REVISED AND IMPROVED POSITIONS OF SOUTHERN VARIABLE STARS

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Received 22 February 1990

Abstract

Improved positions for variable stars located south of the equator are being determined by measuring the first-epoch plates of the Yale-San Juan astrometric survey. The new positions, referred to the system of the SRS, have an average standard error of 0".7 in both RA and Dec. Some of the differences between these new positions and those quoted in the **General Catalogue of Variable Stars** (Kholopov et al. 1985) are as large as one degree. Variable stars having more than one name assigned to them are also identified.

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1. Introduction

The Yale-San Juan or Southern Proper Motion (SPM) program is a joint project of the Yale University Observatory and the Felix Aguilar Observatory (San Juan, Argentina). The program was initiated in 1965 by the late Dr. Brouwer and Dr. Schilt, and it may be considered as the extension to the southern hemisphere of the Northern Proper Motion (NPM) program which is being carried out at Lick Observatory (Klemola et al. 1987).

The main purpose of the program is the determination of absolute proper motions, using external galaxies as a reference frame. In addition, the construction of a catalogue of anonymous faint stars (visual magnitude range 12 to 18) is also planned (van Altena et al. 1989).

The first-epoch plates were taken from 1965 to 1974. While the second-epoch plates are now being taken at the Yale Southern Observatory, at Yale we have started a number of pilot programs in order to test our measuring machines (PDS and the newly constructed Yale Survey Machine (YSM)), software, and the selection of objects to be measured, which are generally taken from the SIMBAD data base. After the objects to be measured are extracted from SIMBAD, we make a preliminary examination of the plate using the YSM in order to update the X-Y coordinates of galaxies and stars; scan codes (to be used in the parameters for the PDS measurement of the plate) are assigned at this phase of the program.

Variable stars are among the objects to be included in our SPM program. Due to the fact that the coordinates of these objects quoted in the **General Catalogue of Variable Stars** (Kholopov et al. 1985) (GCVS) are approximate (thus making impossible any automatic positioning of the stars for measurement by the PDS), it was thought that a prior improvement in the RA and Dec. of variable stars would benefit not only our SPM astrometric survey but also the astronomical community in general, particularly variable star researchers. We report in this paper the first results of new positions for confirmed variables located south of -67°.

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2. Plate Material

17 x 17-inch glass plates that cover an area of about 6°3 x 6°3 are being used for the SPM. Kodak 103a-O (blue, no filter) and 103a-G (yellow, plus GG 14 filter and preflashing) are used to photograph each field. The blue and yellow plates (taken simultaneously) are exposed for 2 hours (called the System I exposures). A second set of exposures is made (called the System II exposures), 2 minutes in length and offset from the System I exposures by about 1 minute of arc in the north-south direction. Both sets of exposures are symmetric around the meridian, with the System I exposures interrupted at the time of meridian passage to take the System II exposures. Both the blue and yellow plates are exposed through a parallel-wire objective grating with a four-magnitude grating constant. The combination of a long and short exposure plus the objective grating allows us to measure stars in the blue magnitude range of 6 to 17.

The SPM field centers (958 in total) lie at 5-degree intervals in declination giving approximately a 1-degree overlap in the north-south direction. The right ascension is adjusted in order to allow a 1-degree overlap east-west, although at large declinations (like the ones reported here) the east-west overlap can be well over a degree.

The plates used for the present study are those located in the zones from -70° to -90°. Images in the system of the System I exposure only are measured.

3. Star Selection, Plate Measurement, and Reduction

Confirmed variable stars located south of -67° are being isolated by searching the magnetic tape version of the GCVS. At the same time, SRS stars (to be used as a reference frame) are also extracted from the tape version of the SRS catalogue, which has been kindly supplied by Dr. Clayton Smith of the U.S. Naval Observatory (Washington, DC).

Variables and SRS stars are then combined in one catalogue for each plate. After the necessary transformation of the standard coordinates into the system of the YSM, the plate is previewed in order to update the X-Y coordinates of the variable and the reference stars. Each of the variables is identified using the finding chart recommended in the GCVS. If for any reason the star is not identified or the finding chart is not available to us, the star is deleted from the files. Due to the plate overlap, the same variable is generally measured more than once, the average at the present being 1.6 times.

Each plate is measured using the high magnification mode available in the YSM, which during the calibration procedure showed that a stellar image position can be determined with an accuracy of ±10 microns (about 0"55 on our plates). The X-Y measurements are transformed to celestial coordinates using the SRS stars and a plate model which includes linear terms and quadratic plate tilt. Table I shows the average standard error for each declination zone. The errors in the Y coordinate seem to be systematically larger than the ones in X; this effect is, probably, the consequence of some backlash in the Y screw of the YSM that has not been totally eliminated in the measuring process.

4. Variables with Multiple Designations

Since each variable is identified using the finding chart recommended in the GCVS, we have been able to isolate confirmed variable stars with more than one designation assigned to them. One of these cases is the variable CR Mus. Although it is not our intention to make a judgment as to who discovered the variability of CR Mus, our search shows that Luyten (1933) was the first to announce this star as a variable, which received the provisional designation of 199.1933.

Later the star received its final designation of CR Mus. The GCVS (third edition) (Kukarkin et al. 1969) cites a finding chart published by Hoffmeister (1963).

More recently, Goossens et al. (1980) reported the discovery of 22 new long period variables in an area centered at RA=13^h and Dec=-70^o. Their star number 9 was named as FP Mus (see 65th Name-List of Variable Stars, Kholopov et al. 1981). A simple comparison between the charts of Goossens et al. (1980) with Hoffmeister (1963) and Marino and Walker (1975) (which is the finding chart for CR Mus recommended in the GCVS), clearly shows that both stars are the same. This allows us to conclude that CR Mus = FP Mus.

Although it is not so evident from the finding charts, a similar conclusion can be reached for DY Mus and FX Mus.

5. Results and Conclusions

Table II contains a representative sample of the newly determined positions. Column 1 gives the variable star name. In columns 2 and 3 we list the new RA and Dec (Equinox B1950.0, Epoch 1966.6-1973.5) which are referred to in the system of the SRS. Column 4 lists the number of individual positions (which is, in fact, the number of plates on which the star was measured) that were averaged to obtain the positions listed in Columns 2 and 3. In Columns 5 and 6 we have computed the differences (in minutes of time and arc, respectively) between the new positions and those quoted in the GCVS (in the sense new positions minus GCVS).

Table III lists those stars with the largest differences between the newly determined positions and those given in the GCVS. The format of Table III is the same as that of Table II.

We would like to thank Drs. Dorrit Hoffleit and Terry Girard for very interesting comments during the execution of this project. Our thanks also go to Dr. Janet Mattei, director of the AAVSO, and Dr. Arnold Klemola for making available numerous finding charts, and to Mr. Andy Layden who made available a tape copy of the GCVS (fourth edition) obtained originally from Dr. Wayne Warren, Jr.

This research is being supported in part by the National Science Foundation.

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TABLE I

Average Standard Errors (arc sec.)

Zone	No. of Plates Measured	RA	DEC
-80	6	0.65	0.68
-75	11	0.66	0.71
-70	8	0.62	0.70

TABLE II

New Positions and Differences from the GCVS (sample)

Variable		RA (1950)	DEC (1950)	Npos.	RA	DEC
DY	Aps	$17^h22^m54\overset{s}{.}884$	$-77°30'55\overset{''}{.}54$	4	$+0\overset{m}{.}081$	$-0\overset{''}{.}426$
EO	Aps	17 31 51.539	-74 26 09.75	2	+0.026	+0.137
HH	Aps	15 53 05.929	-74 39 03.04	1	+0.115	+0.349
LY	Car	09 17 58.830	-73 19 21.32	1	-0.120	-0.155
PW	Car	11 16 20.540	-74 18 21.38	2	+0.042	+0.144
WX	Cha	11 08 31.578	-77 20 50.93	3	-0.007	-0.049
AA	Cha	11 38 45.562	-80 53 23.97	2	+0.126	0.000
RS	Cir	13 47 52.444	-68 35 58.01	1	-0.043	+1.233
BW	Mus	11 28 47.253	-74 48 35.61	2	+0.021	+0.006
CV	Mus	11 42 08.979	-70 26 15.98	1	-0.400	-0.167
AH	Oct	20 25 08.708	-76 29 03.80	1	-0.138	-0.463
BS	Oct	19 41 35.613	-75 38 17.41	2	+0.010	+0.610
EV	Pav	19 33 12.556	-71 51 52.29	3	+0.043	+0.428
QZ	Pav	19 54 42.975	-71 31 28.76	1	0.000	+0.121

TABLE III

New Positions and Differences from the GCVS
Some of the Largest Differences

Variable		RA (1950)	DEC (1950)	Npos.	RA	DEC
FF	Mus	$12^h25^m52\overset{s}{.}634$	$-68°18'31\overset{''}{.}44$	1	$+1\overset{m}{.}627$	$-3\overset{''}{.}324$
FG	Mus	12 37 44.825	-69 50 35.58	2	+1.697	-3.393
FI	Mus	12 45 54.810	-69 46 14.09	1	+2.130	-1.334
FK	Mus	12 47 04.435	-70 12 09.45	1	+1.457	-5.658
FL	Mus	12 47 19.312	-70 25 54.70	1	+1.522	-4.911
FN	Mus	12 50 53.442	-71 56 08.60	1	+1.641	-7.944
FO	Mus	12 53 49.064	-67 45 54.85	1	+1.534	-4.314
FP	Mus	12 55 06.727	-74 00 59.79	1	+1.712	-9.097
FQ	Mus	12 55 10.287	-70 49 35.10	1	+0.655	+7.515
FR	Mus	12 56 19.033	-67 52 59.90	1	+1.551	-4.298
FS	Mus	12 56 59.161	-71 48 43.48	1	+1.653	+51.375
FT	Mus	12 57 15.632	-71 03 35.98	1	+1.777	-8.000
FU	Mus	12 59 59.369	-67 37 19.49	1	+1.556	-4.425
FV	Mus	13 07 38.778	-73 21 26.46	1	+1.830	-7.341
FW	Mus	13 08 04.847	-68 16 43.33	2	+1.714	-7.022
FX	Mus	13 13 31.622	-67 36 42.21	2	+1.527	-2.204
FY	Mus	13 14 59.396	-67 29 50.94	2	+1.407	-0.849
GG	Mus	13 26 49.937	-72 35 36.79	2	+1.966	-7.613
GI	Mus	13 28 36.775	-73 02 27.27	3	+1.996	-7.455