DATA STORAGE REQUIREMENTS IN RELATION TO RADIO INTERFEROMETRY OBSERVATIONS

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Summary

Preliminary results of a search for observational data of radio sources are presented. Emphasis is put on those items which are imperative to make such a data collection amenable to astrometrical exploitation with a view to the identification of optical and radio positions, and the selection of suitable radio stars as reference points for other galactic and extragalactic objects.

1. Introduction

In the past years radio interferometry observations of radio stars and compact extragalactic radio sources yielded positional data which are competitive with meridian circle observations. Apart from minor exceptions radio star positions have been derived from observations by means of short baseline interferometry (SBI), while positions of extragalactic radio sources were obtained by SBI (Elsmore and Ryle, 1976; Brosche et al., 1973) as well as by very long baseline interferometry or VLBI (Rogers et al., 1973; Cohen, 1972).

From this background the existing fundamental astrometric system receives new impulses (e.g. Fricke, 1972), and the role of radio interferometry in the redetermination of astronomical constants has been recognized. Before, however, extragalactic radio sources become eligible as representatives of an extragalactic reference frame which ought to be formally related to the conventional stellar reference system as closely as possible some consistent efforts in acquiring and treating of observational data are indispensable.

C. Jaschek and G. A. Wilkins (eds.), Compilation, Critical Evaluation, and Distribution of Stellar Data. 77-83.

2. Celestial Radio Sources as Reference Points

It is practical to distinguish between radio stars of the Galaxy and compact extragalactic radio sources, the latter ones being comprised of two types: (1), radio sources emitting in the radio frequency domain only and, (2), radio sources with optical associates. While the first type is simply and solely capable to establish a radio astronomical reference system independent of the adopted stellar system, the second type possesses also the potentiality of tying the radio system into the stellar system under the hypothesis of coinciding optical and radio centres of the sources (Fricke, 1974; Walter, 1976). On comparing optical and radio positions of appropriate extragalactic objects the disclosure of inhomogeneities across the sky and, perhaps, their elimination is rendered possible.

Other than extragalactic radio sources the radio stars are affected by proper motions and, hence, are no ideal reference points. Nevertheless they are invaluable intermediaries between the highly accurate positions of extragalactic radio sources and the stars of the fundamental stellar reference system, provided sufficient radio stars are tied to it. Furthermore, they are instrumental in supplying the radio observations with the zero point of right ascension. Unless either appropriate radio sources in the planetary system or precise lunar occultations of radio sources are available, the radio astronomical reference system suffers from the deficiency of letting the vernal equinox undetermined. - At all events, referencing of extragalactic radio sources to the conventional stellar system is one of the presuppositions for further refined studies on kinematics and dynamics of the Galaxy.

3. Extragalactic Radio Sources

To date radio interferometric position measurements of some astrometrical bearing are found in nine lists which are compiled in Table 1. Five of them comprise positions of extragalactic radio sources obtained by means of short baseline interferometry and the remaining ones contain positions derived from VLBI observations.

Radio positions are dependent on the fixing of the origin of right ascension. Since the observing groups adhere to different conventions, their individual results impede an immediate comparison, but suggest to have recourse to FK4 as an expedient. Pursuing along this line Moran (1975) arrived at standard deviations in right ascension and declination of the order of 0.1 arc sec. Besides, the comparison was impaired by the small number of sources common to the lists and by processing measurements acquired over a wide range of frequencies, because different frequencies may refer to different locations of the emission centres. Furthermore, interferometry over baselines several thousand kilometers long tends to resolve the

Establish-ment	Technique	Length of Baseline [km]	Freq. [MHz]	Number of Sources	$\sigma(\alpha)$ $\sigma(\delta)$	Comments	References
RRE, Malvern	SBI, phase	0.7	2695	159	$0^{s}.03$ 0".4	relat.posit.	Adgie et al.,1972
NRAO,Green Bank	SBI, phase	2.7	2695 8085	59	$0^{s}.03$ 0".5	rel.RA abs.DECL	Brosche et al.,1973
WSRT,Wester-bork,Holl.	SBI, phase	1.6	1415	233	$0^{s}.07$ 1"	rel.RA rel.DECL	Katgert, 1973
REE, Malvern	SBI, phase	0.7	2695	161	$0^{s}.03$ 0".5	relat.posit.	Adgie,1974
Mullard, Cambr.,Engl.	SBI, phase	5	5000	53	$0^{s}.008$ 0".03	rel.RA abs.DECL	Elsmore et al.,1976
Cal.Tech., Pasadena	VLBI, fringe rate	∿4000	7850	11	$0^{s}.013$ 0".2	rel.RA rel.DECL	Cohen,1972
MIT,Cambr., Mass.	VLBI,del.and fringe rate	845 3930 3325 ∿4000	7900	12	$0^{s}.006$ 0".1	rel.RA quasi abs.DECL	Rogers et al.,1973
MIT,Cambr., Mass.	VLBI,del.and fringe rate	845 3930 3325	1660 7900	8	$0^{s}.01$ 0".2	rel.RA abs.DECL	Whitney,1974
NRAO,Green Bank	VLBI, fringe rate	3325	1428	13	$0^{s}.03$ 0".3	rel.RA abs.DECL	Hemenway,1974

Table 1. Review on radio interferometric position measurements of extragalactic radio sources

radio sources and, as a consequence,the generated signal exhibits much complexity leading in certain cases to ambiguous positions. This effect is rather widespread since, virtually, most extragalactic radio sources show some angular structure.

Once the accuracy of the VLBI technique has been fully realized the evaluation of the observational data with a view to precise position determination must account for the dependence of the measurements on frequency and baseline length.

4. Radio Stars

On searching the literature for galactic radio sources about seventy of these objects were found and for 52 of them the radio emission is attributed to a star. Their positions are plotted in Fig.1. The distribution of the objects is far from being uniform; they accumulate distinctly in the direction to Cygnus and to the galactic centre. For about 25 of them the places have been determined by radio interferometric measurements to an accuracy of better than one tenth of a second of arc in both coordinates on the average.

A classification of radio stars by apparent magnitude, radio flux and frequency is attempted in Table 2. The majority of the observations have been made with the NRAO interferometer of 2.7 km baseline length; a few observations each were provided by the 5 km Cambridge interferometer and by the Westerbork interferometer.

Numerous radio stars produce only low radio fluxes, thus complicating precise position determination, especially when, in addition, binary stars are involved and radio emitting and optical components urge on proper identification. Further aggravation is caused by the flare stars which at times are bright according to radio astronomical standards but are characterized by variable fluxes.

Although the present overall situation is not yet quite ideal for imparting to radio stars the role of reference objects, it will steadily improve when radio astronomers succeed in making repeated observations of the same radio stars at different epochs under identical instrumental conditions, and in decently distinguishing between absolute and relative position determinations in the specific sense of radio interferometry.

5. In Conclusion

The positional data obtained so far through radio interferometry demonstrate the feasibility of setting up a reference system of extragalactic radio sources and relating it to the stellar system. Before radio sources really qualify as basic constituents

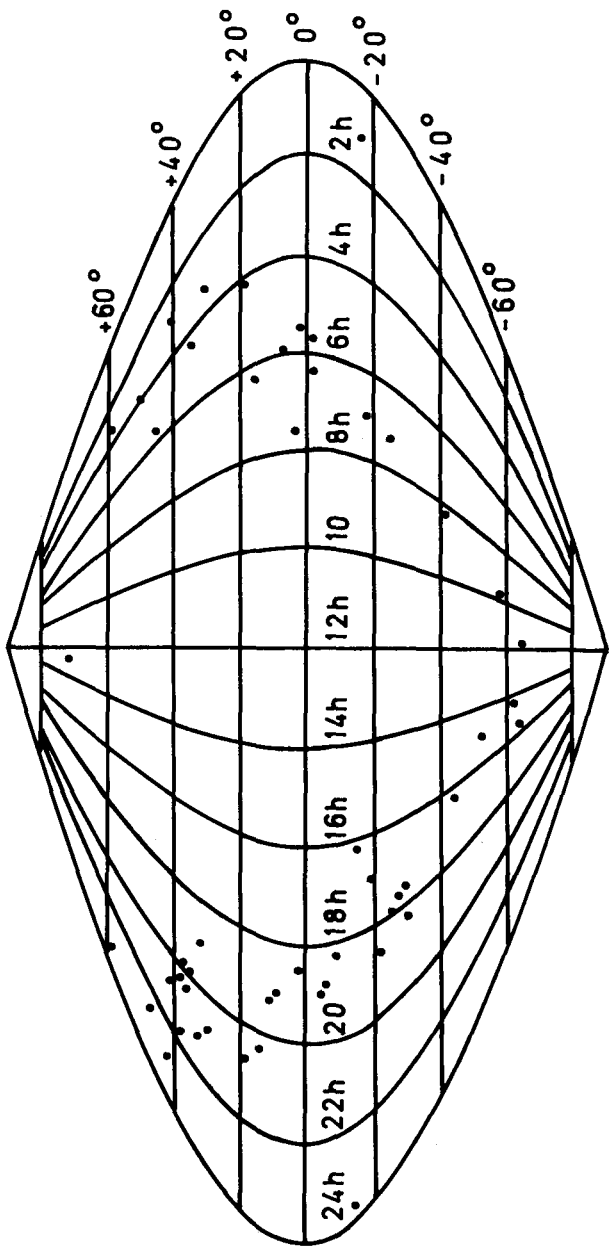

Fig. 1. Distribution of radio stars: northern and southern hemisphere with 29 and 23 stars respectively.

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	No.of Radio Stars	Radio Flux S [10^{-29} Wm^{-2} Hz^{-1}] *)				No.of interferom. obs.of radio stars				FK4 st. AGK3 st. SAOC st.	Flare stars Norm.single st. Binary stars
						MHz					
		<10	10..20	20..50	>50	1415	2695	5000	8085		
m≤ 7.0	9	4	3	1	1		5	2	5	$^{5}6_{8}$	$^{0}2_{4}$
7.0<m≤ 9.0	10	2	3	1	4	1	4		5	$^{7}{}_{8}$	$_{4}$
9.0<m≤11.0	7	1			6		3		3	$_{1}$	$^{1}{}_{1}$
11.0<m≤14.0	23	2	1	3	11	2	5	1	5		3
14.0<m	3			2	1	4	3	3	3		
Total	52	9	7	7	23	7	20	6	21	$^{5}13_{17}$	$^{4}2_{9}$

Table 2. Radio star classification by apparent magnitude, radio flux and interferometric observation techniques.
*) For some of the stars quantitative flux measurements are not expressly stated.

of the radio astronomical reference system dozens of absolute interferometric observations of some tens of extragalactic radio sources uniformly distributed over the sky are required with several years' of epoch spacing. Uncertainties in determining positions from VLBI measurements are conveniently avoided if the baseline geometry and the technical features of the interferometers are kept constant to a great extent.

Acknowledgement

In searching the literature for radio stars the author could avail of the catalogue of radio emission of stars by Wendker (1975).

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