TWO-STEP HUB DEPLOYMENT MECHANISM

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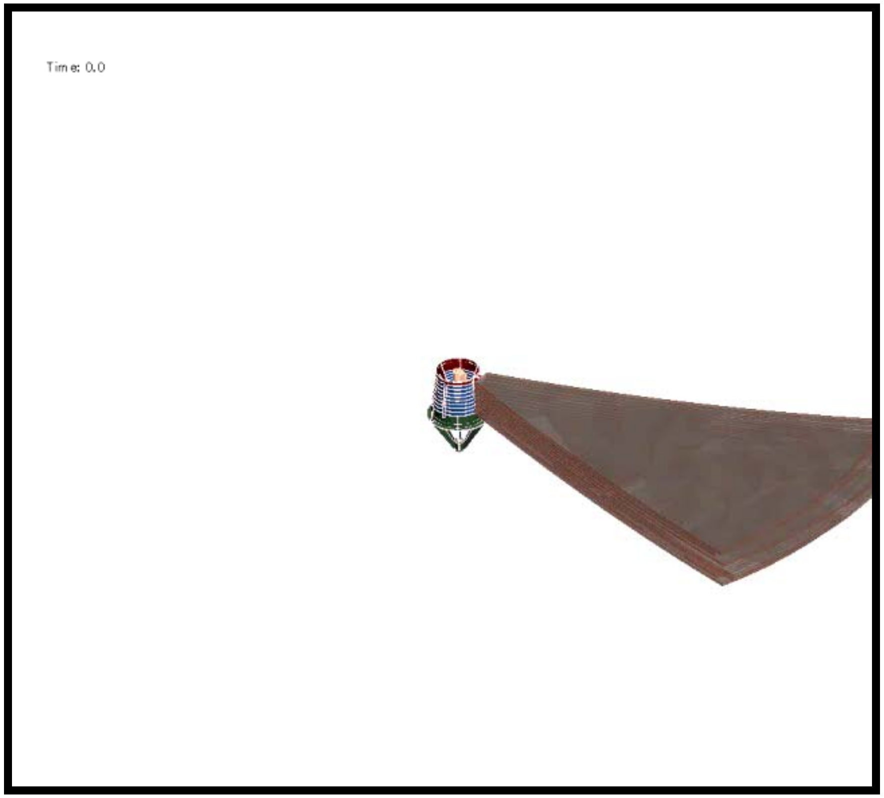
PROBLEM STATEMENT

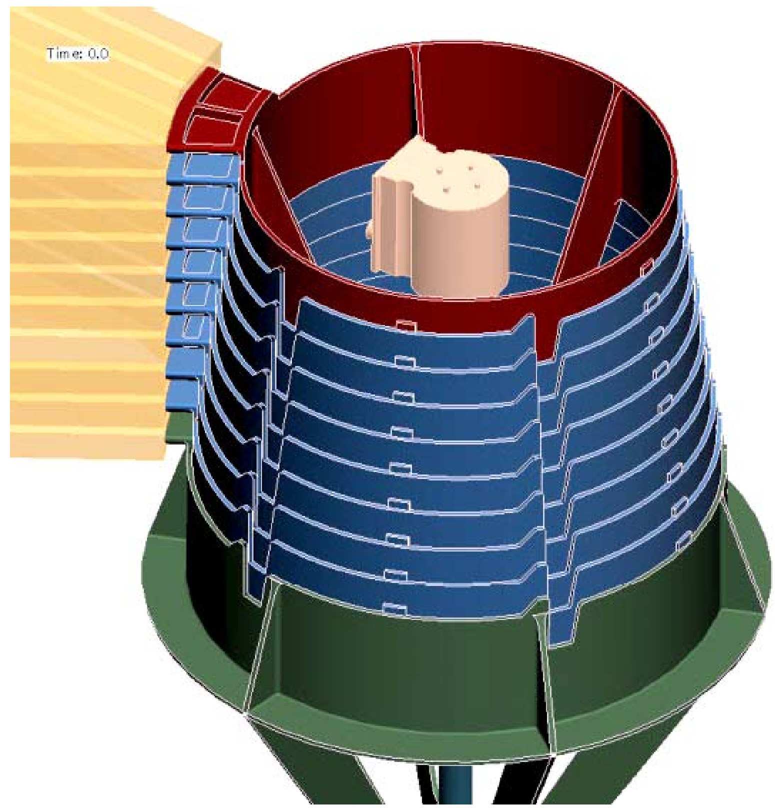
- Design a hub mechanism to deploy a segmented solid reflector
- Create a CAD model to show the dynamic simulation and a scaled prototype



CONCEPT REQUIREMENTS

- Must rotate panels into position and retract them into the same surface plane while maintaining desired spacing between panels during deployment

- Two ways to retract panels into position
  - Two separate motions
  - Step down motion

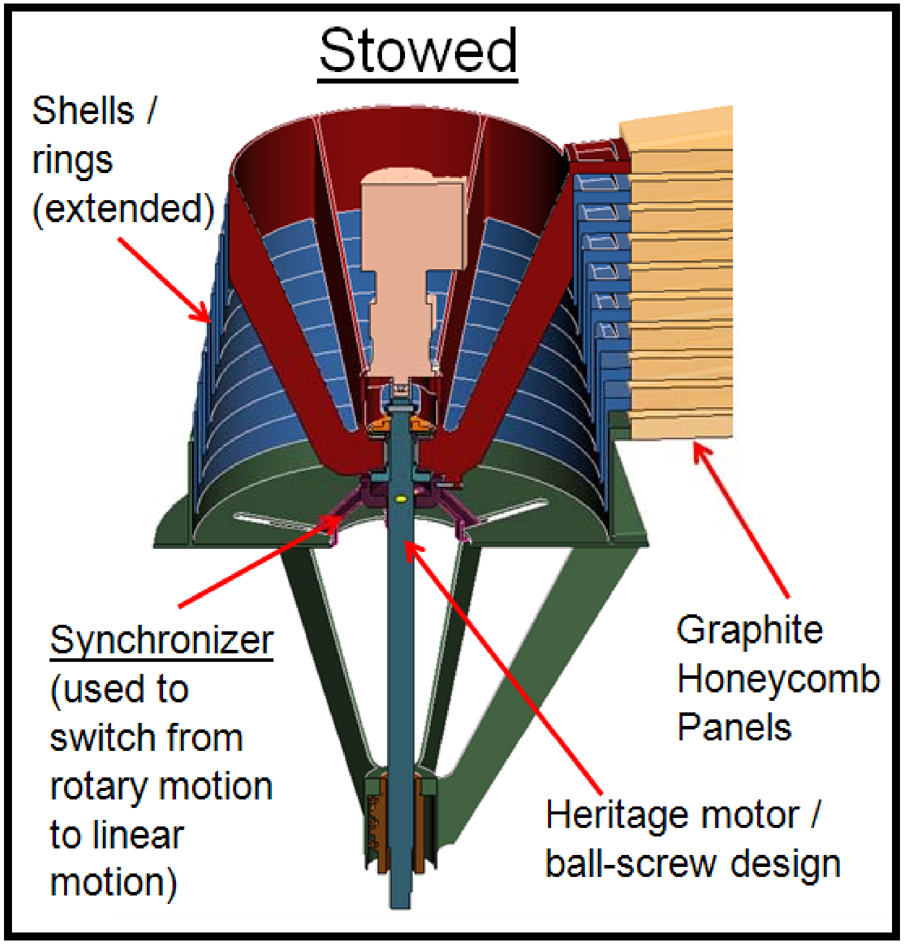


DECISION MATRIX

- Analysis will allow further refining of ratings and weights

Decision Matrix		**Concepts**					
		Synchronized Two Step Deployment		Spring Implementation		Guide Slots	
Specification	**Weight**	*Rating*	*Weighted Score*	*Rating*	*Weighted Score*	*Rating*	*Weighted Score*
Reliability	0.4	4	1.6	3	1.2	4	1.6
Durability	0.05	4	0.2	2	0.1	4	0.2
Weight	0.1	3	0.3	3.5	0.35	4	0.4
Efficiency	0.2	5	1	4	0.8	3	0.6
Ease of Construction	0.15	2	0.3	3	0.45	2.5	0.375
Cost	0.1	3	0.3	3.5	0.35	4	0.4
Total	1	3.7		3.25		3.575	

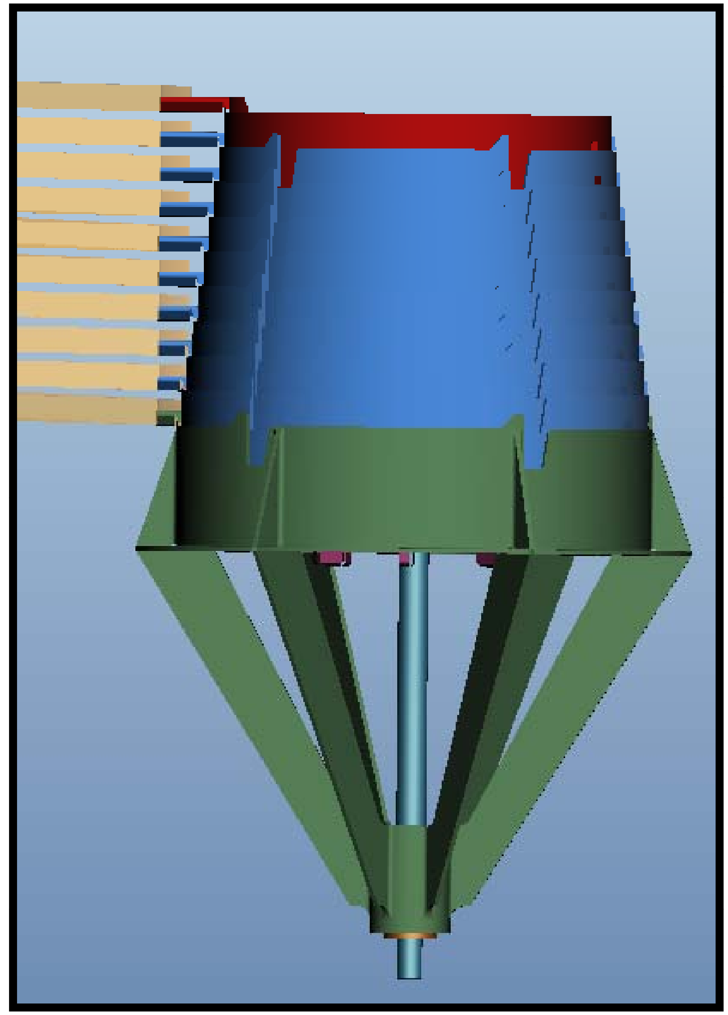
SYNCHRONIZED TWO STEP DEPLOYMENT



- Kinematic Analysis to determine forces
  - Panel weight
  - Ball screw torque
  - Motor selection
- Finite element analysis to determine stresses
- Material Selection

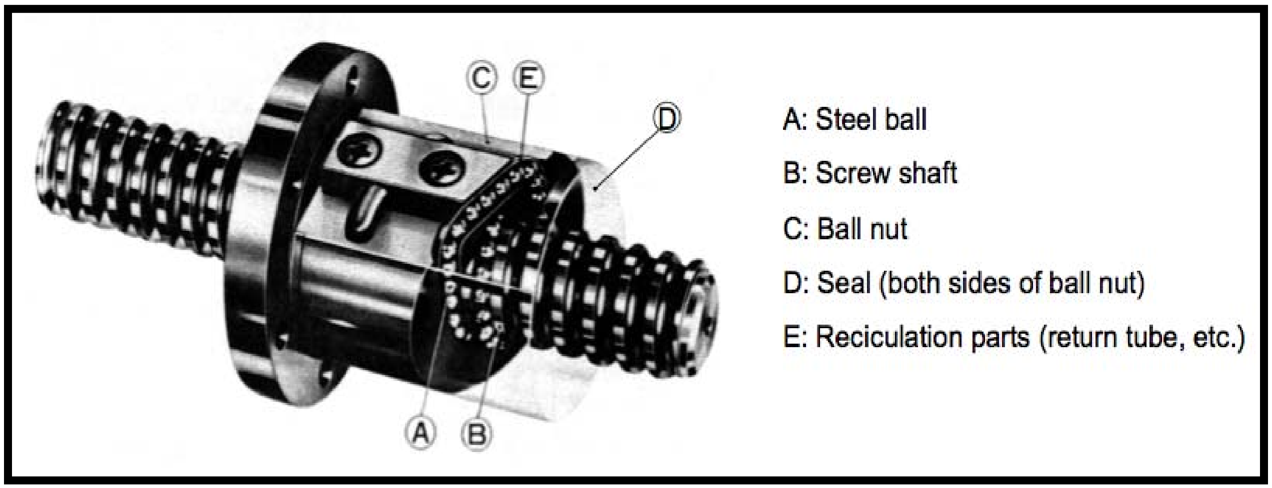
KINEMATIC ANALYSIS

- What to expect from analysis
  - Simulation of ideal/desired motion
  - Determine if ring to panel sizing ratio is correct
- Rotational torque analysis for ball screw
- Motor sizing
- Ring sizing
- Panel weight



BALL SCREW ANALYSIS

- Calculations will be conducted to find the torque and loads in order to select the correct ball screw
  - Permissible Axial Load and Rotational Speed
  - Torque due to load
  - Rotational Torque due to acceleration and deceleration



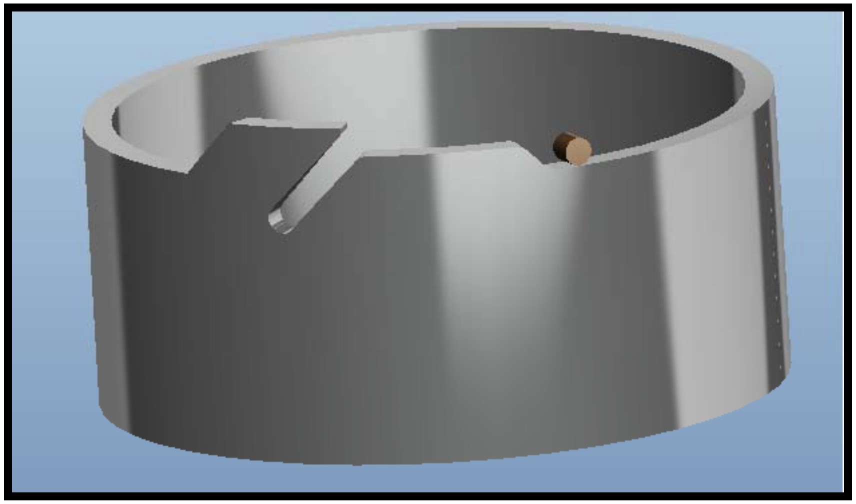
BALL SCREW CALCULATIONS

- Permissible Axial Load: $P_1 := \frac{\eta_1 \cdot \pi^2 \cdot E \cdot I}{l_a^2} \cdot 0.5$ $\quad P_2 := \sigma \cdot \frac{\pi}{4} \cdot d_1^2$

- Permissible Rotational Speed: $N_1 := \frac{60 \cdot \lambda_1^2}{2\pi \cdot l_b^2} \cdot \sqrt{\frac{E \cdot 10^3 \cdot I}{\gamma \cdot A}} \cdot 0.8$

- Rotational Torque:
  - Uniform Motion: $T_t := T_1 + T_2 + T_4$
  - During Acceleration: $T_K := T_t + T_3$
  - During Deceleration: $T_g := T_t - T_3$

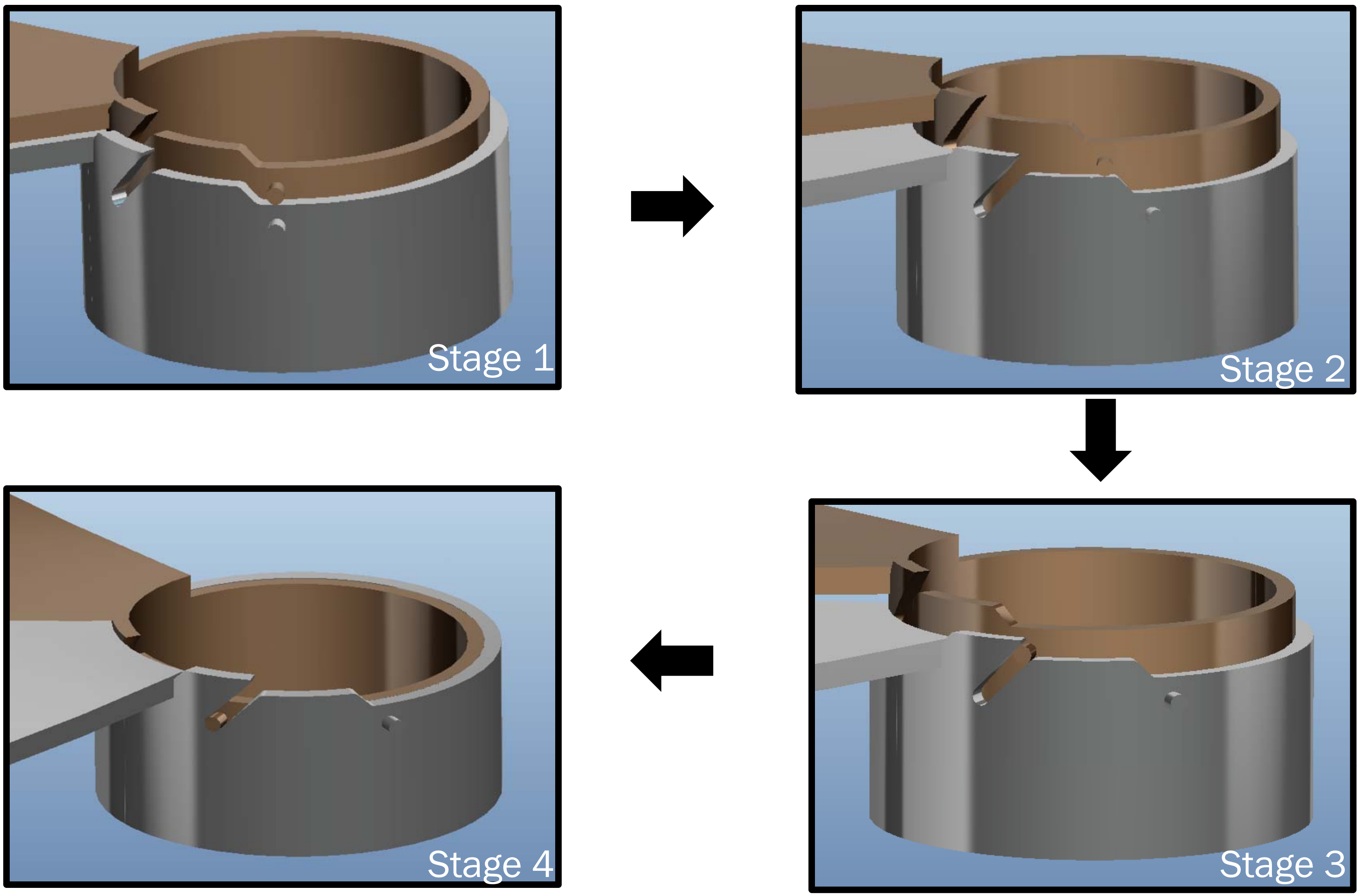
RAMP SLOT CONCEPT



Example of single ring with barrel slider

- Kinematic analysis to determine forces
  - Panel weight
  - Motor selection
- Finite element analysis to determine stresses
- Cam/follower analysis
- Material selection

RAMP SLOT OPERATION

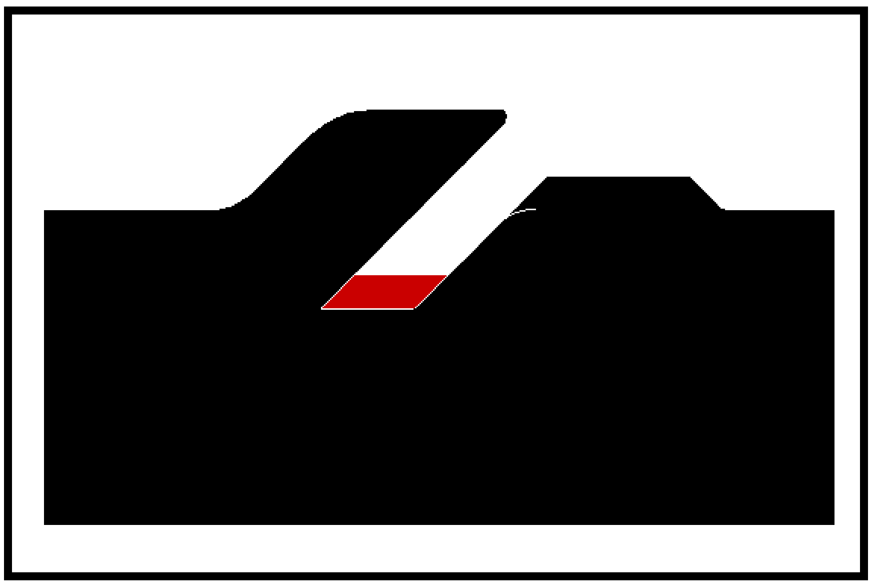


KINEMATIC ANALYSIS

- What to expect from analysis
  - Simulation of ideal/desired motion
  - Determine if ring to panel sizing ratio is correct
- Motor sizing
- Ring sizing
- Panel weight

CAM/FOLLOWER ANALYSIS

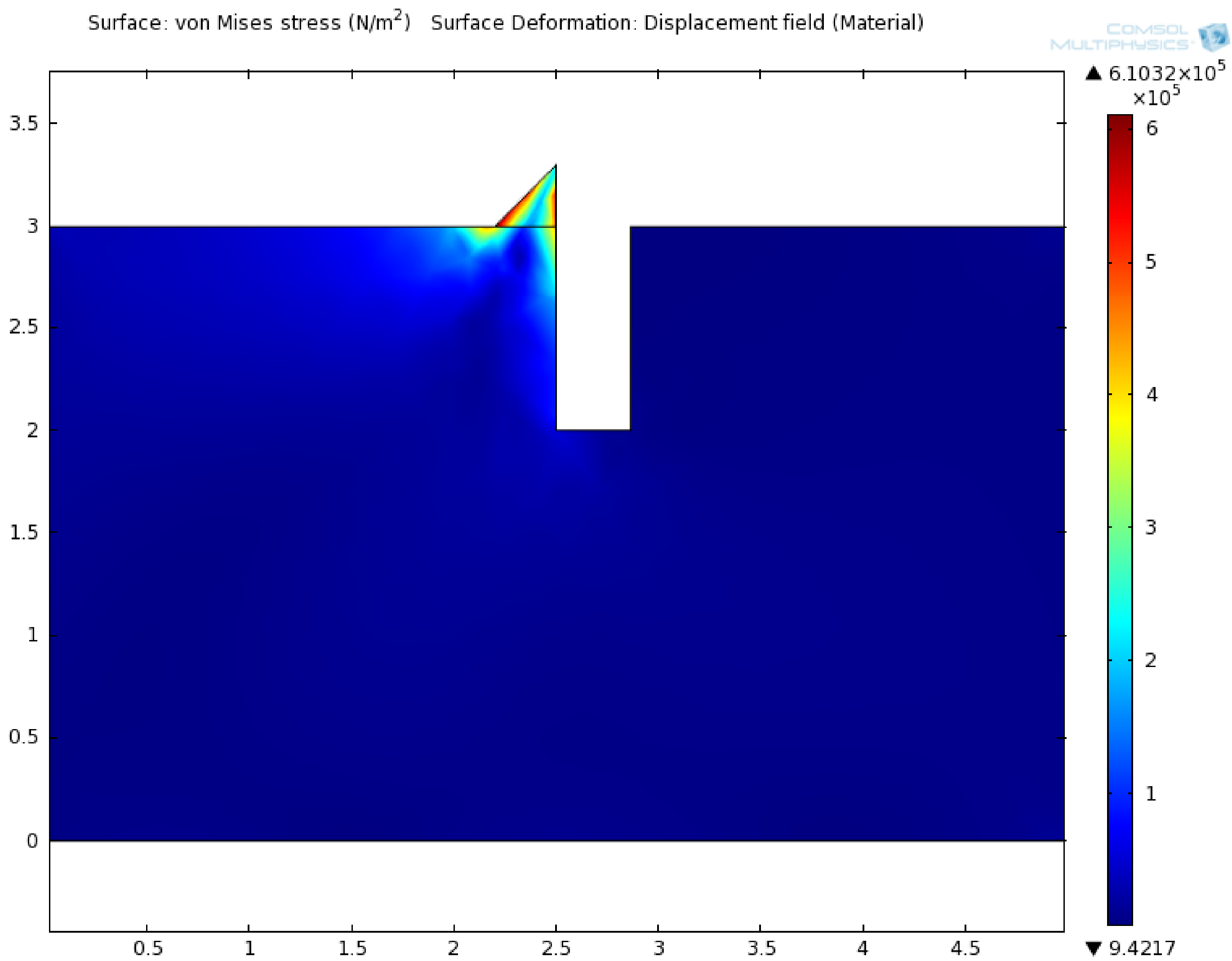
- Determine the best cam profile to ensure precise panel alignment.
- Determine appropriate follower/slider



FINITE ELEMENT ANALYSIS

- Stress/Strain analysis
  - Determine if panels will introduce unwanted stresses in ring
  - Initial results suggest that material strength is not a concern
- Assumptions
  - Material is 4130 Steel
  - Left & Right boundaries are fixed
  - Uniform Distributed Load Applied to triangular tab
  - Simulates a binding or maximum loading situation

FINITE ELEMENT ANALYSIS



MATERIAL SELECTION

- Take all analysis into consideration when selecting a material
- Possible materials
  - Aluminum (2024 or 6061)
  - Stainless steel (302 or 304)
  - Steel (4130)
- We will conduct further analysis of the system to select a final material

Questions or Comments?