

**E-JADE is a Marie Skłodowska-Curie Research and Innovation Staff Exchange (RISE) action, funded by the EU under Horizon2020**



**E-JADE Mid-Term Review**

# **WP3 Linear Collider Targeted R&D**

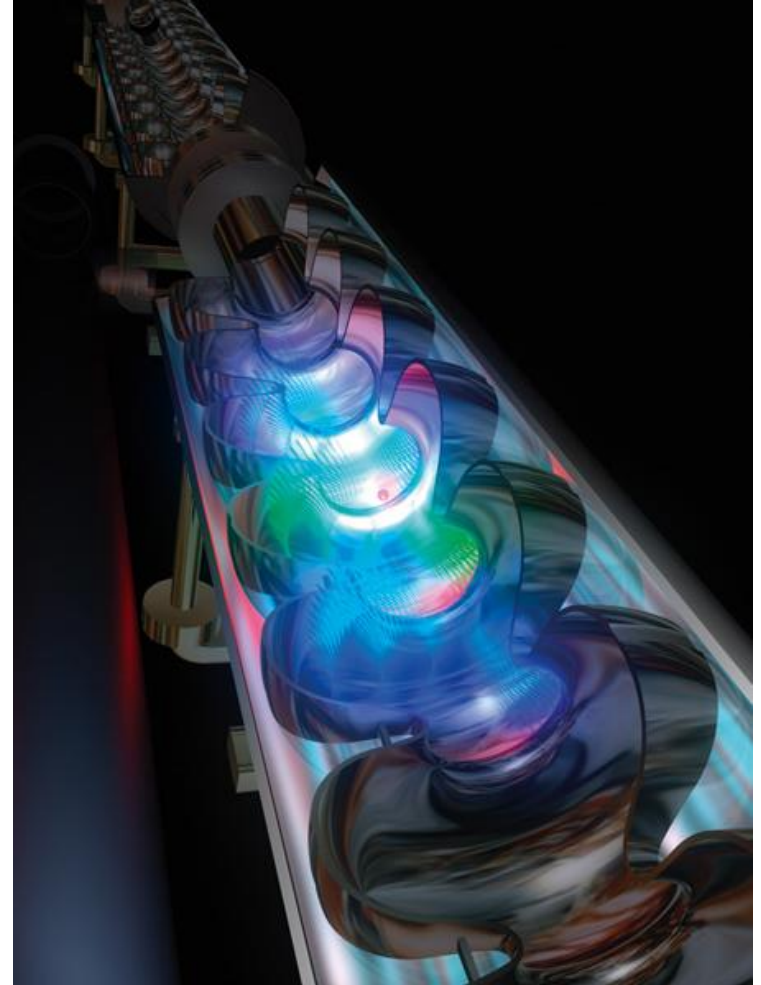
**Marcel Stanitzki (DESY)**



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# WP3: Linear Collider Targeted R&D

- Global Community Consensus future on  $e^+e^-$ 
  - Strong scientific case for an electron-positron collider to complement the LHC
  - Study Higgs & Top with high precision
- Going for Linear
  - To reach energies way beyond LEP-II (209 GeV), using a linear collider is currently the only feasible way
- Two Basic Approaches
  - ILC is using superconducting cavities (SRF)
  - CLIC is using normal-conducting copper cavities



# WP3: Linear Collider Targeted R&D (II)

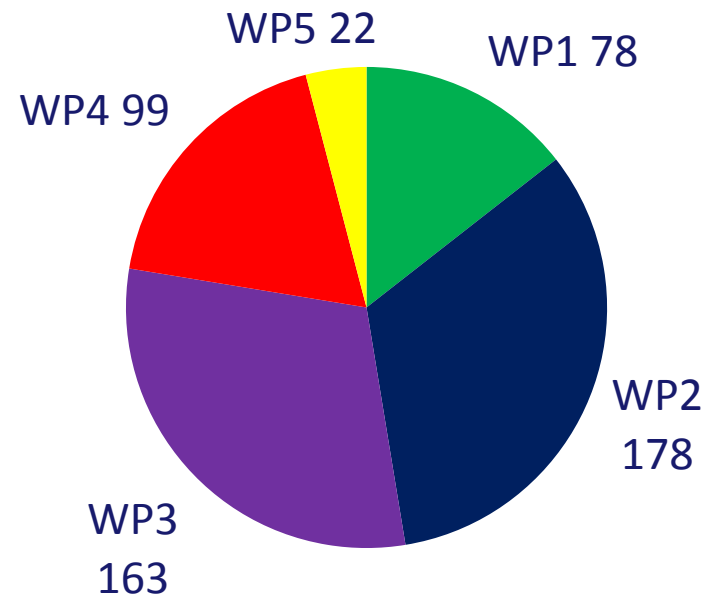
- Strongly driven by European Strategy for particle physics
  - *There is a **strong scientific case** for an **electron–positron collider**, complementary to the LHC, that can study the properties of the Higgs boson and other particles with unprecedented precision and whose energy can be upgraded. The Technical Design Report of the International Linear Collider (ILC) has been completed, with large European participation. The initiative from the Japanese particle physics community to **host the ILC in Japan** is most welcome, and **European groups are eager** to participate. Europe looks forward to a proposal from Japan to discuss a possible participation.*
- This is echoed by similar documents from Asia and the US
- As a response, E–JADE WP3 brings together key players from Europe and Japan to prepare
  - The goal is the realization of the ILC in Japan as an international project with a strong and leading European participation
  - E–JADE is considered as a nucleus of a large European commitment



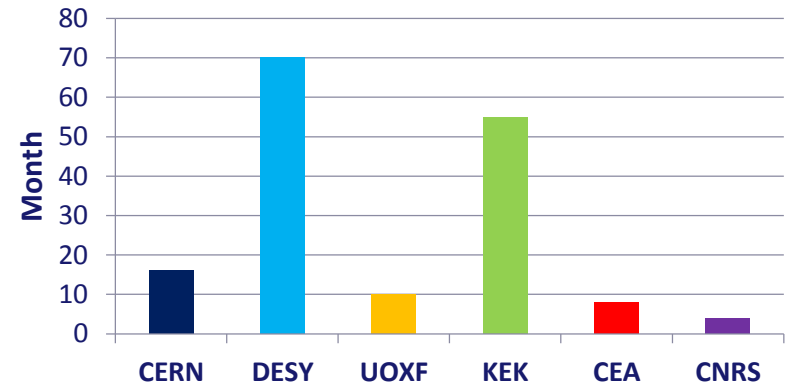
# WP3 Structure

- WP3
  - Four tasks (see next slide)
  - Second-largest WP : 163 secondment month planned
  - Lead Institution DESY
  - WP Leader Marcel Stanitzki (DESY)
- European groups in WP3
  - CEA, CERN, CNRS, DESY, Oxford
- Japanese groups
  - KEK as major player (see talk by K. Tokushuku)
- Well-defined scope
  - “Preparations for the ILC in Japan”

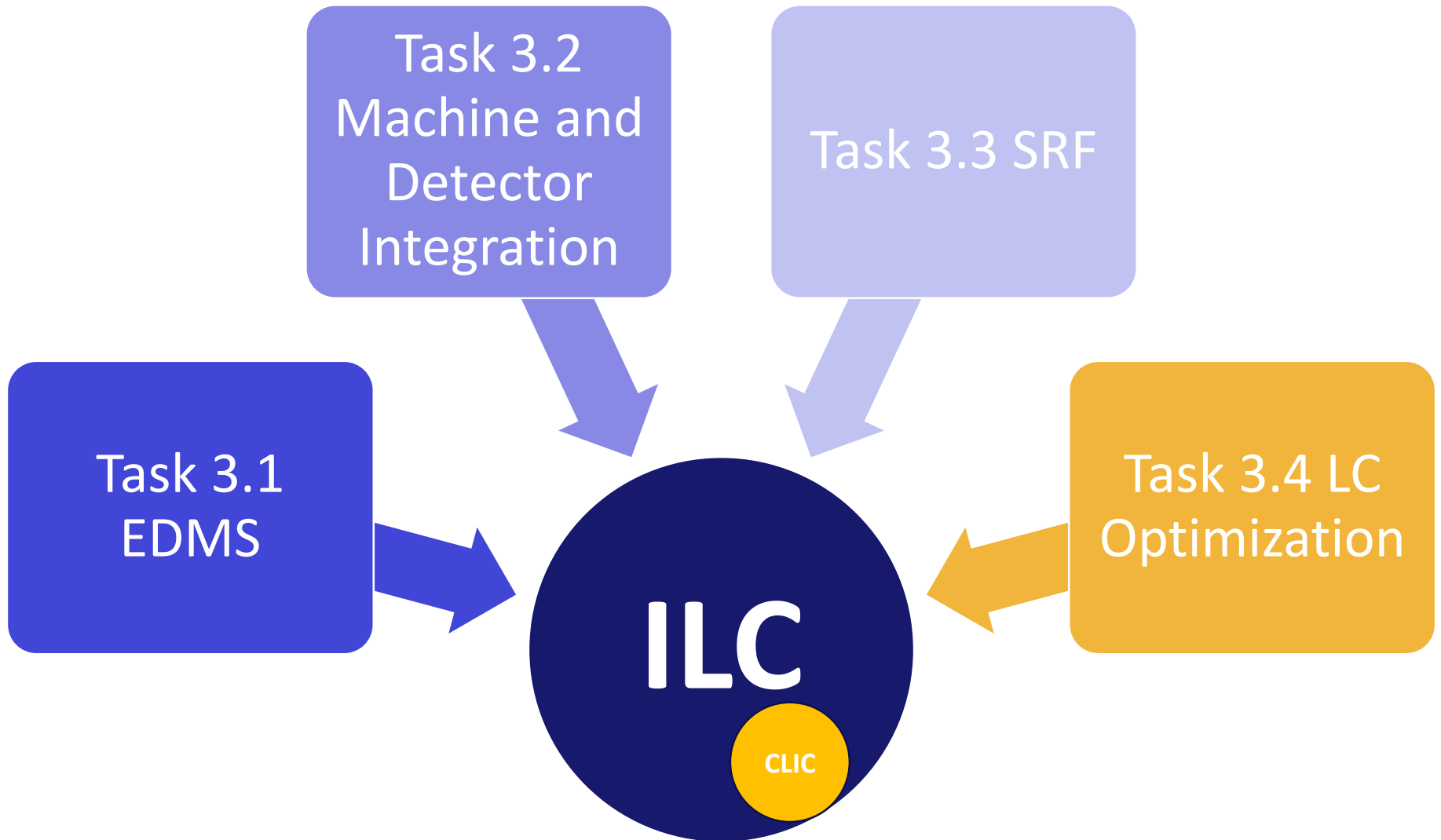
Number of secondments per WP



WP3 Planned Secondments



# WP3 Tasks



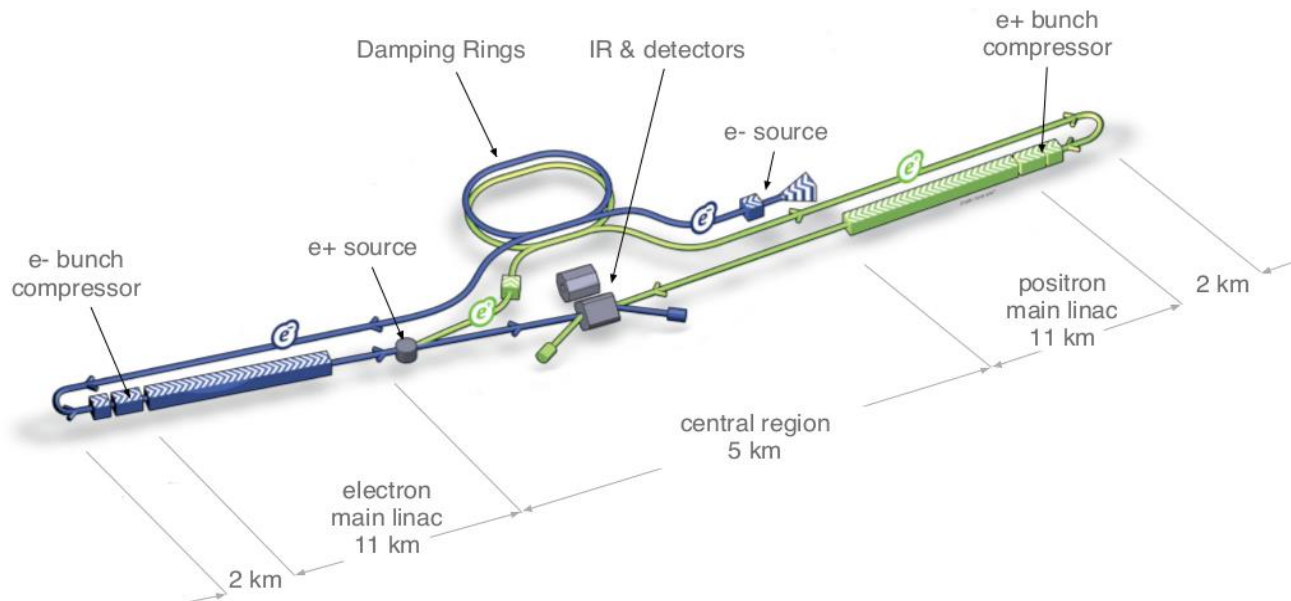


# WP3 Deliverables

- *Month 6 EDMSReqUser*: List of user requirements from the key stakeholders in the EDMS system
- *Month 18 ILCRep*: ILC readiness report including: preparation of high-gradient cavity production, a plan for the international approach to engineering documentation, and a detector deployment study.
- *Month 38 LCOPT*: Performance optimisation of Linear Collider operation including accelerating gradient of copper structures and yield of polarised positrons.
- *Month 48 SRFSharing*: Documentation of international sharing of the SRF production
- *Month 48 EDMSDoc*: Documentation of the international engineering of the ILC building on *EDMSReqUser*.
- *Month 48 MDIPlan*: Site-specific ILC Detector installation plan

# The International Linear Collider (ILC)

- The ILC
  - 500 GeV (baseline) GeV  $e^+e^-$  with Beam Polarization
  - Clear Upgrade Path to 1 TeV
  - 7400 superconducting Cavities in 850 Cryo Modules with a Gradient 31.5 MV/m
  - 163 MW power consumption
- Interaction Region with two detectors and push-pull
  - SiD & ILD



# ILC Status in Japan

- The Japanese HEP community has proposed to host the ILC in Japan in 2012
- Strong support by global strategies for HEP 2012–2014
  - Europe, US, ASIA
- ILC Global Design Effort delivers a TDR in 2012
  - Includes a “generic site”, no site–specific studies have been done
  - Solid Cost estimate
- Japanese Community proposes a site in summer 2013
  - Kitakami mountains, Iwate Prefecture
- E–JADE effort is very welcome in Japan
  - European Experts will help to transform the “generic site design” to a real site–specific design in Japan



# The ILC TDR 2012



- ILC TDR
  - Five volumes covering
    - Physics
    - Accelerator
    - Detectors
  - Culmination of 8 years of effort
- Very favorable review
- Wide community support
- Global Handover Event
  - Tokyo, Geneva, Chicago

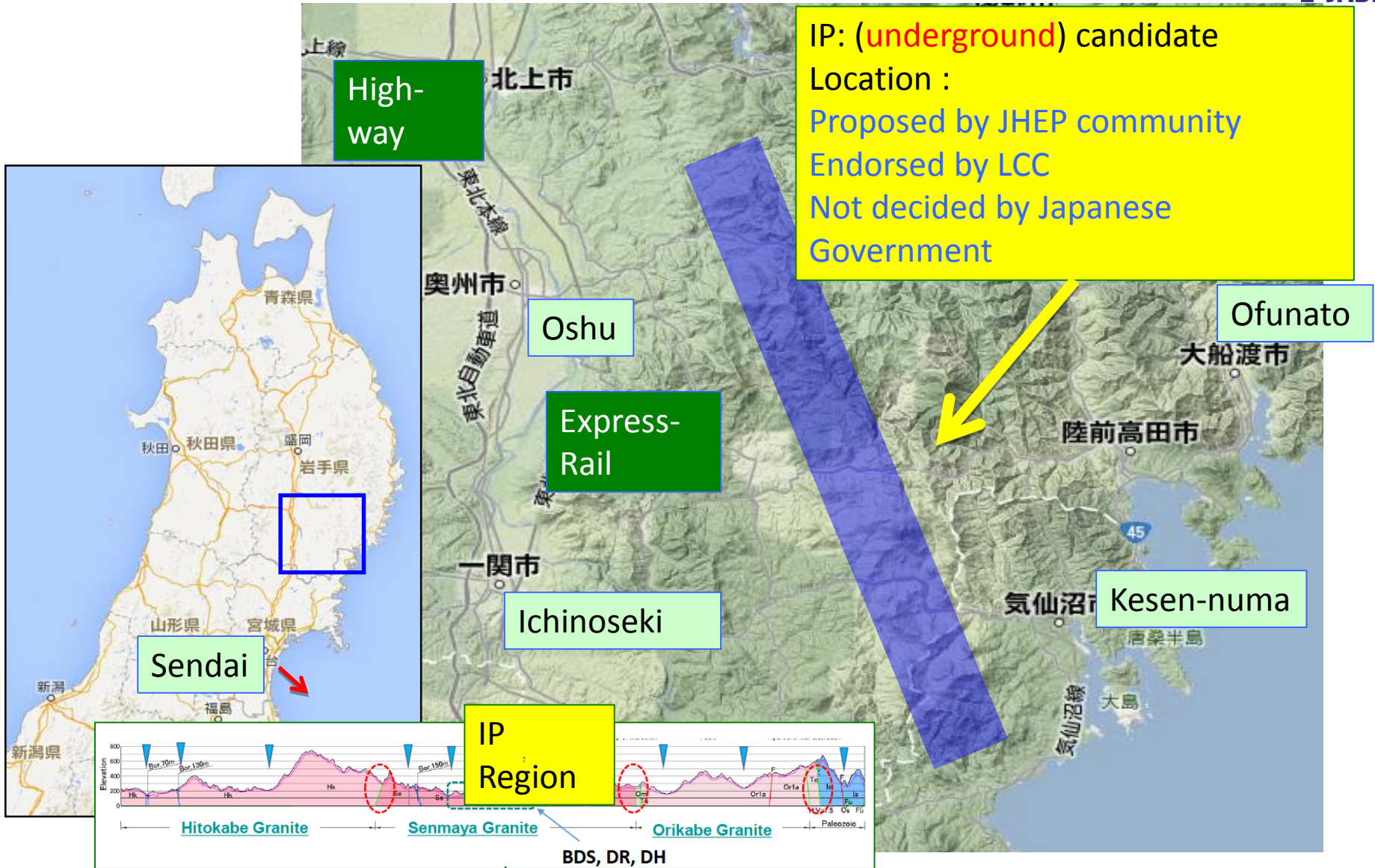
## ILC PAC concluding Statements:

*“As compared to other projects of similar scale (ITER, LHC, ATLAS, CMS, ALMA, XFEL, FAIR, ESS, SSC) the quality of the documentation presented by the GDE team is equal or superior to that utilized to launch into a similar process.”*

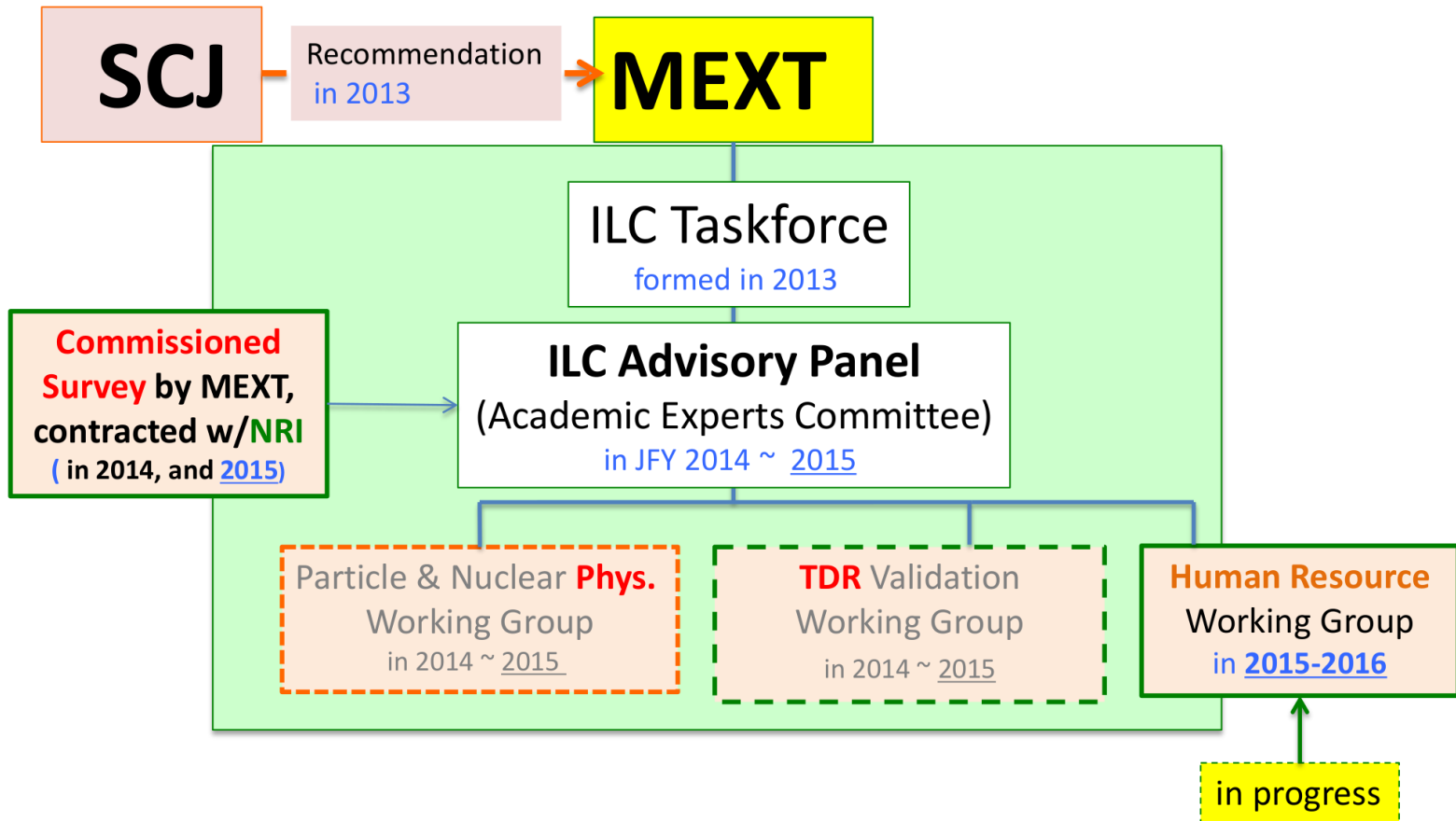
The ILC is good to go!



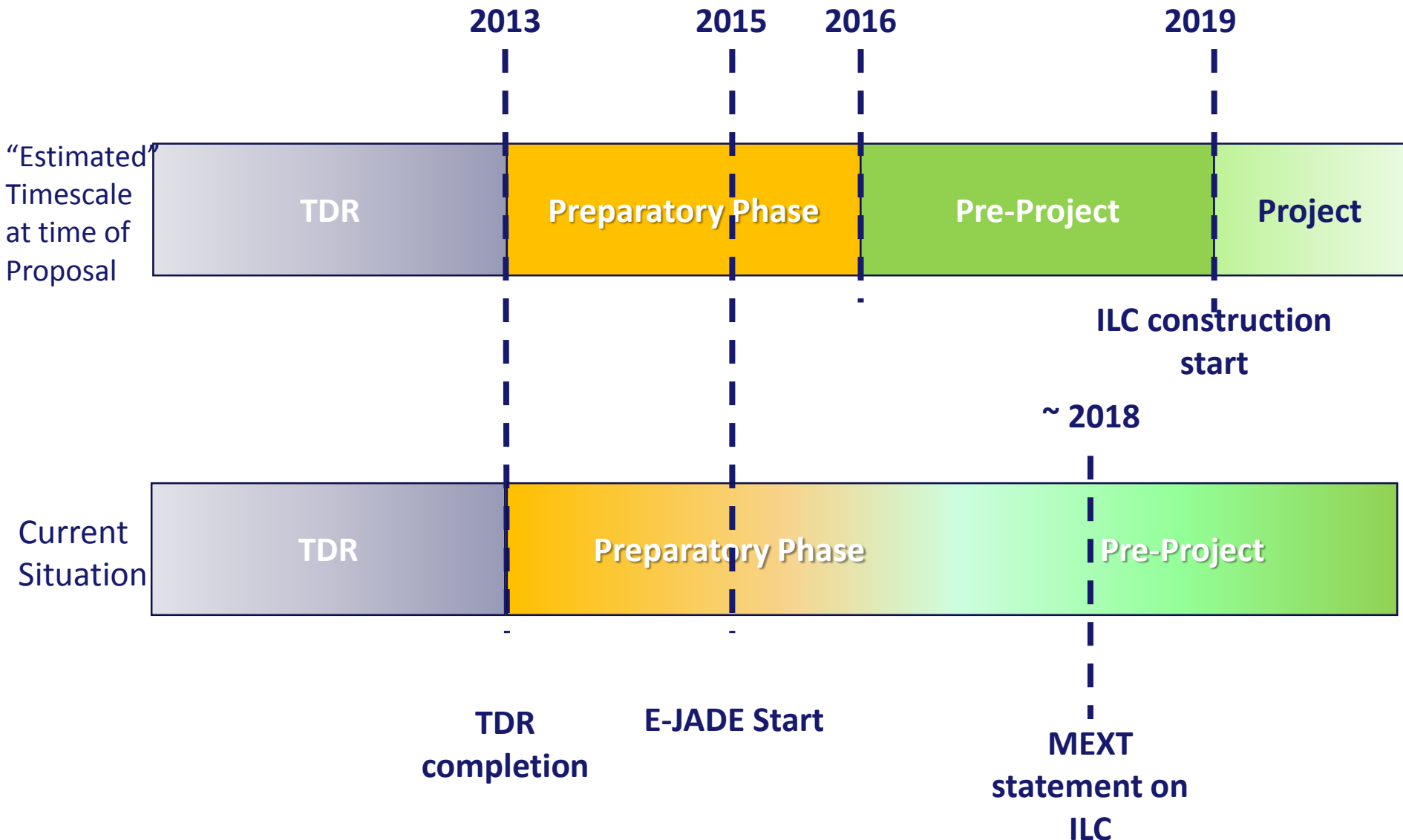
# ILC Site – Kitakami Mountains



# MEXT Review – Currently ongoing



# ILC Status and Impact on E-JADE



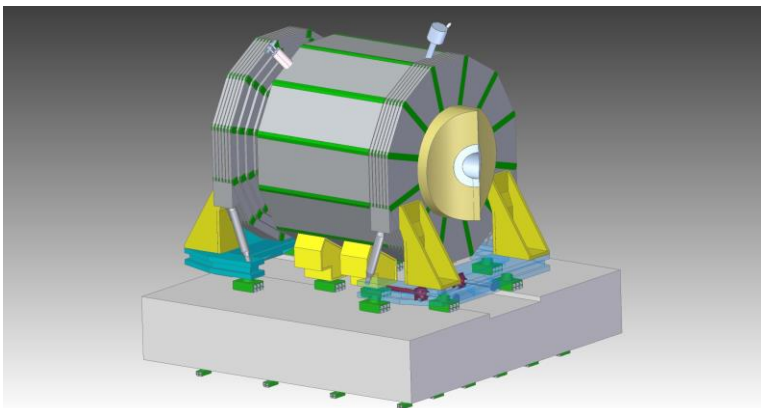
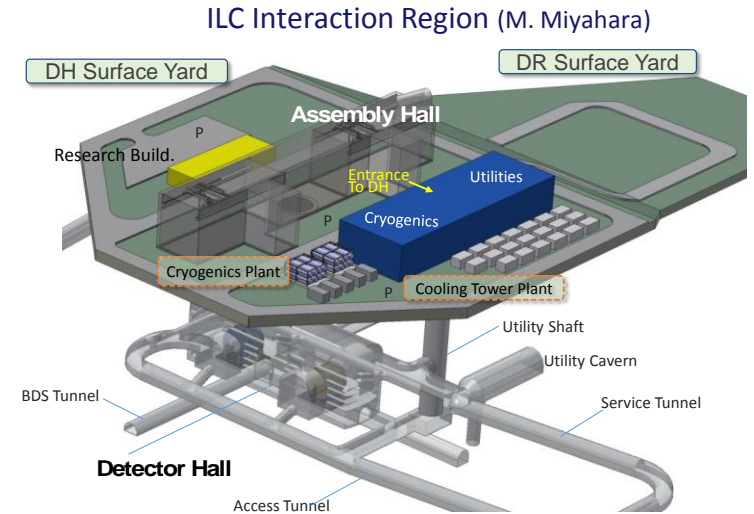
# Task 3.1 EDMS

- The ILC schedule has significantly shifted
  - ~2018 for a statement from MEXT
- Impact on this task
  - Absence of a defined project and an organizational structure with defined stakeholders
  - Difficult to define requirements and needs
  - Funding difficulties of individual groups starts to have an impact
- Delay on Deliverables
  - Both *EDMSReqUser* and *EDMSDoc* will be delayed
- However
  - The group of experts is having meetings and preliminary discussions
  - Learning from other projects, that just have finished
  - Plan to draft a “List of Requirements”, which can be presented to the stakeholders after the project start

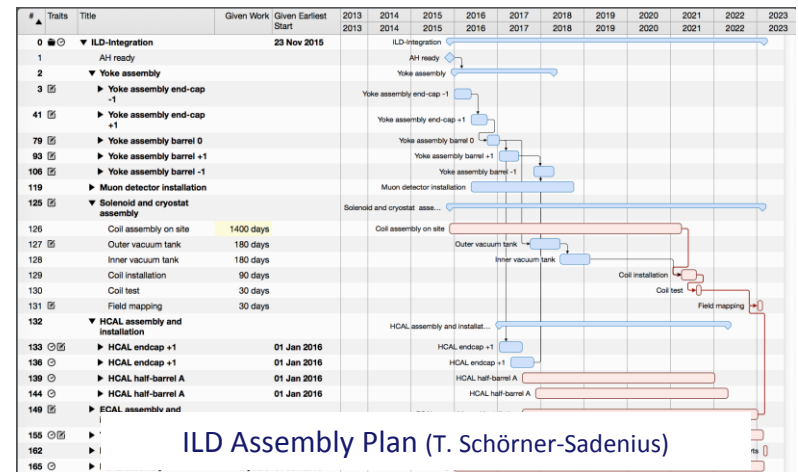


# Task 3.2 Machine and Detector Integration

- Deliverable: Detector assembly plans for ILC in Kitakami
- First versions under discussion
- Understand dependencies of site specific boundary conditions and detector/physics requirements
- Towards engineering design of detectors and IR region



SiD Engineering Model (M. Oriunno)



# Task 3.2 : E-JADE as Facilitating Instrument

- Series of workshops in Japan to bring together global detector and CFS community with local experts
- So far 10 experts from Europe in secondments to Tokyo/KEK
  - Shorter term stays: workshops, expert discussions
  - Long-term secondments (up to 2 months a year)
- Excursions to Kitakami region for discussions with local experts



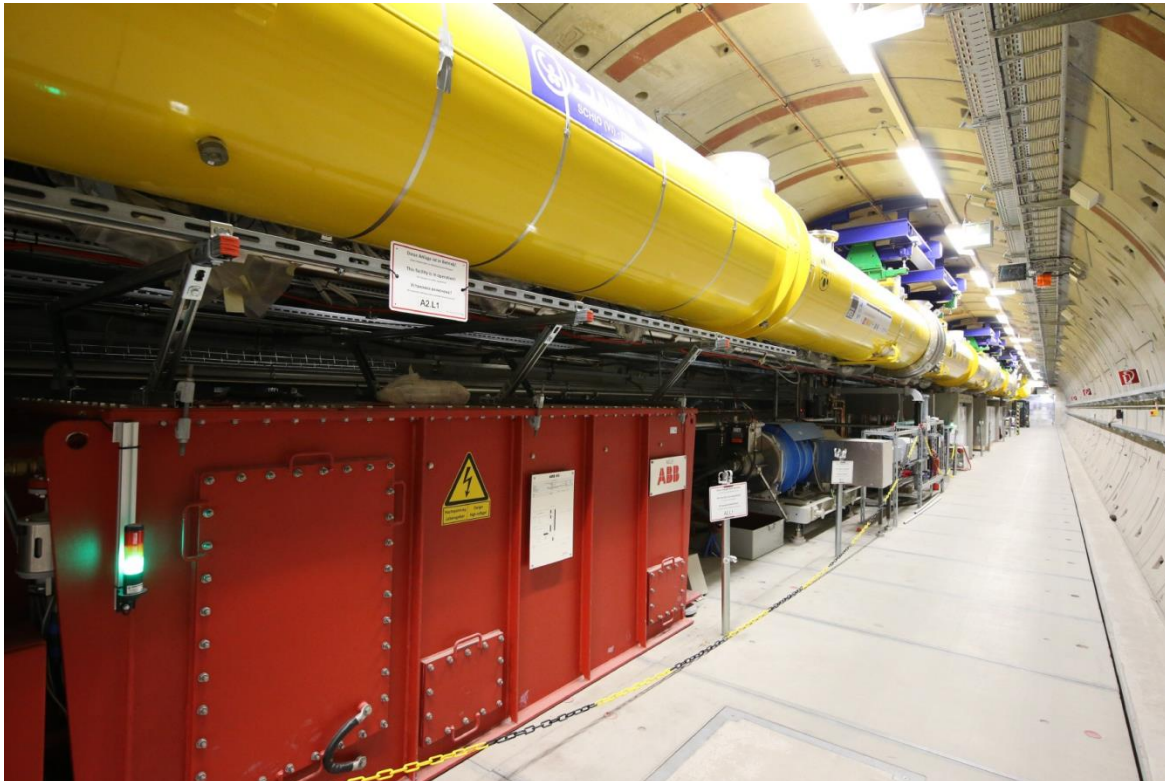
Expert Discussion in IP Area (Photo: K. Buesser)



Port of Kesenuma (Photo: K. Sinram)

# Task 3.3 SRF

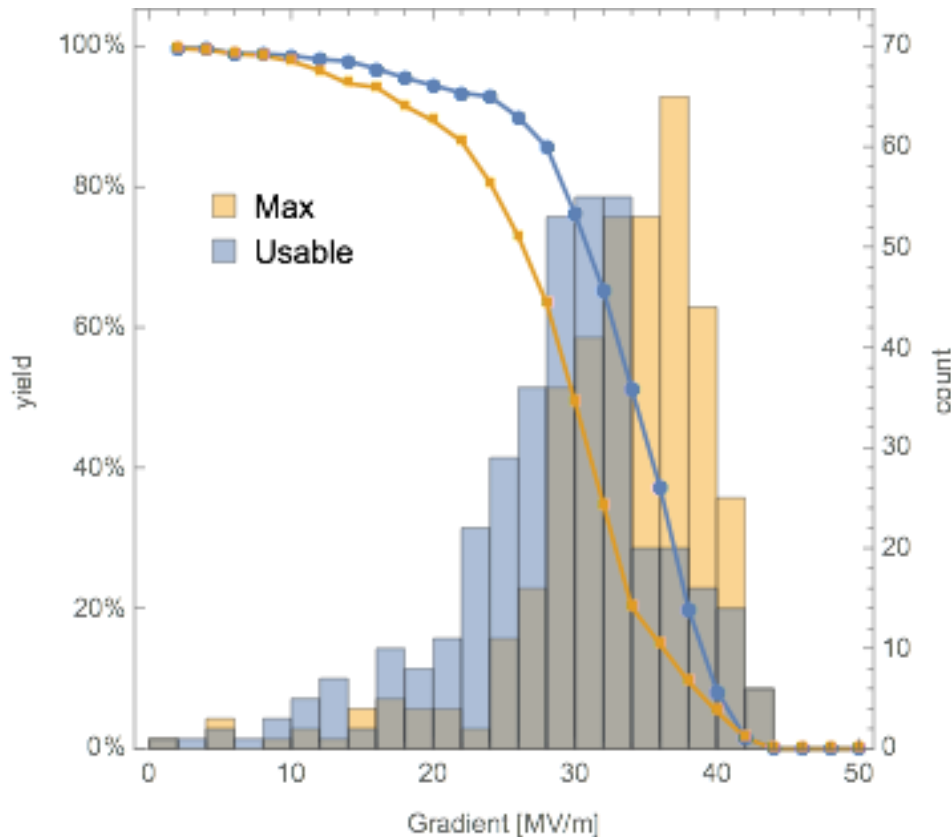
- The European XFEL
  - SRF based free-electron Laser currently being completed at DESY
  - 1/10 prototype of the ILC – XFEL is based on the same technology
  - First test of industrialization of cavity production



- E-JADE Activities
  - Analyze XFEL production data
  - Lessons learned from industrialization process
  - Documentation
- Sharing of expertise between XFEL and ILC SRF teams



# Task 3.3 :XFEL cavity performance RI GmbH using “flash EP”



The XFEL cavity production from RI GmbH (one of two vendors) exactly followed the production “recipe” foreseen for the ILC.

	Max	Usable
Number of tests	377	377
$\langle G \rangle$ (MV/m)	33.	29.
$G_{RMS}$ (MV/m)	6.6	7.4
Yield @ 28 MV/m	86%	63%
Yield @ 35 MV/m	44%	18%

**Max:** predominantly quench limit

**Usable:** limit including field emission and  $Q_0$  spec.

# Task 3.3 Extrapolation to the ILC

- ILC TDR assumed VT acceptance > 28MV/m (XFEL >20 MV/m)
  - Average of 35 MV/m (XFEL 26 MV/m)
  - Assumed first-pass yield: 75%
  - 25% cavities retreated to give final yield of 90% >28 MV/m (35 MV/m average)
    - 10% over-production assumed in value estimate

RI results only (ILC recipe)		ILC TDR (assumed)	XFEL	
			max	usable
First-pass	Yield >28 MV/m	75%	85%	63%
	Average >28 MV/m	35 MV/m	35.2 MV/m	33.5 MV/m
First+Second pass	Yield >28 MV/m	90%	94%	82%
	Average >28 MV/m	35 MV/m	35.0 MV/m ✓	33.4 MV/m ✗
First+Second+third pass	Yield >28 MV/m	-		91%
	Average >28 MV/m	-		33.4 MV/m

*but close!*

More re-treatments - but mostly only HPR

Number of average tests/cavity increases from 1.25 to 1.55 (1st+2nd) or 20% over-production or additional re-treat/test cycles



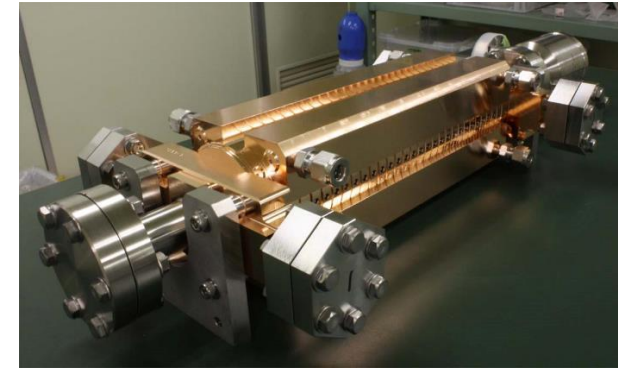
# Task 3.4 LC Optimization

- Positron polarization is required
  - Key improvement for precision and flexibility of physics measurements at LC
- Long-term EU-US-Japan collaboration to develop an intense  $e^+$  source
  - Joint ILC/CLIC positron source working group)
- ILC  $e^+$  source design
  - helical undulator to produce polarized  $e^+$
- Upcoming activities
  - Close collaboration with KEK
  - Optimizing current designs
  - Site-specific implementation

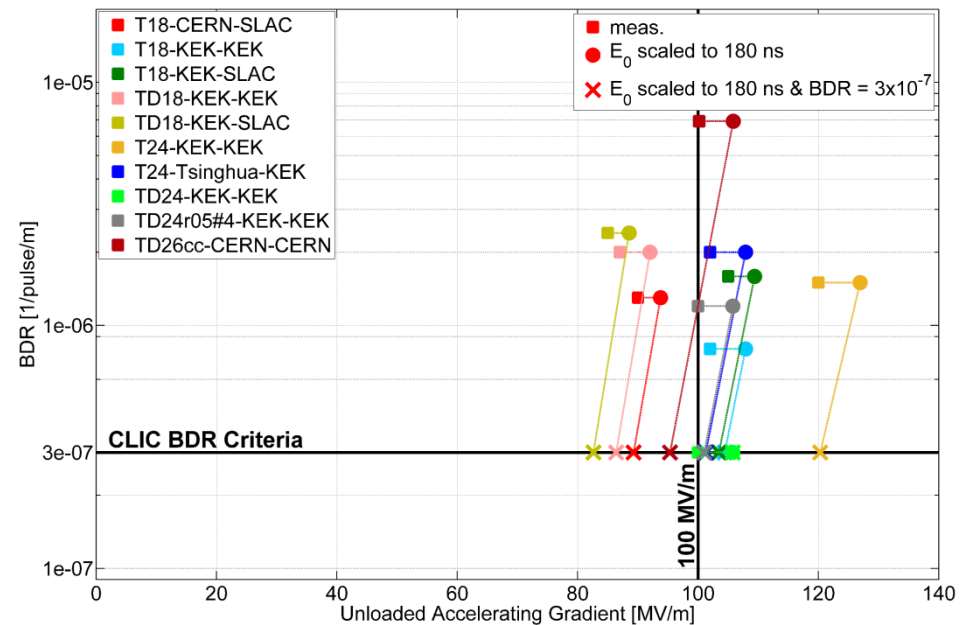
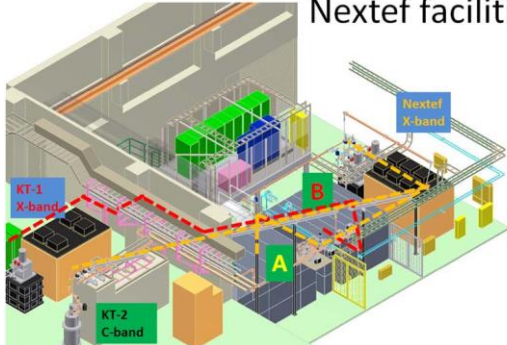


# Task 3.4 LC Optimization

- Optimization of CLIC structures using key facility at KEK
- Parameters: gradient versus breakdown rate; requires conditioning with high power RF system
- KEK tests structures produced with SLAC, and from Tsinghua and SINAP
- The importance of the facility can be seen looking at all the measurements done at KEK

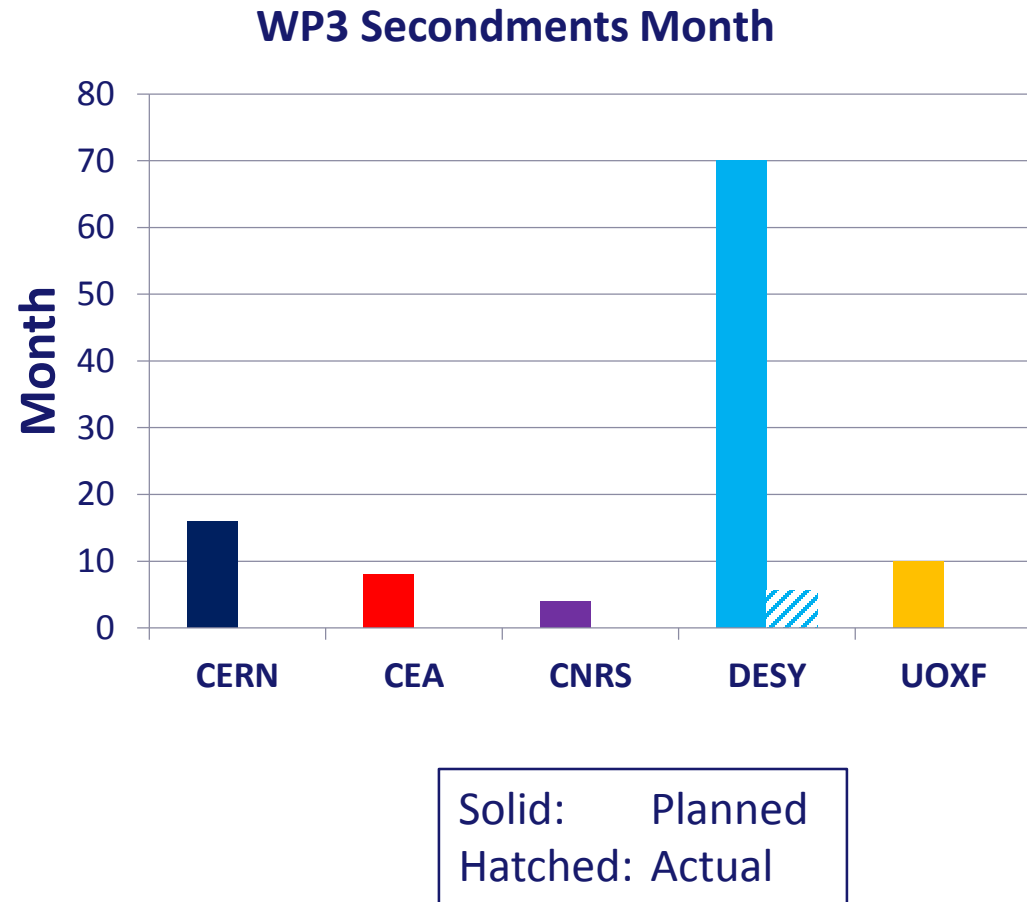


Nextef facilities



# Actual Status of Secondments

- Planned
  - 108 month
  - 55 from KEK
- Actual
  - 5.67 month used
  - 5 % of the planned secondments
- Impact of ILC schedule shift clearly visible
- Experience Researchers
  - Currently 18 E-JADE travelers
  - Most of them have no complete month yet



# WP3 Challenges and Solutions

- Shift of the ILC schedule
  - Significant slow-down of ILC activities
  - Funding problems for many groups
  - Less students
- WP leader was E. Elsen (DESY)
  - Left DESY for CERN in Jan 2016
  - Transition phase started in fall
- Difficulties for ER to spend long periods away from home institutions
- Beyond scope of E-JADE
  - Biggest impact
- WP leadership handed over to M. Stanitzki (DESY)
  - Finalized in Jan 2016
- Talking with E-JADE institutions to make this easier



# ILC Action Plan for Europe

- KEK has published an ILC Action Plan
  - Prepare KEK activities both in the pre-project phase and also after approval
- Initiative to produce a similar document for a future European participation
  - This will be done in close collaboration between KEK and Europe
  - Produce an initial “ILC Action Plan for Europe” within a year
  - Trigger technical activities
- E-JADE plays a key role
  - Action Plan Team can build on the established E-JADE links
  - Technical activities and initiatives
    - SRF (E-JADE WP3.3)
    - Nano-Beams (E-JADE WP2)
    - Beam Dumps/Civil Engineering (WP3.2, 3.4)
- E-JADE ideal and timely framework to produce such a document

# Conclusions

- WP3 is strongly affected by the ILC schedule shift
  - Only 5% of month used
- Significant progress in WP3 despite these problems
  - EDMS Discussions
  - MDI/CFS very active with dedicated meetings in Japan
  - SRF is doing a big “lessons learned” from the European XFEL
  - Steinar/Sabine-Input
- We expect a ramp-up of secondments in the coming years
- The KEK initiative to produce an “ILC action plan for Europe” building on E-JADE is very welcome and will get our fullest support