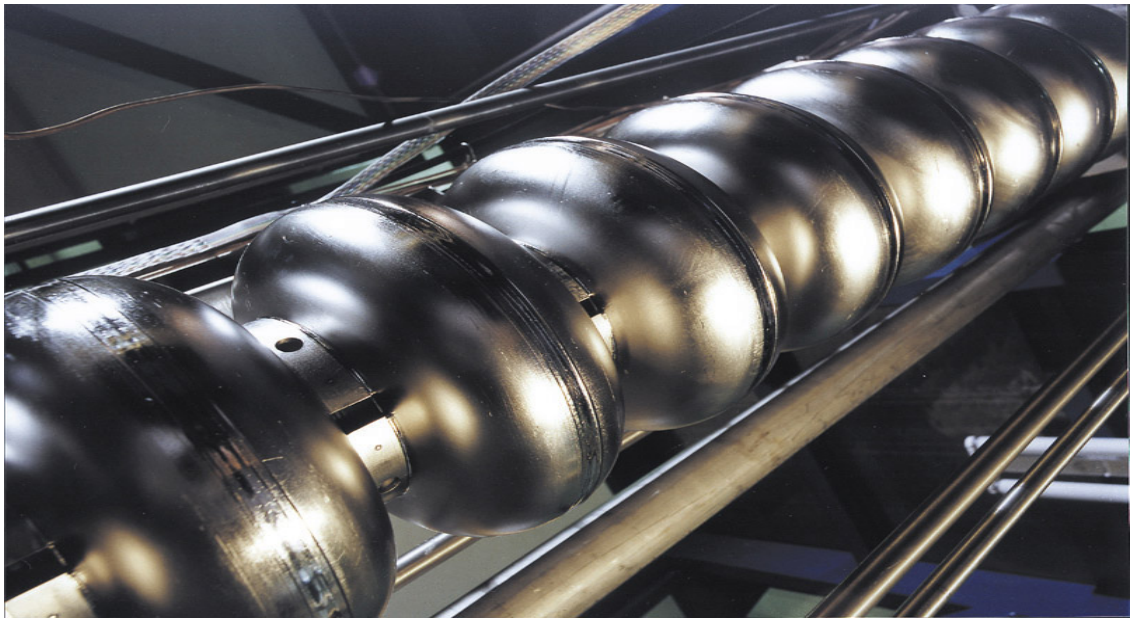
Coating and Testing Nb_3Sn Cavities



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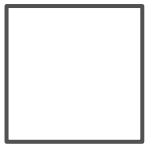
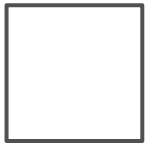
Overall Agenda

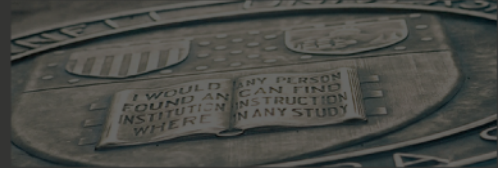
- Coating single cell Niobium cavities

- Testing the cavities



- Surface analysis





What is SRF?

Superconducting Radio Frequency

-The low electrical resistivity of a superconducting material allows an RF resonator to obtain an extremely high quality factor.

Superconductors: consists of small amounts of AC electrical resistance when cooled below a critical temperature (T_c).

Superconductors are significant in the construction of particle accelerators.

What we know:

Nb has a relatively high quality factor (Q_0) and is used by many labs.

- A high Q_0 means that there's a lower rate of energy loss relative to the stored energy within the system.

Nb_3Sn is NEW to this program!!!!!

Nb_3Sn has a higher critical temp (~18K, where as Nb has a T_c of ~9K)-- so it has an *even higher* Q_0.

Higher Q_0 means a high frequency of 1.3 GHz can operate near the boiling temp of liquid He (4K), rather than the inconvenient and costly 2K (used for Nb).

BACKGROUND ON Nb_3Sn

Why Nb_3Sn?

- Cheaper to run refrigeration systems.

- Higher superheating field.

Higher superheating field → Higher accelerating gradients

Higher gradients → Fewer cavities

Fewer cavities → Shorter accelerators

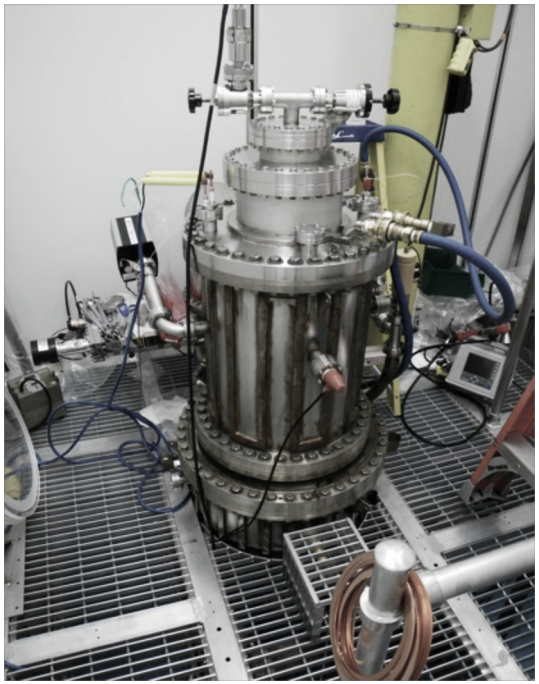
Shorter Accelerators → SAVES $$$$$$$$

Coating the Cavity

What is needed?

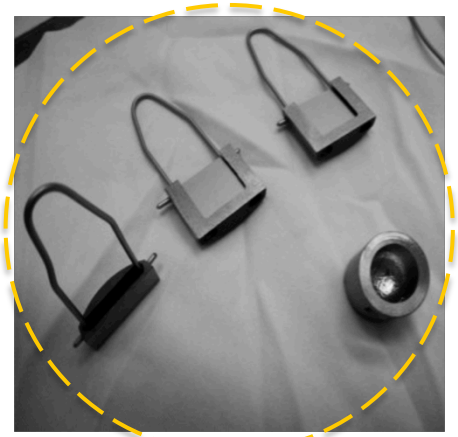
Niobium Cavity

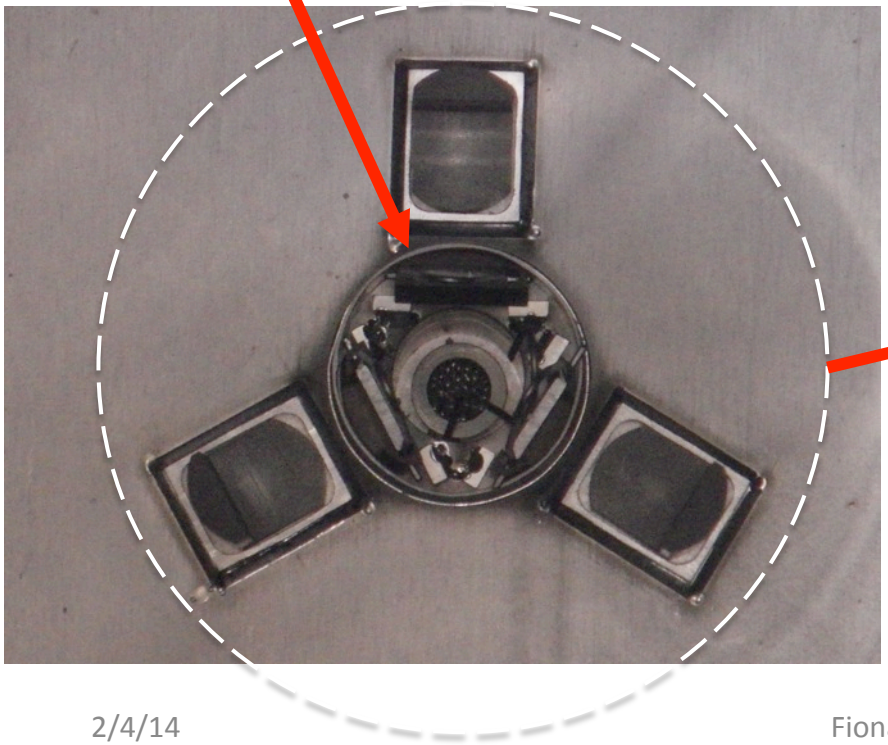
Tin samples

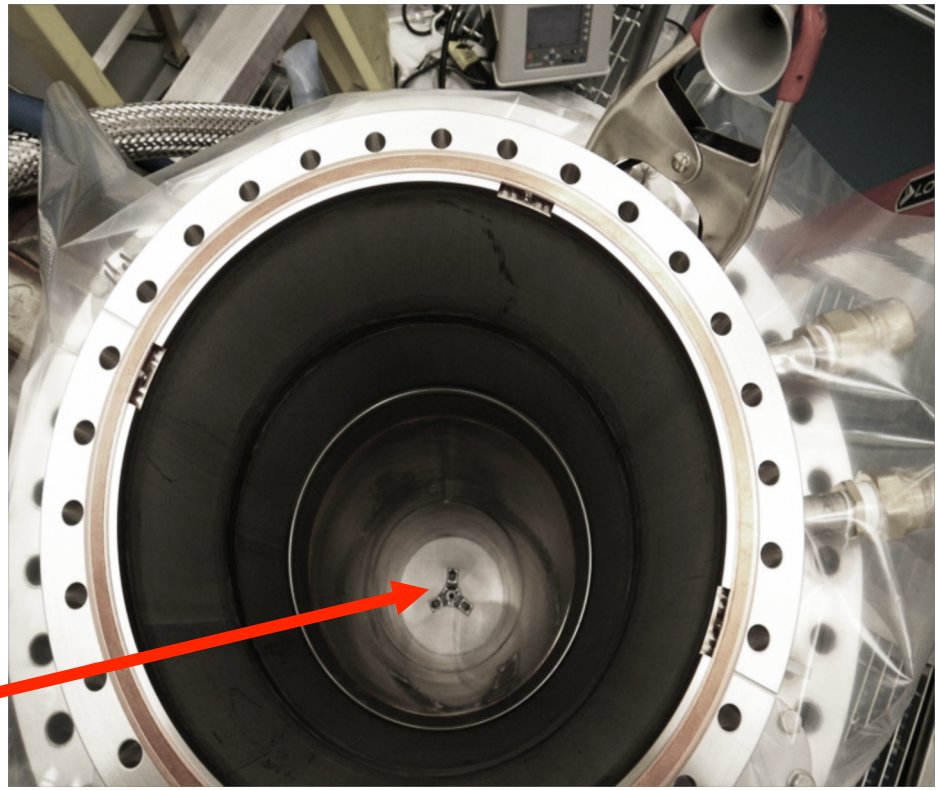


Furnace capable of extreme temperatures.

Coating the Cavity





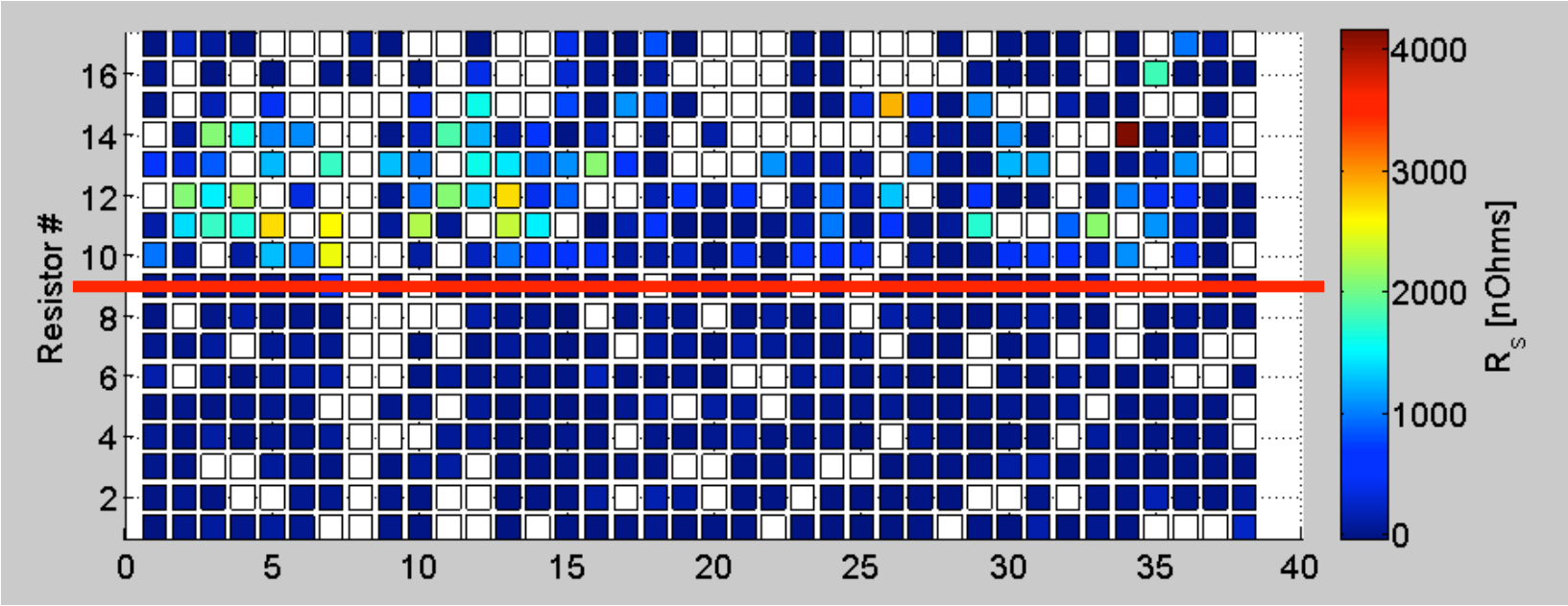


Once these are inserted and the cavity is resting on top of it, the furnace is heated to ~1300 °C.

Testing the cavities

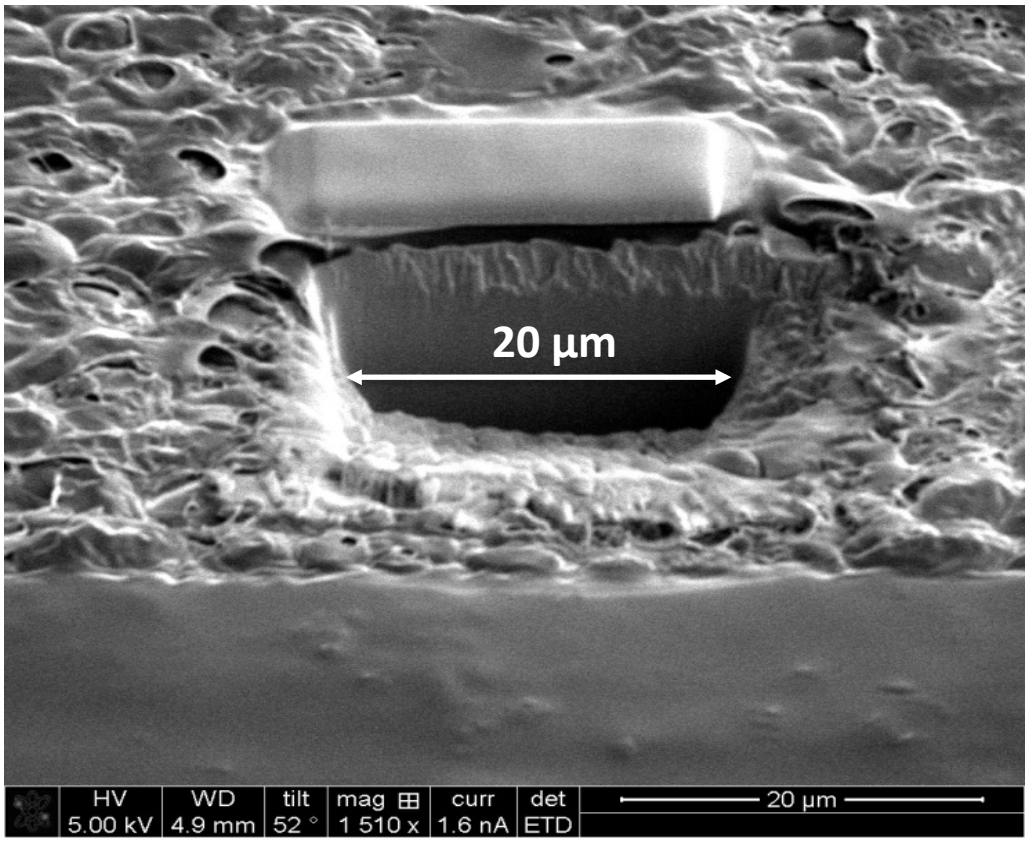
By resting a series of temperature-sensing resistors on the cavity and then submerging it in liquid helium, the t-maps for testing are calibrated.

Once calibrated, a field is put through the cavity and we can record how the cavity responds through t-mapping.



Surface Analyses

Transmission Electron Microscopy (TEM): transmitting electrons through a thin object and forming an image based upon the interaction of the electrons.



By cutting out an incredibly small cross-sectional area from witness samples, the TEM can then be performed on it.

Looks at tin layer thickness, surface roughness, etc.

Overall Goals

- Successfully coat/test cavity
- Study Q-slope and determine possible reasons for its behavior.
- Mess with Matlab to analyze t-maps

QUESTIONS? (don't feel obligated…)