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FOCAL LENGTH DETERMINATION FOR THE 60 cm TELESCOPE AT ASTRONOMICAL STATION VIDOJEVICA

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SUMMARY: The focal length of a telescope is an important parameter in determining the angular pixel size. This parameter is used for the purpose of determining the relative coordinates (angular separation and positional angle) of double and multiple stars, and the precise coordinates of extragalactic radio sources (ERS) that are visible at optical wavelengths. At the Astronomical Station Vidojevica we have collected observations of these objects using two CCD cameras, Apogee Alta U42 and SBIG ST-10ME, attached to the 60 cm telescope. Its nominal focal length is 600 cm as given by the manufacturer. To determine the telescope focal length more precisely for both attached detectors, we used angular-separation measurements from CCD images taken at Astronomical Station Vidojevica. The obtained focal lengths are: $F_{42} = (5989 \pm 7)$ mm using the CCD camera Apogee Alta U42 attached to the telescope, and $F_{10} = (5972 \pm 4)$ mm with the CCD camera SBIG ST-10ME attached to the telescope.

Key words. method: observational – telescopes – instrumentation: detectors

INTRODUCTION

The telescope focal length is an important parameter in determining the angular pixel size. It is used for the purpose of determining the relative coordinates (angular separation and position angle) of double and multiple stars, as well as in determining the precise coordinates of radio sources.

In this paper we present the first results of determining the effective focal length of the new 60 cm telescope mounted at Astronomical Station Vidojevica (ASV) for two cameras. The Astronomical Station Vidojevica is located in southern Serbia on the mountain of Vidojevica with Prokuplje as the nearest town. The geographic coordinates of the station are: the longitude $21^\circ\ 33'\ 20''.4$, latitude $43^\circ\ 08'\ 24''.6$ and altitude of 1150 m above the sea level. More details can be found at `http://belissima.aob.rs/` .

EQUIPMENT AND METHOD

The 60 cm telescope was purchased from Astro Optik - German company which, in the meantime, became a part of a much bigger company Astro System Austria (ASA). The telescope has a German equatorial mount and a Cassegrain optical system with optical elements produced by the LOMO company in St. Petersburg, Russia. The primary mirror is parabolic with a mechanical diameter D=60 cm and f/3 focal ratio. The secondary mirror is hyperbolic with the diameter D=20 cm making a classical Cassegrain optical system (Fig. 1). Both mirrors are covered with a highly reflective AlSiO2 coating. The telescope focal length is 600 cm with focal ratio of f/10 as given by the manufacturer. We have also provided one f/6 focal reducer with 4 lenses organized

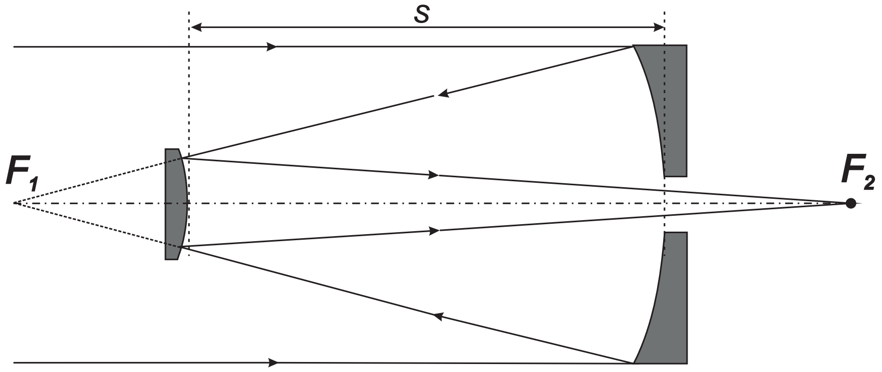

Fig. 1. *Scheme of a two-mirror system: F_1 is the primary mirror focus, F_2 is the effective focus and s is the distance between the two mirrors.*

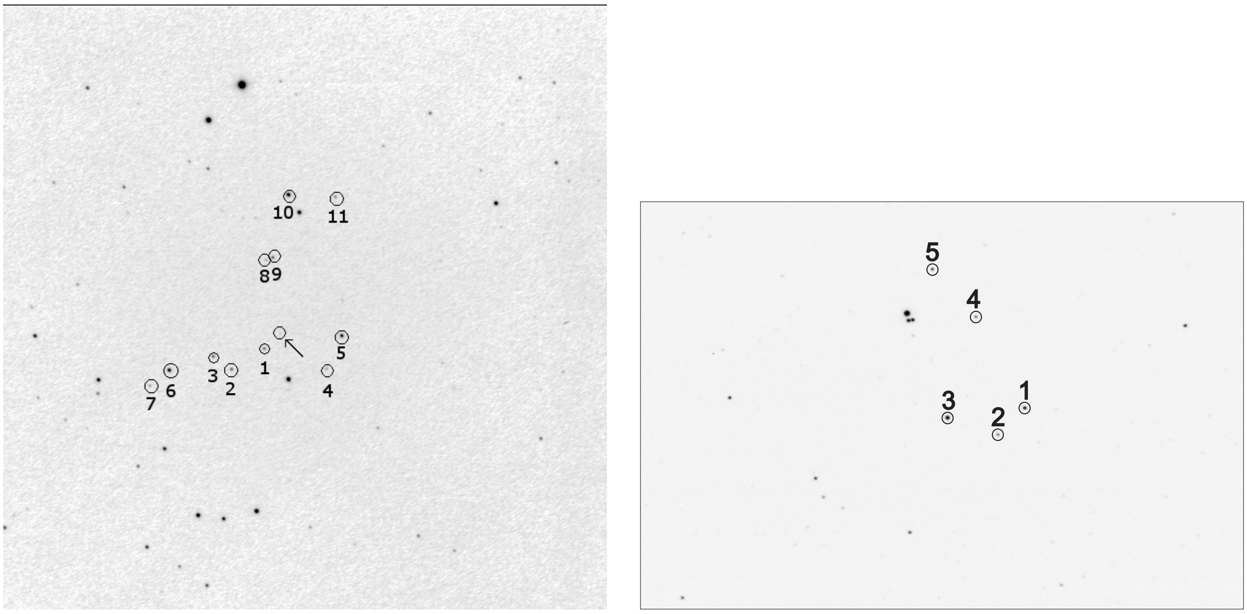

Fig. 2. *CCD frames obtained with cameras Apogee Alta U42 (left) and SBIG ST-10ME (right). The arrow indicates an extragalactic radio source while the stars whose mutual separations were measured and used to determine the telescope focal length are denoted by numbers.*

in three groups. Each lens is Mo coated and has a reflexivity below 0.5%. The telescope was installed in September 2010 but the final Polar alignment and the mirror collimation were performed in June 2011. To compensate the main slewing errors (Polar alignment, collimation, and mount errors) the pointing model was made by means of about 10 stars.

The effective focal length F for a two-mirror system is given by (Bely 2003):

$$F = \frac{f_1 f_2}{f_1 + f_2 - s} \ , \tag{1}$$

where f_1 and f_2 are the focal length of the primary and the secondary mirror respectively, and s is the distance between the two mirrors. As can be seen, the effective focal length depends on s. For each detector (CCD cameras) s is changed during the focus finding procedure which changed the effective focal length F too.

The effective focal length can be determined by comparing the measured separation d_m between the images of two objects on a CCD frame with the separation d_c calculated by using their coordinates taken from a catalogue.

The position of objects in the frames were measured by using the AIP4WIN software (Berry and Burnell 2002).

OBSERVATIONS

The observations were done by using two CCD cameras Apogee Alta U42 and SBIG ST-10ME. Their basic characteristics are summarized in Table 1. Column 1 gives the camera type; the size (in pixel

Table 1. Basic characteristics of the CCD cameras; FOV is the field-of-view size.

CCD camera	pixel array	pixel size [μm]	FOV [arcmin]
Apogee Alta U42	2048× 2048	13.5	15 × 15
SBIG ST-10ME	2184×1472	6.8	8.3 × 5.6

units) of pixel array is given in Column 2 and pixel size in Column 3; Column 4 gives the field-of-view size (FOV). The numbers are given for the telescope without the focal reducer.

As examples, two CCD frames obtained with the two cameras are given in Fig. 2. The identified objects are indicated by numbers (the extragalactic radio source ERS by an arrow). The data on object pairs whose separations d_m were measured and that were used in the focal-length calculation are given in Tables 2 and 3. One frame (left) is obtained with Apogee Alta U42, and the other one (right) with SBIG ST-10ME. The results derived from these frames are labeled by asterisk in Tables 2 and 3.

From June to November 2011, we carried out several series of CCD observations of visual double or multiple stars at Astronomical Station Vidojevica aimed at determining the relative coordinates (angular separation and position angle). For these series we used either SBIG ST-10ME or Apogee Alta U42 CCD cameras. Also, during September and October 2011, we observed about 20 extragalactic compact radio sources (ERS) that are visible at optical wavelengths in order to investigate the relation between the optical and radio reference frames. The optical positions of ERS (α and δ) have been calculated using the positions of reference stars from some of modern star catalogues. For these observations we used Apogee Alta U42 CCD camera only.

The telescope effective focal length for each detector was determined by comparing the measured separations d_m of images of two stars or a star and a radio source on the CCD frames with the separations d_c calculated from their coordinates and proper motions.

For data reduction we used the XPM catalogue[1] that contains the positions and proper motions of 314 million stars distributed all over the sky for the epoch J2000.0. Since the catalogue coordinates (α_0 and δ_0) are given for J2000.0, the corresponding positions for the epoch of the observations (α_i and δ_i) are calculated by taking proper motions into account. The coordinates of radio sources are taken from the ICRF2 list (Fey et al. 2009). These are remote sources with proper motions negligibly small.

CALCULATION AND RESULTS

The angular separation d_c between two objects (the arc along the great circle of celestial sphere) is calculated from coordinates α_i and δ_i, $i = 1, 2$ for the epoch of observations according to the formula:

$$\cos d_c = \sin\delta_1 \sin\delta_2 + \cos\delta_1 \cos\delta_2 \cos(\alpha_2 - \alpha_1)\ . \quad (2)$$

The measured separation d_m is calculated from:

$$d_m = \frac{3600 \times 180}{\pi} \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}\ , \quad (3)$$

where x_i and y_i, $i = 1, 2$ are the measured coordinates from the frame.

The field of view of CCD frames is small sufficiently (see Table 1.) and we did not apply the corrections for apparent displacements such as the differential refraction (Aslan at al. 2010, Kiselev 1989). The main steps of processing the CCD images are the detection of star-like objects (ERS) and stars, and measuring the positions (x, y).

The telescope focal length is obtained from:

$$F = \frac{d_m}{d_c}\ . \quad (4)$$

The calculated values for the focal length as well as the coordinates and proper motions of the objects used in these determinations are given in Tables 2 and 3. The frames containing radio sources were obtained by Apogee Alta U42 which has a significantly larger field of view than SBIG ST-10ME. The radio sources are faint, their apparent magnitudes exceed 14 so that the corresponding exposures lasted more than one minute. The frames containing visual double stars were obtained by both cameras. Their apparent magnitudes are below 12 so that the exposure times were rather short, from a few tenths of a second to a few seconds. Due to this, the frames obtained with Apogee Alta U42 contain more images of stars for which the separations were measured than those obtained with SBIG ST-10ME.

Numbers of objects identified on the CCD frames, where a radio source is assigned zero and stars numbers exceeding zero, are given in Column 1 in Tables 2 and 3. Right ascensions and declinations (in degrees) and proper motions $\mu_\alpha \cos\delta$ and μ_δ (in mas/yr) are given in Columns 2-5 and in Columns 6-9 for the first and second object of a pair respectively. The focal-length calculated from the corresponding coordinates and measured separations on the CCD frames for these pairs is given in the last column. An empty row separates the measurements from different CCD frames. The mean values for the focal length are given at the end of Tables 2 and 3.

[1] http://astrodata.univer.kharkov.ua/catalogs/XPM/

Table 2. Focal length of 60 cm telescope at ASV with CCD camera Apogee Alta U42 attached.

pairs	α_1 [^{o}]	δ_1 [^{o}]	$\mu_{\alpha_1}\cos\delta_1$ [mas/yr]	μ_{δ_1} [mas/yr]	α_2 [^{o}]	δ_2 [^{o}]	$\mu_{\alpha_2}\cos\delta_2$ [mas/yr]	μ_{δ_2} [mas/yr]	F [mm]
0- 1	18.024270	22.744107	0.00	0.00	18.002064	22.755148	-3.57	-8.12	5987
0- 2	18.024270	22.744107	0.00	0.00	18.042636	22.743713	-5.48	2.30	5998
0- 4	18.024270	22.744107	0.00	0.00	17.973797	22.720838	9.26	-4.07	5987
0- 6	18.024270	22.744107	0.00	0.00	17.944004	22.747490	7.26	-0.15	5988
0- 7	18.024270	22.744107	0.00	0.00	17.963545	22.768914	-0.66	-6.66	5988
1- 3	18.002064	22.755148	-3.57	-8.12	18.013677	22.724062	-4.44	-26.81	5984
4- 7	17.973797	22.720838	9.26	-4.07	17.963545	22.768914	-0.66	-6.66	5989
0- 1	15.690677	58.403094	0.00	0.00	15.671078	58.397176	-33.78	0.87	5979
0- 4	15.690677	58.403094	0.00	0.00	15.685314	58.385840	1.86	-2.47	5983
0- 5	15.690677	58.403094	0.00	0.00	15.690276	58.373386	0.16	-1.28	5986
0- 6	15.690677	58.403094	0.00	0.00	15.706665	58.378832	30.57	13.97	5990
2- 3	15.696223	58.397288	-6.16	-13.82	15.683303	58.411670	-4.40	-1.35	5993
0- 1	48.258176	41.333662	0.00	0.00	48.228584	41.352586	8.76	-4.41	5978
0- 2	48.258176	41.333662	0.00	0.00	48.237420	41.350450	-2.02	-4.03	5980
0- 3	48.258176	41.333662	0.00	0.00	48.240528	41.357961	0.85	-3.55	5979
0- 4	48.258176	41.333662	0.00	0.00	48.247778	41.359538	1.53	2.07	5985
0- 5	48.258176	41.333662	0.00	0.00	48.260461	41.359020	-4.90	5.98	5984
0- 6	48.258176	41.333662	0.00	0.00	48.258213	41.371958	-0.25	-0.46	5983
0- 7	48.258176	41.333662	0.00	0.00	48.293863	41.345476	-15.05	-20.85	6002
1- 4	48.228584	41.352586	8.76	-4.41	48.247778	41.359538	1.53	2.07	5980
3- 5	48.240528	41.357961	0.85	-3.55	48.260461	41.359020	-4.90	5.98	6004
6- 7	48.258213	41.371958	-0.25	-0.46	48.293863	41.345476	-15.05	-20.85	5982
0- 1	15.690677	58.403094	0.00	0.00	15.671078	58.397176	-33.78	0.87	6003
0- 3	15.690677	58.403094	0.00	0.00	15.683303	58.411670	-4.40	-1.35	5986
0- 4	15.690677	58.403094	0.00	0.00	15.685314	58.385840	1.86	-2.47	5998
0- 5	15.690677	58.403094	0.00	0.00	15.690276	58.373386	0.16	-1.28	5993
0- 6	15.690677	58.403094	0.00	0.00	15.706665	58.378832	30.57	13.97	5997
2- 3	15.696223	58.397288	-6.16	-13.82	15.683303	58.411670	-4.40	-1.35	5980
0- 1	2.629191	10.974862	0.00	0.00	2.637040	10.985912	-12.58	-18.49	5983
0- 2	2.629191	10.974862	0.00	0.00	2.602697	10.961822	22.15	-16.00	5990
0- 3	2.629191	10.974862	0.00	0.00	2.587667	11.003194	9.55	-11.41	5984
0- 5	2.629191	10.974862	0.00	0.00	2.663336	10.974380	55.76	-47.01	5987
0- 6	2.629191	10.974862	0.00	0.00	2.666270	10.975115	14.84	-0.43	5987
0- 7	2.629191	10.974862	0.00	0.00	2.655826	10.949776	9.03	-4.79	5996
0- 8	2.629191	10.974862	0.00	0.00	2.678776	10.943982	12.30	3.12	5995
0- 9	2.629191	10.974862	0.00	0.00	2.686087	10.928000	-1.13	-2.63	5992
0-10	2.629191	10.974862	0.00	0.00	2.674654	10.930733	16.22	-16.23	5991
1- 4	2.637040	10.985912	-12.58	-18.49	2.648961	10.969686	2.63	-2.78	6007
2- 8	2.602697	10.961822	22.15	-16.00	2.678776	10.943982	12.30	3.12	5992
3- 5	2.587667	11.003194	9.55	-11.41	2.663336	10.974380	55.76	-47.01	5988
6- 7	2.666270	10.975115	14.84	-0.43	2.655826	10.949776	9.03	-4.79	5980
0- 6	48.258176	41.333662	0.00	0.00	48.258213	41.371958	-0.25	-0.46	5970
3- 5	48.240528	41.357961	0.85	-3.55	48.260461	41.359020	-4.90	5.98	6001
6- 7	48.258213	41.371958	-0.25	-0.46	48.293863	41.345476	-15.05	-20.85	5987

Table 2. Continued.

pairs	α_1 [^{o}]	δ_1 [^{o}]	$\mu_{\alpha_1}\cos\delta_1$ [mas/yr]	μ_{δ_1} [mas/yr]	α_2 [^{o}]	δ_2 [^{o}]	$\mu_{\alpha_2}\cos\delta_2$ [mas/yr]	μ_{δ_2} [mas/yr]	F [mm]
0- 1	18.024270	22.744107	0.00	0.00	18.002064	22.755148	-3.57	-8.12	5998
0- 2	18.024270	22.744107	0.00	0.00	18.042636	22.743713	-5.48	2.30	5987
0- 3	18.024270	22.744107	0.00	0.00	18.013677	22.724062	-4.44	-26.81	5975
0- 4	18.024270	22.744107	0.00	0.00	17.973797	22.720838	9.26	-4.07	5989
0- 6	18.024270	22.744107	0.00	0.00	17.944004	22.747490	7.26	-0.15	5989
0- 7	18.024270	22.744107	0.00	0.00	17.963545	22.768914	-0.66	-6.66	5992
1- 4	18.002064	22.755148	-3.57	-8.12	17.973797	22.720838	9.26	-4.07	5996
6- 7	17.944004	22.747490	7.26	-0.15	17.963545	22.768914	-0.66	-6.66	5999
0- 1	343.280705	19.709619	0.00	0.00	343.270844	19.688776	7.53	2.00	6001
0- 2	343.280705	19.709619	0.00	0.00	343.254917	19.704537	26.80	-5.09	5991
0- 4	343.280705	19.709619	0.00	0.00	343.297852	19.733495	0.06	-14.81	5988
0- 5	343.280705	19.709619	0.00	0.00	343.308839	19.738109	6.73	-0.82	5988
0- 6	343.280705	19.709619	0.00	0.00	343.316243	19.739516	-4.73	-3.72	5974
0- 7	343.280705	19.709619	0.00	0.00	343.289007	19.766957	0.12	-14.05	5993
0- 8	343.280705	19.709619	0.00	0.00	343.290858	19.768512	5.03	-4.34	5996
0- 9	343.280705	19.709619	0.00	0.00	343.283758	19.777501	-2.22	-17.06	5991
0-10	343.280705	19.709619	0.00	0.00	343.235601	19.744564	-6.24	-12.42	5989
0-11	343.280705	19.709619	0.00	0.00	343.246837	19.758580	-0.29	1.04	5992
1- 4	343.270844	19.688776	7.53	2.00	343.297852	19.733495	0.06	-14.81	5995
2- 8	343.254917	19.704537	26.80	-5.09	343.290858	19.768512	5.03	-4.34	5994
3- 5	343.277107	19.723909	45.25	-3.12	343.308839	19.738109	6.73	-0.82	5987
9-10	343.283758	19.777501	-2.22	-17.06	343.235601	19.744564	-6.24	-12.42	5991
0- 2*	344.322096	7.720084	0.00	0.00	344.299252	7.733080	0.37	-0.88	6002
0- 3*	344.322096	7.720084	0.00	0.00	344.291939	7.726671	-3.45	0.04	6005
0- 6*	344.322096	7.720084	0.00	0.00	344.272324	7.730363	-19.47	-13.71	6001
0- 7*	344.322096	7.720084	0.00	0.00	344.263055	7.735968	-1.87	-0.95	5997
0- 8*	344.322096	7.720084	0.00	0.00	344.319724	7.688006	9.70	-8.88	5994
0- 9*	344.322096	7.720084	0.00	0.00	344.322800	7.687318	22.00	-23.82	5985
0-10*	344.322096	7.720084	0.00	0.00	344.332775	7.661173	2.38	-2.35	5987
0-11*	344.322096	7.720084	0.00	0.00	344.352911	7.664489	-5.09	-11.54	5986
1- 4*	344.314393	7.725902	16.93	-12.71	344.340401	7.737714	7.81	4.88	5973
2- 8*	344.299252	7.733080	0.37	-0.88	344.319724	7.688006	9.70	-8.88	5986
3- 5*	344.291939	7.726671	-3.45	0.04	344.348585	7.724290	27.90	-7.18	5984
6- 7*	344.272324	7.730363	-19.47	-13.71	344.263055	7.735968	-1.87	-0.95	5982
9-10*	344.322800	7.687318	22.00	-23.82	344.332775	7.661173	2.38	-2.35	5994
1-2	330.690004	23.886323	9.35	1.62	330.797821	23.955989	5.32	-1.66	5987
1-3	330.690004	23.886323	9.35	1.62	330.774980	23.991872	8.91	-2.97	5991
1-6	330.690004	23.886323	9.35	1.62	330.885787	23.901721	2.31	2.86	5990
2-6	330.797821	23.955989	5.32	-1.66	330.885787	23.901721	2.31	2.86	5994
3-6	330.774980	23.991872	8.91	-2.97	330.885787	23.901721	2.31	2.86	5994
1-2	307.728687	20.827776	1.13	-7.48	307.828879	20.854893	-2.04	-15.34	5990
1-3	307.728687	20.827776	1.13	-7.48	307.801487	20.876366	-6.62	-10.68	5989
1-4	307.728687	20.827776	1.13	-7.48	307.798729	20.886201	-7.49	12.52	5988
1-7	307.728687	20.827776	1.13	-7.48	307.713337	20.918212	6.03	-9.07	5993
7-2	307.713337	20.918212	6.03	-9.07	307.828879	20.854893	-2.04	-15.34	5991

Table 2. Continued.

pairs	α_1 [^{o}]	δ_1 [^{o}]	$\mu_{\alpha_1}\cos\delta_1$ [mas/yr]	μ_{δ_1} [mas/yr]	α_2 [^{o}]	δ_2 [^{o}]	$\mu_{\alpha_2}\cos\delta_2$ [mas/yr]	μ_{δ_2} [mas/yr]	F [mm]
7-3	307.713337	20.918212	6.03	-9.07	307.801487	20.876366	-6.62	-10.68	5990
7-4	307.713337	20.918212	6.03	-9.07	307.798729	20.886201	-7.49	12.52	5992
2-4	3.126798	54.991453	2.57	-3.95	3.143864	54.938489	5.97	-1.21	5989
2-5	3.126798	54.991453	2.57	-3.95	3.015123	54.928143	-.93	-8.69	5988
2-6	3.126798	54.991453	2.57	-3.95	3.052320	54.870269	6.84	9.91	5993
4-5	3.143864	54.938489	5.97	-1.21	3.015123	54.928143	-.93	-8.69	5985
4-6	3.143864	54.938489	5.97	-1.21	3.052320	54.870269	6.84	9.91	5975
2-3	3.732744	27.329569	54.24	-18.02	3.840889	27.403257	14.27	-1.86	5975
2-4	3.732744	27.329569	54.24	-18.02	3.791050	27.470552	-4.65	-9.03	5991
3-4	3.840889	27.403257	14.27	-1.86	3.791050	27.470552	-4.65	-9.03	5987
1-2	1.392738	45.791748	6.47	-5.84	1.420091	45.827052	13.85	-7.68	5988
									5989

Table 3. Focal length of 60 cm telescope at ASV with CCD camera SBIG ST-10ME attached.

pairs	α_1 [^{o}]	δ_1 [^{o}]	$\mu_{\alpha_1}\cos\delta_1$ [mas/yr]	μ_{δ_1} [mas/yr]	α_2 [^{o}]	δ_2 [^{o}]	$\mu_{\alpha_2}\cos\delta_2$ [mas/yr]	μ_{δ_2} [mas/yr]	F [mm]
1-2	86.440083	21.452889	5.90	7.03	86.450731	21.462637	-1.30	-1.20	5974
1-3	86.440083	21.452889	5.90	7.03	86.446213	21.494943	3.85	30.77	5963
1-4	86.440083	21.452889	5.90	7.03	86.431670	21.499653	7.71	11.62	5977
1-5	86.440083	21.452889	5.90	7.03	86.413819	21.499539	1.87	4.09	5975
1-6	86.440083	21.452889	5.90	7.03	86.426902	21.478874	-3.13	11.06	5973
2-4	86.450731	21.462637	-1.30	-1.20	86.431670	21.499653	7.71	11.62	5977
2-5	86.450731	21.462637	-1.30	-1.20	86.413819	21.499539	1.87	4.09	5975
2-6	86.450731	21.462637	-1.30	-1.20	86.426902	21.478874	-3.13	11.06	5972
1-2	352.863672	10.350732	-19.50	4.70	352.927719	10.310178	47.77	14.60	5966
1-4*	332.782612	53.743351	-16.48	3.29	332.787919	53.767723	1.55	-3.05	5969
1-5*	332.782612	53.743351	-16.48	3.29	332.797406	53.781951	2.36	-6.46	5971
2-4*	332.796434	53.739722	-4.49	-5.11	332.787919	53.767723	1.55	-3.05	5966
2-5*	332.796434	53.739722	-4.49	-5.11	332.797406	53.781951	2.36	-6.46	5968
3-4*	332.813040	53.747784	-.99	-1.02	332.787919	53.767723	1.55	-3.05	5972
3-5*	332.813040	53.747784	-.99	-1.02	332.797406	53.781951	2.36	-6.46	5976
1-2	1.392738	45.791748	6.47	-5.84	1.420091	45.827052	13.85	-7.68	5969
1-2	292.042071	16.365395	-5.25	10.64	292.105762	16.320301	.43	3.73	5974
1-3	292.042071	16.365395	-5.25	10.64	292.074876	16.298498	18.12	-11.45	5971
1-4	292.042071	16.365395	-5.25	10.64	292.093737	16.288193	-19.94	27.83	5978
2-3	292.105762	16.320301	.43	3.73	292.074876	16.298498	18.12	-11.45	5979
2-4	292.105762	16.320301	.43	3.73	292.093737	16.288193	-19.94	27.83	5974
1-3	275.502369	11.442698	-1.56	.66	275.540938	11.469600	2.46	-.47	5976
1-4	275.502369	11.442698	-1.56	.66	275.612485	11.424737	3.61	-3.25	5970
1-5	275.502369	11.442698	-1.56	.66	275.618087	11.418772	3.90	-12.17	5967
1-6	275.502369	11.442698	-1.56	.66	275.591943	11.403553	4.18	-10.83	5969
2-4	275.519561	11.447564	.43	-5.01	275.612485	11.424737	3.61	-3.25	5972
2-5	275.519561	11.447564	.43	-5.01	275.618087	11.418772	3.90	-12.17	5969
2-6	275.519561	11.447564	.43	-5.01	275.591943	11.403553	4.18	-10.83	5972
3-4	275.540938	11.469600	2.46	-.47	275.612485	11.424737	3.61	-3.25	5969
3-5	275.540938	11.469600	2.46	-.47	275.618087	11.418772	3.90	-12.17	5967
3-6	275.540938	11.469600	2.46	-.47	275.591943	11.403553	4.18	-10.83	5971
									5972

When the CCD camera Apogee Alta U42 was attached to the 60-cm telescope, we obtained the focal length $F_{42} = (5989 \pm 7)$ mm. It is the average of 100 values given in Table 2. In the case of the CCD camera SBIG ST-10ME we obtained the focal length $F_{10} = (5972 \pm 4)$ mm from 31 values (see Table 3).

The temperature variation of the focal length has not been studied because the number of considered observational series within the five-months interval (summer-autumn 2011) is relatively small. Besides, the temperature was measured outside the observational pavilion, not at the instrument. Therefore, the study of temperature effects on the focal length is left for future observations.

CONCLUSION

The focal length of the Astronomical Station Vidojevica 60 cm telescope is close to that declared by the factory. Its values can differ when diverse detectors are used in the observations.

In the case of frames taken with Apogee Alta U42 the telescope focal length obtained here differs from the manufacturer's one by less than 0.2%; in the case of SBIG ST-10ME the difference is about 0.5%. This fact indicates a good quality of the telescope (mirror and construction).

The variation of the focal length with temperature should be examined.

The focal-length values corresponding to other detectors: another CCD, adaptive optics, filters, etc, should also be determined.

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ОДРЕЂИВАЊЕ ЖИЖНЕ ДАЉИНЕ 60 cm ТЕЛЕСКОПА НА АСТРОНОМСКОЈ СТАНИЦИ НА ВИДОЈЕВИЦИ

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Стручни чланак

Жижна даљина је важан параметар за одређивање угаоне величине пиксела. Овај параметар се користи при одређивању релативних координата (угловно растојање и позициони угао) двојних и вишеструких звезда, као и при одређивању прецизних координата вангалактичких радио-извора који су видљиви у оптичком делу таласних дужина. Ми смо посматрали ове објекте на Астрономској станици на Видојевици коришћењем две CCD камере, Apogee Alta U42 и SBIG ST-10ME, монтиране на 60 cm телескоп. Његова фабричка жижна даљина је 600 cm. Да бисмо прецизније одредили жижну даљину телескопа када се користе ова два детектора, мерили смо угловна растојања између ликова објеката на CCD снимцима. Добијене вредности жижних даљина су: $F_{42} = (5989 \pm 7)$ mm када се снима са CCD камером Apogee Alta U42 и $F_{10} = (5972 \pm 4)$ mm када се снима са CCD камером SBIG ST-10ME.