Palomar Laser Guide Star
Adaptive Optics

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Predicted LGS AO performance

• The observed Strehl can be decomposed into
  – High-order LGS Strehl
    • Function of laser power, Sodium density, laser spot size, seeing and telescope elevation
  – Tip/Tilt (TT) Strehl
    • Function of seeing and TT star magnitude
  – Anisoplanitism Strehl
    • Function of seeing and the distance between the TT GS and science object

• The observed Strehl is the product of these three quantities

• Predictions are based on (and roughly agree with)
  – High order LGS correction from 4 hours of observing on one night
  – Low order correction on 3 stars on one night
Predicted High-Order Strehl Reduction

- Future improvements should improve laser return by a factor of 2-4 over our September 2006 results.
Predicted TT Strehl

- In 1.0 arcsecond seeing, a 50% Strehl reduction occurs with a V=14.5 star.
- Future improvements should improve performance by ~2 star magnitudes
Anisoplanatism

- Used average $C_n^2$ from Palomar MASS/DIMM in this calculation
Shared Risk Science (07A) 
(Feb. 19th – July 31st)

- We can support 10 nights of Shared Risk science for LGS observations in 07A.
- All LGS science nights will be preceded by 2 or more engineering nights.
- During 07A there will be a total of 3-4 LGS science runs with each run being 2-3 science nights long.
- The AO team lead will have the authority to preempt/delay science as needed to debug/understand system performance.
- All data taken during the run is available to the engineering team (for engineering purposes only).
- All proposals should:
  - Meet the proposal guidelines (see next slide)
  - Have an NGS AO backup program
  - Be reviewed by the Palomar AO team for technical feasibility
## Shared Risk Guidelines

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Restriction</th>
<th>Demonstration as of 9/14/2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>TT Ref. magnitude</td>
<td>$V &gt; 17.0$</td>
<td>$V = 16.6$ (TT only)</td>
</tr>
<tr>
<td>TT Offset</td>
<td>$\leq 60$ arcsec from science object, with some PA restrictions</td>
<td>Yes, with natural guide stars</td>
</tr>
<tr>
<td>Nodding</td>
<td>Supported in 5 arcsecond steps</td>
<td>2 arcsecond steps</td>
</tr>
</tbody>
</table>

- The above will require significant modifications to suppress Rayleigh scatter contamination in the LOWFS
  - These changes are planned for implementation before the start of the 07A semester
### Shared Risk Guidelines (Con’t)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Restriction</th>
<th>Demonstrated as of 9/14/2006</th>
<th>Work needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Telescope pointing</td>
<td>Elevation &gt; 30 Deg. and Dec. &lt;65 Deg.</td>
<td>BTO has been demonstrated &gt; 45 Deg el.</td>
<td>• Re-calibrate BTO over larger region&lt;br&gt;• FAA Approval</td>
</tr>
<tr>
<td>Spectroscopy and Coronagraphy</td>
<td>Supported, but no additional flexure compensation</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Exposure length in PHARO</td>
<td>Limited by non-common path flexure, estimate 120 sec.</td>
<td>30 sec</td>
<td></td>
</tr>
<tr>
<td>Overheads</td>
<td>• 1 hr start of night&lt;br&gt;• &lt;20 min acquisition per target</td>
<td>Both have been demonstrated</td>
<td>Improve automations</td>
</tr>
</tbody>
</table>
Summary

• We have achieved high-order correction using a LGS.
• We have shown the current performance and predicted performance for various observational scenarios
• We are happy to be able to offer shared risk observing in 07A