

Transportation Fatigue Testing of the pHB650 Power Coupler Antenna for PIP-II at FNAL

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ABSTRACT

The PIP-II Project will see international shipment of cryomodules from Europe to the United States, and as such, the shocks which can occur during shipment pose a risk to the internal components. Of particular concern is the coupler ceramic window and surrounding brazes, which will see stresses during an excitation event. Since the antenna design is new, and because of the setback failure would create, a cyclic stress test was devised for the antenna. This paper presents the experimental methods, setup, and results of the test.

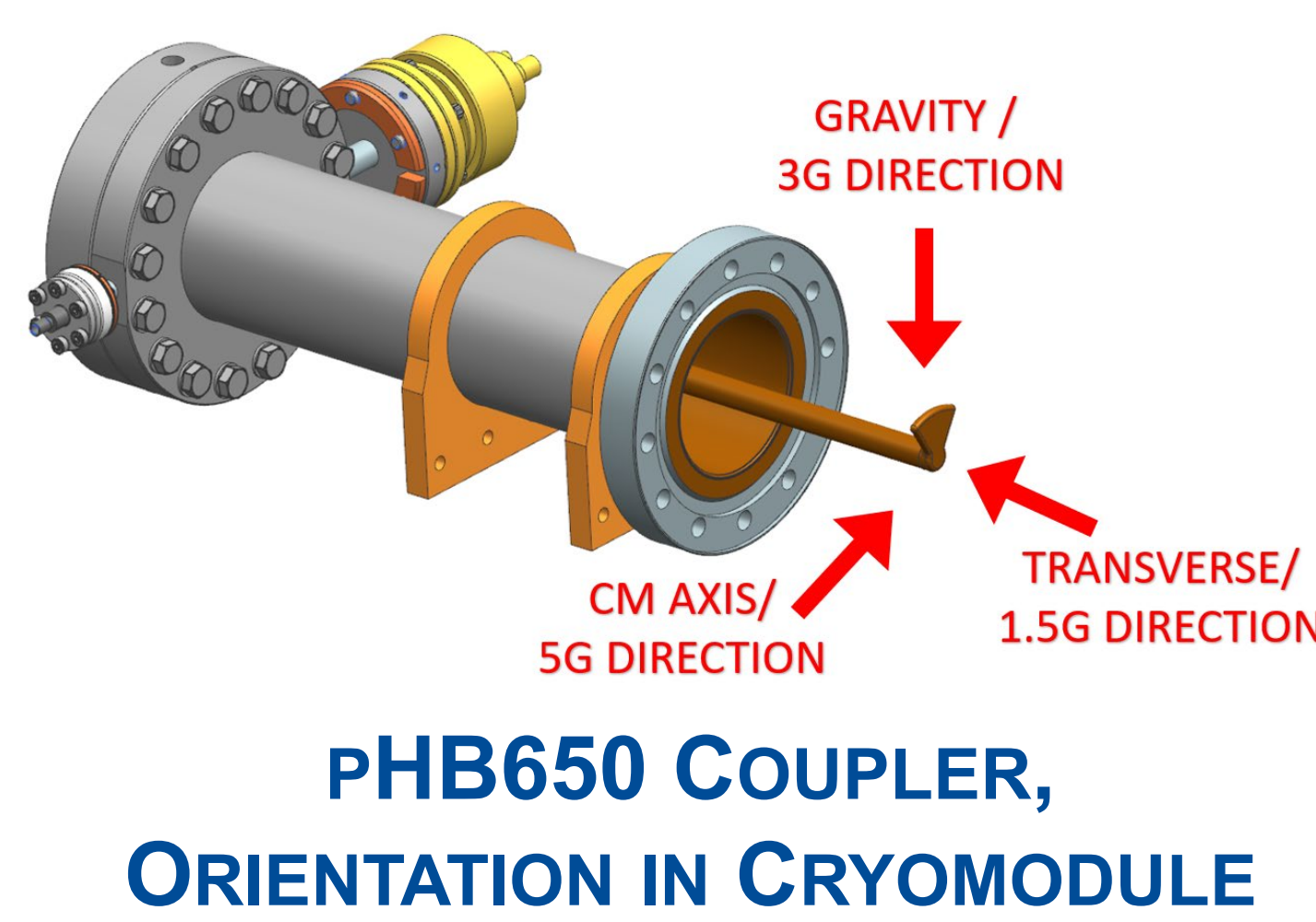
INTRO / METHODS

Introduction

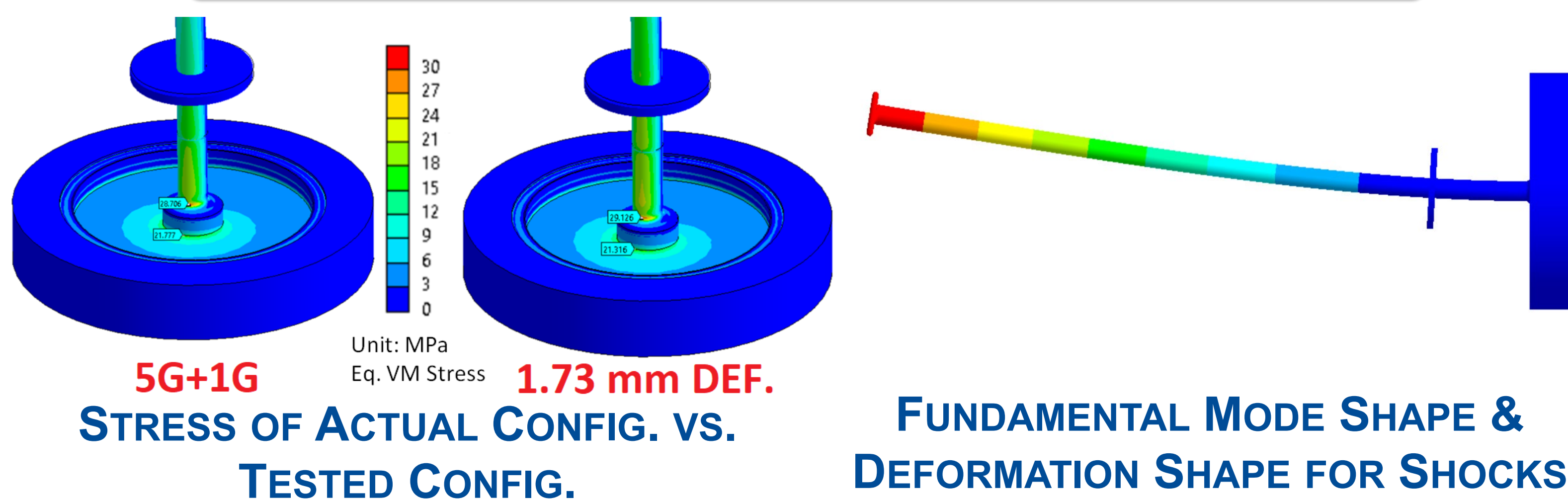
- Antenna will be horizontal during CM transport, can see perpendicular shocks of 5G+1G
- Antenna design is novel, having only one ceramic window separating the beamline volume from atmosphere

Methods

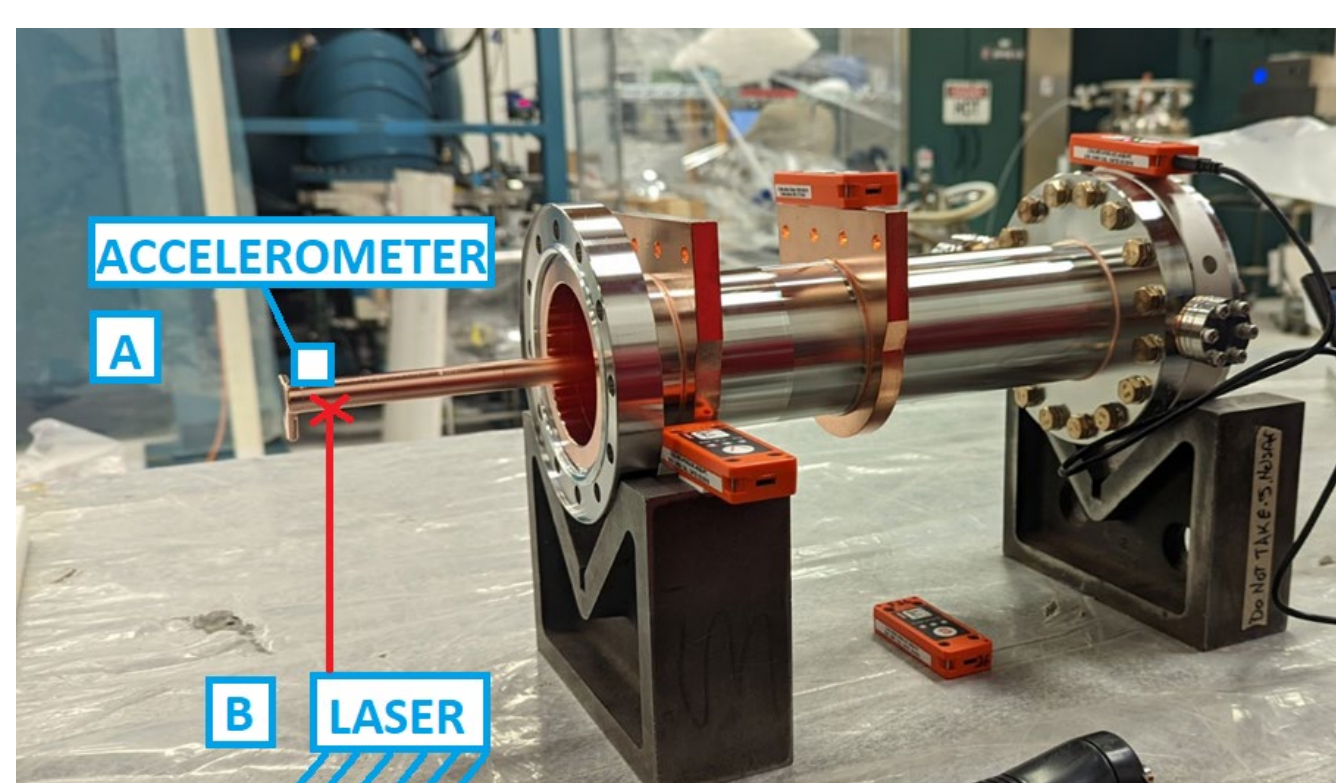
- Verify resonant behavior, estimate ring down time
- Estimate cycles at all shock levels experienced during transport
- Convert all shocks to an equivalent number of fully reversed displacement cycles to be applied to the antenna
- Apply cyclic displacement using an Arduino controlled tester



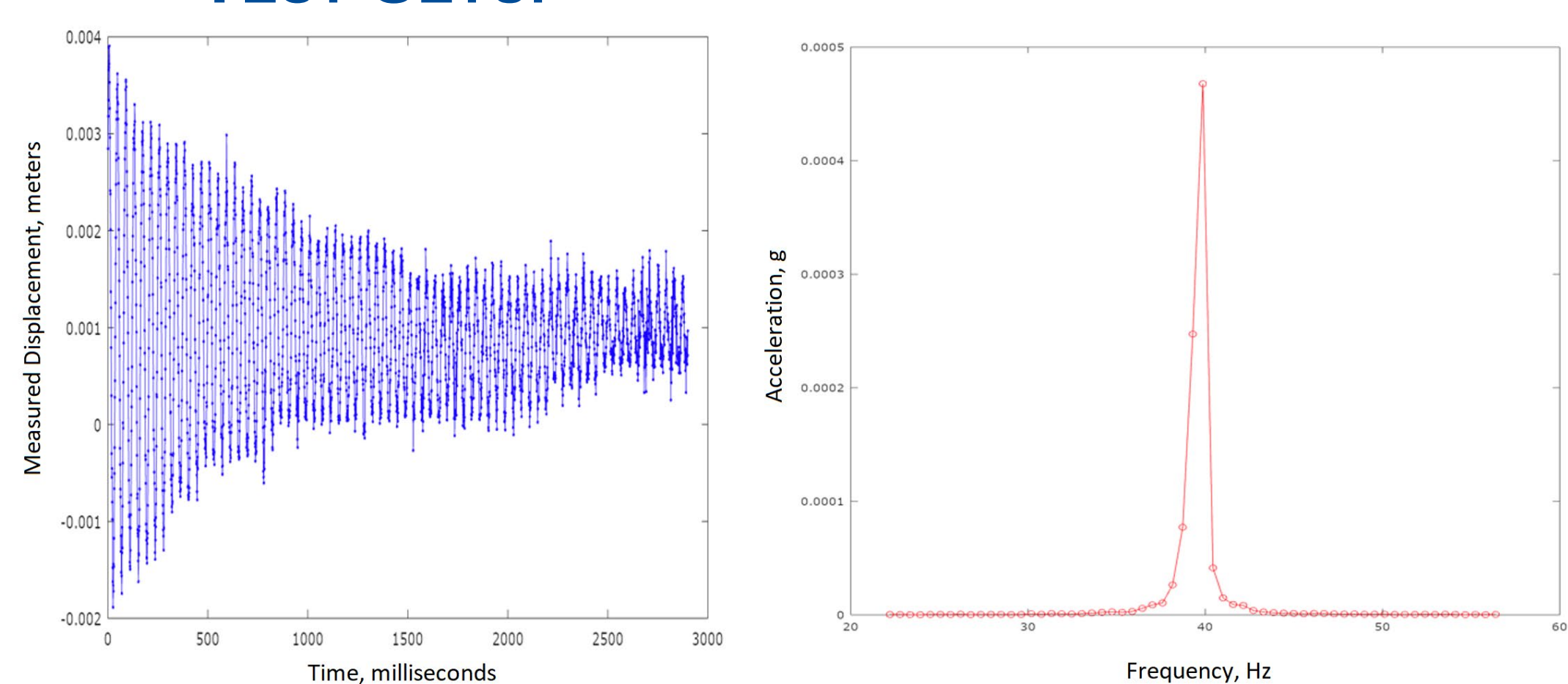
ANALYSIS



RESONANCE



- Predicted: 37 Hz
- Measured: 39 Hz
- Decay: Approx. 1 sec for excitation to decay



Proton Improvement Plan-II



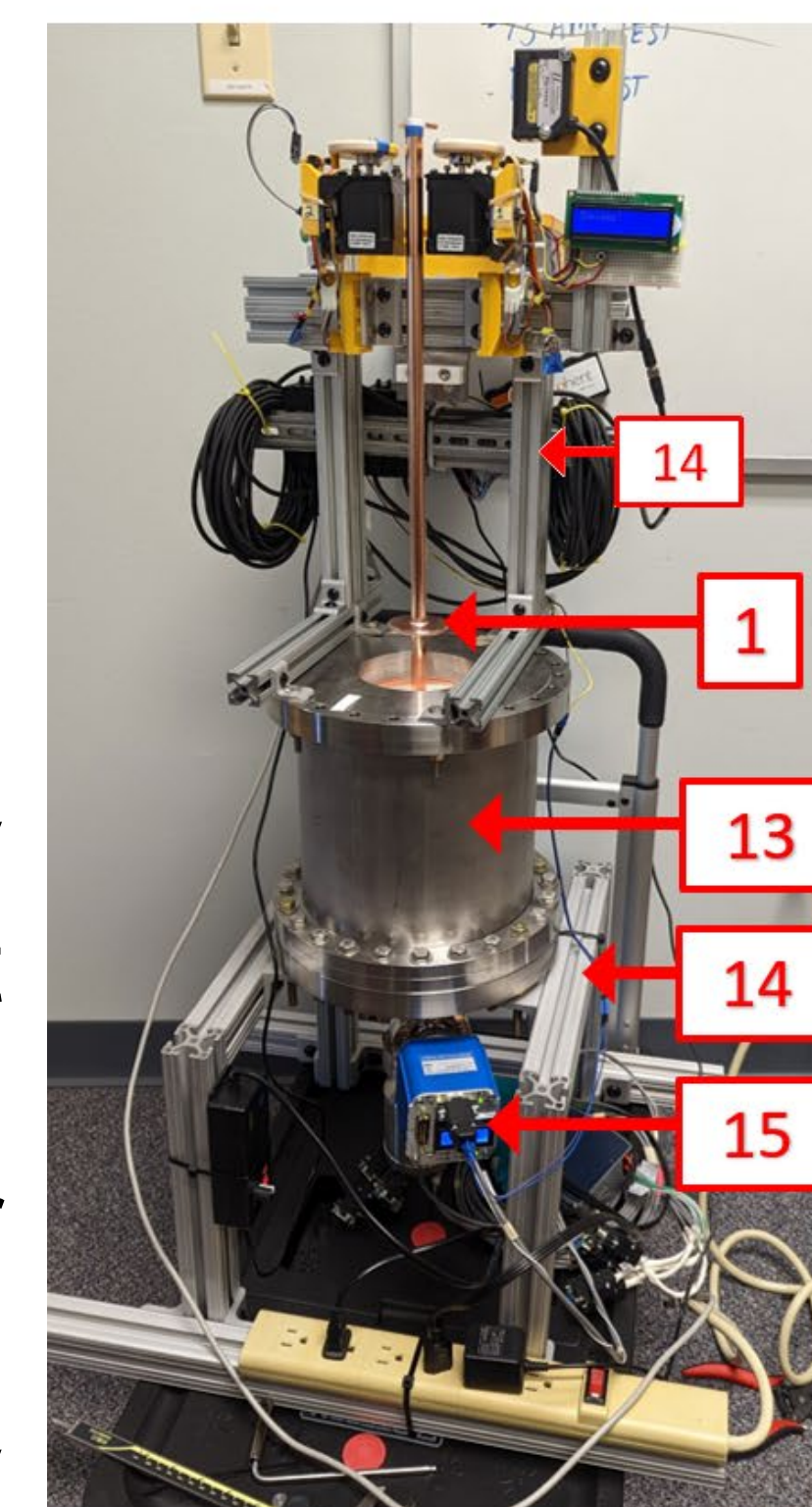
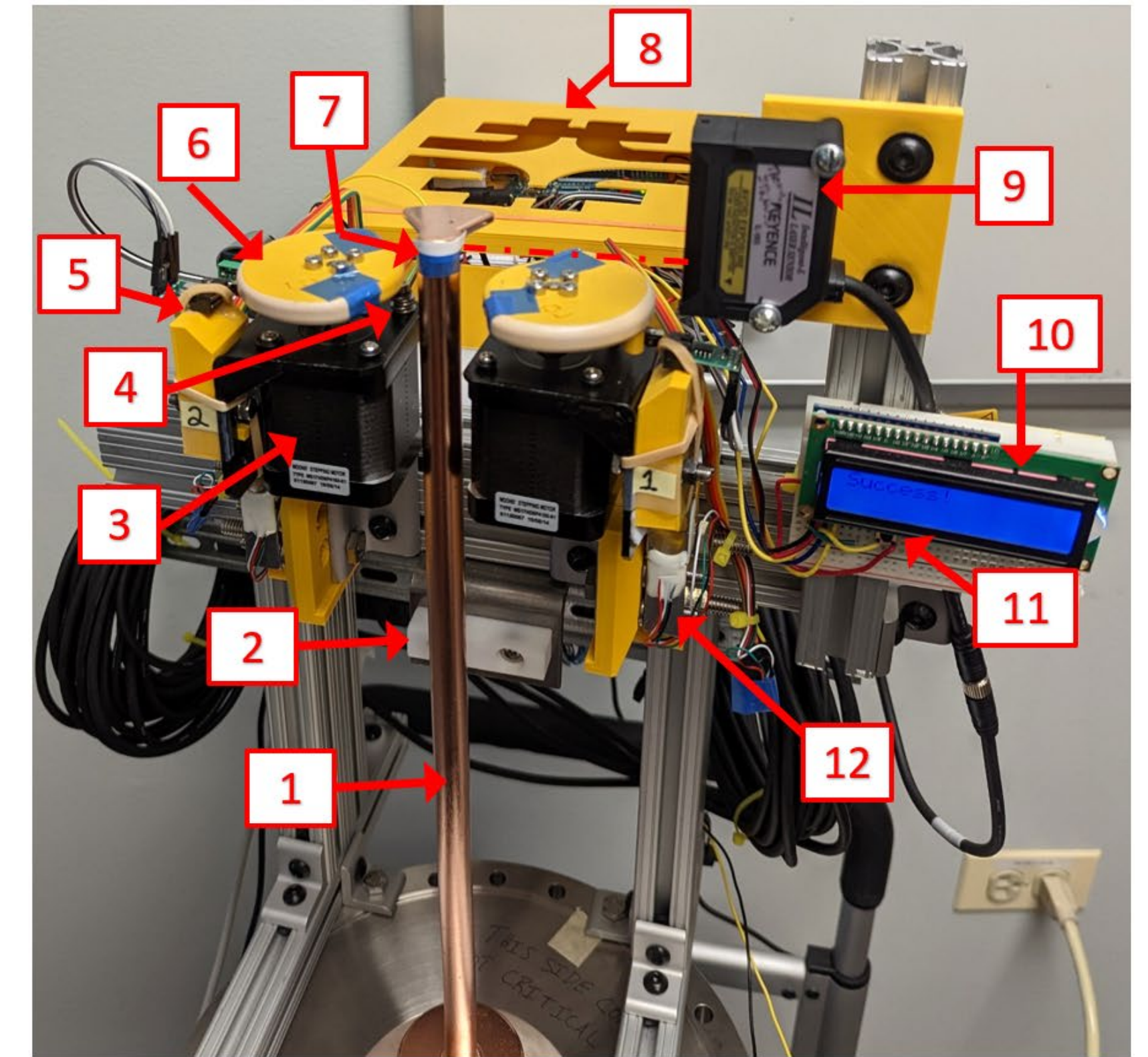
FATIGUE TESTER DESIGN



[VIDEO LINK](#)

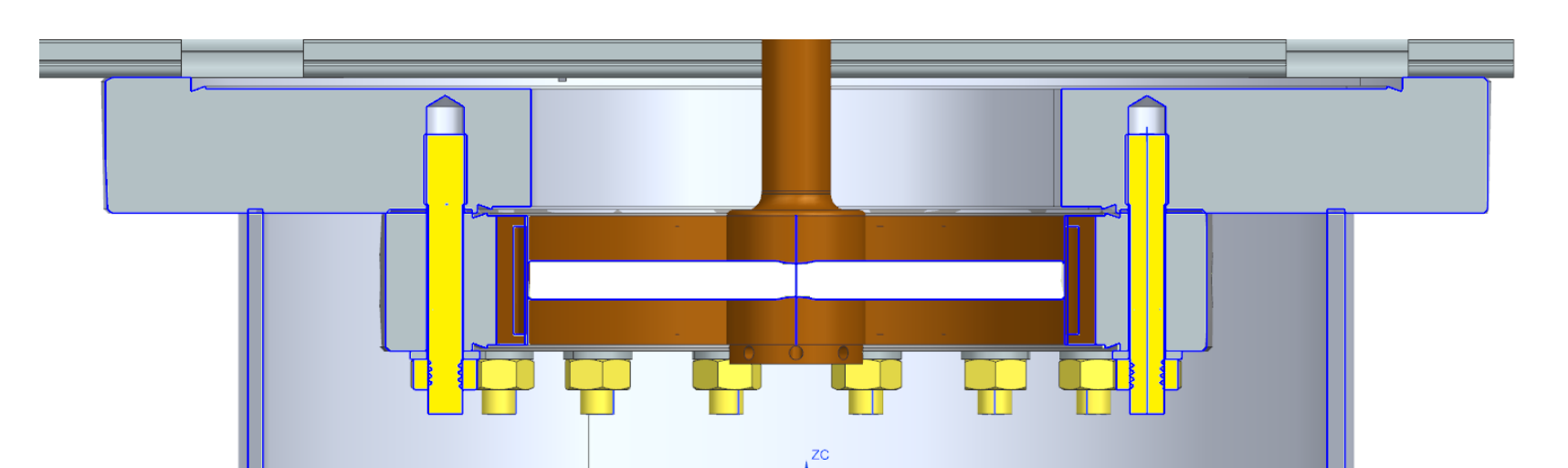
Highlights:

- Arduino Mega Controlled System
- Self correcting displacement
- Load cells to measure force reaction
- Vacuum monitoring
- Various safety features: limit switches, hard stops, sensor reading checks
- Stopped every 50 cycles to take sensor readings and check for problems

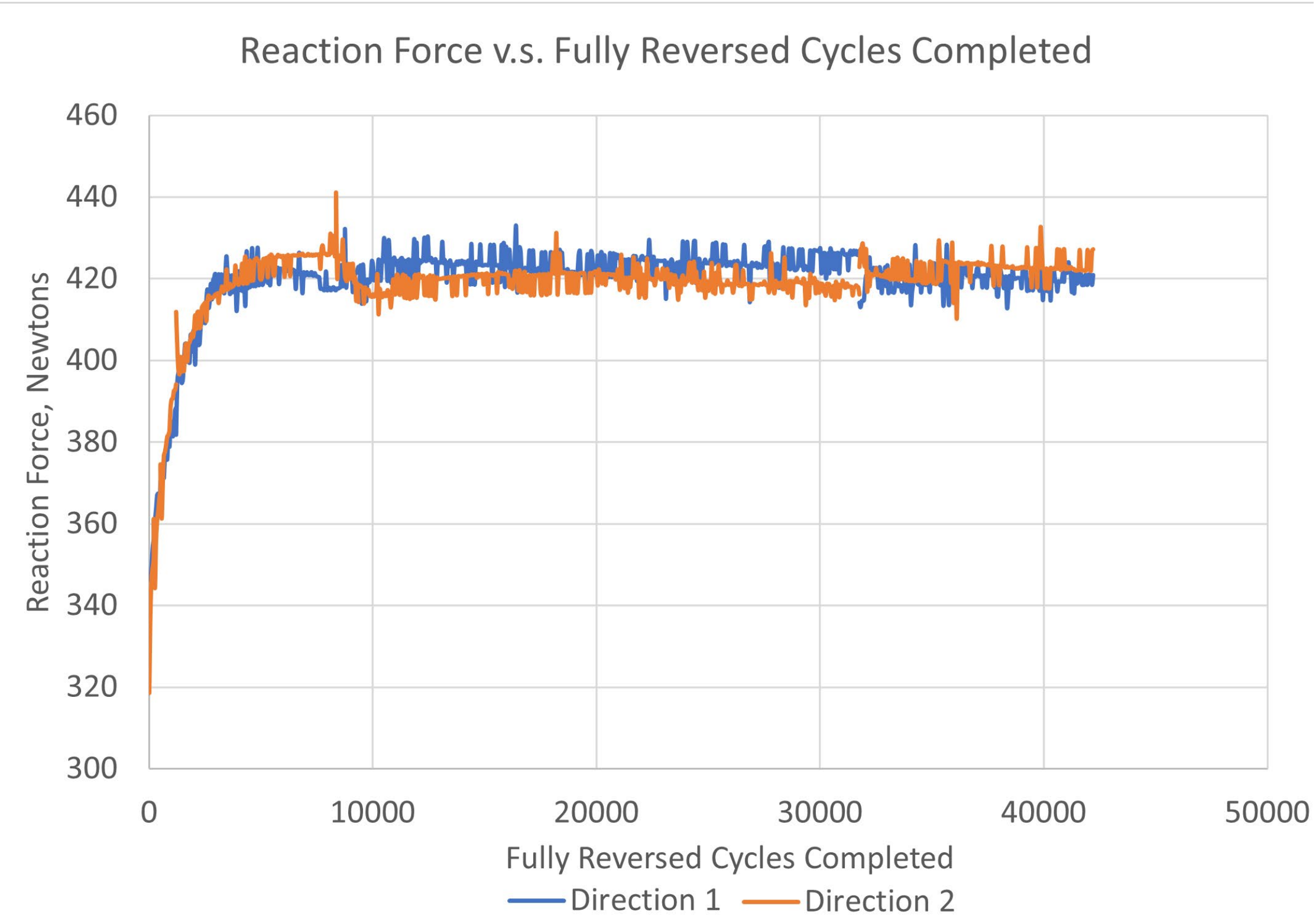


Item	Description
1	pHB650 Antenna
2	PTFE Slider Support Bar
3	Stepper Motor
4	Cam Safety Stop
5	Roller Limit Switch
6	Cam Lobe, Snail Shape
7	Non-Reflective Covering
8	Controls Housing
9	High Precision Laser
10	LCD Readout
11	User Interface
12	Load Cell
13	Vacuum Chamber
14	Framing
15	Vacuum Gauge

TESTER PRIMARY COMPONENTS



RESULTS & SUMMARY



Antenna completed 42,200 fully reversed cycles without damage. Transportation expected to occur without issue.



[EMAIL LINK](#)

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