Palomar Adaptive Optics Test Plan

<table>
<thead>
<tr>
<th>Title</th>
<th>LGS Acquisition and characterization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date</td>
<td>4/2/07, V5</td>
</tr>
<tr>
<td>Lead</td>
<td>A. Bouchez, M. Troy</td>
</tr>
<tr>
<td>Time requested</td>
<td>1 hr</td>
</tr>
<tr>
<td>Required conditions</td>
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**Purpose**

Acquire LGS, focus LLT, determine LGS magnitude and spot size,

**Test procedure**

1. **Setup**
   1.1. Insure laser operator has started execution of procedure for preparation of laser propagation.
   1.2. Configure AO to look at sky
      1.2.1. Configure telescope for sky (open mirror cover, etc) – zenith only
   1.3. Telescope at zenith, at best NGS focus.
   1.4. Acquisition camera V filter not installed.
   1.5. Move LLT mirror to its default position (determined during LLT alignment)
   1.6. Load best available flatmap
   1.7. Go to LGS mode
   1.8. Move lgs_x to lgs position using lgstools
   1.9. Check white light position on HOWFS,
      1.9.1. Move SSMs to center if necessary, then move back to sky
   1.10. Acq focused at 90 km altitude (NGS focus-2450)
      move acq_z 10250 (for NGS use 12700)
   1.11. LLT focused to 90 km altitude (NGS focus - 300).
      bto move llt_focus 11730
   1.12. Check/set laser focus to correct value
      bto move laser_focus 9000
   1.13. Setup acquisition camera:
      1.13.1. Start up IDL program acqview
      1.13.2. Set integration time to 2s
      1.13.3. In an appropriate experiment directory: IDL> ao_plot_vid_image

2. Perform final safety checks and propagate laser

3. Acquire LGS on Acq
   3.1. If LGS is not in the Acq. FOV, use ellipticity of dichroic spots (apex points to LGS) and Raleigh gradient (brighter towards LGS) to steer it in:
      offset llt_a +X=up; offset llt_b +X=left

4. Calibrate UTT mirror throw (one-time calibration)
   4.1. Center LGS in acquisition camera field.
   4.2. Record image with ACQVIEW and note time tag in log in Results section.
   4.3. Record images dithering laser in a cross pattern (see log).
   4.4. Manually center laser behind reflective spot.

5. Focus on Na layer
   5.1. Move LGS to clear region of ACQ. field: offset llt_b +30
   5.2. Rough focus laser spot:
5.3. Block laser, take and save a 2s background image.

5.4. Focus Acq

5.4.1. ao_focus_loop, current-600, 300, 5, ‘acq’, ‘save_name’, sky=’sky_name’,
   time=6.0

5.4.2. move acq_z best_focus

5.5. Focus LLT

5.5.1. ao_focus_loop, current-60, 30, 5, ‘llt’, ‘save_name’, sky=’sky_name’,
   time=6.0

5.5.2. bto move llt_focus XXX

5.6. Repeat steps 4.3 and 4.4 again if necessary

6. Determine laser focus (only first night of run)

6.1. Rough focus laser spot, looking at image in acq. camera

6.2. ao_focus_loop, 0, 2000, 7, ‘laser_focus’,’save_name,sky=’sky_name’,time=6.0

6.3. bto move laser_focus XXX

7. Take photometry (optional)

7.1. Install V filter in Acq. camera

7.2. Record and save a final set of images for measuring photometry and spot
   size. offset llt_a 10 between images.

7.3. Image photometric calibrator

7.3.1. Go to photometric standard NGS, Landolt ~mV=11.0

7.3.2. Move acq_z to NGS focus (move acq_z 14600)

7.3.3. Move star to approximate position of LGS

7.3.4. Take two images, with a ~10” dither between them; record star name and
   image time tags.

7.4. Remove V filter from Acq. camera

Results and conclusions

UTT mirror calibration (section 4)

<table>
<thead>
<tr>
<th>Mirror commands</th>
<th>llt_a position</th>
<th>llt_b position</th>
<th>Image time tag</th>
<th>x centroid (pix)</th>
<th>y centroid (pix)</th>
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</thead>
<tbody>
<tr>
<td>centered</td>
<td>-19</td>
<td>19.9</td>
<td>1165393512</td>
<td>468.3</td>
<td>267.3</td>
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<td>offset llt_a 20</td>
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<td>19.9</td>
<td>1165393596</td>
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<tr>
<td>offset llt_a -40</td>
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<td>271.7</td>
<td>357.3</td>
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<tr>
<td>offset llt_a 20</td>
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<td>59.9</td>
<td>1165393694</td>
<td>285.7</td>
<td>238.1</td>
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Optimal focus settings (section 5)

<table>
<thead>
<tr>
<th>UT Date</th>
<th>Dec 6 2006</th>
<th>Dec 7 2006</th>
<th>Dec 8, 2006</th>
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<tbody>
<tr>
<td>LLT focus (µm)</td>
<td>11730</td>
<td>11730</td>
<td>11730</td>
</tr>
<tr>
<td>Acq_z (µm)</td>
<td>12350</td>
<td>12246</td>
<td>12230</td>
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<tr>
<td>LGS FWHM (pix)</td>
<td>11.5 (!)</td>
<td>13.5</td>
<td>~19</td>
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<tr>
<td>Laser Focus (µm)</td>
<td>7000</td>
<td>9000</td>
<td>9000</td>
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Photometric calibration (section 7)
### Notes:

**Dec 6, 2006:** Fainter star of the pair (mV=10.54) – 2s exposures

**Dec 7, 2006:** At end of test laser spot was ~20 pixels (versus 13.5 at the start) so it is clear the seeing degraded during the test.

**Dec 8, 2006:** Very variable seeing, laser was at 7.5W

- Laser1 and laser2 focus loops did not have laser locked to Na line
- Laser3 was acq camera
- Laser4 was LLT
- Laser5 was an attempt to do the laser focus, but lens was not well aligned and the BTO kept shuttering the system
- Laser8 and laser9 were acq focus loops
- Laser10 was LLT focus loop