RevMexAA (Serie de Conferencias), **46**, 83–84 (2015)

OPTICAL POSITIONS OF ICRF SOURCES FROM CTIO 1.0M DATA

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RESUMEN

Como parte del proyecto del USNO para enlazar los sistemas de referencia en radio y óptico, se tomaron datos con el telescopio CTIO de 1.0 m in 2009. Los primeros resultados para 5 fuentes del ICRF se presentan en este trabajo, como parte de esta investigación, principalmente fotométrica, de sus contrapartes ópticas.

ABSTRACT

As part of the USNO radio-optical reference frame link project, data were taken with the CTIO 1.0 m telescope in 2009. First position results of 5 ICRF sources are presented as part of this primarily photometric investigation of optical counterparts.

Key Words: astrometry — quasars

1. OPTICAL VS. RADIO POSITIONS

The main goal of this program is to obtain photometric data of potential radio−optical extragalactic reference frame link sources. Photometric variability and colors of bright optical targets were observed in 2009 and 2010. This paper presents preliminary astrometric results obtained from the first 3 nights of data of the August 2009 observing run for the subset of ICRF sources.

Table 1 gives properties of the CTIO/Yale 1.0 meter telescope and Y4K camera which were used for this study.

TABLE 1. INSTRUMENT PROPERTIES

aperture	1000	mm
focal ratio	f/10	Cass.
filters used	B,V,R,I	
optical distortion	−88	arcsec/deg^3
CCD image format	4064 x 4064	pixels
pixel size	15	μm
scale	0.289	arcsec/pixel
field of view	20 x 20	arcmin
full well	66	ke-
gain	1.4	e-/DN
binning	1 x 1	
linearity up to	38,000	DN

The raw pixel data were processed with IRAF using Phil Massey's scripts. Object detection and astrometric fits were performed with our custom code using UCAC4 (Zacharias et al. 2013) reference stars and a 7 parameter model (linear plus 3rd order distortion term). A sufficient number of reference stars per field was available for this approach (see below).

TABLE 2. COMPARISON OF POSITIONS

source name	optical−radio $\Delta\alpha*$ mas	$\Delta\delta$ mas	opt.pos.error σ_x mas	σ_y mas
0108−170	−38.0	−103.0	15	15
1355−416	15.7	−25.6	9	9
1619−680	20.6	−0.9	12	12
2152−699	14.1	116.0	19	19
2349−014	−30.3	−34.4	11	11

source name	n. ind exp	n. ref s.	sol. σ_{fit} mas	opt.−radio σ_x sigma	σ_y sigma
0108−170	4	28	55.5	−2.6	−7.1
1355−416	5	220	65.4	1.8	−2.9
1619−680	5	434	73.0	1.8	−0.1
2152−699	4	67	60.5	0.7	6.0
2349−014	4	41	56.7	−2.8	3.2

Weighted mean optical positions of the target sources were compared to the ICRF radio positions and are presented in Table 2. These results are preliminary, because no field distortion pattern was constructed and applied yet. Also, corrections for differential color refraction are not yet considered. The radio structure index of 2152−699 is 4, while it is unknown for the other sources.

Individual position results are shown in Table 3. Individual exposure times range from 180 to 240 sec. The astrometric solution errors are between 53 and 75 mas using UCAC4 reference stars. The

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TABLE 3. COMBINED ERRORS

object name	ref	n. sig mas	ampl DN	image elong	d(RA)* mas	d(DC)f mas	
0108-170	29	24	1365	0.931	-12.1	-0.6	B
0108-170	28	28	2302	0.870	-0.6	-31.6	V
0108-170	27	31	2831	0.836	9.5	8.4	R
0108-170	27	39	1604	1.000	18.1	49.4	I
1355-416	230	21	1866	1.076	67.6	9.1	B
1355-416	217	28	1673	1.048	81.0	31.1	B
1355-416	221	17	2289	1.003	-1.7	-15.9	V
1355-416	212	21	2099	1.032	-17.3	-5.9	R
1355-416	220	16	3027	1.014	-54.2	2.1	I
1619-680	470	25	801	0.941	13.4	81.4	B
1619-680	418	23	1306	0.908	14.5	-45.6	V
1619-680	404	24	2594	0.879	0.6	-10.6	R
1619-680	431	25	1561	0.897	-22.3	-13.6	I
1619-680	446	42	1466	1.028	-25.1	-6.6	I
2152-699	68	40	439	0.920	7.6	52.2	B
2152-699	72	39	1054	0.934	13.3	-20.8	V
2152-699	61	40	2413	0.892	-2.8	-15.8	R
2152-699	68	36	1786	0.956	-15.3	-11.8	I
2349-014	42	19	6907	0.930	-8.7	-52.9	B
2349-014	40	21	7195	1.076	13.8	3.1	V
2349-014	39	25	8667	1.105	24.3	21.1	R
2349-014	41	22	6967	1.011	-22.2	51.1	I

optical position error of a target (per coordinate) (x, y fit precision) ranges from 12 to 41 mas, depending on brightness of the target. The combined, total, optical and radio position error (sig) is given in the table. The position differences (d(RA)cos(Dec), d(DC)) here are with respect to the mean optical position and thus show how consistent the optical data are. The amplitude and image elongation of the target source are listed as well, and the filter is indicated in the last column.

For 2 sources (2152−699 and 0108−170) we see a very large declination offset with respect to the radio position, while all other sources and all RA coordinates agree well with the radio data. As expected, effects from the uncorrected differential color refraction can be seen when comparing optical positions of sources with large zenith distances observed with different filters. The astrometric precision of these observations is high due to the brightness of the targets. Astrometric accuracy will be much more challenging than with the earlier data obtained with the CTIO 0.9m (Zacharias & Zacharias 2014) because of the wider (and multiple) bandpasses used here.

The images in Figure 1 (taken from our data) are 2 arcmin wide and centered on the ICRF target.

Acknowledgments. We wish to thank CTIO/Yale and the SMARTS consortium for granting observing time. We greatly appreciate Phil Massey's IRAF scripts and his time to answer our questions. IRAF is distributed by the National Optical Astronomy Observatory, which is operated by the Associated Universities for Research in Astronomy, Inc., under cooperative agreement with the National Science Foundation.

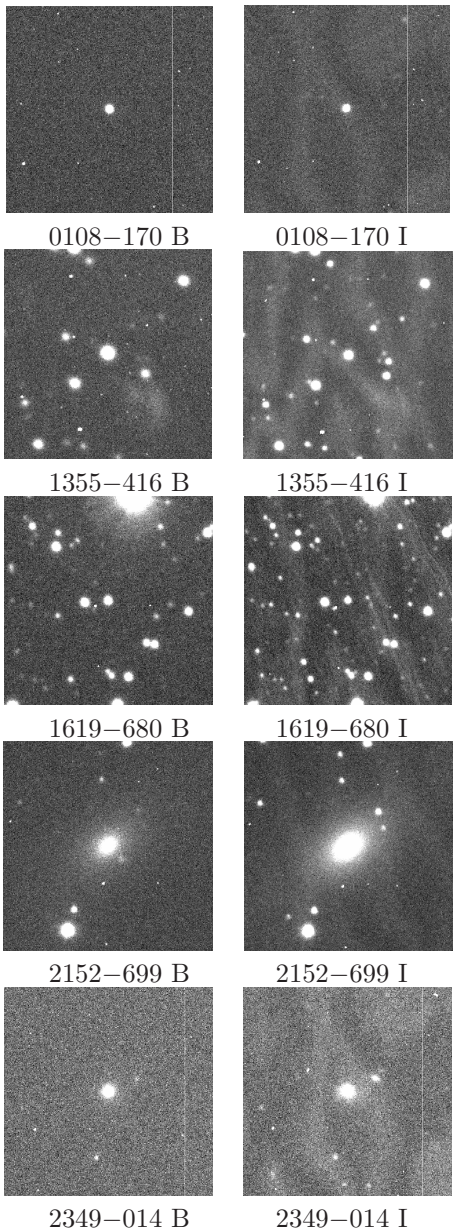

Fig. 1. B and I images of the objects.

REFERENCES

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