NGC 5904 (M5)

Andrew Kuhlman
Dr. Andrew Layden
Bowling Green State University
Dept. of Physics and Astronomy

NGC5904

NGC5904 is a well known and a thoroughly studied globular cluster located in the Serpens constellation. 5904 has 105 known variable stars with 97 of them being RR Lyrae variables. 5904's age is estimates to be around 13 billion years making it one of the oldest globular clusters observed in the Milky Way.

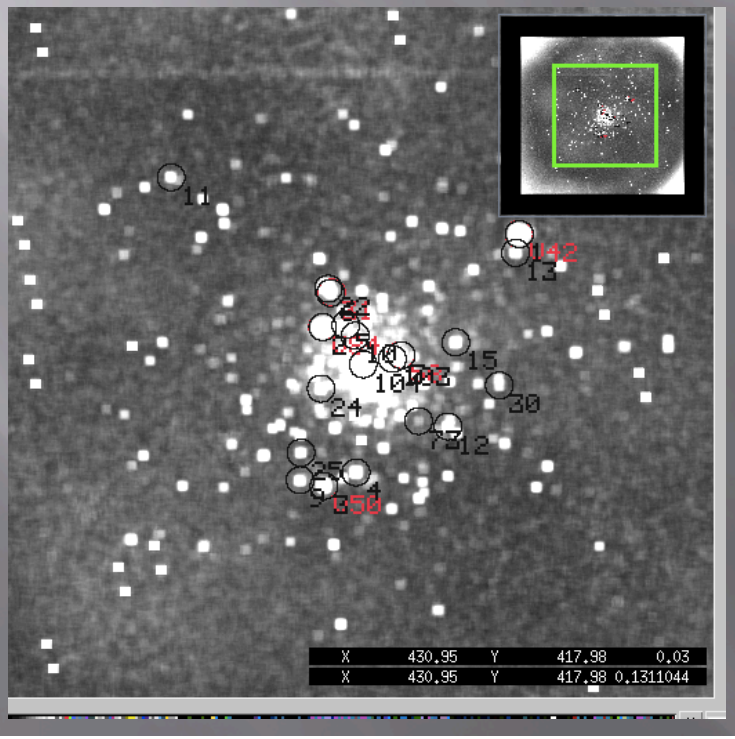
Data Collection

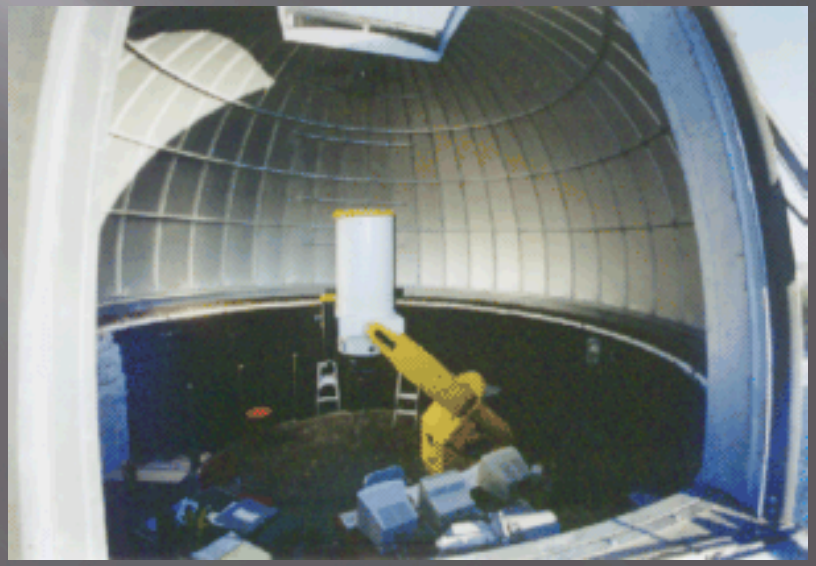
Images of NGC5904 were taken remotely with University of North Carolina's 0.4m Prompt telescope located near La Serena, Chile. 162 images in the visual band were taken from August 2010 to September 2011. The V-band images are 40s exposures with 4 exposures taken every observing session. At the same time, I-band images were also taken, but will be analyzed elsewhere.

Prompt in the snow

Purpose

The purpose of the project is to verify results taken with Bowling Green State University's 0.5m telescope and to possibly find new variable stars in the cluster. Prompt's images give much better resolution allowing for better variable finding capabilities. Combining Prompt with DAOPHOT's image processing sophistication gave a complete and well organized data set.



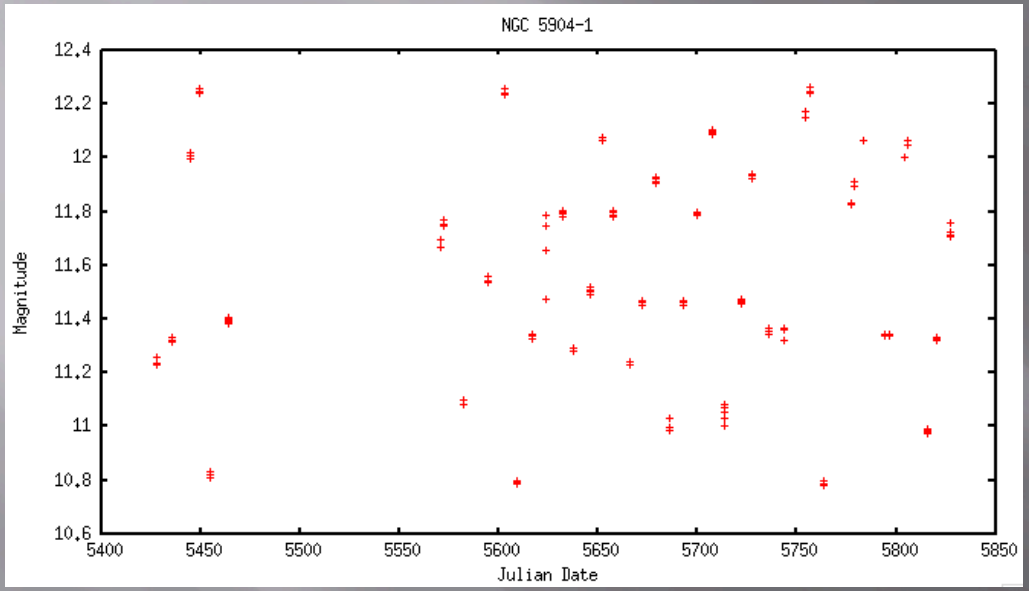


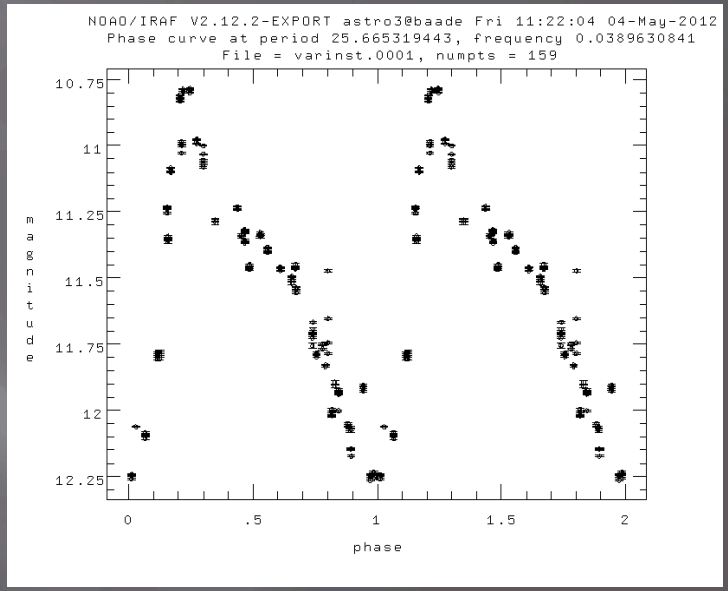
BGSU 0.5m telescope

BGSU's variables (red) and Prompt's variables (black)
(Variables of magnitude of 14 or greater; photo taken by BGSU 0.5m)

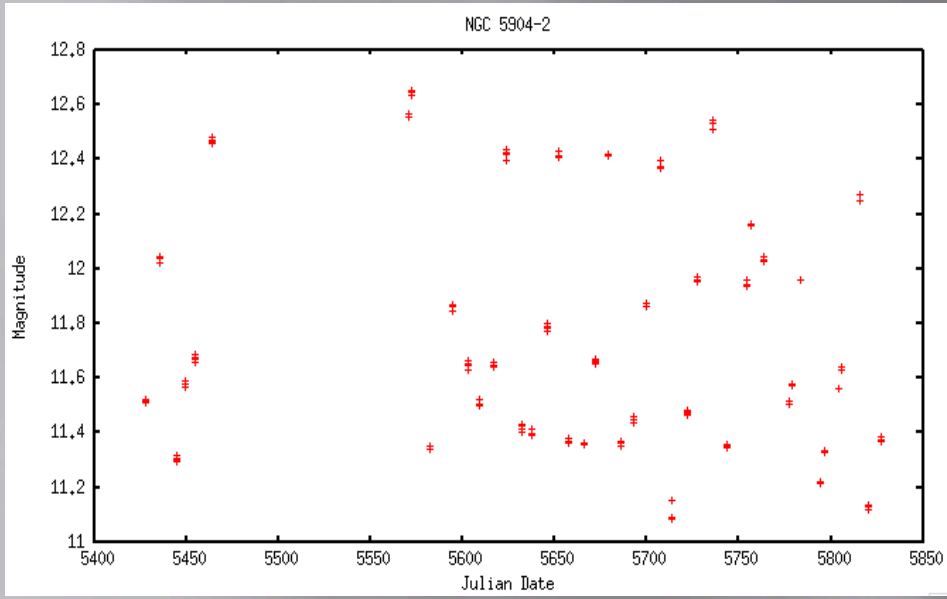
Results

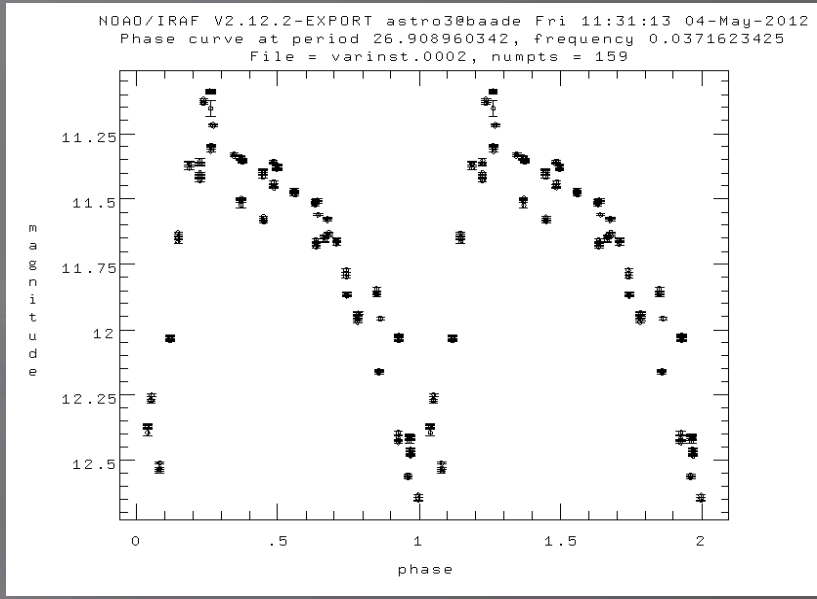
DAOPHOT returned 137 suspected variables. Of these suspected variables, those with a instrumental magnitude of 14 or less and a variability index of 5 or greater were selected for further processing and comparison. All 5 Bowling Green variables matched up with Prompt' s variable stars. Light curves were made to study the period and frequency of oscillation, but to also see the quality of the observation made.



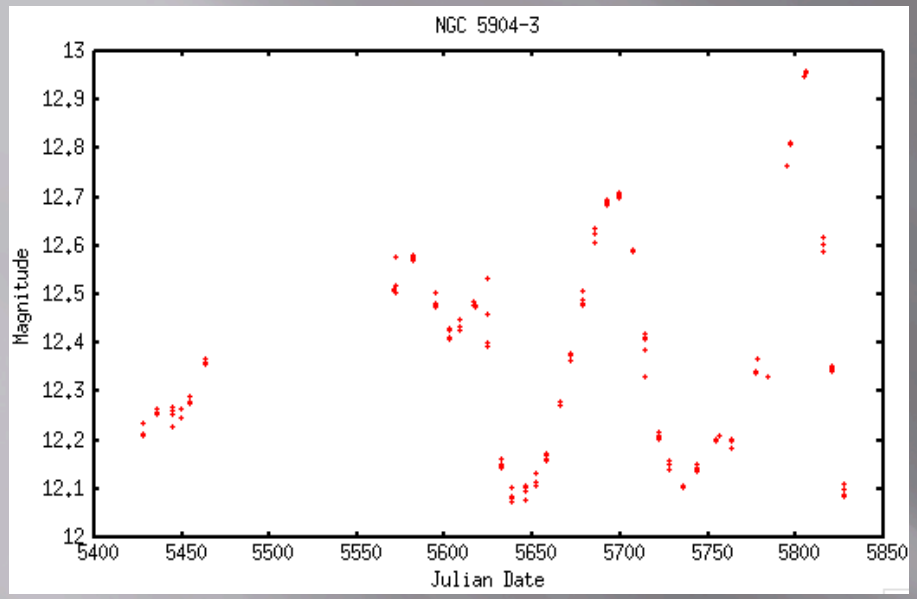


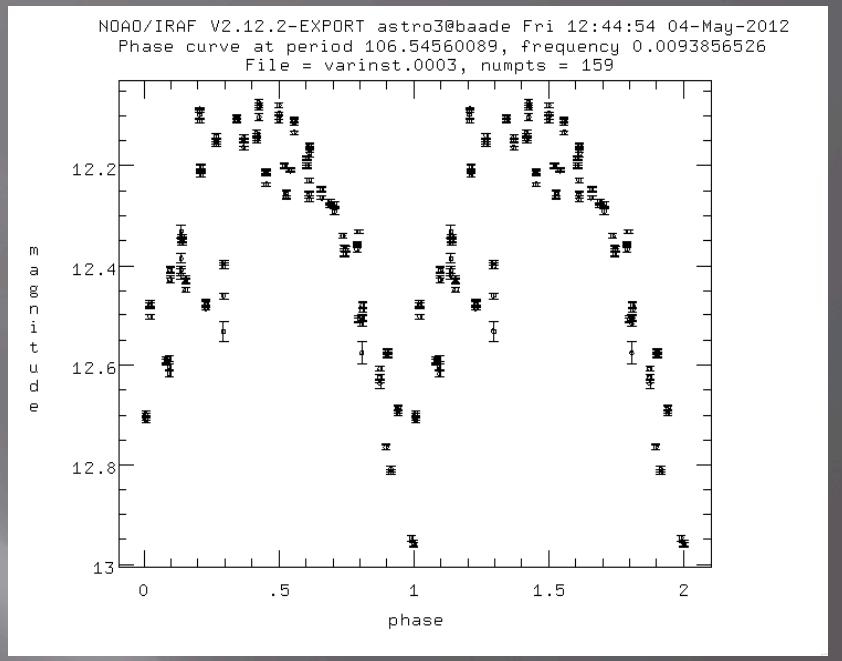
The light curve on the left is of known Cepheid variable V42. The data looks sporadic due to the period of oscillation being much shorter than the data range. The gap in the middle of the light curve is missing data due to a break in observing. The graph on the right shows a phase-magnitude plot of V42 with a period of 25.7 days. V42 is a bright star for this cluster allowing for small uncertainties.



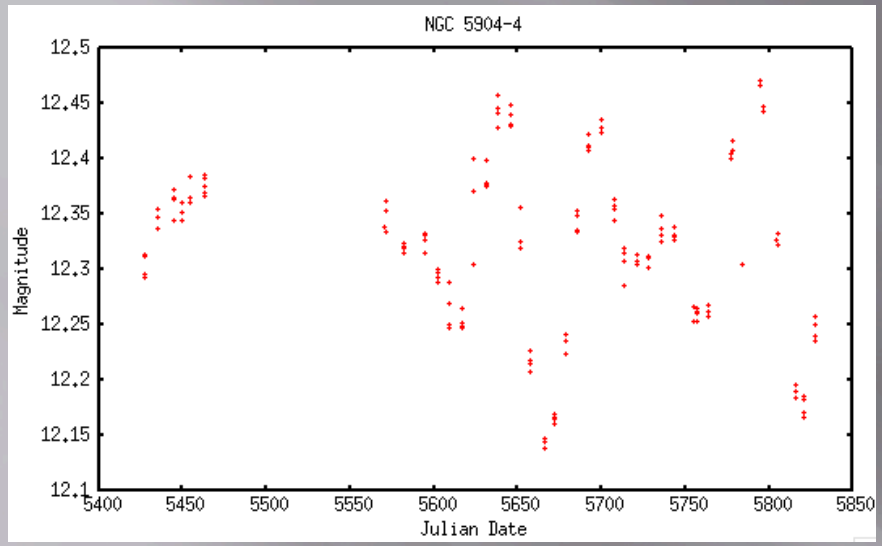


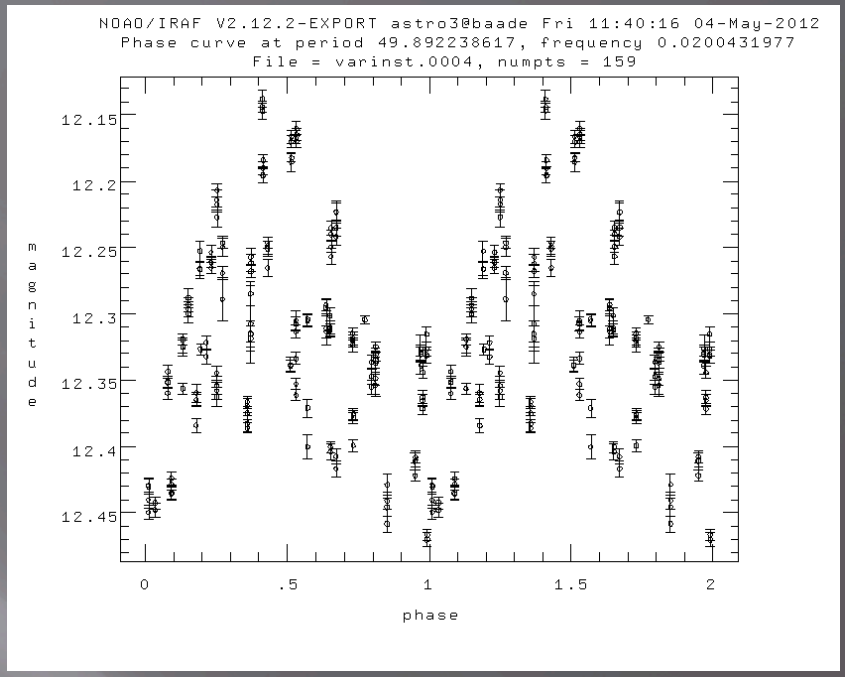
These are two light curves for known variable V84. The light curve on the left shows high variability and a short period of oscillation compared to the data range. The small clumping of the data points is due to the multiple exposures taken in the same night. Given there is a small variability within the clumps shows there is little error.
On the right is the phase diagram with a clear phase and a period of 26.9 days.





The light curve on the left shows a very clear variability with little error. The phase diagram on the right shows a strong phase with a 0.2 instrumental magnitude error. This variable, known as V50, is the brightest LPV found in this cluster. V50 seems to have a regular period with a fluctuating peak magnitude.





The light curve on the left shows a period of 50 days with a clear period of oscillation. There is more error in the measurements as reflected by the greater point variance. This is also shown in the phase-magnitude diagram. The instrumental magnitude error is estimated to be 0.16.