

Adaptive Optics Error Budgets

Why, What, How, Hugh?

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AO Performance: Goals

- Derive system design
- System performance verification
- System optimization
- Understanding unpredicted system behaviors

AO Performance Estimation: Methods

- Theory
 - 1st order calculations (Used at Palomar)
 - Full simulations
- Empirical performance prediction
 - Use AO telemetry data
- Science image Strehl

Error Term	Theory [*]	Measure (on sky)	Science Image
Uncorrectable Tel.	?		?
Calibration (static)			Y
Atmospheric fitting	Y		
HO Bandwidth	Y	Y	
HO Measurement	Y	Y	
T/T Bandwidth	Y	Y	
T/T Measurement	Y	Y	
Total Strehl	Y (calc)	Y (calc)	Y

* Requires atmospheric parameters (measured from AO telemetry)

Models - First Order

Wavefront error budget summary					Wavelengths (microns)	1.25	1.65	2.2	
RMS Residual telescope errors				96 nm		0.79	0.88	0.93	Strehl
RMS Fitting Error				103 nm		0.77	0.86	0.92	Strehl
RMS Bandwidth Error				198 nm		0.37	0.57	0.73	Strehl
RMS Measurement Error				5 nm		1.00	1.00	1.00	Strehl
RMS Anisoplanatism Error				0 nm		1.00	1.00	1.00	Strehl
RMS Non-calibratable Internal AO Error				91 nm		0.81	0.89	0.94	Strehl
RMS Non-calibratable Internal Instrument Error				45 nm		0.95	0.97	0.98	Strehl
Total HO RMS wavefront error				263 nm	Strehl from high order	0.18	0.37	0.57	
RMS Tilt Measurement Error (two-axis):	0.46	milliarcsec		4 nm		1.00	1.00	1.00	Strehl
RMS Tilt Bandwidth Error (two-axis)	12.81	milliarcsec		104 nm		0.76	0.85	0.91	Strehl
RMS Tilt Anisoplanatism Error (two-axis)	0.00	milliarcsec		0 nm		1.00	1.00	1.00	Strehl
Total TT error	62.16	nrad	12.82	milliarcsec	Strehl from Tilt	0.76	0.85	0.91	Strehl
Equivalent RMS wavefront from the Strehl				105 nm	(equivalent rms check)	105	108	110	(rms nm)
					(diffraction limit levels / D)	59.5	66.7	69.9	(microns)