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Calibration Information

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Goodman Comparison Lamps

Updated Mar 2021

The SOAR Instrument Support Boxes (ISBs) contain facility calibration units containing both continuum sources for flat fielding and line sources for wavelength calibration.

Object Flat Comp Dark Zero

Comp Name: HgAr # Comp Exposures 1

Comp Comments:

Hg(Ar) Cu Ne Ar Quartz

% Exposure

% Readout

0 20 40 60 80 100

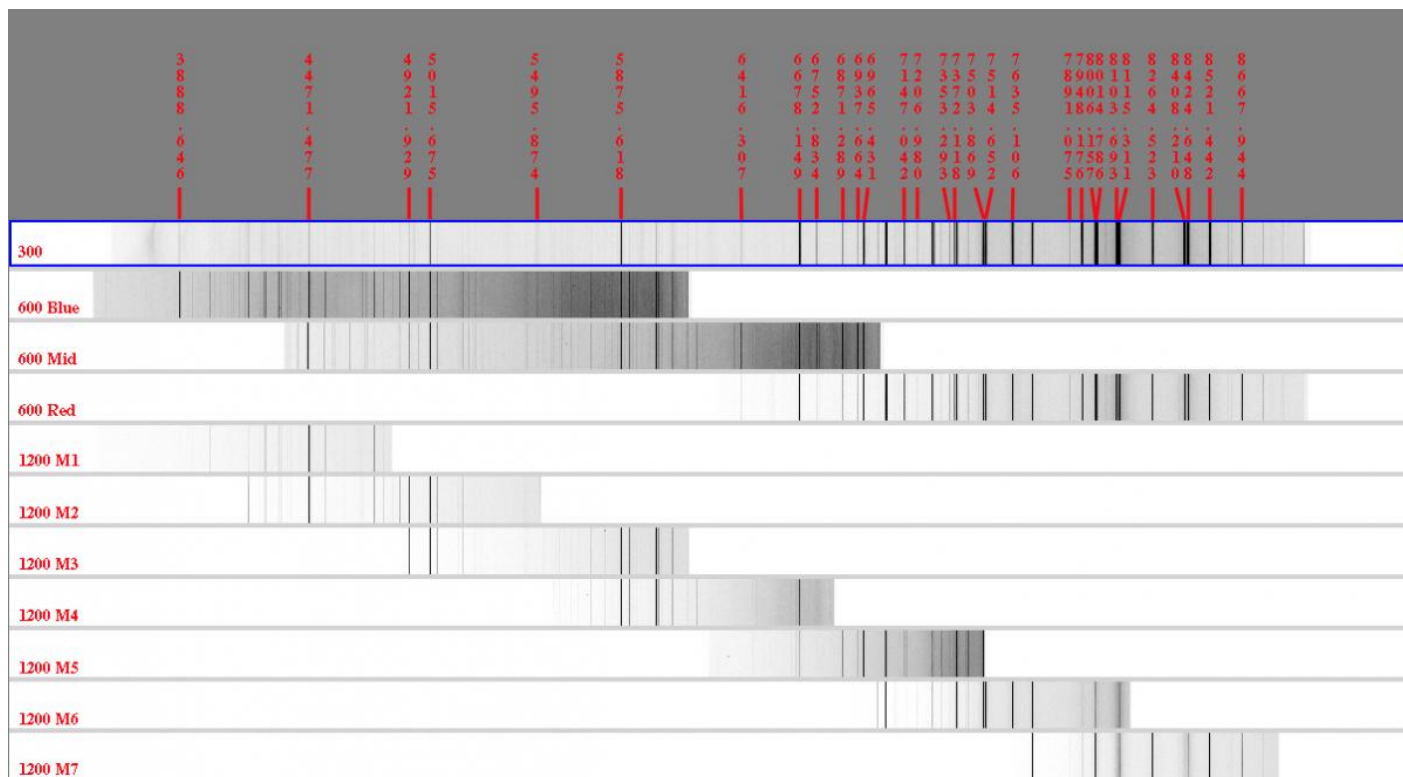
DONE: Waiting for next command

The wavelength calibration lamps normally used with the Goodman spectrograph are: HgAr, CuHeAr, Ne, and Ar. An Fe lamp is also available.

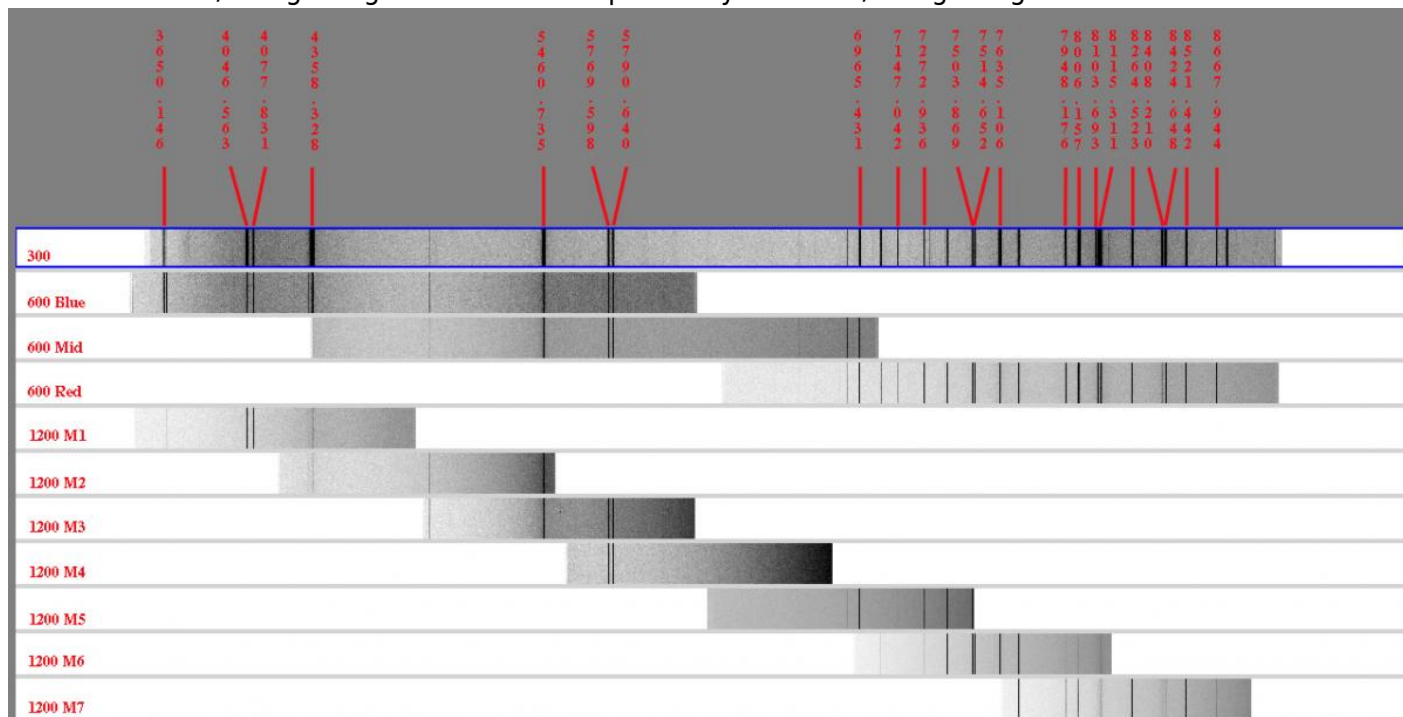
The comparison lamps can be activated from the instrument GUI by you, or you can ask the Telescope Operator (TO) to do it for you from his technical GUI.

Note that you need to make a slow, substantial mouse click on the particular lamp in order for it to actually get the input and turn on or off (a quick click may make the green light go on or off but not turn on/off the lamp). If in doubt, check with the TO. The Fe lamp is not featured in the GUI and you need to ask the TO to turn it ON/OFF for you. When obtaining comparison lamps, make sure you are in Spectroscopic Mode and that the TO has put the pickup mirror in.

In Figure 1 at below we show the **CuHeAr** arc lamp spectra for most of our pre-defined spectroscopic modes. NOTE: the 300 l/mm grating has now been replaced by the 400 l/mm grating.



In Figure 2 below we show the **HgAr** arc lamp spectra for most of our pre-defined spectroscopic modes. NOTE: the 300 l/mm grating has now been replaced by the 400 l/mm grating.



In the following table containing plots of the comparison lamps made with various gratings and setups. However, **for the latest library of comparison lamp spectra, we advise you use the comparison lamp spectra at [this link](#).** [6]

Grating	Setup	Lamp	Wavelength Coverage of the Plot
400	M1	HgAr	3000-7000 (Full range) [7]
400	M1	HgAr	3000-5000 (Zoom) [8]
400	M1	HgAr	5000-7000 (Zoom) [9]
400	M2	HgAr	5000-9000 (Full range) [10]
400	M2	HgAr	5000-9000 (Zoomed/split) [11]
600	UV,Blue,Mid,Red	HgAr	3600-9000 (6 plots) [12]
600	UV,Blue,Mid	CuHeAr	3600-6500 [13]
930	M1	HgAr	3000-4500 (Full range & zoom) [14]
930	M2	HgAr	3750-5500 (Full range & zoom) [15]
930	M3	HgAr	4750-6250 (Full range & zoom) [16]
930	M4	HgAr	5500-7200 (Full range & zoom) [17]
930	M5	HgAr	6400-8000 (Full range & zoom) [18]
930	M6	HgAr	7250-8750 (Full range & zoom) [19]
930	M2	CuHeAr	3750-5500 (Full range & zoom) [20]
930	M3	CuHeAr	4750-6250 (Full range & zoom) [21]
930	M4	CuHeAr	5500-7200 [22]
930	M5	CuHeAr	6400-8000 [23]
930	M6	CuHeAr	7250-8750 [24]
1200	M5	HgArNe	3600-8700 (7 plots) [25]
1200	M1,M2,M3,M4,M5,M6,M7	CuHeAr	3600-8700 (7 plots) [26]
2100	650nm (Littrow)	Ne	6150-6720 [27]

Useful links:

The [KPNO Spectral Atlas Central](#) [28] is a useful resource for comparison lamp spectra

Goodman Dome/Quartz flats and Comps Exposure Times

Updated 02 Mar 2021

Goodman **RED** camera typical **DOME FLAT** lamp exposure times (for 2x2 binning, 344ATTN3 readout

mode)

Mode	Type	Slit	Lamp (%) / Exp (s)	Temp (s)	ADU
400M1 no filter	Spec	1	100	7	28000 (1)
400M2 +GG455 filter	Spec	1	100	5	25000 (1)
600MID + GG395 filter	Spec	1	100	12	29000 (1)
930M2 no filter	Spec	1	100	60	27000 (1)
SDSS-g	Img	---	30	2.5	21000 (2)
SDSS-r	Img	---	15	1.5	24000 (2)
SDSS-i	Img	---	10	1	27000 (2)
VR	Img	---	10	3	25500 (2)

(1) Max ADU count, at red end of spectrum

(2) Average ADU count

Goodman **RED** camera typical **QUARTZ FLAT** lamp exposure times (344ATTN3 readout mode)

Mode	Binning	Slit (")	Lamp (%) / Exp (s)	Temp (s)	MAX ADU
400M1 no filter	2x2	1	70	3	39600
400M2 +GG455 filter	2x2	1	70	1.5	34000
600MID + GG395 filter	2x2	1	70	5	36000
930M2 no filter	2x2	1	100	3.5	29500
2100@650+GG455 filter	1x2	0.45	100	15	24000

Goodman **RED** camera typical **COMPARISON** lamp exposure times (200ATTN0 readout mode)

Mode	Binning	Slit (")	ARC LAMP	Exp (s)
400M1 no filter	2x2	1	HgArNe	0.5
400M2 + GG455 filter	2x2	1	HgArNe	0.5
600MID + GG395 filter	2x2	1	HgArNe	0.5
930M2 no filter	2x2	1	Cu(HeAr)	120
2100@650+GG455 filter	1x2	0.45	HgArNe	0.5
2100@5577	1x2	0.45	HgArNe	1

Goodman **BLUE** camera typical **DOME FLAT** lamp exposure times (for 2x2 binning, 200ATTN0 readout mode)

Mode	Type	Slit	Lamp (%) / Exp (s)	Temp (s)	ADU
400M1 no filter	Spec	1	100	7	29600 (1)
400M2 +GG455 filter	Spec	1	100	7	30000 (1)
600MID + GG395 filter	Spec	1	100	12	29500 (1)
930M2 no filter	Spec	1	100	45	23600 (1)
SDSS-g	Img	---	40	1.5	31000 (2)
SDSS-r	Img	---	15	1.5	24600 (2)
SDSS-i	Img	---	10	1	22000 (2)
VR	Img	---	15	1	25000 (2)

(1) Max ADU count, at red end of spectrum

(2) Average ADU count

Goodman **BLUE** camera typical **QUARTZ FLAT** lamp exposure times (200ATTN0 readout mode)

Mode	Binning	Slit (")	Lamp (%)	Exp (s)	MAX ADU
400M1 no filter	2x2	1	70	2.5	30900
400M2 + GG455 filter	2x2	1	70	2	31800
600MID + GG395 filter	2x2	1	70	4	28700
930 M2 no filter	2x2	1	100	3	29000

Goodman **BLUE** camera typical **COMPARISON** lamp exposure times (for 2x2 binning, 200ATTN0 readout mode)

Mode	ARC LAMP	Exp (s)
400M1 no filter	HgArNe	0.3
400M2 + GG455 filter	HgArNe	0.3
600MID + GG395 filter	HgArNe	0.3
930M2 no filter	Cu(HeAr)	90

Goodman spectrograph typical focus values

Updated 23 Jul 2020

Here we provide typical focus values for the Goodman instrument. The instrument focus is usually set once per night, and is done as the first step before afternoon calibrations. Note that the focus is dependent on ambient temperature, so values will change significantly from summer to winter, in fact, variations of up to ~500 units could happen from one observing run to another. Also, the depth of focus is roughly 100 units, so focus values within +/- 50 units can be considered consistent with no focus difference.

The **BLUE** camera focus values should be mostly positive; **RED** camera focus values are mostly negative.

See [how to perform a spectroscopic focus measurement](#) [29].

See [how to perform an imaging focus measurement](#) [30].

The following values are representative. In some cases we provide actual measured values obtained on different dates to illustrate the variations; both blue and red cameras are affected by focus variations as a function of temperature. You should perform a focus sequence every afternoon.

Red Camera spectroscopic focus values:

Grating	Mode	Camera Temp (C)	Focus
400	M1	19	-300
400	M1	16	-600
400	M1	13	-660
400 (+GG455)	M2	19	-990
400 (+GG455)	M2	16	-1200
400 (+GG455)	M2	11	-1300
400	M2	16	-250
400	M2	11	-690
600red (+GG385)	Mid	17	-1770
600red (+GG495)	Red	17	-992
600old (+GG385)	Mid	15	-1540
1200	M2	17	-700
1800	@700nm	13	-825
1800	@660nm	19	-460
2100	@650nm	16	-200

Grating	Mode	Camera Temp (C)	Focus
2100	@650nm	13	-555
2100	@650nm	17	-376

Blue Camera spectroscopic focus values:

Grating	Mode	Camera Temp (C)	Focus
400	M1	17	1615
400	M1	11	1320
400 (+GG455)	M2	11	773
600blue	UV	17	1650
600blue	Blue	17	1650
600old	UV	11	1370
600old	Blue	11	1440
600old (+GG385)	Mid	11	880
600old (+GG495)	Red	11	1350
600blue (+GG385)	Mid	17	820
600blue (+GG495)	Red	17	1650

Red Camera imaging focus values:

Filter	Lamps/(%)	Exp (s)	Camera Temp (C)	Focus
None	Dome/5	0.5	10	-1130
B	Quartz/50	2	19	-715
V	Dome/20	0.5	10	-580
R	Quartz/50	1	19	-1320
VR	Dome/25	0.5	16	-470
VR	Dome/25	0.5	11	-814
SDSS-u	Dome/20	1	10	
SDSS-g	Dome/20	1	10	
SDSS-r	Dome/20	1	10	-700

Filter	Lamps/(%)	Exp (s)	Camera Temp (C)	Focus
SDSS-i	Dome/20	1	10	-900
SDSS-z	Dome/20	1	10	-1250
	Dome/20	1	10	

Blue Camera imaging focus values:

Filter	Lamps (%)	Exp (s)	Camera Temp (C)	Focus
SDSS-g	Quartz/50	4	11	1100
SDSS-r	Quartz/50	1	11	990
SDSS-i	Quartz/50	0.3	11	860
SDSS-z	Quartz/50	0.5	11	540

Hamuy Spectrophotometric Standards

M. Hamuy led a group at CTIO to obtain observations of 10 secondary spectrophotometric standards from [Taylor \(1984\)](#) [31] and 19 tertiary spectrophotometric standards from [Stone & Baldwin \(1983\)](#) [32] and [Stone \(1977\)](#) [33]. These results were published in two papers:(1) [Hamuy et al. \(1992\)](#) [34] and (2) [Hamuy et al. \(1994\)](#) [35]. The former paper covers wavelengths from 3300Å to 7550Å and the latter paper covers wavelengths from 6000Å to 10500Å. The latter paper also combines both sets of observations and presents AB magnitudes for the 10 secondary standards at 16Å intervals from 3300Å to ~10400Å and for the 19 tertiary standards at 50Å intervals from 3300Å to ~10300Å. The AB magnitudes are converted to flux ($\text{erg cm}^{-2} \text{s}^{-1} \text{\AA}^{-1}$) using the formula:

$$\text{AB Mag} = -2.5 \log_{10}(\text{F}_\nu) - 48.59$$
where F_ν is in $\text{erg cm}^{-2} \text{s}^{-1} \text{Hz}^{-1}$.

Secondary Spectrophotometric Standard Stars								
HR#	Star	Dec (J2000.0)	MKType	(U-B)	(B-V)	V	(V-R) _{KC}	(V-I) _{KC}

718	ξ^2 Cet	0+ 20 :8 2: 82 :7 0: 93 .6 5. 42	B9 III	-0.107	-0.056	4.279	-0.023	-0.063
1544	π^2 Ori	0+ 40 :8 5: 05 :4 3: 60 .0 6. 97	A1 V	...	0.01	4.355	0.014	0.039
3454	η Hya	0+ 80 :3 4: 32 :3 1: 35 .5 4. 61	B3 V	-0.743	-0.200	4.295	-0.083	-0.200
4468	θ Crt	1- 10 :9 3: 64 :8 4: 00 .8 9. 12	B9.5 V	-0.18	-0.07	4.700	-0.023	-0.063
4963	θ Vir	1- 30 :5 0: 93 :2 5: 62 .0 9. 65	A1 IV	-0.01	-0.00	4.375	0.003	0.010

5501	108 Vir	1+ 40 :0 4: 54 :3 3: 00 .2 2. 57	B9.5 V	-0.080	-0.023	5.681	0.004	-0.026
7001	α Lyr	1+ 83 :8 3: 64 :7 5: 60 .1 3. 31	A0 V	0.00	0.00	0.03	-0.037	-0.045
7596	58 Aql	1+ 90 :0 5: 41 :6 4: 42 .4 8. 06	A0 II1	-0.01	0.10	5.62	...	...
7950	ε Aqr	2- 00 :9 4: 72 :9 4: 04 .4 5. 57	A1 V	0.029	-0.001	3.778	-0.005	-0.010
8634	ζ Peg	2+ 21 :0 4: 14 :9 2: 75 .3 6. 42	B8 V	-0.24	-0.09	3.40	-0.037	-0.079

9087	29 Psc	00:00:10 :30:14 :93.94 :20	B7 III-IV	-0.501	-0.136	5.120	-0.052	-0.122
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Tertiary Spectrophotometric Standard Stars											
Star	RA (J2000)	Dec (J2000)	Type	(U-B)	(B-V)	V	(V-R) _{KC}	(R-I) _{KC}	PM (RA) (" yr ⁻¹)	PM (Dec) (" yr ⁻¹)	Plots
¹ CD-34 241	00:41:46.9	-33:39:09	f	-0.065	+0.478	11.229	+0.295	+0.289	-0.45	-0.25	finder [36]/ spectrum [37]
LTT 1020	01:54:49.7	-27:28:29	g	-0.186	+0.557	11.522	+0.361	+0.364	0.33	-0.21	finder [38]/ spectrum [39]
EG 21	03:10:30.4	-68:36:05	DA	-0.661	+0.039	11.379	-0.093	-0.064	0.00	-0.30	finder [40]/ spectrum [41]
LTT 1788	03:48:22.2	-39:08:35	f	-0.281	+0.469	13.155	+0.317	+0.332	0.24	-0.19	finder [42]/ spectrum [43]
LTT 2415	05:56:24.2	-27:51:26	...	-0.215	+0.400	12.214	+0.267	+0.293	0.30	-0.18	finder [44]/ spectrum [45]
Hiltner 600	06:45:13.5	+02:08:15	B1	-0.574	+0.179	10.441	+0.120	+0.140	...	...	finder [46]/ spectrum [47]
LTT 3218	08:41:32.4	-32:56:33	DA	-0.574	+0.220	11.858	+0.096	+0.111	-1.10	1.34	finder [48]/ spectrum [49]
LTT 3864	10:32:13.8	-35:37:42	f	-0.167	+0.495	12.171	+0.323	+0.329	-0.34	-0.01	finder [50]/ spectrum [51]
LTT 4364	11:45:42.9	-64:50:29	C2	-0.664	+0.162	11.504	+0.173	+0.127	6.19	-0.33	finder [52]/ spectrum [53]
² Feige 56	12:06:47.3	+11:40:13	sdB8	...	-0.13	11.06	...	...	-0.007	-0.007	finder [54]/ spectrum [55]
LTT 4816	12:38:50.7	-49:47:58	DA	-0.656	+0.166	13.794	+0.013	+0.027	-0.86	-0.13	finder [56]/ spectrum [57]

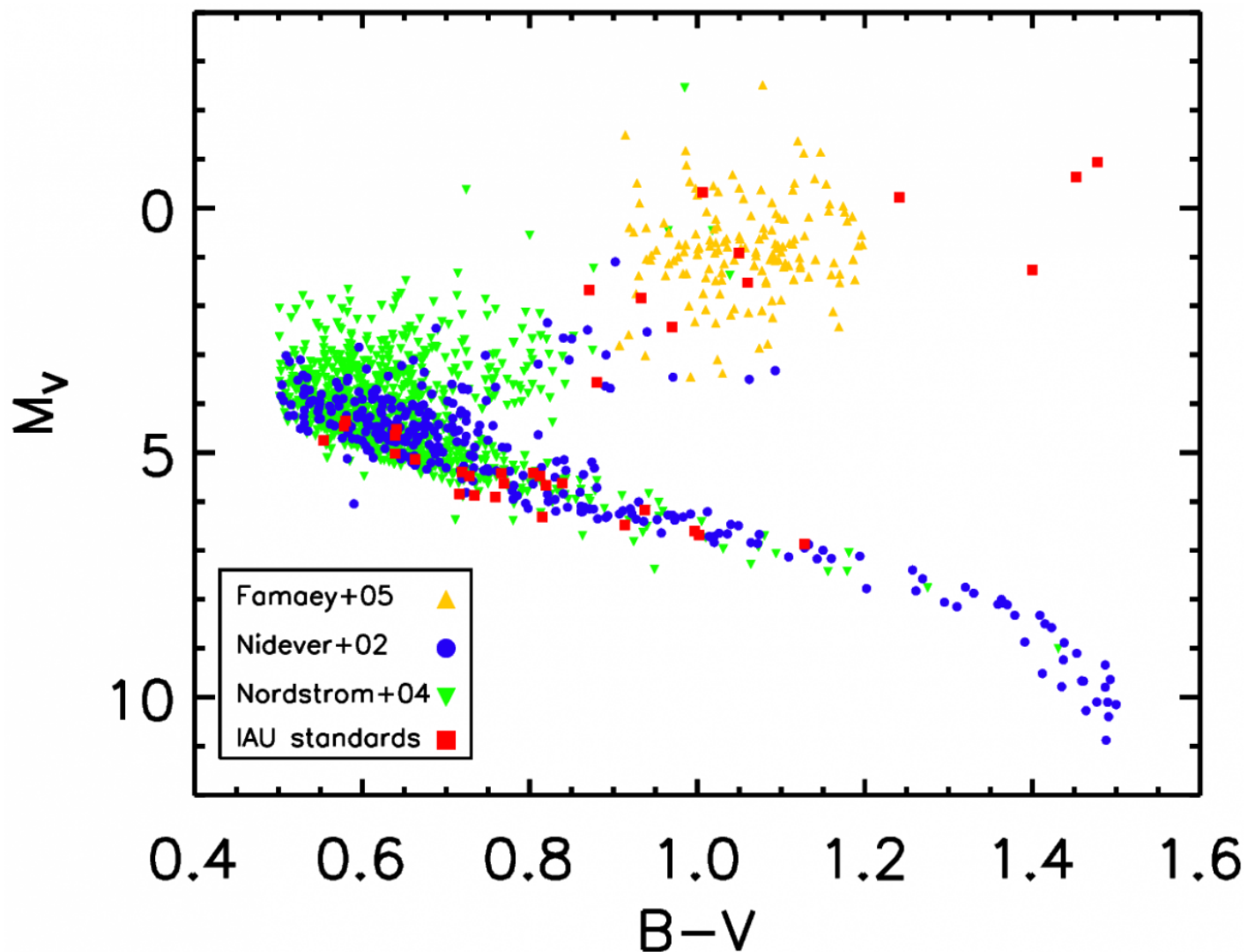
CD-32 9927	14:11:46.3	-33:03:15	A4	...	+0.349	10.444	+0.324	+0.014	-0.004	0.007	finder [58]/ spectrum [59]
LTT 6248	15:38:59.8	-28:35:34	a	-0.197	+0.491	11.797	+0.319	+0.345	-0.25	-0.18	finder [60]/ spectrum [61]
EG 274	16:23:33.7	-39:13:48	DA	-0.969	-0.144	11.029	-0.093	-0.096	0.10	-0.01	finder [62]/ spectrum [63]
LTT 7379	18:36:26.2	-44:18:37	G0	-0.020	+0.605	10.225	+0.366	+0.366	-0.22	-0.16	finder [64]/ spectrum [65]
LTT 7987	20:10:57.1	-30:13:03	DA	-0.670	+0.046	12.230	-0.062	-0.078	-0.43	-0.24	finder [66]/ spectrum [67]
LTT 9239	22:52:40.9	-20:35:27	f	-0.110	+0.609	12.068	+0.397	+0.372	0.10	-0.33	finder [68]/ spectrum [69]
Feige 110	23:19:58.3	-05:09:56	sdO8	-1.09	-0.05	11.50	-0.47	-0.175	-0.011	0.0	finder [70]/ spectrum [71]
LTT 9491	23:19:35.2	-17:05:28	DC	-0.843	+0.007	14.112	+0.045	+0.031	0.27	0.05	finder [72]/ spectrum [73]
Notes: ¹ CD-34 241 is mistakenly named LTT 377 in Stone and Baldwin (1983) and Hamuy et al. (1992 & 1994). ² The coordinates of Feige 56 are given incorrectly in Hamuy et al. (1992).											

Radial Velocity Standards

One of the latest and most complete lists of radial velocity standard stars is that by **Soubiran et al. 2013, A&A, 552A, 64** ([ADS link](#) [74]):

"The catalogue of radial velocity standard stars for Gaia. I. Pre-launch release."

This catalog contains 1420 stars with data over a baseline of over 6 yr, with an overall stability of about 300 m/s



The data in their Table 4, can be accessed in the CDS service by click on [this link](#). [75]

Source URL: <http://www.ctio.noirlab.edu/soar/content/calibration-information>

Links

- [1] <https://soardocs.readthedocs.io/projects/lamps/en/latest/>
- [2] <http://www.ctio.noirlab.edu/soar/content/goodman-domequartz-flats-and-comps-exposure-times>
- [3] <http://www.ctio.noirlab.edu/soar/content/goodman-spectrograph-typical-focus-values>
- [4] <http://www.ctio.noirlab.edu/soar/content/hamuy-spectrophotometric-standards>
- [5] <http://www.ctio.noirlab.edu/soar/content/radial-velocity-standards>
- [6] <https://goodman.readthedocs.io/projects/lamps/en/latest/>
- [7] http://www.ctio.noirlab.edu/soar/sites/default/files/Instrument_Plots/400m1_HgAr_3000-7000.pdf
- [8] http://www.ctio.noirlab.edu/soar/sites/default/files/Instrument_Plots/400m1_HgAr_3000-5000.pdf
- [9] http://www.ctio.noirlab.edu/soar/sites/default/files/Instrument_Plots/400m1_HgAr_5000-7000.pdf
- [10] http://www.ctio.noirlab.edu/soar/sites/default/files/GOODMAN/HgArNe_400M2_GG455_full.pdf
- [11] http://www.ctio.noirlab.edu/soar/sites/default/files/GOODMAN/HgArNe_400M2_GG455_split.pdf
- [12] http://www.ctio.noirlab.edu/soar/sites/default/files/Instrument_Plots/hgar_600.pdf
- [13] http://www.ctio.noirlab.edu/soar/sites/default/files/GOODMAN/CuHeAr_600_Blue_full.pdf
- [14] http://www.ctio.noirlab.edu/soar/sites/default/files/Instrument_Plots/HgAr_930m1.pdf
- [15] http://www.ctio.noirlab.edu/soar/sites/default/files/Instrument_Plots/HgAr_930m2.pdf
- [16] http://www.ctio.noirlab.edu/soar/sites/default/files/Instrument_Plots/HgAr_930m3.pdf

[17] http://www.ctio.noirlab.edu/soar/sites/default/files/Instrument_Plots/HgAr_930m4.pdf
[18] http://www.ctio.noirlab.edu/soar/sites/default/files/Instrument_Plots/HgAr_930m5.pdf
[19] http://www.ctio.noirlab.edu/soar/sites/default/files/Instrument_Plots/HgAr_930m6.pdf
[20] http://www.ctio.noirlab.edu/soar/sites/default/files/Instrument_Plots/CuHeAr_930m2.pdf
[21] http://www.ctio.noirlab.edu/soar/sites/default/files/Instrument_Plots/CuHeAr_930m3.pdf
[22] http://www.ctio.noirlab.edu/soar/sites/default/files/Instrument_Plots/CuHeAr_930m4.pdf
[23] http://www.ctio.noirlab.edu/soar/sites/default/files/Instrument_Plots/CuHeAr_930m5.pdf
[24] http://www.ctio.noirlab.edu/soar/sites/default/files/Instrument_Plots/CuHeAr_930m6.pdf
[25] http://www.ctio.noirlab.edu/soar/sites/default/files/GOODMAN/HgArNe_1200M5_GG455_full.pdf
[26] http://www.ctio.noirlab.edu/soar/sites/default/files/Instrument_Plots/cuhear_1200.pdf
[27] http://www.ctio.noirlab.edu/soar/sites/default/files/Instrument_Plots/GHTS_2100_650nm_Ne.2.pdf
[28] <http://iraf.noao.edu/specatlas/>
[29] <http://www.ctio.noirlab.edu/soar/content/observing-goodman#S5c>
[30] <http://www.ctio.noirlab.edu/soar/content/imaging-focus>
[31] <http://adsabs.harvard.edu/abs/1984ApJS...54..259T>
[32] <http://adsabs.harvard.edu/abs/1983MNRAS.204..347S>
[33] <http://adsabs.harvard.edu/abs/1977ApJ...218..767S>
[34] <http://adsabs.harvard.edu/abs/1992PASP..104..533H>
[35] <http://adsabs.harvard.edu/abs/1994PASP..106..566H>
[36] http://www.ctio.noirlab.edu/soar/sites/default/files/GOODMAN/Hamuy/cd-34241_dss.pdf
[37] http://www.ctio.noirlab.edu/soar/sites/default/files/GOODMAN/Hamuy/cd-34241_spec.pdf
[38] http://www.ctio.noirlab.edu/soar/sites/default/files/GOODMAN/Hamuy/lrt1020_dss.pdf
[39] http://www.ctio.noirlab.edu/soar/sites/default/files/GOODMAN/Hamuy/lrt1020_spec.pdf
[40] http://www.ctio.noirlab.edu/soar/sites/default/files/GOODMAN/Hamuy/eg21_dss.pdf
[41] http://www.ctio.noirlab.edu/soar/sites/default/files/GOODMAN/Hamuy/eg21_spec.pdf
[42] http://www.ctio.noirlab.edu/soar/sites/default/files/GOODMAN/Hamuy/lrt1788_dss.pdf
[43] http://www.ctio.noirlab.edu/soar/sites/default/files/GOODMAN/Hamuy/lrt1788_spec.pdf
[44] http://www.ctio.noirlab.edu/soar/sites/default/files/GOODMAN/Hamuy/lrt2415_dss.pdf
[45] http://www.ctio.noirlab.edu/soar/sites/default/files/GOODMAN/Hamuy/lrt2415_spec.pdf
[46] http://www.ctio.noirlab.edu/soar/sites/default/files/GOODMAN/Hamuy/hiltner600_dss.pdf
[47] http://www.ctio.noirlab.edu/soar/sites/default/files/GOODMAN/Hamuy/hiltner600_spec.pdf
[48] http://www.ctio.noirlab.edu/soar/sites/default/files/GOODMAN/Hamuy/lrt3218_dss.pdf
[49] http://www.ctio.noirlab.edu/soar/sites/default/files/GOODMAN/Hamuy/lrt3218_spec.pdf
[50] http://www.ctio.noirlab.edu/soar/sites/default/files/GOODMAN/Hamuy/lrt3864_dss.pdf
[51] http://www.ctio.noirlab.edu/soar/sites/default/files/GOODMAN/Hamuy/lrt3864_spec.pdf
[52] http://www.ctio.noirlab.edu/soar/sites/default/files/GOODMAN/Hamuy/lrt4364_dss.pdf
[53] http://www.ctio.noirlab.edu/soar/sites/default/files/GOODMAN/Hamuy/lrt4364_spec.pdf
[54] http://www.ctio.noirlab.edu/soar/sites/default/files/GOODMAN/Hamuy/feige56_dss.pdf
[55] http://www.ctio.noirlab.edu/soar/sites/default/files/GOODMAN/Hamuy/feige56_spec.pdf
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