Response to Advisory Panel

Aug.30. 2021 Souces Group

Still on the way of preparation
Eventually, “Slide preparation taskforce” will write the final version

ILC advisory panel

From S.Michizono,
WG2 Aug.24.2021

First advisory panel was held on July 29.
https://www.mext.go.jp/kaigisiryo/2021/mext_00253.html

Charges of the panel:
(1) Prospects for international research cooperation and cost sharing
(2) Academic significance and understanding of the public and scientific community
(3) Clarification of technical feasibility
(4) Reasonableness of cost estimates
(5) Prospects for training and securing human resources
(6) Other issues related to ILC

See the note on Aug.3 in the WG2 mailing list

Schedule:
The panel is planned to be concluded by the end of 2021, or at latest by the end of March 2022.
2nd panel (120 min.)
-Overview of the ILC project and the history to date [5+5].
-IDT proposal [15+20].
-Technical feasibility and validity of cost estimate (accelerator) [20+25].
-Discussions among expert committee members [30].

Speakers are not decided yet. (negotiation with MEXT)

Slide preparation taskforce

From S.Michizono,
WG2 Aug.24.2021

- In order to prepare the slides at the ILC advisory panel, “slide preparation taskforce” was organized. (Chair: Prof. Kawagoe (Kyushu U.))
- Not only the accelerator, but also other presentations will be advised by this taskforce.
- From accelerator, Michizono, Terunuma, Kuriki, Sanuki are the members.
- Concerning the accelerator related presentations, these drafts are under preparation

(a) Basic information about ILC progress (up to now)

Since most of the advisory panel members are non-expert (of the accelerators), we have to include basic information about the ILC t

(b) Response to the previous ILC advisory panel and

- Response to the issues pointed out
- Activities from 2018 to 2021

Based on the information at each group on July.

(c) WPs during pre-lab (corresponding to the issues raised by ILC advisory panel and SCJ)

Based on “Pre-lab proposal”

(d) In addition, I asked some of the IDT-WG2 members to prepare the ILC related activities (~2018, 2018~2021, and future potential for the WPs). (USA, England, France, Spain, CERN etc.)

Total presentation time for them will be less than 30 min. (Even though we will submit various materials, the presentation slides themselves are ~30.)

Advisory Panel: future meetings

- Dates not decided yet. October?
- 2nd meeting (not final yet)
  - ✓ Overview of ILC (Mori) 15+15
  - ✓ Physics (Murayama) 15+15
  - ✓ Technology (Michizono) 20+25
  - ✓ IDT proposal (Nakada) 15+20
  - ✓ Discussion of the panel 30
- 3rd Meeting (not final yet)
  - Technology establishment, cost estimation (civil, environment, safety) (Terunuma) 5+10
  - Academic meaning (Asai) 10+20
  - International cooperation, cost sharing (Yamauchi) 10+20
  - Human resource (Okada) 5+10
  - Discussion of the panel 30

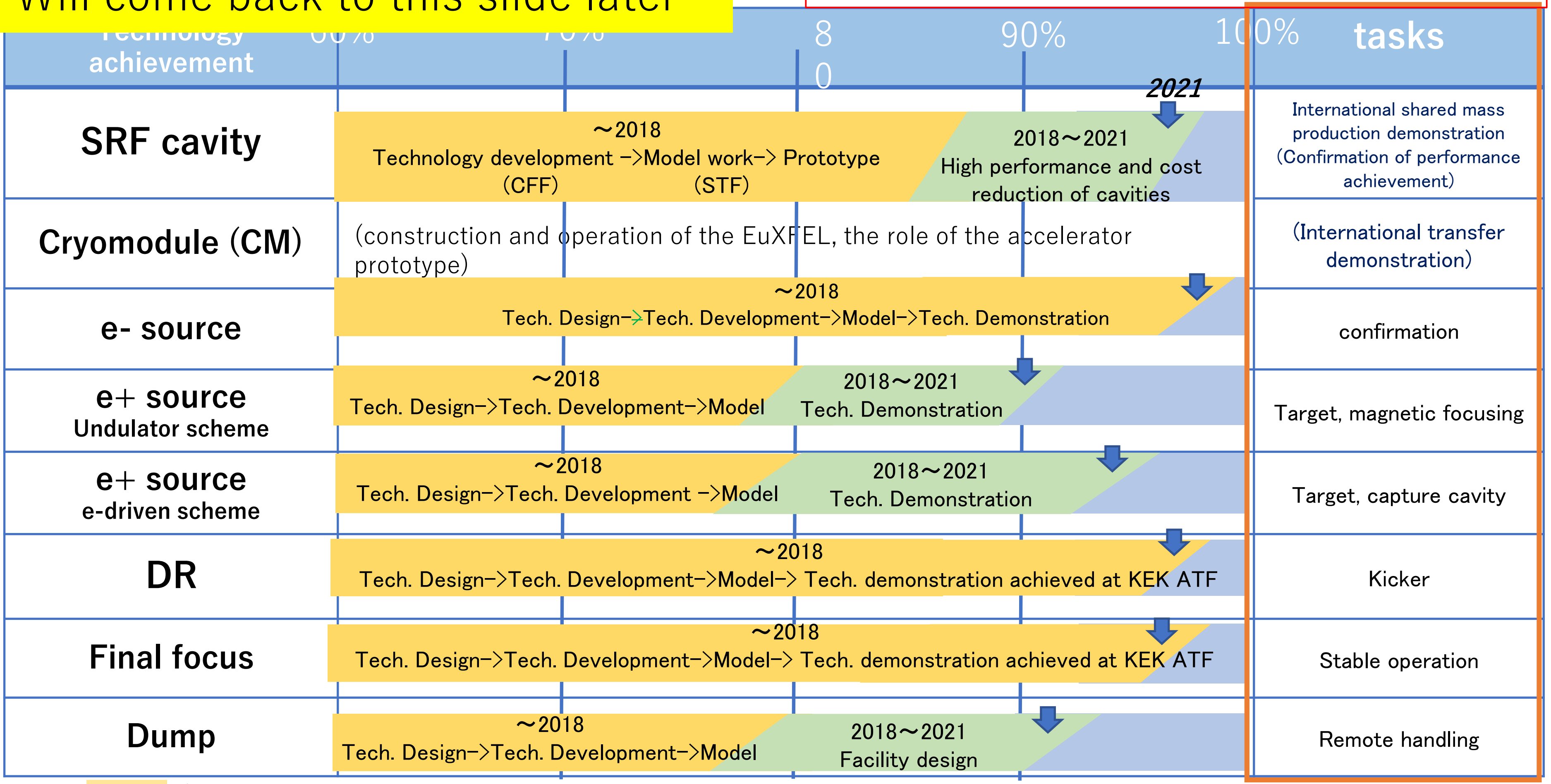
Achievement of ILC technology and future

(a) Basic Draft

Since the publication of the Technical Design Report (TDR) in 2013, the key technical developments have progressed and >90% of the technologies required for construction have been established.

From S.Michizono, WG2 Aug.24.2021

Will come back to this slide later



Technology achievement		tasks
SRF cavity	～2018 Technology development ->Model work-> Prototype (CFF) (STF) 2018～2021 High performance and cost reduction of cavities	International shared mass production demonstration (Confirmation of performance achievement)
Cryomodule (CM)	(construction and operation of the EuXFEL, the role of the accelerator prototype)	(International transfer demonstration)
e- source	～2018 Tech. Design->Tech. Development->Model->Tech. Demonstration	confirmation
e+ source **Undulator scheme**	～2018 Tech. Design->Tech. Development->Model 2018～2021 Tech. Demonstration	Target, magnetic focusing
e+ source **e-driven scheme**	～2018 Tech. Design->Tech. Development ->Model 2018～2021 Tech. Demonstration	Target, capture cavity
DR	～2018 Tech. Design->Tech. Development->Model-> Tech. demonstration achieved at KEK ATF	Kicker
Final focus	～2018 Tech. Design->Tech. Development->Model-> Tech. demonstration achieved at KEK ATF	Stable operation
Dump	～2018 Tech. Design->Tech. Development->Model 2018～2021 Facility design	Remote handling

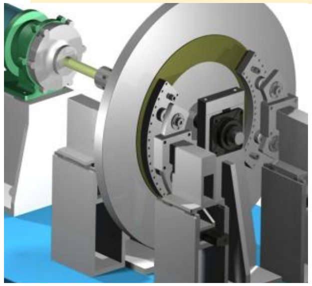
🟨 ：～2018
🟩 : 2018～2021
🟦 : 2022～

Model work: small-scale models, partial/component models.
Prototype: demonstration at the full scale.
Demonstrator: Technology transfer (to industry) for manufacturing of actual equipment.

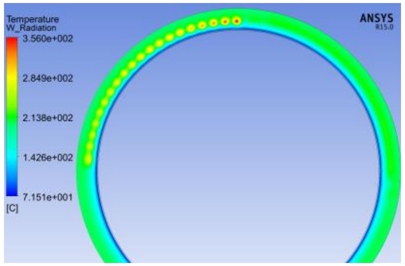
Progress in positron source

(b)Respon
se
Draft

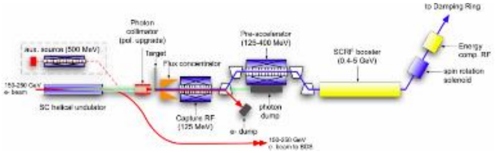
～2018 tech. design



High-speed rotating positron target, Technology Design

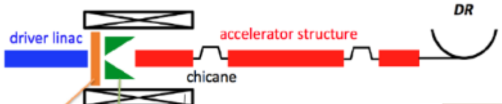


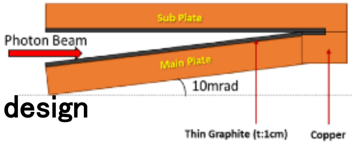
Target thermal simulation



e+ source total design

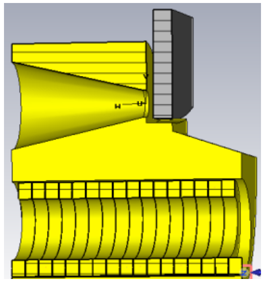
Undulator prototype



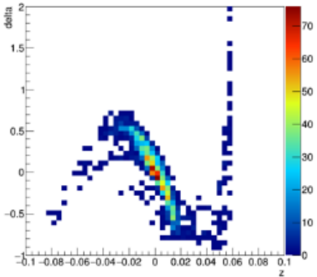


Photon dump design

Mag. focusing



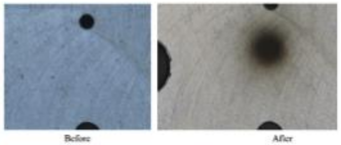
Paricle simulation



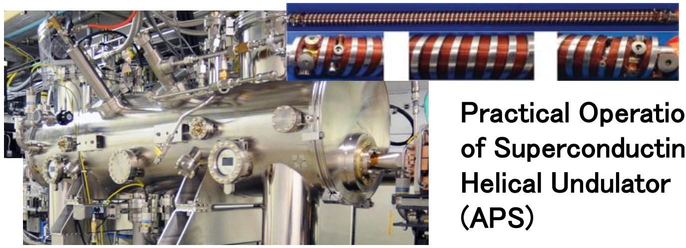
2018～2021 tech. verification

Target Prototyping
Vacuum characteristics
Testing

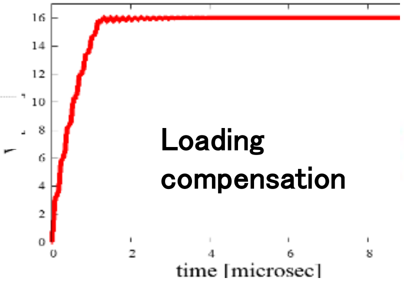
Target before and after radiation:



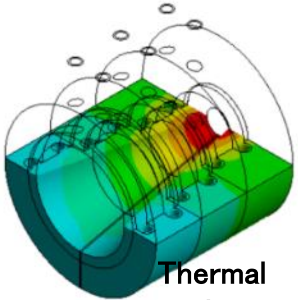
Ti target beam test



Practical Operation of Superconducting Helical Undulator (APS)



Loading compensation

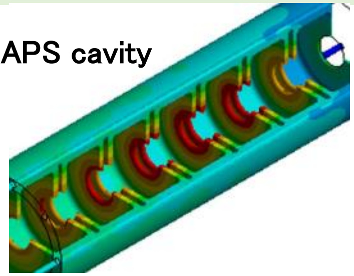


Thermal analysis

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

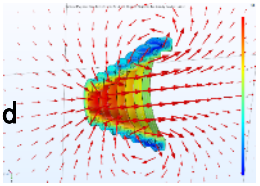
2022～Detailed design.

APS cavity

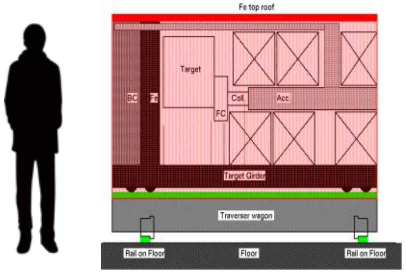


RF stability test

Pulse solenoid design



Target maintenance



Positron Source

Advisory Panel and SCJ Reports

- There are still many issues to be resolved regarding beam dumping, positron source, electron source, beam control, damping ring injection/extraction system, etc. (Advisory panel p5)
- In the main preparatory phase, it is planned that the prototype of the rotating target will be made and the magnetic focusing system immediately after the positron source will be developed. The technology selection is to be made by the second year of the main preparatory phase. The strategy should be clarified, taking into account the R&D cost. (SCJ)
- Clarification of the policy for the two proposals on positron sources, which includes many development elements, taking into account development costs. (Advisory panel , Jul.29, 2021)

Development till 2018

- 2 possible schemes, undulator and e-driven
    - Undulator scheme provides with polarized positron but is a new method
    - e-Driven scheme is technically sure
- Development of 2 schemes in parallel, taking into account the potential of physics of polarized positrons
- Report on the ILC Positron Source was compiled by the Positron Working Group. (May 2018)

Development Since 2018

- For the electron-driven system, the technical design was completed in 2019 in collaboration with the university and KEK. Long-term vacuum and radiation resistance tests of a life-size prototype of the target, and detailed design of the magnetic focusing and capture cavities were conducted. The beam loading compensation was studied in detail and the method was established.
- For the undulator method, progress has been made in target and pulse solenoid design.
- There is a proposal for international cooperation including performance improvement at the Pre-Lab. Technology selection is planned for the third year of the Pre-Lab to determine the results.

Comparison of 2 Schemes of Positron Source

Advisory Panel and SCJ Reports

- Clarification of the policy for the two proposals on positron sources, which includes many development elements, taking into account development costs. (Advisory panel , Jul.29, 2021)

- R&D cost:
  - Undulator: 1.5 OkuYen, 10 FTEy
  - e-Driven: 4.4 OkuYen, 5 FTEy
- The method will be finalized in the third year of the Pre-Lab in order to assess the results of the development studies already conducted for the Pre-Lab
- Undulator method: Detailed design of target, magnetic focusing, and overall design reflecting facility design
- E-Driven method: magnetic focusing, fabrication of prototypes of capture cavities and high-power tests, pulsed power supplies for them, fabrication of prototypes of RF sources, combined test of magnetic focusing and target prototypes.
- System development, including maintenance of targets, is a common issue to be addressed.

Undulator Positron Source

Advisory Panel and SCJ Reports

- The helical undulator scheme is adopted as the positron source. It contains some technologies under development such as the cooling of the target irradiated by the gamma rays from the undulator and the replacement method of the activated target. (Adv.P. p32)
- Helical undulator scheme has no experience technically and contains many elements which require R&D. (SCJ)

Development till 2018

- Prototype undulator to achieve the necessary magnetic field were built in the past and showed good results
- By reexamining the target thickness and other factors, it was found that the heat load was reduced to less than half.

Development Since 2018

- A long undulator is used in the European XFEL, and the necessary techniques for undulator positron source such as alignmen error and orbit correction have been accumulated. The optimization of the undulator parameters is proposed.
- The durability test of the titanium alloy of the target was carried out, and good results were obtained.
- Design of the pulsed solenoid is ongoing as the magnetic focusing device
- The target exchange system being developed for the e-driven source can be used for the undulator scheme

What's to be done in the Pre-Lab

- **Detailed design of the helical undulator source will be promoted, and R&D to improve its performance and reliability will be promoted through international cooperation.**

Electron-Driven Positron Source

Advisory Panel and SCJ Reports

- **The conventional target method of positron source is not an easy target to achieve to obtain the prescribed beam intensity stably. (SCJ, p.7)**

Development till 2018

- KEK, Hiroshima University, Waseda University, and the BINP in Russia have led the research and development of the e-driven positron source.
- Conceptual design completed, working on technical design and considering testing on targets

Development Since 2018

- For the rotating target using magnetic fluid, it has been confirmed that there is no problem with the vacuum seal degradation due to radiation exposure.
- For the magnetic focusing circuit, we have completed the electromagnetic design of the flux concentrator based on the BINP experience, and are currently working on the thermal design
- For the capture cavity in the beam focusing section, a highly stable APS cavity was designed and a compensation method of beam loading was established.

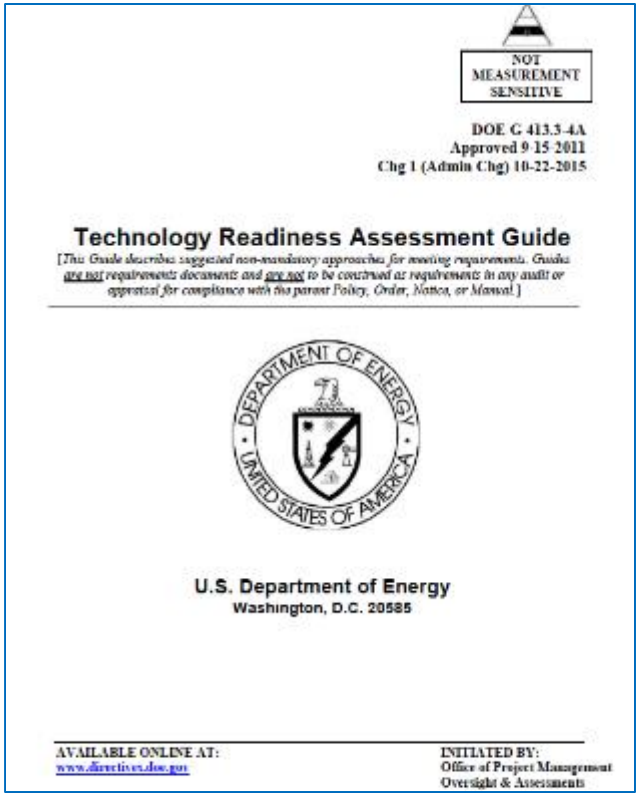
Pre-lab

- High power testing using prototypes of key components (rotating target, magnetic focusing, APS cavity) to improve reliability through long-term operation
- Detailed design of the replacement system for the irradiated target.

Maturity of Technology ?

- What is the percentage of maturity?
- Benno mentioned TRL (Technology Readiness Level)
  - ✓Nine levels
  - ✓DoEfile.pdf uploaded today ‘s indico site (see page 9)
  - ✓Similar level definition for Horizon2020 h2020-wp1415-annex-g-trl_en.pdf also uploaded
- The following slides are still on the way. Eventually, the slide taskforce will create the final version

DOE - TRL



NOT MEASUREMENT SENSITIVE

DOE G 413.3-4A
Approved 9-15-2011
Chg 1 (Admin Chg) 10-22-2015

Technology Readiness Assessment Guide

[This Guide describes suggested non-mandatory approaches for meeting requirements. Guides are not requirements documents and are not to be construed as requirements in any audit or appraisal for compliance with the parent Policy, Order, Notice, or Manual.]

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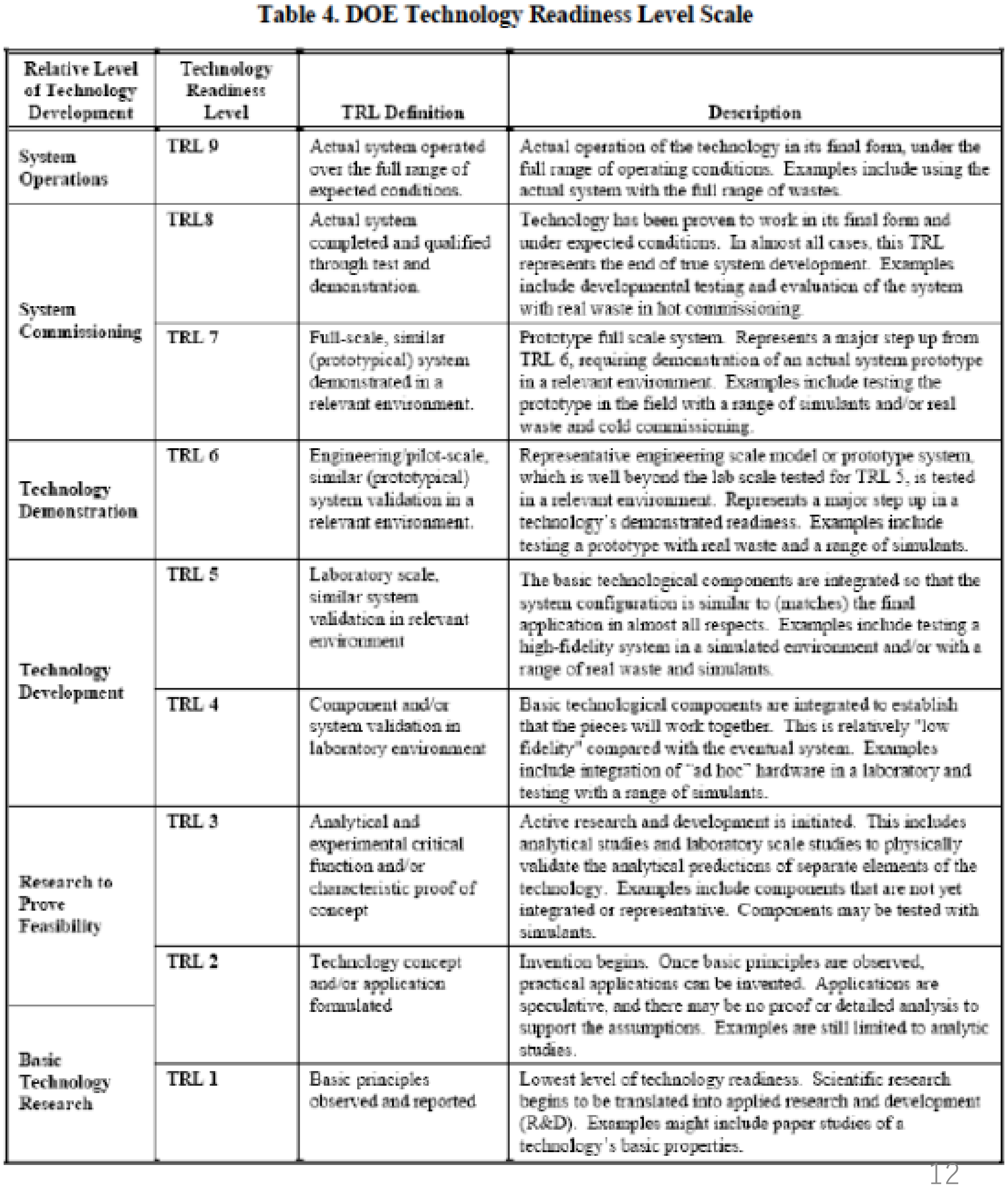


Table 4. DOE Technology Readiness Level Scale

Relative Level of Technology Development	Technology Readiness Level	TRL Definition	Description
System Operations	TRL 9	Actual system operated over the full range of expected conditions.	Actual operation of the technology in its final form, under the full range of operating conditions. Examples include using the actual system with the full range of wastes.
System Commissioning	TRL 8	Actual system completed and qualified through test and demonstration.	Technology has been proven to work in its final form and under expected conditions. In almost all cases, this TRL represents the end of true system development. Examples include developmental testing and evaluation of the system with real waste in hot commissioning.
	TRL 7	Full-scale, similar (prototypical) system demonstrated in a relevant environment.	Prototype full scale system. Represents a major step up from TRL 6, requiring demonstration of an actual system prototype in a relevant environment. Examples include testing the prototype in the field with a range of simulants and/or real waste and cold commissioning.
Technology Demonstration	TRL 6	Engineering/pilot-scale, similar (prototypical) system validation in a relevant environment.	Representative engineering scale model or prototype system, which is well beyond the lab scale tested for TRL 5, is tested in a relevant environment. Represents a major step up in a technology's demonstrated readiness. Examples include testing a prototype with real waste and a range of simulants.
Technology Development	TRL 5	Laboratory scale, similar system validation in relevant environment	The basic technological components are integrated so that the system configuration is similar to (matches) the final application in almost all respects. Examples include testing a high-fidelity system in a simulated environment and/or with a range of real waste and simulants.
	TRL 4	Component and/or system validation in laboratory environment	Basic technological components are integrated to establish that the pieces will work together. This is relatively "low fidelity" compared with the eventual system. Examples include integration of "ad hoc" hardware in a laboratory and testing with a range of simulants.
Research to Prove Feasibility	TRL 3	Analytical and experimental critical function and/or characteristic proof of concept	Active research and development is initiated. This includes analytical studies and laboratory scale studies to physically validate the analytical predictions of separate elements of the technology. Examples include components that are not yet integrated or representative. Components may be tested with simulants.
	TRL 2	Technology concept and/or application formulated	Invention begins. Once basic principles are observed, practical applications can be invented. Applications are speculative, and there may be no proof or detailed analysis to support the assumptions. Examples are still limited to analytic studies.
Basic Technology Research	TRL 1	Basic principles observed and reported	Lowest level of technology readiness. Scientific research begins to be translated into applied research and development (R&D). Examples might include paper studies of a technology's basic properties.

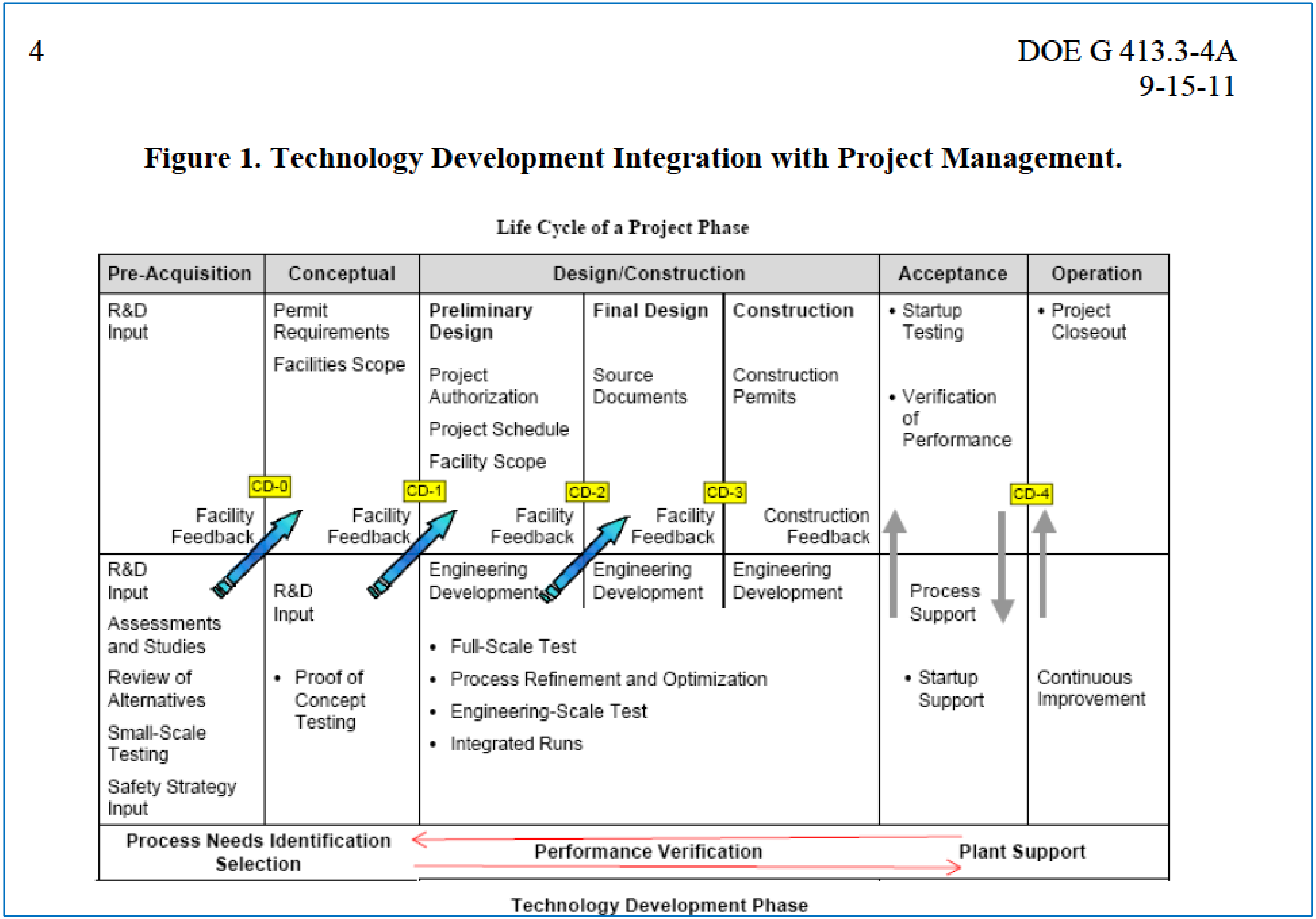


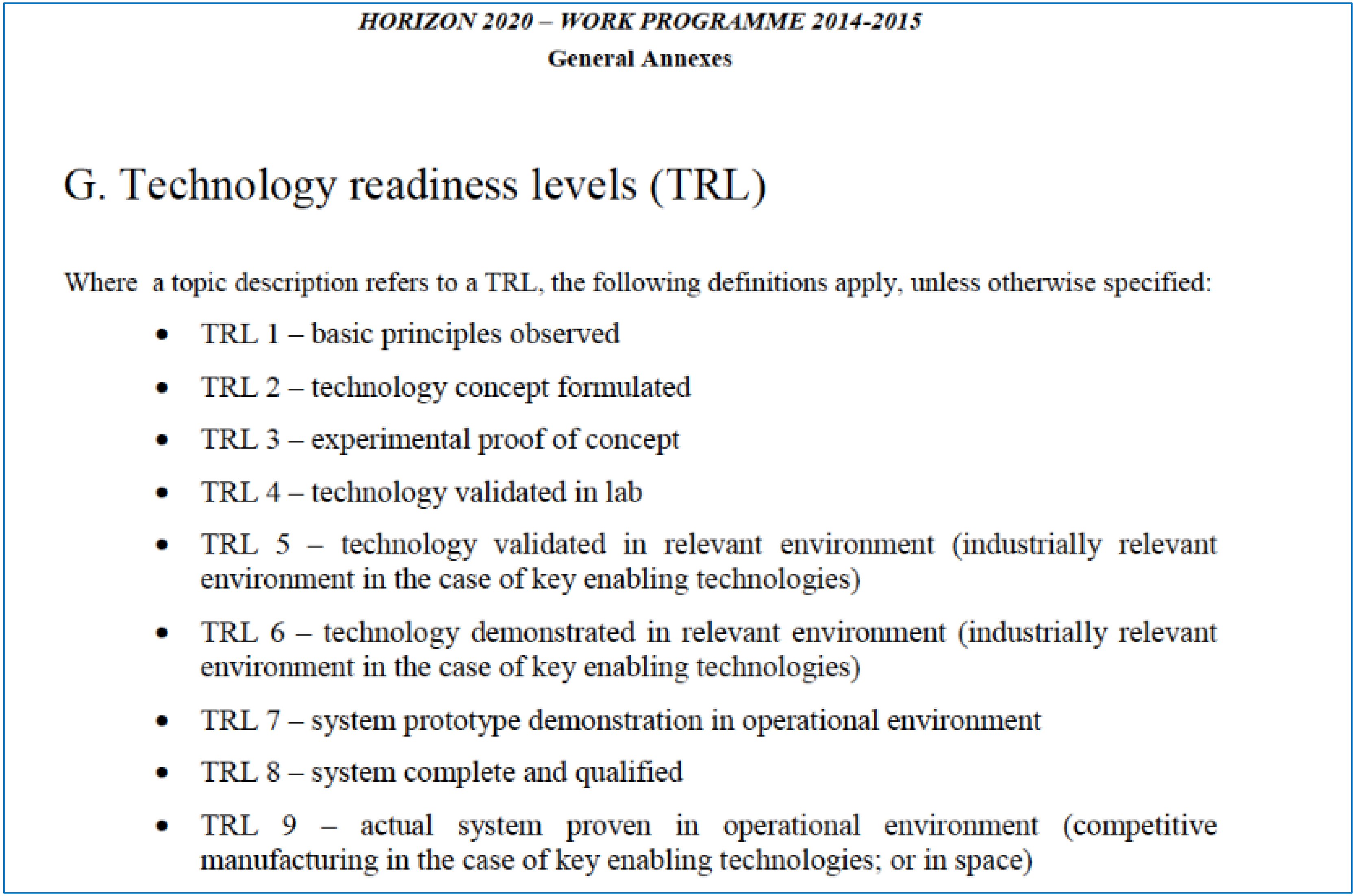
Figure 1. Technology Development Integration with Project Management.

Life Cycle of a Project Phase

Pre-Acquisition	**Conceptual**	**Design/Construction**			**Acceptance**	**Operation**
R&D Input	Permit Requirements Facilities Scope	**Preliminary Design** Project Authorization Project Schedule Facility Scope	**Final Design** Source Documents	**Construction** Construction Permits	• Startup Testing • Verification of Performance	• Project Closeout
CD-0	CD-1	CD-2	CD-3		CD-4	
Facility Feedback	Facility Feedback	Facility Feedback	Facility Feedback	Construction Feedback		
R&D Input Assessments and Studies Review of Alternatives Small-Scale Testing Safety Strategy Input	R&D Input • Proof of Concept Testing	Engineering Development • Full-Scale Test • Process Refinement and Optimization • Engineering-Scale Test • Integrated Runs	Engineering Development	Engineering Development	Process Support • Startup Support	Continuous Improvement
Process Needs Identification Selection		**Performance Verification**			**Plant Support**	

Technology Development Phase

Horizon 2020 Work Programme 2014-2015



HORIZON 2020 – WORK PROGRAMME 2014-2015

General Annexes

G. Technology readiness levels (TRL)

Where a topic description refers to a TRL, the following definitions apply, unless otherwise specified:

- TRL 1 – basic principles observed
- TRL 2 – technology concept formulated
- TRL 3 – experimental proof of concept
- TRL 4 – technology validated in lab
- TRL 5 – technology validated in relevant environment (industrially relevant environment in the case of key enabling technologies)
- TRL 6 – technology demonstrated in relevant environment (industrially relevant environment in the case of key enabling technologies)
- TRL 7 – system prototype demonstration in operational environment
- TRL 8 – system complete and qualified
- TRL 9 – actual system proven in operational environment (competitive manufacturing in the case of key enabling technologies; or in space)

Achievement of ILC technology and future plan

Since the publication of the Technical Design Report (TDR) in 2013, key technological developments have been made and the Technology Readiness Level (TRL) for construction has reached 5 to 6a.

Technology Readilness Level(TRL)	**(1) → 2 → 3 → 4** (RDR-2007) (TDR-2013)	**→ 5 → 6a** (Pre-L. Proposal-2021)	**→ 6b** **(Pre-lab)**	**→ 7~**
SRF cavity, CM	🟨 ～2018 Technology development ->Model work-> Prototype	🟩 2018～2021 High performance and cost reduction of cavities	🟦 Pre-Lab International sharing, mass production, and transfer demonstration	ILC construction
SRF Linac		Eu-XFEL user operation	Eu-XFEL user operation	
e- source	🟨 ～2018 Tech. Design->Tech. Development->Model->Tech. Demonstration		🟦 Pre-Lab Tech. confirmation	
e+ source **Undulator scheme**	🟨 ～2018 Tech. Design->Tech. Development->Model	🟩 2018～2021 Tech. Demonstration	🟦 Pre-Lab Establishment of target and magnetic focusing technology	
e+ source **e-driven scheme**	🟨 ～2018 Tech. Design->Tech. Development->Model	🟩 2018～2021 Tech. Demonstration	🟦 Pre-Lab Establishment of target and capture cavity technology	
DR	🟨 ～2018 . Design->Tech. Development->Model-> Tech. demonstration achieved at KEK ATF		🟦 Pre-Lab Establishment of kicker technology	
Final focus	🟨 ～2018 . Design->Tech. Development->Model-> Tech. demonstration achieved at KEK ATF		🟦 Pre-Lab Establishment of stable op.	
Dump	🟨 ～2018 Tech. Design->Tech. Development->Model	🟩 2018～2021 Facility design	🟦 Pre-Lab Establishment of remote handling technology	

Model work: small-scale models, partial/component models.
Prototype: demonstration at the full scale.
Demonstrator: Technology transfer (to industry) for manufacturing of actual equipment.

🟨 ：～2018年
🟩 ：2018年～2021年
🟦 ：2022年　～ Pre-Lab

Technology Readiness Level

Rel. Level	TRL	DOE (US)	Horison2020 (EU)	ILC (proposed)		
					SRF	Others
Basic technology research	1	- Basic principle observed and reported	**Basic principle** observed and reported	GDE (Global Design Effort for TDR)	技術選択：Technology selection 概念設計： Reference design → 技術・コストレビュー： Technology & Cost Estimate Review → **RDR** (Reference Design Report)	
	2	- Technology concept and/or application formulated CD 0	**Technology concept** formulated			
Research to prove feasibility	3	- Analytical and exp. critical function and/or charact. **proof of concept**	Experimental **proof** of **concept**		技術設計： Technical design 要素技術開発： Component development 要素・モデルワーク: Comp. model-work → 技術・コストレビュー： Technology and Cost-Estimate Review → **TDR** (Technical Design Report)	
Technology development	4	- Component and/or system validation i environment. CD 1	Technology **validation in Lab**.			
	5	- Lab-scale, similar system validation relevant env., (industry ,,) CD 2	Technology **validated** in relevant environment (**industrially** relevant,,,)	LCC—IDT	要素技術実証 Component technology validation Comp. Prototype	
Technology demonstration	6	- Engineering pilot-scale, similar (prototypical) system validation in rel. env.(industry ,,,) CD 3	Technology **demonstrated** in relevant environment (**industrially** relevant ,,,)		加速器での実証 → **Eu-XFEL**	加速器での実証 → **KEK-ATF & Others**
				Pre-Lab	**国際分担・量産技術、国際移送・性能実証** Prod. Readiness, Trans.	**課題技術実証** Tech. Readiness
System commissioning	7	- Full-scale, similar (prototypical) system demonstrated in a relevant environment	**System prototype** demonstration in operational environment	Construction	工業化プレシリーズ Industrial Pre-series 量産 Mass production 組み込み Installation コミッショニング Commissioning	システムプロト実証、 System Prototype 建設 Construction 組み込み Installation コミッショニング Commissioning
	8	CD 4 - Actual system completed and qualified through test & demonstration	**System completed** and qualified			
		- Actual system operated	Actual **system** proven in		加速器運転・物理実験	

Backup Materials
Work Packages

IDT (2019B)

The International Working Group presented a technical preparation plan for the issues pointed out by the Advisory Panel SCJ. The report outlines the necessary technical issues that should be addressed through international cooperation, as well as potential partners for international cooperation.

超伝導空洞

陽電子源

ダンピングリング

衝突点

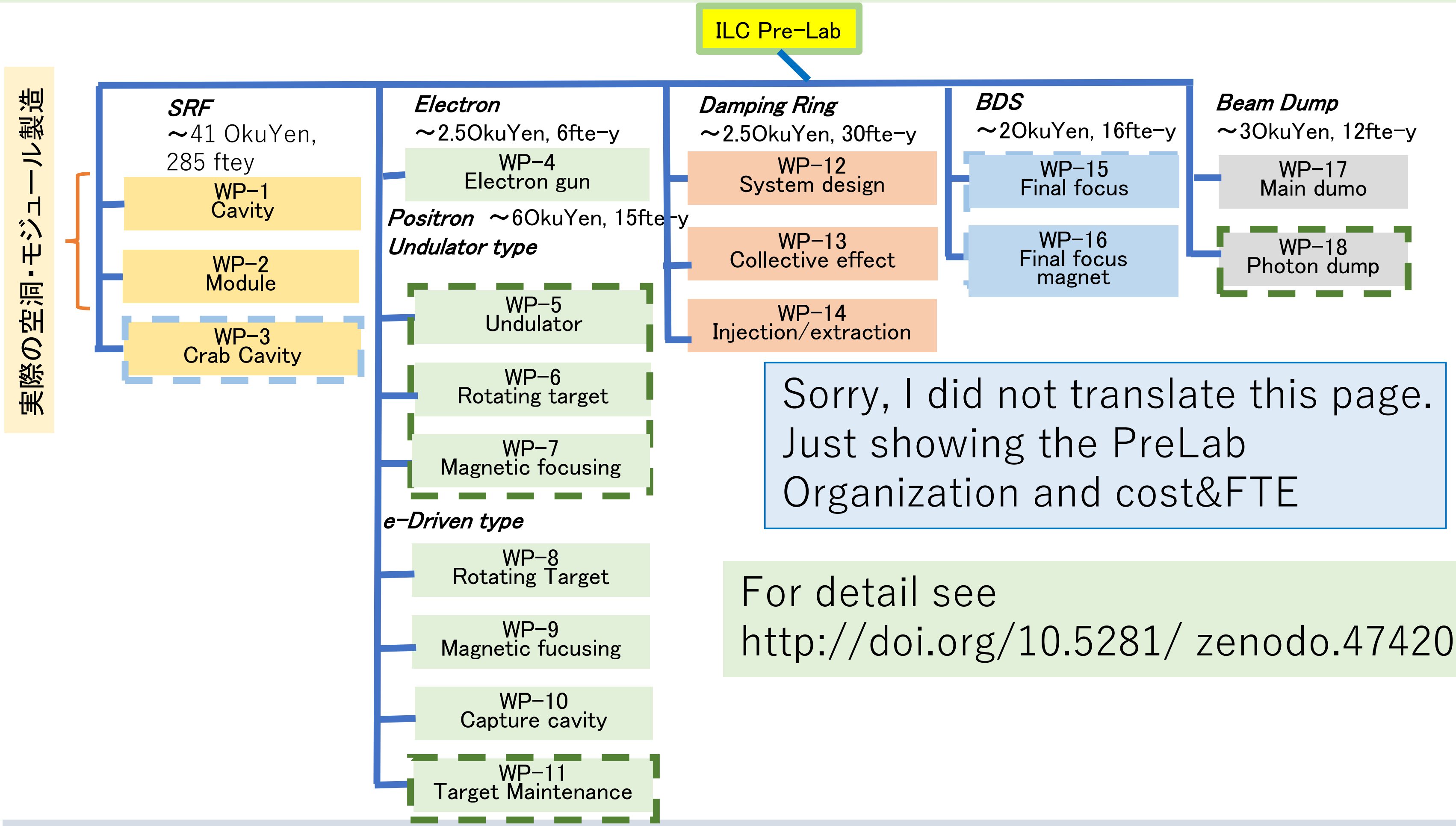
ビームダンプ

Component	Issue	Summary of tasks	Candidates for collaboration
SCRF Cavity	Mass production incl. automation	Performance statistics, mass production technology	France, Germany, US
	Cryomodule transport	Performance assurance after transport	France, German
Positron Source	Rotating target	Exchanging target, system design	CERN, France, Germany, US + industry-academia efforts
	Magnetic focusing system	System design	France, Germany, Russia, US
	Photon dump[23]	System design	CERN, Germany, US
Damping Ring	Fast kicker	Test of long-term stability, system design	CERN, Italy
	Feedback	Test at SuperKEKB	Italy
Interaction Region	Beam focus/position control	Test of long-term stability	CERN, UK
Beam Dump	Total system	System design	CERN, US
	Beam window, cooling water circulation	Durability, exchangeability, earthquake-resistance	CERN, US + industry-academia efforts

ILC国際ワーキンググループ報告書の提言より
https://www.kek.jp/ja/newsroom/2019/10/02/1000/
これを基に、IDT-WG2で検討を進めた。

Technical Issues

IDT-WG2 discussed about the technical issues pointed out by Advisory Panel and SCJ, and summarized them as Work Packages in TPD (Technical Preparation Document)



ILC Pre-Lab

実際の空洞・モジュール製造

SRF ～41 OkuYen, 285 ftey
- WP-1 Cavity
- WP-2 Module
- WP-3 Crab Cavity

Electron ～2.5OkuYen, 6fte-y
- WP-4 Electron gun

Positron ～6OkuYen, 15fte-y

Undulator type
- WP-5 Undulator
- WP-6 Rotating target
- WP-7 Magnetic focusing

e-Driven type
- WP-8 Rotating Target
- WP-9 Magnetic fucusing
- WP-10 Capture cavity
- WP-11 Target Maintenance

Damping Ring ～2.5OkuYen, 30fte-y
- WP-12 System design
- WP-13 Collective effect
- WP-14 Injection/extraction

BDS ～2OkuYen, 16fte-y
- WP-15 Final focus
- WP-16 Final focus magnet

Beam Dump ～3OkuYen, 12fte-y
- WP-17 Main dumo
- WP-18 Photon dump

Sorry, I did not translate this page.
Just showing the PreLab
Organization and cost&FTE

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

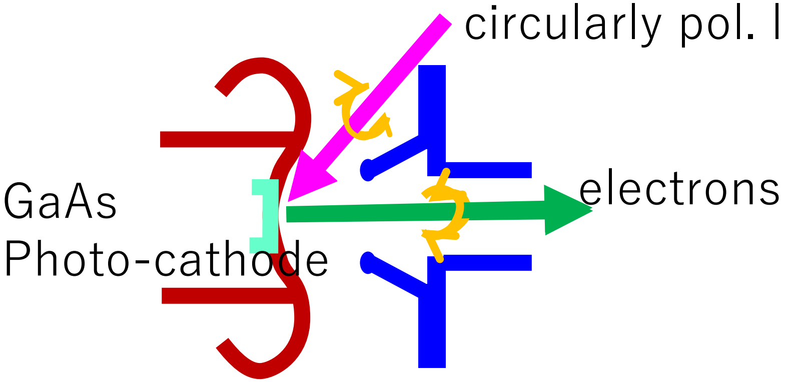
- ●技術課題提案書は、Tor Raubenheimer氏（SLAC国立加速器研究所、加速器部門・加速器研究系研究主幹）を委員長とするレビュー委員会で審議された。
- ●世界全体で約60億円*、360fte-y程度を分担する。（ここには、WP実施に必要となる基盤設備の整備費用は含まれていない。）（*ILCU（2013年の米ドル）を100円と換算した金額）
- ●物納貢献として国際的に分担される。

Electron Source

The electron source has already achieved the target specifications. What remains to be done is to incorporate new technologies after TDR.

- Main components: drive laser, high voltage gun, photo cathode
- ***WP-4 Electron Gun incorporates technological progress since TDR***
- Drive laser system: revisit the laser progress and build a prototype o demonstrate the required beam pattern.
- Design and prototype a photocathode electron gun with a higher voltage based on the technology incorporated in recent photocathode electron guns built for other accelerators.
- A strained superlattice GaAs/GaAsP photocathode, based on recent technology, will provide even higher quantum efficiency and electron polarization.

Polarized Electron Source



$$P \equiv \frac{N_L - N_R}{N_L + N_R} > 0.8$$

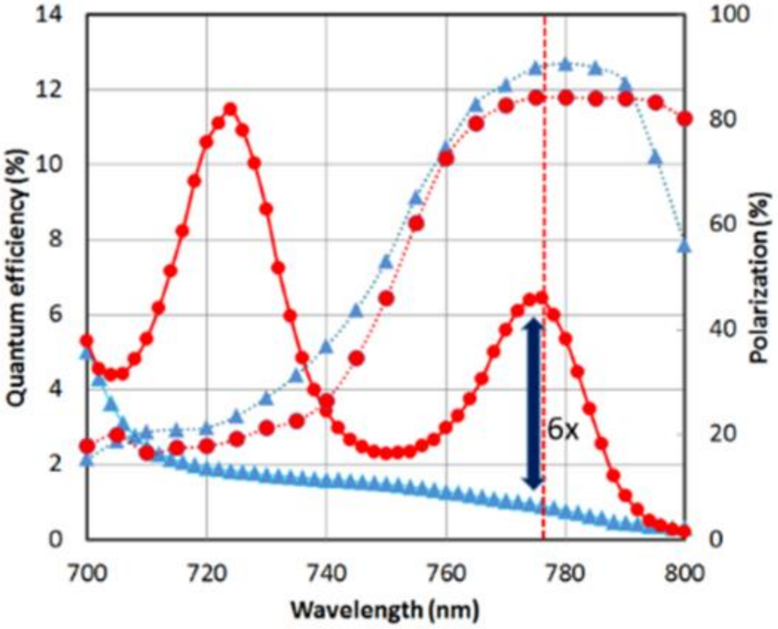
WP-4：偏極電子源

電子源はすでに目標仕様を達成している。残されているのは、TDR以降の新技術の取り込みである。

- 偏極電子源の基本設計には、駆動レーザー、DC200kVの高電圧光陰極電子銃、80%以上の偏極を実現するGaAs/GaAsP光電面、電子入射器の設計要件が含まれている。

（最終確認事項）

- プロトタイプの駆動レーザーを完成させ、それを使って高電圧銃からの歪んだ超格子GaAs/GaAsP光電面の高バンチチャージ、高ピーク電流条件を確認する。
- TDR以降、レーザー、高圧ガン、光電面の技術的な改良が行われており、信頼性、性能、コストを改善する設計とする。



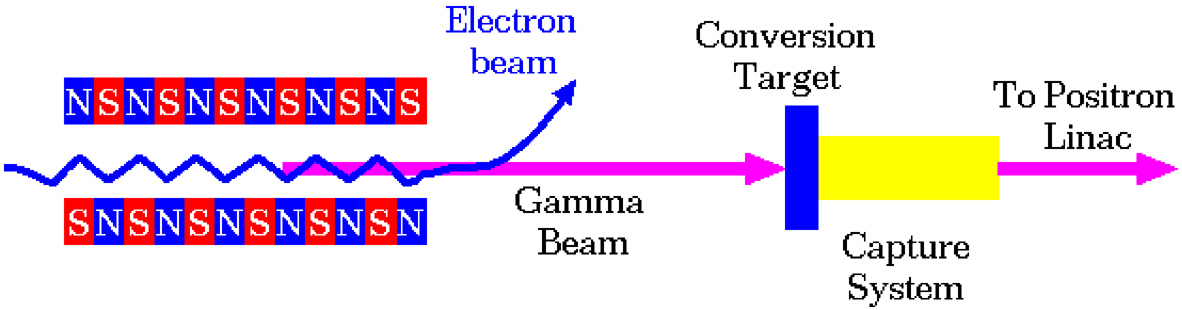
Parameter		TDR
Number Electrons per microbunch	N_e	3×10^{10}
Number of microbunches	n_b	1312
Width of microbunch	t_b	1 ns
Time between microbunches	Δt_b	556 ns
Microbunch rep rate	f_b	1.8 MHz
Width of macropulse	T_B	729 μs
Macropulse repetition rate	F_B	5 (10) Hz
Charge per micropulse	C_b	4.8 nC
Charge per macropulse	C_B	6300 nC
Average current from gun (C_B x F_B)	I_{ave}	31.5 (63) uA
Average current macropulse (C_B / T_B)	I_B	19.8 mA
Duty Factor in macropulse (1 ns / 556 ns)	DF	0.18 %
Peak current of micropulse (I_B / DF)	I_{peak}	11 A

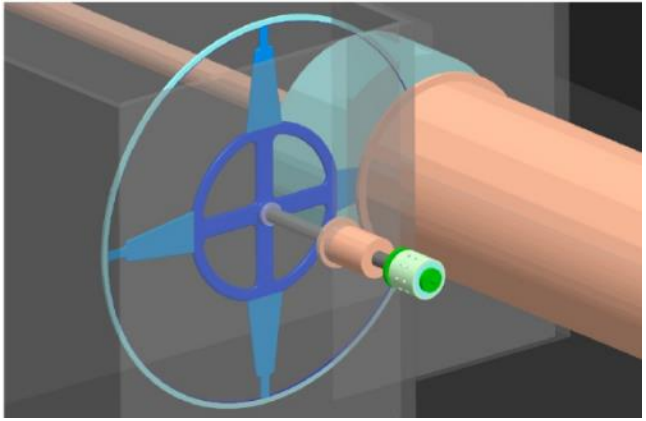
Undulator–type Positron Source

The technical design of the undulator positron source has been completed at TDR. What remains is the detailed technical design of the components and the creation of prototypes.

- To generate a circularly polarized photon, a helical magnetic field is created (undulator).
- 230m undulator needed for sufficient number of photons
- Polarized photons hit the target and create polarized positrons
- The target is rotated and cooled handle the heat load of photons
- Produced positrons are effectively captured by the magnetic focusing system

WP-5 Undulator : Past prototype realized sufficiently strong magnetic field. Conduct simulation studies and design optimization of masks, magnetic field errors and alignment effects to limit heat intrusion into superconducting magnets.
***WP-6 Rotating target:* detailed technical design of the radiative cooling target. Trial manufacture and testing of magnetic bearings for rotating targets**
WP-7 Magnetic focusing: In order to achieve the target positron yield, an improved design using a pulsed solenoid and alternative designs such as QWT (quarter wave transformer) are under consideration. The design is being finalized, and a prototype is being fabricated and



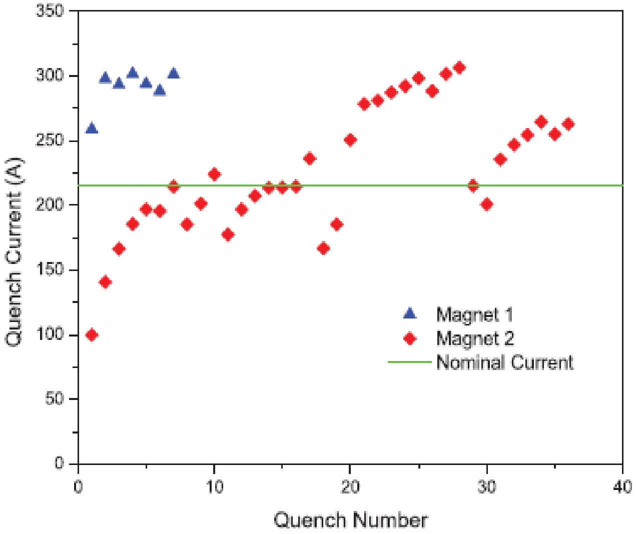


WP-5 Undulator

- Field length of each undulator is 1.75m, 2 undulators in one cryostat
- A pair of undulators realized sufficient field strength in GDE time
- Issues for WP-5: Alignment, masking, operation at 125GeV
- Undulator design: make use of the experience of long undulators at XFEL etc

(Final confirmation)

- Simulation of the influence of misalignment and field errors
- Mask: protect undulator against heating by the photons
- Detailed simulation by masking
- Possible further optimization of undulator parameters for low electron energies



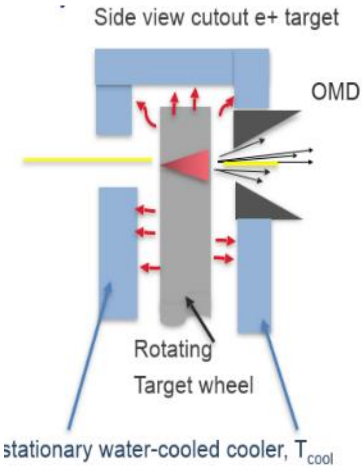
WP-6: Rotating Target for Undulator Source

The technical design of the undulator positron source has been completed at TDR. What remains is the detailed technical design of the components and the creation of prototypes.

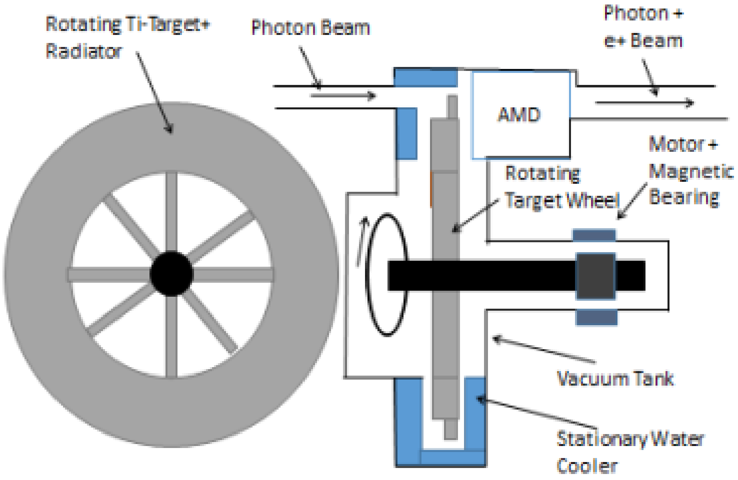
- Titanium alloy parget (Ti-6Al-4V), 7mm thick
- Heating by the photon beam ~2kW
- Target diameter 1m, rotating at 2,000rpm, cooled by radiation cooling
- Detailed engineering design and production studies yet to be done
- Already some examples using radiation cooling in various accelerators
  - CNGS (CERN) graphite targets immersed in stationary He gas were cooled primarily by radiation, supplemented by natural convection. Radiation-cooled targets have also been studied and used in experiments at FRIB-US, J-PARC, PSI, and RAL-UK.

（課題事項）

- WP-6: From final stage of design to production of a prototype



$$P \sim \sigma\varepsilon A\left(T^4_{radiator} - T^4_{cool}\right)$$



WP−7：磁場収束

The technical design of the undulator positron source has been completed at TDR. What remains is the detailed technical design of the components and the creation of prototypes.

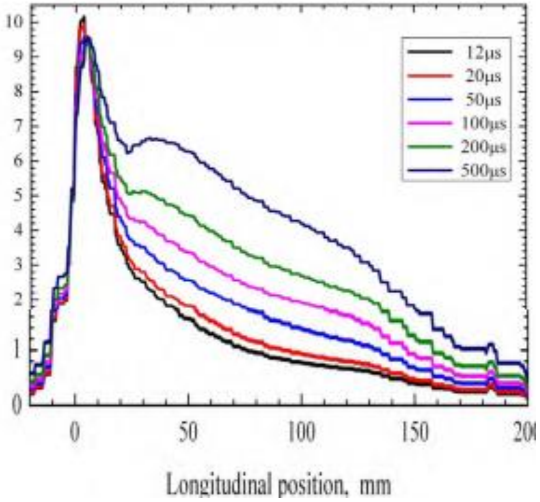
•TDRでは、Optical matching device(OMD)として3.2Tのピーク磁場を持つ収束装置を採用しており、約1msの磁場フラットトップを期待したが、長パルスでは，表皮効果のために磁場の時間変化が避けられないことが判明。

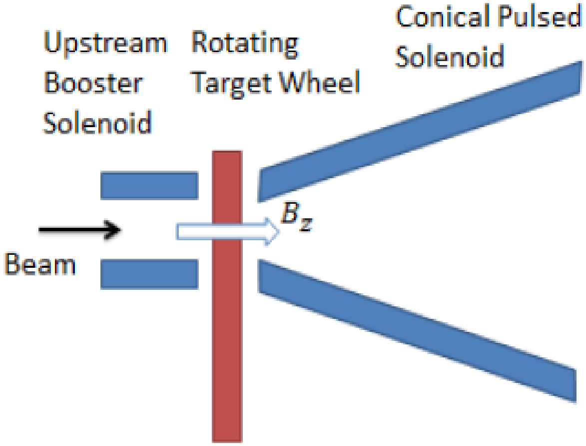
•パルスソレノイドを用いた改良型の設計を検討中。

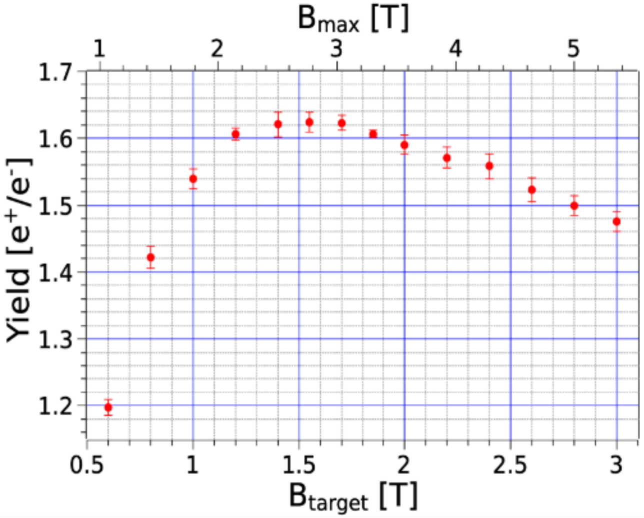
•QWT（Quarter Wave Transformer）、プラズマレンズ、新しい集光装置などを用いた設計も検討されている。

（課題事項）

•WP−7では、設計を最終決定し、プロトタイプを製作して、プロトタイプ・ターゲット・システムで試験を行う。







電子駆動陽電子源

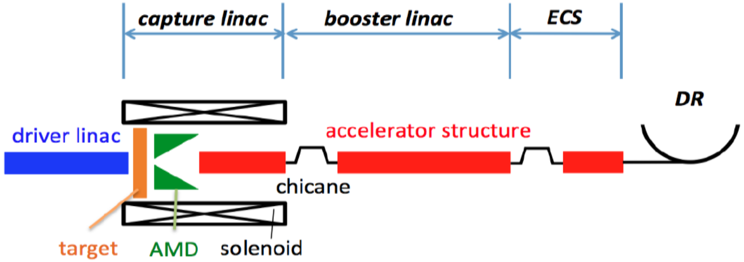
電子駆動型陽電子源は2019年に技術設計が終了した。残されているのは、プロトタイプによる試験である。

- 電子駆動型陽電子源では、駆動用線形加速器で電子ビームを発生させ、回転ターゲットで（偏極していない）陽電子を発生させる。
- 陽電子は磁気的に収束され、キャプチャーリニアック、電子を除去するシケイン、ブースターリニアック、陽電子ダンピングリングへと進む。

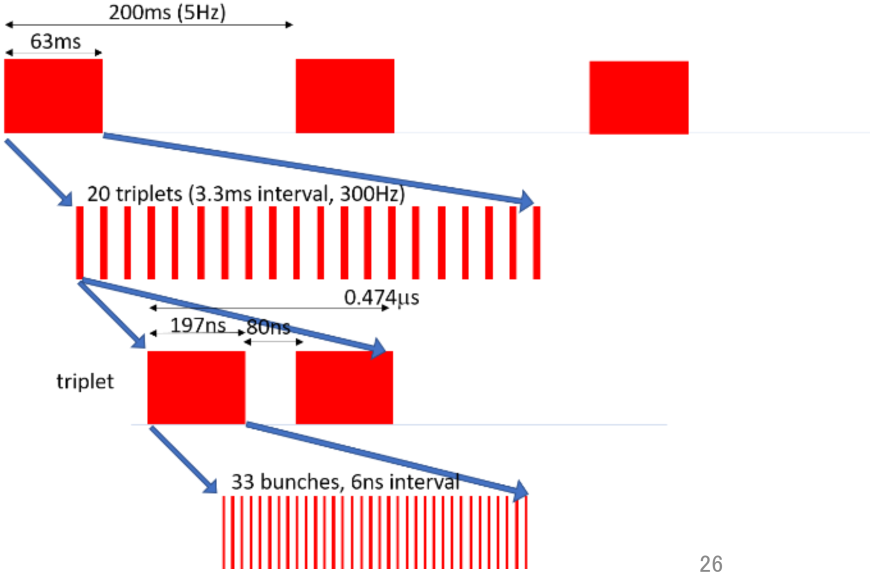
WP-8 回転ターゲット：ターゲット応力・疲労評価、真空シール寿命確認、モジュール試作

WP-9 磁気収束システム：磁気収束導体の電気・熱・機械的特性シミュレーション、電源・伝送ライン設計、システム試作・試験

WP-10 （キャプチャーリニアックの）捕獲空洞：部品設計と試作、ビーム負荷補償と調整方法の検討



Parameter	Value	Unit
Drive beam energy	3.0	GeV
Bunch charge	4.0	nC
N of bunches in a pulse	66	bunches
Bunch spacing in a pulse	6.15	ns
Average current in a pulse	0.78	A
Pulse repetition	300(100)	Hz



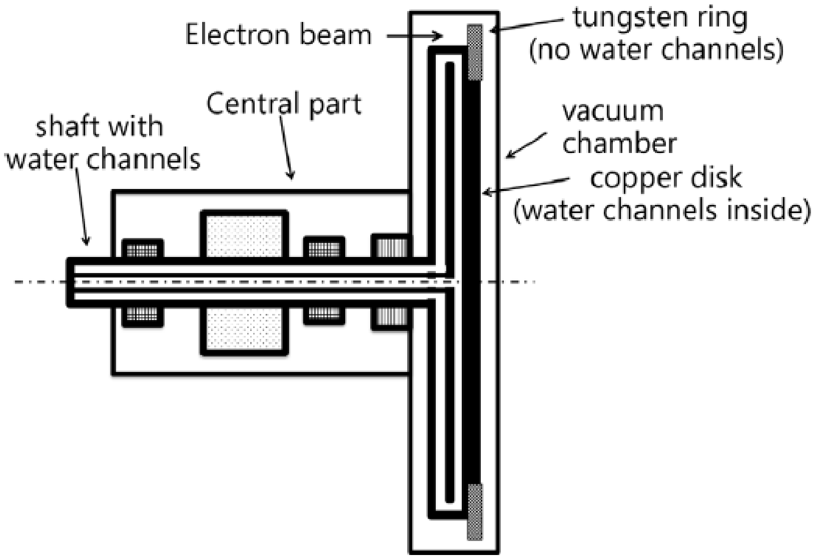
WP-8 電子駆動用回転ターゲット

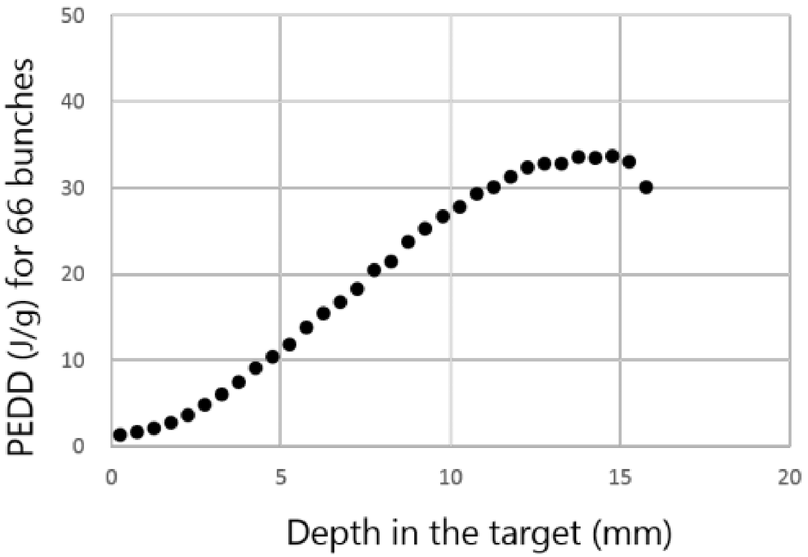
電子駆動型陽電子源は2019年に技術設計が終了した。残されているのは、プロトタイプによる試験である。

- 電子駆動型では、陽電子生成ターゲット材料はW-Re合金で、冷却用水路を持つ銅製ディスクに取付。
- 直径0.5m、厚さ16mmのターゲットを、225rpmで回転。
- 磁性流体により真空は保持される。
- 回転軸とユニット本体の隙間に充填してシールを形成し、永久磁石で固定。
- モーター、ベアリング、吸水口の回転ジョイントなどは空気に曝されている。

（最終確認事項）

- ターゲットの応力や疲労をより正確に計算し、設計を改善する。
- プロトタイプを用いて信頼性の高い長期運転を確認する。





WP-9：電子駆動用磁場収束

電子駆動型陽電子源は2019年に技術設計が終了した。残されているのは、プロトタイプによる試験である。

- 電子駆動型における磁気収束のために，フラックスコンセントレーター（銅製の2導体のを使った磁場収束装置 ）を利用
- 一次導体は螺旋状のコイルで、軸に沿って磁界を発生
- もう1つの部品は2次導体で、一次側の磁界によって誘起された二次導体の渦電流が流れ、円錐状の空間に磁界を発生させる。
- 軸に沿って5Tの磁界が誘起される。ビームホールの直径は16mmである。

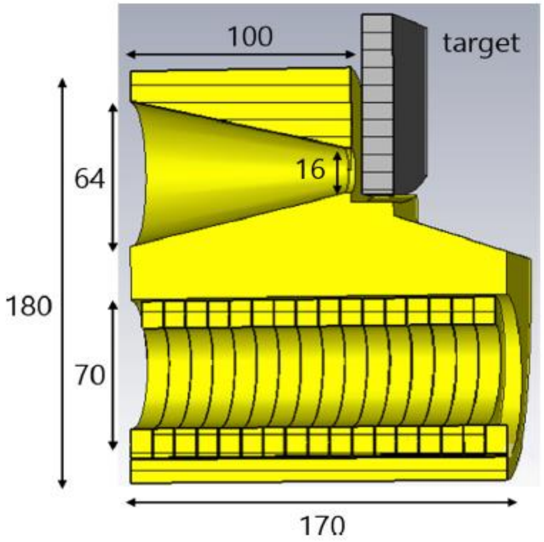
（課題事項）

- 磁気収束装置の工学設計を完成させる。（導体の熱・電気設計、伝送路設計、電源設計）

（最終確認事項）

- システムの試作を行い、確実に動作することを確認する。

Parameter	Value	Unit
Peak field	5.0	Tesla
FC size	120 x 180	mm^2
Conical cavity length	100	mm
Front aperture diameter	16	mm
Rear aperture diameter	64	mm
Number of windings	16	turns
Ohmic loss	14	kW



WP-10：捕獲空洞

電子駆動型陽電子源は2019年に技術設計が終了した。残されているのは、プロトタイプによる試験である。

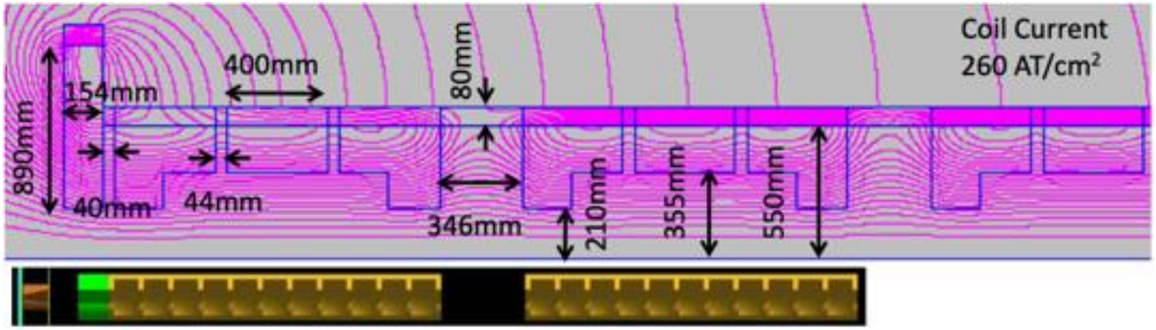
- キャプチャーリニアックは、0.5TのソレノイドでAPS空洞（捕獲空洞）で構成される。
- 開口部が広く、πモード定在波空洞よりもRF安定性に優れている。
- クライストロンは、50MWの電源を2μsのパルス幅で供給する。

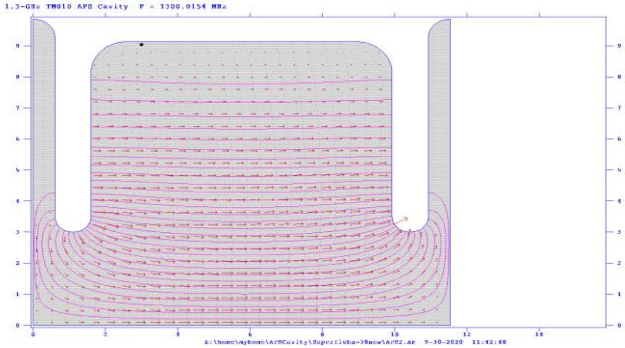
（最終確認事項）

- この条件より性能の高いSバンドのクライストロンは存在するが、設計を発展させたLバンドクライストロンの製作する。

•キャプチャーリニアック用APS空洞のRF設計と試作、電源ユニットの試作、ソレノイドの試作、空洞と電源の試運転を行う。

•キャプチャーリニアックの動作モードは、減速キャプチャー方式という特殊なものであるため、ビーム負荷の補正や調整方法を検討する必要がある。





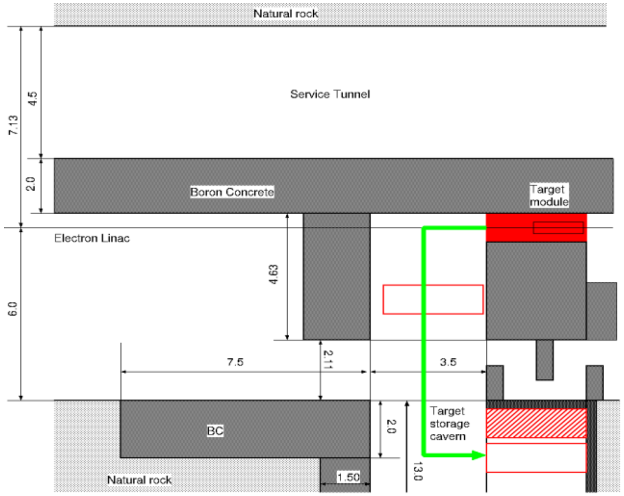
WP-11 Target Maintenance System

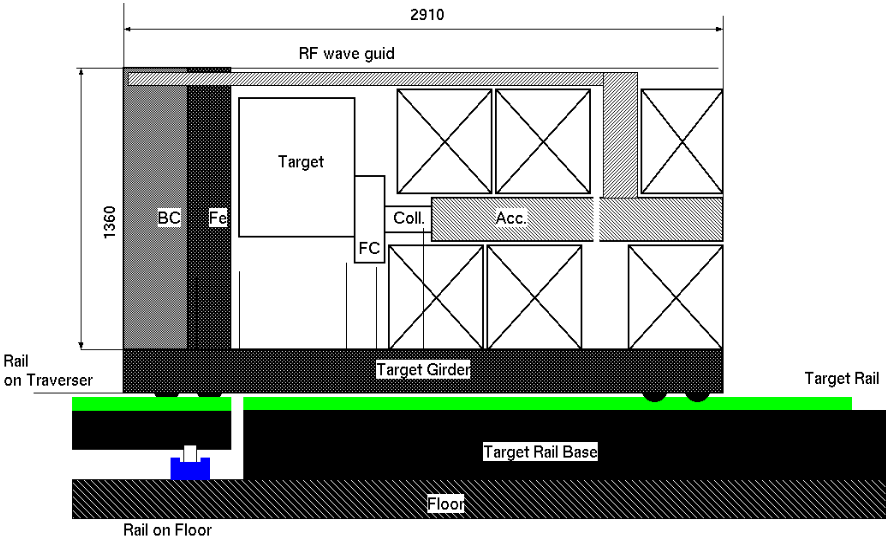
ターゲットの保守はアンジュレータ型・電子駆動型陽電子源の共通項目で概念設計は終了している。残されているのは、詳細技術設計の完成である。

- 陽電子源ターゲットからの放射線は、厚さ2mのホウ素化コンクリートのシールドによって閉じ込められる。
- 100時間の冷却後も、ターゲット表面には10Sv/hの線量。
- ターゲットは放射線損傷のため、2年ごとに交換しなければならず、交換の際には、作業者の放射線被ばくを十分にコントロールする必要がある。
- ターゲットモジュールは、ターゲット、収束器、第一加速空洞などで構成。
- RF、電力、水、制御などの接合部の多くは、モジュールのフロントパネル上に組み立てられており、これらの接合部を安全に切り離す。

（最終確認事項）

- ターゲット交換システムの技術設計を完成させ、モックアップを製作する。

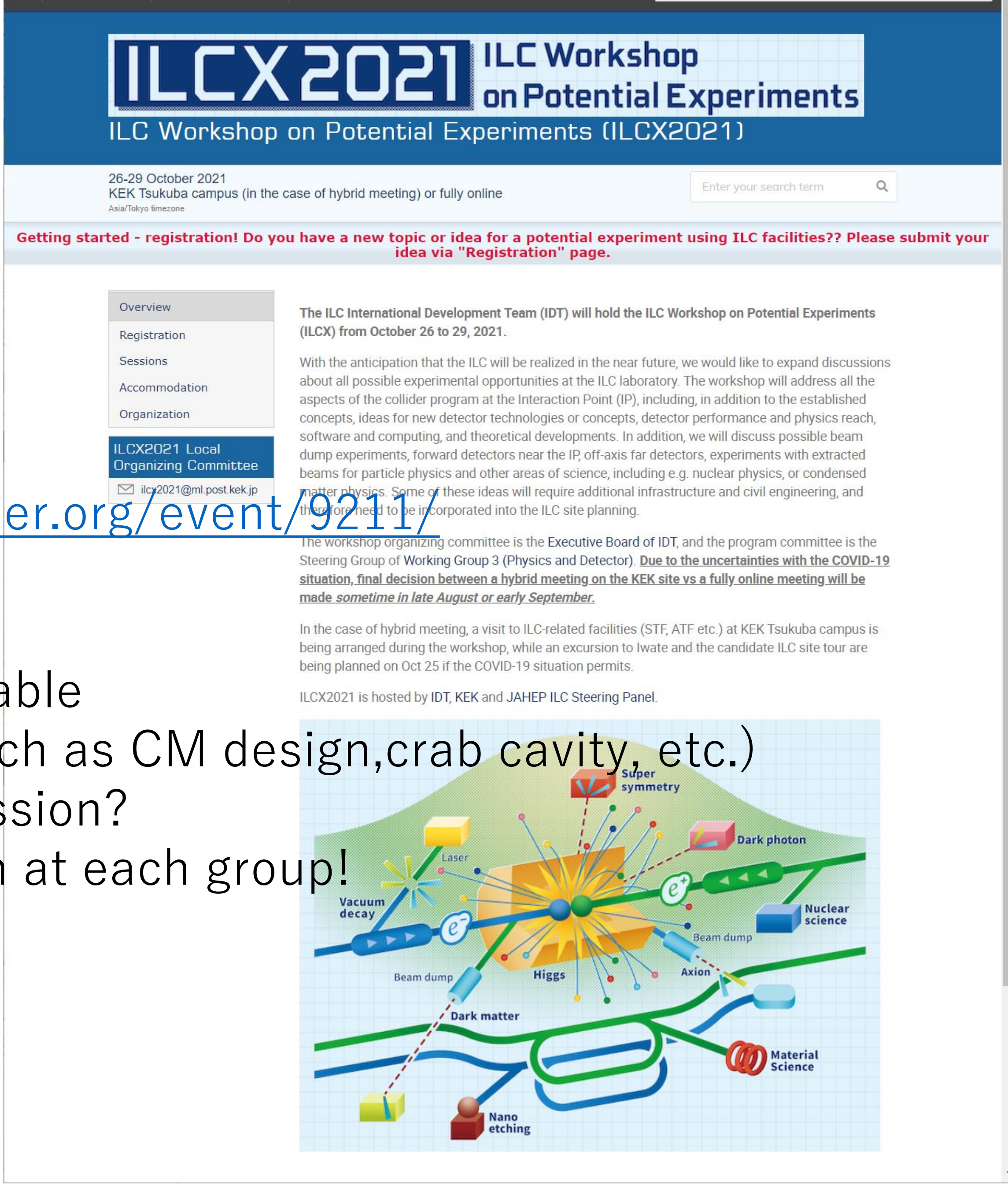




ILCX

[ILC Workshop on Potential Experiments (ILCX2021) (26-29 October 2021): Sessions · ILC Agenda (Indico) (linearcollider.org)]

- Hybrid or full-remote
- https://agenda.linearcollider.org/event/9211/
  - Please register!
- 26-29 October 2021
- Parallel sessions are available
  - Topical workshop? (such as CM design,crab cavity, etc.)
  - Some dedicated discussion?
  - Please start discussion at each group!



ILCX 2021 ILC Workshop on Potential Experiments

ILC Workshop on Potential Experiments (ILCX2021)

26-29 October 2021
KEK Tsukuba campus (in the case of hybrid meeting) or fully online
Asia/Tokyo timezone

Getting started - registration! Do you have a new topic or idea for a potential experiment using ILC facilities?? Please submit your idea via "Registration" page.

Overview
Registration
Sessions
Accommodation
Organization

ILCX2021 Local Organizing Committee
ilcx2021@ml.post.kek.jp

The ILC International Development Team (IDT) will hold the ILC Workshop on Potential Experiments (ILCX) from October 26 to 29, 2021.

With the anticipation that the ILC will be realized in the near future, we would like to expand discussions about all possible experimental opportunities at the ILC laboratory. The workshop will address all the aspects of the collider program at the Interaction Point (IP), including, in addition to the established concepts, ideas for new detector technologies or concepts, detector performance and physics reach, software and computing, and theoretical developments. In addition, we will discuss possible beam dump experiments, forward detectors near the IP, off-axis far detectors, experiments with extracted beams for particle physics and other areas of science, including e.g. nuclear physics, or condensed matter physics. Some of these ideas will require additional infrastructure and civil engineering, and therefore need to be incorporated into the ILC site planning.

The workshop organizing committee is the Executive Board of IDT, and the program committee is the Steering Group of Working Group 3 (Physics and Detector). Due to the uncertainties with the COVID-19 situation, final decision between a hybrid meeting on the KEK site vs a fully online meeting will be made *sometime in late August or early September.*

In the case of hybrid meeting, a visit to ILC-related facilities (STF, ATF etc.) at KEK Tsukuba campus is being arranged during the workshop, while an excursion to Iwate and the candidate ILC site tour are being planned on Oct 25 if the COVID-19 situation permits.

ILCX2021 is hosted by IDT, KEK and JAHEP ILC Steering Panel.

	Day 1 (Tue) **26 Oct**	**Day 2 (Wed)** **27 Oct**	**Day 3 (Thu)** **28 Oct**	**Day 4 (Fri)** **29 Oct**
13:00 - 15:00	Parallel (max. 6 sessions)	Parallel (max. 6 sessions)	Parallel (max. 6 sessions)	Parallel (max. 6 sessions)
15:30 - 17:30	Parallel (max. 6 sessions)	Parallel (max. 6 sessions)	Parallel (max. 6 sessions)	**Plenary** (summary session)
19:00 - 21:00	Parallel (max. 6 sessions)	Parallel (max. 6 sessions)	Parallel (max. 6 sessions)	**Plenary** (summary session)
21:30 - 23:30	**Plenary**	**Plenary**	**Plenary**	**Plenary** (discuss next steps)

- 13:00-15:00 JST (6:00-8:00 CEST, **0:00-2:00 EDT**, 21:00-23:00 PDT)
- 15:30-17:30 JST (8:30-10:30 CEST, **2:30-4:30 EDT**, **23:30-1:30 PDT**)
- 19:00-21:00 JST (12:00-14:00 CEST, 6:00-8:00 EDT, **3:00-5:00 PDT**)
- 21:30-23:30 JST (14:30-16:30 CEST, 8:30-10:30 EDT, 5:30-7:30 PDT)

CEST: Central European Summer Time, EDT: Eastern Daylight Time, PDT: Pacific Daylight Time