**Stellar Surface Imaging of LO Pegasi via Light-curve Inversion**

Rachel Decker¹, Conrad Moore², Dr. Robert Harmon¹

¹Dept. of Physics and Astronomy, Ohio Wesleyan University
²Dept. of Physics, Bucknell University

**Goal**

Our goal was to study dark starspots on the surface of the K8 main-sequence star LO Pegasi. Because stars other than the Sun are so far away from us, even the Hubble Space Telescope images them as mere pinpoints. Thus, in order to map the starspots on LO Pegasi, we had to use an indirect method. We acquired digital images of LO Pegasi during June and July, 2008 through B, V, R, and I photometric filters using a 0.2-m Meade Instruments LX200 Schmidt-Cassegrain telescope and Santa Barbara Instruments Group ST-8XE CCD camera. We then performed differential aperture photometry on our images to create light curves of the star and employed a technique called Light-curve Inversion to map the surface based on the variations in the star’s brightness produced by the starspots as they are carried into and out of view by the star’s rotation.

**Why is this important?**

Starspots, like sunspots, are regions of enhanced magnetic field strength compared to the rest of the stellar surface. Understanding how starspots are formed and move on the surface of the star can give us a greater insight into the dynamo process which generates the magnetic field of this star and thus more insight into our own Sun’s magnetic behavior.

**What is a Starspot?**

It is a spot of cooler, darker plasma (ionized gas, mostly hydrogen) on the photosphere (surface) of the star. A sunspot consists of a dark center called the umbra and a filamentary halo called the penumbra. Sunspots can be over 50,000 kilometers across and can last up to a few months. They are a few hundred Kelvin cooler than the surrounding photosphere and thus appear darker. Starspots that are large enough to be studied with present technology are much larger than the spots on the Sun.

Starspots are caused by bundles of magnetic field lines that suppress convection in the photosphere. Convection is the constant churning of plasma within the star and is how energy is primarily transported within the photosphere. The hot gas rises to the surface, loses heat to space, cools off and sinks to hotter layers where the process begins again. Where the magnetic field lines protrude through the photosphere, they restrict the plasma from moving side to side and so convection is inhibited, the plasma cools and a starspot is formed.

**Procedure**

We used Mira Pro software from Mirametrics to perform differential aperture photometry on our digital images. Aperture photometry is the method of drawing a circle, called a signal circle, around the star using the software and having the software count how many star photons were captured within that circle. By counting the photons from the star we can determine the star’s brightness. Because the sky is not completely dark, there are also photons from the sky that are counted within the signal circle and should not be counted as part of the star’s brightness. To account for this, we draw another annulus around the signal circle that captures only sky photons. This allows Mira Pro to determine how many sky photons there are per pixel so it can subtract the sky photons from the total photons in the signal circle so we are left with only star photons being counted within the signal circle.

**Results**

Below are three light curves and images of LO Pegasi from two previous summers followed by light curves and images obtained this summer. It is easy to see the light curve has changed in shape and size over the past few years to become deeper and wider. This indicates the spots are becoming more spread out and larger.

**Acknowledgements**

We would like to thank Ohio Wesleyan University, the National Science Foundation and the staff of Perkins Observatory for making this research possible.