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BVRI Photometry of CX Cephei (WR 151)

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Abstract The CX Cephei system is a double-line spectroscopic, eclipsing binary, consisting of an O5V and a WN5 (Woft-Rayet star) component. It has the second shortest known period (2.12691d) among O + WR binaries. The primary eclipse is shallow (approx. 0.1 magnitude) and the secondary eclipse even shallower. There is other variability also, accounting for a total range of approx. 12.0 to 12.2 in Lipunova and Cherepashchuk 1982 (*Sov. Astron.* 26, 45–53) published photometry data from the 1980's. Lewis et al. 1996 (*ApJ* 405, 312–326) published radial velocity data, showing that the WR star is in front at primary minimum. To this we add 340+ BVRI points over two years from the Sonoita Research Observatory (SRO), plus assorted time series from Sonoita (by HQA) and from Starhouse Observatory (by KMP). From our observations, we were able to, 1) refine the period given by Lipunova and Cherepashchuk, and show that, 2) there is intrinsic variability in addition to the eclipsing binary light curve, 3) that, unlike the 1980s, the secondary eclipse is now barely detectable, 4) there may or may not be additional "structure" in the eclipsing light curve, 5) and that the light curve varies with color. We see that the minima are pointed (eclipse not total), that the minima have a distinct beginning and end, although there are "shoulders" (ellipticity is important, but sky is seen between the stars at quadrature), that the eclipses are very shallow (low i, barely eclipsing). There is a dimward slope between phase 0.2 and 0.8, ranging from 2.5% in flux in B and V, to less than 1% in I. It seems unlikely that the WR core is substantially cooler than even an O5, so the primary minimum is expected to be at least partly an "atmospheric" eclipse caused by the WR wind (as Lipunova and Cherepashchuk modeled it), rather than the star itself. However, the primary minimum is one of the most stable features with time, so the wind opacity and configuration must not be responsible for observed changes. Changes in the secondary minima must be due to changes in what the O5 is eclipsing. We have not yet modeled all this!

On the Classification of V3798 Sgr

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Abstract In 1972 D. Hoffleit classified V3798 Sgr as an RV Tau variable star. However Springob *et al.* (1998) suggested that it could be an UXOR—a star with sporadic drops of brightness. A retrospective study of the variability of the star was conducted using the Harvard Plate Collection. More than 250 plates were looked at with more than 120 measurements made. The plates were exposed as early as 1895 and as late as 1949. In addition the star was monitored in BVRI with a CCD camera on the Maria Mitchell Observatory (MMO) 24-inch telescope in 2007. In our study of V3798 Sgr, in both our CCD photometry and the plate study, sporadic drops of brightness were confirmed, measuring up to 1.3 magnitudes, within a broad range of time scales—from a year to an hour. No periodicity was detected. Spectra of the star showed typical early A absorption line spectrum with variable narrow emission in the cores of H-α and other absorption lines. A dramatic emission line flare was observed on September 19, 2007, with an increase of H-α equivalent width by a factor of 4 relative to the previous observation, five nights before. No continuum photometry is available for September 19 but the brightness in R two days before and one day after that date differs by only 0.07 magnitude. A closer synchronism of spectroscopy and photometry is needed to verify the lack of correlation between the variations of the emission lines and continuum. So far, the lack of periodicity and an early spectral type seem to disprove the classification of V3798 Sgr as an RV Tau star and support the hypothesis that it is an UXOR. We thank A. Doane for help with measuring the plates and P. Berlind, M. Calkins and O. Shemmer for taking the spectra. This project was supported by the NSF/REU grant AST-0354056 and the Nantucket Maria Mitchell Association.

AH Leo: 2004–2007

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Abstract The RR Lyrae star AH Leo has a distinct RRab light curve with a superimposed amplitude modulation and variation in time of maximum light.

During the 2004 through 2007 observing seasons observations were obtained to try and document observed effects, including an AAVSO observing campaign in 2006. In this presentation we discuss the data validation that was used to bring the campaign data inline with other data, discovered periodicities, and changes in the light curves shape over the four seasons of data.

Time Series Observations of IP Pegasi Using an Inexpensive Ambient Temperature CCD Camera

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Abstract IP Pegasi is an eclipsing cataclysmic variable star. The system occasionally goes into outburst due to accretion disk instabilities. Observations at quiescence were collected with a 20-cm aperture Schmidt Cassegrain Telescope. The images were recorded with a Meade DSI-Pro CCD camera. Co-adding was required to eliminate noise due to the ambient temperature CCD detector. The observations were unfiltered. AAVSO *V*-filtered and unfiltered observations were obtained during outburst. One objective of this study was to obtain time series photometric data from the low cost camera. This camera successfully provided unfiltered light curves of cataclysmic variable stars. A second objective was to analyze light curves of IP Pegasi and determine a probable structure of the system. The light curve during outburst displays a high luminosity midway between narrow eclipses. During quiescence, the peak intensity occurs just before the eclipse begins, and the eclipse is not symmetrical. The light curves support the belief that during outburst the brightest region lies in the vicinity of the white dwarf. During the quiescent state, the brightest regions of the system appear to be distributed among the red dwarf, the white dwarf, and the hot spot on the perimeter of the accretion disk. This study was funded by the American Astronomical Society, Small Projects Grant. It was also funded by the North Carolina Academy of Sciences, Yarbrough Grant.

Search for Dwarf Novae in DASCH Scans Near M44

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Abstract Dwarf novae (DNe) are a subclass of Cataclysmic Variables (CVs) with outbursts powered by a disk instability leading to a sudden increase in the accretion rate. The Digital Access to a Sky Century at Harvard (DASCH) Collaboration is preparing to digitize over 500,000 Harvard plates from the 1880s to the 1980s with limiting magnitudes ranging from B = 14–19. As a demonstration project, we have scanned more than 500 plates in the fields centered on the galactic open cluster M44. There are twenty-one CVs in the fields within ten degrees of M44 covered by the scans Here we present the preliminary results of DN outbursts of the known CVs to derive long-term DN outburst duty cycles. In addition, a one hundred year light curve for a XMM-Newton source is also presented to demonstrate DASCH capabilities.

High Speed Photometry of V455 Andromedae With a Small Telescope (poster)

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Abstract The recent eruption of V455 Andromedae to brighter than magnitude 11 has enabled unfiltered high speed photometry for this system. In mid-September 2007 the star was sufficiently bright that observations every thirteen seconds were acquired using a small telescope (20 cm SCT) and SBIG ST7 CCD camera. Fourier transform techniques detected a strong signal at 68 seconds-per-cycle on September 22–23, 2007 (JD 2454366.6) when the system brightness was about magnitude 12.5. Faint signals at 67 seconds were detected on earlier dates: September 18–19 (JD 2454362.6) and September 19–20, 2007 (JD 2454363.6). Fainter signals were also detected on later dates: September 28–29 (JD 2454372.6) at 71 seconds, and October 5-6 (JD 2454379.6) at 71 seconds. No isolated signals at the short 67–71 second periods were detected on other dates: JD 2454360.0, JD 2454381.6, and JD 2454388.6 (September 15–16, October 7-8, and October 14–15). When the 67–70 second signals were the strongest, the turbulence in the light curve was visibly weakest leading to a strong isolated short period signal. It is hypothesized that the short signal may be closely linked to the rotation period of the white dwarf at the core of the accretion disk. The large signal on one of the dates may indicate a temporary

brightening of a hot spot on the surface of the white dwarf. Students Emily Woodall, Alex Pearce, Gordon Jones, and Ted Risberg assisted the observations and analysis. This study was supported by the American Astronomical Society Small Projects Grants Program.

The Challenge of Finding the Comet for the Deep Impact Extended Mission

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Abstract The spectacular success of the Deep Impact mission coupled with adequate fuel reserves led to the authorization for the Deep Impact project to perform a maneuver on 2005 July 24 that would bring the flyby spacecraft back to the Earth's neighborhood in late 2007 for an extended mission to another comet. The goal of the extended mission will be to explore the diversity of comets, exploring the range of cometary topography, activity, thermal properties and chemistry. There were two possible comets accessible to the spacecraft: 103P/Hartley and 85P/Boethin. Of the two, 85P/Boethin is a much more desirable target. In order to re-direct the spacecraft to the comet, preparations for the December Earth-flyby maneuver are to begin with deep space maneuvers in early November 2007. On January 4, 1975, one day prior to its perihelion passage, short period comet 85P/Boethin was discovered by Reverend Leo Boethin in the Philippines. The comet was followed until early June. With an orbital period of 11.23 years, the comet was expected at its next perihelion passage in January 1986. It was recovered by Alan Gilmore and Pam Kilmartin in New Zealand on October 11, 1985 and followed just beyond its perihelion passage (January 16) until March 1986. Due to very poor observing conditions when the comet reached perihelion near superior conjunction, the comet was not observed during its most recent return to perihelion in April 1997. This comet gets bright enough for small telescope observations right near perihelion and the dust and gas coma and tail becomes visible approximately three months before perihelion. In order to fully map the orbit, observations are needed at three apparitions. This paper will discuss the role that small telescopes can play and will report on our attempts to recover this comet for a third apparition, in what is turning out to be the most challenging comet recovery ever done, using most of the world's largest telescopes. We will know by October 19 if we have a mission target!

Variable Star Spectroscopy: Tools, Techniques, and Recent Results

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Abstract For well over a century, variable star observers have catalogued changes in the brightness of thousands of variable stars. In contrast, there have been very few efforts to monitor changes in variable star spectra over time. This is unfortunate, because spectroscopic observations of variable stars can provide important additional information about the complex physical processes occurring within and around the star itself. For example, the presence of hydrogen emission lines in the spectra of Mira variables indicates the presence of shock waves in the upper atmospheres of these stars.

In this presentation, I will describe some of the resources available for making spectroscopic observations of variable stars with small telescopes, including spectrographs for data acquisition and software for data reduction and analysis. The process of observing a stellar spectrum will also be described, from image acquisition, through wavelength and flux calibration, to the extraction of stellar parameters such as spectral class and atmospheric composition. Finally, I will present results from ongoing research at the Truman State University Observatory to monitor spectral changes in Mira and semiregular variable stars.

Have Scope—Will Travel

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Abstract Since retiring from daily classroom teaching I have developed a program for bringing astronomy instruction and observing parties to elementary schools in southeastern Massachusetts through the existing parent-teacher organizations. In this paper I will show excerpts from my atmospheric, lunar, planetary, solar and stellar presentations as well as a few pictures of student star parties and public sidewalk astronomy.

The New DASCH Web Page (poster)

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Abstract DASCH is "Digital Access to a Sky Century at Harvard," the effort to digitize approximately 500,000 astronomical plates in the Harvard College Observatory collection. The project to date has generated 700 GB of images with 41 MB of supporting data. This paper describes a prototype web site designed to give researchers easy access to this information.

HI STAR: Building Bridges Between AAVSO Observers and High School Students

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Abstract How did a Hawaiian high school student get to use a telescope in Indiana, via the internet, to observe celestial objects of her choosing? It was thanks to an AAVSO member who generously shared his telescope time. Donn Starkey not only shared his telescope and expertise with this student, but with seventeen others this past summer at HI STAR, the Hawaii Student Teacher Astronomy Research program hosted at the University of Hawaii. This week-long "astronomy camp" for middle and high school students included lectures, activities, and—the highlight—observing. After just one week, all students, who had little to no background in astronomy, were able to begin astronomy research projects which they can continue at their schools. The content areas ranged from tracking asteroids, to doing photometry of variable stars, and calculating the rotational velocities of galaxies. We'll discuss highlights of the program, including how astronomers of all types can become involved with such promising students.

Hands-On Astrophysics and the Science Olympiad

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Abstract The *Hands-On Astrophysics* curriculum package is being converted to a web-based product in PDF format. Most of the student chapters have now been converted, with images substitutions and minor text revisions. It is anticipated that the entire student and teacher pages will be converted by spring. The pages will soon be placed on the AAVSO website so that AAVSO staff can enhance the materials with internal links and other materials. The membership is invited to view the status of the chapters and give input as to what should be done to improve *Hands-On Astrophysics* for amateur astronomers. Also, these materials as well as the AAVSO website are major resources for the National Science Olympiad high school astronomy event. There are other sites with Science Olympiad resources as well, and these will be shown to the membership so that if they are invited to assist Science Olympiad coaches with variable star astronomy, they will know where the resources are and how they can best meet the needs of the coaches.

Light and Optics Demonstrations for Astronomy

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Abstract How can you excite your audience about astronomy and telescopes when you have your star parties? What happens to the light coming from distant nebula or planet as it goes through the telescope to your eye? A basic physics review with demonstrations using mirrors and lenses will be used to answer this question. You will experience a discrepant phenomenon with an unexpected outcome. This creates a sense of wonder and the need for an explanation, motivating the person to learn more science. This is the goal of educational outreach, sharing a passion and wanting others to feel that same passion for astronomy.

The Orbit of Venus—A Lab Exercise

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Abstract Galileo observed the phases of Venus and concluded that it orbited the Sun. Students can use a modest sized telescope to make observations that will enable them to plot the orbit and determine its size along with the period.

Maria Mitchell: Portrayed in a New Biography

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Abstract Margaret Moore Booker, a longtime resident of Nantucket, has just published the results of her extensive research in many archives for additional material about "America's first woman astronomer." The result is a very illuminating and well-written portrait of Mitchell as an innovative force in women's education and an inspiring leader in the movement for women's rights. This paper will review some of the well-known details of Mitchell's life and show how Booker's work sheds new light on her subject's persona.

Extending Maria's Legacy

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Abstract Maria Mitchell Observatory (MMO) has long been the leader in Research Education for Undergraduates. This rich legacy includes over thirty-five Ph.D.s during its fifty-year history of programs initiated by Dorrit Hoffleit. A PREST Grant by the NSF purchased a 24-inch RC telescope and CCD camera which have brought MMO into the 21st Century. Additional initiatives will bring a 17-inch telescope on-line this Spring. Six student projects from Summer 2007 are highlighted. The Author also details "The Thrill of Discovery and the Agony of the Arne-fact (Artifact)."