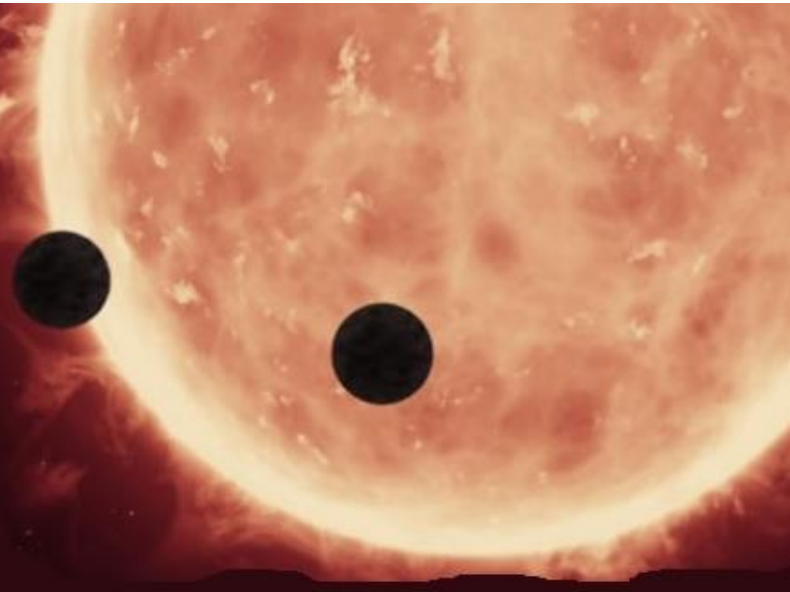
HabEx 4-meter off-axis primary mirror study

Jacqueline Davis

Are we there yet??



Are we there yet??

telescope technology

habitable zone size = large telescope diameter
star size = high line of sight stability
high contrast = mid-to-high spatial frequency resolution
& wavefront-error stability
diffraction limit = low/mid-spatial wavefront error
spatial resolution = line of sight stability

Are we there yet??

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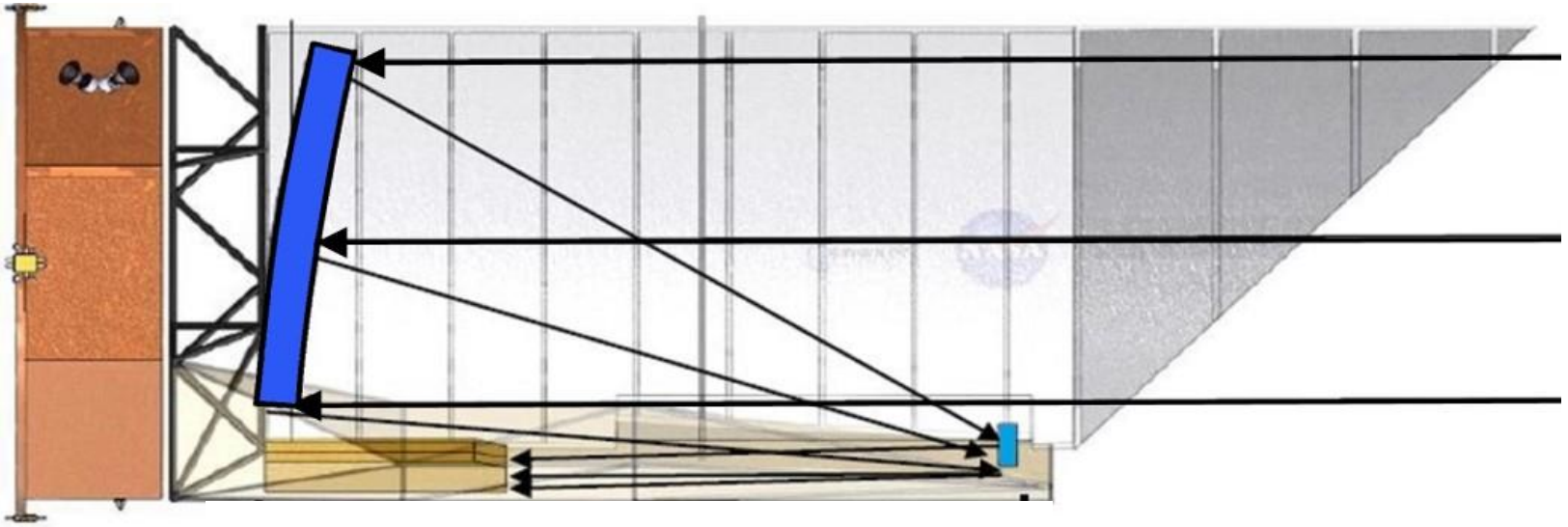
programmatic constraints

launch vehicle constraints = mass budget
fairing size
architecture telescope
budget constraints = telescope diameter

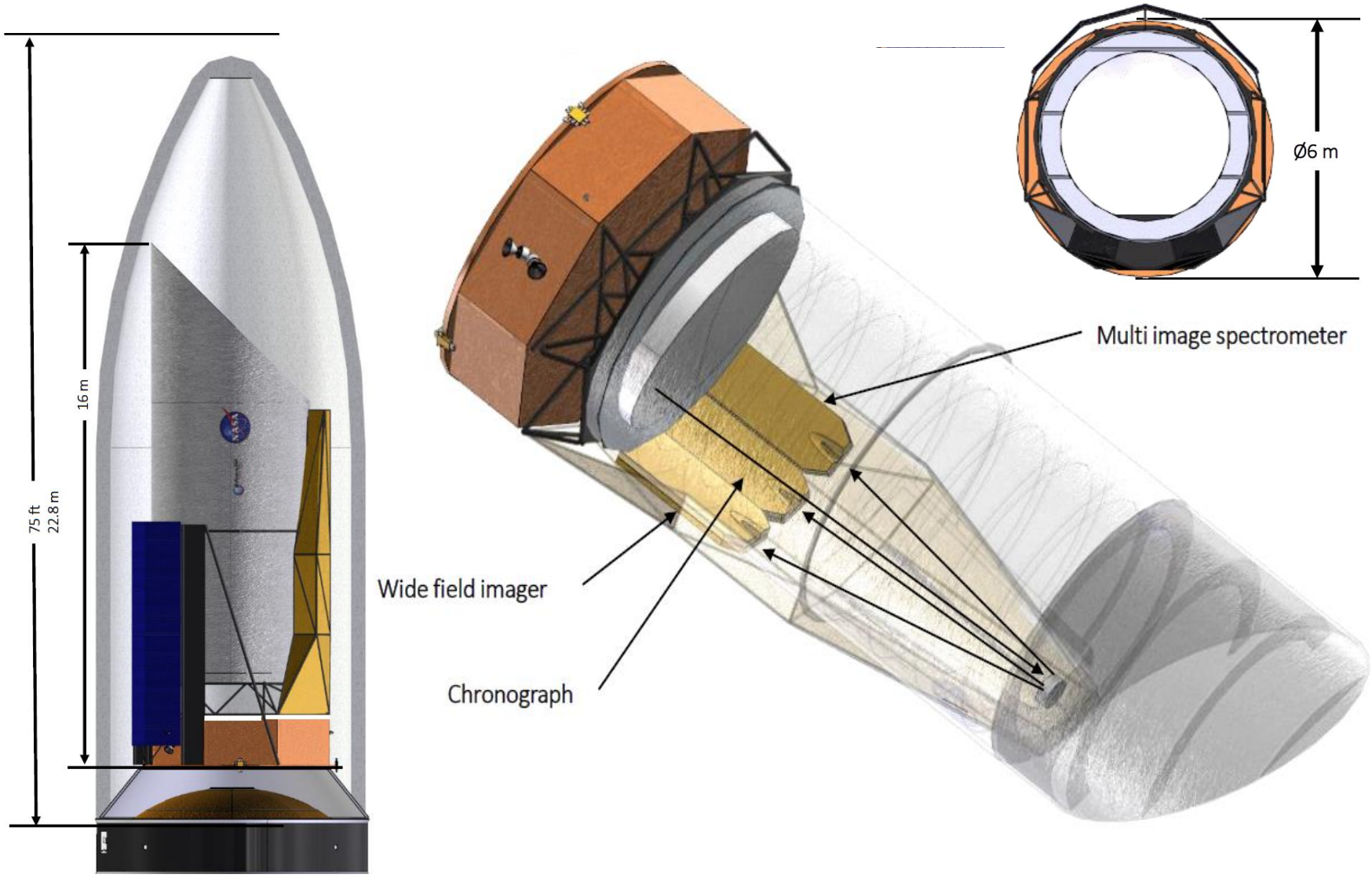
optical telescope assembly

primary mirror assembly



secondary mirror assembly

launch vehicle and science instruments



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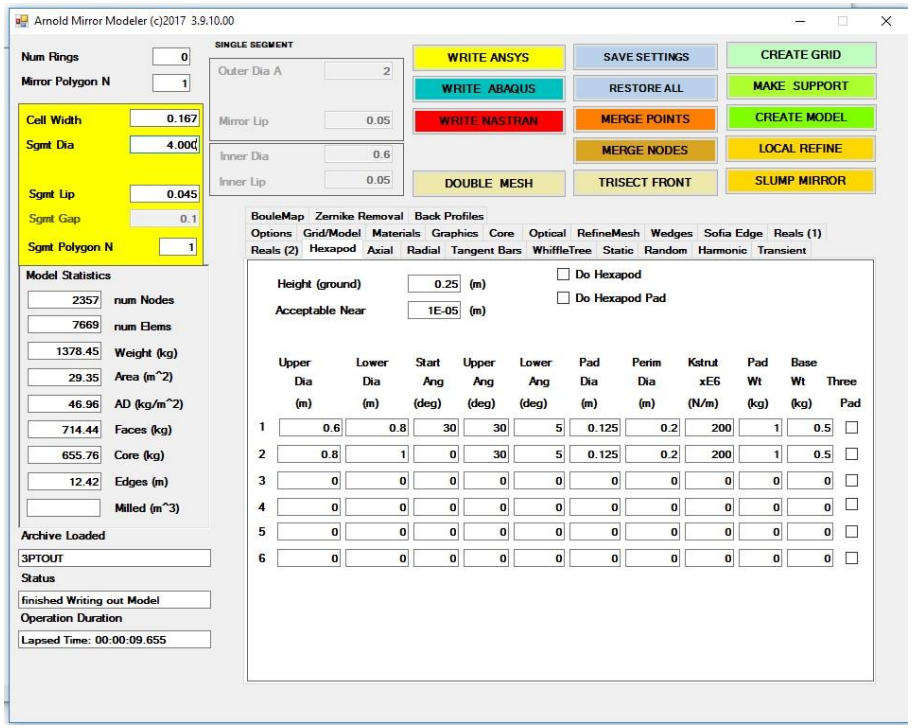
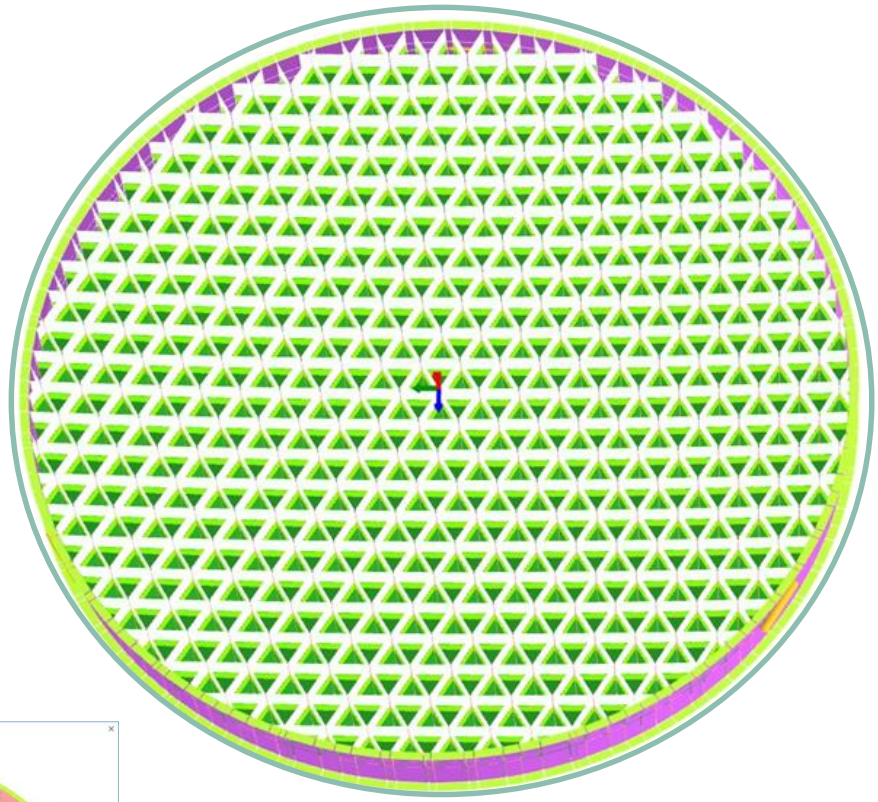
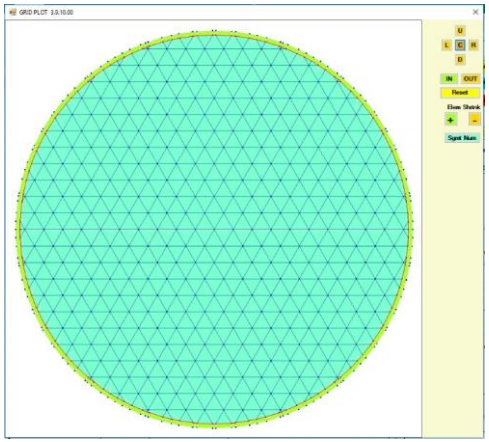
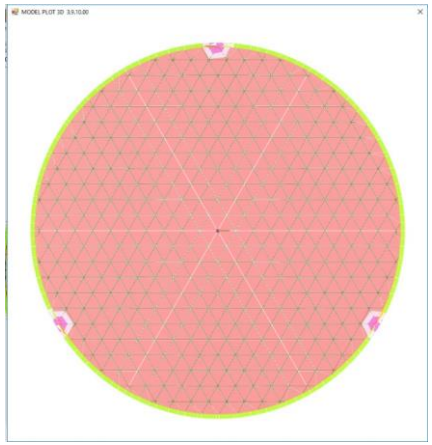
Arnold Mirror Modeler

MARSHALL SPACE FLIGHT CENTER





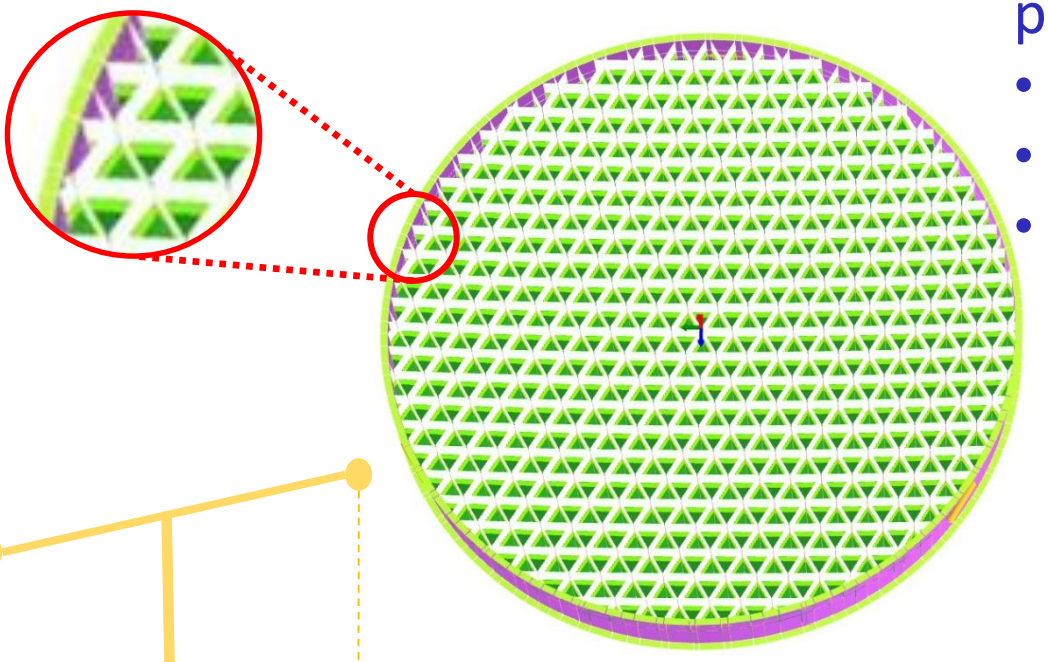


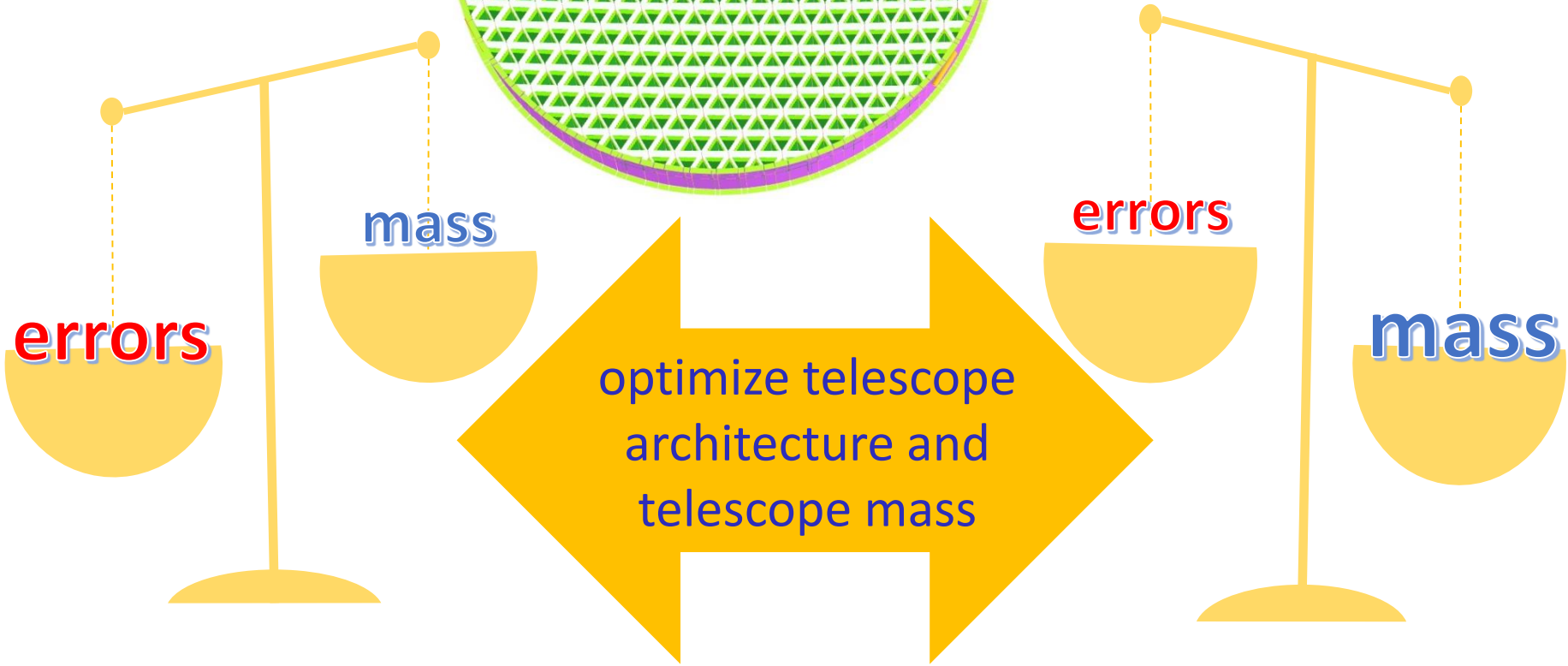


technology vs. constraints

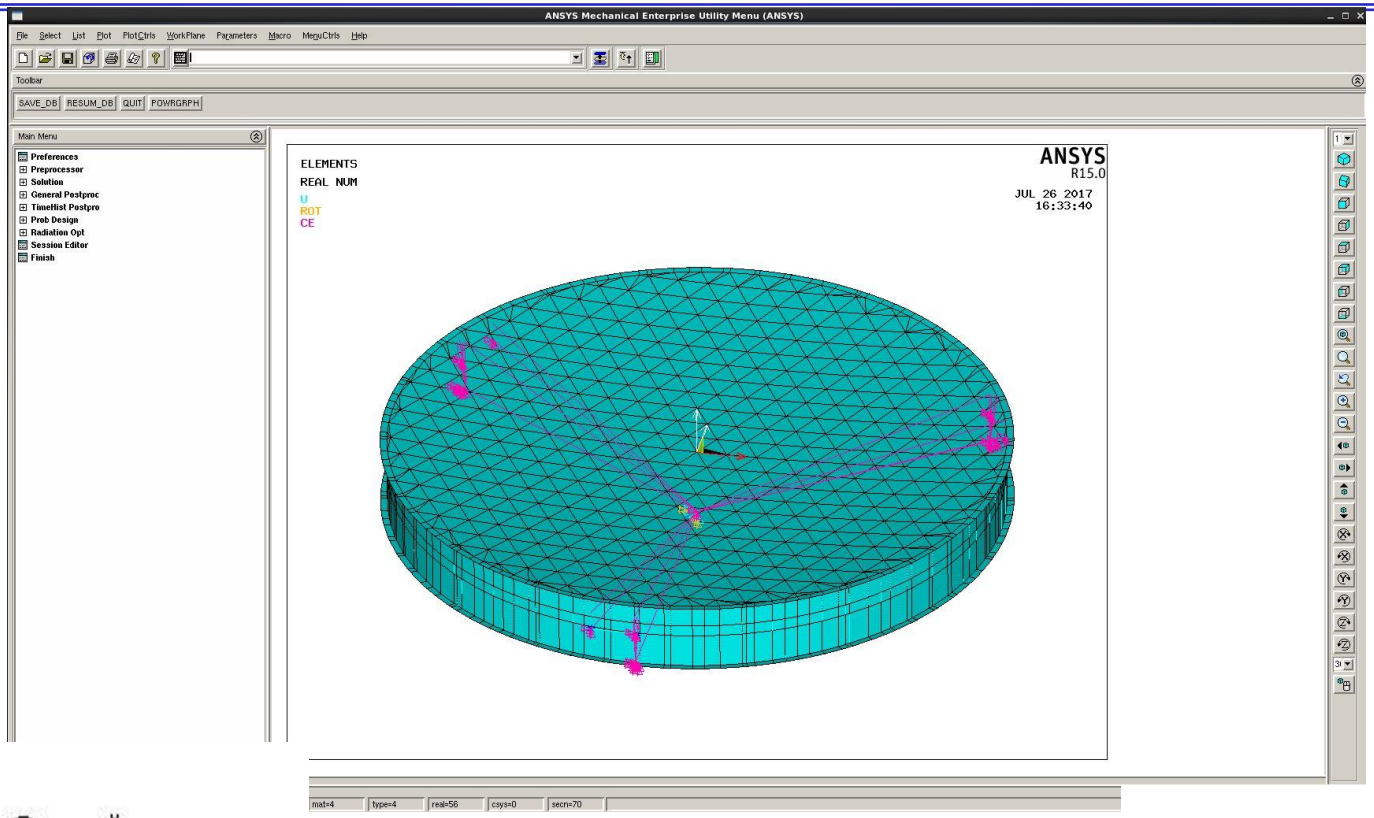
primary mirror architecture

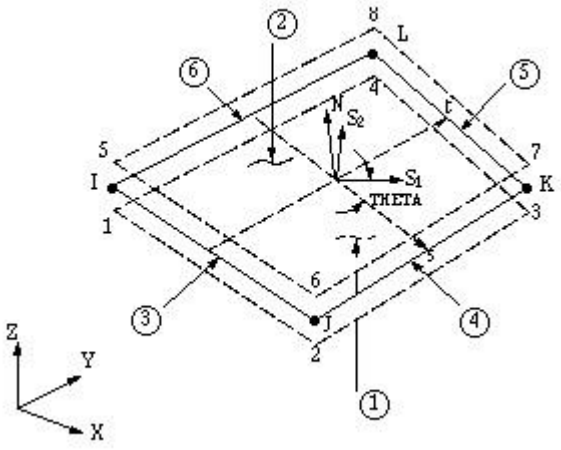
- mirror depth
- cell size
- rib thickness



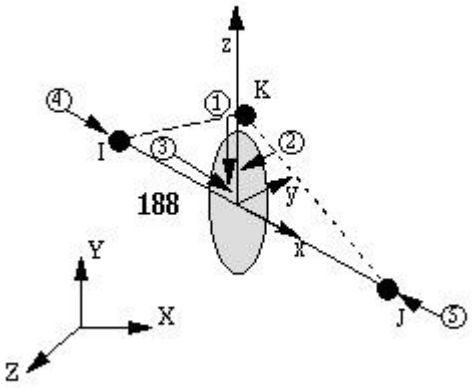


Finite Element Model

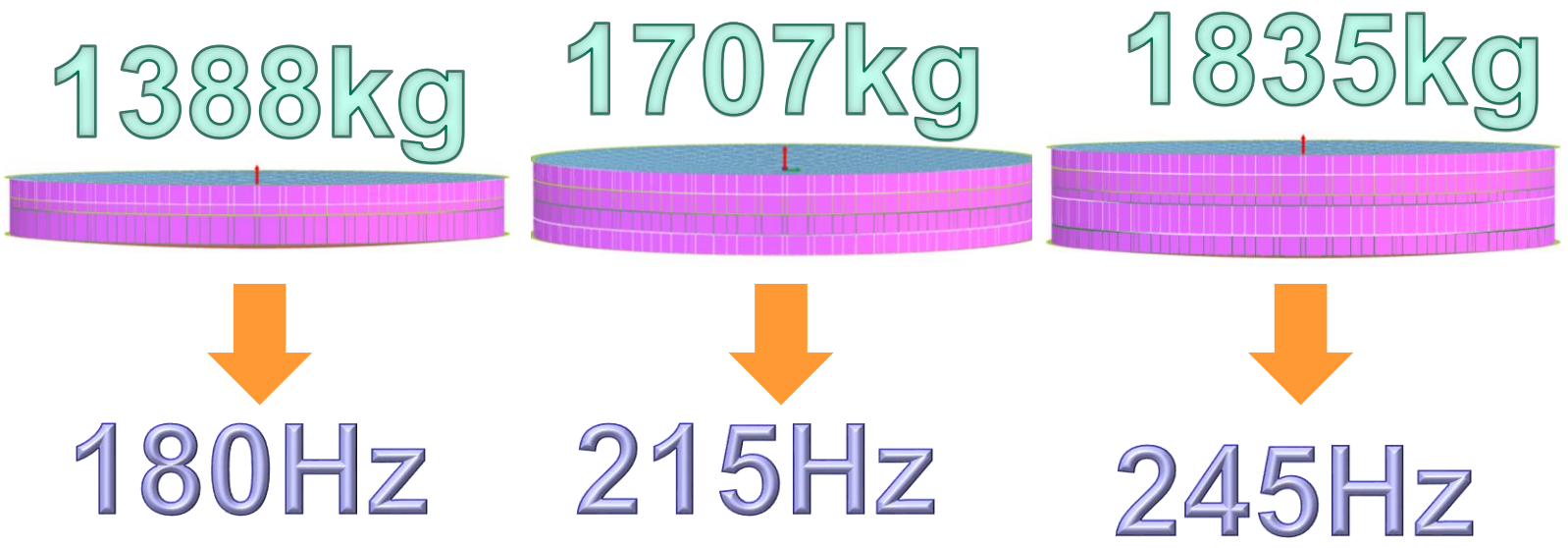




elastic modulus = 6.76E10 Pa
density = 2210 kg/m3
viscosity = 0.17
thermal expansion= 3E-8 m/m/K

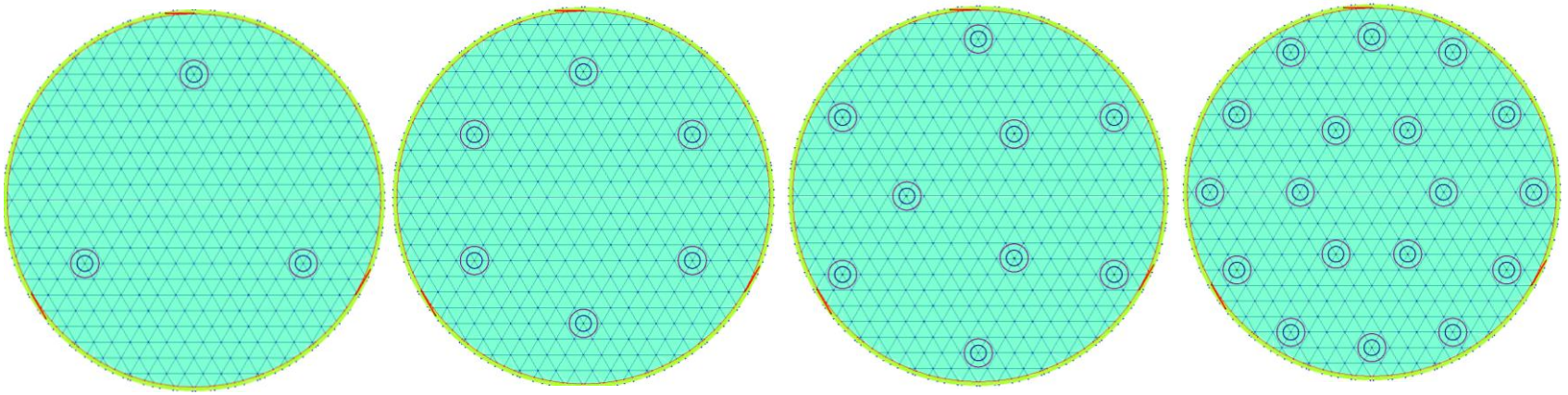


Stiffness Analysis



depth (m)	0.45	0.6	0.75
mass (kg)	1388	1707	1835
cell size (m)	0.167	0.167	0.167
front fs (m)	0.0277	0.028	0.0277
back fs (m)	0.0231	0.023	0.0231
1st mode (Hz)	180	215	245

Gravity Sag



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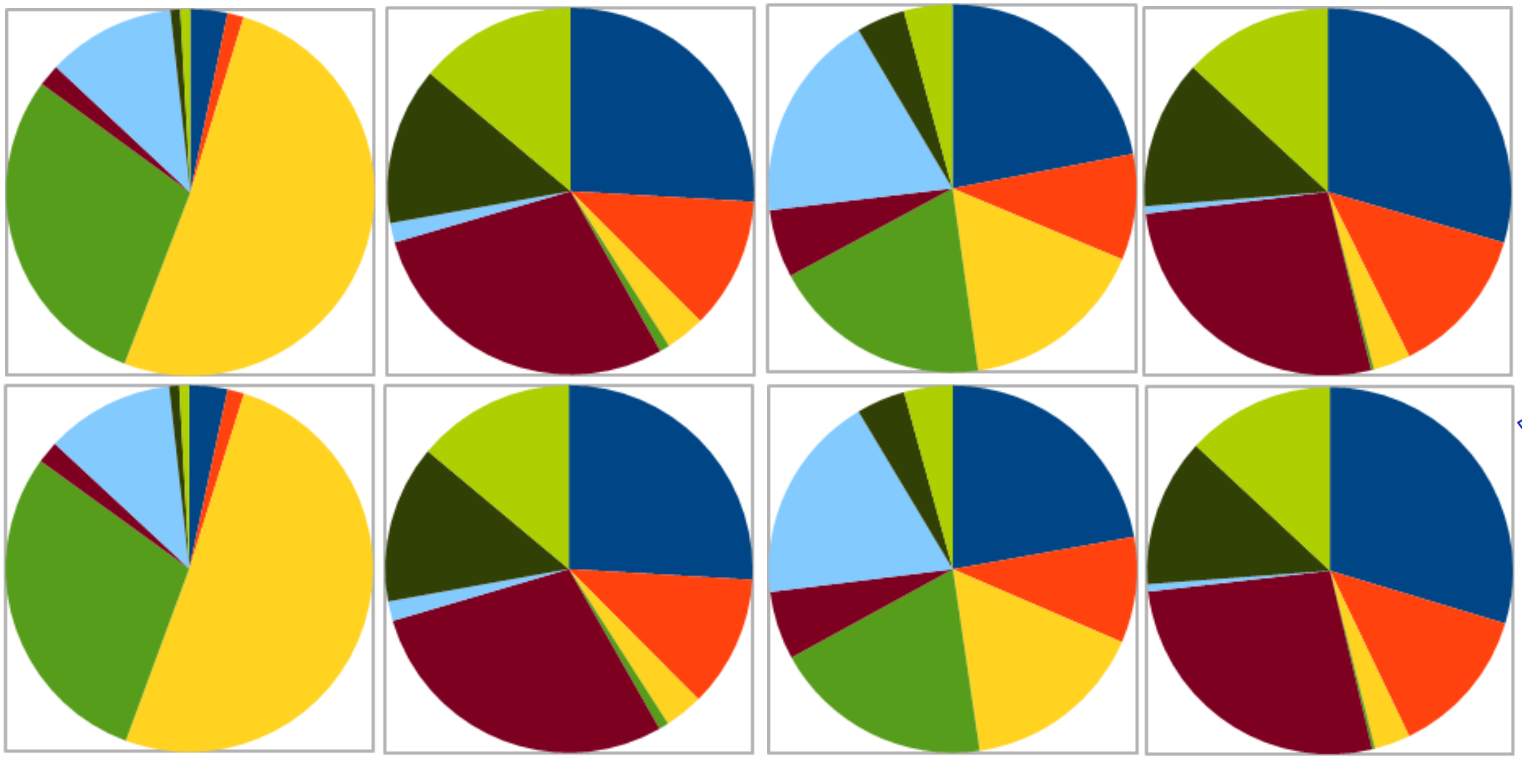
Mounting Effects

3POINT 6POINT 9POINT 18POINT

* very stiff mounts



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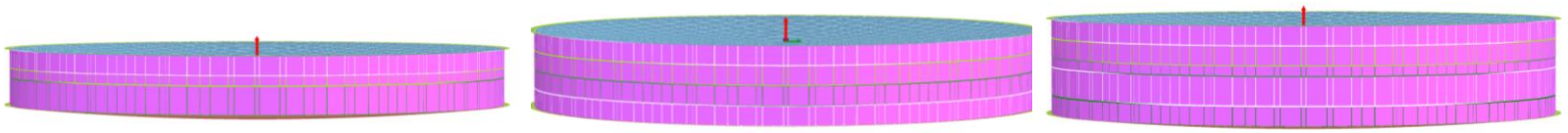
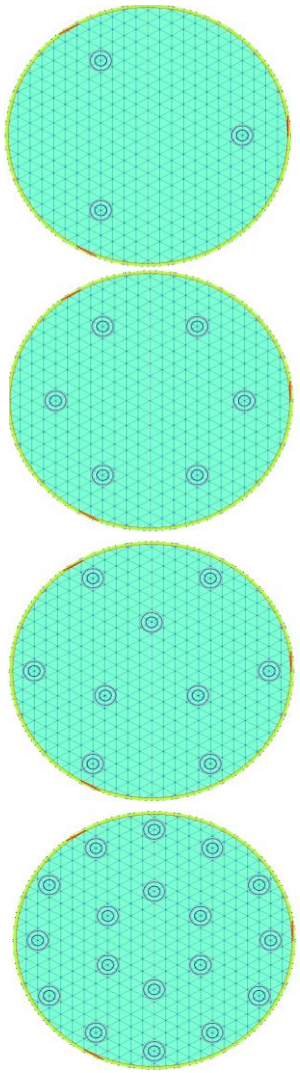
HabEx 4-meter Off-axis Point Design

MARSHALL SPACE FLIGHT CENTER





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18-point Vertical Gravity Sag [μm]	1.12	1.00	0.80

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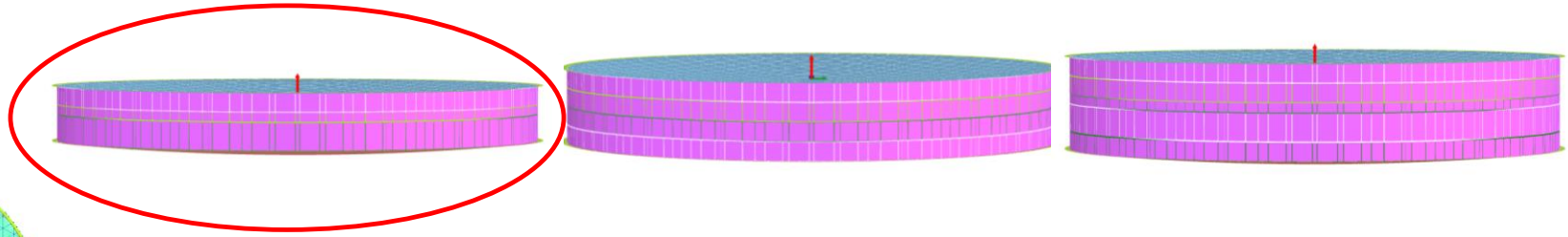

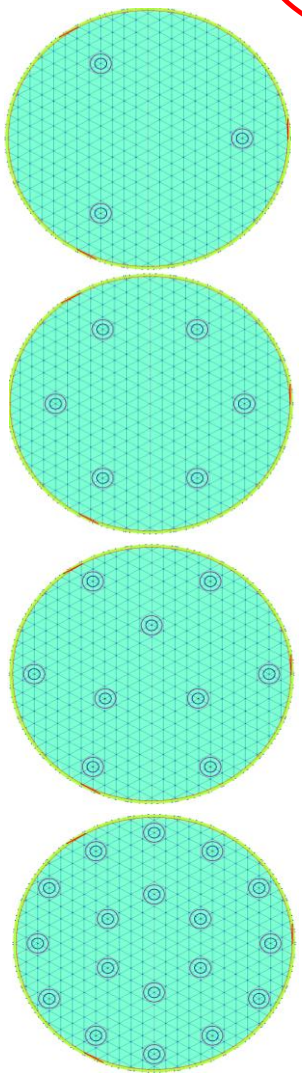

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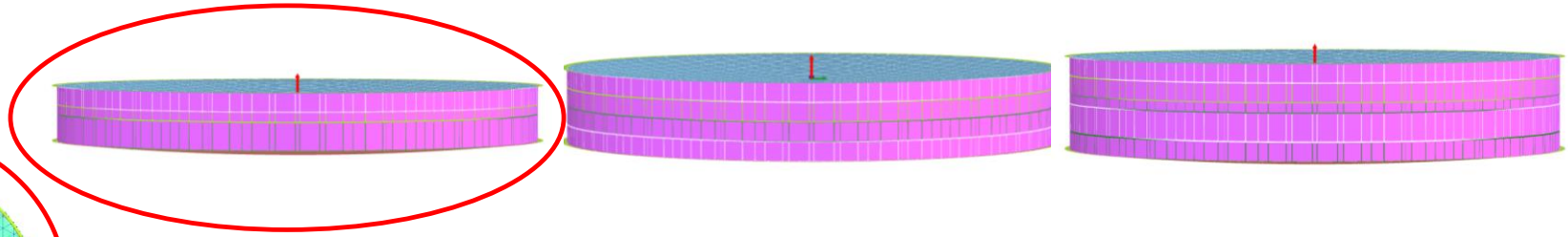

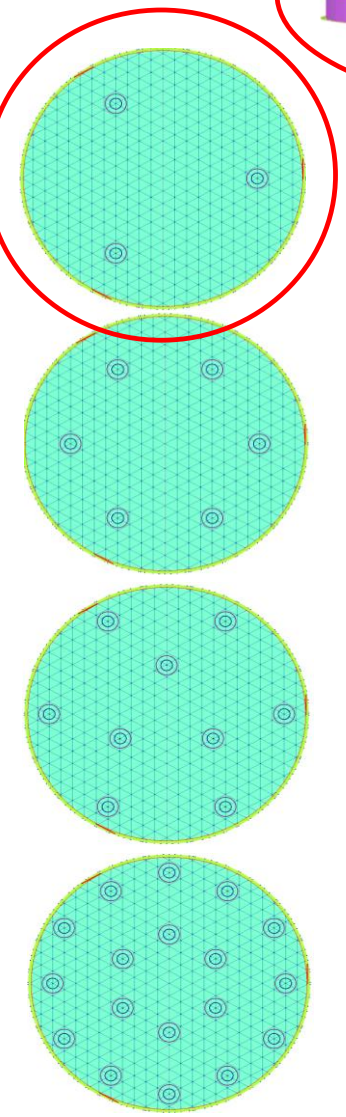

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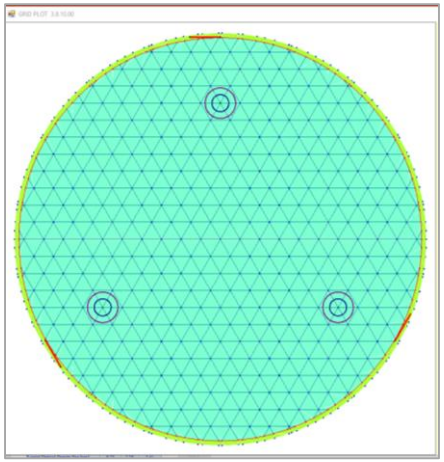
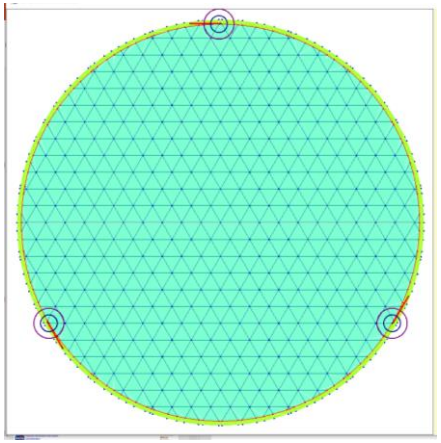
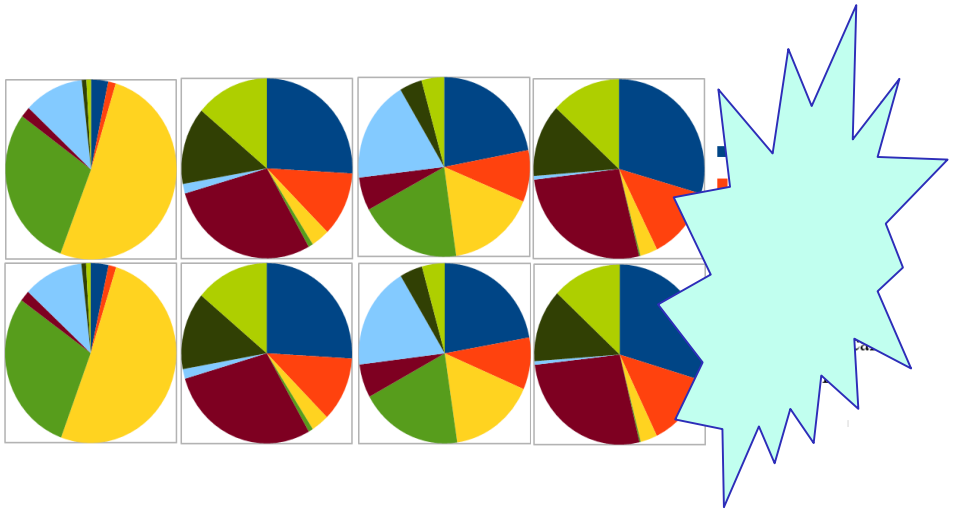
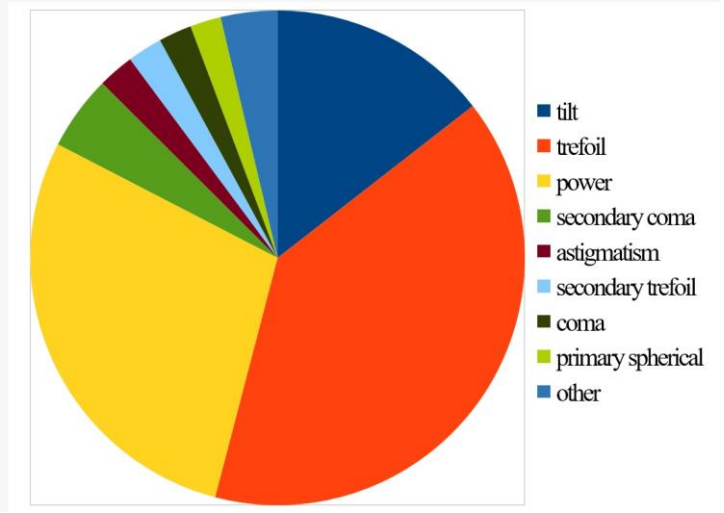
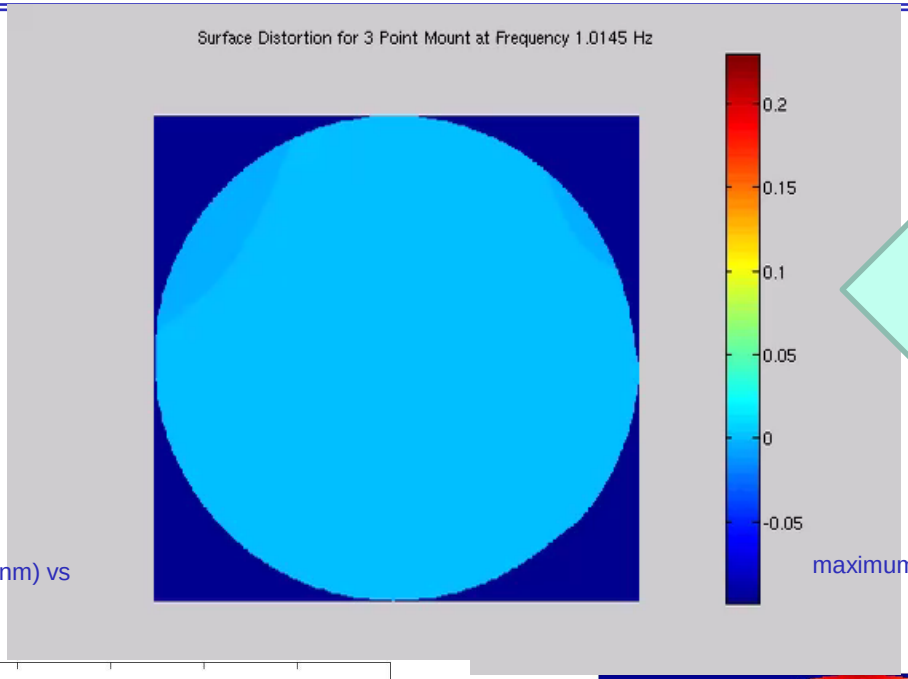
Change mount placement







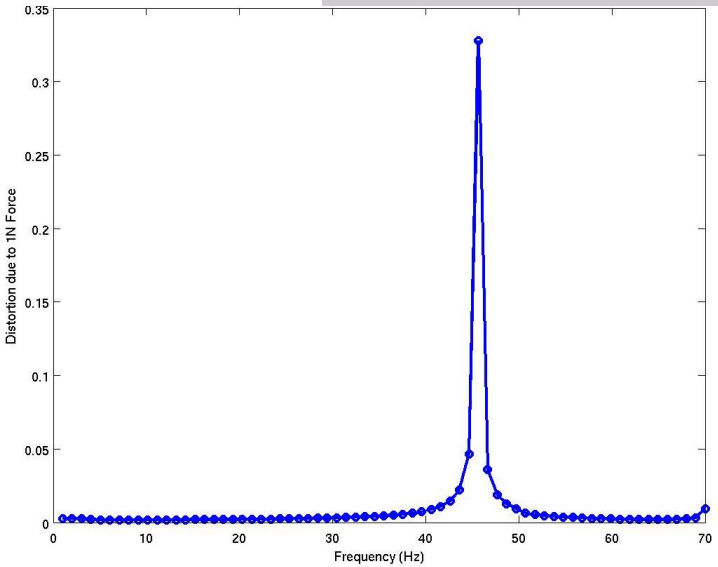


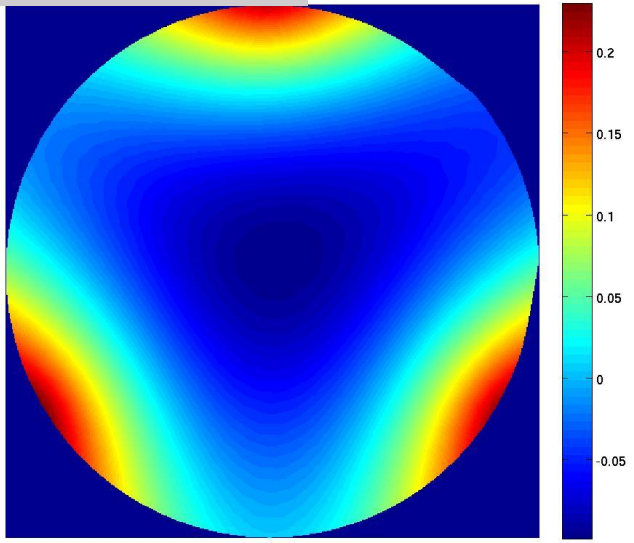


watch video

p-v surface distortion (nm) vs frequency (Hz)

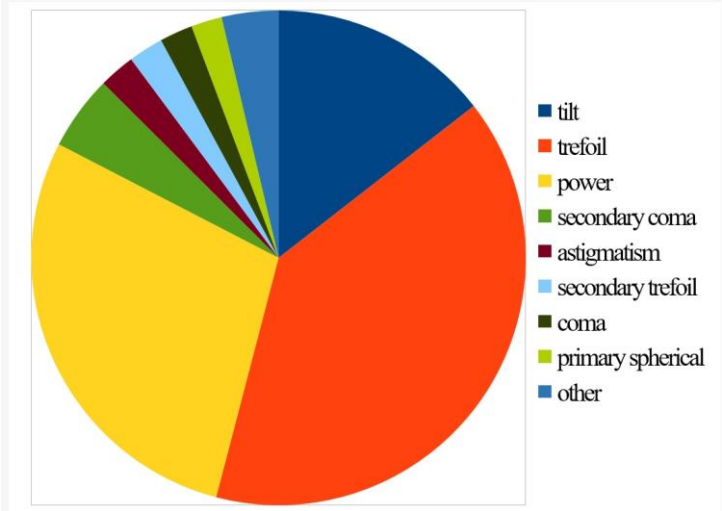
maximum surface distortion (nm)

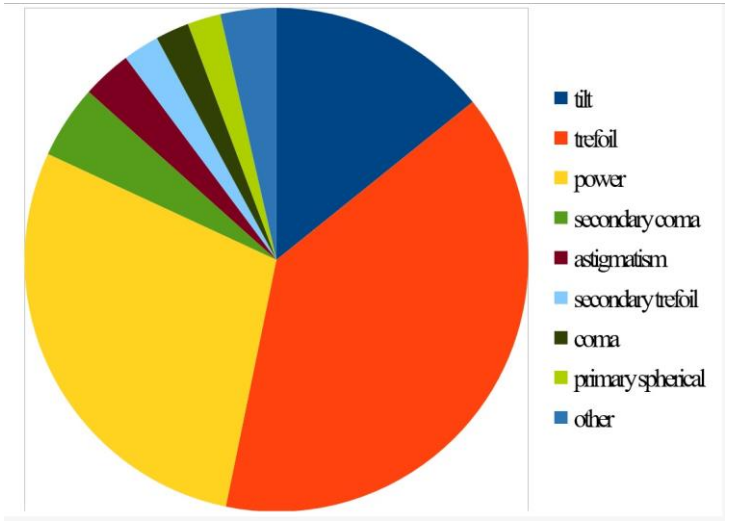




Harmonic analysis

	harmonic	gravity sag
magnitude (m)	9.90E-010	2.39E-005
tilt	14.5%	14.2%
trefoil	39.6%	39.0%
power	28.5%	28.7%
secondary coma	4.9%	4.7%
astigmatism	2.4%	3.2%
secondary trefoil	2.3%	2.3%
coma	2.2%	2.2%
primary spherical	2.0%	2.1%
other	3.7%	3.6%





Mount Stiffness Analysis