3.3 MagAO-X alignment at Telescope Preship Review

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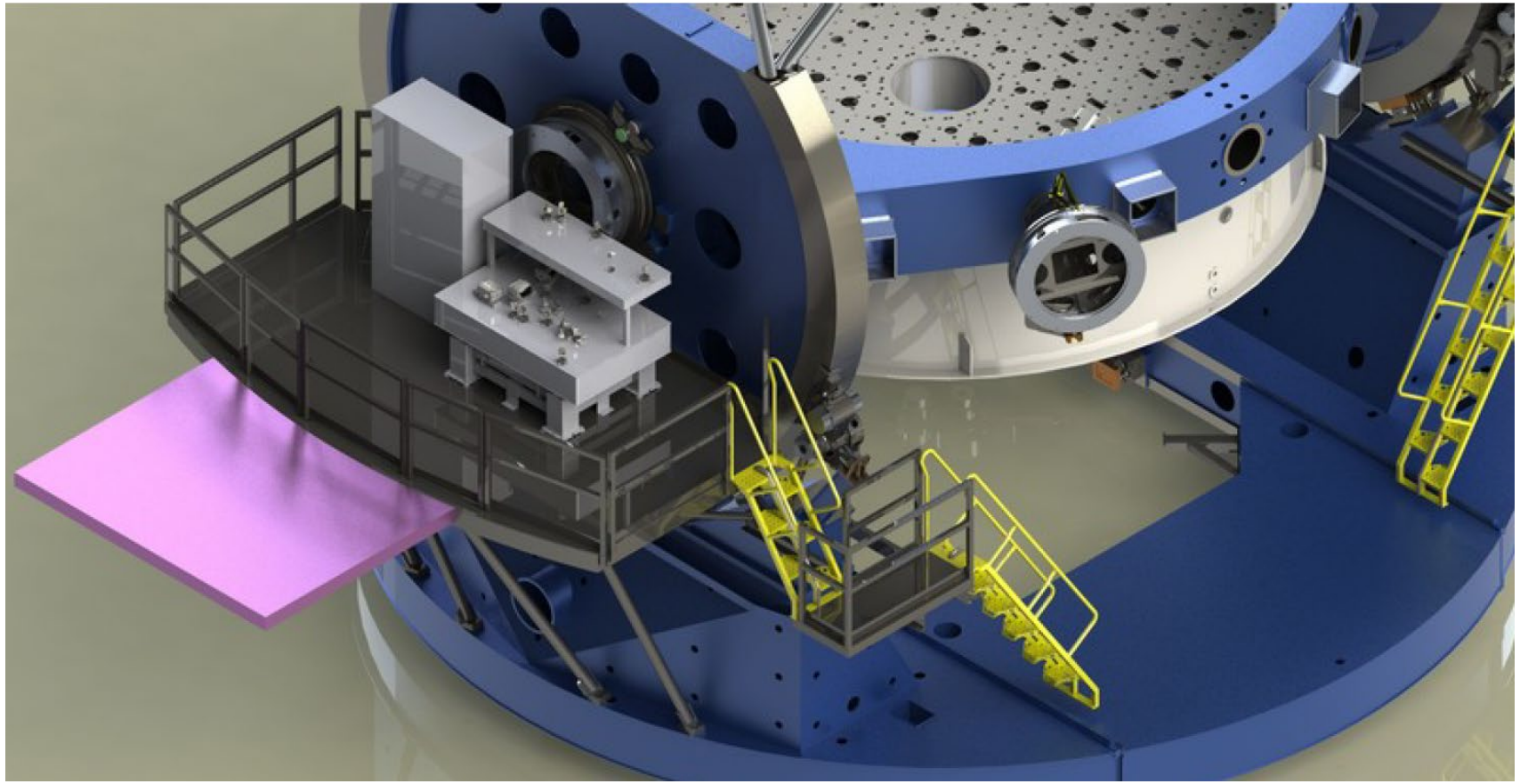
Alignment Procedures for MagAO-X



MagAO-X Daytime Alignment at Telescope

START: Use the Iszu truck to move the table on its cart from the clean to the lift gate at summit, then:

1) Push the cart to NASE platform

2) Independently, position our legs (on their casters) to the correct X position of the legs w.r.t. the guider center of the NASE platform. So all that is needed is a straight push (in Y) towards the guider, rotate the casters in the Y direction. (*see page 4 for details*).

3) Push the cart to NASE platform

5) lower the Table onto the legs with crane, remove cart.

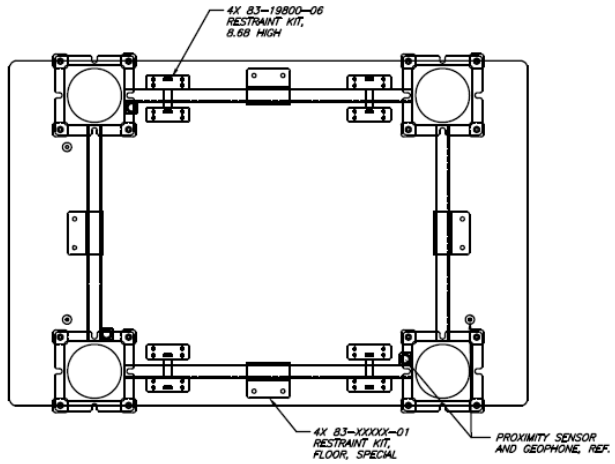
(NOTE: the Table/Legs alignment is guaranteed with alignment pins (that slide into the tiebars on legs).

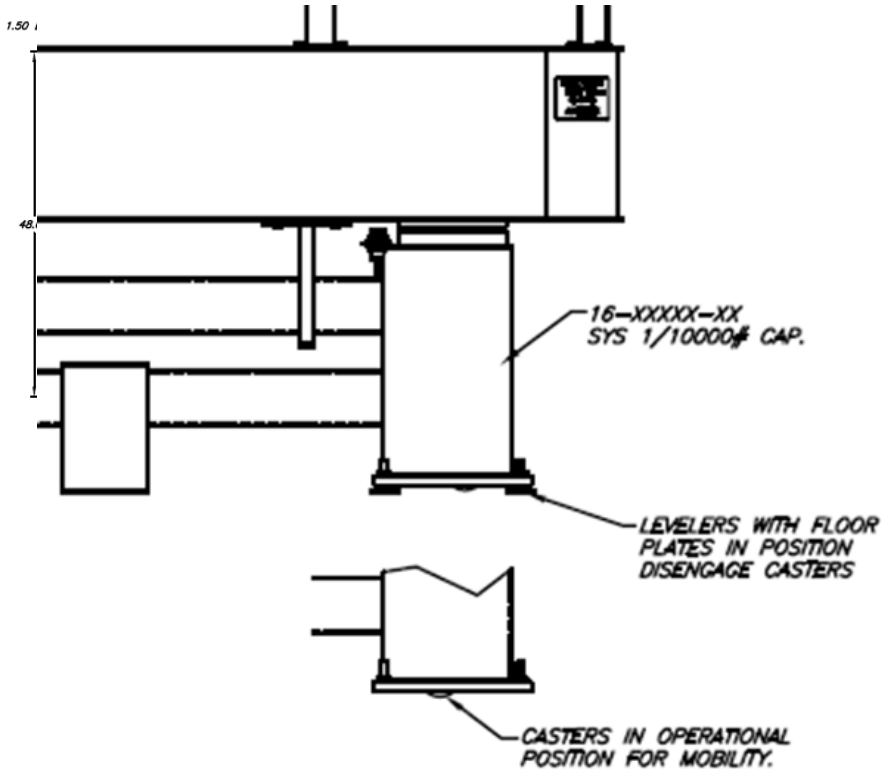
6) Use pushers (page 5) to align table with telescope (see pages 7-10 for details)

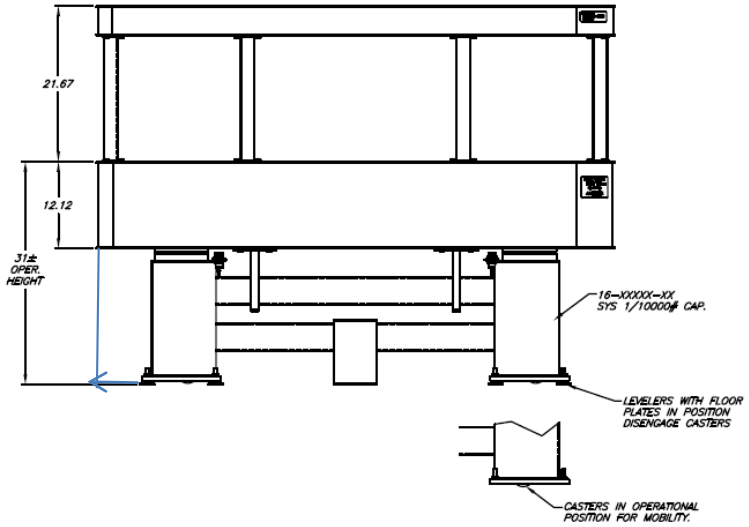
7) Carefully engage all 16 leveling pads (disengaging the casters) and add pinned plates

8) Add any missing upper earthquake brackets.

Unpacking and Alignment at Telescope

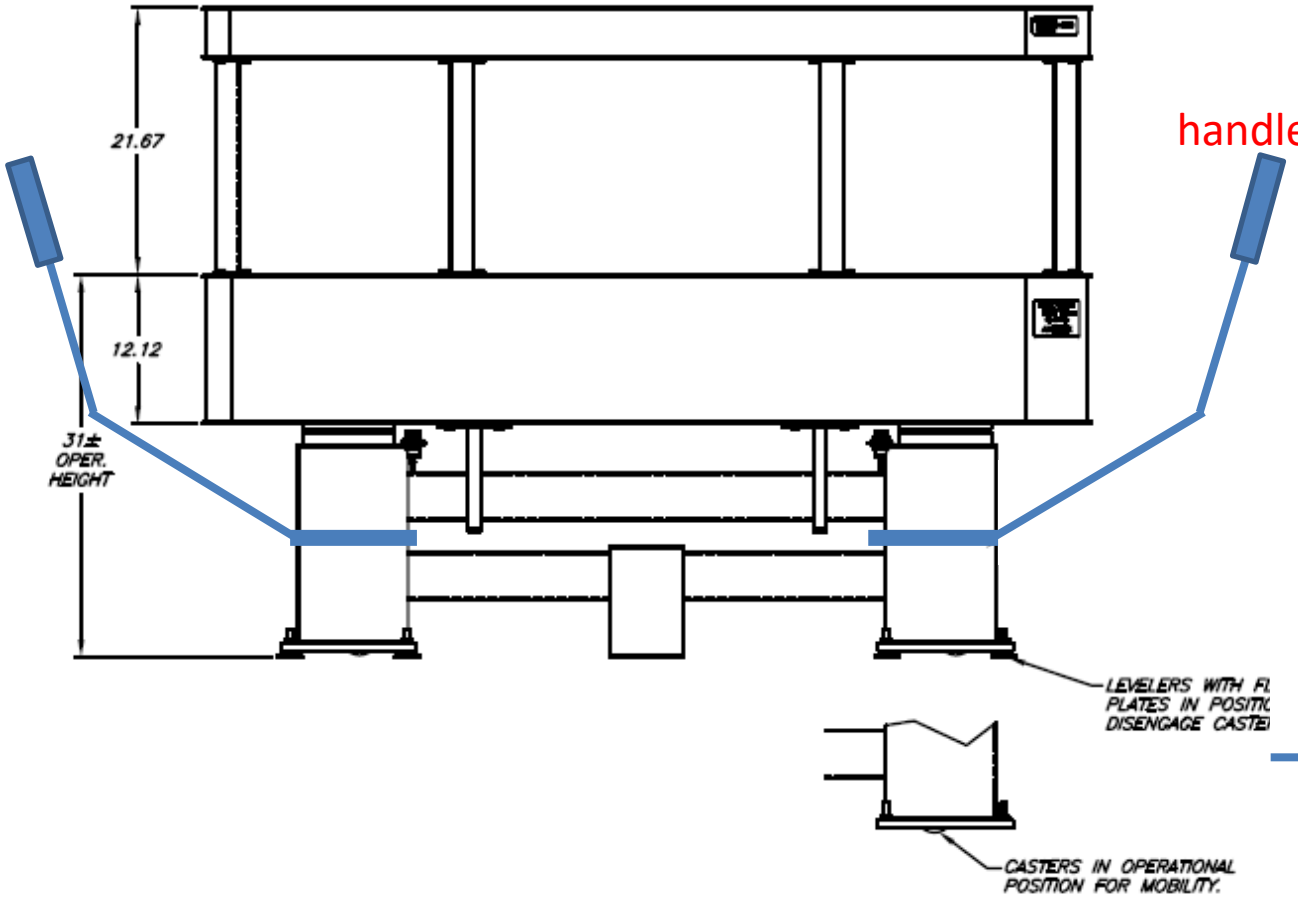


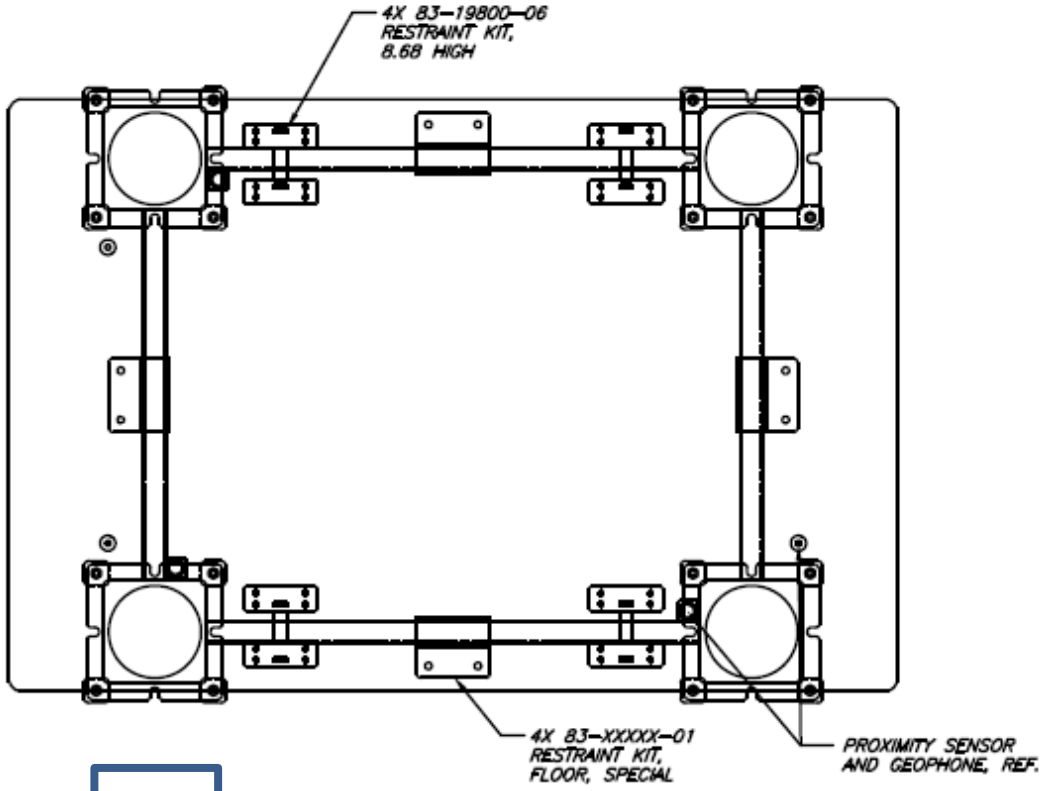




CASTERS ALLOW TABLE TO BE FINELY ALIGNED EVEN UNDER FULL LOAD

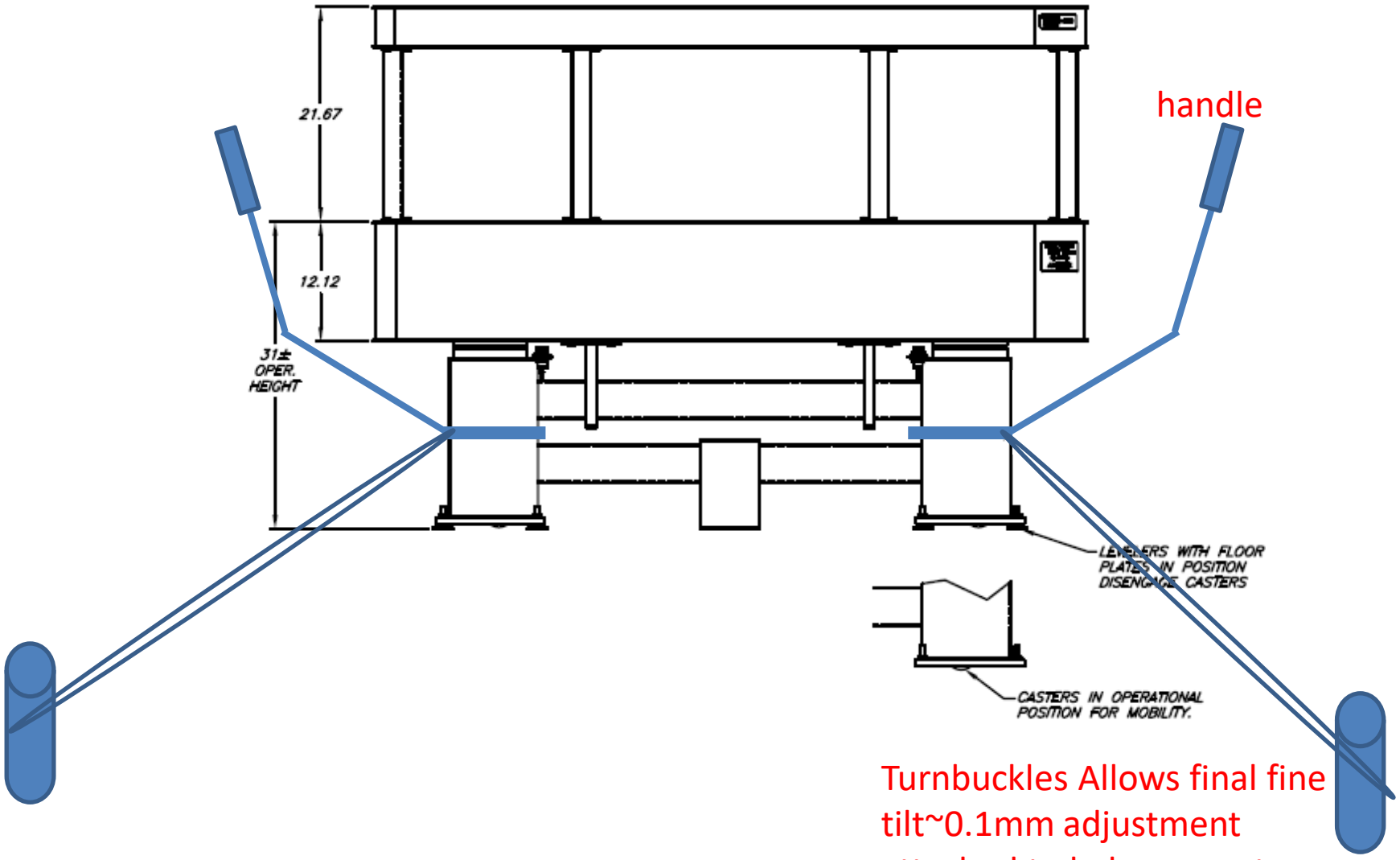
Special “Pushers” will allow alignment





Their square “leg” clamp can be removed after alignment.

“turn buckles” will allow fine alignment to ~0.1mm (0.5mm needed)



Turnbuckles Allows final fine tilt~0.1mm adjustment attached to balcony posts

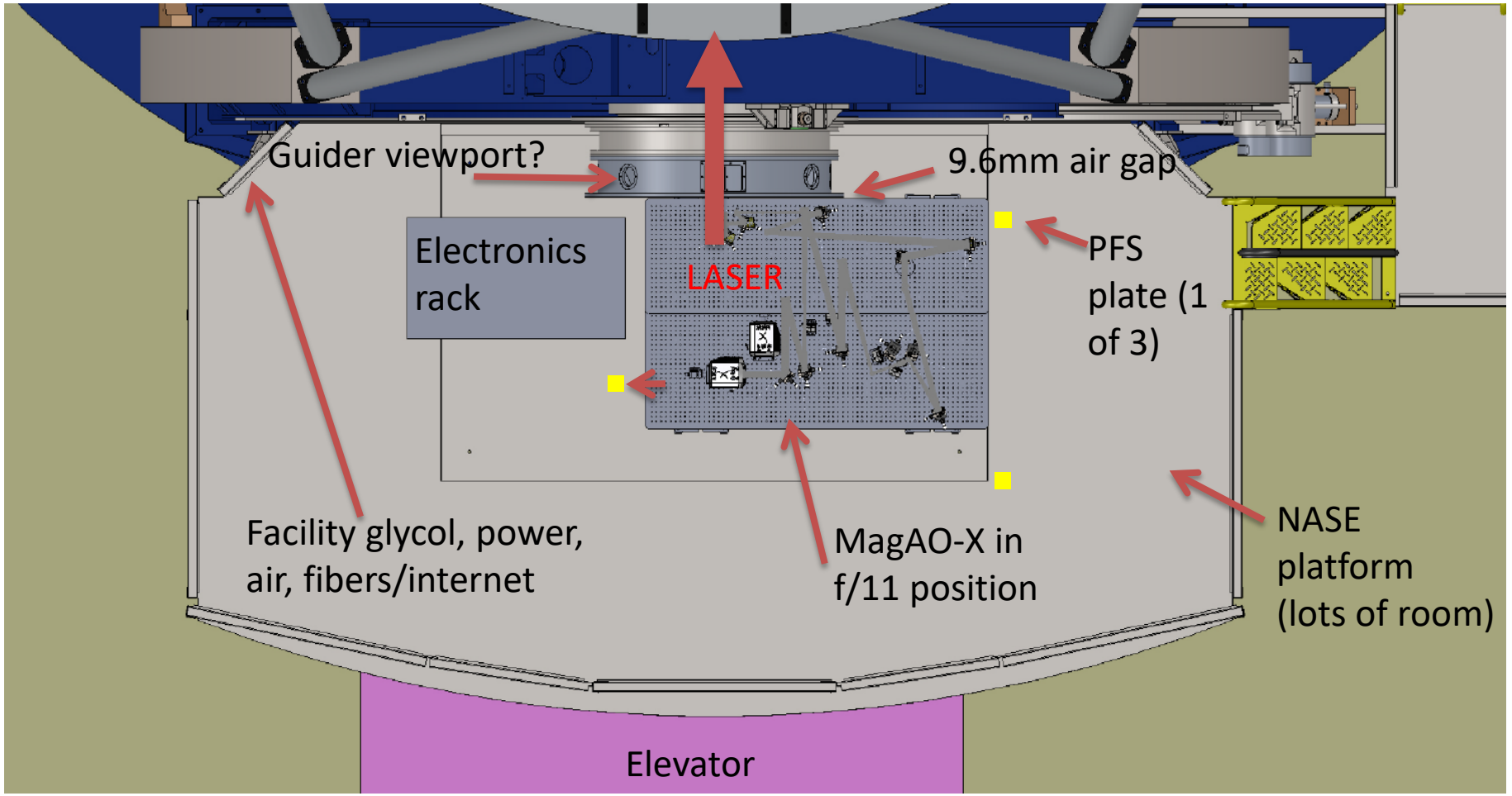
Daytime Alignment of MagAO-X to Magellan

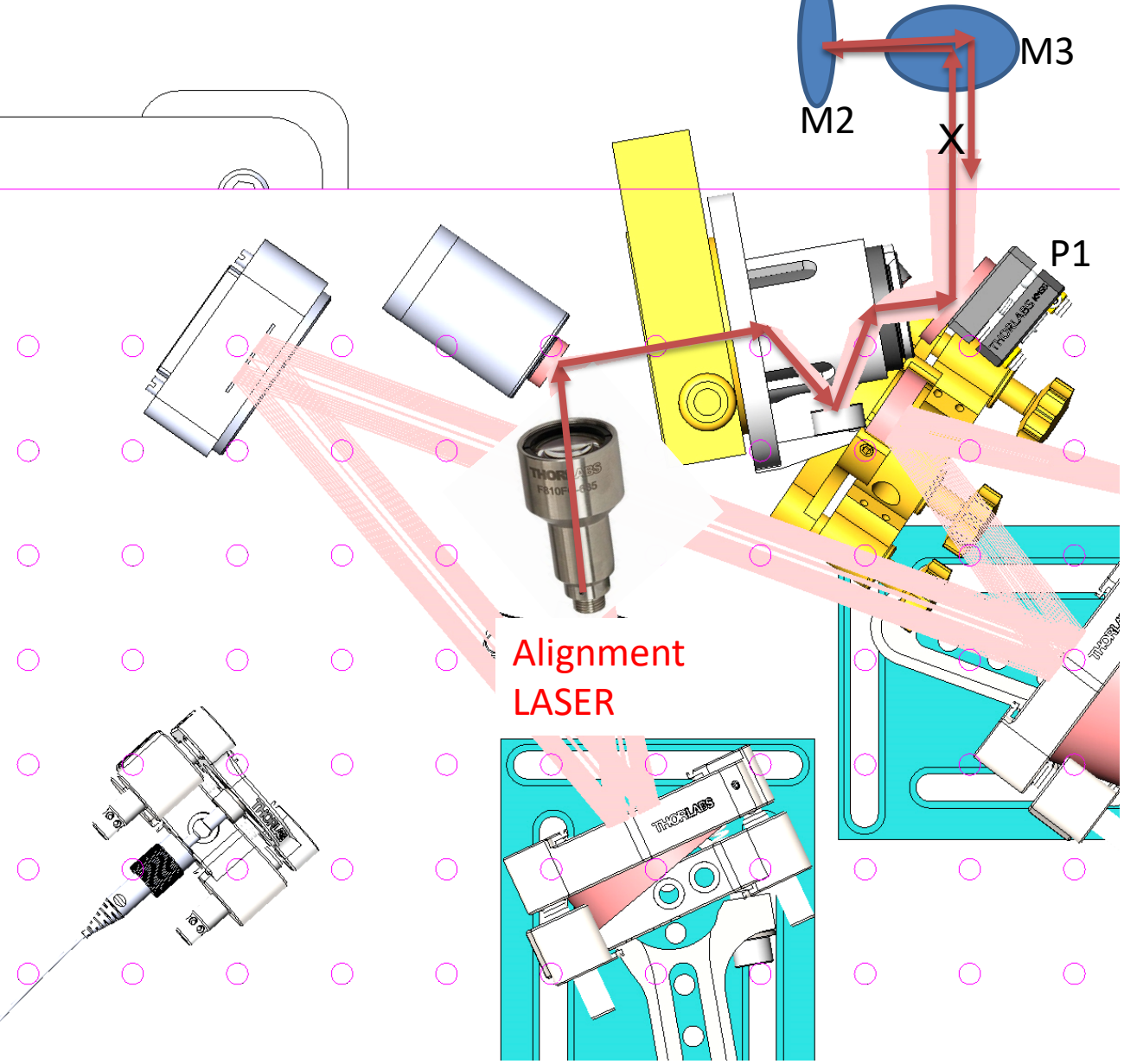
Adjust table Tilt so that laser hits center of "X"

1. Position MagAO-X near X spot but offset directly in Y
2. Drop the "laser pointer" into the f/16 focal station
3. Add a "X" pattern (with thin with installed wire) to the guider to mark the center of the telescope axis. Make sure telescope is "on" and M3 and M2 are in collimated positions.
4. Use the 2 push bars (*need to build*) to rough align the laser beam to center of "X" and to illuminate the center of M2. (This requires that the M1 mirror cover is cracked open --- align the laser spot to illuminate the 2 undersides of the cover – while centered on M2 – *need binoculars*) **SEE COMPLETE DETAILS of this step ON PAGE 8.**
5. Once rough aligned. Drop down the 4 bolts for each wheel – turn each wheel to point straight in the Y direction – so table rolls straight back.
6. Carefully raise the 4 bolts so that weight goes back to the wheels.
7. Then push the Cart *straight* back. Check to make sure the Laser pointer is still aligned on both the near and far targets.
8. Keep moving back until the 9mm airgap (use 2 plastic shims to check) is achieved between guider and plate (check that it is OK to have window mount slightly inside center of guider).
9. Double check that laser pointer is aligned with guider center AND M2 center.
10. Lower the 16 bolts, make sure the table is level as before. Check Laser again.
11. Float the optical table, check laser again. Adjust Periscope 1 mirror for final telescope alignment.
12. Drop the floating, and refloat to check repeatability of laser. If repeatable then move on.
13. Remove the X wire, remove the Laser pointer, ready to cable and test system
14. Drop in pick-off mirror, close loop on the white light source, ready for night time alignment

MagAO-X alignment

(table must be correct w.r.t. optical axis of scope to 1 mrad ~ ±1cm of return spot)





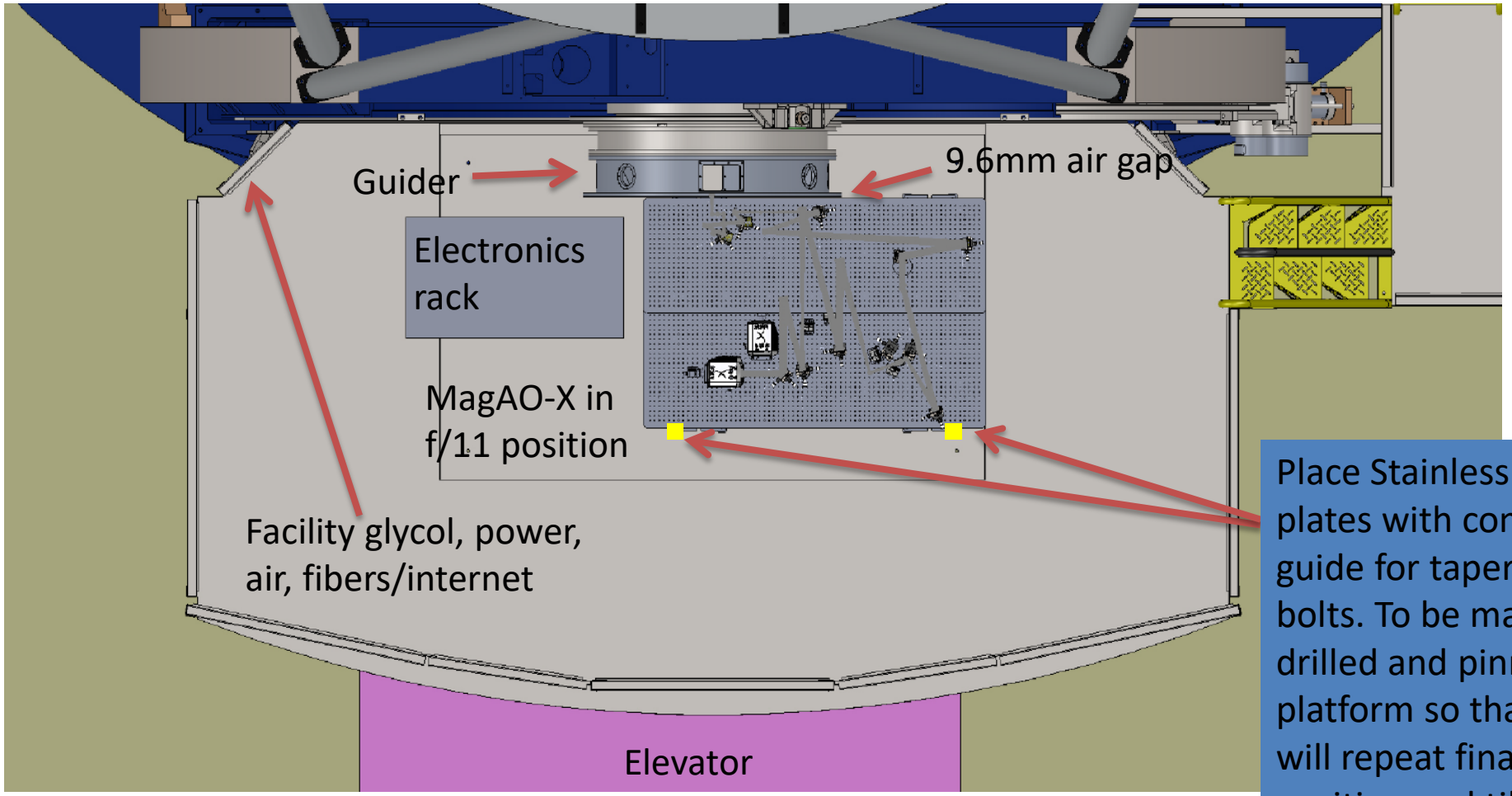
There must be less than 1 cm between the outgoing and return spot for <1 mrad of error.

Detailed Daytime Steps for aligning to the scope

To align the table to the Telescope optical axis requires the addition of a 7mm beam "laser pointer" used as our alignment laser. BLUE are clean room steps, BLACK NASE panels closed steps and RED open panel NASE steps (these we need to minimize due to contamination)

1. Use the internal Telescope Simulator to find the chief ray of MagAO-X and K-mirror.
2. Align a 2 inch long 1" dia. tube with 1mm holes on frosted glass along the chief ray. Lock down both bolts on the Polaris clamp
3. Loosen the ring clamp release. Replace tube with collimator.
4. Check that chief ray passes right through center of collimator. Turn off internal Tel. Sim. Laser.
5. Attach FC fiber laser to collimator
6. Check that laser back illuminates Tel. Sim. Fiber
7. NOTE STEPS 1-7 can be done in clean room.
8. Raise pick-off mirror –illuminate M3 and M2 with 7mm beam. Align table to illuminate center of "X".
9. Check M3 to see if there 2 spots. Pivot about window so there are only 1 spot (return beam overlaps).
10. Small adjustments should bring return beam from M2 into perfect autocollimation.
11. Push table back maintaining tilt. Look through guider port.
12. Float table. OPEN panel Use the P1 mirror as needed for final tilt.
13. Command pick off mirror in and manually adjust the pick off mirror tilt to autocollimation.
14. Remove alignment laser. CLOSE panel
15. Test if loop can close with Tel. Sim. As before.

Aligned MagAO-X



Place Stainless steel plates with conical guide for tapered leg bolts. To be match drilled and pinned to platform so that table will repeat final position and tilt w.r.t. telescope

Doc MagAOX-001
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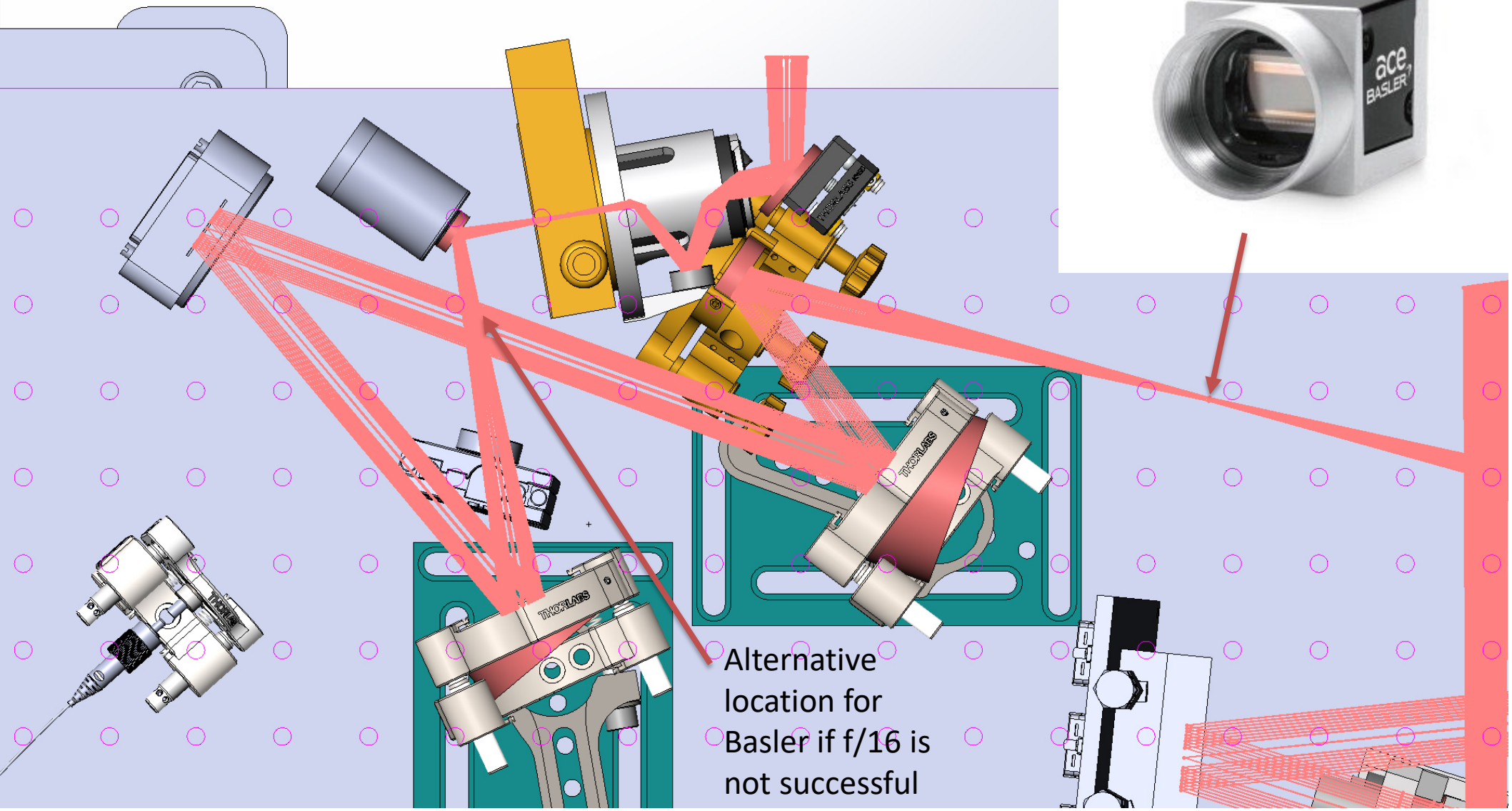
Nighttime Alignment of MagAO-X to Magellan Telescope

1. Open panel Place a 2x2.5k Basler (19x24" FOV **ace acA2500-60um** suggested) at the f/16 focus. Close Panel.
2. Raise Pick-off. Power off laser or white light. Float table.
3. With telescope acquire a bright (<3 mag) star as overhead as possible that night.
4. Place star at the guider rotational axis center.
5. Pull guider probe, see if there is any light on the ace camera.
6. If so skip to line 7, if not TO goes into finding pattern till light does pass through.
7. Focus and center the star on the Xcenter, Ycenter pixel with telescope.
8. Open panel. Remove ace camera from f/16 focus. Close panel.
9. Check the pupil alignment on OCAM, if they are close use the 335 to steer the pupils in
10. IF the pupils are not that close try using the M3 (TBC?)
11. Once pupils are aligned use "star nudger" to fine align on the PyWFS
12. Close the loop, should work at low gain even if spiders are at wrong PA.
13. Check K mirror alignment….
14. rotate K mirror by 5 degrees --- use 335 and star nudger to realign
15. if the alignment error is small goto step 13 and continue tests.
16. **if the K mirror error is huge** (>5mrad of 335/ 5 deg of rotation) we need to better twist the bench w.r.t. the laser pointer test (see page 8). Repeat laser pointer test (might be easier at night). Laser spot must really hit the very center of the M2 and reflect straight back.
17. Then repeat steps 12-14.



Alternative location for Basler if f/16 is not successful

acA2500-60um - Basler ace
Has 12.4 mm x 9.8 mm detector size (24.3x19.23 arcsec FOV @f/16.16)

We will use this CMOS camera at ≤60f/s (as viewed from control room) to acquire the bright ~3 mag star for initial alignment.

THE FUTURE

We only have to open the panel three times on the NASE (once in daytime and twice at night) for the whole run. But this is still not a great procedure for following runs.

If things work well the ACE wide field camera will not be needed after the first night. So in theory no more open panel work needed. That is the plan.

For all future runs we should be able to reproduce the table placement <0.1mm with special stainless steel plates with conical detents attached/pinned to the platform. So that should eliminate all these steps. In run#2, we just roll in the table, lock the leg blots down to the 2 special guide plates, float it and the Magellan guider should just bring in the star as before.