

The New Variable Star Section CCD Target List

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The CCD target list was first developed in 2002 to provide people who were new to the field of CCD photometry with some interesting targets to which they could turn their CCDs, whilst developing their techniques. The existence of such a list was certainly one of the main factors that got me started in CCD photometry. The list has been ably maintained and developed by Karen Holland over the last few years and I would like to thank her for her efforts and enthusiasm in starting this initiative and taking it forward. Recently I was asked to take over the coordination of the target list and I aim to build on Karen's excellent work. I have listed below some projects and some stars, which comprise the new CCD target list, and I would be delighted to hear from anyone who decides to have a go!

There are two main aims of the CCD target list:

1. To encourage people who have CCDs, and who have developed the ability to take reasonable images with them, to point them at Variable Stars and develop their photometry techniques
2. To provide some interesting targets and projects to get people involved in doing some real science.

Beginners Category

The Beginners Category contains eclipsing binaries which show significant brightness variables over a reasonable time scale. These stars are guaranteed to vary! Following one or more of these stars over a few nights allows the beginner to test their photometric system and see some results in a relatively short period. The VSS has a CCD advisor, Richard Miles, who is happy to provide advice. The CCD mentoring scheme also puts beginners in touch with more experienced observers. If you would like to be allocated a mentor, contact Roger Pickard.

Basic CCD Data

Dwarf novae (DNe) show outbursts during which they increase in brightness by two magnitudes and often much more; the shortest outburst duration is two to three days. However recent CCD monitoring of certain infrequently outbursting DNe in the VSS Recurrent Objects Programme has revealed that several stars appear to show intriguing "brief outbursts". These are much smaller in magnitude (often only 1 mag) and in duration (often only 24 h). The Basic CCD Data project involves the long term monitoring of DNe which are thought to exhibit these brief outbursts, with the aim of determining how frequently they occur, whether there is a periodicity and whether they

are in any way associated with true outbursts. Who knows what new science this may reveal?

At its simplest, this project involves taking one image of the DN every clear night and measuring the brightness. Many of the targets are very faint at quiescence, so the target may actually be invisible on the image. If VS photometry is not your main interest, you could even consider following one or two of the targets, taking a few images during the course of your normal observing programme. Given the short duration of the outbursts, the key here is to image as often as possible.

Most of these targets are on the Recurrent Objects Programme (ROP), so that if an outburst is detected then the ROP co-ordinator, Gary Poyner, should be notified. Other ROP targets which CCD observers could consider monitoring are V402 And, V336 Per, V358 Lyr, CI Gem and 1502+09 Boo. These are all very faint at quiescence and are probably undetected by most amateur CCD systems. Monitoring for rare outbursts in these systems is particularly valuable. But be warned: spotting a rare outburst in one of these stars may mean you become hooked!

Time resolved photometry

Time resolved photometry is a technique commonly used in the monitoring of variable stars, especially cataclysmic variables. Again the technique is relatively simple: a series of images of the target is taken over a period of minutes or hours to look for variations in brightness. Sometimes this technique is referred to as “time series photometry”. CVs can show variations over many times scales and sometimes these are associated with orbital features of the binary system which makes up the CV. The technique is often applied to newly discovered CVs during outburst, with the aim of detecting orbital humps or superhumps.

The targets in this project are CVs which have already been shown to exhibit variations of minutes or hours. The aim is to measure the brightness of the stars for as long as possible on a given night to look for such variations. The resulting light curve can then be examined for periodic or stochastic variations, which may in turn reveal information about the underlying cause of the variations.

Other targets and projects

Once the CCD photometry bug has bitten, there are of course thousands of other targets which could be monitored. Some examples are:

1. **BAA VSS Recurrent Objects Programme**; monitoring for outbursts of poorly characterised eruptive stars and follow up with time resolved photometry (programme co-ordinator Gary Poyner)
2. **ICCE** (Identification, Characterisation, Correction of Erroneous GCVS entries). Here the aim is to collect data on certain poorly studied variables with the aim to build up a light curve which can be used to classify the star. These stars include

- some which are red, hence a photometric filter should be used for these studies. Possible CCD targets are **V720 Cas**, **TAV0714+17**, **J0712+296**, and **TAV1933+53**. Further details can be obtained from the co-ordinator, Chris Jones.
3. **Long Term Polar Monitoring Programme.** Monitoring of stars, mostly magnetic CVs, from the Hamburg Quasar Survey at the request of Dr Boris Gaensicke of Warwick University (programme co-ordinator Gary Poyner). Many of these stars are faint, so ideally suited to CCD observation.
 4. **Targets of opportunity:** time resolved photometry of unusual CVs in outburst. Outbursts are usually reported on various user groups such as CVnet and VSnet. Observers worldwide aim to obtain light curves which can be used to classify the CV and to understand the underlying astrophysics

Notes on specific stars

V452 Cas. During 2005 and 2006 has shown several brief outbursts to around mag 16. What is the frequency of these and how are they related to true outbursts?

GO Com. This star has shown two outbursts in 2006 and eleven since 1995. What is the true outburst frequency? Superoutbursts should also be reported: this star shows impressive superhumps at such times.

KV Dra. Shows an active quiescence in the low 16s to mid 17s and frequent brief outbursts. Are there patterns to this behaviour?

V478 Her. This star was brighter than normal for several months in the summer of 2006. Is this typical behaviour? What is the long-term trend? What is its outburst behaviour?

DV Dra. Normally very faint at quiescence, but has shown several short-lived brightenings to around mag 17. Clearly these features are not picked up by visual observers. Is this simply an “active quiescence”? What else is going on? Future outbursts should be reported as a matter of urgency. Superhumps were detected during the 2005 superoutburst.

HR Lyr. This was Nova Lyr 1919 and is possibly a recurrent nova. Well worth keeping an eye on for future activity. Periodic variations on a variety of times scales (hours, days, weeks and even years) have been reported in the literature. A target for long term monitoring, as well as time resolved photometry.

V1363 Cyg. This star is an enigma. Classified at UGZ in the GCVS, observations have shown that this is extremely unlikely. The star shows variations on every possible time scale: seconds, minutes, hours, days and months. Possibly shows low and high states. Something for everyone here!

V1316 Cyg. Observed in superoutburst for the first time in 2006, confirming its UGSU classification. Also shows brief outbursts to around mag 16, which last 24 to 48 hours.

Do these occur with a particular periodicity? And is there a relationship between these brief outbursts and normal or superoutbursts?

TY Vul. Appears to show low amplitude outbursts from about 16.6C at quiescence to around 16.0C, as well as normal outbursts.

V630 Cas. An unusual DN which showed a 4.8 mag outburst in 1950 and a 2 mag outburst in 1992. However, variations on a variety of timescales have been reported, including frequent brightenings of about 0.5 mag from quiescence in the mid 16s.

CG Dra. Shows frequent outbursts. Time resolved photometry has shown dips in the light curve which last a few minutes. Are these orbital features? Are they related to the orbital period? Further time resolved photometry might reveal the answer. Long runs are required due to the long orbital period of this system (ca. 4.5 or 5.5 h)

SV CMi. An active UGZ star. Some modulations in the light curve have been detected during outburst. The period is 0.156 d, so long runs will be required to follow any orbital features.

ES Dra. Time resolved photometry during a future outburst is required to determine whether this is really a UGSU star. Superhumps have been reported, but these need to be confirmed during future outbursts. Reports indicate this is a DN just above the period gap.

Beginners Category

Star	RA (2000)	Dec (2000)	Type	Max	Min I	Min II	Orbital Period	Comp V mag	Comp GSC
AD And	23 36.7	+48 40	EB	10.9	11.6	11.6	0.99 d	10.93	3641 0339
OO Aql	11.19.8	+09 18	EW	9.2	9.9	9.8	0.51 d	10.25	1058 409
AC Boo	14 56.5	+46 22	EW	10	10.6	10.6	0.35 d	9.39	3474 966
EG Cep	20 16.0	+76 49	EB	9.3	10.2	9.6	0.54 d	9.6	4585 413
TZ Lyr	18 15.8	+41 07	EB	10.6	11.3	10.8	0.53 d	10.06	3107 2554
ER Ori	05 11.2	-08 33	EW	9.3	10.0	10.0	0.42 d	9.25	5330 364

Basic CCD Data

Star	RA (2000)	Dec (2000)	Type	Range
V452 Cas	00 52 19	+53 52	UGSU	14-17.5
GO Com	12 56 37	+26 37	UGSU	13.1-18.5V
KV Dra	15 50 38	+64 03	UGSU	13.4-17.7V
V478 Her	17 21 05	+23 39	UGSU	15.5-17.1p
DV Dra	18 17 25	+50 48	UGSU/UGWZ	15.0-<21p
HR Lyr	18 53 25	+29 14	N (or NR)	6.5-15.8v
V1363 Cyg	20 06 12	+33 43	?	13.0-<17.6p
V1316 Cyg	20 12 13	+42 45	UGSU	14.5 – 17.8C
TY Vul	20 41 44	+25 35	UG	14.0-19.0p
V630 Cas	23 48 53	+51 28	UG	12.3-17.1p

Time resolved photometry

Star	RA (2000)	Dec (2000)	Type	Range
SV CMi	07 31 08	+05 59	UGZ	12.6 17.1V
ES Dra	15 25 32	+62 01	UGSU?	13.9-16.3p
HR Lyr	18 53 25	+29 14	N (or NR)	6.5-15.8v
CG Dra	19 07 33	+52 58	UG	15.0-17.5p
V1363 Cyg	20 06 12	+33 43	?	13.0-<17.6p