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THE HIGHLY PROBABLE CONSTANCY OF IS GEMINORUM

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ABSTRACT : THE HIGHLY PROBABLE CONSTANCY OF IS GEMINORUM

The analysis of 4142 visual estimates made by 54 GEOS observers between 1974 and 1982, and of 219 estimates made by 14 observers of the British Astronomical Association between the 1969-72 and the 1979-82 observing seasons, shows that IS Gem, classified as an SRd by the GCVS, does not reveal any significant variation of brightness greater than 0.1 mag.

It therefore cannot be considered as an SRd and, with a high probability, is not a variable star.

RESUME : IS GEMINORUM EST TRES PROBABLEMENT UNE ETOILE CONSTANTE

L'analyse de 4142 observations visuelles faites par 54 observateurs du GEOS entre 1974 et 1982, et de 219 estimations faites par 14 observateurs de la British Astronomical Association pendant les périodes 1969-1972 et 1979-1982, montre que IS Geminorum, classée comme variable de type SRd par le GCVS, ne présente en fait aucune variation d'éclat significative plus grande que 0.1 mag.

Elle ne peut donc être considérée comme une SRd et, très probablement, il ne s'agit pas d'une étoile variable,

RIASSUNTO : LA COSTANZA, FORTEMENTE PROBABILE, DI IS GEMINORUM

Dall' analisi di 4142 stime visuali ottenute da 54 osservatori GEOS tra il 1974 e il 1982, e di 219 stime ottenute da 14 osservatori della BAA tra le stagioni osservative 1969-1972 e 1979-1982, si deduce che la stella IS Geminorum, classificata dal GCVS come variabile di tipo SRd, non presenta alcuna variazione di luminosità significativa superiore a 0.1 magnitudini, e che pertanto non può essere considerata come una SRd, e con grande probabilità non è neppure una stella variabile.

RESUMEN. IS GEMINORUM ES MUY PROBABLEMENTE UNA ESTRELLA CONSTANTE

El análisis de 4142 estimaciones visuales hechas por 54 observadores del GEOS entre 1974 y 1982, y de 219 estimaciones hechas por 14 observadores de la British Astronomical Association durante los periodos 1969-1972 y 1979-1982, muestra que IS Geminorum, clasificada como variable de tipo SRd por el GCVS, no presenta de hecho ninguna variación de brillo significativa mayor que 0.1 mag.

No puede ser considerada como una SRd. Con gran probabilidad no es siquiera una estrella variable.

1. INTRODUCTION

The star BD +32°1414 was used in 1910 as a comparison star for the observations of Nova Geminorum 2 . Bemporad (1912) concluded from his observations that the star could be suspected of variability and that "it could be a short-period variable". The observed amplitude was about 0.6 magnitude. It is of interest to note that the same year Kuhl reported the suspected variability of two other comparison stars in the Nova Geminorum 2 sequence, i.e. HR 2586 and HR 2660.

Any other mention of a possible variability is not be found until 1961, when Wroblewsky reported his own observations (49), made between 1955 and 1960. He concluded on a period of about 49 - 50 days with an amplitude of 0.3 magnitude, in contradiction with the period previously given by Bemporad.

In 1969 the GCVS, using the mesures of Wroblewsky, classified the star as IS Geminorum, a semi - regular variable of subclass "d" with a period of 47 days, and an amplitude of 0.7 photographic magnitude, ranging from 6.6 to 7.3 . The GCVS unfortunately does not mention any source for this latter data.

Crimi and Mantegazza (1983) reported more recent observations of the radial velocity of IS Geminorum and concluded that :

1) the amplitude of variation of the radial velocity is very small, of the order of about 15 Km/s.
2) the spectrum does not show any one of the caracteristics typical of an SR, i.e. there is no emission in the Hα region nor anything out of normal in the blue and red regions. Moreover the intensity of the metallic lines is normal.

IS Gem therefore gives the impression of being a normal K3 giant, belonging to Population I. The authors conclude that there probably exist two kinds of stars inside the SRd type as defined by the GCVS : the first includes stars belonging to Population II, with high luminosities, weak metallic lines and a bright Balmer series (classes Ia and Ib) ; the second includes Population I giants with not spectral peculiarities (classes II and III). According to the authors, the latter group would includes stars as IS Gem, VW Dra, CE Vir. It must be noted, however, that recent photoelectric observations (Murnikova and Vasilyeva, 1979) have shown the non - variability of VW Dra. The probable constancy of IS Gem is another piece of evidence that weakens the validity of the subdivision mentioned above.

2. OBSERVATIONS

GEOS (Gruppo Europeo d'Osservazione Stellare) has always included semi-regular variables in its observing programmes, with the aim of publishing the most accurate light-curves possible within the limits of accuracy of visual observing. The results are published in the "GEOS SR Circulars".

The method of estimation used was the Argelander method and whenever a single observer used the three comparison stars of the sequence, a personal sequence was calculated, fitting the magnitudes of the comparison stars shown on the chart to the magnitudes actually estimated by each single observer.

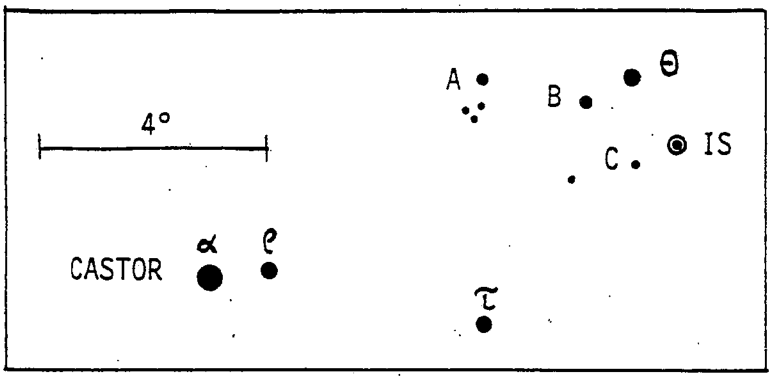

Figure 1. Chart of IS Gem

Stars Designation	V magnitude	Spectrum	Visual magnitude
IS Gem : HR 2512	5.71	K3	
A : HR 2660	5.55	G8 IV	5.49
B : HR 2586	5.89	G5 III	6.12
C : SAO 059594	6.9	B9	6.76

Table 1. IS Gem and its comparison stars

It was also possible to use the estimates made independently by the British Astronomical Association.

Finally, 51 GEOS observers have monitored the star for 9 years, from the 73-74 to the 82-83 observing season, totalling 4142 visual estimates, while 6 observers of the B.A.A. monitored the star from 1969 to 1972, and from 1979 to 1983, totalling 219 estimates (see Table 2)

The following observing seasons were discarded : 69-70, 70-71, 71-72, 72-73, 73-74 and 82-83 because of the scanty data available and their scatter over the interval.

The light curve was determined by means of the ALCEP automatic calculating algorithm (Figer, 1978) running on the PDP 11-34 Digital Computer at the Brera-Merate Observatory. The routine has previously been used on many occasions by GEOS (Figer, 1978 ; Buzzoni, 1981 and 1985 ; Ralincourt, 1982) yielding a most probable light curve trough a processing of the data supplied by the observers by successive iterations, then correcting the systematic errors of each observer (so called "Delta M") and finally calculating weighted means (weight : $1/\sigma^2$). The results are given in the Tables attached to the figures 2 to 9.

Owing to the fact that many observers estimated the star more than once on the same night, nightly means for each observer were used instead of the individual measures. This makes feeding the data into the computer more manageable and moreover gives another dimension to the contribution of observers who carried out 4 or 5 estimates per night instead of the usual 1 or 2.

The observations sometimes reveal the presence of the so-called position angle error, caused by the various positions taken by the comparison stars relative to the variable star in the field of the telescope or of the binoculars, as the night or the observing season evolves. Such as position angle error introduces a shift in the brightness estimates according to whether the star is observed: eastward or westward. The observer who suspects he is subject to the position angle error can palliate it by separating his estimates into two series, eastward and westward. The estimates will then be processed as if they had been carried out by two separate observers. For example the series RAL E and RAL W were made by the same observer, but they were processed separately (East and West) and are therefore identified by two different acronyms (see Table 2 for instance).

An analysis of the light curve (see fig. 2 to 9) immediately reveals a decrease in magnitude but by the contribution, in the later years of a greater number of observers who systematically estimated the magnitude to be lower. The yearly change of observers introduces variations in the sample and therefore a change in the magnitude. This is obviously a limitation to the visual observational methods. According to their density, the visual estimates were lumped into time intervals ranging from 4 days (1975-1976) to 11 days (1976-1977).

3. DISCUSSION

The data obtained from the GEOS and BAA observations from the 1974 - 1975 to the 1981 - 1982 observing season lead to the following conclusions :

1) Not only does IS Gem not reveal any regularity in its brightness variations, but in no case it is possible to evidence a variation superior to 0.1 magnitude. In fact the only variations sometimes to be noted (seasons 77 - 78, 79 - 80, 81 - 82) let alone their little number and their sporadic occurrence, can by no means be considered as significant in view of their weak amplitude (± 0.15 magnitude) and can with high certainty be attributed to observational errors more than to actual variations.

2) Considering also the results obtained spectroscopically by Crimi and Mantegazza at Merate Observatory, IS Gem cannot be considered as a semi - regular variable, subclass "d", nor can it, with a high degree of probability, be considered as variable at all. In any case, to definitely ascertain the latter hypotesis, it would be necessary to have photoelectric measures so as to evaluate the possibility of the existence of microvariations with an amplitude smaller than 0.1 magnitude.

4. ACKNOWLEDGEMENTS

Our thanks to Mr. Taylor and Mr. Saw of the British Astronomical Association for their courtesy and their ready collaboration.

Francesco Fumagalli

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Buzzoni A. : 1981 GEOS Circular SR 2
Buzzoni A. : 1985 GEOS Circular SR 6
Crimi G., Mantegazza L. : 1984 Astrophysics and Space Science 100, 255 - 259

NAME	ACRONYM	INSTR.	1974	1975	1976	1977	1978	1979	1980	1981	1982
TROISPOUX	TRP	10x50	4	31	45						
VERROT	VRR	10x50		9							
RACINOUX	RCX	10x50		19							
RALINCOURT EAST	RAL E	10x50	11	38	29	7	41	34	13		
RALINCOURT WEST	RAL W	10x50		25	5			14			
MARCELIN	MRL	7x35		18							
CARNEVALI	CAR	10x50		20							
MAURIN	MRN	7x25		17	19						
LESTRADE	LST	23x64		37							
ROYER	ROY	6x30		25							
VIALLE	VIA	10x50		47	36	22	31	45	63	38	35
MAURON	MAU	8x30	26	58							
FIGER	FGR	8x40	59	47	20	60					
ROSTREN	RSN	12x50		21							
REMIS	RMS	35x30		57							
BEHAGLE	BHG	12x50		55	23						
DOBY	DBY	7x50		53							
MISSON	MIS	7x50			174	136	73	35	48	28	11
CLOVIN	CLV	7x30			44		26				
GUIRAUDOU	GUI	10x50		10	42	26	19				
BONINSEGNA	BNN	10x50			46	26	30	3			
PASSE	PSS	8x30		5	9						
PENNA	MPN	6x30			39						
TRAVAGLINO	TVG	10x50			16	29	29				
BARUFFETTI	BFF	7x50			104				18	14	
PAMPALONI	PMP	8x30			18		35	24	38		2
RIVIERE	RVR	10x50		2	10						
FRANGEUL	FRL	10x50			40						
BOULARAND	BLR	10x50			12						
LEYDON	LYN	8x30			20						
FUMAGALLI	FUM	12x50			125						
PORETTI	POI	8x30		22	72						
LENZI	LNZ	8x30			5						
LUCENTINI	LCN	20x50			15						
DUMARCHI EAST	DCH E	10x50		10	32	33		68	102	41	58
LEYMAN	LEY	10x70				8	31	3			
BUZZONI	BUZ	30x40				23	71				
FRERE	FEE	10x50					20				
VAN LOO	LOO	10x50					9	16			
NEZRY	NZY	10x50						17	6		
BUSQUETS	BSQ	8x30							44	32	
GRAULUS	GUS	7x50							34		
BOISTEL	BTL	10x50							85	75	
FABREGAT	FBG	10x50							26	30	19
COPPOLA	COP	12x50								54	
DUMARCHI WEST	DCH W	10x50								22	32
MARINELLO EAST	MLO E	7x50								37	7
MARINELLO WEST	MLO W	7x50							19	23	44
PACIFICO	PAC	7x50									11
MAMMOLITI	MAM	16x50									56
EYRAUD	EYR	10x50									17
VETTORI	VET	10x50									16
GIGLI	GIG	10x50									86
TESI	TSI	10x50									33
ACERBI	ACR	10x50								40	3
	MK (BAA)								12	15	
	XN (BAA)								8	6	3
	MM (BAA)								19	28	28
	FB (BAA)									6	2
	NZ (BAA)										14
	AO (BAA)								3	12	

Table 2. List of the observers

SEASON 1974-1975 MEAN MAGNITUDE 5.87
SIGMA .02

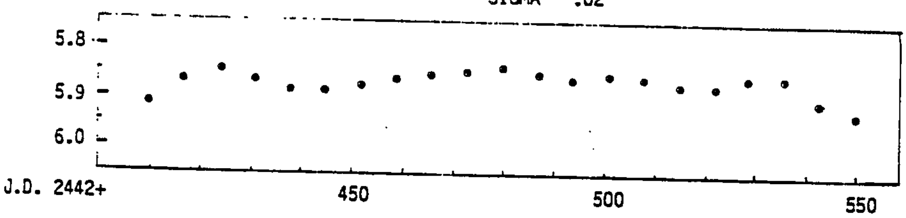


Fig. 2

EPOCH	MAGNITUDE	OBSERVERS	NIGHTLY POINTS	DELTA M.	SIGMA
2410.5	5.91	TRP	13	-.024	.056
2417.5	5.87	VRR	9	.111	.236
2424.5	5.85	RCX	18	.105	.1o3
2431.5	5.87	RAL E	25	-.236	.060
2438.5	5.89	RAL W	21	-.016	.065
2445.5	5.89	MRL	14	-.135	.064
2452.5	5.88	CAR	16	.002	.063
2459.5	5.87	MRN	12	-.008	.034
2466.5	5.86	LST	36	.192	.242
2473.5	5.85	ROY	16	-.111	.089
2480.5	5.84	VIA	30	.010	.301
2487.5	5.86	MAU	10	-.232	.096
2494.5	5.87	FGR	16	-.052	.048
2501.5	5.86	RSN	16	.080	.234
2508.5	5.87	RMS	33	.024	.117
2515.5	5.88	BHG	47	-.036	.083
2522.5	5.88	DBY	45	-.043	.105
2529.5	5.86				
2536.5	5.86				
2543.5	5.90				
2550.5	5.93				

SEASON 1975-1976 MEAN MAGNITUDE 5.83
SIGMA .04

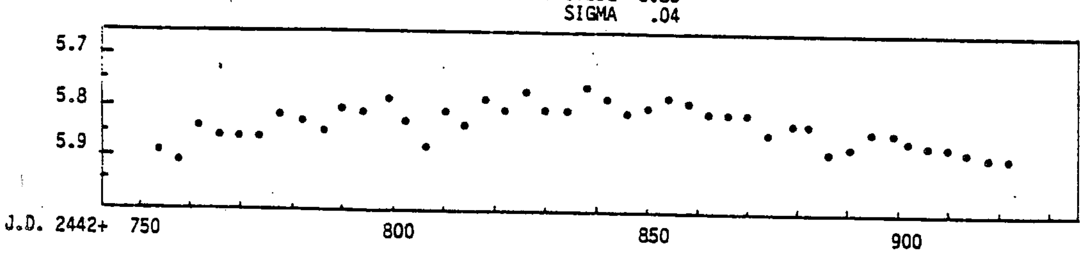


Fig. 3

EPOCH	MAGNITUDE	EPOCH	MAGNITUDE	OBSERVERS	NIGHTLY POINTS	DELTA M.	SIGMA
2754.5	5.89	2842.5	5.78	MIS	62	-.070	.119
2758.5	5.91	2846.5	5.82	VIA	25	.017	.158
2762.5	5.84	2850.5	5.81	CLV	24	-.061	.043
2766.5	5.86	2854.5	5.78	GUI	29	.070	.154
2770.5	5.86	2858.5	5.79	BNN	30	-.034	.068
2774.5	5.86	2862.5	5.82	PSS	9	-.105	.080
2778.5	5.82	2866.5	5.82	FGR	17	.027	.054
2782.5	5.83	2870.5	5.82	MPN	12	-.003	.067
2786.5	5.85	2874.5	5.85	TVG	6	-.006	.037
2790.5	5.80	2878.5	5.83	BFF	51	-.022	.067
2794.5	5.81	2882.5	5.83	PMP	18	.008	.049
2798.5	5.78	2886.5	5.89	BHG	21	.117	.140
2802.5	5.83	2890.5	5.88	RVR	5	-.021	.038
2806.5	5.88	2894.5	5.84	FRL	39	-.027	.172
2810.5	5.81	2898.5	5.84	BLR	12	.043	.128
2814.5	5.84	2902.5	5.86	LYN	13	.099	.238
2818.5	5.78	2906.5	5.87	FUM	25	-.055	.085
2822.5	5.80	2910.5	5.87	POI	54	.046	.047
2826.5	5.77	2914.5	5.88	MRN	19	-.096	.056
2830.5	5.80	2918.5	5.89	LNZ	5	.070	.226
2834.5	5.80	2922.5	5.89	ECN	14	.204	.222
2838.5	5.76			TRP	7	-.001	.019
				RAL E	3	-.230	.097

SEASON 1976-1977 MEAN MAGNITUDE 5.85
SIGMA .04

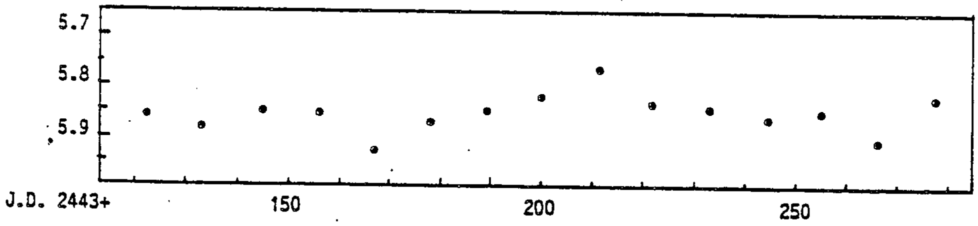


Fig. 4

EPOCH	MAGNITUDE	OBSERVERS	NIGHTLY POINTS	DELTA M.	SIGMA
3123.5	5.86	FGR	25	-.050	.090
2134.5	5.88	CLV	10	-.079	.049
3145.5	5.85	VIA	15	.033	.055
3156.5	5.85	BNN	12	-.087	.063
3167.5	5.93	TVG	26	.070	.177
3178.5	5.87	DCH	13	-.054	.128
3189.5	5.85	MIS	62	.041	.049
3200.5	5.82	POI	44	.001	.114
3211.5	5.76				
3222.5	5.83				
3233.5	5.84				
3244.5	5.86				
3255.5	5.84				
3266.5	5.90				
3277.5	5.82				

SEASON 1977-1978 MEAN MAGNITUDE 5.89
SIGMA .06

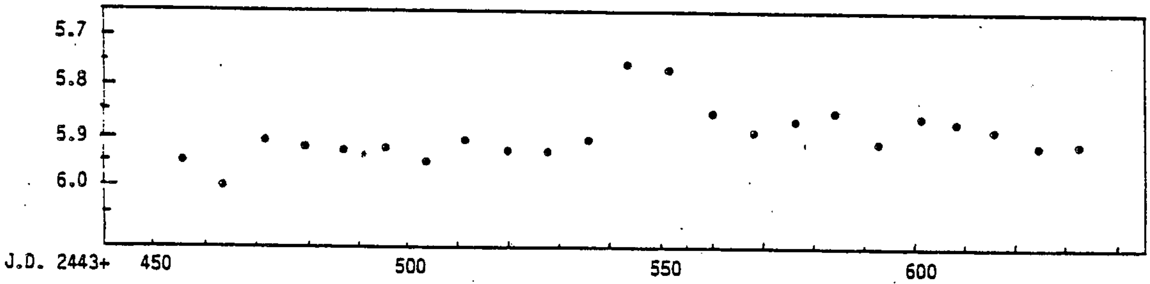


Fig. 5

EPOCH	MAGNITUDE	OBSERVERS	NIGHTLY POINTS	DELTA M.	SIGMA
3456.5	5.95	RAL E	14	-.114	.089
3464.5	6.00	VIA	14	.059	.171
3472.5	5.90	LEY	11	-.102	.157
3480.5	5.92	MIS	53	-.026	.050
3488.5	5.93	GUI	23	-.073	.057
3496.5	5.92	TVG	19	-.023	.100
3504.5	5.95	BUZ	27	-.068	.068
3512.5	5.90	PMP	28	.116	.224
3520.5	5.93	CLV	13	-.102	.058
3528.5	5.93	BNN	14	-.139	.069
3536.5	5.90	FEE	12	.488	.053
3544.5	5.75	FGR	2	.027	.145
3552.5	5.76	DCH	13	.036	.051
3560.5	5.85			.032	.058
3568.5	5.89				
3576.5	5.87				
3584.5	5.86				
3592.5	5.90				
3600.5	5.85				
3608.5	5.86				
3616.5	5.88				
3624.5	5.91				
3632.5	5.90				

SEASON 1978-1979 MEAN MAGNITUDE 5.90
SIGMA .04

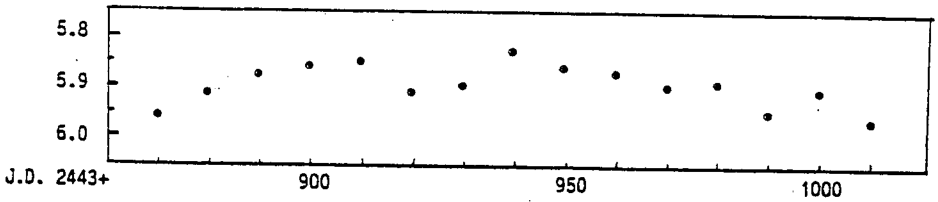


Fig. 6

EPOCH	MAGNITUDE
3870.5	5.96
3880.5	5.92
3890.5	5.88
3900.5	5.87
3910.5	5.85
3920.5	5.92
3930.5	5.90
3940.5	5.83
3950.5	5.86
3960.5	5.87
3970.5	5.90
3980.5	5.89
3990.5	5.95
4000.5	5.91
4010.5	5.97

OBSERVERS	NIGHTLY POINTS	DELTA M.	SIGMA
PMP	14	.186	.168
LOO	10	-.054	.162
NZY	6	.105	.068
RAL E	12	-.129	.071
RAL W	7	-.082	.118
VIA	9	-.068	.038
DCH	30	-.042	.053
MIS	24	.032	.053

SEASON 1979-1980 MEAN MAGNITUDE 5.89
SIGMA .04

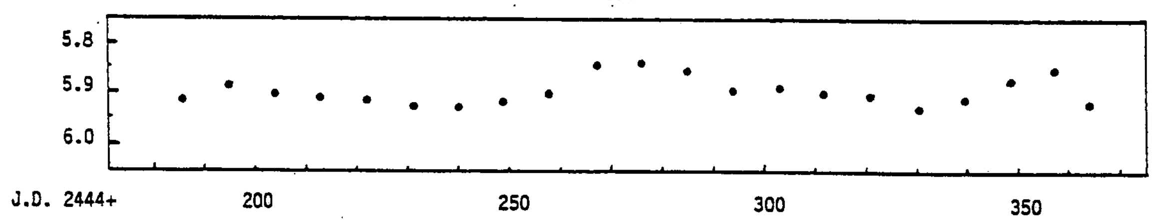


Fig. 7

EPOCH	MAGNITUDE
4186.5	5.92
4195.5	5.89
4204.5	5.90
4213.5	5.91
4222.5	5.91
4231.5	5.93
4240.5	5.93
4249.5	5.92
4258.5	5.90
4267.5	5.84
4276.5	5.83
4285.5	5.86
4294.5	5.89
4303.5	5.88
4312.5	5.89
4321.5	5.90
4330.5	5.93
4339.5	5.91
4348.5	5.87
4357.5	5.85
4366.5	5.92

OBSERVERS	NIGHTLY POINTS	DELTA M.	SIGMA
BSQ	10	.153	.210
GUS	17	.078	.133
BTL	36	.091	.134
FBG	14	-.059	.057
DCH	41	-.007	.055
MIS	32	-.019	.070
PMP	16	.128	.151
VIA	5	-.074	.015
RAL E	5	-.122	.132
MK BAA	11	-.123	.052
XN BAA	8	-.112	.084
MM BAA	18	-.152	.126
FB BAA	5	-.136	.053

SEASON 1980-1981 MEAN MAGNITUDE 5.93
SIGMA .03

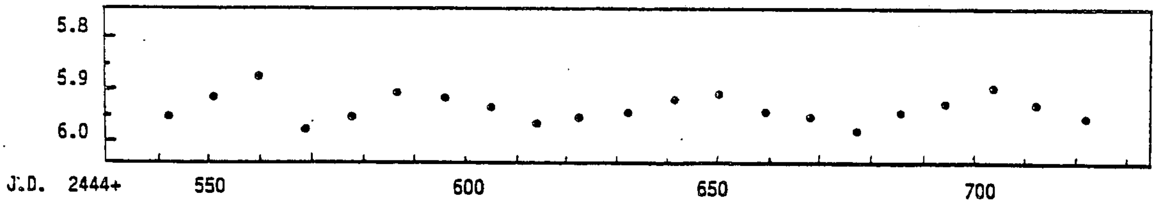


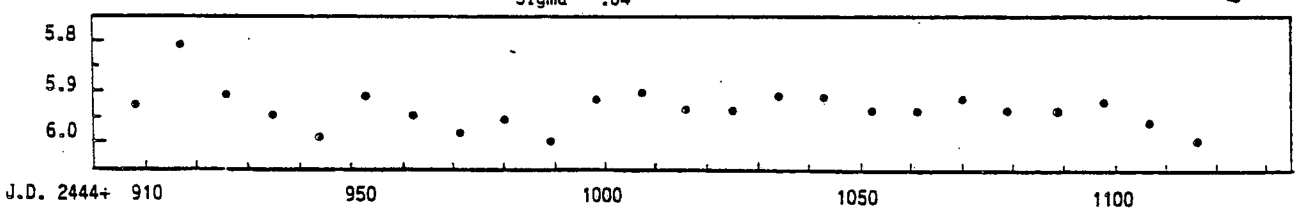
Fig. 8

EPOCH	MAGNITUDE
4542.5	5.95
4551.5	5.92
4560.5	5.88
4569.5	5.98
4578.5	5.95
4587.5	5.91
4596.5	5.92
4605.5	5.94
4614.5	5.97
4623.5	5.95
4632.5	5.94
4641.5	5.91
4650.5	5.9
4659.5	5.94
4668.5	5.95
4677.5	5.98
4686.5	5.94
4695.5	5.92
4704.5	5.89
4713.5	5.92
4722.5	5.95

OBSERVERS	NIGHTLY POINTS	DELTA M.	SIGMA
BSQ	20	.056	.158
FBG	20	-.046	.041
BFF	12	-.142	.112
MIS	19	-.048	.083
BTL	26	.167	.130
COP	49	-.120	.160
VIA	13	-.105	.023
DCH E	26	.010	.062
DCH W	2	.209	.006
MLO E	25	.439	.038
MLO W	7	-.202	.054
XN BAA	5	-.024	.105
FB BAA	6	-.065	.099
MK BAA	11	-.234	.134
MM BAA	26	-.211	.094

SEASON 1981-1982 Mean Magnitude 5.93
Sigma .04

Fig. 9



EPOCH	MAGNITUDE
4908.5	5.93
4917.5	5.81
4926.5	5.92
4935.5	5.95
4944.5	5.99
4953.5	5.92
4962.5	5.94
4971.5	5.98
4980.5	5.95
4989.5	5.99
4998.5	5.92
5007.5	5.89
5016.5	5.93
5025.5	5.93
5034.5	5.9
5043.5	5.9
5052.5	5.93
5061.5	5.93
5070.5	5.9
5079.5	5.93
5088.5	5.91
5097.5	5.96
5106.5	6.00

OBSERVERS	NIGHTLY POINTS	DELTA M.	SIGMA
MIS	14	-.029	.055
VIA	22	-.108	.027
PAC	5	-.087	.110
MAM	24	-.109	.068
EYR	17	-.096	.063
BSQ	5	-.045	.041
VET	8	-.036	.162
DCH E	22	.162	.160
DCH W	23	.270	.129
GIG	34	-.011	.175
FBG	8	.062	.132
TSI	19	.045	.280
MLO E	7	.356	.089
MLO W	9	-.096	.097
ACR	9	-.135	.076
MM BAA	25	-.149	.134
NZ BAA	12	-.114	.076