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

Updated 2016/08/14 9:53am

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″×6.9″
Polarimetry:[2]	Wollaston prism	Half Field aperture = 31.4″×8.4″, 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″×20″
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 100×100 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″×6.9″	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″×0.15″	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

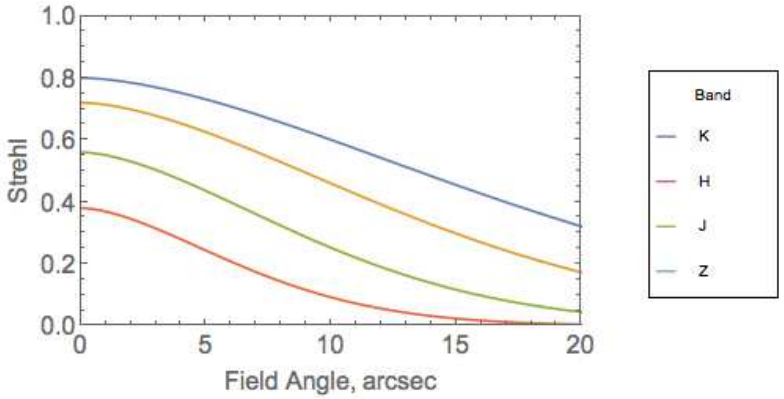

Figure 1. Expected degradation of the Strehl with field angle (distance from the center of the field, in arcseconds). The baseline Strehls at the center (0″) are from the ShaneAO nominal performance budget for the Laser Guide Star mode with 16 subaperatures on the WFS and seeing r_0 = 10 cm.

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

Operation Mode	Maximum Distance 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]	Predicted Limiting Magnitudes for LGS[4]	
	Measured	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 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, with S/N=5 and modeled sky backgrounds. The calibrated background measurements (and measured limiting magnitude) are coming soon.*

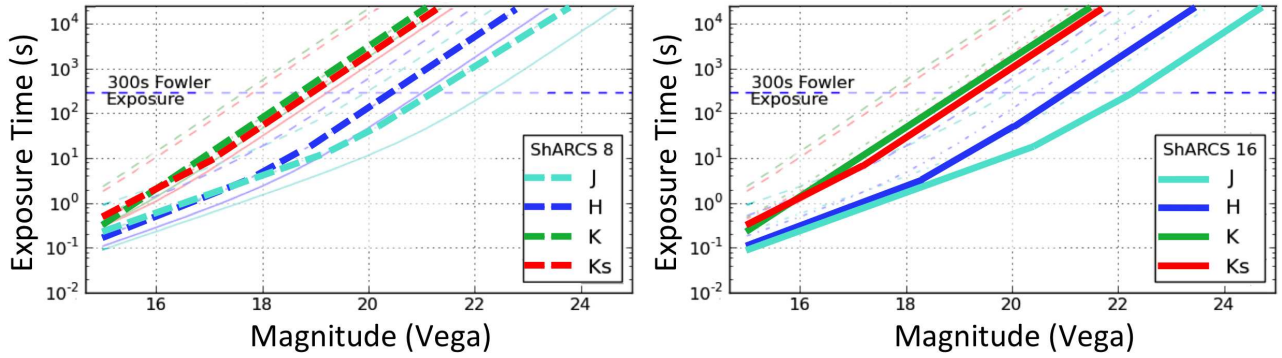

Figure 2. **Predicted** ShARCS exposure time (seconds) required to reach a Signal-to-Noise Ratio of 5 plotted versus point source magnitude for one exposure for ShaneAO LGS using WFS Modes 8x (**left** bold dashed lines) and 16x (**right** bold solid lines). The various filters are shown by different color lines: J in light blue, H in dark blue, K in red, and Kshort (Ks) in green. ShARCS is predicted to be approximately 6 times faster than IRCAL. For more detailed comparisons with IRCAL and the modeled sky backgrounds, please see the website in the footnote.*

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