



Center for Adaptive Optics  
An NSF Science & Technology Center



# Simulation Tools for Next Generation Keck AO

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# Multi-Guidestar AO PSF Codes in Regular Use within the CfAO



	Author	Language	Guide Star		Tomography Reconstructor	Aperture	Simulation	Optics	Speed/Accuracy (subjective assesment)
LAOS/TAOS	Brent Ellerbroek	C	LGS	wave optic	X	any	MonteCarlo	Phase Aberrations	slow / complete
Cibola	Brent Ellerbroek	Matlab	NGS	ray	X	infinite	Covariance	Perfect	fast / approximate
Arroyo	Matthew Britton	C	LGS	wave optic		any	MonteCarlo	Diffraction Wave	slow / complete -or- fast / approximate
TomographyAO	Don Gavel	IDL	LGS	ray	X	any	MonteCarlo	Phase Aberrations	intermediate / intermediate
MCAO Simulator	Francois Rigaut	IDL	?	?		circle	MonteCarlo	Perfect	fast / approximate

# Basic Capabilities

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- Wind profile
- Outer scale of turbulence
- control bandwidth
- photon and read noise in wfs
- wave-optic modeling of Hartmann sensor (some codes)
- Cn2 profiles (and yearly statistical average and outlier models)
- LGS elongation (sodium profile density and variability)
- laser up-path propagation, with fast steering
- sodium return
- Rayleigh, fratricide
- NGS tip/tilt stars
- long exposure closed loop
- multiple wavelengths, wavelength band images

# What We Don't Have

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- models of the instruments themselves e.g. OSIRIS, NIRC2, etc, their systematics, data product formats
- field-dependent PSF convolution with science image (?)
- atmospheric refraction vs wavelength and zenith angle(?)
- atmospheric transmission vs wavelength
- spectrograph particulars
- trouble with tip/tilt star density and color models
- calibration error systematics
- very long closed loop operation, e.g. variable seeing conditions
- telemetry data products for post-processing
- coronagraph imaging(?)