The Science at Clarkson's Reynolds Observatory

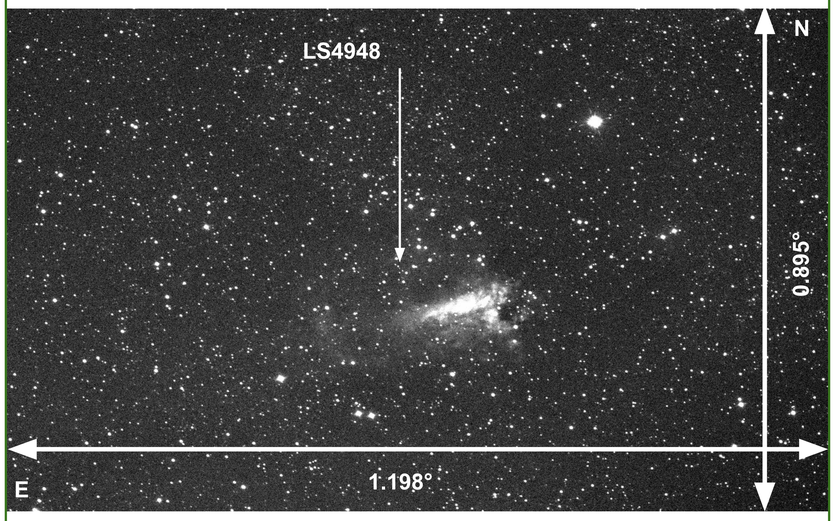
Andrew Couperus, Courtney Maki, and Joshua D. Thomas*
Department of Physics, Clarkson University, Potsdam, NY 13699
*jthomas@clarkson.edu

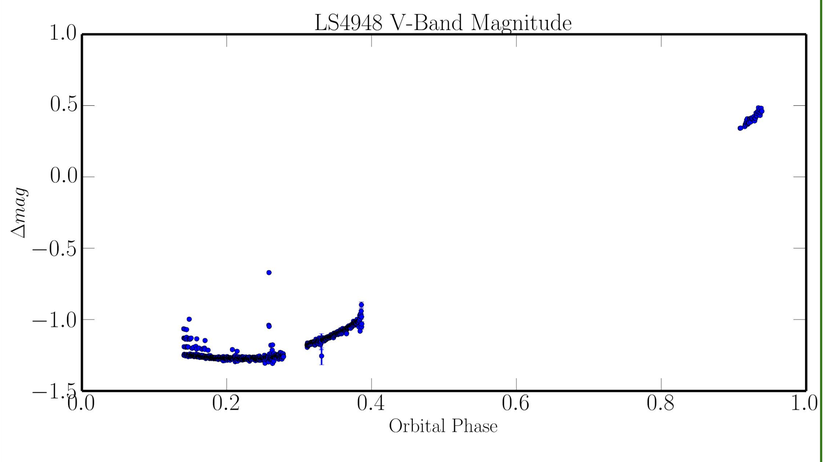
Abstract

Significant upgrades have been made to the equipment at Reynolds Observatory. A new high-quality mount, and the addition of a spectrograph have greatly increased the opportunity for scientific collaboration and undergraduate training in astrophysics. The photometric setup has also been improved, with the addition of narrow band filters and wide-field astrograph. Current research involves the study of binary stars both photometrically and spectroscopically. Our main photometric target is LS 4948, a 1-day binary and potential pre-merger candidate. This current observing season we are focused on an 8-year binary, WR 140, which will have its periastron passage on December 18th. The poster will highlight the technical details of the new equipment.

Differential Photometry

We have a high-quantum efficiency ATIK 414EX 1040x1392 pixel CCD camera. Each pixel is 6.45μm square. The camera is paired with a 9-position filter wheel and 130mm (f/3.3) Takahashi astrograph. We have a set of Johnson-Cousins BVRI filters, 8nm wide: H**α**, [O III], [S II], and 10 nm wide H**β**. The filter set was purchased from Custom Scientific. Flat-fielding is done with a student-built flat-field box. Image reduction is done in IRAF, and the photometric measurements are made with LEMON [1] (an automated photometry program). Future plans include photometry of clusters to identify Be star candidates.

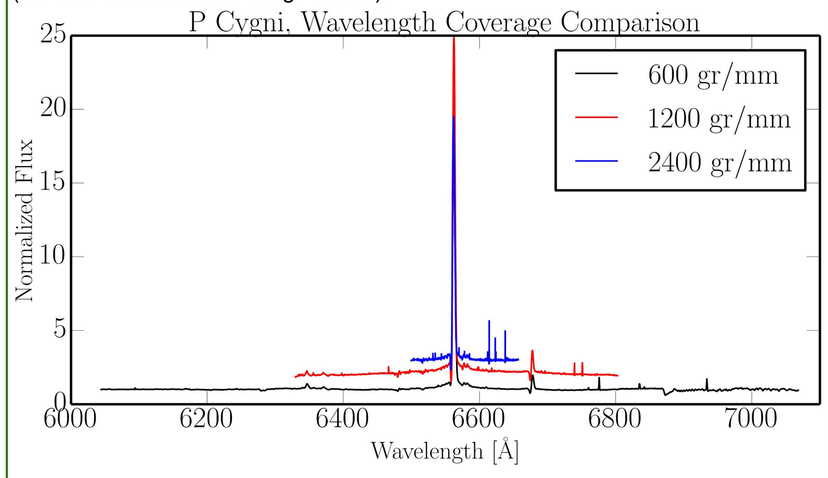




The figure above shows the yellow Takahashi **ε**130d astrograph piggybacked on the blue 12-inch Meade LX200. Attached to the Takahashi is the photometry setup. Attached to the Meade is the spectrograph. The mount is an Astro-Physics 1600GTO.

Spectroscopy

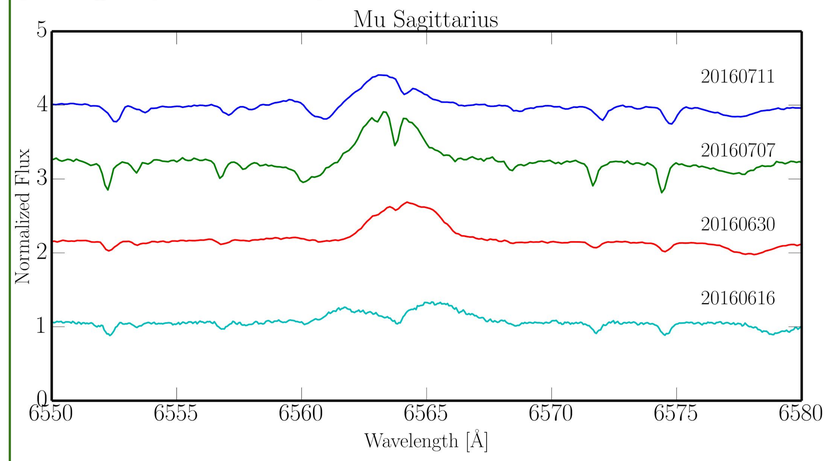
The Shelyak LHIRES III is a Littrow spectrograph with interchangeable gratings. Clarkson has the 600, 1200, and 2400 grooves per millimeter units. The wavelength coverage is show below. The spectra are acquired with an ATIK 460EX monochrome 2750x2200 pixel CCD camera (the red camera in the image above). Each pixel is 4.54μm square. While oversampled, the physical size of the chip gives us the most wavelength coverage. During the CCD readout we bin the data in 2x2 pixel squares. The slit camera for the spectrograph is the ATIK Titan (the blue camera in the image above).



Time-Series Spectra

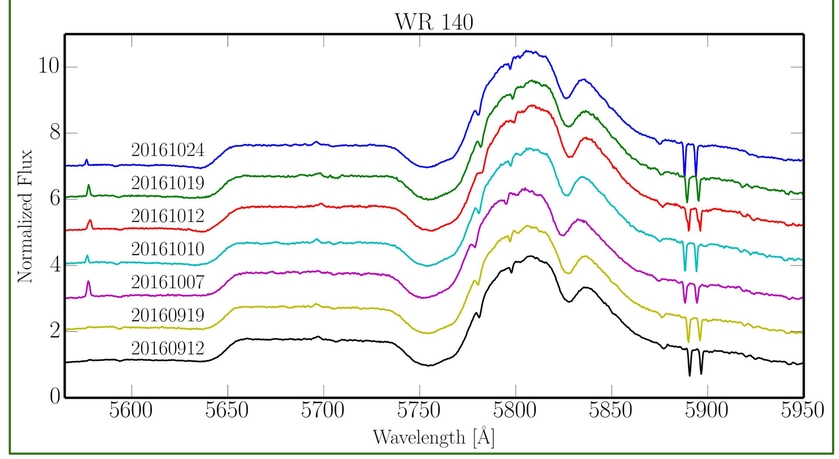
We have joined in collaboration with Noel Richardson at The University of Toledo to obtain and analyze spectra for massive stars. One example is the Be star μ Sgr, seen below, our stacked spectra show the variability in the emission arising from circumstellar material. The aim is to understand the cause of the variability.

μ Sgr (Be Star)



A second example, and primary observing target for the 2016-2017 winter is the 8-year binary WR140, a Wolf-Rayet star with an O-star companion. This exciting system will have its periastron passage on December 18th. The winds of the two massive stars periodically produce dust during the periastron passage. This has never been studied with high cadence spectroscopy. We will be collecting both spectra and photometry of WR140 through the winter. The plot below shows our pre-periastron data as of the making of this poster.

WR 140 (Wolf-Rayet Star)



References

[1] Terrón, V., & Fernández, M., Highlights of Spanish Astrophysics VI, 2011, pp 755-761