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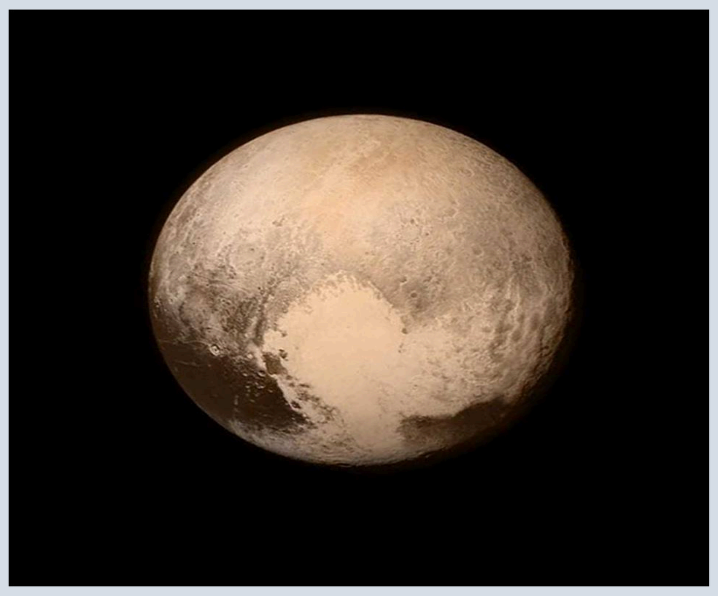

Pluto, 2015 (Image Credit: NASA)

Broadband Photometry of Pluto

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OVERVIEW

Broadband Photometry was obtained to provide data on Pluto, discovered on January 23, 1930 by Clyde W. Tombaugh at Lowell Observatory in Flagstaff, Arizona. Our data was collected over a series of four nights of time-resolved Bessel BVRI photometry using the 0.6-m telescope at the JPL Table Mountain Observatory (TMO) located in Wrightwood, California. Our collected data will complement the data obtained by the New Horizons mission to calculate Pluto's solar phase curve at opposition. The primary objective of our work will be to analyze the solar phase curve of Pluto while it is at opposition. Our work will help in understanding Pluto. It will also provide evidence for seasonal transportation of volatiles within Pluto's atmosphere.

Figure 1: Table Mountain Observatory (TMO) (Image Credit: NASA)

Figure 2: TMO 0.6m (24 inch) Telescope (Image Credit: NASA)

ACKNOWLEDGEMENTS

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INTRODUCTION

Photometry, in astronomy, is the measurement of the brightness or intensity of objects in the sky. Such measurements give large amounts of information on the objects' structure, temperature, distance, age, etc. Broadband photometry refers to photometry using different color filters. With advances in technology, especially charge-coupled-devices (CCDs) our knowledge of planets composition has increased.

METHODS/DISCUSSION

We are able to observe remotely at JPL by establishing a connection to the computer Murzim, which allows us access to the programs we need to control the dome and telescope. With broadband photometry, we first take biases; by taking a series of dark exposures while the dome is closed. This indicates the pixels from the charge-coupled-devices (CCDs) that have remained charged. These images are then formed into a single bias frame to determine which pixels have remained charged and will later need to be removed.

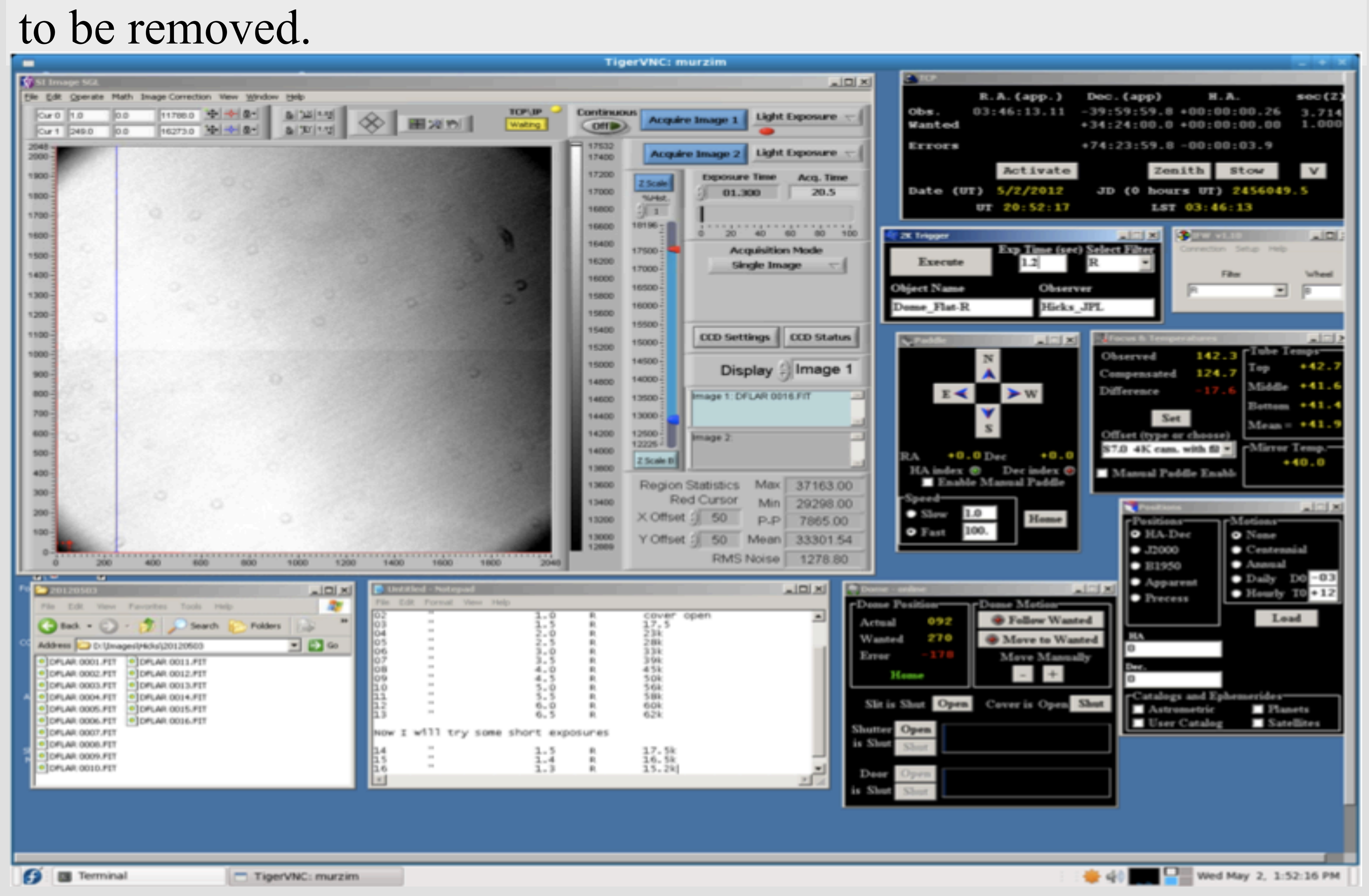

Figure 3: Control Screen (Image Credit: NASA)

Next, we take sky-flats, which are images taken around sunset when the sky appears more uniform. Errors can occur due to the sensitivities of each pixel in the charge-coupled-device. Sky-flats are meant to correct for this error. In addition, sky-flats are taken in each color-band filter.

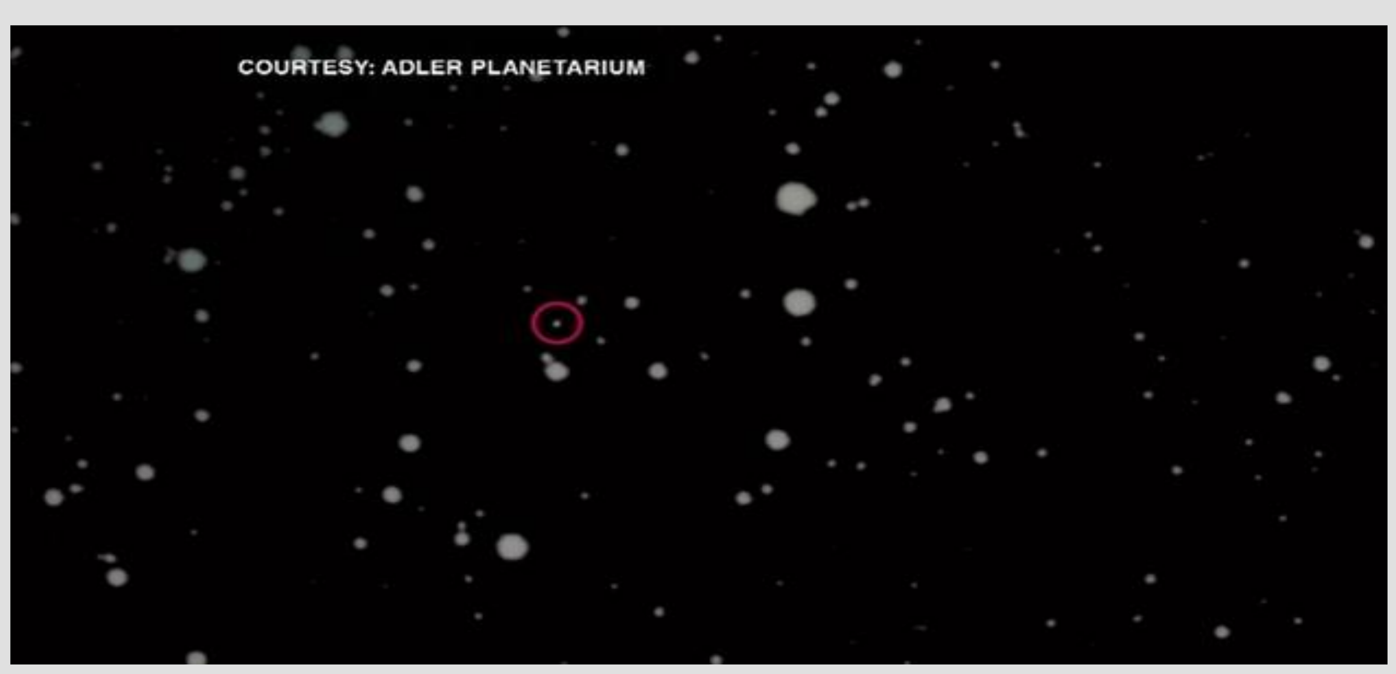

Figure 4: Finder Charts for Pluto (Image Credit: Adler Planetarium)

The remainder of the evening is devoted to observing Pluto, using a pattern of R-V-B-R-V-B (R for red filter, V for visible, and B for blue filter, also known as the broadband spectrum), with differing integration times for each filter. In the middle of observing, we often take observations of standards, which help us account for changes in atmospheric pressure.

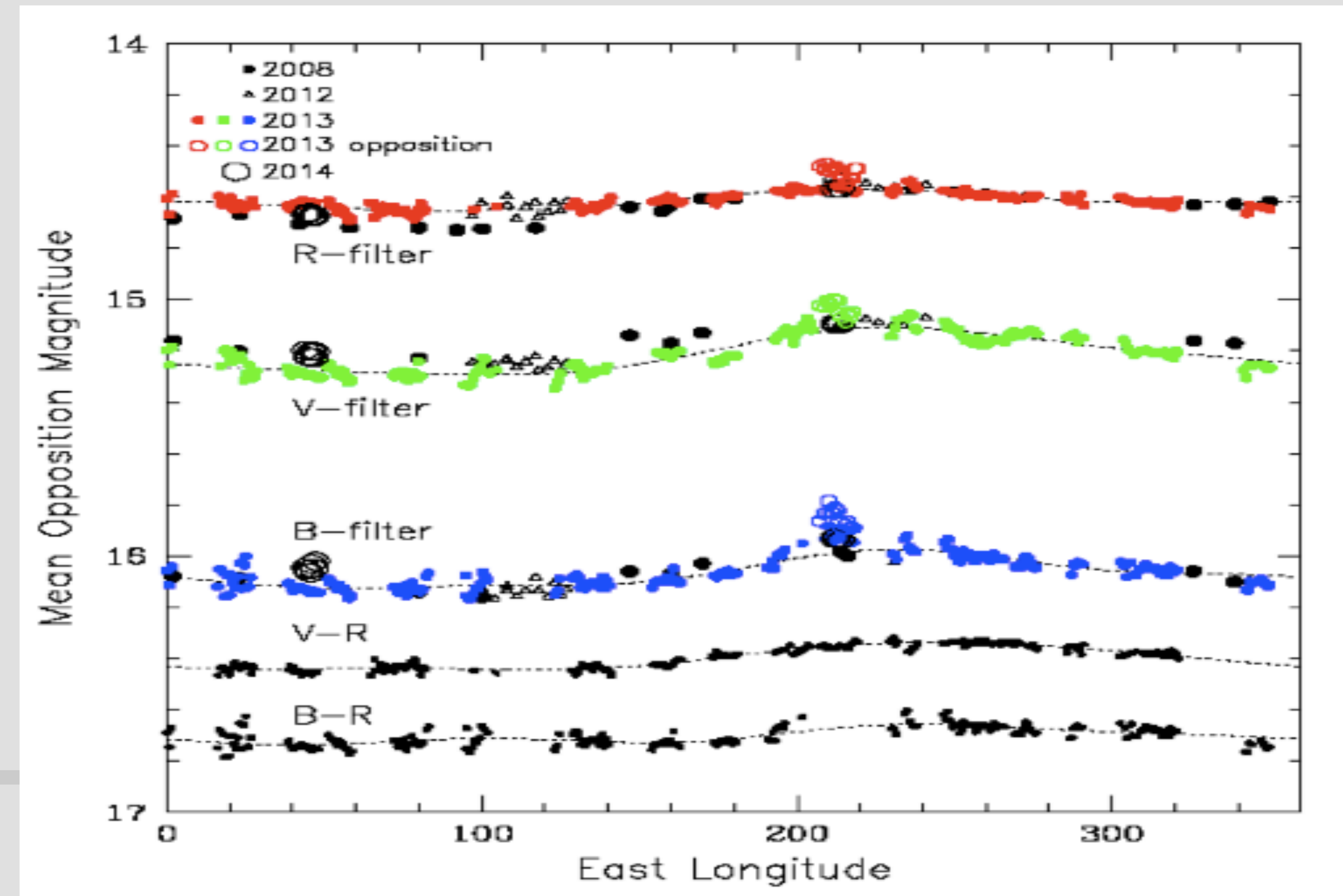

Figure 5: BVR Light Curves of Pluto, 2008-2014 (Image Credit: B. Buratti et al. 2015, Ap. J. Lett. accepted)

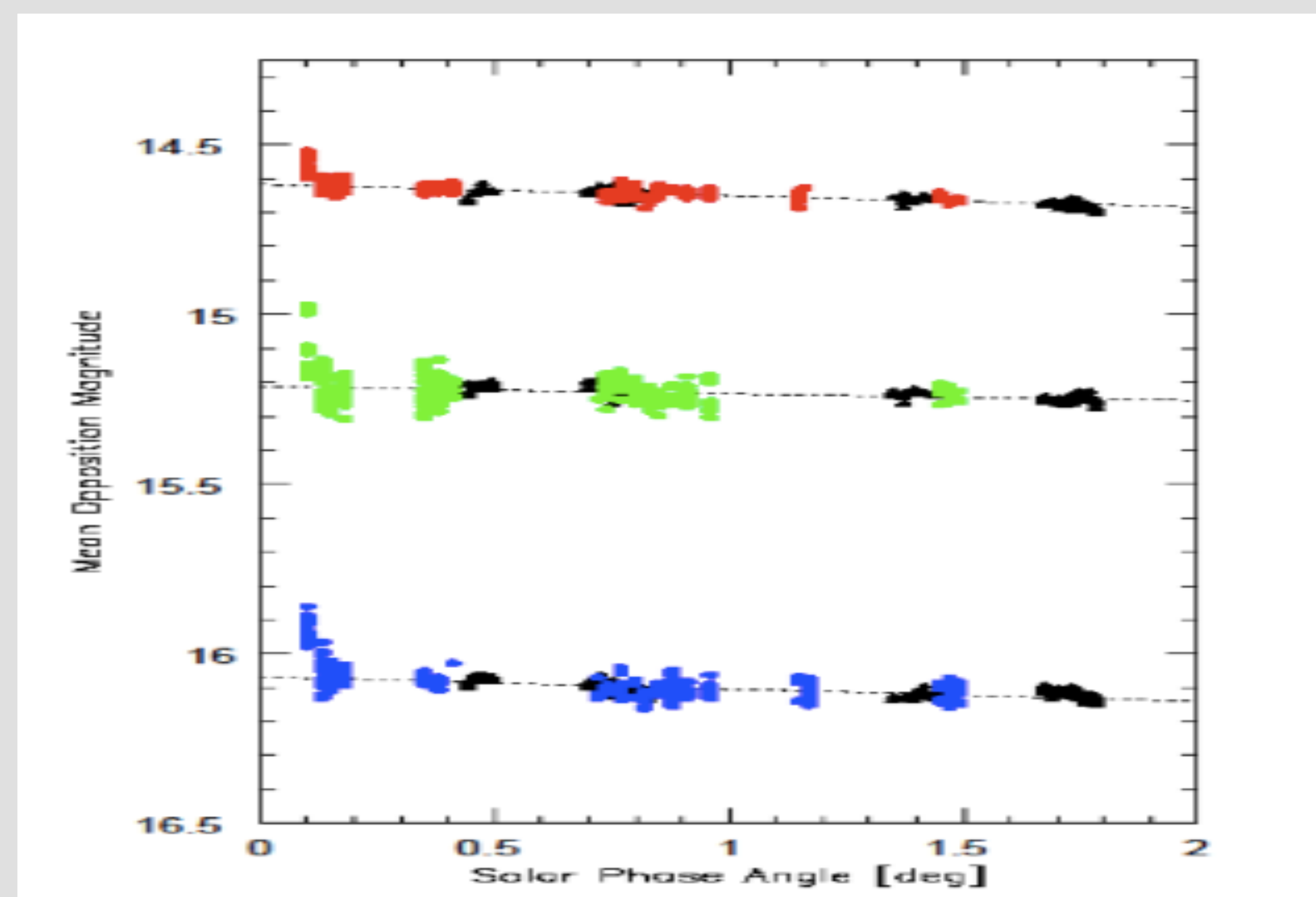

Figure 6: Pluto Solar Phase Curve (Image Credit: B. Buratti et al. , 2003; 2015)

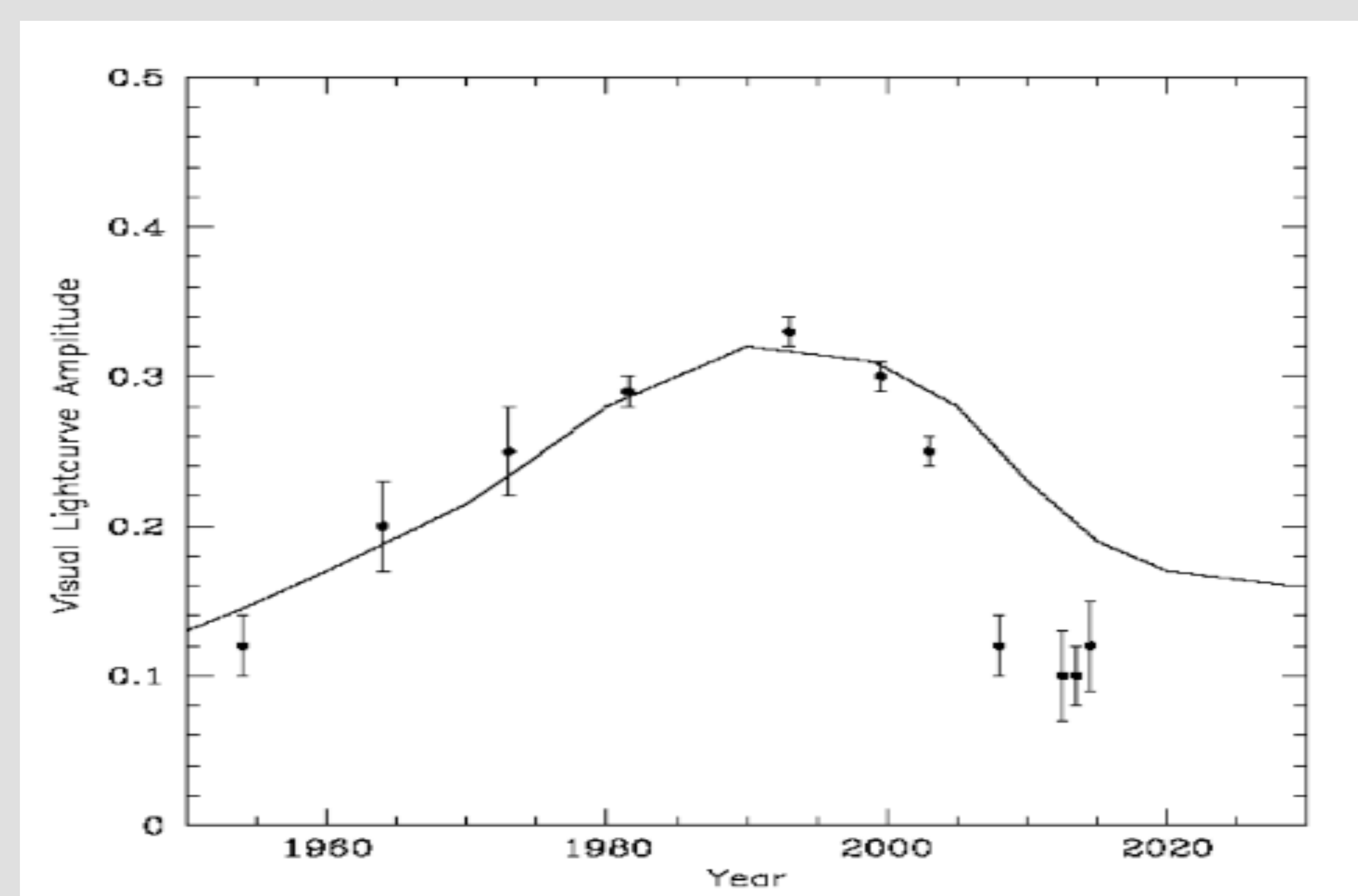

Figure 7: Lightcurve of Pluto (amplitude) through time (Image Credit: B. Buratti et al. 2015)

CONCLUSIONS

Our data will be analyzed through various programs, where we will use both biases and sky-flats to make any correction to the images of Pluto we've obtained (i.e debris). Once we have analyzed the data, we will be able to calculate and plot Pluto's solar phase curve. Our data will be used to complement the data obtained by the New Horizons mission and possibly answer questions regarding the seasonal transport of volatiles as found on Pluto, as well as the albedo patterns.