

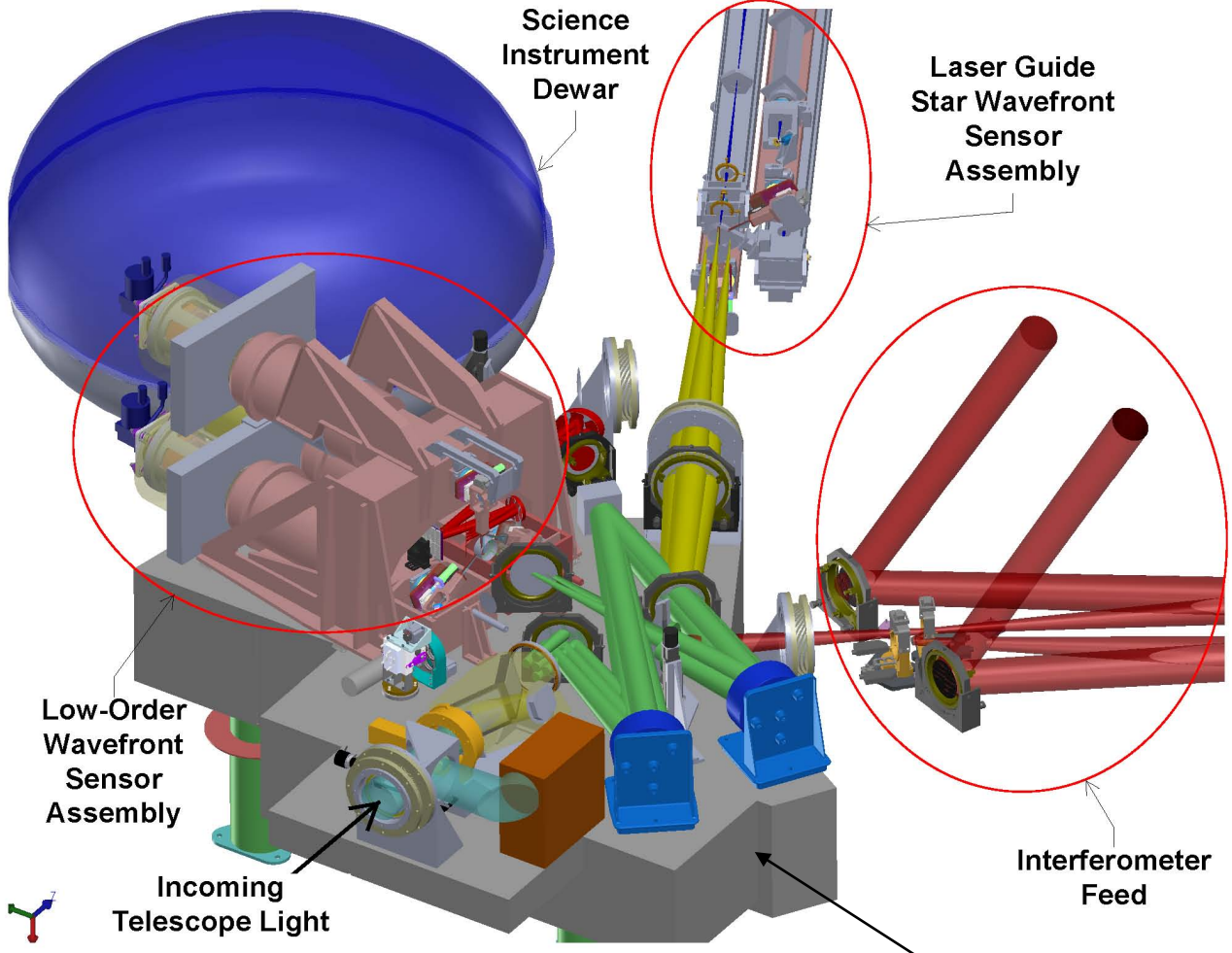
Keck Next Generation Adaptive Optics

Instrument Bench
Preliminary Mechanical Design

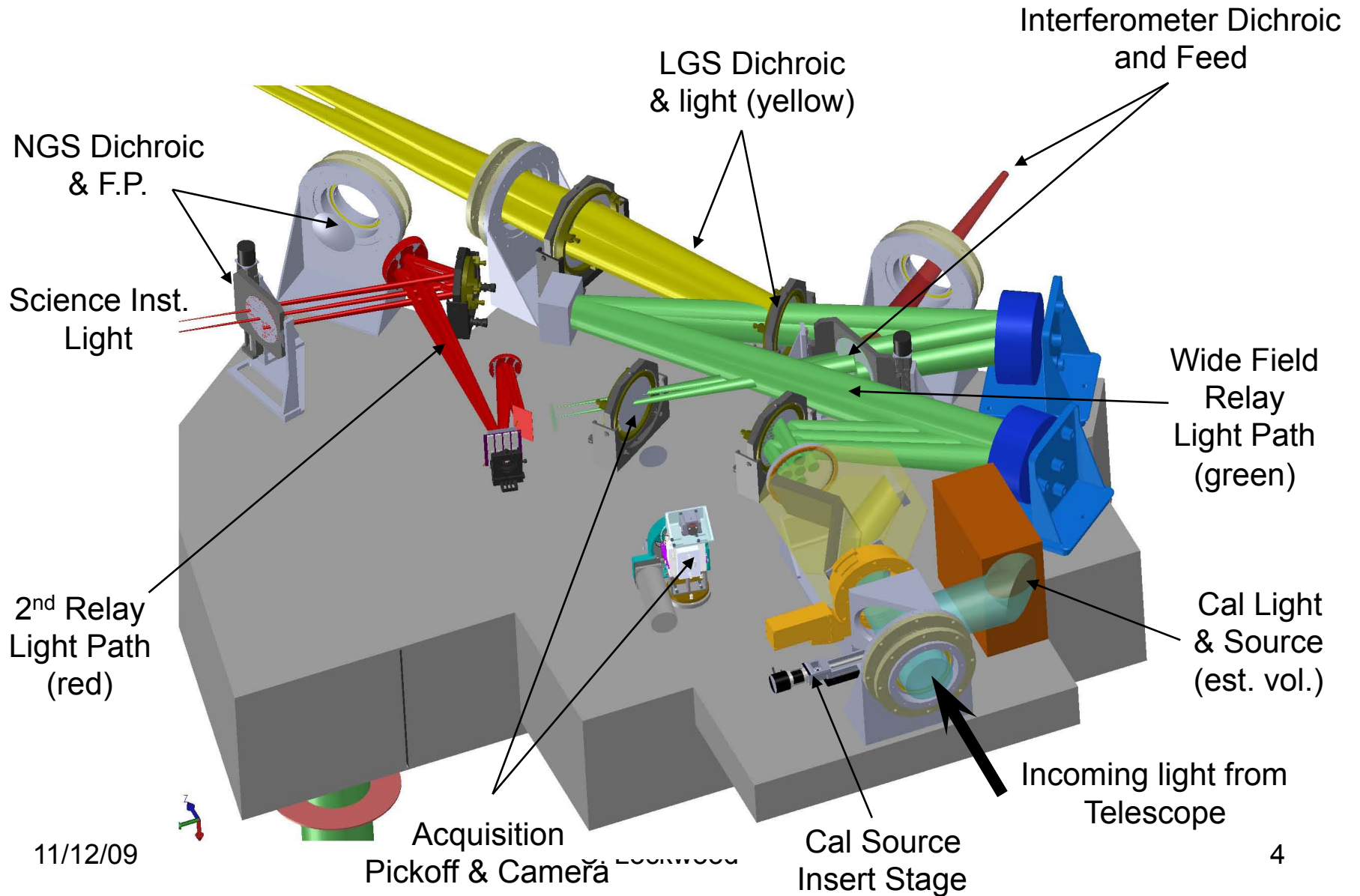
Scope and Goals (Bench only)

- Iterate optical and mechanical designs to a compatible layout.
- Generate design detail at levels adequate to show feasible mountings without interference or vignetting.
- Verify adjustment resolution can satisfy alignment tolerance requirements of optical design.
- Evaluate thermal stability from maintenance (dome) temperatures, to instrument operating conditions.
- Evaluate stability of instrument interface to telescope.
- Assess vibration stability considering internal and external sources.
- Identify challenges for subsequent phase.

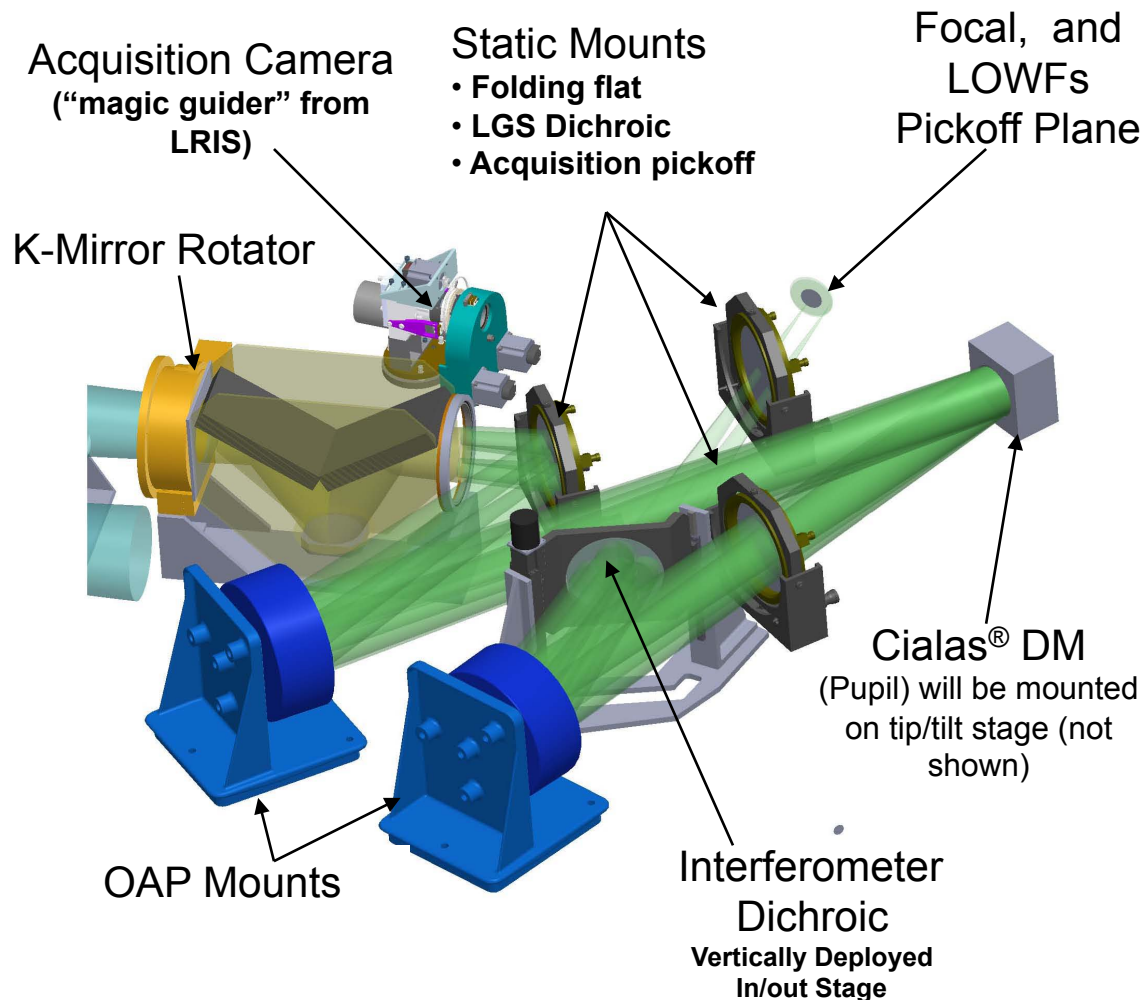
Bench & Related Assemblies



Bench Layout



Wide Field Relay



- Tip/tilt stage-mounted Deformable mirror (mfg's design pending)
- 3 Static mounts (choice – TBD). Shown are Optosigma gimbal mounts w/out lockable adjustments (desired).
- Acquisition camera shown is "magic guider" design from LRIS.
- Interferometer dichroic req's custom in/out stage to avoid vignetting.
- Parabola mounts shown are mfg'd by SORL. Packaging limitations may require other choice.

K-Mirror Rotator

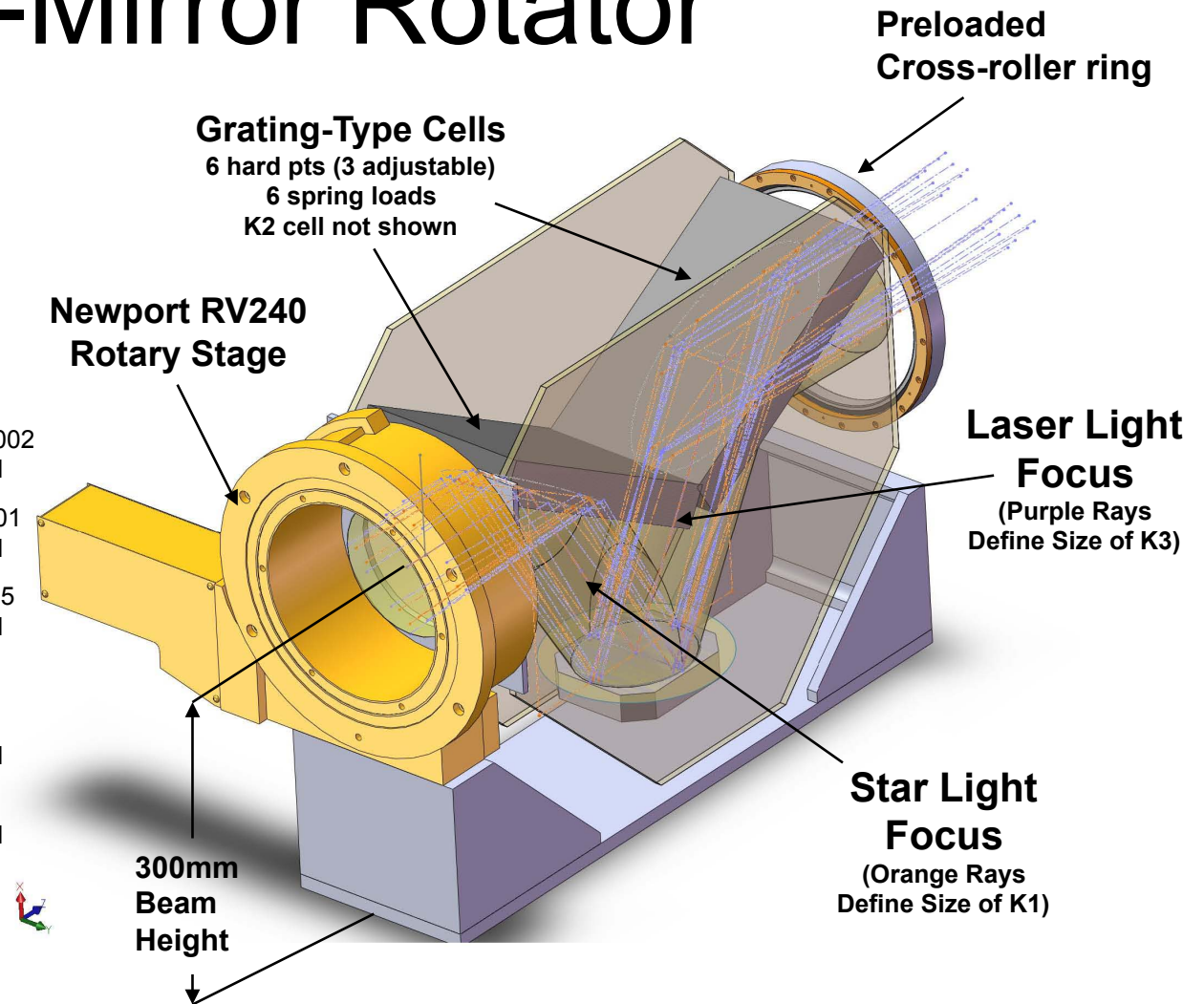
Newport RV240 Rotational Stage

Mfg Specifications

Aperture diameter (mm)	240
Travel Range (°)	±170
Resolution (°)	0.00005
Minimum Incremental Motion (°)	0.0001
Uni-directional Repeatability (°)	0.00011 typical, 0.0002 guaranteed
Reversal Value (Hysteresis) (°)	0.0006 typical, 0.001 guaranteed
Absolute Accuracy (°)	0.003 typical, 0.005 guaranteed
Maximum Speed (°/s)	16
Wobble (μrad)	8 typical, 16 guaranteed
Eccentricity (μm)	1.4 typical, 4 guaranteed

Not Specified

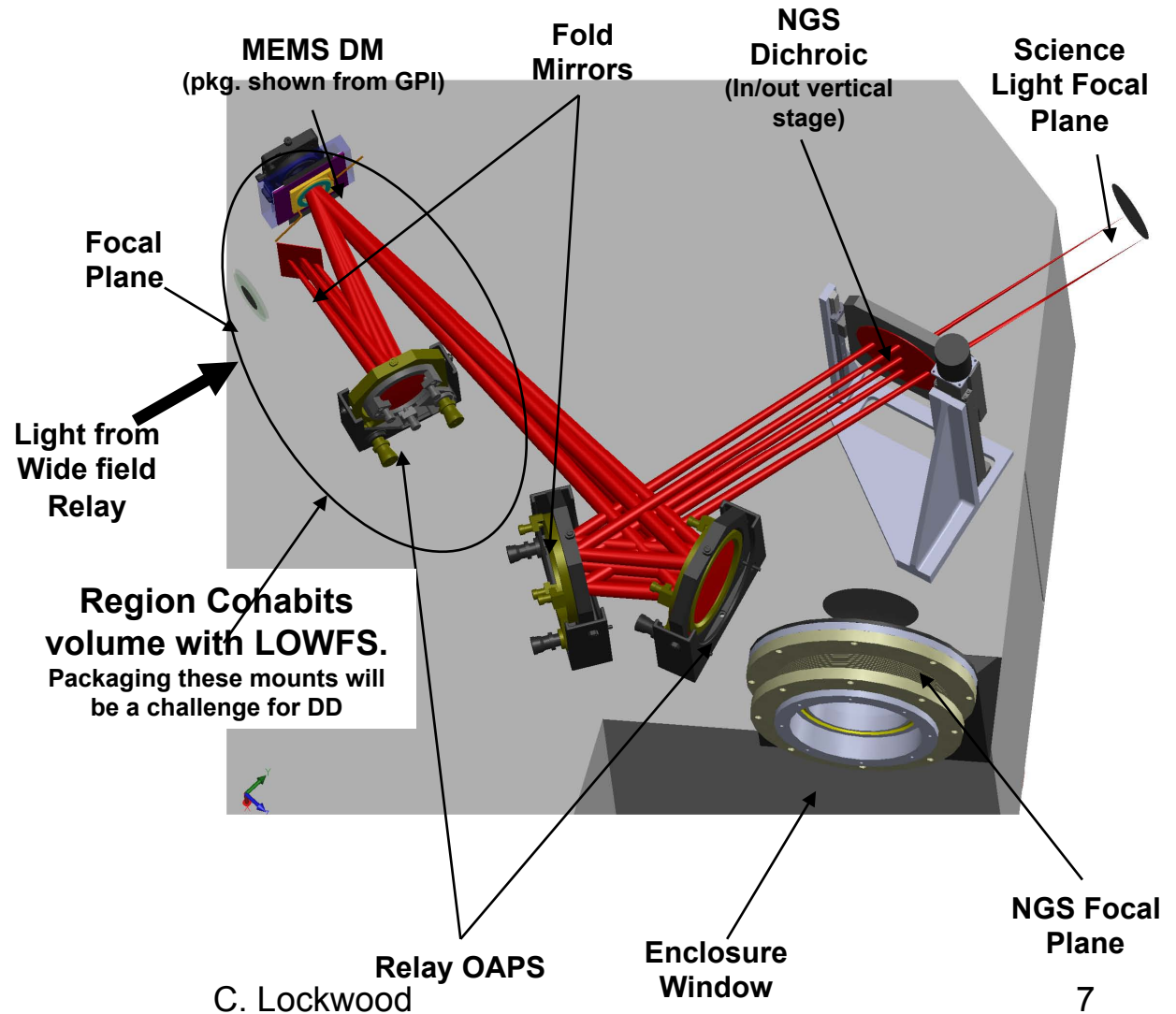
Minimum Operating Temperature
Pressure/Altitude limits



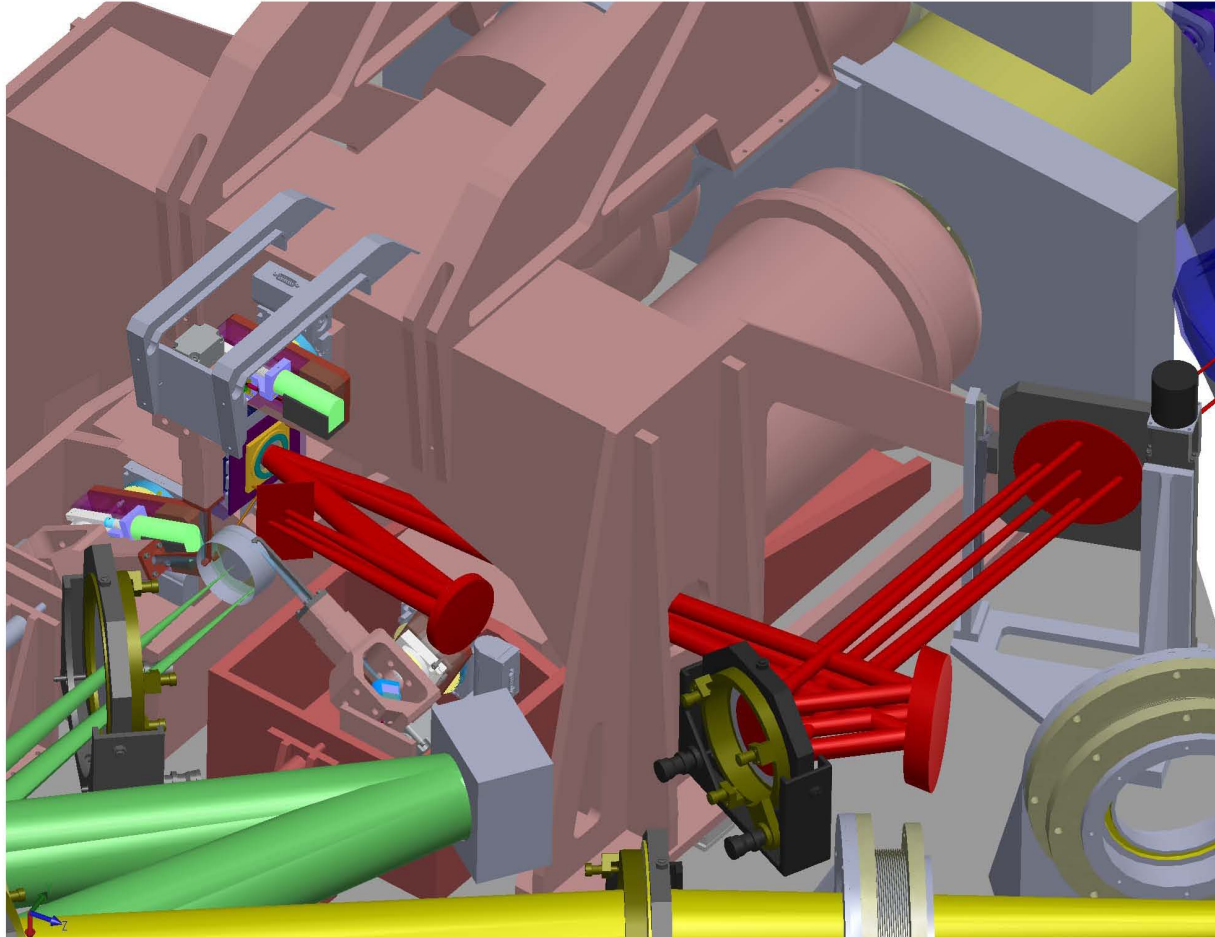
Narrow Field Relay

- MEMs Deformable mirror shown on 5-DOF Newport mirror mount. Slow tip/tilt stage-mount will be pursued in DD.
- MEMs mount must be suspended inside LOWFS structure.
- Static mounts choice TBD. Shown are Optosigma gimbal mounts w/out lockable adjustments (desired).
- In/out stage req'd NGS WFS dichroic.
- Parabola mounts are TBD. Packaging is will be tight for this relay.

11/12/09

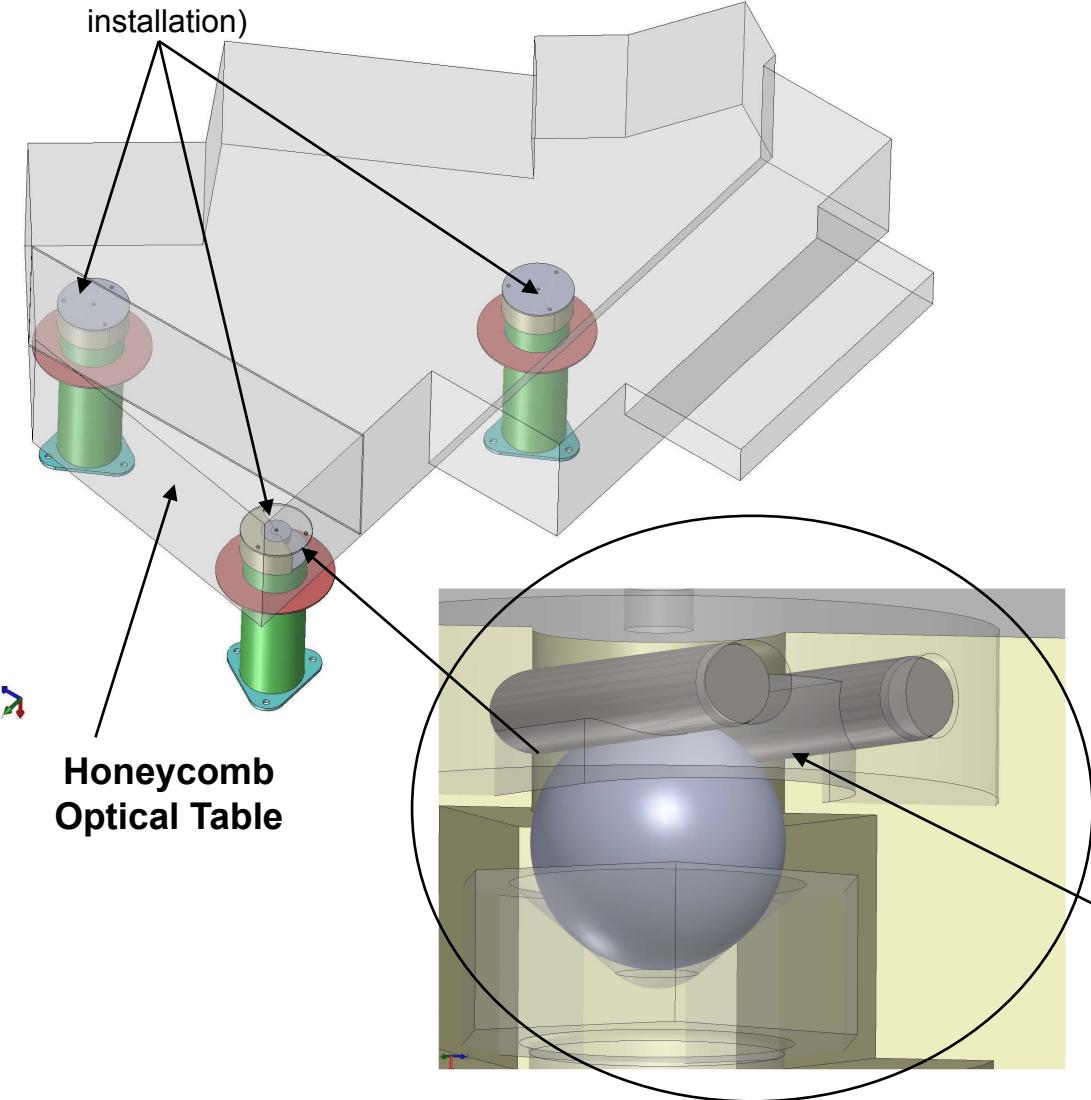


Packaging Issue for Narrow Field Relay



Bench Structure

**Pedestals Mounts
w/kinematic
interface to Table**
(locations from current
installation)



- Complex Table shape required for clrnc of external structures and minimization of thermal enclosure vol. (not shown).
- Location for pedestals based on current configuration – may change in Detailed Design with better mass estimates.
- Current kinematics are cone-groove-flat type. Will evaluate 3-radial-groove type as well as matching upper and lower structures for rolling vs. sliding DOFs, in Detailed design.

Groove element of Cone-groove-flat Kinematic mount

Alignment

- General positioning req'd not difficult to achieve with commercial mounts - from optical design tolerance analysis:
 - Decenter < ~100 micrometers
 - Tilt < ~14 arcsec
 - Separation < ~200 micrometers
- K-mirror Rotator alignment specs not yet set – using those of current rotator at present.
- OAP alignment procedure and requirements to be established in DD.

Vibration Stability

- On-instrument sources – required to operate during observations (all common-path elements):
 - K-mirror rotator
 - Tip/tilt stage for (woofer) deformable mirror
 - Slow tip/tilt mount for MEMs deformable mirror
- Telescope coupling.
- No stability specification set - optical design tolerances set threshold.
- Fleshed-out designs and mass estimates necessary from DD for modal analysis of bench mounting & components.

Thermal Stability

- ~20deg C difference between maintenance/alignment conditions, and operating conditions.
- In-plane displacements of ~ 0.25mm expected for SS (across a meter at $dT=20$) – detailed image quality impact & consideration of options (low cte table material, metering elements) req'd for DD.
- Vertical displacements expected on same scale. Impact and options (optical mount compensators, low cte/compensator table mounts) req'd in DD.

Motorized Mechanisms

Component	Mode	Type	Accuracy	Cooling** ?
Cal source	in/out config	stepper	low, open-loop	unlikely
K-mirror Rotator	tracking	servo	high	likely
Tip/Tilt Stage	Continuous	? (vendor designed)		unknown
Cilas DM	Continuous			
IF Dichroic	in/out config	stepper	low, open-loop	unlikely
LOWFS *				
Slow Tip/Tilt Stage	Continuous	unknown	high	likely
NGS Dichroic	in/out config	stepper	low, open-loop	unlikely

* The LOWFS are addressed in a separate report and mentioned here only for ref.

** Device/motor selection and power dissipation slated for Detailed Design