News from the Society for Astronomical Sciences

Vol. 16 No.2A (April, 2018)

Invitation to the Society for Astronomical Sciences 2018 Symposium and ALPO Annual Meeting

The SAS Program Committee invites you to participate in the Society for Astronomical Sciences' 37th Annual Symposium. The Symposium is the premier annual conference devoted to small-telescope astronomical research. This year will be a joint meeting with the Association of Lunar and Planetary Observers (ALPO).

The Symposium brings together amateur astronomers who are engaged in scientific research, professional astronomers, educators and students for in-depth discussions of topics related to small-telescope research. It is an excellent venue for presenting recent results, discussing targets of observational campaigns, describing instrumentation and data reduction/analysis methods, developing collaborations, and bringing together the community of practice to share expertise and experience. You need not be an expert to benefit from participating in the Symposium: one goal of SAS is to provide a mentoring environment, to enable you to make valuable contributions to astronomical science.

Date & Location: The 2018 SAS Symposium will be held on Thursday-Friday-Saturday, **June 14-15-16, 2018** at the Ontario Airport Hotel, Ontario California.

Workshops: Two educational workshops will be held on Thursday (June 14).

Dr. Bob Nelson will lead a workshop on **"Eclipsing Binary Times of minimum light"**. Determining the time-of-minimum-light of an eclipsing binary system is a valuable increment of knowledge for researchers who study EBs and exo-planets.

The goal of this workshop is to get the participants "up to speed" on the practice of determining Times of Min/Max from their own time-series photometry, understanding the data-analysis methods, and seeing relevant research results.

Dr. John Bally will lead a workshop on **"Detection of Transients in HII and Star Forming Regions Using Narrow-band Imaging"**. This workshop will introduce an innovative pro/am collaboration to search for transients within the HII clouds and Star Forming Regions of the Milky Way. Such a search is well suited for the small telescope scientist. We will pursue flux calibration of images, and comparing the ratio of images taken in O [III], S[II], N[II] H-alpha, H-beta and other filters to discover and alert the wider community to transient events of this nature. Advance material will be provided to all registered participants in early May, to maximize the value of this the workshop.

Technical Presentations: Friday and Saturday (June 15-16) will be the Technical Sessions, including paper presentations and poster sessions. Presentations and Posters will span the wide range of topics of interest to the small-telescope research community: solar-system objects, variable-stars, and binary stars; instrumentation for photometry, astrometry and spectroscopy; and related subjects.

You can read the proceedings from recent SAS Symposia, and view the videos of many recent presentations, on the SAS website: www.SocAstroSci.org.

"Evening with the Pro's" will be featured on Thursday evening. **Dr. Lance Benner** will describe recent results from radar observations of near-Earth asteroids. **Dr. Jessie Christiansen** will provide an update on the TESS mission, and the pressing need for small-telescope photometry and spectroscopy on the parent stars of candidate exo-planet events.

Sponsors: SAS Sponsors – developers, suppliers, and retailers of astronomical equipment – will be on hand with displays of their featured products.

Banquet: The closing banquet will be on Saturday evening. Our keynote speaker this year is astronomical artist and entertainer Chris Butler. His topic will be "From Nine Planets to Nine Billion Worlds".

Registration: The Symposium Registration link is on the SAS website www.SocAstroSci.org. *Look* on the "SYMPOSIUM" tab.

Registration is $60 for SAS or ALPO members ($75 for non-members). This includes the "evening with the Pro's", Friday and Saturday Technical sessions, and the Sponsor/Vendor display room.

The Workshops are $50 each. The closing banquet is $40/person.

Reminder to Authors and Presenters

If you submitted an abstract, but haven't heard from us, please contact the Program Committee at program@SocAstroSci.org – we may have misplaced your submittal.

Papers for Presentation consist of a 20-minute presentation (including Q&A), and a written paper that is published in the Symposium Proceedings. We will record your presentation and make the recording available on the SAS website, unless you ask us not to (e.g. if your presentation will include embargoed data).

Papers without Presentation are included in the Proceedings, without oral presentation.

Poster Papers will be on display throughout the Symposium, and can be included in the Symposium Proceedings book if you provide a version that is compatible with printing at 8.5 X 11 inch format.

Important Dates:

Final papers are due by April 26, 2018 so that we can get the Proceedings book printed before the Symposium.

Your final papers for the Proceedings should be sent to: Bob@RKBuchheim.org, with cc to Program@SocAstroSci.org. Please use MS Word, or plain text file with Figures attached as separate files (no LaTEX, please!) If you can, please format your paper using the SAS Style Guide. If the SAS Style Guide causes you heartache, then send a plain text file (with Figures as separate files) and we will format the paper for you.

Triennial Election of SAS Committee

SAS is a non-profit public benefit corporation incorporated in California, which is managed by a Board of Directors (numbering no more than seven persons). The Directors are elected by the membership, for three-year terms. The 2018 Symposium will include a brief business meeting to elect seven Directors to hold office for the next three years.

The following candidates will be presented to the Membership for election as Directors, to serve from June 2018 through June, 2021:

Robert Buchheim (President)
Robert Stephens (Treasurer)
Robert Gill (Secretary)
Jerry Foote
John Menke
Wayne Green
Dr. John C. Martin

Under SAS Bylaws, members may nominate additional candidates at the meeting. If you intend to nominate a candidate, please inform the Secretary (Robert Gill) before the June Symposium. If no alternate candidates are nominated, then those listed above may be approved by voice vote.

Reminders to the SAS Membership ...

Membership Renewal: Even if you can't attend the annual Symposium, we value your support of the Society for Astronomical Sciences, and your interest in small-telescope science.

As an SAS member, you will receive a bound copy of the Proceedings even if you cannot come to the Symposium.

Symposium Proceedings: Published proceedings from all recent Symposia are freely available in PDF format at the PUBLICATIONS tab of the SAS website (www.SocAstroSci.org).

Symposium Videos: If you missed a recent Symposium, you can still watch many of the presentation videos on the SAS website at the PUBLICATIONS tab.

Workshop Videos: Video recordings of most of the Workshops from recent years are available from SAS. If you were registered for the Workshop, then the recording is free. If you were not a registered attendee, then the price is $25 per workshop. Contact Bob Buchheim (*Bob@RKBuchheim.org*) for the details.

Keeping in Touch: The SAS Yahoo group ("SocAstroSci") is a good way to keep in touch with the members and participants.

Kudos, Criticisms, or fresh Ideas? We are looking forward to seeing you at SAS-2018!

If you have any questions or ideas for the Symposium, ideas for Workshops or Technical topics that you would like to see, or comments on any other subjects related to the Symposium, please share them with the Program Committee at program@SocAstroSci.org.

SAS-2018 Agenda

The tentative agenda of activities for the SAS-2018 joint Symposium with ALPO is on the next page.is (The tentative agenda is subject to possible changes).

Note that the "H II Regions" Workshop will be held on Thursday morning, and the Eclipsing Binary Workshop is being held on Thursday afternoon.

SAS-2018 planning Agenda		
Time	**Subject**	**Presenter/Author**
Thursday June 14: Workshops		
0800 - 0900	Registration	
0830 - 1130	Monitoring HII region transients with narrow band imaging	Dr. John Bally
	Lunch Break	
1330 - 1630	Times of Minimum Analysis for Eclipsing Binaries	Dr. Bob Nelson
	Dinner Break	
1900 - 2100	"Evening with the Pros"	Dr. Lance Benner Dr. Jessie Christiansen
Friday June 15: Technical Papers		
8:00	Registration	
8:15	Welcome	Bob Buchheim and Matt Will
8:45	Explorations in Spectroscopy and Astrophysics of Symbiotic, Solar Analog, Cataclysmic & Be Stars at low and high Resolution	James Foster
9:05	First Year Learning spectroscopy with a Shelyak LISA	Forrest Sims
9:25	Modelling W UMa binary star systems using Binary Maker 3	Rakshak Adhikari
9:45	BVI Photometry of Two Double-mode RR Lyrae Stars	Tom Polakis
10:05 – 10:20	Coffee Break	
10:20	Multi-Epoch Photometry of Luminous Stars in M31 and M33	John Martin
10:40	Exoplanet False Positive Detection using Small Telescopes	Dennis Conti
11:00	Thoughts on Photometric Precision and Accuracy	Eric Dose
11:20	Lessons from DSLR Photometry of b Per "third star" eclipse	Robert Buchheim
11:40	SAS Election of Board Members	
noon – 14:00	Lunch Break	
12:30	lunch Discussion group #1 (photometry topics)	
14:00	Asymmetry in the Light Curve of W Corvi	Andrew O'Dell
14:20	CATNIP 3 – A new device for Optical SETI	Bruce Howard
14:40	Thermal Imaging of Astronomical Objects Using a Cell Phone	Stephen J. Edberg
15:00	The ALPO Podcast	Tim Robertson
15:20	9 New Variable Stars	Maurice Clark
15:40	TBA	
16:00	Sponsor Infomercials	
Saturday June 16: Technical Papers		
8:00	Registration	
8:15	Welcome	
8:25	The North Polar Region of Mars: A Review	Richard Schmude
8:45	Why I Observe Asteroid Occultations	Wayne Thomas
9:05	A Look at Submitted 2017 Total Solar Eclipse Data	Dr. Mike Reynolds
9:25	Chiral Systems on the Sun and their Significance	Komal Daga
9:45	Distinguishing Between Fundamentally Different Types of Solar Prominences	Sara Martin
10:05 – 10:20	Coffee Break	
10:20	Pro-Am-Ed Astronomy with the Prairie View Observatory	Brian Cudnik
10:40	Mary Reagan 1-Meter Telescope Observatory at College of the Desert	Ahmed Elshafie
11:00	A Linux Virtual Machine For Astronomy Education And Small Telescope Research	John Hoot
11:20	Citizen Astronomers…Progress, Collaboratives and Research Projects	Diiulio, Ronald
11:40	The Astronomy Research Seminar: The Wide-Ranging Impact on Student Education and Careers.	Rachel Freed
noon – 14:00	Lunch Break	
12:30	lunch discussion group #2 (spectroscopy topics)	

14:00	Investigation into the Accuracy of Small Telescope CCD Astrometry of Visual Double Stars	Pat Boyce
14:20	Speckle interferometry system & results	Rick Wasson
14:40	Advances in Speckle Interferometry for Smaller Telescopes	Russ Genet
15:00	Scientific Results of the ALPO Remote Planets Section	Richard Schmude
15:20	Good Night and Good Luck	Bob Buchheim & Richard Schmude
17:00	Banquet (dinner service at 18:00)	
19:00	Banquet Speaker	Chris Butler

Other summer meetings related to small-telescope science that might interest you ...

InSTAR Meeting Following SAS

The Institute for Student Astronomical Research (InSTAR) will be meeting at the Ontario Airport Hotel & Conference Center on Sunday morning, June17. The topics of discussion will include:

- Overview of the Astronomy Research Seminar
- Engaging high school and early college students in astronomical research
- PlaneWave Instruments - Connecting Instruments to Education
- Incorporating students into a Community-of-Practice
- How you can get involved!

This is conveniently scheduled at the same location as SAS-2018, so those of you who are interested in merging astronomy research into the educational curriculum can participate. There is no registration fee for this meeting.

If you plan to attend, please RSVP to Rachel Freed at r.freed2010@gmail.com

Remote Telescopes & Education Conference

The 2nd annual Conference on Robotic Telescopes, Student Research and Education (RTSRE-II) will be held in Hilo, Hawaii from July 23-25, 2018. This conference series focuses on building a sustainable community around the educational, technical, and student research uses of robotic telescopes. The conference will be co-located with the interNational Astronomy Teaching Summit (iNATS) from July 25-27, 2018 providing worldwide networking opportunities and hands-on workshops designed to expand educators' teaching strategy toolkit and aimed at innovative astronomy professors, teachers, and outreach professionals.

Find more information at the RTSRE website: https://rtsre.net/.

Northeast Astro-Imaging Conference

This annual gathering will be held April 19 & 20, 2018, at the Crowne Plaza Conference Center in Suffern, New York. While historically devoted to astro-imaging, the past couple of years have seen an increasing number of science-oriented talks. The 2018 agenda will include a talk by our own Bob Stephens, on asteroid photometry.

For more info, go to http://www.rocklandastronomy.com/neaic.html

BAA-AAVSO Joint Variable Star Meeting

The British Astronomical Association Summer meeting this year will feature a joint session with the American Association of Variable Star Observers. The meeting will be held July 7-8, 2018 (Saturday and Sunday) at the University of Warwick in Coventry, England.

The BAA Summer Meeting takes place on Saturday, the BAA/AAVSO Variable Star Meeting on Saturday and Sunday. While the two meetings run independently in adjacent lecture theatres, there are plenary sessions bringing both groups together at the beginning and end of Saturday. Note that it is possible to attend the Summer Meeting on Saturday and the second day of the Variable Star meeting on Sunday.

You will find program and registration information at https://britastro.org/summer2018

2018 Portland XI Alt-Az Workshop

The 11th annual Portland Alt-Az Initiative Workshop will be held Saturday July 21 and Sunday July 22 at Dan Gray's Sidereal Technology plant at TMS. An informal BBQ on Friday evening, July 20 will be held at TMS.

The first Alt-Az Initiative workshop was held in Portland at Dan's TMS facility and was instrumental in getting the initiative off to a solid start. Since then, the Portland Workshop has brought together advanced amateurs, professional telescope makers and astronomers in a unique and informal collaboration with the goal of adapting technologies currently used in the world's largest telescopes for low cost, high performance 1.0 to 2.0-meter amateur telescopes.

We've had several notable successes, including Dan Gray's Direct Drive controller and the continuing accomplishments of Mel Bartels and David Davis in slumping, grinding, polishing, and figuring sub f/3 large aperture meniscus mirrors. Lisa Brodhacker's ongoing work on spin cast epoxy mirrors is also continuing to show promise.

The Workshop is held in the TMS workshop area, so the setting is casual. There will be plenty of opportunities to directly contribute to the agenda or conversationally in small groups.

Howard Banich is chairing the workshop and Dan Gray is the local host. If

you plan on attending, please contact Howard at hbanich@gmail.com.

Directions to Workshop and Accommodations:

To get to the Technical Marine Service, Inc. (TMS) on Swan Island:

6040 N Cutter Cir #302, Portland, OR 97217

(503) 285-8947

- From I-5 northbound (or southbound also) take exit 303 (Swan Island exit) and head west after you get off the freeway. From the northbound direction, this means staying to your left and heading west on North Going Street.
- Follow this past Interstate Avenue and go down the hill towards Swan Island.
- Get in the right-hand lane and at the bottom of the hill follow the signs to Mocks Landing and veer to the right onto Basin Avenue.
- Go about 1.5 miles to the signal light at Leverman and turn right and go over the bridge to the first street on the right, which is N. Cutter Circle.
- Turn right on North Cutter Circle and go to the end of the block to 6040 North Cutter Circle.

TMS is in the first building as you turn in the driveway – look for the big "TMS" sign on the side of the building. Parking and entry for the workshop is at the side of the building.

Accommodations near Sidereal Technology are:

Shilo Inn Rose Garden
1506 NE 2nd Avenue – 866-430-2692
Portland OR 97232

Monticello MotelStation
4801 North Interstate Avenue - 503-285-6641
Portland, OR 97217-3623

Super Value Inn
5205 North Interstate Avenue – 503-285-2556
Portland, OR 97217-3726

ALPO Podcast "The Observer's Notebook"

The Association of Lunar and Planetary Observers releases a podcast roughly every few weeks, featuring interviews on astronomically interesting topics. Check out the ALPO podcast at:

https://soundcloud.com/observersnotebook

AAS Chambliss Amateur Achievement Award: Nominations due June 30

The Chambliss Amateur Achievement Award is for an achievement in astronomical research made by an amateur astronomer — that is, a person not employed in the field of astronomy in a professional capacity — and who is resident in North America. The key factor in deciding the recipient will be that the work contributes to the advancement of the science of astronomy. The award consists of a silver medal.

Self-nominations are allowed. Nominations are due by 30 June each year.

The nomination checklist and instructions for submitting a nomination are on the American Astronomical Society website, at:

https://aas.org/grants-and-prizes/chambliss-amateur-achievement-award

The 2018 award went to Don Bruns, for his replication of Eddington's measurement of the gravitational deflection of starlight during a solar eclipse (see right).

Small-Telescope Science in the News

A surge of light at the birth of a supernova
by M.C. Bersten, et al, *Nature* v.554, 22 Feb 2018, p. 497

OK, I admit I've once or twice said something like, "who needs another picture of M-31?" I'll never do that again. Now it will be, "after you take that picture, compare it very closely with other pictures to see if anything has changed ..."

One of the co-authors of this paper is Argentine amateur astronomer V. Buso. He was testing a camera on his 40 cm (16 in) Newtonian telescope by imaging NGC 613. In a remarkable serendipity, a supernova flashed into view mid-way through his 1.5 hr imaging session. In a case of "luck favoring the prepared mind", he recognized that a new star had appeared near the galaxy, reported it; and the "big guns" of professional (and space-based) observatories were aimed at it within a day after discovery.

The transient has been spectroscopically identified as a type IIb supernova. The initial brightness surge captured by Buso is a remarkable 43 magnitudes per day. His supernova discovery has provided some of the earliest observations of the start of a stellar explosion.

Gravitational Starlight Deflection Measurements during the 21 August 2017 Total Solar Eclipse

by Donald G. Bruns

Many of you will remember Don Bruns' description of his plans for attempting to measure the gravitational deflection of starlight, at the 2017 solar eclipse (presented at the SAS-2016 Symposium).

The experiment was fabulously successful. The details of his equipment and observing procedure, analysis, and details of the results are available in the pre-print at arXiv:

https://arxiv.org/ftp/arxiv/papers/1802/1802.00343.pdf

Symposium Sponsors

The Society for Astronomical Sciences thanks our Sponsors for their participation and financial support. Without them, our Symposium would not be possible. We encourage you to consider their fine products for your astronomical needs.

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The Essential Magazine of Astronomy
http://www.skyandtelescope.com/

DC3 Dreams Software
Developers of ACP Observatory Control Software
http://www.dc3.com/

PlaneWave Instruments
Makers of the CDK line of telescopes
http://www.planewaveinstruments.com/

Woodland Hills Camera & Telescopes
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http://www.telescopes.net/

Sierra Remote Observatories
Hosting telescopes for remote imaging and data acquisition
http://www.sierra-remote.com/

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Sacramento Mountains Spectroscopy Workshop

by Woody Sims

I recently had the opportunity to attend a very special event February 16th - 18th, 2018 in New Mexico.

Joe Daglan and Ken Hudson put out an invitation last fall for a three day Spectroscopy Work shop in their mountain enclave in the Sacramento Mountains in south central New Mexico. The workshop's goal was to promote amateur spectroscopy and facilitate Pro-Am collaboration.

The Sacramento Mountains, east of Alamogordo has many privately owned observatories located at altitudes from 7,000 to 9,000 ft. The Apache Point Observatory containing telescopes from .5 to 3.5m is located nearby at Sunspot NM. The Richard B. Dunn Solar Telescope (DST) is also nearby. Situated east and high above Alamogordo, the skies are very dark with excellent seeing and transparency. There is a slight light dome visible from El Paso Texas to the southwest.

Even living in the desert southwest, one generally does not expect to go to the mountains in winter for balmy warm weather and this weekend was to prove that out. A rather rare winter storm swept across the southwest and afforded us the opportunity to make the whole 500 mile drive from Phoenix to Mayhill NM in the rain! This was to put a bit of a damper on the actual hands-on data collection that was to be part of the program.

On to the good stuff. The key note speaker was François Cochard, the President of Shelyak Instruments in Le Versoud, very near Grenoble France. In addition there were several professional astronomers including Katie Devine, Professor of Physics at the College of Idaho, David Whelan, Professor of Physics at Austin College in Texas and Stella Kafka, the Director of the AAVSO.

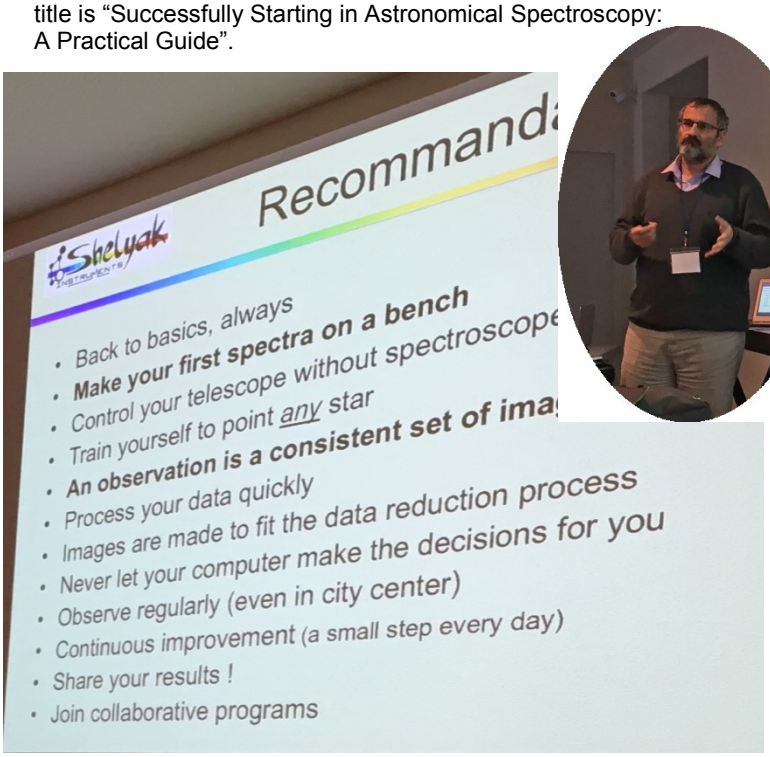
François set out the goals for the workshop and gave an introduction to spectroscopy. He then went on to describe a range of Spectroscopy equipment from the basic diffraction grating up through the Echelle and a higher resolution Visible-IR spectrograph they have designed for the Observatoire de Paris Pic du Midi Telescope.

François took us through all the required hardware (Mount, OTA, pointing system, spectroscope, science camera, guide camera, computer, adapters, cables, etc.) and the required software (acquisition software, guiding software, sky map software and data reduction software). He discussed his recommendations, to get the best data possible from your configuration.

A considerable amount of time was devoted each day on how to configure and use the ISIS software package to process spectrum data. Since LHIRESIII spectrographs were the majority represented at the workshop, most of the time was spent processing high resolution data. I have a Shelyak LISA (Low resolution high luminosity spectrograph). It was interesting to compare my data reduction and processing steps where my data covers the entire visible portion of the spectrum to that of the LHIRESIII (with the 2400 line grating) that includes only something like 100Å of the visible spectrum.

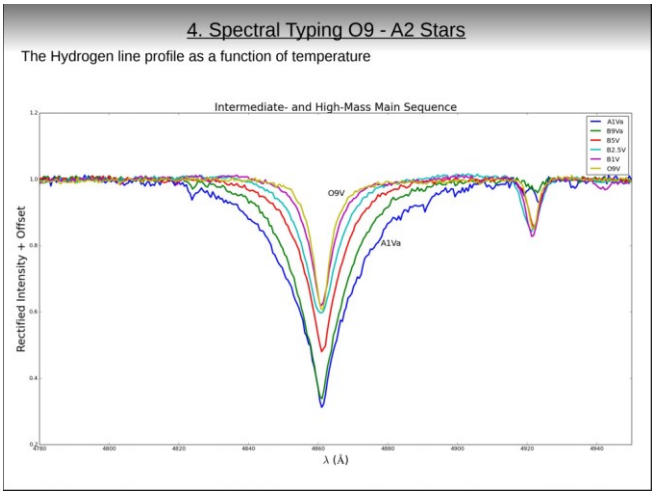
One thing I picked up that I did not know before: "If you have a very narrow spike, then go back and enable the Cosmic Ray filter feature on the General tab in ISIS to see if the spike goes away". There was a bit of discussion on this and with regard to the Coef. cosmic rays filter Value entered on the Settings tab in ISIS. But there was no consensus on the best value to use.

François also discussed a brand new spectroscopy book that he has authored which will be available very soon. The title is "Successfully Starting in Astronomical Spectroscopy: A Practical Guide".



He emphasized that a spectroscopic observation is a *set* of images:

- Target
- Calibration
- Bias
- Dark
- Flat
- Reference star



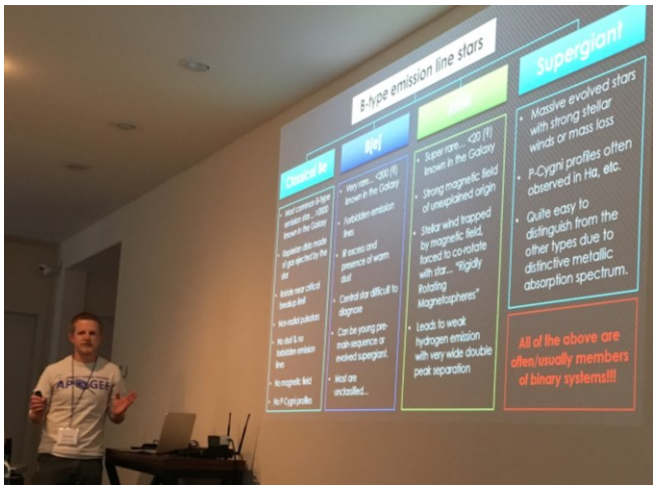
Professor David Whelan gave a very interesting talk “Interpreting Spectra of High- and Intermediate- Mass stars” and discoveries that are within the reach of amateur equipment. He uses a Shelyak LHIRESIII on the Austin College observatory telescope.

High mass stars are B2 V and above stars and Intermediate mass stars are A2 V to B3 V stars. He described their physical properties, spectroscopic properties, line morphology, spectral typing and spectroscopic variability. As an example he discussed the star HD46487 and the first observations of Hα line emission which he believes indicates the Be phenomenon for HD46487 has only very recently “turned on”.

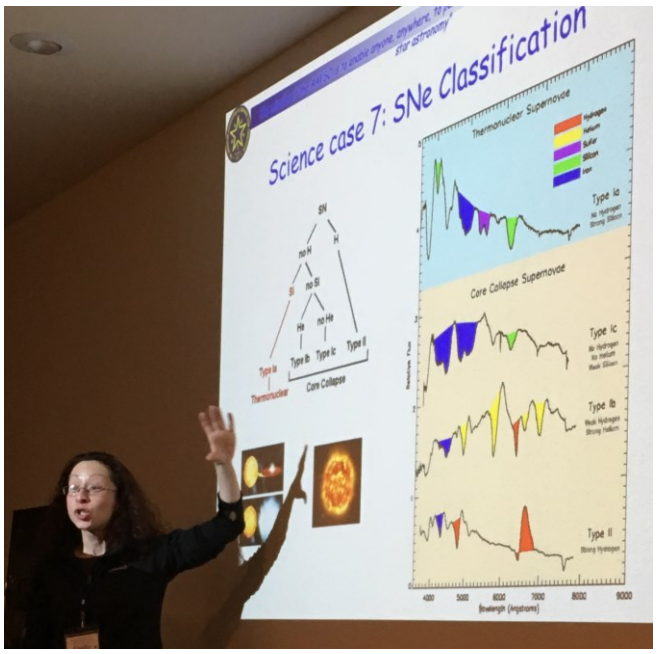
Joe Daglan demonstrated how he operates his observatory remotely and managed to find the only 20 minute gap in the clouds to actually collect spectrum data using his LHIRESIII. He also showed us some clever work he has done in creating an Arduino based control system to remotely control his spectrograph calibration module.

Professor Katie Devine from the College of Idaho took us out into the radio end of the spectrum with a very informative talk on radial velocity and line broadening in spectra. She also discussed Hierarchial star formation and the creation of Bubbles and Yellowballs, and her research on Massive Star Formation using the VLA, Green Bank radio telescopes and the Spitzer and Herschel Infrared systems.

Drew Chojnowski a third year PHD student in Astronomy at NMSU in Las Cruses showed us “Why it’s fun and worth doing - Spectroscopy of Be stars”. He described the work that he is doing on the SDSS/APOGEE project and his research on Be stars including his favorite HD55606. HD55606 turns out be one of just a few known examples of a Be star in a binary with a subdwarf O-type (sdO) star. And there is ongoing mass transfer, possibly in the form of the sdO star accreting Be disk.



Stella Kafka updated us on the AAVSO’s progress in implementing a database to store spectroscopy data. She demonstrated the process for submitting spectrum data and asked for volunteers to help test the system. She also gave an excellent talk on Spectroscopy with Small Telescopes. We learned that we can use spectroscopy to classify stars, study outflows via P-Cygni profiles, rotational velocities, accretion disks, pulsating stars and determine radial velocities of binary stars.

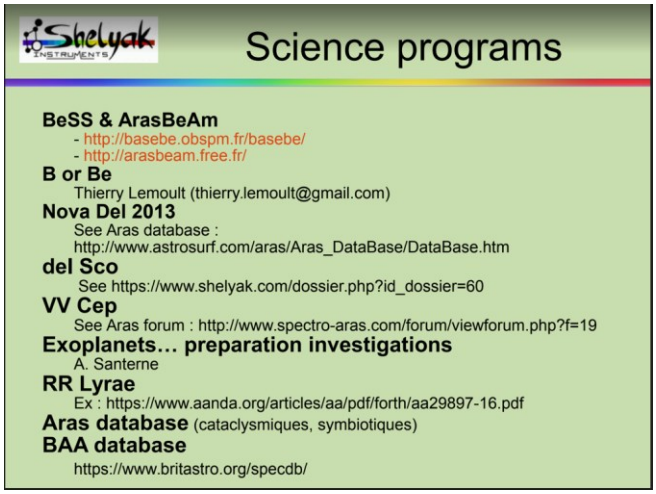


François wrapped up the event demonstrating the new Shelyak Demetra spectrum acquisition and processing software which will come out soon for use with the Shelyak Alpy, followed later for the LISA and perhaps the LHIRESIII.

Four of the most important take-aways for me from the workshop from François were:

1) An observation is a set of images. (Target star, Calibration, Bias, Dark, Flat, and Reference star)
2) Our job as observers is to get as much light from the star coming through the slit as possible. Put the star on the center of the slit and keep it there. Of course the devil is in the details. A stable mount with good tracking, pointing and auto guiding is important.
3) The resolution of the spectrum is entirely determined by the spectrograph.
4) "Always understand why you are doing what you are doing". (Kind of useful for lots of things, eh:)

François gave some good examples of where amateurs are contributing valuable scientific data. Here are some of those he listed:



Many thanks to fellow SAS members Tom and Donna Smith for inviting us to stay with them in their beautiful mountain top home in Weed NM.

2018 Sacramento Mountains Spectroscopy Workshop group photo

Editor's Note: Francois Cochard's new' book *Successfully Starting in Astronomical Spectroscopy* is now available (paperback) from EDP Sciences (220 p, 39,00 €). See http://bookstore.edpsciences.com/en/product/93/9782759822485/Successfully%20Starting%20in%20Astronomical%20Spectroscopy

A working table of Close Binary Stars of the W Uma Type

by Wayne Green

I decided to attend the workshop "Eclipsing Binary 'Time of Minimum' Observation and Analysis" by Bob Nelson at the SAS 2018 Symposium this year. Since I'm getting interested in Close Contact Binary (CCB) stars, I wanted to make a few observations before the event. W Ursa Majoris is the CCB stars' prototype[1] (W Uma) type. I presumed a good starting point was with a WEB SIMBAD look-up of the prototype W Ursae Majoris. That opened up some insight into the state-of-affairs for CCB data. This article reflects my notes on creating an observing project using public data sources, free database and presentation tools.

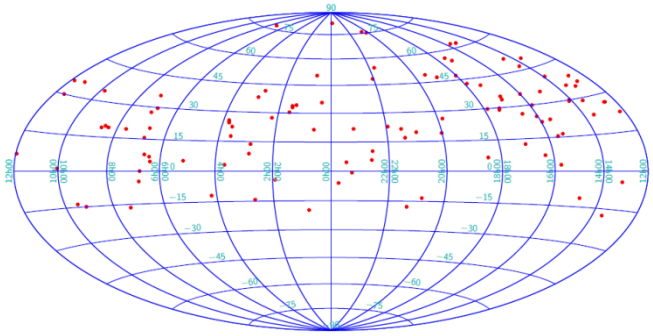


Figure 1-1: Bright W Uma stars (V mag < 12) north of -20 declination from SIMBAD Query for "otype=EW" stars; where BVR magnitudes were reported for candidates. (Plot from TOPCAT)

My goal was to create a table of stars to observe "tonight" showing the time, duration, Right Ascension (RA/ora), Declination (Dec/odec), and magnitude range. Times in the database are "JD"[2] and I want UT times. I also want an opinion of the spectral type. (BTW: I use "ora", "odec", "oname" and "otype" as "column names" in databases I create).

I started with SIMBAD[3] using their "Queries... by identifier" and used "W Uma" as the "identifier" – it is the prototypical star after-all.

I see the list of "other object types" includes "WU*". The "other object types" include type designations of "EB*" and "WU*". The "WU*" is sufficient to develop a good list of candidate stars to play with. Figure 1-1 is an all-sky Atioff-plot of the locations of brighter candidates.

"Queries... by identifier" query returned the following:

V* W UMa -- Eclipsing binary of W UMa type
Other object types: EB* ... WU*
ICRS coord. (ep=J2000) : 145.9394600 +55.9525172 [0.177 0.152 0]
Spectral type: G2Vn C 1975MmRAS..79..131H
Fluxes (6) : ... B 8.54 V 7.75 ...

Figure 1-2: Results from SIMBAD query by identifier = "WU*", abbreviated here. The "Help" page allows you to set one of the coordinate reports give ICRS decimal degrees.

1. 1 VSX Notes

Next, I turned to AAVSO's VSX interface. VSX returns the epoch and period. You can also get the ephemerides (predicted date/time of mid eclipse) via a pop-up off the main VSX page. I started taking a look at the epoch date and noticed some stars have 5 or more reported significant digits while some only have two decimal places (0.05 d ≈ 1.2 hours!). This puts a large error-bar on the time of mid eclipse. See Appendix C for Back-Of-The-Envelope thoughts about epoch and period.

Consider a 1 second error in the period. This will turn into a 1,000 second error in the predicted time-of-minimum light (16 minutes) over a 3-ish year interval. A good reason to seek-out those stars with low precision epoch/period data and few decimal points and follow-up! 1 second is an error of 0.000012 of a Julian day.

Several things are apparent:

1. The database entries with low-precision epoch dates could use some attention. Chances are they were observed long ago and one good observation today would bring the epoch down from hours to within a few sigma of your cadence.

2. Some stars have accurate ephemerides and make good practice stars – stars that are great for home- work/lab experiments.

3. Some stars have a period that is very short, making for a fun time in an evening as opposed to an all-nighter! (We have graduate students for all-nighters).

While there are tools for VSX, like getting the ephemerides for stars that interest you, I could not easily find the error bars anywhere.

While at the AAVSO VSX interface, I entered a few known CCB stars. For a single star, VSX returned a useful presentation – with the "pop-up" to provide ephemerides. Great. I also discovered that on the form I could just enter a variability type "EW" and get a long list of stars. The list only shows the period, without the HJD[4] epoch[5]. Also, this first WEB list is truncated. The form does provide you a way to get the complete list as a CSV file: 5,220,836 bytes long with information on 55401 stars. The fields for Name, AUID[6], Coords, Const, Type, Period, and Mag fields are returned (but not epoch). The Mag field may be either a magnitude

range or a base magnitude and an "amplitude". The Coords field is a single field that uses the sign of the Declination to split the values into the RA/Dec fields in a faux sexigesimal notation.

One important note: The VSX returns its data in the original "text image" (tabular format) so you can determine the number of significant digits in the original epoch and infer the precision of the period.

1.2 SIMBAD

Meanwhile, my effort to get star data from SIMBAD for all the "V*" of type "EW" returned lots of information, but nothing about period or epoch. You can get an opinion of the spectral type(s) that may or may not be accurate. You do get an opinion about various flux bands, but the list may be sparse. While this little experiment was carried out with the "scripts" interface, the same can be done using queries composed in ADQL[7] via the SIMBAD "TAP queries" service.

But then I checked with Vizier (SIMBAD's database collection) to see if they have a catalog for VSX – yes[8]! – It is called "B/VSX".

Fair enough, but the little skeptic in me wanted to see more data across the entire SIMBAD/Vizier database. So TOPCAT became the tool of choice.

The next trick I turned to was to use the TOPCAT program to form a ADQL query to this database – works great if TOPCAT knows about the database. Viola! – "B/VSX' is accessible and you get essentially all the information reported via the AAVSO VSX service for an individual star including (!) the epoch.

2. TOPCAT - Create My Table

To develop the list in Table 2 below, I used the free tool TOPCAT [Taylor (2005)] and its ADQL query option shown in section 2-4 to query the SIMBAD [Wenger et al. (2000)]. It finds 10,388 W UMa stars north of declination -20 and brighter than magnitude 17.5. TOPCAT saved the results into my PosgtreSQL database. Now I can use a series of my own queries to produce results like Table 2. The list was winnowed down to 75 candidates: those

1) having V, B and R magnitudes[9];

2) bright stars with V magnitude < 12.0; and

3) where the main id contained the name "V* ...".

These stars are suited for small telescope work and are accessible with the AAVSO AAVSO (2018) VSX tool[10]. Note: SIMBAD prepends a "V*" to the VSX name for the objects. Just remove the "V*" and enter the remainder into the AAVSO VSX query.

On a lark, given the time of year, V1848 Ori from the list was entered into the AAVSO tool and a plot of data was requested. There appear to be no observation entries in the AAVSO database. The magnitude range reported is 11.11 - 11.55 and the period is 6 hours – well within the time scale for small telescope scientists!

2.1 Building the List

To prepare my candidate list of observable stars ... its back to the SIMBAD TAP ADQL (Astronomical Data Query Language) query[11] and the query shown in figure 2-4 was submitted as a test.

2.2 Preparing your ADQL Query

Browser access to the TAP Query functionality provides a good interface to get the query right. Use the main SIMBAD access at:

http://simbad.u-strasbg.fr/simbad/ to get to the "TAP" section at

http://simbad.u-strasbg.fr/simbad/sim-tap

You can find the "TAP" option under the main site link in the "Queries" column of choices. You cannot "cut and paste" the query text shown in Figure 2-4 because the type-setting features of Word and PDFs change the quote marks away from the correct UNICODE characters. (Eye candy strikes again!). So cut/paste and edit the quotes. The proper quote is the " ' " character (ASCII decimal 39, octal #o47, hex #x27) found under the double quote character on American keyboards. Be sure to use the "check" button on the page to make sure you have a valid query. This takes a minute, and a pop-up with a truncated set of results is returned. (The TOPCAT ADQL query will get all 10,388 of the results). If the results look reasonable, you have your query right!

How did I figure out what database "relations" and fieldnames? That information is on this page. I used the diagram of the "schema" for the database:

http://simbad.u-strasbg.fr/simbad/tap/tapsearch.html

Once the browser's TAP page approves of your query, cut and paste the query text into a scratch-page file or your main planning document using your favorite editor. Wordpad™will work, just save it to the side. You will feed this to TOPCAT next. Now start TOPCAT.

2.3 TOPCAT Usage

TOPCAT carries information in, literally, many hundreds of tables. We want the one from SIMBAD called "0/48" as it ties directly into the merged dataset. Here we will use the TOPCAT TAP Client Taylor (2015) to query the database.

Following these steps in the TOPCAT menu:

File -> Load table
Select From Icon
Keywords = SIM (return) -- brings up a short list
SIMBAD TAP (0/48) (double click)
paste your good query into this textarea.

Figure 2-3: TOPCAT Menu Navigation

The query will produce an internal table and allow you to select, save, plot and query the information. The plot at the beginning of this article was made with TOPCAT.

The query runs and a table appears in the "Table List" of the main window. Select it. Using the File Save Table(s)/Session will pop up a dialog. You can save to a CSV spreadsheet file, or use the little database icon's pop-up form (A stack

of short cylinders in appearance) to enter database account information and save the contents directly to the database.

The direct save from TOPCAT can take some time. Saving as a "CSV file and using an external script to convert a CSV into a psql table is far faster for larger amounts of data.

The TOPCAT/ADQL query used:

```
select a.*,b.*
FROM (
SELECT DISTINCT oid,main_id, c.ids, ra, dec,
'WU*', update_date
FROM basic
JOIN ident ON ident.oidref = basic.oid
JOIN ids as c ON c.oidref = basic.oid
WHERE otype = 'WU*' and
dec > -20) as a
JOIN allfluxes as b
on b.oidref = a.oid
where b.v < 15
;
```

Figure 2-4: TOPCAT ADQL Query

At this point I have created a PosgtreSQL database table "ccbinary" with 10,388 stars. Here is a little digest of the data we have. Counts of targets by criteria from the ccbinary table:

```
select count(*), v::integer from ccbinary  -- first column set
group by v::integer order by v::integer;

select count(*), v::integer from ccbinary  -- second column set
where b is not null   -- if bv/r then probably better observed
and r is not null
and v is not null
and v < 12            -- bright enough for easy photometry
group by v::integer order by v::integer;


All 10,388 stars    BV and R; mag V < 12
 count | v          count | v
-------+----       -------+---
     1 |  5            2 |  7
     2 |  6            2 |  8
     7 |  7            8 |  9
    27 |  8           22 | 10
    50 |  9           41 | 11
    90 | 10           38 | 12
   191 | 11          ----------
   395 | 12           113
  2051 | 13
  4606 | 14
  2968 | 15
------------
 10388
```

Figure 2-5: Count of stars by magnitude for the entire database. Note: quite a few do not have a V magnitude. Humm,,, 113 stars out of 10,338. There is some work to be done.

3. PosgtreSQL Notes

The PosgtreSQL database is a free object/relational database that is very popular with the professional astronomy crowd. It is platform agnostic. I have added a few of my own functions, like "r2s" and "d2s" to convert RA and Dec from an internal decimal degree format to a pretty sexigesimal format. I also make use of Sergey Koposov's Q3C Koposov and Bartunov (2006) package to facilitate fasterjoins.

One issue with astronomical data is the fact that authors, naively use bad column names that are terse (easily misinterpreted) or collide with symbols in programming languages[12].

```
select
DEJ2000 , RAJ2000 , u_Period , Period ,
l_Period , u_Epoch ,
Epoch , n_min , u_min , "min" , l_min , f_min ,
n_max , u_max , "max" , l_max , Type ,
V , Name , n_OID , OID , recno
from "B/vsx/vsx" where Type LIKE '%EW%'
;
```

4. TOPCAT Access to Vizier VSX

The ADQL statement shown in Figure 4-6 was used:

Figure 4-6: The AQSL entry for Vizier's B/vsx/vsx database entry showing the need to use special quote characters for SQL keywords.

Note: the database authors used "min" and "max" as column names. These names collide with SQL functions and *must be quoted with double quotes* to pass without error (e.g. "min", "max"). This query approach returns the epoch and period for 59,637 stars.

The file is saved from TOPCAT as a "CSV" spreadsheet, and converted to PosgtreSQL using a python script. This is far faster than trying to save the table directly to the database.

An example of the Python script in use:

```
csv2psql -c -D ccbdb –t tapvsx CCBinary_TAP_VSX.csv > tapvsx.psql
```

Once the table is in PosgtreSQL , a few simple queries (Shown in Figure 4-7) can give a sense of the data you just acquire. The types are described by the page http://cdsarc.u-strasbg.fr/ftp/cats/B/ gcvs/vartype.txt.

```
select count(*) from tapvsx; -- 59637
select count(*) from tapvsx where epoch is not null and period is not null; -- 9750

select count(*), type from tapvsx group by type order by type;
 count |    type         count |    type
-------+-----------    -------+----------
     1 | BY|EW              1 | EW/D:
     1 | DCEP|EW            2 | EW/DM:
    13 | DSCT|EW           52 | EW|DSCT
  3395 | EB|EW             13 | EW/DW
     2 | ELL|EW            2 | EW/DW:
 55397 | EW                1 | EW/DW/RS
   227 | EW:               6 | EW|EA
     1 | EW+BLEND          1 | EW+EA
     1 | EW/D             17 | EW|EB
```

Figure 4-7: The type field agrees with "General Catalogue of Variable Stars" (GCVS) catalog Kholopov (1987) and extended to VSX Watson et al. (2006, 2015). In 2017 new effort on the GCVS is discussed by Samus' et al. (2017).

5. Summary

Mt. Suhora Astronomical Observatory of Craow Pedagogial University maintains a database Kreiner (2004) of observations and provides ephemerides for its stars. An analysis of 1140 of their observations Kim et al. (2003) where "(1) at least 20 minima have been timed; (2) these minima span at least 2,500 cycles; and (3) the 2,500 cycles are distributed over at least 40 years.". The summary table from their paper shown here:

		Observation Method					
Pri	Sec	Vi	P	Pg	E	CCD	Span-Years
119,690	22,417	64,581	43,098	11,623	18,303	4,502	1783-2002

Table 1: From Kim et.al. Kim et al. (2003) summary of their database.

where: "Vi" indicates visual observations, "P" is a case where a photo was taken near the time of minimum (Kim et.al question the precision), "Pg" is a series of photographic observations, "E" is photoelectric observations, and "CCD" is using a CCD for observations. Note the span of years dating back to 1783. There are a total of 284,214 observations covered by the summary.

6. Conclusions

Finding a set of stars to study and planning their observations is not as easy it may seem. Becoming proficient using tools like ADQL TAP queries, regular SIMBAD queries (provides a wealth of bibliographic references for most targets), and TOPCAT is worth the investment.

I found that only 16 percent (9750) of the W UMa stars in the Vizier VSX database have both epoch and period data. Of these, fewer have good precisions.

The issues found while preparing this article include the fact that published tabular lists of data are often converted into machine-readable formats that do not preserve an implicit form of precision used in print articles. The use of field names (column names) that violate basic names in database, use of case-sensitive single characters. The prose may be acceptable for print tables it can lead to misrepresented in database supported science systems.

We live in an age where we are producing floods of new data, in machine-readable "large-data-informatics" forms that require careful attention to detail. There is a need to develop a common interchange language (json[13]?) and convert existing data to common format. I utilize my own set of standards – made with the same haste and would benefit from serious consideration by the wider community.

7. Acknowledgments

This research has made use of the Vizier and SIMBAD database, operated at CDS, Strasbourg, France. PostgreSQL™[14] was used to manage data and tie to scheduling. Python work was under the greatly appreciated "anaconda" packages from Anaconda.com. I appreciate Anaconda's support of the STSci IRAF environment and the collaborative effort between Anaconda and STSci.

A. Good Candidate Stars

The PosgtreSQL query show in Figure A-8 uses the database format features. It uses and custom "r2s" and "d2s" calls to convert the double precision RA and Dec values to Sexigesimal. It then applies selection criteria to reject stars that are not suitable and orders the results by basic magnitude and Right Ascensions.

```
select r2s(ra),d2s(dec_),main_id,   b::numeric(6,3),   v::numeric(6,3),
   r::numeric(6,3)
from hugewuma where main_id ~ '.*V\*' and   v <= 12 and
     v is not null and  b is not null and  r is not null
order by floor(v),ra;
```

Figure A-8: Using PosgtreSQL to select stars that have all three magnitudes (B,V and R) that are brighter than 12th magnitude. The original table is limited to band from -20 deg to the North celestial pole.

Table 2: Bright W Uma stars by magnitude/RA

Name	RA	Declination	B	V	R
AW UMa	11:30:04.32	+29:57:52.67	7.270	6.920	6.700
VW Cep	20:37:21.54	+75:36:01.47	8.130	7.380	7.000
LV Vir	13:32:46.14	-17:45:32.67	9.290	8.517	9.028
BW Dra	15:11:50.10	+61:51:41.23	9.390	8.740	8.300
BV Dra	15:11:50.36	+61:51:25.28	8.540	8.040	7.700
OU Ser	15:22:43.47	+16:15:40.73	8.840	8.266	7.800
LS Del	20:57:10.29	+19:38:59.25	9.178	8.722	8.300
DY Cet	02:38:33.18	-14:17:56.72	10.020	9.590	9.340
V417 Gem	06:59:48.42	+27:41:58.72	10.640	9.875	9.538
TX Cnc	08:40:01.70	+18:59:59.45	10.710	9.970	9.880
Y Sex	10:02:47.96	+01:05:40.34	10.380	9.950	9.875
PY Vir	13:10:32.22	-04:09:32.61	10.670	9.840	9.844
FW CVn	13:54:18.85	+40:45:42.35	9.920	9.300	8.600
EF Boo	14:32:30.54	+50:49:40.69	9.950	9.450	9.140
V2612 Oph	18:29:13.01	+06:47:13.72	9.970	9.440	9.060
OO Aqr	20:49:43.22	-13:07:35.54	9.754	9.524	9.400
V481 Peg	21:57:11.20	+22:40:10.64	10.280	9.740	9.587
V485 And	00:21:19.18	+35:24:15.38	11.470	10.930	10.890
V523 Cas	00:40:06.27	+50:14:15.53	11.670	10.870	10.405
V527 And	01:22:35.69	+34:19:35.86	11.040	10.640	10.850
HN Psc	01:29:47.93	+33:03:35.67	11.240	10.550	10.850
BO Ari	02:12:08.77	+27:08:18.23	10.550	10.020	9.730
BQ Ari	02:48:40.73	+13:44:48.02	11.550	10.780	10.300
NS Mon	06:36:08.02	+07:51:43.58	10.890	10.590	10.553
QW Gem	06:50:46.07	+29:27:11.35	11.300	10.780	10.000
EZ Hya	09:26:41.06	-13:45:06.41	11.390	10.560	10.600
KM UMa	11:47:49.04	+35:13:35.23	11.720	10.820	10.320
V354 UMa	13:35:38.40	+49:14:06.13	11.640	10.870	10.450
FU Dra	15:34:45.21	+62:16:44.32	11.080	10.480	10.100
V829 Her	16:55:47.87	+35:10:57.60	10.820	10.270	9.970
V1321 Her	18:02:13.88	+47:01:12.32	11.710	10.830	10.340
EL Sge	20:00:57.80	+19:03:30.36	11.310	10.720	10.662
VZ Psc	23:27:48.39	+04:51:23.94	11.390	10.274	10.090
DZ Psc	00:36:27.94	+21:32:14.53	11.640	11.080	11.110
GR Cet	00:47:16.04	-19:41:43.73	11.640	11.130	11.274
V531 And	01:30:15.92	+33:39:18.50	11.770	11.399	11.211
BC Tri	01:35:51.18	+30:19:28.71	11.820	11.570	12.000
V873 Per	02:47:08.21	+41:22:31.92	11.850	11.040	10.680
V881 Per	02:59:53.12	+38:01:48.26	10.700	11.090	10.340
V1188 Tau	03:45:35.99	+24:30:00.80	12.570	11.850	12.300
AH Tau	03:47:11.97	+25:06:59.38	11.590	11.070	11.090
CU Tau	03:47:36.91	+25:23:15.86	12.020	11.230	11.380
BL Eri	04:11:48.21	-11:47:26.70	12.130	11.335	11.443

Name	RA	Declination	B	V	R
V1848 Ori	05:08:36.42	+05:12:22.08	11.000	11.301	10.800
V958 Mon	06:22:06.39	+04:28:16.50	12.100	11.920	12.040
V402 Gem	06:42:17.37	+20:16:48.35	12.300	11.720	11.680
GU Mon	06:44:46.86	+00:13:18.27	11.910	11.570	11.650
V405 Gem	06:47:07.86	+15:38:37.15	11.360	11.010	10.690
V473 Cam	07:17:04.93	+77:10:26.05	12.700	11.536	11.400
RT LMi	09:49:48.32	+34:27:15.44	12.110	11.350	10.990
PS Vir	11:57:51.28	+06:27:04.78	12.550	11.520	11.400
CC Com	12:12:06.04	+22:31:58.69	13.090	11.420	11.400
RW Com	12:33:00.28	+26:42:58.38	12.330	11.682	10.929
DF CVn	12:43:37.24	+38:44:15.62	11.890	11.032	10.808
DR CVn	12:44:41.81	+35:57:56.39	12.080	11.920	11.800
EY CVn	13:06:25.42	+34:29:17.00	12.570	11.965	11.760
FI CVn	13:28:37.27	+35:33:11.60	12.730	11.890	11.430
VW CVn	13:29:42.17	+28:52:49.08	11.990	11.880	11.840
TU Boo	14:04:58.05	+30:00:01.59	12.220	11.610	12.090
IK Boo	14:08:46.21	+29:29:07.96	12.230	11.630	11.500
HH Boo	14:21:44.08	+46:41:59.36	11.800	11.021	10.869
KQ Lib	14:51:17.09	-11:09:43.10	11.843	11.380	10.800
TY Boo	15:00:46.94	+35:07:54.75	12.030	11.390	11.380
CC Ser	15:36:24.37	+15:31:57.68	11.490	11.180	11.320
BS CrB	15:54:31.35	+29:56:52.17	12.420	11.740	11.350
AU Ser	15:56:49.47	+22:16:01.59	11.760	11.040	10.930
AS CrB	16:00:14.51	+35:12:31.69	11.970	11.360	11.000
V384 Ser	16:01:53.57	+24:52:17.54	13.520	11.874	11.845
V1038 Her	16:58:19.78	+33:40:21.59	12.630	11.900	11.871
V1055 Her	17:20:23.94	+41:15:12.77	12.150	11.632	11.421
V1306 Her	17:53:08.09	+42:34:38.55	12.590	11.758	11.298
GU Vul	19:48:57.11	+26:23:22.91	12.160	11.860	11.940
KV Peg	21:22:03.66	+17:07:51.47	11.980	11.450	11.460
DV Peg	21:27:07.02	+21:22:30.34	12.470	11.830	12.170
V2646 Cyg	21:44:34.50	+54:22:01.04	12.090	11.120	11.150

B. Example: The Fastest EB in the VSX

The star with the name “BEST Ircby-18” (recno=402436) has a reported period of 0.102 with no epoch and 3 digits for the period. The fastest brighter than 12th mag is “V1283 Cas” with epoch = 2451501.616 and a period of 0.206292 (4.95 hours). The epoch is for 1999-11-19T02:47:02.399. It doesn’t even have a AAVSO UID.

The Magnitude is reported for “BEST Ircby-18” as 13.293 with an “amplitude” of 0.03 using a “wide” filter 650-800nm for Kabath (2009AJ....137.3911K). Looking this star up in SIMBAD takes you to a paper by Kabath et.al. Kabath et al. (2009) for detections of the LRc2 field by the CoRoT telescope, BEST[15] work. Note: The Arxiv paper is misfiled. This star is in an incredibly crowded field.

C. Epoch and Period Thoughts

Let’s presume the model for a basic EB is a mathematical sine wave. The general mensuration formula Selby PhD, ScD, Ed. (1972) for the sine wave is shown in Eq. 1:

$$A\ sin(B \times \theta\ +\ C\ ) +\ D$$

$$E(t) = E(0) + sin(B \times n(t) \times \theta + C)$$

where for the wave expressed by Eq. 1; A is the amplitude, B is the “frequency” or period, C is the phase shift (related to epoch for this nth event) expressing ingress/egress and other regular features of the event and D is the “DC” offset. We can ignore D for a mathematical discussion.

For Eq. 2 let’s take the minimum of the sine wave to be the point of mid eclipse (a general phase shift of $3/2\pi$). Let $E(0)$ be the one well observed event taken to be the “epoch” – the initial (fixed in time) starting point. This is usually in terms

of JD. For every nth event, where n is an integer, n=0 is the epoch date and n × period is each event into the future.

For variable stars, the magnitude range for the eclipse is usually some treatment of *A*. It can be implicit in the case of stating the minimum and maximum magnitudes of the eclipse or it may be a positive value (amplitude in the literature) "added" to the brightest magnitude to hint at the minimum magnitude.

Footnotes:

[1]AAVSO VSX Definition. These are eclipsers with periods usually shorter than 1 day, consisting of ellipsoidal components almost in contact and having light curves for which it is impossible to specify the exact times of onset and end of eclipses. The depths of the primary and secondary minima are almost equal or differ insignificantly. Light amplitudes are usually <0.8 mag. in V. The components generally belong to spectral types F-G and later.

[2]Julian Date – refers back in time to the Greenwich Noon for a day.

[3]http://simbad.u-strasbg.fr/simbad/

[4]There is a brewing debate about the accuracy of HJD calculations.

[5]The epoch sometimes only has two decimal points. This translates to a possible 4-hour error in event times.

[6]AAVSO Unique Identifier, described in Turner (2010). The field is unique to the AAVSO database system.

[7]Astronomical Data Query Language.

[8]http://cdsarc.u-strasbg.fr/viz-bin/Cat?B/vsx

[9]This little trick – finding that there are at least these bands is a loose-hint that the source of the data was from a well-formed experiment.

[10]https://www.aavso.org/vsx/index.php?view=search.top&ql=2&clear=1

[11]http://simbad.u-strasbg.fr/simbad/sim-tap

[12] Names like min/max and "dec" which means "decending" in SQL). To overcome this, I created a long list of translations that usually prepends a "o" to a column name that can be bothersome.

[13]Javascript Object Notation.

[14]PostgreSQL is copyright (C) 1996-8 by the PostgreSQL Global Development Group, and is distributed under the terms of the Berkeley license.

[15]Berlin Exoplanet Search Telescope

Bibliography and References

AAVSO (2018). Aavso homepage. http://aavso.org/. for Kabath (2009AJ....137.3911K), V. W. P. (2009). J/aj/137/3911 best periodic variable stars in lrc2 field. *WEB/URL*. See note 3.

http://cdsarc.u-strasbg.fr/viz-bin/Cat?J/AJ/137/3911.

Kabath, P., Fruth, T., Rauer, H., Erikson, A., Murphy, M. G., Chini, R., Lemke, R., Csizmadia, S., Eigmüller, P., Pasternacki, T., and Titz, R. (2009). Characterization of CoRoT Target Fields With Berlin Exoplanet Search Telescope. II. Identification of Periodic Variable Stars in the LRc2 Field. *The Astronomical Journal*, 137:3911–3919.

Kholopov, P. N. (1987). *General Catalogue of Variable Stars*.

Kim, C.-H., Kreiner, J. M., and Nha, L.-S. (2003). Statistics of times of minimum light of 1140 eclipsing binary stars. In Cheng, K. S., Leung, K. C., and Li, T. P., editors, *Astrophysics and Space Science Library*, volume 298 of *Astrophysics and Space Science Library*, pages 127–130. http://www.as.up.krakow.pl/publ/kkn-03.pdf.

[15]Berlin Exoplanet Search Telescope

Koposov, S. and Bartunov, O. (2006). Q3C, Quad Tree Cube – The new Sky-indexing Concept for Huge Astronomical Catalogues and its Realization for Main Astronomical Queries (Cone Search and Xmatch) in Open Source Database PostgreSQL. In Gabriel, C., Arviset, C., Ponz, D., and Enrique, S., editors, *Astronomical Data Analysis Software and Systems XV*, volume 351 of *Astronomical Society of the Pacific Conference Series*, page 735. https://github.com/segasai/q3c.

Kreiner, J. M. (2004). Up-to-Date Linear Elements of Eclipsing Binaries. *Acta Astronomica*, 54:207–210.

Vizier: J/AcA/54/207.

Samus', N. N., Kazarovets, E. V., Durlevich, O. V., Kireeva, N. N., and Pastukhova, E. N. (2017). General catalogue of variable stars: Version GCVS 5.1. *Astronomy Reports*, 61:80–88.

Selby PhD, ScD, Ed., S. (1972). *Standard Mathematical Tables, 20th Edition.* CRC Press.

Taylor, M. (2015). TOPCAT's TAP Client. *ArXiv e-prints*. Program available at: http://www.star.bris.ac.uk/~mbt/topcat/.

Taylor, M. B. (2005). TOPCAT & STIL: Starlink Table/VOTable Processing Software. In Shopbell, P., Britton, M., and Ebert, R., editors, *Astronomical Data Analysis Software and Systems XIV*, volume 347 of *Astronomical Society of the Pacific Conference Series*, page 29.

Turner, R. (2010). Aavso unique identifier. *WEB/URL*.

https://www.aavso.org/aavso-unique-identifier.

Watson, C., Henden, A. A., and Price, A. (2015). VizieR Online Data Catalog: AAVSO International Variable Star Index VSX (Watson+, 2006-2014). *VizieR Online Data Catalog*, 1.

Watson, C. L., Henden, A. A., and Price, A. (2006). The International Variable Star Index (VSX). *Society for Astronomical Sciences Annual Symposium*, 25:47.

Wenger, M., Ochsenbein, F., Egret, D., Dubois, P., Bonnarel, F., Borde, S., Genova, F., Jasniewicz, G., Laloë, S., Lesteven, S., and Monier, R. (2000). The SIMBAD astronomical database. The CDS reference database for astronomical objects. *Astronomy and Astrophysics Supplement Series*, 143:9–22.

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