

The New Variable Star Section CCD Target List

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Introduction

The CCD target list was developed to provide people who were new to the field of CCD photometry of variable stars with some interesting targets to which they could turn their CCDs, whilst developing their techniques. The original list was developed by Karen Holland and I have built on her 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 CCD cameras, 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.

Charts and comparison star sequences can be downloaded from the AAVSO Variable Star Plotter: <http://www.aavso.org/vsp>

Beginner's 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.

Star	RA (2000) h min	Dec (2000) deg min	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	19 48.5	+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

Table 1: Eclipsing binaries in the beginner's category

Increasingly, variable star observers are using Digital SLR cameras for photometry of brighter targets. Further information on this approach, especially how they may be used in the study of eclipsing binaries, can be obtained from the VSS Eclipsing Binary Secretary, Des Loughney.

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. Two of the stars go into outburst very frequently: V1316 Cyg every couple of weeks or so and V452 Cas about once a month. Observing these stars for a few weeks more or less guarantees the new observer to experience the delights of spotting an ourburst!

Star	RA (2000) h m s	Dec (2000) deg m	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
V478 Her	17 21 05	+23 39	UGSU	15.5-17.1p
DV Dra	18 17 25	+50 48	UGSU/UGWZ	15.0-<21p
V1316 Cyg	20 12 13	+42 45	UGSU	14.5 – 17.8C
TY Vul	20 41 44	+25 35	UG	14.0-19.0p

Table 2: Basic CCD target stars

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”. Cataclysmic Variables (CVs), DNe especially, 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.

How does one know which CV’s are worth following up with time resolved photometry? Well, outbursts of stars on the VSS Recurrent Objects Programme (see below) almost certainly merit follow-up. In addition, detections of outbursts of potentially interesting CVs are posted by their discoverers on a number of user groups including:

BAA VSS alert: <http://tech.groups.yahoo.com/group/baavss-alert/>

CVnet-outburst: <http://tech.groups.yahoo.com/group/cvnet-outburst/>

CVnet, the AAVSO’s CV section, also maintains a web page highlighting current and recent activity: <https://sites.google.com/site/aavsovcvsection/>

In addition, the Center for Backyard Astrophysics (CBA), coordinated by Prof. Joe Patterson at Columbia University, NY, USA, runs regular campaigns on a variety of CVs. See: <http://cbastro.org/>

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). 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! The latest ROP list is available at: <http://www.garypoyner.pwp.blueyonder.co.uk/rop.html>
2. **BAA VSS ICCE programme** (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 and at the following page: http://www.britastro.org/vss/chartcat_icce.htm

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. The programme is coordinated by Gary Poyner and further details are at: <http://www.garypoyner.pwp.blueyonder.co.uk/vsspolar.html>
4. **Equatorial Eclipsing Binaries.** This programme, run jointly between BAA VSS and Variable Stars South (part of RASNZ), aims to provide new or updated light elements (orbital period and one well-determined time of primary eclipse) of EA type eclipsing binaries. Where possible, it also aims to provide orbital, classification and shape data for the stars. The target stars are located in a band within 10° declination of the celestial equator, to enable collaborative northern and southern hemisphere research. The project is suitable for observers new to CCD photometry as well as for experienced observers. Further details at: <http://www.variablestarsouth.org/index.php/research-projects/equatorial-eclipsing-binaries>

Other resources

BAA VSS web site: <http://www.britastro.org/vss/>

BAA VSS mentoring scheme <http://www.britastro.org/vss/mentormap.htm>

“*Measuring Variable Stars Using a CCD Camera*” a booklet and CD Rom guide by David Boyd, available to purchase from the BAA office or online at: <http://www.britastro.org/sales2006/index.html>

AAVSO CCD observing manual: <http://www.aavso.org/ccd-observing-manual>

AAVSO suggested stars for CCD observers: <http://www.aavso.org/suggested-stars-ccd-observers>