



# CERN-KEK Collaborative Activities for Linear Colliders

Steinar Stapnes – with information/slides from many others at KEK and CERN

Today:

- Agreements and activities: ILC ITN, ATF (collaboration), CERN-KEK offices
- Also: Klystron (completed), and continued X-band common work, ILC IDT mostly/fully replaced by ILC ITN agreement
- Main new developments:
  - ILC future planning and CERN's role – agreement on ITN signed in July
  - EAJADE started March 2023 (exchange programme with Japan (and Americas) for Higgs factories - ATF, SuperKEKb, sustainability studies, SCRF, etc

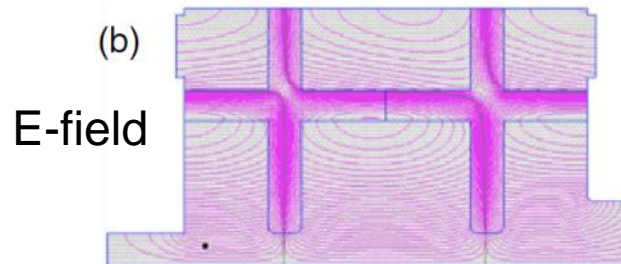
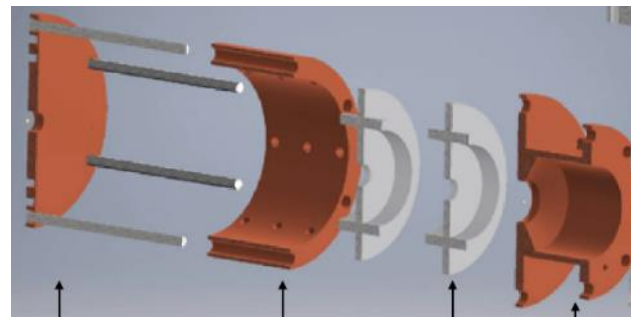
# The 1<sup>st</sup> high-gradient test after the fire performed for X-band Dielectric-Assist Accelerating (DAA) test cavity



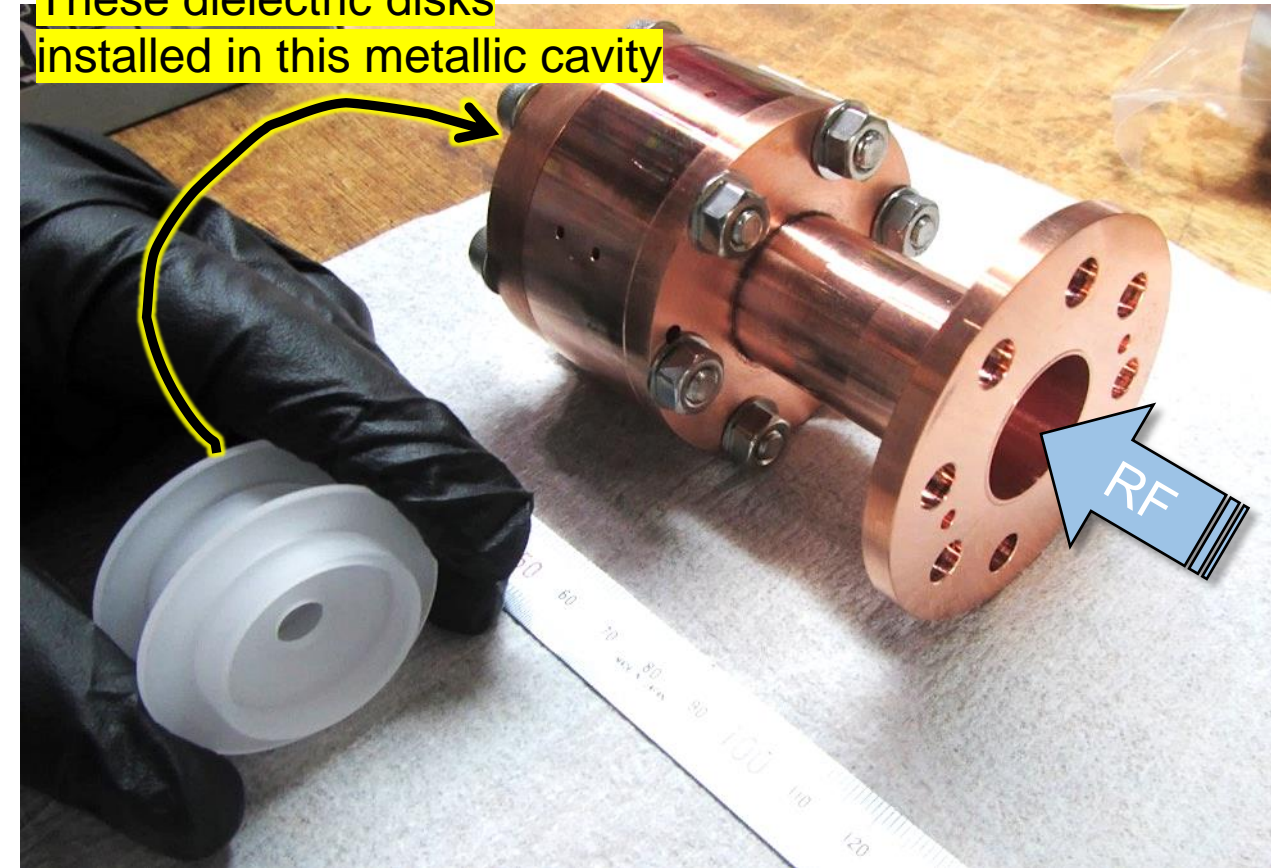
$$\sim 10 \times Q_0^{(conventional)}$$

Developed with C-band structures so far at KEK

**X-band (11.424 GHz)**



These dielectric disks installed in this metallic cavity



Figures excerpted from  
[Shingo Mori, Mitsuhiro Yoshida, and Daisuke Satoh,](#)  
"Multipactor suppression in dielectric-assist accelerating structures via diamondlike carbon coatings",  
[Phys. Rev. Accel. Beams 24, 022001 – Published 12 February 2021](#)





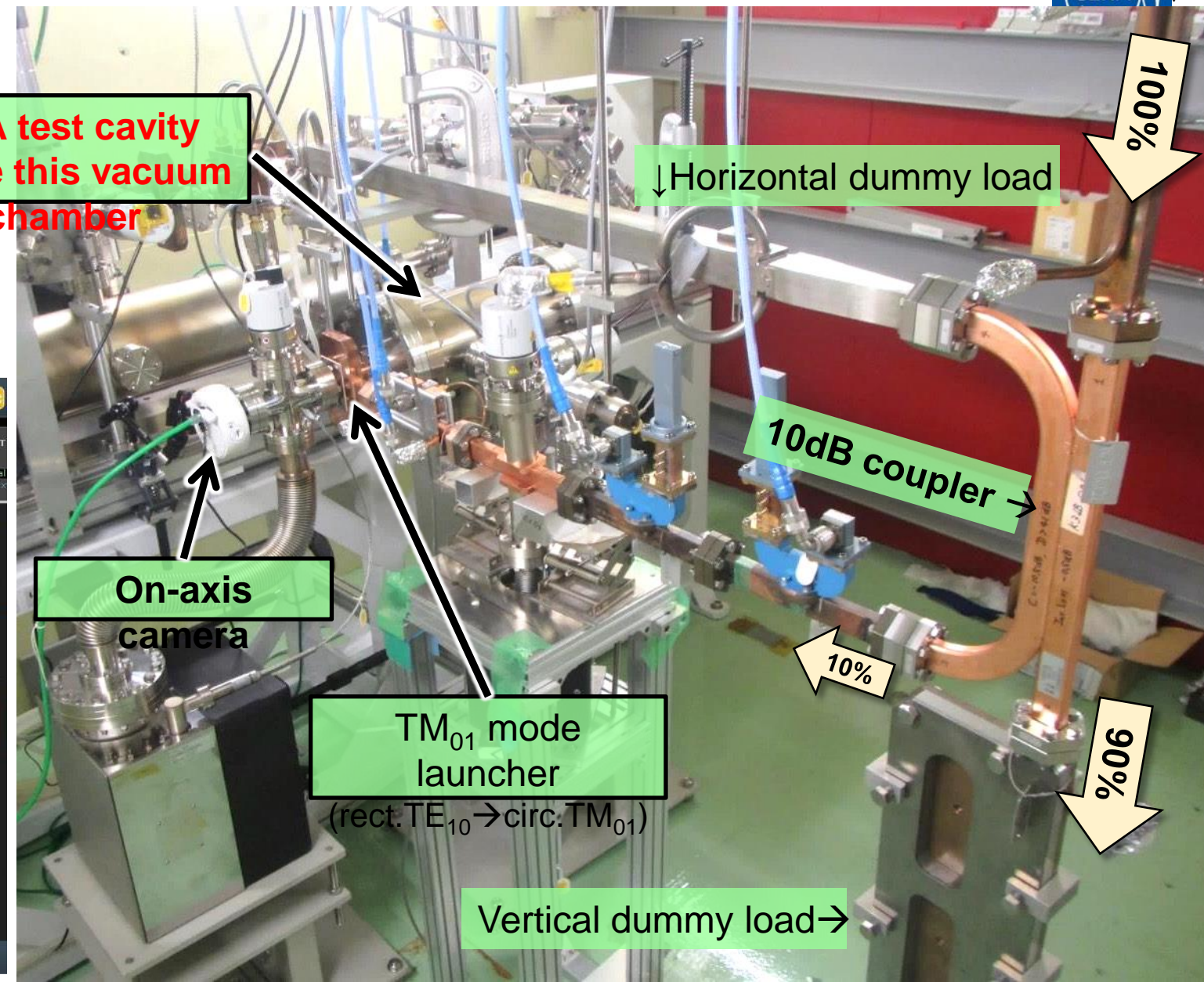
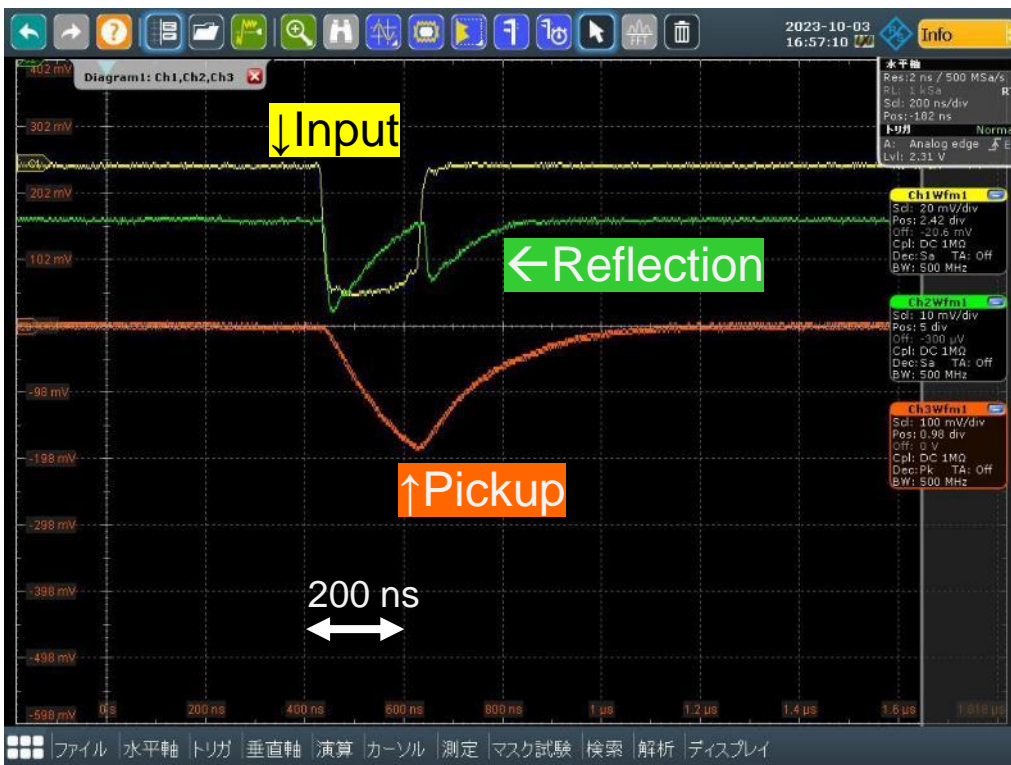
# Setup for the X-band DAA test cavity in Nextef2/Shield-B

With a reduced  $Q_0$  for high-field testing on the dielectric material

→ Fill time: ~200 ns

We collected experimental data on the high-field performance.

DAA test cavity inside this vacuum chamber



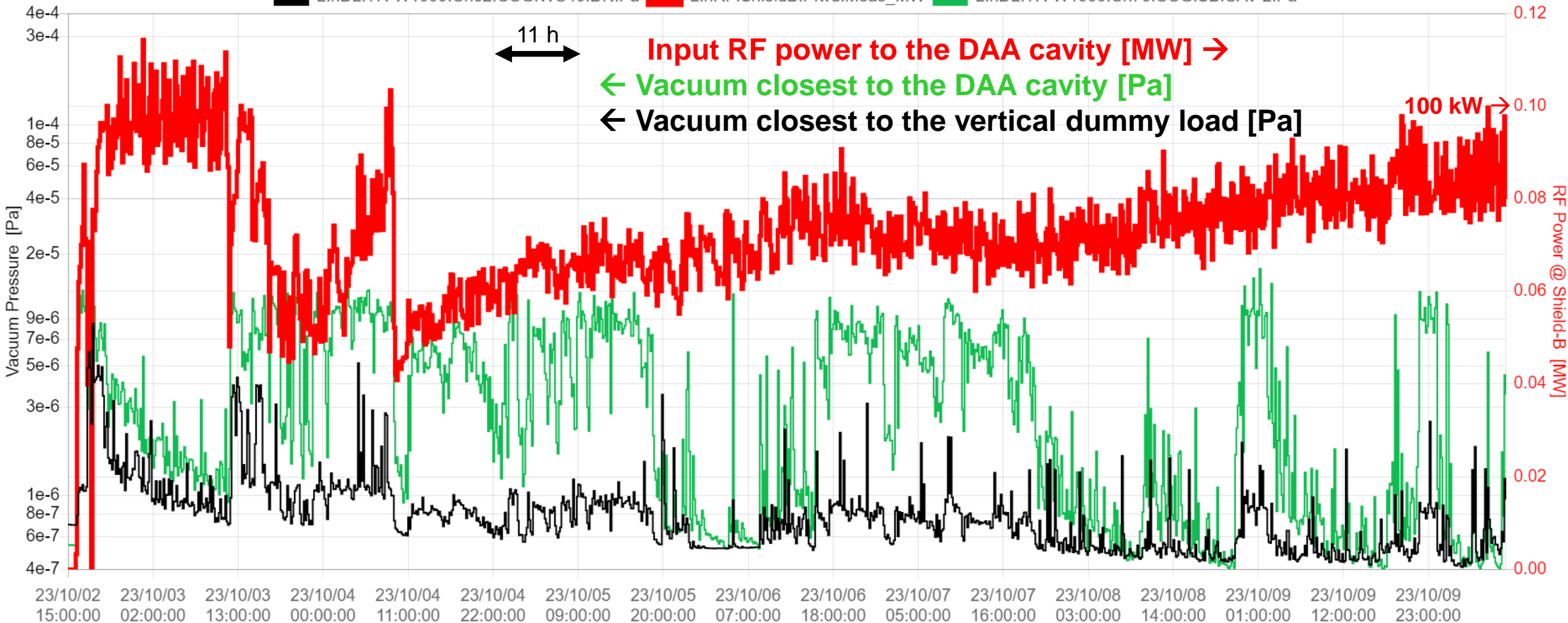
# One week history of the 24-hour conditioning

2023-10-02 15:00 to 2023-10-10 9:00

with no interruption



■ LInDL:TR-W1000:Ch62:CCG:WC40:DN:Pa ■ LInRF:ShieldB:Pfwd:Meas\_MW ■ LInDL:TR-W1000:Ch70:CCG:SB:CAV-2:Pa



100 ns → 150 ns → 200 ns  
(Pulse width)

- ✓ The RF power reached the goal of this test (~100 kW) with 200 ns pulse width.
- ✓ The performance of the dielectric material against the high fields to be evaluated later



# The ILC IDT organization – initiated at the ICFA meeting at SLAC February 2020



**2020-21:** The IDT – created by ICFA and hosted by KEK – was set up to move ILC towards construction. The worldwide structure of the WGs: <https://linearcollider.org/team/>

A set of key activities were identified in a Preparation Phase Programme.

**2022-23:** A subset of the technical activities of the full ILC preparation phase programme have been identified as critical (next slide). These are being addressed by a ~4 year programme called ITN – the ILC Technology Network. Moving forward with this work is being supported by the MEXT (ministry) providing crucial increased funding.

**As of today:** With funding from 1.4.2023 ITN is now starting. An agreement KEK and CERN and several European lab activities have been/are being set up. In the US the P5 process is ongoing, the hope is that ITN planning and interests can turn into important ITN involvements in due time.

# The ITN



Promoting the technological development of the International Linear Collider:  
Twenty-eight research institutes participated in the ITN Information Meeting



WPP	1	Cavity production
WPP	2	CM design
WPP	3	Crab cavity
WPP	4	E- source
WPP	6	Undulator target
WPP	7	Undulator focusing
WPP	8	E-driven target
WPP	9	E-driven focusing
WPP	10	E-driven capture
WPP	11	Target replacement
WPP	12	DR System design
WPP	14	DR Injection/extraction
WPP	15	Final focus
WPP	16	Final doublet
WPP	17	Main dump

## Building the ITN activities:

- Planning in the IDT WG2 – significant interests and expertise already represented
- Information meeting at CERN 16-17.10 jointly organized by KEK and the IDT
- Interest matrix for the ITN work-packages, being consolidated
- The next step: Further technical discussion to define deliverables, followed by agreement who among the laboratories will deliver what

<b>APPENDIX 26</b>
<b>KR5783/ATSAPPENDIX26-to-ICA-J</b>
<b>to</b>
<b>The Agreement on Collaborative Work (ICA-JP-0103)</b>
<b>between</b>
<b>THE HIGH-ENERGY ACCELERATOR RESEARCH ORGANIZATION (KEK)</b>
<b>and</b>
<b>THE EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH (CERN)</b>
<b>concerning</b>
<b>Support for the European International Linear Collider (ILC) Technology Network</b>
<b>2023</b>

# The European ITN activities – 2023



European ITN studies are distributed over five main activity areas:

## A1 with three SC RF related tasks

- SRF: Cavities and Cryo Module (INFN, CEA, DESY, IJCLAB)
- Crab-cavities (UK)
- Main Linac elements: ML quads and cold BPMs (CIEMAT, IFIC)

## A2 Sources

- Positron source, pulsed magnet (Uni.H, DESY, CERN)
- Wheel/target (the same and UK groups)

## A3 Damping Ring including kickers

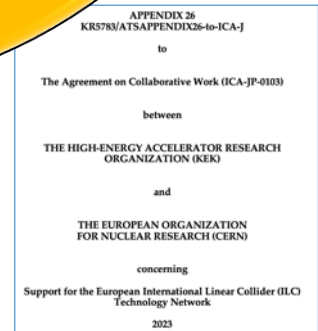
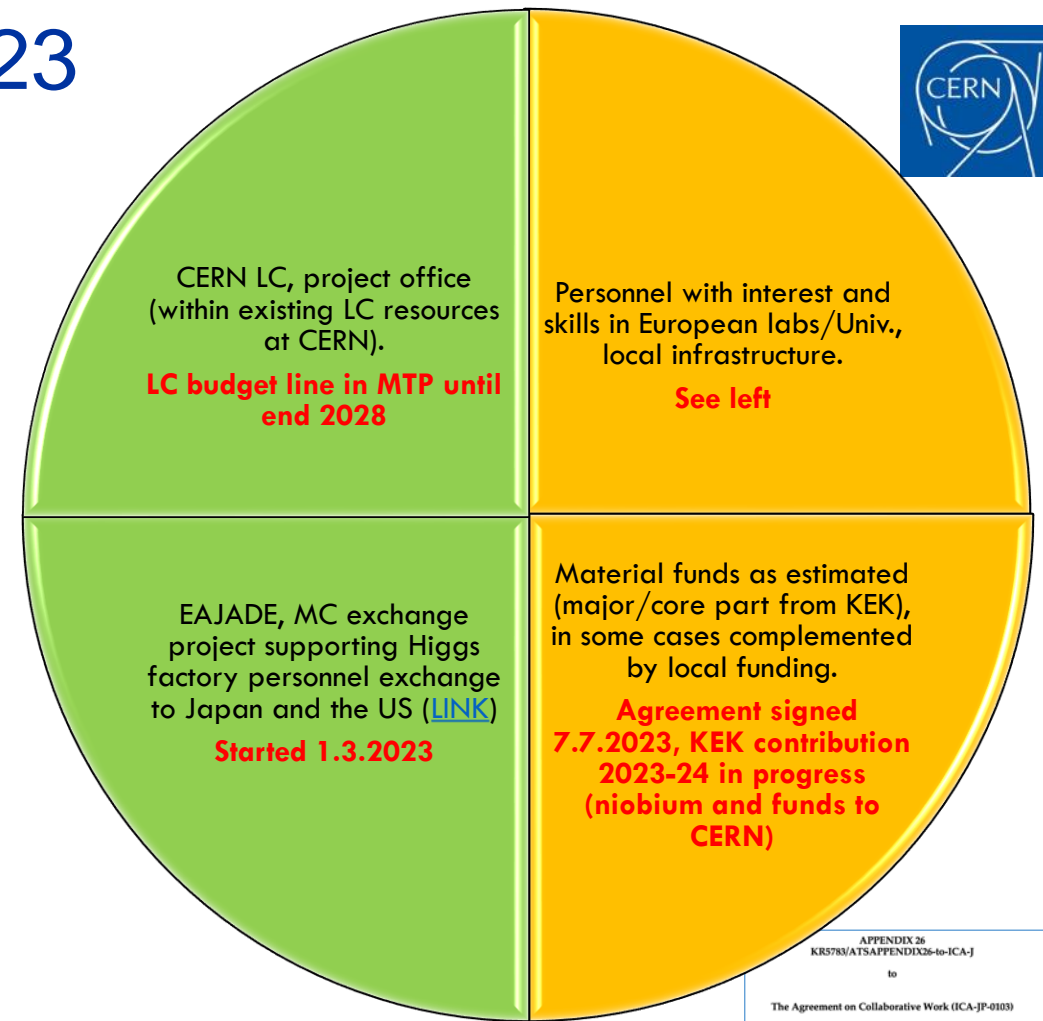
- Low Emittance Ring lab(s) (UK)

## A4 ATF activities for final focus and nanobeams

- On-going/restarted (UK, DESY, IJCLAB, CERN, IFIC)
- MDI (DESY, IJCLAB, Tel Aviv, UK groups)

## A5 Implementation including Project Coordination

- Dump, CE, Cryo – significant earlier efforts at CERN, follow up under discussion
- Sustainability, Life Cycle Assessment (CERN, DESY, CEA, UK groups)
- EAJADE started (EU funding) (DESY, UK, CEA, CNRS, IFIC, INFN, UHH, CERN)



Green: Being implemented

Yellow: Programme being defined with partners

Red: Programme in Europe less well defined

# EAJADE



**EAJADE (Europe–America–Japan Accelerator Development and Exchange programme) is a training, education and staff exchange network in the field of accelerator research for high-energy elementary particle physics (HEP).**

The key technical challenges for the future Higgs factories are many but the most important addressed in EAJADE are, all with important training, skill development and knowledge exchange elements:

- Luminosity performance, hardware and method developments related to this, being addressed in smaller beam facilities, prototypes and laboratory tests (addressed in work packages 1,2 and 3 covering method studies and hardware evaluations in beam tests, development and tests of radio-frequency (RF) systems and special devices that are critical for nanobeam creation, conservation and diagnostics).
- Upgrading to higher energies and accelerating gradients (addressed in work packages 2 and 5 covering RF developments and plasma acceleration studies).
- Power efficiency and sustainability, importantly connected to RF (addressed in work packages 2 and 4 covering RF efficiency improvements and power/energy reductions and recovery, and sustainable facilities in a wider perspective).
- Best practices, international collaboration, exchange of ideas and collaborative studies across Higgs factory proposals, training related to prototyping and tests in facilities and laboratory setup (all work packages).

For all the on-going R&D activities, and for the Higgs factory studies and potential later implementation, training of future accelerator experts will be crucial. These projects are very long term and today it is important to train the future scientists and engineers who will implement them. The training, networking and interdisciplinary focus of EAJADE create an ideal and very international career development environment for these future experts and leaders in the field. Providing such an environment is therefore the overarching goal of EAJADE.

**Specifically for CERN-Japan, can support many of the common activities we have talked about earlier, started March 2023**

**EAJADE** (Europe–America–Japan Accelerator Development and Exchange programme) focused in Higgs Factories, with participation of major EU (CERN, INFN, CEA, DESY, CNRS, CSIC, UOXF), Japan (KEK, Tokyo Univ., Tohoku Univ.) USA (BNL, FNAL, SLAC, JLAB, LBNL, Cornell Univ.) and Canada (VISPA) labs.





WSFA2023

Home

Scientific Program

workshop-photos

Participant List

Registration

Committee

Accomodation

The International Workshop on  
**Sustainability in Future  
Accelerators**  
September 25 - 27, 2023, Morioka, Japan

The banner features a green background with a globe, a recycling symbol, a sun, and a small plant growing from a globe. A search icon is visible in the top right corner.

WEB page: <https://wsfa2023.huhep.org>

# ATF3 in EAJADE project



**EAJADE** (Europe–America–Japan Accelerator Development and Exchange programme) focused in Higgs Factories, with participation of **major EU** (CERN, INFN, CEA, DESY, CNRS, CSIC, UOXF), **Japan** (KEK, Tokyo Univ., Tohoku Univ.) **USA** (BNL, FNAL, SLAC, JLAB, LBNL, Cornell Univ.) and **Canada** (VISPA) labs. **(2023-2027)**

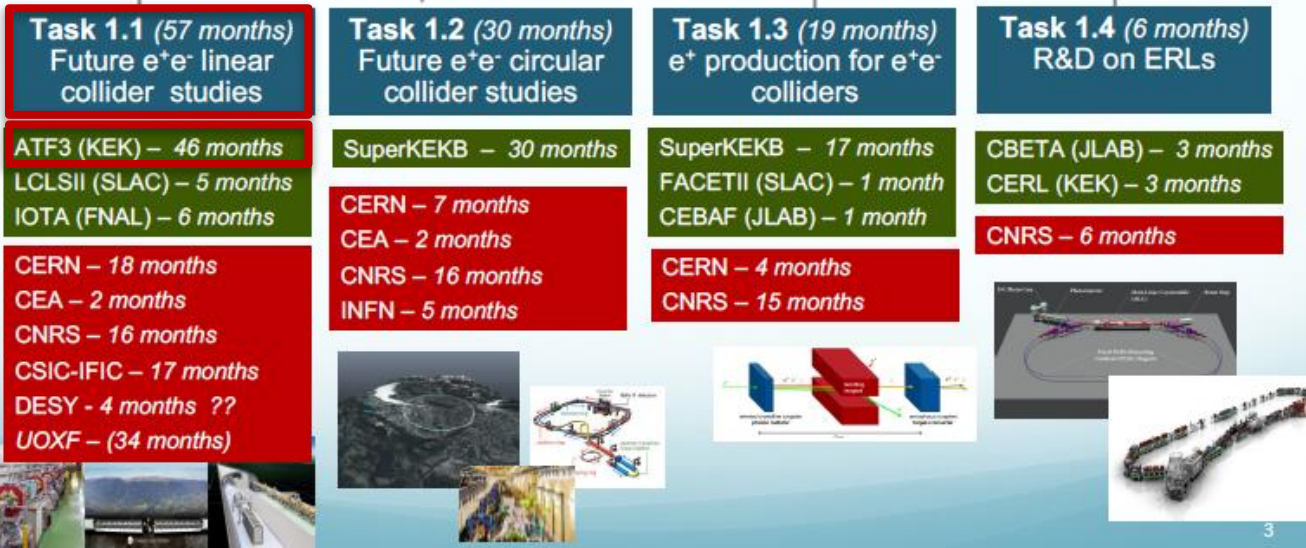
Table 1 – Work Package (WP) List

Work package no.	Work package title	Activity type	Number of person-months involved per secondment	Lead beneficiary	Start month	End month
1	R&D&I at currently operating state-of-the-art facilities	Research, training	143	CNRS	1	48
2	State-of-the-art high-gradient, high-efficiency, reduced-cost radio-frequency structures and power sources	Research, training	68	INFN	1	48
3	Special technologies, devices and systems performance	Research, training	74	CERN	1	48
4	Sustainable technologies for scientific facilities	Research, Training	12			
5	Investigation of potential early applications of novel and advanced technologies for colliders	Research, training	52			
6	Management, dissemination, training, knowledge transfer, and communication	Management, training, dissemination, communication	4			

ATF Beam Plan JFY2023



**WP1 (112 months):**  
**R&D&I at currently operating state-of-the-art accelerator facilities**



# Concluding words and next steps

- Interesting ongoing collaborative R&D with Japan and KEK with relevance for Linear Colliders (and Higgs factories in general), including ATF3 and EAJADE related exchanges of people.
- ILC ITN moving ahead, financial and material support from KEK in the pipeline, initial work and further work-definition in Europe on-going
- The existing and wider ITN activities are very well aligned with European accelerator R&D priorities (for Higgs-factories and the LDG roadmap), and builds on existing expertise, industrial capabilities and infrastructure – and a long history of technology developments for SC linacs and ILC in Europe, as well as common work between ILC and CLIC

Slides/plots and pictures from many colleagues in CLIC and ILC – many thanks