PRELIMINARY PRECISE RADIO/OPTICAL POSITIONS OF SELECTED STARS

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ABSTRACT

Positions of the radio emission associated with stars were determined along with precise optical positions of the stars. The high precision obtained shows that radio star observations are a practical means of determining the relationship between the optical and radio reference frames.

THE OBSERVATIONS

The radio observations were made with the Very Large Array in the high resolution ("A") configuration. The available baselines ranged from 1 to 31 kilometers in length. The radio emmision associated with stars is often weak, usually only a few millijansky, so the observations were made in the continuum at 6 cm (4885 MHz) with a bandpass of 50 MHz. In this mode the Very Large Array is most sensitive. The observations were made in a differential fashion with respect to a quasar which was part of the standard extragalactic reference system (Argue et al. 1984). The angular distance between a standard quasar and a radio emitting star ranged from 1 to 15 degrees. The internal precision of the position of the radio emission was 0.02 arc seconds. Restricting the choice of a reference quasar to members of a standard catalog puts some limitions on the precision because the nearest quasar to a star displaying radio emission is sometimes not part of an adopted reference. The precision given above is not the best possible value, some improvement is obtainable by using quasars that are closer in angular distance to the stars. In the table below twentyfour stars are listed along with their reference quasars. Most of radio emitting stars are bright in the optical region. Almost all of them are 9th magnitude or brighter. In an astrophysical sense they are a heterogenous group. There are a few luminous early-type stars, a late type star, some very closely interacting doubles, and a few wide pairs. It is likely that the continuum radio emission that we observe is the result of several emissions mechanisms, thermal and nonthermal. The physical details about the sites of radio emission from these stars are not understood.

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Very Large Array Radio Positions for Selected Stars

Stars Displaying Radio Emission	Reference Quasar
Algol	0248+430
"	0316+413
UX Ari	0333+321
HR 1099	0336-019
b Per	0300+471
HD 50896	0727-115
KQ Pup	0727-117
"	0859-140
54 Cam	0831+557
RS CVn	1404+286
FK Com	1323+321
HR 5110	1404+286
Sigma CrB	1611+343
Antares A	1622-297
WW Dra	1437+624
9 Sgr	1730-130
Z Her	1749+096
FR Sct	1741-038
Beta Lyr	1751+288
HD 193793	2005+403
V729 Cyg	2005+403
VV Cep	2021+614
RT Lac	2200+420
AR Lac	2200+420
SZ Psc	2320-035
HD 224085	2337+264

In comparing the radio position with the optical position one finds that the uncertainty in the value of the proper motion is very important. In order to minimize the lever arm effect of these errors, optical observations were made contemporaneous to the radio observations. Usually the the optical observations were made within 1.5 years of the radio observations. At present optical positions have been determined for sixteen of the above stars. The astrograph of the Hamburg Observatory was used to find a differential position of the radio star with respect to an optical reference system, the AGK3RN in most cases or else the FK4. For some of the brighter stars a long focal length instrument with a grating was used. The estimated internal precision of the optical positions is 0.05 arc seconds.

DISCUSSION

Parallax effects were removed from the observed optical and radio positions. When available trigonometric parallaxes were used, but for some stars a photometric parallax had to be adopted. For most of the stars the effects of parallax were negligible. Comparison of the positions is sometimes complicated by orbital motion in a multiple star system, e. g. Algol. For HR 1099 and UX Ari, we have radio observations covering a five year interval. The proper motions determined from the radio observations are in good agreement with the optical proper motion.

Since the positions of the radio stars were obtained differentially, with respect to a standard reference frame (either the optical or the quasar systems), then the difference between the optical and radio positions for a given star shows the difference between the optical and radio systems. With this data we find systematic differences betweeen the two reference frames that are similar to those found by de Vegt and Gehlich (1982) using quasars. If one can assume that the radio and optical emission coincide for both radio stars and quasars, then this maybe evidence for systematic differences between the two references frames. The radio stars are between 1st and 9th magnitude, while the quasars are between 17th and 19th magnitude. That they have similar (optical-radio) trends shows that the difficulties of calibrating the optical system, i. e. having to establish a secondary reference frame of stars of 12th to 14th magnitude, can be overcome with care. In the case of the radio stars one must be cautious because most of the stars have only been observed once. More radio and optical positions and additional radio stars are needed to establish the relationship between the optical and extragalactic reference frames. Papers giving details of the observations and the comparison of the two reference frames are being submitted to the Astronomical Journal.

CONCLUSIONS

Radio and optical observations show that the positions of stars can be determined with high precision. Possible trends in the differences between the optical and radio positions could be evidence of systematic differences between the optical and extragalactic reference frames.

REFERENCES

Argue, A. N. et al. (1984) Astron. Astrophys., vol 130, 191.
de Vegt, C. and U. K. Gehlich. (1982) Astron. Astrophys., vol 113, 213.

Discussion:

NIELL: What was the quasar position which you used?
FLORKOWSKI: That of the IAU Working Group of Commission 24.
LIESKE: In your plot you indicated a spread of about 0\".2 in optical/radio positions. What is the approximate uncertainty in the optical positions?
FLORKOWSKI: About 0\".05.

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