

Summary ILC JLab Meeting

ILC-GDE-PM visit to JLab – 14-15 Feb 2008

Summary of activities and discussions

Summary of Thursday Meeting

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Andrew Hutton provided an overview of the place and role of SRF activities at JLab

- serving a uniquely wide range of applications and customers
- enabling a number of new generations of accelerators
- prioritized attention on leadership in high-current CW SRF accelerators
- happy to team with partners for mutual benefit

Warren Funk, Marc Ross, and Akira Yamamoto commented on the context and motivations that brought this meeting together, the principal one being Akira's desire to gain first-hand awareness of assets of each institution contributing to the ILC R&D effort.

Summary of Thursday Meeting

Akira Yamamoto described the current re-planning effort of the ILC SCRF R&D Plan, in view of

- progress to date
 - level of participation from Europe anticipated
 - funding challenges of US
 - priority of establishing the credibility of a 35 MV/m ILC cavity specification
- Must understand “S0” as the resolution of technical problems that impede realization of 35 MV/m
 - Includes important fundamental R&D in tandem/concert with 9-cell cavity processing, test, and “qualification” for use in “S1” cryomodule system tests
 - Identified “primary” and “secondary” S1 plan, the latter creating an option for meeting the S1 goal via partial contributions of “plug compatible” elements from multiple labs, should the US funding situation not resolve quickly enough.

Summary of Thursday Meeting

- **Bob Rimmer** presented an overview of all the current activities and involvements of the JLab SRF Institute
 - Preparations for CEBAF 12 GeV upgrade
 - Support of CEBAF strengthening
 - High-current prototype drivers for FELs
 - BNL & SNS work
 - ILC work (as funded)
 - Low-level collaborative R&D efforts
- **Extended 2-hour tour of JLab SRF facilities**
 - Cavity fabrication, injector gun test facility, cavity processing & assembly, EP facility, cryomodule assembly areas, VTA, surface analysis areas

Summary of Thursday Meeting

- **Series of JLab technical talks and discussions**
 - JLab high-gradient activities overview
 - S0 9-cell program - Status and future plans
 - ACD large grain/superstructure/SC joint
 - High-gradient losses (Q-slope)/thermometry
 - DC gun R&D, synergy with SRF
 - R&D progress, open questions, opportunities

<http://srf.jlab.org/JLabILCinfo/JLabILC0801.html>

Summary of Thursday Meeting

Distillation of the technical discussions:

1. The excellent performance of some single-cell and 9-cell cavities demonstrate that there are no fundamental material problems that will prevent attaining ILC performance goals.
2. The variability/inconsistency of cavity performance results is interpreted as inadequate control of a complex, multi-step process.
3. Consistent, predictable performance approaching theoretical limits requires increasingly more thorough understanding and control.
4. One dimension of the variability includes well-recognized QA issues (e.g. mundane contamination from recognized sources). This dimension can and should be addressed by appropriate process engineering at the appropriate project stage.
5. A second dimension of performance variability is attributed to process variables that are not yet recognized as critical, or if recognized, are not adequately understood to supply a basis for confident control. E.g., what material features are responsible for irreproducible quenches >25 MV/m?
6. A tertiary dimension is the maturation of understanding sufficient to enable process optimization for efficiency (lean process). SRF cavity operations are far from this condition.

Summary of Thursday Meeting

Distillation of the technical discussions (cont)

7. The 9-cell cavity process & test cycles of S0 must become technical learning vehicles as well as a means of “qualifying” cavities for S1. Identifying correlations between performance-limiting sites (at any gradient) and observable material features is an agreed priority. For such a purpose, thermometry is absolutely necessary.
8. If the above correlation study can be expedited via use of single-cell cavities (which are more readily sacrificed), so be it.
9. Direct-from-ingot Nb material (aka large-grain) may well enable a net-cost-saving alternative to now standard polycrystalline Nb. Direct comparisons of properties have just begun; sustained attention is due.
10. A technical description of the required end-state of the cavity surface to necessarily attain 35 MV/m does not exist. Having that would clarify the target of process engineering.
11. A very natural synergy has been found between some of our SRF material processing methods and the push for durable high-current polarized electron sources.
12. JLab staff are full of ideas for addressing both basic and process issues that are important to JLab programs and vital for a credible ILC.
13. JLab has technical infrastructure capacity that is not yet fully subscribed.
14. JLab has collaborative partners (universities, labs, companies) ready and able to leverage our infrastructure and experience to find new solutions.

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Summary of Friday Meeting

Review of Thursday (with partner labs joining via WebEX)

Brief words from Andrew

Above slides from Charlie

Summary from Akira – S0, S1, and broad system

Marc Ross addressed the GDE-desired JLab roll for ILC through '12

- JLAB focus on understanding and development (Cornell also)
 - US program (should/must) recognize that
- Invest in JLAB/Cornell infrastructure
 - Tooling, instrumentation, process control
 - Integration
 - Protect this investment
- Help us develop 'replan' for high gradient R&D – include:
 - » Multi-cell mainstream
 - » Single cells for development
 - » Diagnostic development
 - » Analysis
- Use new and existing diagnostics – localize, characterize, eliminate defects
- Understand and promote full utilization/analysis of existing data
- Improve process controls / process basis as indicated

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Summary of Friday Meeting (cont.)

Hasan Padamsee presented a summary of Cornell SRF R&D facilities and past experience pursuing high gradients.

Hasan then presented a proposal for Cornell high-gradient R&D for 2009

9-cell program

2 cavities × (2-"standard" + 2-"improved") treatment [8 total cycles]

Cryogenic test with full-coverage 2K thermometry to obtain full thermal characterization of all hot spots below quench.

2 cavities × 3 cycles short-fresh vertical EP treatment

No test @ Cornell – offer to JLab for testing

1 re-entrant 9-cell cavity – use 2nd sound system to locate quench

Develop optical inspection system - analyze defects

Adapt repair grinding system and attempt repair – 1 test

1-cell program

~11 tests – 1500 MHz cavities with thermometry quench location changes with reprocessing?

~4 tests – 1300 MHz re-entrant cavity gradient reproducibility (no thermometry)

Summary of Friday Meeting (cont.)

The afternoon discussion continued to explore possible options for deploying available resources toward the identified technical issues. (began with Hasan's proposal)

Bob Rimmer led a discussion of a strawman list of potential JLab activities for FY09--highlight elements:

- 9-cell “standard” or non-”standard” EP processing & VTA tests with 2-cell thermometry & inspection for limit characterization and remediation (30-40 total cycles to be allocated by JLab)
- 1-cell process & test (30-40 test cycles to be allocated)
 - Various research purposes (materials, treatments, etc.)
 - Some for destructive analysis
- Small sample process characterization and analysis
 - EP, BCP, cleaning, materials comparison
- Strengthen and apply new diagnostic methods
- Infrastructure strengthening and integration to support above
- Additional cavity fabrication
- Cryomodule design optimization contributions

Summary of Friday Meeting (cont.)

The afternoon ended with a status update WebEx meeting with M. Harrison.

The chief purposes of the meeting (clarifying JLab high-gradient capabilities and interests) were declared achieved.

There was broad consensus that the chief focus of attention needs to be on establishing improved process control and simultaneously improved characterization of the causes of cavity quenches below 35 MV/m. (Progress following improved characterization is assumed.)

This primary program is also expected to yield sufficient “qualified” cavities for use in at least one “S1” cryomodule and achieve the original “S0” goal by 2012.

Development of detailed plans for rationally allocating resources against available options identified by contributing partners is the next task at hand. GDE-PMs looks to Lutz to coordinate the global contributions for best net effect.

GDE seeks strong intellectual participation from JLab as well as full utilization of available infrastructure capacity.