1. Introduction

From irradiating sewage water to sterilizing medical equipment to repairing our infrastructure, accelerators are a hallmark of modern society. SRF cavities enable accelerators to produce beams of far higher power at a higher efficiency. However, industry does not use these cavities due to the liquid helium they require to stay at superconducting temperatures. Recent advances in SRF technology have enabled operation of these machines near 4 K, a temperature easily achievable using commercial cryocoolers. By using a cryocooler to conductively cool a cavity, it is possible to eliminate the cost of liquid helium from the accelerator. The design of such a conduction cooling scheme poses unique challenges, some of which are investigated in this study.

2. Challenge: Engineering support structure, cooling structure

- Cooling a cavity poses engineering challenges:
  - How do we support the cavity while keeping it thermally isolated?
  - How do we connect the cavity to the cryocooler?

- Through 3D-modeling, we have drafted support structures and cooling structures

- Fabrication and assembly underway

3. Challenge: Optimizing Thermal Connections

In our setup, an Aluminum (Al) thermal bus will connect a Niobium (Nb) cavity to a cryocooler

- At 4 K, mechanical joints likely to dominate thermal resistance

- To minimize resistance, we must find best:
  - Interposer
  - Bolting pressure
  - Surface preparation

- Using the two-heater one-thermometer method [4], we are investigating these variables

4. Progress and the Future

- Apparatus revamped for automated control
  - Expedited joint testing

- Conduction cooling being attempted for the first time ever (1.3 GHz cavity)
  - First cool-down time estimates

- Optimize support and cooling structures to minimize:
  - Static heat load
  - Cool-down time

References