# Status Report on Cornell Activities

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SRF Group

# Overview

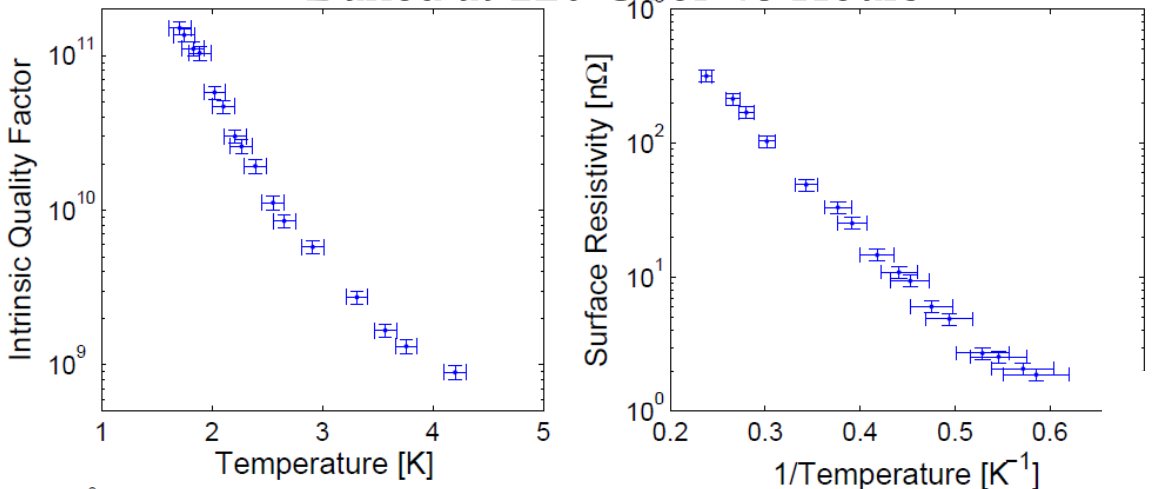
- Cornell's SRF work can be divided into two areas:
  - Basic SRF Science Research and Development
  - SRF Technology Development
- Outline
  - Superheating Field Measurements
    - Bulk Niobium Cavities
    - $Nb_3Sn$ Cavities
  - SRF Cavity Geometry Optimization
  - Reentrant Cavity Results
    - Cavity Repair via Tumbling
    - Cavity Defect Location
  - Vertical Electropolish Status
  - Cavity T-Mapping

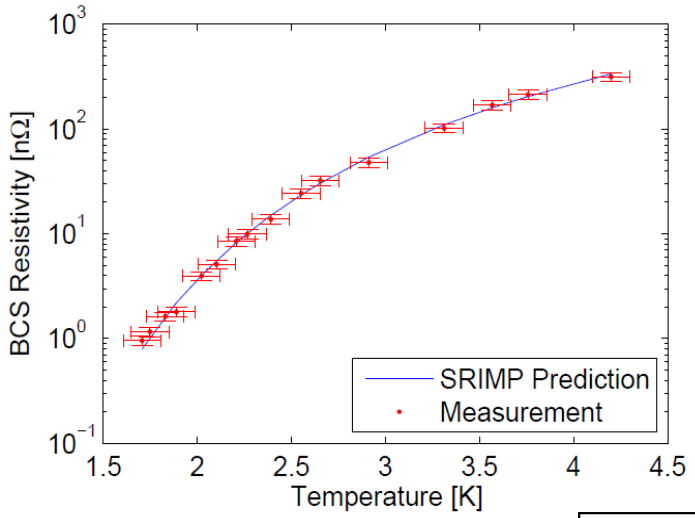
# Superheating Field Measurements

- The purpose is to:
  - Determine the temperature dependence of the superheating field
  - Determine the impact of surface preparation on the superheating field
- This is done experimentally by rapidly pulsing single-cell 1.3 GHz cavities to the superheating field, avoiding thermal effects.
- This work is being performed by Nicholas Valles, a graduate student, working with Prof. Matthias Liepe.

# Superheating Field Measurements

Vertically Electropolished at 20 C
Baked at 120 C for 48 Hours



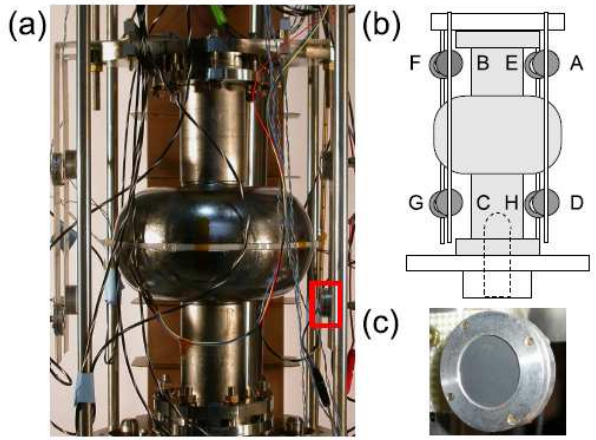

Fit gives for the mean free path of the RF layer:

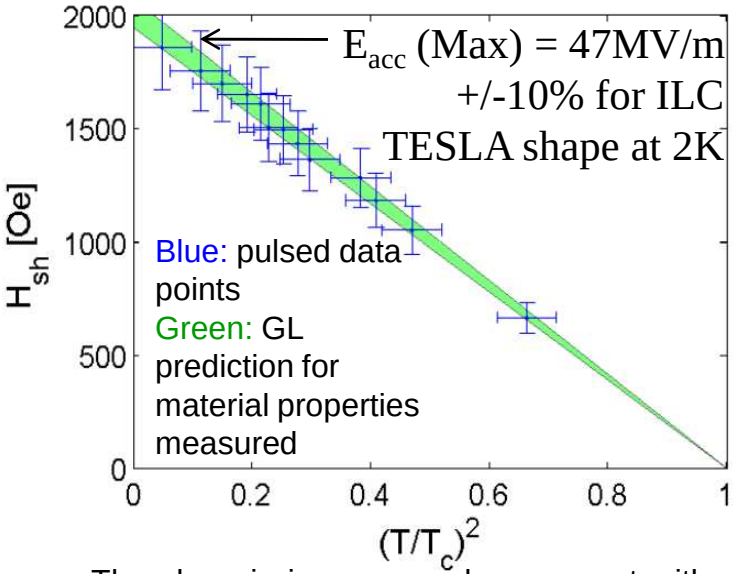
$\ell$ = 26.91±1.19 nm

→ $\kappa$ = **3.49** ± 0.16

→ c(0)=Hsh(0)/Hc =

**1.044** ± 0.001



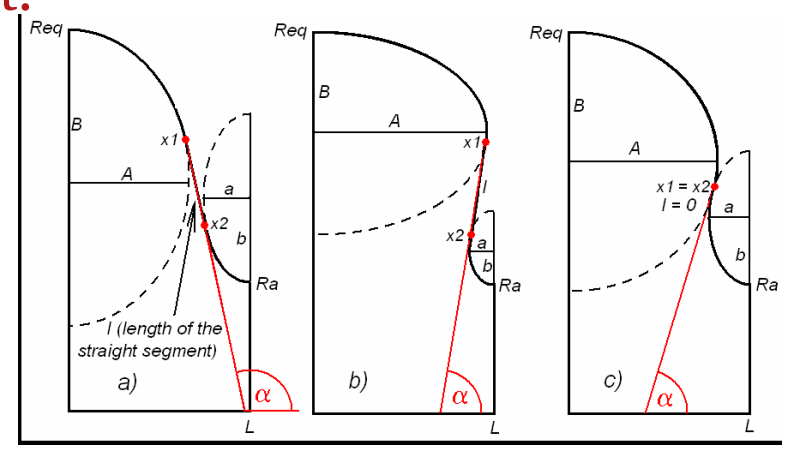

The slope is in very good agreement with prediction from GL theory for material properties measured (κ= 3.5)

**Figures Courtesy of Nick Valles**

**Paper:** arXiv:1002.3182v1

# Cavity Geometry Optimization

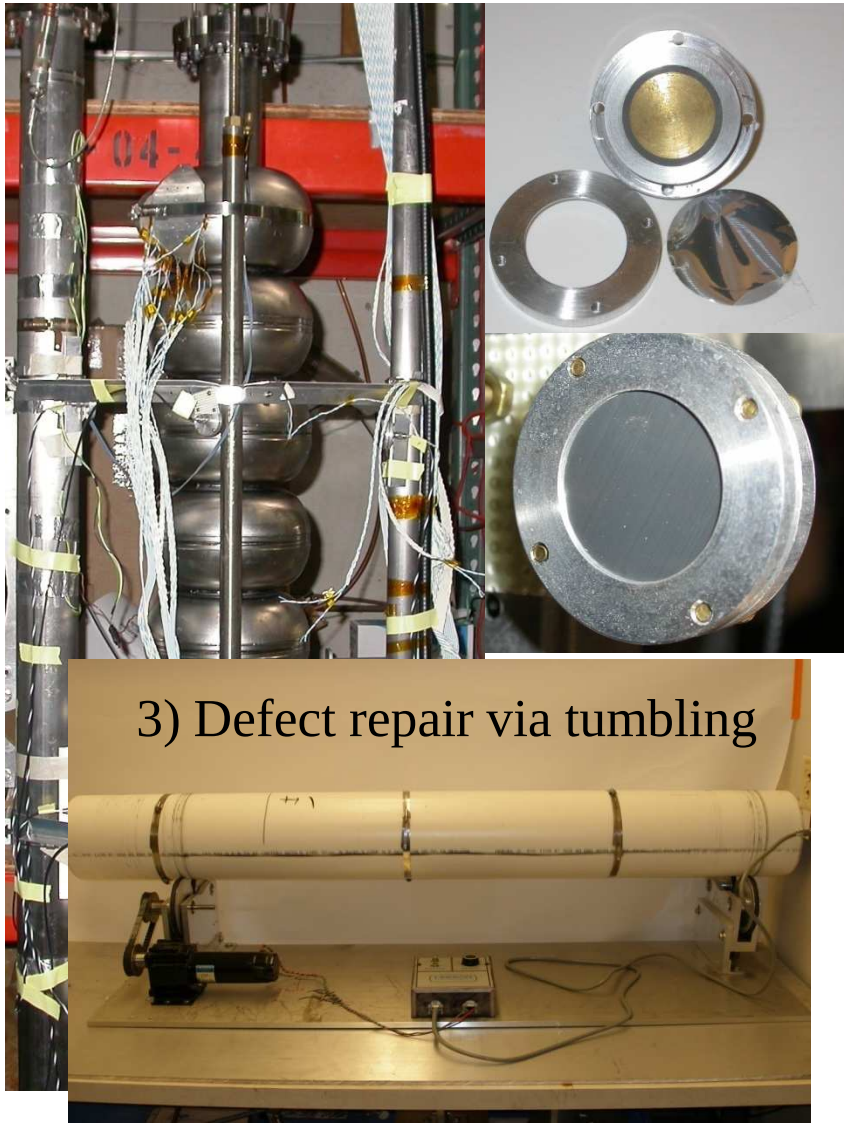
- SRF Cavities for the ILC are now starting to surpass accelerating gradients of 40 MV/m.
- The associated peak surface magnetic fields are approaching the theoretical limit.
- A way to increase the accelerating gradient is modifying the cavity geometry to lower the ratio of the peak surface magnetic field to accelerating gradient.
- Valery Shemelin has optimized a 70mm diameter beam tube cavity geometry which we will build and test.
  - $E_{pk}/E_{acc} = 1.2$
  - $H_{pk}/E_{acc} = 3.76$ mT/(MV/m)
- Our current prototype results next



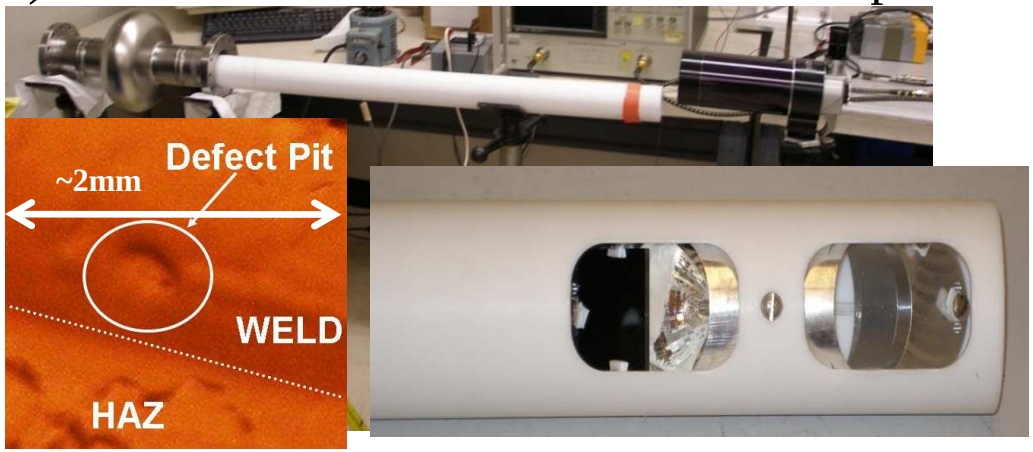

For an guide to this work refer to: V. Shemelin, H. Padamsee, and R. L. Geng. Optimal cells for TESLA accelerating structure. Nuclear Instruments and Methods in Physics Research A, 496:17, January 2003

# Cavity Geometry Optimization: Reentrant Cavity Tests

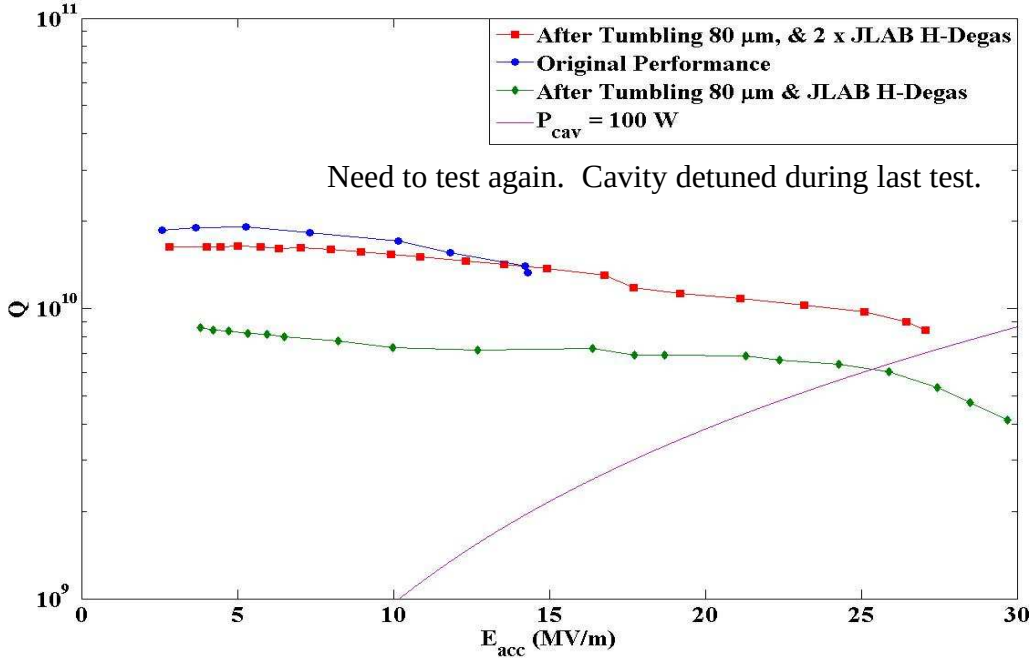
## 1) Defect location with OSTs



## 2) Defect characterization with microscope





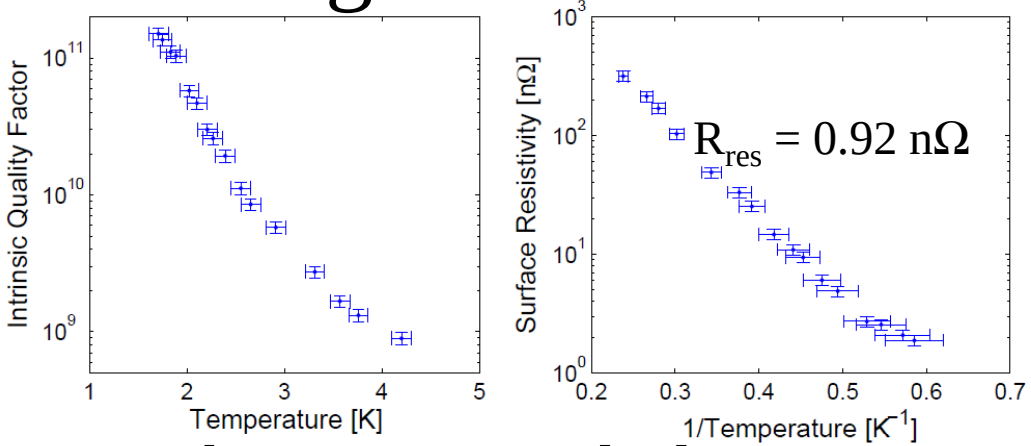

## 3) Defect repair via tumbling

# Vertical Electropolish Status

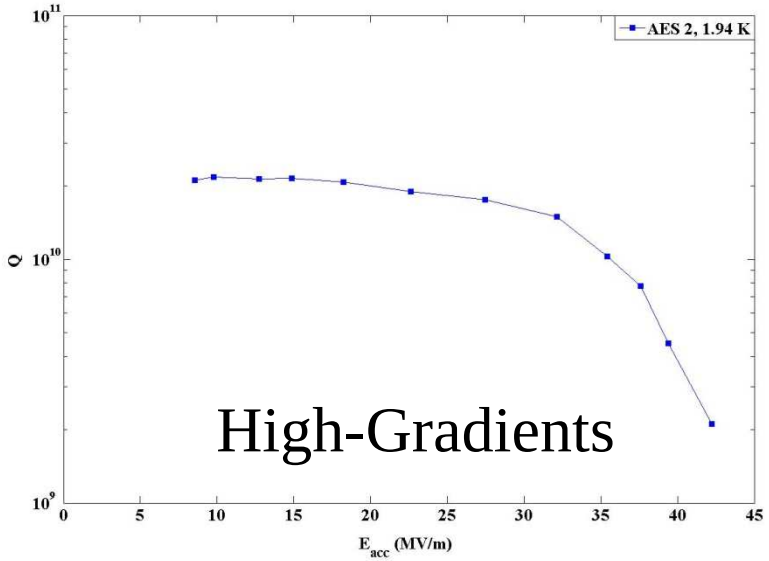
- A new engineer, Paul Carriere, is being trained to take over Vertical Electropolish operation.
- We have had several good results and we are working toward state-of-the-art ILC 9-cell cavity performance.
- We are finding that our JLAB and MSU colleagues recommendations to lower the temperature of the polish and reduce the agitation are helping considerably.
- Due to the high cost of 9-cell tests our work has focuses on single cell cavities.
  - We now have a helium recovery and liquefaction system, we can start test 9-cell cavities in a cost effective manner
  - The first operation of this system occurred last week

# Vertical Electropolish Status

## Single Cell Results

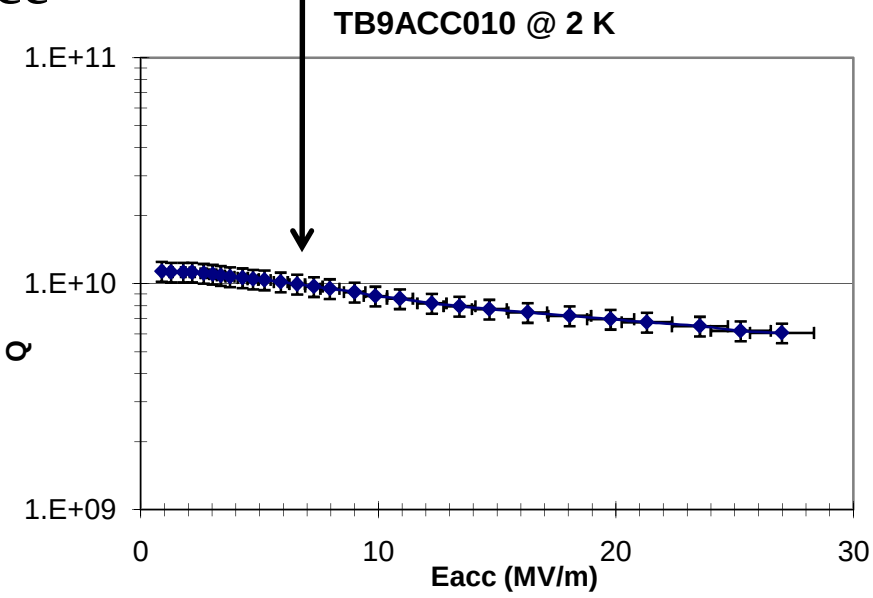



High-Q, Low Residual Resistance



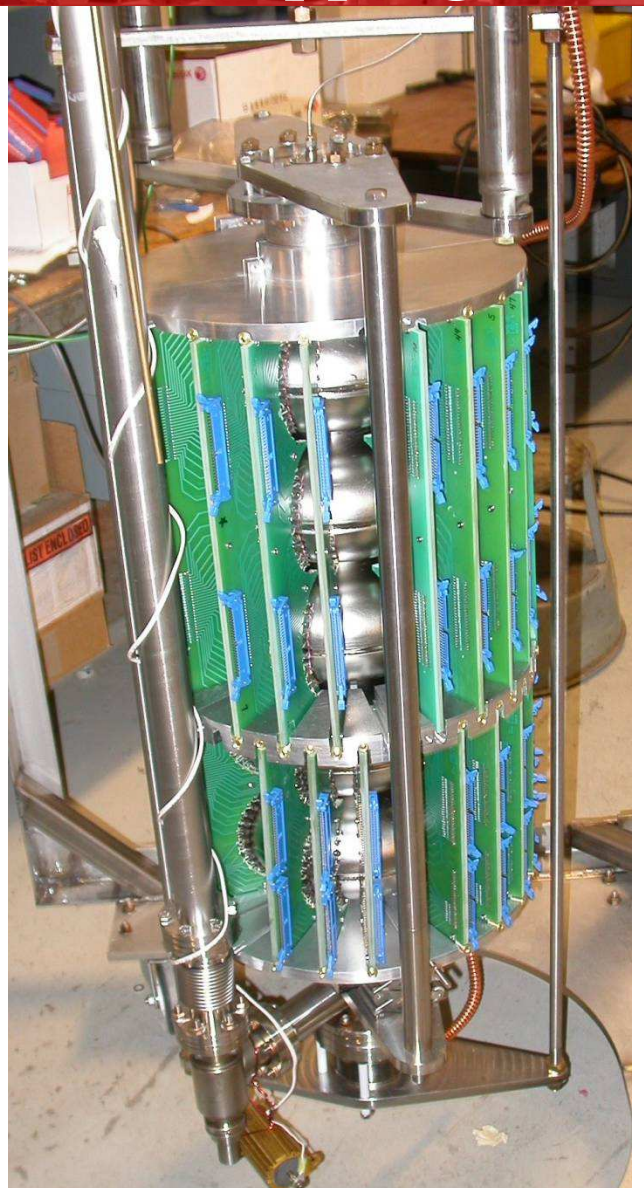

## 9-Cell Results

Too much agitation during polishing is a bad thing!



# Multi-Cell Cavity Temperature Mapping

- In order to better understand the limiting mechanisms in 9-cell cavities for the ILC we are developing a multi-cell T-map system capable of mapping TESLA-style cavities with 3, 5, 6, 8, and 9 cells.
- This work is being performed by David Meidlinger and Eric Chojnacki.



# Summary

- We are working on both basic research and applied development for the ILC superconducting cavities.
- We are now able to recover and liquefy helium.
  - 9-cell ILC tests are starting to be affordable for us.
  - We can process and test more 9-cell cavities
- Our development and proving of vertical electro-polishing in 9-cell cavities is becoming more of a focus.
- New tools are here and coming online to study and repair cavities @ Cornell: OST defect location and multi-cell Temperature mapping.