

Measuring the Magnitude of the Cataclysmic Variable Dwarf Nova SS Cygni Following an Outburst



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Abstract

We observe the decline in magnitude following an outburst of the Dwarf Nova SS Cygni using Stony Brook University's 14" telescope mounted on the roof of the Earth and Space Science Building. Over an observing period of roughly three weeks starting on 09/28/20, we obtained data for a few hours once a week and calculated the V-band magnitude using four nearby comparison stars. **We observe a dimming of V-band magnitude from 9.713(0.015) to about 11.183(0.016). The initial observations capture the decrease immediately following the main outburst on the night of 09/22/20.**

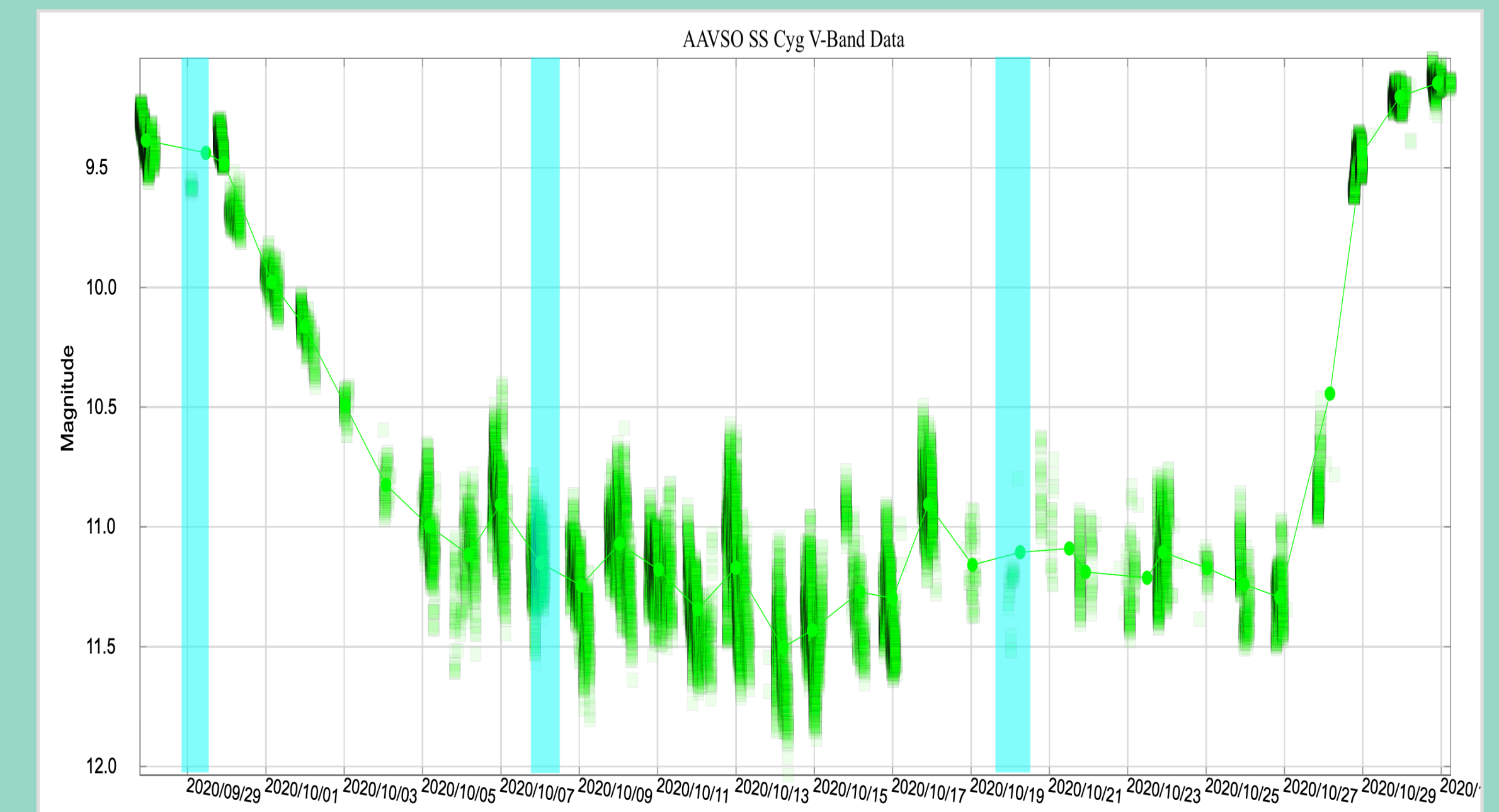
Data Analysis

Using the five marked comparison stars in the image below, the instrumental magnitudes were calculated and using the known V-band mags of each comparison star the nova magnitude is calculated via the offset from the absolute magnitude.

AAVSO Data

In the image to the right an outburst occurred on 9/22/20 followed by roughly 3 weeks of quiescence. Around 9 days after our final observing night, the dwarf nova experienced an outburst rapidly brightening to a magnitude of 8.80.

While SS Cyg is in quiescence nearly 75% of the time, there are short term variations which have relatively dramatic undulations. In future observations it would be interesting to take consecutive nights in order to analyze short term variations.

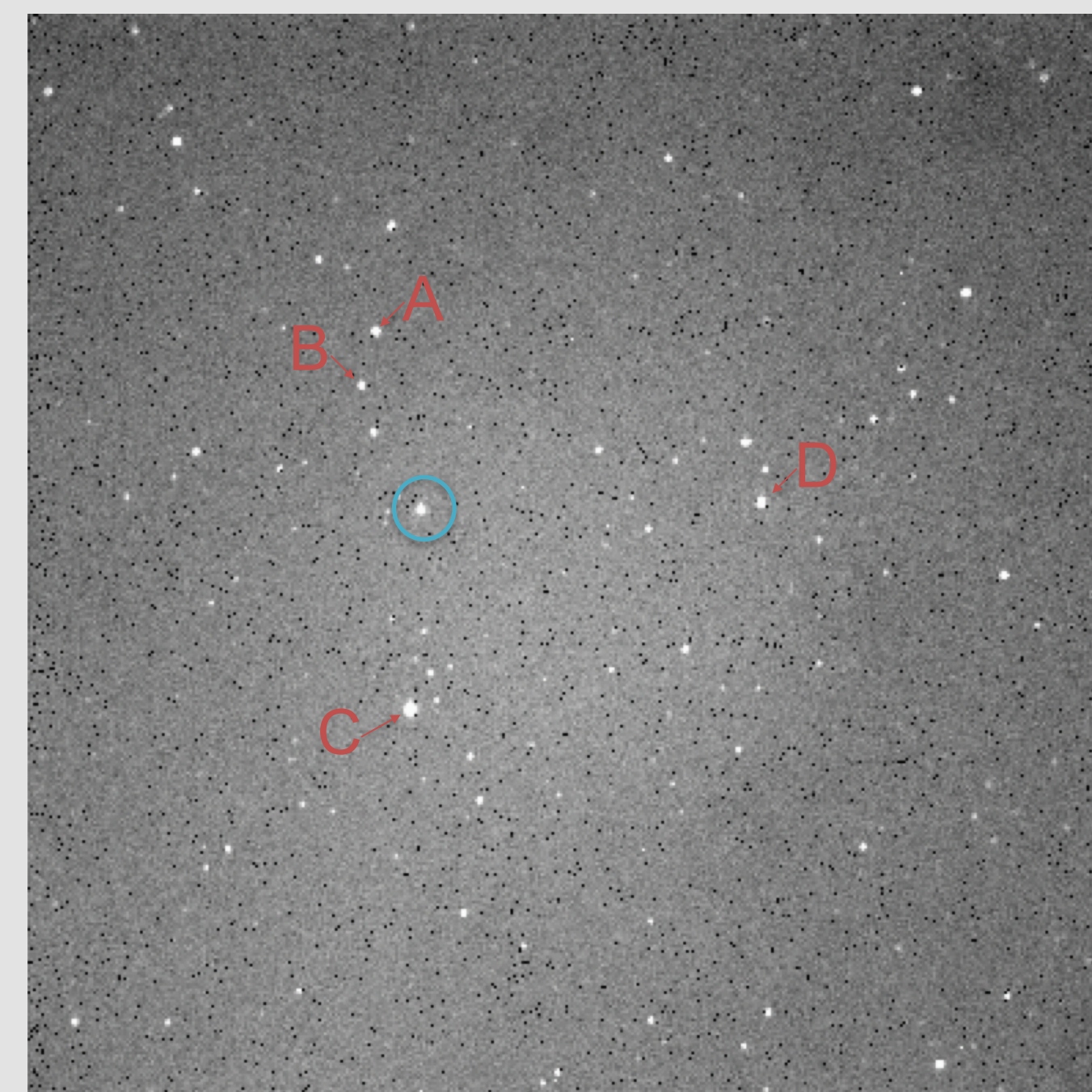


Data collected from the American Association of Variable Star Observer (AAVSO) spanning 9.22.20 to 10.31.20 on the V-Band magnitude of SS Cyg. The highlighted regions represent spans of time in which our team measured the magnitude.

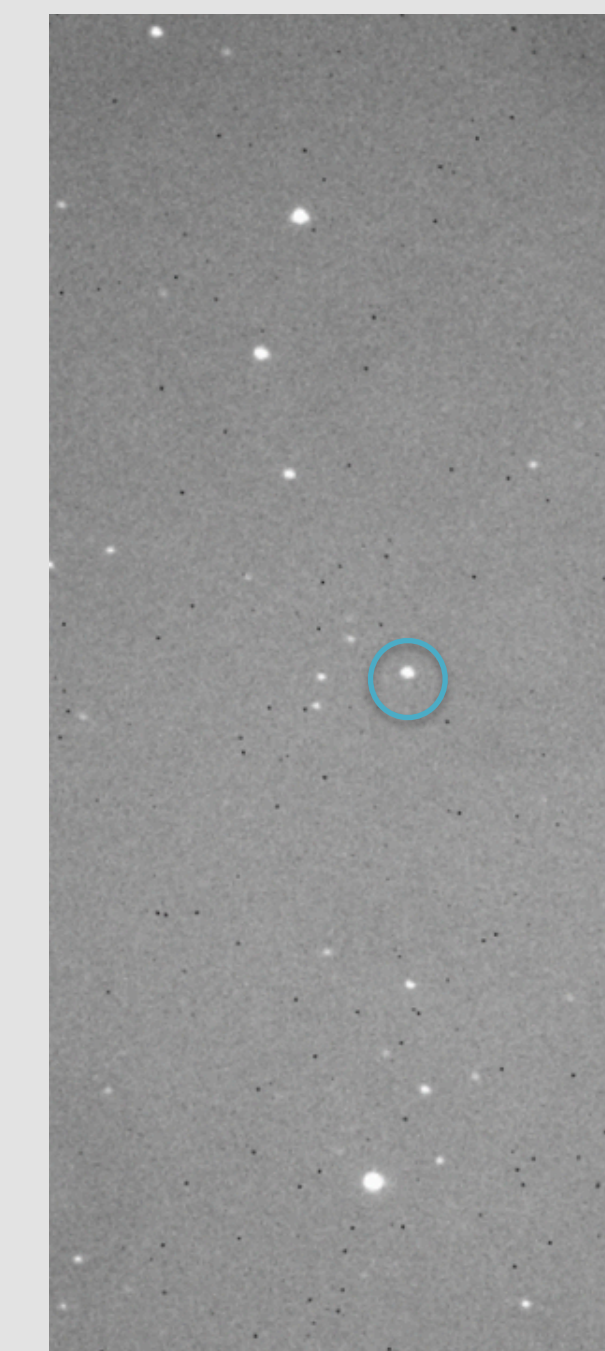
Introduction

Dwarf Nova Mechanisms

Dwarf novae are a subclass of cataclysmic variable stars in which there is a binary system of a white dwarf and a larger companion star. In the case of SS Cyg we have a white dwarf and red giant binary system in which the white dwarf is accreting mass from the red giant. As the mass transfers from the red giant to the white dwarf the material in the accretion disk closer to the surface loses angular momentum and falls onto the surface of the white dwarf. Once the density and temperature at the bottom of this accreted hydrogen layer is high enough there is a runaway outburst effect in the form of a nova outburst. Dwarf novae specifically, undergo this process repeatedly and have a rough periodicity to their outbursts. SS Cyg is known to rise from 12th mag to 8th mag for about 1-2 days every 7 - 8 weeks with some occasional, longer outbursts.



The image above displays SS Cyg circled, with arrows and labels signifying each of the comparison stars used for data analysis. This image was taken on the night of 9/28/20. This image shows the nova at its brightest point during our observing run.



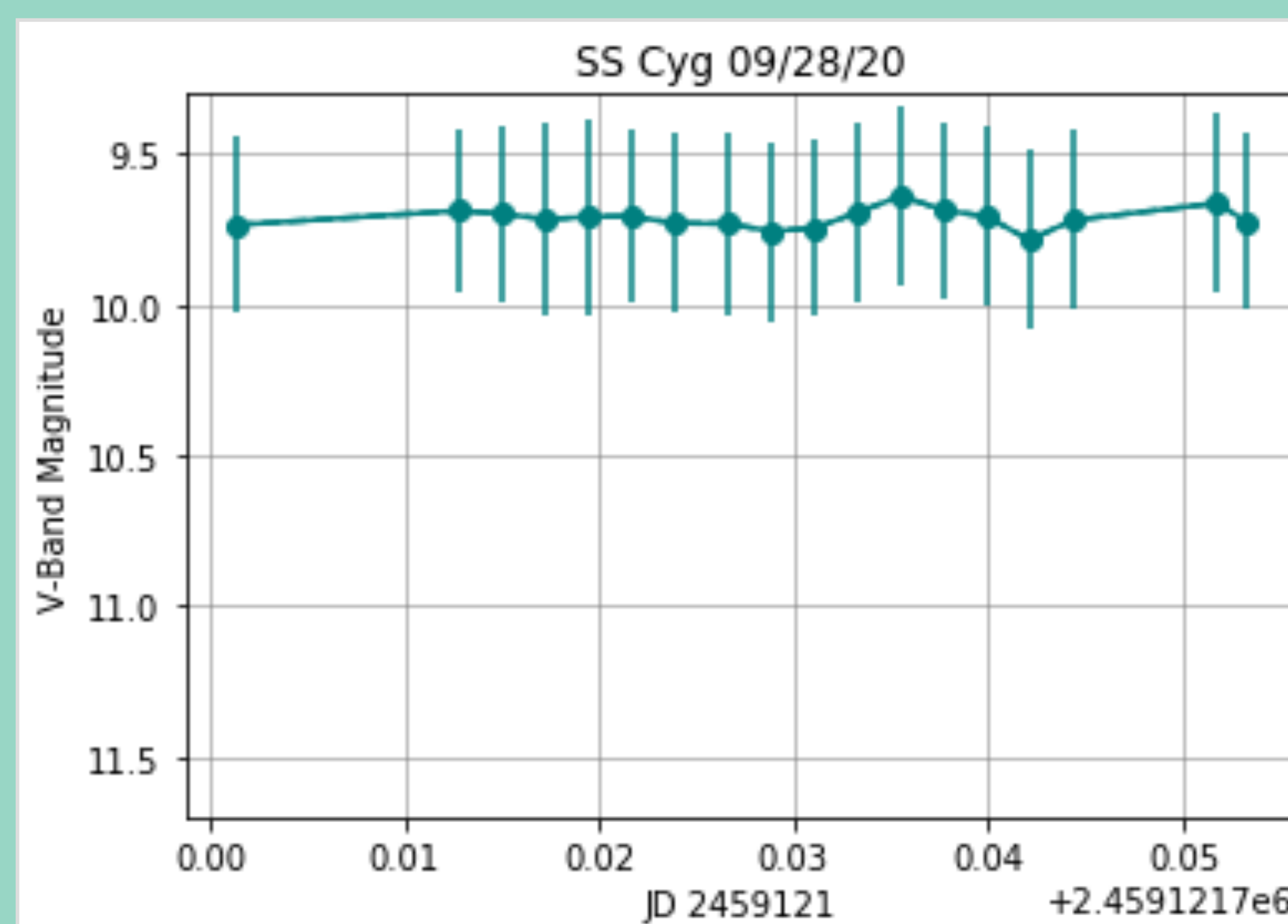
The image above displays SS Cyg on the last night of observing at its dimmest. This dimming is mildly noticeable to the eye when comparing to the image to the left.

Summary

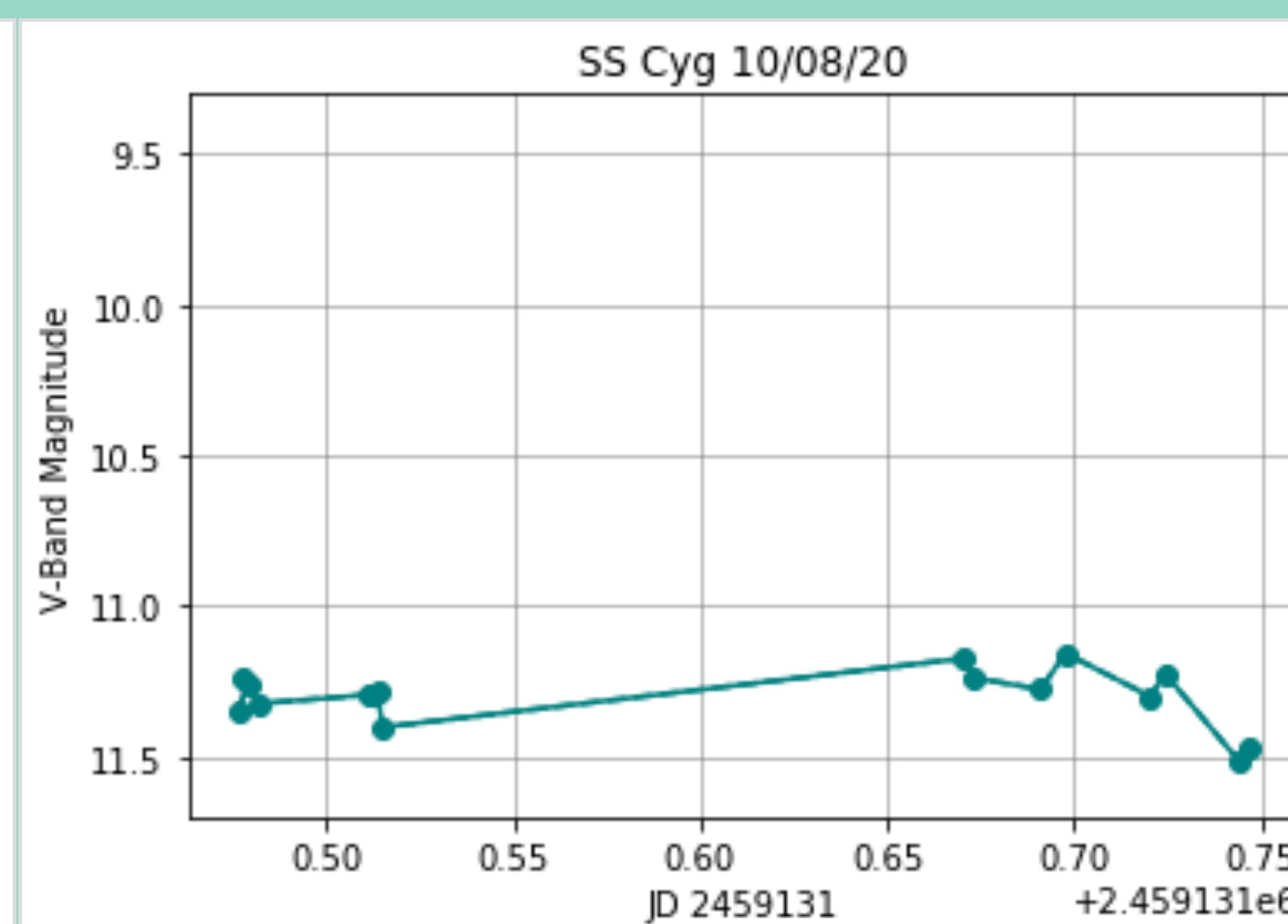
- Initial observations of SS Cyg show the decrease immediately following an outburst of the dwarf nova.
- Quiescent magnitude measurements match those submitted to the AAVSO and follow the same general trend throughout the night of observations
- The most recent outburst of SS Cyg took place on 10/30/20 roughly 9 days after our final measurements. This gives a period between the two outburst that bound our observations of 40 days. This is a rather short period relative to usual gaps in SS Cyg outburst however outbursts have been seen to take place between 4 - 8 weeks of each-other.
- In future observations it would be interesting to cover a span of 8 weeks, with data measurements taken for 3 consecutive days per week in order to cover both the small scale undulations as well as catching an outburst.
- Following the trend of the most recent 5 outbursts, a lower limit for the next outburst occurs on or around 11/20/20

Acknowledgments

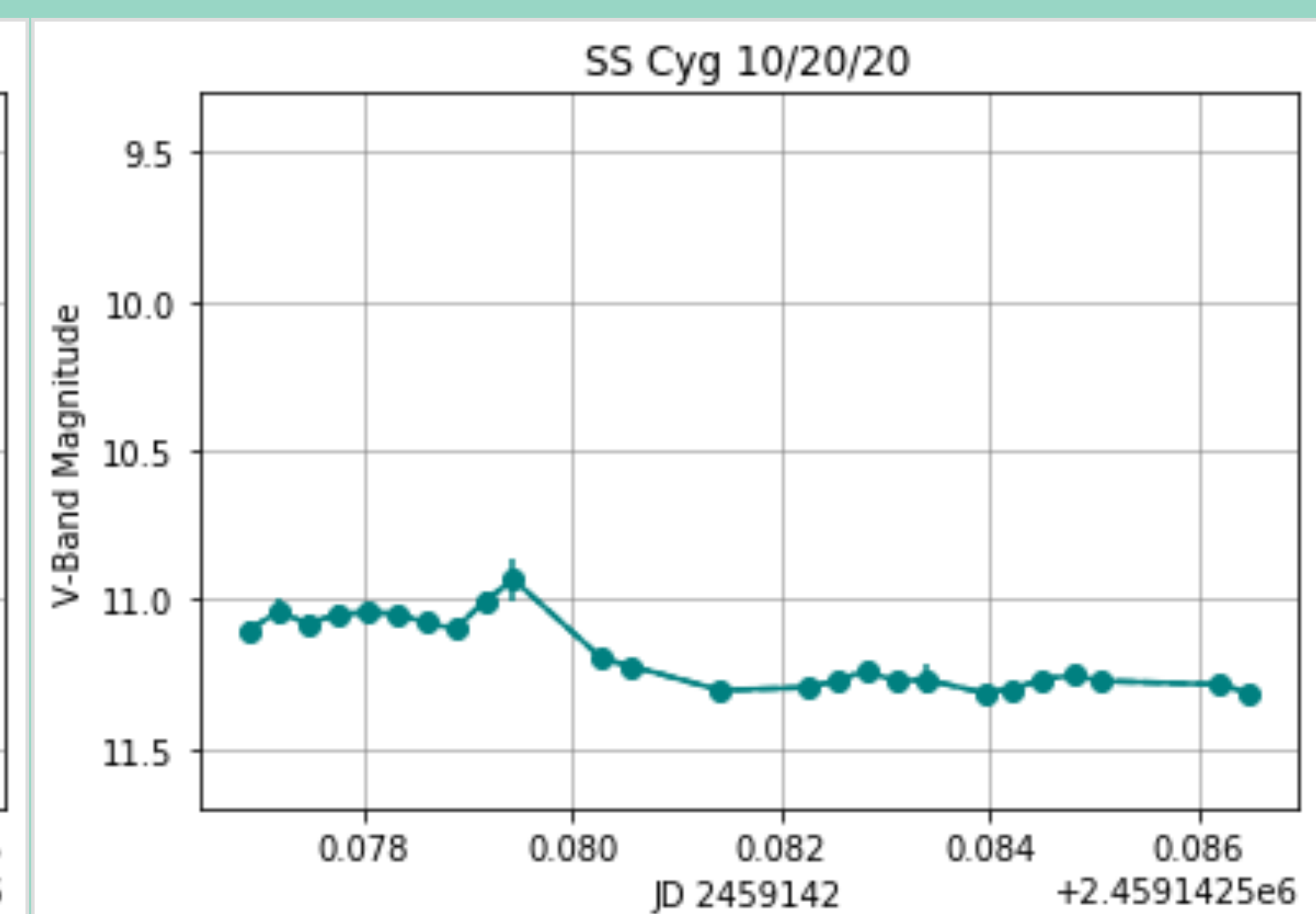
Naomi Gluck, Stony Brook University
John Green, Stony Brook University



Data Collected on the night of 9/28/20 This data starts at roughly a V-band magnitude of 9.713. It stayed relatively constant throughout the night of data collection and is recorded 6 days after the initial nova outburst. Large error due to very poor observing conditions



Data Collected on the night of 10/08/20. Data collected on this night shows a relatively consistent night of measuring a V-band magnitude. Error in magnitude is included, however the conditions of observation were much better on 10.08.20 resulting in more accurate magnitudes.



Data Collected on the night of 10/19/20. This data starts at roughly a V-band magnitude of 11.02 and then dims to about 11.21 for the remainder of the night. Again this was a more clear night resulting in much smaller error in magnitude as compared to 9.28