

## Variable Star of the Year VV Cephei

VV Cep is a red supergiant star that varies in an irregular/semi-regular manner over a small range (roughly 4.9 to 5.4 in V but a little fainter visually due to its red colour) but also at 20 year intervals eclipses a fainter blue companion. The blue star is at magnitude 7.0V and is normally 1.7 magnitude fainter than the red star in V so the eclipse depth is only 0.2 magnitude in V. In B however the eclipse depth is much greater in the order of 0.8 magnitude due to the components being roughly equal in brightness. VV Cep is the brightest eclipsing binary to contain a red supergiant star and also has one of the longest known orbital periods. The mid-point of the next eclipse is in June 2018 with the eclipse due to commence in August 2017.

Spectra taken by Cannon in 1907 & 1908 indicated HD208816 to be a Mira star candidate but examination of photographic plates revealed only a limited variation range of 0.5 magnitude. Visual observations by Wendell in 1908 found an even smaller range in the order of 0.25 magnitude. Although clearly not a Mira HD208816 received the official variable star designation of VV Cep in 1925. Following more striking variation noted by McLaughlin in 1936 Sergei Gaposchkin reviewed historical photometric, spectroscopic & radial velocity data which revealed the long term eclipsing nature of VV Cep. Eclipses had been recorded in 1896, 1916 & 1936 and Gaposchkin calculated the interval to be 7430 days with an eclipse duration of 490 days (450 days for totality). The photographic data showed a consistent eclipse depth of 0.8 magnitude but in visual light the corresponding drop was only 0.1 magnitude. Gaposchkin interpreted that the binary system consisted of two stars: 1) red component: 5.7<sub>vis</sub>, 7.4<sub>pg</sub>; and 2) blue component: 7.4<sub>vis</sub>, 7.3<sub>pg</sub>; and the eclipse occurred when the blue component was obscured by the red component. Both stars were super-massive giants and Gaposchkin's basic assessment of the system stands true today.

There were eclipses observed in 1956-57, 1977-78 and 1997-98 and the physical parameters of the system have been refined to the following:

Both components are roughly 20 solar masses but that is where their similarities end. The cool red supergiant is spectral class M2Iab, between 1000-1800 solar radii in size and with a temperature of 3800K. The hot blue star is spectral class B0-B2V and is much smaller at 13-25 solar radii with a temperature of 25000K. The binary components are on average 25AU apart which is too great for significant mass transfer but there is wind interaction causing an accretion disk around the blue star. The system is 4900 light years distant.

The next eclipse is predicted to be:

4 August 2017: Eclipse commences  
27 October 2017: Totality commences  
1 June 2018: Mid eclipse  
6 February 2019: Totality ends  
16 May 2019: Eclipse ends

The accompanying light curve (50 day means) compiled from NWAVSO visual observations illustrate the shallow (0.2 magnitude) fade recorded during the 1977-78 eclipse which appeared to last 650 days. The accompanying chart includes a sequence for visual observers to use to

monitor the variation of the red supergiant in addition to the smaller variation caused by the eclipse of the blue star.

Due to its small range of variation VV Cep is more suited to DSLR and CCD camera work especially in U and B. Recommended comparison stars are (both identified on the chart):

20 Cep: U=8.46, B=6.68, V=5.27

19 Cep: U=4.33, B=5.17, V=5.11 (also labelled as comparison C)

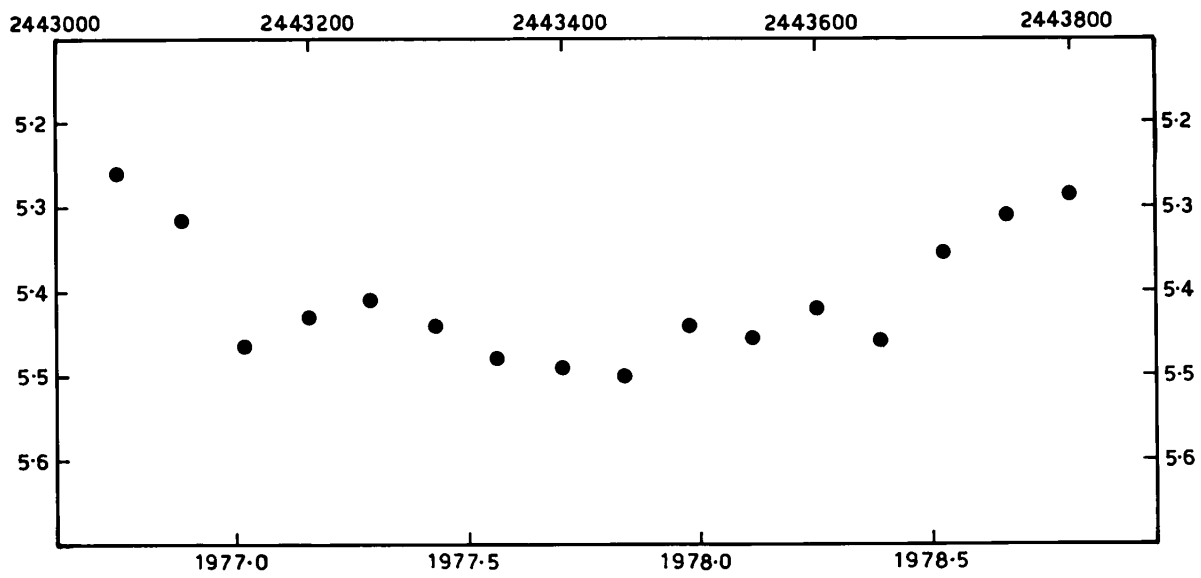
Measurements prior to and after the eclipse that show the variations outside of the eclipse will help to interpret any variation recorded during the eclipse.

Spectroscopic measurements outside of and during the eclipse are also encouraged and will help in particular in interpreting the physics of the accretion disk around the blue star. Useful guidance on undertaking spectroscopy of VV Cep is given in the web-page referenced below.

VV Cep lies in a rich Milky Way field occupying a central position within the diamond of Cepheus and at nearly 64 degrees north it is circumpolar from the British Isles.

An international campaign has been launched to study the 2017-2019 eclipse of VV Cep and details can be found here:

<http://www.ap.smu.ca/~pbennett/vvcep/campaign2017.html>



347-01

6° FIELD DIRECT

VV CEPHEI

21h 56m 39.1s +63° 37' 32" (2000)

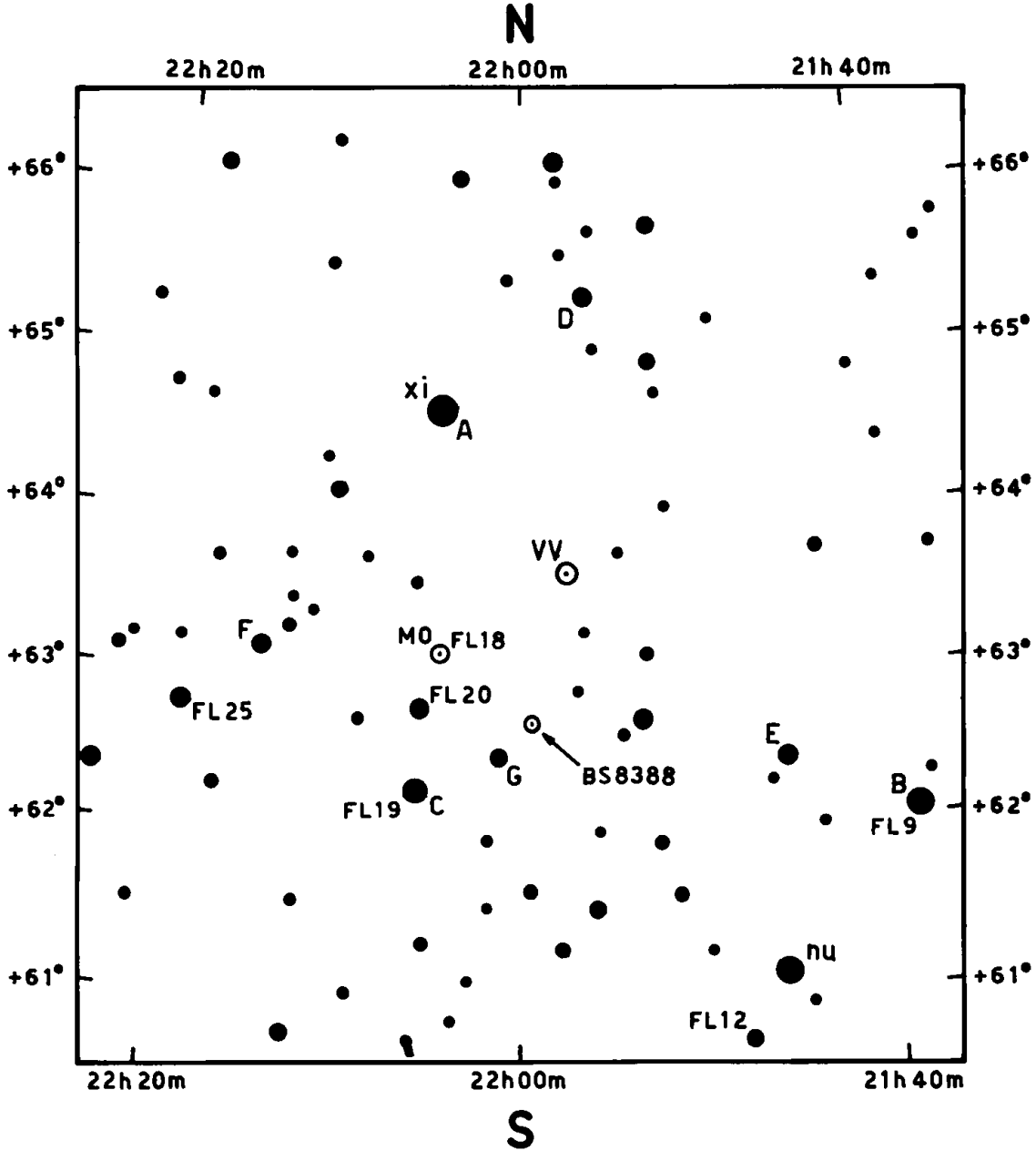


CHART:  
 ATLAS BOREALIS  
 SEQUENCE:  
 HIPPARCOS VJ

A 4-3 E 5-9  
 B 4-8 F 6-1  
 C 5-1 G 6-7  
 D 5-8

BAA VSS  
 EPOCH: 2000  
 DRAWN: JT 18-4-17  
 APPROVED: RDP