OBSERVATIONS OF ERS WHICH ARE VISIBLE IN OPTICAL DOMAIN USING 2 m TELESCOPE

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Abstract

During 2011/2012 we observed about 100 extragalactic radio sources (ERS), visible in the optical domain, from ICRF2 list using the Rozhen (D=2m, F=16m, Bulgaria) telescope with CCD camera. It is of importance to compare the ERS optical (visible in optical domain) and radio positions (VLBI ones) and to search for a relation between optical and radio reference frames. The Hipparcos celestial reference frame (HCRF) was realizing the ICRF in optical wavelengths, and it is necessary to verify and refine the relation between the HCRF and ICRF2 by using different telescopes and methods. At the Rozhen 2m telescope, it was used the CCD VersArray 1300B: 1340x1300 pixels, the pixel size is 20x20 μm. The reduction and preliminary results of some observed ERS objects are presented here.

Introduction

The celestial system is based on IAU (International Astronomical Union) Resolution A4 (1991), and it was officially initiated and named International Celestial Reference System (ICRS) by IAU Resolution B2 (1997). The fundamental celestial reference frame (International Celestial Reference Frame - ICRF) was adopted by the IAU (1997) and there were the original list of radio objects with two extensions (ICRF-ext1 and ICRF-ext2). At the IAU XXVII GA (2009), the second realization of the ICRF (the ICRF2) was adopted (with 3414 compact radio astronomical sources). It is of importance to search the relation between optical and radio reference frames, and we need to make the observations of some ICRF2 extragalactic radio sources (ERS) which are visible in the optical domain. During 2011 and 2012, we observed about 100 ERS using D=2m Rozhen telescope (Bulgaria) and CCD VersArray 1300B. Some results are presented here.

Data

Using 2m Rozhen tel. (see Fig. 1) and CCD VersArray 1300B, the scale is 0.26 arcsec/pix and the field of view (FOV) is about 5.5x5.5 arcmin. The densification catalogues derived from the HCRF and some of them are: Tycho-2, UCAC3, 2MASS, XPM, etc. We used the XPM (Fedorov et al., 2010). About 100 optical counterparts of ERS from ICRF2 list (Fey et al., 2009) were observed at 2m Rozhen tel. during 2011/2012, and an ERS is presented in Fig. 2. (some XPM stars marked with circles, ERS marked with the direction arrow and a circles). We made 6 frames per ERS: 3 at R filter and 3 at V one. The FOV of CCD frames was small and we did not apply the corrections for apparent displacements, as differential refraction (Aslan et al., 2010; Kiselev, 1989). The bias and flat-field frames were not applied to our raw frames. We plan to do it. The dark corrections is not significant at Rozhen site because the CCD chip was cooled to -110 °C .

Procedure & Results

The detection of star-like objects (ERS) and reference stars is the first step for processing the CCD images. The next step is the measuring the positions of centers (x,y) of ERS and stars. And the reduction, to get tangential and equatorial coordinates. The linear model was used, as a standard astrometric “plate” reduction with the available reference stars,

$$\xi = ax + by + c \qquad \eta = dx + ey + f$$

to transform the measured CCD coordinates (x,y) to tangential ones (ξ, η). The unweighted Least-Squares Method (LSM) was applied to calculate the unknown values of parameters a,b and c to get RA. And d,e and f to get DEC. We need at least 3 ref.stars. The AIP4WIN (Berry & Burnell, 2002) image processing package was applied for CCD observations.

Figure 1. Rozhen 2m telescope

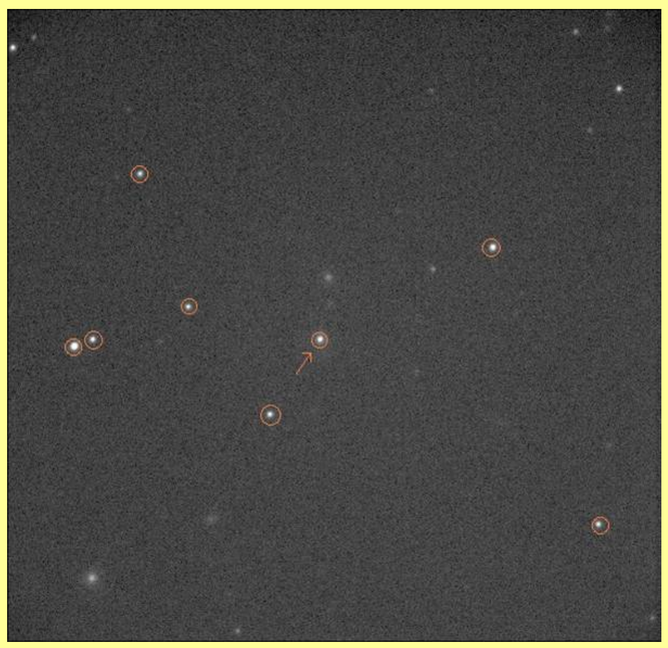

Figure 2. ERS ICRF J001031.0+105829, G 0007+106, 14.2 mag

The XPM catalogue contains the positions and proper motions for 314 million stars distributed all over the sky for the epoch 2000.0. So, the positions of ERS were calibrated with respect to the XPM catalogue by using CCD observations. And we determined the optical coordinates of 6 ERS objects; the ERS radio ones are from the ICRF2 list. We compared the optical (O) positions of ERS with the radio (R) ones to determine the values (O-R) in RA and in DEC (see below):

ERS	$(O-R)_{RA}$["]	$(O-R)_{DEC}$["]
L 0109+224	-0.111 (0.015)	+0.001 (0.019)
A 0059+581	+0.138 (0.050)	-0.028 (0.098)
Q 2250+190	+0.131 (0.166)	+0.159 (0.040)
G 0007+106	-0.151 (0.042)	+0.089 (0.055)
L 2254+074	+0.074 (0.095)	+0.007 (0.040)
G 0309+411	-0.347 (0.133)	-0.250 (0.271)

Conclusion

The ERS observations are possible using 2 m Rozhen telescope and CCD camera VersArray 1300B; some preliminary results were done in the paper (Damljanović & Milić, 2012). The presented offsets (in RA and in DEC) and their standard errors of 6 calculated ERS objects are small and acceptable; the range of magnitude is from 14.2 to 17.0 (it could be to near 20.0).

Some problems of ERS optical positions calculation can be: faintness of the ERS optical counterparts, atmospheric and technical influences. It is possible to improve presented results by using: bias and flat-field during reduction of data, also stacking of data.

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