

Specifications of ShARCS: the Shane Adaptive optics infraRed Camera-Spectrograph for the Lick Observatory Shane 3-m telescope

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This document and the ShARCS manual detail the specifications of ShARCS. For more information, including filter curves and operations details, please see the ShARCS manual online at <http://mthamilton.ucolick.org/techdocs/instruments/sharcs/summary/>.

Table 1. ShARCS Observing Modes and Details

Observing Mode	Filters	Details
Imaging:	J, H, Ks, K continuum bands, various narrow-band filters	2, 3, 4, 4 pixels per lambda/D sampling, respectively. Occulting finger diameter = 0.8''
Spectroscopy: ¹	H and K grisms	R~500, Dispersion=600km s ⁻¹ , slit 0.15''x6.9''
Polarimetry: ²	Wollaston prism	Half Field aperture = 31.4''x8.4'', for use with the externally mounted wave plate

¹ Spectroscopy mode is available, but not yet fully commissioned.

² Polarimetry mode is in progress and not yet available.

Detector Characteristics

Image plate scale:	0.033 arcsec/pixel
Unvignetted Square Field of View:	20''x20''
Illuminated Circular Field:	a circular region with diameter 840 pixels or 27.7''
Detector:	Teledyne HAWAII-2RG
Pixel size:	18 μm
Quantum efficiency:	85% over wavelength range 1.0 –2.5μm
Read noise:	21 e ⁻ with CDS 6 e ⁻ with 16 Fowler reads 5 e ⁻ with 32 Fowler reads
Gain:	2.35 e ⁻ /DN
Operational area:	1976 × 1453 pixels (69.0%)
Minimum full frame readout time:	1.45 seconds
Windowing mode readout time:	0.11 seconds with a 100x100 square pixel region
Linearity:	~30,000 DN, or ~70,500 e ⁻

Aperture and Filter Wheels

Aperture Masks in ApertureWheel	Filters in FilterWheel#1	Filters in FilterWheel#2
Pinhole 0.15''diam	K grism with R~500, Dispersion=4.3μm=600km s ⁻¹	H grism with R~500, Dispersion=3.3μm=600km s ⁻¹
Vertical slit for spectroscopy, 0.15''x6.9''	Pupil Viewer	Dark position
Half-field for polarimetry	BrGamma 2.167μm narrow	Open
Open for imaging	H ₂ 1-0 S(1) 2.125μm narrow	J CH ₄ 1.183μm narrow
Horizontal slit, 6.9''x0.15''	Ks continuum	K CH ₄ 2.356μm medium
Occulting Finger, 0.8'' wide	H continuum	K continuum
	J continuum	Wollaston Prism for polarimetry
	Open	[Fe II] 1.644μm narrow

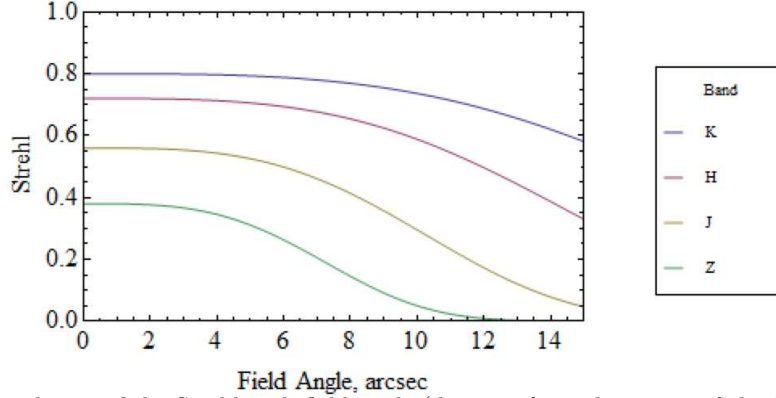


Figure 1. Expected degradation of the Strehl with field angle (distance from the center of the field, in arcseconds). The baseline Strehls at the center ($0''$) are from the ShaneAO nominal performance budget for the Laser Guide Star mode with 16 subapertures on the WFS and seeing $r_0 = 10$ cm.

ShaneAO Guide Star Requirements - note that remote operations in LGS mode are possible.

Operation Mode	Maximum Radius from Target	Faintest Guide Star R magnitude
Natural Guide Star	$10''$	12
Laser Tip-Tilt Star	$60''$	19

Measured Zero Point and Predicted Limiting Magnitudes

Filter	Zero Point (mag) ³ Measured	Predicted Limiting Magnitudes for LGS ⁴	
		8x WFS mode with Strehl=0.6	16x WFS mode with Strehl=0.8
J	22.3	21.3	22.28
H	24.3	20.5	21.0
K	23.5	18.7	19.0

³ ZP = $2.5 \log_{10}(N \text{ photons/second measured from a 0th magnitude star})$

⁴ **Predicted** point source limiting magnitudes (8 or 16 subapertures LGS) for 300s 16-Fowler-read exposure. The calibrated background measurements (and therefore measured limiting magnitude) are coming soon.*

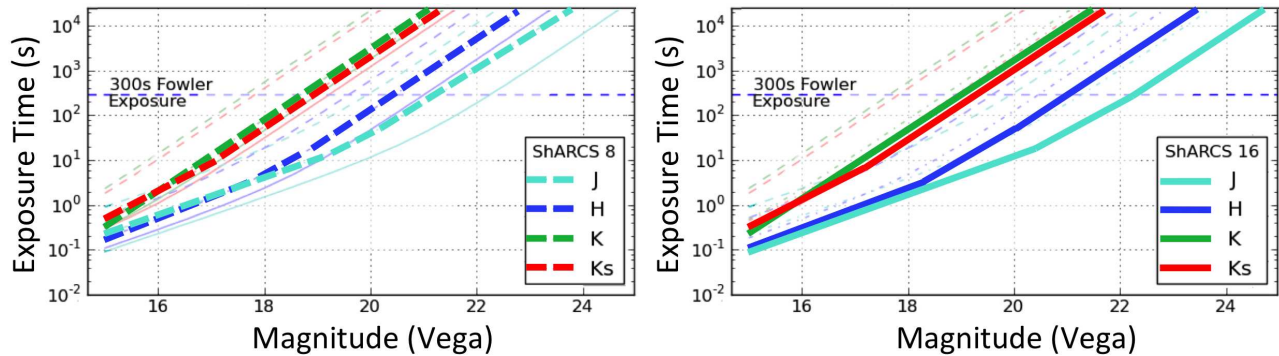


Figure 2. **Predicted** ShARCS Exposure time (seconds) required to reach a Signal-to-Noise Ratio of 5 plotted versus point source magnitude for one exposure for ShaneAO LGS using WFS Modes 8x (**left** bold dashed lines) and 16x (**right** bold solid lines). The various filters are shown by different color lines: J in light blue, H in dark blue, K in red, and Kshort (Ks) in green.*

*More sensitivity calculations are available at <http://www.ucolick.org/~srikar/ShARCS/index.html>