How to Align the Telescope:

Step 1: Position the stand and the telescope

1. Roughly position the feet of the stand so that the telescope is near the beamline (look for old Sharpy marks on the floor). Put metal plates below the feet (optional).
2. Make sure that the square travel stage (mounted between the transit and the stand) is perpendicular to the beamline direction and is positioned at its center so that you have enough left or right lateral slide adjustment.
3. Loosen the leveling screws and turn the spider base so that two leveling screws are parallel and the other two are perpendicular to the beamline direction.
4. Roughly align the telescope to the beamline using two points (make sure the optical micrometer at the front of the scope is positioned at 0 before continuing !):
   - beamline flange for up/down alignment using the stand wheel (see Image 2)
   - floor markings for left/right alignment using the square travel (see Image 3-5)
5. All tangent adjustment screws and clump lock should be loose before you continue to step 2 and 3.

Step 2: Roughly level the telescope.

Do not force any of the screws. A firm (but not tight) tension gives the best results. Tighten the four leveling screws so that the circular bull's eye bubble at the telescope plate is roughly centered.

Step 3: Precise leveling of the telescope + height alignment.

1. Adjust the coarse height on top of the stand using the center of the beamline flange or a marker on the wall (or better the neighboring beamline).
2. Level the telescope by eye by centering the split-bubble level vial (located at the top of the telescope). Gently tighten the vertical tangent lock.
3. Using the vertical tangent adjustment screw, bring the split image of the bubble into coincidence (i.e. the two ends of the bubble should be in line with each other).
4. Rotate the standards 180° so that the telescope is now pointing in the opposite direction. If the bubble is off center, remove one-half of the error with the two leveling screws, which are located directly under the telescope. Remove the other half of the error using the vertical tangent screw.
5. Now rotate the standards 90° so that the telescope is located directly over the other pair of leveling screws. Bring the bubble to center, using only the two leveling screws under the telescope.
6. From this position, rotate the standards 180°. Again, if the bubble is off center, remove one-half of the error with the vertical tangent screw, and the remaining

one-half error with the two leveling screws, which are located under the telescope.

7. Repeat points 3 to 6, alternating over each pair of leveling screws, until the bubble remains in coincidence in all four “compass point” positions.
8. Recheck the height of the telescope with respect to the beamline flange or a wall marker (see Image 1 and 2). If it’s off, readjust up/down using the coarse height, recheck the split-bubble on all four “compass point” positions and repeat point 7 if the bubble is not in coincidence. Redo point 8 after that.

Step 4: Bucking in: left/right alignment.

1. Gently tighten the horizontal tangent lock. Loosen the vertical tangent lock in order to trace the floor black marking line.
2. Align the telescope to the beamline using the floor marking. For that you need to use the left/right lateral slide on the square travel and the horizontal tangent adjustment screw for the rotation. Assign two targets on the floor:
    - Far target: focus on the target and set the telescope cross-wires directly over the target using the horizontal tangent adjustment screw (rotation). No image available here.
    - Near target: focus on the target and set the telescope cross-wires using the lateral slide (see Image 4).

    Repeat these 2 points until the telescope reticle remains centered on the targets.
    Note: The telescope should always be aligned to the left edge of the floor black line marking. The marking line is uneven (you may see a zigzag effect); assign 4 points on the floor, the closest point to the telescope as well one or two of the other three points should be located at the left edge of the line. After doing that, the telescope should be between the 2.5 and the 3rd ring (about 2.8 mm from the center to your right) on the beamline flange (see Images 1-5). Now check far point above the beamline (see image 5.5) by tilting the telescope up.

Final Step: Repeat the leveling procedure (step 3 and 4) to make sure you are truly level. Double check that you are on target. If so, gently tighten the horizontal and vertical tangent lock. Bring in the chamber next: use the differential tube and the needle target at the skimmer to line up the setup.

Refer to the telescope manual for more information.

Note: changing the height or the lateral translation will unlevel the telescope.

Note: if telescope is bumped and the chamber is already in place, use the reference plane towards the marker at the hard X-ray beamline (image 1) to put the telescope back in line (look for the Sharpy and razor blade marks on the red floor, the alignment point of image 1, and the far point next to the pillar of the ALS dome: see image 5.75 below).

End-Station Alignment:

What are the magic points we aligned to BL10

August, 2016:

- relied on black line on the red floor ("August, 2016")
- with this we are not in the center of the beamline flange but approximately 6mm to the right.
- the bellow in between the beamline and the diffstage is slighlty curved as a consequence
- we believed in a horizontal beam (0 degree)
- used height marks to the left on X-ray beamline and hutch
- that turned out to work very well !!! We didn't have to move the chamber. We used a position of the switchyard of 69.65mm.

November 2018 comments (with the M1 mirror being changed):

- The beam was again assumed to be at a 0 degree angle with respect to the horizontal plane (left/right alignment procedure described above for the chamber is good).
- However, we saw that the height is not good for both chamber and spectrometer. In the vertical plane, the beam was coming in with an angle with respect to the chamber axis; the beam was appeared to go towards the upward direction inside the chamber. According to the November 2018 logbook, the chamber needs to go higher by 3 mm and the spectrometer needs to go down by 5 mm.

November 2022 comments:

- Added far point above the switching yard mirror chamber (marked brass clamp, which is about 3m above the floor with red Sharpy).
- Also added new line of floor towards the alignment point (image 1) at the hard X-ray beamline.

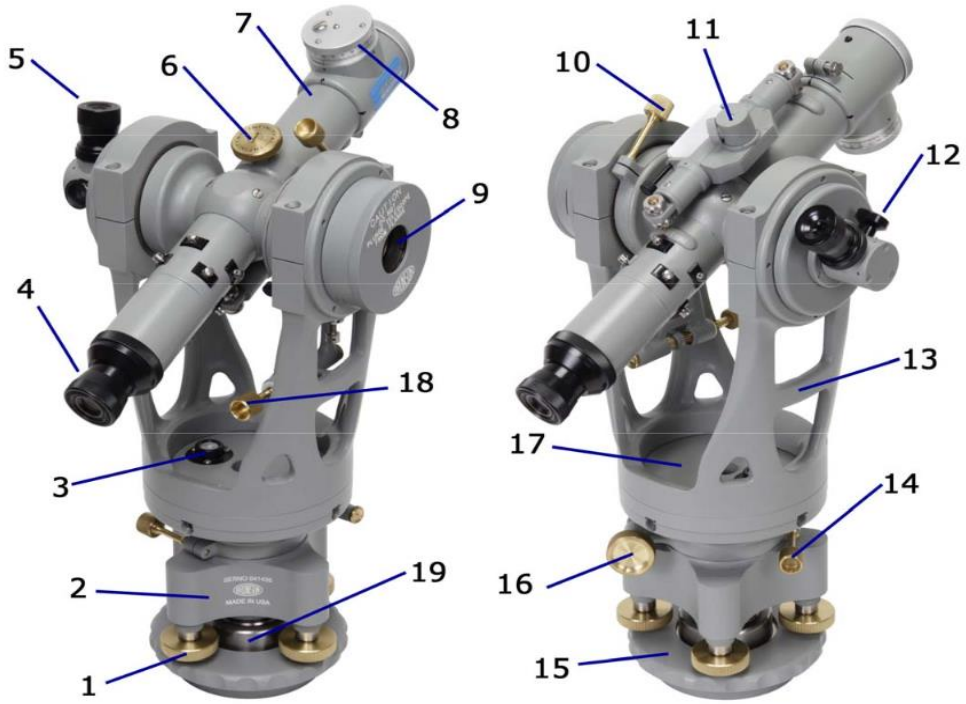


Figure 1.1
Orientation to Components

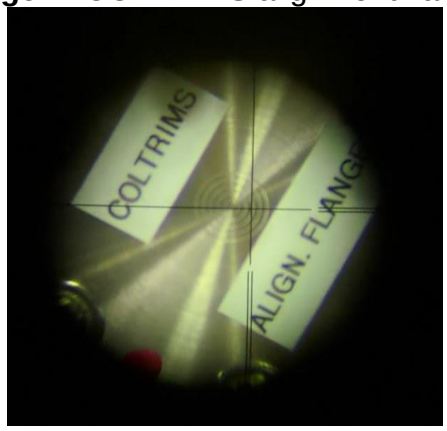
1. Leveling screws (4)
2. "Spider" base
3. Plate vial
4. Telescope (eyepiece end)
5. Cross-axis telescope eyepiece
6. Focus knob
7. Telescope (objective end)
8. 190-x Optical Micrometer
9. Cross-axis telescope objective lens
10. Vertical tangent clamp lock
11. Coincidence level
12. Cross-axis telescope lighting adapter
13. Standards
14. Horizontal tangent clamp lock
15. Base plate
16. Horizontal tangent adjustment screw
17. Plate
18. Vertical tangent adjustment screw
19. Shifting center


CAUTION
DO NOT
PLUNGE TELESCOPE
FROM FLARE
MADE IN USA

Image 1: marker on the neighboring hard X-ray beamline to the left of 10.0.1.3.

Vertical: down/up  (horizontal: left/right)

Image 2: COLTRIMS alignment flange at the end of beamline 10.0.1.3

Vertical: down/up 

(horizontal: left/right)

Image 3: Sharpy marks for beam on floor at beamline 10.0.1.3. Closest target = very close to the Telescope (~0.5m): see image 6.

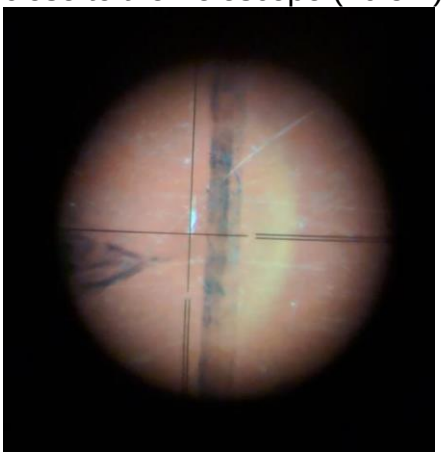


Image 4: Sharpy marks for beam on floor at beamline 10.0.1.3. Near target = 2nd closest to the telescope (~ 1.5m) used as the near target in Step 4): see image 6.

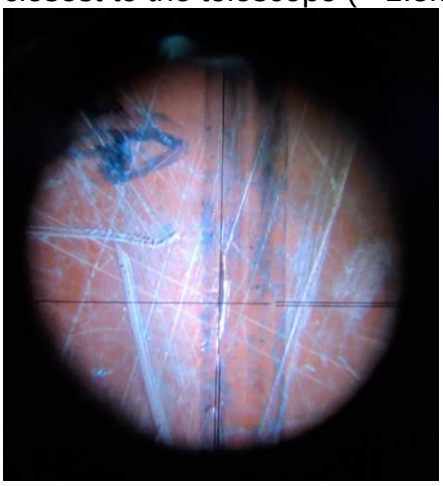


Image 5: Sharpy marks for beam on floor at beamline 10.0.1.3. Middle target = in the middle of the exit flange of the beamline and the telescope (~2.5m): see image 6.

Image 5.5: Far Point Above the Beamline = RED Sharpy mark on brass clamp above the beamline (almost above the switching yard mirrors; approx. 3m above the floor).

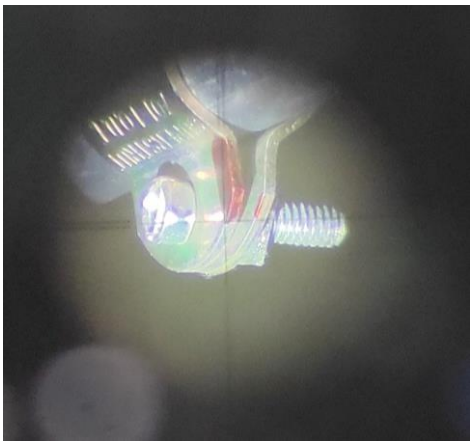


Image 5.75: Reference plane to check the telescope alignment. See Sharpy and razor blade line on the red floor towards the marker at the hard X-ray beamline as well as the far point next to the pillar of the ALS dome (tip of the screw; see photo below).

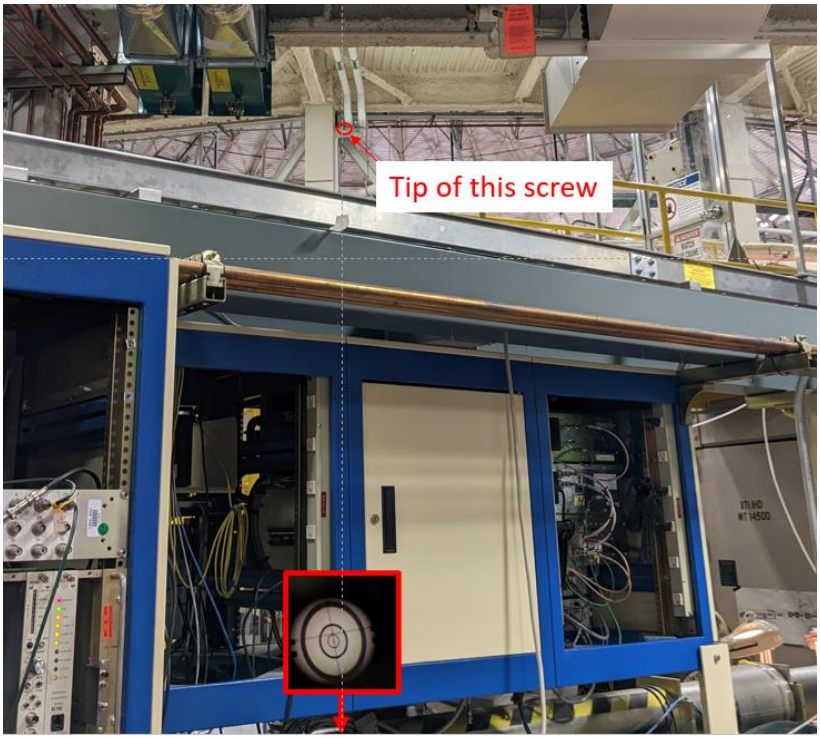


Image 6: Sketch of layout