Abstracts of Papers and Posters Presented at the 99th Annual Meeting of the AAVSO, Held in Woburn, Massachusetts, October 29–30, 2010

The AAVSO Centennial Calendar

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Abstract In celebration of the AAVSO Centennial, we have created *A Century of Variable Star Observing: 1911–2010*, a 13-month, full-color calendar that showcases the AAVSO and the people who have made it the dynamic institution it is today.

The 2010 Eruption of U Scorpii

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Abstract We report on the 2010 eruption of the recurrent nova U Scorpii. This outburst was predicted in 2005 and discovered independently by AAVSO observers Barbara G. Harris and Shawn Dvorak on 28 January 2010 as a result of a monitoring program coordinated by our group at LSU in conjunction with the AAVSO. The eruption lasted approximately 64 days, over the course of which more than 35,000 pre-arranged and serendipitous observations were made in all wavelengths from radio to x-ray. We present multi-wavelength light curves (UBVRIJHKby+UV+x-ray) of the entire eruption which show the overall speed of the event, the expected first plateau, the unexpected second plateau, and the return to quiescence. As anticipated, the onset of the optical plateau coincided with the turn-on of the supersoft x-ray emission and the re-emergence of the eclipses. Our comprehensive coverage shows fine-scale phenomena as well, such as flares of up to 0.5 magnitude in amplitude during the initial fast decline which are as yet unexplained and late aperiodic dips (distinct from the well-known eclipses) that are likely caused by accretion disk geometry.

The Latest Results on Accreting Pulsating White Dwarfs

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Abstract In the last few years, ground- and space-based data on the dozen known accreting pulsating white dwarfs present in cataclysmic variables have produced some surprising results. These include the finding that the instability strip is wider than for non-accreting white dwarfs and that the pulsations can disappear. One of the reasons for the disappearance is the heating of the white dwarf following a dwarf nova outburst, which moves it out of the instability strip. We will show our results from following three systems after their outbursts (GW Lib, V455 And, and SDSS0745+45) and how these objects differ in resuming their pre-outburst pulsation characteristics.

Analyses of "Peculiar" W Virginis Stars in the Milky Way

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Abstract We describe the analysis of light curve data for several candidate "peculiar W Virginis" stars in the field population of the Milky Way. Soszynski *et al.* (2008, 2010) have reported results for the Type 2 Cepheid population from OGLE-III. One of their important findings was a division of the W Vir variables into "regular" and "peculiar" subtypes. The latter are characterized by higher luminosities and a different light curve morphology. Furthermore, the fact that approximately 25% of the sample of "peculiar" W Vir stars were found to be in eclipsing systems suggested that all such stars were in binaries. The orbital periods of the eclipsing or ellipsoidal variations were found to be 10–20 times the pulsation period. Pulsation periods for "peculiar" W Vir stars were found to be between 4 and 10 days in the LMC and between 4.4 and 17.7 days in the SMC, although a claim that such behavior was present in longer-period RV Tau stars was also made. Identifying Milky Way counterparts to "peculiar" W Vir stars would have many potential benefits. The most obvious one is proximity, which allows radial velocity and spectral analysis with intermediate-size telescopes. The number of known or suspected W Vir stars in the Milky Way is large and growing. It would be surprising if there had been no evidence for such behavior in Milky Way stars to date—even if a subclass had not been identified—and indeed it is the case that several stars with similar propertied have been identified. In this paper, we report the time-series analyses of Milky Way "peculiar" W Vir candidates from AAVSO, ASAS-3, MACHO, and SuperWASP photometry in addition to noting binary orbit parameters for the candidates, when known.

RS Sge Observations and Preliminary Analyses

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Abstract New *V-, B-, Ic-,* and *R*-band photometry of RS Sge were obtained using AAVSOnet telescopes and the author's own equipment. Analysis of these new observations allowed a comparison with other previously published observational data. RS Sge was confirmed to be an RVb Tauri type star, showing the characteristic multiple periodic nature of such stars. Observations indicated a fundamental period of 79 days with a longer amplitude modulation of 1,174 days. While RS Sge was being monitored almost nightly for more than 120 days, no eclipses were observed.

Revisiting the Unnamed Fleming Variables

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Abstract In a 1998 article in *JAAVSO*, Dorrit Hoffleit brought attention to fourteen of the nearly 300 variables directly discovered by Williamina Fleming or discovered under her direction at the HCO. These fourteen stars had not been given permanent designations in the *General Catalogue of Variable Stars* at the time of Hoffleit's article. In the intervening twelve years since the publication of her study, a number of these stars have been further observed, both by AAVSO members and automated telescopes (such as Hipparcos). This poster will revisit these fourteen stars and update their status as variable stars.

Multiple Spiral Branches on Late AGB Stars

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Abstract We present some 1-D hydrodynamical models that are capable of generating ring structures around evolved stars. In these models, the pulsation of the star initiates the flow and generates shock waves from a static atmosphere. A secondary period is introduced by an orbiting companion. It creates a series of shocks with different strength. The most energetic one collects all the weak shocks, forming super shocks around the star. The most interesting results are period coupling between pulsation period and orbiting period and multiple spiral

arms in the far zone (>100AU). In the near zone (~100AU), the strong shocks greatly alter the density and temperature structure. This study enriches the possible mechanisms for the morphology of proto-planetary nebulae.

Visual Observations of δ Cephei: Time to Update the Finder Chart

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Abstract The current AAVSO finding chart for δ Cephei continues to reflect the notion that visual eye estimates need to refer to reference stars for which the cited visual magnitudes on the Johnson *V* system have been adjusted for a color correction to the eye *V*-system reflecting what is typical of the "average" AAVSO observer. The correction for the best AAVSO observers, however, appears to be negligible, given that the collected phased eye estimates of δ Cep over the past decade (or more) follow a light curve that is greatly suppressed in amplitude from that displayed for Johnson *V*-band data. The author has previously (1999) advocated the use of a modified finder chart for δ Cep that doubles the number of suitable reference stars and eliminates the problem of a suppressed light amplitude in the light curve. As shown here, light curves generated with such a finder chart are also more suitable for studies of period changes in Cepheids like δ Cep using O–C analyses.

Scientific Literacy of Adult Participants in an Online Citizen Science Project

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Abstract Citizen Science projects offer opportunities for non-scientists to take part in scientific research. Scientific results from these projects have been well documented. However, there is limited research about how these projects affect their volunteer participants. In this study, I investigate how participation in an online, collaborative astronomical citizen science project can be associated with the scientific literacy of its participants. Scientific literacy is measured through three elements: attitude towards science, belief in the nature of science, and competencies associated with learning science. The first two elements were measured through a pre-test given to 1,385 participants when they joined the project and a post-test given six months later to 125 participants. Attitude towards science was measured using nine Likert-items custom designed for this

project, and beliefs in the nature of science were measured using a modified version of the Nature of Science Knowledge Scale. Responses were analyzed using the Rasch Rating Scale Model. Competencies were measured through analysis of discourse occurring in online asynchronous discussion forums using the Community of Inquiry framework, which describes three types of presence in the online forums: cognitive, social, and teaching. Results show that overall attitudes did not change, $p = 0.225$. However, there was significant change towards attitudes about science in the news (positive) and scientific self efficacy (negative), $p < 0.001$ and $p = 0.035$ respectively. Beliefs in the nature of science exhibited a small, but significant increase, $p = 0.04$. Relative positioning of scores on the belief items did not change much, suggesting the increase is mostly due to reinforcement of current beliefs. The cognitive and teaching presence in the online forums did not change, $p = 0.807$ and $p = 0.505$ respectively. However, the social presence did change, $p = 0.011$. Overall, these results suggest that multi-faceted, collaborative citizen science projects can have an impact on some aspects of scientific literacy. Using the Rasch Model allowed us to uncover effects that may have otherwise been hidden. Future projects may want to include social interactivity between participants and also make participants specifically aware of how they are contributing to the entire scientific process.

Leon Campbell and His Fifty Years at Harvard College Observatory

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Abstract In traditional AAVSO historiography, Leon Campbell is presented as the first AAVSO Recorder, serving from 1915 to his retirement in 1949. Archival research provides a far more complex story about Campbell's engagement with AAVSO and variable star astronomy over that extended period. In this paper, Campbell's thirty-five years of support for the AAVSO in both informal and formal capacities will, instead, be set in the context of his full time employment on the staff of the Harvard College Observatory.

Artificial Intelligence (AI) Approaches for Analyzing Automatically Zillions of Eclipsing Binary Light Curves

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Abstract Major advances in observing technology promise to vastly increase discovery rates of eclipsing binaries (EBs) as well as other types of variable stars.

For example, missions such as the Large Synoptic Survey Telescope (LSST), the Panoramic Survey Telescope and Rapid Response System (Pan-STARRS), Gaia, and the AAVSO Photometric All-Sky Survey (APASS) are expected to yield hundreds of thousands (even millions) of new variable stars and eclipsing binaries. Current personal interactive (and time consuming) methods of determining the physical and orbital parameters of eclipsing binaries from the current practice of analyzing their light curves will be inadequate to keep up with the overwhelming influx of new data. At present, the currently-used methods require significant technical skill and experience; it typically takes 2 to 3 weeks to model a single binary. We are therefore developing an Artificial Intelligence / Neural Network system with the hope of creating a fully automated, high throughput process for gleaning the orbital and physical properties of EB systems from the observations of tens of thousands of eclipsing binaries at a time. The EBAI project — Eclipsing Binaries with Artificial Intelligence —aims to provide estimates of principal parameters for thousands of eclipsing binaries in a matter of seconds. Initial tests of the neural network's performance and reliability have been conducted and are presented here. Several practical applications also will be presented. This research is supported by the National Science Foundation: Research at Undergraduate Instituions (RUI) Program Grant AST-0507542.

A Web Interface for the DASCH Photometry Database

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Abstract DASCH is "Digital Access to a Sky Century at Harvard," the effort to digitize approximately 530,000 astronomical plates in the Harvard College Observatory collection. We currently have over 900,000,000 magnitude estimates from the 10,000 plates that we have scanned. This paper presents our web photometry interface which allows access to all of our light curves and their underlying scanned images.

A Variable Star Database for the iPhone / iPod Touch

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Abstract We present a database of variable stars for the iPhone / iPod Touch mobile platform. In the past 10 years, astronomical and biomedical research has been transformed by the ubiquitous availability of data repositories, and the commensurate opportunities for statistical analysis and data-mining. In order to make such databases accessible to mobile users, we have developed an

application framework that allows us to "mobilize" datasets onto the Apple iOS platform. This framework includes the ability to query the data, sort results, and view the details of individual records. For astronomical applications, we have also developed specific extensions to support object visibility based on the observer's geographical location and date/time. We demonstrate the platform using the International Variable Star Index (VSX) database.

Simple Pulse Width Modulation (PWM) LED Source for Linearity Testing of DSLR Camera Sensor

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Abstract To create meaningful photometry data knowledge of the linearity performance of the sensor in use (e.g. CCD or CMOS-array) is essential. The emergence of embedded controllers makes it possible—even for the hobbyist — to build fairly low-cost, highly controlled devices with capabilities that can be utilized to make light sources with pulse-width modulated LEDs. A simple system, comprised of a laptop computer, an embedded controller with an LED, and a few additional parts will be shown. Experiences and data regarding linearity testing of the source itself and, subsequently, characterization of a Canon DSLR camera with the source, will be shown. The technique can easily be extended to other sensors. The camera is currently used to take photometry data of epsilon Aurigae.

Solar Astronomy: Plasma Motion Detection At Radio Frequencies

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Abstract This article discusses a study of solar plasma motion with a radio receiving system designed to detect plasma motion-riven microwaves, and the initial radio systems analysis to understand the receiving characteristics. A phenomenon of interest in solar astronomy is the increase in temperature from the solar photosphere to the solar corona. This study examines a testable hypothesis for how to measure the different altitudes via a temperature scale of the transition zone (between photosphere and corona) of the sun. When we choose the appropriate frequencies—ones close to the surface, 11.7 GHz, and one above the 2km transition breakpoint at 12.2 GHz—we can test for a couple of possible phenomena: (1) at Extremely Low Frequencies (ELF), we see a Doppler shifting in the phase of plasma motions, and (2) in a polarized recording of data we can measure electromagnetic waves in both electric and magnetic components. The temperatures being measured at 11.7 GHz are approximately

15,000 Kelvin and the temperature at 12.2 GHz is approximately 17,000 Kelvin. The plasma motions between these two temperatures should be a measure of the thermal Doppler motion in the solar plasma as phase differences between the two frequencies.

The Water Tank Observatory

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Abstract New York is still at times written-off as a place for a credible astronomy observatory. It is the ideal place for observing by remote methods, yes, but not for direct observation of the stars in the very sky of the City. This is false myth, and it will be more forcibly so in the next few years. You see, we're planning and designing a new observatory on Manhattan. It will probe supernovae, active galactic nuclei, blackholes, quasars, neutron stars. It will collect data every bit as worthy as from similar observatories in the best of other locations. What's more, to a level unheard of before, this facility taps into an urban resource never intended for astronomy. In fact, the targets mentioned above didn't exist in our profession when this resource began construction some 130 years ago. What about luminous graffiti, or light pollution? The emissions captured by this observatory are in a region of energy that has no competition from terrestrial emissions. It's the energy of the cosmic wind, the flux of atomic nuclei propelled at near lightspeed and crashing into air molecules. We capture the fragments of the collisions and construct the original incoming nucleus. One method of detecting the cosmic wind, or rain from the shower of debris, is by slowing the particles in water and monitoring the resulting Cerenkov emission. Several cosmic rain observatories use this technique, such as the Pierre Auger Observatory in Argentina. We can't in New York build such a facility from scratch—our landscape isn't right for that, apart from the fanatical costs. In a historymaking episode in astronomy that bonds the Stars to the City, we found an alternative, one that literally sits on your roof.