ΑΣΤΡΟΝΟΜΙΑ.— **A Photographic Survey for New Flare Stars,** *by* *C. Poulakos and R. Weinberger* *. Ἀνεκοινώθη ὑπὸ τοῦ Ἀκαδημαϊκοῦ κ. Ἰω. Ξανθάκη.

INTRODUCTION

The close association between flare stars and regions of emission nebulosity and obscuring gas and dust clouds has been pointed out by several investigators such as Westerlund (1960), Hidajat (1962) and Sanduleak (1968, 1969).

The obscured areas of Cassiopeia in the Milky Way has given to us a good argument to search for so far unknown field flare stars in these regions.

In the course of a photographic investigation on three areas in Cassiopeia centered respectively at R. A. $= 0^h 0^m$; Dec. $= +62° 10'$, R. A. $= 0^h 27^m$; Dec. $= +63° 00'$, R. A. $= 0^h 54^m$; Dec. $= +62° 41'$, four new flare stars have been discovered. Each of the studied regions has circular shape and covers approximately 14 sq deg in area. The fields were chosen on the basis of their obsuration and the interstellar absorption catalogue published by Neckel (1967) was also considered.

The survey consisted of three steps. First the fields were examined on objective prism spectral plates. Second direct multiple exposure plates in the B range ($\lambda_{eff} = 4350$ Å) were derived. In the end a photographic photometry on direct V photometric plates as well as on the blue and the red plates of the Palomar Sky Survey (hereafter referred to as PSS) was carried out. The properties of the flare stars reported in the present paper are listed in Table 1.

OBSERVATIONS

The photographic observations were made with the help of the 25/40/90 cm Schmidt type telescope of the Heidelberg Observatory in 1975 from July to November. For the survey of flares the Haro's multiple

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exposure method was used. Every field was covered by three multiple exposure plates as well as by direct V photometric plates. The B, plates have been taken through a BG 12 + GG 13 filter with 4 or 3 successive exposures each of 6.5 minutes reaching a limiting magnitude of $B = 15^m.60$. The V, plates have been taken through a GG 14 filter and the m_{lim} was found equal to $V = 15^m.50$. The time interval between two successive exposures was less than 15 seconds.

The cited Schmidt camera was used to obtain the necessary spectrographic material. Spectra were seccured with a 10° UBK — 7 objective prism attached to the telescope. The dispersion was 3500 Å/mm at the atmospheric A-band. The spectra have a length of 0.6 mm corresponding to the wavelength range from 6800 to 8800 Å and the exposure time was 35 minutes. The spectra were classified according to the strength of molecular bands of TiO and VO using the standards given by Nassau and Velghe (1964). A luminosity separation was not possible with the low dispersion spectra used in the present paper, however, giant M stars are favoured in such a classification (Mavridis, 1971).

PHOTOMETRY

The multiple exposure plates were examined with the VIDEOMAT Comparator of the Max - Planck - Institut für Astronomie in Heidelberg as well as with a binocular microscope.

The photographic photometry was carried out with the help of the iris photometer of the Research Center for Astronomy and Applied Mathematics of the Academy of Athens. The measurements were reduced to the V and B magnitudes of the UBV system using for calibration standard sequences from Hoag et al. (1961) and Hardorp (1960).

The probable error of an adopted magnitude from the internal consistency of measures made on the plates were $\pm 0^m.11$ for B and $\pm 0^m.7$ for V.

Stars found during the survey were identified on the blue and the red PSS plates. The R^{PSS} and B^{PSS} magnitudes were determined by

measurements of the diameters of the P(E)SS and P(O)SS stars, as suggested by Perek (1958). For calibration of the diameters of the stars the standard sequences given by Hoag et al. (1961) were used for the blue plates and for the red plates standard sequences from Kron and Smith (1951). Probable errors of the order of $\pm 0^m.3$ at the faint end of the calibration curves have been found for the R^{PSS} and B^{PSS} magnitudes. It can be argued, however, here that the photometric properties of the stars are hardly derived from the measurements in the PSS plates. Nevertheless, it should be pointed out on the other hand, that the main scope of the present work was to find new flare stars which should be measured photoelectrically in the future.

THE CATALOGUE

Flare stars were accepted when $m^{min} - m^{max} \geqslant 0^m.5$ mag and when more than one image were visible. When only one image was visible the star was accepted as flare star if the image was found coincident with a star visible either on the direct V or on the PSS plates.

The search has led to the discovery of 4 new flare stars listed in Table 1. The 1st column of Table 1 gives the serial number, the 2nd and 3rd columns give the α and δ for the epoch 1950. Column 4th gives the difference $\Delta m(B)$ during the flare. The next three columns give the photometric results. Column 8th gives the spectrum and the last column gives the date of flare up.

The coordinates given in Table 1 were derived from measurements made on the PSS charts. Standard deviations of the order of $\pm 0^m.2$ in R. A. and $\pm 1'.7$ in Declination were derived by comparing the measured and the catalogued coordinates of the SAO stars lying within the surveyed regions.

Identification charts for the flares are given in Figure 1. In Figure 1 east is at the top, north is to the right. All charts have the same scale i.e. 6 cm correspond to 11.4 arc min.

TABLE 1

4 New flare stars

N^{O}	α (1950)	δ (1950)	Δ m (B)	V	R^{PSS}	B^{PSS}	B - R	Sp.	Date
1	$23^h\ 52^m\ 21^s$	+ 61° 27′ 50″	$1^m.15$	$13^m.12$	$12^m.20$	$14^m.50$	$2^m.30$	M1	8 - 7 - 1975
2	$23^h\ 54^m\ 57^s$	+ 60° 36′ 30″	0 90	13. 90	13. 30	14. 80	1. 50	M1 - M2	7 - 7 - 1975
3	$00^h\ 13^m\ 10^s$	+ 63° 36′ 20″	1. 20	13. 20	12. 40	14. 40	2. 00	M2	8 - 7 - 1975
4	$00^h\ 27^m\ 42^s$	+ 62° 32′ 40″	1. 30	12. 76	12. 00	13. 90	1. 90	Red. M	8 - 7 - 1975

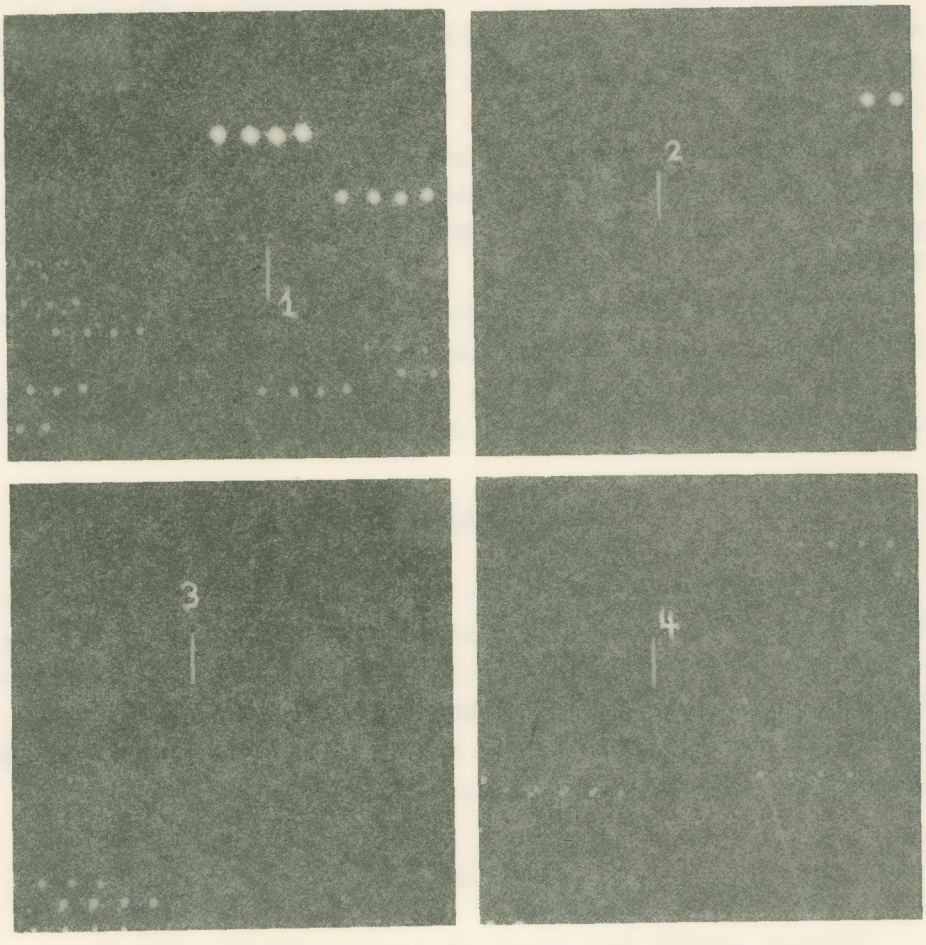

Fig. 1. Identification charts for the flares. East is at the top, north is to the right. All charts have the same scale i. e. 6 cm correspond to 11.4 arc minutes. The order of the exposures is from left to right.

DISCUSSION

No one star from our catalogue can be identified with stars from CIT survey by Neugebauer and Leighton (1969), although they found about 26 stars in our areas. The discovered flare stars, listed in Table 1, have not been found to coincide with other stars listed in the General Catalogue of Variable Stars by Kukarkin et al (1972) or in the Catalogue

given by Stephenson (1973). No further coincidences of the four objects with objects in other catalogues were found. The criterion for coincidence with previously known stars was a 3 σ box, where σ is the standard deviation in both α and δ.

The duration of the flares is generally within 27 min. During the survey no slow flares have been discovered. According to the definition given by Haro and Parsamian (1969) we must consider the stars of Table 1 as „fast" flare stars.

The observed amplitudes of the flares have been mostly between 1.0 and 1.30 magnitudes in the B colour of the UBV system.

The observed flare stars are relatively bright at minimum. The average B magnitude at minimum was near to $14^{m}.50$ mag.

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ΠΕΡΙΛΗΨΙΣ

Τέσσαρες περιοχαὶ λίαν πυκναὶ εἰς μεσοαστρικὴν ὕλην ἠρευνήθησαν τῇ βοηθείᾳ ἀμέσων φωτομετρικῶν πλακῶν ὡς καὶ φασματικῶν πλακῶν ληφθεισῶν διὰ τοῦ τηλεσκοπίου τύπου Schmidt τοῦ Ἀστεροσκοπείου τῆς Ἀϊδελβέργης. Ἐκ τῆς ἐρεύνης ἀπεκαλύφθησαν 4 νέοι ἀστέρες ἐκλάμψεως, τὰ δεδομένα τῶν ὁποίων παρέχονται ὑπὸ τοῦ πίνακος 1.

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★

Ὁ Ἀκαδημαϊκὸς κ. **Ἰωάννης Ξανθάκης**, παρουσιάζων τὴν ἀνωτέρω ἀνακοίνωσιν, εἶπε τὰ ἑξῆς :

Ὁ κ. Κ. Πουλάκος ἐν συνεργασίᾳ μετὰ τοῦ Γερμανοῦ ἀστρονόμου Weinberger Ἰνστιτούτου τῆς Ἀϊδελβέργης, ἠρεύνησε περιοχὰς ἐντόνου ἀκτινοβολίας ὡς καὶ περιοχὰς πυκνὰς εἰς μεσοαστρικὴν ὕλην. Αἱ ληφθεῖσαι φωτογραφικαὶ πλάκες ἠρευνήθησαν τόσον εἰς τὸ Max-Plank τῆς Ἀϊδελβέργης μὲ τὴν βοήθειαν τοῦ Videomat Comparator ὅσον καὶ εἰς τὸ Κ.Ε.Α.Ε.Μ. τῆς Ἀκαδημίας Ἀθηνῶν μὲ τὴν βοήθειαν τοῦ ἰριδοφωτομέτρου τύπου Becker.

Ἡ ἔρευνα ἀπεκάλυψε τὴν ὕπαρξιν 4 εἰσέτι νέων ἀστέρων ἐκλάμψεως.