

POSITIONS, PROPER MOTIONS, AND MAGNITUDES IN THE AREA OF THE OPEN CLUSTER Tr 10

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RESUMEN

Se derivan las posiciones de 979 estrellas en el área de Tr 10 de 15 placas tomadas recientemente con el refractor del CIDA. Para la determinación de los movimientos propios, se usaron como la primera época 9 placas del Catálogo Astrográfico del Cabo. Los resultados nos hacen aparecer como dudoso que el objeto sea un sólo cúmulo.

ABSTRACT

Positions for 979 stars in the area of Tr 10 are derived from fifteen plates taken recently with the CIDA refractor. For the determination of proper motions nine plates of the Cape Astrographic Catalogue are used as first epoch. The results make it appear doubtful that the object is a single cluster.

Key words: PROPER MOTIONS – OPEN CLUSTERS

I. INTRODUCTION

Several years ago a program of modern positions and proper motions for selected open clusters was started at CIDA. Preference was given to those clusters for which only scarce or uncertain proper motion data were available. The open cluster Tr 10 is one such case. It falls within the Cape region of the Carte du Ciel, thus offering an old epoch of good quality. For the brightest stars an intermediate epoch is obtained from the Yale Zone Catalogues.

II. THE OBSERVATIONS

During the 1982-1983 season fifteen plates of Tr 10 were taken with the CIDA refractor which has a focal length of 10.5 meters and an aperture of 0.65 meters. It uses 16-cm by 16-cm plates. In all cases the exposure time, on Kodak 103aG-plates together with a Schott OG512 filter, was fifteen minutes. The limiting magnitude varies from plate to plate, mostly due to seeing variations. Also the plate center was varied somewhat in order to enlarge the covered area. The plate centers, their epochs, and their limiting magnitudes are listed in Table 1.

III. THE MEASUREMENTS

The plates were measured in pairs on a Zeiss PSK2 stereocomparator. This mode permitted the extension of the survey to extremely faint images, since in all cases their reality could be confirmed by their appearance on both plates. Naturally, pairs of plates with similar limit-

TABLE 1

THE CIDA PLATES

Plate No.	Epoch	R.A.		Dec.	V (lim)
		1950.0			
232	1982.02	8 ^h 46 ^m 6.50 ^s		- 42° 14' 9.3"	13.0 ^m
233	1982.02	46 6.55		14 14.4	13.0
249	1982.04	45 56.29		2 54.9	13.0
250	1982.04	45 56.74		2 51.6	13.0
256	1982.05	46 2.61		35 55.2	11.6
257	1982.05	46 2.94		34 58.7	11.6
270	1982.07	45 58.91		15 53.9	12.8
271	1982.07	45 58.57		15 50.3	12.8
273	1982.09	46 6.43		22 22.2	13.0
274	1982.09	46 6.80		22 20.8	13.0
318	1983.05	46 33.89		3 29.2	12.7
319	1983.05	46 36.09		3 40.8	12.7
320	1983.10	45 51.33		19 15.8	12.8
321	1983.10	45 52.37		19 23 8	12.8
323	1983.11	44 48.35		20 55.8	13.0

ing magnitude had to be selected. Along with the measurements of the rectangular coordinates image diameters were estimated for later conversion into magnitudes.

IV. THE REDUCTION

An automatic program was used which is described elsewhere (Stock, Della Prugna, and Cova 1984) for the reduction of the coordinates on each plate to a common system and for identifying objects common to two or more plates, or in common with the reference catalogue.

As reference source two options were available, namely the SAO Catalogue, or the Yale Zone Catalogue (Hoffleit 1970). We preferred the SAO Catalogue in order to use the positions of the Yale Catalogue as a second independent epoch.

The positions obtained have average mean errors for an object measured on one plate only, and depend strongly on the apparent magnitude. This magnitude dependence is shown in Figures 1a and 1b.

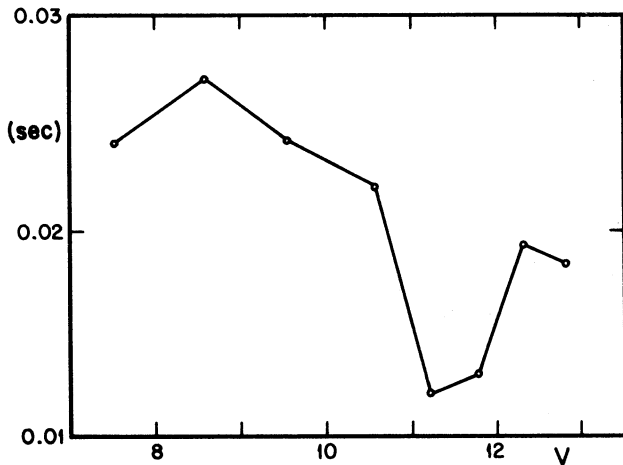


Fig. 1a. Average rms error of the right ascension obtained from CIDA plates for a single image as function of the apparent visual magnitude.

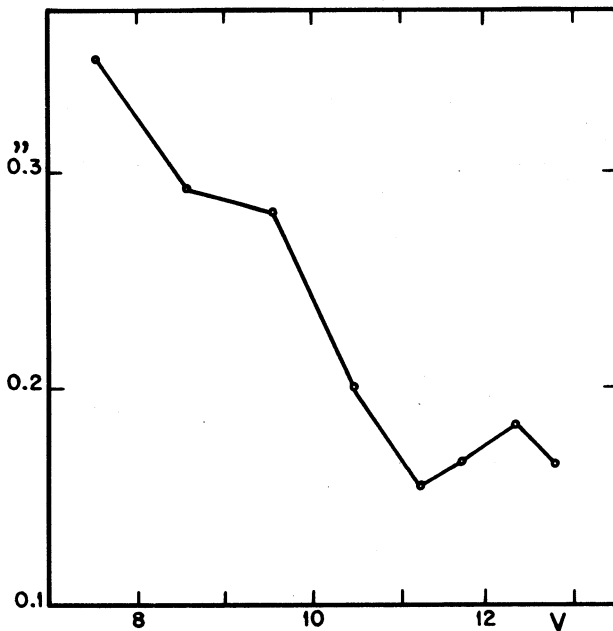


Fig. 1b. Average rms error of the declination obtained from CIDA plates for a single image as function of the apparent visual magnitude.

V. THE FIRST AND THE INTERMEDIATE EPOCHS

The oldest material on hand for the area under investigation is the Cape Astrographic Catalogue (Gill 1913). Nine plates, centered on Tr 10, were selected and their published rectangular coordinates treated in the same way as those of the CIDA plates. The plates used, their centers, and their epochs are listed in Table 2.

TABLE 2

THE CAPE PLATES

Field	Epoch	R.A. 1950.0		Dec.	
		h	m	°	'
-41 52	1906.35	8 ^h	36 ^m 48.29 ^s	-41°	10' 30.2"
53	1899.16	46	49.92	11	3.7
54	1902.15	56	51.66	11	35.7
-42 52	1901.08	31	45.84	-42	10 13.3
53	1902.15	41	47.49	10	47.1
-42 54	1901.08	51	49.25	-42	11 19.1
-43 52	1902.13	36	44.97	-43	10 30.3
53	1899.14	46	46.73	11	3.8
54	1900.12	56	48.59	11	35.9

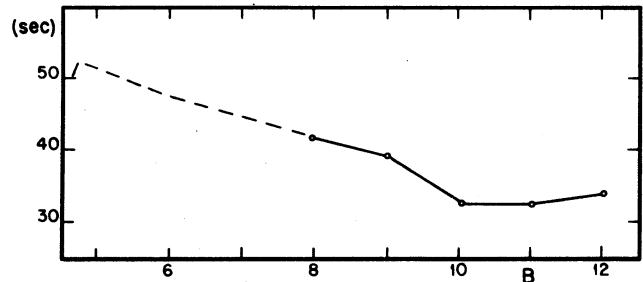


Fig. 2a. Average rms error of the right ascension obtained from Cape plates for a single image as function of the apparent photographic magnitude.

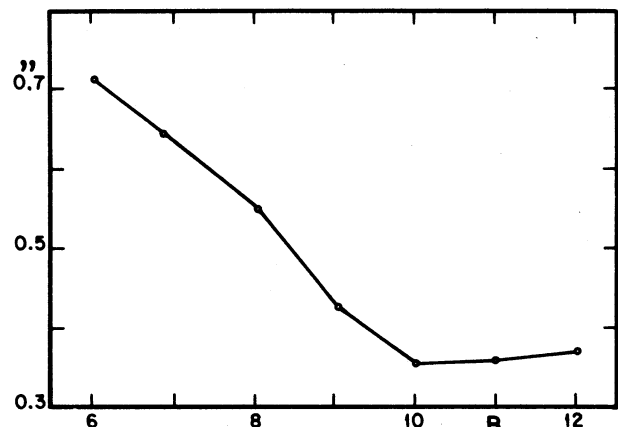


Fig. 2b. Average rms error of the declination obtained from Cape plates for a single image as function of the apparent photographic magnitude.

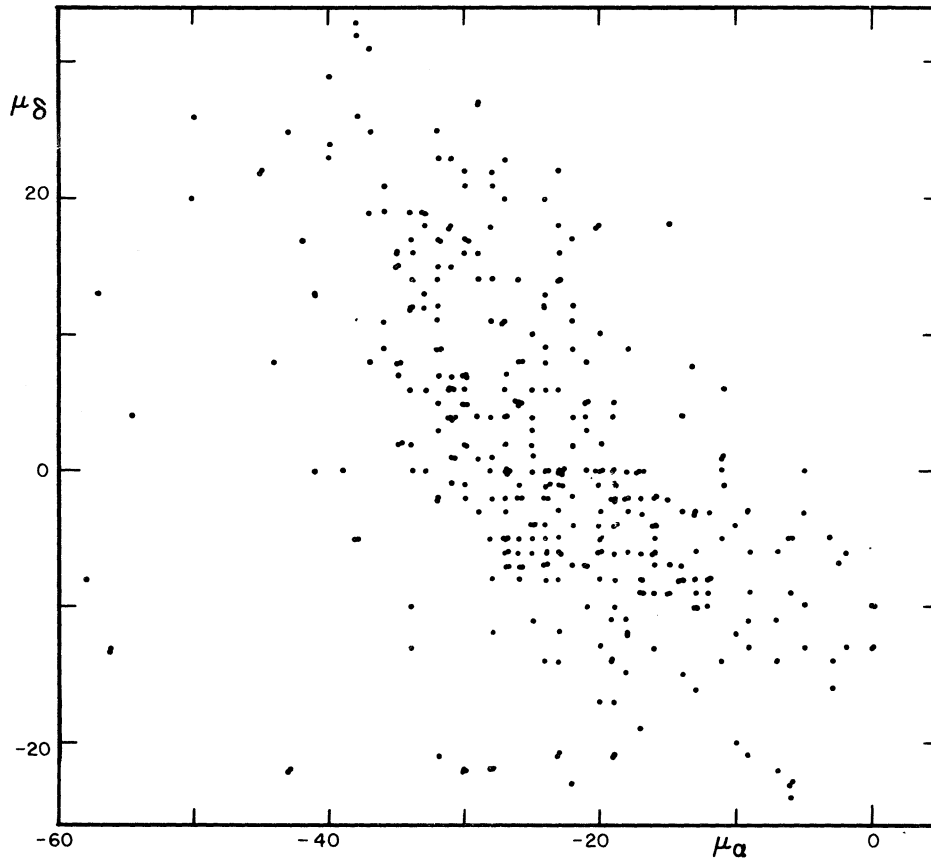


Fig. 3. Proper motion diagram for stars with more than one image measured for either epoch.

The average mean errors of the positions obtained from a single image are shown in Figures 2*a* and 2*b* as functions of the apparent magnitude.

The mean epochs for the CIDA plates and for the Cape plates are 1982.40 and 1902.15 respectively. The area of Tr 10 is also covered by Yale plates, with a mean epoch of 1942.05. There are forty stars in common to all three sources. For these we calculated the predicted 1942.05 positions, interpolating the Cape –and CIDA– positions. The results indicated a mean correction of -0.073 seconds of time and of -0.02 seconds of arc for the Yale positions in order to reduce them to the same system.

VI. THE PROPER MOTIONS

More than half of the stars found on the CIDA plates are also present in the Cape Astrographic Catalogue. For these stars proper motions could be derived with an epoch difference of eighty years. A plot of the proper motion in right ascension versus the proper motion in declination for all stars for which both epochs are based on more than one plate is shown in Figure 3. Evidently, the stars of large proper motion fall outside the diagram.

For stars also in common with the Yale Catalogue a linear time-dependent relation was fitted, star by star, to the three positions, giving unit weight to the Cape –and Yale– positions, and weight five to the CIDA positions. The latter is justified in view of the large number of plates and of the large focal length of the CIDA refractor. For most of these stars magnitudes and HD spectral types are also available. These are mostly late B-and early A-stars within the visual magnitude range 7.0-10.2, and could possibly form a typical cluster HR diagram. Their proper motions are plotted in Figure 4. The apparent relation between the two proper motion components, already present in Figure 3, is not compatible with the model of a single cluster.

VII. MAGNITUDES

Plate by plate the estimated image diameters were calibrated with the visual magnitudes given by Lyngå (1957). The linear or multi-linear relations found were extrapolated to the plate limit. Thus each image diameter estimate could be converted into a visual magnitude. The average mean error of a single estimate was found to be about 0.2 magnitudes.

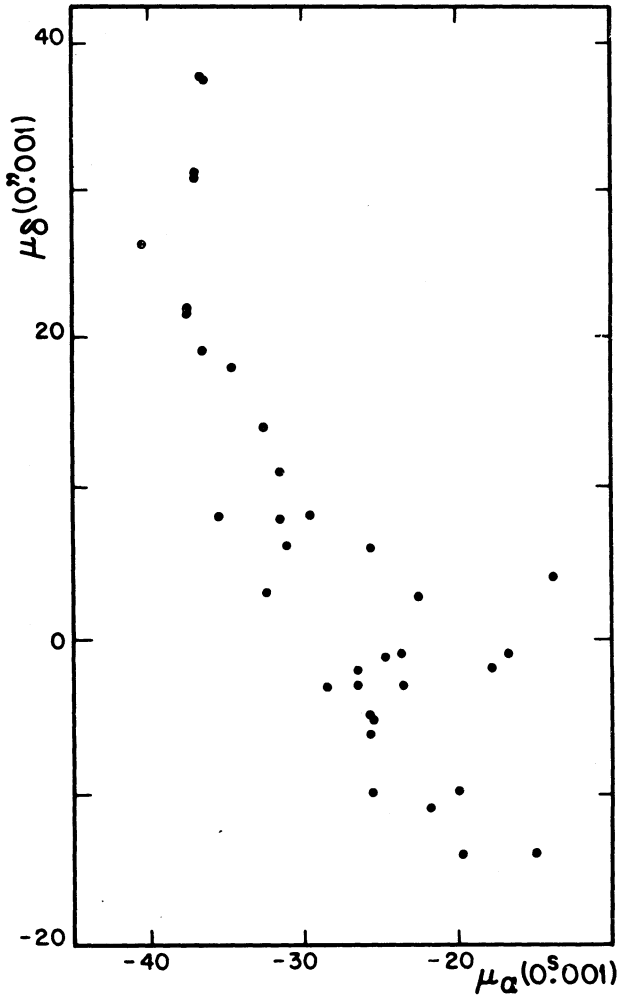


Fig. 4. Proper motion diagram for late B- and early A-stars within the visual magnitude range 7.0-10.2.

For the Cape plates magnitudes are given for star brighter than photographic magnitude 10.3. For the fainter stars image diameter estimates on two different scales are given. A crude conversion into magnitude could be derived for these estimates.

VIII. NGC 2671

Possible members of the open cluster NGC 2671 are present on several of the CIDA plates. Unfortunately they are beyond the limit of the Cape plates, such that no proper motions can be given for this object.

IX. THE CATALOGUES

The final data derived from the CIDA plates are given in Table 3:

- column 1: running number,
- columns 2 - 4: R.A., equinox 1950.0, epoch 1982.4
- columns 5 - 7: Dec.,
- column 8: visual magnitude, derived from CIDA plates,
- column 9: number of images measured on CIDA plates,
- column 10: photographic magnitude, derived from Cape plates,
- column 11: number of images measured on Cape plates,
- column 12: proper motion in R.A. in units of 0.0001 seconds of time year⁻¹,
- column 13: proper motion in Dec. in units of 0.001 seconds of arc year⁻¹.

TABLE 3

THE CATALOGUE
POSITIONS, MAGNITUDES AND PROPER MOTIONS

No.	R.A.	Dec.	m_V	n_V	m_{pg}	n_{pg}	μ_α	μ_δ	No.	R.A.	Dec.	m_V	n_V	m_{pg}	n_{pg}	μ_α	μ_δ
1	6 42 32.632	-42 42 22.32	12.7	1					19	8 42 50.077	-42 19 21.61	12.6	1				
2	8 42 33.655	-42 13 55.32	12.4	1					20	8 42 50.155	-42 16 33.40	12.5	1				
3	8 42 36.039	-42 16 2.76	10.3	1	16.2	2	-7	-11	21	8 42 50.332	-42 36 45.61	12.6	1				
4	8 42 36.050	-42 10 12.74	12.7	1					22	8 42 50.681	-42 38 36.86	12.1	1	12.1	1	-30	3
5	8 42 36.561	-42 27 59.79	3.1	1	6.6	2	-32	44	23	8 42 51.566	-42 25 45.24	12.8	1				
6	8 42 36.706	-42 13 56.66	11.8	1	12.0	2	-13	22	24	8 42 53.747	-42 21 7.03	12.7	1				
7	8 42 36.716	-42 39 36.39	12.6	1					25	8 42 54.914	-42 39 55.65	12.6	1				
8	8 42 37.622	-42 40 48.76	12.7	1					26	8 42 56.453	-42 5 32.68	12.7	1				
9	8 42 40.220	-42 27 37.27	10.2	1	9.7	2	-27	34	27	8 42 57.046	-42 40 13.64	12.7	1				
10	8 42 41.839	-42 43 8.64	12.5	1	12.1	1	-51	42	28	8 42 57.262	-42 41 51.46	12.6	1				
11	8 42 43.367	-42 14 51.61	9.2	1	8.6	2	-14	23	29	8 42 57.467	-42 27 0.72	6.9	1	7.7	2	-9	-27
12	8 42 44.454	-42 34 11.71	12.8	1					30	8 42 59.511	-42 32 31.71	12.8	1				
13	8 42 44.526	-42 23 21.71	6.9	1					31	6 43 3.266	-42 40 21.92	11.6	1	11.7	2	-31	4
14	8 42 47.772	-42 23 59.70	12.6	1					32	8 43 4.635	-42 18 57.08	12.2	1	12.0	2	-21	1
15	8 42 46.025	-42 37 52.53	12.5	1					33	6 43 4.769	-42 14 6.47	10.6	1	9.6	2	-24	1
16	8 42 46.314	-42 10 58.97	12.7	1					34	8 43 4.722	-42 44 30.52	12.2	1	12.1	1	-35	1
17	8 42 46.744	-42 17 39.01	12.4	1					35	6 43 4.855	-42 27 3.79	11.0	1	10.9	2	-36	2
18	8 42 49.911	-42 41 6.07	12.5	1	11.9	2	-14	34	36	8 43 5.078	-42 26 21.38	11.2	1	11.9	2	-30	1

TABLE 3 (CONTINUED)

Io.	R.A.	Dec.	m_V	n_V	m_{pg}	n_{pg}	μ_α	μ_δ	No.	R.A.	Dec.	m_V	n_V	m_{pg}	n_{pg}	μ_α	μ_δ
5	6 46 8.568	-42 24 4.71	12.6	10					932	8 48 22.319	-42 3 9.57	12.6	2				
6	8 48 8.728	-41 42 26.78	10.2	2	10.0	2	-24	-8	933	6 46 23.196	-42 26 34.79	12.8	2				
7	6 46 9.163	-42 36 46.71	10.2	10	9.6	2	-25	-11	934	8 48 23.214	-42 9 9.41	12.8	2				
8	8 48 9.210	-42 40 16.29	10.4	4	10.1	2	-30	17	935	6 46 23.467	-42 12 26.68	10.6	4	10.4	2	-13	-6
9	6 46 9.367	-41 44 54.83	12.1	2	11.6	1	-3	-1	936	8 48 27.242	-41 45 22.95	12.5	2				
10	8 48 9.650	-42 25 53.23	12.7	2					937	6 46 27.491	-42 0 36.03	9.5	2	9.0	2	-34	12
11	6 46 10.153	-42 39 55.63	11.6	2	11.6	1	-24	-15	938	8 48 27.504	-42 0 10.08	10.9	2	10.0	2	-5	-10
12	8 48 10.937	-42 41 4.46	12.3	2					939	6 46 27.662	-42 9 29.46	12.4	2				
13	6 46 12.674	-42 50 54.43	10.1	2	9.4	2	-23	-14	940	8 48 28.516	-42 23 10.58	10.1	2	10.2	2	-21	-7
14	8 48 12.625	-42 5 29.16	11.9	8	11.6	2	-27	-5	941	8 46 30.247	-41 56 36.42	9.9	2	9.2	2	-14	-8
15	6 46 13.694	-42 16 33.66	10.1	10	9.6	2	-13	-9	942	8 48 30.927	-41 42 0.60	8.7	2	8.7	2	-5	-13
16	8 48 14.026	-42 14 19.61	12.7	4					943	6 48 31.689	-41 54 9.44	6.1	2	6.4	2	-4	-26
17	6 46 14.546	-41 45 40.65	11.0	2	10.4	2	-2	-13	944	8 48 31.842	-41 57 11.76	12.3	2				
18	8 48 14.601	-42 22 8.17	12.7	2					945	6 48 33.216	-42 4 38.24	12.4	2				
19	6 46 16.177	-41 55 10.47	7.6	4	7.6	2	-7	-11	946	8 48 33.275	-41 54 9.63	10.8	2	11.4	2	-3	-16
20	8 48 16.856	-42 22 24.27	7.4	6	8.2	2	-10	-20	947	6 46 35.155	-42 10 33.25	10.0	2	9.7	1	-41	5
21	6 46 16.853	-41 39 31.73	10.7	2	11.7	2	-34	16	948	8 48 36.428	-41 51 6.57	10.1	2	9.6	2	-12	-8
22	8 48 16.862	-42 5 12.87	12.7	2					949	6 46 37.101	-41 56 7.66	11.0	2	10.4	2	-6	-9
23	6 46 17.066	-42 23 40.13	12.2	6	12.1	1	-19	-6	950	8 48 37.338	-41 52 41.68	11.4	2				
24	8 48 18.075	-42 26 18.53	10.9	6	11.7	2	84	-58	951	6 46 40.636	-42 14 35.72	11.6	2	11.6	1	-1	2
25	6 46 18.346	-42 26 21.03	11.4	6	10.4	2	17	-41	952	8 48 40.969	-41 48 11.25	12.4	2				
26	8 48 20.171	-42 23 35.40	11.8	6	11.6	2	-8	-9	953	6 48 44.164	-42 22 16.08	10.5	2	10.4	2	-7	-14
27	6 46 20.569	-42 23 59.62	12.7	4					954	8 48 45.021	-41 57 39.47	11.2	2	11.8	2	0	-13
28	8 48 20.989	-42 23 21.58	12.7	4					955	6 46 45.262	-41 56 50.16	10.6	2	10.4	2	-66	89
29	6 46 21.494	-42 41 2.74	12.6	2					956	8 48 45.544	-41 45 34.75	10.0	2	9.6	2	-10	-4
30	8 48 21.969	-41 54 29.57	12.6	4					957	6 46 46.562	-41 44 35.56	12.1	2	11.4	2	-2	-6
31	6 46 22.154	-42 25 53.04	11.6	6					958	8 48 46.976	-41 57 11.50	11.0	2	11.4	2	-28	-64
									959	6 46 47.066	-42 2 16.39	12.2	2				

Positions and magnitudes are also available for the entire area covered by the nine Cape plates. The catalogue contains 2826 stars, and can be made available in machine output form.

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