Preparation of proposal

- Each # of topics will prepare the proposal. (total 19 proposals)
- Each ~3 pages (under discussion inside each sub-group).(template: Technical Preparation_Template_draft-V2B.docx)

Technical Preparation : SCRF cavity and cryomodule production

Outline : SCJ and MEXT's' ILC Advisory Panel had technical concerns about maintaining cavity quality during mass production and cryomodule assembly. This plan is proposed to demonstrate prototype manufacturing using new cost-effective production methods on the scale of 1% of the full production, corresponding to about 100 cavities in the main preparatory phase. Half of the cavities will be produced in Japan and the other half in other regions/countries. The performance of the cavities will be evaluated to confirm their yields, and plug-compatibility will be checked. Other components, such as couplers and tuners, are also expected to improve (in terms of) their performances; they will also be manufactured, and their yields will be evaluated. Overall testing after assembling these parts into a cryomodule will be the final step of evaluating the performance as an accelerator component. The US and Europe have accumulated significant experiences in cavity production and in formulation of countermeasures against performance degradation after cryomodule assembly. It is anticipated that Germany and the US will work on cost reduction of the cavity fabrication process, and on reproducibility and high yield of cavity performance at the design gradient, while France could play a leading role in automation of cryomodule assembly.

Goals of the technical preparation

Parameters	Unit	Design
Baseline: Cavity gradient, E, at Q value (Q0) Cost-Reduction R&D goal: E and Q	MV/m	31.5 (±20%) at Q ≥1E10, 35 at Q ≥0.8 E10 35 at Q ≥2E10, 38.5 at Q ≥ 1.6E10
Cavity production yield	%	90

Items:

- total ~ 100 nine-cell cavities will be produced with international collaboration.
- 9-cell Cavity production by cost effective methods
- RF performance, success yield to be evaluated, under plug-compatible fabrication conditions, with an expected statistics (for example, 20 ~ 30 cavitiy statistics, with fixed fabrication conditions in each region), and enabling to satisfy "high pressure code regulation".
- Ancillaries production (power coupler, tuner, HOM antenna, etc.)
- Cryomodule (CM) production (Prototype, Type A, Type B)

Expected cost:

Issue	***Tasks***	***Cost***	***Human Resources (FTE)***
Mass production	*Performance/ mass production technology*	*k$*	

(not including corresponding cost of human resources)

Candidates:

DESY, CEA-Saclay,FNAL, J-LAB

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Appendix

(Current status)

The beam commissioning for the STF-2 accelerator was successfully done in March 2019 at KEK's Superconducting RF Test Facility (STF). The maximum beam energy achieved was 280 MeV, and the average accelerating gradient estimated from the beam energy was 33.1 MV/m, exceeding the ILC specification of 31.5 MV/m. DESY and FNAL have also demonstrated cryomodule operation satisfying the requirements of the ILC.

At KEK's Cavity Fabrication Facility (CFF), single-cell, 3-cell, and 9-cell cavities have been fabricated in collaboration with some local companies since 2012. CFF is equipped with an electron beam welding (EBW) machine, a chemical polishing (CP) system, and a mechanical pressing machine. Cavity fabrication conforming to Japanese high-pressure gas regulations is in progress.

Concerning cryomodules, cavities and other components manufactured in three different regions (Asia, Europe, and Americas) with a common interface design have been brought together and assembled into a cryomodule at the KEK Superconducting Test Facility (STF), and the cryomodule's performance has been tested and successfully demonstrated with the common interface design for the ILC.

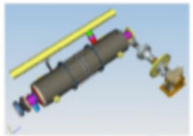
Since 2017, the US and Japan have been collaborating on cost reduction. There are two ways to reduce/save the cost of cavities. One is cost reduction of the niobium material. Another is to improve cavity performance, enabling to reduce the required number of cavities. Research on improvement of cavity performance by new surface treatment such as "nitrogen-infusion" is underway worldwide.

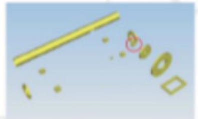
Technology for mass production for the ILC is ready, as demonstrated by successful construction of an accelerator with a few hundred cavities housed in a few tens of cryomodules for the European XFEL and for a similar accelerator currently under construction for LCLS-II in the US. In both cases, after cryomodule assembly, modules were transported on the ground and installed in the tunnel with no major issues caused by the transportation. However, marine/ship transport of cryomodules between two different regions across a sea, and the performance test after transport are yet to be carried out. This will be done as a part of crucial technical preparation in the main preparatory phase.

(Add some figures to explain visually)

Before mass production starts, tuner design should be fixed!!

Which lab. is responsible for cavity, power coupler, tuner, CM, etc.?
How many cavities, couplers, CMs are produced?





Item	Variation	TDR Baseline
Cavity shape	TESLA / LL	TESLA
Length		Fixed
Beam pipe flange		Fixed
Suspension pitch		Fixed
Tuner	Blade/ Slide-Jack	Blade
Coupler flange (cold end)	40 or 60	40 mm
Coupler pitch		Fixed
He –in-line joint		Fixed

L=1,247

12,862 m (flange to flance, to be checked)

Next meeting (2020/12/17)

- ***Technical preparation of FD***

Data: 2020/12/17 THU

- ✓ *23:00-24:00 Japan*
- ✓ *15:00-16:00 Europe*
- ✓ *06:00-07:00 San Francisco*
- ✓ *08:00-09:00 Chicago*

Connection : Zoom Meeting
https://zoom.us/j/99352494698?pwd=bFhPdURyVm9QV3hzemczL1lvc1cwUT09

Preparation of the draft of the technical preparation proposal

Next next meeting (2020/12/23 ; last meeting in this year)

- ***Discussion about the technical preparation plan***

Data: 2020/12/23 TUE

- ✓ *23:00-24:00 Japan*
- ✓ *15:00-16:00 Europe*
- ✓ *06:00-07:00 San Francisco*
- ✓ *08:00-09:00 Chicago*

Connection : Zoom Meeting
https://zoom.us/j/99352494698?pwd=bFhPdURyVm9QV3hzemczL1lvc1cwUT09