

Palomar Adaptive Optics Test Plan

Title	LGS checkout
Version	1.0
Date released	7/31/2007
Lead	A. Bouchez
Time requested	1 hr.
Required conditions	Sufficiently clear for laser projection near zenith

Purpose

1. Register lenslets to DM and create a new flatmap.
2. Optimize the laser guide star (flux, FWHM).
3. Characterize the laser guide star.
4. Evaluate the performance of the LGS-AO system.

Test procedure

The LGS target should be a V=11 flux calibrator (eg. Tycho 2 star) near zenith, approved for laser project by US Space Command. Begin full procedure 15 minutes before LGS projection window opens. However, steps 2-4 may not be necessary if lenslet-DM registration and flatmap calculation were recently performed nearby. [Steps colored blue only need to be performed on the first night of an observing run.](#)

1. Prepare for laser projection
 - 1.1. Confirm that the Laser Status Report has been filed with Space Command.
 - 1.2. Sent aircraft spotters out.
 - 1.3. Raise windscreen.
 - 1.4. Verify that Cass ring is at 335.8°
 - 1.5. Turn on and adjust RADAR.
 - 1.6. Verify that ASCAM and IRCAM are on and shutter signals reset.
 - 1.7. Open coude block.
 - 1.8. BTO configured for 589nm laser and alarm reset.
 - 1.9. Arm alarm system.
 - 1.10. Verify laser focus stage starting positions.
2. Slew to a V=7 SAO star near the LGS target.
3. Setup AO system for NGS.
 - 3.1. Set TAO mode to NGS.
 - 3.2. Click "SETUP FOR NGS" with HOWFS at 500 Hz.
 - 3.3. Stop chopper if running. (R/X)
4. Acquire and register HOWFS.
 - 4.1. Move star behind reflective spot using hand paddle.
 - 4.2. Click "OFFSET + TAKE HOWFS BKG".
 - 4.3. Close TT loop.
 - 4.4. Ask observer to center star at the desired location for LGS acquisition.
 - 4.5. Register DM (coarse and fine).
 - 4.6. Close DM loop.
 - 4.7. Make a new telescope flat map and load.
 - 4.8. Save AO config.

l1t_focus: 11820 (7/24/07)
 acq_z (lgs): 10275 (7/24/07)
 laser_focus: 14000 (7/24/07)

- 4.9. Ask operator to TX the telescope.
5. Record Acq. images of the target star for flux calibration
 - 5.1. Slew to the LGS target.
 - 5.2. Center the star 20" east (right) of the reflecting spot.
 - 5.3. Adjust Acq. integration time to get ~100 peak counts on star.
 - 5.4. Record 2 Acq. frames, offsetting the telescope 20" N between. Note FWHM.
 - 5.5. Center the star behind reflective spot.
6. Request laser propagation.
7. Set up AO system for LGS.
 - 7.1. Set TAO mode to LGS.
 - 7.2. Click "SETUP FOR LGS with HOWFS at appropriate value (150 Hz).
 - 7.3. Start chopper (R/X/E/E).
8. Acquire the LGS
 - 8.1. Center LGS on the reflective spot using UTPADDLE.
 - 8.2. Record centered position of the LLT FSM.
9. Optimize the LGS (use ACQVIEW Gaussian fit)
 - 9.1. Offset the LGS 20" to the East.
 - 9.2. Shutter laser and save an Acq. background frame.
 - 9.3. Manually offset LLT focus in 30 μm steps to minimize LGS FWHM.
bto offset llt_focus 30
 - 9.4. Manually offset Acq focus stage in 2 mm steps to minimize LGS FWHM.
offset acq_z 20000
 - 9.5. Manually offset laser focus stage in 1 mm steps to maximize return flux.
bto offset laser_focus 1000
 - 9.6. Record 2 Acq. frames and note FWHM.
 - 9.7. Offset the LGS back to the reflective spot.
10. Record an NGS
11. Close the DM loop on the laser.
 - 11.1. Move LGS_X to LGS position.
 - 11.2. Click "OFFSET + TAKE HOWFS BKG".
 - 11.3. Close UTT loop.
 - 11.4. Closed DM loop.
 - 11.5. Optimize HOWFS framerate to minimize DM residuals: Open DM and UTT loops, change framerate, take an offset background, close UTT & DM loops.
 - 11.6. Optimize llt_integral_gain to minimize DM residuals.
12. Acquire the NGS and close TT loop.
 - 12.1. Set LOWFS framerate to 1000 Hz.
 - 12.2. Move ACQ_Z to NGS position.
 - 12.3. Identify NGS in ACQVIEW field and send LOWFS.
 - 12.4. Click "OFFSET + TAKE LOWFS BKG".
 - 12.5. Click "ZERO LOWFS CENTROIDS"
 - 12.6. Close TTM loop.
13. Close focus loop (pulldown on LGSFOC).
 - 13.1. Close focus loop on LGSFOC tool, gain=1.0
 - 13.2. Wait for focus to converge to <0.5 mm, then set gain=0.25

14. Check signal level on PHARO
 - 14.1. Initial setup: 25mas FOV, filter BrG, ND 1%, standard cross, 2s integration.
 - 14.2. Adjust the exposure time and filter to get 10-15k peak counts.
15. Open TT loop, offset 60" to sky, and record 3 PHARO background frames.
16. Return to NGS, close TT loop, and set PHARO in continuous acquisition with Strehl estimate displayed.
17. Optimize the Strehl by adjusting the following servo parameters:
 - 17.1. [ttm_integral_gain](#)
 - 17.2. [dm_integral_gain](#)
 - 17.3. centroid offset file ([co_zero](#), [co_default4](#), [co_default2](#))
 - 17.4. [LOWFS focus zeropoint](#)
18. Save 3 PHARO frames in optimized configuration and record average Strehl.

Results (use one column per night)

BTO and servo loop parameters:

UT date			
8.2 LLT FSM position			
9.3 llt_focus			
9.4 acq_z			
9.5 laser_focus			
11.5 HOWFS framerate			
11.6 llt_integral_gain			
17.1 ttm_integral_gain			
17.2 dm_integral_gain			
17.3 cent_offsets			
17.4 LOWFS focus zpt.			

Image data:

Target name			
5.4 Acq. NGS image 1			
5.4 Acq. NGS image 2			
NGS FWHM (pix)			
9.2 Acq. LGS bkgd			
9.6 Acq. LGS image 1			
9.6 Acq. LGS image 2			
LGS FWHM (pix)			
15. PHARO bkgd (3)			
18. PHARO images (3)			
Average K Strehl			

Notes: