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

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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

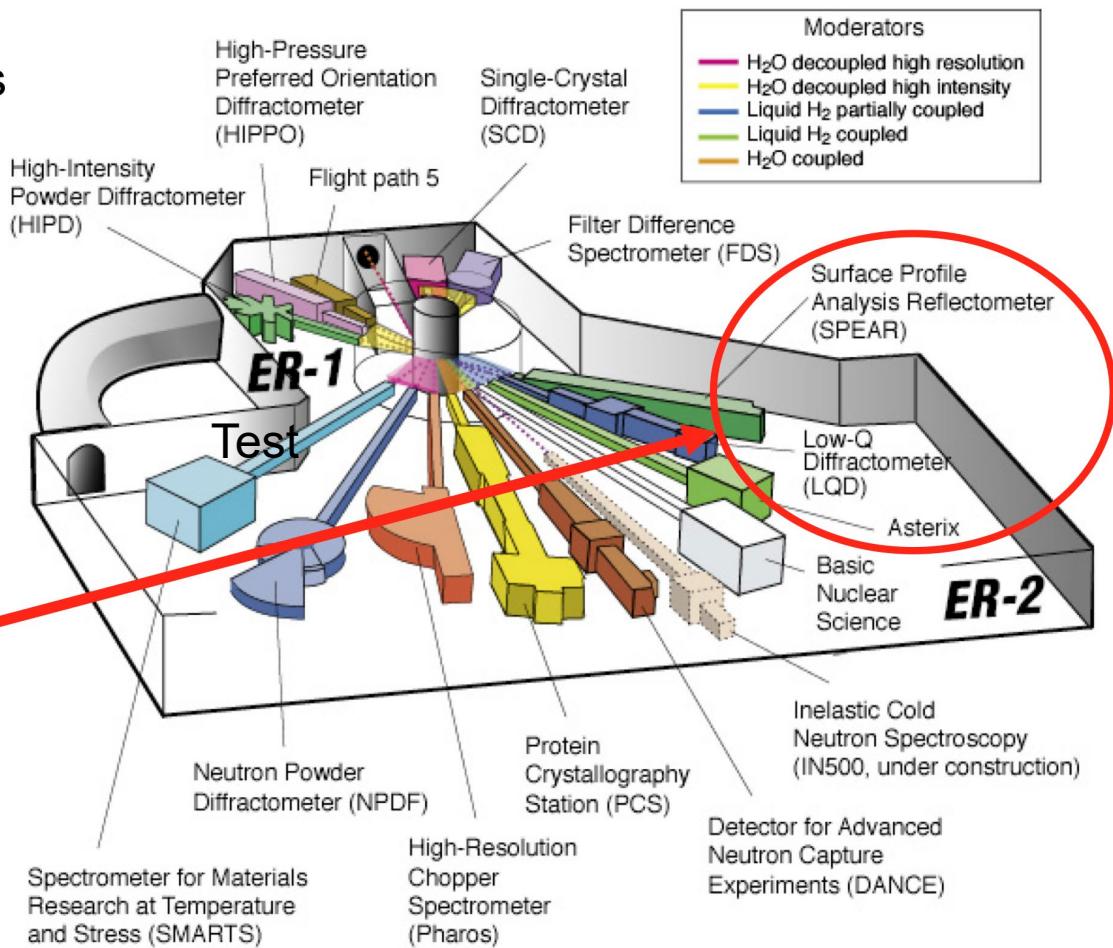
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## ■ TMRS MK IV

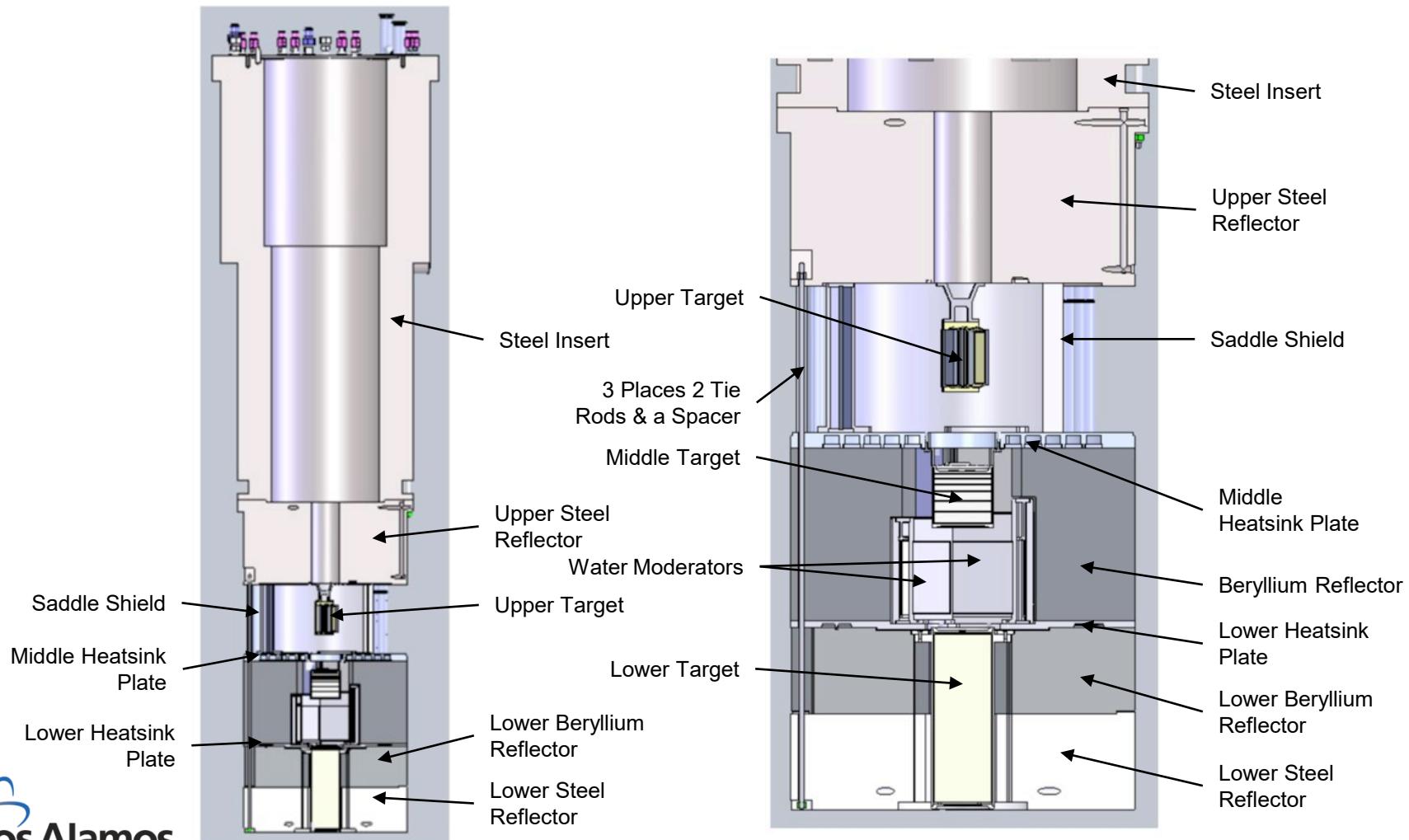
- 1L Upper Target (LANSCE/Lujan)
  - Design Requirements and Operational Characteristics
  - Geometric/Prototype Overview
  - System Summary
  - Structural Analysis
  - Fluids Analysis
  - Thermal Analysis
    - Procurement
    - Induction Coil
- Timeline Consensus

# LANSCE 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**)



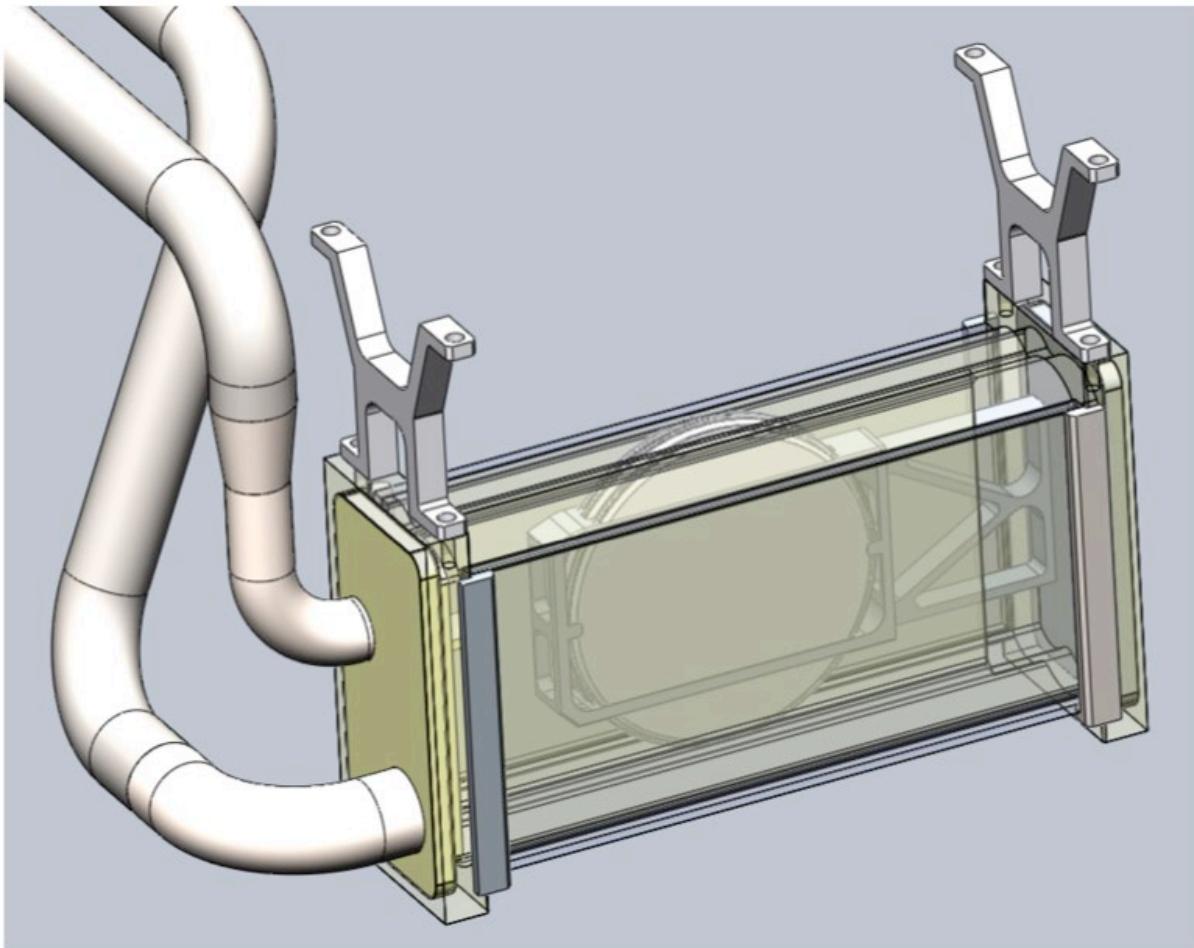
# The TMRS Mk IV



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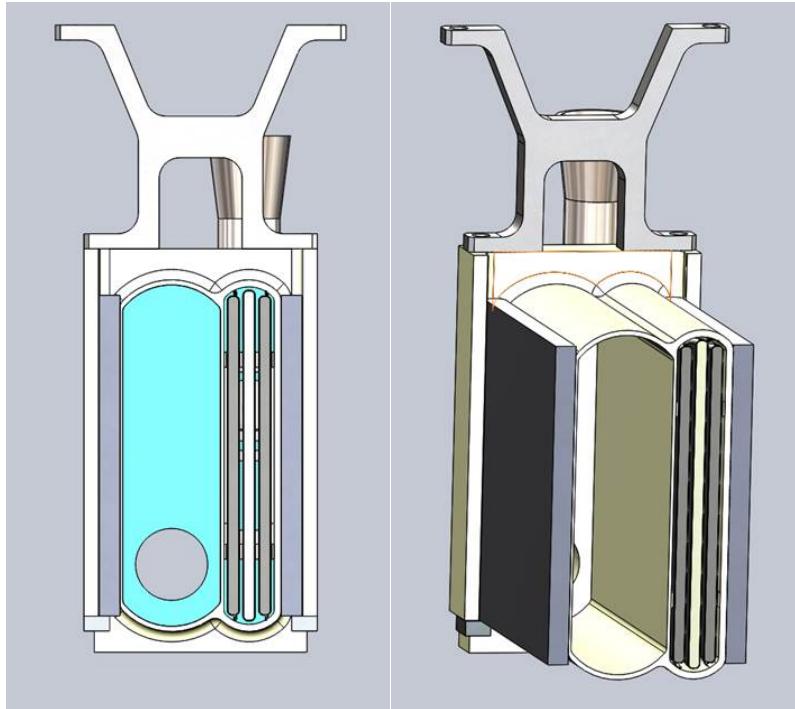
# Geometric Overview

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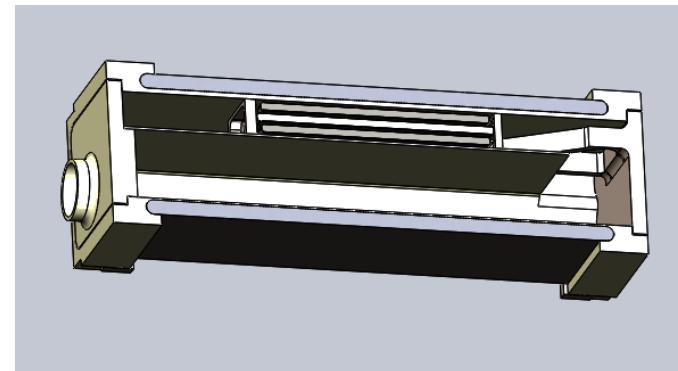


# Geometric Overview

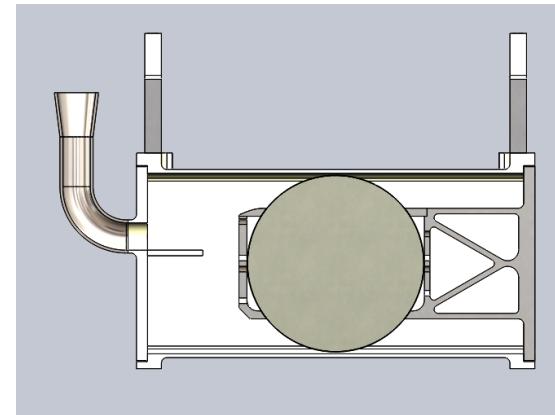
- **Front**



- **Top**



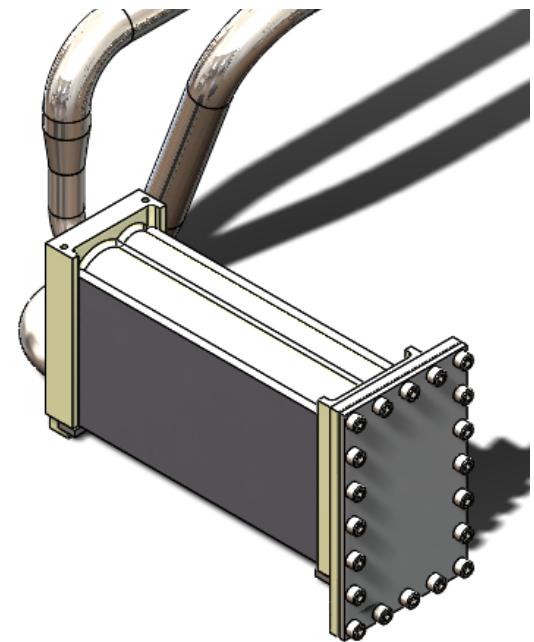
- **Side**



# 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

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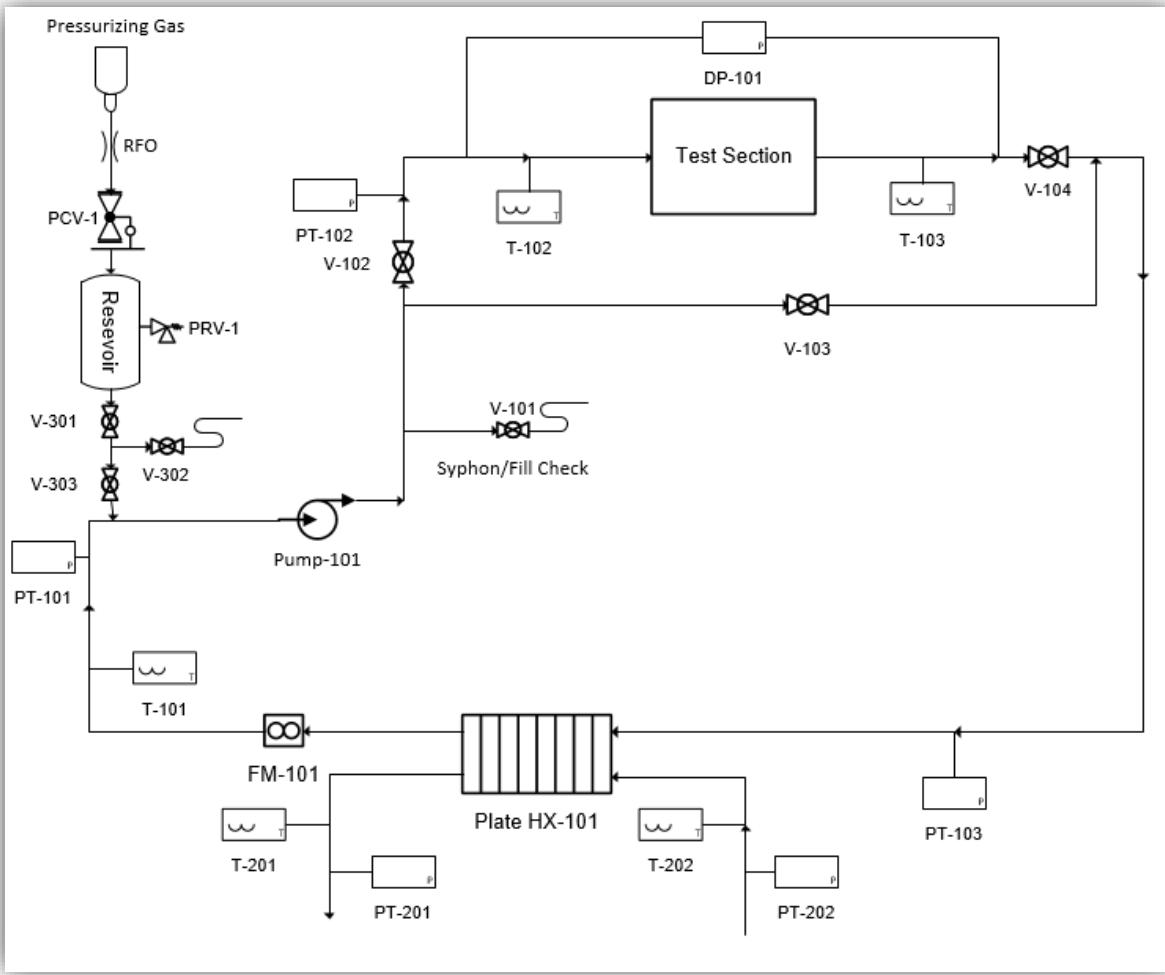
## ■ Design Requirements

- 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

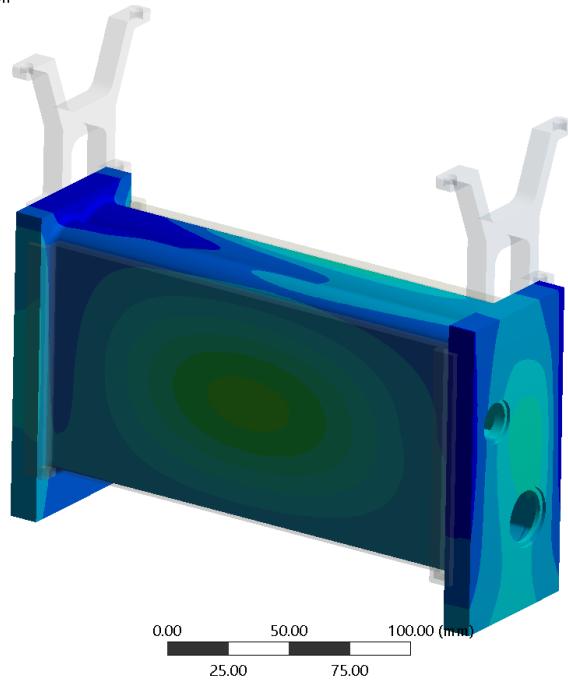
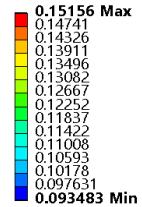


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# Structural Analysis: Mechanical Loading Only

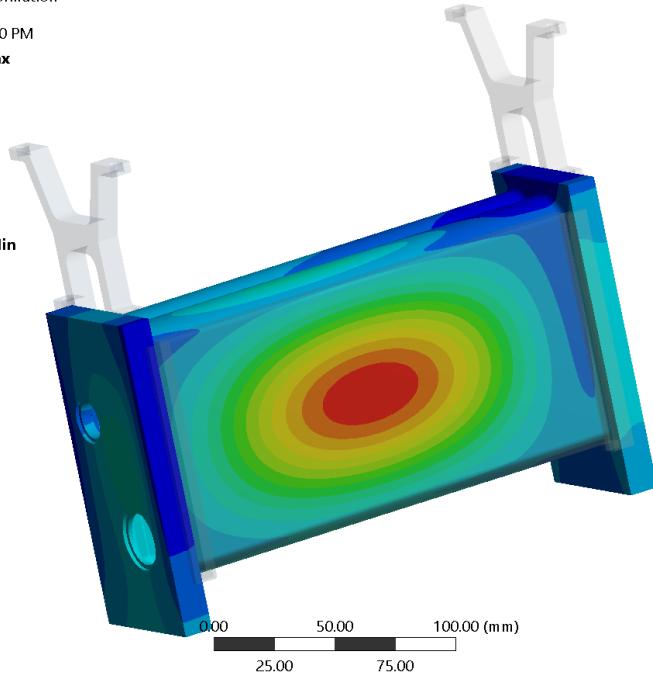
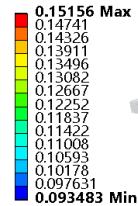
Target side

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



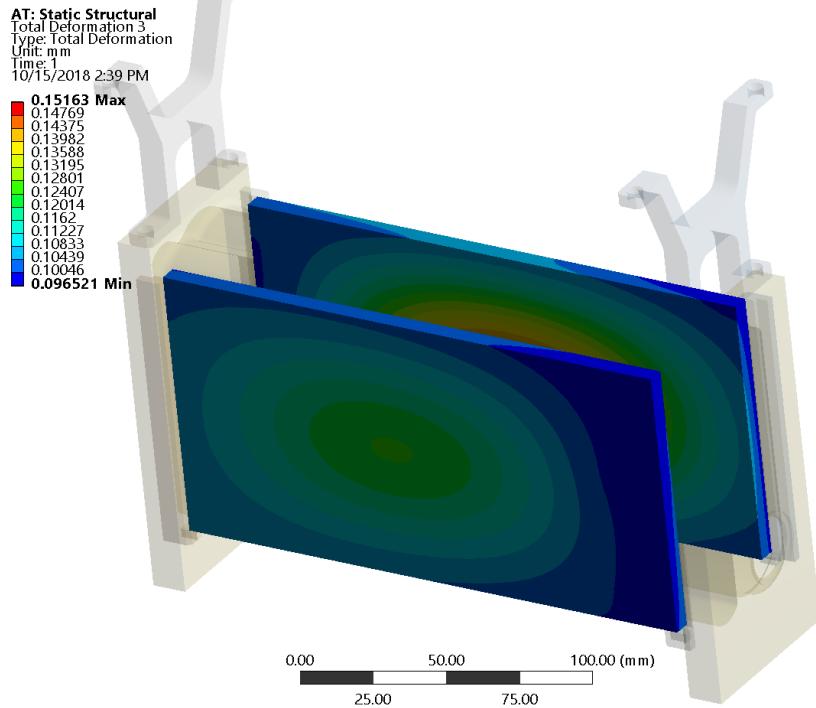
Emission side

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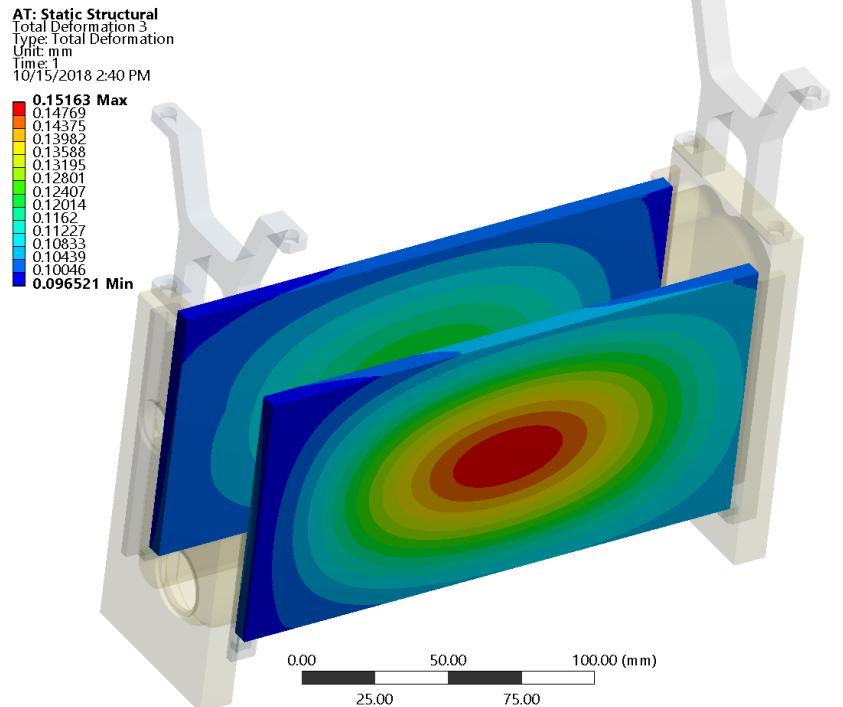


# Structural Analysis: Mechanical Loading Only

Target side

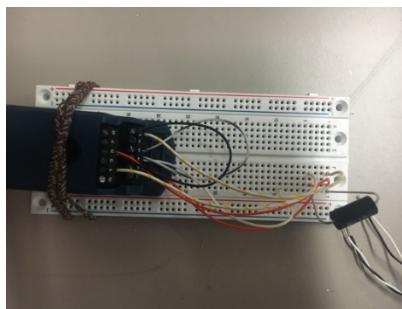
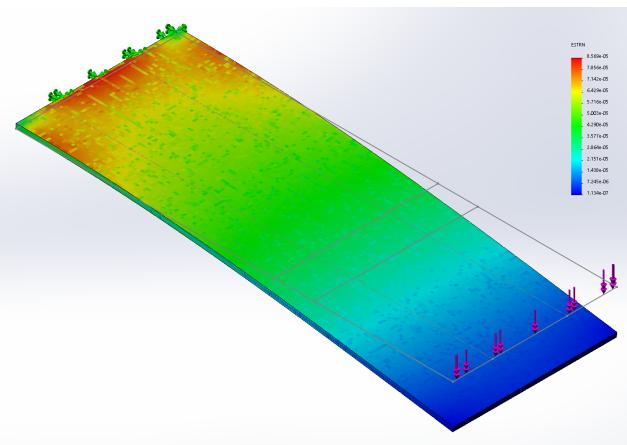


Emission side



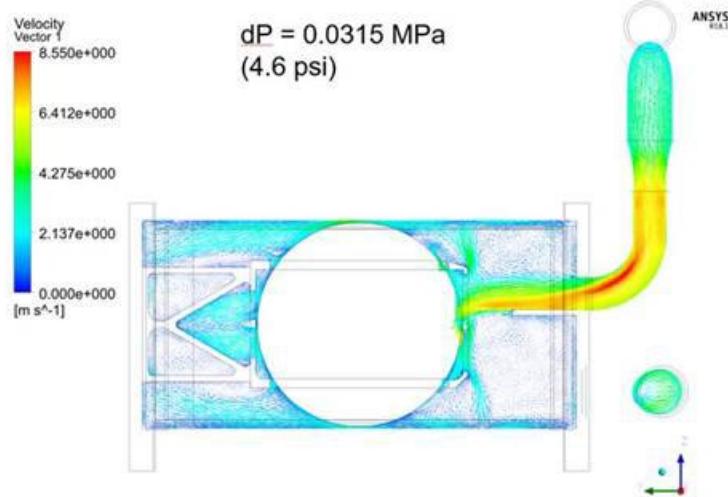
# Structural Analysis Cont'd

- **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**

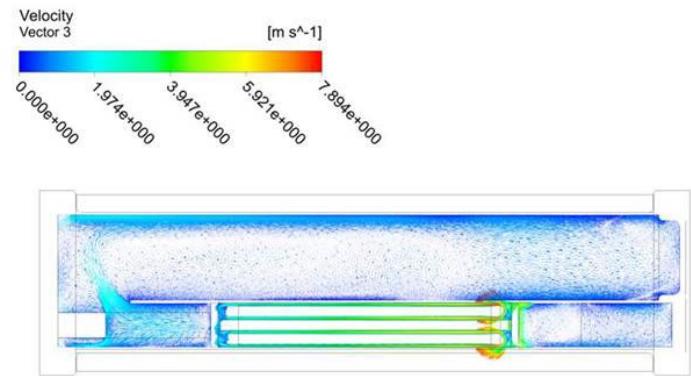


# Fluids Analysis

Velocity YZ Plane – Vector Plot w/ Target Holder

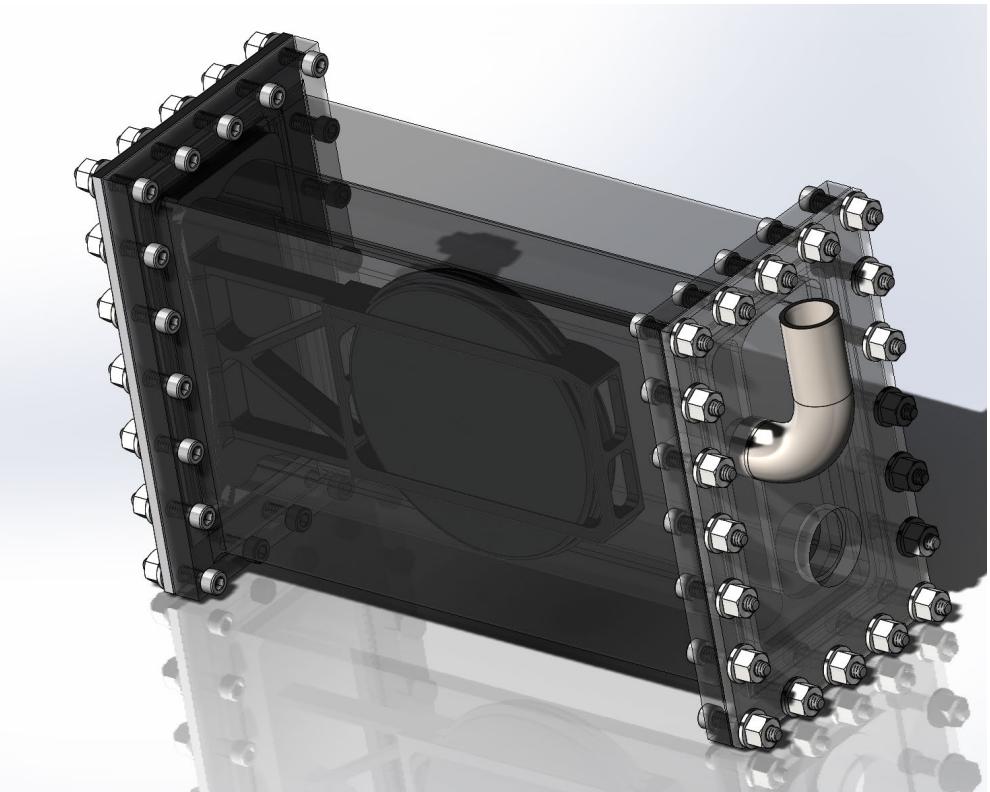
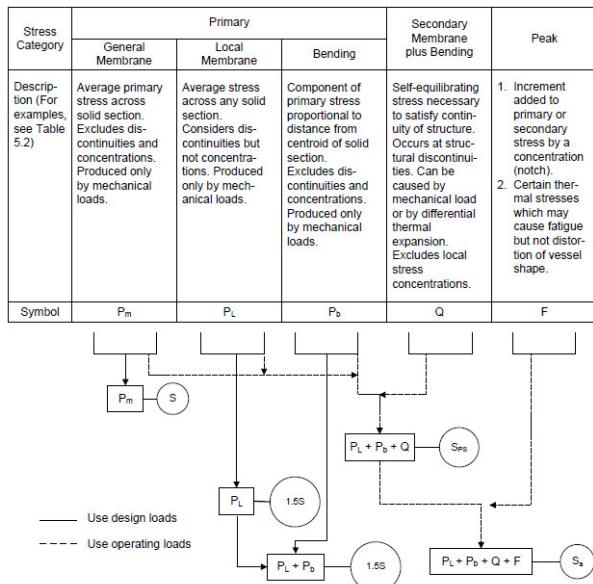


Velocity XY Plane – Vector Plot



# Fluids Analysis Cont'd

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

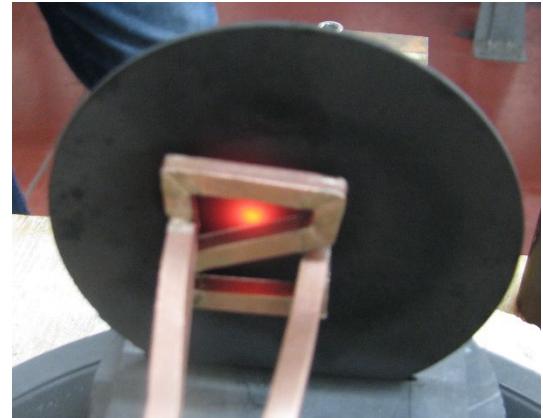


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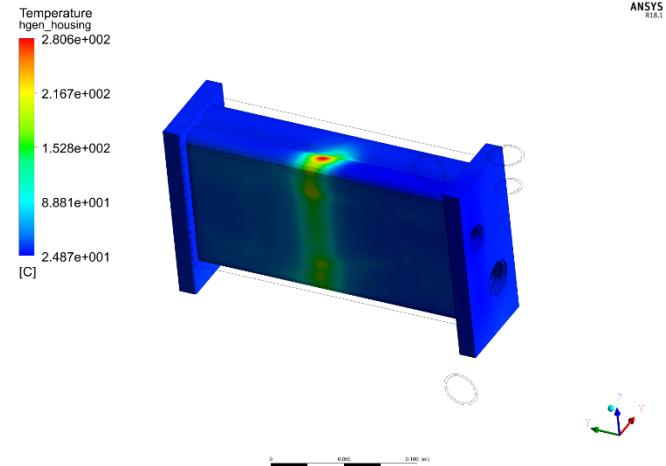
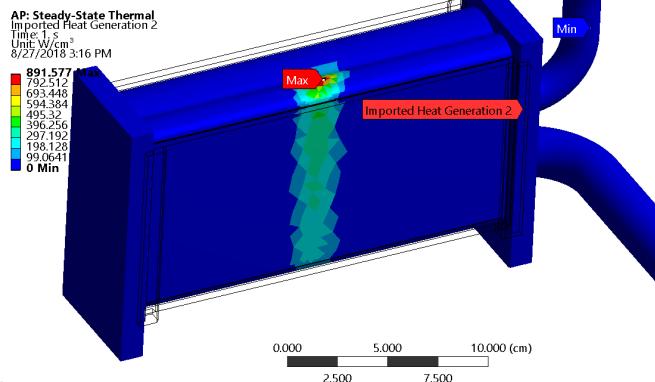
# Thermal Analysis

## ■ Governing Beam Conditions

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

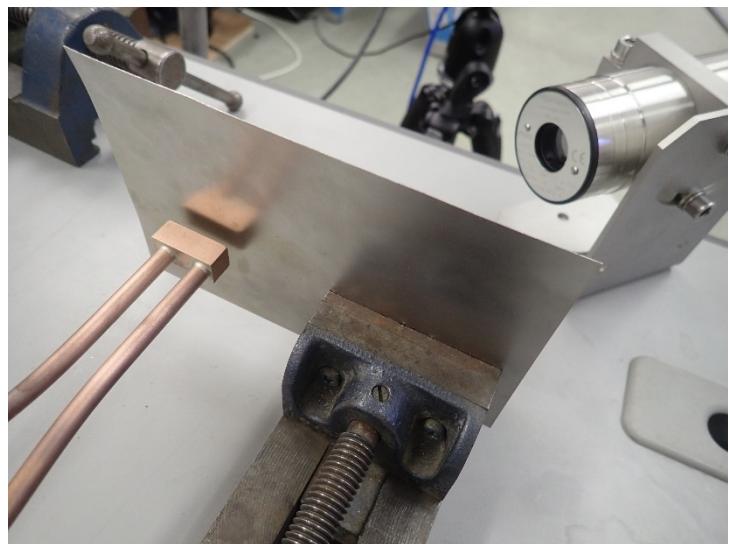
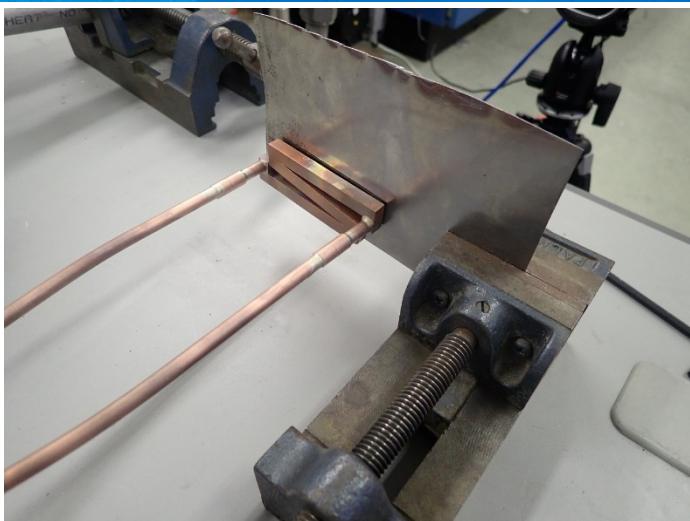
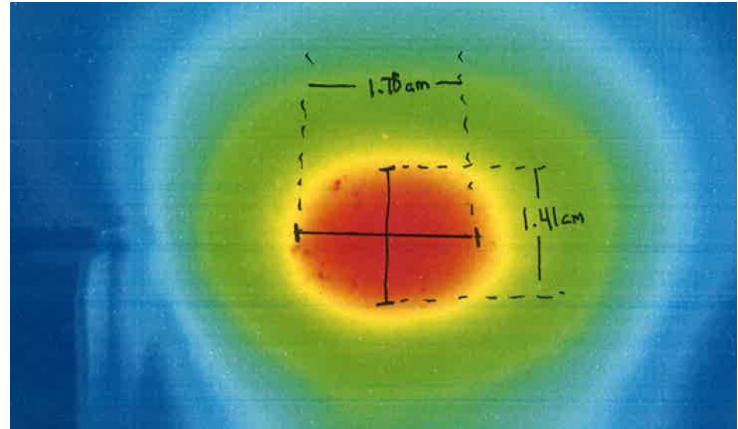
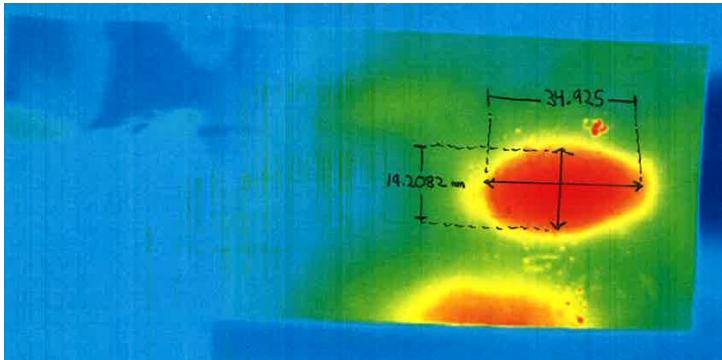


## Housing (718) – 3.69 kW



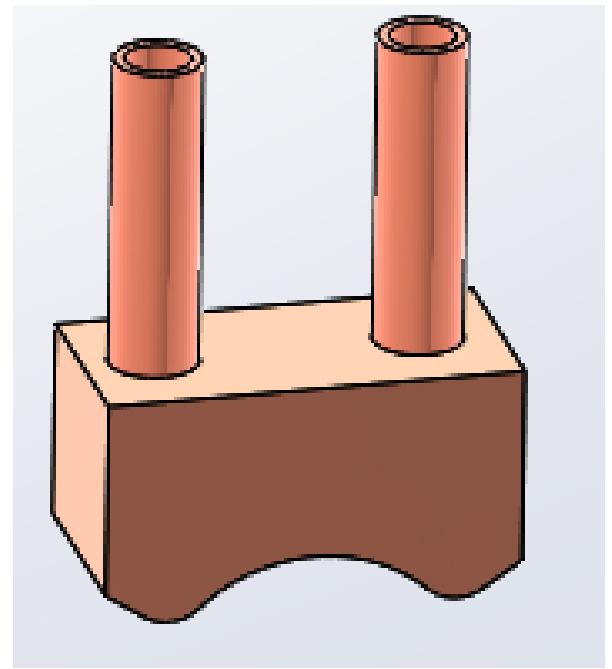
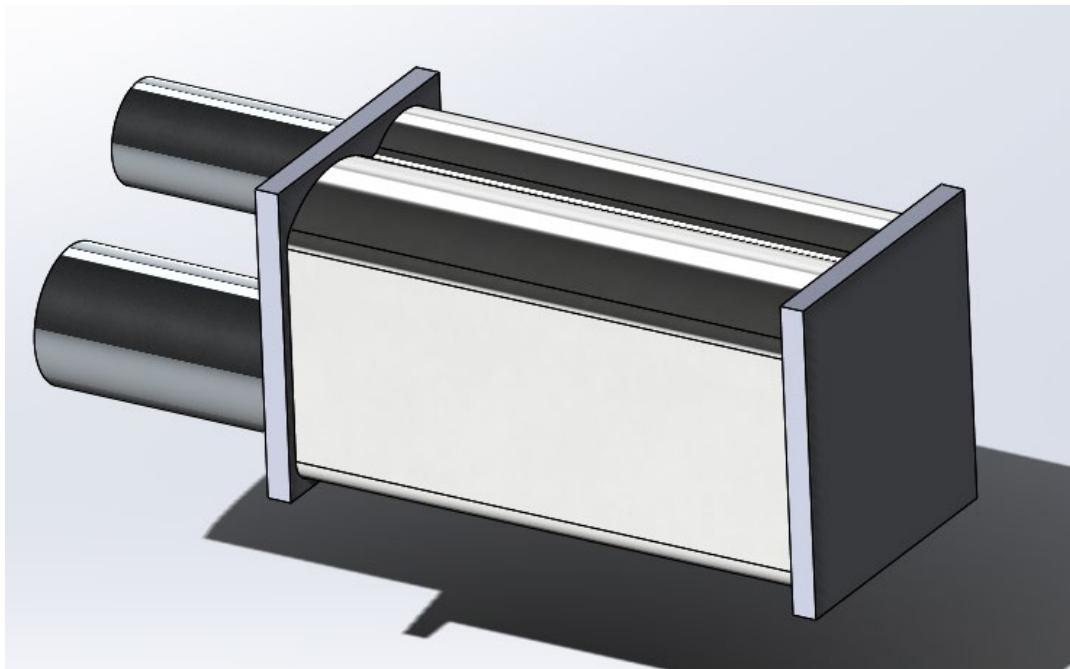
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# Thermal Analysis Cont'd: Induction Coil Design



## 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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