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

The What

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)