ASTROLABE OBSERVATIONS OF RADIO STARS AT THE SOUTHERN HEMISPHERE

F. Noël
Department of Astronomy, University of Chile
and
European Southern Observatory

ABSTRACT

A brief description is given of the program of radio star observations with the Danjon Astrolabe of Santiago. Results in alpha (Astr.-Cat.) for radio star FK4 309, obtained from observations made at its east transit solely, are given for yearly periods of observation from 1976 to 1982. The average mean error of $\Delta\alpha$ is $0^s.006$.

1) INTRODUCTION

Accurate positions and proper motions of radio stars will be very important when tying the radio reference frame based on the position of remote extragalactic radiosources, with the optical reference frame defined by the system of positions and proper motions of the FK4 fundamental catalogue (in a near future FK5).

The working group of Commission 24 of IAU on Identification of Radio/Optical Astrometric Sources, as well as other authors, have prepared lists of galactic radiosources that are bright optically and which could be suitable for the link of the radio and optical system. In this context the most valuable objects would be the FK4 stars, or of other precise catalogue which display radio emission.

Since the astrolabe has made significative contributions to astrometry during the last decades, we have considered the possibility of observing radio stars with the astrolabe of Santiago in the fundamental groups (Noël et al. 1974) of FK4 stars which are observed regularly for earth rotation research since 1965.

However, the lists of galactic radiosources published so far (see for example de Vegt, 1982) include a very low number of radio stars which could be observable with astrolabes from the southern hemisphere.

H. K. Eichhorn and R. J. Leacock (eds.), Astrometric Techniques, 715–719.

2) PROGRAM OF RADIO STAR OBSERVATIONS AT SANTIAGO

The observation feasibilities of the Danjon Astrolabe of Santiago (lat. = -33°.4, zenith distance = 30°) are as follows:

$$-4° > \delta > -62° \quad , \quad m_v \leq 6.0$$

These conditions are fulfilled at the present time, only by the four radio stars given in Table 1.

The three fundamental radio star (306, 309, 616), which represent the 75% of the very low number of FK4 radio sources at the southern hemisphere, are beeing observed systematically with the astrolabe since 1980. For the reductions they are treated as catalogue stars (Débarbat and Guinot, 1970), using as reference group the fundamental group (Noël, 1968) more closely observed. Yearly results for these stars should be available in a near future. The observations of 9 Sgr., which was added later than the other three stars to the list of galactic radio sources, will begin soon.

TABLE 1

FK4 Nr.	Name	Mag.	Alpha 1950.0	Delta 1950.0	|cos S|	P_α	P_δ
306	ζ Pup.	2.3	$08^h01^m40^s.552$	-39°51'40".83	0.014	0.7	0.0
309	γ Vel.	1.9	08 07 59.465	-47 11 18.31	0.252	0.6	0.2
616	α Sco.	1.2	16 26 20.206	-26 19 21.95	0.371	0.8	0.4
-	9 Sgr.	6.0	18 00 48.403	-24 21 48.67	0.424	0.8	0.4

In table 1, S is the paralactic angle, P_α and P_δ represent the accuracy in terms of the maximum precision of the instrument, with which the right ascension and the declination respectively, are determined at Santiago (Débarbat and Guinot, 1970). We can see that the right ascension can be obtained fairly good for the four stars. Nevertheless, the declination is not determinable at all for FK4 306, and very badly or not determinable also for FK4 309 (see section 3).

However, for those stars with |cos S| sufficiently small (|cos S| < 0.3), the right ascension can be determined from the observations made at one of the two transits; it is not strictly necessary the observation of both transits (Débarbat and Guinot, 1970). Now, it happens that the east transit of star 309 is included in the fundamental groups (group Nr. 4) of the astrolabe program, which have been beeing observed continuedly since 1965 for precise time and latitude service. So, the east transit of this star has a long observational history from which we shall see in the next section, the possibility of obtaining its right ascension.

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On the other hand, stars 306 and 309 are included in the First Astrolabe Catalogue of Santiago (Noël et al. 1974). The results obtained in alpha, with results in alpha and delta deduced from meridian observations at Santiago (Carrasco et al. 1983) are given in table 2.

TABLE 2

FK4	ASTROLABE			MERIDIAN CIRCLE					
Nr.	$\Delta\alpha$ ($0^s.001$)	m.e.	t_α 1900+	$\Delta\alpha$ ($0^s.001$)	m.e.	t_α 1900+	$\Delta\delta$ ($0''.01$)	m.e.	t_δ 1900+
306	-17	4	67.61	-54	3	66.22	-10	4	64.45
309	-18	4	69.83	-32	3	66.49	- 1	4	66.69

The sense of $\Delta\alpha$ and $\Delta\delta$ is instrument - FK4; m.e. is mean error and t_α and t_δ are mean epochs of observation for the alpha and delta results respectively.

3) REDUCTIONS OF THE EAST TRANSIT OF FK4 309

The observations of the east transit of radio star 309 have been treated as is usually done with those stars with a small $|\cos S|$ for obtaining the right ascension from one transit solely (Débarbat and Guinot, 1970).

$\Delta\alpha$ (Astr. - FK4) should be obtained in this case by means of:

$$\Delta\alpha = \frac{R}{15 \text{ sen } Z \cos \phi} + \frac{\cos S}{15 \text{ sen } Z \cos \phi} \Delta\delta \qquad (1)$$

assuming that the term in $\Delta\delta$ is zero. In formula 1) R is the mean residual in zenith distance given by the star corrected by group corrections and by term A (Débarbat and Guinot, 1970), Z is the star azimuth and ϕ is the latitude of the instrument. In benefit of simplicity, the terms containing the undetermined parameters ζ, η and ξ are omitted in expression 1).

For star 309 we have:

$$\frac{\cos S}{15 \text{ sen } Z \cos \phi} = 0.026$$

Hence, if we compute $\Delta\alpha$ using 1) assuming $\Delta\delta=0$, the error on $\Delta\alpha$ would be of the order of $0^s.0026$ if the actual value of $\Delta\delta$ would be of the order of $0''.1$. However, the meridian observations show (see table 2) that

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$\Delta\delta$ should be rather small ($0''.01 \pm 0''.04$). In this case the error commited on $\Delta\alpha$ should be less than $0^s.001$. Therefore, the east transits of radio star 309 have been reduced for obtaining $\Delta\alpha$, applying

$$\Delta\alpha = \frac{R}{15 \text{ sen } Z \cos \phi}$$

In the next section we give the results obtained for the last 7 years. However, all the observations of 309, made so far, which represent 18 years, will be reduced on an homogeneous system from which it is expected to get some information on the proper motion in right ascension for this star.

4) RESULTS

The results in right ascension for radio star FK4 309, obtained with the method described in section 3), are given for yearly periods in table 3, where m.e. is mean error, t_α is the mean epoch of the observations for the period and n is the number of transits from which was derived $\Delta\alpha$.

TABLE 3

Radio Star FK4 309
$\Delta\alpha$ (Astrolabe-FK4)

$\Delta\alpha$ ($0^s.001$)	m.e.	t_δ 1900+	n
-45	5	76.51	40
-43	5	77.41	28
-33	8	78.22	20
-46	9	79.29	11
-35	5	80.41	13
-33	6	81.56	12
-39	5	82.55	21

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Discussion:

GLIESE: You mentioned the large error of the α_δ systems of the FK4. One reason for producing these errors is the behavior of the Cape Meridian Circle, which showed unexplained fluctuation of its α system over decades. The most disturbing catalogue has been the First Cape Catalogue for 1950. No absolute azimuth was observed; as azimuth stars were used not the stars near the pole but stars between -75° and -83° which have large systematic α- errors. And this catalogue was included in N30 and the FK4 as an absolute catalogue!

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