

Name: _____

Date: _____

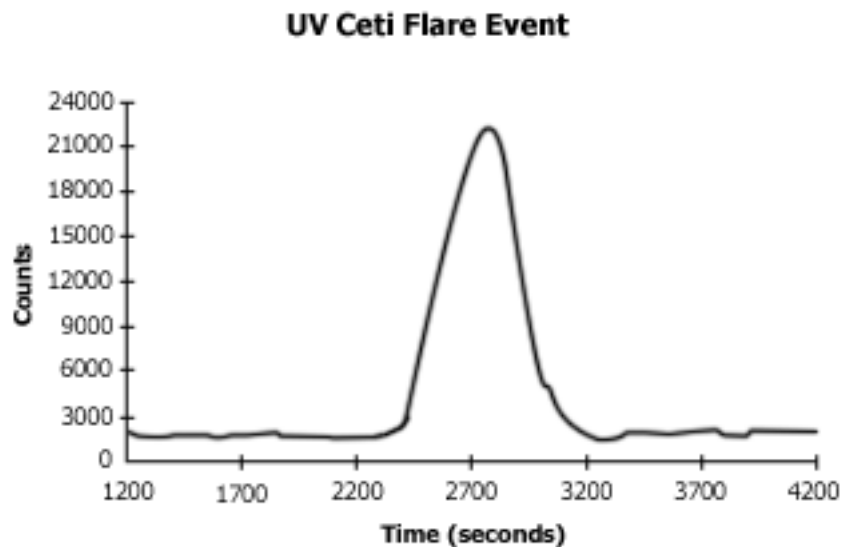
Indoor Laboratory: Flare Stars

Introduction

When stars begin to leave the main sequence, they can enter a phase of instability. This is due to the fact that there is an imbalance of the energy production and the gravitational contraction in the star. These stars will flare in brightness and these flares can happen up to once a day and can last as long as 30 minutes! The change in brightness can be several magnitudes, making a naked eye star into a very bright star in the night sky. Unfortunately, flare events cannot be predicted; so, we just have to hope that we are looking in the right direction at the right time. In this lab, we will use sample data taken from a known flare star, UV Ceti. The plots of UV Ceti flare event are courtesy of Dr Michael Castelaz of East Tennessee State University.

Procedures - Part I

Study the graph of the flare event below. The y-axis is the number of counts, which is a raw value obtained from a camera or photometer. An increase in counts correlates to an increase in overall brightness. The x-axis is time in seconds.



1. Approximately how long did the flare last? _____ seconds
2. The normal magnitude of UV Ceti when it isn't flaring is 12.9. The ratio of intensities can be used to tell the magnitude difference. Use the following calculation to determine the magnitude of UV Ceti at maximum flare.

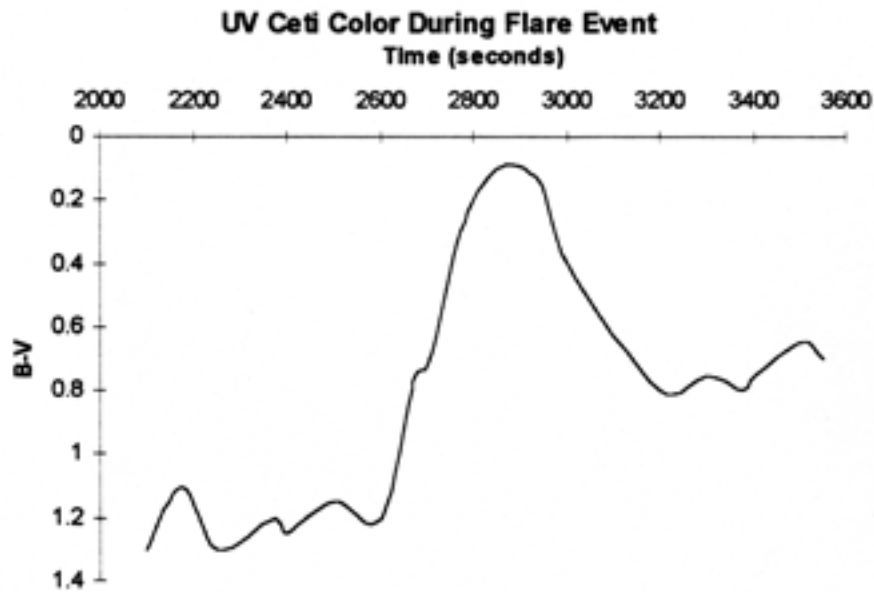
$$\text{Mag} = -2.5 * \text{Log}_{10}(\text{maxcount} / \text{mincount}) + 12.9 = \underline{\hspace{2cm}}$$

...where *maxcount* is the highest count and *mincount* is the lowest count measured

Part II

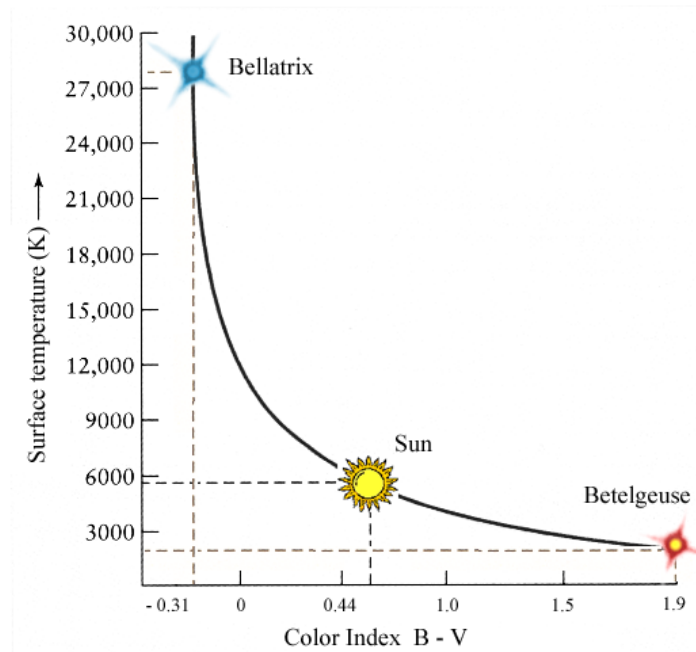
Using a standard set of filters, astronomers can determine other properties of stars. One standard filter set used by astronomers is the Johnson/Cousins U B V R I (Ultraviolet, Blue, Visual, Red, Infrared) prescription. To determine the color of a star, and consequently its relative temperature, astronomers can look at the difference between the B and V filters.

Study the graph below, which illustrates the color of UV Ceti during the same flare event. The color is measured as the difference in magnitude between the B and V filters. This is referred to as B-V photometry and produces a color index of the star. Bluer stars have a low B-V value i.e. ($+0.1$) while redder stars have higher value i.e. ($> +1.0$). Other colors in the visual spectrum fall between these values.



3. What is the color of UV Ceti before the flare event? _____
4. What is the color of UV Ceti at the peak of the flare event? _____
5. What is the color of UV Ceti after the flare event? _____
6. From what you have learned about the relationship between color and temperature, did UV Ceti become hotter or cooler during the flare?

Part III



Plot courtesy The AstroInfo Project

If you were to obtain a spectrum of a star, the wavelength (λ) in Angstrom (\AA) of the maximum emission could be related to its surface temperature by Wien's Law...

$$T = 2.9 * 10^7 / \lambda_{\max}$$

...where T is the temperature in Kelvin (K) and λ_{\max} is the peak wavelength.

Since we do know the peak wavelengths before, during or after the flare event for UV Ceti, we can approximate it using the plot of surface temperature versus color index (B-V) above. We can also obtain a rough approximation of its surface temperature using the formula:

$$T \approx 8450 \div ((B - V) + 0.865) \quad \text{...where T is the temperature in Kelvin (K)}$$

7. What is the approximate surface temperature of UV Ceti before the flare event? _____ K
8. What is the approximate surface temperature at the peak of the flare event? _____ K