News from the Society for Astronomical Sciences

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In-person attendees at SAS-2024. Photo by Bob Stephens.

Notes from SAS-2024

The SAS-2024 Symposium saw 75 people registered in person and 25 people on-line, for 3 days of small-telescope science. Thank you to the presenters, Sponsors, and organizers for making this a great gathering!

The Proceedings book (as a PDF) is now freely available on the SAS website, at: (https://socastrosci.org/wp-content/uploads/2024/06/2024-Proceedings_Ver1.3c.pdf).

Recordings of the presentations are also freely available:

Workshops (Global Meteor Network, and Tri-color Imaging for Science) are at: https://www.youtube.com/playlist?list=PLmQ5Bvz4ACYJLYfswIeAipapoeGeI6QWy

Technical Presentations are at: https://www.youtube.com/playlist?list=PLmQ5Bvz4ACYLNZQMZ0dZ7JhWsSYHWhrel

Flash! – Dates for SAS-2025

SAS-2025 will be held on **June 19-20-21, 2025**, in Ontario, California at the Doubletree by Hilton (same venue as this year). Mark your calendars, start thinking about the talk you'll give, invite your science-oriented friends and club members to participate. And let us know if you have a suggestion for Workshop topics (e-mail to prograrm@SocAstroSci.org).

Due dates for abstracts, registration links, etc. will be in the next SAS Newsletter.

The Role of Small Telescope Research in 21st Century Astronomy

Most of us are enthusiastic about SAS, AAVSO, BAA, IOTA, et cetera because we want to *participate* in astronomical science – making observations and measurements (for a PI, for a database, or for our own projects), conducting analyses, sharing methods, problems and results with fellow scientists.

Astronomy has changed quite a bit in the past few decades. A 3-day workshop at AAS in 2023 addressed "the role of small telescopes in the new era of large surveys". At SAS-2024 we had a panel discussion that was sort of a follow-on to the AAS Workshop, to dig into how recent changes will affect what we do. There was no recording of the panel discussion. Here is one participant's overview of key points in the discussion:

The threats: New systems ranging from Vera Rubin Telescope (http://rubinobservatory.org/) to the ARGUS array (https://evryscope.astro.unc.edu/) may make our routine photometry of stellar variability obsolescent. They will provide high-quality all-sky photometry with good cadence from homogeneous instruments, processed with well-supported pipelines, in easily-accessible databases.

The counterpoints: Vera Rubin has a bright limit that is roughly the same as our faint limits. Targets that become brighter than ≈15th magnitude will be handed off to smaller telescopes for time-series measurements.

While ARGUS might come to dominate bright-star, rapid-cadence photometry, it isn't here yet and its ongoing funding is uncertain. It may – like many space programs – turn out to be a wonderful asset whose life is less than a decade, after which the small telescope community will once again need to pick up following its targets.

New expectations: Independent of the threat from new survey telescopes, researcher's expectations of data quality will continue to become more stringent. We will need to "up our game", with smaller error bars, photometry transformed to a standard system, improved consistency of comp-star magnitudes, observing cadence tailored to specific research questions, multiple filters/bands to augment the big surveys, and coordinated photometry + spectroscopy.

Communications: "Communication" is a multi-dimensional challenge.

One of the current roles of small telescopes and amateur/student astronomers is follow-up on alert notices. Vera Rubin might generate tens of thousands of transient alerts *per night*. How will we decide which few are appropriate follow-up targets for us?

How do we effectively introduce professionals and amateurs so that they can identify projects, targets, phenomena where Pro-Am collaboration makes sense?

How do we demonstrate that we're providing useful value to science? to education? to public engagement with the quantitative sciences?

One of the things that students and amateurs can do that is rare in the professional community is to "tell the story" about their projects and results – explaining their importance in a way that the lay reader can empathize with. How do we implement this idea?

The future is still bright! We still have important roles in astronomical science, making measurements that are difficult for time-allocated observatories to schedule. These include such topics as:

- Speckle interferometry, lunar occultations, asteroid occultations, near earth asteroids photometry
- gamma ray burst afterglows
- near infrared photometry & spectroscopy
- Deep blue Johnson U band and B band photometry to augment the redder spectral band filters that most of these surveys are using
- Exoplanet transits, especially the long duration transits that require cooperation between multiple observatories and widely separated longitudes
- Bright star photometry and daytime photometry
- Photometric and maybe spectroscopic observation of satellites to provide engineering data to the satellite designers and manufacturers
- Decluttering and deconfliction for TESS and similar space-based surveys that have large pixels
- Point spread function photometry for cluttered fields instead of the traditional aperture photometry that most of us have been using
- Monitoring of the SNEWS stars to prepare for the eventual supernova
- Early time observations of transients such as T Corona Borealis
- Narrow band and wide field surveys of the sky like the MPW survey being done in Hydrogen alpha. Similar surveys need to be done in Si II and O III.
- Data mining software development and sensor characterization will continue to be important for any scientific applications
- Following up on poorly-localized gravitational wave sources to find the optical counterparts

One participant advised us to "stop the hand-wringing about large professional surveys potentially putting the amateur scientist out of business: do what we can do, that needs to be done, and do it well!". A chorus of "Amens" wrapped up the discussion.

Call for help with GNAT observations:

In conjunction with Eric Craine's presentation at the SAS Annual Symposium he asked for additional collaborators in the MG Survey O'Connell Effect ("OE") Close Binary Follow-up program.

The current target for this project is the short period W UMa star MG1-1950061, which may represent an OE star at the opposite end of the asymmetrical light curve spectrum from MG1-1995959, an extreme OE star for which GNAT is making final preparations for publication of results.

If you are interested in collaboratively observing this 14th magnitude OE candidate star please contact Eric Craine (ercraine@wrc-inc.com) and he will include you on the invitation list for the GNAT Zoom meetings.

Call for Observations: Asteroids Patroclus & Menoetius in Sept-Oct 2024

Dr. Richard Binzel requests observations (lightcurves) of a rare series of "mutual events" between the Trojan asteroid Patroclus and its large satellite Menoetius. This binary system is a flyby target for the Lucy mission.

Lightcurves recording transits of the satellite in front of the primary, and occultations of the satellite behind the primary will improve the system orbital parameters, allowing the most precise instrument pointing at the time of the spacecraft flyby.

A typical complete event lasts about three hours and can have a depth up to a few tenths of a magnitude. While complete lightcurves of the full events are sought (with ample coverage to establish the out of "eclipse" baseline levels), the timings of the event contacts are the most valuable measurements as these most critically determine the physical parameters of the satellite orbit, always subject to gravitational perturbations.

Observers from many different longitudes are needed to be able to catch the predicted events. The asteroid will be about V = 14.2, and it will be at -14 degrees declination, so more southerly locations are favored to get the longest runs. This encourages collaborations among observers, including those using remote telescopes. [A show of hands at SAS-2024 indicated that several of you can be part of such a coordinated effort].

Brian Warner, at the Center for Solar System Studies in California, is recruiting observers for such a collaboration. The only requirements are high-quality observations (0.01-0.02 mag precision) using no/clear/luminance/Sloan or Pan-STAARS r' filter, and making the processed images (+ flat/bias/dark) available via a cloud sharing site. Warner will do all the measurements and analysis. Anyone submitting images will be included as a co-author on the resulting paper.

Contact Brian Warner (brian@MinPlanObs.org) for additional information, including deadlines for submitting images and returning comments during pre-submission review.

More information is available in the latest issue of the Minor Planet Bulletin (51-3), which is available at https://mpbulletin.org/issues/MPB_51-3.pdf. The call for observations in support of the Lucy Mission is on page 212.

VEGA 2024 Lectures are now available

A very successful International Spectroscopy Symposium for Professional and Amateur Astronomers was held at the Vega Observatory in Haunsberg near Salzburg, Austria (May 30 - June 1, 2024).

Lectures by a large number of professional and amateur astronomers gave a deep insight into current research in astrophysics and spectroscopy, as well as ongoing and future Pro-Am collaborations.

The conference language was in English. There were participants from 11 different countries.

Video recordings of many of the talks are now available at https://www.astrophoto.at/VEGA/vega-2024.html.

Exoplanet Transit data sets needed for Student Projects:

During the evening discussion on the role of small telescopes in 21st century astronomy, one of the topics that was discussed was support of student research. A show of hands proved that many of you are interested in helping with student projects – but we didn't collect your names!

Here is a specific request for help: Kalee Tock's astronomy classes are growing, and she is in need of exoplanet transit data sets for her fall-semester students to reduce and analyze. She wants each student to reduce their own transit because they are motivated by seeing their AAVSO Observer code on the NASA website!

Each transit requires >5 hours of telescope time for a time-series photometry run, under good conditions, with a CCD/CMOS photometry setup that can reliably measure a 0.5% drop in light during the transit. Accurate timing is essential, since part of the science case is monitoring for transit-timing variations.

If you can help, please contact Kalee at kaleeg@stanford.edu.

Starliner approaching ISIS (May, 2024): Image taken by Eric Toops from Magdalena, NM, with a 24" surplus telescope; he has completely reworked the mount and drive system.

Greetings from a group of SAS observers who use products from Software Bisque! Photo by Bob Stephens.

SAS-2024 participants unraveling the secrets of the universe …

SAS-2024 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.

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Small Telescope Science in the News

The best evidence for the ongoing value of small telescopes and amateur research efforts is the steady flow of published science results that used small-telescope data, or that are within the capabilities of our observers. Here are some noteworthy examples.

Enhancing Exoplanet Ephemerides by Leveraging Professional and Citizen Science Data: A Test Case with WASP-77A b

By Federico R. Noguer, et al

http://arXiv:2405.19615v2

Are ground-based small-telescope transit lightcurves valuable for exoplanet research? The authors deal with that question, for the challenge of knowing accurate forecasts for transits and eclipses (to, for example, schedule sophisticated observations of these events). Space-based photometry (such as TESS) is vastly more accurate than ground-based transit lightcurves, for example.

The authors compare the accuracy of predictions based on (a) TESS lightcurves and radial-velocity observations, versus (b) adding in small-telescope – mostly amateur – transit lightcurves. It turns out that including the small-telescope transit lightcurves significantly improves the predictions for future events. The reason seems to be that the small-telescope data brings a longer time baseline, which more than makes up for their higher photometric noise.

So, do continue observing and reporting exoplanet transits … and also striving to improve your photometric accuracy!

Lessons from the high-resolution spectroscopy of AW UMa and ε CrA: Is the Lucy model valid?

By Slavek M. Rucinski

http://arxiv.org/abs/2406.00155v2

The W UMa type of contact binary systems are popular targets for photometric and spectroscopic projects: the short orbital period (usually a fraction of a day) enables observers to gather complete lightcurves in a few nights, and the short period also leads to relatively high orbital velocity that can be detected by amateur-scale spectroscopy. Eclipse timings contribute to O-C analyses, which sometimes show significant changes in orbit period.

The "Lucy model" (see Lucy, L. B., Ap J Vol. 151, March 1968) of these systems based on Roche lobe geometry, and implemented in easily-available programs (Wilson-Devinney, etc.) enables the investigator to transform lightcurves into 3-D models of the binary system.

However, there are unresolved problems. The Roche Lobe model doesn't explicitly account for the energy that must flow from the primary to the secondary in order to achieve nearly-equal temperature for the two stars. Estimates of the mass ratio based on photometry tend to disagree systematically with mass ratios determined by spectroscopy (in the sense that $q_{phot} < q_{spec}$). The work in this paper by Rucinski shows high resolution velocity curves for both components of the two systems observed (R≈ 35,000). These display pretty dramatic features that are unexplained by the Lucy model – particularly in the secondary star. The suspicion is that they arise from mass flow on the surface of the Roche lobe, in which the surface of the primary sort of wraps around the secondary.

If you are a fan of W UMas, this is definitely worth reading (it may be hard going in parts, but the key points and conclusions are compelling).

The multiple nature of CC Com: one of the ultra-short orbital period late-type contact binary systems

By Dolunay Koçak

http://arXiv:2407.12085v1

Speaking of contact binaries – here is a nice analysis of CC Com based on photometry from 0.6 and 1.0 meter 'scopes, plus TESS data; and previously-published radial velocity curves. One of the highlights of the analysis is the importance of having a long history of eclipse timings. The 50-year long O-C curve led the authors to conclude that the system definitely contains a 3rd star in an ≈8-year orbit, plus probably a 4th star in a ≈98-year orbit.

The Ambiguous Rotation Period of 805 Hormuthia is Solved By A Global Collaboration of Observers

By Frederick Pilcher, Vladimir Benishek, Julian Oey, Lorenzo Franco, Nello Ruocco, Alessandro Marchini

Minor Planet Bulletin 51 (2024)

https://mpbulletin.org/issues/MPB_51-3.pdf

Asteroids whose rotation period is close to an integer multiple of 24 hours are a real challenge. Any single observer will see the same portion of the lightcurve over and over each night. The only practical approach to determining the rotation period is to enlist a globe-girdling partnership, to keep the object under 24-hour surveillance. The authors here did exactly that, with observers in USA, Serbia, Italy, and Australia working together to find a rotation period of 23.795 ± 0.004 hours. Well done!

Not So Fast: A New Catalog of Meteor Persistent Trains

By L. E. Cordonnier, et al

Pre-print at https://arxiv.org/abs/2407.18344

The "et al" in the author list includes Dr. Denis Vida, who presented the workshop on the Global Meteor Network at SAS-2024.

If you've watched meteors, particularly meteor showers, you have probably seen the subject of this research: the persistent glowing trail that is left by some meteors after they flash and end. There is a taxonomy to this phenomenon: some are "smoke trails" that are illuminated by scattered sunlight; others are self-emitting chemiluminescent phenomena. It is the latter that are studied in this paper (which includes a clear explanation of their formation).

The researchers used a purpose-built camera (the Widefield Persistent Train camera, WiPT2) to record trains, and correlated the individual meteor properties with the database of the Global Meteor Network.

The results show a few surprises. They find a large population of slow, dim meteors that leave persistent trains. They do *not* find a magnitude cutoff, nor do they see evidence that fast meteor showers preferentially create trains. Since part of the train-production process is related to the atmosphere, it isn't surprising that altitude of formation is important; but the meteor's exo-atmospheric orbit (i.e. its source population) is also an important determinant of the probability of creating a persistent train.

Confirmation and Characterization of the Eccentric, Warm Jupiter TIC 393818343 b with a Network of Citizen Scientists

By Lauren A. Sgro, et al

The Astronomical Journal, 168:26 (10pp), 2024 July (https://iopscience.iop.org/article/10.3847/1538-3881/ad5096/pdf)

Here is a good example of the power of small-telescope amateur observers under the guidance of a professional researcher. The adventure began with TESS detecting a single probable-exoplanet-transit signal while observing this star during Sector 55. With only one event, the orbit period was unknown. A campaign of radial-velocity measurements (template spectrum from the 10-m Keck telescope, and 56 spectra from Lick Observatory's 2.4 m telescope) indicated a probable period of 16.2511 ± 0.0046 days and transit duration of 4.2 hr. From this, predicted transit windows were created for a follow-up photometric campaign.

The campaign made use of the UniStellar network of smart telescopes. Two observers detected partial transit signals near the predicted times. Subsequent transit windows resulted in several additional transit signals from these small ground-based instruments. Several non-UniStellar observers also contributed observations.

The net result is confirmation of a warm Jupiter exoplanet in a 16-day, very eccentric orbit (e≈ 0.6). Perhaps more importantly, this project exemplifies the wonderful ability of commercial small "smart" telescopes in the hands of amateur/student astronomers to contribute to astronomical research.

Photometric and Spectroscopic study of Ten Low Mass Ratio Contact Binary Systems: Orbital Stability, O'Connell Effect and Infra-red Calcium Line Filling

By Surjit S. Wadhwa, et al

Pre-print at https://arxiv.org/pdf/2407.08365

Low mass ratio contact binary systems are popular targets of observational research, because of the hope of finding systems whose orbit is changing, possibly leading to a merger event that will end in a luminous red nova. Here is a nicely-done example of such a study.

The authors report photometric lightcurves of ten systems: time-series photometry observations were made with 0.5m to 0.84m instruments. Two systems showed the O'Connell effect (asymmetry in the brightness of the primary and secondary peaks). Because this is the first time-series study of these systems, assessment of possible orbital changes will await replication of these observations after a few years.

Lightcurves were modelled using the Wilson-Devinney code, to determine the system parameters. The authors offer insightful (and critical) warnings about the use of starspots in the model, as a way of improving the fit and – especially – of modelling the O'Connell effect. Their bottom line is: do not include starspots in the model unless there is good independent evidence of such spots (e.g. Doppler spectroscopy). There are always multiple spot-models that will fit a given observational lightcurve equally well, but each spot-model includes its own unique set of other model parameters. There is at present no good way to identify the "right" spot-model.

They also note that low-mass-ratio contact binaries are expected to display chromospheric effects of magnetic activity, and show the results of spectroscopic observation of the infrared Ca II triplet lines.

They used spectra from LAMOST, but these lines are accessible to our observers with Shelyak UVEX spectrographs. I wonder if any of our spectroscopists can undertake a study of similar systems, to search for core emission or in-filling in the Ca II lines?

Check out the details in the pre-print.

New O-Cs for the Classical Cepheids RY Cas and V Lac over a Century (1873-2022)

By Guy Boistel

Pre-print at https://arxiv.org/abs/2407.03730

We know that Cepheids are critical as standard candles for cosmology, thanks to the Leavitt (period-luminosity) Law. It turns out that making well-done lightcurves of nearby, well-known Cepheids is useful because of a poorly-understood phenomenon of period variation in these pulsating stars.

The author collects a century-worth of lightcurves for two such Cepheids and shows the resulting O-C curves (observed minus calculated time of maximum brightness). The data includes healthy contributions from the AAVSO and BAV (German variable star organization) databases. It turns out that both stars show parabolic O-C curves, indicating changing periods. RY Cas has an increasing (lengthening) period, while V Lac shows a decreasing period.

Both of these are relatively long period pulsators: P= 12.1 d for RY Cas, and P= 5 d for V Lac, so making good lightcurves of them is a project that will fill a few weeks. They are both bright enough (V≈ 9) to be easy photometry targets.

Although the author doesn't mention this, it seems likely that long-term monitoring of other Cepheids (and maybe RR Lyrae's also) would be useful.

Yellow Hypergiant V509 Cas – Stable in the 'Yellow Void'

By A. Kasikov, et al

Pre-print at https://arxiv.org/abs/2406.08276

This looks like a target that deserves regular monitoring by our SAS photometrists and spectroscopists over the coming years.

The interest in this star comes from its location on the H-R diagram. Imagine a ≈20-40 M_{Sun} star, evolving off of the main sequence, making its complicated path up and right into its red supergiant phase, and then migrating leftward to where it now sits as a yellow hypergiant. In that part of the H-R diagram there appears to be an instability strip: stars move leftward to approach this instability strip, display brief large-scale mass ejections at the boundary that bounce them back a bit to the right, and return … until eventually (presumably) they migrate across the instability strip to become something like a B[e] or LBV type star.

The authors of this paper use photometry from the AAVSO, as well as TESS and GAIA; and spectroscopy from 1.5m (R≈ 10,000) and 2.5m (R≈ 45,000 - 60,000) telescopes to describe the star's brightness, color, and spectral changes as it has approached the "yellow void" instability strip, including its three eruptions in the 1970-80s. They conclude that V509 Cas is now near the left-hand (hot) side of the yellow void

Some advice to photometry observers is implied in this paper. Because of the small amplitude of brightness variation, and the long observing interval of interest, the authors cherry-picked the AAVSO data that they worked with. They used only data from observers with the longest time-series record, and who transformed their data to the Johnson-Cousins system. Those three observers (Vollman, VOL; Sblewski, SMAI, and Van Bellegoij, BE) are individually recognized in the paper. AAVSO continues to recommend transforming your data, and "adopting" stars for an appropriate length of time, so that your data is both comparable with other observers and isn't seen as isolated data points. This paper should encourage observers to pay attention to AAVSO's advice!

There is almost no spectroscopy of V509 Cas in the AAVSO, ARAS, or BAA databases; but considering the star's brightness, it should be within range of quite a few amateur spectroscopists. Ongoing observations may turn out to be a useful record of the star's future evolution through a short-lived interval of its life. Read the paper and consider your ability to make useful spectroscopic observations. It is nicely placed for observing right now!

Spectroscopic and Photometric Study of the S-type Mira V667 Cassiopeiae and the Carbon Star OR Cephei

By David Boyd

JAAVSO Volume 52, 2024

https://apps.aavso.org/media/jaavso/3928_wyEQdpD.pdf

Here is another in a series of exemplary reports describing the observations and insights that small-telescope spectroscopy + photometry can yield in the study of variable stars. The targets are two unusual Mira variables, observed with a roughly monthly cadence over their complete pulsation cycles. His description of the analysis approach combining photometry and spectra will be of particular interest to our spectroscopists.

The Long-term Photometric Behavior of 39 Semiregular Variable Stars

By Robert R. Cadmus, Jr.

The Astronomical Journal, 167:200, 2024 May
https://iopscience.iop.org/article/10.3847/1538-3881/ad303a/pdf)

Here is a fine project of long-term photometric observation of a set of semi-regular variable stars, used for analysis of the frequency content of the pulsations.

The results highlight the uniqueness of each star, despite them all falling into the SRB family. They have unique patterns of variability – changing (or rapidly switching) characteristic frequencies – so that any statement about "typical period" must be burdened with several caveats.

One apparent systematic effect related to the "complexity" of the lightcurves, defined as "the extent to which there are abrupt changes in the frequency components". It seems that Carbon stars tend to show high complexity. The author notes that he has begun a program of spectroscopy to investigate this.

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SAS Contact Information

9302 Pittsburgh Avenue, Suite 200, Rancho Cucamonga, CA 91730

On the web:
www.SocAstroSci.org

Program Committee:
program@SocAstroSci.org

Membership:
Robert Stephens:
rstephens@socastrosci.com

Send Newsletter Submissions to:
Bob@RKBuchheim.org