High Mass X-ray Binaries: A Hunt for Optical Variability and Periodicity

A study on BD+53 2262

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Research Prospectus

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Introduction:

High mass X-ray binaries systems consist of a giant O or B spectral type star and a compact object, mainly a neutron star. The optical companion of the system is spinning quite rapidly and tends to have emission lines in their spectra and have an equatorial disk that is formed around the star. The X-ray signatures on these systems come mostly from the accretion disk around the compact object and the visible light comes from the star and the equatorial disk around it. Since the system is quite lopsided in mass, we have a highly eccentric orbit with a large orbital period and brief encounters of the star and compact object together. See Figure 1 for a schematic of a high mass X-ray binary system. These systems are quite understudied in general and even less so in the optical wavelengths. There are still many questions on their basic properties and why certain types are formed over others.

Research Background:

Over the last several years BYU has monitored several high mass X-ray binary systems. The three systems monitored are RX J2030.5+4751, BD+49 3718 and BD+53 2262. We think that there is long term variations of these stars but they are long term on the span of months to years. Variability has been detected but to be sure they are long term and actually periodic, a longer baseline is needed. In this REU we hope to, more specifically, find the optical properties of one system called BD 53+2262 and see if there is some long term variability that is consistent through this system. This would be indicative of a general trend that most

Figure 1. Schematic of a high mass X-ray binary system. This figure shows the disk coming off the star and where the X-rays originate in the system.
high mass X-ray binaries follow. We also want to look at several other systems we have data for and potentially find X-ray data for BD+53 2262.

Methods:
This summer we will reduce and analyze the data we have using IRAF. This computer program is a powerful tool that helps to correct our images from atmospheric conditions and the CCD effects. It also contains several packages to find instrumental magnitudes like ccdproc and nightphot4. We are planning on using nightphot4 to adjust the aperture of our frames to varying atmospheric conditions. Varstar5 will be used to remove potential variable stars from our ensemble and compare our object to a set of standard stars in a process called differential photometry. After we have obtained our differential magnitudes, we can plot them verses time and see how the magnitude changes and those are our light curves. By studying the optical light curves, we can gain information about the stars interaction with the compact object and see a part of what the equatorial disk is doing in the visible spectrum. If available, I will find mainly X-ray data to compare that light curve to the visible to see if there is any correlation between them. We also have plans to continue monitoring these systems by using the 16 inch David Derrick telescope in the Orson Pratt Observatory. There is also data coming from two telescopes from our West Mountain Observatory this summer. The nights from this summers’s observations will also be added to our several year long baseline and will also help determine the long term variability of this system.