News from the Society for Astronomical Sciences

Vol. 21 No.2 (August 2023)

Recap of SAS-2023

The SAS-2023 Symposium was held in Ontario, California on **June 22-23-24**, 2023. We had 72 in-person attendees, plus 26 on-line. Thank you to John Martin and Bob Gill, who made it all work for the people in the room and those around the world.

We hope that the workshops gave you ideas for new targets and projects to add to your observing plans; and ways that you can use professional databases for both planning and analysis. The technical presentations and lunchtime discussions certainly highlighted the diverse ways that small-telescope observations can push our understanding of the universe forward.

For those of you who could not attend the Symposium, videos of the presentations are now freely available to view.

Workshop recordings are at:
https://www.youtube.com/playlist?list=PLmQ5Bvz4ACYK9PzC3SRKpIr1bRuna78dJ

Technical presentation recordings are at:
https://www.youtube.com/playlist?list=PLmQ5Bvz4ACYL-UHoY_dk6KSW76y6IzAK5

In-person attendees should have picked up your Proceedings books at the Symposium. SAS Members who didn't attend in person, but did request a Proceedings book should have received it. Let us know if yours didn't arrive.

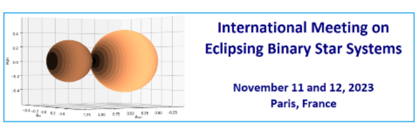
The Proceedings book (as PDF) is freely available on our website at:
https://socastrosci.org/wp-content/uploads/2023/05/2023-Proceedings_Ver1.2.pdf

Thank you to Rachel Freed, who was our Master of Ceremonies; and to Wayne Green for MC'ing the Workshop day.

Upcoming meetings:

There are a couple of meetings later this year that you might be interested in:

International meeting on Eclipsing Binary star Systems (Paris, France), Nov 11-12, 2023.



Meeting website= https://bsnp.info/

The main goal of the 2023 meeting is to review eclipsing binary systems from a theoretical and observational point of view. Therefore, this meeting is planned for both professionals and amateurs. Mmost of the focus of the meeting will be on the W UMa-type binary systems, which are one of the most interesting types of binary systems and are important astrophysical tools for understanding star formation, structure, and evolution. A large number of these binary systems have not been observed and analysed yet. In order to analyse these binaries, it is usually necessary to have appropriate ground-based observations at the large and small observatories. We welcome all branches regarding eclipsing binary systems. Another goal of this meeting is to establish proper communication between professionals and amateur observers in this field.

This meeting was organized by the Société astronomique de France and the BSN project. 'English' is the meeting language.

All travel expenses, including flight, hotel, foods, etc., are the participant's responsibility, and the meeting has no provision for support.

Registration deadline is October 30th.

AAVSO Annual Meeting (Somerville, MA) Nov 3-5, 2023: The annual meeting of the American Association of Variable Star Observers will be near Boston, MA this year.

Meeting website= https://www.aavso.org/aavso-meetings

This will be a hybrid meeting.

On Friday, November 3rd there will be a hybrid all day Python Workshop with Dr. Matthew Craig. Friday evening will feature an opening reception and speaker for all in person participants.

Saturday and Sunday will include the Landolt Lecture, keynote speakers and research presentations, the AAVSO Membership Meeting, and the closing banquet. Presentations and the Membership Meeting on Nov. 4 & 5 will be broadcast via Zoom to online attendees.

There is an early-bird discount if you register before Sept 15th.

NASA's New Horizons Team Calls for the Amateur Astronomical Community to Augment the Mission's Observations of Uranus and Neptune:

Apropos to the Workshop and papers about the outer planets presented at SAS-2023, the following call for observations appeared in the August note to the members of AAS Division of Planetary Sciences:

NASA's New Horizons (NH) spacecraft plans to observe Uranus and Neptune from its location in the outer solar system in September 2023, concurrently with the Hubble Space Telescope in Earth orbit. The NH science team requests and welcomes observations of both of these ice giant planets from the global amateur astronomy community during the week before, during and after these observations to enhance the science that NH and HST observations produce.

The timeframes of NH and HST observations for each object are as follows:

Uranus (NH and HST offset observing times)

NH: 12:15 UT on Sept. 16 until 6:27 UT on Sept. 17 (17.2 hours).

HST: 6:00 UT on Sept. 17 through 21:00 UT on Sept 18.

Neptune (NH and HST are basically concurrent)

NH: Sept. 22, 7:35 UT – Sept. 23, 16:59 UT (32.4 hours)

HST: Sept. 22, 3:20 UT – Sept. 23, 18:10 UT

For more details and general finding charts please see:

http://pluto.jhuapl.edu/News-Center/News-Article.php?page=20230810

Once you have images of Neptune or Uranus to contribute, post them on Twitter or Facebook using the hashtag #NHIceGiants.

Include the date and time of all images you post and the filter bandpass used.

Astrometry Observing Challenge: Gravitational deflection of starlight by Jupiter

Many of you probably saw the note from Don Bruns in the September *Sky & Telescope* magazine, about the possibility of detecting the gravitational light-bending due to Jupiter's gravity.

The concept is similar to the Eddington Experiment, except that it will be done at night, and the anticipated effect is quite a bit smaller than the solar gravitational light-bending.

The night of October 27/28 (USA) is uniquely promising for this observation. On this night Jupiter will pass very close to the middle star of a line of 3 bright (V~7-8) stars.

Dr. Kenneth Carrell (Angelo State University) is helping to organize and recruit more people and observing sites for this project. He would particularly like to have observers who are outside of West/Central Texas and Southern California, to give some protection against bad weather.

Based on preliminary data from Don Bruns and some calculated deflections from Dr. Carrell, they are pretty sure that this is a measurable effect. No one has ever measured this in the optical, and it is one of the things that Einstein apparently suggested early on (but equipment of that time wasn't capable of the necessary precision).

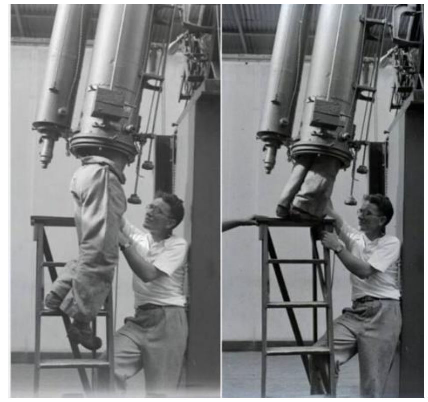
Here is a link to a *Sky & Telescope* article written by Don Bruns: https://skyandtelescope.org/get-involved/pro-am-collaboration/how-to-measure-jupiters-deflection-of-starlight/

And here is a link to almost the same information on Don Bruns' webpage: http://www.stellarproducts.com/jupiterdeflections/jupiterdeflections.htm

It will be important for participants to make some observing runs in advance of the target night, to check out your imaging setup (pointing, exposure, filter) and image processing scheme. Dr. Carrell is planning on taking images of these 3 stars for 1 or 2 nights before and after the close approach to provide a baseline, and he suggests that participants try to do the same. But if you are able to take images for just the night of Oct 27/28, they will be useful.

The group-io for those who are interested in being involved is:

https://groups.io/g/JupiterDeflection

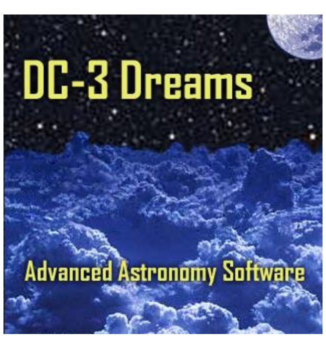


How to clean a large refractor: (source: Boyden Observatory South Africa sent to Antique Telescope Society USA, courtesy of Jack Martin)

Symposium Sponsors

The Society for Astronomical Sciences is grateful to 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.

Sky & Telescope Magazine
The Essential Guide to Astronomy
http://www.skyandtelescope.com/



DC3 Dreams Software
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http://www.dc3.com/

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Enriching your astronomy experience since 1983.
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https://www.sxccd.com/

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

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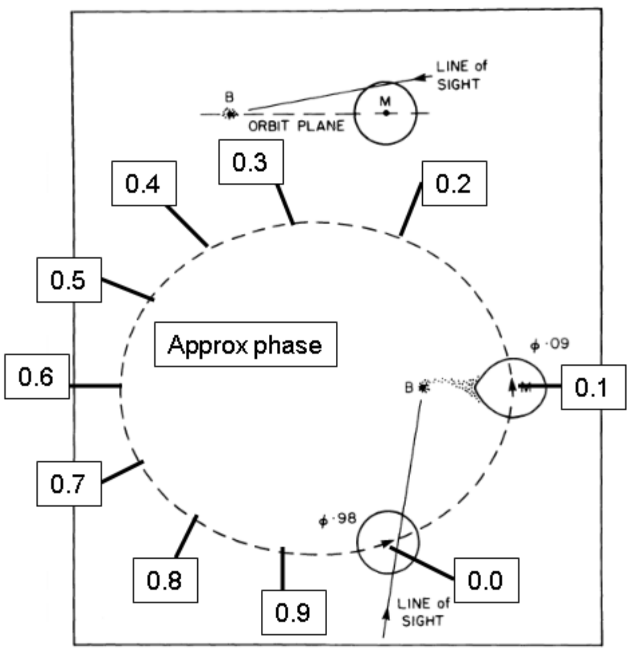
http://www.telescopes.net/

Notes from Members

AZ Cas Interim Report: May 5, 2023
John Menke
john@menkescientific.com

Introduction

AZ Cas is a 9.3 mag, Eclipsing Binary of 9.3 year period and is composed of a red giant and a blue giant. It was analyzed in 1977 by Anne Cowley; however, virtually no work has been done on it since then to verify or advance our knowledge of the system.



Using a homebuilt 18in Newtonian and homebuilt spectrometers, I have been following the behavior of AZ Cas since 2012 when I serendipitously caught what appears to have been a major upset near the Ha line. After years of only occasional observations, in 2018 I began observations on every adequate night, with an average of 3-4 days cadence (the weather in MD is not conducive to continuous coverage!). To date, I have about 450 nights of data (over 1000 hours). A typical set of measurements includes a series of spectra of star SAO11931 (7 mag, B star), SAO11927 (7 mag K star) (both nearby in the sky), and AZ Cas (9mag red & 11mag blue components). The two SAO stars are used as wavelength checks.

The spectrometer used until early 2022 was a homebuilt Littrow R=3000 design having a bandwidth of about 700A. A new spectrometer was built of similar design, but having two (2) gratings with the light beam split into red and blue beams using a dichroic. This allows recording the red and blue spectra simultaneously on the same camera. The current camera is a ZWO 2600MM used in Bin-2 mode.

The blue star in AZ Cas is about mag 11, so the blue spectrum is near the lower sensitivity limit for this observing system. When the weather permits >1 hour total exposure, reasonably good results can obtain down to about 3800A.

Although the observing methods evolved over the period, in general the goal has been to obtain 3-4 hours of AZCas spectral data. The individual 300s spectral images are then calibrated, background subtracted, averaged (combined), then downloaded into spreadsheets. There the spectra are normalized (rectified) to a value of "1" in a region having little structure (6650 or 4600A for the red or blue spectrum), displayed and inspected. Using reference spectra (usually SAO11927) the wavelength offset was adjusted to the observed H lines.

In addition to the spectroscopy observation program, photometry is also conducted using an 11-inch RC scope, equipped with a four-filter system (B,V.R,I). Observation is carried out at about 2–4-week intervals to record AZCas and a set of eight comparison stars.

AZ Cas

Most of what is known of AZ Cas comes from the only significant paper on the star written by Anne Cowley in 1977. Using historic and then-current photometric and spectroscopic data, she developed a model of the system. The system is shown in approximate schematic form. The eclipse shown is the primary eclipse (red star occulting blue star) at Phase=0.0. Periastron is approximately one year (0.11 phase) after the primary eclipse. The secondary eclipse (blue star in front of red star) at approx. phase=0.2 is expected to be <0.002 mag in red, and even less so in blue, and is unlikely to be observable.

Cowley found evidence of mass transfer between the stars, especially near periastron. There has been almost no additional research on the system since Cowley's paper.

The 2012 Event

While testing my new spectrometer in 2012, I observed many (Ha) emission stars. AZCas was present in several lists of Be stars, and being circumpolar, was convenient to observe. On Aug 6, 2012, I began an approximate 6 hour observing run under automatic control. The next morning, it was apparent that clouds had passed over during hours 3-4, and when clouds were present, the telescope had no particular guide star to follow. The Ha spectra from before (A=Red) and after (B=Black) the cloud event were strikingly different as shown in Figure 1.

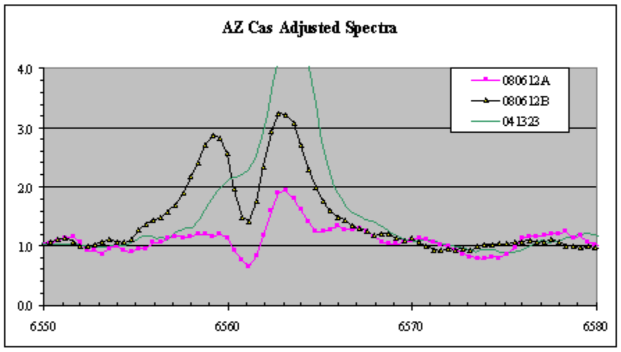


Figure 1 AZ Cas Upset

The curves in this figure differ in detail from those published earlier as a result of a reanalysis of the data of Aug 6, 2012. (1) The wavelength scale of both the A&B groups was carefully matched to details of structure in the spectra, then matched to later spectra that included comparison stars. Among other changes, a 2A difference between the A&B sets was noted and corrected. (2) The results are now compared to the near periastron results of 041323 (green curve), with all curves matched to within 1 pixel (about 0.4A).In each curve, the absorption notch is at 6561A. In curve A and 041323, the notch is approximately 0.5 in amplitude. Note that during the event, the absorption and 6563 peaks remained at the same wavelength, the absorption peak increased to about 1.5 amplitude, and a brand-new emission occurred at 6559A. (3) An analysis every 15 minutes showed no trends in either the A or B sets of data. (4) The spectrum had returned to the red ("normal") curve two days after the event. (5) The non-Ha spectrum of group B appears very similar to Group A, with the possible exception that HeII (at about 6680A) appears not to be present.

At the time of the upset, it appeared that the telescope might have shifted to some other star during the cloudy period; however, later analysis ruled that out. There is no known instrumental or other artifact that could account for the event. No other spectral features show any of the effects.

Results of Observations

Having seen such a large, fast change in AZ Cas, I eventually decided to start a long-term observation of AZ Cas to learn more and to see whether this was a frequent occurrence. The AZ Cas observations to date have covered the phases from about 0.6 to 1.0 to 0.1 on virtually every night with even barely adequate conditions (approx. 1:4 nights in Maryland). No upsets near Ha similar to 080612 have been seen. Approximately 450 nights have been observed for over 1000 hours of observation.

Given the generally steady spectral shape (i.e. the "normal" AZ Cas) I have observed (example in Figure 3), it also occurred to me that smaller upsets like August 2012 might occur too fast to show in a spectrum averaged over several hours. A search about 10 nights of particularly good data were made using 25 min (5 exposure) binning (vs the usual binning of all 2-4 hr of data) ; however, no sign of upsets was seen. Thus, the goal of observing more upsets has not been met, and what caused the 2012 upset is unknown.

As the AZ Cas Project has evolved, we have, of course, modified and improved the observing program. As evolved, the practice is to attempt up to 4 hours of five-minute spectra of AZCas. The session also includes one or more spectra of comparison stars SAO11931 a 7 mag B blue star, and SAO11927 a K2 7 mag red star used for tracking wavelength and amplitude changes.

Far from periastron (phase up to 0.7 or so) one sees a broad emission feature near Ha centered on 6563 with a narrow absorption feature on the blue side at 6561. Figure 2 shows a representative sample: black curve is a comp B8 star, green is the Ha absorption in a K2 comp star used for wavelength calibration (at 6563A), while red is AZCas. The black broken line is the broad Ha emission.

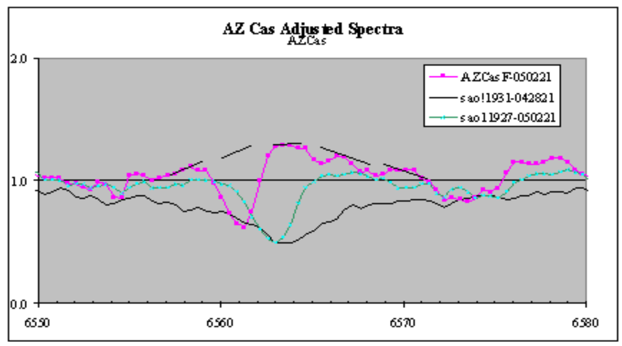


Figure 2 AZ Cas Ha Features

Approaching periastron, as shown in Figure 3, the Ha emission greatly increases in intensity and narrows to about 2.5A FWHM, but the blue absorption line shows only as a notch on the blue side of the emission. Analysis of multiple curves shows that the almost buried absorption line is essentially unchanged: amplitude about 0.5, the wavelength of 6561A, and width of about 2.0A (roughly the resolution of the spectrometer).

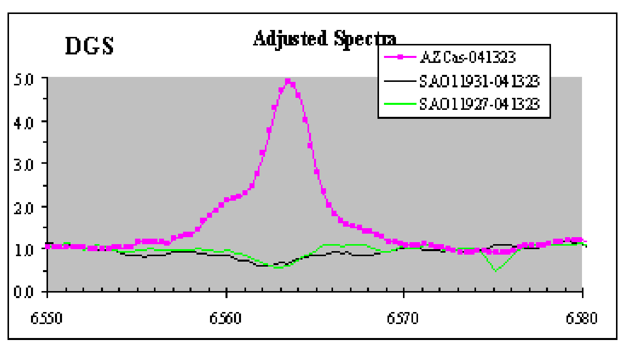


Figure 3 AZCas Ha near periastron

The result of the analysis showed that, within likely observational errors, the absorption feature remained essentially constant in all respects, even as the Ha emission increased nearly fivefold! That is, the absorption feature is unaffected by the nearness of the two stars as periastron is approached, while the Ha emission feature is enormously affected. These characteristics will constrain any models that try to explain the spectroscopic features.

During this observing project, the only additional spectral changes of note have been the “wiggles” on the red side of the Ha emission, as partially seen in Figure 3. These wiggles come and go in hours to days with no apparent periodicity. Their wavelengths are always the same, even as they appear and disappear. One can even see these in the Group A 080612 data during the upset.

The **photometric** observations have been made more difficult by significant equipment issues as well as necessary changes in the equipment (e.g., converting several of the filters from glass to evaporated film filters to improve operational life in the humid environment), and the failure of a camera requiring a different camera with a bigger chip and modifications to the

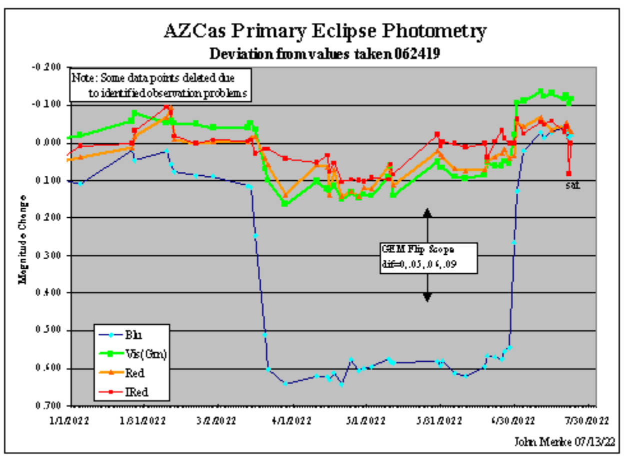


Figure 4 AZ Cas Primary Eclipse

optical train. Further, Maryland skies are not very good, thus very often limiting the quality of photometric observation.

On the other hand, one of the most crucial photometric measurements was of the primary eclipse, which fortunately came at a time of minimal equipment problems and relatively good weather. The result is an excellent light curve in all four colors. During the eclipse another feature of the system was shown—namely, the Ha emission feature discussed above continued without change. That is, the Ha emission feature is clearly not part of the blue star and is likely located on or near the red star. No other changes in the two spectral bands were observed during the eclipse except, of course, for the disappearance of short (blue) wavelength signals from the blue star.

Conclusion

The AZCas observation project has resulted in the development of unique spectroscopic equipment that has operated successfully for several years. However, in spite of intense observation of this system, we have observed no Ha upsets. The data so far developed do expand what is know of the system, and will permit development of a more detailed model of the AZCas system.

This extended AZCas project is yet another demonstration of what an amateur can do, even with relatively modest equipment. While it is disappointing that there has been so little interest in this star by either the professional or amateur community, it is also satisfying (so far as I know) to be the only human to have observed the eclipse last year.

Long live AZ Cas!

Reference

Cowley 1977. A.P. Cowley, J.B. Hutchings, D.M. Popper. The Masses of Cool Supergiants: the Interacting System AZ Cassiopeia p.(:882-895) Dec 1977 ASP

Accessing NASA’s Astrophysics archives using Python

The recent AAS meeting in Albuquerque included a Workshop on “Accessing NASA's Astrophysics Archives using Python”. The information might interest some of you (particularly those of you who attended the “accessing professional databases” at SAS-2023). The organizers have OK’d sharing the slides with SAS participants.

The slides are at:
https://drive.google.com/file/d/1MeRFFLqornxHLw7kF9AhdunJvjxwfKh5/view?usp=sharing

The recording of a webinar on the same topic at AAS-237 is at

https://www.youtube.com/watch?v=wiCCIyXk6-o. The video and other materials are linked from https://heasarc.gsfc.nasa.gov/navo/summary/python.html.

Enjoy!

Small Telescope Science in the News

With JWST now operational, and Vera Rubin Observatory coming along, we may be heading into another season of worrying about the value of small-telescope and amateur observations. The best evidence in favor of small-telescope observations is their contribution to research. Here are some interesting reports that have appeared in the literature over the past few months, illustrating the science that is facilitated by small-telescope photometry and spectroscopy.

The B & V Light Curves for Recurrent Nova T CrB From 1842–2022, the Unique Pre- and Post-Eruption High-States, the Complex Period Changes, and the Upcoming Eruption in 2025.5±1.3
by Bradley E. Schaefer
Monthly Notices of the Royal Astronomical Society, 14 March 2023

Preprint available at https://arxiv.org/pdf/2303.04933.pdf

If you participated in the SAS-2023 Workshop "*Projects that need your attention*", then you are already aware of the importance of monitoring T CrB in anticipation of its nova eruption sometime in the next few years. We have a wonderful opportunity to measure the full development of a nova eruption in both multi-band photometry and low- and high-resolution spectroscopy – providing a unique record that is likely to spawn new understanding of the phenomenon from the pre-eruption changes, the quite short-lived eruption itself, the (probable) secondary bump, and gradual fade.

Modulation of the Blazhko Cycle in LS Her
by Ronald Wilhelm, et al
The Astronomical Journal, 165:194 (7pp), *2023 May*
https://iopscience.iop.org/article/10.3847/1538-3881/acc4ba/pdf

LS Her is an RR-Lyra-type star. Like most RR-Lyra's its brightness rises and falls with a constant period, but it is one of the subset of these stars that displays the "Blazhko effect": the pulsation lightcurve amplitude changes gradually, modulated (sort of like an AM radio signal) with a period that is much longer than the pulsation period. The cause of the Blazhko effect remains unknown. LS Her is a doubly odd duck: its Blazhko modulation appears to itself be modulated at a yet longer period [sometimes called the "longer modulation period (MP)]".

The authors here examine TESS photometry and ground-based photometry to confirm that the star's pulsation period is 0.23 d, its Blazhko period is 12.7 d, and the "longer modulation period" is 109d. All of these periods appear to have been stable over at least an interval of 15 years.

We may not know what causes the Blazhko effect, but this paper offers some important ideas for observers of RR Lyra stars: (1) The Blazhko period and the longer period can interfere, resulting in spans of time (amounting to several Blazhko periods) in which the Blazhko modulation is 'invisible". That means that you need really long runs (months) of photometry in order to reliably rule out a Blazhko effect when you're studying an RR Lyra-type pulsator. This can particularly affect sparse ground-based observations. (2) One hypothesis is that the Blazhko cycle is due primarily to changes in the surface temperature of the star, rather than changes in its radius. The authors suggest a spectroscopic study to follow up on this idea.

I wonder if such a program of time-series spectroscopy of this star, spanning at least a few months, could be done by some SAS spectroscopists, with partnership of some photometrists? That would probably need spectral resolution of at least R≈2000-4000 and cadence of one spectrum every couple of hours (to resolve the pulsations). That might be feasible, considering that LS Her is Vmag≈ 10.8.

In any case, we probably also need to occasionally make long observing runs on all of these RRc stars, to monitor the presence or absence, magnitude, period, and stability of their Blazhko effect.

Testing Ultra-low amplitude Cepheid Candidates in the Galactic Disk by TESS and Gaia
by Taczay-Nehez, et al
Astronomy & Astrophysics, pre-print available at https://arxiv.org/pdf/2306.07627.pdf

Just because a star has been tagged with a particular variability classification (e.g., in SIMBAD or VSX), doesn't guarantee that the classification is correct. Some classifications are tentative, or of marginal confidence, based on limited data. Sure, the lightcurve might "look like a Cepheid", but if the star's absolute magnitude isn't in the right range, or the spectral classification is discordant, or the surface velocity of the pulsations aren't in the expected range ... et cetera ... then the classification isn't rock solid. Which can be a big deal if you are doing research on a particular family of stars: pulling family members from a database will corrupt your "family statistics" with stars that don't belong.

How big is the "misclassification" problem? We've heard different stories from different people, but it certainly seems to be non-negligible.

The authors of this paper took six stars that had been tentatively classified as ultra-low amplitude Cepheids, and did a careful study of their data from TESS, Corot, and Gaia. For each star, they looked at lightcurves over many apparitions, Fourier composition of the lightcurves, color and absolute magnitude (corrected for interstellar reddening) and O-C diagrams (to search for period changes). The net result is they all seem to be not Cepheids. A couple are most likely spotted stars displaying rotational modulation, and four of them are other rotation-induced variables (i.e. not pulsators, after all).

A great value of this paper is the clear description and roadmap for re-examining variable star classifications. It would probably be a useful and interesting project to take a handful of your favorite pulsating stars, and use both observations and archival data to "check" their reported classifications.

A large topographic feature on the surface of the trans-Neptunian object (307261) 2002 MS4 measured from stellar occultations
by F. L. Rommel et al
Astronomy & Astrophysics, pre-print available at https://arxiv.org/abs/2308.08062

Here is a wonderful paper about a campaign to observe occultations by the trans-Neptunian object 2002 MS4. The result is a detailed profile of the object, including detection of topographic features in its profile that have angular size of a few milli-arc-seconds. Almost all of the occultation lightcurves were obtained with small telescopes (less than 0.5 meter).

Those of you who are involved with IOTA will probably recognize some of the observers credited in the paper.

Discovery and physical characterization as the first response to a potential asteroid collision: The case of 2023 DZ2
Marcel M. Popescu, et al
Astronomy & Astrophysics: pre-print available at https://arxiv.org/pdf/2306.11347v1.pdf

If you see an asteroid that is on a collision course with planet Earth, the first thing that is needed is a rapid-response investigation of the properties of the suspected impactor. That will inform the decisions about what countermeasures (if any) to take. This paper describes an attempt to actually conduct such a rapid-response investigation. The good news is that it worked. The better news is that the target turned out to not be an impactor after all.

From our standpoint, it is also heartening to see that the paper acknowledges the amateur observers who conducted important lightcurve observations to augment the relatively sparse photometry provided by professional observatories.

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