Differential Photometry of M39

Lucas, Miles[1] and Brandon, John[1]
Iowa State University Department of Physics and Astronomy

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I. INTRODUCTION

II. DATA ACQUISITION AND SETUP

Observations were made on at the Zaffarano Hall observation deck in Ames, Iowa. The night was mostly clear and the ambient temperature was around 12 °C. The moon was full that night which caused higher than usual lunar presence. Observations were made using a Meade 8" reflector telescope with an SBIG ST-402ME CCD camera with internal V, B, and I filters.

Setting up the telescope was the same as previous observations made with the 8" Meade telescope at Zaffarano Hall. An obstacle we faced with alignment and slewing was the misalignment of our sight by a significant amount. To combat this, we shined a laser through the eyepiece to roughly show the target of the main mirror.

We took 15 frames of data at 13 s at two locations in the sky. Of those 15, 5 were with photometric V, 5 were with photometric B, and 5 were dark frames. The first target contained M39 objects x3 and x5, however this data was deleted by accident and was not used for analysis. The second target contained objects x1, x4, x7, and x9, all of which are recorded in Table II. Of these images, another issue we encountered was centering the images as the telescope shifted according to its tracking movements. Because of this, a few of the images do not contain a clear view of M39 x4.

III. DATA ANALYSIS

Our data analysis involved preparing our science images and performing differential photometry on them. To prepare our images we created a median dark frame in AstroImageJ for our only exposure time, 13 s. We then subtracted this frame from each science image to filter out systematic noise from our CCD. These images were then grouped into two stacks, one for each photometric filter.

We used AstroImageJ to process each stack for the differential photometry. For use in the differential photometry algorithm we use the CCD reported electronic gain of 1.49 e/ADU. AstroImageJ processes the stack of images in a way that allows for quick calculations. An aperture can be placed on each star of interest in an image and AstroImageJ allows placing target stars and reference stars, where the reference stars have predetermined magnitudes.

After placing the apertures for one image in the stack we move forward in the stack and by choosing the same initial aperture AstroImageJ will place the remaining apertures automatically. After each aperture has been placed on each image in the stack and the reference star magnitudes have been set, AstroImageJ will do the photometry and creates a measurement table with the results. This table is shown with the relevant information in section B. This table shows results for target and reference stars and their names are shown in ?? with reference to the object names of M39.

TABLE I. Photometry Results

Object	V Mag	B Mag
x1	7.7707(39)	7.8078(18)
x4	NA	NA
x7	9.3294(45)	9.4730(42)
x9	9.9790(35)	10.233(11)

IV. RESULTS

The table of the results from AstroImageJ are in section B and the results calculated using ?? and ?? are in Table I.

V. CONCLUSIONS

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Appendix A: Observation Log

Appendix B: Photometry Results

TABLE II. Observed 06 September 2017 by Miles Lucas and John Brandon

Time	File	N Frames	Object	Filter	Exposure	Camera Temp.	Notes
21:39	M39_2_V_13s_	5	M39 Objects x1, x4, x7, and x9; stars E, D	V	13 s	5.33 °C	
21:41	M39_2_V_13s_dark_	5	M39 Objects x1, x4, x7, and x9; stars E, D	V	13 s	5.33 °C	Dark frames
21:43	M39_2_B_13s_	5	M39 Objects x1, x4, x7, and x9; stars E, D	B	13 s	5.33 °C	