



High Sensitivity Temperature Mapping of Single Celled Superconductive Radio Frequency (SRF) Cavities

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Summer Research for Community College Students (SRCCS)

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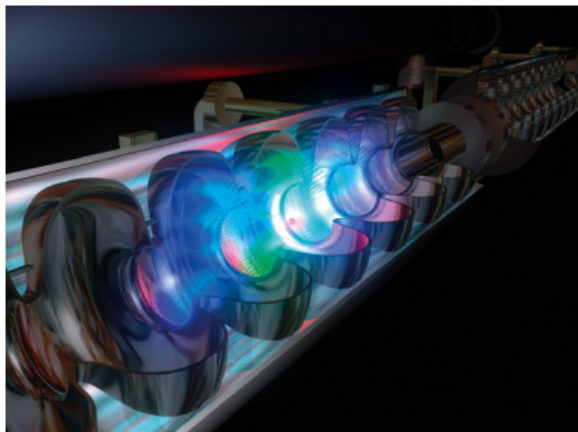




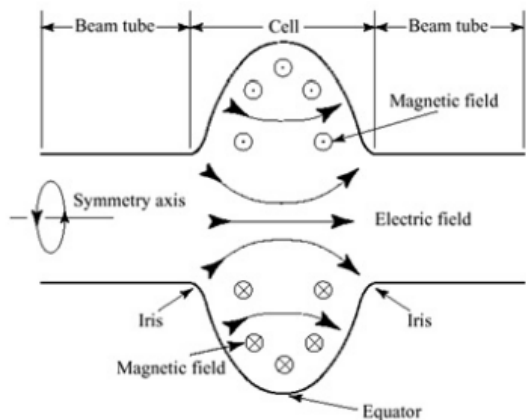
- Introduction to Temperature Mapping (TMap)
- Current Set-up
- Problems that exist
- What am I going to be doing in the upcoming weeks?



What is SRF?



Cutaway view of a superconducting cavity accelerating a beam.



Single cell cavity with electric and magnetic field lines.

Superconductivity

Zero resistance DC

Niobium

9K Critical Temperature

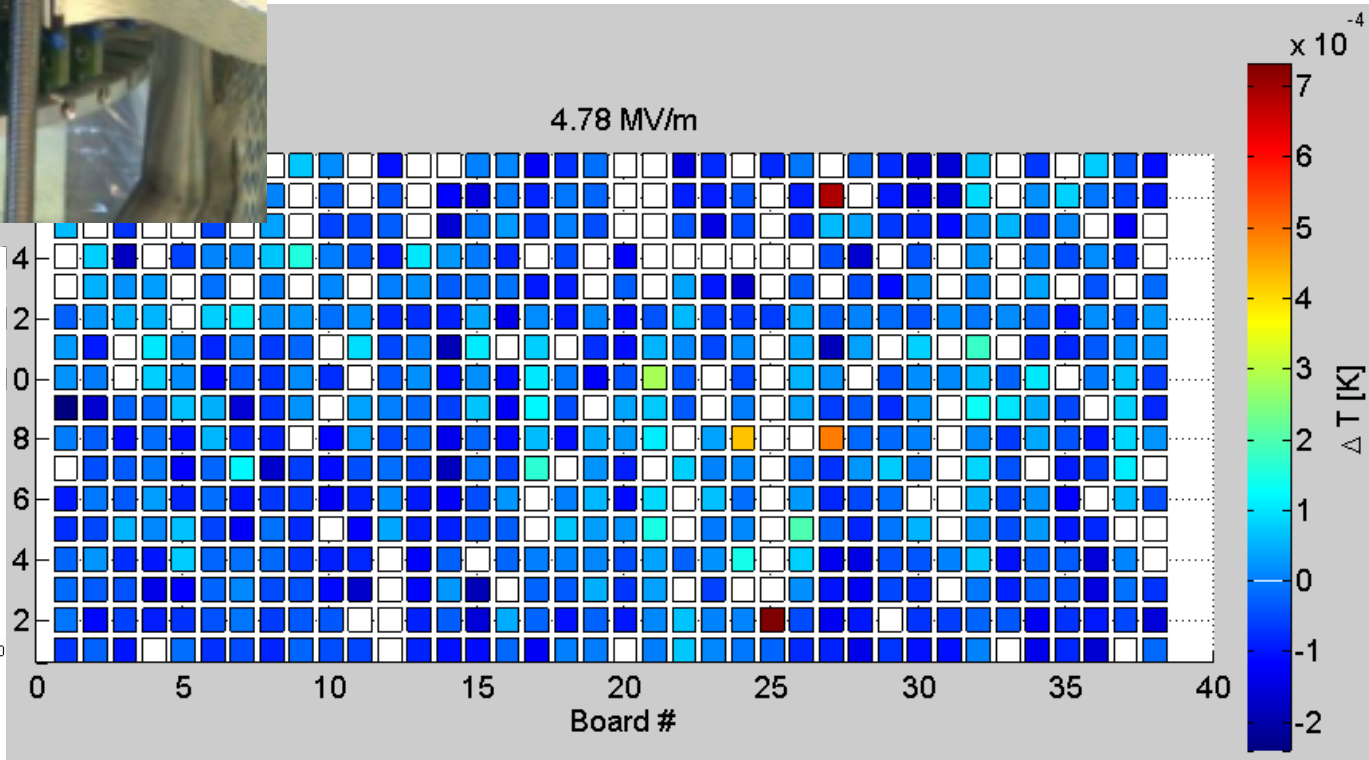
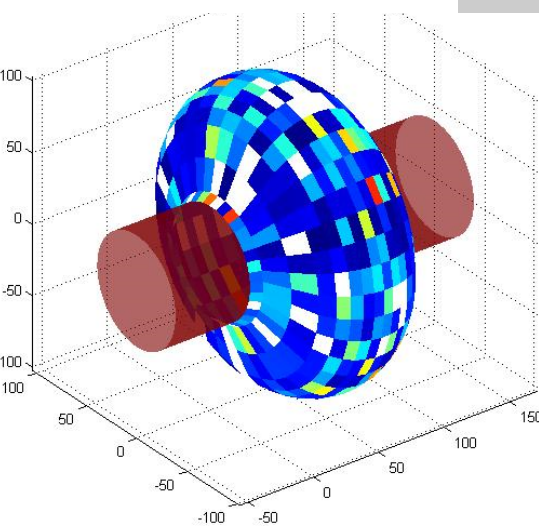
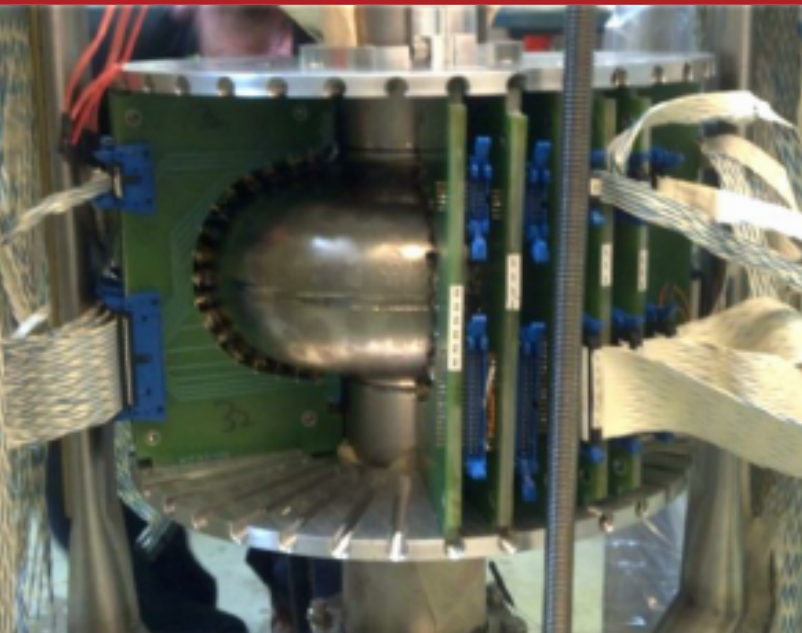
Q_0

Quenching

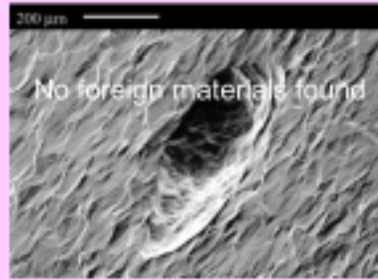
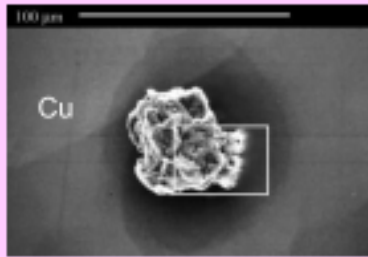
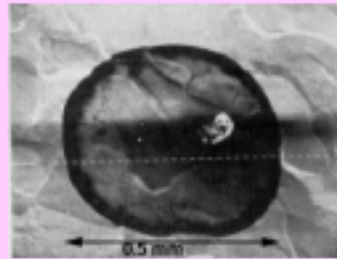
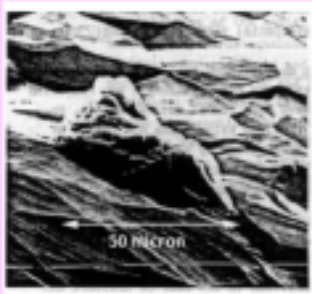


What is TMap?

38 Boards with
17 resistors per board.
That's 646 Resistors!



Why TMap?



Typical examples of quench-producing defects located by temperature mapping and imaged by SEM are: chemical stains, foreign metal inclusions, pits with sharp edges, metal burrs from scratches, voids or delaminated regions of Nb, weld beads and other types of welding mistakes. 0.1 to 1 mm size defects cause thermal breakdown.

- Produces a full temperature profile of the cavity
- Localized heating is a sign of defects on the surface
- Defects lead to quenching
- Increased surface resistance
- Identify the problems to refine the cavity manufacturing process



Current Configuration

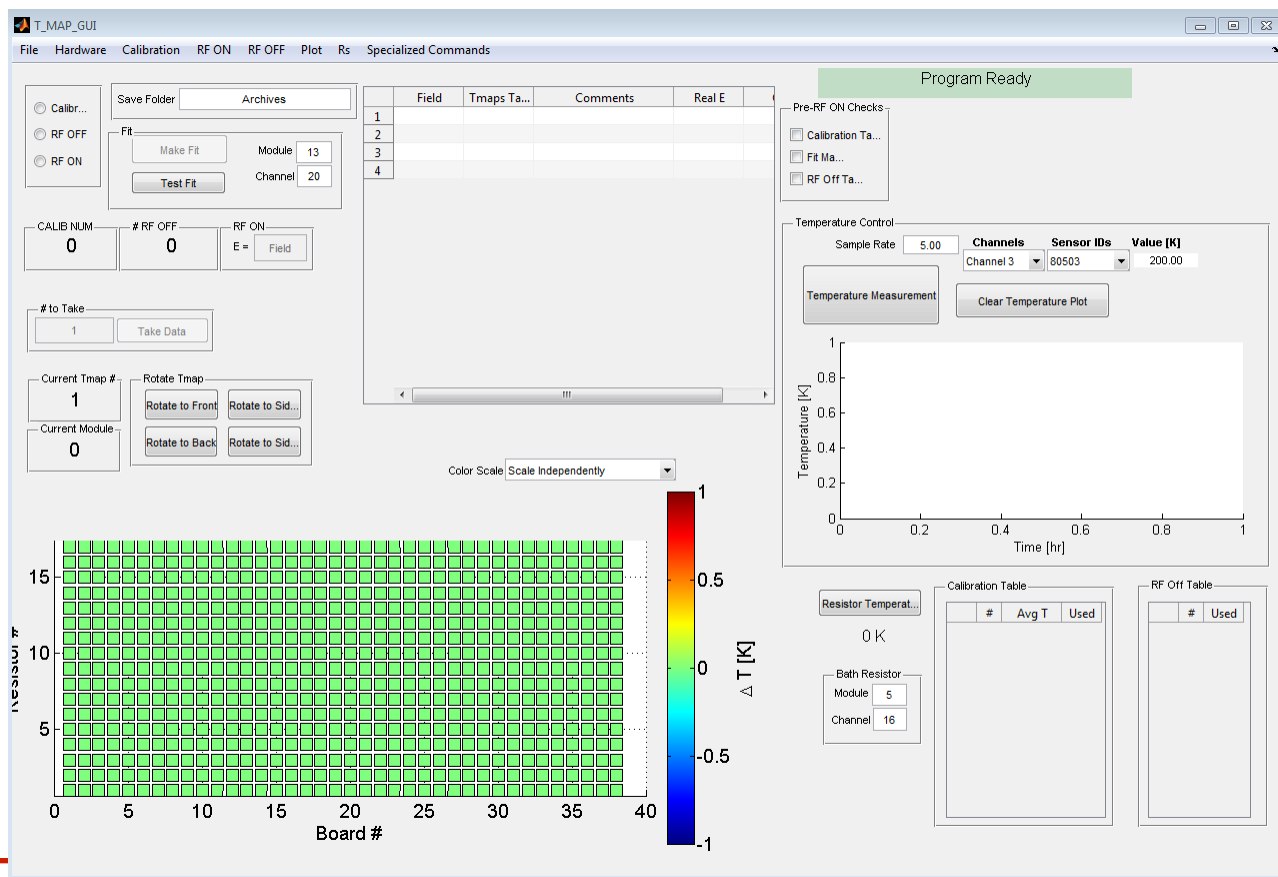
Testing in the center pit (15 inch diameter)

Pumped full of liquid helium

24 modules (cables) with 32 channels per module

Reading 1000 samples
One channel at a time

MATLAB Graphical User Interface





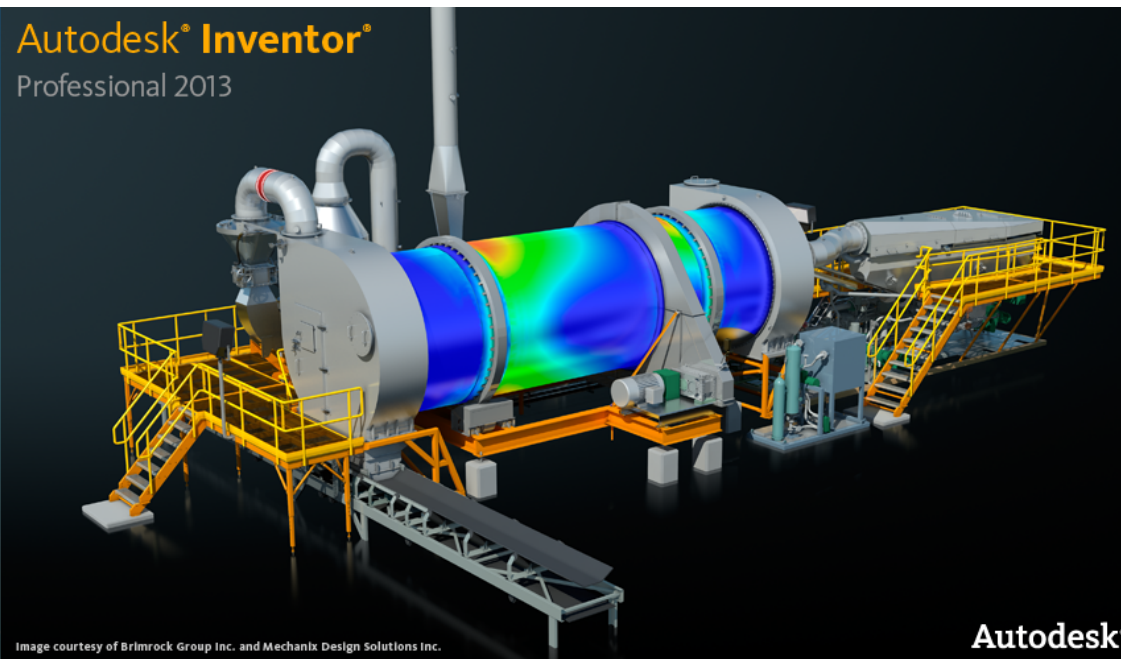
- Size of pit
 - Wrapping produces wear
 - Have to turn the boards
- How MATLAB reads the data
 - Speed limitations
- Scotty, We need more data!!





Move to the West Pit

- West pit is 25" diameter
- Have multiple insert to prepare different cavities for testing



- What will need to be done?
 - ❖ Design vacuum tubes that bend around TMap
 - ❖ Manufacture and test insert



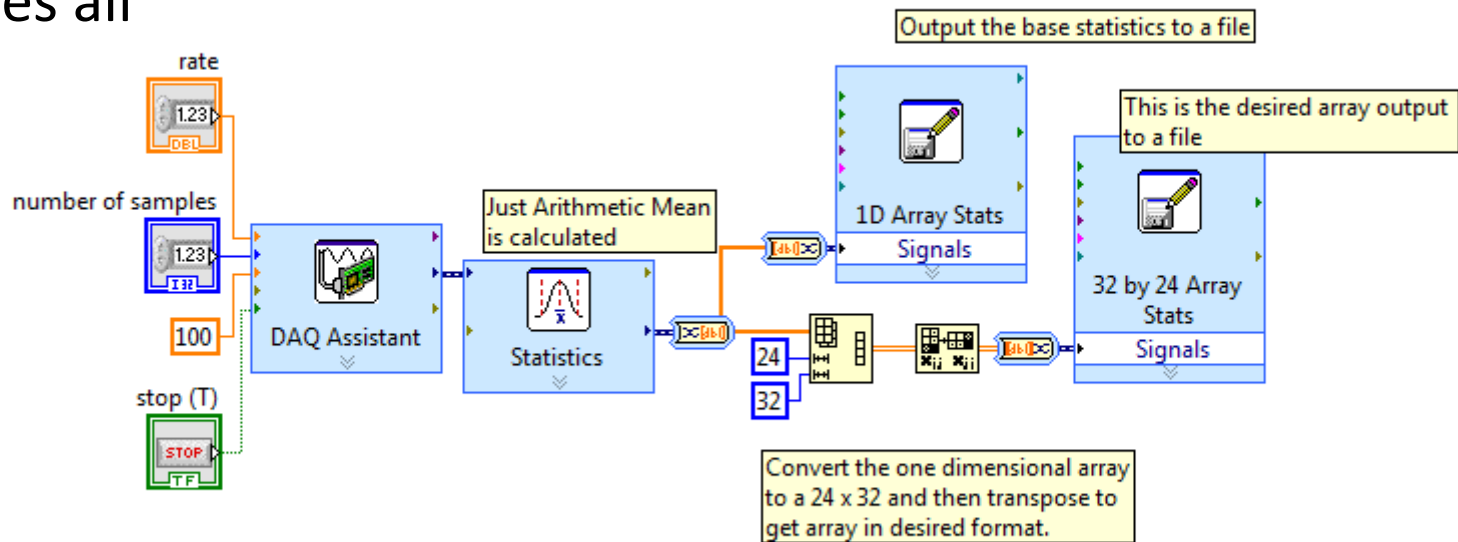
Data Acquisition

National Instruments makes the DAQ
National Instruments makes LabVIEW.



LabVIEW can switch between channels without delay

MATLAB still runs the
GUI and processes all
the data





Are there any
questions?
questions?



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1. "Corning Community College." Corning Community College - Home. 20 June 2013 <<http://www.corning-cc.edu/>>.
2. "LEPP - SRF." LEPP - SRF. Cornell University. 20 June 2013 <<http://www.lepp.cornell.edu/Research/AP/SRF/AboutSrf.html>>.
3. "Liepe Group: About us." Liepe Research Group: About us. 20 June 2013 <<http://www.lepp.cornell.edu/~liepe/webpage/about.html>>.
4. Padamsee, Hasan. "RF Superconductivity 2010." LEPP - SRF. 2010. 20 June 2013 <http://www.lepp.cornell.edu/Research/AP/SRF/rsrc/LEPP/Research/AP/SRF/AboutSrf/RF_Superconductivity_2010.pdf>.