Comments on Optical Photometry and the Generation of Standard Stars

Arlo U. Landolt
Department of Physics & Astronomy
Louisiana State University

landolt@phys.lsu.edu

Abstract

Comments will be made on situations encountered in the process of observational optical photometry and the establishing of standard star sequences.

Prologue

Long term goals for long term needs:

- standards for intensity and color information
- help calibrate new generations of equipment
- looking outward and inward

Introduction

- memory and continuity
  Weaver
  Hearnshaw
  Straizys
  Bessell
  Sterken

- goal regarding tie-ins

Setting the Stage

- photometric characteristics a la Johnson
- a role for spectra

Photometry the Old Way

- photography calibrated photoelectrically
- toddler steps
- learning to walk

Photoelectric Photometry at the Celestial Equator

- community's realization of need
- identifying potential candidate stars
- initial standard sequences

Observational Problems

- the environment
- filters and detectors
- cantankerous problems

The CCD Era

- rules for acquiring data
- taking measure of the data
- do the results make sense?

Results Over Time

- standards as a function of time
- standard star characteristics
- photometric accuracies

Number of Standards as a Function of Time

Reference	**# of stars**	**Filters**	**Sky Location**
Johnson (1963)	104	*UBV*	northern hemisphere
Landolt (1973)	658	*UBV*	celestial equator
Cousins (1973)	255	*UBV*	E and F regions
Graham (1982)	102	*UBVRI*	E regions
Landolt (1983)	223	*UBVRI*	celestial equator
Menzies et al. (1991)	212	*UBVRI*	celestial equator
Landolt (1992)	526	*UBVRI*	celestial equator
Landolt (2007)	109	*UBVRI*	-50 degree fields
Landolt (2009)	595	*UBVRI*	celestial equator
Landolt (2012)	hundreds	*UBVRI*	+45 degree fields
Clem & Landolt (2012)	1000+	*UBVRI*	celestial equator

Summary of Landolt's Standard Star Efforts

Year of Publication	# of Standards	Range in *V*	Range in *(B−V)*	Measures per star
1973	335	10.5 → 12.5	−0.25 → +2.00	11
1983	223	7.0 → 12.5	−0.30 → +2.00	20
1992	217	11.5 → 16.0	−0.30 → +2.00	29
2009	595	8.9 → 16.3	−0.35 → +2.30	24
2012a	hundreds	~ 9.0 → 16.0	~ −0.30 → +2.20	~15
2012b	1000+	~ 10.0 → 16.0	~ −0.30 → +2.00	25+
2012c	1000+	~ 15.0 → 20.0	~ −0.30 → +1.80	25+

Photometric Accuracies

	Mean Errors of a Single Observation				Mean Errors of the Mean			
	1973	1983	1992	2009	1973	1983	1992	2009
V	0.0153	0.0134	0.0160	0.0144	0.0046	0.0029	0.0039	0.0036
B−V	0.0159	0.0124	0.0195	0.0191	0.0048	0.0027	0.0048	0.0051
U−B	0.0250	0.0228	0.0439	0.0492	0.0075	0.0050	0.0125	0.0143
V−R		0.0090	0.0126	0.0115		0.0020	0.0031	0.0029
R−I		0.0095	0.0182	0.0166		0.0021	0.0044	0.0040
V−I		0.0116	0.0228	0.0207		0.0025	0.0055	0.0050

Acknowledgments

Thanks to James Clem and Chris Sterken
for comments

Support over the years by DARPA,
AFOSR, STScI, and NSF