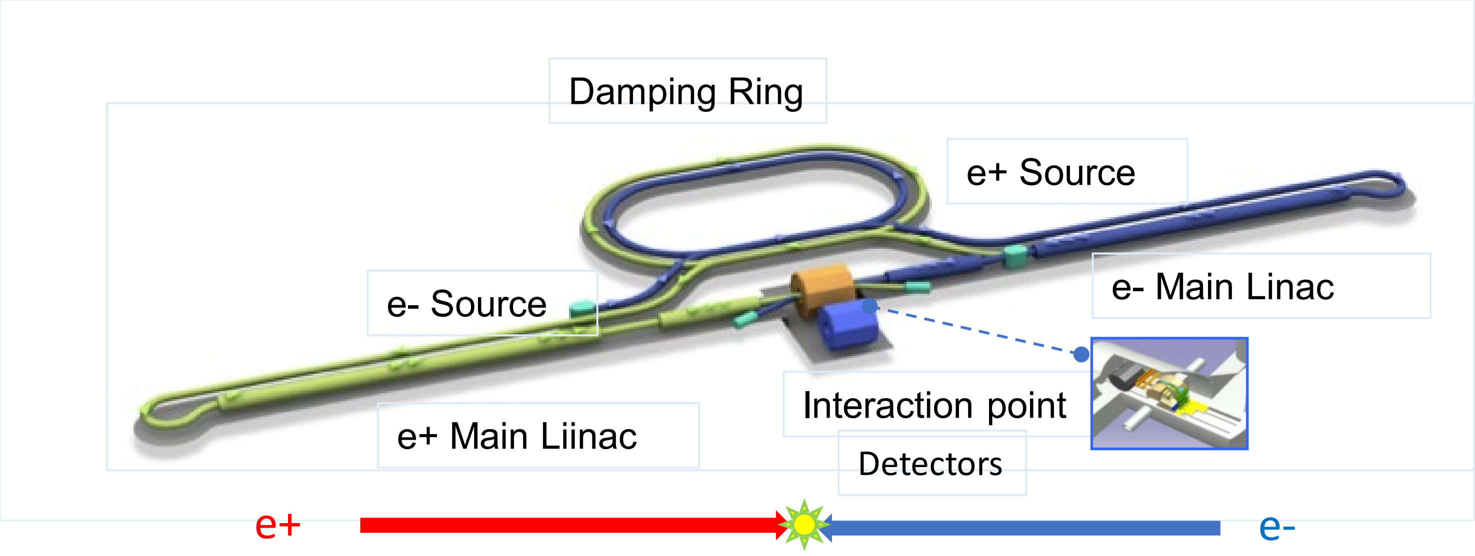
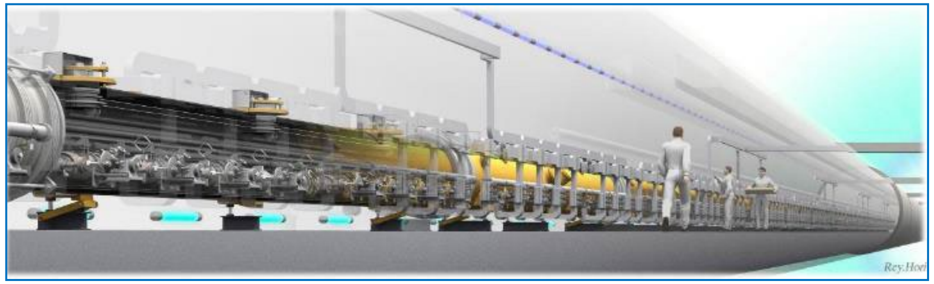
KEK / IDT-WG2

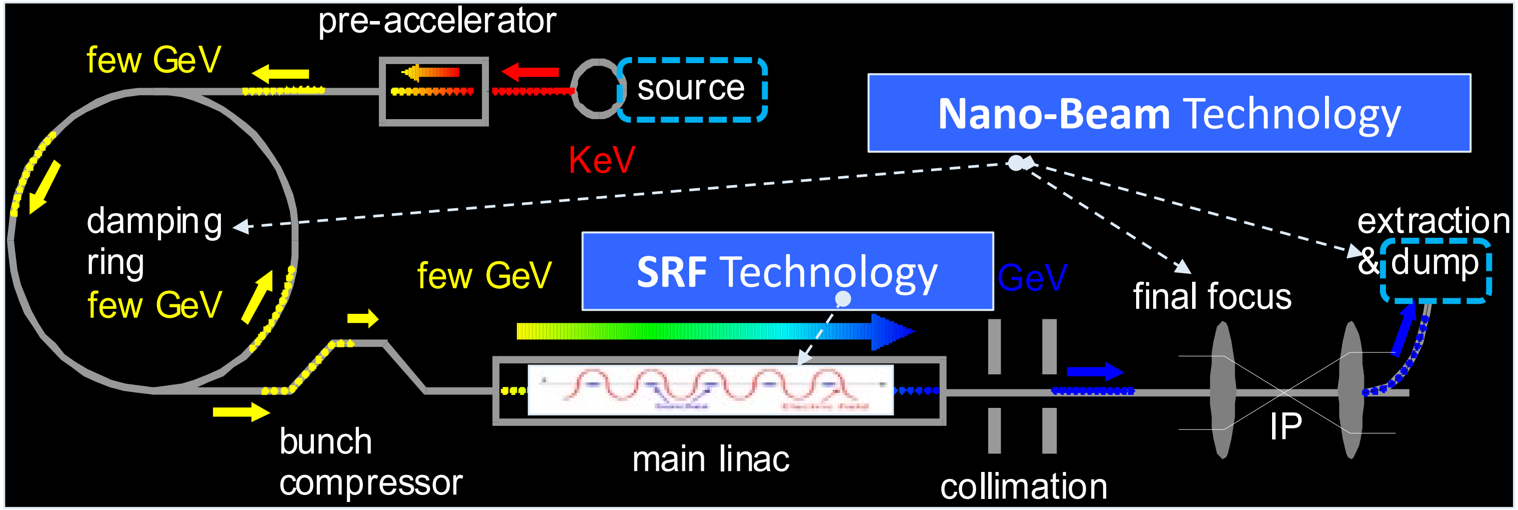
Shin MICHIZONO (KEK)

- ILC accelerator
- ILC Technology network
- KEK's effort
  - SRF
  - Sources
  - Nanobeam
- Topics
- Summary

ILC and the Accelerator Technology







Parameters	Value
Beam Energy	125 + 125 GeV
Luminosity	1.35 / 2.7 x 10^{10} cm^2/s
Beam rep. rate	5 Hz
Pulse duration	0.73 / 0.961 ms
# bunch / pulse	1312 / 2625
Beam Current	5.8 / 8.8 mA
Beam size (y) at FF	**7.7** nm
SRF Field gradient	< 31.5 > MV/m (+/-20%) Q_0 = $1x10^{10}$
#SRF 9-cell cavities (CM)	~ 8,000 (~ 900)
AC-plug Power	111 / 138 MW

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IDT Scope for ILC Realization

-success oriented and asuming no major incident-

Technology Network Phase				Preparatory Phase			Construction Phase ~10 years for the construction and commissioning						
2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	• • •

R&D and effort to gain a common view and understanding.

ILC preparation laboratory and intergovernmental discussion

2021 May

Technical Preparation and Work Packages (WPs) during ILC Pre-lab

Work Packages (**WPs**) for ILC Pre-Lab

2022 June

Time-critical WPs for the ILC construction

WP-Primes for Time Critical

http://doi.org/10.5281/zenodo.4742018

https://agenda.linearcollider.org/event/9735/contributions/50816/attachments/38190/59968/Time-Critical_WPsV8b.pdf

ILC Technology Network (ITN)

-- global collaboration program---

- **Acc. R&Ds** focusing on
  - SRF
  - e- & e+ Sources
  - Nano-beam

} Synergy with other colliders

KEK obtained a budget for these R&Ds and started the activity from this April.

ILC Technology Networkと文科省補助金

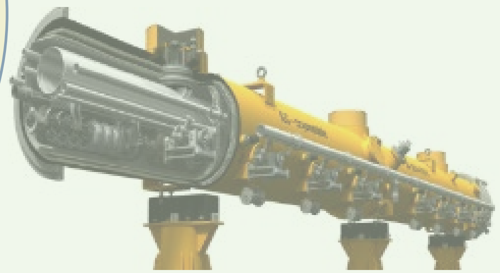
ITN：

WPPの海外分担分
いずれのWPPにもKEKの関与は必要であろうが、WPPによっては海外の比重が高いものもある

WPP-1
WPP-2
WPP-3
・・・

補助金：

COI棟を中心としたSRF関連の基盤設備整備



CM1台の評価
（CMには欧米で製造した空洞各1台程度は入れたい。）

文科省補助金

令和５年度

将来加速器の性能向上に向けた重要要素技術開発
（先端加速器共通基盤技術研究開発費補助金）

公募要領

文部科学省　研究振興局

令和５年２月

取組内容

本事業では、「Ⅰ．２．事業の目的」を達成するため、「将来加速器の性能向上に向けた重要要素技術開発」実施機関（以下、「事業実施機関」という。）は、下記の（１）国際協働による技術開発、（２）加速器技術の飛躍的発展研究を一体的に行います。

（１）国際協働による技術開発　～6.6億円/年

応募者におけるこれまでの成果や最新の知見等を活用しながら、国際的な視野で日本、米国、欧州等の各研究機関における強みや特色などの研究ポテンシャルを最大限活用した国際協働により、技術開発を行います。

特に、加速性能の根幹である以下の次世代加速器の重要技術を中心に、将来加速器の性能向上に関する研究開発に取り組みます。

① ナノビーム収束技術
② 超伝導加速空洞技術
③ 粒子発生技術

～0.4億円/年
（ILCの現在の技術開発は含まれない）

（２）加速器技術の飛躍的発展研究

将来加速器の性能向上にとっては、斬新なアイデアによる加速器技術の飛躍的な発展も必要です。このため、「（１）国際協働による技術開発」に記載の技術開発に限らない斬新なアイデアによる加速器技術の飛躍的な発展につながる研究開発課題等を国内の関連若手研究者から募集し、その研究活動や経費等を支援することで本分野の人材育成にも資する取組を行います。

４．採択予定件数

本事業では、本事業の補助事業者として１機関を採択します。

KEK / IDT-WG2

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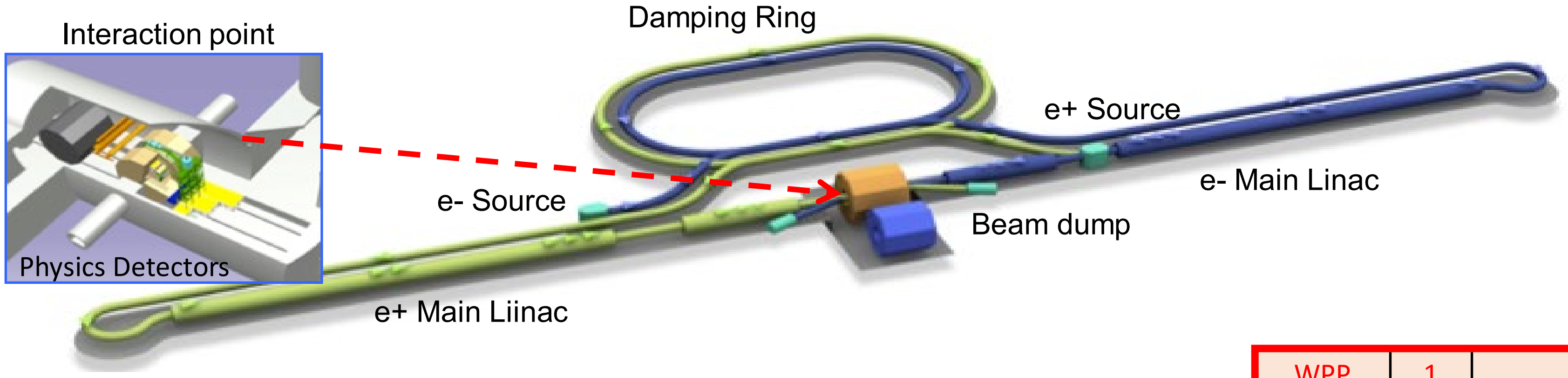
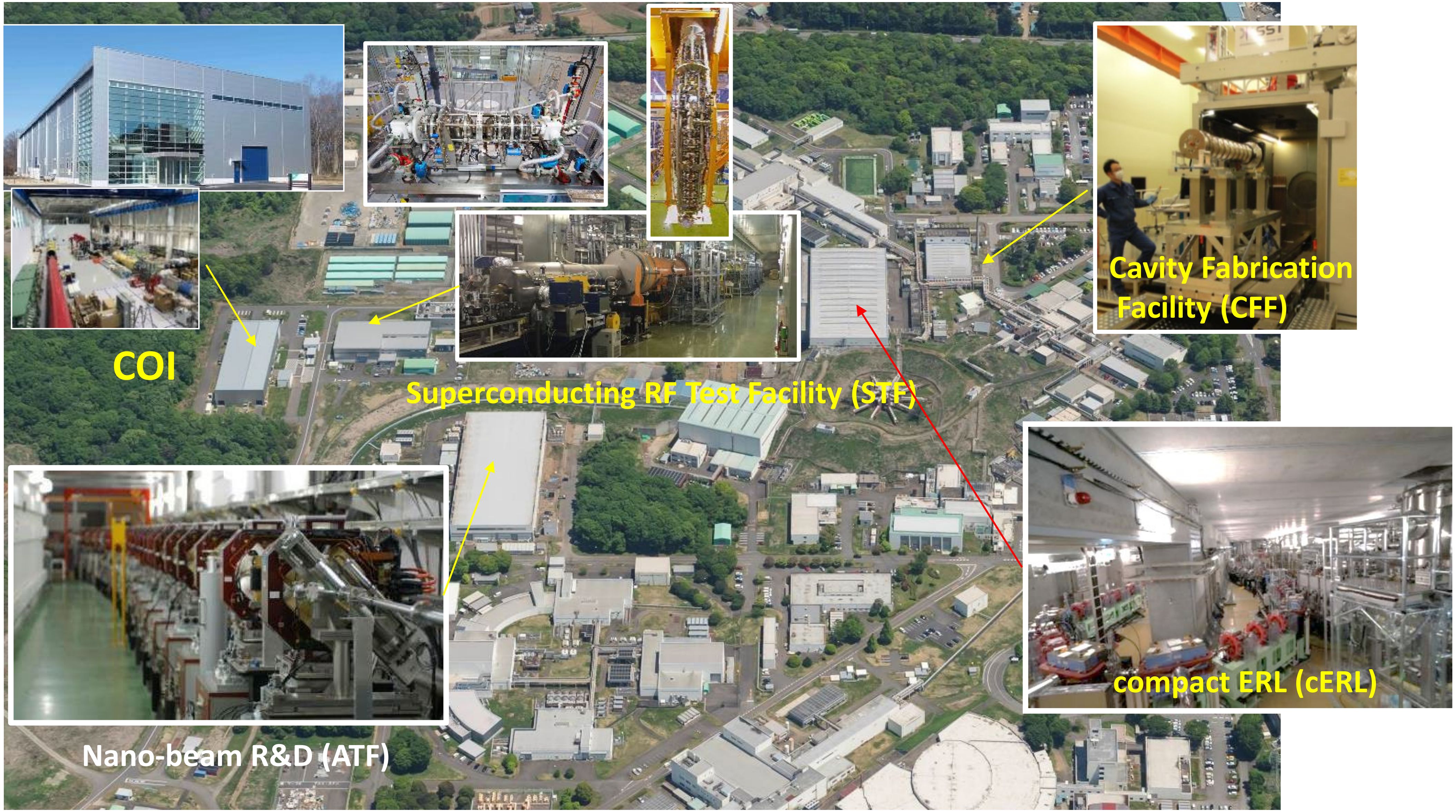
KEK's efforts



- 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***

Group				Note
SRF	WPP	1	Cavity production	Collaboration with Europe, Americas
	WPP	2	CM design	
	WPP	3	Crab cavity	
e-, e+ Sources	WPP	4	E- source	Experiences at SuperKEKB
	WPP	6	Undulator target	
	WPP	7	Undulator focusing	
	WPP	8	E-driven target	
	WPP	9	E-driven focusing	
	WPP	10	E-driven capture	
	WPP	11	Target replacement	
Nano-Beam	WPP	12	DR System design	ATF collaboration
	WPP	14	DR Injection/extraction	
	WPP	15	Final focus	
	WPP	16	Final doublet	
	WPP	17	Main dump	

Advanced accelerator facilities at KEK

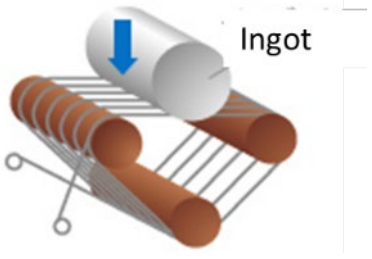


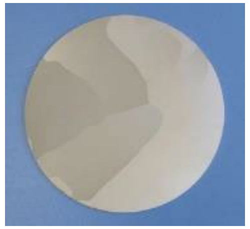
Superconducting RF (SRF) related facilities –STF & CFF-

508MHzTRISTAN (1989)

508MHzKEKB (1998)

SRF cavity R&D since 1980s
Experiences at TRISTAN/KEKB/SuperKEKB





Cavity material R&D at CFF

STF (2005-) for Superconducting Cavity Evaluation

Cavity fabrication, cryomodule assembly will be carried out.

S1 global (2010)
4 KEKs, 2 each from Germany and US Cavities

Vertical test stand

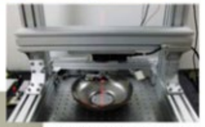
STF-2(2016～)
14 srf cavities

CFF(2011-) cavity fabrication facility

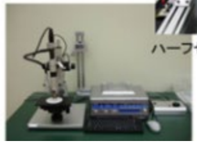
EBW

Chemical polishing

CP室 ドラフトチャンバ



ハーフセル形状測定器(開発中)

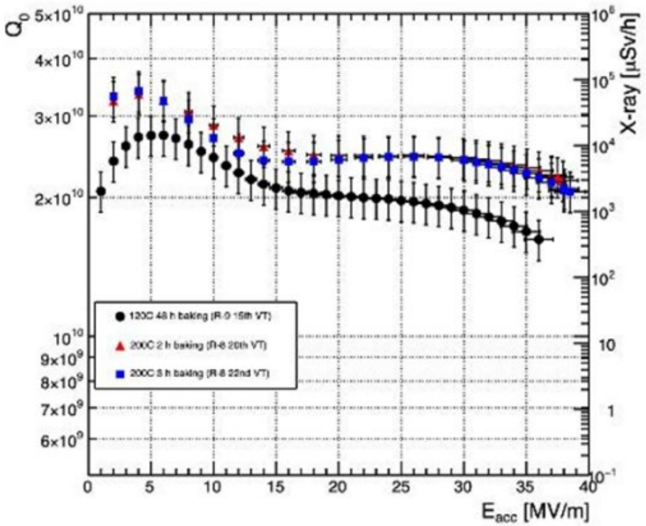


Surface Inspection

Press machine

Vertical lathe

High-Q/G R&D at STF



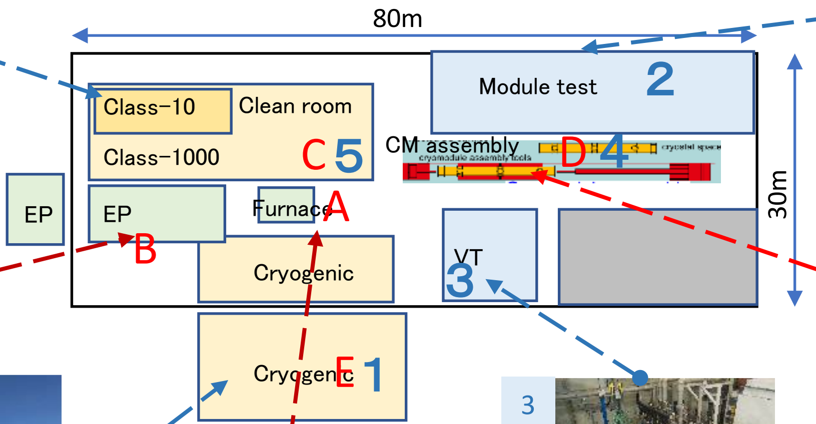
COI (SRF infrastructure)

Current status	Future
A) Heat treatment B) Electro polishing (EP) C) Clean room D) Cryomodule (CM) Assembly (partly done) E) Cryogenic system (partly done)	1. Cryogenic system upgrade 2. High power rf system for module test 3. Vertical test (VT) stand 4. CM assembly 5. Clean room working environment 6. (cavity fabrication equipment at CFF)

SRF infrastructure (including CM test stand) will be completed.

Infrastructure at COI

Future : cavity string at European XFEL



Future : CM test at European XFEL

EP

Cryogenic sytem

Future : VT @FNAL

CM assembly at KEK

Future : CM assembly at XFEL

WP-prime 1: SRF Cavity
(Scoping the Industrial-Production Readiness)

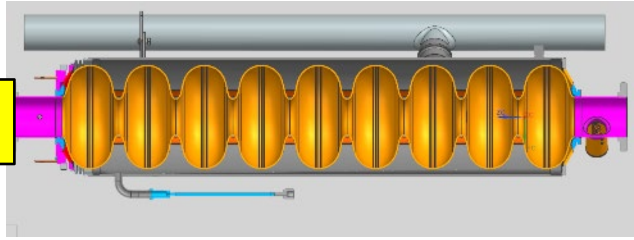
The SRF cavity technology has become matured technology based on TESLA, E-XFEL and LCLS-II experiences. Japan, Americas and EU have attempted R&D for the higher performance with cost-effective production. In WPP-1, the successful production yield will be evaluated.

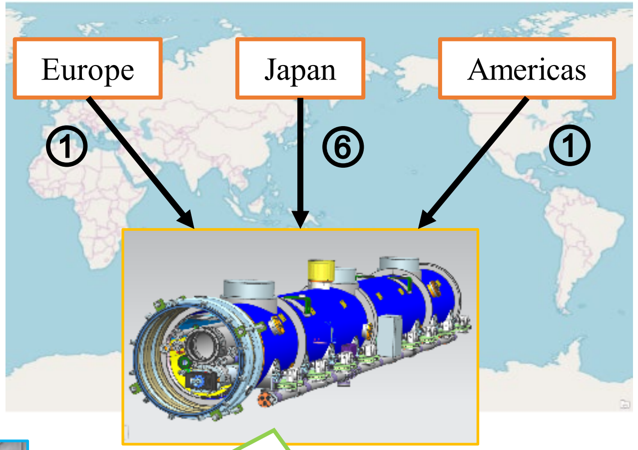
- Industrial-production readiness: 12 cavities produced in JP:
  - Evaluate the successful production yield.
- Cavity performance expected: E_{acc} = <35 MV/m> (+/− 20%), $Q_0 = 1.0 \times 10^{10}$, Yield = ≥90%
- Globally common design applicable to High Pressure Gas Safety (HPGS) regulation in JP.
- Production process with higher performance/lower cost (i.e. cost-effective production)
  - Advanced Nb sheet production: Clean surface by direct slice + cost reduction
  - Advanced surface treatment: High-G and High-Q cavity
- Plug-compatible design
- Optimization of best surface treatment

WPP-1: Work flow

Process to be applicable to JP-HPGS
↓
Preparation of material
↓
Cavity production
↓
Surface treatment
↓
Vertical test and Yield evaluation
↓
(WPP-2: assembled to CM)

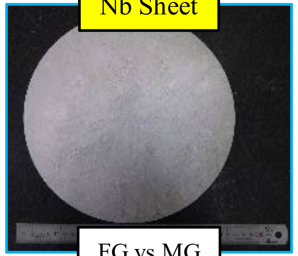
Cavity design based on TESLA/LCLS-II (globally common design)





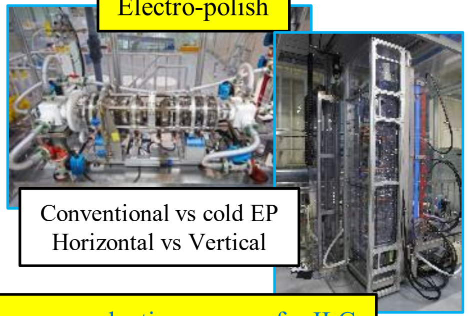
8 cavities produced in three regions to be assembled to one CM, and tested

Nb Sheet



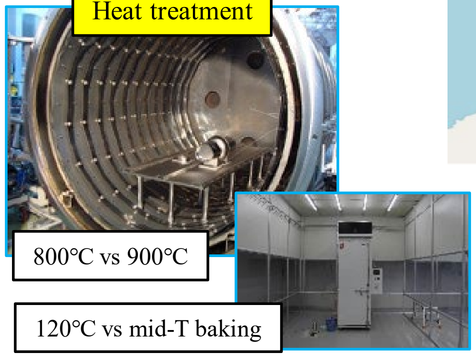
FG vs MG

Electro-polish



Conventional vs cold EP
Horizontal vs Vertical

Heat treatment



800°C vs 900°C

120°C vs mid-T baking

Establishment of best mass-production process for ILC

WP-prime 2: Cryomodule (CM) design optimization

(Scoping the CM Global Transfer and Performance Assurance)

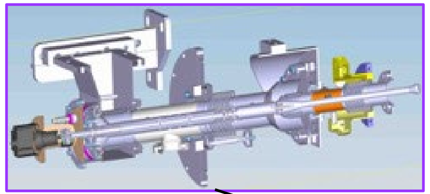
The SRF technology based on TESLA has become matured technology after E-XFEL and LCLS-II. In WPP-2, one CM will be designed globally, produced and tested in Japan with some cavities transferred from overseas.

WPP-2: Work flow

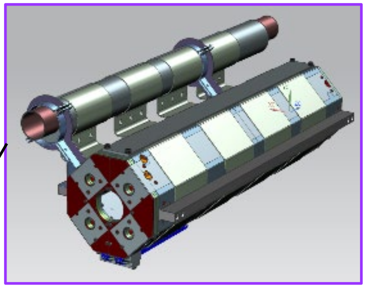
Design of CM and ancillaries
↓
Production of components
↓
Cavity string assembly
↓
CM assembly
↓
CM test
↓
(reflected in the EDR)

- One CM design and preparation for the production/test in Japan
- Cavity performance: E_{acc} = <31.5 MV/m >, $Q_0 = 1.0 \times 10^{10}$
- 8 cavities produced/evaluated in WPP-1 to be assembled, including some cavities from overseas
- Globally common design applicable to high pressure gas safety (HPGS) regulation
- Ancillaries production/evaluation:
    - input power coupler, tuner, SCQ, magnetic shield, advanced clean work
- Change request after TDR (SCQ current lead port, tuner design, etc.)
    - After testing prototype CM, these change requests to be considered

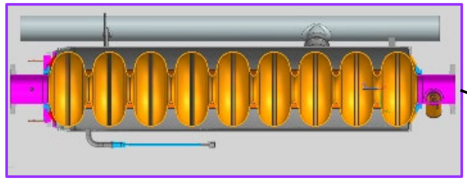
Input power coupler



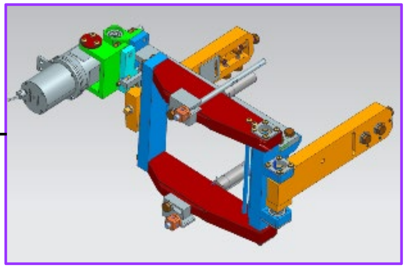
SCQ magnet

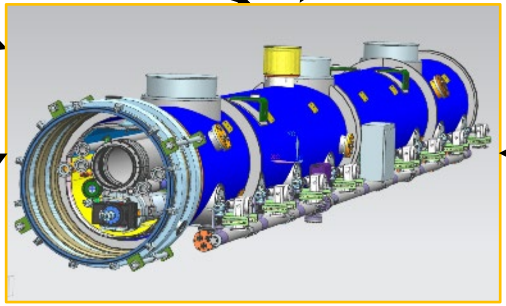


Cavity

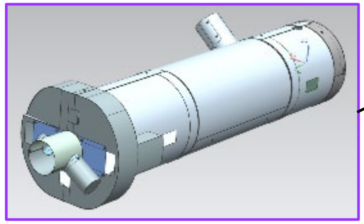


Frequency tuner





Magnetic shield



Construction of prototype CM for ILC designed globally

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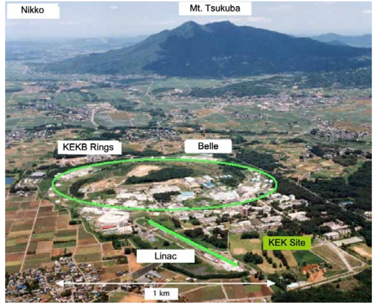
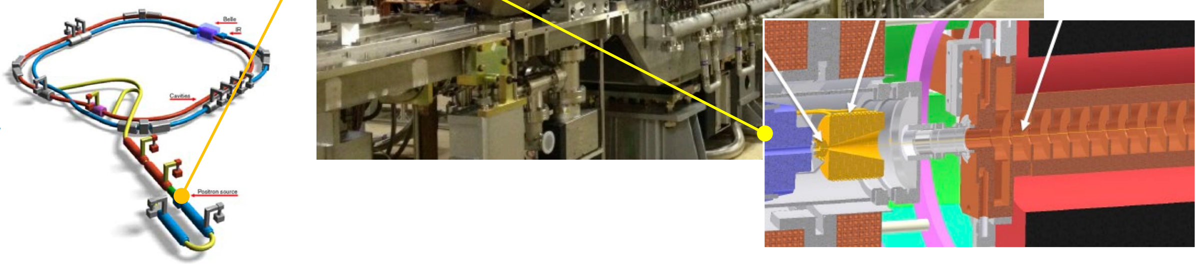
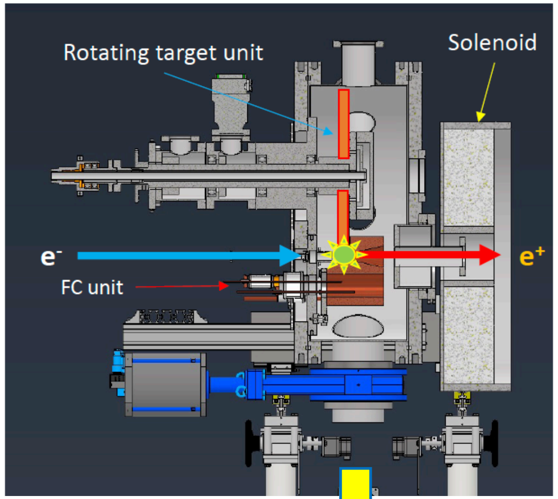
e-driven e+ source R&D

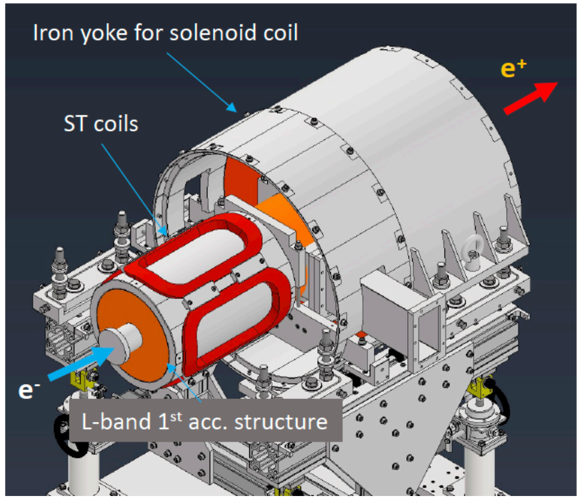
SuperKEKB positron source:
current biggest positron source in the world!

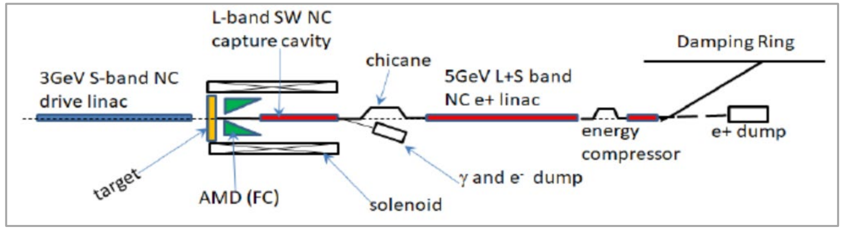
- A prototype development, based on experiences at SuperKEKB e+ source
- Engineering design toward ILC:
  - 3D-CAD model and engineering drawings for manufacturing, based on simulation and experiments





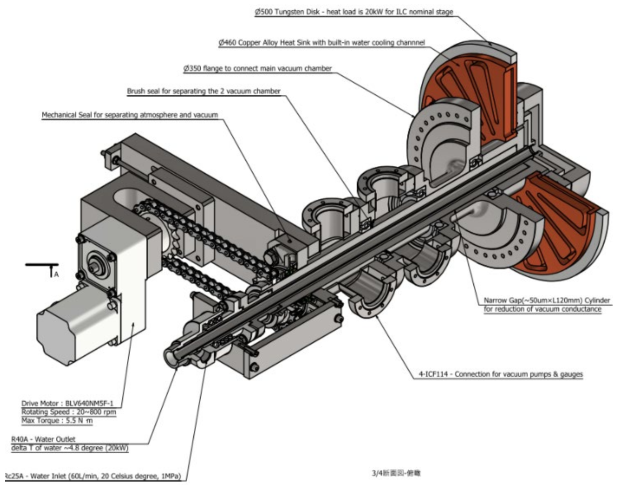


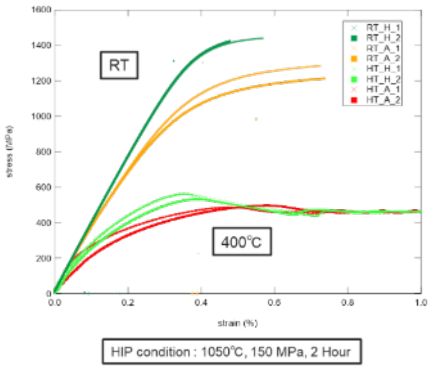


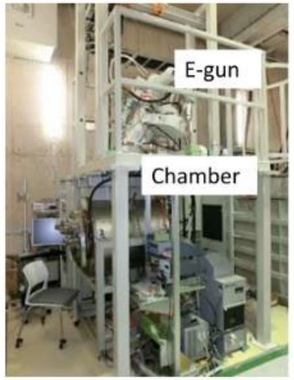


WP-prime 8 Rotating Target for e-Driven Scheme

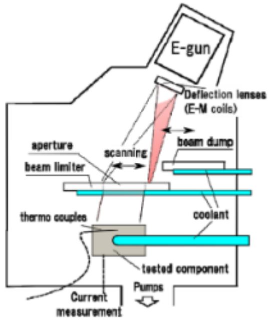
- 74 kW (3 x SLC) beam power
- Rotating mechanism
  - Water-cooled
  - UHV compatible
  - 225 rpm
- Target disk
  - W-Cu connection
    - Mechanical and thermal evaluation
    - CFD simulation using experimental data
    - HIP, SPS, Brazing
  - Target material selection and evaluation
    - Mechanical property at operating temperature



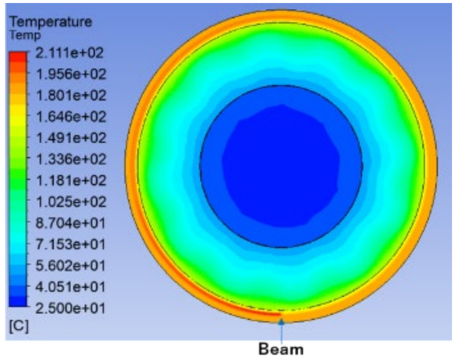


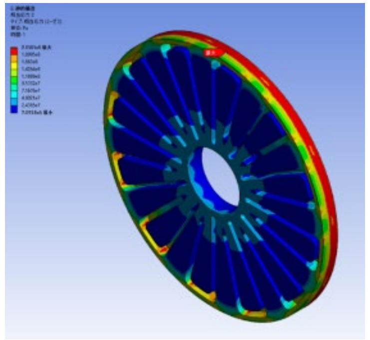


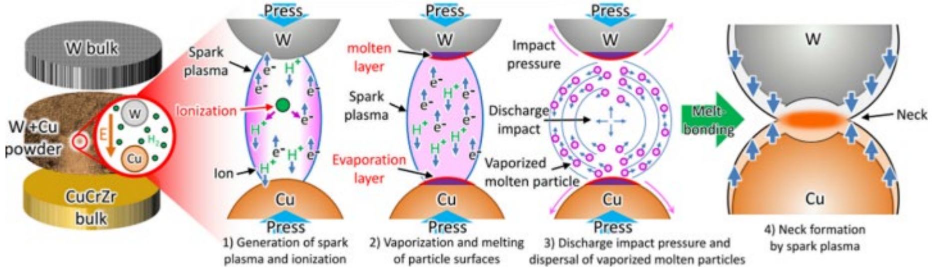
Electron gun: JEBG-3000UB manufactured by JEOL Ltd.

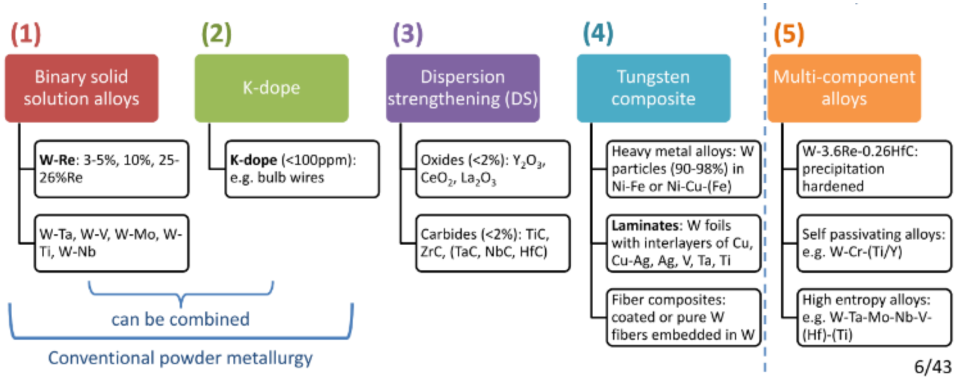


specifications		
parameters	value	unit
max. output power	300 (100)	kW
acceleration voltage	40	kV DC
max. current	7.5	A
max. scanning area	300 x 300	mm
spot size of e-beam	~10	mm







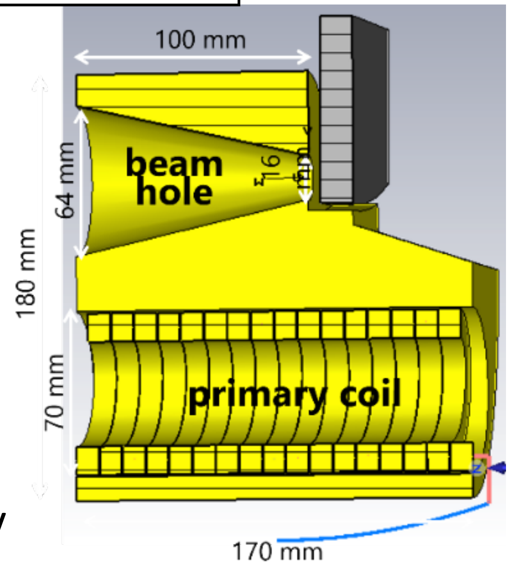


WP-prime 9 Magnetic focusing (from conceptual to engineering model)

- Flux concentrator
  - 20 times higher ohmic loss compared with that of SKEKB
  - Additional beam loss from target
  - Fully 3D simulation established in the SKEKB project.
  - Two prototype and high-power test
- Pulsed power supply
  - 300 Hz compatible
  - 50 times higher power compared with that of SKEKB
  - Energy recovery mechanism is necessary
- Need parameter optimization
  - Present parameters are not realistic especially power supply
  - Shorter pulse length
    - Need higher voltage
    - Counter measure to discharge
    - Flat top control

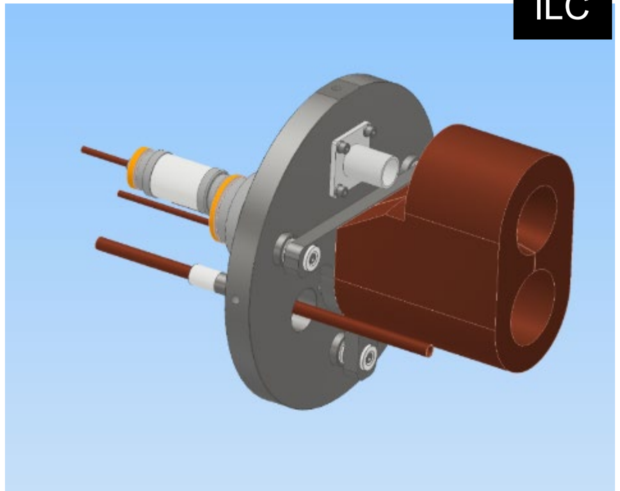
	ILC	SKEKB
Primary current		12 kA
Secondary current	25 kA	12 kA
Pulse width	25 us	5 us
Repetition	300 Hz/100 Hz	50 Hz
Ohmic loss	41 kW/14 kW	0.7～0.8 kW (measured)
Beam loss	4 kW	Small
Total loss@Load	45 kW/18 kW	0.7～0.8 kW (measured)
P.S. power	630 kW/210 kW	12 kW

P. Martyshkin



- Conceptual design and its simulation looks work
- Before going to detailed simulation, prepare “realistic” model ←（now）
- Once the model design finished, it will be imported to CST and ansys
- Detail design will be modified taking into account simulation results
- Iterate several times…

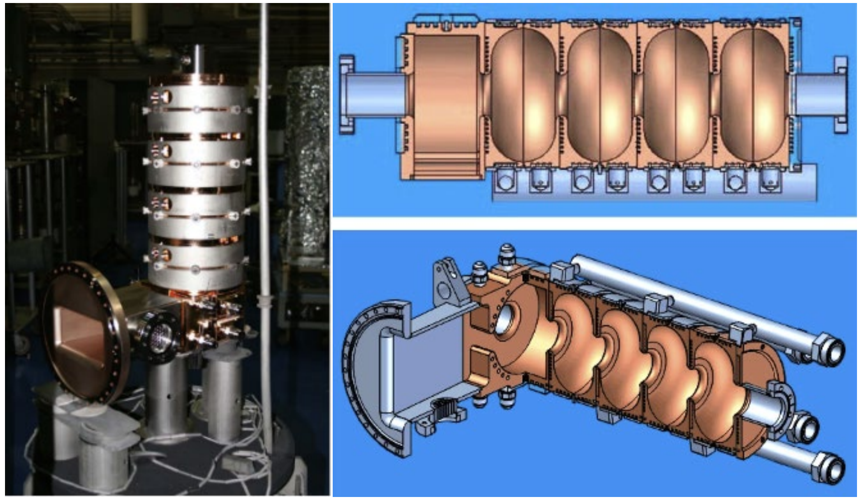
ILC



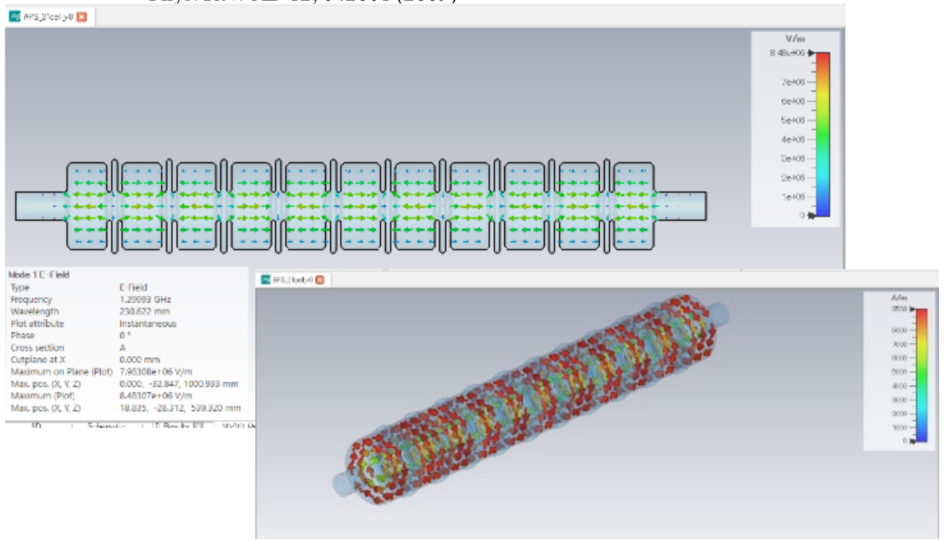
☑Mechanical design
☐Electric feedthrough
experiences in SuperKEKB
☐Cooling water pass
completely new issue

WP-prime 10 Capture cavity

- Design challenges of Large aperture L-band cavity
  - Beam loading compensation for multi bunch operation
    - Full model RF and beam simulation
    - Simulation method using CST is almost established
  - Very high heat load of shower from the target
    - novel cooling design
  - Remote beam flange connection
    - Connection point is surrounded by solenoid
- Two prototype and high-power test



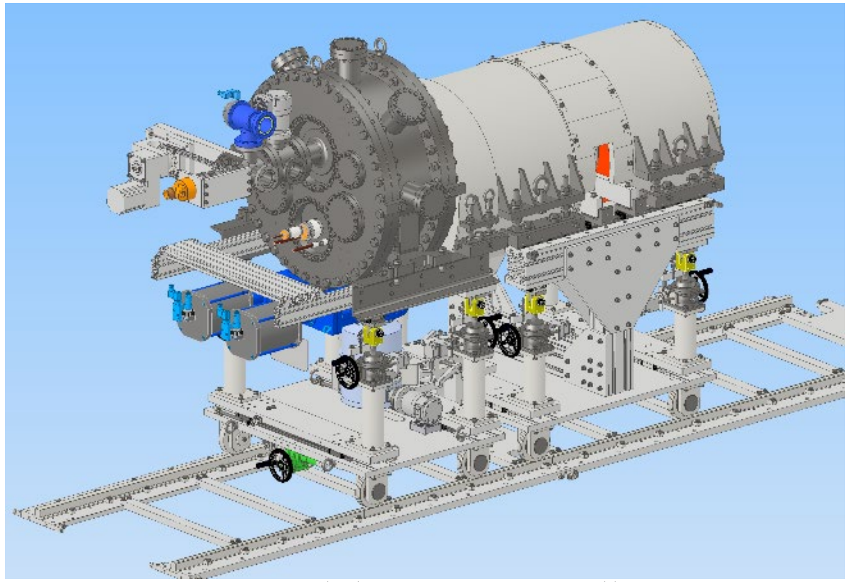
Previous design and prototype at SLAC
Phys. Rev. AB 12, 042001 (2009)



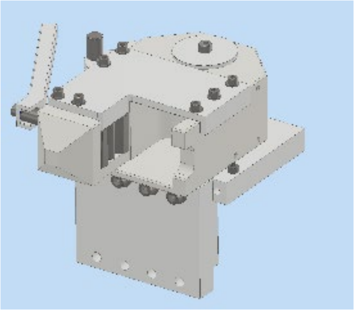
3D RF simulation of APS cavity at KEK

WP-prime 11 Target replacement

- Total model preparation
  - Construct as early as possible
    - Use dummy for FC, Acc. Structure at first
  - Prepare and manage full 3D CAD model
  - Improve continuously
- 3 times exchange experiences through SKEKB operation
- Collaboration with other high power target facilities, J-PARC, RIKEN, FRIB…
- Automatic connection disconnection mechanism
  - Flange connection
  - Movable base connection



Girder structure on rail



Automatic connection coupler

Pillow seal

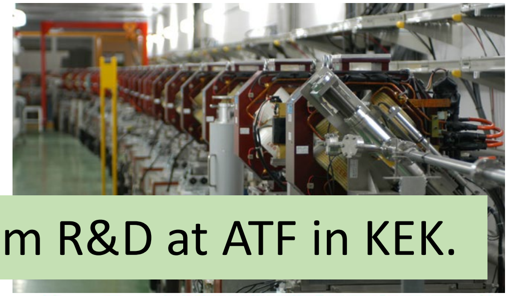
KEK / IDT-WG2
Shin MICHIZONO (KEK)

- ILC accelerator
- ILC Technology network
- KEK's effort
  - SRF
  - Sources
  - Nanobeam
- Topics
- Summary

ATF/ATF2: Accelerator Test Facility@KEK

Develop the nanometer beam technologies for ILC

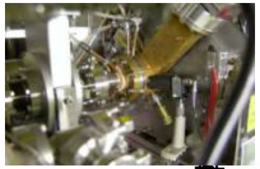
- Key of the luminosity maintenance
- 7.7 nm beam at IP (ILC)

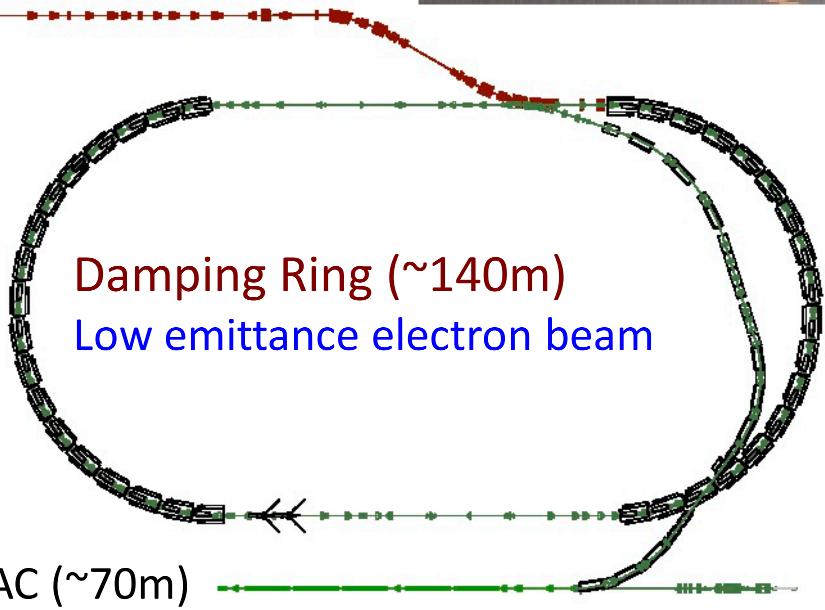


KEK hosts the nanobeam R&D at ATF in KEK.

ATF2: Final Focus Test Beamline

Establish the ILC final focus method with same optics and comparable beamline tolerances





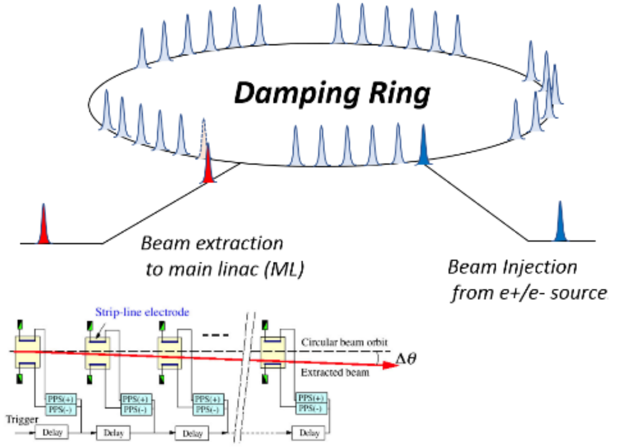
WP-prime 14: System design of ILC DR injection/extraction kickers

WP-prime-14 related items conducted by KEK on ITN

JFY2025： Development of a prototype of the fast kicker power supply for the ILC
JFY2026： Improvement of the prototype fast kicker power supply
JFY2027： Evaluation of the performance of the prototype fast kicker power supply

- ◆A fast kicker system using a semiconductor pulse power supply with nanosecond response was confirmed as proof of principle at KEK's ATF about 10 years ago.
- ◆Semiconductor technology has been evolving, and it is now possible to advance nanosecond response beam injection/excitation systems using the recent semiconductor technology.
- ◆The technical evaluation of the fast kicker power supply using the recent semiconductor technologies.

ILC fast injection/extraction system

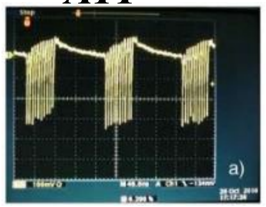


Timeline described in the time-critical work package document

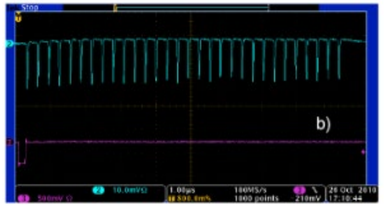
Priority	*Items*	Y1	Y2	Y3	Y4
B+	Confirmation of existing pulse power supply technology based on drift step recovery diode pulsar				

Beam extraction test at KEK ATF

Stored beam in DR



Extracted beam from DR



The same contents as WPP-14 will be carried out, However, we decided to delay the implementation year in order to give priority to other research topics.

WP-prime 15: System design of ILC FFS

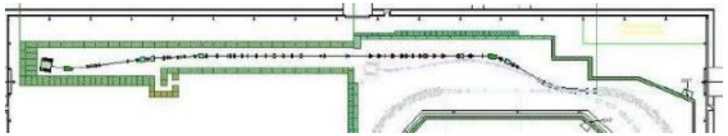
WP-prime-15 related items conducted by KEK on ITN

- The research will be conducted with the following 3 main topics
  - ✓ Improvement of beam tuning techniques for nano-beam
  - ✓ Long-term stabilization of nano-beam
  - ✓ Upgrading of beam diagnostic devices
- The first 2-3 years will be mainly devoted to procurement of the necessary equipment to implement the research items listed in the time-critical WP, and performance tests using the latest accelerator technologies, such as machine learning, will be carried out at the ATF accelerator as needed.

◆ ATF2 beamline is the only existing test accelerator in the world to test the final focus system (FFS) of linear colliders.

◆ The following 3 research topics are important topics to be pursued at the ATF.
- ◆ wakefield mitigation
- ◆ correction of higher-order aberration
- ◆ training for ILC beam tuning

ATF2 beamline



Timeline described in the time-critical work package document

Priority	***Items***	Y1	Y2	Y3	Y4
A	wakefield mitigation				
	mitigation and correction of higher-order aberration				
	training for ILC beam tuning (machine-learning etc.)				

The research topics will be conducted consistent with the content and timeline of WPP-15.

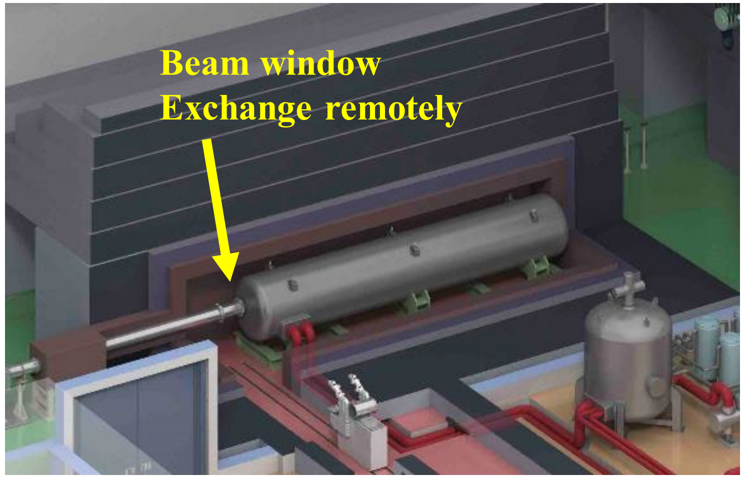
WP-prime 17: Beam Dump

WP-prime-17 related items conducted by KEK on ITN

- Design of earthquake-resistant structures
- Design of the water flow system, including the water vortex flow mechanism in the beam dump
- Design of the beam window exchange system
- The performance of the vortex flow mechanism and beam window exchange system will be evaluated using a prototype for functional verification.

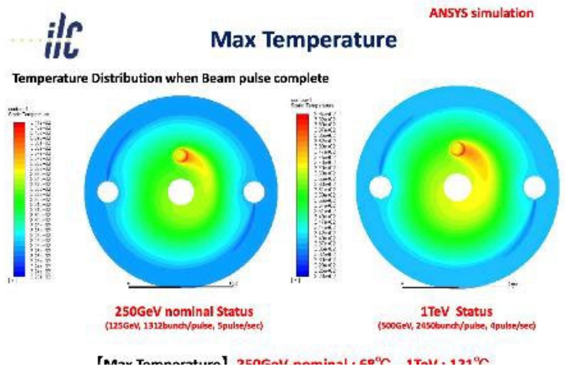
Finalize the engineering design of the main beam dump system

- Vortex water flow in the dump vessel
- Cooling water circulation and heat exchange
- Remote exchange of the beam window
- Countermeasure for failures / safety system



Timeline described in the time-critical work package document

Priority	*Items*	Y1	Y2	Y3	Y4
A	Engineering design of water flow system				
A	Engineering design and small-scale prototyping of vortex water flow system in the dump vessel.				
A	Engineering design and small-scale prototyping of beam window and its remote exchange system.				
A	Design of the countermeasure for failures / safety system				



The contents and timeline are roughly consistent with those of WPP-17.

ITN in progress

For WPP-1&2 (SRF cavity, CM), we have already started technical discussions with researchers in Europe and the USA.
For WPP-15 (Final Focus System), European researchers joined to the ATF experiments in this June operation.

WP-prime 1: SRF Cavity
(Scoping the Industrial-Production Readiness)

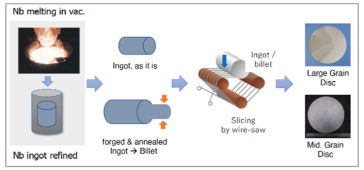
Referring European XFEL and LCLS-II experiences

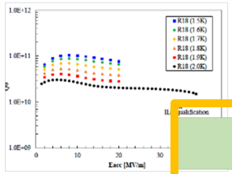
- Research with single-cell cavities to establish the best production process including:
  - Advanced Nb sheet production method
  - Advanced surface treatment recipe
- Globally common design with compatible High Pressure Gas Safety (HPGS) regulation
- 24 nine-cell cavities are to be developed for industrial-production readiness
  - 8 cavities (4 / batch) in each region
  - Production process encouraged to be optimized in each region
  - Cavity performance expected: E_{acc} = <35 MV/m> (+/− 20%), $Q_0 = 1.0 \times 10^{10}$, Yield = ≥90%
- RF performance/success yield to be examined (including 2nd pass and further)
  - 3rd pass to be examined if effective

	# of cavities to be produced		
	Americas	Europe	JP/Asia
single-cell	2	2	2 (+4)
nine-cell	8	8	8 (+4)

Material/Sub-component → QA of Material/Sub-C → Cavity Production → Surface Process → Cavity RF Test

Production process

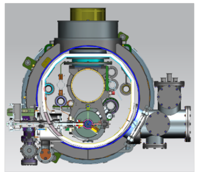


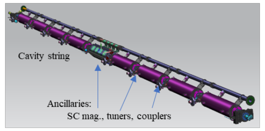


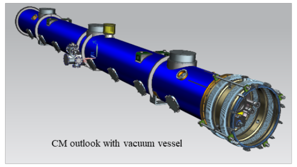
WP-prime 2: Cryomodule (CM) Design
(Scoping the CM Global Transfer and Performance Assurance)

Referring European XFEL and LCLS-II experiences

- Unify cryomodule (CM) design with ancillaries, based on globally common engineering design, drawings & data-base
- Establish globally compatible safety design base to be approved/authorized by HPGS regulations individually in each region, most likely referring ASME guidelines to be compatible with Japanese regulations.







Region Regulation	Americas ASME	Europe Eu-EN, TUV	Japan/Asia JP-HPGS Act
CM tech. design base	LCLS-II	Euro-XFEL	KEK-STF, AST-IFMIF
ILC CM design	Common CM design globally compatible to HPGS regulation in all regions, and most likely ASME guidelines to be compatible with Japanese regulations.		

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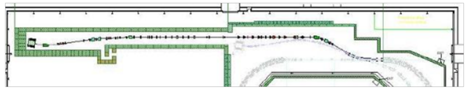
WP-prime 15: System design of ILC FFS

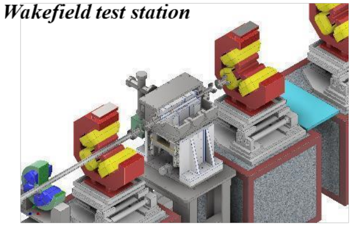
ATF collaboration

- ATF2 beamline is the only existing test accelerator in the world to test the final focus system (FFS) of linear colliders.
- The following 3 research topics are important topics to be pursued at the ATF.
  - wakefield mitigation
  - correction of higher-order aberration
  - training for ILC beam tuning
- The technical research at ATF2 beamline has proceeded, and should continue to be based on the ATF international collaboration, or its extension (welcome to new collaborators).

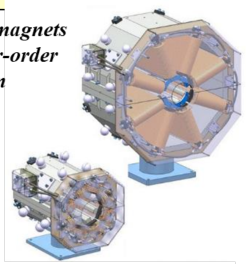
ATF2 beamline



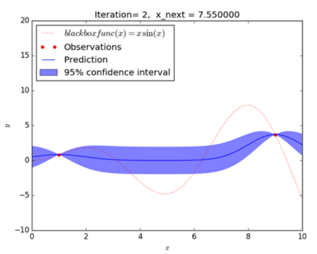
Wakefield test station



Octupole magnets for higher-order aberration



Maximum search algorithms to be applied to beam tuning (Machine Learning)



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KEK / IDT-WG2
Shin MICHIZONO (KEK)

- ILC accelerator
- ILC Technology network
- KEK's effort
  - SRF
  - Sources
  - Nanobeam
- Topics
- Summary

先端加速器の研究開発

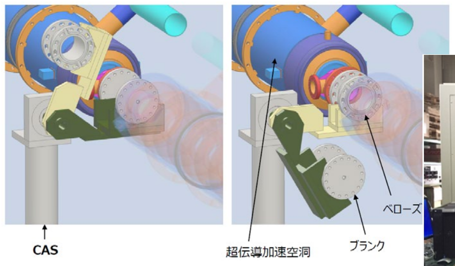
- 高エネルギー物理学実験の歴史は、大型加速器発展の歴史と言っても過言ではありません。過去、超伝導電磁石などは物理実験を実現するために研究開発が進められ、その成果は社会にも広く還元されてきました。
- ILCにおいても、粒子源、超伝導加速、ナノビームなど**ILCでの実験を実現するために不可欠な加速器の研究開発**があります。これらも**将来的には産業・医療応用などを含め社会にも貢献できる**内容であると確信しています。
- 大学の様々な分野からの参加が可能で、本研究開発を通して若手研究者の育成に大きく貢献して行きたいと思っています。
- KEKでは、**大型の装置を用いた実験**が行なえ、世界中の研究者や研究者の卵と肩を並べて研究を進められる機会が得られます。特に、**ハードウェア開発に興味のある学生の皆さん**にはうってつけの場所です。高エネルギー実験などでハードウェアに触れる機会が少ないフェーズに当たっている実験に所属している修士課程の学生さんが、実際の加速器に触れることで、ハードの適用範囲など端末の上の作業だけではない経験を積む機会に活用してもらうことも可能です。

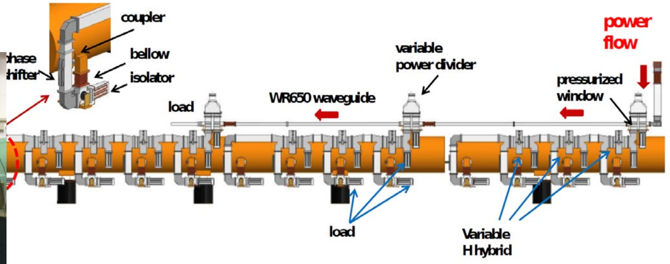
Example of topics (1)

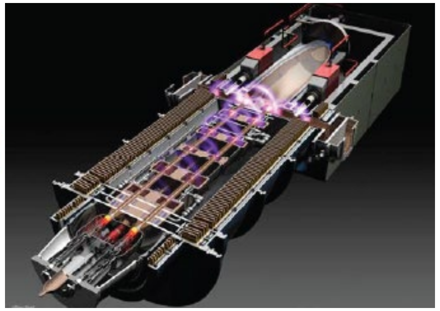
SRF		
超伝導高周波加速技術は、高エネルギー物理学の発展に大いに貢献してきました。国内では、80～90年代のTRISTAN計画、90～2000年代のKEKB-Factory計画、そして現在はSuperKEKB計画へと用いられ、海外では、LEP、LEP-II、LHC、HERA、CESR、BEPC-II、などに用いられてきました。ILCでは**ニオブ材を用いた高性能の超伝導空洞**を大量に用いる計画で、その性能を極限まで高める努力が世界中で行われてきました。具体的には、高品質の**空洞製造**、**電解研磨法**による表面処理、**真空炉**による高温熱処理、性能試験前に実施する低温熱処理、の改良です。ここでは、最適な方法による空洞性能達成およびその成功率の評価を行うことになっており、これを実現するには空洞表面でどのような物理現象が発生しているのかを詳しく理解することが肝要です。表面処理の最適化に加え、**ニオブ材**の評価、**性能試験**の最適化や空洞を調べる測定器開発なども含まれます。		
WPP-1	Optimization of mass production cavity manufacturing	KEK
WPP-1	Automation of cavity inner surface inspection + local polishing	KEK
WPP-1	Automation of pre-tuning	KEK
WPP-1	Optimization of cavity performance measurement	KEK
WPP-1	Nb material fundamentals, FG/MG/LG, optimization	KEK
WPP-1	Nb3Sn, MgB2 for higher Q and thermal efficiency at higher temperatures	KEK
WPP-1	Thin film (including multilayer film) for high electric field	KEK
WPP-1	Cavity shape (optimization of Ep, Bp, etc. by low surface field cavities)	Remote (if the university has someone available to teach)
WPP-1	Development of magnetic shielding materials, reduction of environmental magnetic field, improvement of efficiency of demagnetization method of modules	KEK
WPP-2	Tuner design, manufacturing and testing (for larger LFD)	KEK
WPP-2	(for higher power) Coupler design, manufacturing, and testing	KEK
WPP-2	Design, manufacturing, and testing of SC electromagnets + cold BPM (for higher radiation tolerance)	KEK
WPP-2	Establishment of multi-point simultaneous alignment method	KEK
WPP-2	Module design (optimization of thermal balance), manufacturing, and testing	KEK
WPP-2	Establishment of module transportation and storage methods (including vacuum system and moisture control)	KEK
WPP-2	Development of beam loss monitor in STF-2 accelerator module	Remote (if the university has someone available to teach)
WPP-2	Development of high-power RF equipment by resonant ring	KEK

Example of topics (2)

SRF		
Infra	Construction of high-frequency system + monitor system for VT	KEK
Infra	Development of X-ray/neutron mapping for VT and module testing	KEK
Infra	Optimization of cooling and test evaluation methods for VT and module testing	KEK
Infra	Infrastructure design for VT (cryostat, radiation shield) + refrigerator control	KEK
Infra	Infrastructure design (radiation shielding, installation) for module testing	KEK
Infra	Dark current measurement (including energy) in module testing	KEK
Infra	Cryogenic system control (thermal efficiency optimization) for module testing	KEK
Infra	RF system in module testing (LLRF)	KEK
Infra	RF system in module testing (modulators)	KEK
Infra	RF system in module testing (high-efficiency high-frequency sources)	KEK
Infra	RF system for module testing (distribution system)	KEK
Infra	Establishment of clean room work methods using robots (including tool development)	KEK
Infra	Optimization of surface treatment (electropolishing, heat treatment)	KEK
Infra	Simulation (RF calculations, thermal calculations) related to RF devices and modules	Remote (if the university has someone available to teach)
Infra	Database construction	Remote (if the university has someone available to teach)

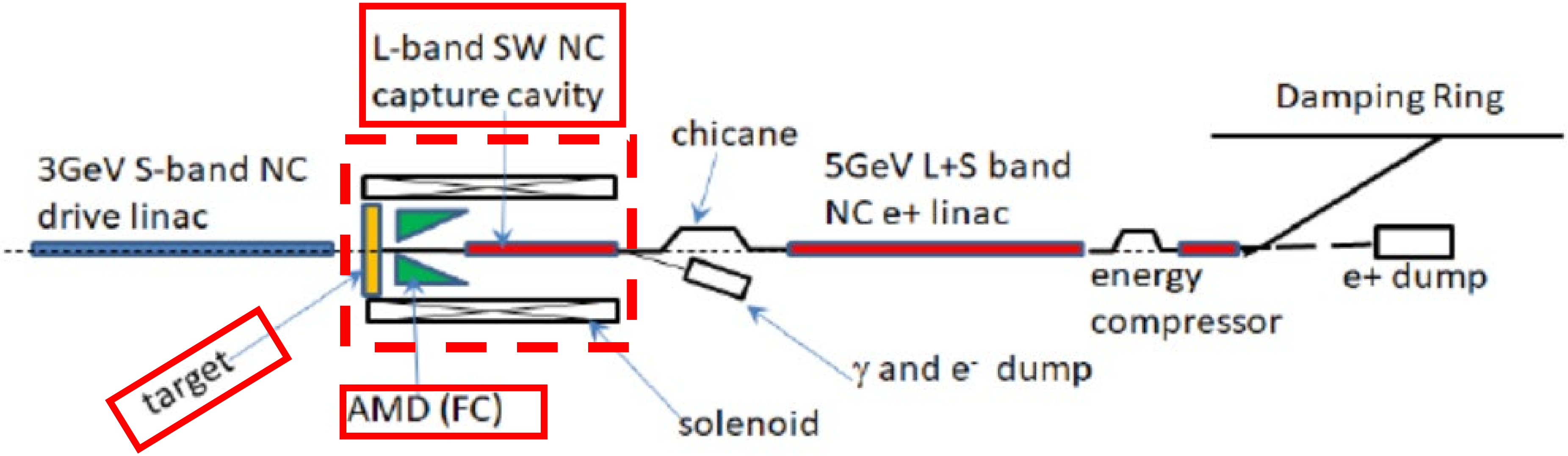






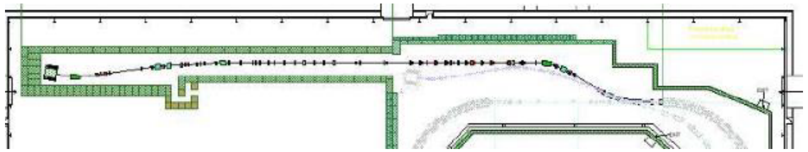
Example of topics (3)

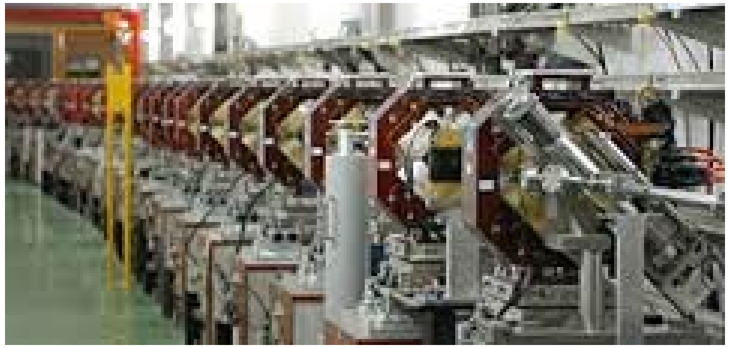
電子駆動陽電子源		
陽電子は、高いエネルギーの電子ビーム（あるいは光子）を標的に入射して生成します。強いビーム負荷のもとでの耐久度の高い標的を製作すること、発生した陽電子を急速に収束させて高い捕獲率を得ること、などが焦点です。 陽電子源は、高エネルギーコライダーを中心に、ますます大強度化が要求されるようになっています。過去においては、SLC, SuperKEKB, DAFNE, CESRなどで使われており、将来にわたっても、ILC, CLIC, CCCなどの直線型コライダーは単位時間あたりの必要陽電子数がもっとも高いです。FCCee, CEPCなどの円形コライダーでも以前よりは要求値が上がっています。さらにはミュー粒子コライダー(LEMMA) などにおいても必要になる可能性があります。CEBAFのように、コライダー以外でも大電流の陽電子源がつかわれています。 これらの陽電子源の技術には共通点が多く、ILC用の陽電子源の開発はそのまま世界の陽電子源につながっています。		
WPP-8	Target	KEK
WPP-9	Flux Concentrator	KEK
WPP-9	Flux Concentrator Power Supply	KEK
WPP-10	APS Cavity	KEK
WPP-10	RF Source	KEK
WPP-10	Beam loading compensation	Remote (if the university has someone available to teach)
WPP-11	Target Replacement	KEK

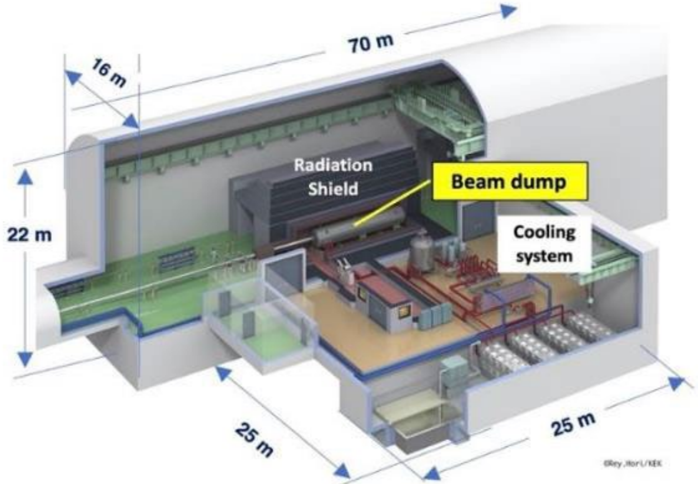


Example of topics (4)

Damping Ring		
円形加速器の設計の高度化は、次世代の放射光源など世界中で研究が進められています。本研究の成果は、ILCへの貢献に限らず 最先端の高性能加速器の設計に多くの知見を提供することになります。		
WPP-12	Damping ring design	Remote (if the university has someone available to teach)
WPP-12	Investigation of fringe field and dynamic aperture	KEK(beam test at ATF-DR)
WPP-14	Injection/extraction system	KEK(test at ATF extraction line)
BDS		
近年、**機械学習**などを活用した加速器の自動化へのニーズが高まっています。最終衝突点へのビームラインのシステム設計はビーム動力学の最先端の研究を進めることで、ILCへの貢献に限らず将来のナノビームの設計や運用に多くの知見を得ることができます。		
WPP-15	Development of online beam diagnostic system	KEK(test at ATF2)
WPP-15	Fast feedback tests	KEK(test at ATF2)
WPP-15	System design of BDS beamlines	Remote (if the university has someone available to teach)
Dump		
将来の大強度加速器では既存設備のビーム強度を超える**数MWのビーム**を取り扱うなど、最先端のビームダンプ技術が求められています。ビームダンプ関連としては、その**放射線遮蔽**、冷却システムや**遠隔操作機構**の設計に加え、ビームダンプを利用した新粒子探索実験やソフトエラー問題評価のための2次粒子照射利用など、先端実験設備としての利用を含めた総合的なシステム設計と鍵となる装置のプロトタイプ試験を行ないます。		
WPP-17	Main Dump design	KEK
WPP-17	Radiation calculation	Remote (if the university has someone available to teach)
WPP-17	Window remote hndling	KEK







KEK / IDT-WG2
Shin MICHIZONO (KEK)

- ILC accelerator
- ILC Technology network
- KEK's effort
  - SRF
  - Sources
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加速器技術開発若手研究プログラム

Early Career Research Program on Accelerator Technology R&D

KEK High Energy Accelerator Research Organization

本プログラムに関する令和５年度の募集を開始しました。

JFY2023 Funding Oppurtunity Announcement for this program has now opened.

令和５年度の募集について / Call for JFY2023

高エネルギー加速器研究機構では、加速器技術の飛躍的な発展につながる研究開発(「飛躍的発展研究」)による若手研究者の人材育成を目的として、令和5年度から加速器技術開発若手研究プログラムを新たに開始しました。

本事業においては、「飛躍的発展研究」を国内の関連若手研究者から募集しますので、以下の募集要項をご確認の上、ふるってご応募ください。

なお、本事業は、文部科学省の令和5年度「将来加速器の性能向上に向けた重要要素技術開発」（先端加速器共通基盤技術研究開発費補助金）の採択事業の一環として行われるものです。

Starting JFY2023, High Energy Research Organization (KEK) has opened call on Early Career Research Program on Accelerator Technology R&D for the purpose of contributing to human resource development leading to the rapid development of accelerator technology("Breakthrough R&D").

Under this program, we look forward to receiving proposals from domestic early career researchers on such "Breakthrough R&D".

This program is conducted as a part of awarded project under JFY 2023 MEXT Development of key element technologies to improve the performance of future accelerators Program.

募集要項等 / Funding Oppurtunity Announcement and Applications

募集要項 Funding Oppurtunity Announcement

申請書等様式 Application Forms

委託契約書テンプレート(準備中)

その他 / Others

KEKの施設を利用した実験を検討している場合は、機器使用の調整が必要になるため、事前に下記の「お問い合わせ」にご相談ください。

If you are considering to use KEK facilities, please consult at the below "Inquires" prior to applying.

お問い合わせ / Inquiries

お問い合せは、本機構・国際プロジェクト推進室までメール（i-promo@ml.post.kek.jp）にてお願いいたします。

All inquiries should be made to International Project Promotion Office, KEK (i-promo@ml.post.kek.jp).

https://www2.kek.jp/kokusai/ECRPAT/index.html

２．概要

（１）経費

１件当たり、年間最大６００万円まで支給。（どうしても超える場合は、応相談）

（２）援助対象経費

設備備品、消耗品費、国内旅費、外国旅費、外国人等招へい旅費、諸謝金、会議開催費、通信運搬費、印刷製本費、借損料、雑役務費等

（３）期間

採択から最長 2025 年度末まで。（2025 年度中の審査により最大２年の延長可能。）

（４）申請対象者

2023 年４月１日時点で 45 歳未満の国内大学・研究機関に所属する若手研究者（科研費申請資格をお持ちの方）

（５）申請締切

2023 年６月 30 日（金）13 時

（６）採択予定件数

10 件以下

https://www.kek.jp/ja/jobs/accl23-9/

大学共同利用機関法人高エネルギー加速器研究機構
加速器研究施設教員公募について

本機構では、下記のとおり教員を公募いたします。

記

公募番号　加速器 23-9

1. 公募職種及び人員
   特任助教　2 名　(任期 4 年、単年度契約で最長 2028 年 3 月末まで)
   本機構の教員の職名は、教授、准教授、講師、研究機関講師及び助教であるが、機構の性格から、大学における講座制とは異なる運営が行われる。
2. 研究(職務)内容
   加速器研究施設に属し、先端加速器共通基盤技術研究開発費補助事業「将来加速器の性能向上に向けた重要要素技術開発」による特任助教として、超伝導加速システム(空洞製造、空洞システム設計・評価)に関する開発研究に従事する。勤務地はつくばキャンパスである。
3. 応募資格
   研究教育上の能力があると認められる者。これまでの研究分野は問わない。
4. 給与等
   給与及び手当は本機構の規則による。(年俸制)
5. 勤務形態
   原則として、専門業務型裁量労働制を適用する。(みなし勤務時間:1日7時間45分)
6. 公募締切
   2023年8月1日(火)　正午必着
7. 着任時期
   採用決定後、できるだけ早い時期
8. 選考方法
   書類選考の上、面接を行う。

KEK特任助教公募中
2023年8月1日締切
23-9　SRF2人
23-10　陽電子源1人

Summary

- SRF technology has matured. Large SRF accelerators (such as at European XFEL and LCLS-II / LCLS-II-HE) are under operation or construction
- The important and time-consuming remaining ILC R&D items will be conducted through the ILC Technology Network, a global collaboration program
- Main topics are SRF, sources and nano-beam.
- KEK started its activity from this April including the SRF infrastructure improvement.
- We welcome the participation of many PhD students.

Thank you for your attention