Eyepiece Views: June, 2005

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E Y E P I E C E   V I E W S   #310

June, 2005

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1. INTRODUCTION

This is the first issue of Eyepiece Views after the long break we took due to staff schedule adjustments. We are back now full force and we look forward to bringing you a consistent and useful publication. We are looking
into ways to improve our publication to make it more reader friendly and useful. We prepared a tiny survey and we would greatly appreciate if you could visit the URL below and fill out our survey. This will help us to better understand your needs and therefore to better serve you.

Best wishes for a wonderful summer ahead!

http://www.aavso.org/publications/eyepieceviews/survey.shtml

Thanks and good observing!

Gamze Menali, AAVSO Technical Assistant (MGQ)
Aaron Price, AAVSO Technical Assistant (PAH)

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2. FROM THE DIRECTOR - Arne Henden

Welcome to the "phoenix" issue of Eyepiece Views. Many of you know me from my numerous postings on aavso-discussion regarding data quality and

chart sequences. While my background is heavily into CCDs and technical instrumentation, I fully realize the importance of the visual observer for the goals of the AAVSO. Visual observing was the only photometric method for
much of the early history of variable star observing, and is the cheapest and most widely spread method of observing with today's telescopes.

Towards those ends, my primary emphasis has been in improving the quality of the chart sequences. This helps all observers of a given object, whether
they are using their eyes or an expensive camera. If the sequence errors are small, then the submitted observations are only prone to observer error.
If the sequence errors are small, observers will be less frustrated with stars they normally observe, and will be more likely to branch out to fields
that they have avoided because of sequence problems. These new sequences have also led to better charts, a project headed by Mike Simonsen.

We are also working to improve everyone's photometry. The Spring 2005 meeting in Las Cruces contained a precision CCD photometry workshop. The Fall 2005 meeting in Newton, MA will have a precision visual observing workshop, with a cast of experienced observers to guide you in sharpening your skills. We will also have a public introductory variable-star observing session, to bring more people into the organization.

We are searching the archives of variable-star organizations throughout the world to find large databases of old visual observations that can be added to our International Variable-Star Database, to be made available on-line to the professional researcher. I will be travelling to the UK and the southern hemisphere this coming year, to meet with amateur organizations and renew our collaborative activities. We've completed the Validation Project, correcting observer errors in the observational database through 2001, and will be asking for a grant extension to complete validation through the current date. Changes are being made to the database to make it
easier to use, both internally for corrections and additions, and for the outside researcher.

This is an exciting time for all observers, regardless of experience or instrumentation. Keep working hard and producing that great data that everyone wants!

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3. FASCINATING MIRAS - Erwin van Ballegoij (BVE)

Nowadays many observers focus their observing efforts on cataclysmic variables and a few other oddballs. They use every clear night to observe as many CV's as possible, hoping to catch one in outburst. It can be very rewarding to be the first to observe an outburst, especially of the little studied or newly discovered systems. It can be also very rewarding to observe Miras. There are many under observed Miras, waiting for someone to study them. Often a big part of the whole light curve can be observed. And even some very well observed stars are in for a surprise or two. In this short letter you will find some theory concerning Miras and some interesting examples are discussed.

Miras

Mira variables pulsate with a period between 80 and 1000 days. In visual light, the amplitude of the light change is in general between 2.5 and 10 magnitudes. In infrared the amplitude is significantly smaller. Miras are of spectral type M, S or C, dependent on the ratio between the amount of carbon and oxygen in their photosphere. M-type Mira stars have less carbon than oxygen, S-types contain roughly an equal amount of both elements, while C-types are over abundant in carbon. M, S and C type stars have a noticeable orange color, especially around maximum. This color points to a relatively low surface temperature of 3000K. Special care has to be taken while estimating Miras near maximum. The orange color makes it difficult to make a reliable estimate of its brightness. This explains the large scatter in brightness estimates of Miras near maximum. US observers mostly use the "quick glance method", while European observers generally use the "out-of-focus" method. It is probably best to observe maxima of Miras with an as small as possible instrument, or to use a diaphragm to reduce the aperture of the telescope. The mass of Mira variables is comparable to the Sun, but with a diameter 200 to 300 times as big. This large diameter causes the big luminosity. Miras radiate 3000 to 4000 times as much light as the Sun.

Mass loss

As a Mira star expands, the diameter increases greatly. Therefore, the escape velocity in the outer parts of the photosphere will be very small. A part of the hot plasma (ionized gas) at the edge of the star will move fast enough (10 to 20 kilometers per second) to escape to interstellar space. This outflow of plasma is connected to shockwaves moving through the star and convection in the outer layers of the star. The out flowing gasses will condense at a distance of 2 to 6 AU from the star. Here they react with the dust present. Infrared satellites have proven the existence of this dust. The dust particles measure about one micron and are mainly composed of silicon dioxide. This makes them grains of sand, "polluted" with iron, magnesium and aluminum compounds. Radio telescopes have shown the presence of hydroxyl (OH) around Miras. This way Miras loose about one millionth of a solar mass a year. When you realize that Miras have a mass of about one solar mass, then it becomes obvious that the Mira stage is only a short period in the evolution of these stars. Mira variables play an important role enriching interstellar space with heavy elements. Because of their continuous mass loss the are predecessors of planetary nebula and as such also of white dwarf stars.

Evolution of Miras

Stars spend most of their time on the main branch of the HR diagram. In this phase they convert hydrogen to helium. When the nuclear fuel runs out, the star expands and gets brighter. The star changes into a giant. At a certain stage the radiation pressure of the star cannot withstand gravity anymore. The star compresses and the brightness decreases. The density and the temperature in the nucleus increase. At this higher temperature helium can be converted into carbon. The star reaches the horizontal branch above the main branch of the HR diagram. When the helium in the nucleus is depleted, the star turns into a giant again. The nucleus contains carbon and
hydrogen, surrounded by two nuclear fusion zones, one in which helium is converted to carbon, surrounded by a layer where hydrogen is fused to helium. The star reaches a second horizontal branch in the HR diagram. This Asymptotic Giant Branch (AGB) lies above and parallel to the first giant branch. The star becomes bigger and more luminous than the first time. In the AGB you can find the Mira stars and the SRa and SRb stars as well.

Thermal Flash

Some Miras do not have a constant period. Some show an increasing period and others a decreasing period, sometimes after a prolonged time with a constant period. Astronomers suspect that the change in period is connected to a thermal pulse. During a thermal pulse there is a short period with an enhanced fusion in the helium layer. This releases extra energy. When the star processes this extra energy, the carbon/oxygen nucleus and the helium and the hydrogen layers mix a little bit, enriching the convection layer of the star with carbon and oxygen. This change in interior structure influences the pulsation period of the star. It could even be that a Mira star stops its pulsations, to become a Mira variable again later on.

Of the about 6000 Mira variables in the General Catalogue of Variable Stars (GCVS), less than 1000 are regularly observed. Of these, only a few handfuls show a clear period change. The most illustrative examples are discussed below.

T Ursae Minoris

Mrs. L. Ceraski discovered T UMi on February 13, 1902. Until 1968 the period stayed almost constant at about 315 days. Starting in 1968, the period of this star started to decrease. Nowadays the period is roughly 240 days and the decrease hasn't stopped yet. T UMi can reach magnitude + 7.8, and can get as faint as +15.2. The average magnitude range lies between +9.2 and +14.0. The maxima are easy to observe in a small scope, but for a faint minimum you need at least a 30 cm (12") telescope. For a big part of the northern hemisphere this object is circumpolar. T UMi is easy to find starting from beta UMi.

R Hydrae

Maraldi discovered the variability of R Hya in 1704. Until 1770, the period was nearly constant at 495 days. From 1770 to 1950 the period decreased to 395 days and has remained constant since that date. R Hya can be as bright as + 3.7 and as faint as + 10.3. On average the brightness lies between +4.5 and +9.5. Although this star has a southern declination, it is also very easy to observe from a big part of the northern hemisphere. At maximum it is a naked eye or a binocular object, at minimum only a small telescope is needed R Hya is very easy to find starting from gamma Hya.

R Aquilae

This star near delta Aql was discovered by astronomers in Bonn, Germany in 1856. Since its discovery the period decreased to about 270 days nowadays. The star varies between magnitude +6.1 and +11.5. Although this star has a northern declination, it can be observed from all major landmasses from the southern hemisphere. At maximum binoculars are sufficient, but at minimum at least a 11 cm (4.5") telescope is needed.

Z Tauri

This star can reach a maximum of +9.0, but the minimum could be as low as +14.8. On average the brightness lies between +9.8 and +13.9. Around 1925 the period was about 500 days, but it has decreased to 450 days at the moment. Z Tau can be observed from both hemispheres, as it lies near the border between Taurus and Orion.

R Centauri

The period of R Cen remained virtually constant at around 550 days until 1950. Nowadays it has decreased to 510 days. R Cen is a so-called "double-peaked" Mira, whose light curve shows two maxima per cycle. Besides the period, also the amplitude of this star has decreased. The amplitude is nowadays one third of what it was in the beginning of the twentieth century. R Cen can only be observed from the equatorial region and the southern hemisphere. It is located near beta Cen. This star seems an easy target, but there are many faint stars out there to confuse you. Take care that you identify R Cen properly. This star is observable in small telescopes.

LX Cygni

There are also Mira's that increase their period. In 1968 the period of LX Cyg was around 480 days, but it has increased to 580 days since then. LX Cyg is only visible from the northern hemisphere, and is located near the open cluster NGC7209. The star is located near the Cygnus / Lacerta border, in a region of the sky devoid of bright stars. This makes LX Cyg a difficult target for beginners. At maximum a small telescope is sufficient, but to follow this star as it goes to its minimum you need a 25 cm (10") telescope.

BH Crucis

Also BH Cru is a variable that has increased in period. In 1979 it had a period of 490 days, nowadays the period has increased to 530 days. BH Cru can only be observed from equatorial regions and the southern hemisphere. The star is easy to locate near gamma and delta Cru. At maximum a binocular is sufficient, around minimum a small telescope will do. Unfortunately, there is no AAVSO chart available for this star. However, there is a good chart available from Sebastián Otero's website: http://ar.geocities.com/varsao/Carta_BH_Cru.htm

W Draco

The last star in this discussion is W Dra. This star also increased in period, from 255 days in the beginning of the twentieth century to 280 days now. W Dra has a declination of +66 degrees, and is therefore only observable form the northern hemisphere. Unfortunately, this star lies in a region with no bright stars and is for beginners difficult to locate. At maximum a small scope will do, but at minimum you will need a 25 cm (10") telescope at least.

Observing

Above a number of stars are discussed that show a period change. They need continuous monitoring, to see how their periods evolve. But do not focus your observing efforts to the mentioned stars alone. There might be many other Miras with this kind of behavior, but they are simply not studied long or frequent enough to draw any conclusions yet. To draw a conclusion, we need a long time base of decades to centuries. Furthermore, realize that some stars that have a 'constant' period nowadays may show period change in the future. T UMi is a clear example. It had a constant period, but this started to decrease in 1968. This period decrease has not stopped yet. Just observe and let the stars surprise you. Clear Skies.

Sources

1. Secular Evolution in Mira Variable Pulsations, Templeton M.R., Mattei J.A. & Willson, L.A. AJ, in press
2. Post-AGB Stars, Van Winckel H., ARAA 41 (2003), p. 391-427

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4. WHEN THE ART OF VISUAL OBSERVING GOES AWRY - Keith Graham (GKA)

The year was 1981 when I was indoctrinated into the wonderful world of variable star observing. Like many others who entered this realm, I had done my share of observing and photographing solar system and deep sky objects. I was ready for something else. Being a high school teacher in geology and astronomy, I really wanted to make a contribution to science. I reasoned that an endeavor in variable star observing would satisfy my insatiable appetite for night sky fare while at the same time allow me to make that contribution to the science of astronomy.

I greatly enjoyed eyepiece variable star observing for 17 years, (with a 3 year hiatus somewhere in there). But alas, during that 17th year, I began noticing that my visual detectors were playing tricks on me. When comparing a variable to a comp star, I would notice that the variable would sometimes appear brighter than the comp and sometimes dimmer - right there as I was looking at it. It is certainly characteristic for variables to change magnitudes, but not to go through a complete light curve within seconds. This got me to thinking that my contributions to science were not going to mean much if I couldn't make accurate magnitude estimates of the target stars. So what now? Must I give up VSOing? Not a chance!

It was about this time that CCD astronomy cameras were coming into their own. I learned through my personal investigation and research that this device could be used very nicely for photometric observing. During my years as an astronomy teacher, I had some experience in using an Optec SSP photometer. I soon discovered that the CCD camera had some advantages over the photometer, and it really peaked my interest. To make a very long story short, I took the plunge and have not regretted it at all. CCD photometry gave me the way to continue my observations of variable stars when I could no longer depend on the reliability of my personal photon collectors.

I have been doing CCD photometry for about 6 years now. I am truly grateful that I am able to continue VSOing via this route, but I also know that it might not be for everyone. After all, we observe variable stars because of our love and passion for doing so. The manner in which we achieve our enjoyment is strictly up to us as individuals. I truly believe that both visual and CCD observing are essential to our understanding of variable stars. Each method has its benefits. But one of the dangers I have discovered with CCD observing is that it can tend to remove one from the beauty of darkness and starlit skies while placing him in his office where he runs his scope remotely from an office computer. With eyepiece astronomy, the observer MUST be at his scope to observe. Not so with a CCD camera. Recently I bought a new mount for my telescope, and I have been out in my observatory testing it and observing. These nights out there reminded me of the many hours I used to spend under the stars as I peered through my eyepieces as I visually estimated variable star magnitudes. This has stimulated me to get back out there under the stars where I belong.

If you are completely, 100% satisfied doing visual VSOing, I highly recommend you stick with your passion. If you have a desire to delve into a little deeper and more involved method, I would urge you to give CCD photometry a try. It is very challenging and rewarding, but you must be prepared to experience a learning curve. When I started out, CCD photometry was truly a DIY effort. Back then, there were very few books to tell one how to do it. Fortunately for me, there were a few observers out there who were well versed in the art of photometry and who were willing to lend a willing hand to this photometric neophyte. But times have changed. There are now many CCD photometrists who are willing and eager to help you level out that learning curve, and there are many good books on the subject. In fact, many of us have been anxiously awaiting the bookstore arrival of the latest book authored by a well-known director of the top variable star organization in the world.

If you do decide to give CCD photometry a try, it certainly does not mean you have to give up visual observing. Why not do both? After all, variety has its place in keeping one's interest peaked. Should the day come when you find you would like to expand your variable star experiences, or just can't do eyepiece estimates any longer, just know you do have an alternative to maintaining your passion for variable stars.

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Good observing!

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