British Astronomical Association

VARIABLE STAR SECTION CIRCULAR

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Contents

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SECTION MEETING

A Variable Star Section meeting will be held at the Humfrey Rooms, Castillian Terrace, Northampton on Saturday October 5th. The preliminary programme includes the following speakers...

Dr. Mark Kidger. ..... (AGN)
Dr Bill Worraker. ..... (Eclipsing Dwarf Novae)
Guy Hurst ..... (Novae/Supernovae)
John Toone ..... TBA
Kevin West ..... (PEP)
John Mackey ..... (V-Band CCD Photometry)
Tonny Vanmunster. ..... (Belgian VVS).

There will be a small charge on the door to cover refreshments . Lunch will be available at extra cost if required. More details will appear in the next Circular and the August BAA Newsletter.

NEW CIRCULAR EDITOR

This edition of the VSSC sees a new editor in charge, with Karen Holland taking over from Tristram Brelstaff. Tristram first took over the job of editor in 1993 with Circular No. 75 at about the same time as he became section director. Tristram has worked hard to revitalise the VSS circulars, and to ensure that they have become once again a regular publication with a good standard of content, which I am confident will be sustained under Karen's editorship. I would like to take this opportunity to thank Tristram on behalf of everyone concerned with the VSS for all his hard work and commitment to the circulars over the past three years.

DENEBOLA

Denebola (β Leo) is a well known suspected secular variable star. In ancient times it was registered as the second brightest star in Leo not much fainter than Regulus (α Leo). In modern times, however, Denebola is catalogued as being fainter than Algeiba (γ Leo). The magnitudes assigned to all three stars in the 1996 BAA Handbook are as follows:-

α ..... Regulus 1.35
β ..... Denebola 2.14
γ ..... Algeiba 1.99

In May 1995 and February 1996, I noticed that Denebola seemed to be brighter than Algeiba even when both stars were at similar altitudes above the horizon. Using the Handbook values for α and γ, I am currently estimating Denebola to be magnitude 1.8 [$\alpha(3)\beta(1)\gamma$]. It's possible the colour difference between β and γ may account for this anomally, but I would welcome feedback from other VSS members on whether they see Denebola or Alfeiba as the brightest. Visual observers should take care to secure estimates if possible when Leo is on the meridian. Photoelectric measures, of course, would be particularly useful. Are there any takers?

UPDATE ON 1995 OBSERVING STATISTICS

The receipt of about 35000 estimates from 37 individuals and two vs organsations for 1995 is gratefuly acknowledged. The total includes 8,300 estimates of stars on the Recurrent Objects Programme but there are no eclipsing binaries (which should go to Tristram Brelstaff, or will be directed accordingly).

The most followed variable was R CrB with over 1100 estimates: CH Cyg has 530, T CrB 501. SS Cyg 479 and U Gem 396. There are some objects which for various reasons (e.g. low altitide, brightness level, ease/difficulty of finding) are rarely , if ever followed. For example, RT CVn, a magnitude 10 to 14 (P 254d) mira type has not been followed in 1995. The relatively new UG star found by Fleet, TT Crt has 3 estimates on file for 1995. FR Sct at declination -12 degrees, a ZA type of mag 10 to 12, is another under-observed variable. Of the 80 stars on the ROP the following have no estimates: CG CMa, TV Crv, EX Hya, T Pyx, V1017, V1172, V3645 Sgr, and V745 Sco. A few mira stars; R And, R Aql, V Boo (SRA), U CVn, S Cas,T Dra, SU Lac, RS Leo, W, X Lyn and T UMa are all in need of a few more observers to keep the variations under observation. BX Mon a unique type star (9.5 to 13.4) at declination -3 degrees has 32 estimates on its light curve for last year. Of the pulsating 'reds'; SS Cep (55 estimates), RU Cyg (18), DW Gem (32) the SR+ZA type NQ Gem (39), SX Her (24), ST Her (37), W LMi (18), W Ori (59), KK Per (57), the Piscium stars: Z, TV and TX all less than 40 estimates. The RV Tau prototype itself has 33 estimates which is too few to well define its activity. W Tri (7.5 to 8.8, SRC) has only 55 estimates which are rather fragmentary and is a worthy cause. The Virgo binocular stars; RW, RX, SS, SW and BK Vir are also under-observed.

The need for good quality, consistent, and continuous data rarely needs stating; early morning observations are most valuable in order to follow the object for as long as possible. The above stars and a few others require more attention and any observer willing to take on a few of these are encouraged to do so.

Charts are available from John Toone, and anyone requiring further details are advised to obtain the chart catalogue (60p charge) from the section Secretary.

Our observers who have submitted observational data for 1995 in paper and/or electronic form have made slightly more estimates than in 1994. Overall, the Director, Gary Poyner, contributed approximately 25% of the grand total, a feat of observing which is tremendous. Ten observers have 1400 to 2500 estimates for the year and 14 have made over 500; a more detailed acknowledgement and breakdown will be made in a forthcoming circular. The SPA VSS supplied over 500 estimates submitted by Tony Markham and there are over 1000 via Frank Bateson (RASNZ VSS) of 'southern' stars on the pro gramme. Other overseas VSS observers are from; Australia, Eire, Finland, Spain and the USA. Kevin West and Roger Pickard are contributing valuable PEP observations to the VSS.

If any observers who have not yet submitted their reports in paper, or on disc for last year, regardless of the totals, please do this as a matter of urgency.

BINOCULAR COMPARISON STAR ANALYSIS

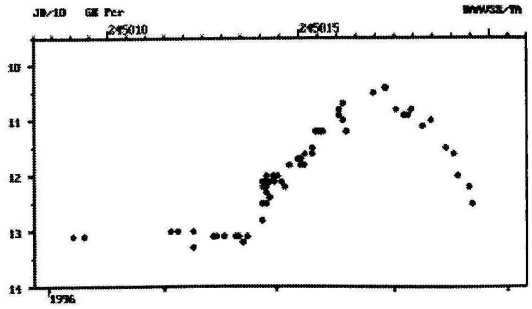
In VSSC No. 85 (December 1995), Patrick Maloney gave brief details of his intention to check out the binocular variables comparison stars for GCVS or NSV objects. Patrick has now completed this major task, and his analysis is now under scrutiny by the director and chart curator. Early indications show that the majority of comparisons used in our binocular charts are constant in magnitude, whilst a few show extremely small variations of the order of 0.1-0.2 magnitude. Several are however worth mentioning here separately. The following table indicates those stars which should now NOT be used for making estimates. To those observers who regularly monitor these variables, can I ask that attention be paid to these comparisons, estimates made of their brightness and reported to the secretary along with observations of the variable.

Comparison	**SAO (or other)**	**Spec**	**Notes**
BL Ori			
F	95697	OE	V?, = NSV 2967 max 6.64v
RR UMi			
5 UMi	8024	K2	D, V?, = NSV 6687 4.0 - 4.8
S, RY, T, Y & Z Uma			
62	15710	K0	D (CPM), Companion = NSV 5452 10.4 - 11.4?v
TU, WY, TV & BU Ge			
A	78050	B1	3 Gem, D, B comp = NSV 2846 7.0 - 10.0 **
R	78029	M1	V, = OX Gem 8.1 - 9.1p EB
V, T & Y CVn			
69	44590	M5	V, amp 0.9v?
VY & VW UMa ,RY Dra 7199	K0	Spec M5?, V?, = NSV 4956 8.0-8.5	
Z			

GK PERSEI

Several observers reported a minor outburst of this interesting intermediate polar (and of course Nova Per 1901) during late February. The previous minor outburst occured during July 1992. At the time of writing (April 23rd), GK Per is now approaching minimum. The light curve shown here is taken from 65 observations reported to the Director during the outburst. An interesting account of intermediate polars (or DQ Her stars) can be found in Publications of the Astronomical Society of the Pacific, 1994 March Vol 106 No.698 p209 entitled “The DQ Her Stars" by Joeseph Patterson.

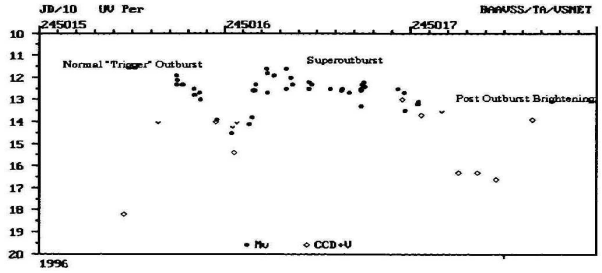
Observers: M. Gill, J. Greaves, G. Hurst, L. Jensen, G. Poyner, J. Toone, W. Worraker, M. Westlund



UV PERSEI: A MOST UNUSUAL OUTBURST

UV Per was observed in outburst on March 14th by Belgian observer Eric Broens (Director of the Belgian VSS) at magnitude 11.9. By March 18.009 UT the star had faded to 15.4 and the outburst resembled a normal one. The Danish observer Lasse Jensen then reported UV Per rising again on Mar 18.792 UT to mv=14.1, thus began the start of a supermaximum - triggered by the normal maximum - which saw UV Per brighter than mag 12.0 for 10 days. By March 30th a CCD (V) observation by R. Zissell (AAVSO News Flash N0.5) recorded UV Per at 16.3. The same observer then recorded UV Per brightening for a third time on April 3rd to V=13.9. This was a classic case of post superoutburst brightening. This post outburst activity was seen during the 1989 superoutburst of UV Per, but this is the first time that all three outburst phenomenon have been observed in UV Per (see light curve).

This behaviour of a normal outburst followed by a superoutburst and post superoutburst brightening has been observed in T Leo in the past, and suspected during the 1995 rare outburst activity in GO Com. Also post superoutburst brightenings have been recorded in UZ Boo, AL Com, VY Aqr, GO Com, V1028 Cyg and BC UMa. It is important that observers of these fascinating objects continue to monitor the star carefully after the outburst is over, in order that any post outburst activity can be monitored.



THE JACK ELLS APT - RESULTS SUMMARY 1995

And so another year passes and still the telescope is churning out results! Not so many during 1995 for a number of reasons.

The year started badly in that we were unable to observe due to a broken photometer head which had to be returned to Norman Walker for repair. Not that it was Norman's fault! Jack had made a small modification to the head which unfortunately become detached and was beyond our ability to repair. Also, as in 1994, many of the "clear" nights were not photometric, at least not in our corner of Kent. A number of observing runs had to be discarded as worthless. Also, many of the bright stars on our programme have been observed sufficiently well that no further observations need to be made for a year or two yet.

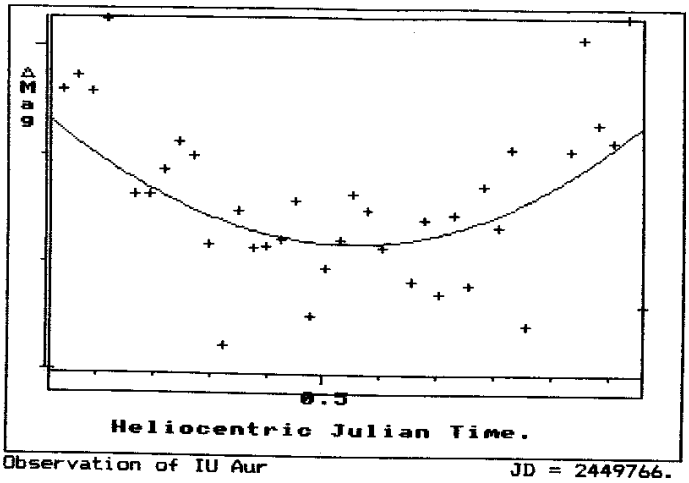
We have also lost one of our observing team due to work commitments, but hope it won't be too long before he is back. For my own part, I have been trying to spread myself too thinly by helping out on other projects as well. This has meant that the brunt of the observing has continued to fall on Malcolm Gough, and as he does shift work, this has inevitably meant that some clear nights have been missed.

Nonetheless, some good results have been obtained, and following the format of previous years, details follow below.

On the graphs, the X-axis is HJT and is marked in hundredths of a day (short ticks) and tenths of a day (long ticks), and the Y-axis is delta magnitude and is marked in tenths (short ticks) and whole magnitudes (long ticks).

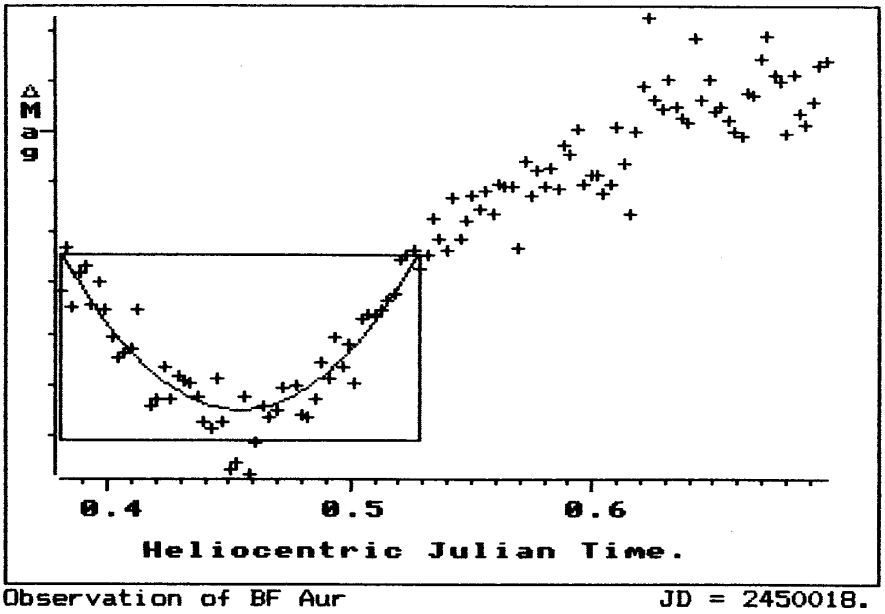
I U Aur

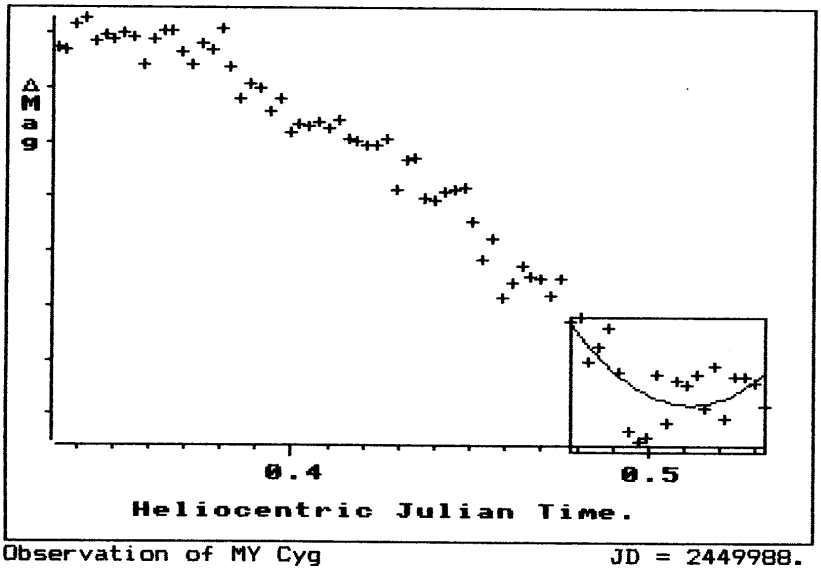
Not a brilliant result at first sight, but it is amazing what the software can do. The scatter in the results is almost a tenth of a magnitude and the total range only three tenths, but to within a whisker, the "O-C" is negligible.



BF Aur

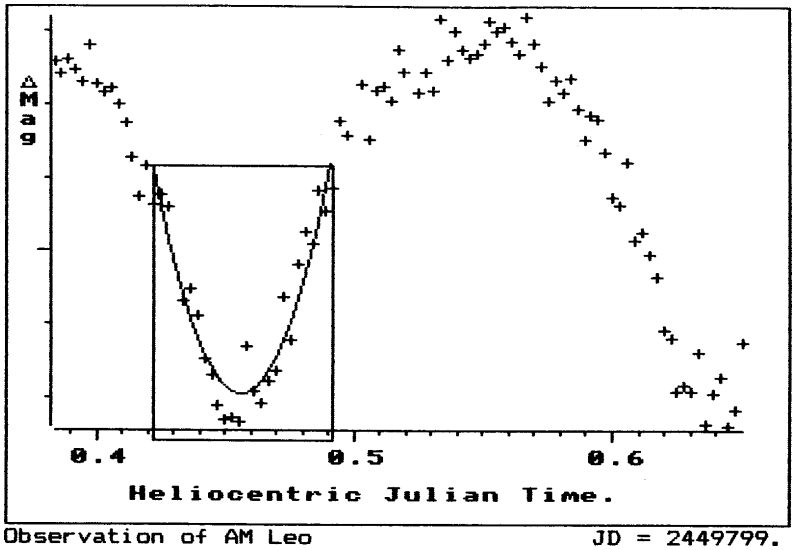
Quite a nice result, although there was still a relatively high degree of scatter, but as with VW Cep, the amplitude is fairly large allowing a reasonably good time of minimum to be obtained.





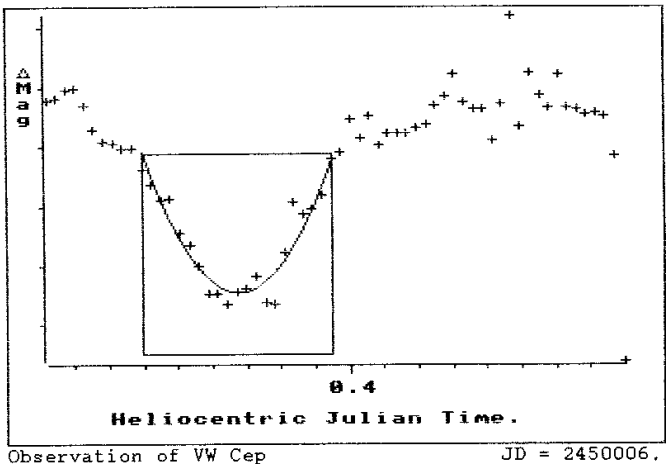
MY Cyg

Not a very satisfactory result as the minimum was only just reached by the time observations ceased. Definitely one to make a note of for the future.



AM Leo

This was the best result for 1995 as far as "pretty" graphs go! Analysis showed that both primary and secondary minimum had been observed (just) with only 0.0011 between the two "O-C" results. A better observing run on the secondary minimum is still awaited to see if this difference will be reduced. (The analysis for Min. II has not been presented).



VW Cep (JD 2450006)

A rather mucky night, so it was fortunate that VW is fairly bright with a relatively large amplitude. Away from minimum, the results show a scatter of almost two tenths of a magnitude. (The O-C for this Min. II was 0.0501 whilst that for the later observation on JD 2450012 for Min. I was 0.0420 - not bad given the poor data on both occasions. The graph for the second observation has not been presented).

The Jack Ells APT at Trottiscliffe

(Operated by Crayford Manor House Astonomical Society)

Results summary 1995

No	Double Date 1995	JD 24.....	Star Name	Star Type	No of Obs	Filter	Comments
1	Feb 15/16	49764	X Per	Be	41	V	For Paul Roche
2	Feb 17/18	49766	"	"	6	V	"
3	Feb 17/18	49766	"	"	8	B	"
4	Feb 17/18	49766	IU Aur	EB	40	V	Min I
5	Mar 22/23	49799	AM Leo	EW	94	V	Mins I & II
6	Apr 11/12	49819	20 CVn	δ Scuti	55	V	For Norman Walker
7	Apr 12/13	49820	"	"	117	V	"
8	Apr 18/19	49826	"	"	106	V	"
9	Apr 25/26	49833	"	"	25	V	"
10	May 02/03	49840	"	"	87	V	"
11	May 03/04	49841	"	"	107	V	"
12	May 04/05	49842	20CVn	δ Scuti	66	V	"
13	May 05/06	49843	"	"	102	V	"
14	Sept 24/25	49985	V1898 Cyg	?	55	V	No result
15	Sept 27/28	49988	MY Cyg	EA	74	V	Min I
16	Oct 09/10	50000	V1425 Cyg	EB	77	V	No result
17	Oct 15/16	50006	VW Cep	EW	82	V	MIN II
18	Oct 21/22	50012	VW Cep	EW	37	V	Min I?
19	Oct 27/28	50018	BF Aur	EB	117	V	Min I
20	Oct 30/31	50021	V836 Cyg	EB	71	V	No result
21	Oct 31/ Nov01	50022	LX Per	EA	82	V	No result

Notes on the Table

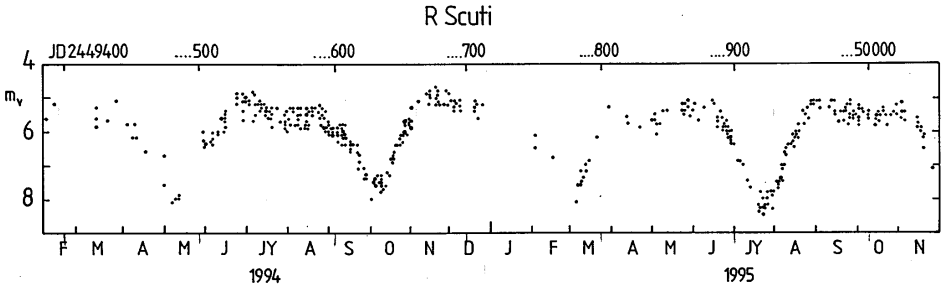
Paul Roche has requested the continued observation of X Per, the bright Be star in Perseus. He has already submitted a couple of papers to professional journals on this star along with his Russian collaborators (one of whom we had the pleasure of meeting at Crayford last year). Paul has given due credit to the BAA for all visual and PEP observation included in the papers.

We have continued to monitor 20 CVn for Norman Walker. This Delta Scuti star has a number of periods, the predominant one being around three hours.

Where “no result” has been written under the Comments heading, against some of the eclipsing binaries it may mean that, although a good result was achieved as far as accuracy is concerned, the star did not produce a minimum. It may also mean that the star was followed close to a minimum,
but insufficient data was obtained to produce a timing; or that cloud interfered during an otherwise good run. Finally, it is interesting to note that on at least one occasion in the past a maximum has been observed rather than a minimum, showing how far out an ephemeris can be! These would obviously be good candidates for future observations.

R SCUTI (1994 & 1995)

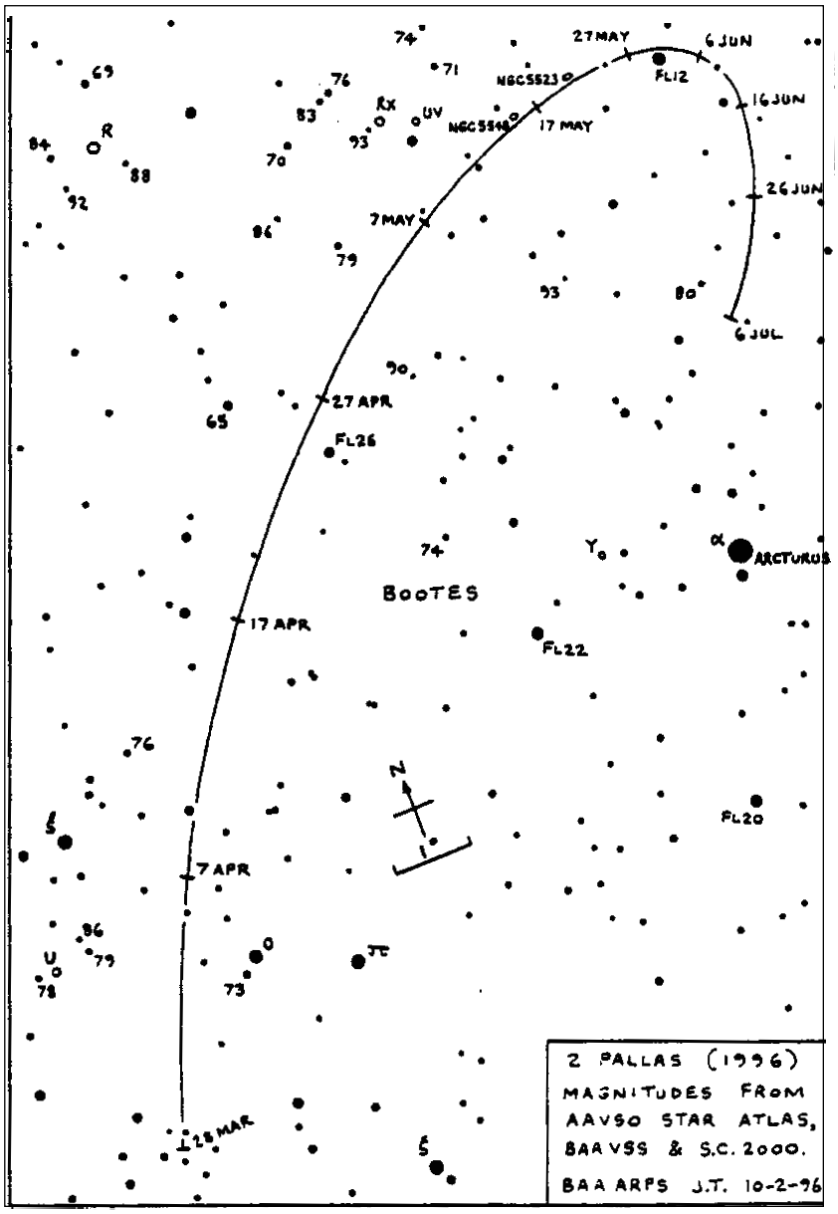
With R Scuti being highlighted as 'the variable star of the year' in the 1996 BAA Handbook, the light-curve as shown by the mean variation in the plot shows its main characteristics and some problems.
This preliminary light-curve is from the observational work of both BAA and SPA (submitted by Tony Markham) VSS members using binocular apertures from 26mm to 80mm. Single dots are one estimate, larger ones are two or more coincident estimates. The deep and shallow minima typical of this RV Tauri Class of variable star is obvious in three of the cycles but a lack of estimates, perhaps due to bad weather, in late 1994 December and early 1995 reflects to some degree the early 1994 data which reduces the accuracy of timing minima. In contrast the star had a well defined primary minimum to magnitude 8.3 on 1995 July 20.
Observers with good south eastern horizons (in particular) and ability to do early morning estimates at the beginning of the year could help by putting this star on their programme.



Observers: Albrighton, Billington, Bone, Britton, Clarke, Coady, Craven, Crawford, Darbyshire, Day, Dryden, Fraser, Gavine, Green, Godwin, Hamilton, Markham, Meacham, Minty, Munden, Taylor, Thorpe, & Worraker.

PALLAS IN BOOTES

It may be of interest to observers of U and RX BOO to note that the asteroid 2 Pallas will pass within 2 degrees of each of these programme stars this forthcoming spring. The asteroid will be just fainter than magnitude 8, thus making it an easy binocular object. Observers are invited to make nightly magnitude estimates of Pallas using the chart opposite and submit them to Andy Hollis, the director of the Asteroids and Remote Planets Section.



SUSPECTED NON-VARIABLES

A recent letter from Melvyn Taylor, regarding a query on the variability of AF Cyg and ST UMa has prompted me to question publicly the variability of 4 other bright stars on my programme. Two of the stars, BU Tau and W Boo are still on the VSS binocular programme and I have a BAA or BSS chart for the other two. All of the stars have very small (< 0.1V) observed photometric range spanning 1-2 years, although the coverage has been rather sparse, because of the low activity. I have listed the relevant details of my observations below and would appreciate any advice to help me decide whether to remove or retain them on my very full observing programme.

Star	**Observed Range**	**Observed between JD**	**No.of Obs.**	**Comparison Star**
Rho Per	3.46/3.56	49705/50024	13	16 Per=4.23
BU Tau	5.02/5.05	49279/50133	17	16Tau=5.46
AE Aur	5.95/6.05	49391/50142	16	19Aur=5.03
W Boo	4.78/4.86	49445/50142	12	Omega=4.81

All observations were made using an Optec SSP3 photometer with a V filter through a 20cm newtonian reflector. All listed magnitudes are from Sky Catalogue 2000.
I realise that it is in the nature of Gamma Cas stars, like BU Tau to have constant phases interspersed with significant fades but I would still be interested to hear of any other visual or photometric observations or any comments on these stars.
Kevin West: 5 Edward St. Ryde. Isle of Wight PO33 2SH, e-mail kwest@aladdin.co.uk

ECLIPSING BINARY PROGRAM - OBSERVER TOTALS FOR 1995

A total of 1506 visual and 109 photoelectric observations of eclipsing binaries have been received for the year 1995. The names of the observers and their individual totals are listed below. Many of the visual observers are members of the Variable Star Section of the Society for Popular Astronomy whose observations have been submitted by Tony Markham. In addition, 83 photoelectric observations of 3 stars in 1993 and 1994 have been received from J Saxton.These observations will be analysed and the results published in a future issue of the VSS Circular.

Visual Observations					
Name	No Obs	No Stars	Name	No Obs	No Stars
K Barnwell	51	2	L Green	3	1
M Barrett	5	1	F Hamilton	192	5
M Clarke	80	2	T Markham	307	10
D Conner	77	4	G Pointer	31	5
CR Curtis	5	2	RW Schmude	147	15
RBI Fraser	2	1	D Storey	3	1
M Gill	19	4	MD Taylor	339	17
S Godwin	131	4	WJ Wilson	114	6
			Total no. of obs =	1506	
Photoelectric observations					
K West	109	4			

SUMMARY OF IBVS 4242-4275

4242 Observations of Superhumps in FO Andromedae. (Kato, 1995)
FO And revealed to be a new addition to UGSU stars

4243 Observations of 1993 Superoutburst of TT Boo. (Kato, 1995)
Superhumps reveal TT Boo as a UGSU star

4244 Photometric variations of the central star of M1-77 and suspected variability of the central star of VV 3-5. (Handler, 1995)

4245 NSV 02733, an eclipsing variable star in Auriga. (Guarro-Flo, et al. 1995)
Observations reveal NSV 02733 to be a Beta Lyr EB.

4246 The eclipsing binary NSV 02980. (Guarro-Flo, et al. 1995)

4247 Observations of NSV 06836. (Gomez-Forrellad and Garcia-Melando, 1995)

4248 Observations of NSV 13191. (Gomez-Forrellad and Garcia-Melando, 1995)

4249 An improved ephemeris for Z camelopardalis. (Thorstensen and Ringwald, 1995)

4250 A new variable in the field of V778 Cygni. (Rosolowsky and Benson, 1995)

4251 Pu Vul during the brightness weakening of 1993-94. (Andrillat and Houziaux, 1995)

4252 On new variables in the Sculptor galaxy. (Antpin and Samus, 1995)

4253 SN 1994W: Unprecedented brightness decline at late stage (Tsvetkov, 1995)

4254 On the new variable Lambda Bootis star. (Paunzen, 1995)

4255 HD 168740: A new variable Lambda Bootis star. (Paunzen and Duffee, 1995)

4256 Observations of 1991 superoutburst of WX Cet. (Kato, 1995)

4257 The overcontact Binary system NSV 05798. (Gomez-Forrellad and Garcia-Melando, 1995)

4258 The detection of narrow absorption components (NACS) in FX Lib = 48 Lib. (Hanuschik and Vrancken, 1995)

4259 Improvement of the period of CQ UMa. (Ziznovsky and Mikulasek, 1995)

4260 Outburst observations of PU Per. (Kato and Nogami, 1995)
CCD Observations of this poorly studied DNe in outburst reveal that it is a good candidate for UGWZ classification.

4261 The Small-Amplitude Variable Star HD 191495 in the open cluster NGC 6871. (Zakirov and Arzumanyants, 1995)

4262 Photoelectric observations of SZ Psc during 1993-194. (Antonopoulou et al, 1995)

4263 Photoelectric minima of Eclipsing Binaries. (Ogloza, 1995)
Unpublished photoelectric times of minima of the following stars made between 1988 and 1995; KP Aql, SS Ari, CK Boo, YY CMi, AS Cam, CW Cep, EK Cep, CC Com, V477 Cyg, RW Gem, TX Gem, DI Her, SW Lac, AR Lac, TZ Lyr, V508 Oph, FT Ori, β Per, DR Vul.

4264 New Photometry of the Hyades δ Scuti star V777 Tau (71 Tau). (Krisciunas et al, 1995)

4265 HS2324+3944: A New H-Rich Pulsating PG 1159 White Dwarf. (Silvotti, 1995)

4266 BX Draconis: New Ephemeris and lightcurve. (Agerer and Dahm, 1995)
Results of photographic and CCD photometry on this β Lyr type variable.

4267 NSV 11802 - A New Algol-Type eclipsing Binary. (Roizman et al, 1995)

4268 New Outburst of V1118 Ori.

4269 New Outburst of V1143 Ori. (Mampaso and Parsamian, 1995)

4270 Optical observations of the active star RE J1816+541. (Robb and Cardinal, 1995)

4271 UBV Photometry of W Ser Stars. (Benko, 1995)

4272 Improved Ephemeris and Photometric Elements for HY Virginis. (Garcia-Melando et al, 1995)

4273 HD 161223 - A New Variable in the field of IC 4665. (Martin and Rodriguez, 1995)

4274 Two New Variable Stars. (Kaiser, 1995)
Discoveries made with the APP. Mira star in Taurus, 12.5-<15.5p, P~322d; and SR star in Pegasus, 11.7-12.4p, P~60d.

4275 Photometric Observations of NSV 13368. (Gomez-Forrellad and Garcia-Melando,1995)

4276 HY Com REVISITED. (Oja, 1995)

4277 V-Band Photometry of XY UMa in 1993 and 1995. (Jeffries et al, 1995)

4278 V491 CYGNI. (Wolf & Sarounova, 1995)
CCD Photometry of this poorly observed eclipsing binary.

4279 The 1995 Outburst of DV Dra. (Iida et al, 1995)
Details the recent outburst of this new addition to the Recurrent Objects Programme.

4280 Small Amplitude Variables in the Open Cluster IC 4665. (Zakirov & Arzumanyants, 1995)

4281 Optical Observations of the Active Star RE J2220+493. (Robb et al, 1995)

4282 Photometric Observations of NSV 01651 and The New Variable Star GSC 0669.0468. Gomez-Forrellad & Garcia-Melando, 1995)

4283 Three New Variable Planetary Nebula Central Stars: M 2-54, M 4-18 and NGC 2392. (Handler, 1996)

4284 The Period of Eclipsing Binary DHK 40. (Kaiser et al, 1996)

4285 Optical Minimum of V1057 Cyg in 1995. (Ibrahimov, 1996)

4286 Starspots on the young single KOV star HD 82443. (Messina & Guinan, 1996)

4287 NSV 10183 is a New Cepheid Variable Star. (Antpin & Berdnikov, 1996)

4288 Update on the Eclipsing Binary V514 Per. (Prosser, 1996)

4289 HD 116475: A New Late Type Variable in Canes Venatici. (West & Lloyd, 1996)
Publication of work carried out by Kevin West & Chris Lloyd on star 69 for BAA charts Y, TU & V CVn.

4290 Photoelectric Observations and New Classification of V4061 Sgr. (Berdnikov & Pastukhova, 1996)

4291 Spectral Classifications for fifteen Red Variables. (Bidelman, 1996)

4292 CCD Photometry of the Eclipsing Binary HP Aurigae. (Wolf & Sarounova, 1996)

4293 Confirmation of the Period of GW Cep found by Hough Transform.

PRO-AM EXCHANGES REPORT 12

Covering period 1994 Jan 1 to June 30.

D**ate Subject Professional and remarks**

940101 V705 Cas Yasuto Takenaka, Japan
Requests data on this nova and we set up a regular exchange.
940103 V630 Cas Dr.Kent Honeycutt, USA
Sends us a paper on above variable showing outburst recently detected by him which was not reported by our observers. Copied to Gary Poyner as recurrent object.
940103 V705 Cas Taichi Kato, Japan
V-band CCD extension of comparisons sent to us to improve our sequence
940103 LL And Brian Skiff, USA
We fax our chart as sequence considerably weak. Skiff undertakes to re-measure in due course.
940103 V705 Cas Ulisse Munari, Italy
Report of search for progenitor sent to us. Part of a double.
940103 SN 1993J Michael Richmond, USA
Supplies map and V magnitudes to us for fainter comparisons.
940105 LL And Steve Howell, US
Proposed joint paper on LL And and recent outburst.
940106 SN 1993J Paul Murdin, UK
We supply light curves for above object and are sent in return an explanation of the ‘double peak’.
940107 GRO J0422+32 Taichi Kato, Japan
Kato supplies details of new outburst with V measures.
940108 Kuiper Belt Objects Richard Taylor, UK
As requested we supply orbital elements on these objects.
940110 Recurrent Objects Steve Howell, USA
We supply details of stars on the above programme. In return we establish Steve Howell has been studying almost an identical list and provides us with various references.
940115 OJ 287 Mark Kidger, Tenerife
As part of a PRO-AM project on this object, we receive a report of spectrophotometry undertaken at Tenerife.
940115 SS Cygni Chris Mauche, USA
As requested Gary Poyner alerts Chris Mauche to an outburst.
940117 OJ 287 Leo Takalo, Finland
Visual estimates Jan 11-16 supplied as part of joint project
940118 Pos SN in M66 Harold Corwin, USA
We receive an appeal for confirmation. No new object found.
940202 OJ 287 & 3C66A Leo Takalo, Finland
We supply further data Jan-Feb.
940202 SN 1993J INT Group, La Palma
Details of measures in multiple wavelengths supplied to us
940216 V705 Cas Andrew Scott, UK
Report received of possible DQ Her-type fade and Andrew appeals for further observations.

940217 V705 Cas Peter Hauschildt, USA
Further report on the fade received. Appeals for more data!
940224 OJ 287 & 3C66A Leo Takalo, Finland
Further report sent including some unfiltered CCD results.
940303 Nova Sgr 1994 Pam Kilmartin, NZ
Astrometry supplied to us based on images of Mar 2.62UT.
940304 OJ 287 Leo Takalo, Finland
Further report of Mar 2-3 sent to Finland. Feedback on 940304 from Takalo confirms object brightening. Thereafter numerous frequent reports not always listed here.
940305 Nova Sgr 1994 Pam Kilmartin, NZ
Photometric report received. 1994 Mar 4.67UT V=8.76.
940305 Nova Sgr 1994 Brian Skiff, USA
Report received of progenitor candidates on POSS.
940305 VS Archives Hilmar Duerbeck, Germany
Copy of paper received detailing archives of variable stars and commenting on value of long term visual work.
940305 TT Crt Paula Szkody, USA
Outburst Mar 2, 13.6v by Richard Fleet, relayed.
940309 SN 1994D in NGC 4526 Alex Filippenko, USA Report received of a possible SN, R=15.2 by Leuschner Observatory Supernova Search (LOSS) on Mar 7.
940309 SN 1994D in NGC 4526 Brian Skiff, USA We are supplied with Kilkenny & Malcolm V mags for comps.
940310 SN 1994D in NGC 4526 Gerard de Vaucouleurs
Detailed report on the SN and its galaxy received.
940311 SN 1994D in NGC 4526 Brian Marsden, CBAT
Visual estimate by Hurst (Mar 10.96, 12.5v) supplied to CBAT
940312 SN 1994D in NGC 4526 Brian Marsden, CBAT
Further report by Hurst (Mar 12.01UT, 12.4v) sent.
940313 SN 1994D in NGC 4526 Alan Gilmore, NZ
Astrometric report received.
940318 IP Pegasi Various
Bill Worraker mounts a project to observe eclipses in IP Peg at the suggestion of professionals at Keele, Sussex and Munich TA agrees to publicise the project details.
940322 Variables Peter Tuthill, UK
Data requested and supplied on α Ori, μ Cep, α Her and α Sco. Light curves 1989 onwards.
940328 Wakuda's Obj in Sgr Taichi Kato, Japan
Details received of a new discovery by Minoru Wakuda
940401 3C 279 C.Shrader, USA
At our request supplies his paper on this object in view of our joint interest.
940401 Pos SN in M51 Harold Corwin, USA. Appeal received for confirmation of this object reported by Wayne Johnson, USA. Reports of confirmation received from Brian Skiff (USA) and Alex Filippenko (USA).
940402 Pos SN in M51 Alejandro Clocchiatti
Full report received on M51 and catalogue data.

940403 SN 1994I in M51 Brian Marsden, CBAT
Visual confirmation by Hurst (Apr 2.92UT, 13.6v) sent
940405 SN 1994I in M51 Brian Skiff, USA
Preliminary sequence measured and supplied to us
940409 SN 1994I in M51 Michael Richmond, USA
Leuschner data supplied to us. Apr 7, V=13.70.
940411 OJ 287 Leo Takalo, Finland
Poyner reports 15.5v on Apr 10 and relayed to Finland
940421 Pos SNe N3353 and 3655 Harold Corwin, USA
Searches on plates by various observers confirm foreground stars.
940428 BC UMa Taichi Kato, Japan and Steve Howell, USA
M.Iida, Japan reports outburst Apr 28, 13.0: Confirmed by various observers and relayed to Steve Howell. Iida later detects superhumps.
940429 LL And Steve Howell, USA
Draft of joint paper with G.Hurst completed re BAA Journal.
940506 OJ 287 Leo Takalo, Finland
Results for Apr 2-30 sent. Apr 4, 15.8 (Hewitt)
940511 Suspected variables Ivan Andronov, Odessa
Odessa group express interest in following up the TASV and TAV objects, mainly found by Mike Collins. They will keep us informed of progress.
940523 Pos Nova Sgr Kenji Hirosawa, Japan
Report of possible nova found by Yukio Sakurai, Japan on patrol films of May 20.71UT at mpv=10.8.
940526 Nova Sgr 1994 No 2 Scott Austin, USA
Confirms new object in Sgr by spectral analysis.
940601 SN 1993J P.Benson, USA
Supplies us with new paper (Astron.Journal) with light curve
940601 AR UMa R.Remillard, USA
Paper sent to us giving analysis of the above variable.
940601 Catalogue of SNe Sidney Van Den Bergh
Supplies to us catalogue recently appearing in Astrophysical Journal Supplement.
940603 Pos nova in Oph Taichi Kato, Japan
Yamamoto reports discovery of a possible nova in Oph on June 2 at mpv=6.5. Independent discovery by A.Tago in Japan confirms.
940603 TV Crv Taichi Kato, Japan
Outburst of this variable (=Tombaugh's variable) detected by M.Iida, Japan June 3.5UT mag 13.5.
940608 V404 Cy

RECENT PAPERS ON VARIABLE STARS

'Supernova 185 is really a Nova plus Comet P/Swift-Tuttle (Schaeffer, Astron. J., 110, 1795, 1995)

The Chinese History of the Later Han Dynasty reports a 'guest star' on 7 Dec 185 AD. Some people have suggested that this was a supernova and there has been some discussion about possible remnants. It has also been suggested that it was a comet that was visible for over 210 days(!). Schaeffer proposes that the report is the result of confusion of two objects - a nova and comet P/Swift-Tuttle which was then at a particularly good return.

A Re-evaluation of Eastern and Western Records of the Supernova of 1054 (Breen & McCarthy, Vistas in Astronomy, 39 363-379, 1995)

According to Chinese sources this supernova was first sighted between 9 June and 7 July 1054 to the North-West of Zeta Tauri. It became as bright as Venus and was visible in daylight for 23 days. It disappeared just before 17 Apr 1056; Japanese sources indicate that the first sighting was probably on 4th July 1054.

Was Fritz Zwicky's "Type V" SN1961V a Genuine Supernova? (Fillipenko et al, Astron. J., 110 2261-2273, 1995)

Tentatively identify the 'remnant' of SN 1961V as a 25.6V reddish star in a group of 24-25V blue stars. This is consistent with a highly reddened post-erruption Eta Carinae type variable.

An Expansion Parallax for PW Vul (Nova 1984) (Ringwald & Taylor, Mon. Not. Royal Astron. Soc., 278, 808-810, 1996)

H-alpha images give a shell diameter of 1.1 milliarcsecs in 1993, Spectra show a shell expansion velocity of 470+/-60km/s. This gives a distance of 1.6+/-1.2kpc and a Mv at max of -6.3+/-0.3, which is typical for a slow nova.

CCD Photometry of Nova V1500 Cygni Twenty Years on (Semeniuk et al, Acta Astron., 45, 747-752, 1995)

Find this old nova to be mag 18 in July 1995 and still showing the 0.1396d periodicity.

BT Monocerotis: Another Extraordinary Old Nova (White et al, Astrophys. J., 456, 777-787, 1996)

The light-curve of this eclipsing old nova suggests the presence of an accretion disk but there is no evidence in the spectrum for one. The spectrum does show evidence for unusually high-velocity gas motions near eclipse. The authors propse various possible models for the system.

Analysis of Long-term AAVSO Observations of RS Ophiuchi (Oppenheimer & Mattei, J. Am. Assoc. Variable Star Observers, 22, 105-109,1993)

A light curve of RS Oph covering 5 outbursts shows that the shapes of the outbursts are all very similar. The authors suggest that an unrecorded outburst may have occurred in 1945 but only the lower parts of the decline were observed.

Dynamical Evidence for a Black Hole in the X-Ray Transient QZ Vul (=GS 2000+25) (Casares et al, Mon, Not, Toyal Astron. Soc., 277, L45-L50, 1995)

Report the spectroscopic detection of the secondary component. This is a K5 dwarf in an 8.3 hour orbit. The amplitude of the radial velocity curve is 520 km/s which gives a mass function of 5.02+/-0.46 solar masses. This is the second largest for a black hole candidate after V404 Cyg.

Is Her X-1 a Strange Star? (Li et al, Astron. Astrophys, 303, L1-L4, 1995)

'Strange stars' are conjectured objects similar to neutron stars but with a different mass-radius relationship. The authors estimate the mass-radius relation for Her X-1 (=HZ Her) and find that it fits a 'Strange star' better than a neutron star.

The White Dwarf in AM Herculis (Gansicke & Beuermann, Astron, Astrophys., 303, 127-136, 1995)
Report UV spectroscopy with the IUE of AM Her in high and low states. Find that the hot spot gets hotter but not larger in the high state (it covers about 0.1 of the white dwarf's surface). Derive a distance of 91+/-16pc. The accretion rate onto the white dwarf is about 10^{-11} solar masses per year in the low state.
Transitions to and from Stable Discs in Cataclysmic Variable stars (Warner, Astrophys. Space Sci., 230, 83-94, 1995)
Interprets the properties of Z Cam stars, nova-like variables and old novae in terms of the disk instability model. The variations of VY Scl stars are interpreted as due to irradiation of the secondary and the inner parts of the disk. The first leads to a higher mass transfer rate and the second reduces the disk instability. Irradiation may also produce the low-amplitude modulations on time scales of 10's of days that are also seen in VY Scl stars.
Identification of the Soft X-Ray Source WGA J1802.1+1804 with a New Magnetic Cataclysmic Variable (Szkody et al., Astrophys. J., 455, L43-L46, 1996)
Report discovery of a 14.5V cataclysmic variable during observations of soft X-ray sources. Is probably a magnetic AM Her star. Shows periodicity of 113 mins in photometric, polarimetric, spectroscopic and X-ray observations.
The Eclipsing Dwarf Nova HS 1804+6752 (Billington et al, Mon. Not. Royal Astron. Soc., 278, 673-682, 1996)
Present observations of this recently-discovered dwarf nova. In H-alpha light most of the radiation comes from the elongated hot-spot. The accretion disk itself is small and faint. There is probably a significant amount of radiation coming from the irradiated surface of the M1-M2 secondary.
Photometric Observations of an Extreme ER UMa Star, RZ Leo Minoris (Nogami et al, Publ. Astron. Soc. Japan, 47, 878-902, 1995)
ER UMa stars are SU UMa stars with very short superoutburst periods. The authors identify RZ LMi as an ER UMa star with a superoutburst period of 19d and a 'superhump' period of 0.05946d. The peculiar light-curves of ER UMa stars suggest extraordinarily high mass transfer rate which do not fit into current models for the origin and evolution of SU UMa stars. The apparently high incidence of these stars amongst the CV's suggests that an important stage in CV evolution may have been overlooked.
The Nova-like Variable WX Centauri and the V Sagittae Phenomenon (Diaz & Steiner, Astron. J., 110, 1816-1823, 1995)
Spectrophotometry of WX Cen shows it to be a binary system similar to V Sge with an orbital period of 10 hours and a distance of about 1400pc.
Spectroscopy of Poorly-studied Cataclysmic Variables (Downes et al, Astron. J., 110, 1824-1837, 1995)
Present spectra of 15 poorly studied stars from the catalogue of Downes & Shara (1993). Find that 8 are definitely cataclysmic variables, 4 are possibly not, and 3 are definitely not.
Unstable Wind of 6 Cassiopeiae (Chentsov, Astrophys. Space Sci., 232, 217-232, 1995)
Spectroscopy of this A2.5Ia-0 hypergiant reveals an unstable stellar wind similar to that of P Cygni.
A Pulsating Star inside Eta Carinae: I, Light Variations 1992-1994 (van Genderen et al, Astron. Astrophys., 302, 415-430, 1995)

Analyse results of a photometry campaign covering 2 seasons. The main star showed no S Dor type eruptions during this time. This allowed the observation of micro-pulsations, similar to those shown by Alpha Cyg, with a quasi-period of 58.56d. Short dips lasting a few days were recorded at intervals of 52.4d - these are presumably eclipses of another star in the system, or else of the hot-spot on an accretion disk.

The Period of RU Sextantis (Williams, J. Am. Assoc. Variable Star Observers, 22, 116-120, 1993)

Uses 193 Harvard plates to confirm that this star is a RR Lyr variable and identifies 3 possible periods: 0.26, 0.35 and 0.54 days (these are 1-day aliases of each other). Finds that 0.3502323d gives the best fit. Brelstaff and Isles (JBAA, 97, 23-25,1986) preferred 0.539806d.

An Improved Cepheid Distance Estimation (Kanbur & Hendry, Astron. Astrophy., 305, 1-16, 1996)

Present evidence that the Cepheid period-luminosity and period-luminosity-colour relationships can be made more accurate if the maximum light is used instead of (or as well as) the mean light.

The Molecular Envelope around 89 Herculis (Alcolea & Bujarrabal), Astron. Astrophys., 303, L21-L24, 1995)

Study of CO emission reveals two shells around this small-amplitude yellow supergiant variable.

Asymmetrical Mass Loss from Rotating Red Giant Variables (Asida & Tuchman, Astrophys. J., 455, 286-292, 1995)

Investigate the effect of rotation on mass loss from the atmospheres of pulsating red giant stars. This is a possible mechanism for producing asymmetrical planetary nebulae.

Long-term Diameter Variations in the Long-period Variable Omicron Ceti (Tuthill et al, Mon. Not. Royal Astron. Soc., 277, 1541-1546,1995)

Interferometry in the light of TiO features shows the diameter almost doubled between Sep 1991 and Dec 1993. There is no obvious correlation with the pulsation period but the rate of increase is about what would be expected from pulsation-driven mass loss from the star's atmosphere.

NSV 12872 is a Mira-type Variable (Collins & Westlund, The Astronomer, 32, 236+back cover, 1996)

Find a range of 11.5 - 15V and a period of 265 days.

Is HR 1469 + NSV 1671 a Constant Star? (Bradley et al, J. Am. Assoc. Variable Star Observers, 22,133-144,1993)

Propose that the apparent fade of this star recorded by the HST Fixed Head Star Trackers was spurious.

Space Densities of Cataclysmic Variables and Nova Recurrence Times (Duerbeck & Covarrubias, Proc. Int. Astron. Union Colloq. No. 151, Flares and Flashes, Springer Verlag, Berlin, p264-267, 1995)

- Use recent catalogues of CVs and recent absolute mag determinations, along with the assumption that novae, dwarf novae and nova-like variables represent three different stages in the evolution of CVs, to estimate the mean interval between nova outbursts to be 10,000 years. In this time the CV spends about 2000 years as a nova-like variable and 8000 years as a dwarf nova. During the dwarf nova stage the white dwarf would accrete about $3x10^{-5}$ solar masses, which is similar to the amount ejected by a nova eruption.

Ground-based Detection of Terrestrial Extrasolar Planets by Photometry: the Case for CM Draconis (Schneider & Doyle, Earth Moon Planets, 71, 153-173, 1995)

Suggests that present-day technology should be able to detect eclipses by planets with masses in the Earth-Neptune in the light-curve of the 13th-mag red dwarf eclipsing binary CM Dra.

Dwarf Nova Outbursts (Osaki, Publ. Astron. Soc. Pacific, 108, 39-60, 1996)
Proposes a 'unification model' for dwarf nova outbursts based on the disk instability model. This involves two types of instability in the disk: thermal and tidal. Uses this model to explain the rich variety of behaviour found in cataclysmic variables below the period gap ('permanent superhumpers', Z Cam like stars, SU UMa stars, ER UMa stars, ordinary SU UMa stars and WZ Sge stars.

Orbital Periods for Seven Dwarf Novae of the SU Ursae Majoris Subclass from Radial Velocities at Minimum Light (Thorstensen et al, Publ. Astron. Soc. Pacific, 73-80, 1996)
Derive the following periods from radial velocities of H-alpha emission lines: FO And 103.1 mins, FS Aur 85.7, WX Cet 83.9, AQ Eri 87.7, TY Psc 98.4, CY UMa 100.2, and SS UMi 97.6. The last 4 show variations of about 0.2 mag over the orbital period but none show eclipses.

Optical Activity of HDE 249119 (Stepan & Hudec, Astron. Astrophys., 305, 869-870, 1996)
This star lies within the error box of the gamma-ray burster GRB 790929 and was found to be 'optically active' only 7 hours after the burst. Here the authors examine photographic and visual observations covering 1800 hours and find the star to be constant except for 5 brightenings each of about 0.5-0.6 mag.

Speckle-masking Imaging Polarimetry of Eta Carinae: Evidence for an Equatorial Disk (Falcke et al, Astron. Astrophys., 306, L17-L20, 1996)
Find evidence for a circumstellar disk and a bipolar structure which may be the inner part of the bipolar outflow into the Homunculus Nebula.

Interferometric Molecular Line Observations of the Circumstellar Envelope(s) around U Camelopardalis (Lindqvist et al, Astron. Astrophys., 305, L57-L60, 1996)
Find evidence in HCN and CN lines for two envelopes, one at $7x10^{16}$cm from the star and expanding at $25kms^{-1}$, the other at $6x10^{15}$cm and expanding at $13kms^{-1}$. This suggests that the rate of mass loss during the formation of the outer envelope was much higher than it is now.

ECLIPSING BINARY PREDICTIONS

The following predictions are calculated for an observer at 53 degrees north, 1.5 degrees west but should be usable for observers throughout the British Isles. The times of mid-eclipse appear in parentheses with the start and end times of visibility on either side. The times are hours GMAT, that is UT-12h. 'D' and 'L' are used to indicate where daylight and low altitude, respectively, prevent part of the eclipse from being visible. Charts for all of the stars included in these predictions (17 in all - see VSSC 85 for a list) are available from the Eclipsing Binary Secretary at 10p each (please enclose a large SAE).

1996 Jul 1 Mon
TW Dra D10(11)14D
Z Dra 11(13)14D
RZ Cas 13(15)14D
RW Tau L14(13)14D
1996 Jul 2 Tue
U Sge D10(05)11
ST Per 13(17)14D
1996 Jul 3 Wed
SW Cyg D10(12)14D
1996 Jul 4 Thu
TW Dra D10(06)11
S Equ D10(14)14D
1996 Jul 5 Fri
Z Vul D10(13)14D
U Sge D10(15)14D
ST Per L11(09)13
U Cep 12(16)14D
Z Dra 13(15)14D
1996 Jul 6 Sat
RZ Cas D10(10)12
1996 Jul 7 Sun
RZ Cas 12(14)14D
1996 Jul 8 Mon
Z Dra D10(08)11
1996 Jul 9 Tue
Z Per D10(05)10
Y Psc L11(14)14D
1996 Jul 10 Wed
Z Vul D10(10)14D
U Cep 11(16)14D
ST Per 12(16)14D
1996 Jul 11 Thu
TX UMa D10(05)10
S Equ D10(11)14D
1996 Jul 12 Fri
Z Per D10(07)12
U Sge D10(09)14D
RZ Cas D10(09)11
Z Dra D10(10)12
SW Cyg 10(16)14D
TW Dra 11(16)14D
RW Tau L13(15)14D
1996 Jul 13 Sat
ST Per L10(07)11
Y Psc L10(09)13
RZ Cas 11(14)14D
1996 Jul 14 Sun
TX UMa D10(07)11
1996 Jul 15 Mon
Z Per D10(08)13
Z Vul D10(08)14
TW Dra D10(12)14D
U Cep 11(16)14D
U Sge 12(18)14D
RW Tau L13(09)14
1996 Jul 16 Tue
Z Dra D10(12)14
1996 Jul 17 Wed
SW Cyg D10(06)12
TX UMa D10(08)13
Z Vul 14(19)14D
1996 Jul 18 Thu
TW Dra D10(07)12
S Equ D10(08)14
RZ Cas D10(09)11
Z Per D10(09)14
ST Per 10(14)14D
1996 Jul 19 Fri
RZ Cas 11(13)14D
SS Cet 14(19)14D
X Tri 14(17)14D
1996 Jul 20 Sat
Z Vul D10(06)11
TX UMa D10(10)13L
U Cep 11(15)14D
Z Dra 11(13)14D
X Tri 14(16)14D
1996 Jul 21 Sun
Z Per D10(11)14D
ST Per L10(06)10
X Tri 13(15)14D
SW Cyg 13(19)14D
S Equ 13(19)14D
1996 Jul 22 Mon
U Sge D09(12)15D
Z Vul 12(17)15D
X Tri 12(15)15D
SS Cet L14(18)15D
1996 Jul 23 Tue
TX UMa D09(11)13L
X Tri 12(14)15D
RW Tau L12(17)15D
1996 Jul 24 Wed
RZ Cas D09(08)10
Z Per D09(12)15D
X Tri 11(13)15D
Y Psc 12(16)15D
Z Dra 13(15)15D
1996 Jul 25 Thu
S Equ D09(05)11
X Tri 10(13)15D
RZ Cas 10(13)15D
U Cep 10(15)15D
SS Cet L13(18)15D
1996 Jul 26 Fri
SW Cyg D09(09)15D
TX UMa D09(13)13L
ST Per L10(13)15D
X Tri L10(12)14
RW Tau L12(11)15D
TW Dra 12(17)15D
1996 Jul 27 Sat
Z Dra D09(08)11
Z Per D09(13)15D
Z Vul 10(15)15D
X Tri L10(11)14
1996 Jul 28 Sun
Y Psc L09(10)15D
X Tri L10(11)13
S Equ 10(16)15D
SS Cet L13(17)15D
Z Dra 14(17)15D
1996 Jul 29 Mon
U Sge D09(06)12
TW Dra D09(13)15D
TX UMa 10(14)13L
X Tri L10(10)12
1996 Jul 30 Tue
RZ Cas D09(07)10
X Tri L10(09)12
U Cep 10(15)15D
Z Per 10(15)15D
1996 Jul 31 Wed
Z Dra D09(10)12
RZ Cas 10(12)14
X Tri L10(09)11
SS Cet L13(16)15D
1996 Aug 1 Thu
TW Dra D09(08)13
Z Vul D09(13)15D
Y Psc L09(05)09
X Tri L10(08)10
U Sge 10(16)15D
TX UMa 11(16)13L
RZ Cas 14(17)15D
1996 Aug 2 Fri
X Tri L10(07)10
Z Per 11(16)15D
RW Gem L14(19)15D
1996 Aug 3 Sat
ST Per L09(12)15D
SS Cet L13(16)15D
RW Tau 14(18)15D
1996 Aug 4 Sun
SW Cyg D09(13)15D
S Equ D09(13)15D
Z Dra 09(12)14
U Cep 10(14)15D
TX UMa L15(17)15D
1996 Aug 5 Mon
RZ Cas D09(07)09
Z Per 13(18)15D
RW Gem L14(16)15D
1996 Aug 6 Tue
Z Vul D09(11)15D
RZ Cas 09(11)14
RW Tau L11(13)15D
SS Cet L13(15)15D
1996 Aug 7 Wed
RZ Cas 14(16)15D
TX UMa L15(19)15D
1996 Aug 8 Thu
U Sge D09(10)15D
Z Dra 11(14)15D
Y Psc 13(18)15D
RW Gem L14(13)15D
Z Per 14(19)15D
ST Per 15(19)15D
1996 Aug 9 Fri
U Cep 09(14)15D
RW Tau L11(07)12
SS Cet L12(14)15D
TW Dra 13(18)15D
1996 Aug 11 Sun
Z Dra D09(07)09
Z Vul D09(08)14
S Equ D09(10)15

ST Per D09(10)14
U Sge 13(19)15D
RW Gem L14(09)15
1996 Aug 12 Mon
RZ Cas D09(11)13
Y Psc D09(12)15D
TW Dra D09(13)15D
SS Cet L12(14)15D
Z Dra 13(15)15D
1996 Aug 13 Tue
SW Cyg 10(16)15D
RZ Cas 13(16)15D
Z Vul 14(19)15D
1996 Aug 14 Wed
U Cep 09(14)15D
S Equ 15(20)15D
1996 Aug 15 Thu
U Sge D09(04)10
Z Dra D09(08)11
TW Dra D09(09)14
SS Cet L12(13)15D
1996 Aug 16 Fri
Z Vul D08(06)11
Y Psc D08(06)11
ST Per 13(18)15D
Z Dra 15(17)15D
1996 Aug 17 Sat
RW Tau L11(15)16D
1996 Aug 18 Sun
TW Dra D08(04)09
SW Cyg D08(06)12
S Equ D08(07)12
RZ Cas D08(10)13
U Sge D08(13)16D
Z Vul 12(17)16D
SS Cet L12(13)16D
1996 Aug 19 Mon
ST Per D08(09)13
Z Dra D08(10)13
U Cep 09(13)16D
RZ Cas 13(15)16D
1996 Aug 20 Tue
RW Tau L10(09)14
1996 Aug 21 Wed
Z Vul D08(04)09
SS Cet L12(12)16D
S Equ 12(17)16D
X Tri 15(18)16D
1996 Aug 22 Thu
SW Cyg 14(20)16D
X Tri 14(17)16D
RW Gem 15(21)16D
1996 Aug 23 Fri
Z Dra 09(12)14
Z Vul 10(15)16D
X Tri 14(16)16D
TW Dra 14(19)16D
Y Psc 15(19)16D
1996 Aug 24 Sat
RZ Cas D08(10)12
U Cep 08(13)16D
SS Cet L11(11)16D
ST Per 12(16)16D
X Tri 13(15)16D
1996 Aug 25 Sun
S Equ D08(03)09
U Sge D08(08)13
RZ Cas 12(14)16D
X Tri 12(15)16D
RW Gem L13(17)16D
1996 Aug 26 Mon
TX UMa D08(04)09
TW Dra 09(14)16D
X Tri 12(14)16D
1996 Aug 27 Tue
ST Per D08(08)12
SW Cyg D08(09)15
Y Psc 09(13)16D
X Tri 11(13)16D
Z Dra 11(14)16D
SS Cet L11(11)15
1996 Aug 28 Wed
Z Vul D08(13)16D
S Equ 09(14)16L
X Tri 10(13)15
U Sge 11(17)15L
RW Tau 12(16)16D
RW Gem L12(14)16D
1996 Aug 29 Thu
TX UMa D08(06)10
TW Dra D08(10)15
U Cep 08(13)16D
X Tri 10(12)15
1996 Aug 30 Fri
Z Per D08(04)09
Z Dra D08(07)09
RZ Cas D08(09)12
X Tri 09(11)14
SS Cet L11(10)15
1996 Aug 31 Sat
Y Psc D08(08)12
X Tri 08(11)13
RW Tau L10(11)16
RZ Cas 11(14)16D
RW Gem L12(11)16
Z Dra 13(15)16D
1996 Sep 1 Sun
TW Dra D08(05)10
TX UMa D08(07)11L
X Tri D08(10)13
ST Per 11(15)16D
1996 Sep 2 Mon
Z Per D08(06)11
X Tri D08(09)12
Z Vul D08(11)16L
SS Cet L11(09)14
1996 Sep 3 Tue
Z Dra D08(08)11
X Tri D08(09)11
U Cep D08(12)16D
RW Tau L10(05)10
RW Gem L12(08)13
1996 Sep 4 Wed
ST Per D08(06)11
X Tri D08(08)10
TX UMa D08(09)10L
S Equ D08(11)15L
U Sge D08(11)15L
TX UMa L13(09)13
Z Dra 15(17)16D
1996 Sep 5 Thu
Z Per D08(07)12
X Tri D08(07)10
RZ Cas D08(09)11
SW Cyg D08(13)16D
SS Cet L11(09)13
1996 Sep 6 Fri
X Tri D08(07)09
RZ Cas 11(13)16
TW Dra 15(20)16D
1996 Sep 7 Sat
X Tri D07(06)08
Z Vul D07(08)14
TX UMa D07(10)10L
Z Dra 08(10)13
TX UMa L13(10)15
U Sge 14(20)15L
RZ Cas 16(18)16D
Y Psc 16(21)16D
1996 Sep 8 Sun
X Tri D07(05)08
Z Per D07(08)13
U Cep D07(12)16D
SS Cet L10(08)13
RW Tau 14(18)16D
1996 Sep 9 Mon
ST Per 09(14)16D
TW Dra 10(15)16D
Z Vul 14(19)15L
1996 Sep 10 Tue
SW Cyg D07(03)09
TX UMa D07(12)10L
TX UMa L13(12)16
1996 Sep 11 Wed
U Sge D07(05)11
S Equ D07(08)13
RZ Cas D07(08)10
Z Per D07(10)15
RW Tau L09(13)16D
Z Dra 10(12)14
SS Cet L10(08)12
Y Psc 10(15)16D
1996 Sep 12 Thu
ST Per D07(05)09
Z Vul D07(06)12
TW Dra D07(10)15
RZ Cas 10(13)15
1996 Sep 13 Fri
U Cep D07(12)16D
TX UMa 08(13)10L
TX UMa L12(13)16D
RZ Cas 15(17)16D
1996 Sep 14 Sat
Z Dra D07(05)08
Z Per D07(11)16
U Sge 09(14)14L
RW Tau L09(07)12
SS Cet L10(07)12
SW Cyg 10(16)16D
Z Vul 12(17)15L
S Equ 13(18)15L
RW Gem 14(19)16D
1996 Sep 15 Sun
TW Dra D07(06)11
Y Psc D07(09)14
Z Dra 11(14)16
1996 Sep 16 Mon
TX UMa L12(15)17D
1996 Sep 17 Tue
Z Vul D07(04)09
RZ Cas D07(08)10
Z Per 08(12)17D
ST Per 08(12)16
SS Cet L10(06)11
RW Gem L11(15)17D
1996 Sep 18 Wed
S Equ D07(05)10
Z Dra D07(07)09
U Cep D07(11)16
RZ Cas 10(12)15
1996 Sep 19 Thu
Y Psc D07(04)08
SW Cyg D07(06)12
Z Vul 10(15)15L
TX UMa L12(16)17D
Z Dra 13(15)17D
RZ Cas 14(17)17D
RW Tau 15(20)17D
1996 Sep 20 Fri
ST Per D07(04)08
Z Per 09(14)17D
SS Cet L10(06)10
RW Gem L11(12)17D
TW Dra 15(20)17D
1996 Sep 21 Sat
U Sge D07(09)14L
S Equ 10(15)14L
1996 Sep 22 Sun
Z Vul D07(02)07
Z Dra D07(09)11
RW Tau 10(15)17D
TX UMa 13(18)17D
V640 Ori L14(12)14
ST Per 15(19)17D
X Tri 16(19)17D
1996 Sep 23 Mon
RZ Cas D07(07)09
U Cep D07(11)16
SS Cet L09(05)10
Z Per 10(15)17D

RW Gem L11(09)14
TW Dra 11(16)17D
SW Cyg 14(20)17D
Z Dra 15(17)17D
X Tri 16(18)17D

1996 Sep 24 Tue

Z Vul 08(13)14L
RZ Cas 09(12)14
U Sge 12(18)14L
V640 Ori L14(12)15
X Tri 15(18)17D

1996 Sep 25 Wed

S Equ D07(02)07
ST Per 07(11)15
RW Tau L08(09)14
RZ Cas 14(16)17D
X Tri 14(17)17D
TX UMa 14(19)17D

1996 Sep 26 Thu

TW Dra D07(11)16
Z Dra 08(10)13
RW Gem L11(06)11
Z Per 12(17)17D
Y Psc 12(16)17L
V640 Ori L13(13)15
X Tri 14(16)17D

1996 Sep 27 Fri

X Tri 13(16)17D
Z Dra 16(19)17D

1996 Sep 28 Sat

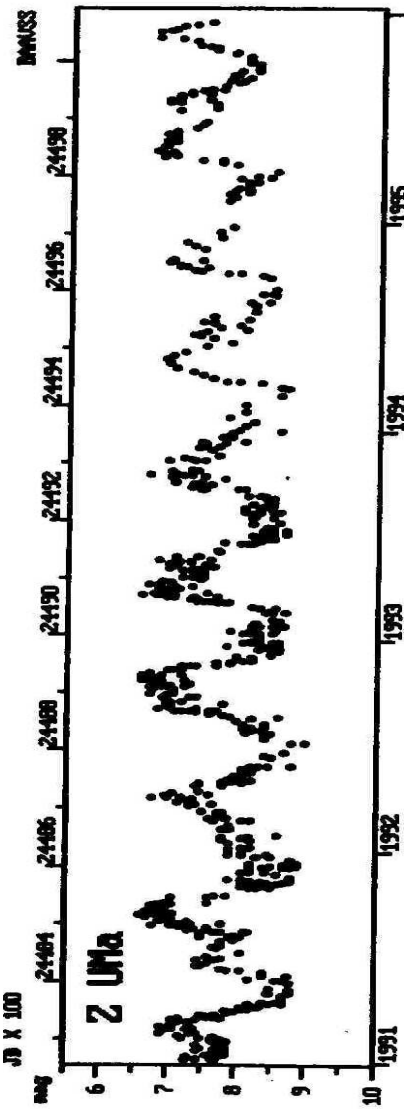
U Sge D07(03)09
SW Cyg D07(10)16
U Cep D07(11)16
S Equ 07(12)14L
RW Tau L08(03)08
X Tri 12(15)17D
V640 Ori L13(13)16
TX UMa 16(21)17D

1996 Sep 29 Sun

RZ Cas D07(06)09
TW Dra D07(07)12
Z Vul D07(11)14L
X Tri 12(14)17
Z Per 13(18)17D

1996 Sep 30 Mon

Y Psc D07(11)15
RZ Cas 09(11)13
Z Dra 10(12)14
X Tri 11(14)16
V640 Ori L13(14)16
ST Per 14(18)17D



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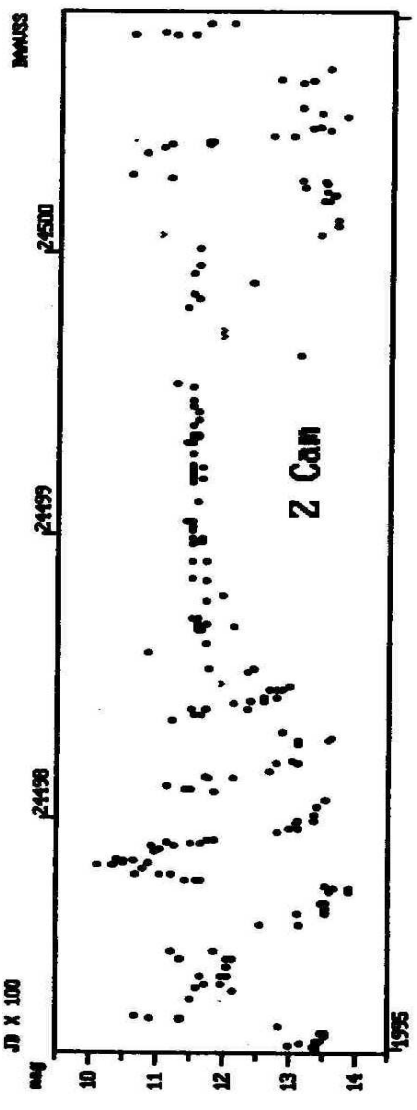

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