ROYAL ASTRONOMICAL SOCIETY OF NEW ZEALAND

VARIABLE STAR SECTION.

CIRCULAR No. 193.

GU SAGITTARII.

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SUMMARY:- GU Sgr is shown to have superimposed on its typical R CrB type variation a semi-regular period of approximately 38 days, with an amplitude that changes from a few tenths of a magnitude to 1.5 magnitudes at certain stages of its main light curve.

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OBSERVATIONS: Table 1 lists visual observations of GU Sgr from JD. 2,435,618 (1956 May 24) to 2,440,536 (1969 Nov. 10). These results, mainly due to A.F. Jones, form a homogeneous series. Ten day means are given when two or more observations were made within a ten day period. This applies mainly from 2,439,940 when other observers made observations.

CHARTS & SEQUENCE: Chart 111, based on a photo kindly supplied by Yerkes Observatory, was published by Bateson (1). Lettered comparison stars were added to this chart after the first edition. V and B-V magnitudes for these stars were published in Circ. 187 (2), except for "d" for which the magnitude, 10.9, was the Harvard photometric value. This star is CoD -24° 14307 (HD 169441) and has a spectrum AO and photographic magnitude of 9.4. The Harvard photometric value of 10.9 is obviously in error. In the present paper a visual magnitude of 9.6 has been used, taken from Cordoba Resultados.

DISCUSSION: GU Sgr (HV 4053) was investigated by Luyten (3), who published a light curve from 183 Harvard plates for the years 1889 to 1926. Hoffleit (4) published a light curve based on over 600 Harvard and Nantucket plates taken from 1924 to 1959. Based on these results the G.C.V.S. (3rd Edition) lists GU Sgr as a variable of type R CrB with a photographic range of 11.3 to 15.0.

Table 2 lists minima below magnitude 12.0 taken from the foregoing light curves and from the observations included in this Circular. The dates are approximate because it is difficult to determine the precise dates from the small scale plots of Luyten and Hoffleit. For the current observations dates of minima have been taken as the dates on which the variable first reached its minimum brightness.

The behaviour of GU Sgr is typical of R CrB stars. For long intervals it fluctuates slightly around its normal maximum brightness of 10.4v. Such intervals are often followed by periods of frantic activity with fairly sharp, sudden decreases to 13.7v, with slower erratic recoveries, during which the variable often reaches an intermediate magnitude before declining again to a deep minimum.

The present observations show that superimposed on the erratic variations is a semi-regular period of 37-38 days with an amplitude that changes according to the whether the variable is at maximum brightness, declining, at minimum or rising. The period derived for this semi-regular variation is 37.9 days from maxima; 36.9 days from minima.

When GU Sgr is at normal maximum brightness the semi-regular variation is small, amounting to 0.4 magnitude at the most.

V.S.S. CIRCULAR No. 193 (cont).

Despite the difficulty of determining a period for this portion of the curve the observations appear to be satisfied by a mean cycle of 41 days. When the variable is declining to a minimum, or is at or near minimum brightness, the semi-regular variation can amount to 1.5 magnitudes These changes then occur in the shorter period of 26 days. It should be noted that the semi-regular fluctuations occur in a marked manner during the decline from maximum to an intermediate magnitude of 11.5 to 12.5. Then the steep decline sets in and the smaller fluctuations disappear in the steep portion of the decline.

Unless recovery to some intermediate magnitude is very steep the semi-regular fluctuations are most marked on the rise, amounting to 1.5 magnitudes at first and gradually decreasing in amplitude as the star brightens. During the rising phases, periods for the semi-regular variations were found of 38 days from the small maxima points and 33 days from the minima points.

It might be considered that the semi-regular fluctuations of the nature outlined are beyond the capacity of a visual observer to detect. When the amplitude is large this consideration must be dismissed. At maximum brightness when the variation is very small it might be considered to lie within the errors of visual observation, were it not for two facts. One is that the semi-regular period is obvious at other stages of the light curve. The other is that the results discussed have been derived from the records of an exceptionally skilled observer and comparison with photo-electric results on other stars has proved that his observations are extremely accurate.

It is concluded that GU Sgr is a typical R CrB star that has superimposed on the long term changes a semi-regular variation in a period of approximately 38 days. The amplitude of this short period variation changes from a few tenths of a magnitude near normal maximum brightness to 1.5 magnitudes, or more, at other phases of the main light curve. These variations are largest when the star falls from maximum to an intermediate brightness; at minimum and on the rise from primary minimum.

ACKNOWLEDGEMENTS: Our thanks are due to G. Van Biesbroeck for his photo, on which chart 111 is based; to P.J. Gordon and B. Menzies for determining the magnitudes of the sequence stars and to the Trustees of the Auckland Observatory for use of their instrument and equipment.

This paper has been made possible by the careful records of A.F. Jones to whom full credit must go. All reductions are the responsibility of the senior author and any defects in presentation are his.

1972 December 21

18 POOLES ROAD,
GREERTON.
TAURANGA, NEW ZEALAND.

REFERENCES:-

(1) Bateson, F.M., Jones, A.F. & Stranson, I. 1967. "Charts for Southern Variables;Series 4." Published by F.M. Bateson.
(2) Bateson, F.M., Gordon, P. & Menzies, B. 1972 Circ. 187, VSS,RASN
(3) Luyten, W.J. 1927 H.B. 852.
(4) Hoffleit, D. 1959. Ast. J. 64, 6 (1271), p. 241.

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V.S.S. CIRCULAR No. 193 (cont).

TABLE 1--OBSERVATIONS OF GU SAGITTARII.

J.D.	MAG.	No.	J.D.	MAG.	No.	J.D.	MAG.	No.	J.D.	MAG.	No.	J.D.	MAG.	No.
2,435,000+			2,436,000+			2,437,000+			2,438,000+			2,439,000+		
618	10.1	1	673	10.5	1	489	10.5	1	469	11.40	2	235	12.2	1
631	11.0	1	691	10.5	1	513	10.8	1	481	11.4	1	248	11.5	1
641	11.0	1	699	10.4	1	522	10.5	1	493	11.4	1	259	11.5	1
656	11.1	1	718	10.40	2	528	10.4	1	501	11.3	1	268	11.40	2
683	10.9	1	727	10.5	1	539	10.3	1	510	<11.4	-	290	11.40	3
698	11.00	2	736	10.90	2	558	10.55	2	522	11.4	1	299	11.4	1
713	10.3	1	748	10.5	1	570	10.5	1	530	11.3	1	321	11.40	2
730	11.15	2	756	10.4	1	579	10.3	1	534	11.0	1	330	11.07	3
738	10.60	2	771	10.47	3	587	10.5	1	536	10.7	1	340	11.4	1
760	10.6	1	782	10.4	1	604	10.4	1	559	11.40	2	350	11.20	2
772	10.1	1	788	10.55	2	614	10.5	1	567	11.2	1	358	11.2	1
791	10.1	1	803	10.5	1	699	10.2	1	587	11.1	1	369	11.1	1
880	10.4	1	810	10.40	3	734	10.5	1	596	10.8	1	379	11.1	1
897	10.3	1	820	10.30	2	759	10.7	1	608	11.1	1	393	11.3	1
930	10.6	1	831	10.4	1	765	10.6	1	623	10.5	1	397	10.6	1
969	10.3	1	841	10.1	1	774	10.9	1	633	11.0	1	407	11.0	1
984	10.3	1	847	10.0	1	793	10.4	1	651	10.50	3	414	10.5	1
997	10.5	1	851	9.9	1	824	10.5	1	659	10.4	1	424	10.9	1
2,436,000+			854	10.3	1	839	10.5	1	666	10.8	1	430	10.8	1
008	10.5	1	861	10.3	1	848	10.4	1	673	10.50	2	452	11.0	1
021	10.3	1	872	10.0	1	857	10.4	1	680	10.4	1	525	10.4	1
026	10.6	1	882	10.15	2	866	10.5	1	693	10.80	2	528	10.9	1
045	10.5	1	890	10.3	1	880	10.40	2	698	10.8	1	542	10.8	1
074	10.3	1	973	9.9	1	892	10.4	1	706	10.50	2	563	11.2	1
080	10.00	2	989	10.0	1	908	10.5	1	722	10.5	1	575	10.8	1
097	10.5	1	2,437,000+			920	10.5	1	802	10.95	2	585	10.8	1
111	10.3	1	003	10.4	1	933	10.4	1	803	11.1	1	597	10.80	3
130	10.35	2	017	10.5	1	946	10.5	1	818	10.9	1	612	10.9	1
142	10.6	1	026	10.4	1	959	10.5	1	825	11.3	1	618	10.90	2
160	10.6	1	057	10.2	1	978	10.6	1	848	11.35	2	626	10.6	1
244	10.4	1	076	10.4	1	985	10.4	1	863	11.4	1	639	9.8	1
278	11.0	1	088	10.5	1	2,438,000+			876	12.3	1	649	10.85	2
294	10.6	1	099	10.6	1	079	11.2	1	882	11.8	1	660	10.5	1
307	10.6	1	102	10.4	1	095	12.2	1	888	12.3	1	667	10.9	1
316	10.4	1	112	10.5	1	111	12.6	1	903	12.3	1	680	10.80	2
340	10.5	1	118	10.40	2	122	13.10	2	907	12.2	1	687	11.0	1
352	10.4	1	129	10.4	1	127	13.3	1	920	12.35	2	695	10.9	1
363	10.4	1	138	10.5	1	140	13.2	1	932	12.4	1	711	10.80	2
371	10.3	1	146	10.3	1	150	13.7	1	940	12.20	2	723	11.0	1
380	10.35	2	156	10.4	1	167	13.0	1	948	12.0	1	739	10.70	2
395	10.4	1	170	10.35	2	181	13.25	2	960	11.4	1	753	10.9	1
406	10.4	1	178	10.2	1	192	<12.3	-	971	12.2	1	760	10.95	2
421	10.4	1	188	10.4	1	194	13.2	1	976	12.4	1	772	10.5	1
429	10.4	1	199	10.3	1	201	13.50	2	990	13.6	1	780	10.9	1
445	10.5	1	215	10.2	1	209	13.0	1	2,439,000+			790	10.43	3
450	10.5	1	232	10.35	2	222	13.7	1	001	13.7	1	799	10.50	2
458	10.5	1	250	10.5	1	233	13.6	1	022	11.4	1	807	10.5	1
470	10.4	1	258	10.4	1	237	13.6	1	032	11.45	2	820	10.3	1
482	10.5	1	344	10.4	1	253	13.60	2	039	11.4	1	887	10.95	2
491	10.4	1	356	10.5	1	260	13.7	1	050	11.40	2	897	10.60	2
498	10.4	1	370	10.5	1	283	12.35	2	065	11.4	1	911	11.05	2
509	10.4	1	384	10.4	1	290	12.4	1	159	12.2	1	917	11.1	1
518	10.5	1	402	10.4	1	311	12.25	2	173	11.4	1	940	10.33	3
607	10.5	1	410	10.5	1	317	12.3	1	182	11.8	1	953	10.7	1
616	10.4	1	440	10.4	1	335	12.9	1	190	12.2	1	960	10.4	1
639	10.40	2	447	10.5	1	340	12.0	1	206	12.2	1	973	10.27	4
651	10.6	1	458	10.45	2	353	<12.4	-	217	12.1	1	979	10.47	3
661	10.5	1	470	10.45	2	434	12.2	1	231	11.8	1	991	10.35	2

V.S.S. CIRCULAR No. 193 (cont).

TABLE 1 (cont).

J.D. 2,440,000+	MAG.	No.	J.D. 2,440,000+	MAG.	No.
002	10.35	2	171	10.47	3
007	10.95	2	179	10.45	2
017	10.4	1	275	10.70	2
027	10.5	1	338	10.94	5
039	10.55	2	366	10.8	1
047	10.45	2	354	10.45	2
062	10.45	2	379	10.60	2
069	10.60	2	412	10.7	1
081	10.75	2	437	10.8	1
091	1042	4	464	11.1	1
098	10.55	2	467	10.7	1
109	10.85	4	495	10.9	1
119	10.70	2	517	10.9	1
131	10.35	4	536	10.4	1
140	10.43	3			
159	10.80	3			

TABLE 2.

GU SAGITTARII--~~MAXIMA~~ MINIMA BELOW MAGNITUDE 12.0

J.D.	MAG.	INT. d	AUTHORITY.	REMARKS.
2,413,800	13.8p	...	Luyten	
2,421,200	12.0p	7,400	"	
2,423,800	12.2p	2,600	"	
2,425,850	13.8p	2,050	Hoffleit	
2,426,100	12.4p	250	"	
2,428,750	14.5p	2,650	"	
2,429,075	12.3p	325	"	
2,429,500	14.7p	425	"	
2,429,900	<15.2p	400	"	Rose to 12.3p after previous deep minimum.
2,432,050	<12.9p	2,150	"	Could be the same minimum.
2,432,325	14.5p	275	"	
2,432,790	13.5p	465	"	
2,436,035	12.0p	3,245	"	
2,438,150	13.7v	2,115	Bateson	
2,438,335	12.9v	185	"	Possibly this due to activity on decline & a deep minimum took place during 340-433 when there was a gap in the records.
2,438,917	12.4v	582	"	
2,439,001	13.7v	84	"	Rose to 11.4 after previous min. Possibly a deeper min. between 065 and 160 during gap in records.
2,439,190	12.2v	189	"	

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