PRISM Structure Scoping Study

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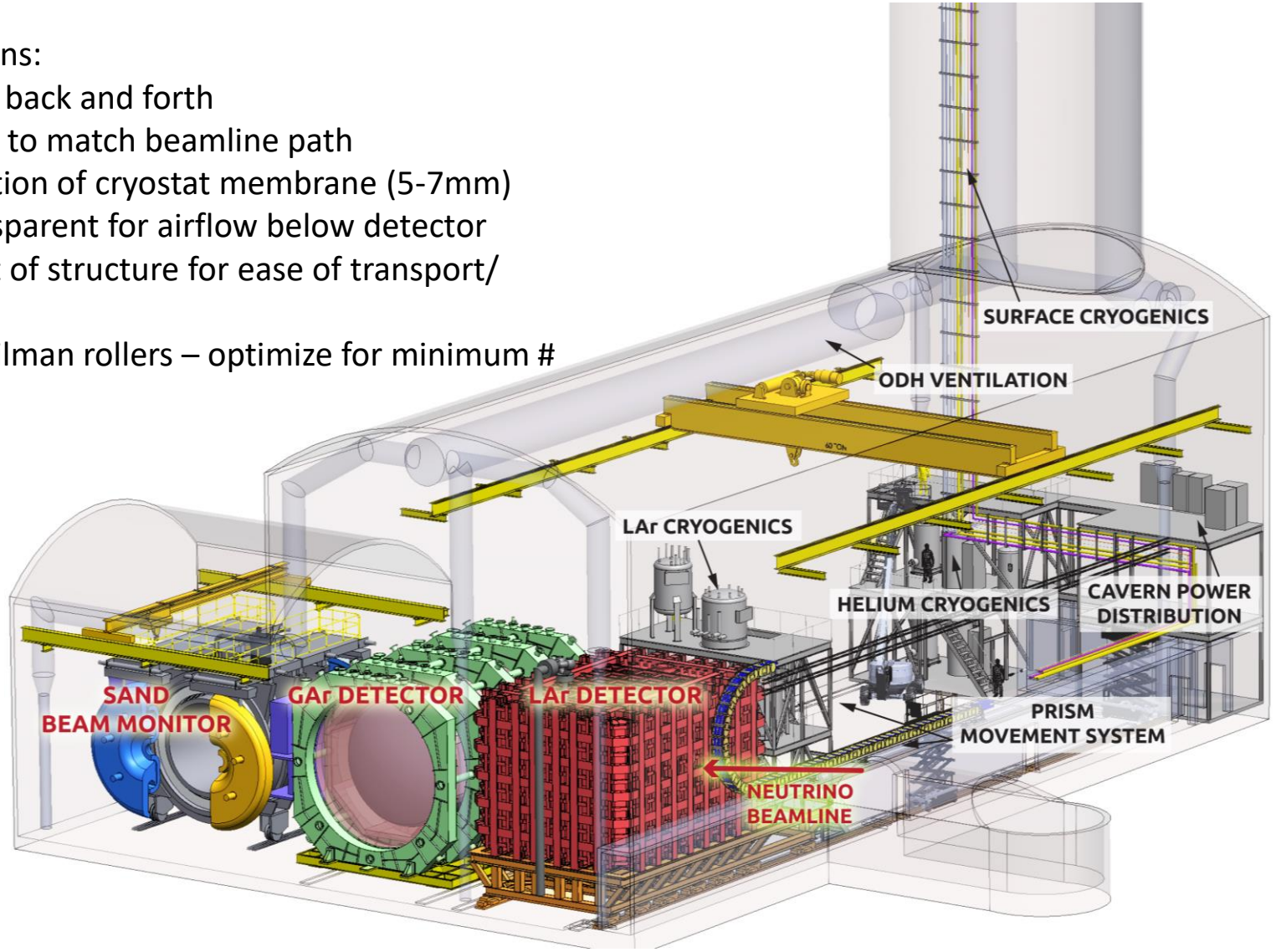
PRISM Structure Analysis Update

Near Site Hall

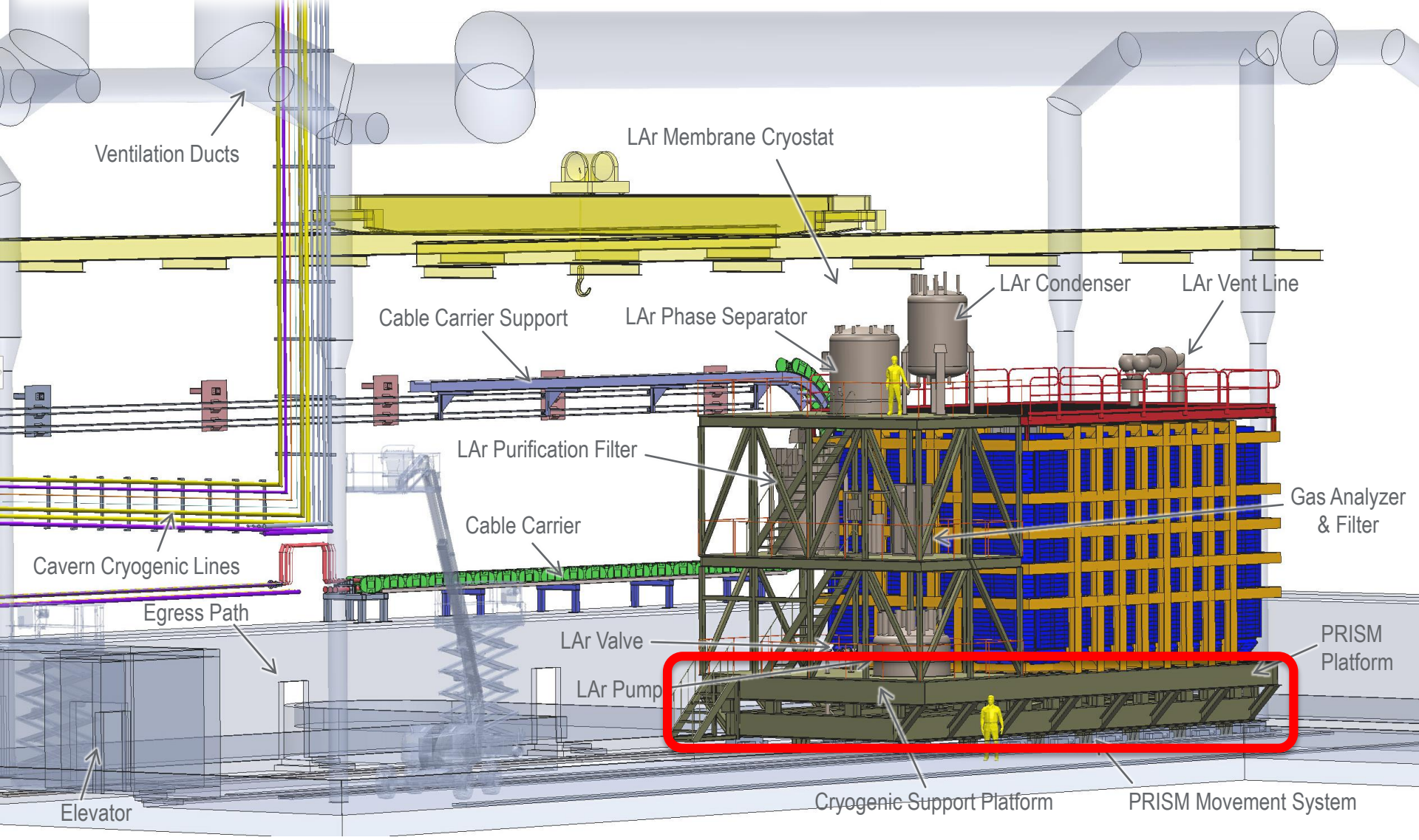
Design Considerations:

- Be able to move back and forth
- Elevate detector to match beamline path
- Minimize deflection of cryostat membrane (5-7mm)
- Sufficiently transparent for airflow below detector
- Minimize weight of structure for ease of transport/ installation
- Interface with Hilman rollers – optimize for minimum #



PRISM Structure Analysis Update

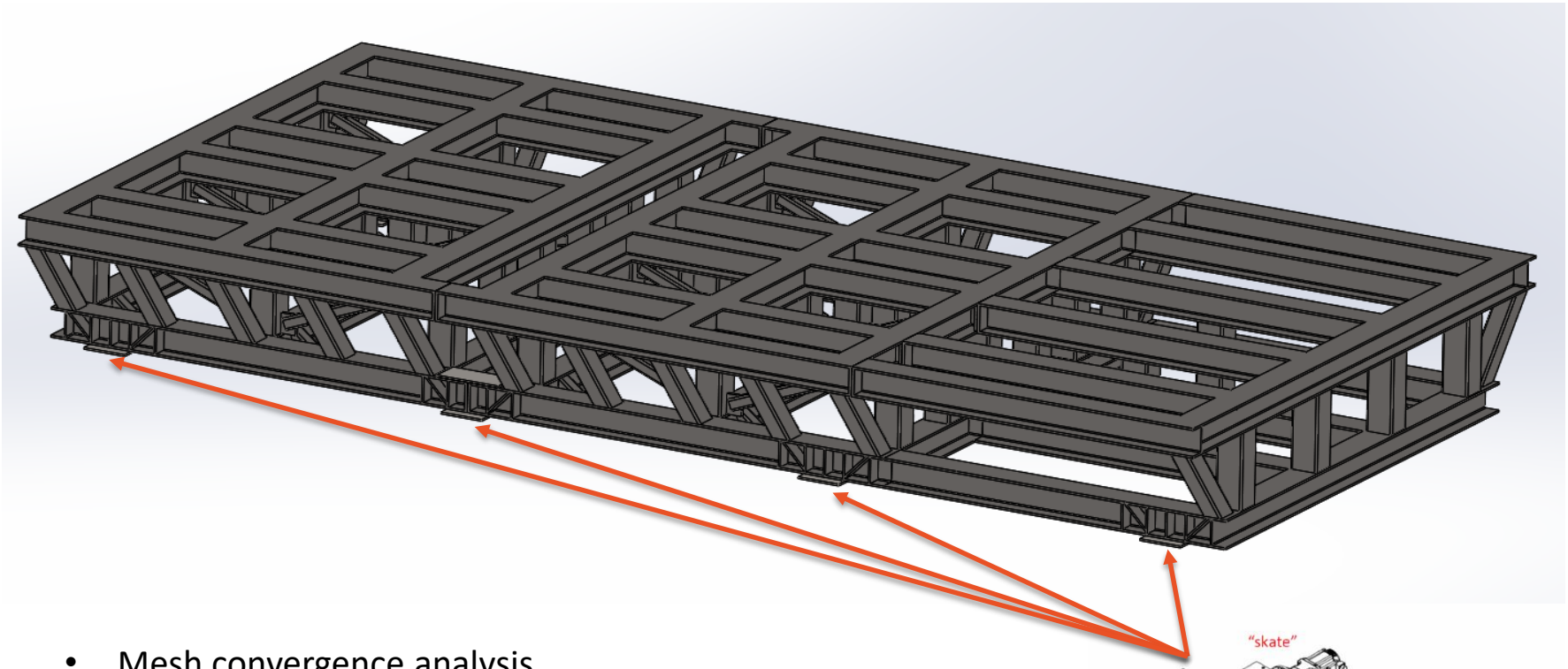
PRISM Structure



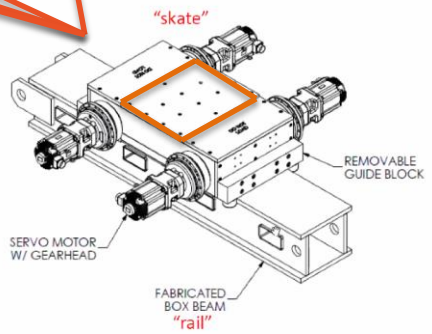
Fermilab DUNE

PRISM Structure Analysis Update

Overview



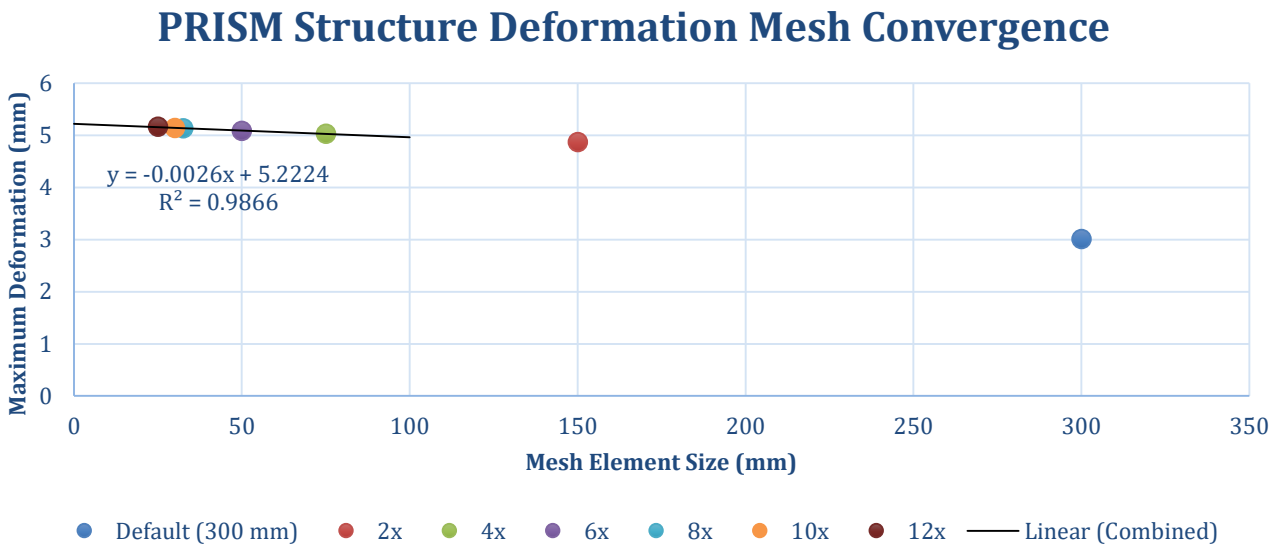
- Mesh convergence analysis
- Modelling of joints between structure sections
- Effect of spacing between detector rails [frame width] on frame deformation
- Ascertain required number of Hilman rollers

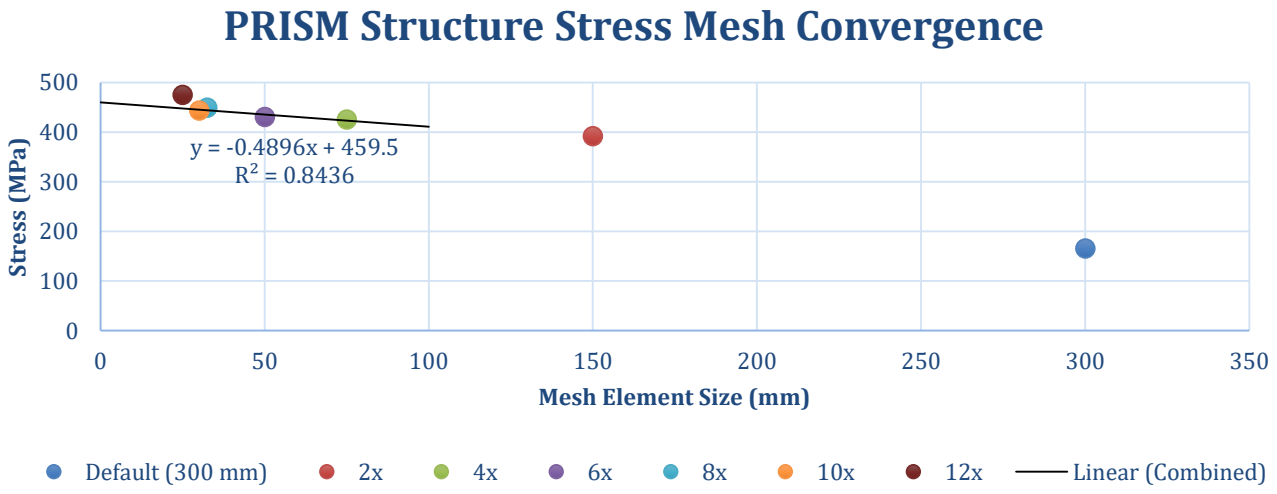


Hilman 200 Tonne capacity unit

PRISM Structure Analysis Update

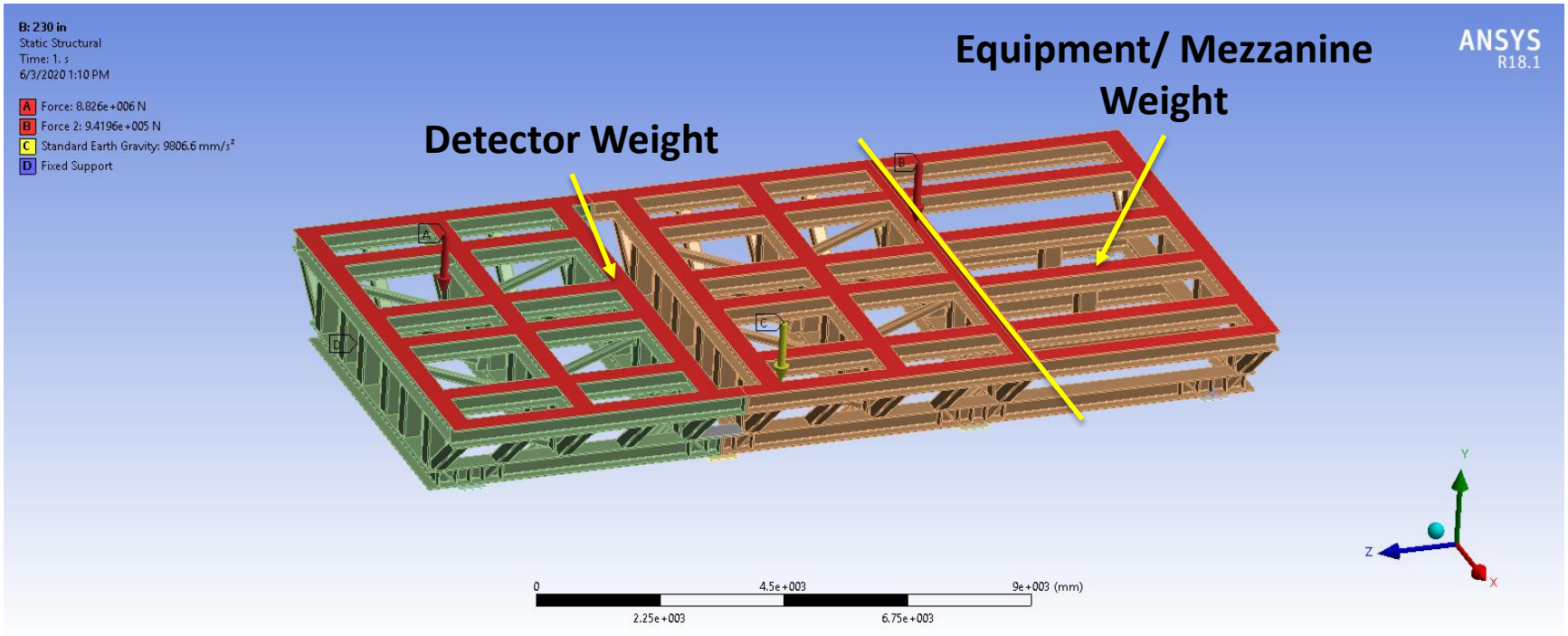
Mesh Convergence





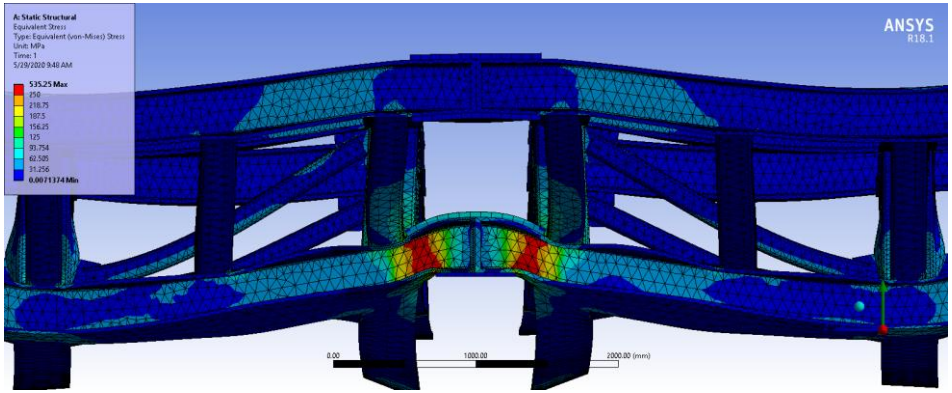
Legend indicates level of refinement
e.g. 2x = 150mm mesh size

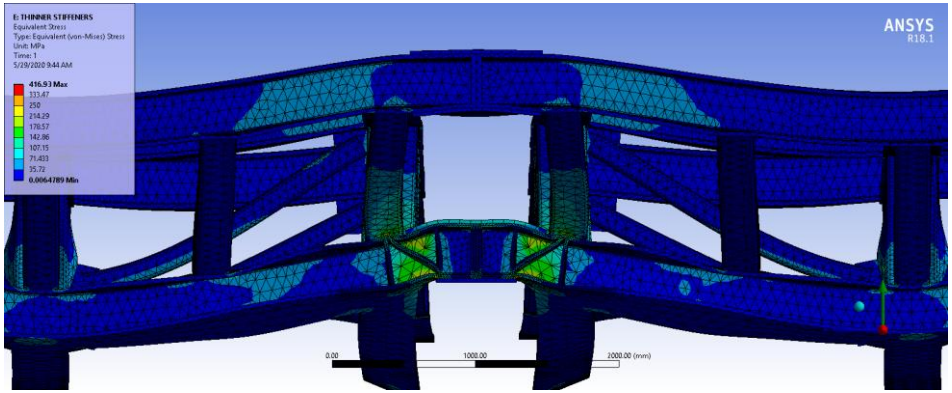
PRISM Structure Analysis Update
ANSYS Parameters



Detector Weight Estimate: 900 metric tons
Cryogenic Equipment Mezzanine: ~96 metric tons
Overall Mesh Size: 50 mm
Mesh Around Joints: 15 mm

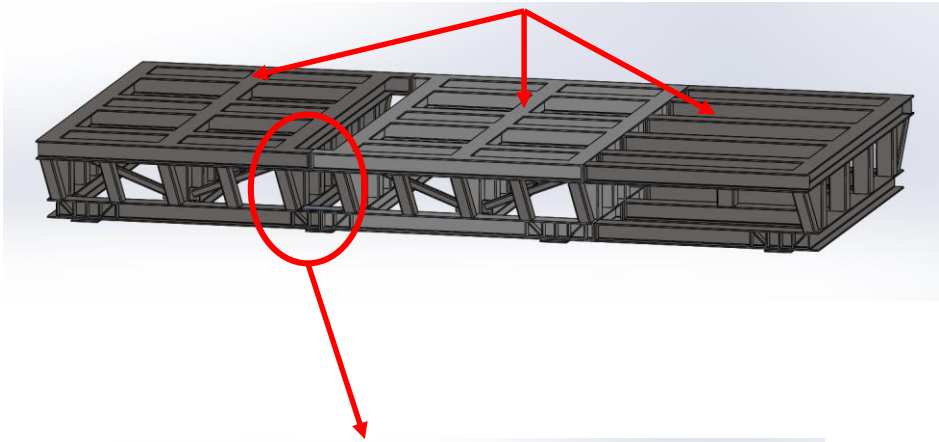
PRISM Structure Analysis Update
Joint Reinforcement

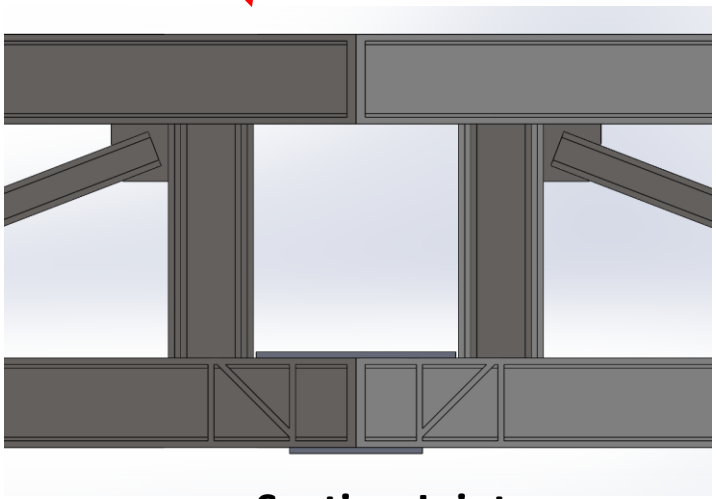




Unsupported vs Stiffened Joint

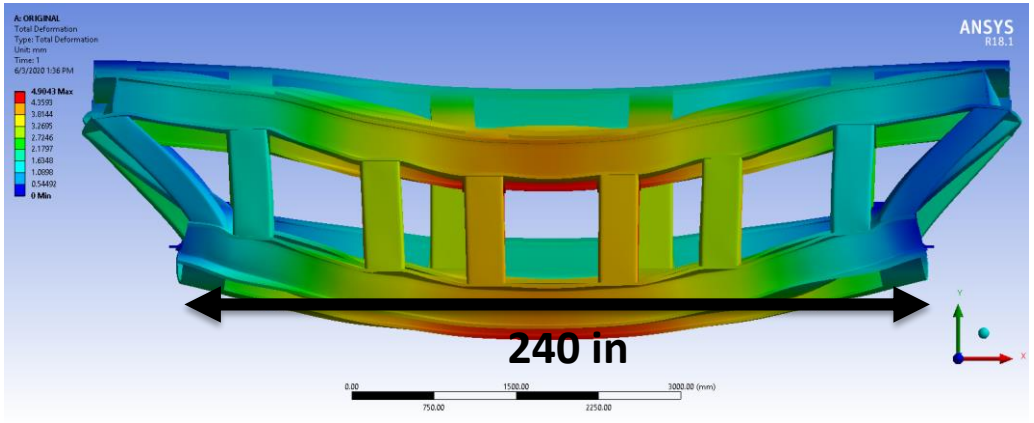
Three Frame Sections

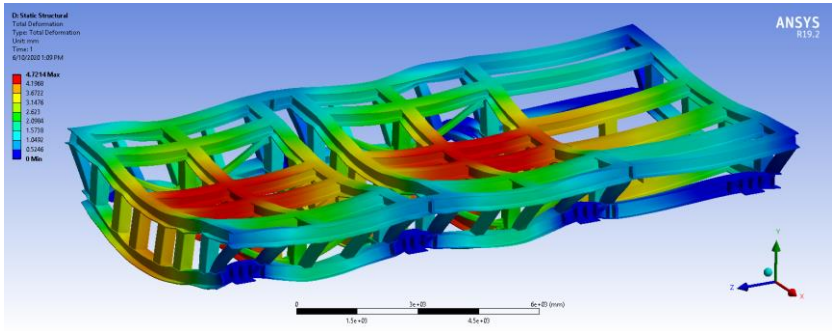




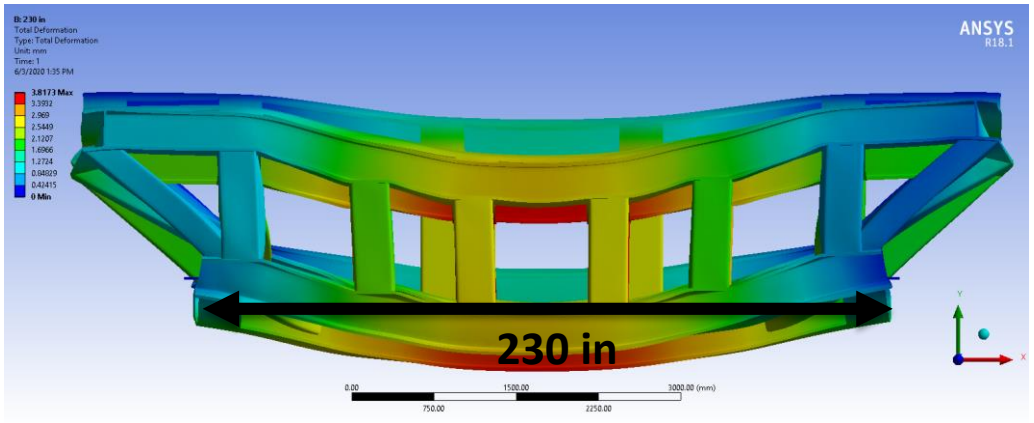
Section Joint

PRISM Structure Analysis Update
Detector Rail Separation





Base Width: 240”
Max Deformation: 4.9 mm



Base Width: 230”
Max Deformation: 3.8 mm

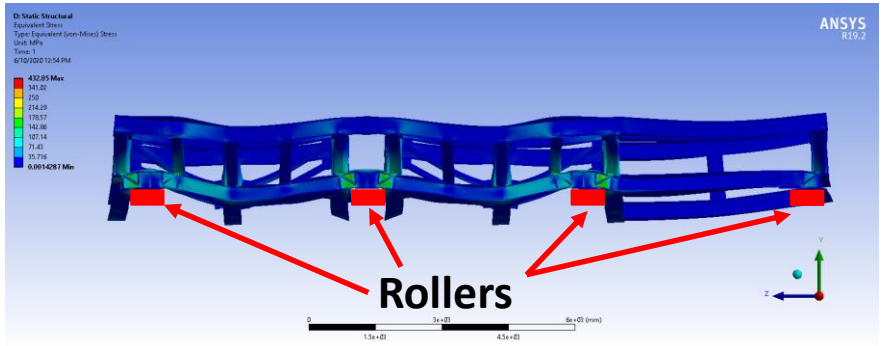
- Further analysis needed on torsional effects/ cross brace stiffening

PRISM Structure Analysis Update
Number of Hilman Rollers

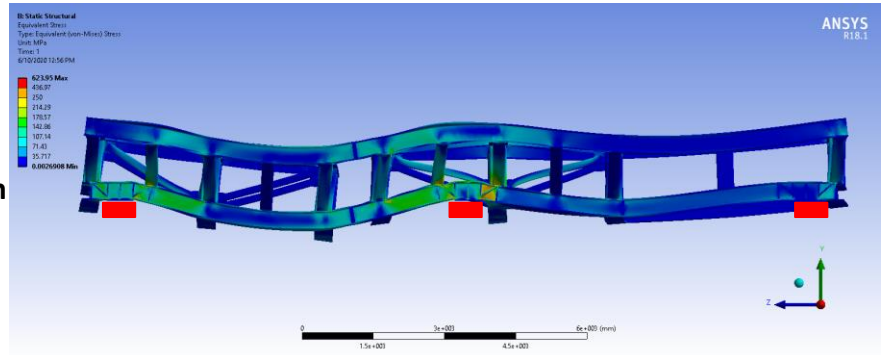
Considerations:

- Rollers are expensive units ($1.16M for 6 + ctrl system)
- Stress/ deformation increases when number of rollers decreased
- Increasing beam thickness decreases deflection but increases weight
- Compatibility of Hilman rollers with non powered supports -TBD

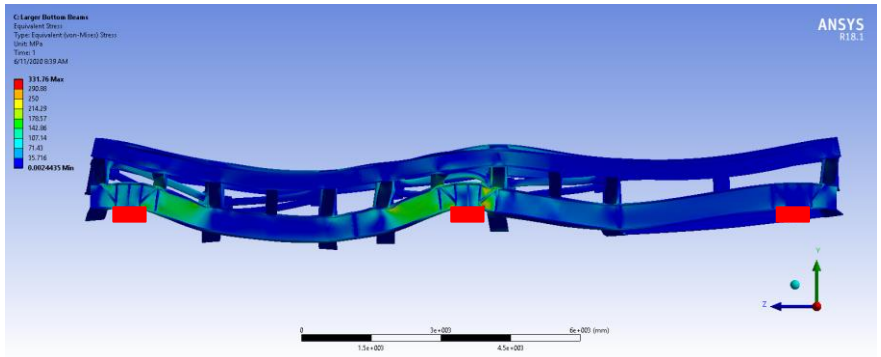
8 Rollers
Max Deformation: 4.9 mm



6 Rollers
Max Deformation: 12.2 mm



6 Rollers - Larger Lower Beams
Max Deformation: 5.8 mm



PRISM Structure Analysis Update
Summary

- Identified areas of deformation and stress concentration through finite element scoping study
- Current structure optimized for airflow and low weight
- Need for further analysis to fully define structure