International Development Team

Activities in IDT WG2 (Accelerator Design)

Benno List, DESY

European ILC Community Meeting

4.11.2020

IDT-WG2 organization

Bi-weekly *Tuesday* meeting: Sep.22, Oct. 6, 20,...

IDT WG2
Shin Michizono (Chair)
Benno List (Deputy)

https://agenda.linearcollider.org/category/256/

SRF — *Bi-weekly Tuesday Oct.13,27,...*

Yasuchika Yamamoto	***KEK***
Nuria Catalan	CERN
Dimitri Delikaris	CERN
Rongli Geng	JLAB
Hitoshi Hayano	KEK
Bob Laxdal	Triumf
Matthias Liepe	Cornell
Peter McIntosh	STFC
Olivier Napoly	CEA
Sam Posen	FNAL
Robert Rimmer	JLAB
Marc C. Ross	SLAC
Akira Yamamoto	KEK

Hans Weise DESY

DR/BDS/Dump — *Bi-weekly Tuesday Oct.13,27,...*

Toshiyuki Okugi	***KEK***
Karsten Buesser	DESY
Philip Burrows	U. Oxford
Angeles Faus-Golfe	LAL
Jenny List	DESY
Thomas Markiewicz	SLAC
Brett Parker	BNL
David L. Rubin	Cornell
Nikolay Solyak	FANL
Luis Garcia Tabares	CIEMAT
Nobuhiro Terunuma	KEK
Glen White	SLAC
Kaoru Yokoya	KEK

Sources — *Bi-weekly Monday Oct.12,26,..*

Kaoru Yokoya	***KEK***
Jim Clarke	STFC
Steffen Doebert	CERN
Joe Grames	JLAB
Hitoshi Hayano	KEK
Masao Kuriki	U. Hiroshima
Benno List	DESY
Gudrid Moortgat-Pick	U. Hamburg

Civil engineering

Nobuhiro Terunuma	***KEK***
John Andrew Osborne	CERN
Tomoyuki Sanuki	U. Tohoku

Charges of Sub-groups

- Discuss and coordinate the topics for
  - technical preparation (remaining topics) at Pre-lab
  - preparation for mass production at Pre-lab
  - possible schedule at Pre-lab
  - international sharing candidates of these activities
- Report to the IDT-WG2

All members belong to some sub-group(s).

Note: Summer to Winter time transition will be specially considered at next sub-group meeting.

1pm (->2pm) UTC (6am US Pacific, 8am US Central, 2pm U.K., 3pm Geneva, 10pm (->11pm) Japan)

Accelerator activities at ILC Pre-lab phase

Technical preparations /performance & cost R&D [shared across regions]

- SRF performance R&D, quality testing of a large number of cavities (~100), fabrication and shipping of cryomodules from North America and Europe (for validating shipping)
- 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

Technical preparation

Final technical design and documentation [central project office in Japan and possibly regional project 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, CE, safety and infrastructure (see below for details)
- Review office
- Resource follow up and planning (including human resources)

Engineering Design Report (EDR)

Preparation and planning of deliverables [distributed across regions, liaising with the central project office and/or its satellites]

- 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 (including Hub.Lab)
- Financial follow up, planning and strategies for these activities

Planning and preparation of Hub lab.

Civil engineering, local infrastructure and site [host country assisted by selected partners]

- 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

Civil engineering

Assumed Pre-lab timeline

For Engineering design

1st year: Work on TDR-based cost-estimate confirmation, started by an international team centered on the Pre-lab.

2nd year: Complete the cost-estimate confirmation, and an internal review in the latter half of the 2nd year.
The review also reports on the progress of technical issues during the preparation period.

3rd year: Conduct an external review and completed scrutiny of costs and risks.
Complete the draft of Engineering Design Report (EDR).

4th year: Publish EDR (in first half yr), report progress on technical issues,and prepare each large bid.

For technical preparation (example of SCRF and positron)

1st year: Extend SCRF cost reduction R&D, Start a pre-series SCRF cavities production preparing for industrialization
Continue positron survey

2nd year: Complete SCRF cost-reduction R&D, and extend the work to assemble the cavities with cryomodule (CM),
Select positron scheme

3rd year: Demonstrate "Global CM transfer, aiming at HPG legal-process, shipment, and SRF QA test after transport
Mature Lab. planning and preparation
Prototyping of critical items (such as positron target)

4th year: Evaluate CM performance based on CM shipment, and prepare for Hub Lab. functioning
Progress prototyping of critical items (such as positron target)

Goals of Sub-WGs

- Develop R&D plan for budget request to MEXT
- Timeline:
  - Feb 2021: Submit plan
  - Aug 2021: Budget decision
  - Apr 2022: Start of Japanese FY
    -> Pre-lab funding available

Main discussion items based on
"Recommendations on ILC Project Implementation"

AWLC2020

SRF

◆Cavity and cryomodule production
- ◆100 cavities produced in preparation for mass production
  - ◆~1% of full production
  - ◆Japan: 50 cavities, other regions/countries: 50 cavities
- ◆By new cost-effective production method
- ◆Plug-compatibility re-confirmed/re-established
- ◆To be checked RF performance/success yield
- ◆High pressure gas regulation in Japan (cavity/cryomodule production)
- ◆Coupler/tuner improved/produced/assembled/tested
- ◆Cryomodule production/test

◆ Cryomodule transport ("Global Cryomodule transfer")
- ◆Shipment/transport incl. inspection
- ◆RF performance rechecked after transport

3/Nov/2020 Report of 3rd meeting of IDT WG2 SRF subgroup 5

Sources

e-Driven scheme

Subcomponent	Study Item (WP)	IDT period	Preparation period (4 years)				Tunnel construction period
			Effort	Human resource	cost (MJPY)	possible partners	
Electron driver		none	Engineering design				
Target	Target stress calcuation	FEM calculation	FEM calculation				
	Vacuum seal	confirm the longterm seal performance, prototype	none				
	Target module	Conceptual design	Engineering design, Prototyping, Operation				
Capture device (FC)	Flux concentator conductor	cooling design including the radiation	Engineering design	Omori	2		
	Power source	Conceptual Design	Engineering design	KEKB	2		
	Transmissin line	Conceptual Design	Engineering design	KEKB	1		
	system prototyping	none	Prototyping and operation	KEKB, Omori	100	J-lab	
Capture linac	L-band APS cavity	Engineering design	Prototyping	Kuriki, Hayano	20		
	Transient Beamloading and its compensation	Construct the model	none	Kuriki	0	CERN, J-Lab	
	Power unit prototype	Engineering design	Prototyping	Omori	100		
	fast position monitor (separate e+ and e-)	rely on KEKB	Prototyping	Hayano	4		
Booster linac	L-band TW accelerator	Conceptual design	Engineering design	KEKB	1	J-lab	
	S-band TW accelerator	Conceptual design	Engineering design	KEKB	1	J-lab	
Shield	CFS	Conceptual design	Engineering design	Hayano, Kuriki, Omori	2		
	Maintenance system	Conceptual Design, Estimate Radiation environment	Engineering design	Miyamoto, Sanami, Kuriki	2		

BDS/Dump/DR

	Grade	Items	Technical Preparation	human resources [FTE]	budget [kUS$]	candiate collaboration	Presenter	Date
Damping Ring	A	Fast kicker	Long-term stability test					
	A	Fast Ion Instability	Feedback : system design					2020/10/27
	A		Feedback : damping time test					2020/10/27
	B		Evaluation by simulation					2020/10/27
	B	Electron Cloud	Evaluation by simulation					2020/10/27
	B (?)	Parmanent Magnet	System design					
	B (?)	Injection kicker for e-driven P-source	System design					
		RF system	Prototype test	N/A	N/A	N/A	N/A	
		Wiggler Magnet	Prototype test	N/A	N/A	N/A	N/A	
BDS, MDI	A	ATF3	Long-term stability test			ATF (ATF3) collaboration	Angeles Faus-Golfe	
	B	Final doublet (incl. Anti-solenoid)	System design (include the anti-solenoid)				Brett Parker	
	B		Vibration test				Brett Parker	
	B (?)	Crab cavity	System design				Yasuchika Yamamoto	
		Anti-solenoid	System design and vibration test	considered within FD package			Karsten Buesser	2020/10/27
		Anti-DID	System design	considered as detector matter			Karsten Buesser	2020/10/27
Beam Dump	A	17MW main dump	System design of water flow system				Nobuhiro Terunuma	2020/10/13
	A		System design of window sealing and remote exchange				Nobuhiro Terunuma	2020/10/13
	A		System design of countermeasure for failure				Nobuhiro Terunuma	2020/10/13
	A/B (?)		Robustness test of window				Nobuhiro Terunuma	2020/10/13
	B	300kW photon dump	System design				Nobuhiro Terunuma	2020/10/13

Rank	
A	Technical preparation, which is recommended by KEK ILC international WG
B	Technical preparation, which is necessary to write EDR

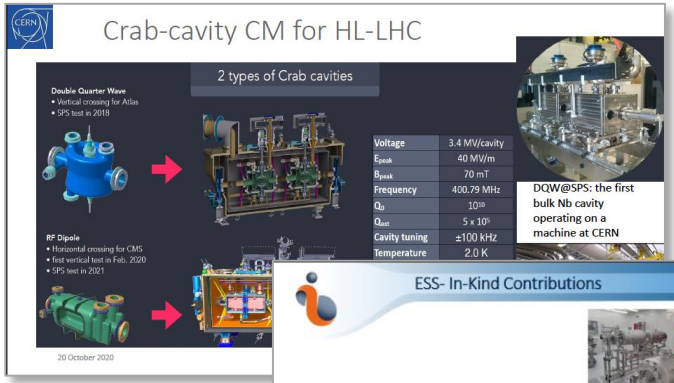
Europe Regional Report:
SRF technology developments relevant to the ILC

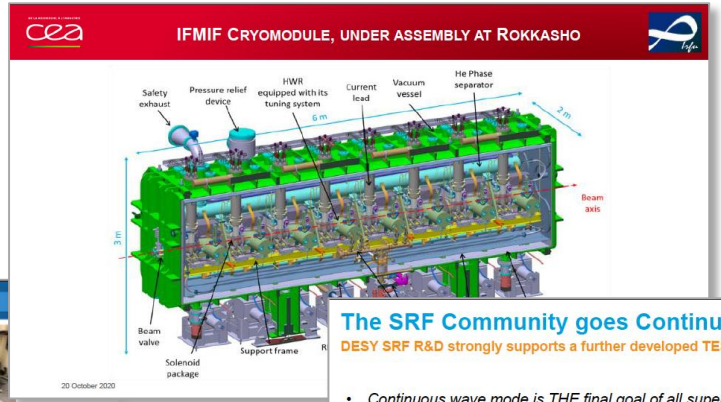
Olivier Napoly

CEA

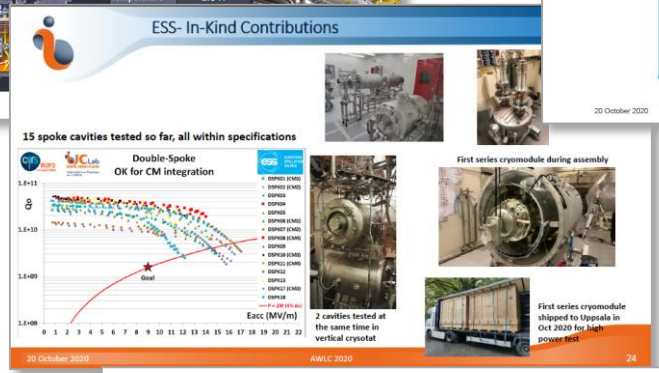
Olivier Napoly's excellent overview at AWLC 2020:
https://agenda.linearcollider.org/event/8622/contributions/46392/
Please have a look

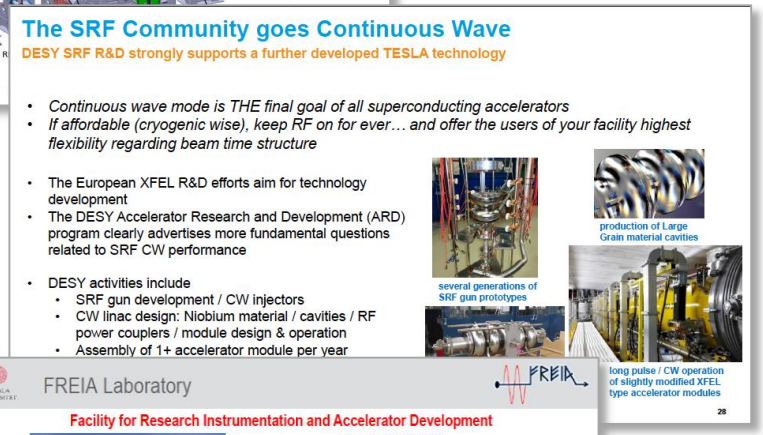
European has strong broad a SRF technology base





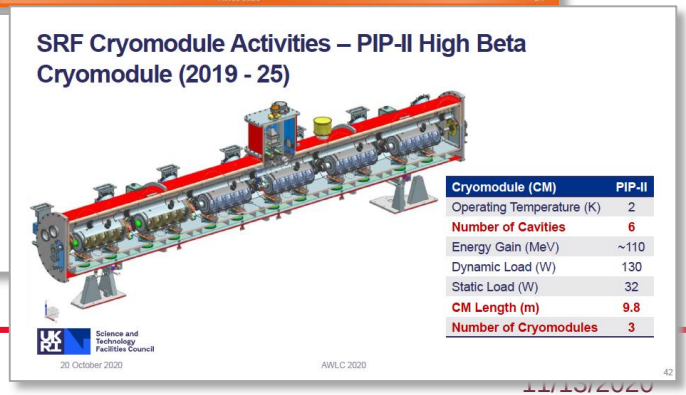
Please refer to full talk for details

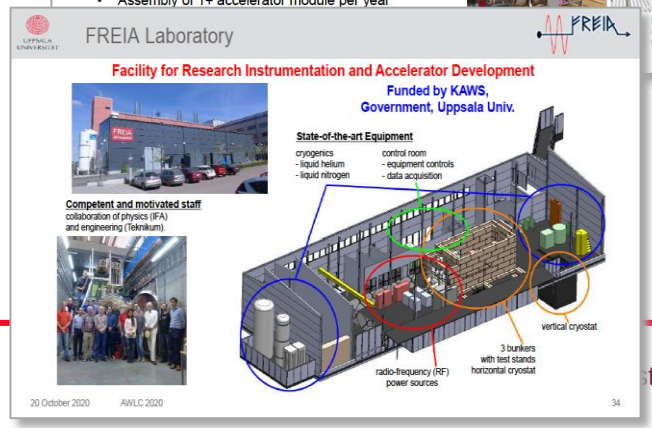




INFN Istituto Nazionale di Fisica Nucleare

Milano





SRF Work / Competence Matrices

ESS LINAC Work Matrix

	EU	Germany	France		Italy		Poland	Spain	Sweden	UK
	ESS-Lund	DESY	CEA	CNRS	Elettra	INFN	IFJ-PAN	ESS-Bilbao	Uppsala	STFC
Linac Components										
RF systems	✓				✓			✓		
LLRF									✓	
Cryomodules			✓	✓						
SRF cavities			✓	✓		✓				✓
Powers Couplers			✓	✓						
Frequency Tuners			✓	✓						
Cold vacuum	✓		✓	✓						
Module Assembly			✓	✓						
Test Infrastructures										
RF cavities/ couplers		✓	✓	✓						✓
RF cryomodules	✓		✓	✓			✓		✓	

20 October 2020 AWLC 2020 4

PIP-II LINAC Work Matrix / EU

Fermilab is leading and hosting the project, for LBNF/DUNE.

Four DAE (India) labs are major contributors for cavities, couplers, cryomodules, RF amplifiers, etc.

Legend:
✓ Prototypes

	France		Italy	Poland	UK
	CEA	CNRS	INFN	WUST	STFC
Linac Components					
Cryogenics				✓	
Cryomodules	✓				✓
SRF cavities		✓	✓		✓
Powers Couplers	✓	✓			
Frequency Tuners		✓			✓
Cold vacuum	✓				✓
Module Assembly	✓				✓
Test Infrastructures					
RF cavities/ couplers		✓			✓

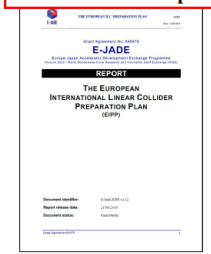
HL-LHC-Crab/EU Work Matrix

DQW cryomodules (5)	RFD cryomodules (5)	Solid State RF Systems (20)
Cavities + processing + helium vessels by Research Instruments (DE) under CERN	Bare cavities by Zanon (IT) under US-AUP	High power solid state amplifiers by BINP-Russia collaboration
Cold magnetic shields: UK	Processing + cold magnetic shield + helium vessel + HOM couplers + antennas + cold tests by US-AUP	First step, one amplifier prototype for qualification of SSPA technology
HOM couplers + antennas: MEPHI-Russia & CERN		
4 CM: UK (STFC) & 1 CM: CERN, with some components by CERN	5 CM by TRIUMF-Canada with some components by CERN	
All cavities & CM cold validation tests at CERN (and a few at Uppsala-Sweden)	CM cold validation tests at CERN	

20 October 2020 AWLC 2020 7

Contribution from each lab. (case of E-JADE)

Kirk will make template table after discussion with Michizono-san and Akira Yamamoto-sensei. Please wait a minute!



Item/topic	Brief description	CERN	France C	Germany	Time line
SCRF	Cavity fabrication including forming and EBW technology.	✓			2017-18
	Cavity surface process: High-Q & -G with N-infusion to be demonstrated with statics, using High-G cavities available (# > 10) and fundamental surface research		✓	✓	2017-18
	Power input-coupler: plug compatible coupler with new ceramic window requiring no-coating	✓			2017-19
	Tuner: Cost-effective tuner w/ lever-arm tuner design	✓	✓		2017-19
	Cavity-string assembly: clean robotic-work for QA/QC.		✓		2017-19
Cryogenics	Design study: optimum layout, emergency/failure mode analysis, He inventory, and cryogenics safety management.	✓			2017-18
HLRF	Klystron: high-efficiency in both RF power and solenoid using HTS	✓			2017- (longer)
CFS	Civil engineering and layout optimization, including Tunnel Optimization Tool (TOT) development, and general safety management.	✓			2017-18
Beam dump	18 MW main beam dump: design study and R&D to seek for an optimum and reliable system including robotic work	✓			2017- (longer)
Positron source	Targetry simulation through undulator driven approach			✓	2017-19
Rad. safety	Radiation safety and control reflected to the tunnel/wall design	✓			2017 – (longer)

Table 1: Current common studies between European institutions and Japan relevant for ILC.

- SRF sub-groups need to make similar table for each region (Asia, America).
- Addition to these items, some new contents need to be added to the table.
  - CM transportation, automation, etc.
- And, budget, human resources…

KEK starts development of automation technique

	Germany	France		Italy	Poland		Russia	Spain
	DESY	CEA Saclay	LAL	INFN Milan	IFJ PAN	WUT	NCBJ	BINP	CIEMAT
Linac									
Cryomodules	✓	✓		✓					
SCRF Cavities	✓			✓					
Power Couplers	✓		✓						
HOM Couplers							✓		
Frequency Tuners	✓								
Cold Vacuum	✓							✓	
Cavity String Assembly	✓	✓							
SC Magnets	✓				✓				✓
Infrastructure									
ΔΔ/TF	✓				✓	✓		✓	
Cryogenics	✓								
Sites & Buildings									
ΔΔ/TF hall	✓								

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

	Germany	France		Italy		Poland	Spain	Sweden		UK
	DESY	CEA	IPNO	Elettra	INFN-LASA	IFJ-PAN	ESS Bilbao	ESS	Uppsala	STFC
RF systems				✓			✓	✓		
LLRF									✓	
Cryomodules		✓	✓							
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.

13/Oct/2020 2nd meeting of SRF subgroup in IDT/WG2 21

WG2 Plans for Prelab Phase and Summary

- SRF subgroup plan for R&D during Prelab phase
  - Produce ~100 cavities: 50% Japan, 50% abroad -> 25 cavities in Europe?
  - Produce ~2 cryo modules per region, verify transport
  - Resolve high pressure regulation issues
- BDS/Dump/DR subgroup:
  - Finalize Dump design(s)
  - ATF3 project
- Sources subgroup: Prepare for a concept downselect in 2022
- Aim: Fund prelab with ~200M€ over 4 years (2022-25), 2/3 Japan, 1/3 Foreign -> naïve scaling: 200M€ * 1/3 * ½ over 4 years => ~8M€/year from Europe
- AWLC discussions indicate interest by DOE and U.S. and Canadian labs
- Accelerator design will be finalized during years 1-2 (2022/23): cavity fabrication recipe, positron source concept etc
- Strong European Participation in IDT WG2 and its subgroups