News from the Society for Astronomical Sciences

Vol. 20 No.1 (January 2022)

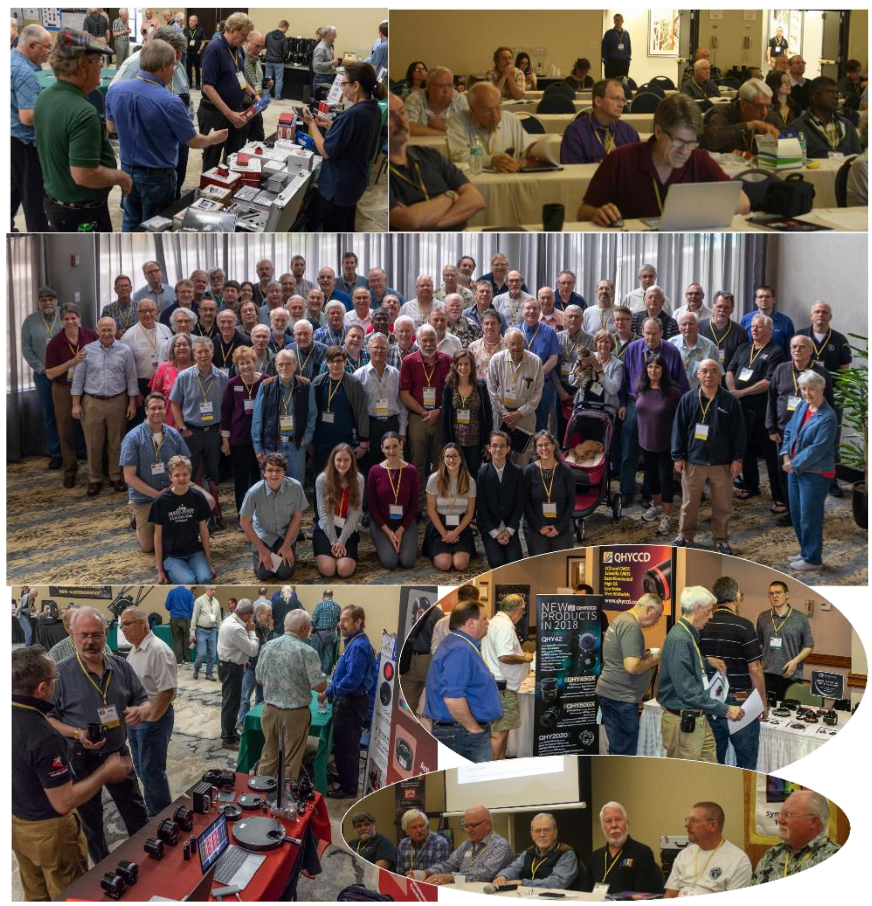
Mark Your Calendars!

SAS-2022 Symposium = June 2-3-4

Remember what it was like to meet people in-person at a conference, chat in the hallway, and discuss projects and life in the bar?

Yes! We will be having an in-person SAS-2022 Symposium, on June 2-3-4 in Ontario, California. We look forward to seeing old friends and meeting new enthusiasts of small-telescope astronomical research in *real-life*, after two years of "online-only" sessions. For those who cannot participate in person, we will also have an on-line option, that will include as much interactivity as practical.

Registration will open in early February. Registration details are available from our website (SocAstroSci.org) on the Symposium page (scroll down to the registration links.



Call for Abstracts for SAS-2022

Papers for presentation at the SAS-2022 Symposium are solicited on all aspects of astronomical science that are (or can be) pursued by observations with small telescopes (less than 1-meter aperture). We encourage presentation of work which follows the Scientific Method, including clear hypotheses, reproducible experiments, and results. Examples of work presented at previous Symposia include:

- Observations, data, and analysis of variable stars, eclipsing binary stars, double stars and stellar systems
- Observations, data, and analysis of asteroids and other solar system objects; and exoplanets
- Progress, status, and planning for upcoming observing campaigns such as the TESS follow-up initiative.
- Instrumentation/hardware and techniques (including software) for photometry, astrometry, spectroscopy, polarimetry, and fast-cadence observations (e.g. occultations)
- Investigations of atmospheric effects, light-propagation and scattering, light pollution monitoring as they affect astronomical observations.

We welcome three types of papers: "Paper with Presentation" includes both a written paper for the Proceedings and a 20-minute presentation; "Paper without Presentation" is a written paper for the Proceedings; and "Posters". We will include time in the agenda for 5-minute "sparkler talks" for most Posters.

All abstract submissions will be reviewed by a panel of experienced amateurs and professionals who will provide helpful feedback to authors and decide which submissions to schedule as part of the symposium as either presentations or posters.

Submit your abstracts via e-mail to: Program@SocAstroSci.org.

Abstracts are due by March 20, 2022. You will be informed of acceptance by March 27.

Final papers for the Proceedings will be due by April 20, 2020.

Two other summer events of interest

Bracketing SAS-2022 are two events that you might be interested in: one in Salzberg, Austria, and the other in Pasadena, California.

Vega: European Spectroscopy Symposium

Ernst Pollmann and Manfred Schwarz have announced the conference VEGA in Salzburg (Austria) for Amateurs in collaboration with professional astronomers.

Professional astronomers and amateurs will report in talks and presentations of the recent state of modern research, observations and campaign results, methods of reduction, evaluation and interpretation of different object spectra (among others B stars, Binary stars and related objects).

Further information is available at the VEGA website:

www.astrophoto.at/VEGA/program-1.html

240th AAS Meeting

The 240th meeting of the AAS (joint with the Laboratory Astrophysics Division) will be held at the Pasadena Convention Center in Pasadena, California on June 12-16.

Meeting details are at

https://aas.org/meetings/aas240

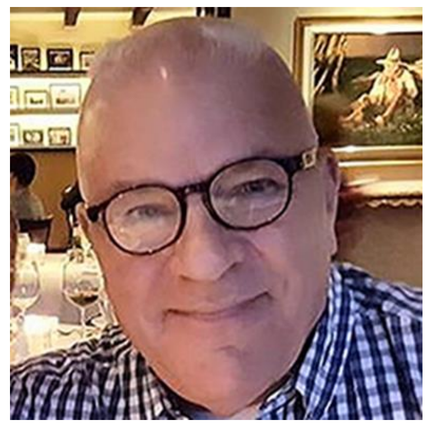
Russ Genet and a group of professional and amateur astronomers may be hosting a 2-day Special Session on the feasibility and science case for small-aperture UV and IR CubeSat telescopes in space. Stay tuned ...

Congratulations to Bob Denny

Long-time friend and Sponsor of the SAS Symposium, Bob Denny has been awarded the 2022 Hubble Award by the Advanced Imaging Conference! The Hubble Award is presented to those individuals who have demonstrated significant and sustained contributions to the astrophotography community over a period of years.

Bob Denny joins an esteemed list of significant contributors who have advanced and contributed to astrophotography over many years.

Bob is the originator and a primary evangelist for the ASCOM Initiative, which maintains common universal standards for communication between astronomy programs and the wide variety of instruments used by astronomers, plus tools for developers to use these standards. He has also given software support and volunteer time for educational outreach in both science and art astronomy with the AAVSO, Great Basin Observatory, Montana Learning Center and many others.



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
Developers of ACP Observatory Control Software
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Enriching your astronomy experience since 1983.
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Starlight Xpress
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Shelyak Instruments
Astronomical spectroscopy for research, industry, education and leisure: Stars won't look the same.
https://www.shelyak.com/?lang=en

Reminiscences from a Member ...:

How I got Started in Small Telescope Research

by Robert Stephens

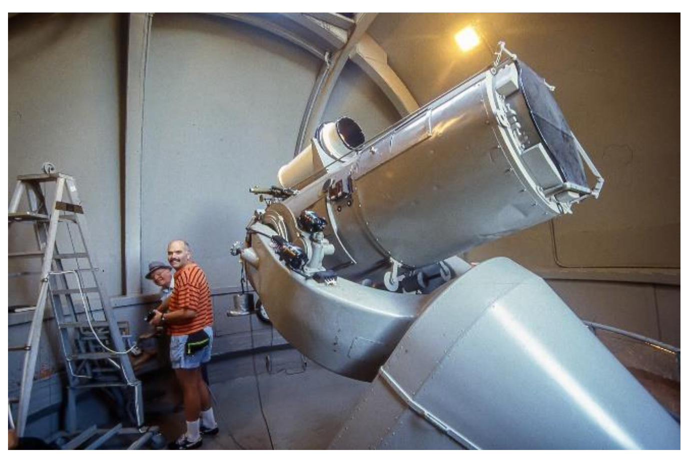
My first exposure to astronomical research was with my local astronomy club, the Riverside Astronomical Society, which used to do various Pro-Am research projects such as grazing occultations. Later, a RAS club member got me doing visual observations of variable stars. But my first real exposure to working directly with professional astronomers occurred by accident in September 1994. Steve Edberg, then Executive Director of the RTMC star party and an astronomer at JPL, had arranged a private tour of Palomar Observatory. Jean Mueller, also on the Board of the RTMC, was running the POSS II survey on the 48-inch Schmidt and conducted the tour.

At the time, Steve was working with Gene and Carolyn Shoemaker on their Near-Earth Asteroid survey using the 18-inch Schmidt telescope at Palomar. He and David Levy were working as the 18-inch Schmidt telescope operators since Gene Shoemaker was in Australia. After our tour of the 200-inch dome, Steve asked if I would like to come to the 18-inch dome and talk to David and Carolyn. Sure!

When we arrived, David was working on his latest book, and Carolyn planning the observations for the night. Carolyn showed me the original discovery plates for Comet Shoemaker-Levy/9, which crashed into Jupiter three months earlier. She had them in her purse, and we mounted them on the blink comparator. I don't think I would have seen the comet if she didn't tell me where it was. That chat took much the afternoon and Carolyn invited me to dinner with Steve and David. She baked lasagna for her observing crew.

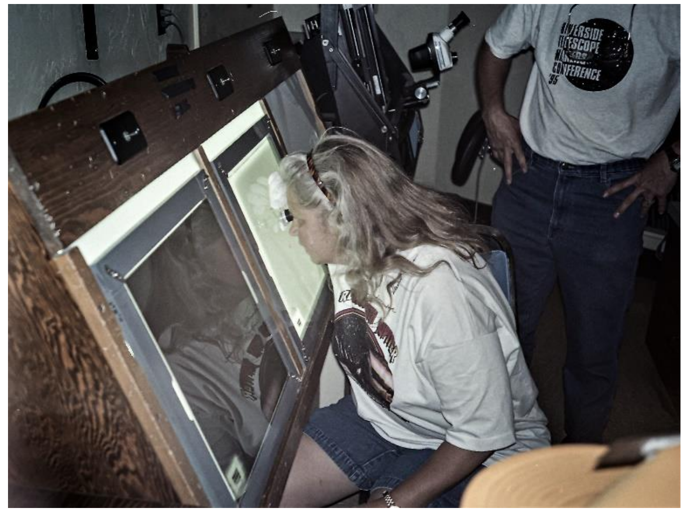
By the time we got back in the evening, I found that my car was behind a locked gate in the parking lot. Carolyn quipped that it looked like I was there for the night. Too bad! I ended up helping guide the 18-inch Schmidt by eye. Even though SBIG's ST4 was starting to appear in professional observatories, and was operating on the 48-inch Schmidt, the 18-inch Schmidt had no such luxuries. Early in the morning, David and I ran some plates over to the 48-inch Schmidt dome as the photography lab was in the basement. There I got to watch David and Jean argue in the basement of the 48-inch Schmidt over who got to use the newer chemicals to develop their plates. Jean won; her program paid for the chemicals.

Despite this wonderful experience, I didn't immediately jump into asteroid observations. A few years later I read an article by Dennis di Cicco about discovering asteroids. Soon after, in April 1999, I saw an advertisement for a Pro-Am workshop at Lowell Observatory on asteroid observations. Visions of discoveries danced in my head, and I made it my mission to attend. Carolyn, David and Dennis were there along with a hundred other amateur and professional astronomers. The stories from that workshop are legendary, but that is a tale for another day.



Steve Edberg with the 18-inch Schmidt used for Near-Earth asteroid hunting at Palomar Observatory.

Carolyn Shoemaker and David Levy in the control room of the 18-inch Schmidt at Palomar Observatory in September 1994.



Jean Muller searching for comets and asteroids on the POSS II plates from the 48-inch Schmidt telescopes

Tech Talk ...

A photon's treacherous path from target to publication

Wayne Green, 24 Jan 2022

I'll offer up a 'fun' collimation tale here... and a few great video links below.

The OTA's aperture forms a converging beam or rays, carrying phase information about the aperture. There is no 'image' per se. A star is not an 'image' nor a 'point' at the focal plane. The star may be poorly described as an Airy disc (1.22 λ / D) where the 1.22 is a truncated value of the first Bessel coefficient. The star may be better described by Maxwell's equations, better yet described by a vast bit of quantum theory bother.

Here are the basic 'points of interest':

- the target,
- the intervening ISM (extinction),
- the atmosphere (PA, seeing and all sorts of Bad Things™),
- the OTA and its PSF (a lot sub-galleries in this problem), and
- the so-called focal plane (a train wreck of photon-phase bother).

The above points result in a blurry star at the focal plane. Let’s stick with the poor Airy disc idea. The ‘star’ becomes the input 'point' source for the spectrograph.

Then Magic. The telescope ceases to matter and the spectrograph pops into being. But! That little zone within the thickness of the slit is where the simple of idea of the f/ratio of the scope as a converging beam for the collimating lens dies and is replaced by complex optics. There is no 'f/ratio beam' leaving that slit area.

A simple experiment to perform is to shine a laser through your slit and to look at the pattern that emerges! Thomas Young did it and it is frightening!

Young's single slit experiment is an easy analog to the Airy disc of the OTA model. The converging beam from the OTA may be modeled as a 'pencil of rays'. Each ray forms a Fraunhofer diffraction pattern coming out of that slit. Each input pencil is polychromatic, the light from the slit is spread as a function of wavelength, so overlapping Fraunhofer fields form. The slit is a bad grating in disguise. We need to stop using 'lens' language inside the spectrograph (f/ratio) and start using 'grating' language 'm x λ x D / a' and ‘dλ / dx’.

So, the expensive telescope's image is wrecked in terrible ways by that slit! (Hint: Use a cheap fast scope for spectroscopy and spend the big bucks on the mount). You can play with the probability of a photon leaving the slit in terms of its exit-angle at:

http://hyperphysics.phy-astr.gsu.edu/hbase/phyopt/sinint.html

Back to the story: The collimating lens is designed to turn the now diverging polychromatic beam leaving the slit area into a 'collimated' (parallel/infinity-like) beam. Collimated -- with the goal that each polychromatic ray hits the grating with the same angle of incidence. For each ray the collimated/diffracted ray (as a function of λ) hitting/leaving the left side of the grating has to be the parallel with another ray hitting/leaving from the right side of the grating. Any difference is 'noise'. Each ray's goal is to land on the same pixel. Note: All the blue rays are 'parallel' and 'collimated', hence focused at 'infinity' like the original star. The camera lens sorts all that out (you may loop the above telescope OTA story here).

Young's model of the slit means that the angle of exit from the slit can take many angles ala Fraunhofer! The input angle to the slit includes all the angles over the range defined by the f/ratio of the OTA. Along the optical axis the f/ratio is infinity! Fraunhofer diffraction kicks in within the slit so the 'f/ratio' notion dies in the slit. If you merge the principal lobes of the Fraunhofer rays together then you get a now almost useless f/ratio cone.

With the FlexSpec, we place a small baffle behind the slit to mask/block the higher orders of the Fraunhofer pattern. With tiny toy spectrographs, where collimator focal lengths are short, this is critical.

If you're not looking for a new hobby at this point...

The collimating lens, if out of focus by a little bit, will form a converging/diverging beam of its own. This means the incidence angle at the left side of the grating will differ from that at the right -- and viola! Noise.

We have found both thermal expansion and flexure play merry hob with collimating lens focus. That problem, this early in the optical path, only gets worse towards the sensor.

In short, it is more important to focus the collimating lens than the 'camera' lens. The camera lens is another frightening campfire tale on its own, best left for another time.

Now that you'll not sleep well for a few days, might as well watch a few videos.

Microscopy: Resolution in Microscopy, etc. (Dr. Jeff Lichtman, Harvard):

https://www.youtube.com/watch?v=sTa-Hn_eisw

https://www.youtube.com/watch?v=n2asdncMYMo

and to the point:

https://www.youtube.com/watch?v=JQy94K94nL0

This is the same problem as with spectrographs and very well covered by Dr. Lichtman.

PS: Speaking of deadly slits -- what about a slit on a glass substrate? (Think OVIO).

PPS: The diffracted beam leaving the grating has each color collimated -- therefore at infinity. Taken together as all colors, it makes up a 'diverging' beam! That makes the collection of rays (beam) behave, less rather than more, like a 'near field' object. 'Near field' as in flower in the yard vs mountain on the horizon or a star at infinity. So that 'camera' lens may need some counter-intuitive focusing and most likely some tilt to get the curved diffraction trace from red to blue into the best focus w.r.t. the flat sensor.

Small Telescope Science in the News

Here are some interesting notes that have appeared in the literature over the past few months, showing the science that is facilitated by small-telescope photometry and spectroscopy.

Asteroid Photometry with PIRATE: Optimizations and Techniques for Small Aperture Telescopes

by Samuel L. Jackson et al, (accepted by PASP)

pre-print available at https://arxiv.org/pdf/2107.04390.pdf

Considering the large number of high-quality rotational lightcurves of asteroids that are determined by amateur-scale telescopes, it is a bit sad that so few asteroid observers are compiling phase curves. The reasons for this shortfall are understandable (particularly if you've ever done a phase-curve project): it dramatically increases the observing time required, and the photometric analysis is much more complicated. Analysis must unravel the effects of rotational modulation and longer-term brightness changes caused by changing Earth- and Sun-distance, in order to yield the effect of changing phase angle. It can also benefit from two-color photometry. The prize is worth aiming for, however. Phase curves provide information about the asteroid that isn't readily apparent from its V-band (or C-band) rotational lightcurve.

This paper is particularly focused on near-Earth asteroids, which are tricky – but important – targets. In addition to the normal asteroid light curve observing challenge, the NEA's add rapid apparent motion (a pointing-and-tracking challenge) and rapidly-changing phase angle. The NEA's offer the opportunity to characterize the object over a much broader range of phase angles than we can see from a main-belt asteroid.

This paper gives an educational overview of the phase-curve challenge, and approaches to meeting it using small telescope photometry. In particular, there is useful discussion of the challenge of photometry using images where both the stars and the target re trailed (on account of the rapid sky-motion of the target); an interesting section about the use of transforms to put your asteroid photometry onto the standard system; and examples of NEA phase curves from the author's research.

Our asteroid observers will want to read this paper!

Discovery of Super-Slow Rotating Asteroids with ATLAS and ZTF photometry

by N. Erasmus, et al: (submitted to MNRAS)

pre-print available at https://arxiv.org/pdf/2106.16066.pdf

Very few asteroids are known with long (hundreds of hours) rotation periods. This is almost certainly influenced by an observational bias – after you've spent a few long nights gathering time-series photometry on an asteroid, and all you see is a flat line, it is easy to lose interest and move on to something more exciting. As a result, the long-period objects never get properly treated; and indeed, they are likely to go unreported at all.

The nightly surveys are better positioned to recognize long periods, since they are likely to observe the asteroid occasionally over weeks or months. However, (as Brian Warner and Alan Harris have noted), the lack of rapid-cadence observations leads to a serious risk of being misled by aliasing. A rotation period of a few dozen hours, sampled at a rate of one or two data points per night, can lead to plausible-looking periods that are completely wrong.

The authors here report on asteroids with very long periods, based on combining years-worth of photometry from ZTF and ATLAS surveys. They find 39 asteroids with strong evidence of very long periods (rotation period > 1000 hours).

The insightful discussion of their procedures for rejecting erroneous long periods (due to aliasing) is worth studying. Partly they rely on a massive comparison of simulated lightcurves with the actual data; and partly they do some "checks" by conducting long observing runs on selected targets. The results lend confidence in the long periods that are inferred from the ZTF+ATLAS periodograms.

You will also see reference to some of our SAS friends in here: Tom Polakis and Bob Stephens figure prominently, as do Brian Warner and Alan Harris.

If you run across a "flat line" lightcurve that continues for a few nights, should you drop the target? Maybe not: There are probably plenty more slow-rotators awaiting discovery, and the modern star catalogs make it much easier to get high-quality photometry over long observing intervals. And since "replication" is an important feature in any science, it is probably worth the time and effort to confirm some of these purported long-periods, just to be sure.

The First Light Curve Solutions and Period Study of BQ Ari

by A. Poro, et al

pre-print available at https://arxiv.org/pdf/2006.00528.

Here a group of Turkish astronomers report a study of the W-UMa system BQ Ari, done with a half-meter telescope and B-V-R CCD photometry. It is a good example of what can be accomplished with a small telescope and a few nights of dedicated time-series photometry; plus a diligent consideration of previous observations of the star. It should also encourage ongoing programs of small-telescope observations of these systems, to add data points to the record of time-of-minimum measurements.

They show a very nice three-color photometry result, which they then used to model the system (using Wilson-DeVinney code). The system displays the O'Connell effect (the two orientations of maximum light have significantly different brightness), which they model as due to a star-spot on the brighter component of the eclipsing pair.

The variation of orbital period is examined by using the author's own times of minimum light, combined with previously-reported Tmin values from the literature. The resulting O-C curve shows a strong hint of a 6.28 year cycle, with amplitude of 3.37 minutes. That might be due to a third body ("light-time effect") or a magnetic interaction between the two stars.

Perhaps more importantly, their O-C curve serves as a reminder that as we continue to monitor this – and other similar systems – it is important to tailor our observation plans to achieve excellent timing accuracy of Tmin. Some of the published times of minimum light have error bars that are larger than the effect being reported here. Getting reliable and repeatable time-of-minimum measurement with uncertainty of one minute or better (1 minute = 7×10^{-4} day) on a system like this requires observing runs lasting at least a couple of hours (to capture the steepest parts of the lightcurve), an imaging sequence that balances the desire for good photometric accuracy (higher SNR is better) with dense coverage of the lightcurve (more data points is better); and attention to details such as the stability of the time-sync of the observatory computer, and correctly distinguishing between primary vs. secondary minima.

Photometry and model of near-Earth asteroid 2021 DW1 from one apparition

by T. Kwiatkowski, et al (*Astronomy & Astrophysics*)

pre-print available at https://arxiv.org/pdf/2109.11689.pdf

Lead author Tomasz Kwiatkowski sent a gracious acknowledgement to the MPML about this project:

In March last year I wrote to MPML about the observing campaign for 2021 DW1. Thanks to efforts of many observers we collected enough lightcurves to derive its rotation period, spin axis, 3D shape, colour indices, taxonomy, phase curve and diameter. We showed its spin axis is not perpendicular to the orbital plane as some YORP theories predict. Results were published in A&A.

This is a wonderful example of how small telescopes and diligent photometrists can support professional research in planetary science. The paper is also a good tutorial on the wealth of information that can be gleaned from a set of lightcurves taken at a broad range of phase angles. Their Figure 1, in particular, is a nice display of how dramatically the lightcurve shape changes as a function of phase angle.

Study of Pluto's Atmosphere Based on 2020 Stellar Occultation Light Curve Results

by Atila Poro, et al

(pre-print at https://arxiv.org/abs/2011.04737)

Here is a tale of devotion to observing Pluto's occultation of a 13th magnitude star in June, 2020. The key science result is an updated assessment of Pluto's atmospheric pressure; but to me the best part is the dedication of these astronomers to getting the data, despite really challenging circumstances.

The observers are in Iran. They used a private observatory near the city of Karaj. At the time of the event, Pluto (and the occulted star) would be just skimming the south-eastern horizon. So, they relocated the observatory's equipment – a 24-inch and a 14-inch SCT, both atop a Paramount – to a location that provided an unobstructed view of the horizon. Atmospheric extinction and scintillation would be of major concern. They dealt with this by taking simultaneous images through both 'scopes (each of which had an identical SBIG CCD), so that each pair of images could be combined into a merged image. The time-series of merged images was then processed to show the lightcurve dip during the occultation, and fit to an atmospheric model.

You can watch Mr. Poro's description of astronomy in Iran, and of this project, in his presentation at the IOTA annual meeting, at https://www.youtube.com/watch?v=pt8rjbhyuKE&list=PLY2hxQmBE-LEB9AI-5NESPkPU6Lxkqf_G&index=11

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The Society for Astronomical Sciences welcomes everyone interested in small telescope astronomical research. Our mission is to foster amateurs' participation in research projects as an aspect of their astronomical hobby, facilitate professional-amateur collaborations, and disseminate new results and methods. The Membership fee is $25.00 per year.

As a member, you receive:
• Discounted registration fee for the annual Symposium.
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Membership application is available at the Membership page of the SAS web site: http://www.SocAstroSci.org.

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