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Title: 1L Target TMRS MK IV Upper Target Progress Report

Author(s): Scheel, Matthew Henry

Intended for: Inform my academic advisor of progress

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1L Target TMRS MK IV Upper Target Progress Report

12/4/2018

Matthew Henry Scheel

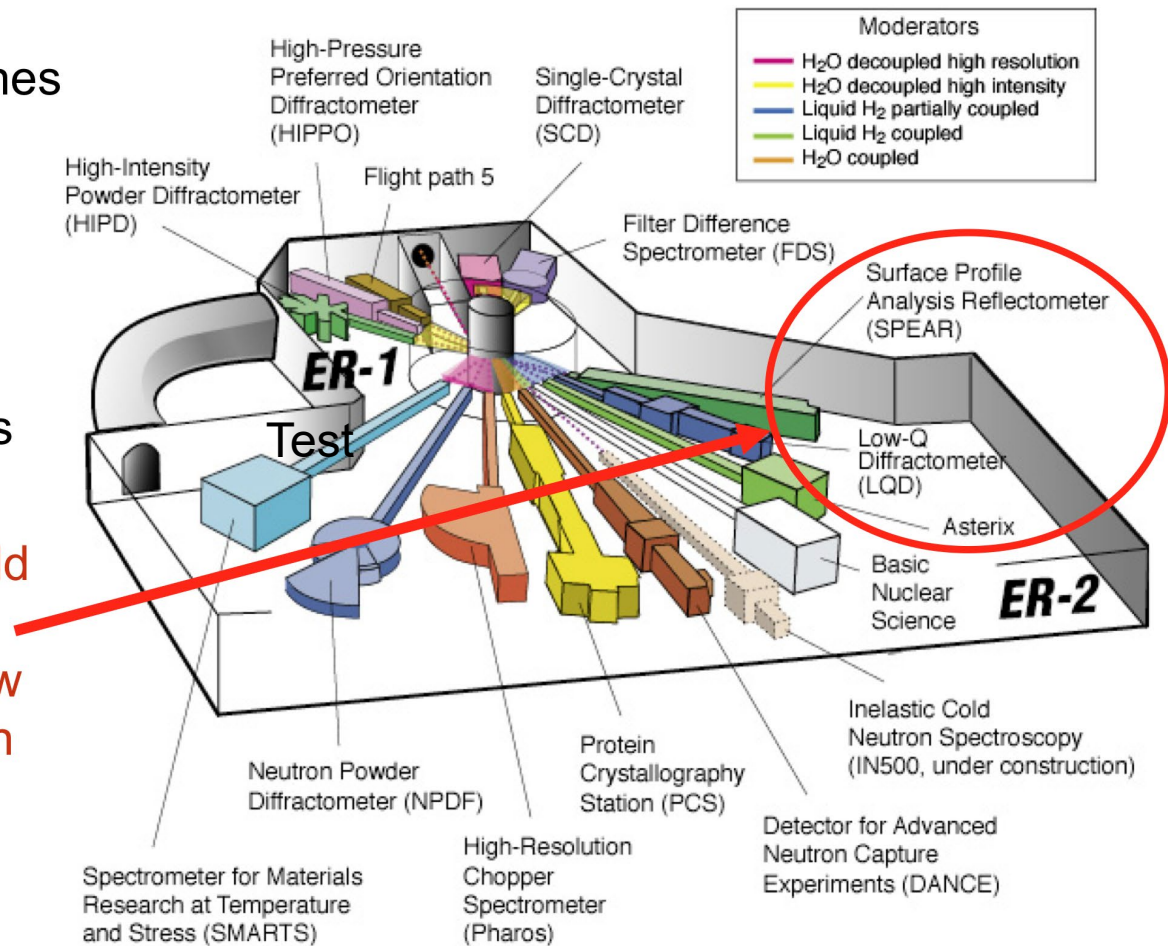
Outline

■ TMRS MK IV

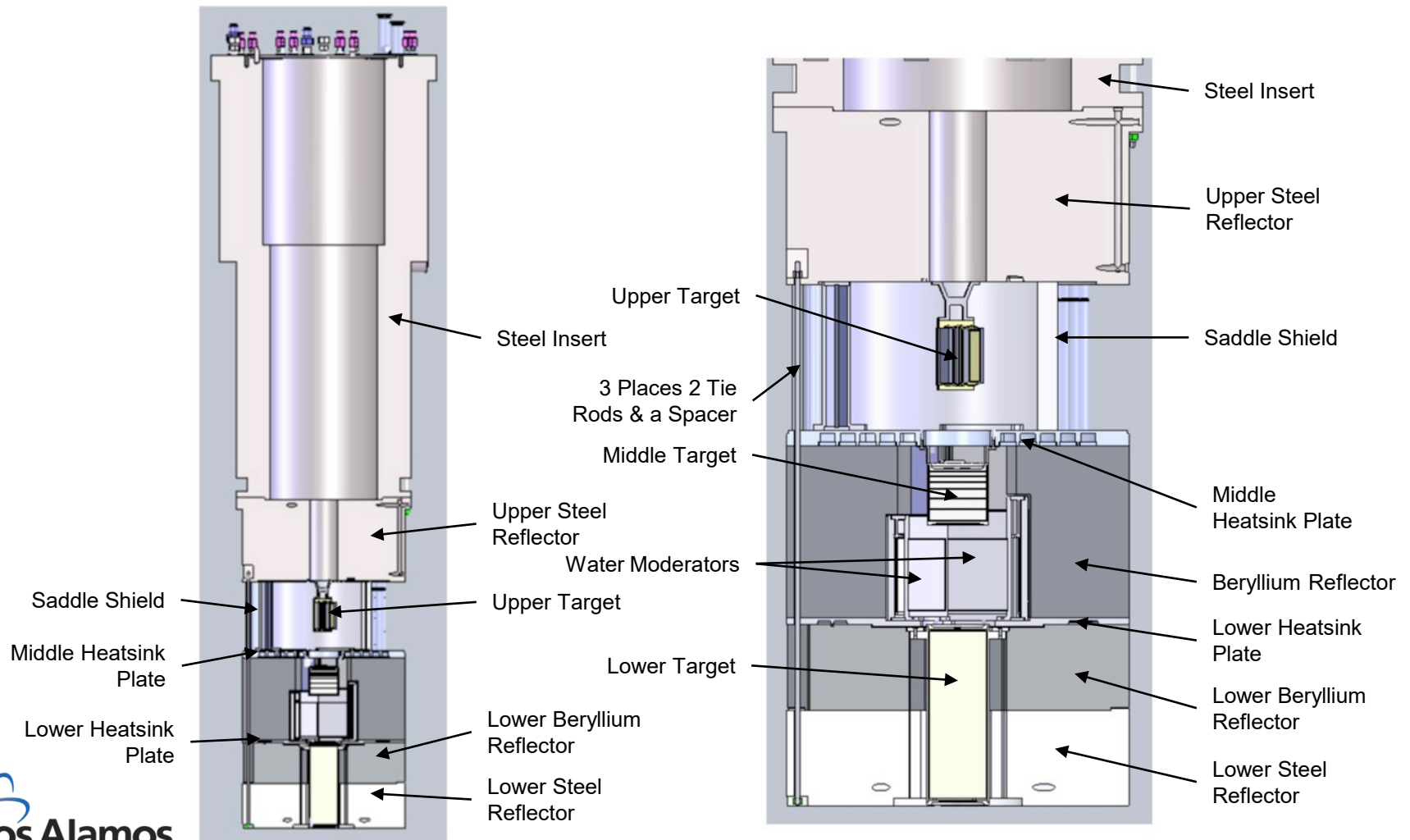
- 1L Upper Target (LANSCE/Lujan)
 - Design Requirements and Operational Characteristics
 - Geometric/Prototype Overview
 - System Summary
 - Structural Analysis
 - Fluids Analysis
 - Thermal Analysis
 - Procurement
 - Induction Coil
- Timeline Consensus

LANSCCE Lujan Center General Arrangement

- 16 neutron beamlines
 - Lower tier
 - Upper tier
- 2 liquid hydrogen moderators
- 4 water moderators
- Increase flux of cold neutrons for 3 instruments for new generation of Lujan TRMS (MK III)

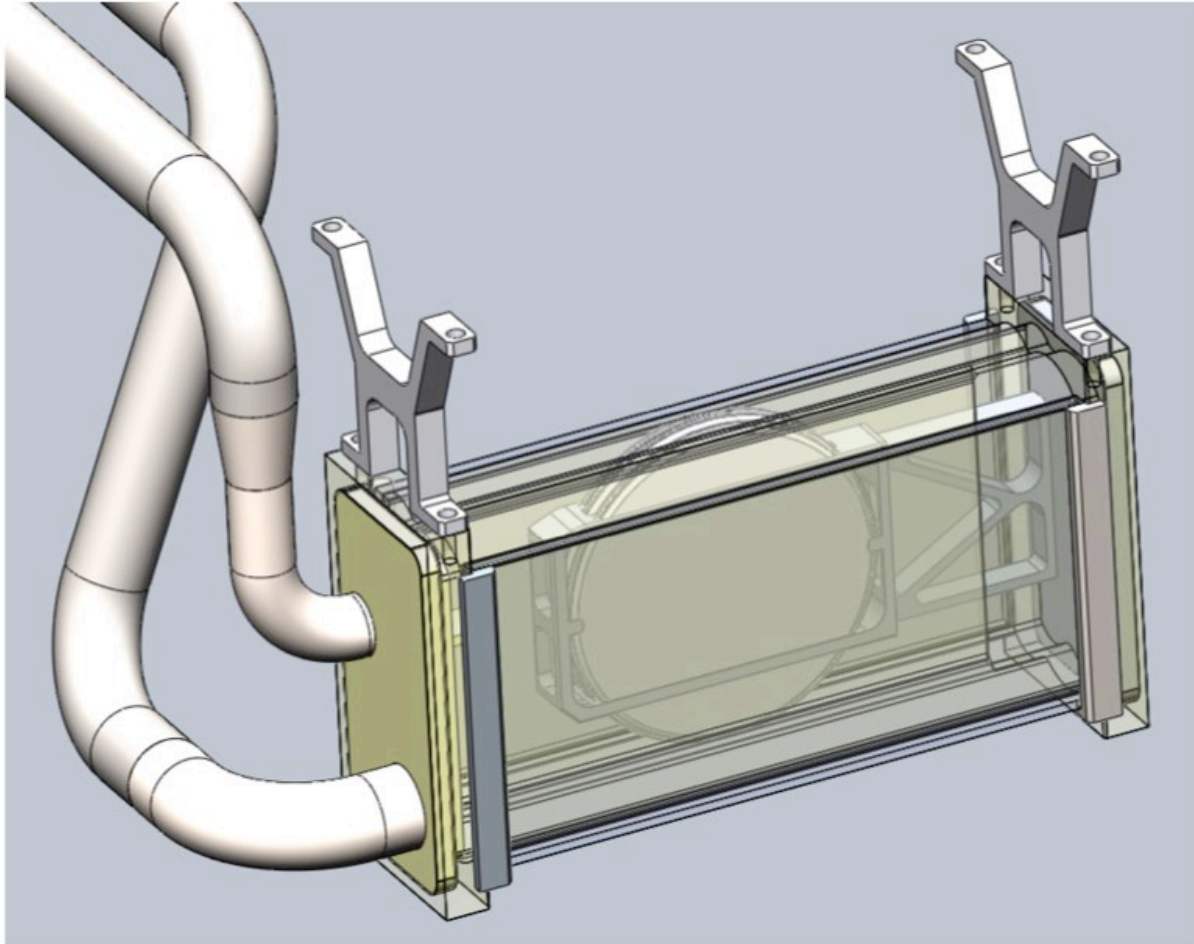


The TMRS Mk IV



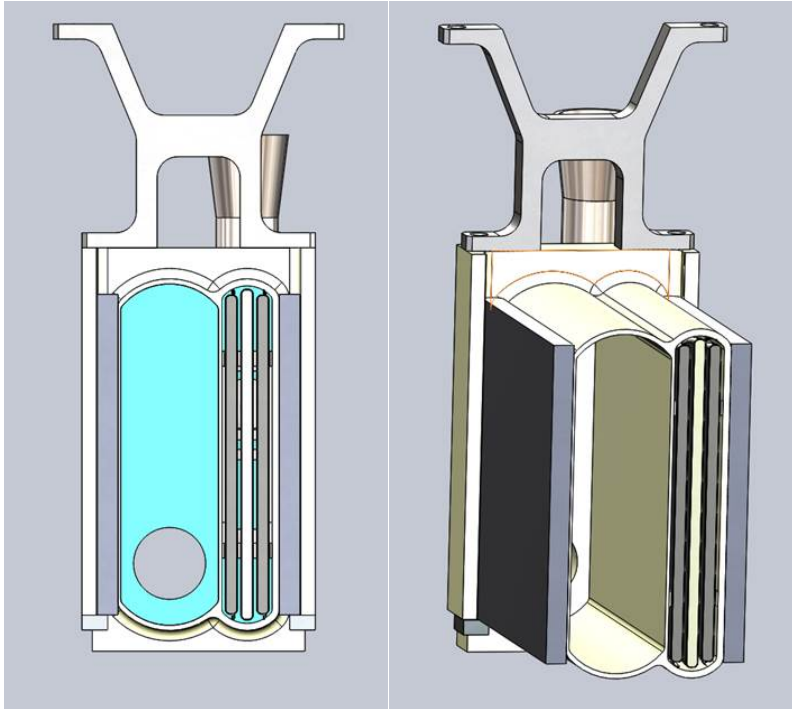
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Geometric Overview

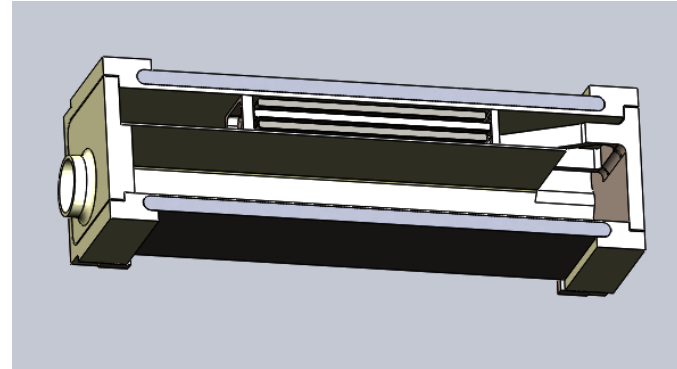


Geometric Overview

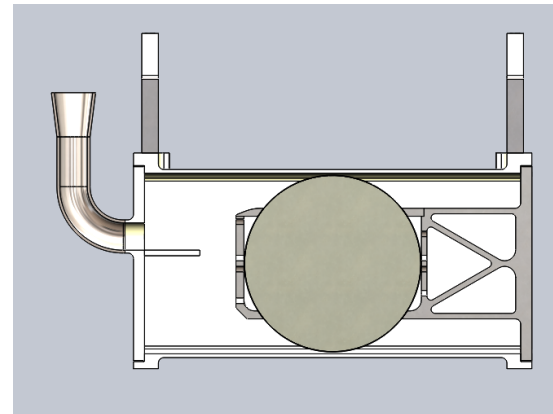
■ Front



■ Top



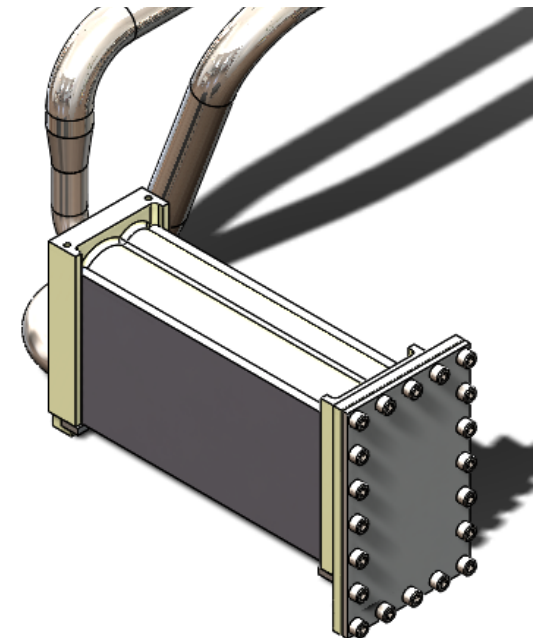
■ Side



Prototype Design Review (Package 1)

■ Nine-Element Assembly

- 144Y620
 - 859: Disk Holder Top Upper Target
 - 860: Coolant Manifold Weldment Upper Target
 - 861: Coolant Manifold Supply-Return Upper Target
 - 863: Strongback Weld Bracket Upper Target
 - 864: Support Upper Target
 - 865: Tube Support Clamp Upper Target
 - 867: Housing 3 Disk Upper Target Prototype
 - 869: Disk Holder Main Body Upper Target Prototype
 - 871: Aluminum Disk Upper Target Prototype



Design Requirements & Operational Characteristics

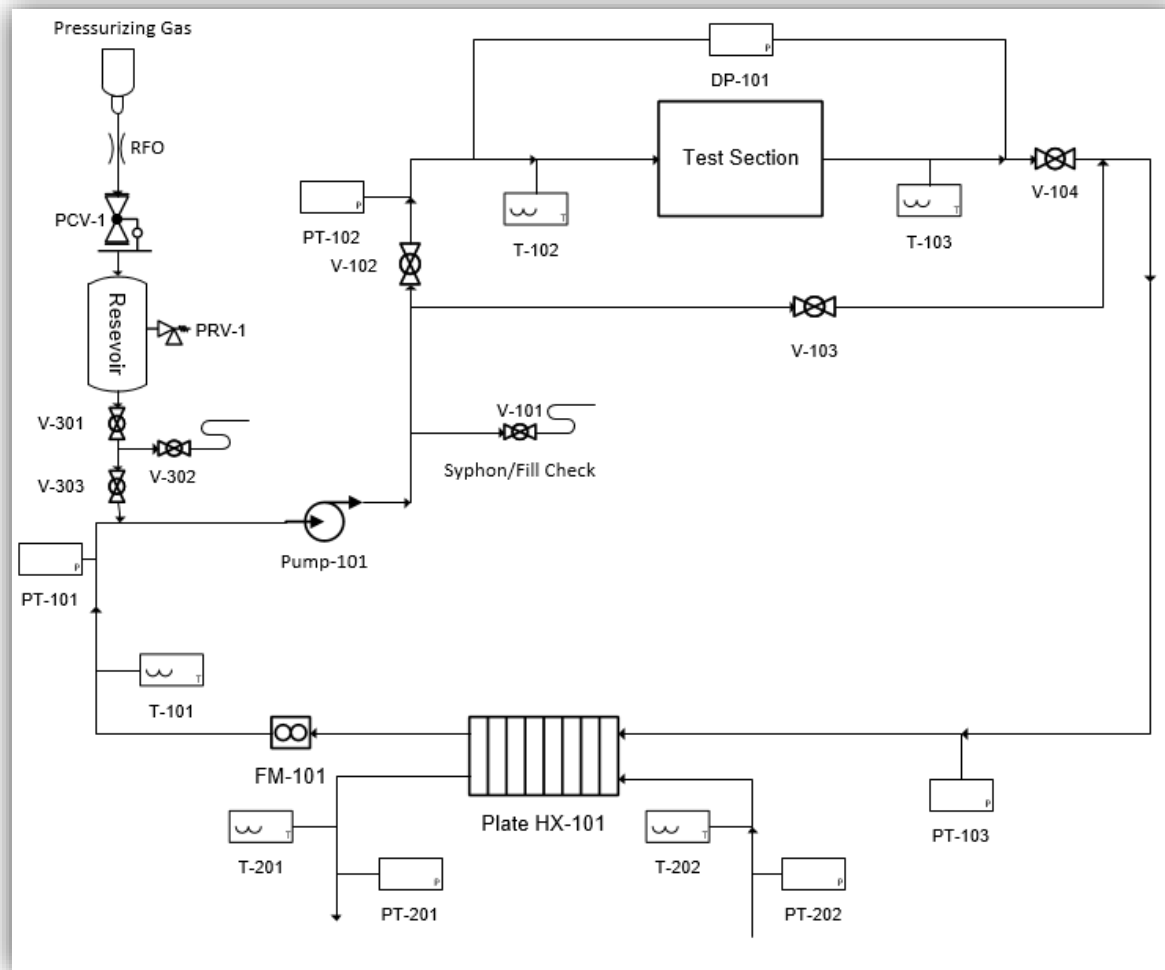
■ Design Requirements

- Unprecedented Design
- 3 Thin Clad Target Disks
 - Parallel Beam Impingement
- Be Strongbacks to compensate mechanical stresses

■ Operational Characteristics

- Working Fluid: Water (~296 K)
 - Mass flow rate of 1.258 [kg/s]
 - Inlet pressure of 150 psi
 - Design Review

System Summary



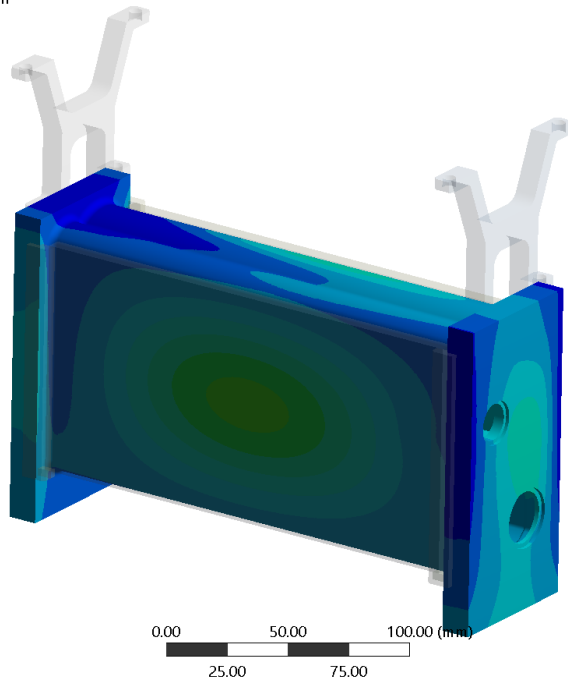
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Structural Analysis: Mechanical Loading Only

Target side

AT: Static Structural
Total Deformation 2
Type: Total Deformation
Unit: mm
Time: 1
10/15/2018 2:29 PM

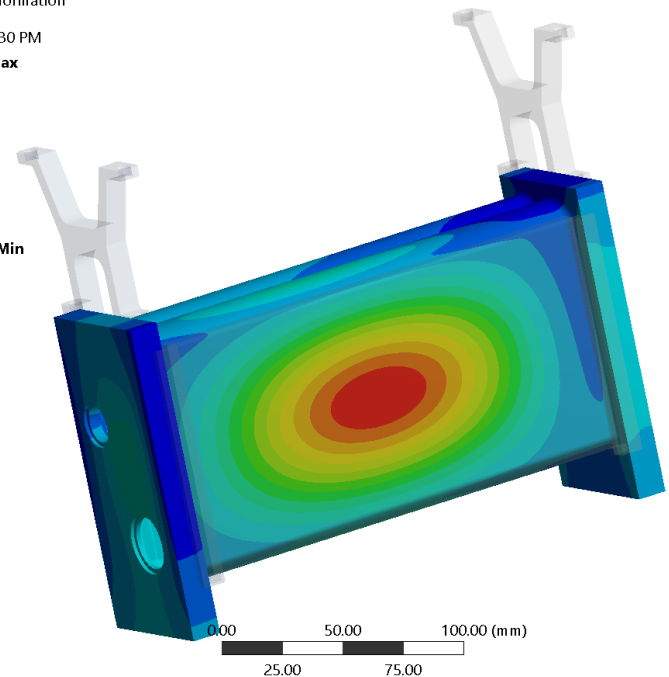
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0.14741
0.14326
0.13911
0.13496
0.13082
0.12667
0.12252
0.11837
0.11422
0.11008
0.10593
0.10178
0.097631
0.093483 Min



Emission side

AT: Static Structural
Total Deformation 2
Type: Total Deformation
Unit: mm
Time: 1
10/15/2018 2:30 PM

0.15156 Max
0.14741
0.14326
0.13911
0.13496
0.13082
0.12667
0.12252
0.11837
0.11422
0.11008
0.10593
0.10178
0.097631
0.093483 Min

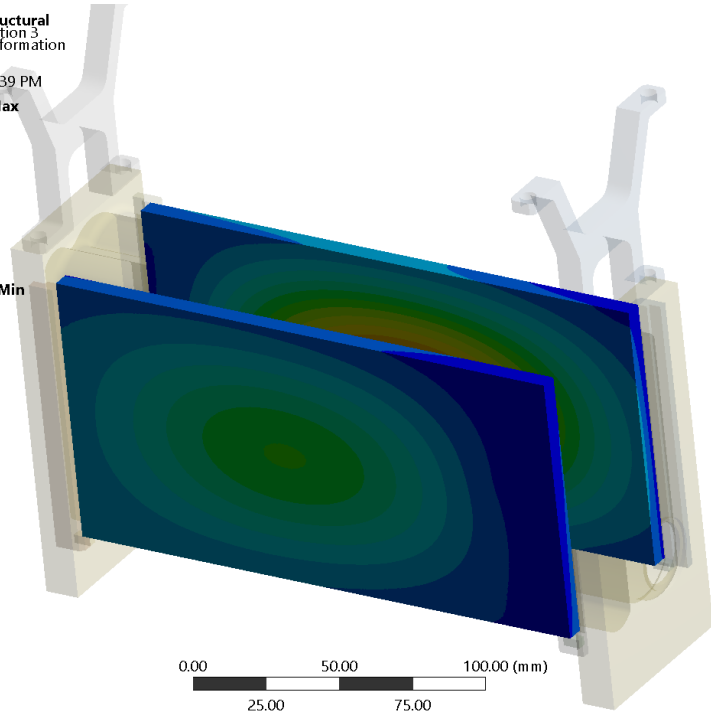


Structural Analysis: Mechanical Loading Only

Target side

AT: Static Structural
Total Deformation 3
Type: Total Deformation
Unit: mm
Time: 1
10/15/2018 2:39 PM

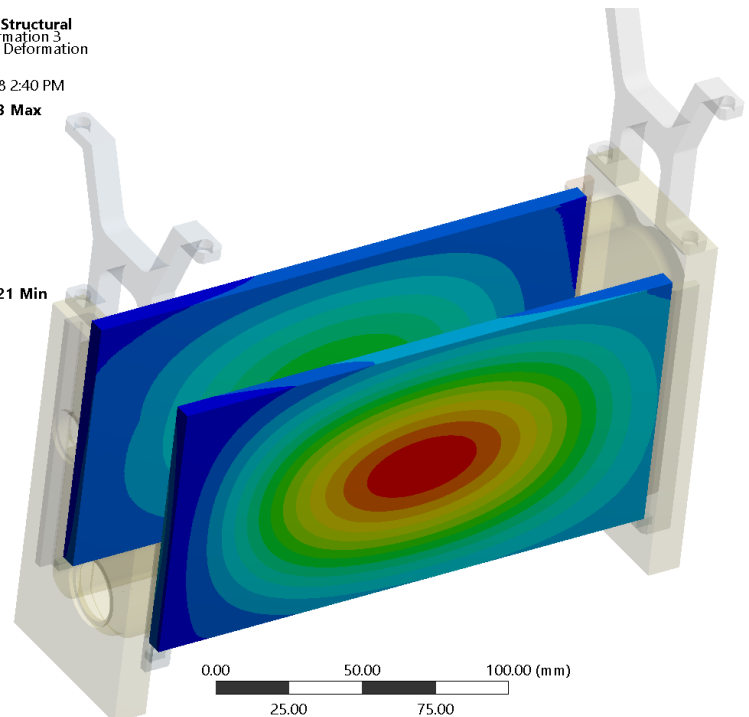
0.15163 Max
0.14769
0.14375
0.13982
0.13588
0.13195
0.12801
0.12407
0.12014
0.1162
0.11227
0.10833
0.10439
0.10046
0.096521 Min



Emission side

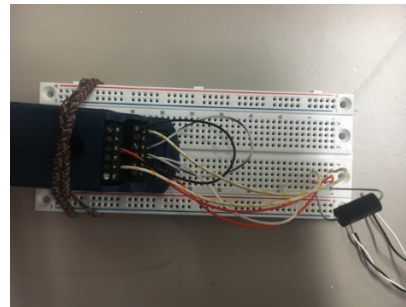
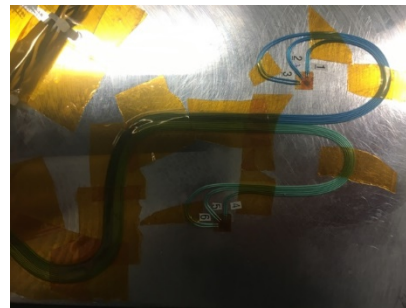
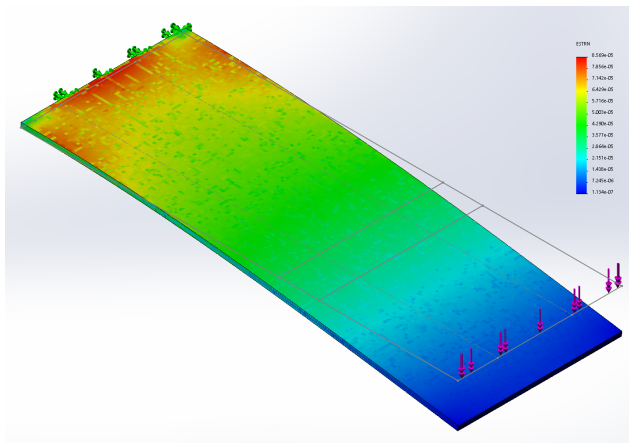
AT: Static Structural
Total Deformation 3
Type: Total Deformation
Unit: mm
Time: 1
10/15/2018 2:40 PM

0.15163 Max
0.14769
0.14375
0.13982
0.13588
0.13195
0.12801
0.12407
0.12014
0.1162
0.11227
0.10833
0.10439
0.10046
0.096521 Min



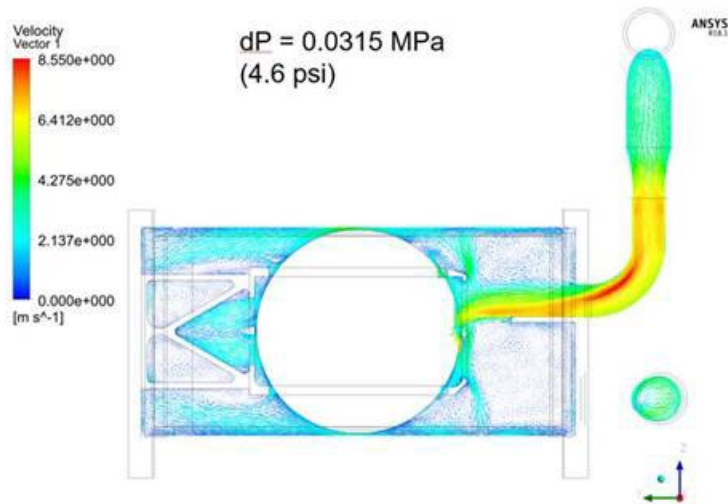
Structural Analysis Cont'd

- **Mechanical loading only as opposed to Thermal/Mechanical**
 - ¼ Bridge arrangement w/o temperature compensation
 - Stress linearization another caveat? ASME PV Code
- **Labview Difficulties**
 - Arithmetic mean accuracy vs. overall system noise
- **Bench Test**

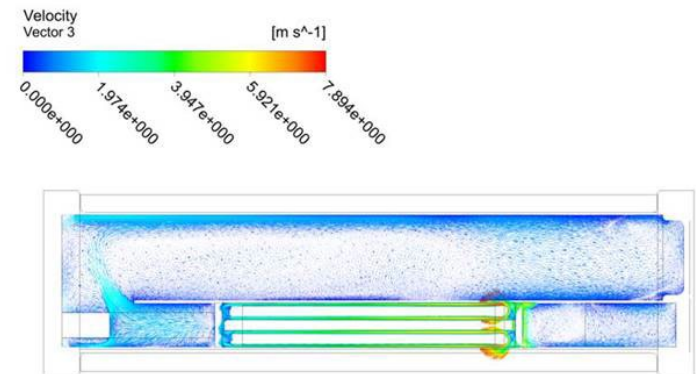


Fluids Analysis

Velocity YZ Plane – Vector Plot w/ Target Holder



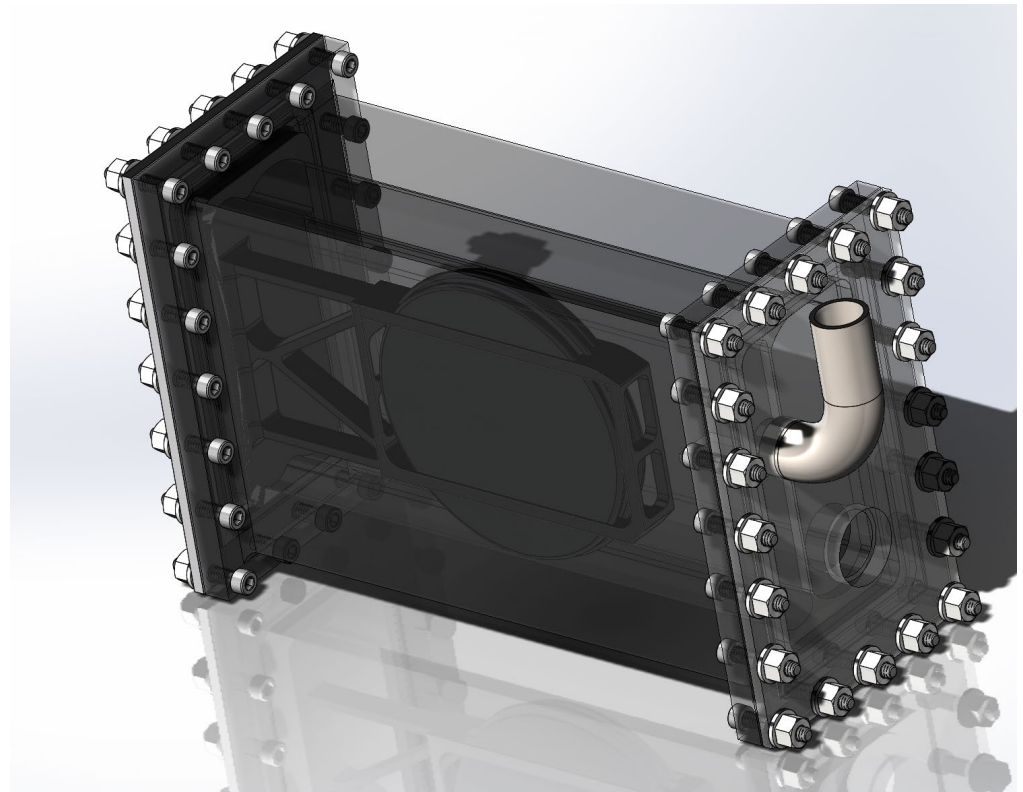
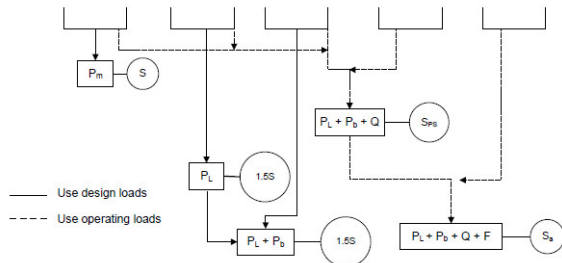
Velocity XY Plane – Vector Plot



Fluids Analysis Cont'd

- Flow Visualization vs. PIV
- Mechanical Loading Only
 - Linearize Stresses?
 - Operating Conditions

Stress Category	Primary			Secondary Membrane plus Bending	Peak
	General Membrane	Local Membrane	Bending		
Description (For examples, see Table 5.2)	Average primary stress across solid section. Excludes discontinuities and concentrations. Produced only by mechanical loads.	Average stress across any solid section. Considers discontinuities but not concentrations. Produced only by mechanical loads.	Component of primary stress proportional to distance from centroid of solid section. Excludes discontinuities and concentrations. Produced only by mechanical loads.	Self-equilibrating stress necessary to satisfy continuity of structure. Occurs at structural discontinuities. Can be caused by mechanical load or by differential thermal expansion. Excludes local stress concentrations.	1. Increment added to primary or secondary stress by a concentration (notch). 2. Certain thermal stresses which may cause fatigue but not distortion of vessel shape.
Symbol	P_m	P_L	P_b	Q	F

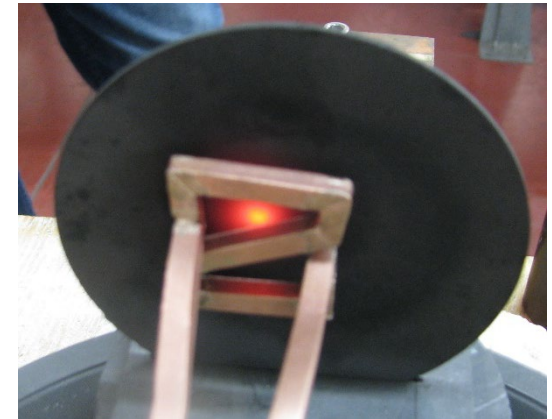


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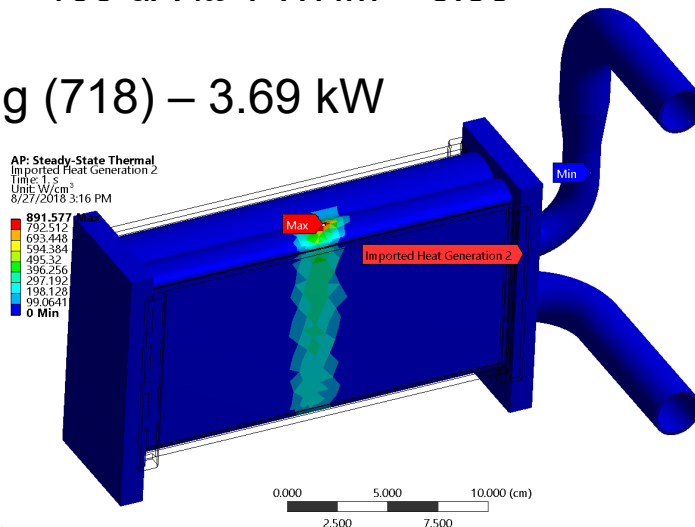
Thermal Analysis

■ Governing Beam Conditions

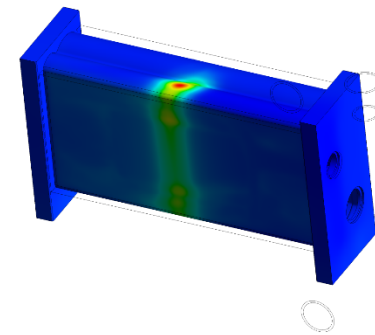
- 200 μA peak current
 - Minimum Beam Spot Size
 - $\text{FWHM}_x = 1.0148 \text{ cm}$
 - $\text{FWHM}_y = 2.4308 \text{ cm}$
 - Inlet pressure 150 psig
 - Mass flow 1.258 kg/s (20 gpm)
- Focused beam -7mm mis-steered in vertical direction
 - 100 μA @ $\text{FWHM} = 3.53$



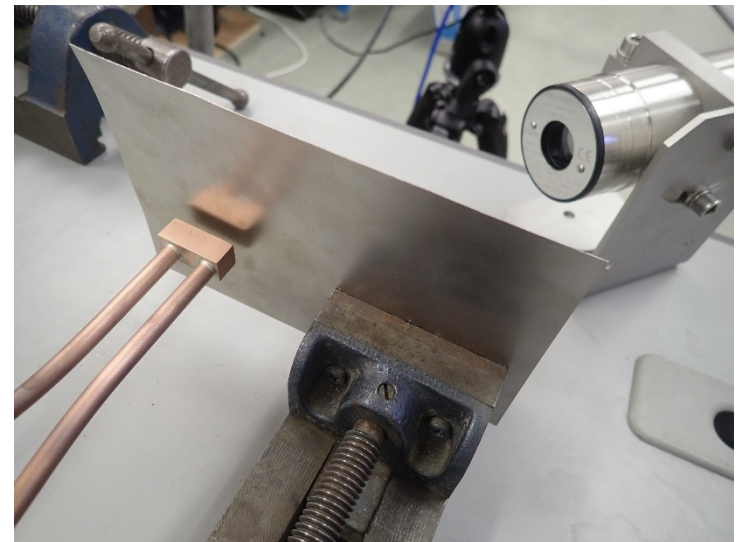
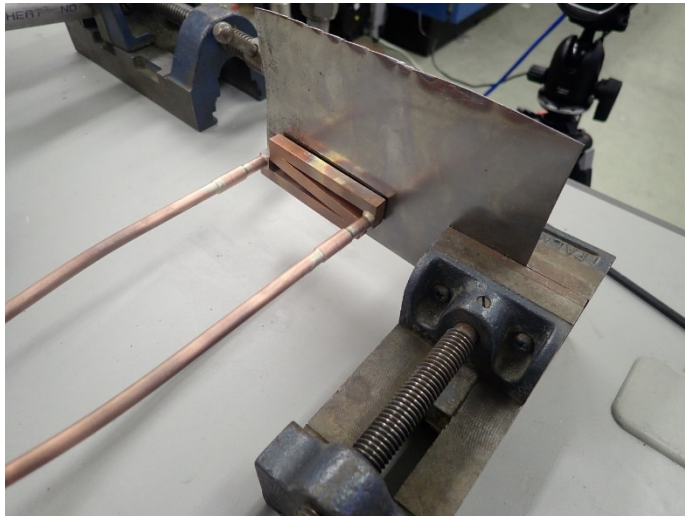
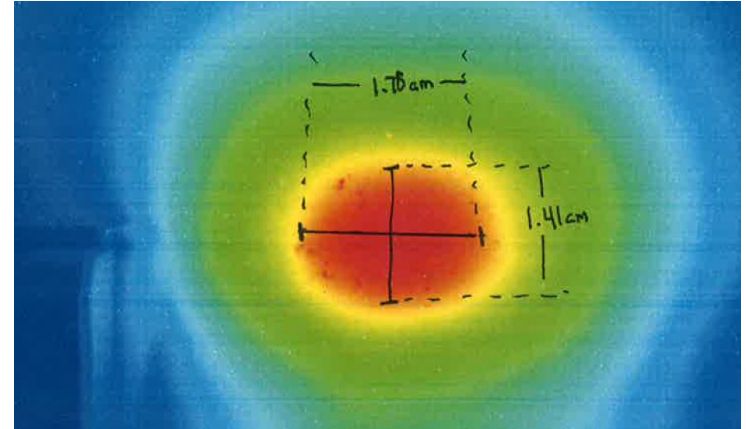
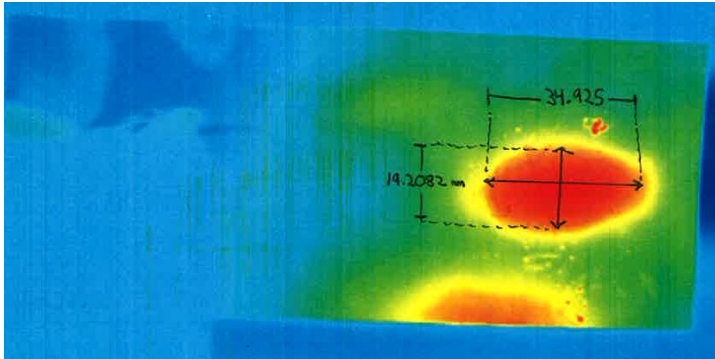
Housing (718) – 3.69 kW



Temperature
hgen_housing
2.806e+002
2.167e+002
1.528e+002
8.881e+001
2.487e+001
[C]

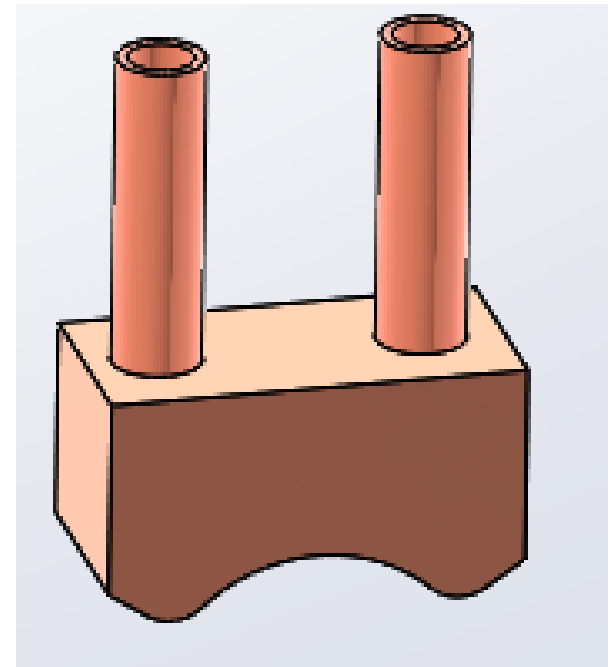
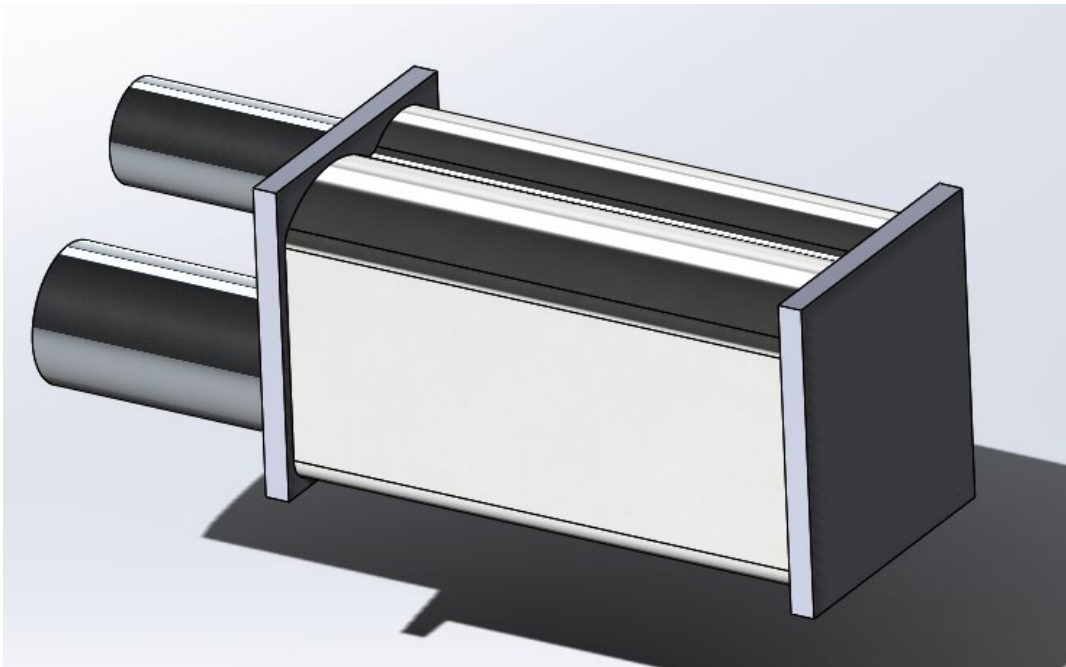


Thermal Analysis Cont'd: Induction Coil Design



Thermal Analysis Cont'd: Induction Coil Design

- New test piece, pivot from quasi-adiabatic to steady state
- Couple Sergey's MicroWave Studios w/ Solidworks Thermal Modeling



Synopsis

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