The 100th Annual Meeting of the AAVSO
Cambridge & Woburn, MA
October 4 - 8, 2011

Paper Session Schedule & Abstracts

Friday, October 7, 2011

1:30pm – 3:00pm **Paper Session 1**

"Medical effects of poor lighting" *20 minutes*
Mario Motta, MD

The effects of poor lighting and glare on public safety are well-known, as are the harmful environmental effects on various species and the environment in general. What is less well-known is the potential harmful medical effects of excessive poor nighttime lighting. A significant body of research has been developed over the last few years regarding this problem. One of the most significant effects is the startling increased risk for breast cancer by excessive exposure to nighttime lighting. The mechanism is felt to be by disruption of the circadian rhythm and suppression of melatonin production from the pineal gland. Melatonin has an anticancer effect that is lost when its production is disrupted. I am in the process of developing a monograph that will summarize this important body of research, to be presented and endorsed by the American Medical Association, and its Council of Science and Public health. I will in this talk give a brief overall summary of this little known potential harmful effect of poor and excessive nighttime lighting.

"Star Watching promoted by the Ministry of the Environment, Japan" *15 minutes*
Seiichi Sakuma

My letter concerning to the "Star Watching" was introduced in AAVSO Newsletter No.2 (1987). The program is continuing still now. This paper describes 20 years summary. Visual observations are carried out on a moonless night about one hour after sunset during January and August. Observers try to find the Milky Way in the constellations of Perseus, Gemini and Monoceros in winter and Cassiopeia, Cygnus and Sagittarius in summer. 7x50 Binocular is recommended for the star counting in an area encircled by 6 bright stars in Pleiades cluster in winter and in an area of triangle formed by alpha Lyr (Vega), epsilon Lyr, and zeta Lyr. The positions of stars which one sees are drawn in a notebook. Photographic method is carried out by a camera with a focal length of 50~55 mm and f-ratio brighter 2.0 and a reversal colour film with ISO 400. The camera is fixed on a tripod and is set in the center of the field alpha Tau in winter, alpha Lyr in summer. Three exposures of 80, 150 and 300 seconds without guiding are carried out after setting the f-ratio at 3.5 or 4.0. Three exposed films are measured the density of the sky background relative to standard stars in that field using a densitometer. Method will be changed to use digital single lens reflex (DSLR) camera, this summer. Number of the observer group keeps more than 300 throughout 20 years. In 2010 summer, 6786 observers in 418 group, 2011 winter 3033 observers in 313 group were contributed. Binocular observation results show slightly down (brighter) the limiting magnitudes in winter. Judging from the results of 23 fixed point, background brightness of the sky does not change in recent 20 year.

"An Amateur-Professional International Observing Campaign for the EPOXI Mission: New Insights into Comets"
Karen J. Meech *15 minutes*

Comets are leftovers from the early solar system and may have played a role in delivering water and organics to the pre-biotic Earth. Because comets may preserve a record of the early solar system conditions, they are the focus of small body missions. The EPOXI flyby of the nucleus of comet 103P/Hartley 2 pro-vided us with physical properties of the nucleus and clear evidence of chemical heterogeneity with CO2-driven jets as a dominant volatile loss mechanism at perihelion compared to subsurface water-ice sublimation. An international Earth-based observation campaign played a complementary role to the in-situ data, providing recovery images of the comet at large distances, physical information about the nucleus size, and from a coordinated multi-wavelength program nearly continuous coverage from Aug. 2010 through encounter on 4 Nov. 2010. From the Earth-based campaign it was clear that comet Hartley 2 had a small nucleus (0.57 km radius), with a rotation period near 16.4 hours prior to the onset of activity. As the activity developed the periodicity was found to change significantly over a period of months. The highly active nucleus had long- and short-term gas production variability with peak activity shortly after perihelion. The comet's activity has been photometrically monitored (as scattered light from the dust coma) from the time of recovery to the present, and the nearly continuous coverage of the comet from Aug. 2010 into 2011 would not have been possible without the amateur contributions. Using

this brightness data, we have developed an ice sublimation model to estimate the amount of dust emitted from the comet (and hence the total scattered light) as a function of heliocentric distance as it is driven by a gas flow. The model includes nucleus ices: H2O, CO2, CO and H2O sublimating from the large chunks seen both from the EPOXI spacecraft and the Arecibo radar observations (Harmon et al. 2011). The model indicates that like other comets, water-ice sublimation began to create an observable dust coma / tail near 4~4.4 AU as the comet approached the sun, but that near perihelion, strong CO2 outgassing in the form of jets (as seen by the spacecraft) was responsible for lifting large ice/dust grains from the surface. CO2 is likely a strong contributor to activity on the outbound leg of the orbit. The models show that the fractional active nucleus area is small for water production (typical of other comets) and that at perihelion most of the water production is likely from the ice grain halo. Sublimation from deeper CO2 reservoirs is likely an important driver of activity for this comet, including out to and beyond aphelion, and this may be a characteristic of unusually active comets – relating to differences in chemistry from either formation or subsequent evolution.

This paper will present mission highlights, and emphasize the important role that the amateur observations has in understanding the behavior of this comet.

"High School Students Watching Stars Evolve" *15 minutes*
John Percy, Drew MacNeil, Leila Meema-Coleman, Karen Morenz

Some stars pulsate (vibrate). Their pulsation period depends primarily on their radius. The pulsation period changes if the radius changes, due to evolution, for instance. Even though the evolution is slow, the period change is measurable because it is cumulative. The observed time of maximum brightness (O) minus the calculated time (C), assuming that the period is constant, is plotted against time to produce an (O-C) diagram. If there is a uniform period change, this diagram will be a parabola, whose curvature -- positive or negative -- is proportional to the rate of period change. In this project, we study the period changes of RR Lyrae stars, old sun-like stars which are in the yellow giant phase, generating energy by thermonuclear fusion of helium into carbon.

We chose 59 well-studied stars in the GEOS database, which consists of times of maximum measured by AAVSO and other observers. We included about a dozen RRc (first overtone pulsator) stars, since these have not been as well studied as the RRab (fundamental mode) stars because the maxima in their light curves are not as sharp. We will describe our results: about 2/3 of the stars showed parabolic (O-C) diagrams with period changes of up to 1.0 s/century, some with increasing periods and some with decreasing periods. The characteristic times for period changes (i.e. period divided by rate of change of period) were mostly 5-30 million years. These numbers are consistent with evolutionary models. Some stars showed too much scatter for analysis; we will discuss why. A few stars showed unusual (O-C) diagrams which cannot be explained simply by evolution.

This project was carried out by coauthors MacNeil, Meema-Coleman, and Morenz, who were participants in the prestigious University of Toronto Mentorship Program, which enables outstanding senior high school students to participate in research at the university. We thank the AAVSO and other observers who made the measurements which were used in our project.

"The World's Strangest Supernova May Not Be A Supernova At All" *20 minutes*
Caroline Moore

SN 2008ha is the least luminous supernova ever to be observed. It is unclear what caused this obscurity to occur. For the last three years I have been doing independent follow up research on SN 2008ha.

SN 2008ha is believed to be 100 times brighter than a nova, but 1000 times dimmer then a supernova. The spectrum to some degree was classic type la supernova because of the lack of hydrogen and abundance of silicon, but there are many other factors to be considered. SN 2008ha had a short rise time of only 10 days (typical type 1a is 19.5 days). It has low expansion velocities of only 2000km compared to the typical la with very small kinetic energy per unit mass of ejecta. Although some elements of the spectrum are consistent with that of a type la, narrow lines were observed. This is just one of several characteristics that SN 2008ha shares with the "SN 2002cx- like class" of supernovae. SN 2008ha is believed to be the most extreme of this sub class of supernovae with the smallest amount of space between lines, 5 days shorter rise time, being significantly fainter, and having lower velocities. With all these things considered, it does make classification as a type 1a questionable. In fact it is even questionable if this is a supernova at all, and not just an "imposter". This may have just been a "star burp" which means that the supernova may have failed resulting in some parts of the star left, maybe even enough remains to explode again like seen in the case of SN 2006jc. This may have occurred because the explosion was not deep enough in the core of the star, and only eliminating some or all of the hydrogen envelope and leaving behind the carbon and oxygen inner layers, instead resulting in a type 1c supernova.

It would be interesting to see what, if anything is left of the star, this could make it a possible Hubble candidate, The idea that it may "burp" again, makes it especially important.

COFFEE BREAK

3:30pm – 5:00pm **Paper Session 2**

"28 Years of CV Results with AAVSO" *20 minutes*
Paula Szkody, Boris Gaensicke, Arne Henden, Steve Howell, Janet Mattei, Anjum Mukadam, Ed Sion, Matthew Templeton, Dean Townsley, Elizabeth Waagen, Gary Walker

I have worked with AAVSO data on cataclysmic variables since the 1980's, resulting in 29 papers from 1984 to 2011. The early work began with characterization of optical light curves of various dwarf novae and novalikes, then moved into coordination of optical observations with satellites (IUE, EUVE, XMM, Chandra, HST, GALEX) to explore the ultraviolet and xray regimes of disk systems vs those containing magnetic white dwarfs. The major advances in the field derived for dwarf novae and polars from these observations will be briefly summarized, ending with the recent results on the cooling of the white dwarfs and the return of pulsations in GW Lib and V455 And following their 2007 outbursts.

"Inventing Mira Ceti: First Inklings, Second Guesses, Second Thoughts" *30 minutes*
Robert Alan Hatch

This presentation offers a fresh interpretation of the early history of Mira Ceti, the oldest, largest, and most controversial variable star. Mira was historically important. But ironically, variable stars have never enjoyed the notoriety of the fleeting Super Novae. Blazing across the celestial stage, Tycho's Star (1572) and Kepler's Star (1604) are famous because they appeared unexpectedly—and equally dramatic—they disappeared unexpectedly. Mira was different. Mira appeared and disappeared again and again. Mira is important because Mira did not go away.

The purpose of this presentation is to show that the traditional narrative of Mira is not only muddled and wrong-headed but that a more nuanced account shows that variable stars were central to the New Science. In re-thinking the traditional narrative, I survey the period from the earliest sightings of David Fabricius (1596) to first speculations of William Herschel (1780). Here I show that two traditional heroes associated with Mira offered dramatic claims but no understanding of variable stars. Little known, like Columbus discovering the West Indies, Fabricius and Holwarda not only saw different things, they laid claim to two different and entirely unknown continents. In place of these pioneer observers, I present two new heroes. Not without irony, they were the two of the best-known astronomers of their day, Johannes Hevelius (1611-1687) and Ismaël Boulliau (1605-1694). In presenting an entirely new interpretation of Mira, I present fresh historical evidence from neglected printed works and otherwise unknown and unpublished manuscripts.

My thesis is that Hevelius and Boulliau were the actual founders of variable star research, not only due to their individual efforts but to their longstanding collaboration. In brief, if Hevelius the 'observer' gave Mira a history and an identity, Boulliau the 'theorist' gave Mira a future and a new audience. To be clear, "inventing" Mira Ceti meant re-thinking all the ways that stars were no longer "fixed." Mira required continuous observation of her changing magnitudes, a strategy for predicting her overall period, and a new theory of stellar phases. Theory aside, Mira also signaled the need for creating an army of observers with the discipline of Spartans. But to that end, observers needed reasons to observe Mira. Earning a returning audience of observers required a theory of when Mira would return. Mira's future hung on the expectation of her audience. Predicting Mira's future meant finding deeper levels of order behind the flux of appearance.

In the end, Mira drove a stake through the heart of ancient cosmology. The New Star in the Neck of the Whale also tested the promise of the New Science—new concepts of space, time, matter, and motion. Mira changed everything. Like Halley's Comet, Mira became a returning reminder that the world remained somehow rational.

"Illinois - Where Astronomical Photoelectric Photometry Grew Up " *20 minutes*
Barry B. Beaman

In 1903 Dr. Joel Stebbins joined the University of Illinois faculty as an astronomy instructor and Director of the University of Illinois Observatory. In 1905 he and F. C. Brown began experimenting with Selenium Cell photometry and developed the equipment and many of the photometric practices used then. Some of those practices still apply today. This talk will trace the history of Dr. Stebbins career and his development of photoelectric photometry from 1903 to 1922. Join me to find out how Dr. Stebbins' wife, May, caused a change in astronomical observing that continues today.

"The Variable Star Observations of Frank E. Seagrave" *20 minutes*
Gerald P. Dyck

I will discuss the relationship between Frank Evans Seagrave (1860-1934) of Providence RI and the Harvard College Observatory, and analyze the modest contribution Seagrave made to our database between 1895 and 1913, relating a few

anecdotes from his life as a self-taught astronomer whose relationship with Dr. Pickering ended in controversy, but whose legacy is carried on by Skyscrapers Inc, the astronomical society which now owns and operates Seagrave Observatory in N. Scituate RI.

Saturday, October 8, 2011

9:00am – 10:30am **Paper Session 3**

"Solar Cycle 24 – Will It Be Unusually Quiet?" *20 minutes*
Rodney Howe (HRHA), SID Analyst, AAVSO Solar Section

For the last 40 years or so all the AAVSO (American Association of Variable Star Observers) Very Low Frequency (VLF) Solar Ionospheric Disturbance (SID) data has been sent to NGDC (National Geophysical Data Center). In this paper these data are put into a database and graphed in hopes of understanding these VLF SID submissions. The graphics show the NGDC accumulated Importance Rating, (an index of the duration of solar flares), for all the AAVSO VLF SID submissions over the past 40 years. And, if we compare these VLF SID data with the last 3 solar cycles of sunspot number counts compiled by the Solen group (Jan Alvestad): http://www.solen.info/solar/cyclcomp.html it seems that the AAVSO VLF SID submissions to NGDC show our accumulated Importance Rating signals lag by 18 to 24 months after the start of each of the last three solar cycles! That puts our VLF radio's SID IR index measure at a point where it takes at least 100 sunspot counts per month before the VLF SID accumulated IR index even shows a signal through the noise floor of our ionosphere. The VLF observer's importance rating index is just monitoring the tip of these solar cycles with our VLF radios when compared to the sunspot number count indexes. And if the Solen sunspot predictions are right for Cycle 24, the solar sunspot peak won't even reach the 70 mark for this next cycle. So, our VLF SID IR index signal submissions may not even be detectable in Cycle 24!

"A Generalized Linear Mixed Model for Enumerated Sunspots" *20 minutes*
Jamie Riggs

Monthly sunspot counts data from consistently submitting observers were provided to determine monthly average sunspot numbers, and the individual observer parameters that correct each observer's counts to the monthly average. The data span a fourteen-month period from May 2010 through June 2011. The parameters are determined from a mixed effects, loglinear model constructed specifically from the fourteen months of Poisson-distributed, sunspot numbers. This model differs in the treatment of the data distribution assumptions of the existing linear regression model developed by Shapley (1949). The loglinear model methodology exceeds the correction coefficient performance criteria set by Shapley, and provides a method for determining the relative sunspot number reported monthly by the American Association of Variable Star Observers Solar Section. Model improvements are discussed.

"Data Evolution in VSX: Making A Good Thing Better" *20 minutes*
Sebastian Otero

A review of the current status of VSX is presented. Starting with an heterogeneous set of catalogs automatically imported, the data included in VSX have been constantly evolving and the role of observers contributing their new discoveries or revising known variable stars is getting more important each day. Examples of the improvements made in several aspects of star data such as identification, classification, elimination of duplicate entries and updates are given.

"VSX: The Next Generation" *20 minutes*
Christopher L. Watson

The AAVSO International Variable Star Index (VSX), the most comprehensive and up-to-date assemblage of publicly-maintained variable star data on the planet, will be undergoing a major overhaul in the coming year to greatly improve the database design, as well as the Web-based user interface. Five years after its official launch, VSX has evolved into an essential component of the AAVSO enterprise information architecture, tightly integrated with many of the technical organization's other mission-critical processes. However, its unique configuration and functionality are largely based on decades-old data formats and outmoded Web methodologies which will generally not scale well under the anticipated deluge of data from large-scale synoptic surveys. Here, we present the justifications and vision for VSX 2.0, the next generation of this indispensable research tool, including overviews of the creation of a brand new, fully-normalized, database schema, and the ground-up redesign of the front-end Web interface.

"Exploring the Breadth and Sources of Variable Star Astronomers' Astronomy Knowledge: First Steps"
Stephanie J. Slater *15 minutes*

There is considerable interest related to the astronomy content knowledge of various groups, whether that group consists of 3rd graders who have just learned the phases of the moon, or astronomy graduate students who are working on original research. Similarly, the Center for Astronomy & Physics Education Research (CAPER) Team and the American Association of Variable Star Observers (AAVSO) are interested in the general astronomy content knowledge of the AAVSO members. To increase our understanding of the knowledge base of today's variable star astronomers, we asked a subset of members to respond to an online general astronomy content knowledge survey called the Test Of Astronomy Standards (TOAST). The TOAST is a 29-item, multiple-choice format assessment instrument which addresses the full range of topics commonly taught in an introductory astronomy survey course, and is criterion referenced aligned to the consensus learning goals stated by the AAS Chair's Conference on ASTRO 101, the AAAS Project 2061 Benchmarks, and the NRC National Science Education Standards. This paper presents preliminary results on this work to the AAVSO membership in the hope that the findings will begin a conversation about the kinds of experiences and education that are transformative for this important group of astronomy researchers.

COFFEE BREAK

11:00am – 12:30pm **Paper Session 4**

"Intense observations of Cataclysmic variables, RR Lyr stars and High Amplitude Delta Scuti (HADS) stars"
Josch Hambsch *30 minutes*

An intense observing campaign is ongoing to study cataclysmic variables, RR Lyr stars (with and without Blazhko effect) and High Amplitude Delta Scuti (HADS) stars. These observations are based on requests and in collaboration with different organisations (CBA, VSNET, GEOS) and individuals. Observations are taken from my private observatories in Belgium, Chile and via a shared use of an observatory belonging to the AAVSOnet in New Mexico. Examples of intense follow up of individual stars will be shown during the presentation. Many publications in different journals including Astronomy and Astrophysics have already emerged from this research.

"RS Sge - Looking for Eclipses" *20 minutes*
Jerry Horne

New V, B, Ic, and R band photometry of RS Sge has been obtained for 2011. These new observations, when combined with observations from previous years, indicates the presence of a shallow eclipse every 28.77 days. Because of both the intrinsic short and long period variation in this RV Tauri variable, the eclipse is only detectable when it occurs during the relatively short quiescent segments of the stars overall variability. The observations also allowed development of B-V, V-I, and V-R color indexes for RS Sge and construction of an O-C diagram for the past two years..

"Things We Don't Understand About RR Lyrae Stars" *15 minutes*
Horace A. Smith

RR Lyrae stars were discovered before the founding of the AAVSO, and they have been studied using many techniques for more than a century. Although considerable progress has been made in understanding the evolution and pulsation of RR Lyrae stars, there remain important gaps in our understanding of them. Why do RR Lyrae stars exhibit noisy period changes and can we nonetheless use observed period changes to measure the evolution of such stars? What causes double-mode pulsation in some RR Lyrae stars, how stable is the double-mode pulsation, and why do double-mode RR Lyrae differ in different star systems? What causes some RR Lyrae stars to show a seocndary Blazhko period, and are we closing in on an explanation for the Blazhko effect? Observations by AAVSO observers are providing important clues that will aid in the solution of these and other outstanding problems.

"Eclipsing Binaries that Don't Eclipse Anymore: The Strange Case of the Once (and future?) Eclipsing Binary QX Cas"
Edward Guinan, Michael Bonaro, Scott Engle, Andrej Prsa *20 minutes*

We report on the cessation of eclipses of the former 6.005-day eclipsing binary QX Cas. This 10th mag star is a member of the young open cluster NGC 7790 and in 1954 QX Cas (B1 IV-V + B3 V) was discovered by Erleksova (1954; Astr. Circ. 155) to be an eclipsing binary. Subsequently Sandage (1958: ApJ,128,150) and Sandage & Tammann (1969: ApJ,157, 683) obtained accurate photometry of QX Cas that confirmed its eclipsing nature and provided accurate measures of UBV magnitudes and colors. The early light curves display two narrow eclipses with depths of~ 0.32 mag

and ~0.28 mag, respectively. Moreover the Min II occurs at 0.37 P - indicating an moderately eccentric orbit. To secure modern light curves, we have carried out UBVRI photometry using the 0.8-m Four College Automatic Photoelectric Telescope (FCAPT). Photometry was conducted on >110 nights and the observations now cover all the orbital phase-space of the binary. However, this photometry (and overviews of all recent photometry) show no evidence of eclipses. Thus QX Cas is no longer an eclipsing binary! QX Cas joins another former eclipsing binary - SS Lac - that over 20-yrs ago also ceased eclipsing.

We present the analysis of previous light curves and the analysis of recent spectroscopy and HST observations of QX Cas to determine its orbital and physical properties. We discuss the reasons that could cause QX Cas to stop eclipsing. These include binary system disruption or an impulsive orbital change from a close encounter with another cluster star or (most likely) from orbital perturbations from a putative bound tertiary companion.

QX Cas and other related eclipsing binaries that stopped eclipsing or show changes in their eclipse depths could be interesting targets for AAVSO members to monitor using CCD or photoelectic photometry. In addition, the changing orbital inclination of QX Cas and other similar, previous eclipsing binaries can be studied with spectroscopic radial velocity observations which are dependent on the star's orbital inclination.

This research is supported by NSF/RUI Grants AST05-07536 as well as NASA Grant HST-GO 10116 which we gratefully acknowledge.

LUNCH BREAK

2:00pm – 3:30pm **Paper Session 5**

"What mass loss modeling tells us about planetary nebulae" *20 minutes*
Lee Anne Willson, Qian Wang

Planetary nebulae are the result of mass loss from an AGB star (specifically, a Mira variable or post-Mira infrared source) that is swept up by a later fast wind and/or ionized when the central star becomes hot. The central stars of planetary nebulae are the naked cores of the former AGB star. Not all AGB stars form PNe, however, and the ones that do may be mostly binary star systems. Using both a large grid of detailed mass loss models and some simple analytical mass loss formulae we can relate observations of PNe and their nuclei to the character of the late AGB (Mira stage) mass loss.

"Introduction to Digital Archiving: Where the Past lives again..." *30 minutes*
Kevin B. Paxson

In the Harvard Annals paper from 1890 entitled "Index to Variable Star Observations," Edward C. Pickering documented and analyzed over 125,000 variable star observations known to exist from 1837 to the end of 1887. Up until recently, very little of this data has been entered in to the AAVSO International Database. Additionally, another estimated 105,000 variable star observations prior to 1911 have been identified by the author which await capture by Digital Archiving methods.

The author reviews the Digital Archiving process for variable star data and describes his Excel spreadsheet template for manual data entry, along with hints and guidelines. Recent archiving work is described and a brief overview of older variable star data in the literature is presented. Spreadsheet tools for unreduced variable star observations, which include an Argelander Method Magnitude Calculator and a Julian Date Calculator for Excel, are also described. Additional variable star data sources and some of the AAVSO's archival records with older variable star observations are discussed.

"Use of APASS to Calibrate Harvard Plates" *10 minutes*
Edward J. Los

The Digital Access to a Sky Century @ Harvard (DASCH) has scanned over 17,000 plates and developed a pipeline to calibrate these plates using existing photometric catalogs. This paper presents preliminary results from the use of the AAVSO APASS catalog for DASCH plate calibration. Photometric accuracy with APASS is comparable to that obtained with the GSC2.3.2 and Kepler Input catalogs.

"The Acquisition of Photometric Data" *40 minutes*
Arlo U. Landolt

The planning and execution of a typical observing run will be outlined. Particular attention will be addressed to details which aid in the acquisition of quality photometry.