILC final convergence.

* https://agenda.linearcollider.org/event/8626/

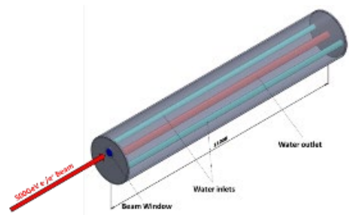


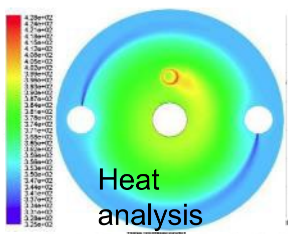
Modify the beam monitor system, etc. at ATF to demonstrate stable operation.

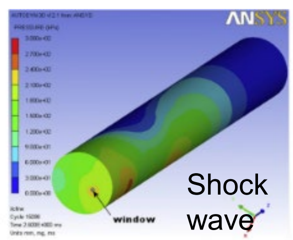
Progress in beam dump

~ 2017	2018 ~ 2021	Pre-lab
Basic design (by researchers abroad)	Design revalidation and specific facility design	~3M$, 12FTE-yr Remote Maintenance

Designed with 500GeV beam (17 MW) based on the SLAC water dump. ILC250 (2.6 MW) has enough margin. Absorber: Water(10 atm)





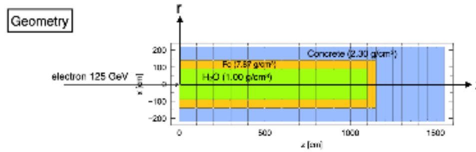


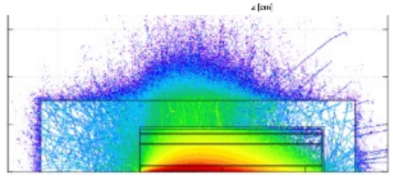
Consultations with beam target/dump experts from around the world beyond

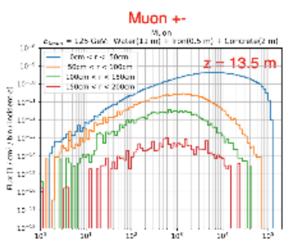
LHC beam dump

RADIATE collaboration

Specific design of radiation shield



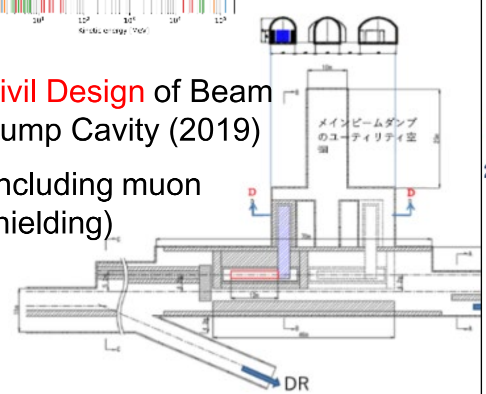




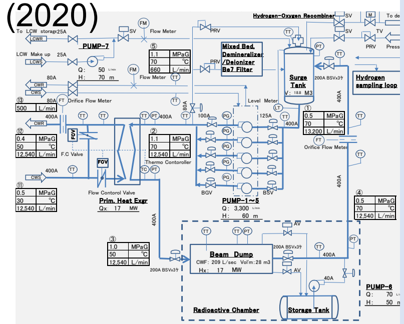
Design for shielding of muon particles generated by beam dump

Civil Design of Beam Dump Cavity (2019)

(including muon shielding)

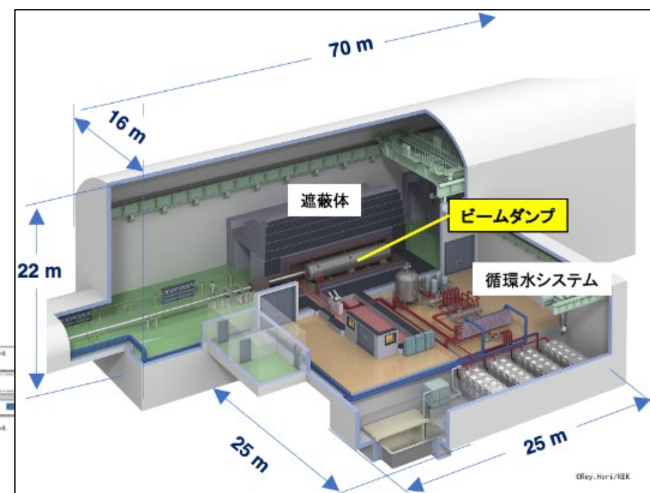


Beam Dump Water Circulation System Design (2020)



- Testing of main components of circulating water system
- Beam window replacement device
- Leakage countermeasures for radiating dump water
- Earthquake resistant design

Detailed system design (pursuit of safety design)



Status of ILC Global Activities / KEK

KEK / IDT-WG2
Shin MICHIZONO (KEK)

- ✓ ILC accelerator
- ✓ ILC international collaboration
- ✓ Technology level
  - ✓ SRF
  - ✓ Positron source
  - ✓ Damping ring
  - ✓ Final focus
  - ✓ Beam dump
- ✓ **Technical preparation at Pre-lab**
  - ✓ WP-1/2
- ✓ Civil/Safety/Environment
- ✓ Summary

Technical preparation

IDT-WG2 summarized the technical preparation as work packages (WPs) in the technical preparation document.

Actual cavity /CM manufacturing

ILC Pre-lab

- ***SRF*** ~41MILCU, 285 FTE-yr
  - WP-1 Cavity production
  - WP-2 Cryomodule assembly
  - WP-3 Crab cavity
- ***e- source*** ~2.5MILCU, 6 FTE-yr
  - WP-4 Electron source
- ***e+ source*** ~6MILCU, 15FTE-yr
  - ***Undulator scheme***
    - WP-5 Undulator
    - WP-6 Rotating target
    - WP-7 Magnetic focusing
  - ***e-Driven scheme***
    - WP-8 Rotating target
    - WP-9 Magnetic focusing
    - WP-10 Capture cavity
    - WP-11 Target replacement
- ***DR*** ~2.5MILCU, 30FTE-yr
  - WP-12 System design
  - WP-13 Collective effect
  - WP-14 Injection/extraction
- ***BDS*** ~2MILCU, 16FTE-yr
  - WP-15 Final focus
  - WP-16 Final doublet
- ***Dump*** ~3MILCU, 12FTE-yr
  - WP-17 Main dump
  - WP-18 Photon dump

For detail,
http://doi.org/10.5281/ zenodo.4742018

SRF technology is energy-efficient, and its applications are increasing around the world.
These WPs will contribute to the promotion of SRF accelerators in each region.

- The technical preparation document was reviewed by the international review committee (chair:Tor Raubenheimer (SLAC)).
- The total global cost of the project is about 60 MILCU* and about 360 FTE-year. (This does not include the cost of the infrastructure for the WPs.)
- The cost will be shared internationally as in-kind contribution.

1MILCU=1M$(2012)

WP-1: Cavity industrial-production readiness

In recent years, U.S.-Japan/Europe-Japan cooperation is working on cavity performance improvemen and cost reduction. The yield will be evaluated.

- ◆ Demonstration of mass-production, 120 cavities
  - ◆~1% (total required number) → 40 cavities / region

(Goal)

- ◆ Cavity performance (35MV/m), success rate (yield) 90%.

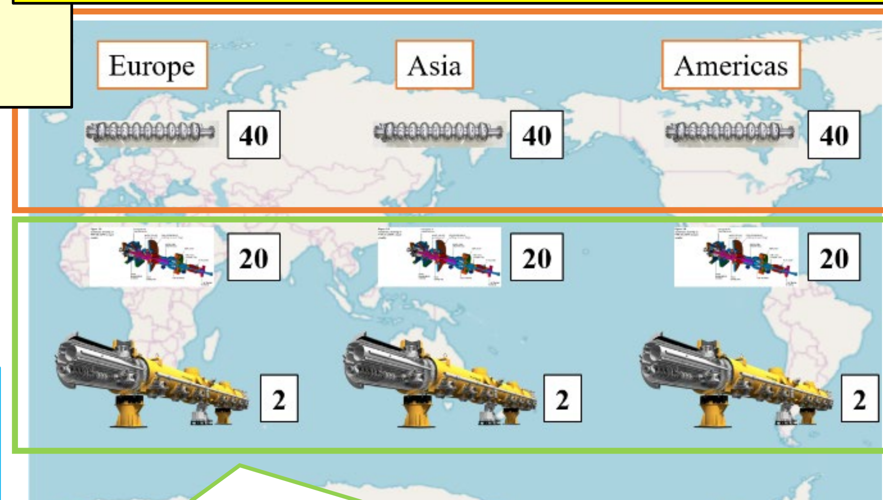
(Final confirmation)

- ◆ Establishment of HPGS for mass-production
- ◆ Demonstration of performance/cost effective manufacturing method (results after TDR)
  - ◆ Material (Nb) production: No impurity contamination (direct slicing) + cost reduction
  - ◆ New surface treatment method: Improved performance due to high electric field and low loss in cavity
- ◆ Reconfirmation of plug-compatibility: Final design to be confirmed
- ◆ Confirmation of best surface treatment

40 cavities

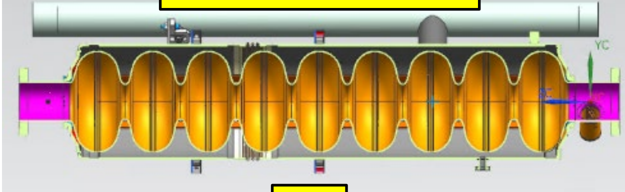
Cavity production
↓
Surface treatment
↓
VT incl. success yield
↓
Installation into CM

Of the 40 cavities, about half will be used for CM assembly and the rest will be used for cost reduction evaluation



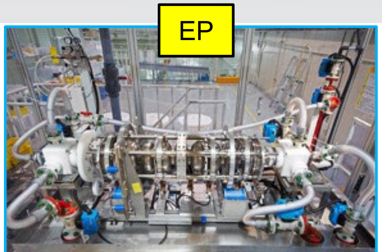
Items in green frame is related to WP-2 (next page)

Baseline design in TDR



Nb sheet

EP



HT

To be confirmed the best method for mass-production

WP-2: CM Assembly, Global transfer and Performance assurance

Two CMs production / region

Work flow of WP-2

CM production

↓

Performance test @region

↓

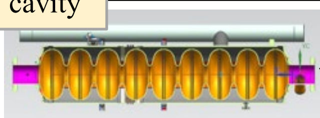
CM global transfer

↓

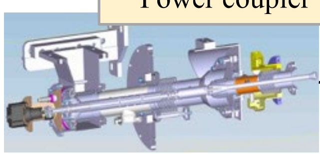
Performance assurance in Japan

- Two CM production per region
- 48 cavities produced in WP-1 will be installed
- Satisfied with HPGS (Final confirmation)
- Incl. ancillaries (coupler, tuner, SC-Magnet)
- CM global transfer (as first case in SRF)
  - CM transfer from each region
  - Preparation for shock absorber, vacuum monitoring system
  - To be evaluated performance assurance in Japan

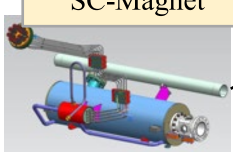
cavity



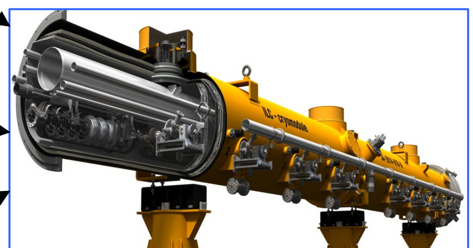
Power coupler

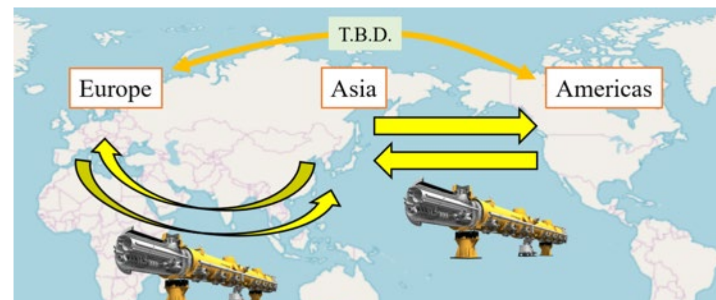


SC-Magnet



Completion of CM final design

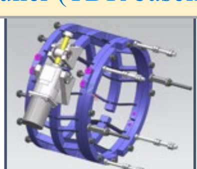


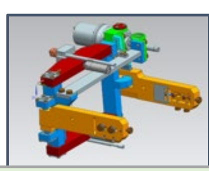


After the performance tests in each area, they will be transported to Japan via sea. The performance tests will be done again in Japan.

For the components that have progressed after TDR, evaluate the performance before deciding whether to use it

Tuner (TDR baseline)

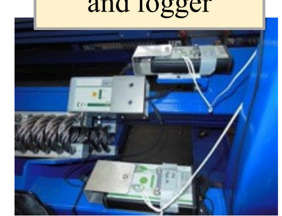




Improved tuner

Cage for transfer

Shock absorber and logger



Vacuum monitoring system

Status of ILC Global Activities / KEK

KEK / IDT-WG2
Shin MICHIZONO (KEK)

- ✓ ILC accelerator
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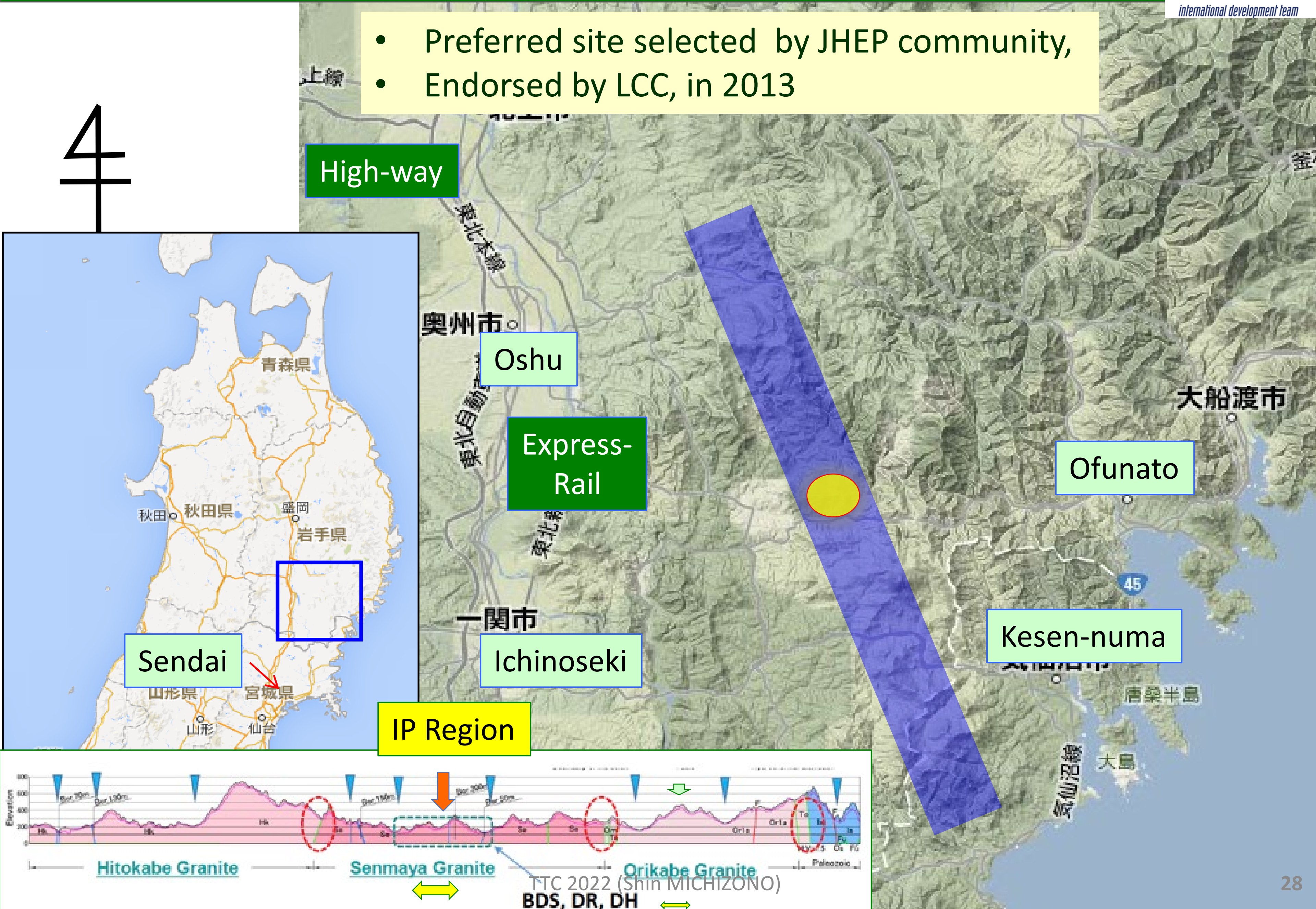
- ✓ Technology level
  - ✓ SRF
  - ✓ Positron source
  - ✓ Damping ring
  - ✓ Final focus
  - ✓ Beam dump
- ✓ Technical preparation at Pre-lab
  - ✓ WP-1/2
- ✓ Civil/Safety/Environment
- ✓ Summary

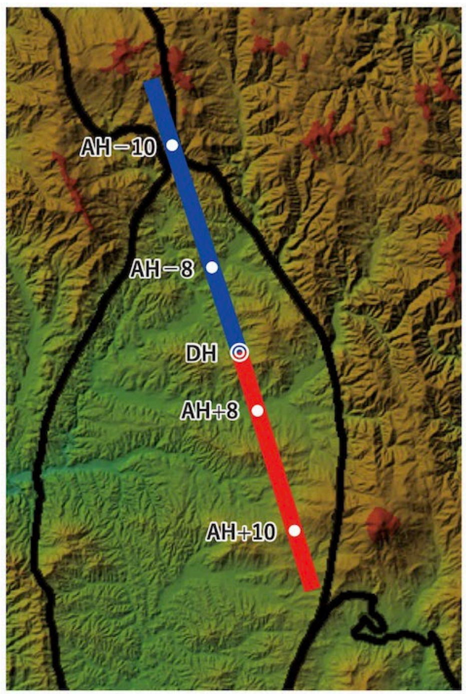
ILC Site Candidate Location in Japan: Kitakami

- Preferred site selected by JHEP community,
- Endorsed by LCC, in 2013

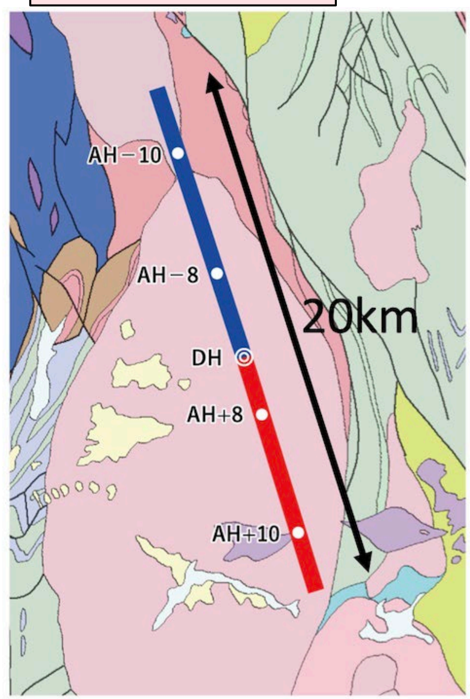


Topography and geology assumed in civil engineering design of ILC

- Rock mass is generally uniform over a long distance of 50 km
- Solid rock zone is less susceptible to ground vibration
- No "known faults" crosses the site, which is expected to be active faults



granite zone



We evaluated candidate sites by selecting the most suitable geology for construction.

Reduces civil and cost risks due to massive water inflow, etc.

Construction of road tunnels and other projects may pass through areas with poor geology, depending on the conditions of the starting and ending points. ILC selects candidate sites with priority given to geology, avoiding soft ground in advance.

- Seismic survey (total 30 km), electromagnetic survey (13 km), and borehole survey (7 boreholes) were carried out.
- In the area of the accelerator tunnel, hard and uncracked granite is considered to be widely distributed.

Radiation safety and community understanding

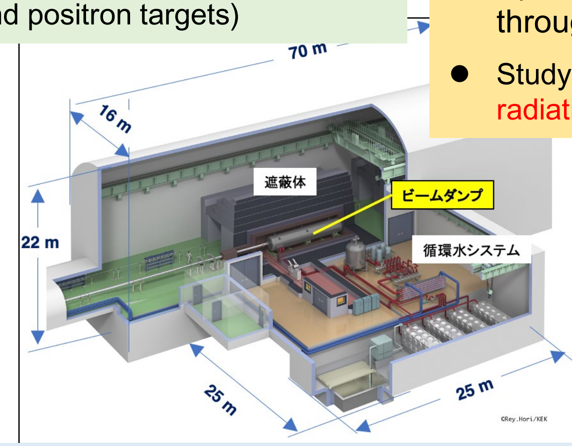
Facility design for radiation safety (radiation protection and long-term maintenance of radioactive materials)

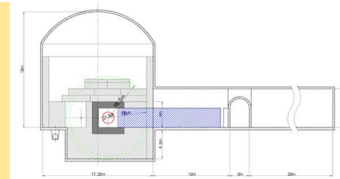
- KEK and other large accelerators around the world have enough experiences

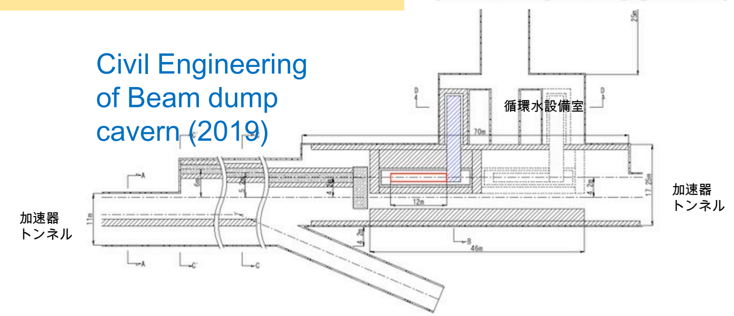
  Such as proton accelerators with more severe activation (Selection of materials for beam dump windows and positron targets)

- The final design for safety, including the structure of radiation shielding, maintenance methods for activated components, measures against leakage of beam dump water, and long-term maintenance of activated materials, is being carried out with international cooperation.

- Specific design of facilities and equipment through industry-academia collaboration
- Studying measures for drainage, earthquake, and radiation (AAA WG)







Civil Engineering of Beam dump cavern (2019)

Briefing sessions to promote understanding among local residents

KEK, local Universities and local government

- Explanation of safety management and environmental impact measures
- Briefing sessions were held at 13 venues, including the Community Exchange Center, in order to broaden the participation of local residents.
- Questions asked at the briefing sessions and answers to questions and concerns raised by local residents were compiled and made available on the website.

https://tipdc.org/inquiries#qa (in Japanese)

Environmental Initiatives

- Environmental impact assessment policy

“ILC Environmental Assessment Advisory Board” was established with external experts (2019)

Chair: Kenichiro Yanagi (Professor Emeritus, Meiji University), Chairman of Tokyo Olympic and Paralympic Environmental Assessment Committee

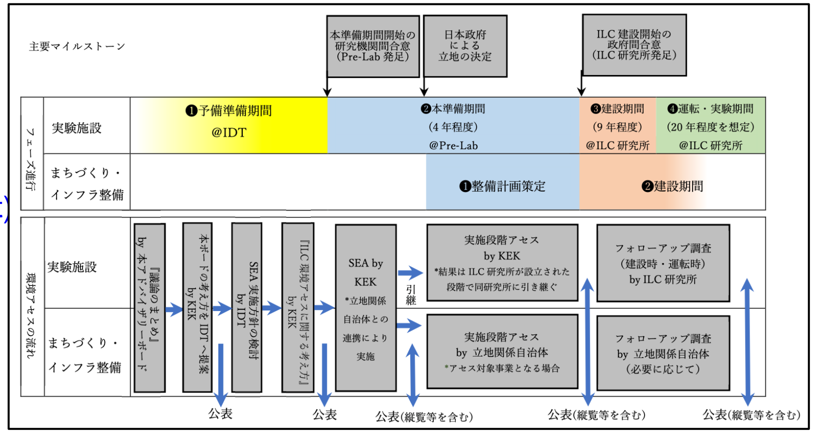
Based on the project characteristics of ILC,

- Basic guidelines for assessment, and
- Implementation structure, process, and
- Methodology and assessment targets

  (environmental impact, social and economic impact)

Summary of the Discussion

https://www2.kek.jp/ilc/ja/contents/docs/Strategic_Environmental_Assessment_of_the_ILC_Project_Summary_of_the_Discussion_r.pdf



Flow of environmental assessment for the ILC project (assumed)

- "Green ILC" for the environmen (Green ILC WG, AAA)

https://tipdc.org/assets/uploads/2020/12/guideline03.pdf (in Japanese)
https://tipdc.org/assets/uploads/2020/12/guideline04.pdf (in Japanese)

- Energy measures: Biomass, Power-GRID, waste heat utilization
- Utilization of resources: Use of local wood for ILC-related facilities, use of high-quality granite produced during tunnel excavation

Status of ILC Global Activities / KEK

KEK / IDT-WG2
Shin MICHIZONO (KEK)

- ✓ ILC accelerator
- ✓ ILC international collaboration
- ✓ Technology level
  - ✓ SRF
  - ✓ Positron source
  - ✓ Damping ring
  - ✓ Final focus
  - ✓ Beam dump
- ✓ Technical preparation at Pre-lab
  - ✓ WP-1/2
- ✓ Civil/Safety/Environment
- ✓ Summary

Summary

- ILC R&D activities have been carried out by international collaboration.
- Now IDT (International Development Team) leads the ILC collaboration.

- Efforts to improve the performance and reduce the cost of SRF cavities are being made through US-Japan and Europe-Japan cooperation.
- IDT-WG2 summarized technical concerns pointed out by the ILC advisory panel and the SCJ in the “Technical preparation document” as work packages (WPs) (by the global in-kind contribution).
- Since the cavity production in the ILC construction will be shared among the world's three regions, and mass production demonstration of SRF is an important next step.

- The design of the facility has been carried out based on the topographical, geological and hydrological surveys of the envisioned area.

Thank you for your attention