

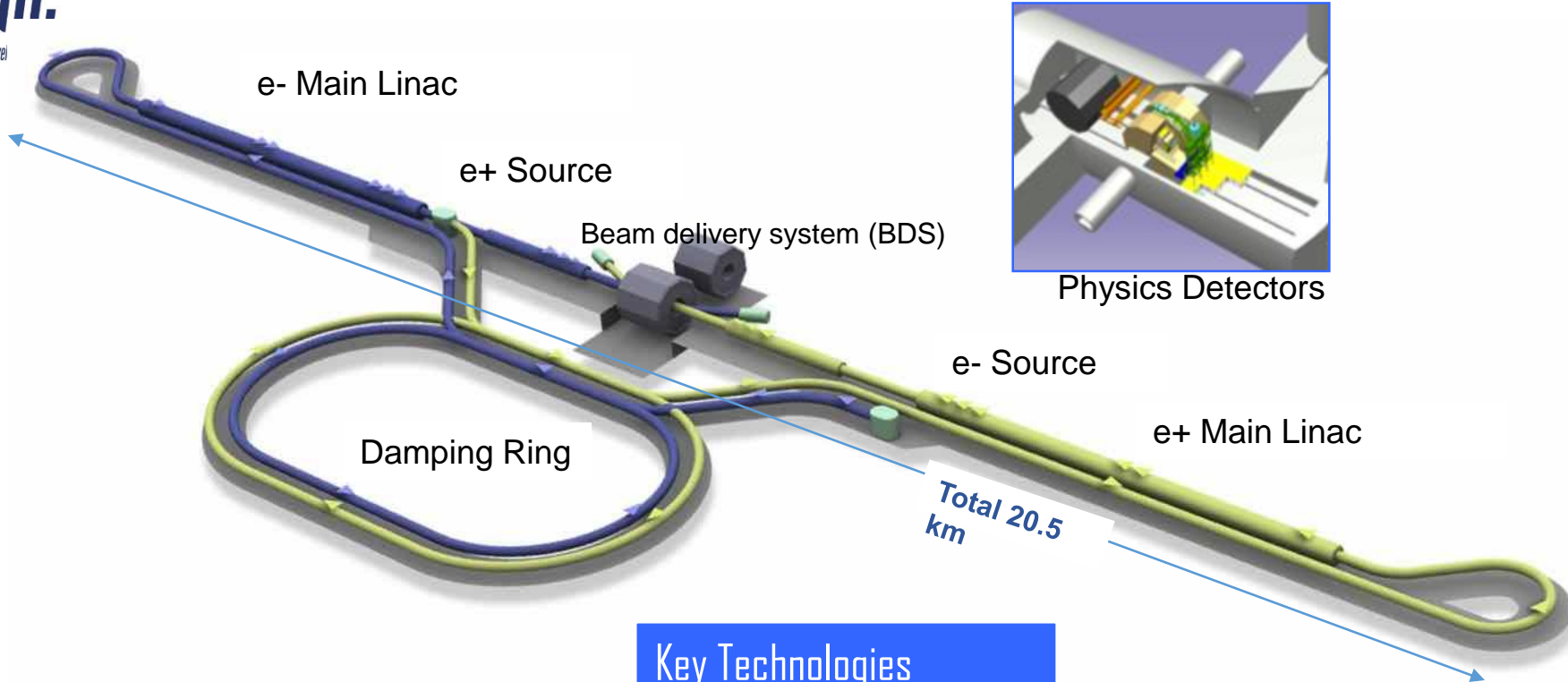
# ILC status and planning

## Outline

- ILC – accelerator and site (brief)
- Project Timelines and recent news
  - International Development Team (on-going work)
  - Pre-lab phase (4 years) planning
  - Construction (ILC-lab) – not covered today
- Brief updates on:
  - Japan
  - Americas
  - Europe
- Final words

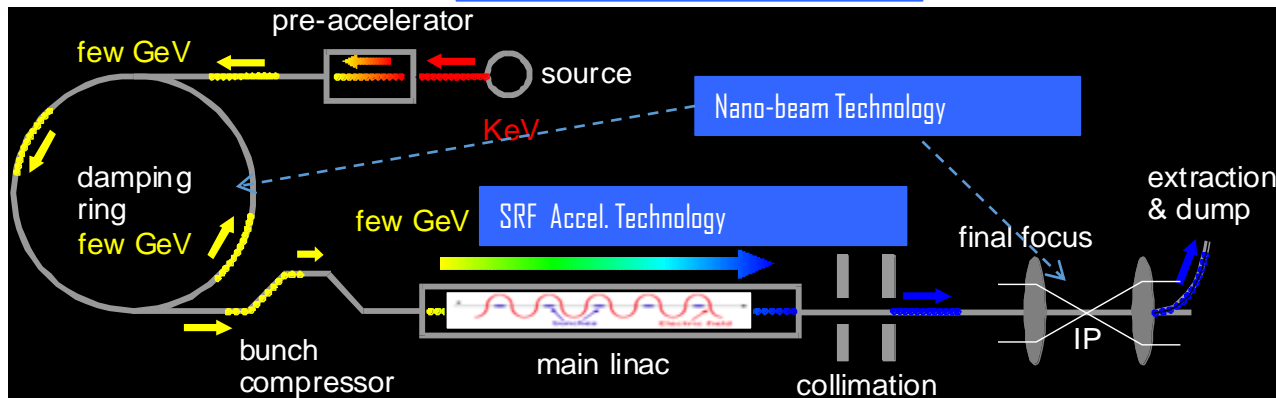
Steinar Stapnes, CERN  
([steinar.stapnes@cern.ch](mailto:steinar.stapnes@cern.ch))

# Design outline: ILC250 accelerator facility



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

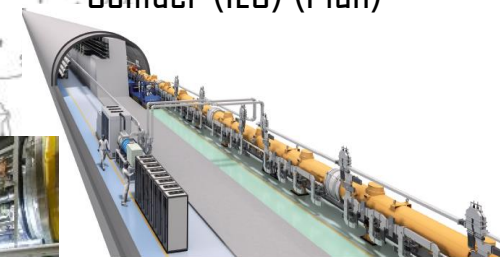
## Key Technologies



# Worldwide large scale SRF accelerators



International Linear Collider (ILC) (Plan)



**LCLS-II + HE** (under construction)

- 35 + 20 cryomodules
- 280 + 160 cavities
- 4 + 4 GeV (CW)

● SLAC

● FNAL

● Cornell

● JLab

**Euro-XFEL**

Operation started from 2017

- 100 cryomodules
- 800 cavities
- 17.5 GeV (Pulsed)

● LAL/Saclay

● DESY

● INFN



**ILC**

- 900 cryomodules
- 8,000 cavities
- 250 GeV (Pulsed)

● SINAP

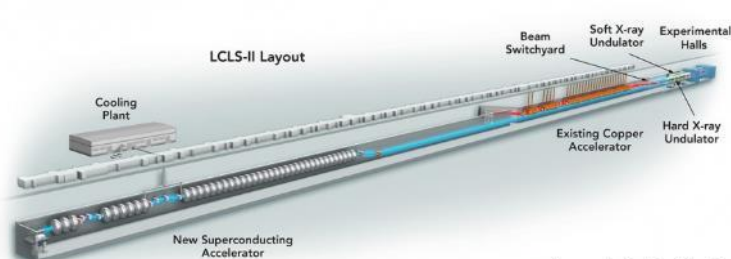
● KEK

**SHINE** (under construction)

- 75 cryomodules
- ~600 cavities
- 8 GeV (CW)



LCLS-II



— Superconducting Linac Beamline  
— Copper Linac Beamline



1.3GHz 9 cell cavity

# Potential for upgrades

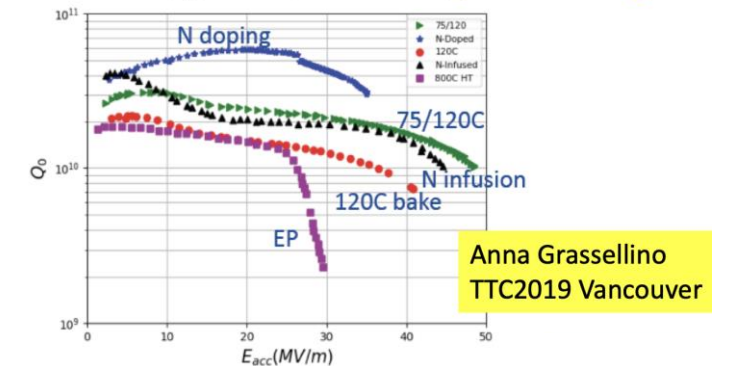
The ILC can be upgraded to higher energy and luminosity.

|                                       |                |                  | 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     |
| 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                      | $\Delta t_b$   | 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           | $\sigma_z$     | mm               | 0.41       | 0.41    | 0.30        | 0.30    | 0.30      | 0.30        | 0.30    | 0.225    |
| Emittance at IP (x)                   | $\gamma e^*_x$ | $\mu m$          | 6.2        | 6.2     | 5.0         | 5.0     | 5.0       | 10.0        | 10.0    | 10.0     |
| Emittance at IP (y)                   | $\gamma e^*_y$ | nm               | 48.5       | 48.5    | 35.0        | 35.0    | 35.0      | 35.0        | 35.0    | 30.0     |
| Beam size at IP (x)                   | $\sigma^*_x$   | $\mu m$          | 1.118      | 1.118   | 0.515       | 0.515   | 0.515     | 0.474       | 0.474   | 0.335    |
| Beam size at IP (y)                   | $\sigma^*_y$   | 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     |
| 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             | $\delta_{BS}$  | %                | 0.157      | 0.157   | 2.62        | 2.62    | 2.62      | 4.5         | 4.5     | 10.5     |
| AC power [6]                          | $P_{site}$     | MW               |            |         | 111         | 138     | 198       | 173         | 215     | 300      |
| Site length                           | $L_{site}$     | km               | 20.5       | 20.5    | 20.5        | 20.5    | 20.5      | 31          | 31      | 40       |

Increase in energy and luminosity foreseen already at TDR times (see table)

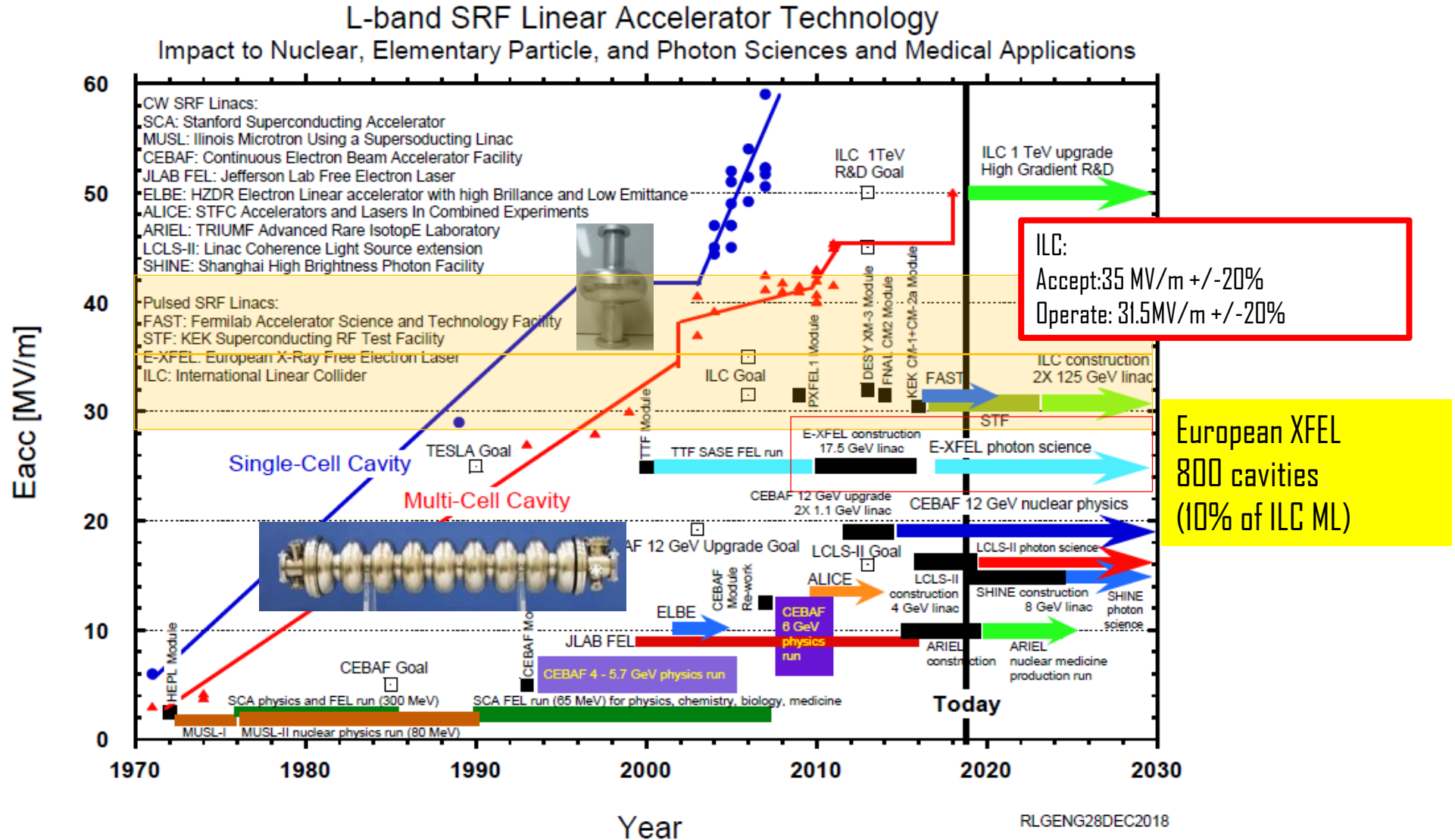
New cavity results open for further optimization (reduce costs, increase energy, increase luminosity ... )

- Surface treatments for high-Q and high-G



\*There were several typos in the values of the luminosities in the TDR. They have been fixed by CR-0005. <https://edmsdirect.desy.de/item/D00000001100895>

# Technology timeline and prospects for improvements

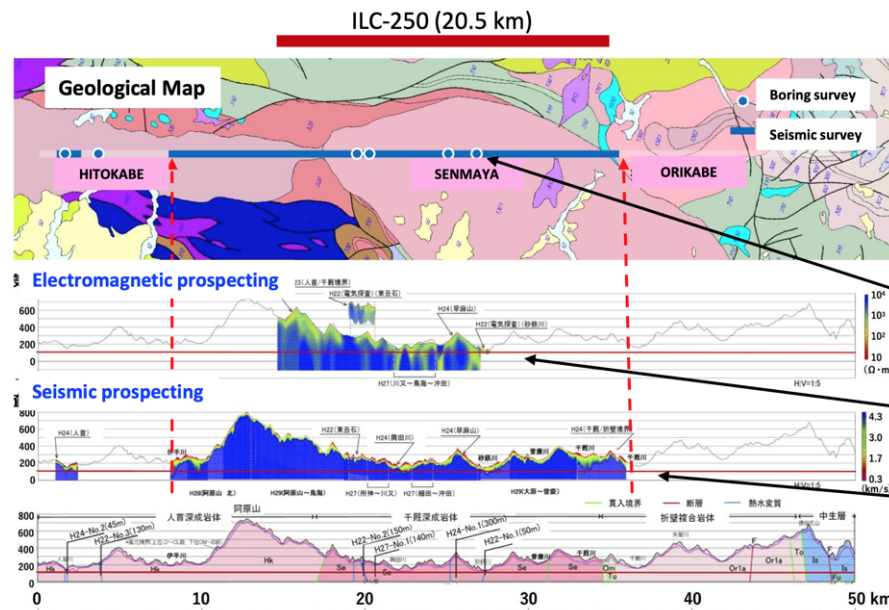


Local governments and universities in Tohoku area established Tohoku ILC Project Development Center this summer to solve issues that should be handled by the region regarding the construction of research facilities and environmental improvement around the ILC candidate site.

## Mandate of the center

- Examination of the impact of ILC construction on the natural environment, society, and economy
- Utilization of local resources associated with the location of research facilities and examination for regional promotion
- Examination of system and town development corresponding to acceptance and settlement of researchers and families

## Geological survey of the ILC candidate site



- Continuous **granite region**  
HITOKABE, SENMAYA and ORIKABE bedrock
- Have capability to extend the ILC up to 50 km in future
- Boring geological survey → Direct sampling down to the accelerator depth
- Electromagnetic prospecting → Cracks in the rock
- Seismic prospecting → Rock hardness

# Diet bills related to recovery efforts

On June 5, 2020, the National Diet (parliament) of Japan passed a series of bills related to the recovery efforts after the Great Eastern Japan Earthquake of 2011, including a 10-year extension of the Reconstruction Agency, which is now set to expire in March 2031. The special annual budget allocated for the recovery efforts will also be sustained.

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## 参議院附帯決議

26 国際リニアコライダー計画は東北が世界的候補地になっていることから、その推進は福島イノベーション・コースト構想と並んで東北をフィールドとした科学イノベーションの創出による「新しい東北」に資するものであり、国内誘致に向け関係機関と検討を進めること。

Supplementary Resolution #26 by the House of Councillors (unofficial translation)

*Since the Tohoku area is the world's candidate site for the International Linear Collider project, its implementation will contribute, alongside the Fukushima Innovation Coast Framework, to the creation of a "New Tohoku" by becoming a breeding ground for scientific innovation; considerations towards hosting in Japan should proceed together with the relevant organizations.*

# ILC status and planning

## Outline

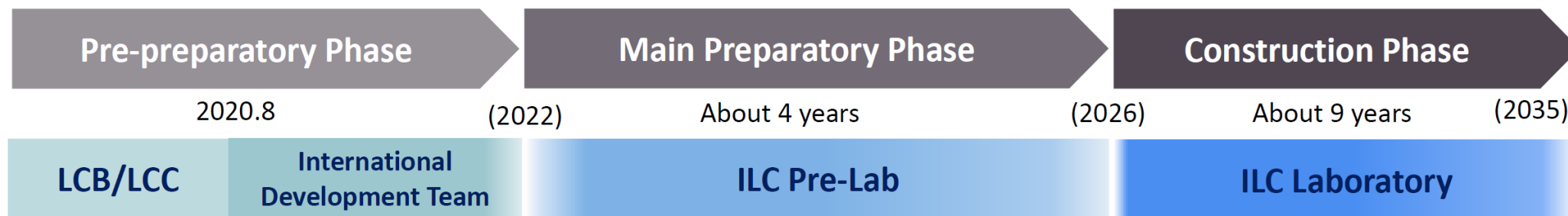
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# Developments in 2020

- In February ICFA/LCB meeting at SLAC:  
After the presentations by
  - Mr. H. Masuko, Deputy-Director General, MEXT Research Promotion Bureau
  - Hon. T. Kawamura, Chairperson of the Federation of Diet Members for the ILCICFA asked the LCB to propose a way to move to the preparatory phase for the ILC to be constructed in Japan.
- LCB worked out a proposal to setup the International Development Team (IDT), with KEK as the host, to pave a way to establish the ILC Pre-laboratory.
- In June, LCB/LCC ended their terms defined by the ICFA.
- In August ICFA meeting: ICFA setup the ILC IDT and appointed the members of the Executive Board, with an aim to establish the ILC Pre-lab within ~1.5 year.
- Since then, the IDT Executive Board has started working.

# Overall timeline



## ILC IDT (~1.5 years)

- Prepare the work and deliverables of the ILC Pre-laboratory and work out, with national and regional laboratories, a scenario for their contributions
- Prepare a proposal for the organisation and governance of the ILC Pre-laboratory

## ILC Pre-laboratory (~4 years)

- Complete all the technical preparation necessary to start the ILC project (infrastructure, environmental impact and accelerator facility)
- Prepare scenarios for the regional contributions to and organisation for the ILC.

## ILC laboratory

- Construction and commissioning of the ILC (~9-10 years)
- Followed by the operation of the ILC
- Managing the scientific programme of the ILC

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

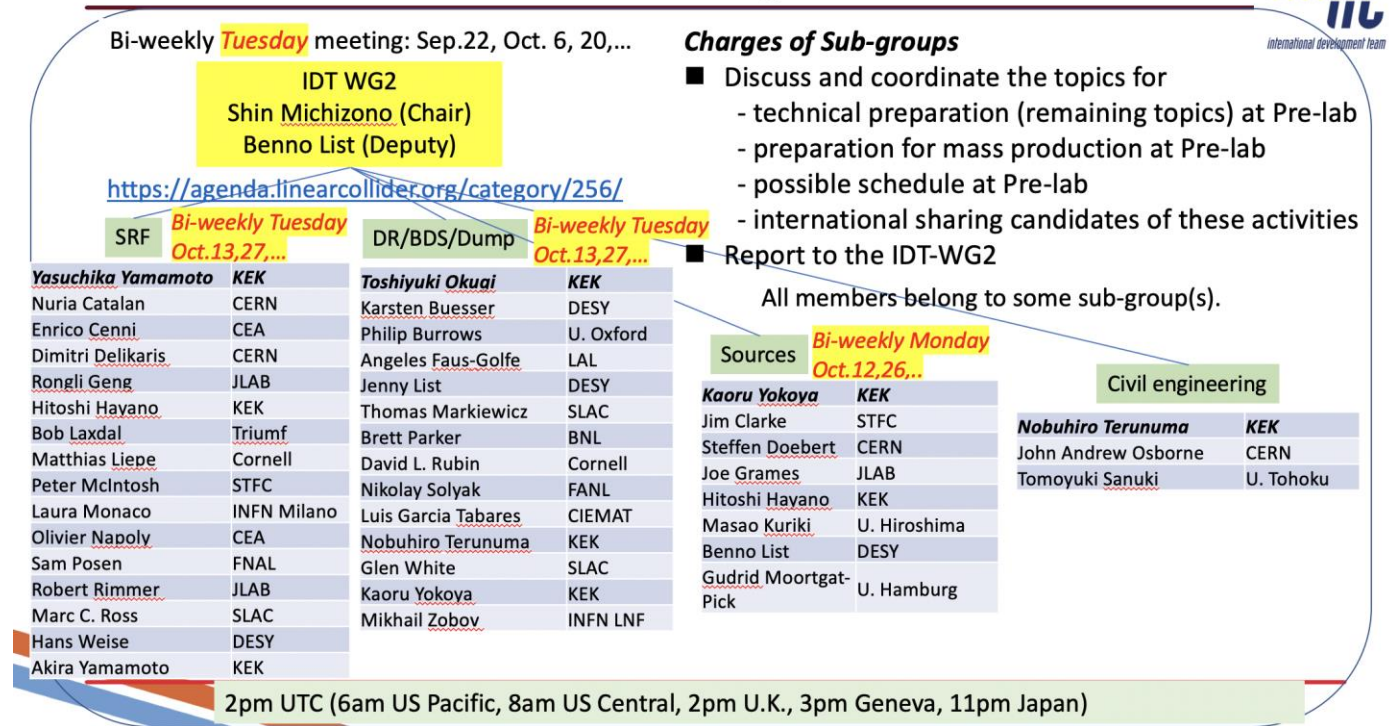
**Working Group 3**  
Physics & Detectors

WG1 is being set up with representation from/nominated by major labs in some cases in consultation with FAs (around ~5 per region)

In Europe nominations from the Lab Directors Group (LDG)

WG3 (structure and composition evolving):  
 Hitoshi Yamamoto, Jim Brau, Juan Fuster, Dmitri Denisov, Keisuke Fujii, Frank Simon, Andy White, Aidan Robson, Ties Behnke, Maksym Titov, Christophe Grojean, Michael Peskin, Karsten Buesser, Yuanning Gao, Gerald Eigen, Norman Graf, Frank Gaede, Jenny List, Sakue Yamada

## IDT-WG2 organization



The WGs are still be evolved and the membership expanded/adjusted – in particular WG2 and 3 will remain flexible to involve experts as needed

# ICFA mandate for the IDT

- Clarifying the function and organisation of the ILC Pre-Lab based on the KEK International Working Group report (EB and WG1)
- Developing a common understanding for the condition to start the ILC Pre-Lab (EB and WG1)
- Providing an international framework for the ILC accelerator effort and coordinating further R&D and engineering design work for the ILC in order to sustain the community effort and to guarantee a smooth transition to the ILC Pre-Lab phase (WG2)
- Providing an international framework for the ILC physics and detector activities and coordinating physics and detector R&D effort in order to sustain the community effort and guarantee a smooth transition to the ILC Pre-Lab phase (WG3)
- Discussing with international partners (e.g. universities, national and regional laboratories) for resources needed for the ILC Pre-Lab (EB and all WGs)
- Providing necessary information to the national authorities to support their discussion of the establishment of the ILC Pre-Lab (EB and WG1)

All these “activities” are now on-going and followed up in weekly or biweekly meetings of the the IDT-EB, WG2 and WG3 (the two latter also have several subgroups)

# Pre-lab accelerator activities

- **Technical preparations & SRF R&D for cost reduction [shared across regions]**
  - SRF performance R&D
  - Positron source final design and verification
  - Nanobeams (ATF3 and related): Interaction region: beam focus, control and Damping ring: fast kicker, feedback
  - Beam dump: system design, beam window, cooling water circulation
  - Other technical developments considered performance critical
- **Final technical design and documentation [central office in Japan with the help of regional offices]**
  - Engineering design and documentation, WBS
  - Cost confirmation/estimates, tender and purchase preparation, transport planning, mass-production planning and QA plans, schedule follow up and construction schedule preparation
  - Site planning including environmental studies, civil engineering, safety and infrastructure (see below for details)
  - Review office
  - Resource follow up and planning (including human resources)
- **Preparation and planning of deliverables [distributed across regions coordinated by the central office]**
  - Prototyping and qualification in local industries and laboratories, from SRF production lines to individual WBS items
  - Local infrastructure development including preparation for the construction phase
  - Financial follow up, planning and strategies for these activities
- **Civil engineering, local infrastructure and site [mainly by the Japanese institutions]**
  - Engineering design including cost confirmation/estimate
  - Environmental impact assessment and land access
  - Specification update of the underground areas including the experimental hall
  - Specification update for the surface building for technical scientific and administrative needs

# Pre-lab physics and detector activities

- Preparing the ILC physics programme by
  - Setting up the ILC Committee (ILCC) as a programme committee for the ILC at the start of the Pre-lab.
  - Call for Expressions of Interest (Eols) after ~0.5 year for experiments covering a broad physics spectra which can be done at the ILC.
  - Call for Letters of Intent (Lols) about one year after the Eols. The ILCC will select a subset of Lols to proceed for the next step.
  - Call for a Technical Proposal/Technical Design Report shortly before the transition to the ILC Laboratory, where the final approval of the experiments will be made by the ILC Laboratory.
- Approving and monitoring of the progress for the detector R&D programme by the ILCC.
- Organising physics workshops to reflect on the ongoing progress relevant for the ILC physics.

This timeline is the current IDT thoughts and the actual implementation will be led by the Pre-lab directorate

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# ILC R&D at KEK



ATF: Technology to handle nano-size beam

STF: Technology to assemble and operate superconducting cavities

CFF: Technology to manufacture superconducting cavities

# KEK's role at IDT and beyond

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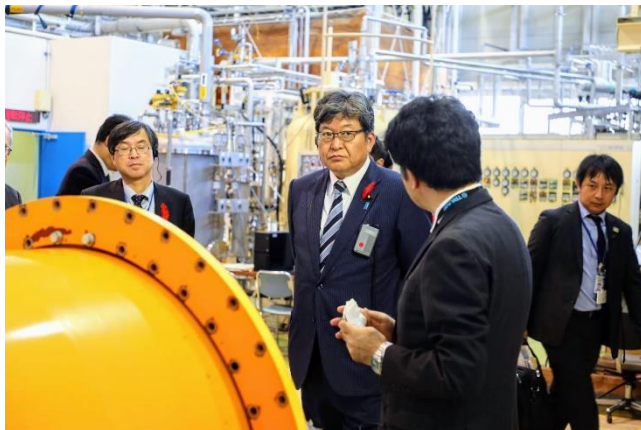
- The next focus will be when ILC Pre-Lab can be started following the IDT.
- The function of the ILC Pre-lab is to do the remaining works in four years.
  - Solve remaining technical issues of the accelerator.
  - Design of the organization and functions of the ILC laboratory
  - Launch the ILC laboratory!
- Since the start of the ILC Laboratory is the official start of the ILC project, it is necessary to reach an international agreement including cost sharing before its start. The ILC Pre-Lab also plays an important role in supporting such international negotiations
- KEK is making every possible effort to start the ILC Pre-Lab soon after the IDT completes its mandate, and to realize the ILC together with the Japanese physics community and supporting groups in the political sector, industrial sector and Tohoku region.

# Messages from the Japanese Government



Koichi Hagiuda, Minister of MEXT

- As the Minister of Education, Culture, Sports, Science and Technology, which has jurisdiction over the nation of science and technology, I think it is important for Japan to take an active and bold challenge in this field. (Hagiuda, Feb. 2020)
- It is an international project that requires a huge resource, and we recognize that it is necessary to solve various issues, including technical feasibility and international sharing, and to obtain wide-ranging cooperation both domestically and internationally. (Hagiuda, Feb. 2020)
- The Ministry of Education, Culture, Sports, Science and Technology will keep an eye on discussions by the international research community while exchanging opinions with government authorities in the United States and Europe. (Hagiuda, Sep. 2020)



## Federation of the Diet Members for ILC

- Bipartisan parliamentary league established in 2008 consisting of 150 members from the Japanese National Diet. Chair is Mr. Takeo Kawamura, former MEXT minister.
- It conducts activities in many aspects to promote ILC, including discussions with the U.S. and European Governments. Delegation the Federation have visited U.S. and Europe twice every year before the COVID pandemic.
- It advocates to realize ILC as a national project that crosses ministries.
- “I believe the ILC should be realized through politically-led efforts, cutting across different ministries and agencies. As such, we’re proceeding to realize a budgeting as a national project with a separate budget outside of the regular science and technology budget.” (Statement of the ILC Federation, March 2019)



21

## Advanced Accelerator Association (AAA)

- An organization of industrial sector to aim to make a leap in science and technology through the development of cutting-edge accelerators jointly by industry and academia.
- 102 companies and 41 universities and research laboratories
- Activities
  - Activate public relations about the ILC by organizing public symposia and awareness event targeting influencers
  - Consider the direction of technological development for the ILC, and make recommendations to related organizations.
  - Create innovative technology to support advanced accelerators.



23

# JAHEP ILC Steering Panel

- In October 2020, the Japan High Energy Physics Committee (HEPC) that represents the Japanese high energy physics community (Japan Association of High Energy Physics – JAHEP) established the ILC Steering Panel to accelerate community-wide efforts to realize the ILC.
- The ILC Steering Panel, chaired by Satoru Yamashita, is charged to lead the community to advance the ILC project and actively cooperate with other scientific communities, government authorities, legislators, corporate leaders, regional governments, and media, as well as international communities and authorities, toward timely realization of the ILC in Japan.
- The Panel is expected to work closely with the ILC International Development Team and KEK.

## **ILC Steering Panel Members :**

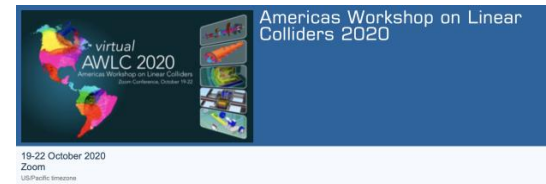
Shoji Asai (University of Tokyo)  
Kazunori Hanagaki (KEK)  
Toru Iijima (Nagoya University)  
Kiyotomo Kawagoe (Kyushu University)  
Sachio Komamiya (Waseda University)  
Shinichiro Michizono (KEK)  
Toshinori Mori (University of Tokyo)  
Hitoshi Murayama (UC Berkeley/University of Tokyo)  
Yutaka Ushiroda (KEK)  
Hitoshi Yamamoto (Tohoku University/IFIC Valencia)  
Satoru Yamashita (University of Tokyo) – Chair

# Summary of the Japan and KEK slides above

Large activity in at least five directions:

- Work towards Japanese funding of the ILC Pre-lab
- Central role in Pre-lab planning discussions and leadership in many aspects of the technical work followed up in the IDT WGs, and KEK hosts the IDT
- Collaborative projects with many partners across the world and associated agreements
- Activities towards the wider Japanese physics and general community
- Work with Tohoku ILC Project Development Center for site preparation

# US – Japan on ILC



U.S. Deputy Secretary of State Stephen Biegun sent a letter to Japan's Foreign Minister Motegi in February 2020.

It is necessary to take decisive action to ensure that Japan and the United States continue to be at the forefront in particle physics, and I strongly support the progress of the International Linear Collider Program. (Article in the Yomiuri newspaper on May 13, 2020, translation by MY)



Workshop pages [\(link\)](#)

|  |   |
|--|---|
| <b>US government views of the ILC - DOE</b><br>Zoom              | <i>Dr Chris Fall</i>     |
|  | 15:10 - 15:20   |
| <b>US government views of the ILC - NSF</b><br>Zoom              | <i>Dr Saul Gonzalez</i>  |
|  | 15:20 - 15:30   |
| <b>US government views of the ILC - State Department</b><br>Zoom | <i>L. Reece Smyth</i>    |
|  | 15:30 - 15:40   |

We support the decision to move the ILC efforts forward through the ILC International Development Team, and will continue to work to help educate partner governments about the value of this facility. We also look forward to coordinating with the Government of Japan to advance the facility.

- As I have expressed before, there is strong interest in participation by the United States in the ILC program.
- Earlier this year in February, the Secretary of Energy Brouillette also expressed these same thoughts when he wrote to Japan's Cabinet Minister of State for Science and Technology Policy, Mr. Takemoto.
- We plan to continue discussions both bilaterally with MEXT and other officials in the Government of Japan, and multilaterally with the governments of other global regions to not only have a dialogue on the sharing of costs and resources, but also in understanding organizational and governance models for such a largescale research facility as the ILC.



- US Labs excited for possibility to leverage experience in mass production of high performance SRF cryomodules for ILC
- LCLS-II provided key experience for Fermilab and JLab

Cryomodule Production for ILC at Fermilab

- We would be delighted to assemble and test cryomodules for the ILC
- Now have key experience with mass production of ILC-like cryomodules with LCLS-II and LCLS-II HE
- Facilities, staff, knowledge, and experience are ILC-ready
- Collaborating in this way on international projects is standard at Fermilab – recent examples include LHC, HL-LHC, PIP-II



Fermilab

Jefferson Lab SRF Production

**JLab SRF by the numbers**

- >135 cavities of various types fabricated
- >960 different cavities processed and tested
- >5300 vertical cavity tests performed
- >530 cavities and 90 cryomodules produced and in continuous operations

- Full cycle – from R&D and prototype to design, construction, operation and refurbishment
- Support NP goals and DOE partner labs programs

AWLC2020, A. Seryi

Jefferson Lab

Potential MSU Contribution to ILC

- FRIB SRF team just roll off large production and capable engage large SRF project.
- Infrastructure is available and support ILC work
- FRIB take on portion of cryomodule work is feasible

Vast knowledge and experience in SRF can be directed towards ILC

**Potential Cornell SRF Contributions**

SRF component design and testing  
E.g. cavity tuner, HOM absorbers, RF coupler  
HOM absorber material studies

Horizontal dressed cavity testing in Cornell's  
Horizontal-Test-Cryomodule (HTC)  
3 cavity cryomodule, e.g. used for first LCLS-II  
HE 9-cell cavity cryomodule test.  
Horizontal test bed to study cavity  
performance, RF coupler performance, cavity  
operation, LLRF controls...

Copyright Cornell University, October 19, 2020 – American Linear Collider Reference

SRF@ANL - Design to Operation

Assembly of ANL-designed ATLAS Intensity Upgrade 72 MHz Quarter-Wave Resonator Cryomodule (2014)

Superconducting cavity processing at the ANL facility jointly funded and staffed by Argonne and Fermilab. Four full time staff (2 ANL, 2 FNAL)

Cavity and accelerator systems testing (ADTF)

Argonne

Full SRF Infrastructure at MSU for FRIB Construction & SRF Research

- 2014 MSU invested a brand new SRF infrastructure to support FRIB and SRF research
- 2015 SRF infrastructure in full operation with high availability and high throughput
- More than 500 cavity testing conducted
- 49 cavity strings and modules assembled
- Peak rate: 1 cavity test per day, 3 test mass per month, 2 module per month
- Full infrastructure allow MSU to perform all cryomodule work in-house

FRIB Facility for Rare Isotope Beams

In-situ plasma processing at SNS

- Cleaning technique uses a neon gas discharge with reactive oxygen for SRF cavities at room-temperature
- Plasma ignited in each cell of a cavity sequentially
- Oxidation of hydrocarbon surface contaminants creates volatile by-products pumped out continuously
- Cleaned surface has increased work function helping mitigating field emission and multipacting



OAK RIDGE

Jefferson Lab SRF Production

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AWLC2020, A. Seryi

Jefferson Lab

Cryomodule Assembly at Fermilab



- One cryomodule assembly per month has been achieved in LCLS-II production.
- One cryomodule assembly per week is feasible when properly staffed.

Fermilab

Possible Vision for US Production Floors late 2020s?

- Looking forward to possible new cryomodule decoration in near future!



Please see details from parallel session of the Americas Workshop on Linear Colliders (pictures extracted from summary by S.Posen): [link](#)

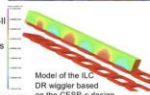
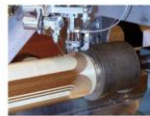


# Beam Physics, Simulation, Damping Ring Dynamics, Beam Delivery System, & Sources

- Use of high performance computing, design, and other resources to tackle key ILC deliverables

## BNL Accelerator Engagement

- Interaction Region
  - Strong basis for interaction region magnet design
  - Unique Direct-Wind capability for developing highly custom IR magnets
- Damping Rings
  - High brightness storage ring capabilities at NSLS-II match well to ILC DR design and construction needs
  - Superconducting magnet expertise enables industrialization of the ILC DR wiggler design
- Other areas
  - Broad experience in electron accelerators (ATF, NSLS-II and EIC electron source) provides deep expertise for beam physics and technology engagement
  - Accelerator instrumentation and laser expertise couples to a range of baseline efforts
  - Advanced accelerator capabilities couples to potential ILC follow-on steps
    - Options
    - Energy upgrades



## ARGONNE IS THE HOME OF THE elegant CODE

- Code of choice for modeling storage rings and linacs. Continuously updated with new physics and algorithms. Many new features added for design of APS-U.
- Advanced design optimization targeting key performance metrics
- Benchmarked simulation tools – against current APS data
- Combined single and multi-bunch modeling
- Detailed machine error simulations
- Direct simulation of different beam loss mechanisms including swivel injection
- Coupled vacuum & physics modeling. New module includes comprehensive ion modeling.
- SR masking modeling for high-current electron rings
- Automated machine commissioning simulation → AI / ML

## THE APS UPGRADE IS SIMILAR TO ILC DAMPING RINGS

- Uses multiple technologies envisioned for ILC DR
- Entry year 4/2017, 200-nm, including
  - Advanced multi-band achromat lattice-42 m
  - 104 m of vacuum systems
  - On-axis injector with four stripline kickers
  - 1320+ high-strength conventional magnets
  - Superconducting 60-Harmonic Cavity for ILC
  - Orbit correction system with 1 kHz bandwidth
  - Will exceed capabilities of today's storage ring light sources by 2 to 3 orders of magnitude



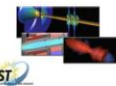
- SLAC can also make intellectual contributions in other key areas
- Beam Delivery Systems
  - Experience in BDS design & FFS
    - e.g. contributed design, operations & hardware to ATF2 program
- Many participating personnel still at SLAC
- Beam physics
- Considerable experience in electron injectors, Linac and ring operations

## Jefferson Lab and ILC

- Jefferson Lab has made important contribution to R&D on ILC cavities and continuing to contribute to ILC efforts
- Jefferson Lab contributes to ILC Global Design Efforts
  - tech transfer, vendor qualification, gradient program, and now the cost-reduction program
- Jefferson Lab is participating in International Development Team
  - SRF R&D, sources (polarized positrons)
  - Can contribute to other IDT WGs – e.g. beam delivery / beam transport / damping ring
- ILC SRF cryomodule production
  - Jefferson Lab together with Fermilab will lead the ILC cryomodule production in US
  - Jefferson Lab would aim to cover 50% of the US cryomodule production
  - Infrastructure exists but assembly and testing facilities would have to be augmented to achieve the rate of 1 CM/week (total with FNAL)
  - ILC production timeline is a good match for ongoing and future production activities (LCLS-II-HE, EIC)
  - JLab has all of the technical lead staff in place

## Berkeley Lab Accelerator Modeling offers Expertise Applicable to ILC

- Linac design & simulation
  - o Design optimization – conventional and AI/ML
  - o Space-charge effects
  - o High-order optics effects
  - o Realistic beamline elements (fringe fields, overlapping fields,...)
  - o Multi-physics modeling (e.g. WARP+ICOLL)
- High performance computing
  - o Start-to-end modeling (code integration, standards for I/O,...)
  - o Developers of widely used community codes within the Berkeley Lab Accelerator Simulation Toolkit (BLAST)
    - Including: IMPACT suite, Warp, BeamBeam3D.



## Potential contributions from Cornell

- 1) Accelerator design
  - a) Electron source optimization
  - b) Electron beam-transport optimization, including space charge, CSR, micro-bunching, polar
  - c) Damping-ring design / simulation / optimization
- 2) SRF topics
  - a) SRF material qualification
  - b) Vertical bare cryogenic cavity tests
  - c) Horizontal dressed cavity testing in Cornell's HTC
  - d) SRF component testing, e.g. cold tuners, HOM absorbers, couplers
  - e) HOM absorber material studies
  - f) SRF simulations, cavity design, RF component design
- 3) Damping ring dynamics
  - a) Permanent magnet optics (from CBETA experience)
  - b) Superconducting wigglers (from CESR experience)
- 4) Positron production
  - a) Helical undulators (from optical stochastic cooling experience)

## ILC Lattice Design and Beam Dynamics

- On CDR/TDR stage Fermilab team actively participated in ILC design, incl. lattice design and beam physics studies
  - Lattice design:
    - DR to RTML injection/extraction lines; RTML and ML lattices; Bunch compressors; Tune-up extraction lines
  - Low Emittance transport studies for RTML and ML
    - Static and dynamic misalignments, jitter, ground motion; Effect of cavity wakefields (short/long range) and coupler kicks; Development of BBA algorithms to mitigate emittance preservation
  - Dark current dynamics and radiation in ML
- Fermilab scientists are ready to restart these ILC activities for pre-Lab and post ILC upgrades

SRF Cryomodule Production for the ILC: FNAL, MSU, J-LAB  
 SRF Component Treatment, Design, & Test: Cornell, ANL, J-LAB, ORNL, FRIB, FNAL  
 Beam Physics, Simulation, Damping Ring Dynamics, Beam Delivery System, & Sources: BNL, ANL, LBL, Cornell, SLAC, J-LAB  
 Magnets –Wigglers, Undulators, Quadrupoles, IR Magnets: FNAL, LBL, FNAL  
 Key Ancillary Systems: SLAC, LBL, FNAL  
 Accelerator R&D for Future: FNAL, J-LAB, LBL, ANL

Workshop followed up by KEK/DOE/US labs meeting and WG2 discussions

# Americas— summary

Strong push in the US (all the examples above) at all levels, many labs interested and well aligned towards ILC, and in many cases using significant resources in developments directly relevant for ILC

Snowmass process important: in addition to collider experiments at ILC also other possibilities, as for example Dark Sector physics at ILC, etc.

Focus on young/next generation in many sessions (Americas workshop on LC and Snowmass)

Interests and capabilities in Canada (talks by A.Bellerive and D.Kester) and Latin America (talk by M.Losada)

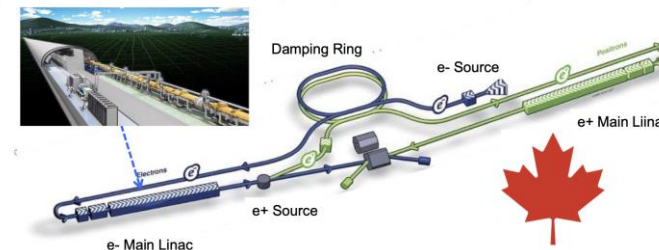
### ILC Pre-Lab US SRF Program Draft

Version: November 9, 2020

| Task  | Notes  | Goal                     | US Labs                      | Year 1 | Year 2 | Year 3 | Year 4 |
|---|--|--------------------------|------------------------------|--------|--------|--------|--------|
| Field emission and cavity cleaning R&D, e.g. HPP and plasma processing on cavities, development of robotics during cavity assembly, and LN cleaning   |  | (1) Perf                 | Cornell, FNAL, JLAB, others? |        |        |        |        |
| Yield study (1) with 30 new 9-cell cavities; cold EP + 2-step bake  | use new cavities from established vendor   | (2) Yield                | FNAL, JLAB                   |        |        |        |        |
| Single cell and 9-cell R&D program to further optimize cavity preparation protocol  |  | (1) Perf                 | Cornell, FNAL, JLAB, others? |        |        |        |        |
| Yield study (2) with 30 new 9-cell cavities; optimized preparation protocol   |  | (2) Yield                | FNAL, JLAB                   |        |        |        |        |
| Module transport engineering design and studies, including dummy module transport   |  | (3) CM                   | FNAL, JLAB, SLAC             |        |        |        |        |
| Cryomodule optimization for transport   |  | (3) CM                   | FNAL, JLAB, SLAC             |        |        |        |        |
| Cavity accessory components R&D (e.g., tuner, coupler...), e.g. for higher gradients  |  | (3) CM                   | Cornell, FNAL, JLAB, others? |        |        |        |        |
| Order/fab components for 4 prototype cryomodules  |  | (3) CM                   | FNAL, JLAB                   |        |        |        |        |
| Assembly and testing of two prototype cryomodules, with cavities from yield study (1)   |  | (3) CM                   | FNAL, JLAB                   |        |        |        |        |
| Field emission studies, including HPP and plasma processing on cryomodules  |  | (3) CM                   | FNAL, JLAB                   |        |        |        |        |
| Cryomodule transportation testing (US roundtrips)   |  | (3) CM                   | FNAL, JLAB                   |        |        |        |        |
| Cryomodule transportation testing (ship to Japan)   | cavities used from yield study (1) would have to be compliant with Japanese HPG regulation | (3) CM                   | FNAL, JLAB                   |        |        |        |        |
| Assembly and testing of two prototype cryomodules, with cavities from yield study (2); implement field emission prevention methods during assembly, e.g. robotics in collaboration with CEA |  | (3) CM                   | FNAL, JLAB                   |        |        |        |        |
| Engineering Design Report (SRF part)  |  | EDR                      | AE                           |        |        |        |        |
| Preparation for mass production / module assembly   |  | Planning and preparation | FNAL, JLAB, others?          |        |        |        |        |
| US supply chain development   |  | Planning and preparation | FNAL, JLAB, others?          |        |        |        |        |

### Potential areas of Canadian Contribution to ILC via TRIUMF

- SRF/RF (crab (or other) cavities, cryomodules, rf ancillaries)  
SRF research on break-down fields and effect of doping
- HV kickers, beam painting magnets and Rf bunch deflectors
- Beam physics (space charge dominated beam, Hamiltonian based fast envelope code, machine learning)
- High brightness electron gun
- e-beam diagnostics
- Normal conducting magnets (also permanent magnet optics for e-beam lines)



## LASF4RI



Latin American Strategy Forum for Research Infrastructure

*Developing a strategy to strengthen Latin American Scientific Collaborations and their impact.*

# Europe and ILC

Homework done in 2018: [European planning document 2018](#) – presented to CERN Council in June 2018  
(slightly more was done than showed in the document concerning in-kind and resource profiles)

Focus on European capabilities for ILC (e.g. SFR on the right)

July 2, 2018

## Preparation Plan for European Participation in the International Linear Collider

Towards a European Contribution to the ILC

**Authors:** Philip Bambade (LAL Orsay)  
Philip Burrows (Oxford)  
Angeles Faus-Golfe (IFIC-Valencia and LAL)  
Brian Foster (DESY)  
Andrea Jeremie (LAPP Annecy)  
Benno List (DESY)  
Olivier Napoly (CEA-Saclay)  
Thomas Schörner-Sadenius (DESY)  
Marcel Stanitzki (DESY)  
Steinar Stapnes (CERN)  
Nick Walker (DESY)  
Hans Weise (DESY)

### Content

|   |    |
|---|----|
| Executive Summary . . . . .   | 2  |
| 1 Introduction . . . . .  | 3  |
| 2 Past European contributions to the ILC and current activities within Europe . . . . . | 6  |
| 3 Preparation phase for the ILC construction 2019–2022 . . . . .                        | 14 |
| 4 European in-kind contribution to the ILC construction. . . . .                        | 20 |
| 5 Possible involvement forms of Europe . . . . .  | 21 |
| 6 References . . . . .  | 23 |
| 7 Glossary . . . . .  | 24 |

|                              | Germany<br>DESY | France<br>CEA Saclay | LAL | Italy<br>INFN Milan | IFJ PAN | Poland<br>WUT | NCBJ | Russia<br>BINP | Spain<br>CIEMAT |
|------------------------------|-----------------|----------------------|-----|---------------------|---------|---------------|------|----------------|-----------------|
| <b>Linac</b>                 |                 |                      |     |                     |         |               |      |                |                 |
| Cryomodules                  | ✓               | ✓                    |     | ✓                   |         |               |      |                |                 |
| SCRF Cavities                | ✓               |                      |     |                     |         |               |      |                |                 |
| Power Couplers               | ✓               |                      | ✓   |                     |         |               |      |                |                 |
| HOM Couplers                 |                 |                      |     |                     |         |               | ✓    |                |                 |
| Frequency Tuners             | ✓               |                      |     |                     |         |               |      |                |                 |
| Cold Vacuum                  | ✓               |                      |     |                     |         |               |      | ✓              |                 |
| Cavity String Assembly       | ✓               | ✓                    |     |                     |         |               |      |                |                 |
| SC Magnets                   | ✓               |                      |     |                     | ✓       |               |      |                | ✓               |
| <b>Infrastructure</b>        |                 |                      |     |                     |         |               |      |                |                 |
| AMTF                         | ✓               |                      |     |                     | ✓       | ✓             |      | ✓              |                 |
| Cryogenics                   | ✓               |                      |     |                     |         |               |      |                |                 |
| <b>Sites &amp; Buildings</b> |                 |                      |     |                     |         |               |      |                |                 |
| AMTF hall                    | ✓               |                      |     |                     |         |               |      |                |                 |

Table 2: Responsibility matrix for cryomodule production and testing for the European XFEL.



|                        | Germany<br>DESY | France<br>CEA | IPNO | Italy<br>Elettra | INFN-LASA | Poland<br>IFJ-PAN | Spain<br>ESS Bilbao | Sweden<br>ESS | Uppsala | UK<br>STFC |
|------------------------|-----------------|---------------|------|------------------|-----------|-------------------|---------------------|---------------|---------|------------|
| <b>RF systems</b>      |                 |               |      | ✓                |           |                   | ✓                   | ✓             | ✓       |            |
| LLRF                   |                 |               |      |                  |           |                   |                     |               |         |            |
| <b>Cryomodules</b>     |                 | ✓             | ✓    |                  |           |                   |                     |               |         |            |
| SCRF Cavities          |                 | ✓             | ✓    |                  | ✓         |                   |                     |               |         | ✓          |
| Power Couplers         |                 | ✓             | ✓    |                  |           |                   |                     |               |         |            |
| HOM couplers           |                 |               |      |                  |           |                   |                     |               |         |            |
| Frequency Tuners       |                 | ✓             | ✓    |                  |           |                   |                     |               |         |            |
| Cold Vacuum            |                 | ✓             | ✓    |                  |           |                   |                     | ✓             |         |            |
| Cavity String Assembly |                 | ✓             | ✓    |                  |           |                   |                     |               |         |            |
| RF Tests (Cavities)    | ✓               |               |      |                  |           |                   |                     |               |         | ✓          |
| RF Tests (Cryomodules) |                 | ✓             | ✓    |                  |           | ✓                 |                     | ✓             | ✓       |            |

Table 3: Responsibility matrix for the cryomodule production and testing for the ESS.



# A broad SRF technology base

## Crab-cavity CM for HL-LHC

2 types of Crab cavities

- Double Quarter Wave
  - Vertical crossing for Atlas
  - SPS test in 2019
- RF Dipole
  - Horizontal crossing for CMS
  - First vertical test in Feb. 2020
  - SPS test in 2021

|                |                 |
|----------------|-----------------|
| Voltage        | 3.4 MV/cavity   |
| $E_{peak}$     | 40 MV/m         |
| $B_{peak}$     | 70 mT           |
| Frequency      | 400.79 MHz      |
| $Q_b$          | $10^{10}$       |
| $Q_{ext}$      | $5 \times 10^5$ |
| Cavity tuning  | $\pm 100$ KHz   |
| Temperature    | 2.0 K           |
| RF power (SPS) | 40 kW           |

DQW@SPS: the first bulk Nb cavity operating on a machine at CERN

20 October 2020

## IFMIF CRYMODULE, UNDER ASSEMBLY AT ROKKASHO

Labels: Safety exhaust, Pressure relief device, HWR equipped with its tuning system, Current lead, Vacuum vessel, He Phase separator, Beam axis, Solenoid package, Support frame, Beam valve.

20 October 2020

See talk of D.Napoly at ALCWS: [\(link\)](#)  
Summary slide by B.List

## ESS- In-Kind Contributions

15 spoke cavities tested so far, all within specifications

Double-Spoke OK for CM integration

First series cryomodule during assembly

2 cavities tested at the same time in vertical cryostat

First series cryomodule shipped to Uppsala in Oct 2020 for high power test

20 October 2020

## The SRF Community goes Continuous Wave

DESY SRF R&D strongly supports a further developed TESLA technology

- Continuous wave mode is THE final goal of all superconducting accelerators
- If affordable (cryogenic wise), keep RF on for ever... and offer the users of your facility highest flexibility regarding beam time structure
- The European XFEL R&D efforts aim for technology development
- The DESY Accelerator Research and Development (ARD) program clearly advertises more fundamental questions related to SRF CW performance
- DESY activities include
  - SRF gun development / CW injectors
  - CW linac design: Niobium material / cavities / RF power couplers / module design & operation
  - Assembly of 1+ accelerator module per year

production of Large Grain material cavities

several generations of SRF gun prototypes

long pulse / CW operation of slightly modified XFEL type accelerator modules

## LASA ESS Medium beta cavities: from design to

PIP-II LINAC Work Matrix / EU

|                       | France | Italy | Poland | UK   |
|-----------------------|--------|-------|--------|------|
|                       | CEA    | CMS   | INFN   | STFC |
| Linac Components      |        |       |        |      |
| Cryogenics            |        |       |        |      |
| Cryomodules           | ✓      |       |        | ✓    |
| SRF cavities          |        | ✓     |        | ✓    |
| Powers Couplers       | ✓      | ✓     |        |      |
| Frequency Tuners      |        | ✓     |        | ✓    |
| Cold vacuum           | ✓      |       |        | ✓    |
| Module Assembly       | ✓      |       |        | ✓    |
| Test infrastructures  |        |       |        |      |
| RF cavities/ couplers |        | ✓     |        | ✓    |
| RF cryomodules        | ✓      |       |        |      |

Legend:  
✓ Prototypes  
✓ Production Series

20 October 2020

## SRF Cryomodule Activities – PIP-II High Beta Cryomodule (2019 - 25)

| Cryomodule (CM)           | PIP-II |
|---------------------------|--------|
| Operating Temperature (K) | 2      |
| Number of Cavities        | 6      |
| Energy Gain (MeV)         | ~110   |
| Dynamic Load (W)          | 130    |
| Static Load (W)           | 32     |
| CM Length (m)             | 9.8    |
| Number of Cryomodules     | 3      |

20 October 2020

## FREIA Laboratory

Facility for Research Instrumentation and Accelerator Development

Funded by KAWS, Government, Uppsala Univ.

State-of-the-art Equipment

- cryogenics
- control room
- liquid helium
- equipment controls
- liquid nitrogen
- data acquisition

Competent and motivated staff  
collaboration of physics (IFA) and engineering (Teknikum).

radio-frequency (RF) power sources, 3 bunkers with test stands, horizontal cryostat, vertical cryostat

20 October 2020

# More accelerator possibilities – and detectors

|                        | CERN | France<br>LAL LAPP | Germany<br>DESY | Spain<br>IFIC | UK<br>Oxford RHUL |
|------------------------|------|--------------------|-----------------|---------------|-------------------|
| <b>Goal 1</b>          |      |                    |                 |               |                   |
| Very-low $\beta$       | ✓    |                    |                 |               |                   |
| Ultra-low $\beta$      | ✓    |                    |                 |               |                   |
| Halo control           |      | ✓                  |                 | ✓             |                   |
| Wakefield/Intensity    | ✓    |                    |                 | ✓             | ✓                 |
| Instrumentation        | ✓    | ✓                  |                 | ✓             | ✓                 |
| Ground motion          | ✓    |                    | ✓               |               | ✓                 |
| Background             |      |                    | ✓               |               | ✓                 |
| <b>Goal 2</b>          |      |                    |                 |               |                   |
| Stabilisation/Feedback |      | ✓                  |                 |               | ✓                 |

Table 4: An overview of present European activities in ATF2.

ATF2, large European participation, including PhD students, and large interest for ATF3

| Topic                               | Details   |
|-------------------------------------|---|
| Beam-dynamics                       | Overall accelerator design<br>Modeling and simulation tools   |
| Damping rings<br>RTML<br>BDS<br>MDI | Design<br>Optimisation and performance studies                |
| Cost and power                      | Cost comparison and reviews<br>Power estimates and comparison |
| Physics and Detector                | Physics studies<br>Detector design<br>Software tools          |

Table 5: An overview of present common activities between ILC and CLIC.

Many common WGs with CLIC – over nearly a decade

## Detectors & Physics:

Strong European participation related to ILD, SiD, R&D, physics – BUT many countries not represented. This is problematic when planning for the future. Building up more European membership and participation in IDT WG3 is therefore a priority.

|                    | CERN | DESY | Czech Republic | France | Germany | Italy | Israel | Netherlands | Norway | Poland | Serbia | Spain | UK |
|--------------------|------|------|----------------|--------|---------|-------|--------|-------------|--------|--------|--------|-------|----|
| Vertexing          | ✓    | ✓    | ✓              | ✓      | ✓       | ✓     |        |             |        | ✓      |        | ✓     | ✓  |
| Tracking           | ✓    | ✓    |                | ✓      | ✓       |       |        | ✓           |        |        |        | ✓     | ✓  |
| Calorimetry        | ✓    | ✓    | ✓              | ✓      | ✓       | ✓     | ✓      |             | ✓      | ✓      | ✓      | ✓     | ✓  |
| MDI                | ✓    | ✓    |                |        |         |       |        |             | ✓      |        |        | ✓     | ✓  |
| System Integration | ✓    | ✓    |                | ✓      |         |       |        |             |        |        |        | ✓     | ✓  |

Table 6: An overview of present activities in the area of ILC-related detector R&D and integration in Europe.

Obviously, if one includes the capabilities in Europe built up in LHC, CLIC, R&D projects, etc. one can find world-leading expertise in virtually any technology and detector system

# What is needed now ?

Pre-lab planning: two main entry points:

- Pursue R&D interests and capabilities, link to “local” strategic interests [Scientific and Technical Collaboration]
  - For some countries and groups this is the easiest entry point to Pre-lab contributions
- Identification and preparation of ILC deliverables – one main one is a European SFR module line, then other individual WBS items [Qualify to deliver specific parts]
  - SFR module production line requires a multinational approach, other deliverable are a good entry point for countries and groups, linking to capabilities and industry

On-going activities:

- Participation in IDT WG from Europe systematically encouraged (but not complete – see current situation on page 13)
- European monthly information meetings ([link](#))
- SFR capabilities in Europe (labs and industry) to be consolidated into a model for ILC cryomodule production
- “National contacts/communities” actively planning for the next five years (IDT and Pre-lab period) and beyond for ILC - examples from UK, CERN, Spain

In summary, we are working towards a potential contribution list for the Pre-lab:

| WB item | R&D interest/skills | Prototypes/Hardware | Local infrastructure | Timeline | Industry | Lab/Group/Country | Resources |
|---------|---------------------|---------------------|----------------------|----------|----------|-------------------|-----------|
| ...     |                     |                     |                      |          |          |                   |           |

# UK – renewed engagement in view of Pre-lab planning

## Linear Collider UK (LCUK) Collaboration

Contacts: Philip Burrows, Aidan Robson

Long standing Consortium of UK particle physics experiment, theory and accelerator groups with interests in a linear collider.

- Previous strong UK research council support for ILC R&D projects, but only very modest support since 2013
- Strong joint CERN/UK CLIC programme 2011-20 ('CLIC-UK')
- Detector R&D largely pursued via CALICE, AIDA2020 ... main UK technical interests in silicon vertex/tracking, calorimetry, DAQ/trigger
- Synergies with CLIC, FCCee, CEPC in both detector + accelerator systems remain important

### Updates:

- STFC engaged and informed on ILC, UK Tokyo Embassy following ILC developments closely
- LCUK community planning meeting on ILC 18/9/20: <https://indico.cern.ch/event/943948/>
- UK physicists are engaging with IDT WGs
- UK PP roadmap update (in light of EPPSU) → Spring 2021
  - LCUK input (16/10/20): 'UK participation in the International Linear Collider'
  - Outline case made for UK contributions to Pre-lab + Construction phases (see matrix on the right of key "capabilities")
- Engagement with UK industry ongoing → 'in-kind' contributions essential



| Institute                   | Technical system | Accelerator |    |            |           |    | Detector   |             |     | Physics |
|-----------------------------|------------------|-------------|----|------------|-----------|----|------------|-------------|-----|---------|
|                             |                  | BDS/MDI     | DR | Beam dumps | e+ source | RF | Si tracker | Calorimetry | DAQ |         |
| Birmingham                  | X                |             |    |            |           |    | X          | X           |     | X       |
| Bristol                     |                  |             |    |            |           |    | X          |             | X   | X       |
| Brunel                      |                  |             |    |            |           |    | X          |             | X   | X       |
| Cambridge                   |                  |             |    |            |           |    |            | X           |     | X       |
| STFC – Daresbury Laboratory | X                |             |    |            | X         | X  |            |             |     |         |
| Durham IPPP                 |                  |             |    |            |           |    |            |             |     | X       |
| Edinburgh                   |                  |             |    |            |           |    | X          |             |     | X       |
| Glasgow                     |                  |             |    |            |           |    | X          |             |     | X       |
| Imperial College            |                  |             |    |            |           |    |            | X           | X   | X       |
| Lancaster                   |                  |             |    |            | X         | X  | X          |             |     | X       |
| Liverpool                   |                  |             | X  |            |           |    | X          |             |     | X       |
| Manchester                  | X                |             |    |            |           | X  | X          |             |     | X       |
| Open University             |                  |             |    |            |           |    | X          |             |     |         |
| Oxford                      | X                |             | X  |            |           | X  | X          |             | X   | X       |
| QMUL                        |                  |             |    |            |           |    | X          |             |     | X       |
| STFC – RAL                  |                  |             |    | X          |           |    | X          | X           | X   | X       |
| RHUL                        | X                |             |    |            |           |    |            |             | X   | X       |
| Sheffield                   |                  |             |    |            |           |    | X          |             |     | X       |
| Southampton                 |                  |             |    |            |           |    |            |             |     | X       |
| Sussex                      |                  |             |    |            |           |    |            | X           | X   | X       |
| UCL                         | X                |             |    |            |           |    |            | X           | X   | X       |
| Warwick                     |                  |             |    |            |           |    | X          |             |     | X       |

## Spanish Network on Future Colliders

Chairs: Marcel Vos (IFIC) & Alberto Ruiz (IFCA)

### Scope:

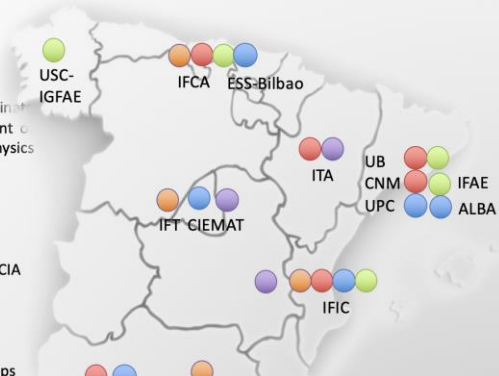
The main objective of this Thematic Network is to coordinate the Spanish activities on physics studies and development of new technologies in view of future colliders for Particle Physics (mostly ILC & CLIC)

**Includes:** Accelerator, Theory, Experimental and Technological groups

Close contact/synergy with industry through the INDUCIENCIA and INEUSTAR platforms

Active since 2005

Organizes 1-2 national meetings every year + mini-workshops (last meeting: <https://indico.ific.uv.es/event/5365/overview>)



| Activity      | # Groups |
|---------------|----------|
| Accelerator   | 5        |
| Si/Tracking   | 6        |
| Si/Pixel      | 5        |
| Calorimetry   | 3        |
| Phenomenology | 4        |



## Japanese-Spanish regular meetings for ILC planning and possible contributions

- Documentation of Scientific and Technology case of the ILC, as well as Industrial Opportunities
- On-going discussion on possible Spanish technological/industrial interests to the ILC accelerator.

**CIEMAT/IFIC:** exploring a possible contribution to the splittable, super-conducting magnets of the main LINAC

**ALBA-synchrotron:** interest in the design of parts of the ILC damping ring,

**ESS-Bilbao:** interest expressed in the beam dump system of the ILC

**INDUCIENCIA/INEUSTAR:** identifying companies with interest/capacity to contribute to the construction and matching with scientific and technological interest of the public institutes

**Network meetings being followed by:** Steinar Stapnes (CERN), Nobuhiro Terunuma (KEK), Akira Yamamoto (CERN/KEK), Hitoshi Yamamoto (Tohoku University /IFIC)

# Spain – consider deliverables from labs and industry, linking to industrial programmes



# CERN – KEK agreement for the ILC IDT



CERN will facilitate the European participation in the work during the transition to the Pre-Lab Phase; including working groups on Pre-Lab preparation, accelerator and facility, and physics and detectors.

CERN will coordinate the European contributions to the IDT's common fund, as well as the in-kind contributions to the tasks supported by the common fund during the preparation of the Pre-Lab Phase. The CERN office at KEK (set up under Appendix 10) will, as one of its tasks, provide administrative support to the European efforts related to transition to the Pre-Lab Phase.

The Parties will continue, or, as the case may be, undertake, collaborative work in studies related to:

- the accelerator's beam-delivery system and the Accelerator Test Facility 2 (ATF2) (as set out in the 2009 Agreement on Collaborative Work and Appendix 13);
- high gradient acceleration for linear colliders;
- high efficiency klystrons (as set out in Appendix 23);
- detector, physics and software (as set out in Appendix 8);
- cryogenics systems, beam-dumps, superconducting radiofrequency (SC RF) module components and technologies, civil engineering (all areas where CERN has provided technical advice as part of the LCC collaboration); and
- other areas of common interest (e.g.: positron production and beam-dynamics) and/or information exchange related to common challenges (e.g.: costing methodology and power reduction studies).

Any existing collaborative work referred to above will continue to be executed under its relevant Appendix.

## APPENDIX 24

to

**The Agreement on Collaborative Work (ICA-JP-0103)**

between

**THE HIGH-ENERGY ACCELERATOR RESEARCH  
ORGANIZATION (KEK)**

and

**THE EUROPEAN ORGANIZATION  
FOR NUCLEAR RESEARCH (CERN)**

concerning

**The work of the ILC International Development Team to facilitate  
the transition into the "Pre-Lab Phase"**

2020

| Topic  | CLIC – ILC<br>communality | Other                   | Status wrt ILC and KEK   |
|--|---------------------------|-------------------------|--|
| <b>CE and Cryo</b>   | CE common                 | LHC, all future project | WG2 reps from CERN   |
| <b>ATF2(3), BDS, beamdynamics, instrumentation and related beam-elements</b> | Common                    | Other nanobeam projects | Participate in ATF3 study – BDS optimization   |
| <b>Positrons</b>   | Common for e-driven       | All e+e- colliders      | WG2 rep. from CERN, target, AMD  |
| <b>Damping Rings</b>   | Common                    | All low emittance rings | Possible effort (performance studies, design and also kicker for CLIC relevant)  |
| <b>Hi-Eff klystron</b>   | Common (L-band)           | FCC, CEPC etc           | Designed (also ongoing SC solenoid work with KEK)  |
| <b>SCRF cavities</b>   | For ILC                   | SCRF generally          | Common manufacture studies, e.g. internal EB welding studies/hydro-forming, long term Nb3Sn studies, surface treatment, WG2 rep. from CERN |
| <b>Couplers</b>  | For ILC                   | SCRF generally          | Possible design effort, also common work in the past   |
| <b>Beam dump</b>   | Common                    | (HL)LHC/FCC/muons ..    | Advisory and common studies to be considered   |
| <b>Physics and Detectors</b>   | Common                    | Higgs factories         | Some common tools, not defined longer term   |
| <b>CERN – KEK office, agreements, WEB pages, LCWS</b>                        | Partly common             | NA                      | LC project office at CERN working with KEK communication and international office  |

# The ILC-IDT goals this year and next

## Establish

- A preliminary list of Pre-lab tasks and deliverables and national/regional laboratories which might be interested in contributing to those
- Pre-lab resource needs for the regional activities and central office (a few % of the ILC cost)
- A preliminary proposal for the Pre-lab organisation and governance by the end of this year.

⇒ Needed for the Pre-lab Japanese funding request preparation by KEK in 2021 to obtain funding in 2022: a similar requirements for the other countries expected.

- Finalise all the inputs needed to set-up the Pre-lab
- Attract more (new) people for the physics and detector activities by
  - During the next Linear Collider workshop (LCWS series, i.e. both CLIC and ILC) in Spring 2021 in Europe (will be remote), include a broad discussion/session on the ILC physics opportunities
  - Organising a dedicated workshop in Autumn 2021 to discuss ideas for experiments at the ILC, at the collision point and beyond covering a broad physics spectra, and associated R&D activities.

Thanks to my IDT colleagues - and their sources - for most of the slides/information  
For the Americas slides most of the information is from the Americas Workshop on Linear Colliders  
For European slides in particular: D.Napoly, B.List, P.Burrows, J.Fuster – and the European EJADE team  
(In most cases I have included links to the more detailed sources in the slides)

Thank you