

The 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 CCD mentoring scheme also puts beginners in touch with more experienced observers. If you would like to be allocated a mentor, contact the Director.

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

One field in which the amateur CCD photometrist has made important contributions in recent years is the study of dwarf novae (DNe). These systems show outbursts during which they increase in brightness by two magnitudes and often much more; the shortest outburst duration is two to three days.

The Basic CCD Data project involves the long-term monitoring of several DNe. Several of the stars go into outburst very frequently: CSS 121005:212625+201948 every 11 days or so, V1316 Cyg every couple of weeks, V452 Cas about once a month and V1227 Her about once every six weeks. Observing these stars for a few weeks more or less guarantees the new observer to experience the delights of spotting an outburst! These stars are DNe of the SU UMa type (“UGSU”) which can undergo superoutbursts from time to time during which the star is slightly brighter than a normal outburst and the light curve shows modulations called superhumps

HW Boo is a more enigmatic system. It shows small outbursts of ~ 2.5 - 3.5 mag every few weeks or months. But they are very short-lived at 2 to 5 days, so they are often missed. This is why intensive photometry is useful – people observing around the world whenever it is clear means it is more likely that an elusive outburst will be detected.

At its simplest, this project involves taking one image of the DN every clear night and measuring the brightness. Some of the targets are very faint at quiescence, like CSS 121005:212625+201948, so the target may 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.

Star	RA (2000) h m s	Dec (2000) deg m	Type	Range
V452 Cas	00 52 19	+53 52	UGSU	14-17.5
HW Boo	13 43 23	+15 09	?	13.8-18.5
V1227 Her	16 53 59	+ 20 10	UGSU	14.6 - 18.1
V1316 Cyg	20 12 13	+42 45	UGSU	14.5-17.8
CSS 121005:212625+201948	21 26 25	+2019	UGSU	15.7-20

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, as mentioned for the UGSU systems in the Basic CCD category.

How does one know which CV’s are worth following up with time resolved photometry? 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, managed by Gary Poyner, highlights current and recent CV activity: <https://sites.google.com/site/aavsocvsection/>

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. These could be stars on the other VSS programmes, such as the “CV & Erupting stars” programme.

From time to time the VSS organises campaigns to observe particular stars, often in association with professionals. These are notified via the BAA website, via the BAAVSS-alert Forum and via the VSS Circulars.

The VSS programme also includes objects other than stars. For example, one object is V404 Cyg, which is believed to comprise a 17 solar mass black hole with a red giant in a 6.5-day orbit around it. It undergoes outbursts similar to those in dwarf novae. These are quite rare, the last ones being in 1938 1956 and 1989 and 2015. Even in quiescence the object is detectable in amateur telescopes and there is something very special about being able to go out to one’s telescope at night and observe the goings on of a black hole! The VSS



programme contains another X-ray nova and black hole candidate, V518 Persei – definitely worth keeping an eye on!

Other resources

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

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

AAVSO CCD observing guide: <https://www.aavso.org/ccd-photometry-guide>