The Southern Hemisphere u'g'r'i'z' Standard Star Network

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ABSTRACT

The primary $u'g'r'i'z'$ standard star network for the northern hemisphere and equatorial regions has been completed (Smith, Tucker, Kent et al. 2002). We have started on a four-year (NOAO Survey) program to extend the standard network into the southern hemisphere. We present the goals for this extension, describe the reduction software, candidate standard stars and differences from the northern hemisphere effort. We present initial results for a sample field with multiple observations.

1. Scientific Justification

The $u'g'r'i'z'$ filter system is defined by Fukugita et al. (1996) and is the basis of the photometric calibration of the Sloan Digital Sky Survey (SDSS), a northern hemisphere five-band imaging and spectroscopic survey. The $u'g'r'i'z'$ system is tied to the AB_{95} spectrophometric system and is based on metal-poor subdwarfs. The direct transformations from $UBVRI \longrightarrow u'g'r'i'z'$ are unreliable except for metal-poor stars. Hence the need for a separate standard star network.

The existing $u'g'r'i'z'$ system (Smith, Tucker, Kent et al. 2002) is essentially a northern hemisphere and equatorial network. As the $u'g'r'i'z'$ filters gain acceptance in the community, the need for southern standard stars will become critical. Therefore, we have undertaken this effort to provide a uniformly developed standard star network. The major advantages of a global system are: to obtain leverage for extinction measurements at southern latitude observatories (CTIO, ESO, Las Campanas), to minimize distances from objects of interest to the closest standards, and to reduce slew times for standard star observations on space missions (e.g., HST ACS).

2. Experimental Design

We are using the CTIO-0.9m + Tek2k CCD (13 arcmin FOV). This combination mimics the USNO-1.0m + Tek1k (11 arcmin FOV) which was used to set up the original network. We plan to obtain 10–12 observations per candidate star or field. To save time hunting for variable in the fields, we are making use of existing standard stars when possible. The southern extension will be tied to the existing $u'g'r'i'z'$ network via equatorial and the few existing southern standards.

To maintain internal consistency, the same investigators who did the work on the northern system are performing this work. Further, the same SDSS software is being used for the reductions (`mtpipe`) (Tucker et al. 2002). Our current plan is to have the archive served via webpages at FNAL.

The primary differences in the southern effort (versus the northern network) is the switch to several and fainter standards in large fields – an approach more suitable for large mosaic-based surveys. Further, to make the fields even more useful for large surveys, we are coordinating some of the potential new fields with Arlo Landolt so they will include $u'g'r'i'z'$ and $UBVRI$ standard stars.

The planned spacing for the southern fields is:

- approximately every hour at $\delta \approx -30°$
- every 2.5–3 hours at $\delta \approx -45°$ (E-regions)
- every 2 hours at $\delta \approx -60°$
- every 4–5 hours at $\delta \approx -80°$

The initial field positions are shown in **Figure 1**. Fields for which have obtained data are indicated by filled symbols; fields for which have yet to obtain data are indicated by unfilled symbols.

3. Sample Data

We show preliminary data for one of our E-region fields (E5-B). This field contains the stars E5-mYhock (Graham 1982) and is presented to show the approximate magnitude and error ranges that will constrain the initial effort.

Figure 2 shows the E5-B field in RA-Dec space. The Graham (1982) standard stars (mYhock) are labelled.

Figure 3 shows a histogram of all stars from this field versus the reduced $(g' - r')$ color as an indication of typical field colors. We intend to calibrate a large fraction of (non-variable) stars in each field for use as $u'g'r'i'z'$ photometric standards.

Figure 4 shows the standard error versus magnitude in each of the filters. Potential variables are clearly seen. The acceptable error limits for the SDSS are 1.5% in u' & z' and 1% in the g', r', & i' bands. Our aim is to maintain these error limits in the southern fields.

Table 1 lists the six sample stars (mYhock) with their reduced (preliminary) magnitudes, uncertainties and numbers of observations.

Acknowledgments

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Fig. 1

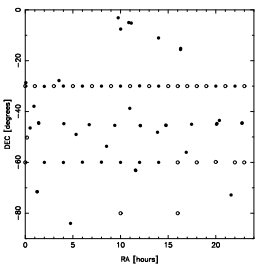

Table 1. Preliminary Magnitudes for Some Graham (1982) E5 Region Standard Stars

Star	u'	$\sigma_{u'}$	$n_{u'}$	g'	$\sigma_{g'}$	$n_{g'}$	r'	$\sigma_{r'}$	$n_{r'}$	i'	$\sigma_{i'}$	$n_{i'}$	z'	$\sigma_{z'}$	$n_{z'}$
Y	13.785	0.011	9	12.801	0.007	9	12.977	0.005	9	13.156	0.005	9	13.265	0.006	9
c	15.582	0.010	9	13.808	0.007	9	13.139	0.005	9	12.879	0.008	9	12.748	0.008	9
h	17.517	0.017	7	14.834	0.009	7	13.826	0.007	7	13.385	0.011	7	13.141	0.009	7
k	16.759	0.016	9	15.599	0.004	9	15.261	0.004	9	15.160	0.006	9	15.133	0.006	9
m	17.368	0.011	9	16.166	0.004	9	15.710	0.004	9	15.537	0.007	9	15.471	0.008	9
o	18.294	0.011	9	16.900	0.011	9	16.361	0.006	9	16.174	0.006	9	16.092	0.006	9

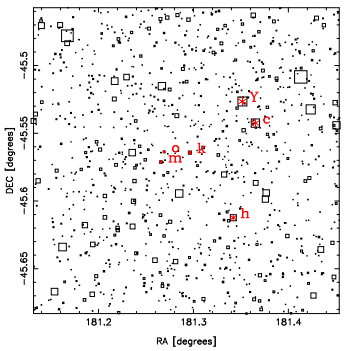

Fig. 2

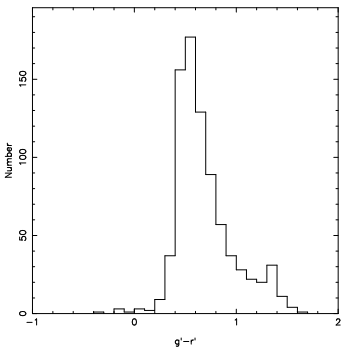

Fig. 3

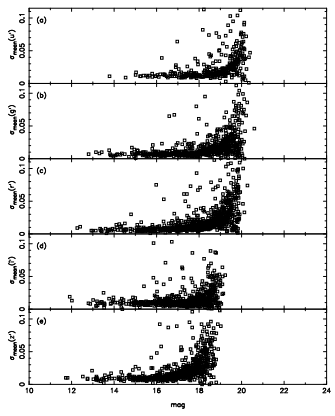

Fig. 4

http://home.fnal.gov/~dtucker/Southern_ugriz/index.html