Astrodon® Imaging

Astrodon Photometrics

Test Summary (Dr. Arne Henden, AAVSO; May, 2009)
100%-Coated Sloan and Johnson-Cousins Filters

We have complete sets of Astrodon dielectric, 100%-coated UBVRcIc and u'g'r'i'z' filters, along with an older set of Bessell prescription colored glass BVRcIc filters. This report discusses the differences between the new filters, and in the case of the Johnson/Cousins filters, how the new filters perform.

The equipment used was the Sonoita Research Observatory (SRO) configuration: Celestron C-14 f/11 Schmidt-Cassegrain OTA; Paramount; SBIG STL-1001E CCD camera, yielding 1.3 arcsec/pixel and field of view of 20x20arcmin. The telescope is located in southern Arizona at a dark site. The tests were performed during moonless nights in November and December, 2008. As a comparison, results for the USNO-Flagstaff Station (NOFS) 1.0m telescope, SITe/Tektronix thinned, backside illuminated 2048x2048 CCD, and custom colored glass filters, is shown for the Johnson/Cousins tests.

Johnson/Cousins

Runs were made on sequential nights between the new coated and old colored glass filters. Using only photometric nights, and several dozen Landolt standards per night, comparisons were made. The new filters have significantly different throughput than the older colored glass filters.

Filter Improvement Compared to Colored Glass

B	84%
V	-7%
Rc	43%
Ic	-17%

The colored glass and dielectric V filters have essentially the same throughput. Rc is improved with the new formulation, so that exposures are shorter. The colored glass filter version of Ic actually has a long red tail in comparison with the Cousins bandpass. The dielectric filter version cuts off that tail to give a good representation of the Cousins filter, which decreases the throughput. Johnson B is the big winner with the new filters, with exposures nearly 50% shorter.

Transformation coefficients (+/- 0.02):

Filter	Tv	Tbv	Tub	Tvr	Tri	Tvi
New Coated Glass	0.010	0.954	1.222	1.073	0.995	1.035
Old Colored Glass	0.049	0.880	-	1.152	0.955	1.049
NOFS	-0.031	0.952	1.071	0.999	0.957	0.981

The first thing to note is that you can use this telescope for U-band observations, which surprised me. All transformation coefficients are closer to the standard system with the new coated filters.

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Exposure times

With the new filters, and an F-type star, the typical exposure times for identical throughput, referenced to V, are:

Filter	ratio/SRO	ratio/NOFS
U	33	23
B	2.5	2.5
V	1.0	1.0
Rc	0.54	0.82
Ic	1.0	0.80

U is always long-exposure because: the Balmer decrement means a star has intrinsically less flux through this bandpass; the atmosphere absorbs significantly more light; the absorption in the telescope optics become important; and the detector typically has lower quantum efficiency in the far-blue. Even so, the C14/STL/filter combination compares favorably with the RC/thinned/filter combination.

The filter quality is high and the acquired images look fine. The only noticeable defect with the dielectric filters is an increased reflection halo around saturated stars in comparison with glass filters. Astrodon reformulated the filters recently to reduce the amount of light scattered into the halo; it is at a low level.

Sloan Filters

Exposure times, for an F-type star, referenced to Johnson V:

Filter	Raio
V	1.0
u'	69
g'	0.98
r'	0.54
i'	1.03
z'	2.7

The Sloan u' exposures are significantly longer than the Johnson U exposures, primarily because the filter bandpass is 40% narrower (60nm vs. 98nm). The larger width of the Johnson U filter also picks up a bit of the stellar flux redward of the Balmer decrement. Sloan z' is a long exposure because its bandpass is where the CCD QE is quite low. Image quality seems good; no reflection halos were seen.

Transformations using specific filter pairs were made to ensure that each filter is close to the Sloan standard. Stars from *Smith et al.* were used as standards, with typically 20-40 standard stars used per night.

Filter	Color	Coeff
u'	(u'-g')	0.290
g'	(g'-r')	0.075
r'	(g'-r')	-0.006
i'	(g'-i')	-0.049
z'	(g'-z')	-0.001

These transformations are all acceptable, with u' being the worst as usual with these "ultraviolet" filters and normal CCDs.