

Summer Research for Community College Students – 2013

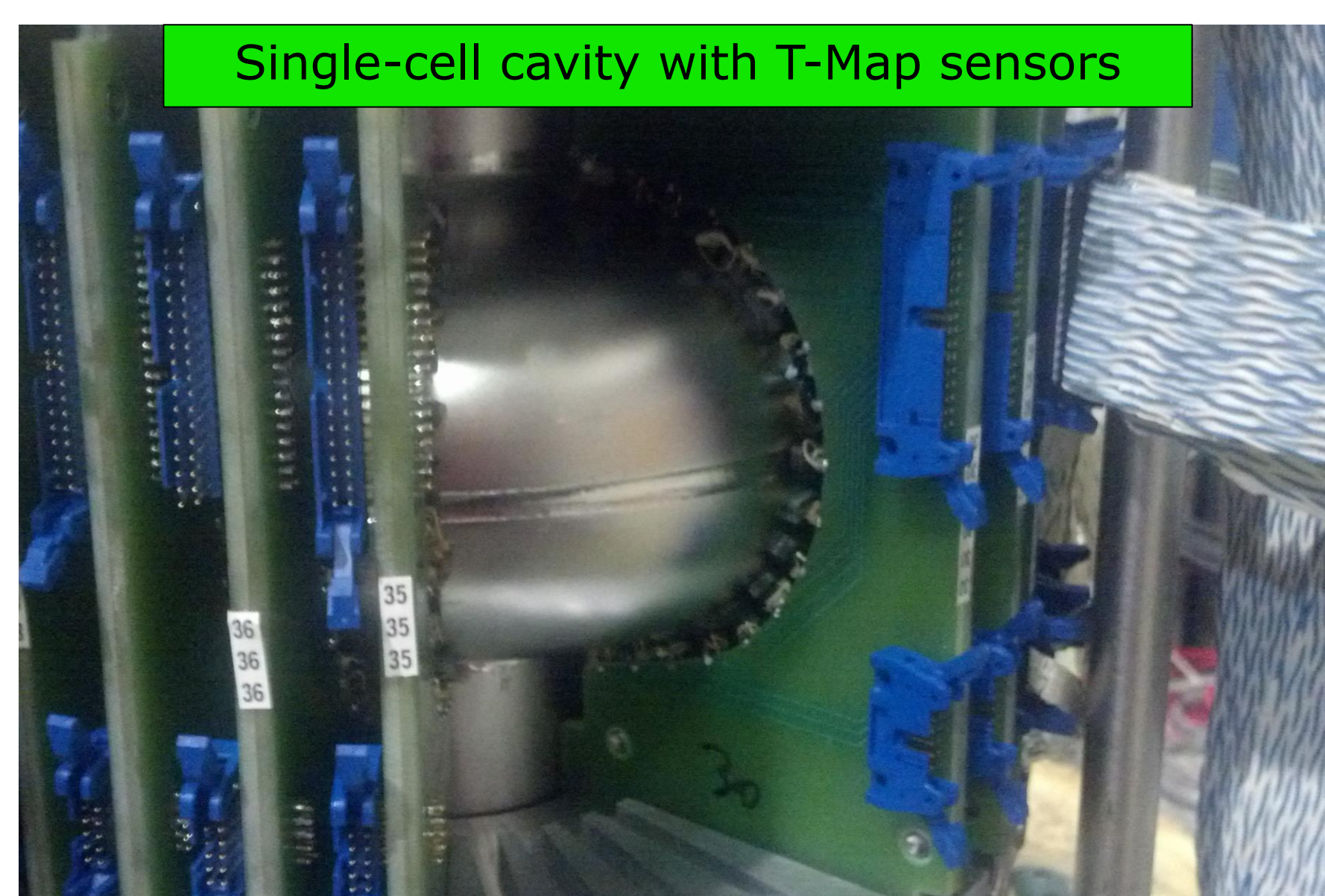
Temperature Mapping of Single-Cell Superconducting Radio Frequency Cavities

Data Acquisition Using LabVIEW

Introduction

Cornell University manufactures niobium superconducting radio frequency (SRF) cavities for research and development of future particle accelerators. Single-cell cavities are built to understand the fundamental physics behind SRF to make continuing improvement in production and performance of particle accelerators.

A temperature map (T-Map) of a SRF cavity provides a full temperature profile of the cavity. From a T-Map material properties can be interpreted to better understand SRF. T-Map measurements are performed in a cryogenic dewar that is filled with liquid helium to test at temperatures from 4.2 K to 1.6 K.



Current Configuration

On cavity:

- 38 circuit boards
- 17 Allen and Bradley resistors per board
- 646 Resistors on the cavity

Cabling in test pit:

- 24 cryogenically rated cables connect to boards
- 32 twisted pairs per cable

National Instruments (NI) Hardware:

- 1 NI-DAQ PCI 6229 Card in testing computer
- 2 NI SCXI-1001 chassis daisy chained together
- 12 NI SCXI-1100 Modules per chassis
- 32 Channels per module
- 768 channels to read voltages from

1000 samples per channel are taken and averaged

A fully functional MATLAB graphical user interface (GUI) for data acquisition and analysis is used

Using NI LabVIEW

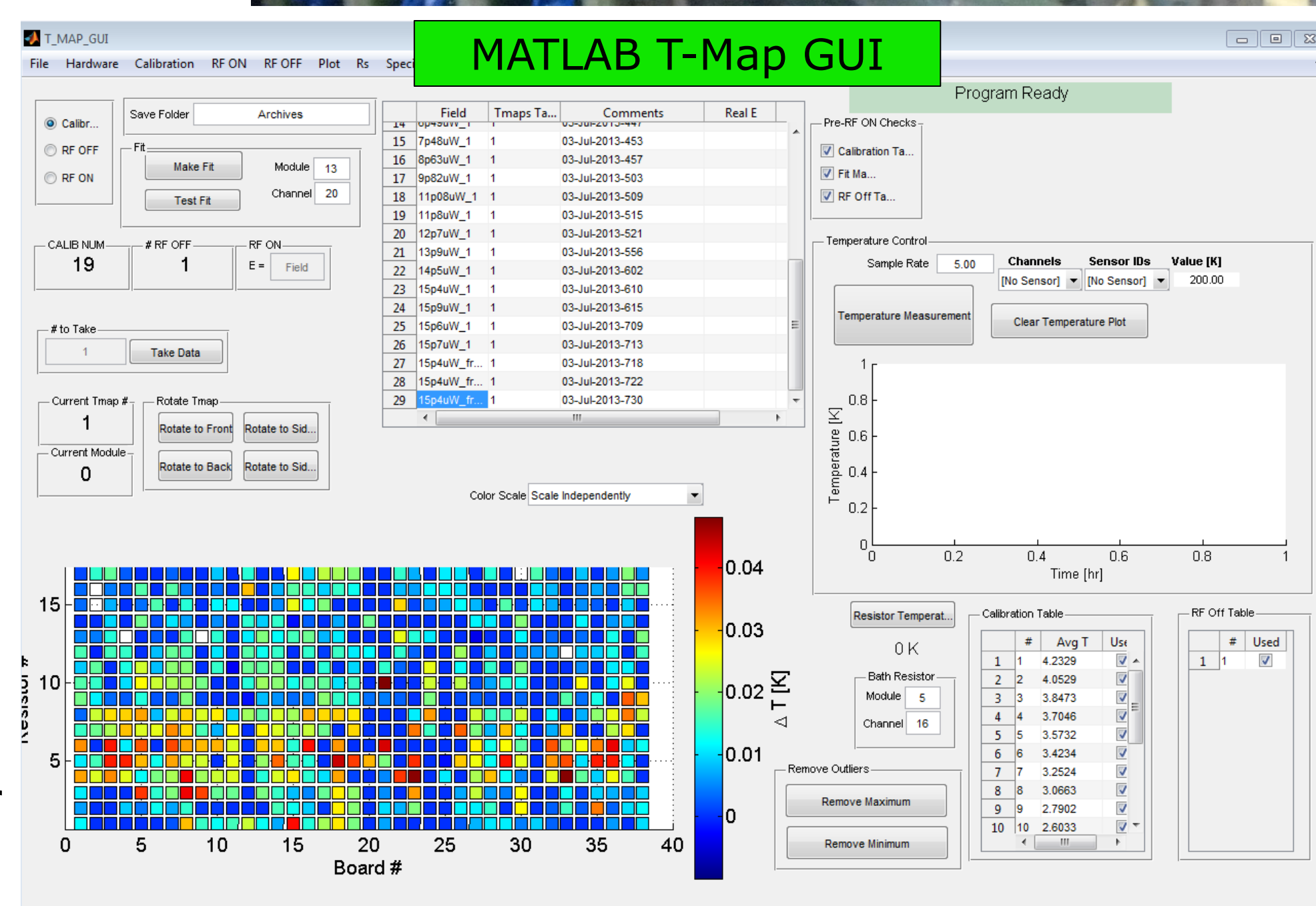
LabVIEW is ideal for data acquisition due to the fact there is no delay between reading channels unlike in MATLAB.

- MATLAB reading all channels: 160 seconds
- LabVIEW reading all channels single channel: 46 seconds
- LabVIEW reading all channels multiplexed: 26 seconds

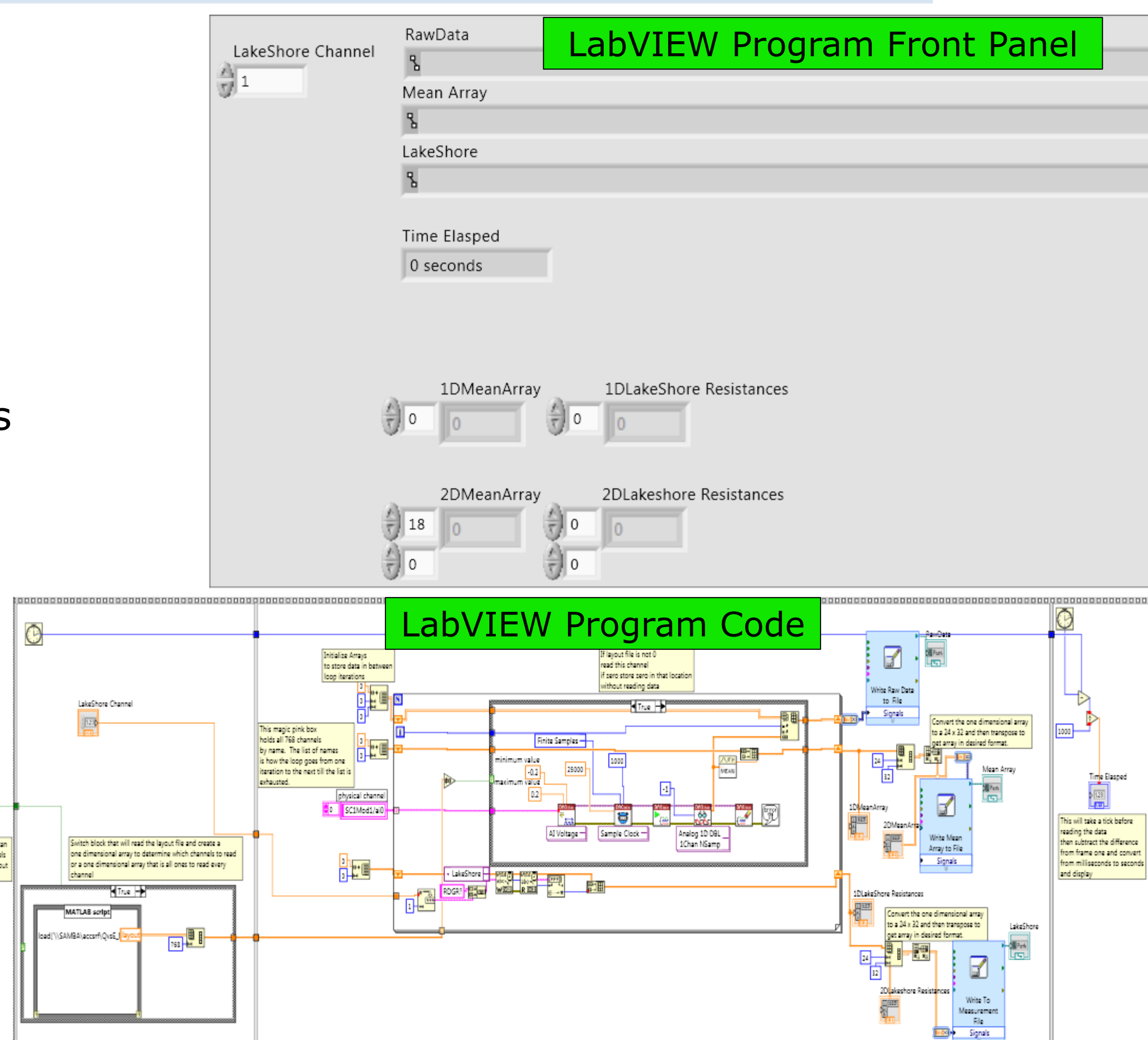
Decreased read times means more T-Maps per test cycle

Current Limitations

Does not interface with MATLAB GUI



LabVIEW Program Front Panel



LabVIEW Program Code

Design of Vacuum Tubes for Transition of Testing Pits for Temperature Mapping System

Motivation

- 17.5" Diameter dewar in center pit
- 22" Diameter dewar in west pit

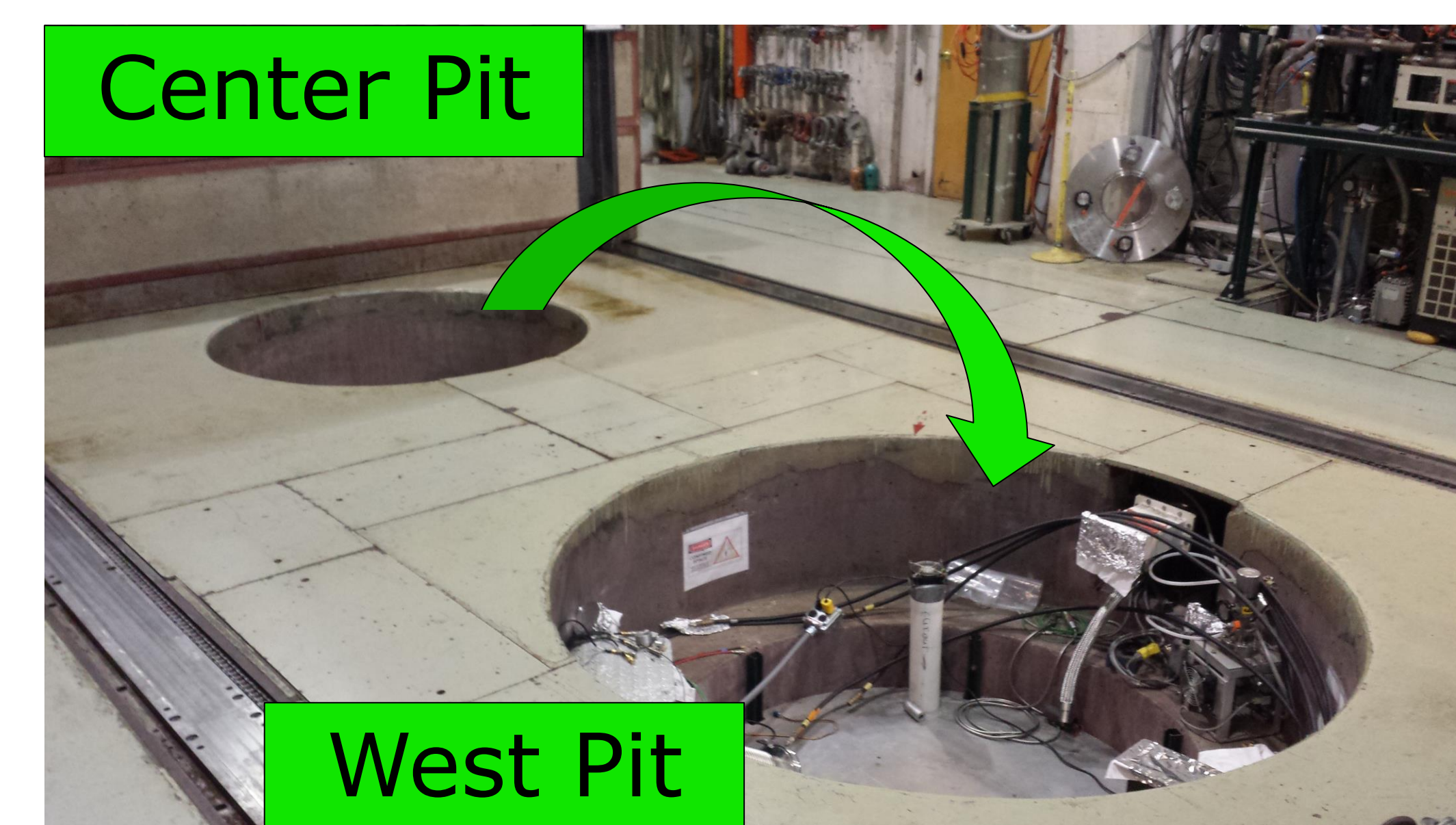
Advantages of west pit:

- Increased time for testing (more helium)
- Reduce wear on resistors, boards and cables
- Boards won't have to be rotated into position
- Space for an all-metal valve

Reasons to have all-metal valve:

- Cleaner transfer from one cavity to the next
- More efficient with the possibility of two lower insert assemblies

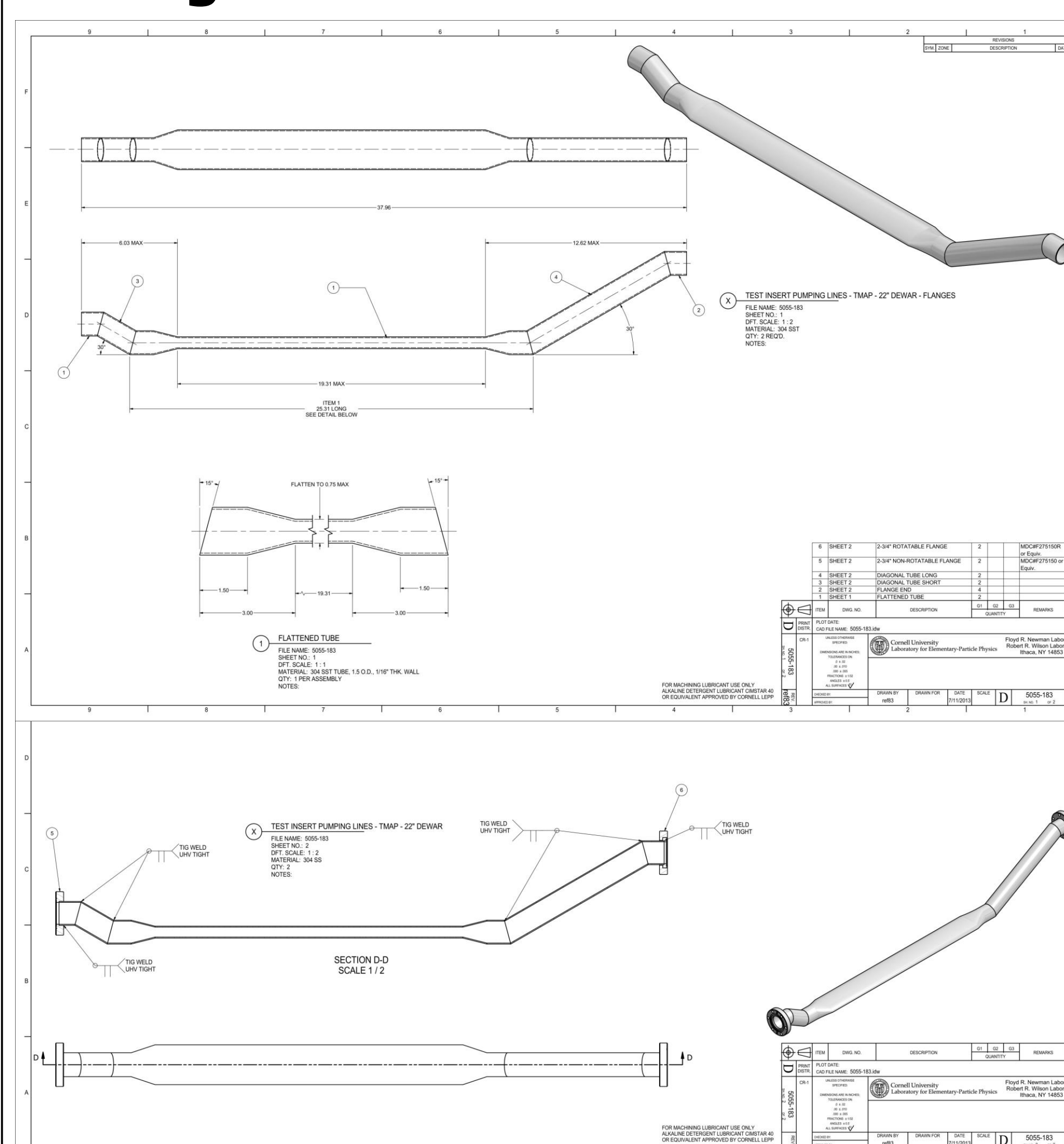
Same day cavity swap vs. two days to transition insert to next cavity to be tested



Design considerations

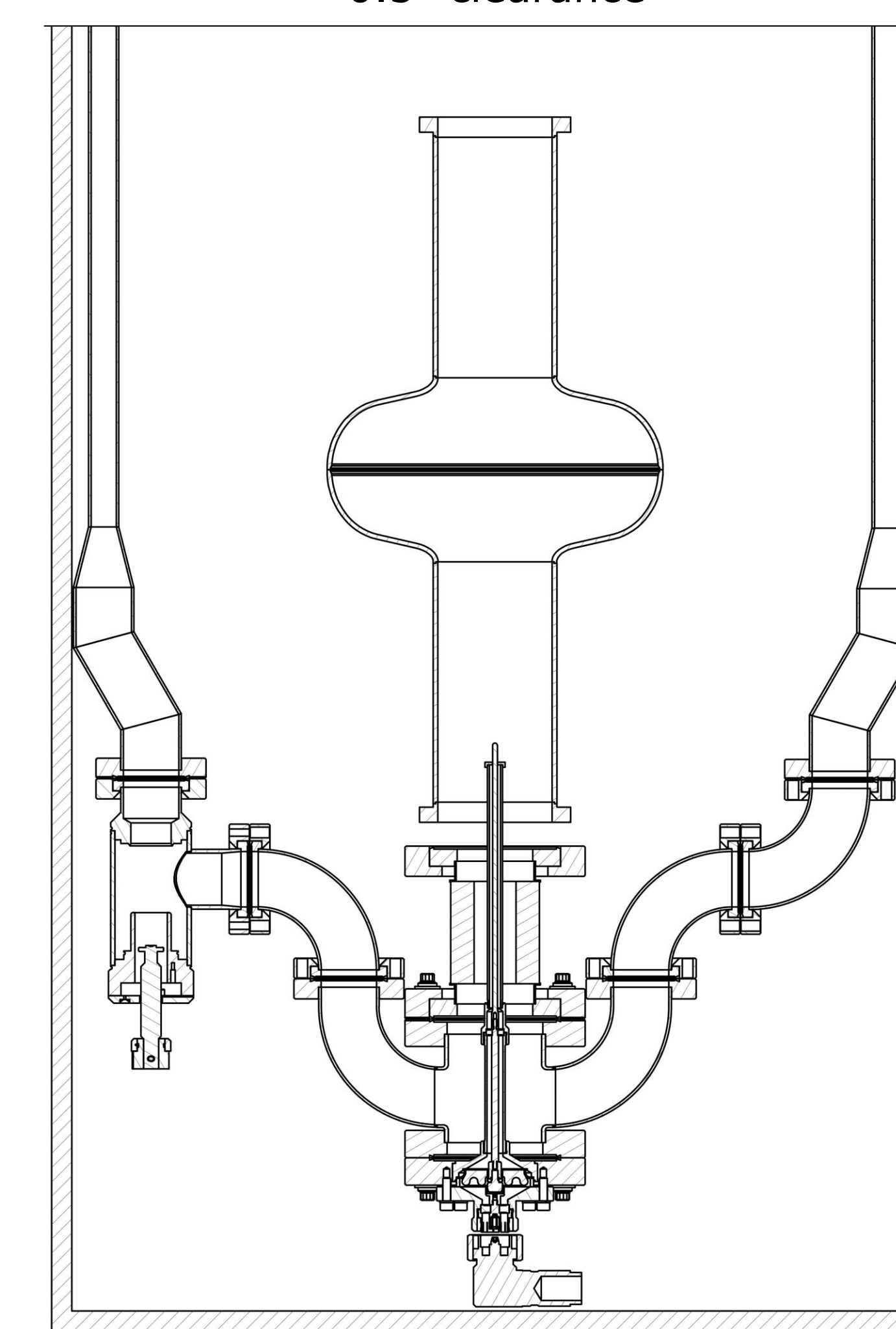
- 0.5" of clearance on all sides between the insert and the dewar
- Maximize interior clearance between cavity and vacuum tubes
- Purchase new vacuum accessories (all-metal valve, 90° elbows)

Designed West Pit Vacuum Tubes



Proposed West Pit Insert Design

Shown with 22" dewar and 0.5" clearance



Center Pit Insert

