

#### Nitrogen Diffusion into Niobium: A Step Toward Consistent High Qo-Cavities

#### Nicolai Giedraitis





# My Background

#### Summer Research for Community College Students (SRCCS)





#### Mohawk Valley Community College

Advisor: Matthias Liepe Mentor: Daniel Gonnella



An Outline

- Introduction to Nitrogen Treatment
- Current Results from Treatment
- Next Steps in Development
- What I Hope to Contribute...





# Surface Resistance

- AC still experiences resistance
- BCS Resistance
- Residual Resistance



- Q<sub>0</sub> Slope in Medium Field Region
- Limitation for CW operations



# **Cavity Preparation**

- 1.3 GHz single-cell
- RRR 300 Niobium

- Electropolish (VEP)
- Bake
- Heat Treatment in Vacuum
- Heat Treatment in Nitrogen





# **Depth Profile**



Fermi National Accelerator Lab published the first paper on Nitrogen doping in Niobium

Additionally, Argon doping was tested

#### **FNAL SIMS Nitrogen Profile**



### **Depth Profile**



Higher Levels of Nitrogen.

Cornell set record Q0 with this Nitrogen Treatment.

Q0 = 6x10<sup>10</sup> At 30 MV/m

#### **Preliminary Cornell Nitrogen Profile**



# **Chemical Analysis**



XPS Data Collected at CCMR

Provides great detail into the surface chemistry (  $\approx 2\mu m$  deep)

Utilizes XPSCasa to provide quick analysis (if user has spent a lot of time in Casa)



### More XPS Data



#### Wider Energy Range XPS Data collected at CCMR



### Further





- Modifying models to promote better understanding of treatments
- Measuring data that reproduces or exceeds FNAL results
- Changing variables in treatment to reach optimal performance





#### Please keep it civil.

# I retain the right to not answer questions at my discretion.



### **Contact Information**

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### References

#### Many Thanks to CLASSE SRCCS Program, the SRF Group, Matthias Liepe, Daniel Gonnella, Jonathan Shu, FNAL, NSF, NASA, and the NY Space Grant Consortium.

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