News from the Society for Astronomical Sciences

October, 2010

"Measuring the Universe" Workshop held at PATS

Thanks to generous support from the National Science Foundation (through NSF grant AST-1032896), and diligent work by Brian Warner, the SAS-sponsored photometry workshop "Measuring the Universe" at Pacific Astronomy and Telescope Show was well-attended. Undeterred by the crack-of-dawn starting time, 26 people attended the 4-hour class taught by Warner. The class was a "hands-on" experience using *MPO Canopus* software for asteroid photometry and variable star photometry. Participants received a fully licensed copy of the software as part of class.

The "Measuring the Universe" workshop on photometry of asteroids and variable stars was well-attended at Pacific Astronomy & Telescope Show

Brian Warner giving a photometry lesson as part of the "Measuring the Universe" workshop at PATS.

Thanks also go out to Bob Stephens and Bob Buchheim for providing assistance to the students during the class.

The good attendance suggests that there is a corps of amateur astronomers and students who are excited about the chance to become backyard scientists. Hopefully, we'll begin seeing asteroid lightcurves and variable star measurements from these new photometrists in the near future!

SAS Represented at DPS Meeting

The 42nd annual meeting of the Division for Planetary Sciences of the American Astronomical Society was held at the Pasadena (CA) Convention Center in early October 2010.

More than 1000 attendees filled five full days with technical presentations, workshops, and poster papers spanning the wide range of planetary science topics. Working from the most-distant inward, the objects under study included extra-solar planets, trans-neptunian objects, satellites of the outer planets, spacecraft data from Saturn, Jupiter, and Mars, Trojans, main-belt and near-Earth asteroids, short-lived Earth satellites, and – on the home world – computer simulations of everything from solar system dynamics to hypervelocity impacts.

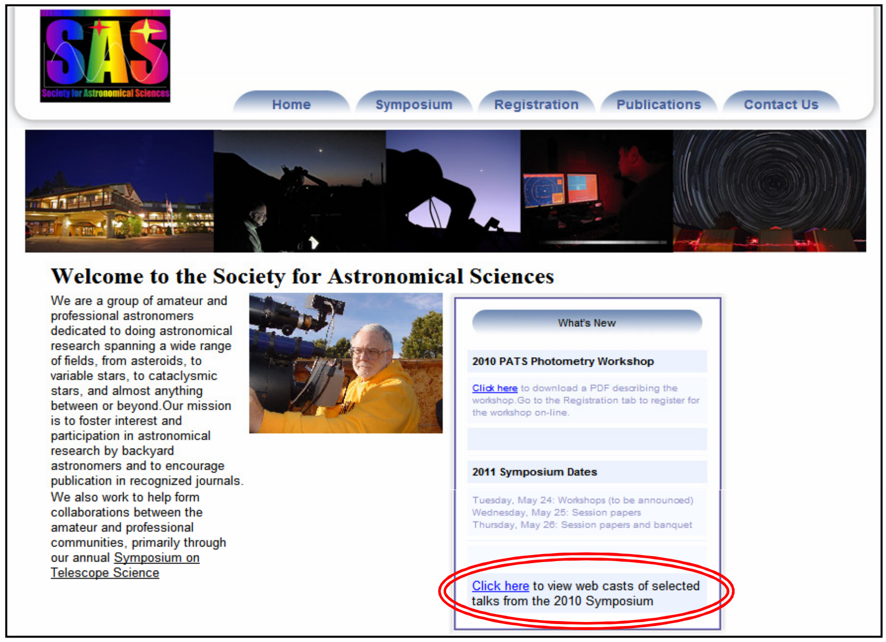
This is a meeting for professional astronomers, but quite a few non-professionals were in attendance, some of whom presented papers.

SAS's Brian Warner gave an oral presentation of "Potential Biases in Future Asteroid Lightcurve Surveys". He highlighted the pitfalls of attempting to use sparse data to interpret asteroid rotational properties. Such data can miss unusually short or long periods, small-amplitude lightcurves, binary objects, and tumblers, all of which are of special interest. There is an ongoing need for high-quality complete lightcurves of these objects. In a companion paper, Dr. Alan Harris showed some specific cases that illustrated these pitfalls. His message was "don't try to use sparse data to describe the statistics of a population".

Brian Warner, Bob Stephens, and Dr. Harris also presented a description of "A Proposed Standard for Reporting Asteroid Lightcurve Data". There has long been a need for a universal archive of asteroid lightcurve data, and it appears that we are on the verge of having one (see the article below).

SAS members Bob Buchheim and Shelia Cassidy worked as volunteers during the meeting which, by the way, is a good deal – free registration in return for 16 hours of easy work assignments.

Dr. Harris came prepared, in case he needed to get the speaker's attention (happily, not during Brian Warner's presentation!)



Videos of many of the presentations from the 2010 SAS Symposium are available from the SAS Website

Videos of 2010 Symposium Technical Papers Are Now Available on SAS Website

Those of you who were at the 2010 Symposium know that we recorded the presentations of many of the technical papers. This was a bit of an experiment, to make the presentations available to far-flung friends of the SAS who were not able to attend in person. (We do not post the presentations that contained embargoed material).

The recorded presentations are available on the SAS website: www.SocAstroSci.org (the link is highlighted in the screenshot below). The files are all Windows media files (".WMV"), so they should be compatible with most home PCs. Feel free to point members of your astronomy club to this resource. The files are large, so it is probably best to download them and view them from your local drive.

We hope to improve the video and audio quality for the 2011 Symposium. If you have any comments on the videos or on this experiment, please send us a letter to the Editor.

ALCDEF: The Asteroid Lightcurve Database Exchange Format

A poster paper presented by Stephens, Warner, and Harris at DPS noted the crying need for an easily-accessible database of asteroid lightcurve photometric data. Two critical points are highlighted by this work.

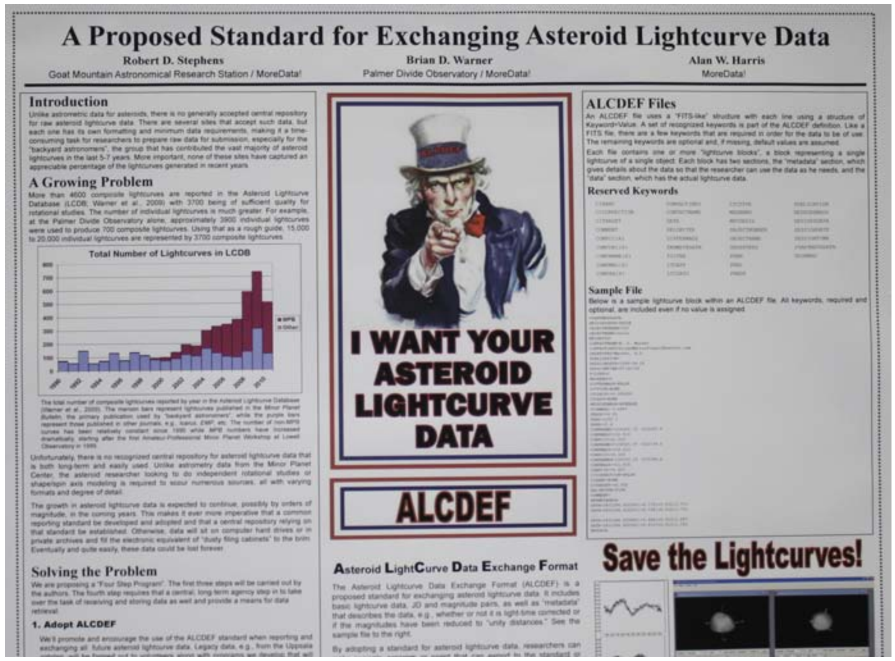
First, virtually all published asteroid lightcurves present the data in graphical form, which is not amenable to retrieving the actual data points accurately, and almost all present the results "wrapped" to an assumed period. If the period is later found to be mistaken (not an unusual situation, especially with sparsely-sampled photometry or long rotation periods), the raw data must be provided or reconstructed in order to provide meaningful information from those observations.

Second, the raw data (magnitude vs. time) for the vast majority of asteroid lightcurves are not archived anywhere, aside from the individual investigators' hard disks and dusty file drawers. This means that the data are not available to later researchers who may need to perform additional analyses (e.g., to investigate possible alternative period solutions). The lack of an archive also means that combining data from different observers and different epochs requires that the observers themselves coordinate the data sharing, which can be a difficult clerical task for data that are more than a decade old, and perhaps an impossible task in the case of deceased observers.

Bob Stephens and Brian Warner, caught by surprise at DPS

The purpose of ALCDEF is to provide a standardized format for submitting, archiving, and retrieving asteroid lightcurve data. This format provides the necessary information to interpret the raw data and avoids the risks and pitfalls of archiving the results of analyses (e.g., period analysis, which may later turn out to have been mistaken). It will form the core of a permanent, growing archive of asteroid photometry data that is somewhat analogous to the AAVSO's permanent and growing archive of variable star photometry.

Brian Warner has taken on the task of creating the parsing program that will accept lightcurve data and enter it into a master database. He is also investigating ways to ensure the perpetual life of this database. For users of his *MPO Canopus* software, a version has been released that creates the necessary database interchange files. Look for a complete description of the database, the procedures for using it, and examples of what it can do in the near future.



Poster paper describing ALCDEF, by Stephens, Warner, Harris, was displayed at DPS

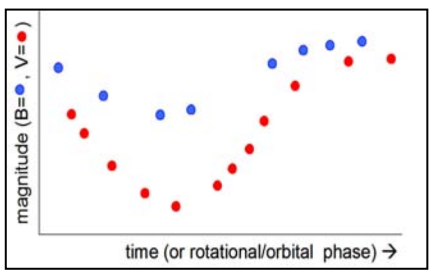
Bob Stephens photographed this Chilean Fox at Cerro Tololo International Observatory

HELP WANTED!

One of the missions of SAS is to provide education and training that will help backyard scientists improve the quality of their projects, expand their understanding of the physics, math, equipment and procedures involved, and to share their knowledge of "best practices". In that spirit, your newsletter editor would appreciate receiving short articles addressing the following topics.

Color index vs. time. In the literature we occasionally see plots of the changing color index of an object; for example the [V-R] color of an asteroid vs. time, or the [B-V] color index of an eclipsing variable star vs. orbital phase. We know how to generate two time series (lightcurves) by cycling the filter wheel of our CCD imager to get a series of images B-V-B-V- … etc.

From that we can plot "B vs. time" and "V vs. time":



With the need for longer exposure in "B" and the need to drop the occasional bad image, the data points are not evenly spaced, the "B" and "V" points are non-synchronous, and there is noise-driven uncertainty hidden within each data point. Given all of that, how do we determine the color index [B-V] vs. time? Our high school math teacher taught us how to do a linear interpolation (say, to line up interpolated "B" data with the measured "V" points), but we suspect that there is a better way.

If any of you can offer an explanation of the ways that astronomers compute color index vs. time from such a data stream, along with their relative merits and drawbacks, it would be applauded.

Cataloging and searching image archives. Professional observatories prize their archives of images, and researchers often revisit old astronomical images (even glass plates) to unravel the history of interesting objects. Backyard scientists probably have libraries of similar value. When following asteroids, monitoring the brightness of variable stars, or making artistic photographs of beautiful objects, small-telescope CCD users accumulate huge libraries of images. It is possible that those images might contain information beyond their originally-intended purpose. There might be a pre-discovery image of a nova's precursor, or an asteroid's position long before being officially discovered, or an optical gamma-ray afterglow. The possibilities are many.

Have any of you developed a convenient way of indexing or cataloging your image library, so that it can be searched by RA/Dec or other criteria? Inquiring minds would like to know ...

Planning for the 2011 Symposium on Telescope Science

It isn't too early for you to start planning for the 2011 SAS Symposium on Telescope Science. Select the project on which you're going to report, decide whether to propose an oral presentation or a poster paper, get that data analyzed, and start drafting your paper!

The submission deadlines haven't been set yet, but abstracts will be due about the middle of the first quarter of 2011.

Flash report – Our keynote speaker will be Dr. Petrus Jenniskens, who will describe the discovery of 2008 TC3 and his subsequent recovery expedition to the desert of Sudan.

More information will be in the next newsletter.

A Chilean Fox waits for dinner (above). The summit of Cerro Tololo (right). © Robert Stephens

Small-Telescope Astronomical Science in the News – June, July, August 2010

compiled by Bob Buchheim

We live in the era of mega-telescopes but, nevertheless, there is still important research being done with smaller telescopes – much smaller, of the type and size that are available to college observatories and backyard scientists. Here are some recent papers whose data were obtained in whole or part using such small telescopes. I hope that these examples will give you ideas for your own projects or encourage you to add some research to your astronomical hobby.

In the first edition of this column, I asked for reader comments as to whether it should be continued. The readers have spoken ... sort of. The vote is 2 in favor, and 0 against. It's unanimous! However, the polls are still open...

A Large Sample of Photometric Rotation Periods for FGK Pleiades Stars

by J. D. Hartman, et al
http://arxiv.org/PS_cache/arxiv/pdf/1006/1006.0950v1.pdf

HATNet is an array of small (11-cm = 4.3-in) wide-field CCD imaging systems with excellent photometric accuracy. They observed the Pleiades as a serendipitous side-effect of their primary mission of searching for extra-solar planets.

When you stare at the Pleiades, you get a great deal of data (nearly 6800 images, at nominal 5.5-minute intervals). If you examine the lightcurve of each star, a good number of them show periodicity (with typical peak-to-peak amplitude of about 0.02 to 0.06 magnitudes in Sloan r' band, hidden within a larger brightness scatter). For about 350 stars, this periodicity can be inferred to be due to sunspots rotating in and out of view – that is, the lightcurve period is displaying the rotational period of the star. This is a big deal because large, unbiased catalogs of stellar rotation rates in clusters are rare.

The magnitudes, cadence, and accuracy achieved by HAT-Net in this study appear to be within the reach of experienced amateur photometrists. By focusing a larger instrument on an open cluster, it might be practical to replicate this sort of study in one observing season. Is anyone up to the challenge?

Transit Timing Variation in Exoplanet WASP-3b

by G. Maciejewski, et al
http://arxiv.org/PS_cache/arxiv/pdf/1006/1006.1348v1.pdf

This project barely fits into my definition of a "small-scope" project. The authors used 0.6-m (24-inch) and 0.9-m (35-inch) telescopes and CCD imagers to determine new transit timings for this exoplanet. The new timings, in combination with previous observations, were subjected to an "observed minus calculated" ("O-C") analysis to search for time variations that could be interpreted as "light-time effect" indicators of additional planets or moons in the system. The photometric accuracy must be quite good – a standard deviation of a few milli-mags – to model the transit reliably, whose depth is about 12 mmag (i.e. 1.2%). The timing must also be quite good, since the light-time effect that is sought is of the order of one minute. Recalling the article I mentioned last month about the challenge of absolute time accuracy (Eastman, et al), I note that this paper follows Eastman's recommendations: time of transit is given in BJD (barycentric – not heliocentric – JD), and the time scale is explicitly stated as Terrestrial Dynamic Time.

The net result of the analysis is a tantalizing hint that there may be a second planet of about 15 Earth masses in the system. If it does exist, its radial velocity signal would be too small to detect, so clearly there is a need for additional transit timings over the next several years.

NLTT 41135: A Field M-Dwarf + Brown Dwarf Eclipsing Binary In A Triple System, Discovered By The MEarth Observatory
by Jonathan Irwin, et al
http://arxiv.org/PS_cache/arxiv/pdf/1006/1006.1793v1.pdf

The MEarth Observatory consists of four independent 16-inch Cassegrain telescopes. Its principle purpose is to monitor the closest M-dwarf stars for transit events that might indicate planets. This paper describes the discovery of a transiting object and characterization that shows that it is not a planet but a brown dwarf (about 30 Jupiter masses) in orbit around one star in a visual double.

The detailed description of the observation method (both photometry and spectroscopy) is fun and useful, since it describes some of the problems that arose during the observations and data reduction (problems that rarely seem to make it into final papers). It sounds as if life in a professional observatory can be as trouble-prone as life in our backyard observatories. The study is also a nice example of how a small-telescope discovery can lead to many other large-telescope studies to characterize the new object. Follow-up photometry was done with the 2.2-m University of Hawaii telescope and the Fred Lawrence Whipple Observatory (FLWO) 1.2-m telescope. Follow-up spectroscopy and a preliminary radial velocity curve were done using the TRES fiber-fed echelle spectrograph on the FLWO 1.5-m Tillinghast reflector. Precise radial velocities were obtained using the FIbre-fed Echelle Spectrograph (FIES) on the 2.5m Nordic Optical Telescope (NOT) at La Palma, Spain.

I suspect that further observation of this object may be well within the capabilities of SAS member's equipment – the period is 2.88 days and the eclipse depth is roughly 2% (0.02 mag).

WASP-21b: A Hot-Saturn Exoplanet Transiting a Thick Disc Star
by F. Bouchy, et al
http://arxiv.org/PS_cache/arxiv/pdf/1006/1006.2605v1.pdf

The British superWASP system comprises an array of 8 imagers, each with a 200-mm (4.4 inch) f/1.8 aperture and an unfiltered CCD system, conducting a wide FOV survey for transiting exo-planets. Here is a report of the discovery of a new extrasolar planet, its WASP photometry, and large-telescope follow up observations for precision photometry and radial velocity determination.

The "raw" WASP photometry is worth a look – it is a pretty dramatic example of just how clever modern algorithms are at finding a small signal deeply hidden in noisy data.

Multicolor Photometry of SU UMA and U Gem During Quiescence, Outburst and Superoutburst.
P. Wychudzki, M. etal
http://arxiv.org/PS_cache/arxiv/pdf/1006/1006.2971v1.pdf

The authors, all from Nicolous Copernicus University, Torun, Poland, used a 60-cm (24-inch) telescope and CCD with C-B-V-R-I filters to obtain rapid-cadence photometry of SU UMa and U Gem. Their observations give a picture of the extremely dynamic fluctuations of these cataclysmic variables. Their phased lightcurve of SU UMa shows "flickering" of up to 0.1 mag on a timescale of a few minutes. No color change is apparent in these flickers.

Orbital Period Changes and Their Explanations in Two Algol Binaries: WY Per and RW Leo
by Liao Wen-Ping and Qian Sheng-Bang
Publ. Astron. Soc. Japan v.62, p.1109–1116 (2010 August 25)
pre-print at:
http://arxiv.org/PS_cache/arxiv/pdf/1006/1006.5259v1.pdf

This article barely fits into my concept of "small telescope" science because (a) the author's observations were made partly with a small 0.6-m (24-inch) telescope and partly with a not-small 1-m (40-inch) telescope, but (b) much of their analysis is based on historical data taken with small telescopes.

For those of you who regularly measure and report the times of minimum (T_{min}) of eclipsing binaries, this report gives a good example of the great value of such data. The O-C ("observed minus calculated") diagram for 89 years of WY Per minima shows strong evidence of a cyclic variation. This cyclic variation can be explained by the light-time effect caused by an object with ≈ 2.3 solar masses (M_{Sun}) orbiting the eclipsing pair once very 71.5 years. In their model, the third body's orbit is highly eccentric, e = 0.6. Their calculations show that it is highly unlikely that the 71.5-year period could be caused by magnetic activity in the eclipsing pair, leaving the light-time effect as the preferred explanation. However, as the authors note, this model is a bit of a strawman. In the light-time explanation, the third star should be roughly as bright as the primary star of the eclipsing pair and so should be detectable in a careful spectroscopic study, which apparently nobody has done yet. So, in a refrain that will be familiar to the visual-binary astrometrists, and the asteroid photometrists, "more data are needed!"

The case of RW Leo is even more complicated. After collecting 90 years worth of T_{min} data, the authors conclude that in order to fit the data they need to assume a modest, constant period change plus two additional periodicities. One is fit by a 0.9 M_{Sun} star in an eccentric (e = 0.7) orbit with a 78-year period. The other is a bit of a mystery – it might be a fourth body in the system, in which case stars 3 and 4 are in unstable orbits, or it might be apsidal motion, or it might be something else. Again, more data are needed, so put this star on your observing list for T_{min} and don't overlook opportunities to time the secondary minima.

The Most Plausible Explanation of the Cyclical Period Changes In Close Binaries: The Case Of The RS Cvn-Type Binary WW Dra
by Liao W.-P. and Qian S.-B

Another paper by the same authors as above discusses their analysis of historical times-of-minima of the eclipsing binary WW Dra, including their own recent measurement of T_{min} in 2007 May. They used a CCD imager on the 1-meter reflector at Yunnan Observatory, but at *V* = 8.3, this system should be well within the range of much smaller instruments.

The system shows a nearly-perfect sinusoidal variation with a period of 112 years in its O-C curve. The authors argue that this long period makes it unlikely that the O-C variation is caused by magnetic cycles of one or both stars and, therefore, it must be due to a third body in the system. If so, this third body would be substantially more massive than either of the stars in the eclipsing pair ($M3 \approx 6.5\ M_{Sun}$). If it is a normal star, its spectral lines should be discoverable, although it sounds as if nobody has looked for them in the modern era. Alternatively, it could be a non-luminous object such as a black hole.

I note that the O-C analysis is based solely on primary minima, and that very few secondary minima are recorded. There aren't sufficient secondary minima to justify any conclusions, but, to my eye, it appears that while the secondary minima roughly follow the trend defined by the primary minima, they are a relatively poor quantitative fit.

WASP-8b: A Retrograde Transiting Planet In a Multiple System
by Didier Queloz, et al
http://arxiv.org/PS_cache/arxiv/pdf/1006/1006.5089v1.pdf

The WASP team has detected the transit signature of an exoplanet orbiting the 9.8-mag star TYC2 7522-505-1. This is a bit of a strange beast. The star is a visual double (ρ = 4 arc-sec, PA = 170 deg) and this pair is almost certainly a common-proper-motion pair. The exoplanet is in orbit around the primary star, in an 8.15-day orbit, and displays transits with a depth of about 1%. Spectroscopic radial velocity data are consistent with this orbital period, and the combined data set implies a large planet, about the same size as Jupiter but over two times Jupiter's mass, in a retrograde orbit.

The star is at Dec = -35 deg, so it is probably too far south for our North American exoplanet folks, but the southern hemisphere observers may find this to be a nice target.

Speckle Interferometry at the U.S. Naval Observatory. XV.
by Brian D. Mason, William I. Hartkopf and Gary L. Wycoff
The Astronomical Journal, 140:480–482, 2010 August
preprint at:
http://arxiv.org/PS_cache/arxiv/pdf/1006/1006.5676v1.pdf

One of the ongoing projects at the US Naval Observatory's venerable 26-inch refractor is the measurement of double stars. The authors here report the results from observations gathered over the past couple of years, giving the separation and position angle of over a thousand systems. There are several interesting features of this research.

First, although the data were reduced using speckle-interferometry algorithms, the majority of these systems are within reach of conventional CCD astrometry. The average separation of components reported here is about 13 arc-sec, and the minimum separation is just under 1 arc-sec. Second, some of the systems reported here hadn't been measured for more than 50 years. There is an ongoing need for double-star measurements (say, each pair once every 10 to 20 years) to provide the basis for assessment of orbits or to establish that the pair is an optical-only alignment. Amateur observers can make important contributions to the WDS database by doing these measurements and reporting them to the Journal of Double Star Observations (www.jdso.org). Third, for several of the reported systems, this report is the first confirming measurement after the initial discovery (in some cases, long after the initial discovery report). There are doubtless many more systems in the WDS for which confirmation is needed. It isn't unheard of for the initial reports to be garbled or misinterpreted (wrong star, 180-degree error in position angle, etc.), and prompt confirmation or correction can assist future generations of double-star astronomers.

A Long Term Spectroscopic And Photometric Study Of The Old Nova HR Del
by M.Friedjung, M. Dennefeld, and I. Voloshina
http://arxiv.org/PS_cache/arxiv/pdf/1007/1007.0932v1.pdf

At the 2010 SAS Symposium, Dr. Arne Henden issued a few challenges to amateur photometrists. One of those was to maintain surveillance on classical nova so that they are monitored until they return to their pre-eruption status. This article reports on the ongoing evolution of Nova Del 1967 (HR Delphinus). Four decades after the nova event, the star is still doing unexpected things. At V ≈ 12.5, it is well within the range of backyard scientists. The data reported here consist of photoelectric photometry in U, B, and V bands taken with a 60-cm (24-inch) telescope and CCD photometry in V and R bands taken with 38-cm (15-inch) and 50-cm (20-inch) telescopes. The photoelectric photometry was very low cadence – two or three measurements per night – whereas the CCD photometry had a cadence of only a few minutes between data points. The CCD photometry was able to detect the orbital period (P ≈ 5 h) with a peak-to-peak amplitude of about 0.08 mag in V-band. Rapid "flickering" is also detectable in the CCD lightcurve. Both the CCD and photoelectric photometry show ongoing long-term changes in brightness of indeterminate periodicity.

As usual, more data and continued monitoring are required. Backyard astronomers can probably do a fine job of keeping this star under surveillance.

Anchoring the Universal Distance Scale via a Wesenheit Template
Daniel J. Majaess, et al
http://arxiv.org/PS_cache/arxiv/pdf/1007/1007.2300v1.pdf

This article caught my eye because the "et al" includes two friends of SAS – Dr. Arne Henden and Tom Krajci – and because the photometric data were gathered from CCD observations in V- and I-bands using telescopes with apertures of 35-cm (14-inches) and 6-cm (2.4-inches).

The subject is variable stars and the cosmic distance scale. Cepheid variables are recognized as wonderful standard candles, with a consistent relationship between magnitude, pulsation period, and color. However, there are two types of Cepheids (Type I and Type II), with different period-luminosity (P-L) relations, the P-L relation is affected by the star's chemical composition, there are very few Cepheids with good parallax-based distances, and the apparent brightness and color of Cepheids in distant objects (globular clusters and galaxies) may be altered by interstellar/intergalactic extinction and reddening. A proposed solution to the observational issues is to transform the period-luminosity relation into a period-Wesenheit relation, where the VI Wesenheit function is:

$$W_{VI} = V - 2.55 * (V\text{-}I)$$

This function turns out to be almost independent of reddening. Even better, it turns out that Type I Cepheids and δ-Scuti stars fall on a single Wesenheit –period function. Type II Cepheids and RR Lyrae stars fall on their own, different Wesenheit-period curve. Hence, with a set of variable stars calibrated against Hipparcos parallax, cosmic distance determinations can take advantage of several different types of variable stars.

Observation of Light Echoes Around Very Young Stars
by Ortiz, J.L. et al
http://arxiv.org/PS_cache/arxiv/pdf/1007/1007.2556v2.pdf

The authors report a fascinating piece of small-telescope science that might be replicable by backyard scientists: recording light-echoes that are created when the light from a variable star is reflected by an adjacent dust cloud. This project combined an imaging study of the variable star and its associated reflection nebula with a time-series project to search for changes in the nebula, and culminated in quite sophisticated image processing to visualize the "light echoes" as they propagated over time.

The imaging was done with a 0.45-m (18-inch) f/2.8 telescope and a broad-band CCD imager, giving a modest resolution (1.5 arc-sec/pixel). The targets in this study were the variable stars R CrA and S CrA. These are about 12th magnitude but are located at declination -37 degrees, making them relatively easy CCD targets best placed for Southern Hemisphere observers. I suspect that there are similar targets for Northern Hemisphere observers to try.

In concept, the project's plan was simple: (a) take a good high-SNR image of the star and its neighborhood every couple of weeks, (b) search for changes in the light around the star, and (c) correlate these changes with brightness variations of the star itself. The imaging consisted of 30 to 50-minute images in order to provide deep but unsaturated views of the nebulae surrounding the stars. The search for changes began with normalizing, registering, and scaling the series of images so that they had the same average brightness and were astrometrically aligned at the same scale. At this point, it was just possible to see hints of the light-echoes propagating away from the star and across the nebulae. In order to confirm the shape and motion of the light-echoes and to characterize their properties, the images were enhanced by subtracting out a reference image, which could be either one single image in the series or one formed by averaging all the images in the series. This is where the image processing became tricky. If you've every tried simply subtracting two images as a way to search for changes, you know that big obvious changes are, well, obvious but that subtle changes are hidden in a clutter caused by cosmic-ray hits, defective pixels, saturated star-cores, and varying PSF between the two images. All of these can be handled. See "Expanding the Realm of Microlensing Surveys with Difference Image Photometry", by Tomaney, A. B., et al., *Astronomical Journal* 112, 2872, and Newman and Rest, PASP, at

http://www.journals.uchicago.edu/doi/pdf/10.1086/508758).

Finally, the observed outward-flowing light-echoes were correlated with brightness changes of the variable star, the outward flowing light-echo being a time-delayed child of a brightness-pulse of the parent star.

So, if you would like to combine imagery of infrequently-observed nebulae with variable-star photometry and sophisticated image processing, this may be a project to try.

HAT-P-18b and HAT-P-19b: Two Low-Density Saturn-Mass Planets Transiting Metal-Rich K Stars
by J. D. Hartman, et al
http://arxiv.org/PS_cache/arxiv/pdf/1007/1007.4850v1.pdf

The Hungarian-made Automated Telescope Network (HAT-Net) has become quite an "exoplanet factory" – six telescopes, each with 11-cm (4.3-inch) aperture – have discovered 19 extra-solar planets in the past 7 years. This paper reports the discovery of planets number 18 and 19. These two new planetary systems share several observational and morphological similarities. Observationally, their parent stars are at about +34 deg declination, they are a bit brighter than V = 13, the optical depth of their planetary transits are just about 2%, and the transit durations are about 2.8 hours, all of which makes these systems good targets for Northern-Hemisphere exoplanet observers. Morphologically, both planets are approximately Saturn-mass objects with orbital period of a few days (4.0 and 5.5 days), and their parent stars both have noticeably higher metallicity than our Sun.

The authors note that based on the planets' sizes (inferred from the transit signature) and masses (inferred from radial velocity measurements), both planets have no or very small cores. The apparent lack of dense cores breaks a trend which had been hinted at from other planets, including Saturn, that higher-metallicity stars seemed to give rise to planets with relatively large dense cores. These two new planets fall way off the trend line that had suggested this correlation, so they indicate that there is more to learn about planetary formation.

Optical and Near-Infrared Photometry of Nova V2362 Cyg: Rebrightening Event and Dust Formation
by Akira Arai, et al
Publ. Astron. Soc. Japan v.62, p.1103–1108 (2010 August 25)
pre-print at:
http://arxiv.org/PS_cache/arxiv/pdf/1008/1008.0432v1.pdf

One reason for maintaining photometric observation of classical novae for at least a year after peak brightness is the need to build a large database of nova lightcurves that can be used for statistical and comparative studies. Another reason is that something completely unexpected might be discovered. This paper from a group of Japanese researchers is an example of the latter. Nova V2362 Cyg started out as a fairly normal "fast" nova in early April 2006 – a quick rise of about 12 magnitudes, followed by a gradual decline in brightness, falling by 3 magnitudes after about 29 days. The researchers here collated broadband photometry from "several 30-cm [12-inch] telescopes" and found a dramatic secondary rise in brightness beginning about 100 days after the initial outburst, which culminated in a second maximum brightness about 220 days after the initial outburst.

This unusual, but not unique, lightcurve in B, V, R, and I bands is augmented by more sporadic far-infrared measurements in the J, H, and K bands. The best interpretation of the resulting lightcurves is that the nova's initial outburst generated a radial explosion of high-velocity matter that, after about 200 days, collided with previously-shed matter. The collision precipitated clouds of dust-grains, which absorbed much of the visible light and re-radiated it in the infrared.

One of the morals of this story is that Dr. Henden was right (again): it is important to keep watch on these events as they fade, because there are plenty of surprises out there awaiting discovery.

Fast Optical Variability of a Naked-Eye Burst—Manifestation of the Periodic Activity of an Internal Engine
by G. Beskin, et al
Astrophysical Journal Letters, 719:L10–L14, 2010 August 10

I have vague memories of an article in *Sky & Telescope* in the 1980's about an attempt to coordinate naked-eye observers to watch for the suspected-but-never-observed optical flashes associated with gamma ray bursts. The organizers may have been a bit over-optimistic about the feasibility of making visual observations, but they were certainly onto something – the brightest optical flash (so far) recorded from a gamma ray burst reached mag 5.7.

Now comes this report of the high-speed optical photometry of GRB080319B. The instrument was the TORTORA photometric camera. It consists of an image intensifier whose output is re-focused onto a fast-response CCD not too different from the CCDs in video cameras. With a 120-mm (4.7-inch) objective lens, it images a very wide 24° X 32° field of view at 7.5 frames/sec.

Fortuitously, TORTORA captured images of the location of the gamma ray burst beginning several seconds *before* the gamma ray signal. The optical lightcurve shows strong evidence of quasi-periodic brightness oscillations, which the authors model as four individual brightness pulses. These fluctuations have quite healthy amplitudes – a couple tenths of a magnitude (peak-to-valley) – and the peaks occur at intervals of about 10 sec. They appear to be nicely correlated with the gamma-ray signal oscillations, except that the optical signal is delayed by 2 seconds relative to the gamma rays.

The XO Planetary Survey Project: Astrophysical False Positives
by Radosaw Poleski, et al
Astrophysical Journal Supplement Series, 189:134–141, 2010 July

It comes as no surprise that if you watch a great many stars for a long time at high photometric accuracy, you'll see that many of them display some sort of brightness variations. The XO project has been doing just that for seven years now – using a pair of 200-mm (7.9-inch) telescopes and CCD imagers to monitor the brightness of stars between about 8.5 and 13.3 mag, searching for the signatures of exoplanet transits.

The project uses two sieves to distinguish "real" exoplanet transits from "false positives". First, the project's "Extended Team" of amateur astronomers provide higher-resolution, higher-accuracy lightcurves (sometimes in multiple color filters) and, second, radial velocity measurements provide information about the mass of any orbiting object.

This paper reports on 69 "false positive" objects which present lightcurves that appear very transit-like, but whose radial velocity or other spectral characteristics show that they are something else – mostly eclipsing binary stars.

Detection of a Cyclic Period Change In The W UMA-Type System HT Virginis
by Wen-Ping LIAO and Sheng-Bang QIAN
Publ. Astron. Soc. Japan 62, 521–524, 2010 June 25

I enjoy stories about period changes in eclipsing binary systems, especially when the system itself is complicated, and even more so when the professional researchers acknowledge the contributions of amateur observers. This paper has all three.

The visual double ADS 9019 (current separation about 0.5 arc-sec) consists of two 7th mag stars. The B component is an eclipsing binary, known as HT Vir. The A component is a spectroscopic binary, so this is (at least) a quadruple system.

The authors collected new times of minimum light of HT Vir during 2007-2009 using a CCD on a 1-meter telescope, and received 3 times of minimum light from photoelectric observations made on a 60-cm (24-inch) telescope. These observations, along with a compilation of previously-reported T_{min} give a strong hint of a cyclic variation in the period of HT Vir.

What is causing this variation? It could be the light-time effect of a 5th star in the system, but the hypothesized star's orbit would be unstable. It could be due to a magnetic cycle (the Applegate effect), but that explanation would require very extreme variations of the stars' quadrupole moments. It could be caused by an additional body orbiting the non-eclipsing component A, but there are problems with this hypothesis, too.

So, the "bottom line" is that more observations of T_{min} are needed – which I note is a perfect way for backyard astronomers to contribute to understanding this system. In that spirit, the authors include a nice acknowledgement of the value of observations by the Variable Star Observers League in Japan: "We are indebted to the many observers (including VSOLJ), amateur and professional, who obtained the wealth of data on this eclipsing binary system."

Forecast For Phoenicids in 2008, 2014, And 2019
by Mikiya SATO and Jun-ichi WATANABE
Publ. Astron. Soc. Japan 62, 509–513, 2010 June 25

This is a bit of a mystery story. In 1819 comet D/1819 W1 was discovered, but no subsequent apparitions were observed and its calculated orbital elements had sizable uncertainties. In early December 1956, a quite active meteor shower was observed (ZHR = 50 – 100) with a radiant near the southern constellation of Phoenix. However, it didn't match up with any previous meteor shower observations and no subsequent showers were observed. At the time it was recognized that computed orbits suggested that the meteor shower and the comet were related, but with no further observations, it couldn't be proven. Then in 2003, asteroid 2003 WY25 was found to closely match the orbit of the old comet: they were apparently the same object. In 2006, the asteroid was observed to have a faint coma, thus adding credence to the idea that the asteroid was a not-quite-dead comet nucleus (see Jewitt, D. *AJ* **131**:2327, 2006 April).

Now comes this analysis of debris streams from 2003 WY25. The authors predict that in late 2014 the Earth will pass through the remnants of several debris streams emitted by this object over the past two centuries. They predict a nice meteor shower on Dec 1-2, 2014 (UT) with a radiant in the constellation Puppis (just south of Canis Major). Put this on your observing calendars! Observations of meteor rates during this predicted shower can be used as a surrogate to estimate the cometary activity of the asteroid over historical times.

Photometric Study of the Very Short Period Shallow Contact Binary DD Comae Berenices
by L. Zhu, et al
Astronomical Journal, 140:215–223, 2010 July

There are a great many eclipsing binary systems for which complete photometric studies have not yet been done. CCD photometry on modest-size telescopes can help to remedy this situation. This paper reports on the lightcurve, in several filters, and times of minimum for the very short-period (P ≈ 0.3 day) overcontact binary DD Com.

Three aspects of this report struck me. (1) The system is evolving rapidly enough that slight changes in the shape of the lightcurve can be detected over intervals of just a few years. (2) The O-C diagram shows quite definite period change in the past decade. (3) The authors kindly acknowledge the value of amateur observations: "We are indebted to ... the many observers, amateurs, and professionals, who obtained the wealth of data on this eclipsing binary system."

Observations and Analyses of the Eccentric Orbit Eclipsing Binary HP Draconis
by E. F. Milone, et al
Astronomical Journal, 140:129–137, 2010 July

HP Dra is a bright (mag 8) eclipsing and spectroscopic binary with a period of 10.7 days that was first recognized as variable by the Hipparcos satellite data. The authors here report on B- and V-band photoelectric photometry gathered on the 50-cm (20-inch) telescope at Cracow Observatory, combined with radial velocity data gathered on larger (1- and 2-meter telescopes).

The photometric data show that the primary minimum is very slightly deeper than the secondary minimum, and that the system has an eccentric orbit (secondary minimum occurs at phase = 0.517).

There are a few features of the photometric portion of this project that may be of interest to backyard photometrists. First, although this system was first noted in Hipparcos data, the data are sparse and hence led to an incorrect estimate of the orbital period. Thus, follow-up photometry of Hipparcos variables is a valuable effort. Second, the very nice B- and V-band observations made in 1999-2001 were used (in combination with the radial velocity data) to create a Wilson-Devinney model of the system that suggested a very small apsidal rate. The authors then used follow-up photometry of a primary minimum in 2009 to confirm the very small value of $d\omega/dt$. Third, by gathering photometry in two passbands, the model revealed the presence of "third-light" in the system, which turns out to represent about 10% of the total light. The authors note that it is unexplained why the third-light object cannot be detected in the spectrum of the system.

Rapid Apsidal Motion In V381 Cassiopeiae
by M. Wolf, et al
New Astronomy 15 (2010) 530–532

This paper reports an analysis of the times of minimum light of the 10th magnitude eclipsing binary V381 Cas (P ≈ 1.75 days). The core of the data set is T_{min} timings gathered with small telescopes – ranging from 20-cm (8-inch) to 60-cm (24-inch) aperture – at university and private observatories in the Czech Republic. Both primary and secondary minima times are well-represented in their data. Interestingly, although there is now a fairly dense set of times of minimum, apparently there has been no photometric study of the complete lightcurve of this system. Is anyone interested in taking up this project?

The orbit of V381 Cas is slightly eccentric and the data indicate a very rapid apsidal motion (periastron advance $d\omega/dt \approx$ 18 deg/yr). This is significantly larger than would be predicted by general relativity or the classical theory of tides. It is conceivable that a third body in the system is present, but the authors find no evidence of the sort of light-time effect that such a third body would cause when using plausible guesses about the range of third body properties.

This rapid apsidal motion is rare but not unique. Still, as the authors note, there is need for ongoing measurement of times of minima to better characterize the effect and to better understand the properties of this system.

Recent Transits of the Super-Earth Exoplanet GJ 1214b
by Pedro V. Sada, et al
Accepted for the Astrophysical Journal Letters
http://arxiv.org/PS_cache/arxiv/pdf/1008/1008.1748v1.pdf

The discovery that an extra-solar planet transits its star makes possible a set of observations that help to characterize the planet. Happily, valuable observations can be made with small telescopes. This paper reports on the optical transit photometry made with 0.36-m (14-inch) and 0.5-m (20-inch) telescopes and infrared J-band (1.25 µm) transit photometry made with a larger telescope.

The shape of the ingress and egress stages of the transit lightcurve is a sort of convolution of the size of the planet, the size of the star, the star's limb darkening, the impact parameter, and any stellar variability during the ingress/egress period. Compared to the optical transit lightcurve, the transit lightcurve in the infrared is less affected by limb darkening and stellar activity. The authors use it to improve the estimate of the planet's diameter, which they find to be 2.6 Earth diameters. Then they use their four optical transit lightcurves to improve the transit ephemeris (P = 1.58 days).

The transit depth is about 1.5% and the red-dwarf star is about V-mag 14.7, so this system should be within the reach of amateur exoplanet observers. The authors don't call for specific future observations, but I suspect that additional transit timings will eventually prove to be valuable as an aid to searches for additional planets in the system through their light-time effect.

By the way, this transiting extra-solar planet was discovered by the 16-inch MEarth system (see the article above by Jonathan Irwin, et al).

Early Spectroscopy of the 2010 Outburst of U Scorpii
by Masayuki Yamanaka, et al
(submitted to Publ. Astro. Soc. of Japan)
http://arxiv.org/PS_cache/arxiv/pdf/1008/1008.2843v1.pdf

The discovery of U Sco's outburst earlier this year, by amateur astronomer Barbara Harris, served science in several ways. It helped to validate the theoretical model of how this recurrent nova works; it demonstrated (again) the value of ongoing amateur monitoring of interesting stars; and the timely announcement enabled other astronomers to gather observations at the very early phases of the explosion.

This report presents time-resolved spectroscopy that began just 9.6 hours after the outburst was discovered. The authors used three instruments, two of which were small: a 40-cm (16-inch) telescope at Fujii Kurosaki Observatory, and a 28-cm (11-inch) telescope with an SBIG DSS-7 at the observatory in Okayama University of Science. The third instrument was "not small": the 1.5-m Kanata telescope at Higashi-Hiroshima Astronomical Observatory.

The results clearly show that the shape of the Hα spectral line is changing during the first few days of the eruption. The standard model of this sort of eruption is that a white dwarf is accreting matter from a companion, and when the density gets too high the white dwarf erupts in a nuclear explosion that blows off some of the excess material. It seems reasonable to imagine that the explosion, in its earliest stages, is non-spherical (e.g., it has an ignition point somewhere on the surface of the white dwarf so that the initial explosion is distorted by the presence of the star). The observations offer some support to this idea. The authors state that the data can be qualitatively described by a model in which the earliest phase of the explosion includes bipolar winds (the blue-shifted and red-shifted Hα peaks are clearly visible in the early spectra) which eventually are swallowed up by the larger spherical part of the explosion.

So, the moral of the story – for backyard scientists – seems to be to monitor interesting stars, announce promptly if you observe something interesting, and apply your "small" telescope to science investigations.

WASP-37b: A 1.7 MJ Exoplanet Transiting a Metal-Poor Star
E. K. Simpson, et al
http://arxiv.org/PS_cache/arxiv/pdf/1008/1008.3096v1.pdf

Here is another exoplanet discovery from the superWASP team using their 11.8-cm (4.6-inch) f/1.8 instruments. The target star is mag 12.7, hence possibly a difficult target for backyard exoplanet observers, but the transit depth is nearly 2% and the star is close to the celestial equator, so it is visible to both Northern and Southern hemisphere observers.

The planet is a bit larger than Jupiter, heavier and more dense than Jupiter, and in an orbit of period P ≈ 3.6 days. The parent star is a very old (11 Gyr), very low-metallicity star

HAT-P-20b–Hat-P-23b: Four Massive Transiting Extrasolar Planets
by G. ´A. Bakos, et al
http://arxiv.org/PS_cache/arxiv/pdf/1008/1008.3388v1.pdf

HAT-P-25b: a Hot-Jupiter Transiting a Moderately Faint G Star
by S. N. Quinn, et al
http://arxiv.org/PS_cache/arxiv/pdf/1008/1008.3565v1.pdf

HAT-P-17b,c: A Transiting, Eccentric, Hot Saturn and a Long-period, Cold Jupiter
by A. W. Howard, et al
http://arxiv.org/PS_cache/arxiv/pdf/1008/1008.3898v1.pdf

The HAT team's small telescope network has been very productive! Here is a collection of more discovery reports of exoplanets from this team.

HAT-P-20 orbits the "A" star of visual double POU 2795, which is almost certainly a bound pair. The most recent reported measurement of this pair was done in 1998, so it is about time for some double-star observer to update the measurements of separation and position angle on this system.

HAT-P-21 is a Jupiter-sized but very heavy planet. Its mean density of 4.68 g/cm^3 is almost as dense as Earth's ($\rho_{Earth} \approx$ 5.5 g/cm^3).

HAT-P-22's parent star is relatively near to us (82 parsecs), and, like HAT-P-20, seems to be a member of a visual binary. It has a common-proper-motion companion (9 arc-sec separation), but apparently this pair is not listed in the Washington Double Star Catalog (WDS).

HAT-P-17b and c present a two-planet "solar system". The inner planet transits the star every 10.3 days with a transit depth of about 2%. The outer (Jupiter-mass) planet has not been observed to transit but the authors note that their radial-velocity data/model suggests that a campaign to search for a transit should be done in October 2012. You exoplanet observers may want to put this one on your calendars. The star is GSC 2717-00417, at RA= 21h38m08.88s, Dec = +30d29m19.4s; V=10.5.

The FU Ori Candidate V582 Aurigae: First Photometric and Spectroscopic Observations
by Evgeni H. Semkov, et al
http://arxiv.org/PS_cache/arxiv/pdf/1008/1008.3899v2.pdf

A fairly short-lived period during the birth of a main sequence star is the "FU Ori" phase. A low-mass pre-main-sequence object is surrounded by a circumstellar disk. At some point, instabilities in the disk create a dramatic increase in the accretion rate and the star brightens by 4 to 5 magnitudes. The star V582 Aur was recognized as an FU Ori object in 2009. The authors here report on spectra gathered with a large telescope and photometry gathered with the 50/70-cm (20/28-inch) telescope of the National Astronomical Observatory Rozhen (Bulgaria). The currently-available photometric data are sparse but clearly show that the object brightened by at least 3 magnitudes between 1982 and 1990.

The authors report that they are now undertaking a search for additional pre-recognition photometric data among plate archives. The star is associated with a variable reflection nebula (albeit an obscure one, that isn't contained in the database of TheSky™), and it is in the same field of view as the bright visual double star ARY 36 (J2000 RA: 05h 25m 15.1s Dec: +34°51'32"). This makes me wonder: do any amateur astro-imagers have data that might be useful to these researchers, and is there an easy way to search the thousands of CCD images that many amateurs have accumulated to find images that might include this star?

Pre-Discovery and Follow-Up Observations of the Nearby SN 2009nr: Implications for Prompt Type Ia SNe1
by Rubab Khan. et al
http://arxiv.org/PS_cache/arxiv/pdf/1008/1008.4126v2.pdf

Here's another report that shows the importance of small-telescope photometric data and the value of searches through archival data. Observations of Type Ia supernovae provide critical information on the cosmic distance scale, but in order to calibrate them as "standard candles" – and distinguish between "normal" versus "over-luminous" supernovae Ia – astronomers need good observations that encompass the times prior to peak brightness. For this purpose, Khan et al examined the ASAS North images and found 7 useful photometric data points that were taken prior to the discovery report and which extend to 11 days prior to maximum light. The ASAS data provide a nice lightcurve through 45 days after maximum brightness. ASAS North is a 10-cm (4-in) aperture telescope + CCD that creates a continuous sky survey, touching each point roughly once every three days.

These photometric data were then augmented by large-telescope spectral studies to characterize the time-evolution of the supernova. The results show that SN 2009nr is an "over luminous" supernova and that a comparison with a "normal" SN Ia lightcurve shows how important it is to find pre-max-brightness data to characterize these events.

Ground-Based Multisite Observations of Two Transits of HD 80606b
by A. Shporer, et al
http://arxiv.org/PS_cache/arxiv/pdf/1008/1008.4129v1.pdf

I am still amazed that small telescopes can detect extra-solar planets by monitoring the transit lightcurves. Such monitoring is important because follow-up observations can improve the transit ephemeris and might provide the basis for an O-C ("observed minus calculated") search for orbital deviations. The planet orbiting the star HD 80606 is a particularly useful target because of the planet's highly eccentric orbit. Transit monitoring is well within the range of modest amateur telescopes (the star is 9th magnitude, and the transit depth is about 1%), but observing the transit is tricky because the orbital period is long (111.4 days) and the transit is also long (about 12 hours).

This report describes a coordinated effort of 10 observatories – scattered from Israel to Europe to USA – to create a complete transit lightcurve. The result is a very clean transit lightcurve, with good estimates of ingress and egress times. The small-telescope data came from 0.41-m (16-inch) and 0.36-m (14-inch) instruments and stands proudly – and accurately – among the data from much larger instruments.

MML 53: A New Low-Mass, Pre-Main Sequence Eclipsing Binary in the Upper Centarus-Lupus Region Discovered By SuperWASP
by L. Hebb, et al
http://arxiv.org/PS_cache/arxiv/pdf/1008/1008.4312v1.pdf

In addition to monitoring exoplanet transits, the SuperWASP system can do a fine job of finding variable stars. Here the authors report the discovery of a pre-main-sequence eclipsing binary and provide a complete lightcurve and ephemeris for this curious system. This is only the seventh pre-main-sequence eclipsing binary known, and it is the only one that is outside of the Orion star-forming region.

The photometry indicates that the system is in synchronous rotation, but that in addition to the eclipses, there is a noticeable brightness variation that is most likely caused by starspots on one or both stars. Archival spectroscopy indicates that there might be a third body in the system, hence further eclipse timings might be valuable to detect the light-time effect from this putative object.

This system may be an interesting target for additional photometric studies by Southern Hemisphere backyard scientists. The star is mag 11, the depth of primary minimum is about 0.3 mag, the depth of secondary minimum is about 0.15 mag, and the period is just over 2 days. For those of you who monitor eclipsing binary eclipse timing, it isn't too soon to put this star onto your observing list given that the most recent eclipse reported here was in 2008 April. The authors also note that a multi-band photometric study will be useful to confirm the inferred three-star system properties. The superWASP system is single-color, so a set of BVR lightcurves might be a useful addition to the data on this system.

A break during the AAS Division for Planetary Sciences meeting – perhaps the highest density of IQ per square foot that the Pasadena Convention Center has ever seen! © Robert Buchheim

SAS Leadership

Committee:
Lee Snyder – co-Chairman
Robert Stephens – co-Chairman

Webmaster:
Robert Gill - Audio Visual

Newsletter Editor:
Dale Mais

Program Committee
Brian Warner – co-Chairman
Jerry Foote – co-Chairman
Robert Buchheim

SAS Leaders serve without compensation.

Advisors:
Dr. Arne Henden
Dr. Dirk Terrell
Dr. Alan W. Harris

Membership Information

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, and to encourage dissemination of new results and methods. The Membership fee is $25.00 per year.

As a member, you receive:

- Discounted registration fee each year for the Symposium at Big Bear, CA.
- A copy of the published proceedings each year, even if you do not attend the Symposium.

Membership application is available at the REGISTRATION page of the SAS web site: http://www.SocAstroSci.org

You can pay on-line, or by mail to:
Society for Astronomical Sciences,
8300 Utica Avenue, Suite 105, Rancho Cucamonga, CA 91730;

The SAS is a 501(c)(3) non-profit educational organization. Your Membership dues may be tax deductible.

SAS Contact Information

8300 Utica Avenue, Suite 105
Rancho Cucamonga, CA 91730

Lee Snyder: lsnyder@socastrosci.com

Robert Stephens:
rstephens@socastrosci.com

Newsletter Editors,
Dale Mais: dmais@socastrosci.com,
Bob Buchheim: rbuchheim@earthlink.net