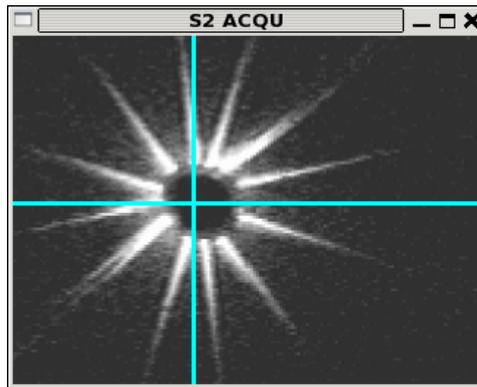


## LABAO Alignment Notes 2015\_12\_07 TtB

- Started off by aligning the S2 LABAO system as described elsewhere in the Wiki. This included checking the focus of the beacon using the 2-hole mask.
- Checked POP and M10 Alignment
- With SPARE dichroic in place centered beacon on hole using acquisition.
  - Down = Down and Right = Right



*Beacon centered on the hole using the acquisition camera zoomed in.*

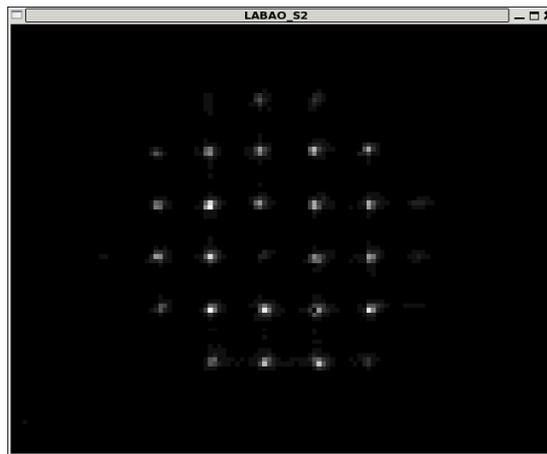
- Fired up the TWFS camera using the following settings:
  - COOL ON
  - SHUTTER OPEN
  - Vspeed 3
  - EMCCD
  - EM Gain 30
  - Exposure 0.001 for SPARE and 0.1 for YSO dichroic
- Centered beacon on TWFS – this will be automated.
- Changed to YSO dichroic and re-centered. We might be able to start on the correct dichroic.
- Blue LED is seen on LWFS, red LED on TWFS
- Use auto-align to center beacon on LWFS. This is automated but needs more testing.

### **Side note – what if you don't see the beacon on the LWFS?**

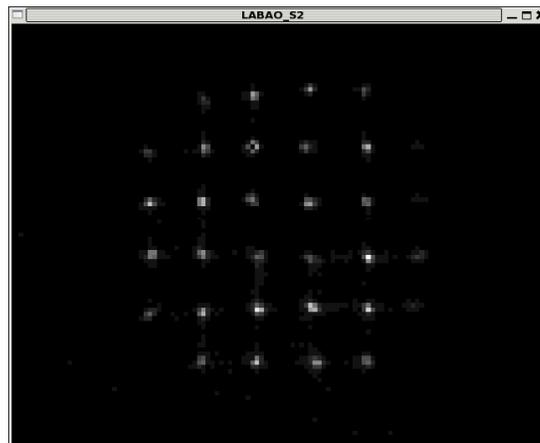
- Check the M10 alignment
- Put in the corner cube and adjust T-Dichroic to get laser spot through hole. The question is which spot? It should normally be which ever is already close to the hole. On the spare dichroic in S2 it's the lower spot. It's harder to tell on the YSO, but if you end up not seeing the beacon on the LWFS you have the wrong spot.
- Center the beacon on the spot.
- You should now see the beacon on the LWFS, if not you centered the wrong spot as described above.

**Back to notes....**

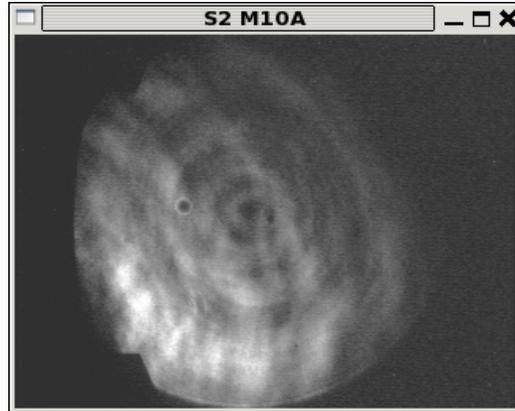
- Use auto-align to center beacon on LWFS. This is automated but needs more testing.
- In this procedure we started by manually checking the beacon focus using the two-hole mask. This is not something we would do every day. It would most likely be at this point that we use the LWFS to check beacon focus. This will be automated.
- Once the beacon is centered on the LWFS, (Blue LED), one can check that the pupil alignment is good. There is a central obscuration on the beacon (from the fiber holder) so the four central spots on LWFS should be equally illuminated but slightly fainter than the surrounding spots. Often it works out that this obscuration is over one LWFS subaperture, which means there is a pupil offset between the telescope and the lab. This can be fixed:
  - o Using M10 move the spots in the opposite direction you wish to move the pupil, but do not move them outside the boxes on the LWFS
  - o Use the align SCOPE button to re-center the spots which will move the Telescope dichroic.
  - o Repeat until you have both the pupil position and angular alignment right.



*Blue LED beacon on LWFS. The spots are well centered but one subaperture is faint because it is behind the central obscuration of the beacon. The pupil needs to move up and to the right.*

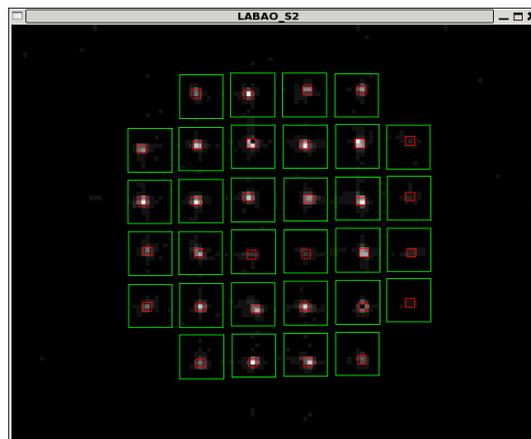


*Beacon centered on LWFS using M10 and Telescope dichroic. Spots on right are faint, we think, due to poor TWFS alignment.*

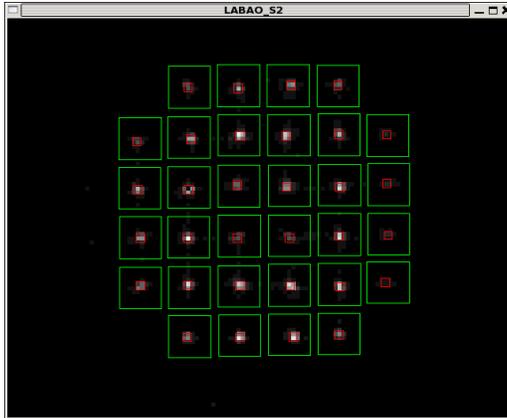


*M10 alignment after re-centering the pupil. Note that it has shifted slightly from the nominal position. This is caused by some sort of pupil shift between the lab and the telescope, probably by the telescope dichroic being in back to front. The shift is smaller than many seen during the night.*

- At this point we used the LAO servo to find a new default flat. In future alignment steps this flat will be used, along with LWFS, to check the beacon focus as mentioned above.
- Gail's new reconstructor calculation code was tested and is now the default.

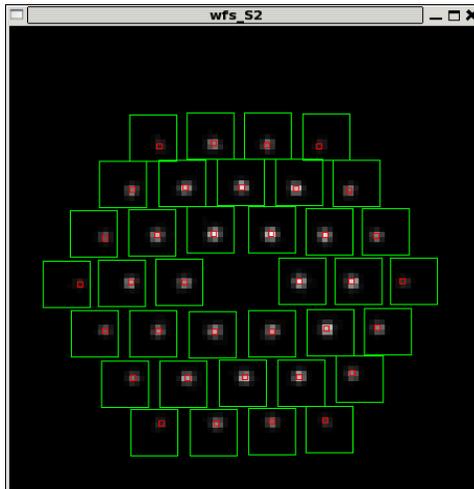


*Blue LED beacon centered on LWFS. The focus of the beacon was set using the two-hole mask. Here it looks out of focus because we are using the old default flat.*

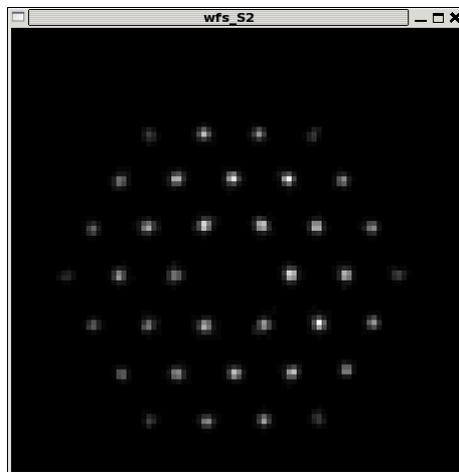


*The same thing after closing the LAO servo loop and defining a new default flat. This will now become the focus reference for the beacon, and thereby everything else.*

- The beacon was then viewed on the TWFS, and it looked out of focus. The WFS/ACQ-parabola was adjusted so that the beacon was in focus on the TWFS.



*TWFS before adjusting WFS/ACQ parabola focus.*



*TWFS spots after focusing the WFS/ACQ-parabola using the TWFS as a reference.*

- This was checked against the acquisition, and the TWFS and acquisition agreed on the best focus.
- Found that moving WFS/ACQ-parabola in -ve direction decreased focus estimate on TWFS.
- Found the moving the beacon flat in +ve direction increased the TWFS tilt estimate for both X and Y.

### **Proposed Nightly Alignment Procedure**

- Perform Lab alignment as we have up to date, including M10 alignment check.
- Use corner cube and lab laser to center laser on hole.
- Use beacon flat to center beacon on hole.
- Center beacon on LWFS. (Automation needs full testing with Az rotation)
- Use LWFS as focus reference to focus the beacon (needs automation).
- Check the beacon is still centered on LWFS.
- Center beacon on hole and then TWFS (needs automation).
- Focus WFS/ACQ parabola using beacon and TWFS as reference.
- Check that beacon is centered and in focus on TWFS .
- Zero centroids on TWFS.

### **Proposed Alignment Procedure for Each Star**

- Quickly check that beacon is well centered on both WFS. This will require RED for TWFS and BLUE for LWFS. This will require moving the telescope dichroic, and the hope is that this will be relatively well automated. If you loose the beacon on LWFS use the laser and corner cube as described above to get it back.
- Turn off beacon(s).
- Use acquisition to center star on hole.
- Close tip/tilt servo using TWFS
- Is the star visible on LWFS? If so lock servo on star. If not turn on BLUE beacon and turn LAO servo on that.
- There may have to be period offsets of angle from LWFS to telescope dichroic as we track – we have yet to learn about this.

**FINAL NOTE** – There will need to be different default flats for each dichroic and each telescope. The LABAO software will need to have this capability.