the appropriate amount of shots with the same exposures. Making the Flat files is a little more complicated. Ideally, they are easy to get on evening or predawn twilight sky. You need to choose the exposure to get a ¼ - ½ of the value of complete saturation of the pixel. For example, full saturation for 16 bit camera is 65535. The value of a pixel in the Flat file should be in the range of 15.000 – 30.000. I use 20.000.

Another way of obtaining the Flat files is to use the so-called flat-box. I use a white screen which is attached to the dome. Am bringing him a telescope and the illuminating light bulb. For more scattered light, the telescope tube can be covered with a white cloth. Flat files must be taken separately for each filter. The number of calibration frames depends on a particular camera model. I usually make 15-20 frames of each type.

Once the calibration files are completed, the observational data can be processed. The first step is to calibrate frames containing the target object using the same calibration files. At this step we get a clear picture without any unnecessary noise content. The second step is photometry measurements. Don't forget to specify multiple comparison stars and their brightness in the range the data frames are.

With a series of photometric observations, we can build a light curve, find the period of a variable star, other parameters, depending on the variability type.

There are lots of software to make the analysis of the photometric data. A good example is a software package created by Andrey Prokopovich and Ivan Adamin (the VS-COMPAS project core team). There are desktop and web versions available. It is a powerful software that allows you to build the light curves, search for possible periods, combine data from a number of photometric surveys and more.

I would also like to mention another program called MCV created by professor Andronov. The program is unique in its kind and allows you to make a very accurate and detailed analysis of the photometric data.

Valery Tsehmeystrenko

The FU Orionis phenomenon: further reading (references) – see p.3 for the article

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- The Herbig-Bell Catalog; online: http://www.stsci.edu/~welty/HBC/HBC.html
- The Furor over FUORs; online: http://www.universetoday.com/78796/the-furor-over-fuors/

The VS-COMPAS Project

The project was started in fall of 2011 by four amateur astronomers from Belarus. The main intention is to expand the International Variable Star Index (VSX) catalog with new variable stars, variable stars data analysis and research. Among the most significant achievements it is worth to mention more than 1200 variable stars discovered by combined efforts of seven active team members. All data about discovered stars is submitted to the VSX catalog running by the AAVSO. Another valuable goal the project has is increasing public interest to variable stars science.

More information about the team and discoveries can be found at http://vs-compas.belastro.net

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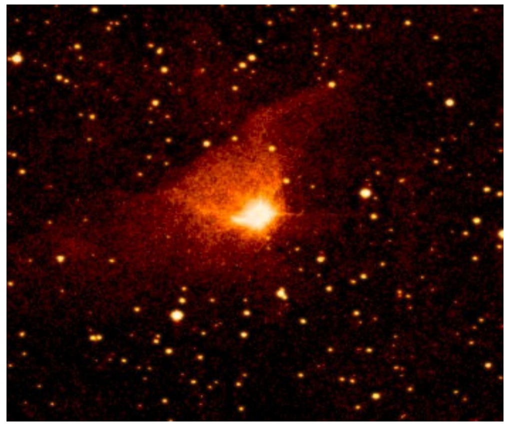
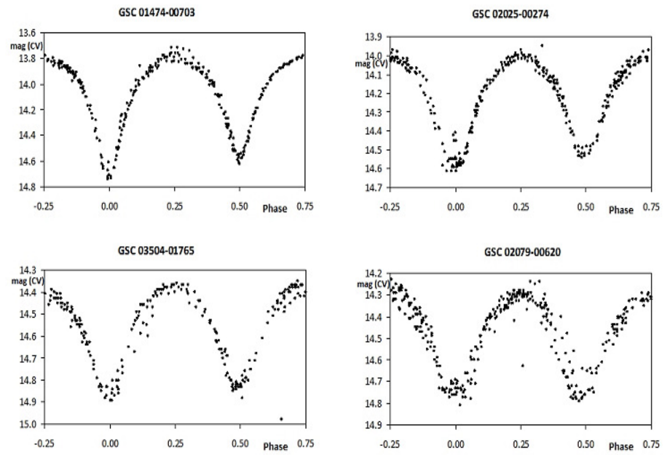


The FU Orionis phenomenon

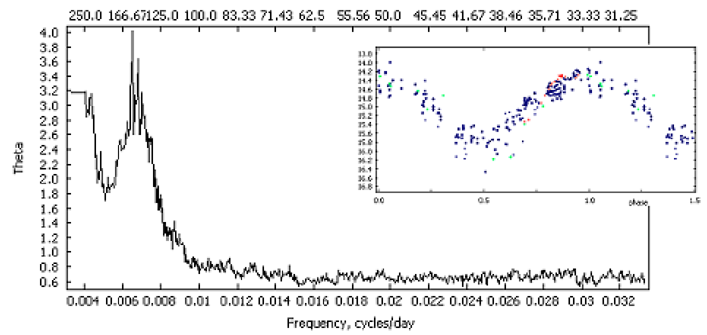
FU Orionis stars are pre-main-sequence eruptive variables which appear to be a stage in the development of T Tauri stars. Image: FU Orionis. Credit: ESO

Twenty new W Ursae Majoris-type eclipsing binaries from the Catalina Sky Survey

Details for 20 new WUMa systems are presented, along with a preliminary model of the totally eclipsing system GSC 03090-00153.

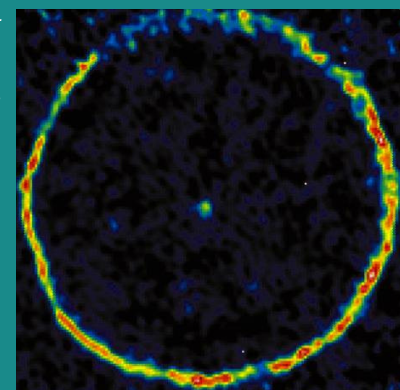


NSVS 5860878 = Dauban V 171 A new Mira variable in Cygnus

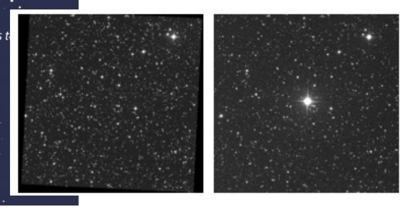


Carbon in the sky: a few remarkable carbon stars

The list of the most interesting and bright carbon stars for northern observers is presented.



Right: TT Cygni. A carbon star. *Credit & Copyright: H.Olofsson (Stockholm Observatory) et al.*

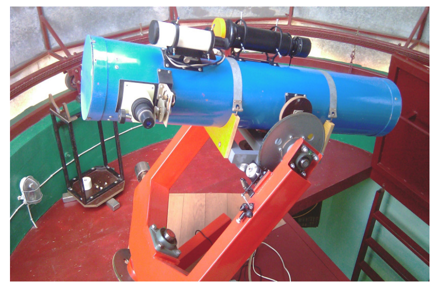


Nova Delphini 2013

Nova has reached magnitude 4.3 visual on August 16

The "Heavenly Owl" observatory:

seeing above the Black Sea waterfront



VS-COMPAS Project: variable stars research and data mining. More at **http://vs-compas.belastro.net**

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Amateurs' Guide to Variable Stars

September-October 2013 | Issue #2

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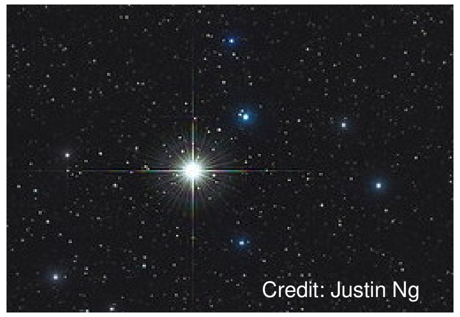
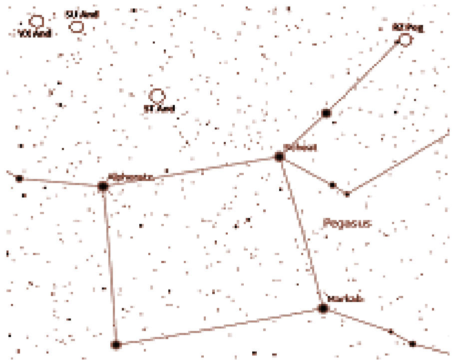
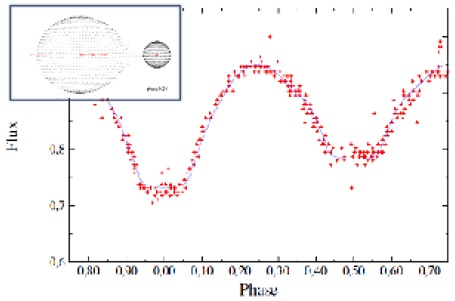

Credit: Justin Ng





Software is the key

One more, and the last, thing that is needed to start the observations and study of variable stars is software. There are too much of software available to be able to discuss it all. Let's focus only on those samples which are widely used by the amateurs of astronomy for variable stars observations.

For autoguiding the ProGuider, Guidemaster, PHD Guiding, GuideDog or Maxim DL can be used. The latter is a true all-in-one processor, which does all the above programs do, and much more. For photometry measurements the IzmCCD, Maxim DL are primarily used. Don't forget about preparing the maps when you plan observations. This is essential if you are going to observe a set of targets during the night. You need a good time management skills to cover many targets in a short period of time.

On the AAVSO website there is a good chart plotter http://www.aavso.org/vsp. It can generate star maps with the desired coordinates and field of view. Also, there you can get a table with the parameters of the comparison stars, which are surrounded by the observed variable star.

Now we have prepared all the necessary equipment and got it snapped to the sky by known bright stars, focused and ready for observations. Take a test single shot. The duration of exposure depends on the characteristics of your camera and magnitude of stars that you want to measure. Start with 15-20 seconds. After receiving the first shot, make a conclusion about the need to increase or decrease the exposure. Supporting factor here is the signal-to-noise ratio. The SNR level of about 30 is considered sufficient, but sometimes it is possible to carry out photometry at smaller ratio.

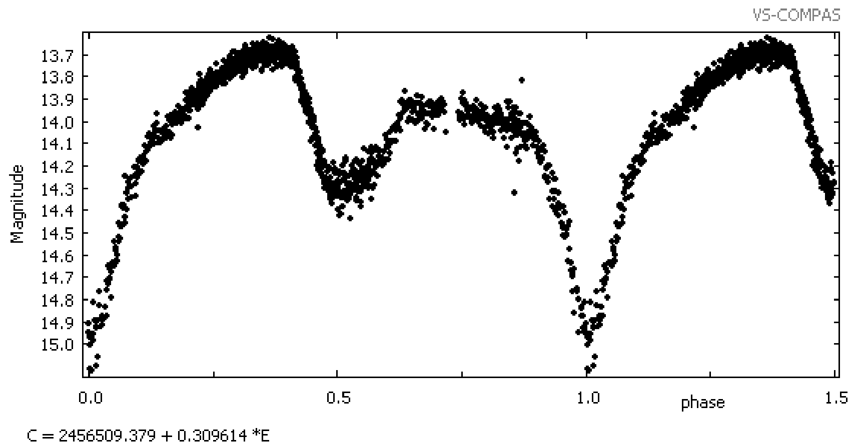
Compare the captured image with the map and make sure that the target object is located in the center of the field. Sometimes it is necessary to shift the telescope a little to cover the comparison star. Select the desired filter. The most used filter is V, since it's the closest one to the visual band. The process can be automated by using a motorized optical filters wheel. Before launching a series of pictures do a few more important manipulation - synchronize the time on the computer where the observation is conducted with the standard. While you can do that online or using other precise watches, previously amended, GPS receiver is the best choice.

When the setup is ready - start series of frames. The software allows you to specify any sequence, the automatic change of filters, exposure time, number of frames and more. The number of images and the intervals between them depend on the observed object, or rather of his period. The more frames you make, the more light measurements you can get for the object - the more accurate the resulting light curve will be.

For a short-period variable star the frames should be taken continuously or with minimal pauses. It is better to cover the whole period with one session, if the period is comparable to the duration of the night time and object visibility. For example, for intermediate polars, the observations of which, in particular, are held at the "Heavenly Owl" a continuous shooting is required at the minimum shutter speed. This is due to the presence of two periods, one of which can be from tens of seconds to 20 minutes.

As an example, I present (see the light curve below) the light curve of an interesting binary system in the constellation of Lyra. This is the result of observations made at the observatory "Heavenly Owl" during the summer of 2013. Measurements are done in visual band.

In the case of the long-period variable stars, there is no need for a large number of frames. Take several shots in each filter. At the end of the observations set, we still have to make the calibration frames. They can be of three types:



Bias, Dark and Flat. Bias frames are frames with zero exposure. They are used to compensate for internal noise of the CCD camera itself. Dark files are taken with exposures equal to the basic shots exposure with the same temperature of the matrix. They allow you to remove artifacts such as hot and dead pixels of the matrix.

Flat files are used to compensate for the artifacts associated with the dust on the sensor, the optical surfaces and vignetting. To make Bias and Dark frames the telescope cover must be attached. Do

The type and the size of a CCD sensor sets a restriction for a field of view available to a camera. A few more parameters that need to pay attention to when choosing a camera: the maximum sensitivity, the lowest dark current, the presence of anti-blooming and the cooling system on the matrix.

The telescope setup

In my observatory I use the following optical system:

- Newtonian telescope with a 200 mm primary mirror diameter and a focal length of 1256 mm. The relative aperture is 1:6.3.

- The Atik-314L + mono camera with a Sony icx285 chip (pixel size is 6.45 x 6.45 microns). The size of the matrix is 11mm. The Peltier element is used for active cooling.

- B and V photometric filters from Baader Planetarium (the R filter is still desirable though).

This configuration allows the field of view of 18'x24' with a resolution of about 1'' per pixel. Given the level of light pollution of the sky and its transparency, this equipment allows to reach the magnitude limit of up to 19m and do photometric measurements up to 16-17m confidently. Field of view is sufficient for comparison stars locating, but quite enough for most of observations.

In addition to the optical system , it is necessary to acquire more quality equatorial mount. This is perhaps the most complex and expensive component of the astronomical setup in amateur astronomy. Without a mount making precise and serious observations is extremely difficult. The mount must be equipped with hour angle drive to compensate for the daily rotation of the sky. Since the objects of observations are often quite dull, i.e. invisible to the naked eye, and can not be close enough to the bright star to guide, the visual guidance on such objects is virtually impossible. A general advise is to equip the mount with an automatic guiding system. Once the setup is calibrated by known bright stars, it will be easy to navigate the telescope to a target object via just a single mouse click.

The modern market offers a wide range of telescopes and mounts suitable for any purposes. But there people who using handmade custom mounts. And I am one of them. But before describing my own mount for the telescope, let's see what else a serious telescope must have.

No matter how accurate and quality the mount is, there are a sufficient number of factors that affects smooth mount motion. Even very small inaccuracies in mechanics or the polar axis alignment, atmosphere turbulence, etc. leads to an object “floating” in the telescope's field of view and tend to blur the image on a resulting frame. To prevent this, the telescope is equipped with a guiding system.

Optical guidance system is a system equipped with a single camera (or matrix) which is mechanically connected to the main telescope and purposely designed for automatic compensation of object's displacement in the telescope's field of view. Guidance can be off-axis or separate. In a case of off-axis guiding, a small prism in the eyepiece optics is installed, diverting part of the light guide to the camera . It is better to use a separate guiding optics. For that purpose a small refractor can be used, or camera with “fast” lenses with a focal length of 250-300 mm. It can be attached to the adjustment rings of the main telescope's tube along with the camera.

I use a self-made fork-type equatorial mount with a large capacity. GoTo mount is equipped with a system based on software created by a well-known amateur Mel Bartels. Guiding system is made of lenses with a focal length of 300 mm and a relative aperture of 1:4.5. In addition, the Phillips SPC900 camera adapted for long-term exposures is used. Camera's native matrix was replaced by a black-and-white Sony ICX618 camera. This increased the sensitivity of the camera significantly.

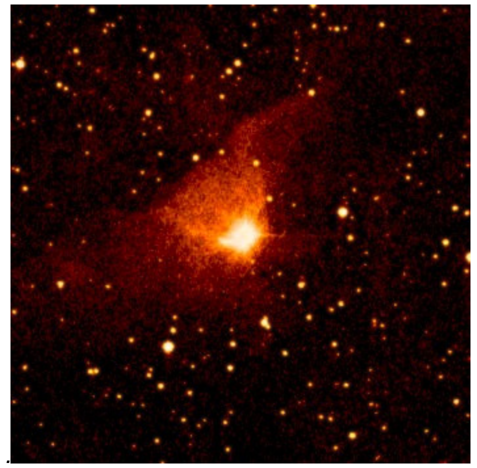
The FU Orionis phenomenon

FU Orionis stars are pre-main-sequence eruptive variables which make up a small class of young low-mass stars appear to be a stage in the development of T Tauri stars. They gradually brighten by up to six magnitudes over several months, during which time matter is ejected, then remain almost steady or slowly decline by a magnitude or two over years. All known FU Ori stars (commonly known as fuors) are associated with reflection nebulae. The article gives a brief description of this kind of objects.

FU Orionis is somewhat 1600 light-years away and associated with a reflection nebulae in the Orion constellation. It is located about three degrees NW of Betelgeuse, and less than a degree east of the small planetary nebula NGC2022. FU Orionis is the prototype of a class of young stellar objects (YSOs), which have undergone photometric outbursts on the order of 4-6 mag in less than one year (Herbig 1966). These stars are still in the process of forming, accreting gas from the clouds they formed from. The first outburst of FU Ori was observed in 1936-37, when an ordinary undiscovered 16th magnitude star began to brighten steadily. Unlike novae bursts, which forth suddenly and then begin to fade within weeks, the FU Ori kept getting brighter and brighter for almost a year being around 10^{th} magnitude ever since.

Typically, FU Orionis star's luminosity peaks at approximately 500 luminosities of the Sun and then appears to decay for decades. FU Orionis stars exhibit large infrared excesses, double-peaked line profiles, apparent spectral types that vary with wavelength, broad, blueshifted Balmer line absorption, and are often associated with strong mass outflows. For more details on this phenomenon please refer to Hartmann & Kenyon (1996).

The FU Orionis stars have been convincingly modeled as low-mass pre-main-sequence stars (similar to T Tauri stars) that are surrounded by luminous accretion disks. Such systems demonstrate that disk accretion in early stellar evolution is highly episodic. It seems that the phenomenon is restricted to early phases of stellar evolution. Steady accretion disk models successfully explain many observations of the FU Orionis. Photometrically FUors are characterized by violent and probable recurrent outbursts.



FU Orionis and its associated nebula. Image credit: ESO

Since the outburst of FU Ori itself in 1936 (Wachmann 1954; Herbig 1966), only a small number of other FUor outbursts have been discovered, notably V1057 Cyg and V1515 Cyg (Herbig 1977). The light curves of these three best studied FUors show remarkable differences between each other (Vittone & Errico, 2005). In 1969, a star embedded in the "East Texas" region of the North America Nebula (NGC 7000) jumped from 16th to 10th magnitude.

The star, V1057 Cygni, attained maximum luminosity in mid-1970, and afterwards it slowly faded; it now lies three magnitudes below peak brightness. A number of objects are known that are spectroscopically similar to FUors, but for which the outburst phase has not been documented. Spectroscopically, FUors have no-emission-lines spectra with optical characteristics of G-type supergiants, yet near-IR characteristics of cooler K- or M-type giants/supergiants dominated by deep CO overtone absorption (Vittone & Errico, 2005).

Researchers led by Jean-François Donati of the Observatoire Midi-Pyrénées in Toulouse, France, have observed the magnetic fields in the central regions of a disc around FU Orionis. They used a new high-resolution instrument called ESPaDOnS on the Canada-France-Hawaii Telescope (CFHT) in Hawaii to detect polarised light (*due to the magnetic fields*) from the disc. The magnetic fields surrounding a young star have been detected for the first time. Several of fuors were also discovered in the past years, including those from the data of the Catalina Real-time Transient Survey. One more remarkable addition is the embedded protostar V1647 Orionis which erupted in January 2004.

About ten FU Orionis objects are currently known. Others almost certainly lurk undiscovered among the stars in the Herbig-Bell Catalog, provided on-line by Karen Strom at UMass. *For more information on these interesing and rare objects please refer to the list of resources published in this issue on the page 24.*

Ivan Adamin

NSVS 5860878 = Dauban V 171: a new Mira variable in Cygnus

Ivan Adamin (1), **Siarhey Hadon** (2)

1 – ivan.adamin@gmail.com; The VS-COMPAS Project
2 – zenit76@tut.by; The VS-COMPAS Project

Abstract: We present details of a new Mira variable in the constellation of Cygnus. The variability of the NSVS 5860878 source was detected in January of 2012 by Ivan Adamin, based on photometric data from the Northern Sky Variability Survey, as a part of data mining project, the VS-COMPAS. Lately, by the time the star's data was finally analyzed in 2013, the object was identified as the Dauban V171 in the VSX catalog, with no period and classification specified. Thus, a revision with actual data was submitted.

During the candidates selection process in the constellation of Cygnus as a part of data mining activity performed by VS-COMPAS Project team in January of 2012, the source identified as NSVS 5860878 was considered a variable. The object was not on the record in the AAVSO International Variable Star Index (VSX).

The photometric data of NSVS 5860878 was analyzed in 2013. By that time the object was submitted to the VSX as a result of the Dauban Survey activity. The Dauban Survey project is a collaboration between Francois Kugel and Jerome Caron (2012).

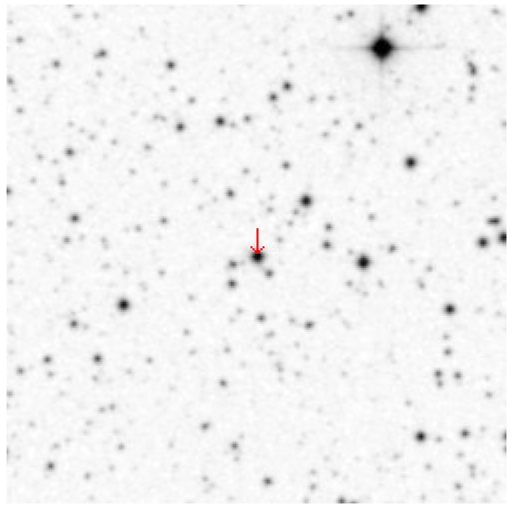


Figure 1. – *NSVS 5860878 and Dauban V171 references to the same object*

The Northern Sky Variability Survey (Woźniak et al., 2004) has a moderate resolution, so there are cases when the source object for the photometric set is uncertain in the crowded fields. NSVS 5860878 was later cross-identified as *Dauban V171,* but the corresponding record in the VSX did not contain any information about the period or classification. The pictures made by the Dauban Survey clearly demonstrate that the variable object in the area referencing by NSVS 5860878 is the unique variable source among its neighbors.

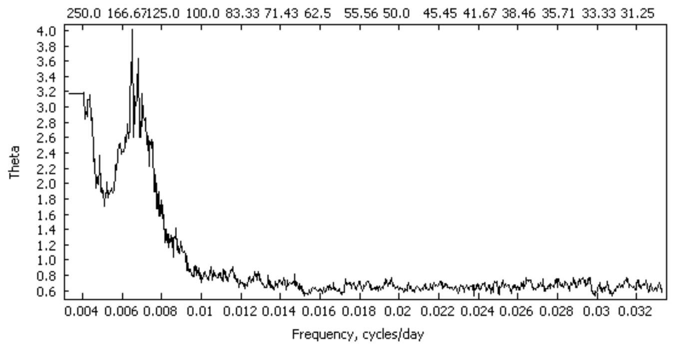


Figure 2. – *Periodogram for NSVS 5860878, based on data from the NSVS*

Detailed analysis was made by Siarhey Hadon in September 2013. Periodogram analysis revealed a strong peak (cf. Figure 2) around a period value of 150 days. Further investigation ended up with a statistically strong period of 149.78 days. This value has a good match with the photometric data points gathered by Kugel and Caron.

The light curve data from the NSVS database was contaminated by two neighboring non-variable stars:

1) 2MASS J21245238+4624154
J-K = 1.02, V = 14.7, sep. 38"

2) 2MASS J21244963+4623437
J-K = 1.32, V = 14.4, sep. 53"

Performed deblending of the light curve data allowed to find the real magnitude range. Taking in to consideration other properties of the star and its color index, it was classified as a Mira variable. The revision is submitted to the VSX.

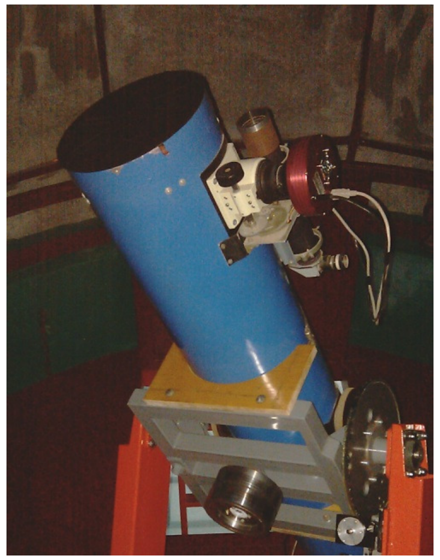
Below there is a phased light curve along with a short summary for the NSVS 5860878 is presented. This is a typical light curve for Miras (cf. Figure 3).

This research has made use of the SIMBAD and VizieR databases operated at the Centre de Données Astronomiques (Strasbourg) in France; of the International Variable Star Index (AAVSO), and

The "Heavenly Owl" observatory: Seeing above the Black Sea waterfront

Just two decades ago one had to put quite a lot of efforts to build a quality light curve for a variable star. It was required even more to discover a new one, dealing with lots of frames taken during a night, then printed and compared. Nowadays, variable stars observers are in a privileged situation: there many ways of making a discovering process easier and more fun. Sure, you need some devices, but the variety of choice and affordability is like never before. In this article Valery Tsehmeystrenko from Odessa is going to share his experience in variable stars observation and analysis.

There are two basic ways of studying variable stars in modern amateur astronomy. The first approach is classical observations of the real sky being equipped with modern hardware. Another way is a so-called data mining technique, when it is possible to use large photometric surveys' databases and obtain the data for further analysis via the Internet. In that case a one does not need a hardware and real clear sky above to make discoveries, as everything can be done by just using a software.



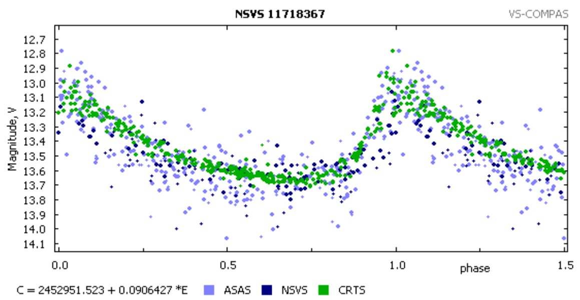
Data mining activity is a basis for the VS-COMPAS team. It's all about a searching for variable stars in the data of photometric surveys. Those surveys are conducted with the help of robotic telescope arrays continuously monitoring the sky every single clear night. The advantage of this approach is its physical independence of latitude: the whole telescope array can be installed on a mountain and controlled remotely.

But this article is dedicated to making your own "old-school" real observations of the sky. Not necessarily you are about to search for a new variable star – observations and light measurements of an existing variable as important as the discovery of a new star. In this article I'd like to share my experience in making variable stars observation in the private observatory called "Heavenly Owl" in Odessa, Ukraine: what hardware/software is used and how the photometry analysis can be done.

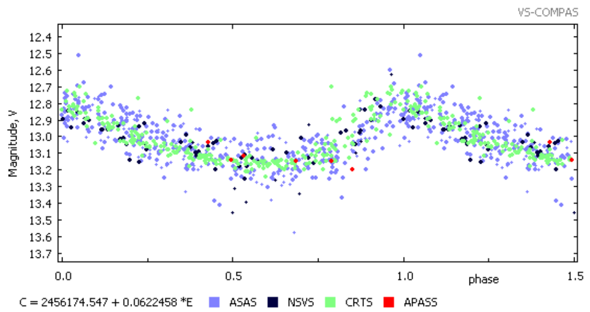
The main requirement and a driving force at the same time is a desire. Unfortunately, this is not enough for a true success :) In the world where every piece of iron can be controlled electronically, you need an advanced telescope setup as well. It depends on what program you are going to follow. For a visual observations a good binocular or telescope with an appropriate eyepiece is fine. The more faint object you are going to observe the larger aperture you need. But you would need a good training experience for a reliable brightness evaluation using comparison stars with the permanent [known] brightness. Accuracy of such measurements may be beyond the expectations. Thus, visual observations are losing their position to a modern electronic light detectors and CCD cameras.

CCD cameras have much better sensitivity, resolution and never get tired of sequences of measurements. Almost nobody uses films today, but there are still thousands and thousands unprocessed photographic frames with useful data from the past. For example, in Odessa, there is a collection of photographic frames of sky regions covering more than 40 years! Taking into consideration how important the coverage time frame in astronomy is, one could imagine the value of those collections.

Widely used handy amateur photo cameras are not so good in photometry gathering, since they use color sensors and not designed for a specific purposes, such as taking quality pictures at night. For a good photometry you would need a set of filters combined with cameras based on a black-and-white sensors designed for astronomers. Wheels of filters are useful for light measurement in different ranges. Combining a black-and-white CCD camera with filters is a good way to obtain a photometry with a scientific value.



NSVS 11718367 in Pegasus
by Alexandr Ditkovsky (VS-COMPAS)



NSVS 17436362 in Sculptor
by Alexandr Ditkovsky (VS-COMPAS)

Table 1. – The list of discovered HADS variables.

Object Designation	RA (J2000)	DEC (J2000)	Rise Dur.	Epoch, HJD	Period	Mag. Range
VSX J024048.2-070617	02 40 48.21	- 07 06 17.3	34%	2451536.735	0.0750339	13.5 - 13.95 V
VSX J043039.1+124954	04 30 39.12	+12 49 54.9	21%	2453701.658	0.0973764	13.85 - 14.4 V
CSS_J044535.5+012336	04 45 35.48	+01 23 36.6	27%	2455453.994	0.0594189	14.73 - 15.17 CV
NSVS 7446012	09 14 52.36	+34 18 34.6	40%	2454094.871	0.067751	12.90 - 13.28 CV
NSVS 7467387	09 47 05.64	+32 01 55.0	40%	2454884.684	0.1490839	13.10 - 13.35 CV
NSVS 18433413	10 01 35.50	- 24 57 15.7	24%	2454590.947	0.0844877	13.05 - 13.55 V
NSVS 13316502	14 18 09.96	- 04 05 22.4	26%	2453524.750	0.0853062	13.40 - 14.15 V
NSVS 10553101	14 47 29.92	+11 58 38.9	36%	2454503.994	0.0777748	13.35 - 13.68 V
NSVS 10590484	15 13 22.01	+18 15 58.3	43%	2455981.032	0.0541911	13.40 - 13.70 V
NSVS 8748519	21 19 05.29	+27 31 47.9	60%	2452836.971	0.1148894	12.55 - 12.9 V
NSVS 11718367	22 04 02.39	+14 21 51.2	25%	2452951.523	0.0906427	13.0 - 13.68 V
NSVS 17436362	23 47 23.28	-33 37 50.5	35%	2456174.547	0.0622458	12.76 - 13.2 V

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of the Two Micron All Sky Survey (2MASS). Period search and analysis software is created by Andrey Prokopovich and Ivan Adamin, members of the VS-COMPAS data mining project.

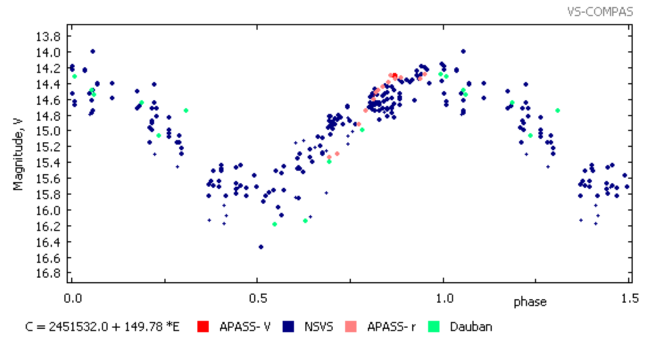

Figure 3. – *Generated phased light curve for NSVS 5860878. The period is 149.78 days. J-K = 1.66*

Table 1. – A short summary of the NSVS 5860878 object with updated elements.

NSVS 5860878 = Dauban V171	
AAVSO UID	--
Constellation	Cygnus
Other Names	2MASS J21245478+4623475 AKARI-IRC-V1 J2124548+462347 GSC2.3 N31G094716 UCAC4 682-102837
Coordinates	21 24 54.79 +46 23 47.4 (J2000.0)
Mag. range	14.2 - <17.5 V
Epoch	19 Dec 1999 (HJD 2451532)
Period	149.78 days
Var. type	M

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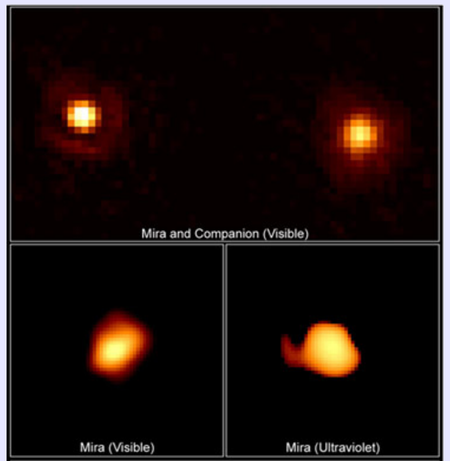
Mira variables named after the star Mira, are a class of pulsating variable stars characterized by very red colors, pulsation periods mostly between 100 and 800 days, and amplitudes greater than one magnitude in infrared and 2.5 magnitude at visual wavelengths by definition. Mira is the brightest and most famous long-period pulsating variable in the sky.

The variability of Mira was recorded by the astronomer David Fabricius beginning in August 1596. At first he believed it to be another nova, as the whole concept of a recurring variable did not exist at that time. When he saw Mira appeared again in 1609, it became clear that a new kind of object had been discovered in the sky.



Mira • Omicron Ceti
Hubble Space Telescope • FOC

What is interesting about Mira is that it has a companion star. This allows for a variety of physical investigations, such as mass determination. The binary star system consists of a red giant (Mira A) undergoing mass loss and a high temperature white dwarf companion (Mira B) that is accreting mass from the primary. The companion star was resolved by the Hubble Space Telescope in 1995, when it was 70 astronomical units from the host star.

The companion's orbital period around Mira is approximately 400 years. It means that it did only a single turnover since its discovery by Fabricius in XVI century.

Twenty New W Ursae Majoris-type Eclipsing Binaries from the Catalina Sky Survey

Stefan Hümmerich (1,2), **Klaus Bernhard** (1,2), **Gregor Srdoc**

1 - Bundesdeutsche Arbeitsgemeinschaft für Veränderliche Sterne e.V. (BAV)
2 - American Association of Variable Star Observers (AAVSO)

Abstract: A short overview of eclipsing binary stars and their traditional classification scheme is given, which concentrates on W Ursae Majoris (WUMa)-type systems. Details for 20 new WUMa systems are presented, along with a preliminary model of the totally eclipsing system GSC 03090-00153, which was computed using Binary Maker 3.

I. Introduction

Binary stars are of great importance in astrophysics as they allow the derivation of fundamental stellar parameters such as mass, radius and temperature of their components. Eclipsing binaries – binary systems whose orbital plane happens to be aligned with the line-of-sight of an observer from Earth – are especially well suited for these analyses because they provide additional information through their light variations. Thus, they are among the most important of variable stars.

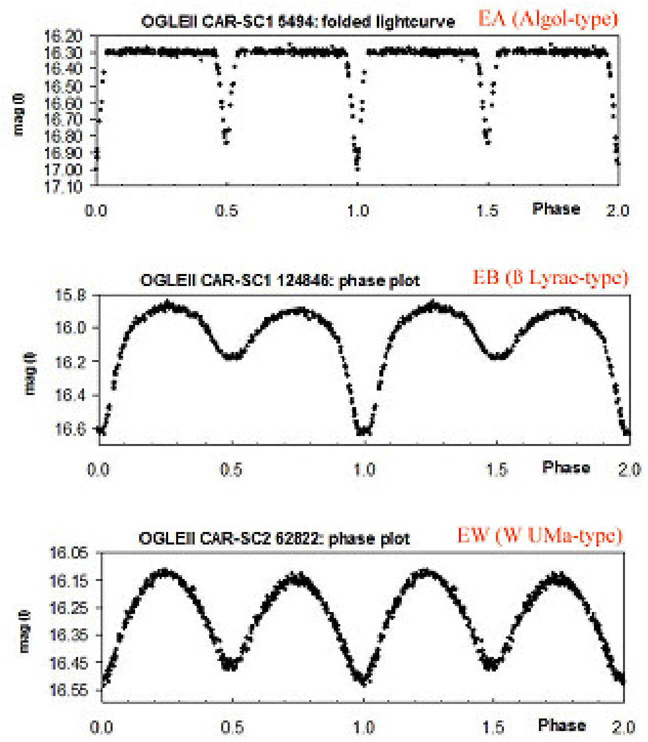


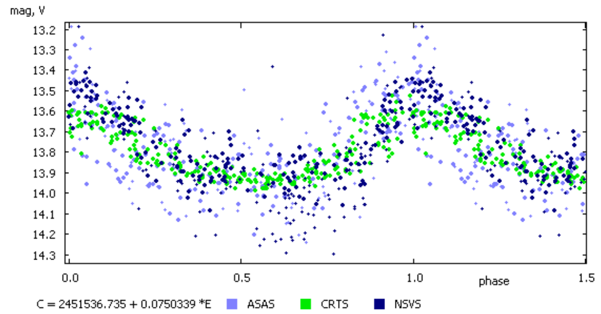
Figure 1. – *Representative light curves of the different types of eclipsing binary stars (EA, EB and EW); graphics are based on OGLE-II data (Szymański, 2005) and were taken from Hümmerich and Bernhard (2012).*

Eclipsing binaries come in a great variety of configurations. Traditionally, they were classified according to their characteristic light variations. While this system has become less important in modern astrophysics and is largely superseded by the concept of Lagrangian surfaces and Roche lobes (cf. e.g. Percy, 2007), it is still widely used today and useful for arriving at a preliminary classification of an eclipsing binary. It also forms the basis of the classification in the present paper.

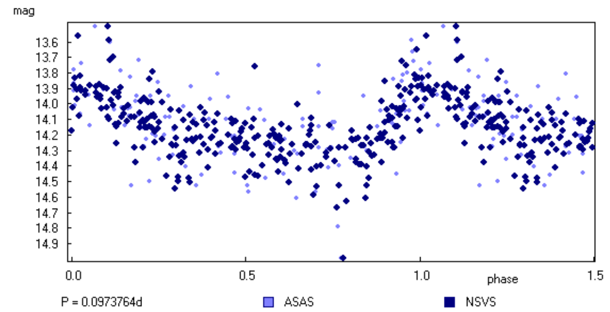
Generally, the light curve of an eclipsing binary is characterized by periods of constant light that are interrupted by periodic drops in brightness as one star eclipses the other. The GCVS (Samus et al., 2007-2013) differentiates three major groups of eclipsing binaries. **Class EA** – also called Algol-type binaries after their prototype β Persei – encompasses stars that are characterized by light curves with an almost undisturbed maximum light and distinct drops in brightness. Thus, it is possible to exactly determine the beginning and end of the eclipses from an investigation of the light curve. Variables of **Class EB** – also denominated β Lyrae-type binaries after the famous eclipsing system in Lyra – exhibit continuous light variations that make the specification of the beginning and end of eclipses impossible. This is due to the stars being distorted into ellipsoids by tidal effects and rotation. This is also true for stars of **Class EW** – named W Ursae Majoris (WUMa)-type eclipsing variables after their prototype – which will be dealt with in more detail in the following chapter. Representative light curves of the different types of eclipsing binaries are shown in Figure 1; graphics are based on OGLE-II data (Szymański, 2005) and were taken from Hümmerich and Bernhard (2012).

II. WUMa-type Eclipsing Binaries (Class EW)

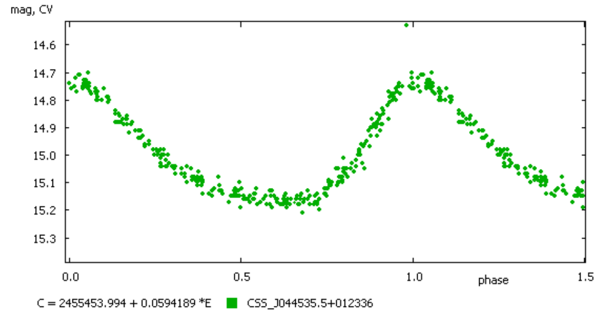
WUMa-type variables are binary systems made up of similar stars that generally belong to spectral types F to K. They are contact systems, i.e. very



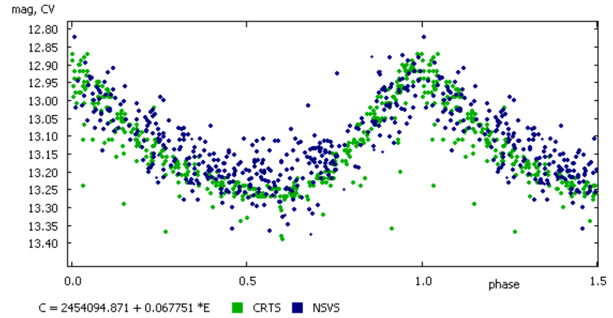
VSX J024048.2-070617 in Cetus
by Andrey Prokopovich (VS-COMPAS)



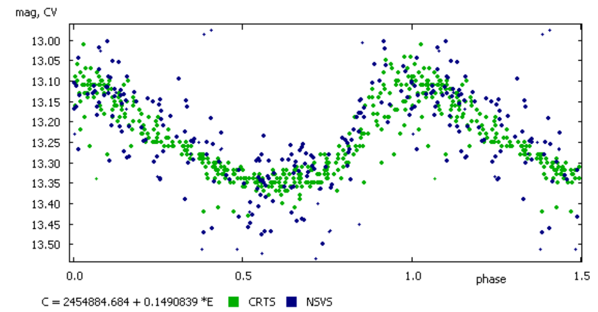
VSX J043039.1+124954 in Taurus
by Andrey Prokopovich, Ivan Adamin, Alexey Tkachenko (VS-COMPAS)



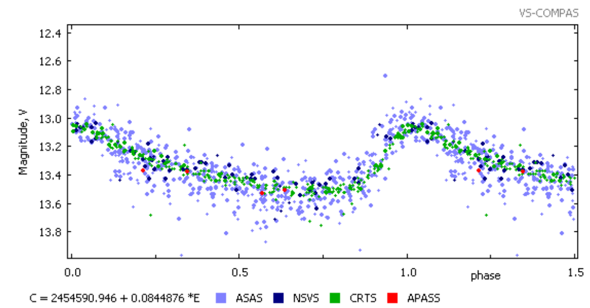
CSS_J044535.5+012336 in Taurus
by Andrey Prokopovich, Ivan Adamin (VS-COMPAS)



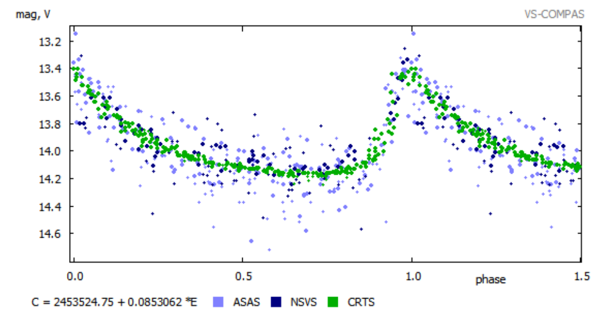
NSVS 7446012 in Lynx
by Alexandr Ditkovsky (VS-COMPAS)



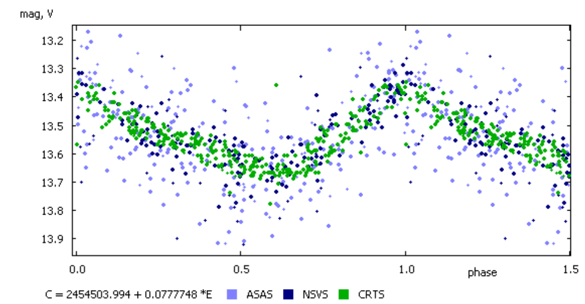
NSVS 7467387 in Leo
by Alexandr Ditkovsky (VS-COMPAS)



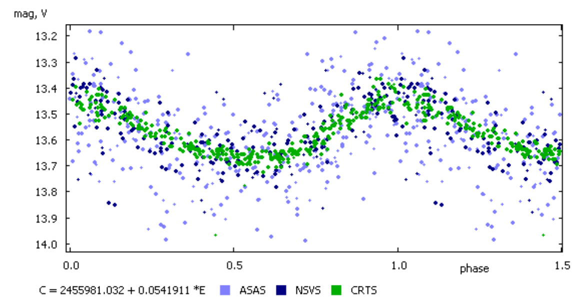
NSVS 18433413 in Hydra
by Alexandr Ditkovsky (VS-COMPAS)



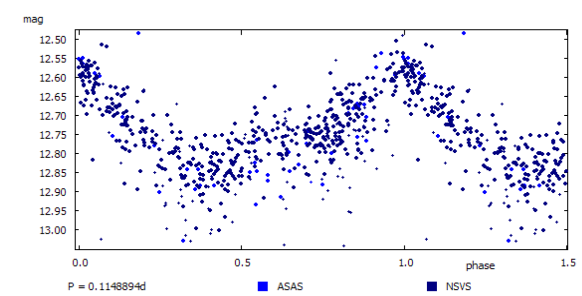
NSVS 13316502 in Virgo
by Siarhey Hadon (VS-COMPAS)



NSVS 10553101 in Boötes
by Alexandr Ditkovsky (VS-COMPAS)



NSVS 10590484 in Serpens
by Alexandr Ditkovsky (VS-COMPAS)



NSVS 8748519 in Vulpecula
by Valery Tsehmeystrenko (VS-COMPAS)

Twelve new High-Amplitude Delta Scuti variables from the NSVS and CRTS surveys

Ivan Adamin (1), **Andrey Prokopovich** (1), **Alexandr Ditkovsky** (1),
Valery Tsehmeystrenko (1), **Siarhey Hadon** (1)

1 – The VS-COMPAS Project; http://vs-compas.belastro.net

Abstract: As a part of VS-COMPAS data-mining program, here are twelve new pulsating High-Amplitude Delta Scuti variables presented. The research result on these objects is submitted to the VSX catalog for the first time by the VS-COMPAS team members. Photometric data from publicly available surveys (primarily, from the NSVS and CRTS) was used as a source for light curves.

I. Introduction

The δ Scuti variables are pulsating variable stars with periods less than 0.3 days and spectral types A0 to F5. They were known as early as 1900. The large-amplitude ones were classified as RR Lyrae stars, sub-type RRs. Visual amplitudes for Delta Scuti variables are in the range from a few thousandths of a magnitude to about 0.8 mag. As of October, 2013 there are about 360 HADS variables in the VSX database.

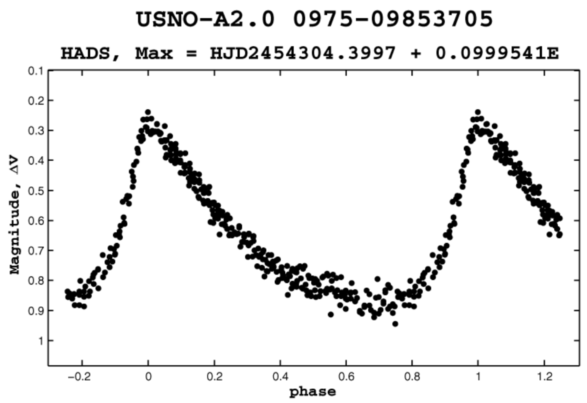


Figure 1. – Typical light curve of High-Amplitude Delta Scuti variable USNO-A2.00975-0985370, found on the Scanned Moscow Archive Plates (Antipin et al., 2007)

The variability of δ Scuti was discovered by W.W. Campbell and W.H. Wright (Lick Observatory). By June 1956, four delta Scuti stars were known (Eggen 1956): delta Scuti, rho Puppis, CC Andromedae, and DQ Cephei. Soon Eggen also discovered a fifth, delta Delphini. And the number of known Delta Scuti stars began to raise rapidly since then.

The Delta Scuti variables form a group which lies in the downward extension of the Cepheid instability strip in the H-R diagram which also includes the classical Cepheids at its bright end and the pulsating white dwarfs. δ Scuti stars can show very complex light variations, since the pulsations may simultaneously include both radial and non-radial modes, i.e. multiperiodic.

In 1955, Harlan J. Smith introduced the term *Dwarf Cepheid*, which was later used to denote the large-amplitude RRs variables. In the 1970s, Michel Breger showed that the majority of Dwarf Cepheids were not fundamentally different from Delta Scuti stars.

High-amplitude Delta Scuti variables were first classified as AI Velorum stars. Typically, they show non-sinusoidal asymmetrical light curves, similar to those of RRab. Population II HADS stars are called SX Phoenicis and are discovered mainly in the globular clusters. SX Phoenicis variables are generally considered to be a subclass of Delta Scuti variables that contain old stars. SX Phe variables also follow a period-luminosity relation

II. Candidates pre-selection and analysis

Candidates for analysis were selected by a custom piece of software created by Ivan Adamin. The software used the publicly available photometric databases, such as the Northern Sky Variability Survey (Woźniak et al., 2004), The Catalina Real-time Transient Survey (Drake et al., 2012), as a source of photometric measurements.

Then, the whole set of candidates was distributed among the VS-COMPAS Proejct team members for further analysis. During this phase of research there was a custom period search and data analysis software used, created by combined efforts of Andrey Prokopovich and Ivan Adamin.

For high-precision periodogram calculation the Lafler-Kinman (Lafler, Kinman, 1965) statistical algorithm implementation was used. The VizieR web services were broadly used for obtaining data on the objects.

III. The list of discovered objects

Below the results of this research are presented: light curve for each object along with the name of its discoverer and light curve elements (cf. Table 1).

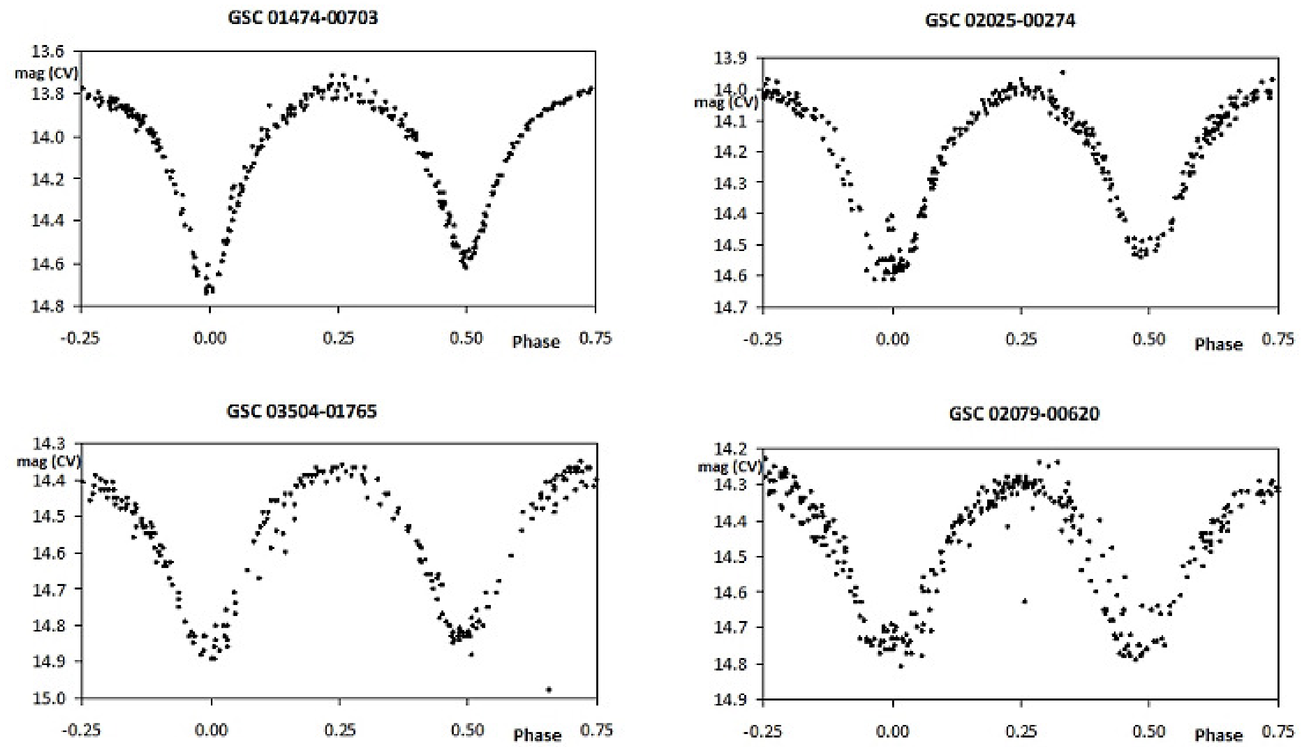


Figure 2. – *Exemplary light curves of four of the W UMa-type variables presented in this paper. There is evidence of light curve variability in GSC 02079-00620 and, possibly, in GSC 02025-00274.*

close systems, in which both stars are actually in contact with each other (or nearly so) and share a common envelope. Because of this, luminosity is transferred from one star to the other (cf. e.g. Jiang et al., 2009), which results in both stars sharing similar surface temperatures although the masses may be different. Because of their close proximity, both stars are ellipsoidal, as is observed in β Lyrae-type systems. WUMa-type systems have short periods, which range from about 0.2 to 1.0 days (cf. e.g. Percy, 2007); the observed amplitudes are usually <1 mag (V). They are easily recognized by their distinctive light curves, which are characterized by continuous light variation and minima of similar depth (cf. Figure 1).

WUMa systems have been subdivided into two classes (cf. Binnendijk, 1970; Sterken and Jaschek, 1996), which are thought to constitute slightly different evolutionary states. **W-type systems** usually have shorter periods (about 0.22 to 0.4 days) and are less massive systems of later spectral types (G to K). **A-type systems**, on the other hand, comprise of more massive stars of earlier spectral types (A to F). They usually have periods in the range of 0.4 to 0.8 days.

Period changes are common amongst WUMa-type stars and are probably connected to mass transfer between the components. Many systems show a complex behaviour, exhibiting sudden period changes of alternating sign rather than a smooth and continuous period evolution (cf. e.g. Sterken and Jaschek, 1996). Additionally, many WUMa variables show evidence of star spots in their light curves and some are strong X-ray emitters, indicating magnetic activity.

For more information on WUMa variables compare e.g. van Hamme (1982), Rucinski (1993) and Li et al. (2007). A good summary about W Ursae Majoris itself can be found in the Variable Star of the Season Archive at the American Association of Variable Star Observers website (AAVSO; http://www.aavso.org/vsots_wuma).

III. Twenty New WUMa-type Systems from the Catalina Sky Survey

During an extended investigation of candidate variable stars from the SuperWASP database (http://www.superwasp.org/; cf. e.g. Bernhard, Srdoc and Hümmerich, 2013), many new WUMa variables have been discovered. In the present paper, we present details for 20 previously unrecorded WUMa stars. Unfortunately, data from the SuperWASP public archive is currently unavailable via the Internet, because of which we had to fall back on data from the Catalina Sky Surveys (Drake et al., 2009; http://nesssi.cacr.caltech.edu/DataRelease/), which is available for most of the candidate variable stars. Periods, magnitude ranges and epochs of the new variable stars were derived using Period04 (Lenz and Breger, 2005). Table 1 provides data of all new W UMa-type binaries presented in this paper, along with remarks on objects of special interest; exemplary light curves are shown in Figure 2.

Quite a few of the presented binaries show indications of secondary variability in their light curves, like e.g. GSC 02079-00620 (cf. Figure 2), which may be due to spot activity on one or both components. Further support for chromospheric activity comes from long-term mean magnitude shifts observed in some systems (e.g. GSC 02612-01769 and GSC 02075-02348). Objects with possible secondary variations are indicated in Table 1 and might be interesting targets for follow-up observations.

Some systems (e.g. GSC 03090-00153 and GSC 03090-00296) exhibit "flat-bottomed" minima indicative of total eclipses. As this puts additional constraints on modelling attempts, we have developed a preliminary model for GSC 03090-00153 using Binary Maker 3 (Bradstreet and Steelman, 2004). This procedure involves the fitting of a theoretical light curve to the observed data in order to derive fundamental parameters of the system. While Catalina Sky Surveys data is limited to one bandpass only, this model – although including a number of assumptions – still provides a lot of information about the system.

Pickles et al. (2010) derive a fitted spectral-type of F2 for GSC 03090-00153, which agrees with the star's J-K index of 0.256 from 2MASS (Skrutskie et al., 2006). We have included this information in our analysis. From our computed model, which produces a solid fit to the observed light curve, we derive a mass ratio of 0.21, temperatures of 7050 K (spectral type ~F2) and 6530 K (spectral type ~F7/8) for the component stars and an inclination angle of 88.9° for the system, which is in agreement with an A-type WUMa variable.

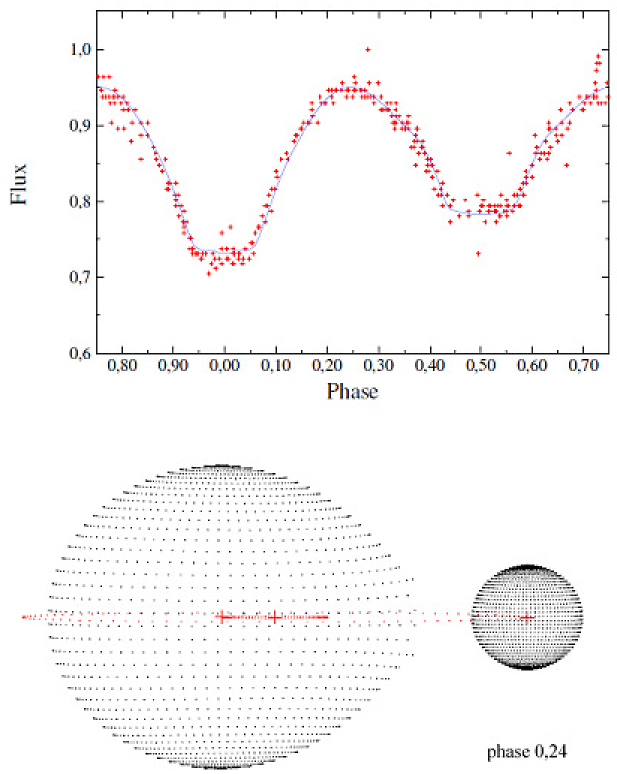
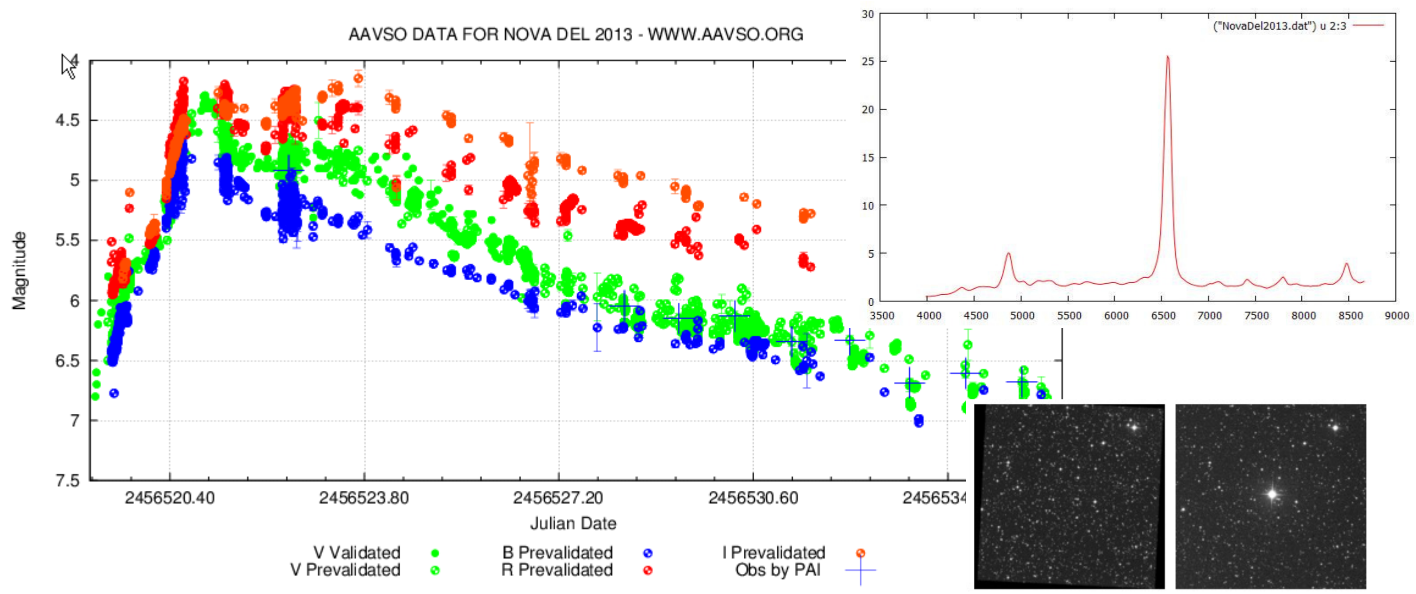


Figure 3. – *Top panel shows the phase plot of GSC 03090-00153, based on data from the Catalina Sky Surveys (red dots) and the corresponding computed light curve (solid blue line). Bottom panel shows the 3D model of GSC 03090-00153 at phase 0.24.*

The latter conjecture is also in accordance with the observed period of 0.426111 days. Figure 3 shows the fit of the computed light curve to the observed data including a 3D model of GSC 03090-00153. A more detailed analysis of GSC 03090-00153 is in preparation.

Table 1. – *Data for all new WUMa-type systems presented in this paper, ordered by right ascension. Positional information was taken from UCAC4 (Zacharias et al., 2012). J-K indices were derived from 2MASS (Skrutskie et al., 2006). The abbreviations in the Remarks column have the following meanings: "lc var" = light curve variable; "tot ecl." = total eclipses; "A-type" = A-type system according to the classification of Binnendijk (1970).*

ID (GSC)	Pos (J2000)	Period (d)	Epoch (HJD)	Mag. Range (CV)	J-K index	Remarks
02544-00521	13 53 12.731 +30 45 13.33	0.3257965	2454141.965	13.75-14.05	0.586	lc var
01474-00703	14 04 17.417 +21 45 52.65	0.3069993	2453885.772	13.80-14.70	0.559	
01482-00837	14 28 55.427 +21 31 11.84	0.2506134	2453537.802	13.70-14.05	0.542	
03045-00012	15 19 15.662 +39 09 53.07	0.6675045	2454232.932	14.10-14.35	0.128	A-type; tot ecl.
02025-00274	15 23 37.662 +22 55 42.80	0.3769321	2454467.035	14.00-14.60	0.363	lc var?
02028-00551	15 25 19.447 +25 42 58.88	0.3972135	2455350.817	13.25-13.70	0.456	
02048-01240	16 35 39.308 +24 51 30.57	0.3245911	2453925.828	14.15-14.40	0.344	lc var



Nova Delphini 2013 photometric observations. Measurements marked with blue crosses are done by Andrey Prokopovich (VS-COMPAS) using DSLR. Spectra (top right) shows strong H-alpha (credit: E. Ricciardiello, A. Porcelli, D.Castellano, A.Marino, C. Perrella). The chart is generated by the AAVSO web service.

DSLR photometry is not really as complicated as it looks like. If you have a DSLR camera with standard lens all you need is to study some details of shooting parameters, camera settings and image processing. DSLR photometry can produce high quality data in a fairly short period of time at modest cost.

The main workflow is:

1. Getting images in a RAW data format.
2. Calibration of images.
3. Processing images in photometric software (obtaining instrumental magnitudes).
4. Analyzing data in spreadsheet.

Successful photometry can be done from a backyard with a typical suburban light pollution. Use focal length that allows you to see the variable star and at least one comparison star in the FOV. Longer focal length will make images less affected by vigneting, but also less "sensitive" to faint stars. Keep in mind that longer exposures require star tracking. Slightly defocus images to spread stars on a bigger area of the sensor surface. Remember to never oversaturate images, since camera's sensors have non-linear response. In addition to a series of sequential star field images, you also need dark frames and flat frames.

Once we done with the frames, we need to extract the green portion of the RGB Bayer array of the RAW images because it most closely corresponds to the photometric V-filter.

The final step is the most important - the instrumental magnitudes should be entered into a spreadsheet to calculate calibrated Visual or V-magnitudes. Spreadsheet calculates Transformation Coefficient to make this conversion possible. Air Mass must be taken into account to calibrate your data correctly if calibrator-to-variable distances less than 34 degrees at zenith angles.

Online resources for further reading:

More detailed information and a nice explanation on DSLR photometry are available at:

http://www.citizensky.org/content/dslr-documentation-and-reduction
http://www.britastro.org/vss/JBAA%20120-3%20%20Loughney.pdf
http://www.variablestarssouth.org/techniques/dslr-photometry-guide

Details on Nova Delphini 2013:

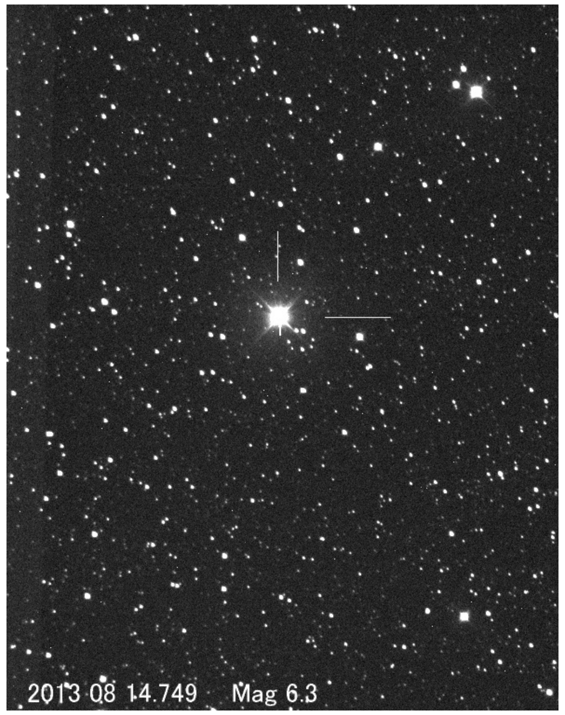
http://www.cbat.eps.harvard.edu/unconf/followups/J20233073+2046041.html
http://www.aavso.org/aavso-alert-notice-489
http://ooruri.kusastro.kyoto-u.ac.jp/mailarchive/vsnet-alert/16337
http://www.aavso.org/nova-del-2013-makes-top-30
http://www.aavso.org/vsx/index.php?view=detail.top&oid=322784

Andrey Prokopovich

Nova Delphini 2013:
a naked-eye visible flare in northern skies

On August 14, 2013 a new bright star (6.3m) was detected in the constellation of Delphinus on the frames taken by Koichi Itagaki (Yamagata, Japan). Later it was assigned a status of Nova Delphini 2013 and became the brightest nova visible to a naked eye since Nova Scorpii 2007 (which reached magnitude 3.9 on February 17, 2007).

The star was discovered by Koichi Itagaki, Yamagata, Japan, in the northwest corner of Delphinus, near the border with Sagitta and Vulpecula using 0.18-m reflector on unfiltered CCD images. Nothing was visible at this location on Koichi's past frames (limiting mag. 13.0) taken on 2013 August 13.565 UT., a day before the discovery.



Nova Deplhini 2013
RA: 20 23 30.68; DEC: +20 46 03.8
Image Credit: Koichi Itagaki

Initially, the Nova received temporary designation PNV J20233073+2046041 when it was posted on the CBAT TOCP webpage, and soon the name was changed to Nova Delphini 2013. Soon it has received a permanent designation V0339 Del, according to IAUC 9258.

Nova is identical to the blue star USNO-B1.0 1107-0509795 and ultraviolet source GALEX J202330.7+204603.

For now it is brightest nova since 2007. Despite the name, the star is not truly new but an explosion on a star otherwise too faint for anyone to have noticed. A nova occurs in a close binary star system, where a small but extremely dense and massive (for its size) white dwarf grabs hydrogen gas from its closely orbiting companion.

After swirling about in a disk around the dwarf, it's funneled down to the star's 150,000 degree F surface where gravity compacts and heats the gas until it detonates like an enormous number of thermonuclear bombs. Suddenly, a faint star that wasn't on anyone's radar vaults a dozen magnitudes to become a standout "new star".

Novae are distant cousins to Type Ia supernovae. In novae, the surface of the white dwarf produces a powerful explosion, but the white dwarf itself survives.

In a Type Ia supernovae, the white dwarf accumulates just enough mass from its binary partner to be pushed above the Chandrasekhar limit of about 1.4 solar masses. This triggers a massive thermonuclear explosion that blows the entire white dwarf to smithereens.

In the last 112 years, 47 novas have brightened into naked-eye view and novas as bright as Nova Delphini 2013 occur about every 10 years, skywatching experts say.

According to the light-curve from AAVSO Nova has reached magnitude 4.3 visual on August 16.45. It immediately entered the decline phase. For a few next days the nova stopped fading at mag. ~5 and then continue its declining. So far, it appears as Nova Del 2013 is a type NA in the VSX. As a final preliminary estimate, the distance of the nova is about 4 kpc (or a bit less).

It worth to mention the opportunity for amateurs to make a contribution to the research of this kind of bright stars - and variable stars as a whole - without the use of any special hardware equipment. Below there is a photometric data for Nova Del 2013 is presented with the measurements done with DSLR camera (blue crosses). All the measurements have a good match with those obtained by other methods.

ID (GSC)	Pos (J2000)	Period (d)	Epoch (HJD)	Mag. Range (CV)	J-K index	Remarks
03504-01765	17 14 59.308 +47 39 08.58	0.3311171	2453880.883	14.35-14.85	0.884	
03512-01333	17 15 57.316 +47 54 51.55	0.2740691	2453656.662	14.65-15.05	0.522	
03508-00985	17 16 25.146 +46 12 36.44	0.4405509	2453561.710	14.00-14.45	0.592	
03508-01555	17 17 53.056 +45 38 07.34	0.4067042	2453531.851	14.35-14.80	0.372	lc var?
02596-00133	17 19 17.308 +32 01 33.73	0.5963582	2454258.889	13.60-13.95	0.203	A-type
03090-00153	17 20 38.745 +40 17 47.28	0.4261110	2454295.784	14.10-14.40	0.265	tot ecl.
02079-00620	17 29 00.871 +24 48 40.87	0.3602838	2454572.873	14.25-14.75	0.362	lc var; tot ecl.
03090-00296	17 29 43.825 +39 40 36.42	0.3198175	2453644.636	14.50-15.15	0.510	tot ecl.
02075-02348	17 34 07.107 +22 40 37.38	0.4131365	2455004.878	14.10-14.45	0.345	lc var
02076-01399	17 35 14.169 +23 50 15.75	0.2540383	2453523.876	14.35-14.65	0.608	
02080-03142	17 40 55.824 +25 08 37.77	0.3010301	2454236.898	14.80-15.50	0.584	lc var
02077-04137	17 47 23.196 +23 04 08.79	0.2768728	2455359.828	14.00-14.30	0.497	
02612-01769	17 59 54.664 +32 38 55.12	0.3287677	2453526.870	13.75-14.00	0.427	lc var

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MISCellaneous variables revision: new periods and classification for 10 MISC records in the VSX database

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Abstract: Updated periods and variability class for ten MISC records from the International Variable Star Index (VSX) database are presented. Initially, photometric variability of mentioned sources was determined using the fully automated algorithm (Pojmanski, 2002) and photometric data published by the All Sky Automated Survey (ASAS). Later, the results of Machine-learned ASAS Classification (Richards et al., 2012) became available. Own software is used for candidates selection, found a set of records for which periods can be improved considerably. Here the first portion of results is published along with the elements available for the selected sources from the mentioned research programs.

I. Introduction

The International Variable Star Index (VSX) is a comprehensive relational database of known and suspected variable stars gathered from a variety of respected published sources (Watson, 2006). The database is operated by the AAVSO and contains nearly 30000 records for which variability type is declared as MISC (miscellaneous). This is a considerable part of the whole database. For many of MISC sources light curve elements are available via the VSX web service. We noticed that for several of them the submitted value of a period can be improved. Particularly, this can be done for variables covered by the *All Sky Automated Survey* (ASAS; Pojmanski, 1997 and 2002)

Since the original data for many of selected sources was submitted to the VSX a decade ago, it was decided to look for updated elements in more recent publications. In 2012, Richards et al. published the Machine-learned ASAS Classification Catalog (MACC) containing the analysis of 50124 variable stars (Richards et al., 2012). This catalog was considered a good source for double-checking. To retrieve classification results the VizieR web service operated at the Centre de Données Astronomiques (Strasbourg) in France was used.

II. MISC candidates pre-selection

To make the first step of analysis there was a custom piece of software created by Ivan Adamin. The software allowed to iterate over the MISC variables retrieved from the VSX dump, download a corresponding set of photometric data from the ASAS web service and perform a precise periodogram analysis fully automatically.

For high-precision periodogram calculation both Lafler-Kinman (Lafler, Kinman, 1965) and phase-dispersion minimization (PDM; Stellingwerf, 1978) statistical algorithms implementations were used. This approach allowed to obtain independent period value and compare the given results with previously published data for objects. Once the period value was considerably different, such an object was proposed for further review.

The advantage of the method is that it tries to automatically determine whether the best-match period found from the calculated periodogram a false positive or not.

Using the same technique there were objects pre-selected for which more detailed analysis was conducted by Siarhey Hadon.

III. Improving a period value and variability class

The next step of analysis required a human attention being involved to improve the result quality. Siarhey Hadon has made use of a custom software *VSC Effect* created by Andrey Prokopovich and Ivan Adamin which finally led to a new period value and variability class updated.

Along with the ASAS photometric data, a search for other surveys coverage for the object was performed, such as the Northern Sky Variability Survey (Woźniak et al., 2004), The Catalina Real-time Transient Survey (Drake et al., 2012), The AAVSO Photometric All-Sky Survey (Henden et al., 2012). Where possible, the corresponding photometric data set was included into calculations to check if the period matches the value was found by the software. This improved the quality and confidence of the result as well.

Below the table containing ten MISC records with updated elements and light curves along with the data previously published is given.

WZ Cassiopeia, SAO 21002

S Cephei, SAO 10100

*The constellation of Cepheus and Cassiopeia. Carbon stars to look at: **WZ Cas**, **S Cep**.*

The following table lists more bright carbon stars in the sky to see with a binocular or telescope. More detailed descriptions of the stars are out of the scope of the article though.

Object Designation		RA (J2000)	DEC (J2000)	Sp. Type	Period	Mag. Range
WZ Cas	SAO 21002, HIP 99, HD 224855	00 01 15.7	+60 21 19	N1p;C9,2	186	6.9 - 11.0
S Cep	SAO 10100, HIP 106583	21 35 13.1	+78 37 25	N8e;C7,4e	487	7.5 - 12.9
FU Aur	SAO 58449, HIP 27398	05 48 08.2	+30 37 54	N0;C7,2		~8.3
R Lep	SAO 150058, Hinds Crimson Star	04 59 36.3	-14 50 48	N6e;C7,6e	427	5.9 - 11.0
W Ori	SAO 112406, HIP 23680	05 05 23.7	+01 10 40	N5;C5,4	210	6.5 - 10.0
UU Aur	SAO 59280, HIP 31579	06 36 32.9	+38 26 42	N3;C5,3		~6.2
V Aql	SAO 142985, HIP 93666	19 04 24.4	-05 41 06	N6;C6,4	350	6.5-8.1
U Cyg	SAO 49477, HIP 100219	20 19 36.4	+47 53 39	Npe;C9,2e	463	6.7-12.0
V Hya	SAO 179278, HIP 53085	10 51 37.3	-21 15 0	C9I	18y/530d	7.0 – 11.5
Y Cvn	SAO 44317, La Superba	12 45 08.0	+45 26 25	N3;C5,5	158	4.8-6.4
T Lyr	SAO 67087, HIP 90883	18 32 19.0	+36 59 50	R6;C6,5	Irr.	7.5-9.3
U Cam	SAO 12870, HIP 17257	03 41 47.8	+62 38 57	N5;C5,4		~6.9
X Cnc	SAO 98230, HIP 43811	08 55 22.9	+17 13 51	N3;C5,4	195	5.6-7.5

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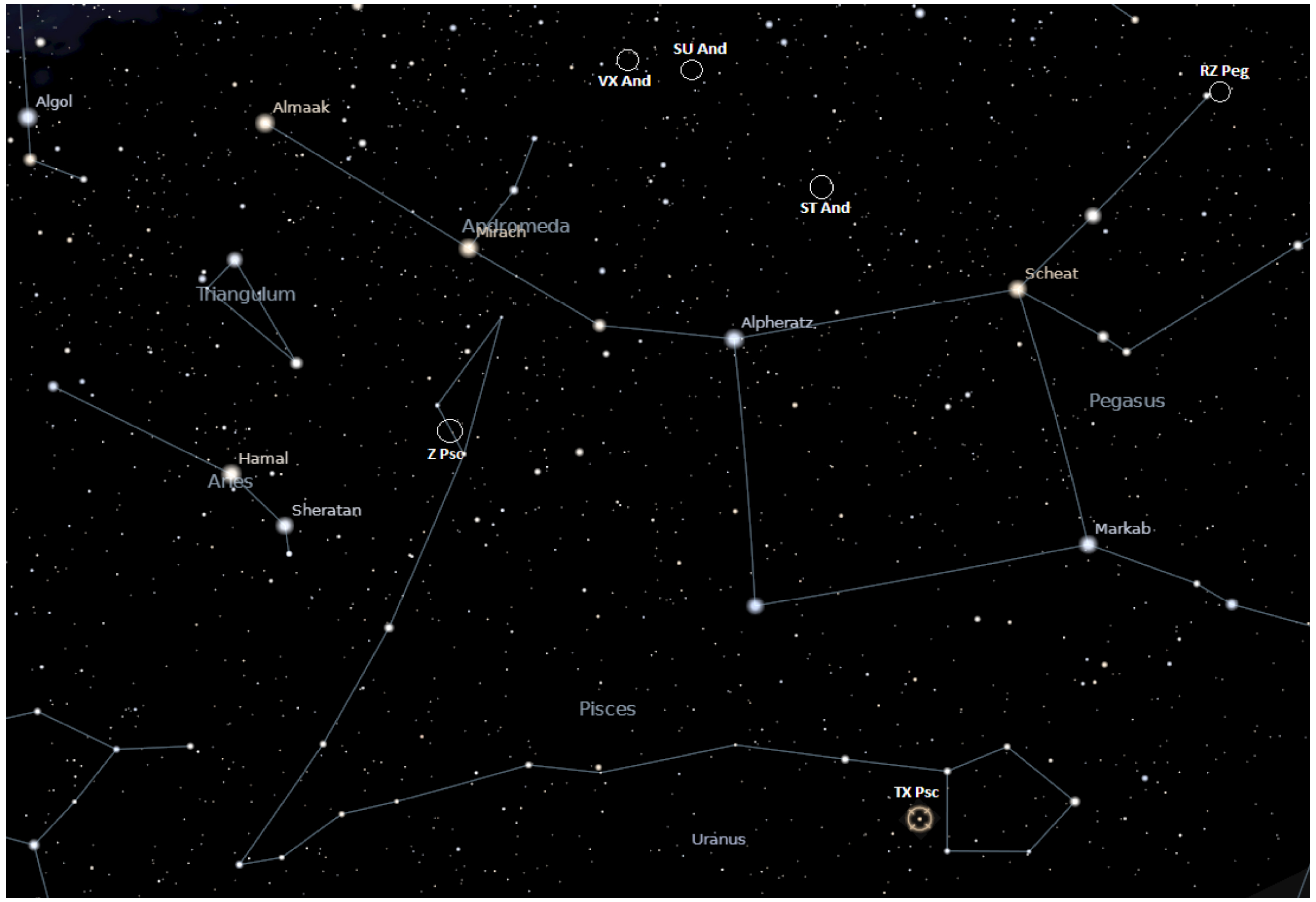
Ivan Adamin



The constellation of Pisces, Pegasus, Andromeda.
*Carbon stars to look at: **TX Psc** (19 Psc), **Z Psc**, **RZ Peg**, **VX And**, **SU And**, **ST And**.*

Autumn sky provides a nice view of the Pegasus Square area and its neighbor constellations. There are a number of fairly bright carbon stars to observe there. Some of them are presented in the table below.

Object Designation		RA (J2000)	DEC (J2000)	Sp. Type	Period	Mag. Range
SU And	HIP 363, HD 225217	00 04 36.4	+43 33 05	C6,4	Irr.	8.0 - 8.5
VX And	HIP 1593, HD 1546	00 19 54.2	+44 42 34	N7;C4,5	367	7.8 - 9.5
Z Psc	SAO 74593, HIP 5914, HD 7561	01 16 04.7	+25 46 08	N0;C7,3	144	6.7 - 7.9
RZ Peg	HIP 109089, HD 209890	22 05 52.9	+33 30 24	Ne;C9,1e	439	7.6 - 13.5
ST And	HIP 116681, HD 222241	23 38 45.2	+35 46 26	R3e;C6,4e	328	8.2 - 11.8
TX Psc	19 Psc, SAO 128374, HIP 117245	23 46 23.5	+03 29 11	N0;C7,2	Irr.	5.3 - 6.0

VX Andromedae, HIP 1593

V Aquilae, SAO 142985

UU Aurigae, SAO 59280

U Cygni, SAO 49477

Table 1. – *Updated data for ten MISC records presented in this paper, ordered by right ascension.*

	ID (ASAS)	Type	Epoch (HJD)	Period (d)	Mag. Range (V)	Src *
1	**ASAS J032020-7551.3**	**SR** MISC SRS-B	**2451946** 2451950.2	**51.65** 51 86.20785	**10.6-11.4 V** 10.46 (0.38) V 10.46 (0.28) V	**VSC** VSX MACC
2	**ASAS J061545-0335.5**	**EW** MISC EW	**2453458.798** 2451950.2	**0.66362** 117.4 0.33181	**12.20-12.57 V** 12.13 (0.35) V 12.13 (0.317) V	**VSC** VSX MACC
3	**ASAS J062040+0553.0**	**SR** MISC SR	**2454507** 2452885.2	**169** 329.401 1.00308	**12.5-13.2 V** 12.55 (0.42) V 12.55 (0.4885) V	**VSC** VSX MACC
4	**ASAS J064648+2353.6**	**SR** MISC SR	**2451585** 2452793.9	**64.5** 52.5 0.99890	**10.6-11.0 V** 10.69 (0.27) V 10.69 (0.3365) V	**VSC** VSX MACC
5	**ASAS J065313+1804.6**	**SR** MISC SRS-B	**2451469** 2452797.3	**48.2** 52.5 1.01882	**12.4-12.8 V** 12.54 (0.28) V 12.54 (0.3545) V	**VSC** VSX MACC
6	**ASAS J070634+1113.3**	**SR** MISC SRS-B	**2454803** 2452597	**55.5** 91.9 0.49343	**11.4-12.2 V** 11.52 (0.52) V 11.52 (0.4495) V	**VSC** VSX MACC
7	**ASAS J070803-2323.4**	**ELL** MISC RV	**2455354** 2452023.5	**160.2** 80.6 80.01960	**9.92-10.05 V** 9.93 (0.13) V 9.93 (0.1785) V	**VSC** VSX MACC
8	**ASAS J074800-2120.6**	**ELL** MISC RV	**2452008** 2452179.1	**219.5** 108.5 109.55139	**9.38-9.52 V** 9.26 (0.2) V 9.26 (0.1890) V	**VSC** VSX MACC
9	**ASAS J084351-4509.0**	**SR** MISC LSP	**2453732** 2452525.1	**74.8** 147.8 5494.95650	**12.1-12.8 V** 11.99 (0.38) V 11.99 (0.5460) V	**VSC** VSX MACC
10	**ASAS J124146-7012.1**	**EB** MISC SR	**2454929** 2452597	**257.5** 130.434784 128.87305	**12.02-12.84 V** 12.08 (0.56) V 12.08 (0.5760) V	**VSC** VSX MACC

* **VSC** = VS-COMPAS; **VSX** = Variable Star Index (AAVSO); **MACC** = Machine-learned ASAS Classification Catalog

Remarks on objects

1) J-K = 1.29; Range has been corrected.
ASAS-3 magnitudes are contaminated by 2MASS J03202022-7550552 (J-K = 0.74, V = 11.71, sep. 20").

2) J-K = 0.303.

3) J-K = 1.87; Carbon star;
ASAS-3 and NSVS magnitudes are contaminated by 2MASS J06204045+0552546 (J-K = 2.68, V = 16.5, sep. 10").
NSVS magnitudes are contaminated by: 2MASS J06204102+0553285 (J-K = 0.48, V = 15.6, sep. 33"),
2MASS J06203804+0552346 (J-K = 0.44, V = 16.1, sep. 36").

4) J-K = 1.22.

5) J-K = 1.16; Range has been corrected.
NSVS magnitudes are contaminated by 2MASS J06531409+1804274 (J-K = 0.42, V = 16.28, sep. 24"),
2MASS J06531263+1804130 (J-K= 0.26, V= 15.12, sep. 26").

6) J-K = 1.25; Range has been corrected.
ASAS-3 and NSVS magnitudes are contaminated by 2MASS J07063461+1113219 (J-K = 0.85, V = 13.41, sep. 10.6").
Possible other period: Max = 2451511 + 41.8* E.

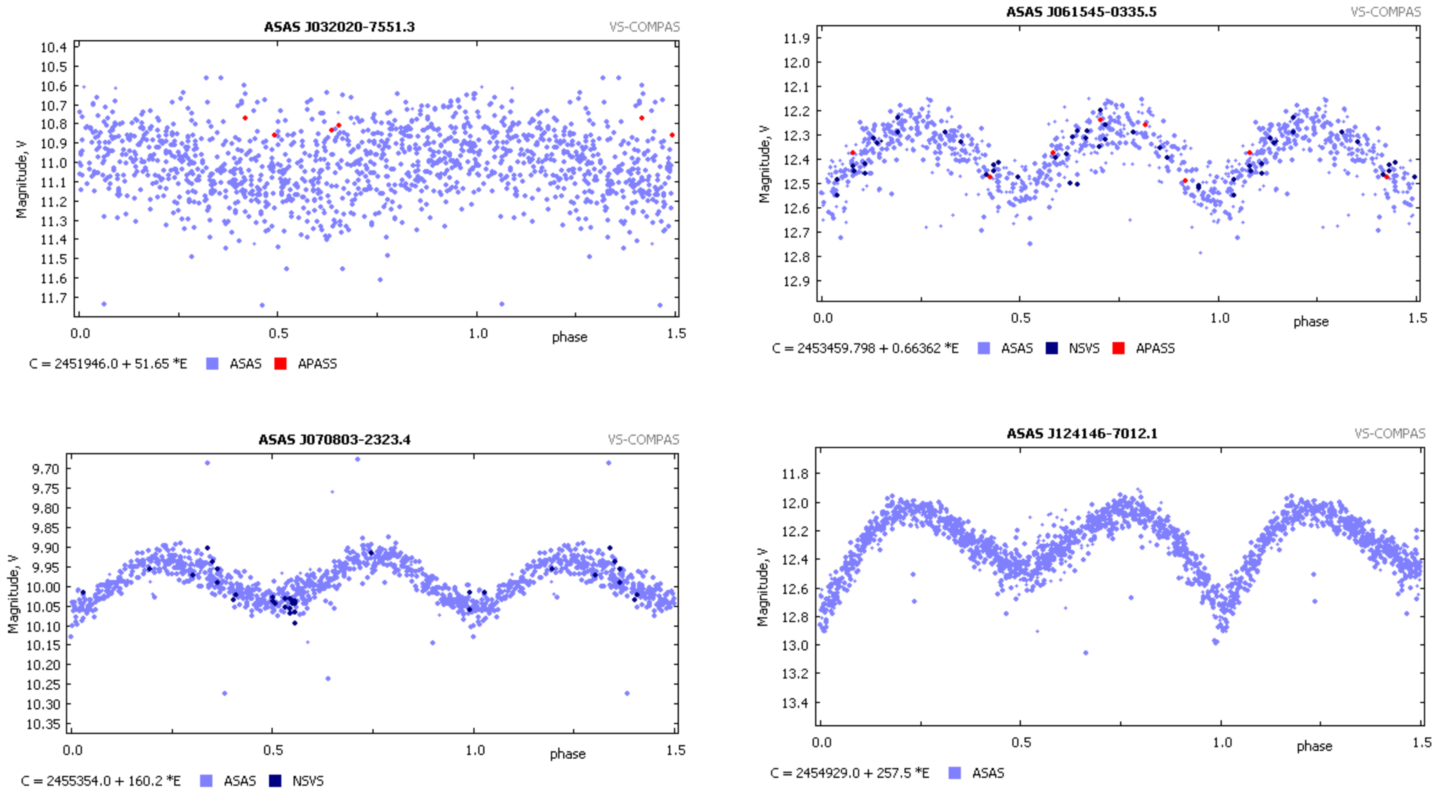
7) J-K = 1.11; Sp. M3 (Catalogue of Stellar Spectral Classifications (Skiff, 2009-2013)).

8) J-K = 1.10;
ASAS-3 and NSVS magnitudes are contaminated by 2MASS J07475898-2120498 (J-K = 0.77, V = 13.66, sep. 18").
Range has been corrected. Sp. M0.5II-III (Catalogue of Stellar Spectral Classifications (Skiff, 2009-2013)).

9) J-K = 1.51; Possible cycle: Max = 2454125 + 2230* E.

10) J-K = 1.33; Min II 12.52 V. Large period for eclipsing binary system. It may be of type ELL.

Remarkable Light Curves



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Carbon in the sky: a few remarkable carbon stars

A carbon star is a late type star similar to a red giant whose atmosphere contains more carbon than oxygen. The two elements combine in the outer layers of the star, forming carbon monoxide, which consumes all the oxygen in the atmosphere. These usually deep-red stars are good objects to look at. Here is the list of the most interesting and bright carbon stars published for northern observers.

Carbon stars are evolved cool giants (and sometime dwarf) with circumstellar shells or clouds of carbon dust material. It's a late stage in the evolution of a star on its way to death.The typical surface temperature is between 2000K and 3000K. The apparent color of this stars is deep red and all are irregular or semi-regular variables. They have quite distinctive spectral characteristics, and were first recognized by their spectra by Angelo Secchi in the 1860s, a pioneering time in astronomical spectroscopy.

The Henry Draper catalogue produced at Harvard by Annie J. Cannon and her assistants, was the primary source of data on carbon stars until the 1940s. Starting with the pioneering work of Lee et al. (1940), low-dispersion objective-prism spectra have been widely used for the identification of red stars. Regular stars, like our Sun, have atmospheres which is richer in oxygen than carbon. This fact makes it possible to search for specific lines in stellar spectra and recognize carbon stars reliably.

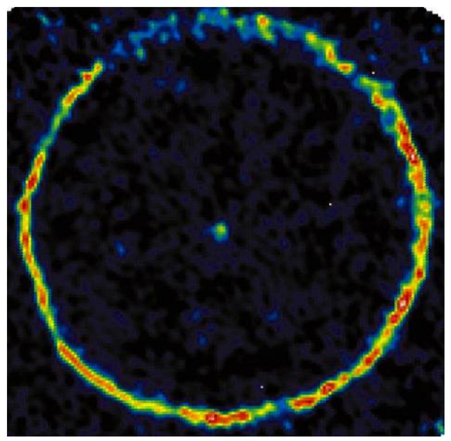
By 1989, *A General Catalog of Cool Galactic Carbon Stars, 2nd ed.* (GCCS2) compiled by Stephenson at the Warner and Swasey Observatory, included 5987 carbon stars. The third edition of this catalog (2001) includes 6891 entries. Carbon stars are asymptotic giant branch (AGB) stars. AGB classification derives three main types, based on their atmospheric composition: carbon-rich, oxygen-rich and S-type.

When astronomers developed the spectral classification of the carbon stars, they faced a difficulty in trying to correlate the spectra to the stars' effective temperatures. The reason is that the atmospheric carbon hiding the absorption lines in the spectra. These lines are normally used as temperature indicators for stars.

Angelo Secchi

(1818 – 1878) — an Italian astronomer. He was Director of the Observatory at the Pontifical Gregorian University for 28 years. Secchi is known for pioneering an astronomical spectroscopy and valuable contribution to the field of Sun study. special interest was the Sun. Angelo was one of the first scientists to state authoritatively that the Sun is a star. He also revised Struve's catalog of double stars, compiling data for over 10,000 binaries, and discovered three comets.

Some presumed giant C stars were seen to have high proper motions, and coupled with low luminosity, were determined to be the elusive dwarf carbon (dC) star. To get more information on dwarf carbon stars please refer to Paul Green's articles.



TT Cygni*. A carbon star.*

Credit & Copyright: H. Olofsson (Stockholm Observatory) et al.

Due to the insensitivity of night vision to red and a slow adaption of the red sensitive eye rods to the light of the stars, amateur astronomers making magnitude estimates of red variable stars, especially carbon stars, have to know how to deal with the Purkinje effect in order not to underestimate the magnitude of the observed star.

One of the interesting carbon stars is *TT Cygni*. This is a cool red giant star with a wind. This false-color picture (left) of TT Cyg was made using an array of millimeter wavelength radio telescopes and shows radio emission from carbon monoxide (CO) molecules in the surrounding gas.

Carbon stars may be fascinating objects to look at even for backyard stargazers. There are dozens bright of them to see in binocular and even with a naked eye. Below there is a list of the most bright and interesting carbon stars for northern observers.