R&D Board Task Force on High Gradient SCRF Cavities

FNAL

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Overview

- ILC R&D framework
- Gradient Task Force Charge
- ‘S’-issues
- Workplan

ILC R&D Framework

- The need of making gradients more reproducible is a top priority
- Single-cell cavities in various labs obtain very high performance
  - Yield rates vary between labs
  - Probably we are not far away from the good parameter set
- Looking at the history of TTF some significant effort is needed to transfer results to multi-cells
  - Three cavity productions (20-30 each) were done to improve the gradient from the level of 5-10 MV/m to 25 MV/m with classical etching
    - This included especially the training of companies to provide the required niobium and electron beam weld quality
  - Currently, we are in EP Production No.1 at DESY
  - Other regions are in the process of being able to do research, they are not yet ready for a production-like run
- A dedicated facility in each region with sufficient redundancy and flexibility is needed to have fast turn-around of cavity tests.
  - Waiting for the repair of infrastructure is painful
  - From the TTF experience the bottleneck is typically the cavity preparation, not the cryogenic testing

Gradient Task Force Charge

- The RDB is asked to set up a Task Force to carry out a closely coordinated global execution of the work leading to the achievement of the accelerating gradient specified in the ILC Baseline.
- A definition of the goals for the cavity performance in terms of gradient and yield and a plan for achieving them should be proposed by this group, which should take account of the global resources available and how they may be used most rapidly and efficiently.
- The accelerating gradient performance and yield should be specified both for an individual 9-cell cavity and for an individual cryomodule, and the plan should cover the demonstration of this performance in both cases.
- The GDE will facilitate the coordination at the global level to achieve this vital goal as soon as possible.

S: Definitions

- These details are still under discussion to some degree, final version by Vancouver

- S0
  - Achieve 35 MV/m in a sufficiently large sample (~20-30) of 9-cell cavities in the low-power vertical dewar testing in a production-like operation e.g.
    - all cavities get the same treatment
    - Re-treatment of cavities should be limited to 2 or 3 preparations
  - Final goal:
    - BCD assumption: 37 +/- 5% MV/m (95% yield)
    - Could be optimised
  - Intermediate goal
    - more than 90%(80%) achieve 35 MV/m
    - assumed in the costing exercise
  - First step:
    - achieve 31.5 MV/m in a sufficient number of cavities to pursue S1

S1: Definition

- Achieve 31.5 MV/m@10^10 as operational gradient as specified in the BCD in more than one module of 8 cavities including e.g. fast tuner operation and other features that could affect gradient performance
- Final goal (following the Snowmass definition):
  - 31.5 MV/m including enough overhead as described in the BCD (all cavities are 35 +).
  - At least three modules
    - Could include re-assemblies
    - Does not need to be final module design
  - Operation for a few weeks
    - Long-term is in S2
- Intermediate goals
  - Achieve 31.5 MV/m average operational gradient as a proof-of-existence

Workplan: Organisaton

- Accumulate information of regional programs
  - That‘s one reason why we are here today
- Involve TTC
  - Could help in organizing forums
    - TTC Meetings
    - Monthly teleconference with America and Europe started
      - » Seeking to integrate Asia soon
  - A lot of expertise is accumulated there
  - Steps towards accumulation of various parameters of EP has started
- Involve Industry for surface preparation
  - In America maybe directly on multi-cells?

Workplan: Topics

- Data assesment
  - What has been achieved?
  - What not?
- Define tests needed on a multi-cell cavity e.g.
  - Passband modes measurement
  - Check for Q-disease
- Assesment of infrastructure
  - Availabbility for testin
  - Cavities available

S0 Work Plan I

- Assessment of data
  - See example for TTF cavities (preliminary!)
- Assessment of production and preparation capacity
  - Infrastructure status and plan
  - Industry involvement

Assessment of data

Project name	Cavity batch	# of cavities	Average Gradient (all tests)	Spread (all tests)	Average Gradient (best tests)	Spread (best tests)	Average Gradient (last tests)	Spread (last tests)	Material defects	Fabrication defects	# of cavities with Q-disease	# of tests with Q-disease	Average # of tests/cavity	Field emission onset (all tests)	Spread	Field emission onset (best tests)	Spread (best tests)	Field emission onset (last tests)	Spread (last tests)	Comments
TTF (9 cells)	1 BCP 1400	27			19.7	8.1	17.8	7.6	3.0	9.0			4.7			16.9	5.4	15.9	6.2	Nb material not scanned, weld preparation not done to spec. At one company
TTF (9 cells)	2 BCP 1400	27			25.6	3.4	24.0	4.0		1.0			4.1			19.4	3.8	19.2	3.8	Hole burnt during EBW
TTF (9 cells)	3 BCP 1400	22			26.6	4.5	26.6	4.5	1.0				1.7			20.3	4.8	20.3	4.8	Cold leak
TTF (9 cells)	3 EP	11			34.7	4.5	28.9	7.4			2.0	3.0	8.4			27.3	5.1	22.1	9.0	Tests before and after bake
TTF (9 cells)	4 EP 800	30			28.5	4.4	27.6	4.3		3 (1400 C treated)	2.0	5.0	2.9			21.8	5.4	22.7	5.5	Weld preparation not done properly,Tests before and after bake

S0 Work Plan II

- Arrive at the best recipe
  - Start to work with TTC on EP parameters in Labs
- Adress contamination issues
  - 5 um EP a la Kenji
  - Alcohol rinse
  - Other Options?
- Optional 1400 C postpurification

S0 Work plan III

- Definition of treatment
  - Distribution of variations on recipe e.g.
    - alcohol rinse at DESY
    - Short EP at KEK
  - Distribution of
    - Production-like effort (many cavities ~20-30 , one turn) vs.
    - Tight-loop (one cavity, many turns)
- Definition of required data set on X years (Hasan: X=3?)
  - Number of cavities needed
  - Number of tests needed
- Distribution of work load
  - There are obvious data points we will get:
    - XFEL: EP+ 800 C
  - There are trickier ones
    - Who does tight-loop in US?
      - JLab, Cornell, ANL?
    - Who does production effort in US?
      - JLab, ANL?
    - Can we do production-like effort at KEK?

S1 Work Plan

- Gather information
  - TTF module assembly
  - SNS module assembly
    - Need to look on how much useful information is there, some difference in asssembly
- Define Goals
  - First Goal: Proof-of-existence
    - DESY module 6 (I hope so…)
  - Second Goal: Reproducible yield
    - Look at DESY data
    - Can possibly done by re-assembly of the same module