

Magellan AO Fit-Check Run Report

Dec 12-20 2010, at Magellan Observatory

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V1- released

1 Executive summary

A short summary of the AO fit-check run:

The ASM cart, ASM mount, CRO, CRO plate and Shim ring all worked well. Safe procedures were developed for moving the ASM on the mount, moving the ASM up the mountain, and installing it on the scope. Also the CRO was mounted and the CRO plate was mounted, as well as the mirror cover.

Here are some of the major findings:

1. ASM FOCUS

The final shim plate for the real ASM needs to be 17.75 \pm 2.5 mm thick (so we are within spec for focus ! -- this is just -1.25 mm different from what we used on this run)

2. ASM TILT

The ASM mount with the 0.29 degree spacer is within tilt X and Y spec. Added 0.009 inch shim to A side. But the torque on the bolts made a larger difference than this. So bolt torque can be the final "tweet" before using the top end vanes to clean up tilt.

3. ASM CENTRATION

But the ASM mount is 3 mm to high in the vertical direction (about perfect in horizon direction)

So we need to lower the mount by 3mm (and check if the real ASM is centered) -- it might not be sitting down right in the Keyhole mounts due to the warps...

A draft plan is in place to do this with a 3mm vertical shift from the wedge plate to 9 M6 tapped holes in a new shim plate.

4. NAS port

The AO NAS shim ring fit perfectly.

But one side of the pins need to be turned down to fit into the bushing

Also the standard encoder light baffle is too big. Tyson working on lower profile design

5. NAS CABLES

We have a plan for the cable wrap.

6. VANE CABLE TRAYS

The cable vane trays were successfully installed, and removed for painting

7. MOVING ASM CART

The liftgate at the mountain top needs a valve to slow down the decent >1 g shock at bottom otherwise

8. COOLING

The cooling was all plumbed up to the secondary top end. Flow and pressure at top was 6 psi, @ 17 l/min and 47 psi @ 0 l/min (flow blocked) showed the pump produced sufficient flow and pressure. Therefore the system met the specification of 11 l/min with a 28 psi (2 bar pressure drop) across the ASM. (NOTE: ASM measured pressure drop is 4.2 psi (0.3 bar) giving system extra capacity.

Change sex of cooling fittings to reflect change in MAOP-021. Supply on telescope side is male and return on telescope side is female. (ASM side; Inlet is female/outlet is male.

TO DO LIST (relatively minor punch-list):

- 1. lower the 3 ASM 3mm (hold on this till real ASM is tested)-- see this report for more detail (AZ)*
- 2. cut the 3 buttresses (cut down the top triangle along the diagonal and weld plate in Italy)-- see report)(AZ and performed after fit check on actual ASM in Italy))*
- 3. in Tucson modify the wedge plate (clear 9 more ASM holes) (AZ)*
- 4. in Tucson modify the shim plate (clear the same 9 ASM more holes) (AZ)*
- 5. LCO fab a new (lower profile) encoder baffle (Tyson designing now)*
- 6. LCO fab 2 new pins for the NIR ring to fit currently installed drill bushings in NIR (Tyson)*
- 7. In Tucson anodize vane trays black (AZ), clear a few holes for tie wraps, remove extra hole on tabs and excess length.(AZ)*
- 8. LCO paint ASM mount black, respect masking, don't paint through and threaded holes (LCO)*
- 9. LCO build ship canvas cover for whole ASM cart (LCO lead)*
- 10. LCO add valve to the liftgate at mountain top to slow decent (LCO)*
- 11. Lanyards on ASM cart pins. (UA? @ commissioning run 1)*
- 12. Collar and screw to retain cart gearbox handle. (Tyson)*
- 13. Starter for heat exchanger fan motors (UA purchase/ LCO install)*
- 14. Remoted control system for Cooling System pump. (UA purchase/ LCO install)*
- 15. Finish cooling lines to secondary cage, swap sexes on cooling fittings to reflect change in MAOP-021. (LCO)*
- 16. Install vane end trays once they are received from UA. (LCO)*

2 Background

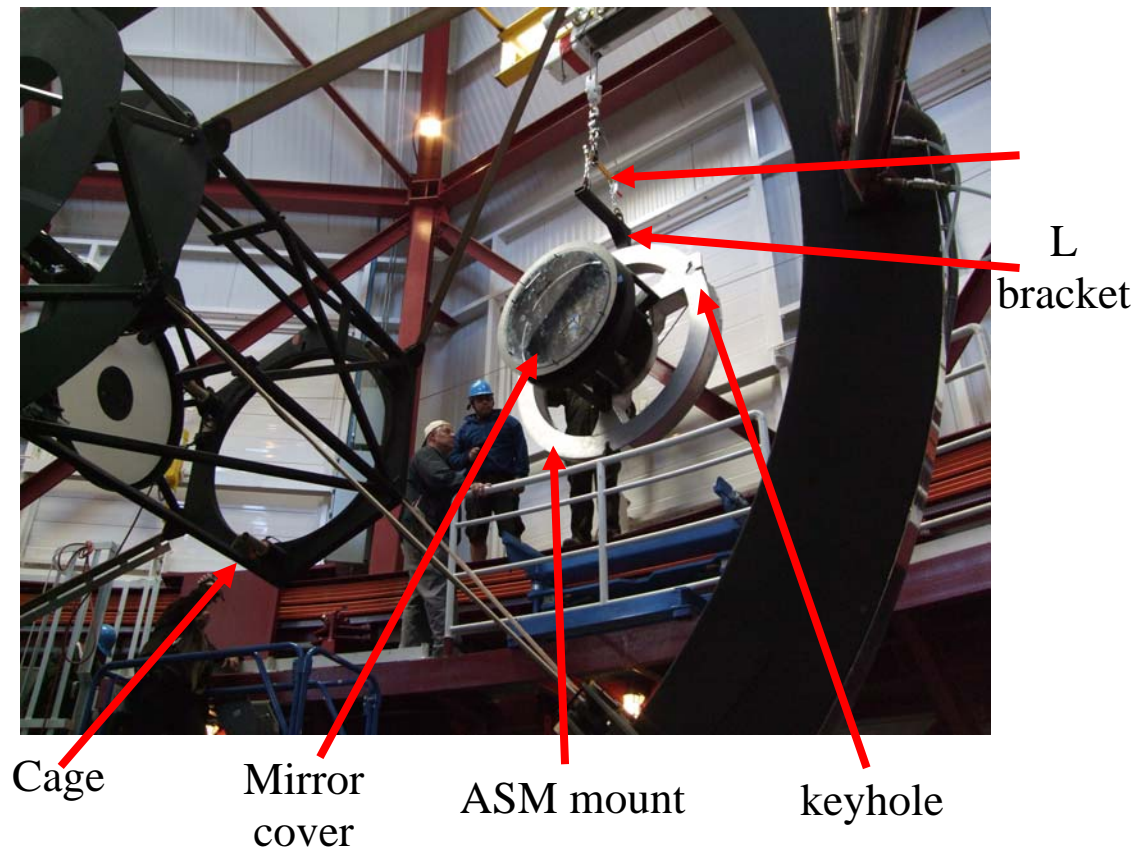
The Magellan Adaptive Optics secondary mirror mount was fitted to the Clay telescope in December 2010 to test handling and mounting procedures. The secondary mirror will not be installed but a non-optical mass equivalent dummy will be in the system.

Also the dummy will be removed and a “mirror plate” will be installed. The mirror plate will allow a sensitive check of the XY (in this doc. +Y=up at horizon looking at mirror, +X=right look at mirror) alignment and tilt of the ASM mount.

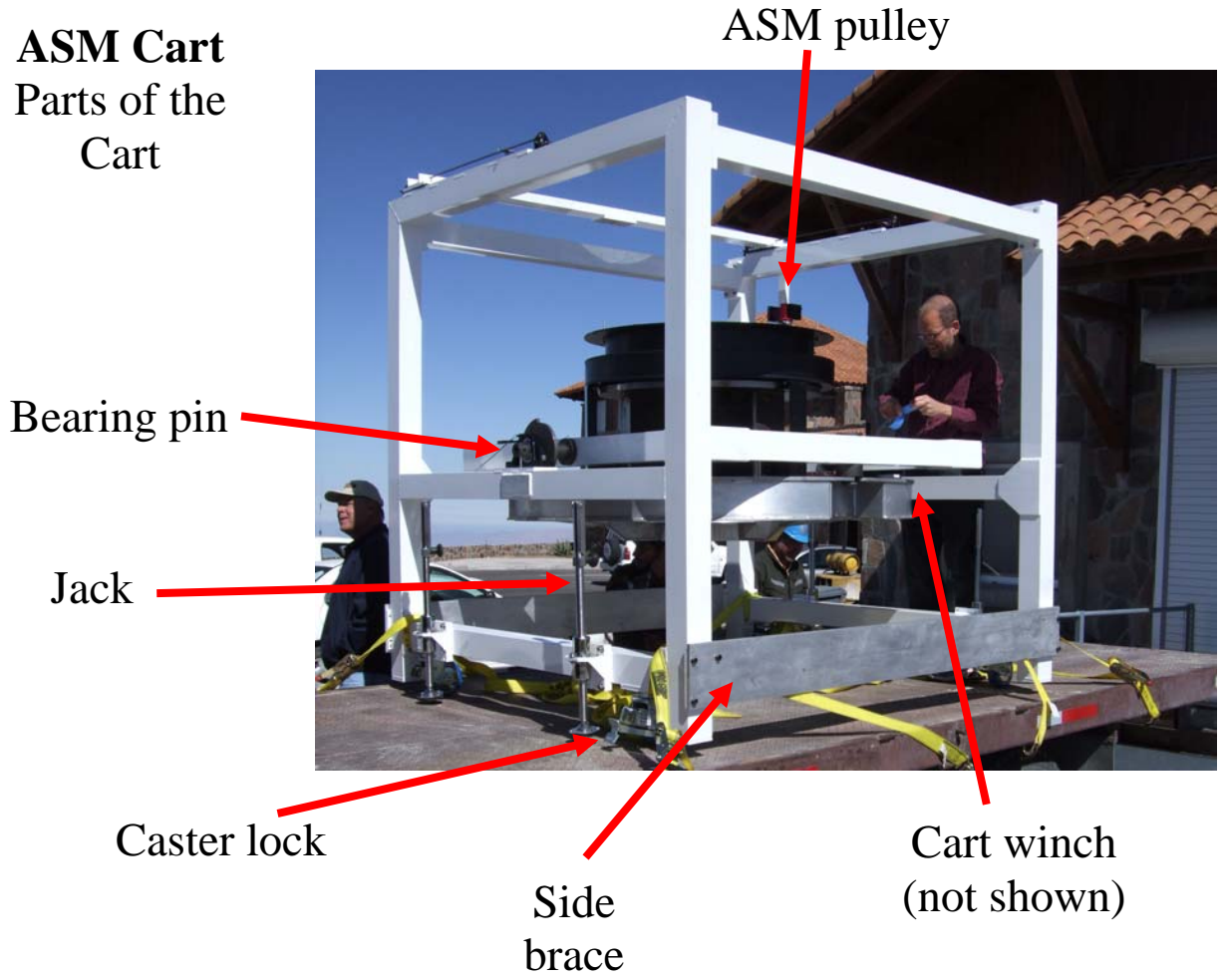
We developed, and practiced, safe procedures for the installation, checking utilities, and measuring the primary to secondary mirror distance and decenter of the dummy mirror.

3 NAMING CONVENTIONS

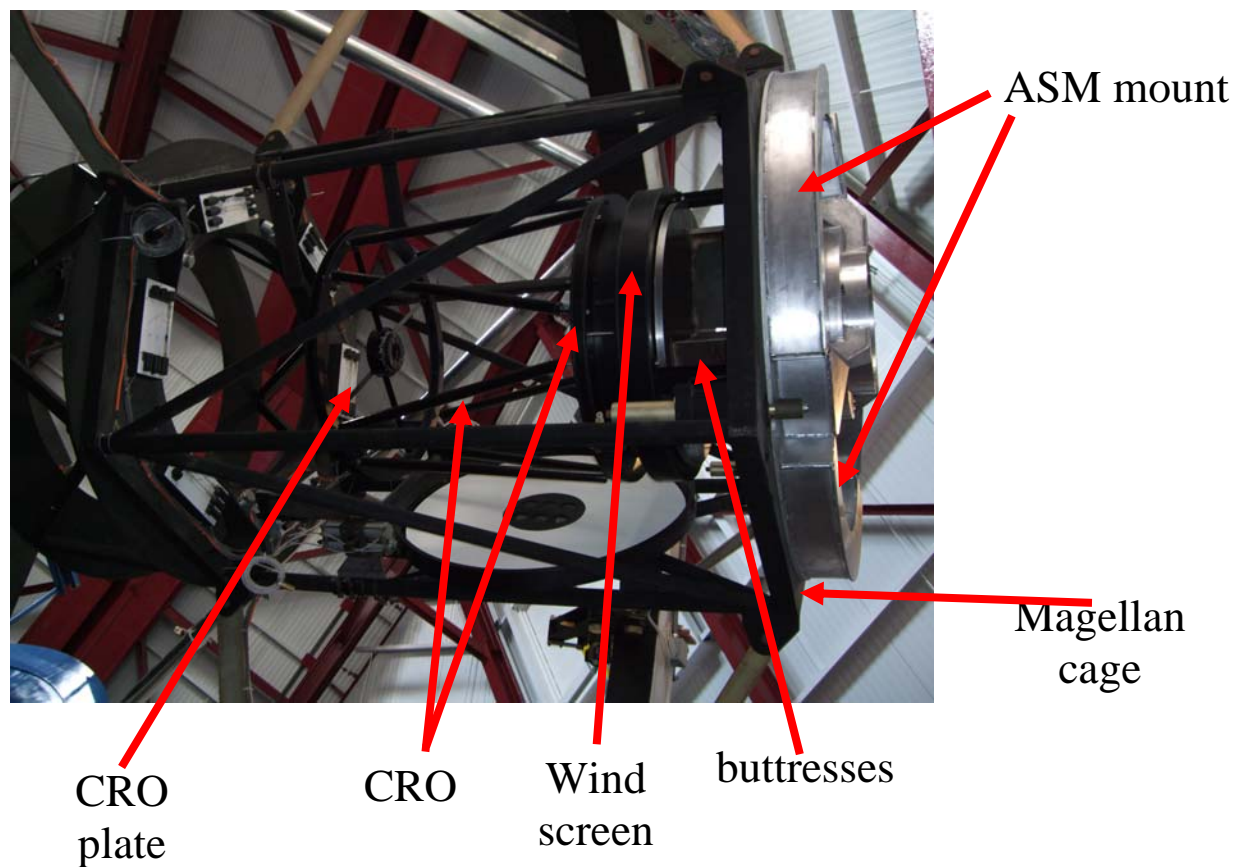
PARTS of ASM



ASM Cart
Parts of the
Cart



PARTS OF THE ASM & CRO (dummy ASM)



4 Equipment & hardware to ship

These air-shipped out of Tucson to LCO from September to mid-November:

- ASM mount
- Dummy ASM
- CRO
- ASM cart
- L-bracket for lifting ASM mount
- Slings and other rigging accessories
- Plumbing (September)
- Heat exchanger
- Mirror plate (hand carry)
- ASM Wedge Shim Plate (hand carry)
- ASM Shim Plates (hand carry)
- 3 feet for mounting ASM (hand carry)
- Vane-end trays. (hand carry)



5 Before going to the telescope (December 13-14, 2010)

5.1 *Unpacked and rebuilt the ASM items in the clean room*

The ASM Cart and CRO were rebuilt in the unpack area of clean room. The Magellan AO locker is located there. The dummy ASM was mounted to the ASM mount.

5.2 *Inspect the cooler functions.*

The cooling lines were tested and found in spec. The test consisted of:

- inspecting the plumbing lines for obvious leaks – none found.
- inspecting flow and pressure at pump no restrictions – 37 psi @ 16.5 l/min
- Inspecting pressure relief valve on pump – max pressure no flow was 60 psi.
- Inspecting pressure at top ring of telescope no restrictions – 6 psi
- Inspecting max pressure and no flow with cooling test rig – 47 psi

Pneumatic System for Tank

Coolant Pressure Tank



Filter

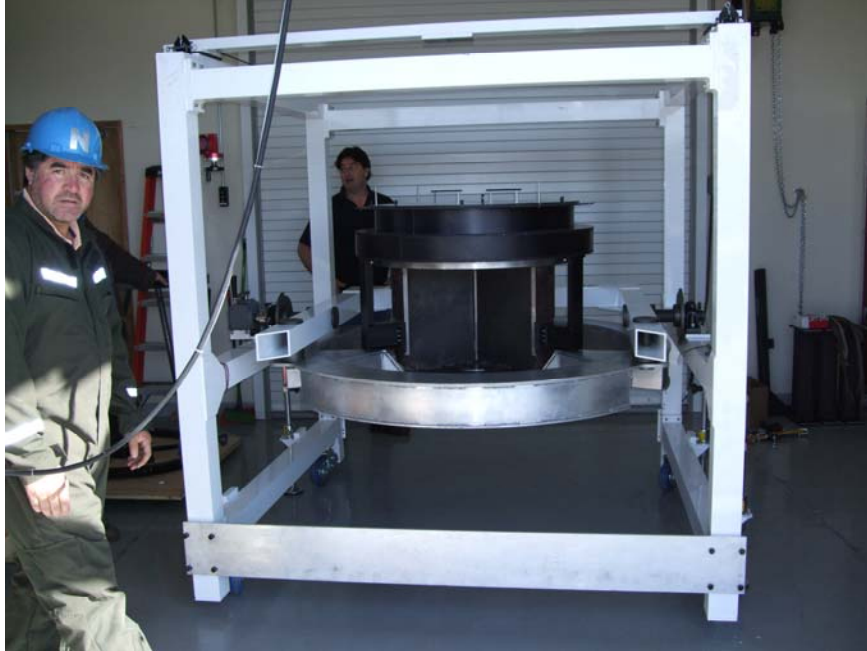
Gear Pump



Cooling System Test Rig

5.3 Mount the dummy ASM and put the assembly onto the cart.

Then we mounted the feet on the dummy (while held up by crane) and lifted dummy (with the 3/8" wedge 3/8" shim plate) onto the ASM mount. NOTE we actually mounted the 0.29deg. wedge plate 180 deg backwards on the dummy.



6 Move ASM to the telescope.

6.1 Move the loaded ASM cart to the dome from the clean room on Isuzu flatbed truck (see photo above).

1. ASM should be face UP
2. The side bases should be ON.
3. Mirror cover should be ON
4. the top pulley rail should be pinned all the way forward (see photo above)
5. the jacks should now be UP
6. the wheel brakes OFF
7. the U should be horizontal and pinned on both sides
8. the large pins in the U itself should be pinned in to the bottom of the Keyholes (see photo below)
9. In future: Cover the whole cart with a boat canvas cover for dust (TBD)



Here is photo of us loading the truck it should be noted that gravity pushes the 1500 lb cart downhill and it got a nasty bump as the wheels dropped off the liftgate “flaps” onto the ISUZU truck.



Strap down the cart till you see the casters start to bend down. Don't use the jacks.



Drive slowly up the mountain (~30 min)

7 Procedure

FOCUS: Measure the distance from the NIR disk to the guider mounting surface (including the spacer).

7.1 *Install the collimating telescope.*

Already done in 6.1

7.2 *Set up collimating telescope and note F/11 mirror positions.*

A collimating telescope at a Nasmyth port is aimed (tip-tilt) at the fiducial mark on the F/11 Gregorian secondary mirror. This is done to assure correct re-installation of the F/11 mirror after its removal.

The telescope rotator spins the collimating telescope for proper alignment.

7.3 *Check collimating telescope is on the optical axis.*



Decentering the collimating telescope (a radial offset) is degenerate with tip-tilt for a fixed-distance target like the F/11 secondary. This isn't important for replacing the F/11 mirror but since the F/16 AO secondary will be at a different distance than the F/11 secondary we probably want to see if the collimating telescope is decentered.

Turn on the illuminated crosshair in the collimating telescope and tip/tilt the secondary mirror until the aerial image is in-line with the reticule on the collimating telescope objective. Then spin the telescope rotator to see if the illuminated crosshair moves.

We do not want to re-tilt the collimating telescope to correct an offset since that would lose our F/11 secondary position reference. Instead, compute the on-axis location in the collimating telescope eyepiece for a particular rotator angle.

SET TELESCOPE TO El=+1.5 deg and Az=69.28 deg

TURN HYDOSTACTIC OIL PUMPS OFF

MEASURE (with f/11) the top end positions (flexure model fcfg 71)

X position: 2009

Y position: 3660

thetaX (horizontal tilt) H: 42

thetaY (vertical tilt) V: 130

7.4 Remove the F/11 secondary

ASM mount position: Scope at El=+1.5 deg and Az=69.28

This went very fast (<20 min)

7.5 MOUNT ASM

- Make sure to Remove f/11
 - Park scope at service pos. **El=+1.5 deg and Az=69.28 deg**
 - PUMPS OFF –scope is frozen in El and Az
- Remove f/11

- get ASM into chamber

1. roll out cart from truck, use “come-along” to pull cart
2. lower cart on liftgate slowly!

– NOTE >1 g shock recorded as lift gate hit ground – this must be fixed before real mirror arrives



3. roll cart to Clay scope lift



(yes it just fits in)

MOUNTING THE ASM

PRE-CHECK LIST:

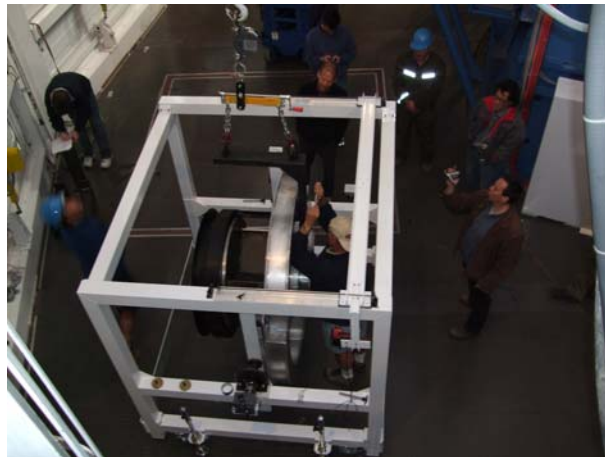
1. place ASM mount in vertical position
2. place vertical pins in
3. big key hole pins OUT, Caster locks OFF, Jacks UP

MOUNTING PROCEDURE LIST:

1. Place cart at right hand side of scope, mount L bracket (make sure all shackles are tight and lifting eyes tight), set load spreader to the “start” position (see photo below).



- Zero crane scale, move L to ASM. Mount L on back of ASM . (see photo below)



2. **MAKE** sure to set load spreader to the **OTHER** position for the load (see photo above)!
3. Raise ASM off cart ~880 lbs with crane (from left side of walkway)
4. Use 2 tag lines to place ASM to walkway. (Rotate dome to get in place)



5. Need 2 staff to guide ASM in front of flange -very slow here, only approx. 5-10” clearance on all sides.



6. Guide ASM onto flange, drop into keyhole



7. Lock-up, move load spreader bar to center of L bracket, pull L bracket



8. ASM is now mounted

7.6 Mount the CRO to the ASM

With the CRO plate OFF bring CRO up the scissor lift nearest the primary.

MAKE sure Plexiglas mirror cover is on ASM mirror!

Note the positions of the 2 blue lifts (slide the lift extender under the cage as close as possible)



1. Use CRO guide pins at right clocking A->A (blue tape on upper left as facing mirror)

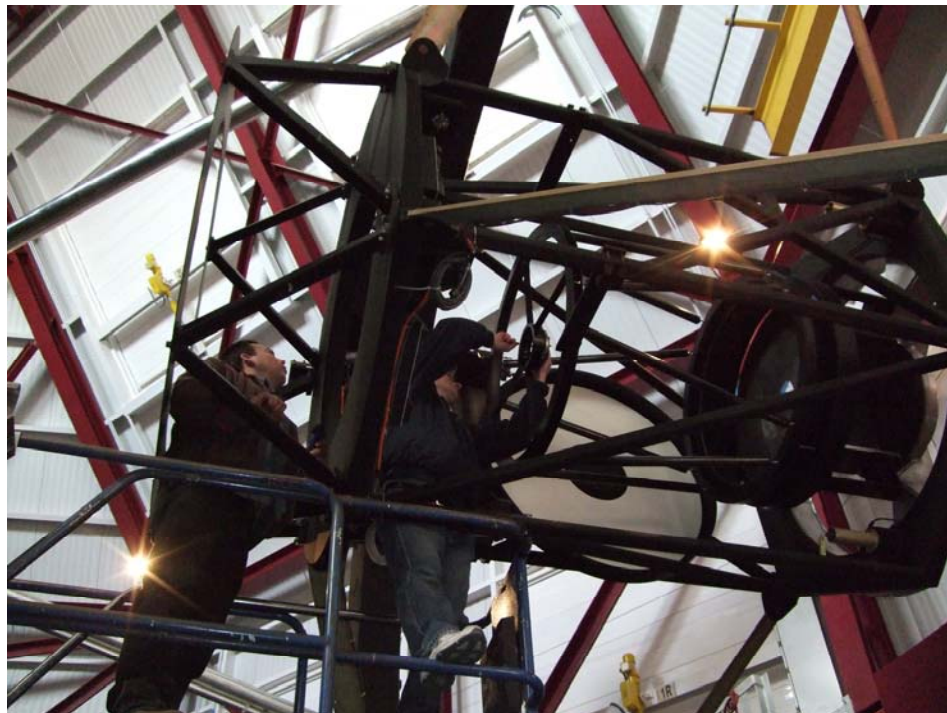
2. use angled wrench and ball drivers to attach flange nut/bolt combinations. NOTE the nuts are on the mirror cover side of the CRO.



3. Add the CRO plate to the end of the CRO (see photo below)

4. Be sure to mount all 4 shoulder bolts tight on CRO plate (need Allen key)

NOTE we may add a strap to avoid accidental dropping of CRO plate





Remove cover, mount cover. NOTE BE SURE TO KEEP THE COVER WELL AWAY FROM MIRROR – this is a dangerous activity and should be done slowly by two people
NOTE SHOULD add an addition handle in the center of the mirror cover.



7.7 Adjust the x-y position of the ASM so the fiducial target is on dummy AMS (near the optical axis)—and redo in 5.14

With dummy ASM on (with 0.58 deg error due backward mount plate)

We noted offset was X=0.120inches and

Y=0.060 inches low – this Y is mainly wrong do to wedge plat in 180 deg. Wrong see mirror plate measurement for the real values.

7.8 Measure the distance from the Guider to the back side of the collimating telescope spider vane. This is the surface that we'll use to hook the laser tape

See table

7.9 Measure the distance to the ASM dummy secondary with the laser tape.

Distance from Primary to Secondary Vertex	9191.695544 mm
Distance from Secondary to Tertiary Vertex	8492.600000 mm
Distance from Tertiary to F/16 Focus	5221.654126 mm
Distance from Secondary Vertex to F/16 focus	13714.25 mm
Distance from NIR mount to F/11 focus	$125 + 15 * 2.54 = 506$ mm
Distance from NIR mount to F/16 focus	723.54 mm
Measured ASM Mount to Dummy face + shims	$(518-25.4) + (0.375 * 2 * 25.4) = 511.65$ mm
Distance from ASM bottom to secondary Vertex	490.8 mm (zero shim)
Distance from f/16 foc. To ASM mount	$13714.25 + 490.8 = 14205.05$
length of Dummy + shim - ASM Vertex	$511.65 - 490.8 = 20.85$
Measure distance from NIR to Dummy face	12985.75 mm (Laser tape measurement at 1.5 deg)
Measured distance F/16 foc. To ASM mount	$12985.75 + 723.54 + 511.65 = 14220.94$ mm
ASM (dummy meas.) shim thickness	$14220.94 - 490.8 - 13714.25 = 15.89$ mm
2 nd try (mirror plate meas.) shim size=	$14224.665 - 490.8 - 13714.25 = 19.61$ mm
ASM shim thickness	17.75 ± 2.63 mm

As might be clear from the table above based on our laser tape experiments it appears that the ASM mount is 17.75 ± 2.63 mm too far from the primary. Hence we need a 17.75 ± 2.63 mm spacer to place the real ASM's vertex exactly 13714.25 mm from the f/16 focus (which is the design value – see MOAP 004 for more details). In the table above red numbers were measured, while black are by design.

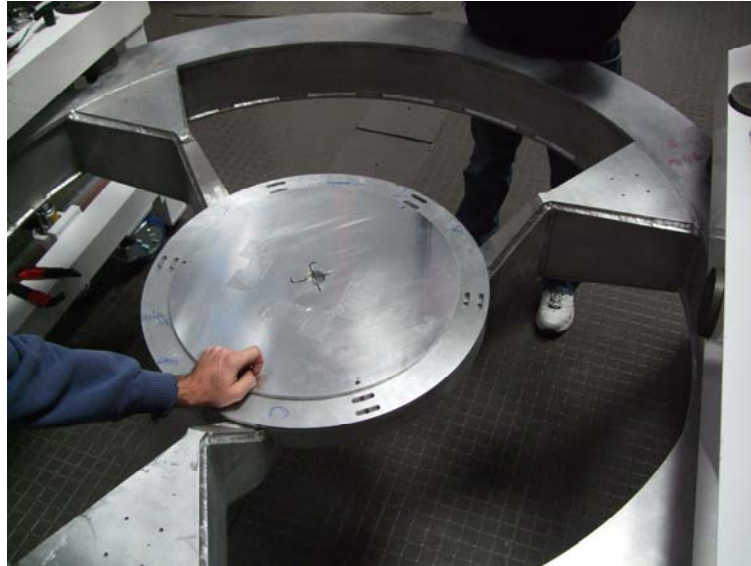
7.10 Unmount the CRO

Reverse the process in above section

7.11 Remove ASM from scope and the dummy ASM from mount

Reverse above procedure

7.12 Install the “mirror plate” on the ASM mount



7.13 Mount the ASM mirror plate on scope

Look through the collimating scope. IF the angle is way out of range then attach the green laser to end of the collimating scope (on-axis) with angle bracket mount. It was due to wedge plate 180 rotation.



Then align the green laser tilt to illuminate the center of the mirror (at this point we are on the chief ray the scope)



Keep scope at horizon

Flipped plate, and then used Collimating scope, these were the results:

Tilt was within Vane End alignment !

X: about right <1 mm !

Y: about 3mm too high –out of Vane end range

(need to move whole ASM mount down 3 mm)

Mark the deviation of the beam off-center wrt the f/11 (see photo below)

Mirror plate (hence ASM mount) appears to be ~3mm too high up



One possible reason is that the ASM mount is slightly curved in and so it might not be sitting well on the TOP of the keyhole mounts – pressing more on the sides?



7.14 Double check distance to ASM mount plate

Doubled checked with the LASER tape, agreed to within 3 mm of the Dummy ASM measurements. See table above for details.

7.15 Remove ASM mount with Mirror Plate

Reversed steps above
Return to cart
Remove plate and spacers.

7.16 Install F/11 mirror

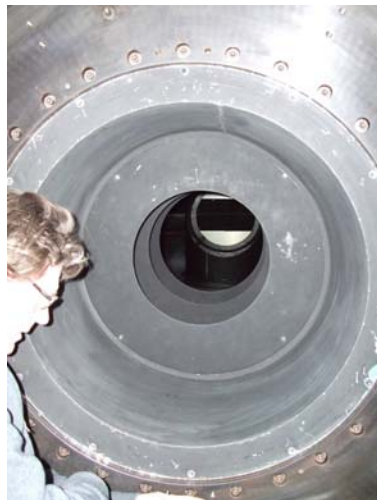
Process took ~30 min, came right back to the exact f/11 position!

7.17 Remove the Nasmyth guider and spacer.

And, of course, the instrument if this hasn't been done already.

7.18 Fit-check the AO rotator shim.

The encoder baffle must be redesigned to be a lower profile, interferes with the cables from CCD47. Tyson working on this.



The NAS shim ring was a good fit to the NIR plate (baffle removed in photo below).



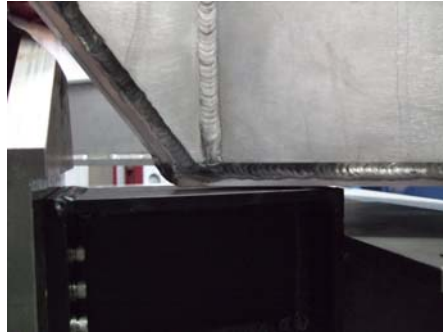
But the step pins need to be cut down to fit into the bushing in the NIR plate. Tyson working on this.

7.19 Move all back to clean room

7.20 Pack CRO, buttresses, mirror plate, windscreen, cover, for Italy

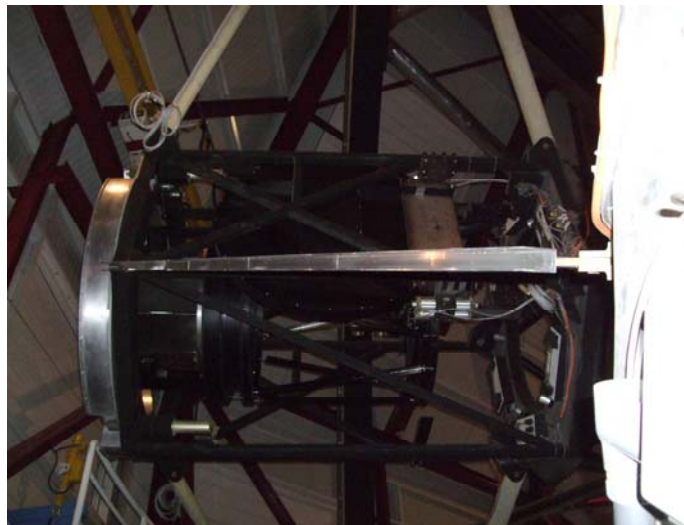
Attach the required shipping documents, Victor working with Ana on this.

To be safe the buttresses need to be cut diagonally down and have a plate welded to the top in Italy so we can accommodate a possible need to have less than the 17mm shim on the real ASM. In fact, if the shim is less than ~12 mm we hit the current buttresses.



7.21 Pack the Wedge plate and shim plate to have the correct M8 clear holes drilled in Tucson, and Vane Cable Trays

Also bring the spider vanes back to Tucson for anodizing and clear holes for the tie wraps added.



Picture of the vane cable trays installed on spider.

7.22 Painting ASM Mount (LCO)

The ASM is left on the large pallet to be painted flat black. The areas NOT to be painted are masked off with blue tape and labeled. Very important to not paint those faces attaching to ASM and the face above ASM – else paint chips fall into ASM! **Also please DO NOT PAINT any of the bolt holes.**