Observations at OPD

Prof. Jorge Meléndez

Observations at OPD

Coordinates

Longitude : -45° 34' 57"
Latitude : -22° 32' 04"
Altitude : 1864m

Telescopes

- 1,6m : spectroscopy
(backup: characterize spectrograph)

- IAG (60cm): imaging + photometry
(backup: characterize CCD)

- Zeiss (60cm): photometry (+ imaging?)
Characterization of CCD

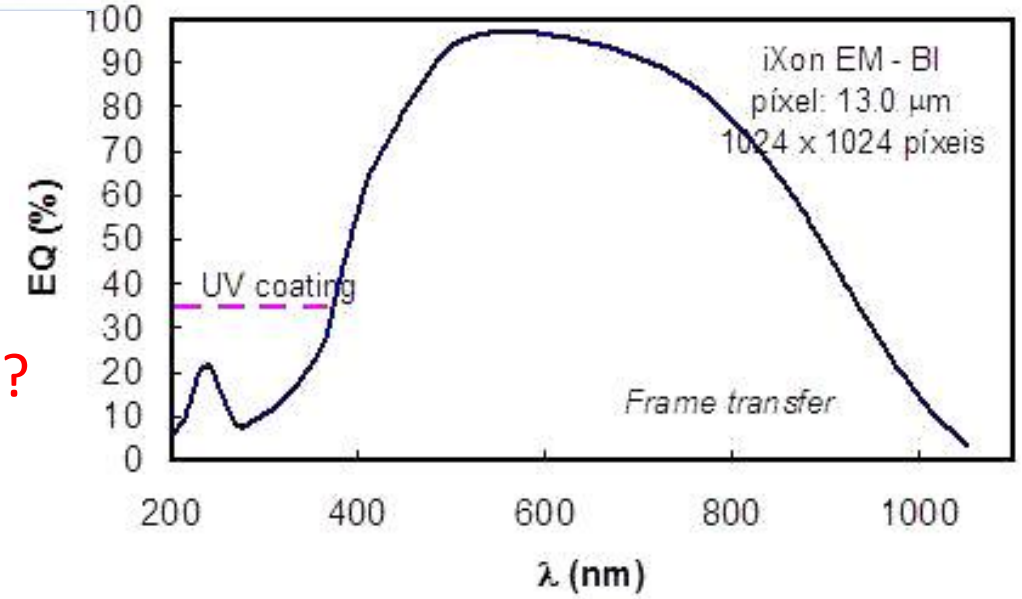
Tel. IAG (60cm) + CCD Ixon?

Field: 10'x10' ? Check the field

TIPO	E2V CCD201-20 Fino, back-illuminated
TAMANHO IMAGEM [pixels]	1024 x 1024
TAMANHO PIXEL [microns]	13,0 x 13,0

Note: Pending confirmation

- Imaging
- Photometry



CAM 4?

Roda de 6 filtros? d=50mm?

Filtros B V R I Hα Hα_{cont}

HAlfa narrow #2

HAlfa cont #2

Tel. Zeiss (60cm) + CCD IkonL

Field?: 12'x12' ? Check the field

TIPO	E2V CCD42-40 Fino, back-illuminated
TAMANHO IMAGEM [pixels]	2048 x 2048
TAMANHO PIXEL [microns]	13,5 x 13,5

Note: Pending confirmation

Photometry (also imaging?)

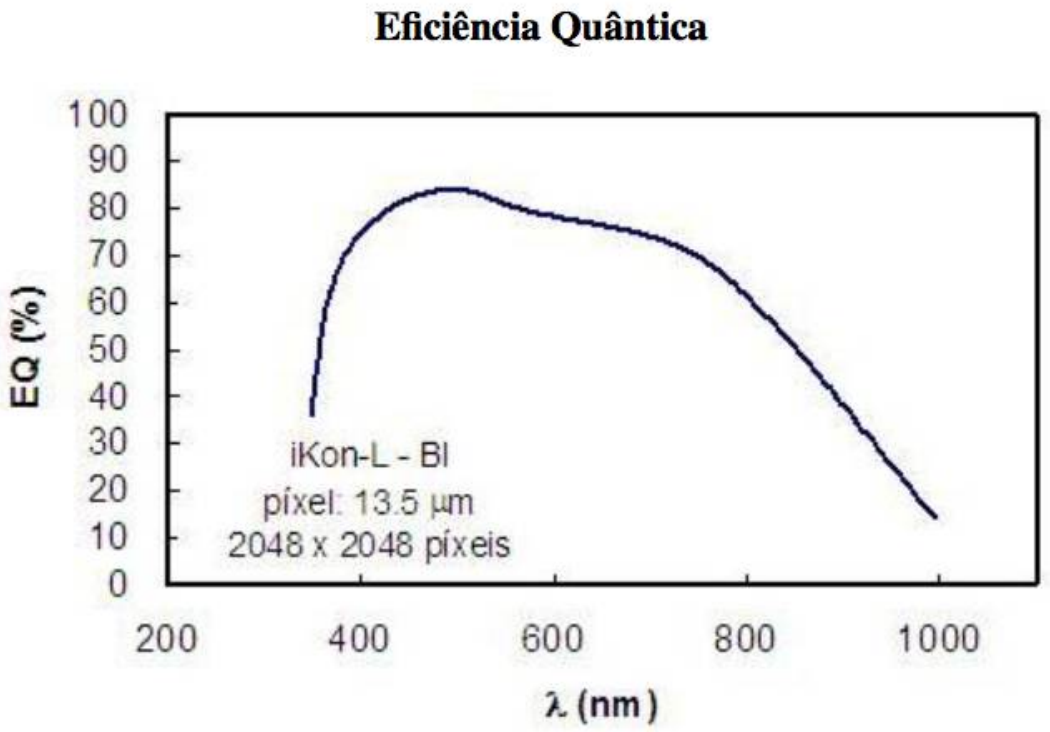
CAM 4

Roda de 6 filtros? d=50mm?

Filtros B V R I Hα $H\alpha_{cont}$

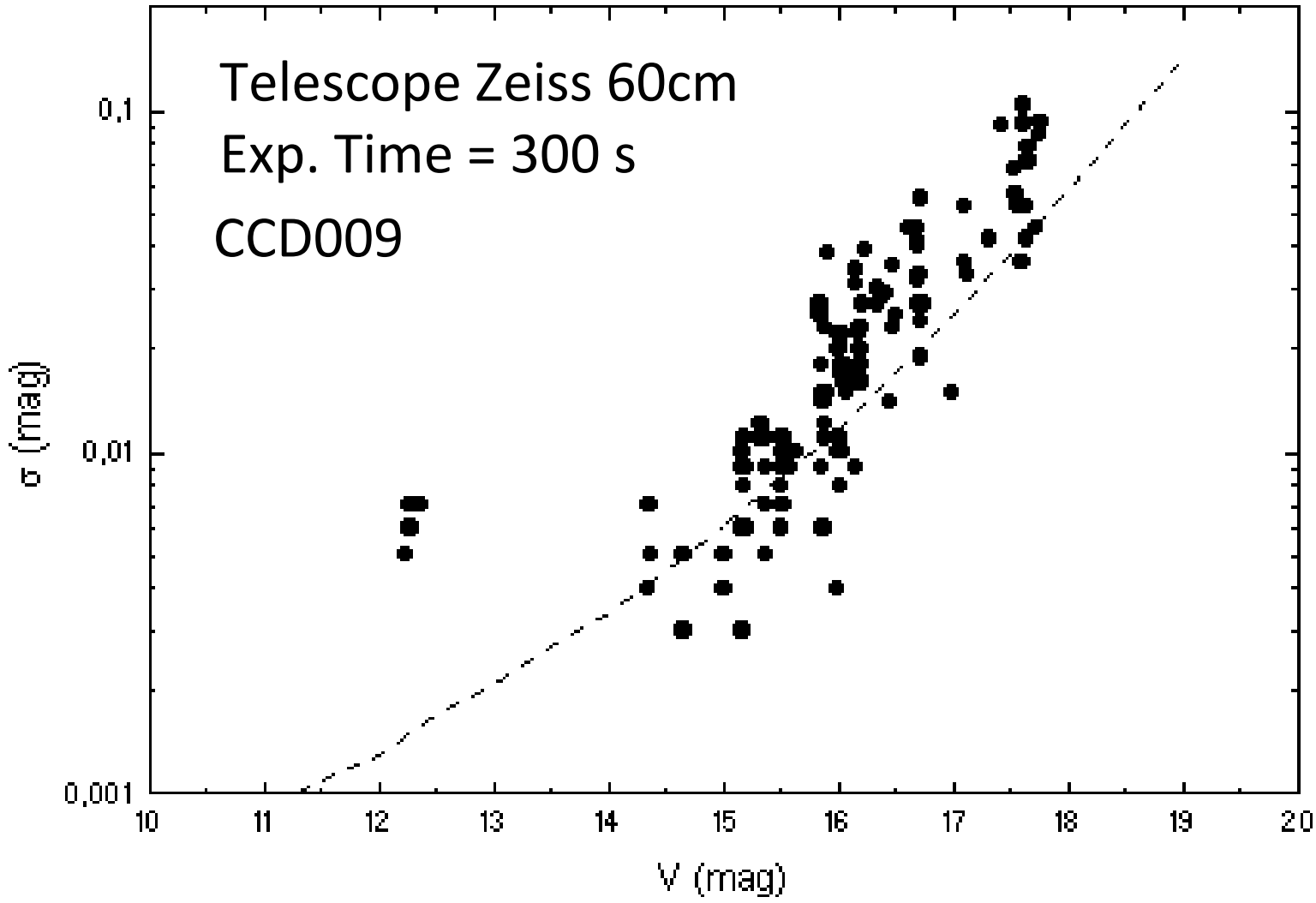
HAlfa narrow #2

HAlfa cont #2

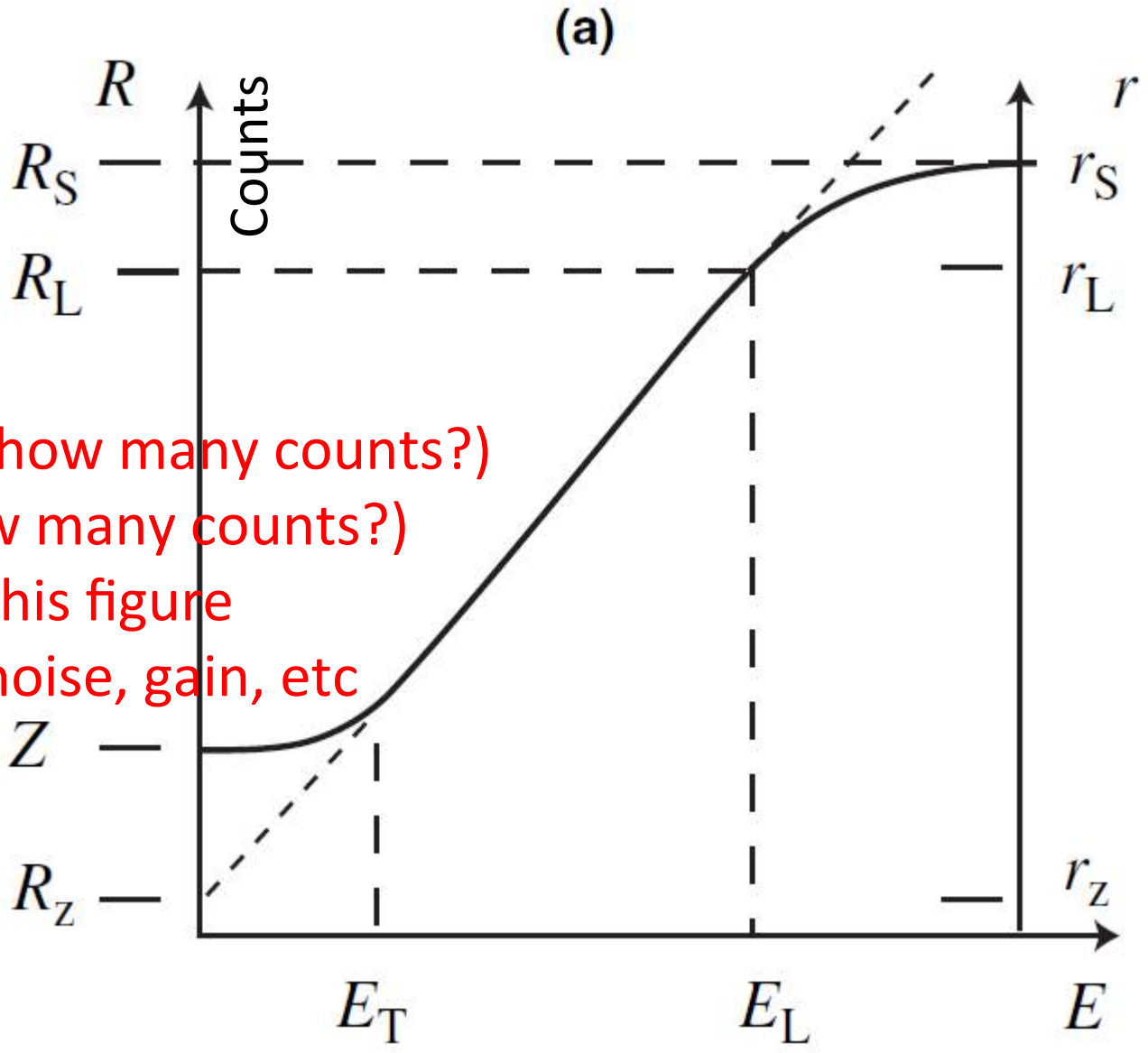


https://www.gov.br/lna/pt-br/composicao-1/coast/obs/opd/instrumentacao/disponibilidade-de-instrumentacao-no-opd

Error in V magnitude for tel. 60cm, 300 s



Zeiss (or IAG): characterization of CCD



Determine:

1)Linearity limit (how many counts?)

2)Saturation (how many counts?)

3)Plot similar to this figure

4) Estimate readnoise, gain, etc

Fig. 9.10 Linearity: (a) A schematic of the output R, in ADU, and the response, r, in electrons, of a single pixel in a detector that is linear over a restricted input range. The sloped

Characterization of the CCD (anytime, day or night)

- Take 7 bias frames at five different temperatures, starting a few degrees below the local temperature and until ~ -80^{o} Celsius. Use different names. For ex.: biasp10c, bias0c, biasm25c, biasm50c, biasm75c
- Take 7 dark frames at the same temperatures. For each temperature use exp. times = 1, 60, 120, 240s
- BIAS: plot average, standard deviation vs. Temperat.
- DARK: first subtract the average bias, then plot of average vs temp. for each exposure time (1s, ... 240s)
- What can you conclude about dark current and CCD temperature?

READNOISE

- Using the 7 bias frames at the coolest temperature, determine the readnoise in ADU.
- Combine the bias frames into a master bias, then subtract each individual bias from the master bias. The standard deviation is the readnoise in ADU.
- Later, once you determine the gain, estimate the readnoise in electrons

Counting cosmic rays (optional, if sky is cloudy)

- Take 2 dark frames of 15 minutes each at the coolest temperature.
- Subtract the two dark frames
- How many cosmic rays detected in the 2 frames?

Repeat for dark exposure times of 5, 10 and 20 min

Plot cosmic ray number vs. time

Linearity and saturation

- At a given filter (for example, B filter) take flat fields of different exposure times, to determine the linearity and saturation levels. Make a plot of counts vs. time

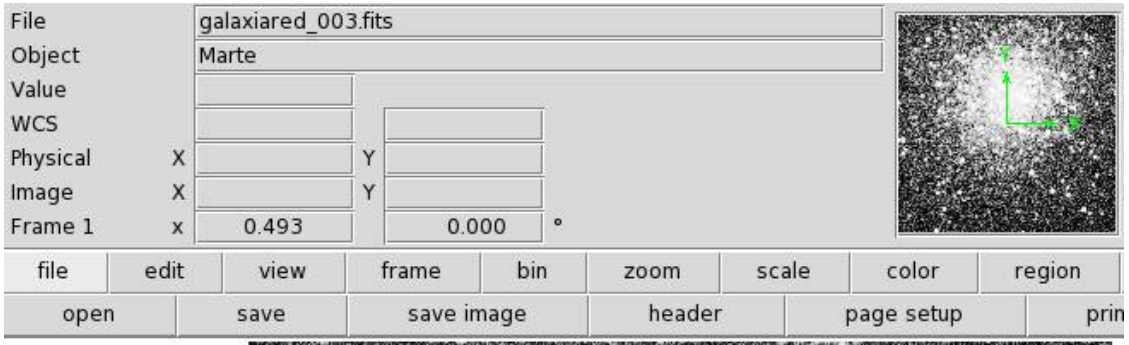
Gain

- 1 count is not necessarily 1 electron. Find the gain of the CCD following any of the procedures described at:
http://spiff.rit.edu/classes/phys445/lectures/gain/gain.html

Additional reading:
http://www.physics.rutgers.edu/~pryor/ph629/lab2.pdf
https://blog.jpuschnig.com/instrumentation/ccd-atik383-linearity-readout-noise-gain/

Second job: make one (1) image in 3 filters and combine the frames to obtain a color image

Example: image taken by IAG/USP undergrads in 2014, using the 60cm telescope



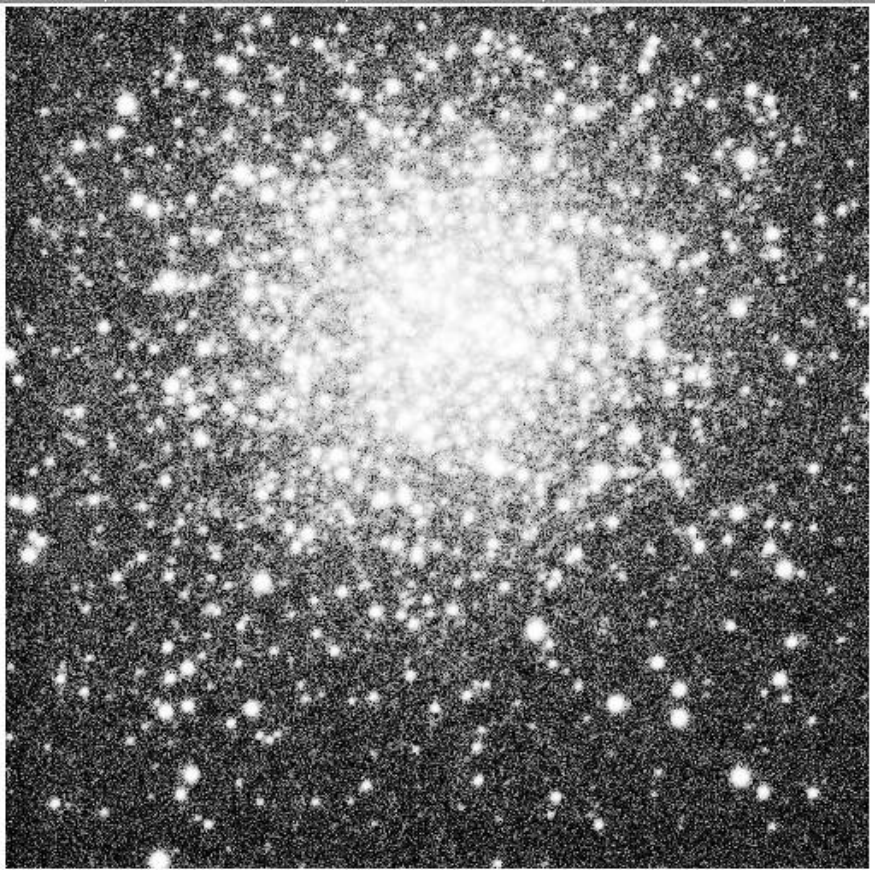


Image must be taken in B, V, R filters, and combined to get a color image

Second job. Make 1 pretty color (BVR) picture

Class 1: Solar system planet or comet

Class 2: Planetary Nebula

Class 3: H II Region

Class 4: Open Cluster

Class 5: Globular Cluster

Class 6: Galaxy (single or interacting)

Class 7: Galaxy Group or Cluster **(≥ 3 galaxies in picture)**

Any class of object can be chosen

Some examples below, feel free to choose others

Class 1: Planet

Mars

Jupiter

Saturn

Class 2: Planetary Nebula

M27 NGC 1535 (Cleopatra's Eye) NGC 6302 (Bug)

Class 3: H II Region

Trifid (M20) Eagle (M16) Omega (M17)

Class 4: Open Cluster

M6 (butterfly) M7 M48

NGC 2547 NGC 3293 NGC 3766 NGC 6633

Jewel Box

Class 5: Globular Cluster

M3 M4 M5 M13 M15 M22

NGC 6397 NGC 6752 Omega Cen 47 Tuc

Class 6: Galaxy

Centaurus A Sombrero M33

Black Eye Galaxy M83 (Southern Pinwheel) NGC 6744

Class 7: Galaxy Group or Cluster

Abell 1656 Abell 2151 Abell 1367

HCG 90 HCG79 (Seyfert's Quintet) HCG61 HCG42

Recommendations

Prepare at least 2 targets in the OPD format. You have to do imaging of only 1, but the other is a backup object. If possible, the 2 targets must have R.A. that differ by at least 2 hours (even better if the difference is 3 or 4 hours). If the weather forecast is not good, perhaps prepare 2 backup objects.

The targets should be observable for at least 2 hours, to have some flexibility in the observation

Part 3: photometry. Differential photometry (1 filter), HR diagram (2 filters) or extinction at OPD (1 or 2 filters).

Could be done alone or in groups of 2

Suggestions for differential photometry: Exoplanet transit, asteroid transiting white dwarf, Nova, Delta Scuti stars or any other short period (< 3 hours) variable, eclipsing binaries

Suggestions for HR diagram: open or globular cluster

Suggestion for atmospheric extinction at OPD: observe at 5 different airmasses in at least in 1 filter

Atmospheric extinction at OPD: could be done observing a star field with stars of different color. If this cannot be done, observe at least 1 bright star in 2 different filters

Group in 2022: atmospheric extinction

V

B

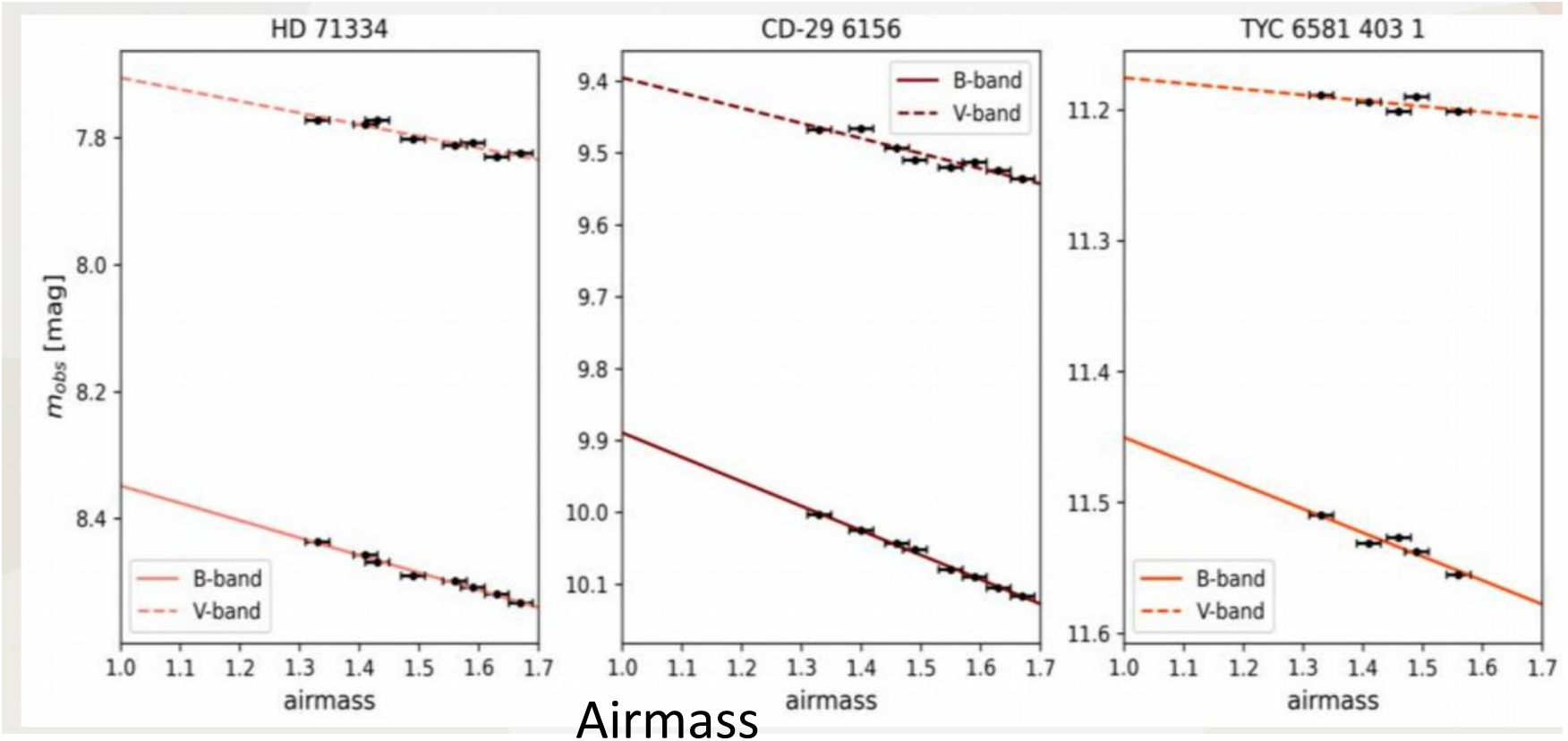


Tabela 2.2 - Parâmetros obtidos no ajuste da Lei de Bouguer dos dados no filtro V.

Estrela	k [mag/airmass]	m_0 [mag]
HD71334	0.18 ±0.03	7.52 ±0.04
CD-29 6156	0.21±0.03	9.18 ±0.04

Airmass = sec z

z : zenital distance

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UBVRI PHOTOMETRIC STANDARD STARS AROUND THE CELE
ADDITIONS

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Some photometric standards for estimating the extinction coefficient. Feel free to select other targets (perhaps V ~ 5 – 13). For V ~ 5, 1 second should be OK. Be careful with saturation

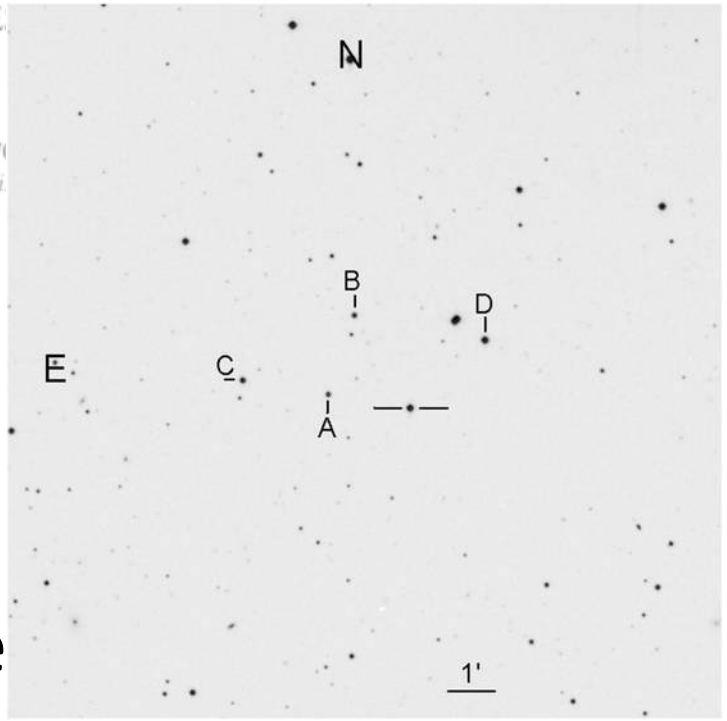

Figure 46. Field, 15′ on a side, of the sequence in the vicinity of the star PG0918+029.

Star	α (J2000.0)	δ (J2000.0)	V	$B-V$	$U-B$	$V-R$	$R-I$	$V-I$
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
PG0918+029D	09 21 21.936	+02 47 28.28	12.272	+1.044	+0.821	+0.575	+0.535	+1.108
PG0918+029	09 21 28.217	+02 46 02.27	13.327	−0.271	−1.081	−0.129	−0.159	−0.288
PG0918+029B	09 21 32.924	+02 47 59.08	13.963	+0.765	+0.366	+0.417	+0.370	+0.787
PG0918+029A	09 21 35.107	+02 46 19.43	14.490	+0.536	−0.032	+0.325	+0.336	+0.661
PG0918+029C	09 21 42.306	+02 46 37.07	13.537	+0.631	+0.087	+0.367	+0.357	+0.722

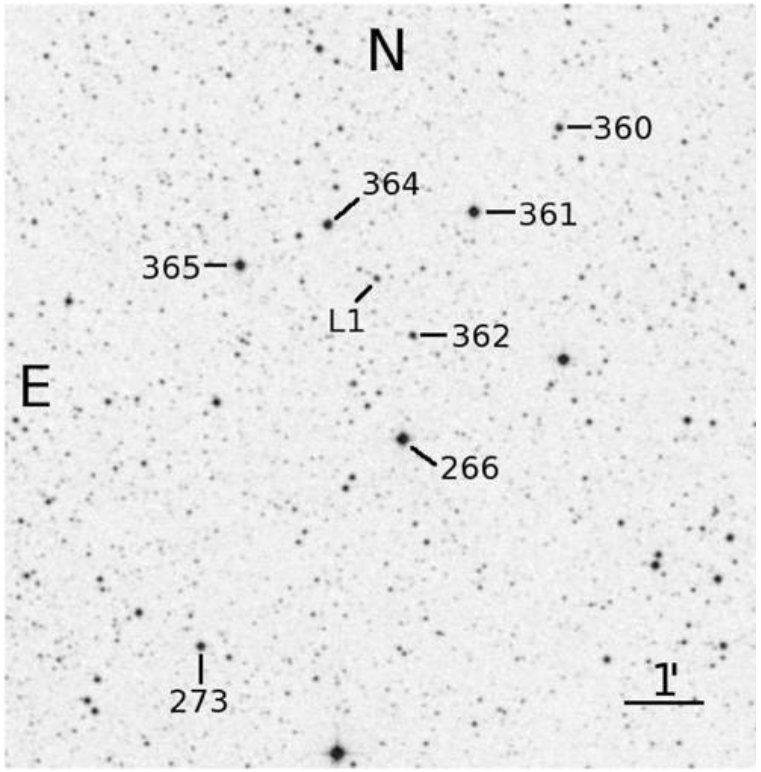

Figure 103. Field, 10′ on a side, of SA 110 SF2.

Star	α (J2000.0)	δ (J2000.0)	V	$B-V$	$U-B$	$V-R$	$R-I$	$V-I$
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
110 360	18 42 40.477	+00 09 10.71	14.618	+1.197	+0.539	+0.715	+0.717	+1.432
110 361	18 42 45.010	+00 08 04.70	12.425	+0.632	+0.035	+0.361	+0.348	+0.709
110 362	18 42 48.277	+00 06 27.77	15.693	+1.333	+3.919	+0.918	+0.885	+1.803
110 266	18 42 48.798	+00 05 06.44	12.018	+0.889	+0.411	+0.538	+0.577	+1.111
110 L1	18 42 50.187	+00 07 12.76	16.252	+1.752	+2.953	+1.066	+0.992	+2.058
110 364	18 42 52.785	+00 07 54.89	13.615	+1.133	+1.095	+0.697	+0.585	+1.281
110 157	18 42 56.472	−00 08 58.45	13.491	+2.123	+1.679	+1.257	+1.139	+2.395
110 365	18 42 57.444	+00 07 23.12	13.470	+2.261	+1.895	+1.360	+1.270	+2.631
110 496	18 42 59.294	+00 31 09.13	13.004	+1.040	+0.737	+0.607	+0.681	+1.287
110 273	18 42 59.542	+00 02 23.92	14.686	+2.527	+1.000	+1.509	+1.345	+2.856

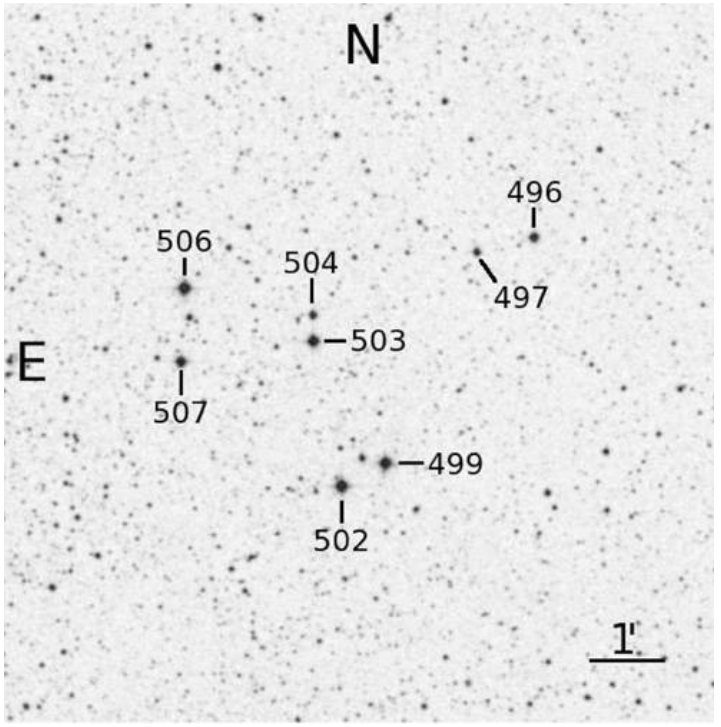

Figure 104. Field, 10′ on a side, of SA 110 SF3.

Star (1)	α (J2000.0) (2)	δ (J2000.0) (3)	V (4)	$B-V$ (5)	$U-B$ (6)	$V-R$ (7)	$R-I$ (8)	$V-I$ (9)
110 496	18 42 59.294	+00 31 09.13	13.004	+1.040	+0.737	+0.607	+0.681	+1.287
110 273	18 42 59.542	+00 02 23.92	14.686	+2.527	+1.000	+1.509	+1.345	+2.856
110 497	18 43 02.506	+00 30 56.79	14.196	+1.052	+0.380	+0.606	+0.597	+1.203
110 280	18 43 06.960	−00 03 41.52	12.996	+2.151	+2.133	+1.235	+1.148	+2.384
110 499	18 43 07.663	+00 28 01.47	11.737	+0.987	+0.639	+0.600	+0.674	+1.273
110 502	18 43 10.111	+00 27 42.37	12.330	+2.326	+2.326	+1.373	+1.250	+2.625
110 503	18 43 11.696	+00 29 42.95	11.773	+0.671	+0.506	+0.373	+0.436	+0.808
110 504	18 43 11.712	+00 30 04.57	14.022	+1.248	+1.323	+0.797	+0.683	+1.482
110 506	18 43 18.927	+00 30 27.14	11.312	+0.568	+0.059	+0.335	+0.312	+0.652
110 507	18 43 19.126	+00 29 26.00	12.440	+1.141	+0.830	+0.633	+0.579	+1.206

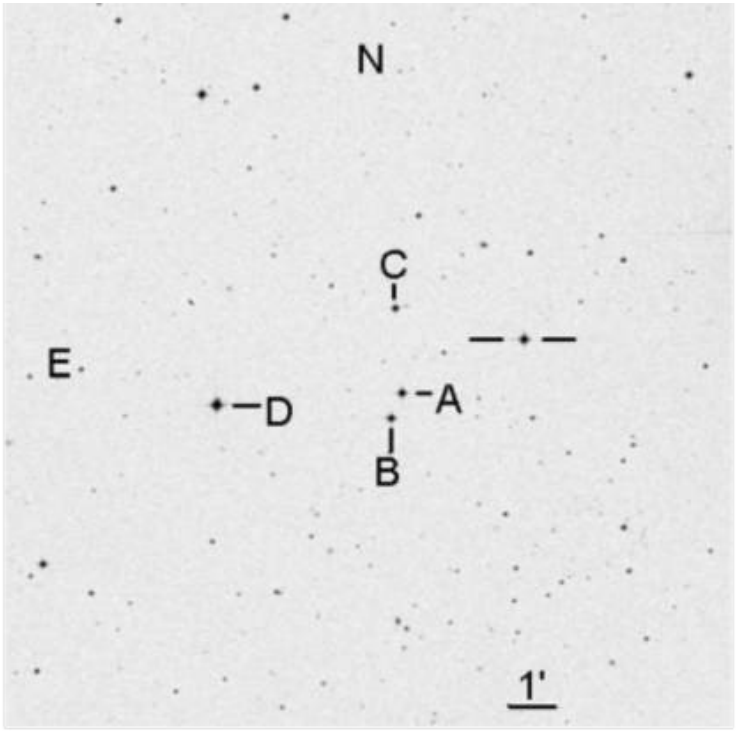

Figure 75. Field, 15′ on a side, of the sequence in the vicinity of the star PG1323−086.

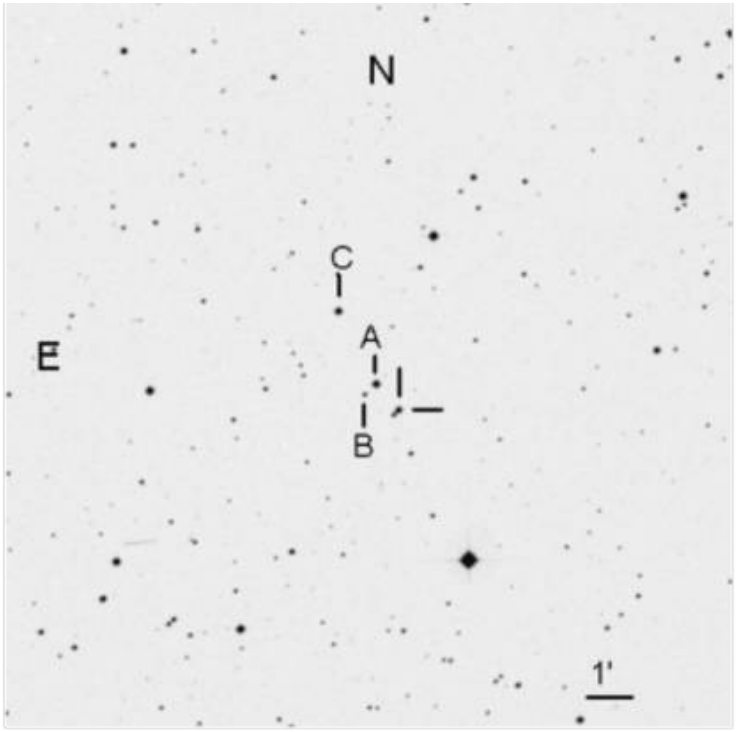

Figure 77. Field, 15′ on a side, of the sequence in the vicinity of the star PG1525−071.

Star	α (J2000.0)	δ (J2000.0)	V	$B-V$	$U-B$	$V-R$	$R-I$	$V-I$
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
PG1323−086	13 25 39.468	−08 49 19.12	13.481	−0.140	−0.681	−0.048	−0.078	−0.127
PG1323−086A	13 25 49.722	−08 50 23.53	13.591	+0.393	−0.019	+0.252	+0.252	+0.506
PG1323−086C	13 25 50.222	−08 48 38.94	14.003	+0.707	+0.245	+0.395	+0.363	+0.759
PG1323−086B	13 25 50.651	−08 50 55.10	13.406	+0.761	+0.265	+0.426	+0.407	+0.833
PG1323−086D	13 26 05.252	−08 50 36.19	12.080	+0.587	+0.005	+0.346	+0.335	+0.684
PG1525−071	15 28 11.57	−07 16 32.7	15.046	−0.211	−1.177	−0.068	+0.012	−0.151
PG1525−071D	15 28 12.00	−07 16 39.1	16.300	+0.393	+0.224	+0.405	+0.343	+0.756
PG1525−071A	15 28 13.416	−07 16 01.03	13.506	+0.773	+0.282	+0.437	+0.421	+0.862
PG1525−071B	15 28 14.39	−07 16 13.2	16.392	+0.729	+0.141	+0.450	+0.387	+0.906
PG1525−071C	15 28 16.502	−07 14 30.36	13.519	+1.116	+1.073	+0.593	+0.509	+1.096

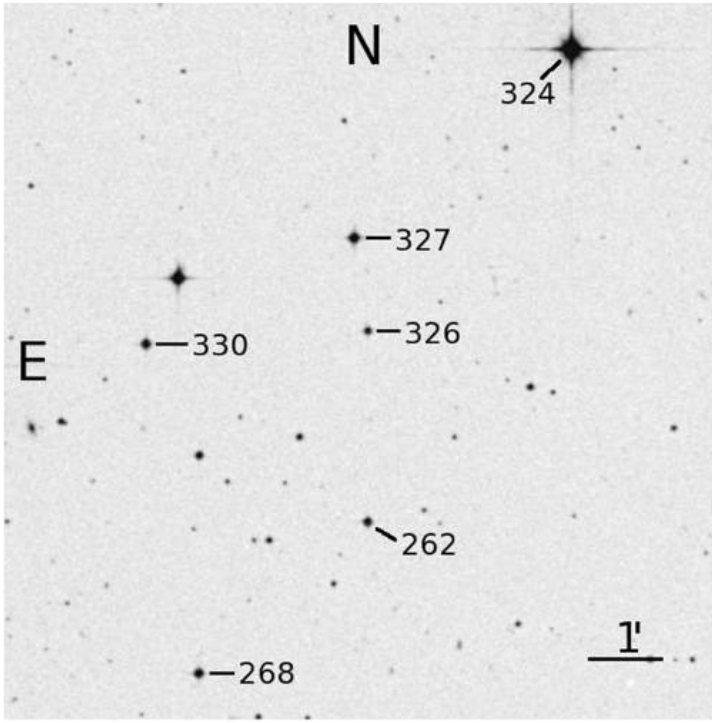

Figure 52. Field, 10′ on a side, of SA 101 SF2.

Star (1)	α (J2000.0) (2)	δ (J2000.0) (3)	V (4)	$B-V$ (5)	$U-B$ (6)	$V-R$ (7)	$R-I$ (8)	$V-I$ (9)
101 324	09 55 56.650	−00 23 15.10	9.737	+1.161	+1.145	+0.591	+0.519	+1.109
101 408	09 56 08.001	−00 12 41.28	14.785	+1.200	+1.347	+0.718	+0.603	+1.321
101 262	09 56 08.096	−00 29 50.50	14.295	+0.784	+0.297	+0.440	+0.387	+0.827
101 326	09 56 08.101	−00 27 10.94	14.923	+0.729	+0.227	+0.406	+0.375	+0.780
101 327	09 56 08.86	−00 25 53.5	13.441	+1.155	+1.139	+0.717	+0.574	+1.290
101 410	09 56 09.136	−00 14 02.23	13.646	+0.546	−0.063	+0.298	+0.326	+0.623
101 413	09 56 14.009	−00 11 54.86	12.583	+0.983	+0.716	+0.529	+0.497	+1.025
101 268	09 56 17.377	−00 31 57.05	14.380	+1.531	+1.381	+1.040	+1.200	+2.237
101 330	09 56 20.587	−00 27 22.12	13.723	+0.577	−0.026	+0.346	+0.338	+0.684

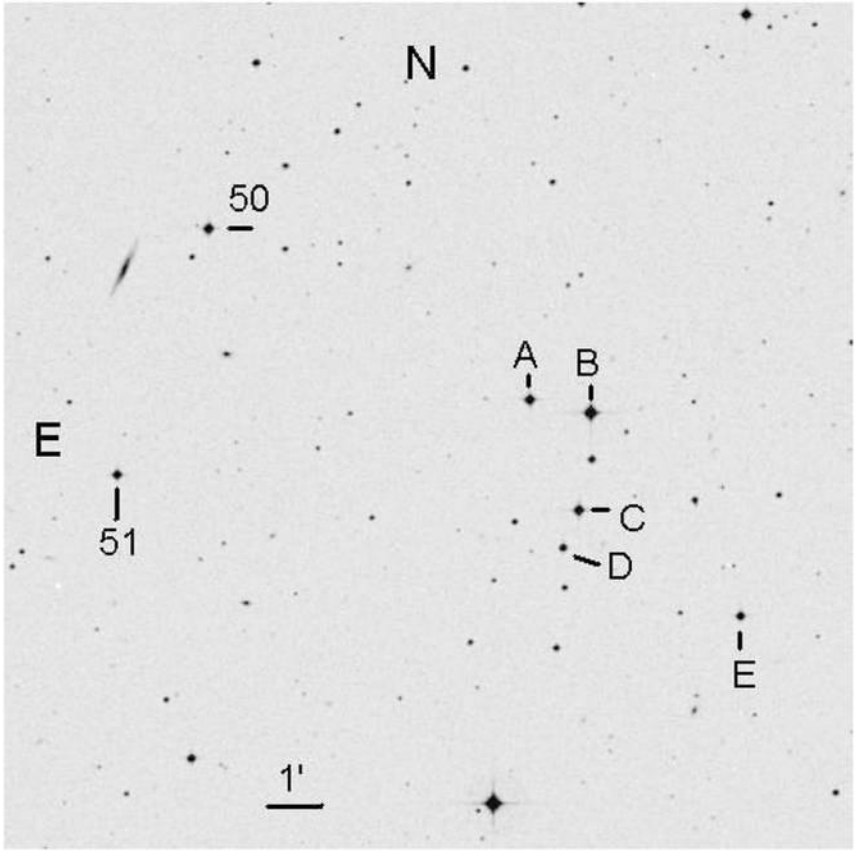

Figure 61. Field, 15′ on a side, of the sequence in the vicinity of the stars G 163-50 and G 163-51.

Star	α (J2000.0)	δ (J2000.0)	V	$B-V$	$U-B$	$V-R$	$R-I$	$V-I$
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
G163 51E	11 07 22.332	−05 16 13.86	14.466	+0.611	+0.095	+0.381	+0.344	+0.725
G163 51B	11 07 32.846	−05 12 37.29	11.292	+0.623	+0.119	+0.355	+0.336	+0.692
G163 51C	11 07 33.782	−05 14 20.26	12.672	+0.431	−0.009	+0.267	+0.272	+0.540
G163 51D	11 07 34.915	−05 15 00.50	13.862	+0.844	+0.202	+0.478	+0.466	+0.945
G163 51A	11 07 37.196	−05 12 23.31	12.504	+0.666	+0.060	+0.382	+0.371	+0.753
G163 50	11 07 59.950	−05 09 26.10	13.057	+0.036	−0.696	−0.084	−0.072	−0.158
G163 51	11 08 06.539	−05 13 47.19	12.559	+1.499	+1.195	+1.080	+1.355	+2.434

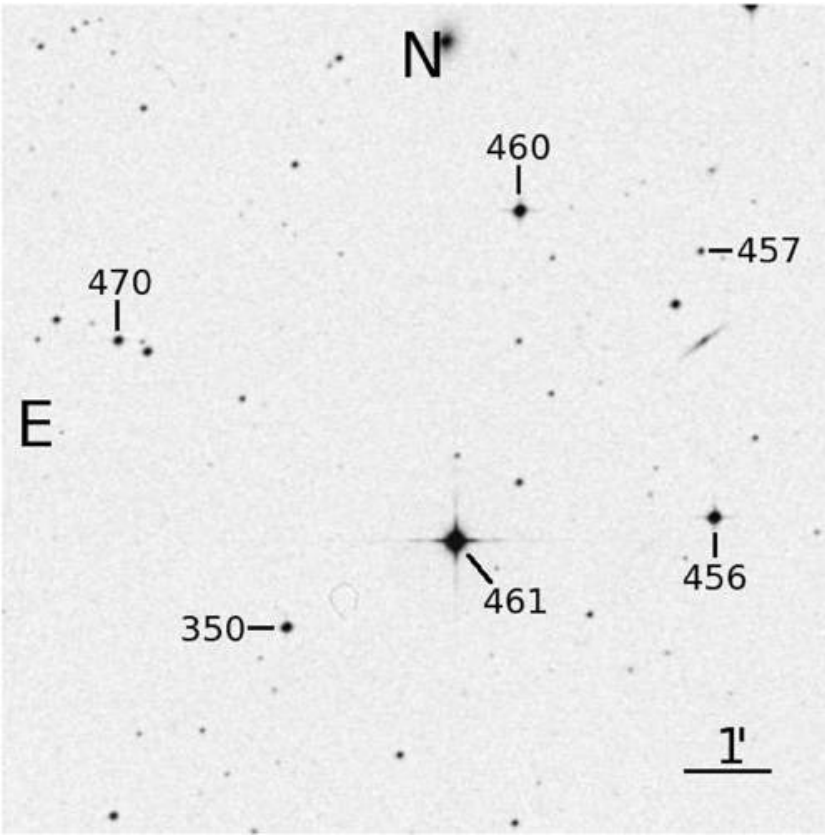

Figure 73. Field, 10′ on a side, of SA 104 SF1.

Star	α (J2000.0)	δ (J2000.0)	V	$B-V$	$U-B$	$V-R$	$R-I$	$V-I$
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
104 456	12 42 53.505	−00 32 00.91	12.362	+0.622	+0.135	+0.357	+0.337	+0.694
104 457	12 42 54.195	−00 28 48.68	16.048	+0.753	+0.522	+0.484	+0.490	+0.974
104 460	12 43 02.86	−00 28 19.0	12.895	+1.281	+1.246	+0.813	+0.695	+1.511
104 461	12 43 06.031	−00 32 18.01	9.705	+0.476	−0.035	+0.288	+0.289	+0.579
104 350	12 43 14.204	−00 33 20.54	13.634	+0.673	+0.165	+0.383	+0.353	+0.736
104 470	12 43 22.314	−00 29 52.83	14.310	+0.732	+0.101	+0.295	+0.356	+0.649

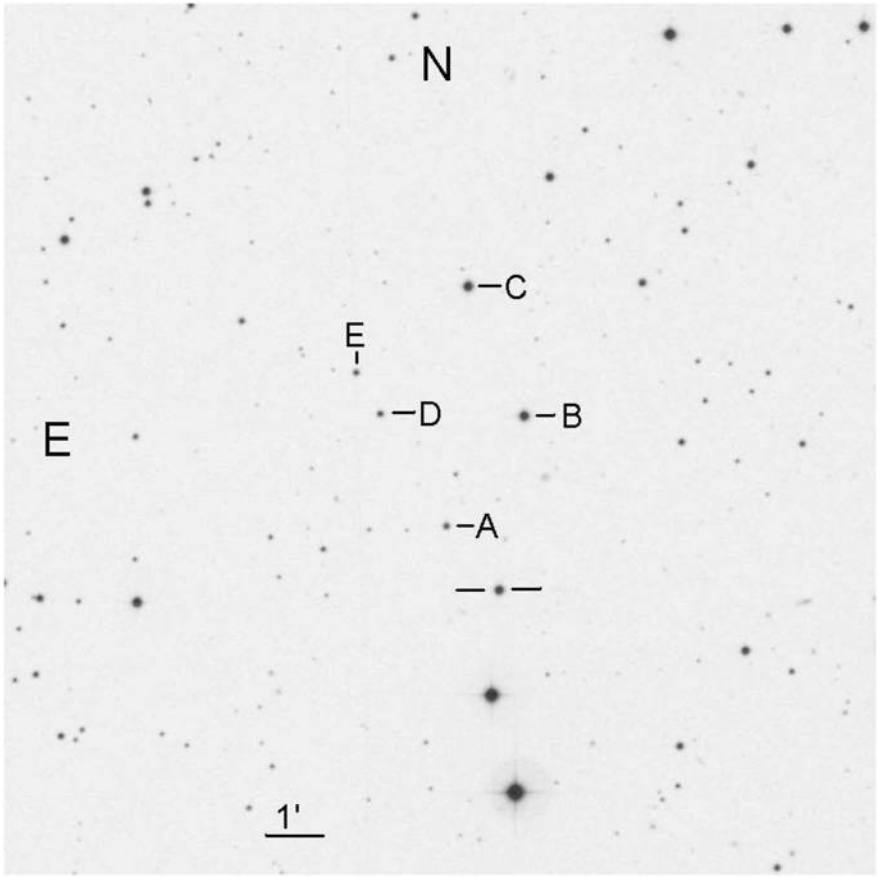

Figure 76. Field, 15′ on a side, of the sequence in the vicinity of the star PG1407−013.

Star	α (J2000.0)	δ (J2000.0)	V	$B-V$	$U-B$	$V-R$	$R-I$	$V-I$
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
PG1407−013B	14 10 24.181	−01 27 16.52	12.471	+0.970	+0.665	+0.537	+0.505	+1.037
PG1407−013	14 10 25.915	−01 30 16.61	13.758	−0.259	−1.133	−0.119	−0.151	−0.272
PG1407−013C	14 10 28.013	−01 25 03.05	12.462	+0.805	+0.298	+0.464	+0.448	+0.914
PG1407−013A	14 10 29.547	−01 29 10.18	14.661	+1.151	+1.049	+0.617	+0.569	+1.178
PG1407−013D	14 10 34.083	−01 27 14.00	14.872	+0.891	+0.420	+0.496	+0.472	+0.967
PG1407−013E	14 10 35.721	−01 26 31.42	15.182	+0.883	+0.600	+0.496	+0.417	+0.915

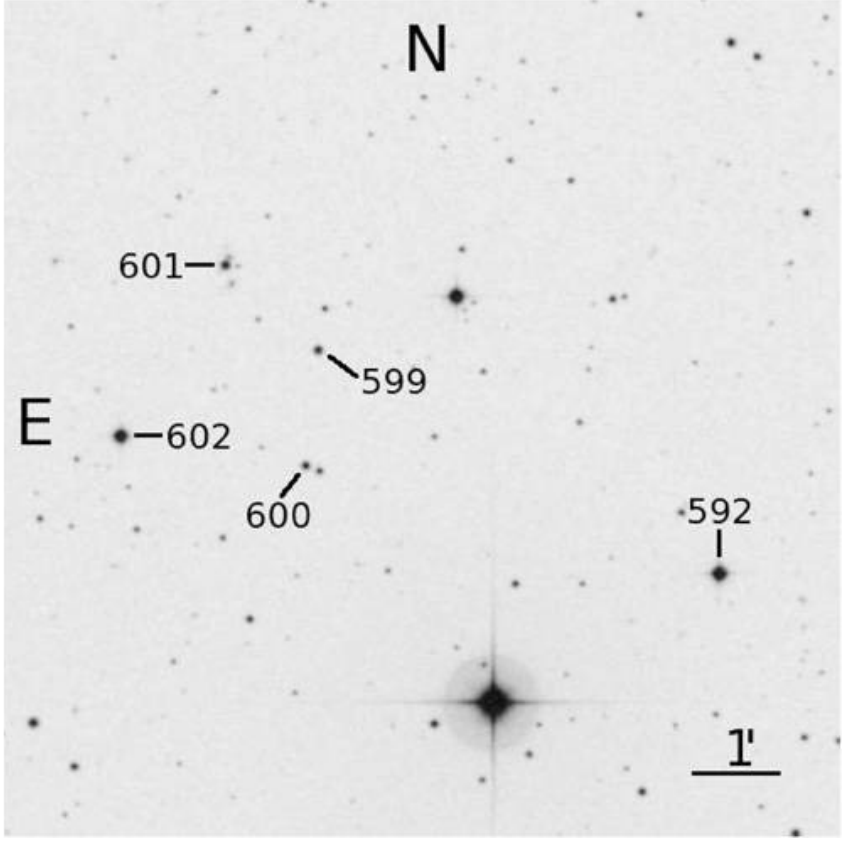

Figure 86. Field, 10′ on a side, of SA 107 SF2.

Star (1)	α (J2000.0) (2)	δ (J2000.0) (3)	V (4)	$B-V$ (5)	$U-B$ (6)	$V-R$ (7)	$R-I$ (8)	$V-I$ (9)
107 592	15 38 50.382	−00 17 09.17	11.847	+1.318	+1.380	+0.709	+0.647	+1.357
107 599	15 39 09.457	−00 14 28.74	14.675	+0.698	+0.243	+0.433	+0.438	+0.869
107 600	15 39 10.065	−00 15 51.15	14.884	+0.503	+0.049	+0.339	+0.361	+0.700
107 601	15 39 13.88	−00 13 28.0	14.646	+1.412	+1.265	+0.923	+0.835	+1.761
107 602	15 39 18.878	−00 15 29.94	12.116	+0.991	+0.585	+0.545	+0.531	+1.074

UBVRI PHOTOMETRIC STANDARD STARS AROUND THE SKY AT −50° DECLINATION

ARLO U. LANDOLT[1]

STAR (1)	α (J2000.0) (2)	δ (J2000.0) (3)	V (4)	$B-V$ (5)	$U-B$ (6)	$V-R$ (7)	$R-I$ (8)	$V-I$ (9)	n (10)
JL 163B	00 10 24.88	−50 13 55.6	15.554	+1.077	+1.053	+0.665	+0.560	+1.226	24
JL 163A	00 10 26.309	−50 15 03.52	12.927	+0.524	−0.058	+0.317	+0.315	+0.632	21
JL 163	00 10 33.221	−50 15 24.37	12.963	−0.240	−1.006	−0.122	−0.158	−0.278	20
JL 163C	00 10 38.238	−50 15 26.39	14.391	+0.828	+0.369	+0.458	+0.433	+0.892	21
JL 163D	00 10 41.62	−50 13 45.6	14.300	+0.896	+0.695	+0.520	+0.444	+0.967	21
JL 163E	00 10 58.017	−50 14 17.44	13.544	+0.699	+0.218	+0.389	+0.362	+0.752	18
JL 163F	00 11 00.225	−50 12 53.81	12.638	+0.808	+0.361	+0.448	+0.430	+0.881	18

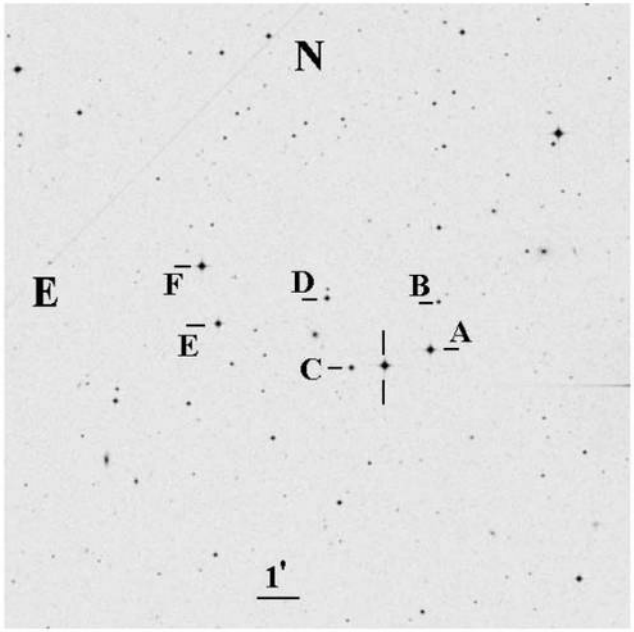

FIG. 13.—Field, 15′ on a side, of the sequence in the vicinity of the star JL 163.

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UBVRI PHOTOMETRIC STANDARD STARS AROUND THE SKY AT −50° DECLINATION

ARLO U. LANDOLT[1]

STAR (1)	α (J2000.0) (2)	δ (J2000.0) (3)	V (4)	$B-V$ (5)	$U-B$ (6)	$V-R$ (7)	$R-I$ (8)	$V-I$ (9)	n (10)
MCT 0401−4017E.....	04 02 28.087	−40 09 35.57	10.636	+0.527	+0.040	+0.307	+0.299	+0.606	20
MCT 0401−4017F	04 02 29.559	−40 10 21.19	12.990	+0.790	+0.380	+0.441	+0.400	+0.841	20
MCT 0401−4017D.....	04 02 55.219	−40 15 52.60	11.947	+0.549	+0.045	+0.319	+0.304	+0.623	20
MCT 0401−4017	04 03 04.540	−40 09 41.05	14.418	−0.272	−1.180	−0.141	−0.156	−0.291	21
MCT 0401−4017A.....	04 03 05.195	−40 11 02.88	10.709	+0.562	+0.001	+0.328	+0.321	+0.649	21
MCT 0401−4017B.....	04 03 29.846	−40 10 58.46	12.654	+0.506	−0.092	+0.315	+0.319	+0.633	20
MCT 0401−4017C.....	04 03 34.273	−40 07 02.53	12.395	+0.906	+0.589	+0.551	+0.524	+1.075	21

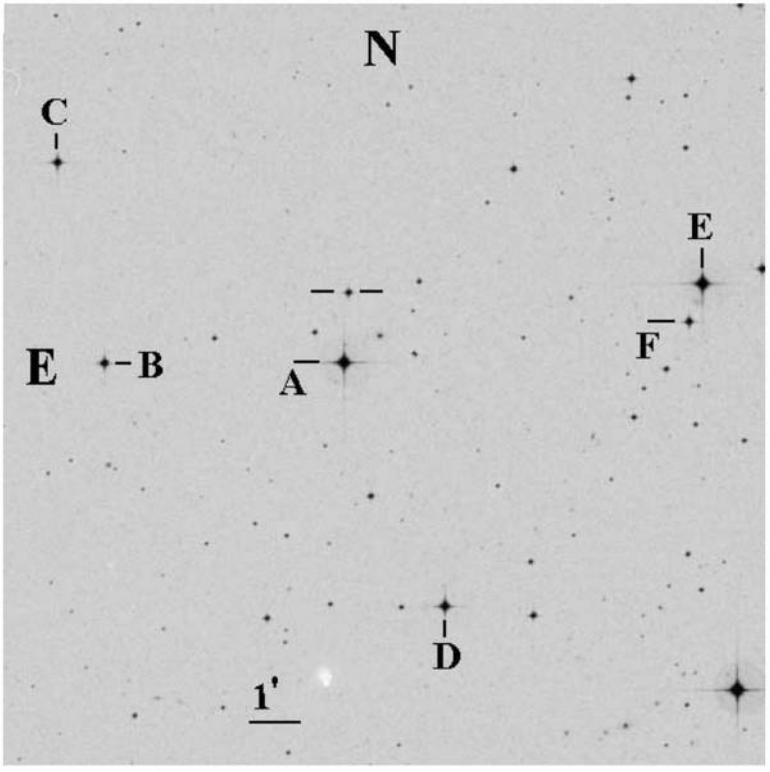

FIG. 15.—Field, 15′ on a side, of the sequence in the vicinity of the star MCT 0401−4017.

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UBVRI PHOTOMETRIC STANDARD STARS AROUND THE SKY AT −50° DECLINATION

ARLO U. LANDOLT[1]

STAR (1)	α (J2000.0) (2)	δ (J2000.0) (3)	*V* (4)	*B* − *V* (5)	*U* − *B* (6)	*V* − *R* (7)	*R* − *I* (8)	*V* − *I* (9)	*n* (10)
LSE 259C	16 53 30.037	−56 00 54.62	10.866	+1.025	+0.700	+0.561	+0.525	+1.087	15
LSE 259D	16 53 41.607	−55 59 08.96	11.719	+0.331	+0.183	+0.191	+0.209	+0.400	15
LSE 259E	16 53 43.240	−55 58 30.06	11.922	+0.613	+0.118	+0.362	+0.362	+0.725	17
LSE 259B	16 53 44.377	−56 01 32.85	13.596	+0.888	+0.468	+0.506	+0.482	+0.991	18
LSE 259H	16 53 48.077	−56 00 42.24	14.164	+1.317	+1.272	+0.699	+0.614	+1.314	15
LSE 259A	16 53 53.147	−56 02 02.58	13.545	+1.692	+1.980	+0.993	+1.013	+2.006	19
LSE 259	16 53 54.573	−56 01 54.76	12.551	−0.127	−1.123	−0.019	−0.026	−0.046	22
LSE 259F	16 53 55.538	−55 59 26.16	13.580	+0.615	+0.052	+0.374	+0.375	+0.749	17

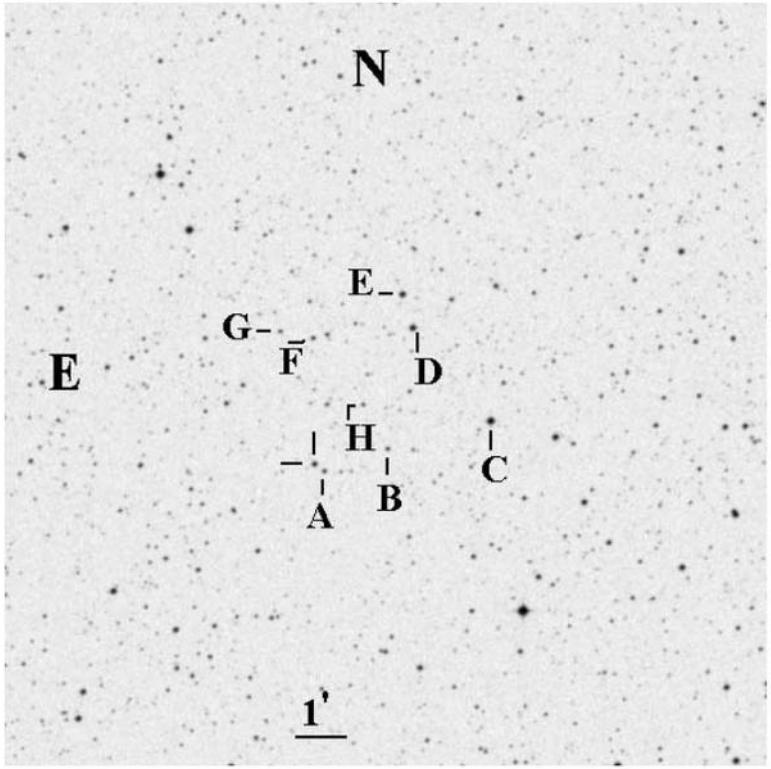

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FIG. 24.—Field, 15′ on a side, of the sequence in the vicinity of the star LSE 259.

Star (1)	α (J2000.0) (2)	δ (J2000.0) (3)	V (4)	$B-V$ (5)	$U-B$ (6)	$V-R$ (7)	$R-I$ (8)	$V-I$ (9)	n (10)
MCT 2019−4339E	20 22 38.910	−43 31 17.07	13.693	+1.029	+0.788	+0.566	+0.530	+1.096	28
MCT 2019−4339D	20 22 40.476	−43 27 26.39	13.205	+0.924	+0.748	+0.518	+0.434	+0.953	19
MCT 2019−4339A	20 22 45.332	−43 29 43.33	13.055	+0.521	−0.011	+0.307	+0.295	+0.602	20
MCT 2019−4339B	20 22 46.726	−43 28 10.88	13.923	+0.671	+0.208	+0.369	+0.347	+0.716	19
MCT 2019−4339	20 22 49.056	−43 30 11.53	13.685	−0.288	−1.212	−0.115	−0.149	−0.261	24
MCT 2019−4339C	20 23 02.134	−43 28 22.40	12.440	+0.939	+0.726	+0.547	+0.466	+1.011	20
MCT 2019−4339F	20 23 03.99	−43 31 21.9	13.936	+0.647	+0.097	+0.369	+0.360	+0.729	20
JL 82C	21 35 45.005	−72 50 12.76	13.440	+0.612	+0.041	+0.357	+0.358	+0.715	19
JL 82B	21 35 59.34	−72 50 15.1	13.507	+0.705	+0.121	+0.411	+0.414	+0.825	19
JL 82	21 36 01.289	−72 48 27.21	12.389	−0.208	−0.947	−0.098	−0.115	−0.211	21
JL 82D	21 36 15.362	−72 45 27.21	12.371	+1.062	+0.865	+0.551	+0.509	+1.061	19
JL 82A	21 36 17.052	−72 50 08.57	11.226	+1.050	+0.803	+0.543	+0.503	+1.048	21

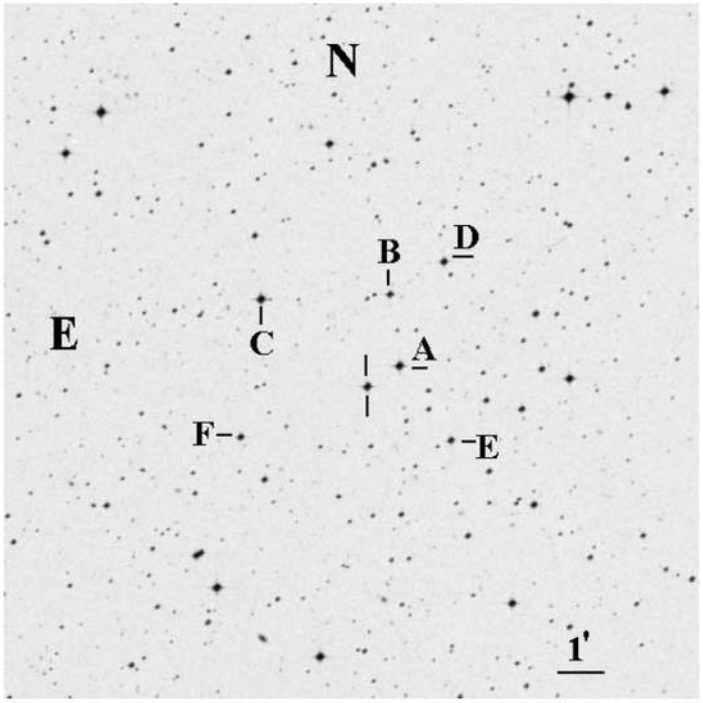


Fig. 25.—Field, 15′ on a side, of the sequence in the vicinity of the star MCT 2019−4339.

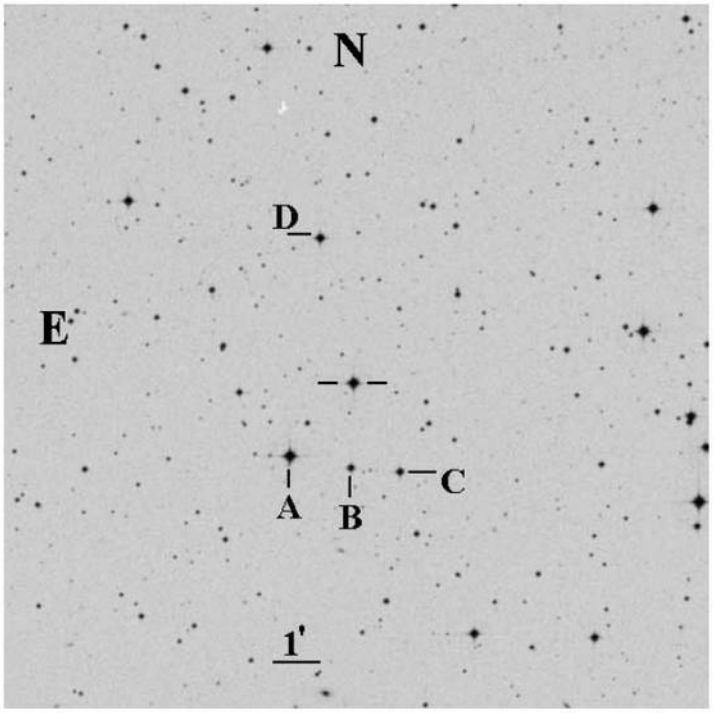
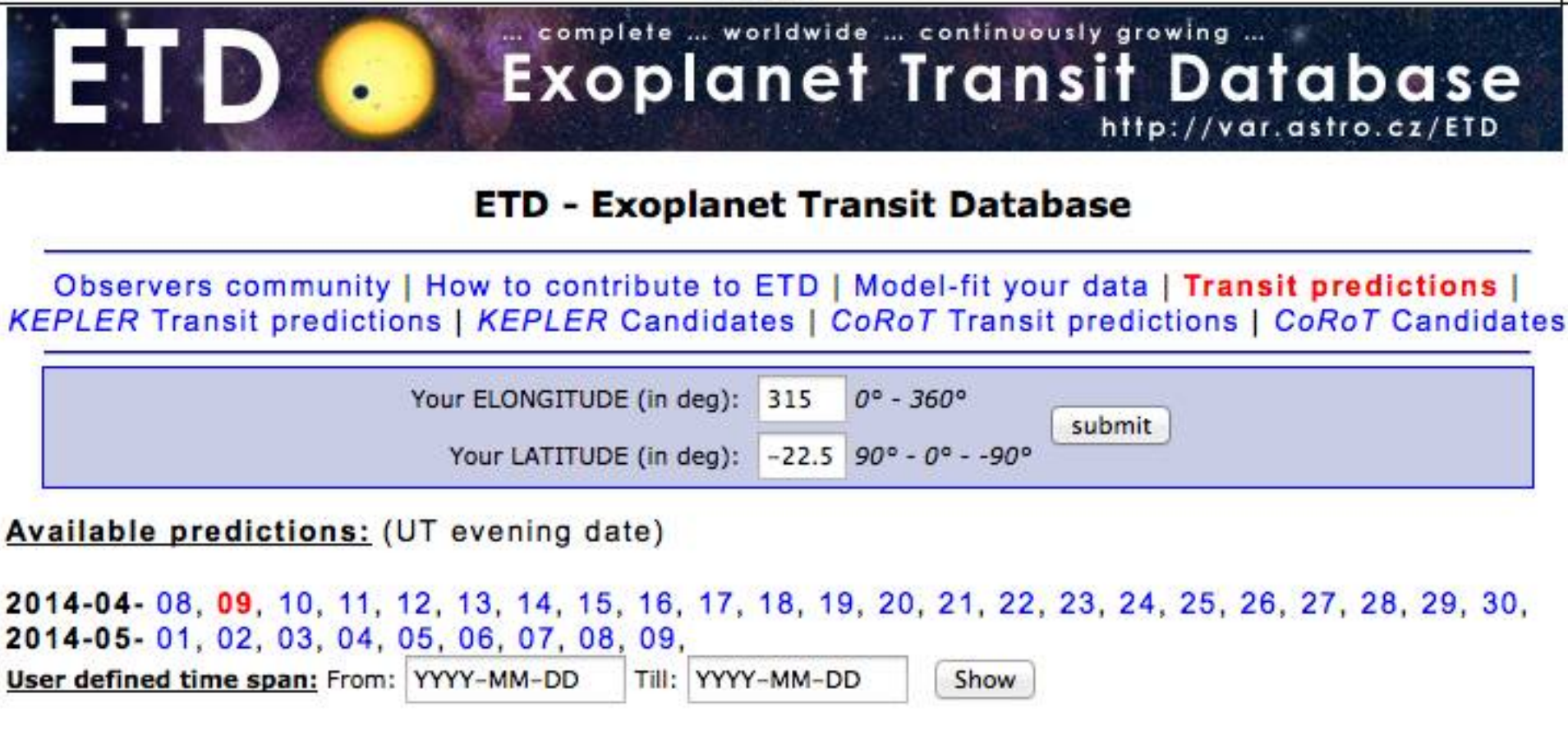


Fig. 26.—Field, 15′ on a side, of the sequence in the vicinity of the star JL 82

Exoplanet transits

- Forecast for transits:
- http://var2.astro.cz/ETD/index.php

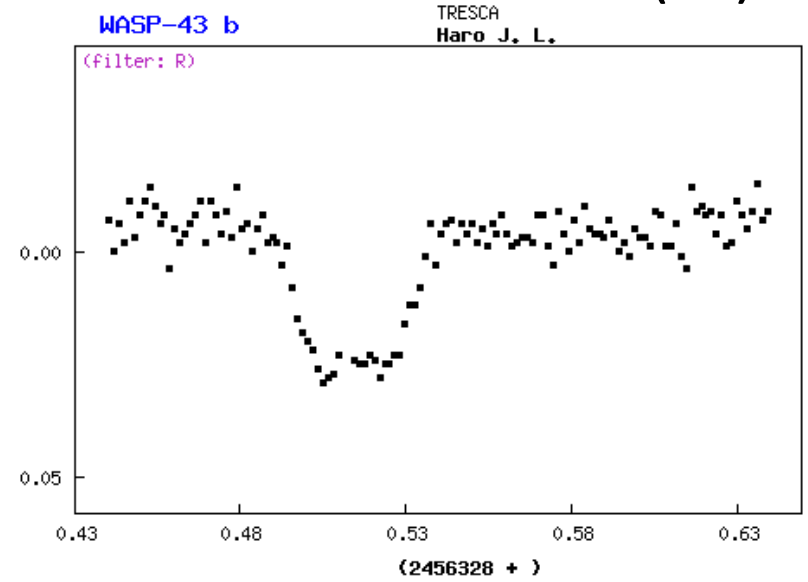


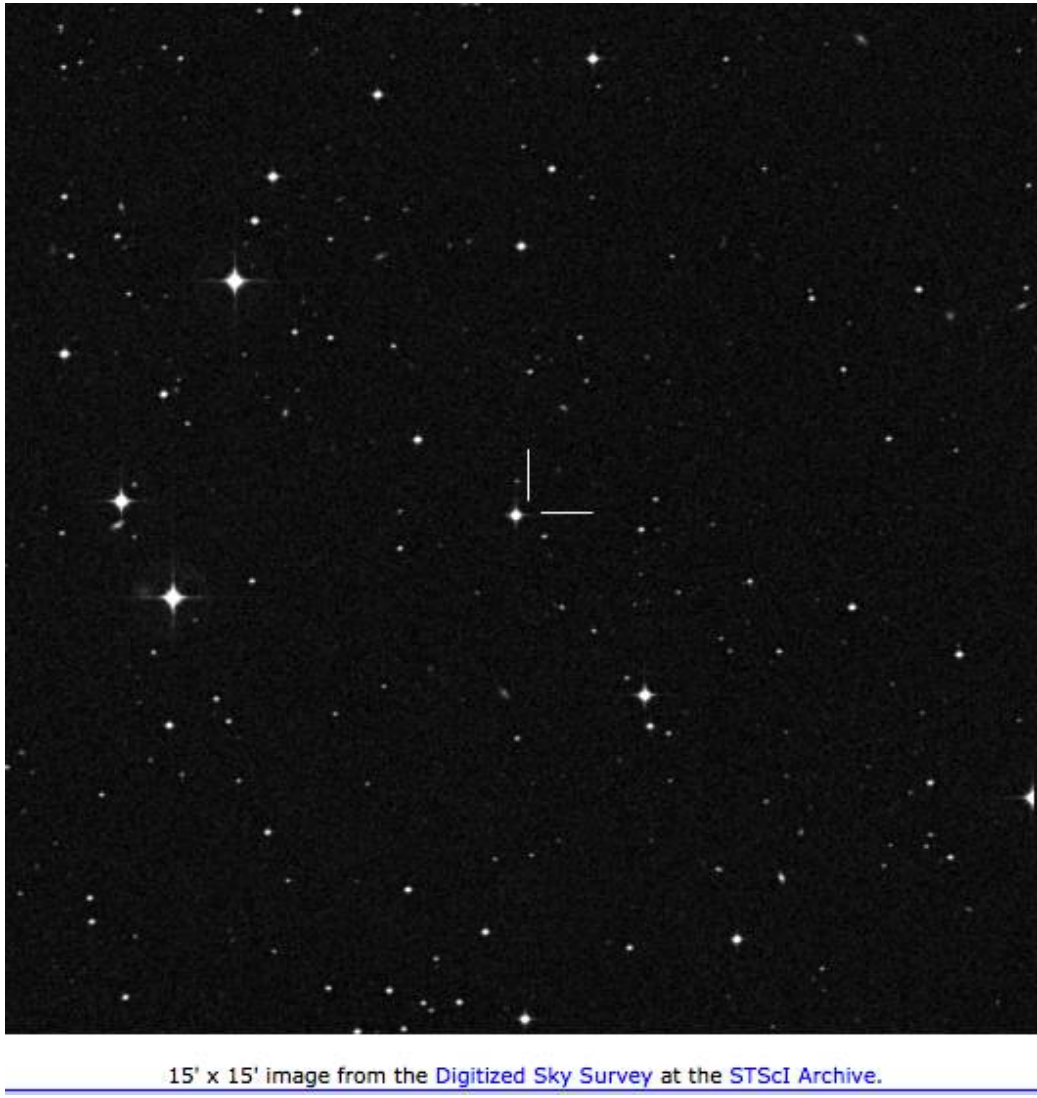
WASP-43

RA (J2000): **10 19 38.01**, DE (J2000): **-09 48 21.9**,
V = **12.4 mag**, dV = **0.029 mag**, duration = **69.5 min**

P = 0.813475d,

T0 = 2455528.86774 (JD)





Example from 2014 undergrad observing plans:

Tmid (HJD)	BEGIN (UT/h,A)	CENTER (DD.MM. UT/h,A)	END (UT/h,A)
2456760.469	12.04 22:40 (68°,NE)	12.04. 23:15 (74°,NE)	12.04 23:49 (76°,N)

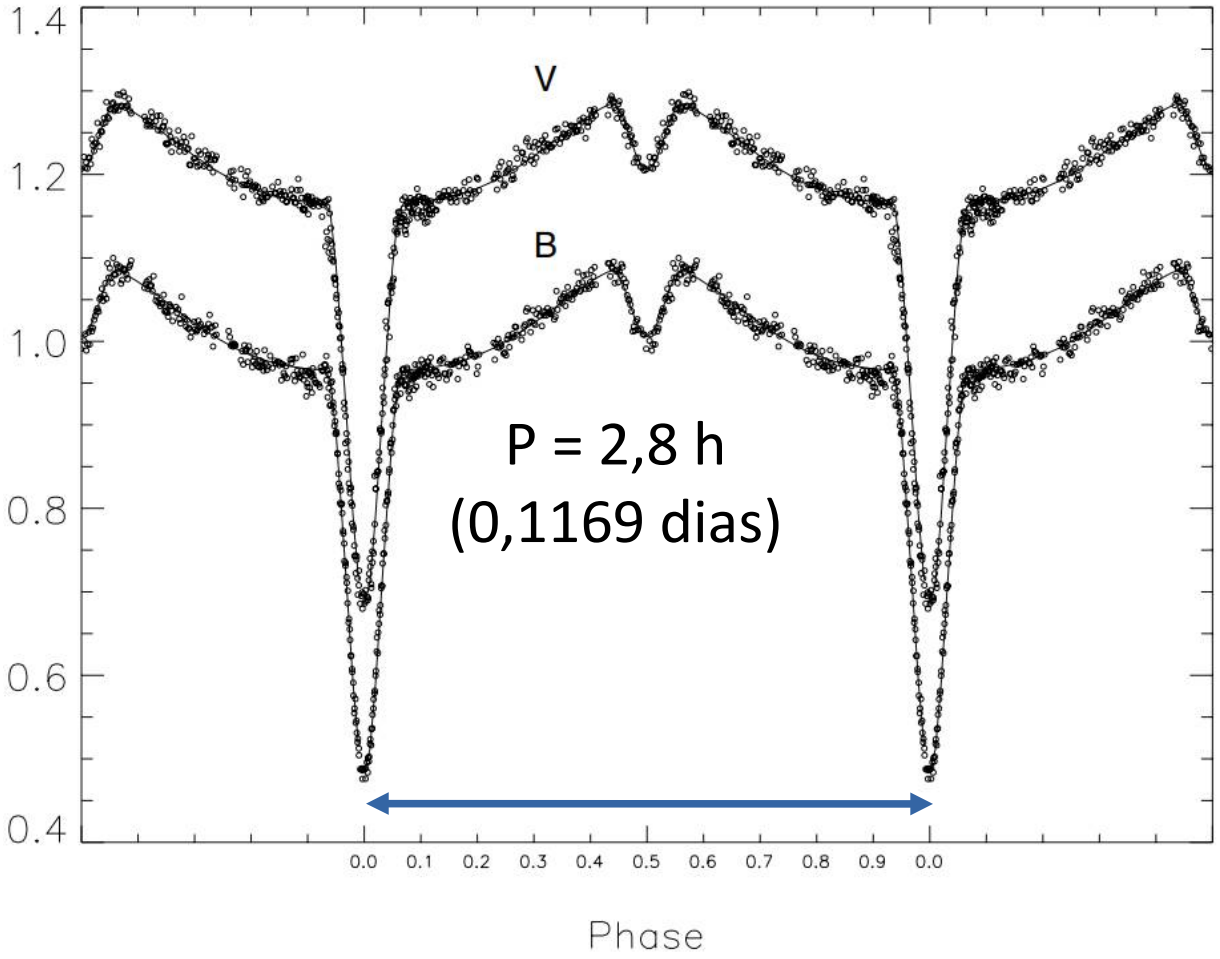
Tips for exoplanet transits

- Choose visible transits with large transit depths (meaning a large variation in magnitude, ΔV)
- Choose relatively short transits, meaning duration below 1,5 hours, if possible
- Check nearby star(s) for differential photometry
- If possible, try to start the observations ~15 min before the transit begins and finish ~15 min after the transit ends. For variable stars, also try to get ~15min more than the full phase coverage

Eclipsing binaries: the amplitude of the primary eclipse is very large, so it is very easy to detect.
- Could detect only 1 of the eclipses, that could last less than 1 hour

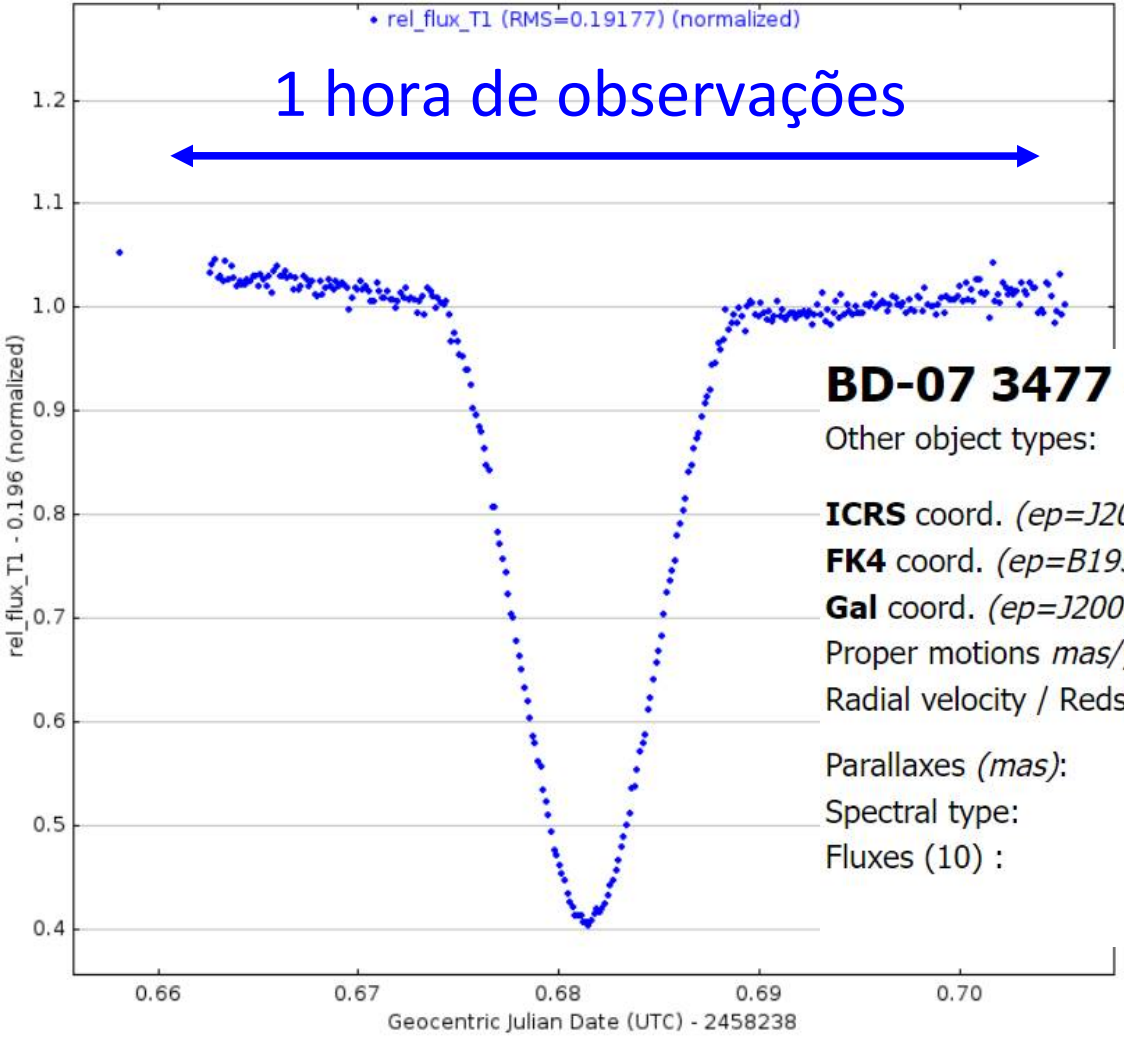
HW Virginis (Ibanoglu et al. 2004)

- Some have short periods, so that both eclipses (primary and secondary) could be observed.



Exemplo de turma anterior AGA 5802 para binária eclipsante

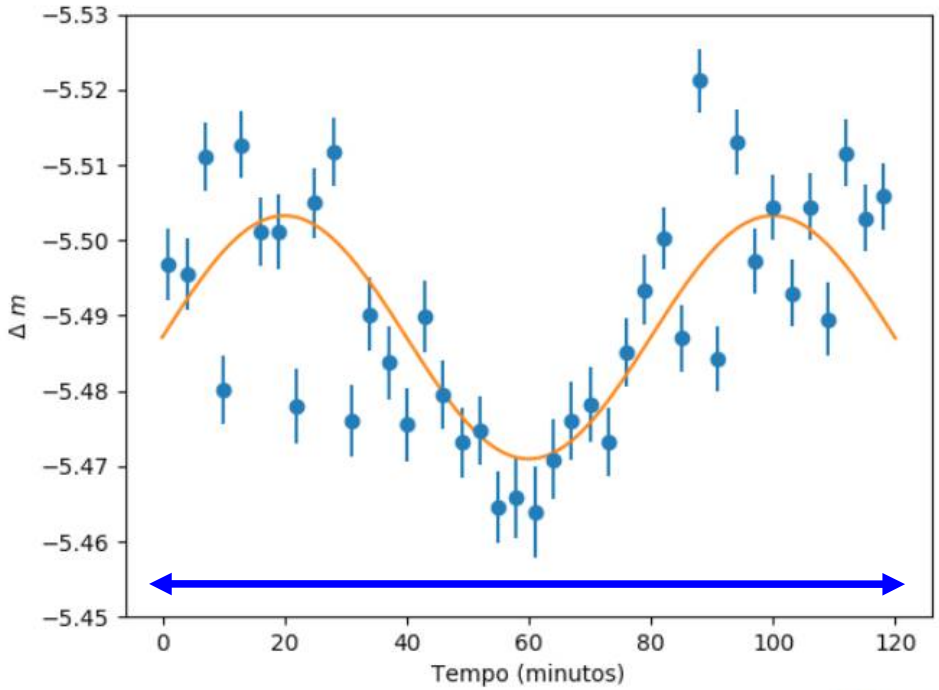
HW Virginis (primary eclipse)



BD-07 3477 -- Hot subdwarf

Other object types:	* (BD,GSC,...), **EB*** (2012A&A), **V*** (1SWASP (2019A&A)
ICRS coord. *(ep=J2000)* :	**12 44 20.2386233232 -08 40 16.846099536**
FK4 coord. *(ep=B1950 eq=1950)* :	12 41 44.5777301956 -08 23 51.398935743
Gal coord. *(ep=J2000)* :	299.9340286152722 +54.1590646428120 [0
Proper motions *mas/yr* :	**9.009 -15.829 [0.090 0.056 90] A 2020yC**
Radial velocity / Redshift / cz :	**V(km/s) -13.00 [0.8] /** z(~) -0.000043 [**A 2015A&A...576A..44K**
Parallaxes *(mas)*:	**5.7728 [0.059] A 2020yCat.1350....0G**
Spectral type:	**sdB2VIIHe3 B 2013A&A...551A..31D**
Fluxes (10) :	**B 10.46 [0.04] D 2000A&A...355L..27H**
	V 10.594 [0.06] D 2012yCat.1322....0Z
	R 10.895 [0.05] D 2012yCat.1322....0Z

Exemplo de turma anterior AGA 5802 para pulsante de tipo delta Scuti

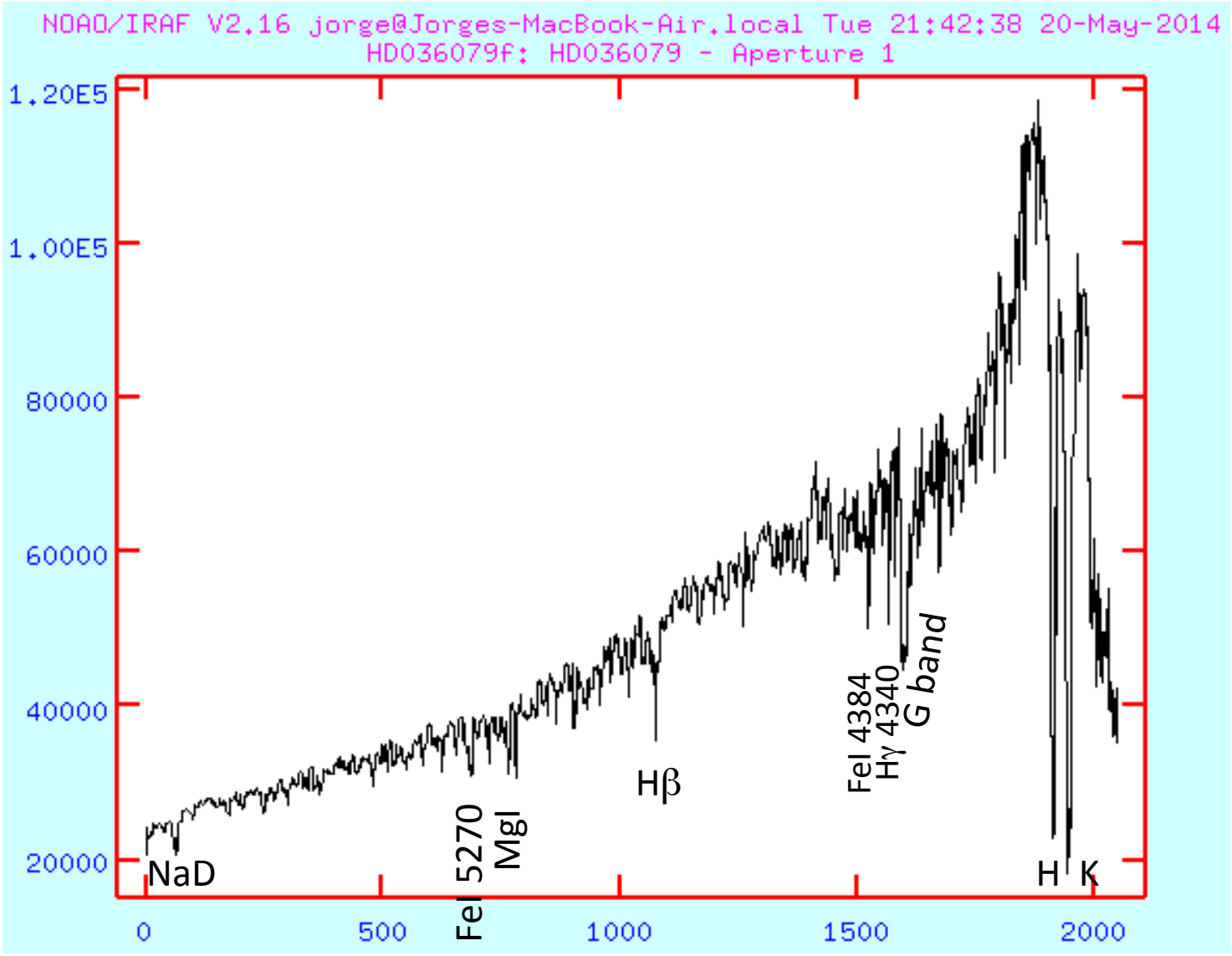


2 horas de observações

V* QQ Tel -- Variable Star of delta Sct type

Other object types:	dS* (), * (HD,CD,...), V* (V*), IR (2MASS)
ICRS coord. *(ep=J2000) :*	19 39 41.7793823544 -45 16 42.787048080
FK4 coord. *(ep=B1950 eq=1950) :*	19 36 06.5626124582 -45 23 38.359634228
Gal coord. *(ep=J2000) :*	353.5280631416599 -27.0577408390006 [0.
Proper motions *mas/yr* :	-22.160 5.375 [0.031 0.025 90] A 2020yCa
Radial velocity / Redshift / cz :	V(km/s) 7.80 [1.5] / z(~) 0.000026 [0.00 B 2006AstL...32..759G
Parallaxes *(mas)*:	9.8017 [0.0327] A 2020yCat.1350....0G
Spectral type:	F2IV C 1978MSS...C02....0H
Fluxes (6) :	B 6.53 [~] E ~ V 6.26 [~] E ~

Spectroscopy: low resolution (~2Å)



Configuration of the spectrograph

- 600 l/mm grating at Cassegrain
- Detector ikon.
- Slit 120 um (1,5 arcsec)
- Previous years: $\lambda_{central}$: 4875 Å (3700 – 6000 Å)
- Turma 2023: $\lambda_{central}$: 5900 Å (from 4800 - 6900 Å ?)
- Resolution: 5 Å?
- Backup: characterize spectrograph if time is cloudy

TIP: select objects with V magnitude ≤ 12

Part 4: spectroscopy. Choose a set of targets and backup targets differing in ~3 hours of R.A.

1) B, Be and B[e]. Compare among them
2) T Tauri AND normal star of same spectral type
3) Compare Asteroid (or Ganymede) AND Moon.
4) Integrated spectra of globular cluster
5) Integrated spectrum of elliptical, spiral, just bulge, or active galaxy
6) Spectrum of H II region (identify lines)
7) Spectroscopic exoplanetary transit
8) Suggestions welcome

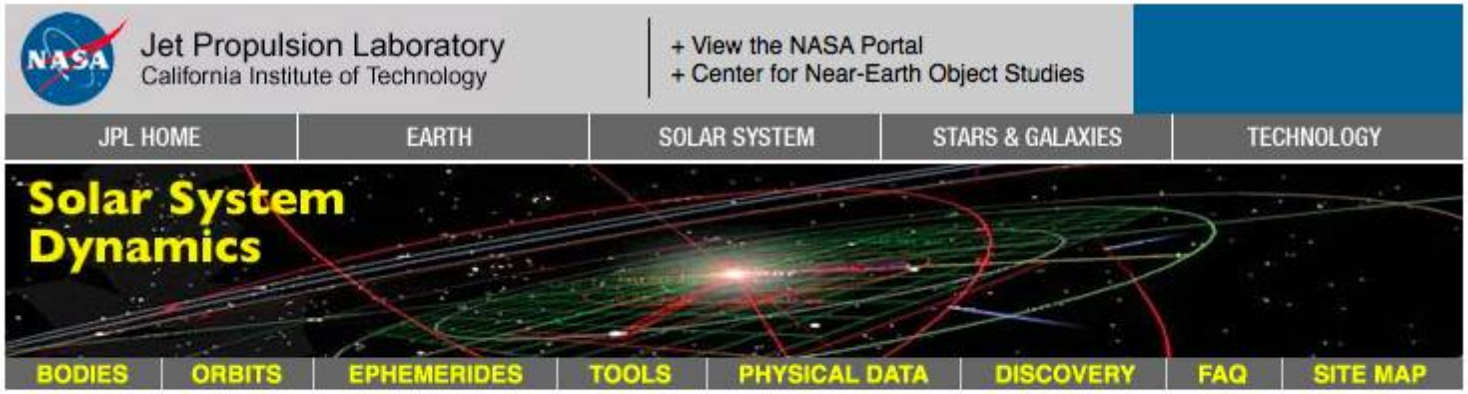
4, 5: discuss/select for comparison at least 6 giant stars covering different spectral types

Also try to observe 3 bright spectrophotometric standards per night

Asteroids or Planets. One position per night

(for observing run should compute every 20min)

https://ssd.jpl.nasa.gov/horizons.cgi



HORIZONS Web-Interface

This tool provides a web-based *limited* interface to JPL's HORIZONS system which can be used to generate ephemerides for solar-system bodies. Full access to HORIZONS features is available via the primary telnet interface. HORIZONS system news shows recent changes and improvements. A web-interface tutorial is available to assist new users.

Current Settings

Ephemeris Type [change] : **OBSERVER**
Target Body [change] : **Mars** [499]
Observer Location [change] : **Geocentric** [500]
Time Span [change] : Start=**2017-05-30**, Stop=**2017-06-29**, Step=**1 d**
Table Settings [change] : *defaults*
Display/Output [change] : *default* (formatted HTML)

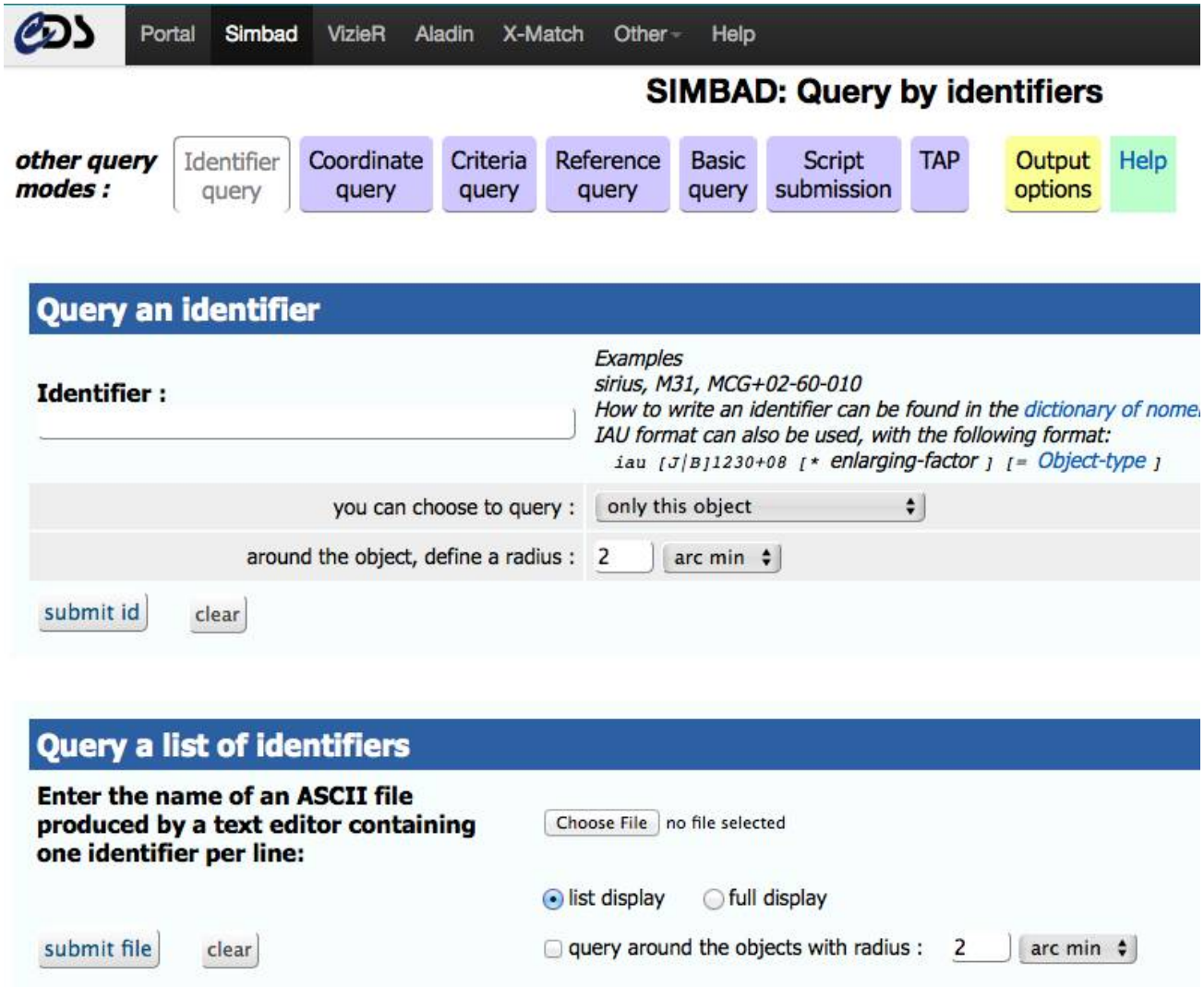
Generate Ephemeris

Special Options:

- set default ephemeris settings (preserves only the selected target body and ephemeris type)
- reset *all* settings to their defaults (caution: all previously stored/selected settings will be lost)
- show "batch-file" data (for use by the E-mail interface)

To check coordinates of non-moving targets you can use Simbad

http://simbad.u-strasbg.fr/simbad/sim-fid



OPD format: use 2000 epoch

Nome	AR	DEC	MAG	Movimento próprio AR	Movimento próprio DEC
HR9077	00 00 19.2	-44 17 26	6.29	0.08	-0.111
HR9078	00 00 23.9	+26 55 06	6.46	0.044	-0.052
HR9079	00 00 30.9	+59 33 35	6.19	-0.077	-0.024
HR9080	00 00 43.	15 15 12	6.38	0.027	0.005
HR9081	00 01 04.5	-48 48 36	5.71	-0.022	-0.009
HR9083	00 01 19.3	+49 58 54	6.22	0.018	-0.006

Espaço

Atenção: todos os catálogos carregados deverão possuir coordenadas J2000.

HR 9079 -- Star

Other object types:	* (HR,AG,BD,CSI,FK5,GC,GCRV, (IRAS,IRCO,2MASS)
ICRS coord. (ep=J2000) :	00 00 30.88833 +59 33 34.849 2007A&A...474..653V
FK5 coord. (ep=J2000 eq=2000) :	00 00 30.888 +59 33 34.85 (
FK4 coord. (ep=B1950 eq=1950) :	23 57 58.02 +59 16 54.0 (Op
Gal coord. (ep=J2000) :	116.5145 -02.6761 (Optical
Proper motions *mas/yr* [error ellipse]:	-80.81 -23.64 [0.37 0.28 0]

-0.081 -0.02364

OPD: proper motion in "/year:
Divide by 1000 SIMBAD's value

In short

1. CCD characterization with Zeiss (or IAG or 1.6m)
2. Imaging of 1 target (planet, cluster, nebula or galaxy)
3. Differential photometry (exoplanet transit or variable star), atmospheric extinction, or CMD
4. Spectroscopic observations: must observe target and comparison(s) object(s). (OPTIONAL: coordinate to observe 3 spectrophotometric standards per night. If so, then you could perform also the flux calibration using spectrophotometric standards).
5. Check your targets with the lists of other students, so that the objects are well distributed

Backup: more work on CCDs and spectrograph

Update 2023

1. Color image [3 filters] of 1 target (e.g., a galaxy)
2. Atmospheric extinction in B, V and R bands
3. Spectroscopic observations: it could be only 1 object, or 2 objects (science and comparison). In any case, must explain what is the science case

Must show preliminary analysis on June 29, to see if the results would be achieved. There is no need for a full data reduction of your own data (is optional), it could be just screenshoots obtained at the OPD. For (1), you could combine image of the 3 filters with DS9 at the OPD. For (2), get instrumental magnitudes at OPD. For (3), take screenshots of DS9's projection. Upload at Moodle the PDF of the slides with preliminary analysis.

4. Cannot repeat targets among different groups

Logistics 2023 (to be confirmed)

23/Jun (sexta) – 9:15 boarding at IAG (bolsão lateral).
9:30 Departure.
Arrival to OPD in about 5±1 hours (40-min stop for lunch)
Accommodation at OPD: all included; bring hygiene products
26/Jun (segunda)- 9:45 boarding. 10:00 departure from OPD.

Meals (refeições):

On the day of arrival: Dinner (jantar) from 17h to 18h
Night snacks at the "Copinha" (1,6m building)

24-25/Jun: Lunch (almoço) from 12h to 13:30h
24-25/Jun: Dinner (jantar) from 17h to 18h
Night snacks at the "Copinha" (1,6m building)
26/Jun: Possibly a breakfast will be offered