Getting Started with Variable Star Observing

The primary types of variable stars you will be observing are:

Cepheids - Named after Delta Cephei, these luminous stars brighten and fade with clockwork regularity. There are several types of Cepheids ranging from Beta Cepheids with 0.1 magnitude fluctuations and short periods from 3 to 7 hours to W Virginis Stars with fluctuation of about one magnitude over a period of up to 20 days. In 1910, Henrietta Leavitt learned that the longer a Cepheids period was, the brighter the absolute magnitude was. This led to Harlow Shapely developing the method of using Cepheids to determine the distance to globular clusters and nearby galaxies. See the attachment Delta Cep for the chart.

Mira Stars - These long period variables are very large red pulsating stars having brightness magnitude ranges of up to 11 magnitudes and a time period from 24 days to 5.7 years. These stars can be regular, semiregular, or irregular. Some examples are Mira 2.0-9.3 332 days, R Leo 5.9 -10.1 313 days, Chi Cygni 3.3-14.2 408 days, Betelgeuse .4-1.3 5.7 years. Estimates should be done at least twice per month.

Eruptive Stars - This group contains Novae and Nova like stars with a great range of types. Recurrent Nova such as T Coronae Borealis may have outbursts that are decades apart. Stars like U Geminorum and SS Cygni repeat their outbursts every few months. One type, R Coronae Borealis, instead of erupting drops by as much as eight magnitudes. UV Ceti stars may flare several magnitudes in a matter of minutes. This class of stars is not generally recommended for starting observing programs, h. However one of the most exciting stars in the sky is SS Cygni going from ~mag 12 to ~mag 8 in a few days.

Eclipsing Binaries - These are not true variable stars like the ones listed above. They are binary star systems with the stars rotating in the same plane as our line of vision. The best- known example is Algol. Their periods range from 0.2 days to 30 years. See the attachment B Per (Algol) for the chart.

The manuals describe more categories of variable stars and go into greater detail.

How to Estimate a Variable

A good way to start estimating variable stars is to start with Delta Cephei or Algol. On the chart for Delta Cephei note the triangle Delta Cephei, Epsilon Cephei, and Zeta Cephei. Epsilon Cephei has a magnitude of 4.2 and Zeta has a magnitude of 3.35. Now look at Delta which has a variation of 3.5-4.4. Is it almost as bright as Zeta or dimmer than Epsilon. Is it between the two, closer to the brighter star or closer to the dimmer star. Estimate the brightness to a tenth of a magnitude. You can use binoculars or naked eye.

When you locate the variable field, identify the variable and comparison stars that are closest to the current magnitude of the variable. Be patient. Try to develop map memory,

memorizing patterns of the stars. If it doesn't look like the star field in the chart trace out the stars you used to find it and review your maps again. For some stars you may want to sketch your own finder maps from an atlas or atlas program.

Try to get the variable and the chosen comparison star equally distant from the middle. It is nice to have two comparison stars one with a higher and one with a lower magnitude than the variable. Estimate the variable as we discussed with Delta Cephei. Other techniques include throwing the eyepiece out of focus and comparing the brightness. Red stars appear brighter than they really are and this method is often used for comparison. Averted vision may need to be used for dim stars.

If you plan to use a CCD please review the manual for making CCD estimates at http://www.aavso.org/observing/programs/ccd/manual/ .

Charts for making Observations and setting up a program.

Use these charts for the naked eye binarys and cepheids required:
http://www.citizensky.org/content/10-star-training. Charts for the other variables required in this program can be obtained from AAVSO at
http://www.aavso.org/observing/charts/vsp/ . For submission to AAVSO, only current charts from the AAVSO Variable Star Plotter (or citizen sky) can be used.

The following link shows a list of easy to observe binocular and telescopic stars
http://www.aavso.org/observing/aids/easystars.shtml

Select from these lists stars that are within reach of your equipment, stars that are in season and that can be viewed from your observing site. The AAVSO Bulletin on the AAVSO website can help you determine when Long Period Variables (LPV) are nearing their peak within reach of modest equipment.

To use binoculars on brighter variables or variables as they near maximum choose charts that have North up. These charts are: a, ab, or b. Using a telescope you will probably want c, d, or e charts. These charts have North down just like a reflecting telescope. If you have a Schmidt Cassegrain then left and right will be backwards. Turning the chart around and shining a light through it puts the stars in the right orientation.

Only AAVSO charts will be accepted for submission to AAVSO and for this program.

Recording Observations

For keeping data use the attached Variable Star Log Sheet or similar sheet. If you have a log book you might want to record it in that and then recopy to a log sheet you can use for submission. Your log book gives you a permanent record you can go back to if other data is lost. Record the date and location at the top of the entry. Each variable observation needs to include the Variable Name (W Cyg) or designation (2132+44), Time, Variable

Magnitude, and Comparison Stars. Special conditions are also noted such as moonlight, haze, etc. For your records you will want to record instrument used and possibly magnification.

The time can be in any format -local time or Universal Time- that can be converted later to Julian format i.e. 8:35 pm CST, 20:35 CST, 2:35 UT.

The variable magnitude should be to a tenth of a magnitude. If the star is too faint for you to see add (to the magnitude of the dimmest star you can identify i.e. (13.2. Add a question mark or colon if you are not sure of your estimate (i.e. 13.2: - 13.2?).

Visit the AAVSO site. Take time to look around, you will find a lot of interesting information.   Register with AAVSO and you will receive a user name to use when submitting your observations.   Submitting your observations will be quick once you get the hang of it. Don't wait till you complete the observing program to submit your observations. Submit them nightly or at the least weekly. As soon as your data is submitted it will be available in a data base that can be observed in charts. You can check the charts and see where your data fell in the data spread.

Glossary

Designation - the six digit number assigned to each variable that approximates it's position in the sky. R Leo's designation is 094211 which represent 9 hours 42 minutes and 11 degrees north. The declination (last two digits) with an underline or in italics represents south. The designation comes from the 1900 coordinates for the star.

Variable Name -– Variable stars in a constellation normally start with the letter R and go through Z and are named in the order of discovery. After Z, it goes RR, RS, RT, ... SS, ST, SU ... ZZ. Then back to AA ...AZ, BB.. BZ.....QZ with J left out. When a constellation exceeds these 334 letters the next variable star becomes V335 and so on. Naked eye variable stars normally have regular constellation nomenclature or names because they were placed on early charts, like Mira or Omicron Ceti.

Julian Day - The Julian day is the number of the day from January 1, 4713 BC at 12:00 noon. May 1, 1997 at 12 noon is 2,450,570.00 days since Jan 1, 4713 BC. May 1, 1997 at 12 midnight is 2,450,570.50. If you use the AAVSO on line data entry, you can enter Universal Time or the Julian Date (which is preferred). AAVSO provides a Julian Date calendar each year.

References:

Other sources for Variable Star information and history:

Robert Burnham, Jr.; *Burnham's Celestial Handbooks ;*Dover Publications, Inc.

David H. Levy; *The Sky, a user's guide* , Cambridge University Press

David H. Levy; *Observing Variable Stars , a guide for the beginner* ; Cambridge University Press

Webb Society Deep-Sky Observer's Handbook, Volume 8, Variable Stars; Enslow Publishers, Inc.

Richard Dibon-Smith; *Starlist 2000*; John Wiley and Sons

Leslie C. Peltier; *Starlight Nights: The Adventures of a Star-Gazer;* Harper and Row 1965