News from the Society for Astronomical Sciences

January, 2011

30th Anniversary of the Society for Astronomical Sciences

The 2011 Symposium on Telescope Science will mark the 30th anniversary of the Society for Astronomical Sciences. The enthusiasm of the participants for small-telescope science has not changed over those three decades. The growth in the size and participation by both amateur and professional astronomers bear witness to the important roles that the Symposium plays:

- An opportunity for non-professional researchers to present their projects and results, and learn from other backyard scientists.
- The privilege of receiving research advice from professional astronomers.
- Continuing education on methods, results, and opportunities for pro-am collaboration in small-telescope astronomical research.
- Venue for informal networking among the small-telescope research community, both amateur and professional.

The Program Committee has been busy, to ensure that the "30th Anniversary" 2011 Symposium is both useful and memorable. The Symposium will be held on May 24-25-26, 2011 at the Northwoods Resort in Big Bear, CA. The agenda will feature two half-day Workshops, two full days of technical papers, evening banquet and keynote lecture. Both oral paper presentations and poster papers are being solicited. We look forward to seeing you there!

Call for Papers

Papers are now being accepted for the SAS 2011 Symposium on Telescope Science. Topics on the full range of small-telescope science are welcomed: pro-am collaboration, science education, evaluation of recent professional results on relevant targets (e.g. small solar system bodies, planets, variable stars), and special uses of astronomical data.

Please send the abstract of your proposed paper to the Program Committee at program@SocAstroSci.org.

Deadlines are:

Abstract submission: March 12, 2011

Final Papers due: April 16, 2011

Abstracts may be submitted in plain text or MS Word format. The formatting requirements for final papers -- including an MS Word template – will soon be posted on the SAS website (www.SocAstroSci.org).

2011 Keynote Speaker: Dr. Petrus Jenniskens

"The impact and recovery of 2008 TC3"

On October 7, 2008, a small 3-4 m sized asteroid was discovered to be on a collision course with Earth, the first time an asteroid was seen coming in. Now called "2008 TC3", astronomers studied the asteroid's lightcurve and reflection properties. Twenty hours later, it crashed in the Nubian desert of Northern Sudan. When satellites saw it explode at an unusually high altitude of 37 km, many thought that was the end of the story.

Dr. Peter Jenniskens, however, traveled to Sudan in December at the invitation of Dr. Muawia Shaddad of the University of Khartoum, and together with students and staff of the University succeeded against all

Dr. Jenniskens in the Nubian Desert (Sudan) strewn field of 2008 TC3.

expectations: they ended up collecting over 600 fragments and slightly more than 10 kg of meteorites.

The strewnfield is unlike any other, with many different meteorite types found. Dr. Jenniskens will report on his travels to Sudan, the results of research on these meteorites, and the remarkable asteroid 2008 TC3.

Dr. Peter Jenniskens is a senior research scientist with the SETI Institute. He is an expert on meteor showers and author of *Meteor Showers and their Parent Comets*, a 790 page book by Cambridge University Press available through Amazon.com. Bring your copy for Dr. Jenniskens to sign!

Richard Kowalski: Discoverer of 2008 TC3

Richard Kowalski – the discoverer of 2008 TC3 – has been invited to attend the SAS-2011 Symposium. He will be able to tell us more about the discovery of 2008 TC3 along with the past, current and future NEO operations at Catalina Sky Survey and the Catalina Real Time Optical Transient Survey, the latter being a new opportunity for pro-am collaboration, in which amateurs help professional astronomers by participating in a network of follow-up observations of very recent transient events, e.g., supernovae, gamma-ray bursts, etc.

SAS 2011 Workshops

In keeping with our long tradition, we plan to include workshops on topics of current special interest on the first day of the 2011 Symposium (May 24, 2011). One workshop topic has been confirmed.

"Developing and Using Your Remote Observatory", by Tom Krajci and Tom Smith. This workshop will cover practical aspects of automating your observatory so that you can run your telescope and instruments from the warmth of your home, be it 100 feet or 10,000 miles away. Our two presenters have a wealth of experience in this subject.

The topic for the second workshop has not been finalized yet.

More information on the workshops, including pricing and schedule, will be distributed as it becomes available.

Epsilon Aurigae at the AAS

We are pleased to report that two good friends of the SAS – Dr. Robert Stencel and Jeff Hopkins – will be at the podium presenting papers at the January 2011 meeting of the American Astronomical Society in Seattle, WA.

Dr. Stencel is the chair of the Special Session on "Emerging Results on the Extreme Binary, Epsilon Aurigae". He will present "Interferometric Imaging of Epsilon Aurigae".

Jeff Hopkins, one of the longest-participating members of SAS and owner of the Hopkins Phoenix Observatory, will present "Photometric Monitoring of Epsilon Aurigae in Eclipse".

Epsilon Aurigae poster papers are also being presented by other friends of the SAS, including: Dr. Arne Henden, Olivier Thizy, and Stan Gorodenski. Congratulations to all of you!

The abstracts of these and other papers being presented in the Epsilon Aurigae Session are available at the AAS website (www.AAS.org).

Special thanks to Gene Lucas for bringing this news to our attention.

Help Wanted

SAS is in need of an assistant webmaster. Yes, we do have a website, and yes, it is functional and informative. Alas, it is also quite pedestrian, it was written with a tool that has been described as "#@^&%$ beyond all imagination" and as a result, it is a pain to maintain. If you understand a bit about websites and HTML code, and can volunteer a little time to your Society, we would very much like to hear from you.

The principal responsibility of the webmaster will be to handle the periodic maintenance of the site. This includes updating news, uploading files, adding pages and moving content among pages as needed. In general, this is a once-a-month task, possibly less frequently in summer and fall.

The assistant webmaster will probably want to translate the current website to a more familiar publishing tool and will be called on to offer advice related to our anticipated migration to a new host.

If you would like to help in this responsibility, please contact the SAS Committe at committee@SocAstroSci.org.

Correspondents Wanted

The last newsletter posed a couple of questions, but we haven't heard answers from any of you. We would still appreciate your letters on those topics! They were:

- How to translate asynchronous B- and V-band lightcurve data into a plot of color index vs. time.
- How to catalog and search an archive of FITS images, by their header's RA, Dec coordinates.

We also have new request. Some of you are probably going to attend the American Astronomical Society meeting in Seattle (January 2011), and the Lunar and Planetary Conference (March, 2011 in Houston). We'd appreciate a letter describing what you saw, heard, and learned, along with a couple of photos for use in the next newsletter.

Modern cosmological principles notwithstanding, it turns out that the Center of the Universe is on Vancouver Island (British Columbia, Canada), on the grounds of the Dominion Astrophysical Observatory. photo: Bob Buchheim

Asteroid (596) Scheila

In early December, the Minor Planet Mailing List was a-twitter with reports of unusual goings-on at asteroid (596) Scheila, which had suddenly developed a comet-like coma. CBET 2583, issued on 2010 Dec. 12, announced the discovery of a spiral like structure around main belt asteroid (596) Scheila by Steve Larson of the Catalina Sky Survey (CSS) on images from 2010, Dec. 11.4 taken through the Catalina 0.68-m (27-inch) Schmidt telescope,. It was quickly confirmed by quite a few small-telescope observers.

A spectrum: SAS member John Menke was able to record a spectrum of the asteroid + coma on December 16 (UT), using his 18-inch (46-cm) Newtonian telescope and DSS-7 spectrograph. This was done by collecting 71x120s images. The spectrometer slit was approximately 7 a-s wide oriented E-W and centered on the centroid of brightness. This was both lucky (science data taken just before a pretty large snowstorm), and heroic (temperature about 20ºF).

His spectrum shows that Scheila does not have a typical asteroid spectrum. There is a significant drop-off in the red (longer than 6500Å) compared to G2v (Sun). The spectrum has no apparent features until short of 5000Å where there appear to be at least three spectral bands. John opined that it “Sure looks like more than dust to me!”

An Evaluation: Dr. Richard Miles (SAS and BAA) highlighted the unusual nature of (596) Scheila. This object is quite a rare type of asteroid. It is of the 'T' type class as detailed in the Bus-DeMeo catalogue.

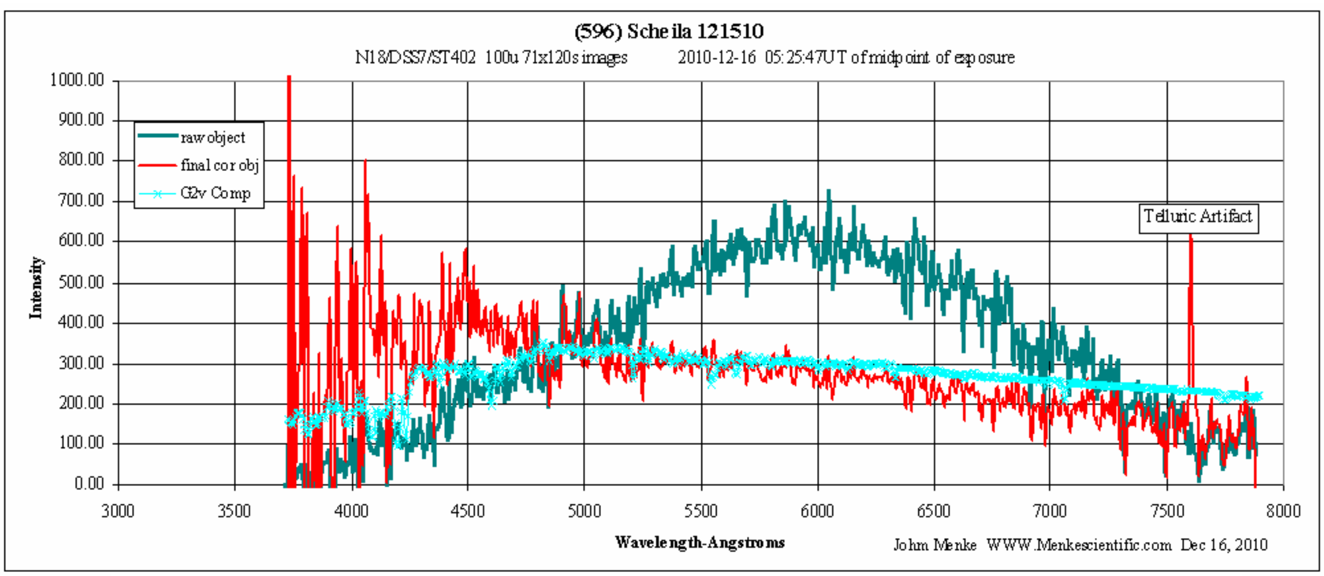
Of 371 objects described in Bus-DeMeo, only 4 belong to this 'T' classification of which (596) Scheila is one. The nearest related class is the 'D' type which is regarded as the most like a comet nucleus as evidenced by the observations of Comet C/2001 OG108 [see Abell, *et al*, "Physical characteristics of Comet Nucleus C/2001 OG108 (LONEOS)", Icarus v.179 (2005) p.174-194]. Bus DeMeo have identified 16 objects with comet-like 'D' type spectra. So Scheila may be representative of just 1-5% of the asteroid population with reflectance properties similar to a comet nucleus. Figure 6 in Abell, et al shows the similarity between various asteroid spectra and that of the bare comet nucleus.

A call for more observations (I): Dr. Miles also offers a reason for backyard scientists to continue paying attention to this asteroid over the next couple of months. “The sudden ejection of material into space (possibly following a collision) should modify the reflectance of part of the surface of the asteroid. This is because a fraction of the material will have been traveling at speeds below the escape velocity from the 110-km body - I estimate this to be around 30 m/s. All of this material would gradually fall back onto the surface. The rotation period of Scheila is around 15.9 hr, i.e. long enough for the material to fall back largely onto the same hemisphere. We may therefore expect Scheila to show some sort of color change or modification of its rotational lightcurve if a large blemish has been created in the region of the disrupted surface. The fresh material, laid down in this way, may also exhibit a different phase-magnitude relationship to that of the normal surface.”

Scheila reaches opposition about February 3 at a phase angle of 6.2

A call for more observations (II): Dr. Alan Harris (SAS Advisor) also recommends continued attention to this object. He noted that SAS’ Brian Warner reviewed his observations taken of (596) Scheila in 2005-2006, and found that it was a well-behaved asteroid then, with a lightcurve amplitude of only ~0.09 mag and period of 15.89 hours.

Of importance to the recent outburst is that Warner was able to confirm the MPC absolute magnitude to within a few hundredths of a magnitude. (MPC lists H = 8.9 for an assumed G = 0.15; Warner found H = 8.84 and G = 0.076. In the mid phase angle range from 10 to 20 degrees or so, these two sets of (H,G) functions lie within a couple hundredths of a magnitude of each other, so ephemeris magnitudes generated using MPCORB or ASTORB elements should be accurate



John Menke’s spectrum of asteroid (596) Scheila during outburst to within a couple hundredths of a magnitude. Applying these results to the current outburst, it appears that in November, (596) was already two to three tenths of a magnitude brighter than the ephemeris prediction, thus the "outburst", whatever it was, may have already started even before any coma was visible. Currently, it is running about one full magnitude brighter than the ephemeris (possibly because recent aperture photometry captures both asteroid + coma).

It will be useful to take photometrically calibrated images in the coming months to quantitatively measure the magnitude of the outburst.

Further reading: For those wanting additional information, refer to the following links:

• MPML: The Minor Planet Mailing list is at http://tech.groups.yahoo.com/group/mpml/

• Bus-DeMeo catalogue is available at http://sbn.psi.edu/pds/resource/busdemeotax.html

• An informative chapter dealing with asteroid reflectance spectra by Bus et al. is available at: http://www.lpi.usra.edu/books/AsteroidsIII/pdf/3032.pdf

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Small-Telescope Astronomical Science in the News

September – October – November 2010

compiled by Bob Buchheim

Giant telescopes, high mountain-tops, and even higher budgets are the usual image of "astronomical research". Nevertheless, small telescopes and backyard scientists can still make important – even irreplaceable – contributions to astronomical research. Here are descriptions of the small-telescope research that appeared in the literature during the past three months.

I have included the link to arXiv for items that were posted on the preprint server, so that you can read the papers that spark your enthusiasm in their entirety. For other papers you'll have to spend some time at your local University library.

Properties, Evolution and Morpho-Kinematical Modeling Of the Very Fast Nova V2672 Oph (Nova Oph 2009), a Clone of U Sco
by U. Munari, et al
http://arxiv.org/PS_cache/arxiv/pdf/1009/1009.0334v1.pdf

In mid-August 2009, Japanese amateur astronomer Koichi Itagaki discovered a nova (mag 10) in Ophiuchus, using a 0.21 m (= 8 in) F/3 telescope. The resources that modern astronomy can bring to bear on a target are diverse and impressive. Nova V2672 Oph was promptly observed in the visual bands with ground-based optical instruments, in x-rays (with the SWIFT satellite), in gamma rays (a "negative" observation by INTEGRAL – no gamma rays were seen from this nova), and in radio wavelengths (~8 GHz and ~22 GHz, with the VLA).

This paper reports on follow-up photometric and spectroscopic observations over the subsequent two weeks. Two small telescopes, both of them 0.25 m (= 10 in) aperture, were used for multi-color photometry (B-V-R-I). Larger telescopes (0.6 m and 1.2 m) were used for spectroscopy. Additional photometric data came from the Japanese amateur network VSNET.

The photometric lightcurve shows that this nova has many similarities to U Sco (which was in the news a few months ago): very rapid decline in brightness at almost constant color, a brightness plateau and color change about a week after maximum brightness, then a return to fading. The authors point out that the plateau may be telling some details about how a nova explosion progresses: they attribute it to a brief period of stable nuclear burning on the surface of the white dwarf.

This similarity further suggests that V2672 Oph may itself be a recurrent nova, but that its previous outbursts were missed because it is a difficult object for nova patrols (relatively faint, southerly declination, long seasonal loss behind the Sun and frequent obscuration by moonlight). As they point out, however, this area of the sky is much-photographed by astro-imagers. Are any of you interested in searching your image archives for earlier outbursts? The J2000 coordinates are RA= 17h38m19s, Dec= −26◦44′14″.

At the 2010 SAS Symposium, Dr. Henden reminded us that novae such as this deserve periodic photometric observation for up to a year after peak brightness. Which begs the questions: has anyone attempted photometry on this target in the intervening year? The last observation recorded in the AAVSO database is from October 2009 (when the object was R-mag 17).

OGLE-2009-BLG-092/MOA-2009-BLG-137: A Dramatic Repeating Event with the Second Perturbation Predicted by Real-Time Analysis
by Y.-H. Ryu, et al
http://arxiv.org/PS_cache/arxiv/pdf/1009/1009.0338v1.pdf

I am continually amazed by the optical gravitational lensing projects. First, just the idea that stars are so densely packed on the celestial sphere that they can gravitational lens each other's light is quite boggling to my simple mind. Second, it is wonderful to learn how the observers and the analysts work together so harmoniously and productively. Third, this area of research has a curiously "inverted" approach to telescope usage. Many small-telescope projects begin with initial observations by small 'scopes, and then progress to ever larger telescopes (on Earth and in orbit) and ever more complex instruments. The OGLE project on the other hand uses relatively large telescopes to discover the initial anomaly that presages a potential gravitational lensing event, and then calls into service a healthy corps of small-telescope observers to monitor the object and create the full lightcurve. Along the way, the gradually-growing data set is used by the analysts to project times when particularly dense lightcurve coverage is warranted. From all of this come quite amazing descriptions of stars and stellar systems at far higher resolution than conventional imaging could provide.

It is also fun to recognize some of the people involved: the "et al" in the authors of this paper includes people who have attended recent SAS Symposia: Dr. A. Gould (of Ohio State Univ.), J. McCormick and B. Monard (both of the micro-FUN collaboration).

This particular paper shows the lightcurve and analysis of gravitational lensing by a binary star system, which in effect resolves the two stars (each less massive than our Sun), separated by 10.9 AU at a distance of 5.6 kpc – an effective resolution of 2 milli-arc-seconds ... much of the data coming from 0.3 to 0.4 m (= 12 to 16 inch) telescopes with CCD imagers. Pretty remarkable!

Detailed Interstellar Polarimetric Properties of the Pipe Nebula at Core Scales
by G. A. P. Franco, et al
http://arxiv.org/PS_cache/arxiv/pdf/1008/1008.5327v2.pdf
(accepted for *The Astrophysical Journal*)

Those of you who attended the SAS-2010 Symposium probably remember Gary Cole's paper describing the polarimeter that he created to study the polarization of ε-Aurigae. (If you missed Gary's talk, you can see a video of it at the SAS website:
http://www.socastrosci.org/videos/WebCasts.htm).
The authors of the present paper used a polarimeter of very similar technology to study stellar polarization in the neighborhood of the Pipe Nebula. About one-quarter of their data came from observations made with the polarimeter mounted on a 60 cm (= 24-inch) telescope, so this report fits into my loose definition of "small telescope" science.
When a dust cloud lies between us and a star, alignment of the dust grains can polarize the light from the star. (The dust-grain alignment might be caused by, for example, magnetic fields or some sort of aerodynamic flow in the dust cloud). Since stars are presumed to form within clouds of gas and dust (and indeed we find newborn star clusters buried within some of these dust clouds), it seems wise to examine areas where stars are seen through an intervening dark cloud. The pattern of polarization may be telling something important about the density, content, motion, and magnetic field within the dust cloud.

These researchers applied a CCD-based polarimeter to determine the polarization (magnitude and direction) of about 11,000 stars in 46 fields of view near the Pipe Nebula. They found that there were, indeed, tantalizing patterns of polarization caused by the dark nebula, that the nebular material is a rather inefficient polarizer, and that the polarization pattern indicates that dust-grain alignment is most likely caused by magnetic fields rather than turbulent flow.

"TNOs Are Cool": A Survey of the Trans-Neptunian Region: II. The Thermal Lightcurve of (136108) Haumea
by E. Lellouch, et al
http://arxiv.org/PS_cache/arxiv/pdf/1006/1006.0095v1.pdf

This report is primarily about space-borne far-infrared observations of Haumea, but I noticed it for two reasons: (1) the "et al" in the author list includes Dr. A. W. Harris, a good friend of SAS, and (b) the data includes a visual-band lightcurve of Haumea based on CCD observations made with a 0.4 m (= 16 in) f/3.5 telescope. It is intriguing to learn that a modest instrument can not only see, but also do effective photometry on such a distant member of our solar system.

This TNO has a rapid rotation (P≈ 3.9 hr) and large lightcurve amplitude (Δm ≈ 0.28 P-P)

HAT-P-16b: A 4 Mj Planet Transiting a Bright Star on an Eccentric Orbit
by L. A. Buchhave, et al
The Astrophysical Journal, v.720, p.1118–1125 (2010 September 10)

The Hungarian-made Automated Telescope Network (HAT-Net) has become quite an "exo-planet factory" – six telescopes, each with 11 cm (=4.3 inch) aperture, have discovered 25 extra-solar planets in the past 7 years. This paper reports the discovery of planet number 16. The HAT-Net procedure is that the initial transit signal is reported by one or more of these small-aperture instruments, and then initial follow-up spectroscopy is used to confirm that the signal is, indeed, an exo-planet transit. This then triggers high-resolution spectroscopy (for radial velocity determination) and high-accuracy photometry with larger telescopes.

The host star is mag 10.5. The transit depth is about 1.5%. The planet is over 4 times Jupiter's mass, has roughly twice the mean density of Jupiter, and is in a slightly eccentric (ε≈0.036) orbit with a period of P≈ 2.8 days.

GSC 2314–0530: The Shortest-Period Eclipsing System With dMe Components
by Dinko P. Dimitrov and Diana P. Kjurkchieva
Mon. Not. R. Astron. Soc. v.406, p.2559–2568 (2010)

Remember "O-B-A-F-G-K-M"? The O-stars are the hot bright ones, and the M-stars are small, relatively cool, faint, and hence poorly observed. There are surprisingly few well-determined sizes of M-dwarf (dMe) stars), despite them being the most numerous stars in our galaxy.

Photometric and spectroscopic study of eclipsing binaries is one of the best ways to determine absolute parameters of stars (temperature, size, mass, luminosity). Here, two Bulgarian astronomers report the characterization of an eclipsing binary whose components are both M-dwarfs. Their primary instrument was a 60-cm (= 24-in) Cassegrain telescope with a Finger Lakes Instruments' PL09000 CCD camera. (Additional photometric and spectroscopic data was gathered with a 2-m telescope).

The star (pair) is a 13th magnitude quite red (B-V ≈ 1.2) target, with a very short orbital period (P≈ 4.6 hr), and a lightcurve amplitude of about 0.3 mag (P-P).

The lightcurve has several interesting features. An asymmetric shape, it displays the "O'Connell" effect (the two maxima are unequal, presumably because of a "star-spot"), there is a noticeable color change across the lightcurve, and several significant flares – very rapid brightening of up to 0.1 mag, lasting less than 30 minutes – were observed.

Their photometric lightcurves (in V, R, and I bands) were fit to an eclipsing binary model (anchored with their good radial velocity data) to determine that the primary and secondary stars are (respectively) 0.5 and 0.26 solar masses, and luminosities of 0.053 and 0.007 solar luminosities – pretty dim!

Curiously, this pair might have a companion. The authors note that the 17th magnitude star USNOB1 1233–0046425, 61 arc-sec away from their target, appears to have the same proper motion. They note that a program of astrometric observations will be needed to determine if the two stars are indeed related. I note that such observations could very well be begun by interested backyard scientists with modest telescopes.

CCD Photometric Analysis of the W UMA-Type Binary V376 Andromeda
by C. Çiçek
New Astronomy v. 16, p.12–16 (2011)

It is remarkable how much information can be gleaned from photometric studies of eclipsing binary stars. The period of the lightcurve tells the orbital period of the pair; two- or three-color lightcurves give indications of the stars' temperatures; the shape of the lightcurve gives an indication of the size and orbital separation of the stars, and can provide evidence of star-spots. If the photometric data is combined with radial velocity information (from spectroscopy) then many of the parameters of the pair can be unambiguously anchored.

It is also wonderful that so much of the necessary data can be gathered with quite modest telescopes. This report describes a photometric study of an over-contact binary system, done with a 30 cm (= 12 in) telescope and an SBIG ST-10 CCD imager, in B- and V-bands.

The lightcurves (and radial velocity data, published elsewhere) are very well-matched by a model with a large, hot star (M_1= 2.44M_{sun}, T_1= 9000K) and a smaller, cooler star (M_2= 0.74M_{sun}, T_2= 7040K) in a very close 19-hour orbit. The lightcurves show very pronounced "O'Connell effect" (in which the primary and secondary maxima are of different brightness, as are the respective minima) – evidence of the existence of star-spots. The author used the Wison-Devinney code to model both hot and cool spots on the smaller star. The hot-spot model is a slightly better fit to the data.

It is also useful to note that this star was first recognized as a variable in data from the Hipparcos satellite. This paper is a nice example of what can be done by diligent follow-up observation of suspected variables from major missions that don't have the opportunity to concentrate on any given star.

Photometric Observation and Light Curve Analysis of Binary System ER-Orionis
by M. M. Lame'e, et al
J. Astrophys. Astr. v. 31, p. 97–104 (2010)

Here is another example of a small-telescope study that provides detailed information about an eclipsing binary star system. The authors report their U-, B-, V-band photoelectric photometry, done with a 51-cm (=20-in) telescope on this 9th mag star. Their lightcurve data is used (with the Wilson-Devinney code) to infer that the system is an "overcontact" binary. This system has been studied by other researchers, and the present results in general provide confirmation of the previously-inferred stellar parameters (the two stars are nearly the same temperature and nearly the same size, but they have significantly different masses).

Prior studies hinted that the orbital period (P≈ 10 hr) may be changing over time. The present research included compilation and analysis of a great wealth of times-of-minimum-light. The O-C ("observed minus calculated") curve shows that the period has, indeed changed. The system has alternately slowed and speeded up over the past 77 years, but not in a periodic manner. This result presents a bit of a mystery: the period changes are almost certainly not due to the light-time effect of a third object (which would create a cleanly sinusoidal/periodic signal), and almost certainly not due to mass transfer from one star to the other (which would create a monotonic period change – either always increasing or always decreasing).

I suppose that means, as usual, that more data is needed. Happily, backyard scientists probably have the equipment and skill to gather this additional data.

The Near-Contact Binary Star RZ Dra Revisited
by A. Erdem, et al
New Astronomy, v.16, p. 6–11 (2011)

Continuing the theme of the two previous articles, here is an extensive observational and modeling effort to understand the eclipsing binary star RX Dra. Photometric lightcurves were determined with an SBIG ST-10 CCD on a 60 cm (=24 in) telescope. (I note that the present lead author is at the same institution as Dr. Cicek -- Çanakkale Onsekiz Mart University in Turkey -- making effective use of modest equipment for astronomical research).

The very densely-sampled data shows a small asymmetry in the lightcurve (primary max slightly brighter than secondary max, and the "falling" and "rising" slopes to minimum light are slightly different). These are well-modeled by treating the system as a semi-contact binary (one star filling its Roche lobe, the other not-quite filling), with a cool spot on the larger/brighter star.

The authors also reconsider the long history of eclipse timings, and find compelling evidence for two variations in the ephemeris: (1) a gradual decrease in the orbital period (which they attribute to stellar wind-driven mass loss from the system), and (2) a cyclic variation in O-C, which they attribute to a third body in an eccentric, 73-year orbit. Assuming that it exists, this third body would be an M-dwarf, too faint to observe spectroscopically, too close to the primary pair to observe astrometrically, and causing too small a radial-velocity variation to detect.

Outburst Activity in Comets: II A Multi-Band Photometric Monitoring Of Comet 29P/Schwassmann-Wachmann 1
by Josep M. Trigo-Rodríguez, et al
http://arxiv.org/ftp/arxiv/papers/1009/1009.2381.pdf

At the 2009 SAS Symposium, Richard Miles described his very detailed photometric study of the outburst of comet Holmes. Here is another detailed and long-term photometric study of comet outbursts, this time with 29P/Schwassman-Wachmann 1 as the target. The authors are Spanish astronomers (some professional, some amateur), and almost all of the photometry was collected with modest-size telescopes, ranging from 18 to 40 cm (= 7 to 16 in) aperture, using CCD imagers with V-, R- and I-band filters.

The rotation period of this comet's nucleus is controversial: previous researchers have suspected periods ranging from14 hours to 60 days or more, and it isn't even certain that it has a stable rotational axis. The present researcher's long-term study provides compelling evidence for a 50-day rotational period, and outbursts that are pseudo-periodic at the same rate. This appears to be an unusually long rotation period (compared to other comets and to TNO's).

The apparent synchrony between rotation and outburst suggests that the outburst mechanism is related to periodic heating of an active region on the nucleus.

A Study of Differential Rotation on II Pegasi via Photometric Starspot Imaging

by Rachael M. Roettenbacher, et al

http://arxiv.org/PS_cache/arxiv/pdf/1009/1009.2308v1.pdf

The Sun does not rotate as a solid body: the equatorial region has a shorter rotation period than do the mid-latitude regions, and the polar regions rotate more slowly still. Is this unique to the Sun, or do other stars exhibit similar differential rotation?

Here is a clever piece of research designed to address that question. It consists of two related pieces: (1) small-telescope CCD photometric monitoring of a star, with the goal of detecting the brightness modulation caused by star-spots, and (2) development of an algorithm that resolves the stellar rotation period and characteristics of the star-spots.

The photometry was done with a 0.4 m (= 16 in) telescope, CCD imager and B- and V-band filters. This was a long-term project, comprising nearly 20 years' worth of photometric data. The star's rotation period (determined from both photometric and spectroscopic studies) is 6.7 d, so in order to get a reasonably complete rotational+starspot lightcurve it is required to observe almost every night.

The algorithm is a lightcurve-inversion method that creates a map of the star's surface brightness, and adjusts the size and location of star-spots to best match the B- and V-band lightcurve data. By following the inferred star-spots as they march across the visible surface of the star, the authors are able to observe the shape- or position-changes that illustrate the differential rotation of the stellar surface. It turns out that this star's differential rotation is in the same sense as the Sun's (i.e. slower at the poles).

Precursor Outbursts and Superoutbursts in the SU UMa-Type Dwarf Nova NN Camelopardalis

by Jeremy Shears, Jerry Foote, William Mack Julian, Tom Krajci, Igor Kudzej, Ian Miller, Etienne Morelle, Richard Sabo, Irina Solovyova, Bart Staels and Tonny Vanmunster

[accepted for publication in the *Journal of the British Astronomical Association*]

Pre-print at: http://arxiv.org/ftp/arxiv/papers/1009/1009.1725.pdf

I included the names of all of the authors of this paper because several of them are good friends of the SAS. If you aren't familiar with the intrigue and excitement of cataclysmic variables, I refer you to the recorded lecture that Dr. Joe Patterson presented at the 2010 SAS Symposium, which is available for download on the SAS website.

This report presents photometric observations of three outbursts of NN Cam, recorded with CCD imagers on telescopes mostly in the 0.3m to 0.4 m (= 12 in to 16 in) range, plus Jerry Foote's larger 0.6 m (=24 in) instrument. The 2007 event is the first recorded super-outburst of this star. All three events (2007, 2008, and 2009) were probably superoutbursts – with the star rising over 4 magnitudes in only a couple of days – and the 2007 and 2009 events clearly showed brightness modulation from both the orbital period and the precession period of the accretion disk (the "superhump period"). Interestingly, the 2007 event appears to have been preceded by a "normal" outburst only a few days prior to the superoutburst – unusual but not unheard of in other cataclysmic variables – but neither the 2008 nor the 2009 events displayed a precursor.

This study is a good example of the power of rapid-cadence small-telescope photometry in the study of cataclysmic variable stars.

CSS090530:144011+494734: a new SU UMa-type dwarf nova in Boötes

David Boyd, Nick Dunckel, Jerry Foote & Ian Miller

J. Br. Astron. Assoc. v.120, No.4, p.219, 2010

It is no longer a secret that the big sky surveys are discovering more transient phenomena that can be adequately studied by the professional astronomical community; and that the survey's databases provide fruitful opportunities for backyard scientists to conduct detailed follow-up studies. Here is an excellent example of that notion. The authors – three of whom are SAS members -- report their photometric study of a dwarf nova that was discovered by the Catalina Real-time Optical Transient Survey. That survey uses a 0.7 m (= 28 in) telescope to detect transient objects/events, and them immediately distributes the events to interested observers who can then conduct confirmation and follow-up studies (see http://crts.caltech.edu/ to learn more, and to sign up for e-mail alerts).

Whereas many "small telescope science" projects begin with small telescope observations, and then quickly blossom into "large telescope" projects for detailed measurements, this one goes in the opposite direction: the telescopes used for this detailed study are roughly half the size of the discovery instrument (except for Jerry's very nice 0.6 m = 24 in 'scope).

The authors show that this object is a cataclysmic variable (a binary system with mass transfer and occasional violent outbursts). They convincingly detect "superhumps" (rapid brightness fluctuations with period of approximately 1.5 hr and amplitude of 0.16 mag P-P), and the signature of the binary's orbital period (slightly shorter than the superhump period, as is the norm). They also note that the superhump period definitely changed over the 11 days of their observations, most likely due to a step-change in period, although a more gradual evolution of the superhump period isn't inconceivable. In either case, it is quite impressive that small-telescope data on a 16th magnitude object can reliably demonstrate that the superhump period changed by a bit less than 1 minute.

Formation of Asteroid Pairs by Rotational Fission
by P. Pravec, et al
Nature, v. 466, no. 7310, p1085 (26 August 2010)
pre-print at: http://arxiv.org/ftp/arxiv/papers/1009/1009.2770.pdf

This paper is primarily concerned with correlating the theory of fission of a rotating body to the (observable) spin periods of the resulting fission products; but since the vast majority of asteroid rotation periods have been determined by small telescopes (and many of those by backyard scientists), this seems to fit within my loose definition of "small telescope science". It is also worthy of note that the "et al" in the author list includes Dr. Alan Harris (a good friend of the SAS) and Don Pray (who ran the observations, and whose asteroid projects at Carbuncle Hill Observatory are familiar to regular readers of the Minor Planet Bulletin).

Here's the story: Since many asteroids appear to be loosely-consolidated "rubble piles" with negligible internal strength, and some have large boulders scattered across their surface; and since there are forces such as YORP that can gradually increase the spin rate of an asteroid-size body (thereby increasing the centrifugal force that tends to either fling boulders off, or break the main body into two), it is reasonable to expect that asteroids may occasionally undergo "rotational fission" – break into two pieces. The creation of a binary asteroid is one possible consequence of such fissioning. A second population – considered in this paper – is created when the two pieces separate with a high-enough velocity that they don't stay bound to each other, but instead follow individual orbits around the Sun. These asteroid pairs can be recognized by the similarity of their orbital elements, and several such pairs have been identified.

It turns out that the theory of rotational fission makes two predictions that can be tested by observations. First, the splitting tends to result in unequal fragments: one small, and one large body. The smaller body will almost always have 1/5 or less of the mass of the larger body. Second, if the smaller body is very small, then larger body will end up with a fast rotation (shorter period). If the smaller body has a healthy fraction of the mass of the larger body (say 10%), then the rotation of the larger body will be slower (i.e. longer period). The largest possible mass ratios (e.g. smaller body nearly 1/5 the mass of the larger body) give rise to extremely long rotation periods of the larger surviving body. This is (roughly) due to the smaller body carrying angular momentum away from the larger body.

So Pravec, et al examined the relative masses of these asteroid pairs (judged by their absolute magnitude, H), and the rotation period of the larger asteroid of each pair (determined by lightcurves). They found that the observations were a quite good verification of the theoretical predictions.

Transit Timing Variation and Activity in the WASP-10 Planetary System
by G. Maciejewski, et al
submitted to *Mon. Not. R. Astron. Soc.*
pre-print at:
http://arxiv.org/PS_cache/arxiv/pdf/1009/1009.4567v1.pdf

The discovery report of WASP-10 indicated a slightly eccentric orbit. The parent star displays rotational variability associated with star-spots, which could conceivably affect both the photometric (transit) signature and the (spectroscopic) radial velocity signature. Therefore, the present authors conducted a follow-up study to monitor additional transits, to characterize the eccentricity and to search for possible transit-time variations that might indicate additional bodies in the system. They used telescopes ranging from 0.6 m to 2 m aperture, but as it worked out almost all of their successful transit observations were done with the 0.6 m (=24 in) instruments. [Lesson: a large telescope is nice, but good weather is nicer!].

Their transit lightcurves are very impressive, for both coverage and accuracy. The host star is 12.7 V mag, and the transit depth is only about 35 mmag (= 0.035 mag). Their typical photometric uncertainty is better than 3 mmag, yielding very clean transit lightcurves. They accomplished this by using ensemble photometry in R-band, and exposures ranging from 1 to 2 minutes. Between 4 to 6 comp stars were selected, by iteratively examining most of the brighter stars in the field-of-view, to find those which were (a) the most stable/constant sources, and (b) bright as possible, just below the linearity limit of the imager. Then they iteratively varied the photometric measuring aperture radius, to select the radius that gave differential lightcurves with the smallest scatter. A couple of transits that were observed simultaneously by two different instruments indicate that their time of mid-transit were consistent to within 16 sec (after placing them on Barycentric Terrestrial Dynamic Time).

The conclusions of this study are that WASP-10b is most likely in a circular orbit ($P \approx 3.09$ d), and that there is a second planet in a $P \approx 5.2$ d orbit. They leave us with the tantalizing possibility that this second planet (if it transits the star) might be detectable with transit depth of about 3 mmag.

HAT Discovery of 76 Bright Periodic Variables Toward the Galactic Bulge
by D. M. Nataf, et al

It turns out that if you use a quite modest instrument (one of the HAT 11-cm = 4.3-in aperture lenses and CCD imager), and stare at a dense star field (near the galactic bulge) every night for a few months, you'll find quite a few variable stars. This experiment was done to assess the feasibility of conducting a micro-lensing survey, but as a side-benefit it yielded a harvest of 76 previously-unrecognized variable stars.

While the concept and equipment involved are well within the range of backyard scientists, if you consider replication of a study like this, beware that there are a great many ways that spurious "periodic lightcurves" can creep into your data set: a bright variable can corrupt the light from nearby fainter stars, random photometric errors can be aliased into very reasonable-appearing variations, etc. The authors used some pretty clever statistical methods to identify and eliminate spurious signals and winnow their results down to secure discoveries. Nevertheless, they note that more detailed (rapid-cadence) photometric study would be needed to confirm the nature of each of these newly-discovered systems.

The authors also suggest that broad-brush surveys such as this one may yield interesting statistical knowledge about the distribution of variable star periods.

Another Look at the BL Lacertae Flux and Spectral Variability: Observations by GASP-WEBT, XMM-Newton, and Swift in 2008–2009
by C. M. Raiteri, et al

BL Lac is the active nucleus of a distant galaxy – a "blazar" that presumably has a relativistic jet directed almost directly toward us – that displays quite pronounced brightness variability in all wavelengths. It is bright enough (V mag ≈ 15) that its lightcurve can be studied with modest telescopes and CCD imagers. The "Whole Earth Blazar Telescope" is a network of observers spread around the Earth who can keep a target blazar under continuous observation (see http://www.oato.inaf.it/blazars/webt/). Most of the optical telescopes in WEBT are modest – the median aperture is 40 cm (= 16 in) – and several of the observers are backyard scientists.

This paper reports on the correlated observations obtained by ground-based optical and radio telescopes, plus satellite based gamma-ray, x-ray, and UV data.

The optical data is reduced by aperture photometry, with careful attention to consistency: all observers use the same comp stars, the same measuring aperture and sky aperture radii (critical, to deal with contamination by light from the galaxy itself).

BL Lac's brightness fluctuations are pretty dramatic, capable of changing by a sizable fraction of a magnitude in a few days, and displaying noticeable color changes (e.g. (B-V) and (V-R)].

WASP-29b: A Saturn-Sized Transiting Exoplanet
by Coel Hellier, et al
http://arxiv.org/PS_cache/arxiv/pdf/1009/1009.5318v1.pdf

The WASP system discovered the transits of an exoplanet which is slightly smaller and lighter than Saturn, in a 3.9-day orbit around an 11.7 mag star. The transits are roughly a 1% (10 mmag) depth.

The First WASP Public Data Release
by O. W. Butters
Astronomy & Astrophysics, September 28, 2010
pre-print at:
http://arxiv.org/PS_cache/arxiv/pdf/1009/1009.5306v1.pdf

The WASP consortium shows up in this column frequently, as its two arrays of 8 (each) 11-cm (4.3-inch) camera lenses have been extraordinarily productive discoverers of exoplanets. Now the consortium announces its first public release of the data archive – nearly 120 billion data points organized into lightcurves of 18 million objects, plus 3.6 million of the raw images.

The data is nicely organized and easily accessed (by RA, Dec) at http://www.wasp.le.ac.uk/public/ . All data (images and lightcurves) are stored as FITS files.

On my low-end Win-XP computer, I had no trouble opening the image files with CCDSoft and Maxim-DL. The lightcurve data tables were read by TOPCAT and translated into CSV for manipulation with Excel.

This first data release encompasses only objects that could be linked to the USNO B1.0 star catalog, so moving objects are not included; and few, if any, transient objects are expected to be in the data. (An asteroid lightcurve survey extracted from the WASP data is planned, but it hasn't been released yet).

The Multi-periodic Blazhko Modulation of CZ Lacertae
by A. S´odor, et al
http://arxiv.org/PS_cache/arxiv/pdf/1009/1009.5498v1.pdf

RR Lyra stars are pulsating variables. A subset of this family – the Blazhko (RRab) stars – have complex lightcurves that seem to consist of several different periods (operating simultaneously), plus frequency changes and/or phase modulation. The result is a complex lightcurve, whose attributes may change noticeably over intervals of a year or so, and for which there is no generally-accepted theory.

In order to help unravel what is going on in these stars, the Konkoly Blazhko Survey conducts long-term photometric studies using a 0.6m (=24 in) telescope. This report, whose author list includes Dr. Arne Henden (AAVSO Director and good friend of the SAS), describes photometry of the star CZ Lac. It is important the observation plan provide both high-cadence and long duration. Rapid cadence is needed to map the shape of each pulsation cycle (Pp≈ 0.43 day in the case of CZ Lac). Long duration – several years of observation – is needed to capture the effect of the much slower modulation frequencies and their interaction (Pm≈ 14 and 19 days in the case of CZ Lac).

The study reported here monitored the star CZ Lac over two observing seasons, to get quite high-fidelity lightcurves that showed the changing shape of the primary pulsations, the "beat frequencies" between the two amplitude modulations, and phase- or frequency-changes in the modulations; as well as an apparent small change in the pulsation frequency. All of this is likely to give the theorists more to chew on!

Measurements of Transit Timing Variations for WASP-5b
by Akihiko Fukui, et al
http://arxiv.org/PS_cache/arxiv/pdf/1009/1009.5769v1.pdf

If a stellar system has more than one planet, then we expect that the times of transit will vary, deviating slightly from a linear ephemeris. (There are other possible explanations for such transit-timing variations, but if the timing variation is large, then the "additional planet" hypothesis is likely to stand out). The authors used a 61-cm (24-inch) telescope and CCD imager to record seven transits of WASP-5b, from which they refined the ephemeris, confirmed previous calculations of the properties of the planet and star, and searched for transit timing variations.

Their photometry was impressively accurate: the out-of-transit variation of their lightcurves was about than 0.2% (i.e. 2 mmag). Their imaging was done in I-band, using 60-second exposures, almost always at air mass less than 2. They explored a tricky approach to maximizing SNR and minimizing the variance of out-of transit photometry. For each image they determined the photometric measuring aperture that maximized the SNR of the target star (considering the full suite of noise sources), and applied that aperture to each of the two to four comparison stars. This meticulous approach did give slightly smaller standard deviation in the out of transit data (compared to using a single photometric aperture size for all images), but the improvement was pretty small, and may not be worth the trouble in most cases.

The present study provides tantalizing hints that the transits of WASP-5b do, indeed, show transit-timing variations. Although the formal statistical significance of these variations is plausible, and although models of the implied second planet can be made, still there is no clear pattern to the transit timing variations and the models can be fit by a wide range of possible second planets. So – you knew this was coming, didn't you? – more data is needed!

WASP-25b: A 0.6 MJ Planet in the Southern Hemisphere.
by B. Enoch, et al
http://arxiv.org/PS_cache/arxiv/pdf/1009/1009.5917v1.pdf

While other researchers do the necessary follow-up studies to better characterize the WASP planets, the WASP consortium continues discovering additional, new exo-planets.

Here is the 25th WASP discovery. It is a sub-Jupiter mass planet, orbiting a solar-like star (V≈11.9) every 3.67 days and providing a transit depth of 2%. Radial velocity studies show that it has an unusually low density – only 1/3 of Jupiter's density. This might have something to do with the star being of significantly lower metallicity than our Sun.

HAT-P-26b: A Low-Density Neptune-Mass Planet Transiting a K Star
by J. D. Hartman, et al
http://arxiv.org/PS_cache/arxiv/pdf/1010/1010.1008v1.pdf

The Hungarian-made Automated Telescope Network (HATNet) has also continued to sweep up exo-planets: here is their 26th discovery. It is a Neptune-size object in a 4.2-day orbit around a star that is somewhat smaller and cooler than our Sun. The transit depth is only 5 mmag. The parent star has quite high proper motion of nearly 150 mas/yr.

WASP-38b: A 6.87 Day Period Exoplanet Transiting a Bright F-Type Star
by S. C. C. Barros, et al
Astron & Astrophysics v. 525, A54 (Jan 2011)
preprint at http://arxiv.org/PS_cache/arxiv/pdf/1010/1010.0849v1.pdf

This WASP discovery is a bit unusual in that it has a long orbital period – 6.87 days – and a small but definite eccentricity in its orbit (ε≈ 0.03). It is big (just about the same diameter as Jupiter), heavy (2.7 times Jupiter's mass), and hot (equilibrium temperature ≈ 1300 K). It appears to be a good candidate for follow-up by backyard scientists, since the parent star is 9.4 magnitude, and located at +10 deg Dec. But check the ephemeris and plan carefully – with a period of nearly 7 days it takes a bit of luck to find a transit time when the star is up and the Sun is down at your location.

WASP-32b: A Transiting "Hot Jupiter" Planet Orbiting a Lithium-Poor, Solar-Type Star
by P.F.L. Maxted, et al
http://arxiv.org/PS_cache/arxiv/pdf/1010/1010.1742v1.pdf

Here is another WASP discovery: a planet with a 2.7 day orbit providing transits with a depth of about 1% (10 mmag). Radial velocity and photometry studies with large telescopes show that it is one of the heavier exoplanets, tipping the scales at about 3.6 times Jupiter's mass.

A sub-Saturn Mass Planet, MOA-2009-BLG-319Lb
by N. Miyake, et al
http://arxiv.org/PS_cache/arxiv/pdf/1010/1010.1809v1.pdf

About 6 kpc from us, in the direction of Sagittarius, there is an anonymous magnitude V18.5 star that hosts a planet in orbit at a radius of about 2.4 AU. The planet's mass is about half that of Saturn. Viewed from Earth, the star-planet angular separation is about 0.3 milli-arc-sec.

How do we know? Because the star's proper motion happened to make it pass almost directly in front of another, more distant star. The gravitational light-bending ("microlensing") amplified the brightness of the distant star by nearly 200X, and the initial stage of the brightening was discovered by the Microlensing Observations in Astrophysics (MOA) consortium's 1.8-m telescope. MOA notified the worldwide network of microlensing observers, who turned their instruments on the target object. Successful observations were contributed by 20 telescopes, half of which were less than 1-m aperture – ranging from 0.28-m to 0.8-m (11-inch to 31-inch) aperture. This worldwide network of observers kept the object under almost continuous observation for the three-day duration of the brightening event. Subsequent analysis of the lightcurve showed the characteristic spikes that denoted "caustic crossings" in the gravitational lens. The lightcurve was matched to a model consisting of a K or M dwarf, and the sub-Saturn-mass planet.

The authors of this paper include a long list of noted backyard scientists, including some whose names you may recognize: Jennie McCormick (New Zealand), and Berto Monard (South Africa), who have attended SAS Symposia; Alain Maury (Chile) who will be recognized by participants of the Minor Planet Mailing List; and David Higgins (Australia) – all of whom participant in the "µFUN" (Microlensing Follow-Up Network). Participants in the RoboNet, PLANET, and MiNDSTEp collaborations also contributed observations. All of these observers are included as co-authors in the paper reporting the discovery. This is a pretty remarkable example of what dedicated observers with small telescopes can accomplish!

WASP-30b: A 61MJup Brown Dwarf Transiting A V=12, F8 Star
by D. R. Anderson, et al
http://arxiv.org/PS_cache/arxiv/pdf/1010/1010.3006v1.pdf

The WASP system's 11-cm (4.3-inch) camera lenses have found that the 12th magnitude star GSC 5834:95 displays transits, with a depth of about 1% (10 mmag), and a period of 4.16 days. Although the WASP goal is the search for exoplanet transits, this is a somewhat different object. Radial velocity and spectroscopic studies (made with large telescopes) show that the companion is a brown dwarf – heavy enough to burn deuterium (hence too heavy to be a planet), but not heavy enough to burn hydrogen (hence not a star). Despite weighing in at about 61 times Jupiter's mass, the object's radius (determined by the ingress and egress durations) is about 10% smaller than Jupiter's.

Curiously, the parent star appears to have a common-proper-motion neighbor (about 13 arc-minutes away). It is not clear if they are related, or if this is just happenstance.

Monitoring Of the Terrestrial Atmospheric Characteristics with Using Of Stellar and Solar Photometry
by Alekseeva G. A., et al
http://arxiv.org/ftp/arxiv/papers/1010/1010.4068.pdf

We astronomers sometimes bemoan the deleterious effects of the atmosphere on our observations, but of course that's a bit tongue-in-cheek; for without the atmosphere, we'd be left gasping for breath and hence unable to argue about global climate change. So, here comes a bright idea. Why not make a virtue of necessity, and use our astronomical instruments to monitor the atmosphere's long-term changes? It turns out that monitoring of the atmosphere (aerosol, ozone, and water-vapor content) is routinely done during daytime, but night-time data is hard to come by.

This method of measuring water-content in the atmosphere has been correlated with radiosonde data and microwave radiometry, and found to be consistent to within a few percent. I'm not certain, but other references seem to indicate that the instrument is 180-mm (7.1-inch) aperture.

The SuperWASP cameras. The TORUS fork mount supports 8 identical Canon 200mm f/1.8 lenses (11 cm aperture). Each CCD is a 2048 x 2048 thinned e2v camera produced by Andor Technology (photo credit: David Anderson)

On the Rebrightenings of Classical Novae during the Early Phase
by Jumpei Tanaka, et al
http://arxiv.org/PS_cache/arxiv/pdf/1010/1010.5611v1.pdf

Dr. Henden presented a challenge at the 2010 SAS Symposium: "Please monitor classical novae all the way down to pre-eruption brightness, even though it may take a year or longer to do so." Here is a report on lightcurves and spectra of six classical novae, monitored for up to 1½ years after initial peak brightness. This is "small telescope science" on two counts: Many of the photometric data points come from AAVSO observations (both visual and V-band CCD), while most of the low dispersion spectra (resolution $\lambda/\Delta\lambda \approx 600$) were made with the 28-cm telescope of the Fujii-Bisei Observatory (Okayama, Japan).

All six of these events showed several "re-brightenings", anywhere from ≈10 days to ≈100 days after the initial explosion. This and other studies have suggested that there are patterns to these re-brightenings, but data on many more novae will be needed to understand these with certainty. Being able to correlate photometry with spectroscopy appears to give important insight into the evolution of the nova explosion, such as the cause of the re-brightening? (e.g. mass expulsion? hydrogen burning instability? something else?)

I note that these targets tend to be bright enough that visual ("eyeballs to the eyepiece") brightness measurements are useful, especially in the first few weeks or months. CCD photometry, despite the diligent efforts of AAVSO members is quite sparse for some of these novae, so additional observers will definitely add value. Finally, these spectral observations can probably be replicated by backyard scientists with an SBIG DSS-7, and can certainly be replicated with an SBIG SGS or a Shelyak LHires spectrograph.

Meteor showers of comet C/1917 F1 Mellish
by P. Vereˇs, et al
http://arxiv.org/PS_cache/arxiv/pdf/1010/1010.5733v1.pdf

Multi-station video monitoring of meteors is a potentially accurate way to determine the pre-entry orbits of meteors, and to assess the suspected heritage of a meteor stream with a (possible) parent comet.

This report analyzes an excellent record of the December Monocerotids and November Orionids, both of which have previously been associated with comet C/1917 Mellish. The data were recorded by the Japanese SonotaCo network of meteor observers, apparently using very-small-aperture wide field of view video cameras. The conclusion is that both of these weak meteor showers are, indeed, associated with C/1917 Mellish, but they represent two different streams, whose releases are separated by at least several thousand years.

Survey of Period Variations of Superhumps in SU UMa-Type Dwarf Novae. II: The Second Year (2009–2010)
by Taichi Kato, et al
http://arxiv.org/PS_cache/arxiv/pdf/1009/1009.5444v2.pdf

I suppose that most of you who are fans of cataclysmic variables have already read this paper; or contributed to it, since I recognized many of the co-author names as friends of the

SAS: Dr. Arne Henden, Berto Monard, Thomas Krajci, and Mike Simonsen. If you aren't an observer of cataclysmic variables (aka "dwarf novae"), you may want to watch Dr. Joe Patterson's talk from the 2010 SAS Symposium to learn what all the excitement is about. These are binary systems, consisting of a white dwarf, a close companion that is shedding mass toward the white dwarf, an accretion disk that "wobbles" relative to the two stars' orbits, and occasional explosive events when the white dwarf picks up too much mass.

Study of these objects depends heavily on the contributions of small telescopes and backyard scientists. It is impressive to see the wealth of photometric data contained in this paper – almost all of which came from telescopes of about 30 cm (12 inches) aperture with CCD imagers, including healthy reference to the AAVSO and VSOLJ databases – and the sophisticated analysis that this data supports.

This large collection of superhump lightcurves and O-C diagrams shows their diversity and displays tantalizing hints of consistent patterns. Among these patterns are (1) an almost universal tendency for the photometric signature of superoutbursts to go through three well-defined phases, characterized by both the lightcurve and the O-C curve, and (2) a tendency for a system to undergo the same explosion, over and over again, at reasonably regular intervals.

I also note in passing that this paper follows a trend that seems to be emerging, of referring event times to BJD (Barycentric Julian Date) rather than HJD (Heliocentric Julian Date).

A Mid-Term Astrometric and Photometric Study of Trans-Neptunian Object (90482) Orcus
by J.L. Ortiz, et al
Astronomy & Astrophysics, v. 525, A31 (Jan 2011)
preprint at http://arxiv.org/PS_cache/arxiv/pdf/1010/1010.6187v1.pdf

How many of you have "seen" a trans-neptunian object (other than Pluto) in your CCD images? There is at least one that can not only be seen, but can also be studied with a modest telescope. These authors report on a photometric and astrometric study of 90482 Orcus – a known-binary TNO – done with a 0.45-m (17.7-inch) f/2.8 telescope.

Their observing method is readily replicated by backyard scientists. A very broad-band filter and 5-minute exposures gave SNR ≈30. They pointed the telescope at the same FOV during the 18-night project (i.e. they let Orcus pass through the FOV, rather than pointing directly at it each night) because it was more important to maximize photometric and astrometric accuracy by using the same reference stars each night.

Their photometry shows (barely) a lightcurve with amplitude of 0.06 mag (P-P) when phased to 9.7 days.

The astrometric part of this project was clever. The idea is that even though Orcus' satellite, Vanth, is unresolved (its separation is about 0.3 arc-sec), its presence and orbital motion should "pull" the intensity centroid (the photocenter) of the combined star-like image. Indeed, a plot of astrometric residuals in RA does show (barely) evidence of a sinusoidal pattern at the satellite's orbit period.

Their conclusions are a mixed bag for small-telescope scientists. On the one hand, it is definitely worthwhile to spend time trying innovative approaches on difficult targets – who knows, you might learn or discover something! On the other hand, they acknowledge that if the existence and properties of the satellite weren't already known, a 2-m telescope would be needed to provide sufficiently high SNR to provide plausible evidence of its existence (and of Orcus' lightcurve).

But it does make me wonder: Has anyone tried to detect non-eclipsing main-belt asteroid satellites by looking at photocenter residuals?

Optical Multicolor Observations of the SS 433=V 1343 Aql Microquasar
by A.N. Sazonov
http://arxiv.org/PS_cache/arxiv/pdf/1011/1011.0923v1.pdf

This unusual object appears to consist of a close binary pair (in a 13-day orbit), an accretion disk that is occulted by the larger of the two stars and which precesses with a period of 162.5 days. The accretion disk is relativistic, with the gas reaching a speed of about ¼ of the speed of light, and it apparently hosts two polar jets. This report presents 4 years of multi-band (W, B, V, R) photoelectric photometry conducted with modest telescopes – a 0.6 m (24-inch) and a 0.48 m (19-inch) aperture. The object ranges from about 13.5 to 15 Vmag). The long sequence of lightcurves shows both the orbital modulation and the precession of the accretion disk (and its polar jets), as well as not-infrequent sudden outbursts (flares).

Optical and infrared photometry of the blazar PKS0537-441: long and short time scale variability
by D. Impiombato, et al
http://arxiv.org/PS_cache/arxiv/pdf/1011/1011.1100v1.pdf

The authors report on a 4-year campaign of visible (V, R, I) and near-infrared (J, H, z) photometry of this "blazar" active galaxy nucleus, using a 60-cm (24-inch) telescope. The target ranges from Vmag ≈ 16 to 13, and is located at RA=05:38 29.6, DEC=-44:24:17.8 (J2000), so it is out of reach of North American observers. The brightness change can be quite dramatic – several magnitudes in a few weeks. The color does not appear to change noticeably as the brightness fluctuates. Although much of their data is relatively low-cadence and contains gaps of up to several months long, the authors searched for short-time-scale fluctuations, and found one event in which the brightness changed by about 6% in just 3 minutes.

They recommend further photometric studies, with (if possible) near-simultaneous imaging in visible and near-IR, and denser time coverage in order to better characterize the short- and long-time-scale variations.

Contribution of amateur observations to Saturn storm studies
by M. Delcroix and G. Fischer
http://arxiv.org/ftp/arxiv/papers/1011/1011.1290.pdf

Amateur observers with telescopes of 15 cm to 40 cm (6 inch to 16 inch) aperture have observed and tracked the white-spot storms on Saturn quite effectively. The software "winjupos" (familiar to Saturn observers of the BAA and ALPO) is used to analyze Saturn observations.

These storm data have been correlated with Cassini spacecraft measurement of lightning bursts ("Saturn Electrostatic Discharges"). The two data sets are nicely complimentary. The spacecraft notes the time of a lightning discharge but not its source location. The amateur/visual data provides evidence for candidate sources.

The authors end with: "We would like to thank all amateurs who have been providing their images for their time and dedication."

New Double-Mode and Other RR Lyrae Stars From WASP Data
by Wils, Patrick
Intl Bulletin of Variable Stars 5955
http://arxiv.org/PS_cache/arxiv/pdf/1011/1011.1422v1.pdf

The first public release of data from the WASP consortium (see article above) can be expected to generate a series of "data mining" studies. Here is the first one that I've seen. The author examined the WASP data for many known or suspected RR Lyrae stars, and found 8 of them that are double-mode pulsators. He also examined WASP data for 3670 field Horizontal Branch stars, and found that 190 of them were RR Lyrae's, including 5 double-mode pulsators. This data set provides the basis for statistical examination of the overtone period vs. fundamental period, and the distribution of periods of these stars.

The Orbital and Superhump Periods of the Dwarf Nova HS 0417+7445 in Camelopardalis
by J.H. Shears
http://arxiv.org/PS_cache/arxiv/pdf/1011/1011.1594v1.pdf

Cataclysmic variables are wonderfully complex systems. The accepted picture is of a main-sequence secondary that is shedding material into a precessing accretion disk from which the material settles onto the white dwarf primary. Occasional outbursts can increase the brightness by several magnitudes in just a day or so. Photometric studies of these outbursts (both normal- and super-) are a primary way of anchoring theoretical models of the outburst mechanism. The need for regular checks on these systems is highlighted by the relatively short duration of outbursts – about 6 days in the case of this system.

The authors used CCD photometry with telescopes in the range of 0.27 m (11 inches) to 0.4 m (16 inches) to provide dense coverage of the March 2008 outburst of this system. Their lightcurves show the orbital modulation (about 0.1 mag P-P) and superhumps (about 0.4 mag P-P) riding on top of the rise and fall of the outburst (almost 4 mag P-P). The lightcurve also provides compelling evidence that this particular superoutburst was preceded by a normal outburst, by just a few days. A precursor outburst is occasionally – but not always – seen preceding superoutbursts of other systems, and is sometimes – but not always – accompanied by superhumps. In the case of the precursor outburst described here, there are definitely no superhumps (they only appear shortly after the onset of the superoutburst).

Physical Parameters of 62 Eclipsing Binary Stars Using the ASAS-3 Data–I
by Sukanta Deb and Harinder P. Singh
http://arxiv.org/PS_cache/arxiv/pdf/1011/1011.2574v1.pdf

The subject of this column is "small telescope science, but here is a study that might be considered a "no telescope" affair. The authors took advantage of three databases: the ASAS-3 photometric data, the radial velocity data of eclipsing binaries, published in a series of articles by Rucinski and Collaborators, and the 2MASS spectral data. They searched through these data sets and found 62 stars that were clearly eclipsing binaries, had ASAS-3 lightcurves, had mass ratios determined by radial velocity, and had spectral types determined either by spectroscopy or by color index. They then determined improved periods (using an entropy-minimization algorithm which is nicely described and doesn't sound too hard to replicate on a home computer), present improved lightcurves based on their improved periods, and determined system properties using the Wilson-Devinney model. It is all quite a neat piece of work that translates previously-published observations into physical descriptions of these binary star systems.

Such work is valuable because binary stars still provide the best way to establish fundamental stellar parameters (size and mass). The authors note that for many of these systems there is value in more accurate lightcurves that dedicated CCD photometry can provide – and since these are bright objects (typically Vmag ≈ 9 to 11) they are well within the reach of backyard scientists.

The Outburst of the Very Fast Nova Aql 2009 (V1722 Aql)
by Ulisse Munari, Arne Henden, etal.
Publications of the Astronomical Society of the Pacific, vol 122, p 898-904, 2010 August

I have heard it opined that the next big thing in amateur astronomy will be spectroscopy. Here is a paper that illustrates just how much can be done with a few small telescopes devoted to photometry and spectroscopy.

Nova Aql 2009 was followed with BVRI photometry using three telescopes ranging from 6 cm (2.4 inch) to 30 cm (12 inch) aperture, and spectroscopically with a 0.6 m (24 inch) aperture telescope providing dispersion of about 2Å/pixel – resolution that is probably within the capabilities of backyard scientists with commercial spectrographs.

This array of data enabled the researchers to determine: the interstellar reddening, and hence the intrinsic brightness and color of the nova; the brightness vs. time profile, and hence the distance to the nova; the width of the Hα spectral line, and hence the expansion velocity of the explosion; the evolution of the [O I] lines, and hence the total mass ejected from the nova explosion.

Searching for Long-Period Variables in Globular Clusters: A Demonstration on NGC 1851 Using PROMPT
by Andrew C. Layden et al
Publications of the Astronomical Society of the Pacific, vol. 122, p.1000-1007, 2010 September

By now you have probably seen the wonderful project that Robert Vanderbeu described in the December, 2010 issue of Sky & Telescope, in which he created color-magnitude diagrams of several clusters using amateur equipment. Here is an extension of that concept.

The authors of this study used a 0.4-m (16-inch) Ritchey-Chretien telescope and CCD imager (an Apogee Alta) to take images of the globular cluster NGC 1851 in B, V, R, and I. They did this on each of ten nights, over about a half-year period. From the resulting photometry, they created quite good color-magnitude diagrams, and also identified several long-period variable stars in the cluster. These included three previously-known, and two newly-discovered long period variables; plus seven more suspected variables.

They conclude that small-telescope photometry can make new discoveries in globular clusters, and help to characterize both known and newly-identified long-period variables. Key elements of their observing strategy were to: (a) make BVRI sequences all night, on the nights devoted to this project (thereby helping to reduce noise and accidental defects in the images and photometry; (b) ignore the dense central region of the cluster, where photometry will almost certainly be corrupted by crowding; and (c) use PSF-fitting photometry rather than aperture photometry.

Photometric monitoring of Luminous Blue Variables
by Carla Buemi, et al
http://arxiv.org/PS_cache/arxiv/pdf/1011/1011.3346v1.pdf

The authors have been using a 60-cm (24-inch) telescope for the past two years, in an ongoing program to monitor 25 known or suspected Luminous Blue Variables (LBVs), at a cadence of about once per week, in the visible (V, R, I) and infrared (J, H, K) bands. This paper is an interim report on some of their infrared observations. The three stars for which lightcurves are presented show both a secular trend (increasing by about 1 to 1.5 mag over 2 years), and cyclical variation of a few tenths of a magnitude with timescale of about 2 months. The cyclical variation includes a significant change in color [Δ (J-K) > 0.1 mag].

I note that all but 4 of their program stars are at southerly declinations. One suspects that a similar study of northern-hemisphere LBVs would be interesting and useful.

The Light and Period Variations of the Eclipsing Binary AA Ursae Majoris
by Jae Woo Lee, et al
http://arxiv.org/PS_cache/arxiv/pdf/1011/1011.3553v1.pdf

This report is from researchers at the (South) Korea Astronomy and Space Science Institute, based on observations made using the 60-cm (24-inch) telescope at their Sobaeksan Optical Astronomy Observatory in central Korea. As (bad) luck would have it, I am reading it shortly after North Korea's artillery attack on Yeonpyeong Island (far off the western coast of South Korea).

AA UMa is a 10^{th} magnitude eclipsing variable ($P\approx 0.47$ d) in contact-binary configuration. The lightcurves in B, V, and R bands saw the O'Connell effect (the maxima are of unequal brightness), usually explained by the presence of a hot or cold spot on one of the stars. In this case, the best model is a cool spot on one star, but the choice of star (and, indeed the choice of cool versus hot spot) does not significantly affect the fit between model and data – either will do nicely.

The authors find that their times of minimum, combined with historical Tmins, show compelling evidence of both a slow secular lengthening of the period, and a 28-year periodic component of the observed-minus-calculated (O-C) curve. The periodic component might indicate a third body in a 28-year orbit, or it might be caused by magnetic activity in the system. It turns out that existing observations cannot reliably distinguish between these two: a third body fitting the data would be too faint to show up on existing spectroscopic or photometric data, and the level of magnetic activity demanded is not unusual, by analogy to other similar systems. Conduct of additional lightcurve studies over several future epochs might begin to distinguish between these two hypotheses.

Physical Parameters of Close Binaries QX And, RW Com, MR Del And BD +07o 3142
by G. Djuraˇsevi, et al
http://arxiv.org/PS_cache/arxiv/pdf/1011/1011.3677v1.pdf

This is an interesting small-telescope photometry project. Of the four eclipsing binaries considered here, three have been the subject of previous photometric studies. The present study was motivated by the fact that other researchers have now gathered and reported radial-velocity data for these systems, so that reliable mass ratios (and spectral types) – which were not available to previous researchers – are now known.

The authors used a 40 cm (16 inch) aperture telescope and CCD imager to prepare high-quality B-, V-, and R- lightcurves of these four stars and combined this data with spectroscopic mass ratios to prepare detailed models of the systems. This effort resulted in substantial revision to the masses of these stars, compared to previous studies.

On The Angular Momentum Evolution of Fully-Convective Stars: Rotation Periods for Field M-Dwarfs from the MEarth Transit Survey
by Jonathan Irwin, et al
http://arxiv.org/PS_cache/arxiv/pdf/1011/1011.4909v1.pdf

The MEarth project is a small-telescope survey to photometrically monitor small stars (M dwarfs). The MEarth observatory consists of 8 telescopes of 40-cm (16-inch) aperture.

This paper reports on a project to determine stellar rotation periods for field stars. This information is valuable because stellar rotation period is presumed to be correlated with stellar age. As the pre-solar nebula collapses, it should spin up to conserve angular momentum, and after stellar ignition the spin should slow down as the stellar wind carries angular momentum away.

The MEarth telescopes monitored a large number of stars for low-amplitude brightness variation. Each star was measured several times per night, and the stars were followed for roughly 1 to 3 years. The idea is that if a (roughly sinusoidal) periodic signal is found, it most likely results from stellar rotation and star-spots, and therefore tells us the rotation period of the star. Such signals were detected for 41 of the stars that were monitored. The signal amplitude amounted to about 0.01 magnitude, and the periods ranged from less than one day to over 150 days. The results tend to validate the expectation that young stars spin more rapidly than old stars. More importantly, having a reasonably large sample enables the researchers to see that the rate of spin-down depends on stellar mass. It is worth noting that although spectroscopy can measure stellar rotation period of relatively fast rotators, the slow rotators are best found and measured by this sort of photometric study; and if both spectroscopic and photometric data is available, then they can be combined to estimate the radius of the star.

The First Confirmed Superoutburst of the SU UMa Type Dwarf Nova SDSS J083931.35+282824.0
by Jeremy Shears, et al

Here is another example of the critical contribution that small-telescope CCD photometrists make to the characterization of cataclysmic variables. This system was identified as a dwarf nova from SDSS data (evaluated by AAVSO's P. Szkody). Japanese amateur astronomer and prolific nova discoverer Koichi Itagaki discovered it to be in outburst in April 2010 (at mag 14, versus its quiescent state mag ≈20) and issued his announcement so that follow-up observations could be conducted. This is an urgent matter because CV outbursts only last a couple of weeks.

The authors monitored the system for 7 nights following Itagaki's discovery, using telescopes in the range 0.2m (8 inch) to 0.4 m (16 inch) and unfiltered CCD imagery. They show that the outburst amplitude as at least 5.8 mag, and that by 15 days after outburst, the system had returned to its quiescent brightness of about 19th magnitude. During the outburst, superhumps (rapid periodic brightness fluctuations, of about 0.25 mag P-P with a period of just under 2 hours). Their "observed minus calculated" (O-C) analysis of the superhumps shows the characteristic change in period as the outburst evolves. A lower-amplitude brightness fluctuation is interpreted (less confidently) as the orbital period of the system.

Nature of Light Variations in the Symbiotic Binary V417 Cen
by M. Gromadzki, et al

Long-period variable stars are challenging because their attributes can only by described by very long records of comparable observations. The consistent effort of generations of variable star observers to observe, record, and populate the AAVSO database are therefore essential in this area. Here is a report that describes period analysis of the (presumed) symbiotic binary V417 Cen, using the AAVSO's data from 2000-2010 (which is almost entirely visual observations), and the ASAS CCD data.

They find that the best estimate of the period is 1698 ± 220 days (4.6 ±0.6 years), with an amplitude of about 1.5 mag P-P. Other shorter periods also appear in the data, whose cause is uncertain. The limited amount of published spectroscopic data indicates that the spectrum – particularly the strength of certain emission lines – changes over time. There is not sufficient data to correlate these changes to the brightness cycle; nor, indeed, to be sure that the brightness cycle is coherent over multi-decade-long intervals.

This star is about Vmag ≈ 12, so should be within the range of backyard scientists, for visual, CCD, and spectrographic study.

The 40-cm astrograph dome on ZNB station (Zvenigorod, Moscow region) in August 2004.
Source: Maxim Yereshko

New Variable Stars on Digitized Moscow Collection Plates. The Field of 66 Ophiuchi
by D. M. Kolesnikova, et al
Astronomy Reports, 2010, Vol. 54, No. 11, pp. 1000–1018 (

From 1948 to 1996, the 40-cm (16-inch) Astrograph of Moscow Observatory exposed about 22,500 photographic plates, each plate being 30 cm (12 inches) square, and covering a 10-degree-square field of view (FOV). The digitization of these plates has been underway since 2004, using a procedure that accomplishes two simultaneous goals: creation of a digital archive of the plates, and discovery and photometric characterization of variable stars from these plates.

Here is an initial report, describing the results from digitization of the 254 plates centered on 66 Ophiuchi. The net catch was 480 new variable stars in just this 10 degree FOV – stars that are not found in the General Catalog of Variable Stars (GCVS) nor in the AAVSO Variable Star Index. The magnitude range is roughly 13.5 to 16.5. This collection includes periodic and semi-regular variables with periods ranging from fractions of a day to over 200 days.

The authors make a couple of procedural observations that are doubtless applicable to other searches of old plates for variable stars. First, the FOV of these plates is large enough that the change in air mass across the plate must be taken into consideration (unlike the modern CCD paradigm that usually assumes negligible air mass change across the – much smaller – FOV). Second, automated photometric processing can (and in their case, almost certainly did) create selection effects: there are zero Mira variables in their discovery list, due to the way their algorithm implicitly rejects stars that are below the detection limit on the reference frame or on many subsequent frames.

One suspects that many more "data mining" projects are possible, as the world's collections of old plates are digitized and made available on the Web. And that our own collections of CCD images may hold undiscovered data, if only we could easily search or catalog them by RA/Dec.

By the way, the Astrograph has a curious history. It was installed at the Sonneberg Observatory (Germany) in 1938. It survived the 2nd World War, but it was taken by the USSR as part of their war reparations. It was relocated first to Crimea and finally to its current site near Moscow.

WASP-31b: A Low-Density Planet Transiting A Late-F-Type Star
by D. R. Anderson, et al
http://arxiv.org/PS_cache/arxiv/pdf/1011/1011.5882v1.pdf

The WASP "south" system has identified the photometric signature of a transiting planet in a 3.4-day orbit around an 11.7 Vmag star in Crater. Follow-up spectroscopy (with large telescopes) confirmed the radial-velocity signal, and high-accuracy photometry (also with large telescopes) provided accurate transit times and lightcurve shape. The transit depth is about 1.5% (15 mmag).

There are a couple of interesting oddities about this system. The planet is one of the more "bloated" hot Jupiters, having about half the mass of Jupiter but a diameter of 1.5 times Jupiter's, yielding a very low average density, roughly 1/7th of Jupiter's. Current models of planetary "bloating" have a hard time accounting for such a large, low-mass body. The parent star has a common-proper-motion companion (Vmag=15.8, separation = 35 arc-sec). Based on the assumption that this star is coeval with the WASP-31 host, the distance to the system is estimated to be 400 parsecs.

The outburst of V713 Cephei in August 2009
by David Boyd, Denis Denisenko, Robert Koff, Ian Miller, Bart Staels
http://arxiv.org/ftp/arxiv/papers/1012/1012.0138.pdf

Two of the authors of this paper (Boyd and Koff) are good friends and members of the SAS. The team reports on the first well-observed outburst of V713 Cephei (a regular, not super-outburst), and their photometric results using CCD imagers and schmidt-cass telescopes ranging from 25 cm (10 inches) to 35 cm (14 inches) aperture.

From their light curves, they were able to refine the orbital period of the system ($P \approx 2$ h), observe the quite-large eclipse depth ($\Delta \approx 3$ mag) which indicates a nearly edge-on inclination, and observe evidence that the eclipse is more shallow as the outburst becomes brighter (presumably because the accretion disk is brightening and is large enough to be incompletely eclipsed by the primary star).

This system is quite faint at quiescence (about 18th magnitude) and even at the height of this outburst was only 15th magnitude, putting it out of the reach of most visual observers. Thus, if future outbursts are to be discovered and studied, regular CCD monitoring by backyard scientists is necessary.

A photometric long-term study of CP stars in open clusters
by E. Paunzen, et al
Astron. & Astrophysics v.525 A.16
preprint at http://arxiv.org/PS_cache/arxiv/pdf/1012/1012.0149v1.pdf

Acquiring knowledge of a star's rotation period is tricky to obtain, but it is important for a variety of reasons. Here is a report on a 6-year photometric study of chemically-peculiar stars within open clusters. Most observations were conducted using photoelectric photometers mounted to 50-cm (20-inch) or 61-cm (24-inch) telescopes, in the Stromgen u, v, b, y bands. Quite exquisite accuracy is needed for these measurements, because the typical amplitude of the brightness variations being examined is less than 50 mmag (0.05 mag) – about the same accuracy demanded for exo-planet transit lightcurves, but in this case maintained over several years.

Stars within open clusters were selected for special attention because the cluster's properties could be used to estimate the star's chemistry and age. The author's typical cadence was about 15 measurements per star over the roughly 6-year observing period. The resulting (sparse) lightcurves were subjected to a variety of time-series analyses, on the assumption that the principle period would represent the effect of star-spots modulated by the star's rotation. Rotation periods were determined for about half of the 27 open-cluster stars reported here, ranging from $P_{rot} \approx 0.7$ days to 4.6 days.

An ongoing follow-up series of observations is being done with the 60-cm (24-inch) "Rapid Eye Mount" telescope at La Silla, Chile.

Discovery Of The Predicted 2010 Eruption And The Pre-Eruption Light Curve For Recurrent Nova U Scorpii

by Bradley E. Schaefer, Ashley Pagnotta, Limin Xiao, Matthew J. Darnley, Michael F. Bode, Barbara G. Harris, Shawn Dvorak, John Menke, Michael Linnolt, Matthew Templeton, Arne A. Henden, Grzegorz Pojmanski, Bogumiłł Pilecki, Dorota M. Szczygiełl, and Yasunori Watanabe
The Astronomical Journal, v. 140, p. 925 (2010 October)

By now, you probably already know the story of U Scorpii – the first prediction of a nova outburst, the subsequent validation of the prediction by observation of the outburst, and that the discovery was made by an amateur astronomer (Barbara Harris). Less publicized, but worth noting in the author list of this report of the discovery are the contributions of John Menke (a long-time SAS member), Arne Henden (AAVSO Director and Advisor to SAS). Menke's CCD observations with his 18-inch (46-cm) Newtonian telescope during pre-outburst monitoring helped to constrain the time of the outburst – particularly difficult observations because the star was so close to the Sun. The very last observation prior to outburst was made by another amateur astronomer on the author list: Yasunori Watanabe using his 60 mm (2.4-inch) refractor – probably one of the smallest telescopes to provide observations for an AJ paper in a long time!

This successful observation of a predicted nova lends strong support to the theory that created the prediction. Based on that theory and these observations, the next outburst should occur at 2020 ± 2 yrs. However, a schedule of observations of the star (both visual and CCD) should continue between now and then, because the critical input data to the theory is the time-integral of B-band flux. The star varies more or less randomly by about 1 magnitude, so a steady stream of brightness observations (reported to AAVSO) can help to tighten up the error bars on the predicted time of the next nova.

CCD observers are therefore encouraged to put this star onto your observing schedule, for occasional measurement in B-, V-, and R-bands.

Multi-Epoch Near-Infrared Interferometry Of The Spatially Resolved Disk Around The Be Star Z Tau
by G. H. Schaefer, et al
The Astronomical Journal v. 140, p. 1838 (2010 December)
pre-print at http://www.chara.gsu.edu/CHARA/Papers/Paper40.pdf

Olivier Thizy gave a presentation about the Be Star Spectroscopic database at SAS-2010. He noted in his SAS presentation that the majority of spectra in the BeSS are from backyard scientists, not professional observatories. It is heartening to read this acknowledgement in this paper: "We thank Christian Buil, Benjamin Mauclaire, Ernst Pollmann, and the other observers who contributed to the BeSS database of ζ Tau spectroscopy".

Stellar Tidal Streams In Spiral Galaxies Of The Local Volume: A Pilot Survey With Modest Aperture Telescopes
by David Mart´ınez-Delgado, R. Jay Gabany, Ken Crawford, et al
The Astronomical Journal, v. 140 p. 962 (2010 October)

You may recognize Jay Gabany and Ken Crawford as premier astrophotographers. They are participating in a research project to search for and categorize the debris streams that are (presumably) the remnants of small galaxies that have been torn apart and devoured by larger galaxies (mostly spirals). "Participating" may be too soft a description: all of the images on which this study is based came from their private observatories, using commercial CCD cameras on RC telescopes ranging from 37 cm (15 inches) to 51 cm (20 inches), and a 16 cm (6 inch) refractor.

The images used for this paper required excellent conditions (dark skies in California, New Mexico and Australia, with typical seeing of 1.5 arc-sec), fine image scale (0.5 to 1.5 arc-sec/pixel), and very long exposures (5 hr to 18 hr, depending on the target). They detect and display impressively faint structures: about 27 mag/arc-sec (compared to the SDSS g-band detection limit of about 25 mag/arc-sec – roughly ten times brighter).

The tidal streams displayed here show surprisingly diverse morphologies, ranging from loops (that are easy to envision as the death-spiral of a small galaxy) to spikes, to umbrella-shaped masses. Surprisingly (to me) simulations of galactic encounters also show this diversity of shapes. The researchers hope to use this study and its successors as a way of confirming some predictions of modern cosmological models, and to help map the structure of galaxies' dark-matter halos.

A Comprehensive Photometric Study Of The Algol-Type Eclipsing Binary: BG Pegasi
by E. Soydugan, et al
New Astronomy vol. 16, Iss. 3, p 72 (April 2011)

Here is a photometric study of 10^{th} magnitude BG Peg that was conducted with a 40 cm (16 inch) telescope and CCD imager at the Çanakkale Onsekiz Mart University Observatory (Turkey). It is an interesting system: an eclipsing binary, whose brighter member is a δ-Scuti pulsating variable star. By creating a complete lightcurve in both B- and V-bands, the orbital period was determined (P= 1.95 days), and modeling with the Wilson-DeVinney code showed the system to be semi-detached (secondary star fills its Roche lobe). By subtracting out the effects of eclipses, the residual lightcurve displays the pulsations of the primary star, with two characteristic periods (25.54 cy/d and 21.05 cy/d), and amplitude of about 0.03 mag peak-to-peak.

An O-C (observed minus calculated) analysis of reported times of minimum light show a parabolic change in period that is presumably caused by magnetic braking; and a sinusoidal variation that may be indicative of a third component in the system. This putative third star would have a period of about 61 years, and a mass of between 0.8 and 1.7 solar masses (depending on its orbital inclination to the line of sight). These masses are comparable to or larger than the mass determined for the secondary star of the eclipsing pair, and yet the photometric solution did not require any "third light" contribution. The authors note that radial-velocity data on the eclipsing pair is needed to pin down their properties; and that high-resolution spectroscopy should be used to search for the ≈9.5 km/sec signal that would come from the third object (if it exists).

They also note that the star GSC 4550-1408 has also been identified as an eclipsing binary with a δ-Scuti component, but that no complete photometric solution has yet been published. Do any of you want to take on that project? (It is at Dec = 75 deg, so it never sets for mid-northern latitude observers).

Discovery Of Cyclic Spot Activity On The G8 Giant HD 208472
by O. Ozdarcan, et al
Astronomische Nachrichten, v. 331, No. 8, p.794 (2010)

When you have a robotic photometric telescope, you can monitor a variable star for however long it takes to reach a conclusion about it – in the case of this 7.5 mag star, that meant 17 years of photometry, mostly from the 40 cm (16 inch) Automated Photometric Telescope at Fairborn Observatory (in Arizona, but operated by the Univ. of Tennessee).

This is a complex system: an eclipsing pair, one of whose members is heavily spotted and has an activity cycle analogous to our Sun's 11-year cycle. In the case of this star, the spot cycle period is about 6.3 years, Further, the photometric period appears to not be constant, but rather goes through "jumps" that are synchronous with the star-spot cycle (e.g. spots moving from the "leading" to the "lagging" hemisphere).

Δ Sct-Type Pulsations In Eclipsing Binary Systems: Y Cam
by E. Rodrıguez, et al
Mon. Not. R. Astron. Soc., v.408, p.2149 (Nov., 2010)

What are the odds of two studies on two different Eclipsing binary systems, each wiht one member that is a pulsating variable, showing up in the same quarter? Here we have Y Cam, a system with some similarities to BG Peg (see the paper above). This particular research barely fits into my concept of "small telescope science", because the telescopes used range from 40cm (16 inches) to 1.5 m (60 inches), but I include it because one of the authors is amateur astronomer P. van Cauteren, who gathered photometric data using the 40-cm (16-inch) Newtonian at his Beersel Hills Observatory in Belgium.

Based on 86 nights of photometric monitoring in V-band and uvby bands, conducted on three continents, the authors created a complete lightcurve, showing both the 2-mag-deep primary eclipse and the much more subtle secondary eclipse ($\Delta V \approx 0.05$ mag), and the change in color during the secondary eclipse. Wilson-Devinney modeling shows that this is a semi-detached system with a photometric mass ratio of $q \approx 0.24$. After subtracting out the eclipse signature, they find that the residual brightness fluctuations of Y Cam's primary star show 8 characteristic modes, ranging from 15 to 20 cy/d, with amplitudes of a few mmag each. This modal analysis (a form of helioseismic study) might be valuable input to modeling of the star's structure.


SAS-2010 Symposium on Telescope Science will be held Tues-Wed-Thur May 24-25-26, 2011, at Big Bear CA. The annual RTMC (aka Riverside Telescope Maker's Conference) will be just a few miles away on Fri-Sat-Sun May 27-28-39. We look forward to seeing you at both events!

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