ABSTRACTS OF PAPERS PRESENTED AT THE 89TH SPRING MEETING OF THE AAVSO, HELD IN HUNTSVILLE, ALABAMA, APRIL 15, 2000

GRASSROOTS ASTRONOMY

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Congress has a large impact on the amount and quality of astronomical research that takes place in the United States. By funding NASA and NSF, as well as other agencies such as the Department of Education and the Department of Defense, the Federal Government enables U. S. astronomers to perform cutting edge research. However, Congress makes its decisions based on input from citizens. If the citizens are silent on an issue, Congress does not know it exists. Last summer the U. S. amateur community rallied in support of professional research, resulting in a healthy budget for both NASA and NSF astronomy research. I will present a summary of how the funding process works and how and why amateurs can and should help ensure continued research funding for U. S. astronomy.

ON THE OBSERVATIONAL HISTORY OF CHI CYGNI

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Since its discovery in 1686 by Gottfried Kirch, chi Cygni has attracted the attention of many observers. Until 1738 the star was mainly monitored by G. Kirch and C. Kirch, and occasionally by Cassini and Halley. Later on, Le Gentil, Pigott, and Olbers, among others, provided series of observations, although these had long interruptions in between. During the 19th century significant contributions came from Argelander and contemporaries. In the second half of the 19th century, J. Schmidt obtained observations covering nearly 40 years! From the end of the 19th century on, amateurs have gathered an uninterrupted series of observations. An analysis of the available observations since the discovery date yields substantial cycle-to-cycle variations in the pulsation period with quite strong evidence for a linearly increasing period. A quadratic fit $T_{max} = T_0 + PE + 0.5\ (dP/dE)\ E^2$ over the complete range of available data yields a period change dP/dE = 0.014 day/century (P = 405.27 days), implying that chi Cygni's pulsation period has increased by about 4 days since the discovery date three centuries ago.

R CENTAURI: AN UNUSUAL MIRA VARIABLE IN A HE-SHELL FLASH

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R Cen is an oxygen-rich Mira variable with a period of 546 days, amplitude of 5.3–11.8 V, and spectral type of M4e-M8IIe, as listed in the *General Catalogue of Variable Stars* (Kholopov *et al.* 1985). It is one of only a few Miras with double-peaked maxima in its light curve (*e.g.*, Keenan *et al.* 1974). Our power spectrum shows harmonics up to 8 times the main mode at 546 days. The most likely explanation for the double-peaked light curve is a resonance between the fundamental and an overtone mode, with $f_o = 2f_f$ similar to that observed in bump Cepheids (Buchler *et al.* 1990), or a half integer resonance as suspected in Cepheids with period doubling (Kovács and Buchler 1988).

Visual observations from 1918 to 2000 from the AAVSO International Database show two unusual properties: 1) the pulsational amplitude has decreased by 3 magnitudes since 1950 (Figure 1), and 2) the period of the dominant mode has been steadily decreasing from 550 days at JD 2434000 (1951) to its present value of 505–510 days (Figure 2). Figure 2 shows the results of a statistical analysis using the weighted wavelet Z-transform (Foster 1996) and a Cleanest Fourier analysis (Foster 1995). We suggest that the recent behavior is due to R Cen entering a He-shell flash in its interior, as the period decrease of 1 day/yr is similar to that of other Miras thought to be undergoing a He-shell flash, such as R Hya and R Aql (Wood and Zarro 1981), and T UMi (Mattei and Foster 1995; Gál and Szátmary 1995).

A star in a He-shell flash may show a period change lasting only a few tens of years if it is caught right after the flash begins, or the change could last a few hundred to a few thousand years if it appears after the luminosity of the He-shell flash reaches the surface (Wood and Zarro 1981). However, R Cen should be monitored closely in the future, as some Mira variables (such as S Her and T Cep, see Wood and Zarro 1981) show short term period changes that are unrelated to a He-shell flash. We give further discussion of this unusual Mira variable in Hawkins, Mattei, and Foster (2001).

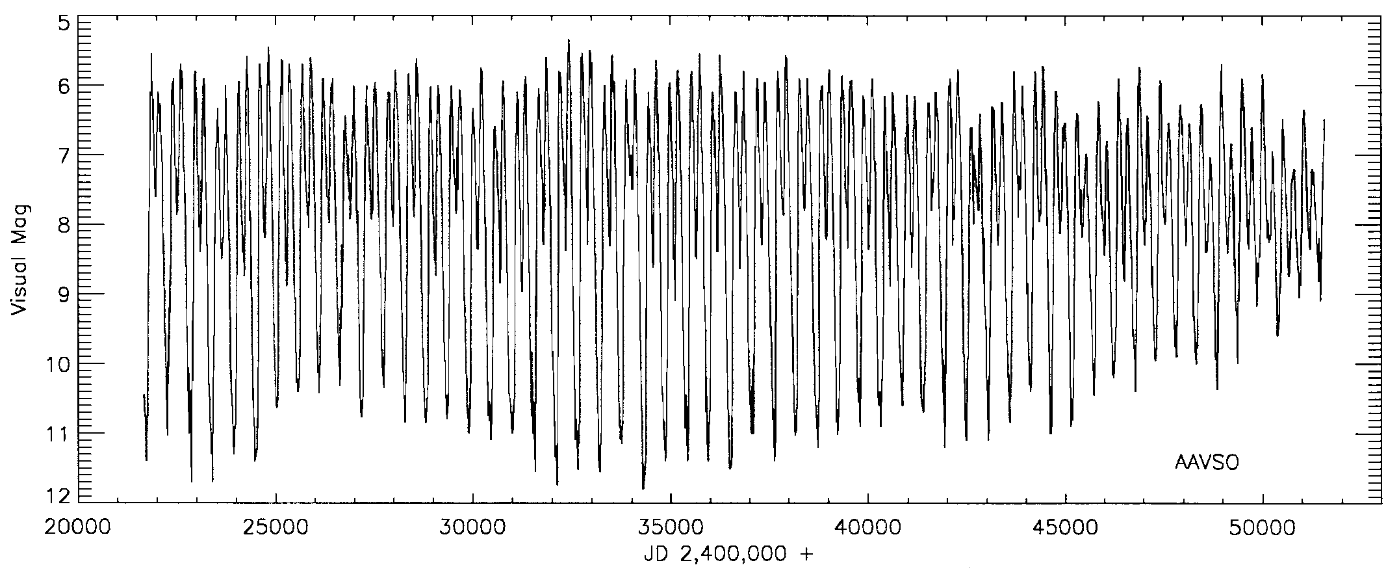

Figure 1. AAVSO light curve of R Cen for 1918–2000. 10-day averages of the data have been connected by a solid line for visual clarity.

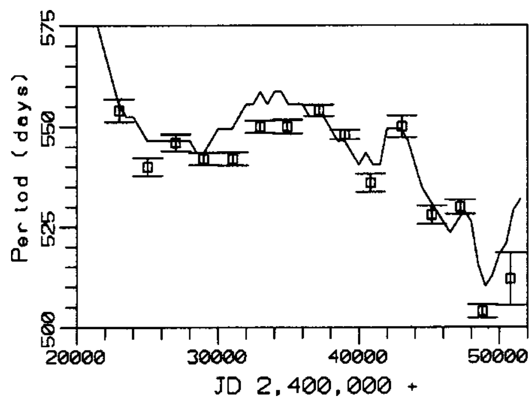

Figure 2. Wavelet plot (solid line)showing the period change in the primary mode from 1918 to 2000. The squares show a Fourier analysis of the data in 2000-day segments.

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WATER MASER PROPER MOTIONS NEAR EVOLVED STARS

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A summary is presented of recent observations obtained using very long baseline interferometry of water masers near evolved stars. We find that that masers do not have simple kinetic motions such as radial outflow at constant velocity. Recent results from infrared speckle imaging hint at very clumpy mass loss, which could lead to confused kinematics in the water maser region.

WAVELENGTH DEPENDENCE AND LONG-TERM TIME VARIATION OF POLARIZATION OF THREE RV TAU STARS

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The authors have studied polarimetric photometry data collected at Dodaira Observatory using a 91-cm eight-channel polarimeter. Three RV Tau stars (U Mon, SS Gem, and RV Tau) which show some interesting behavior in the light variation and pulsation period are discussed.

MIRAS AND THE ULTIMATE FATE OF THE EARTH

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What do AAVSO's favorite stars have to do with the ultimate fate of Earth? We have been learning about the most extreme conditions that the planets will encounter as the Sun ages. In about 7 Gyr, when the Sun is a Mira, the Earth will most likely be in serious trouble. Some results of recent calculations are presented showing what is most likely to occur, and giving a couple of possible (but unlikely) "outs."

CURRENT PHASE OF THE SUNSPOT CYCLE

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A brief introduction of how sunspot numbers are derived is discussed. A 200-year sunspot curve is presented and discussed, with emphasis on the alternating height of cycle maximum—one cycle higher, the next cycle lower, the next cycle higher, etc.—since 1850. Predictions of the current cycle maximum are also presented, demonstrating that the chances of continuation of the 150-year alternation are in doubt.

EVIDENCE FROM SUNSPOT STATISTICS THAT THE SUN HAS CHANGED ACTIVITY MODES DURING THE LAST TEN CYCLES

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An examination of sunspot cycle data suggests that the Sun has occupied two activity modes in the years for which the most reliable records are available. Evidence for this is found, first, in the graph of the yearly averages of the daily sunspot numbers dating from 1882 to the present; and second, from statistical comparisons of various data sets for the years 1882 to 1946 (Early period) with their counterparts for 1947 to 1996 (Late period). Examination of a plot of the running correlation coefficient between the number of days per year when the Sun's disk was devoid of spots and the yearly average of the daily sunspot numbers, starting in 1882, is quite consistent with the two-mode hypothesis and a transition around 1946. The most compelling quantitative evidence for separate modes comes from comparing the Early with the Late daily sunspot numbers averaged over each cycle. The former (the average over cycles 13–17) is 42.0 ± 8.7. The latter (cycles 18–22) is 78.2 ± 13.1. The separation of the averages is 36.2 ± 15.7, or 2.3 standard deviations. Finding distributions this compact compared to their separation lends considerable support to the correctness of the hypothesis.

A RITZIAN INTERPRETATION OF VARIABLE STARS

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A revived version of de Sitter's 1913 binary stars argument against Ritz's emission theory of light is presented. De Sitter's argument provides a falsifiable theoretical framework from which to examine the observed modulation of magnitude and color of variable stars. In this presentation Ritz's approach is applied to Cepheid and Mira variables.