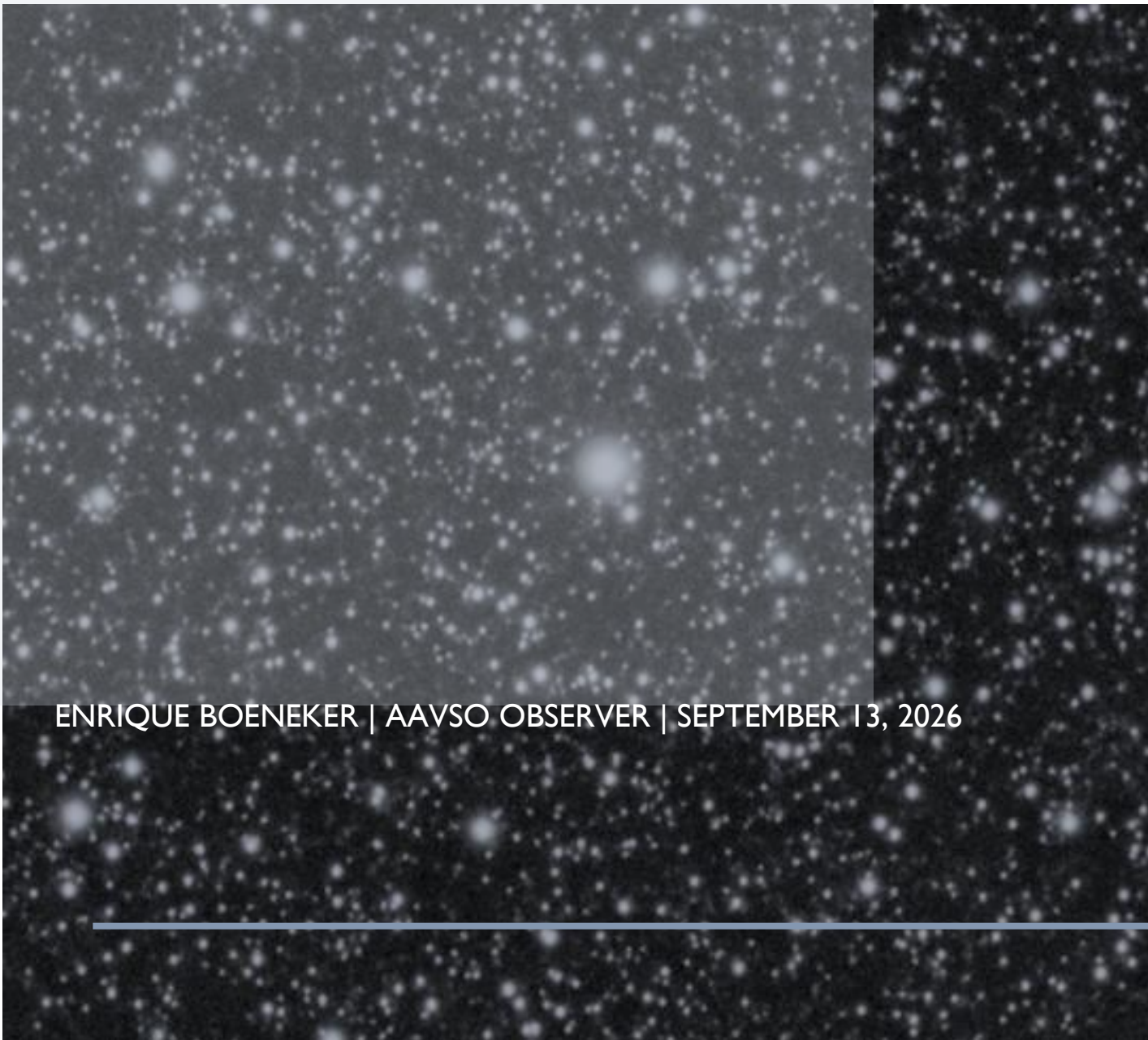


NOVA V0488 SGE!

POSSIBILITIES FOR AN AMATEUR ASTRONOMER TO MAKE
A PRELIMINARY SPECTROSCOPIC AND PHOTOMETRIC
ANALYSIS OF AN EXTRAORDINARY TRANSIENT EVENT



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SUMMARY

This brief study has two main goals. To test how much science can be done by an amateur astronomer equipped with a modest photometry and spectroscopy system (Brady I); and to report the follow-up photometric and spectroscopic observations done with that system and data available in astronomical databases of Nova V0488 Sagittae (PNV J19450648+1822422, V0488 Sge) (Barnhart, K., Sokolovsky, K., Perla, D., Charya, P., Worley, J., Antoniou, V., and Aydi, E. 2026; KB2026) and, finally, produce a preliminary analysis of the collected data. The photometric observations were obtained from AAVSO's International Database (AID 2026) and from our telescope at Brady I. All the spectra used in this study are from Brady I. The spectral analysis focused on two aspects: the chemical composition of the nova and an approximation of the expanding shell's velocity. The photometric analysis focused on the shape of the light curve and its behavior in the H α band, which can help professional astronomers determine the nova's physical characteristics (Richard J. Strobe, Bradley E. Schaefer, & Arne A. Henden 2010; SSH2010). Both analyses confirmed that V0488 Sge is a classical nova, with an S(9) class light curve in the V band, featuring a positive sinusoidal shape light curve in the H α band, composed of several metals, and a shell with an expansion velocity (V_{∞}) of about 3732.91 ± 789.27 km/s.

INTRODUCTION

A nova is a powerful stellar outburst that happens in a close binary system comprised of a white dwarf (main star) and a main-sequence red star or a red giant star (companion star). As the white dwarf accretes hydrogen-rich material from its companion, the gas accumulates on the accretion disk until conditions become so hot and dense as to trigger a thermonuclear runaway explosion. This explosion increases the system's brightness, often by several magnitudes, while ejecting material into space at speeds up to thousands of kilometers per second, thus depleting the amount of mass in the accretion disk. The white dwarf generally survives the explosion, and the process can repeat, producing a recurrent nova (RN). Novae are important phenomena that help us understand accretion physics, thermonuclear reactions, stellar evolution, and the chemical enrichment of the interstellar medium.

V0488 Sge became a nova on August 25, 2026, JD 2461277.944 (KB2026), increasing in apparent brightness from ~ 14.3 to 7.42 mv.

After the outburst, when weather conditions at Brady I (Table I) were favorable, we conducted low-resolution spectroscopic and Johnson B & V photometric observations. We uploaded the photometric and spectroscopic observations obtained with Brady I to AID and the AAVSO Spectroscopic Database (AVSpec), respectively.

The spectra show the evolution of the explosion shell and a significant increase in H α flux ($\lambda 6562.8$). Spectral analysis reveals several metals and the shell's high expansion velocity. V-band photometry from Brady I and AID data shows smooth dimming that appears to correspond to an S(9) class light curve (SSH2010). In contrast, the H α -filter photometric observations show the opposite behavior, brightening up to 5.547 ± 0.027 on JD 2461284.5020. For the photometric analysis, we rejected some observations for various reasons, which we explain in detail later in this report.

This study is organized into 3 sections: how the spectroscopy and photometry were performed and obtained, the corresponding analysis results in their respective sections, and a conclusion & discussion section summarizing the results of this study.

SPECTROSCOPY

Six spectra were obtained from JD 2461279.6213 to JD 2461285.7100, following the outburst of V0488 Sge (Figures 1-6). The observations were performed with a refracting Askar 103APO f/6.8 telescope, a cooled CMOS camera with a square sensor, and a Paton Hawksley Star Analyzer 200 diffraction grating (SA 200) mounted in an electronic filter wheel (Table I). This configuration produces spectra with a resolving power of $R_{\lambda 3965.25 \pm \lambda 2.72} = \lambda 82.94 \pm \lambda 11.30$. We adjusted exposure times based on the star's magnitude for each session (Table 2), and dark-calibrated,

registered, and averaged all spectra with Siril (2023). We reduced the data, identified emission and absorption lines in the spectra, and calculated the radial velocity (V_{∞}), as reviewed in the following subsection, using RSpec (2026), following the methods described by Trypsteen and Walker (2017) (T&W2017). The JD capture dates for the spectra are the start times of each session (Table 2).

The spectra show the evolution of the star's explosion shell during this period.

CHEMICAL IDENTIFICATION

After analyzing the spectral features, the following comments were drawn:

Figure 1. This spectrum shows strong lines that stand out from the normally strong hydrogen Balmer (H Balmer) lines. These are an emission line at $\lambda 3946.9$, most likely corresponding to triply ionized magnesium, and an absorption line at $\lambda 4490.9$, probably corresponding to ionized sodium. Iron emission lines at $\lambda 3886.3$, $\lambda 5031.0$, and $\lambda 5270.9$ could also be found. Ionized carbon at $\lambda 6578.0$ and $\lambda 6582.9$ apparently contributes to the H α emission line. Equally, the line at $\lambda 4113.7$, which corresponds to ionized sodium, seems to be contributing to the H δ emission line. We included lines from other elements that might seem irrelevant in this spectrum, but they appear prominently in later spectra.

Figures 2-6 show subsequent spectra with increasing strength of the H Balmer emission lines. In Figs. 2, 5, and 6, the sodium doublet (D1/D2) at the $\lambda 4890.0$ and $\lambda 4895.9$ absorption lines is evident and could be due to the interstellar medium (ISM) or to another medium most probably unrelated to the explosion shell. The cause of this feature remains undetermined. The increase in flux over time of H α and H β ($\lambda 4861.3$) emission lines is also noticeable (Fig. 9).

Spectra in Figs. 2, 4, and 6 show an intermittent emission line at $\lambda 7291.0$, which can correspond to neutral titanium or neutral magnesium.

Figure 7 shows a profile comparison of the six observations.

In summary, we identified ionized hydrogen, neutral helium, neutral iron, neutral and ionized sodium, neutral titanium, and possibly triply ionized and neutral magnesium and ionized carbon; the latter blended with the H α emission line. Nevertheless, the spectra show an interesting metallicity level.

CALCULATION OF THE EXPLOSION SHELL'S VELOCITY

As shown in Figure 7, the explosion shell shows stronger H Balmer lines as it expands into space, apparently leaving heavier elements behind, probably belonging to the star's photosphere. Therefore, it was of particular interest in this study to approximate the shell's expansion velocity using our own spectroscopic observations.

To approximate the velocity (V_{∞}) of the explosion shell, we applied the following mathematical model to each spectrum, as described by T&W2017 pp. 100 & 101, therefore assuming that.

"P Cygni profiles are also observable in spectra of relatively dense and rapidly expanding explosion shells of novae and supernovae. More often such extreme events show just a strong broadening of the emission lines. ... The expansion or terminal velocity v_{∞} can be estimated with the conventional Doppler equation, if $\Delta\lambda$ is simply replaced by $FWHM_{\text{emission}}$."

$$V_{\infty} = \frac{FWHM_{\text{emission}}}{\lambda_0} \cdot c \quad (1.1)$$

However, this formula requires a corrected FWHM that accounts for instrumental broadening, as also explained in T&W2017 p. 79.

$$FWHM_{\text{corrected}} = \sqrt{FWHM_{\text{measured}}^2 - FWHM_{\text{instrument}}^2} \quad (1.2)$$

To calculate $FWHM_{\text{instrument}}$, we first determined the resolving power of the diffraction grating in combination with the imaging train used to take the spectra (equation 1.3).

$$R_{ref} = \frac{\lambda}{\Delta\lambda} \quad (1.3)$$

$\Delta\lambda$ was taken by measuring the narrowest absorption line ($\lambda 3965.25 \pm \lambda 2.72$) of the reference star (HD 182919) used for wavelength calibration and to produce the instrument response curve (IRC).

The result of R for each reference star's spectrum was applied to (equation 1.4) using the value of the peak of the H α and H β emission lines of the corresponding target star spectrum to obtain the $FWHM_{instrument}$.

$$FWHM_{instrument} = \frac{\lambda_{target}}{R_{ref}} \quad (1.4)$$

The instrumental FWHM for H α and H β were averaged, resulting in the $FWHM_{instrument}$ used for the calculation of the corrected FWHM (equation 1.2).

The measured FWHM of the same emission lines of the target star were also averaged.

We used the measured and instrumental FWHM to calculate the corrected FWHM for each wavelength of each spectrum (equation 1.1). We approximated V_{∞} for each observation as the average of $V_{H\alpha}$ and $V_{H\beta}$. At the end, we estimated a total average V_{∞} of 3732.91 ± 789.27 km/s from the six spectra. However, these figures might differ greatly from those derived from higher-resolution spectra. This is due to the following, according to T&W2017 p. 79:

“...the width of a spectral line depends on temperature, pressure, density, and turbulence effects in stellar atmospheres.”

These factors can alter our results, and we must consider that our spectra are low resolution, which can blend several lines into one and broaden the emission lines.

Figure 8 and Table 4 show the expansion-velocity results for the six spectra in detail.

PHOTOMETRY

Identifying and analyzing the light-curve shape of novae helps derive some of their physical properties, as pointed out by SSH2010. Fortunately, several AAVSO observers have reported their observations of V0488 Sge to the AID, and we also contributed our own observations made with BradyI (Table 3). The exposure times were also adjusted according to the target star's brightness. The total volume of observations from both sources was sufficient to determine the light curve's class. For this study, the observations covered the time frame from JD 2461278.5 to JD 2461296.5. The first observation was very close to the explosion (t_0), which we set at JD 2461277.944, based on the brightest value reported by KB2026.

To produce a useful light curve that showed its shape during the decline after the explosion, the following restrictions were applied to all the observations:

- Only CCD/CMOS observations with the Johnson V filter were considered.
- Evident outliers were identified and discarded. We also discarded the complete data of the observers who reported these outliers.
- From the remaining observations, we discarded those that were beyond the range of $\pm\sigma$, i.e., $-\sigma < x < +\sigma$.
- From the observations left, we considered only those that had a reported magnitude error < 0.01 .

We binned the resulting observations into 0.5-day periods. We also discarded bins with only one observation (JD 2461280.0, 2461280.5, and 2461287.5). A total of 736 observations were considered.

Following the novae classification of SSH2010, we found that V0488 Sge belongs to class S(9) (Figure 10). The light curve shows a smooth decline and dims by 3 m_V in about 9 days after the explosion (t_3). We fit a third-degree polynomial to show the light-curve shape better.

We also considered the photometric H α (λ 6562.8) observations (Figure 11). The number of good observations available at AID for this particular band was not the same. Only 26 observations from one observer, and those with a reported magnitude error < 0.3 , were considered. The other reported observations were evident outliers. This data set spans from JD 2461279.496 to JD 2461295.505, which is a similar time range to the V band and spectroscopic observations. A third-degree polynomial was added to the light curve.

These observations confirm how energetic the H α emission line became after the nova event, as also shown in our spectra. Rather than decreasing in brightness, this passband increased considerably, peaking at magnitude 5.547 ± 0.027 on JD 2461284.5020, one day before our last spectroscopic observation at JD 2461285.7100, which we assume was very close to its true brightness peak date. Unfortunately, we do not have reliable H α photometric observations for that day to confirm that.

Apparently, this band has not been widely reported in past novae observations. We consider that H α photometry can reveal new information about the physics involved in nova events. We are confident we can identify a new set of H α light-curve classes and correlate them with the classes set by SSH2010.

DISCUSSION AND CONCLUSIONS

The main goal of this study was to determine how much science an amateur astronomer can do with off-the-shelf equipment, software, and astronomical databases available. We think we achieved this goal to a good degree. For example, the spectroscopic data produced, although very limited, can hint to the professional astronomer at the possible physical phenomena produced by this nova. The photometric data available at AID, however, has the required quality and, more importantly, volume. AVSpec also contains (though not considered here) high-resolution spectra that should be more helpful to the professional astronomer. In better hands, the data available in these databases will undoubtedly be useful for research and advance our understanding of novae.

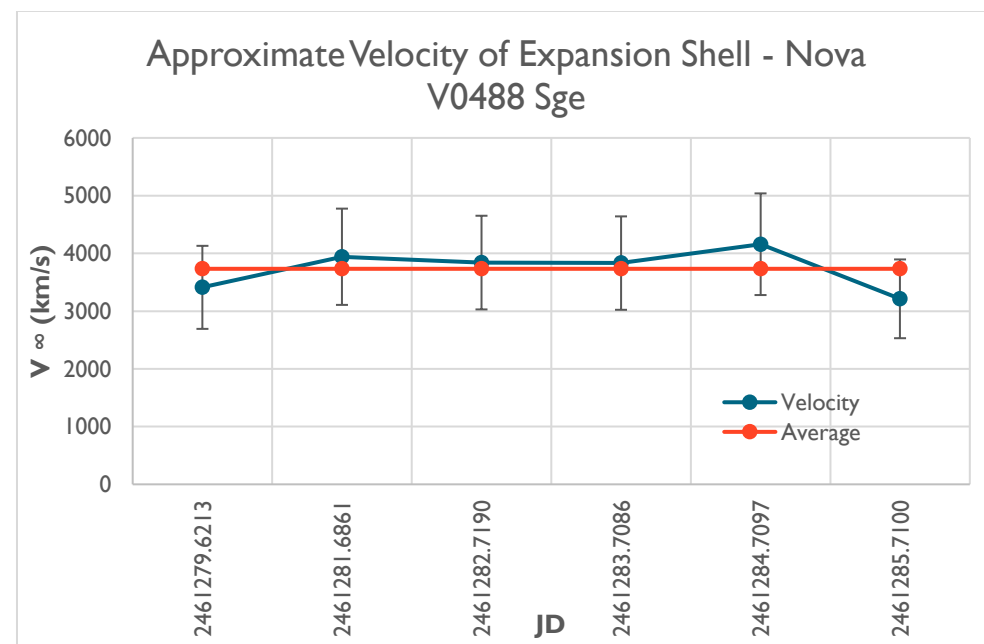
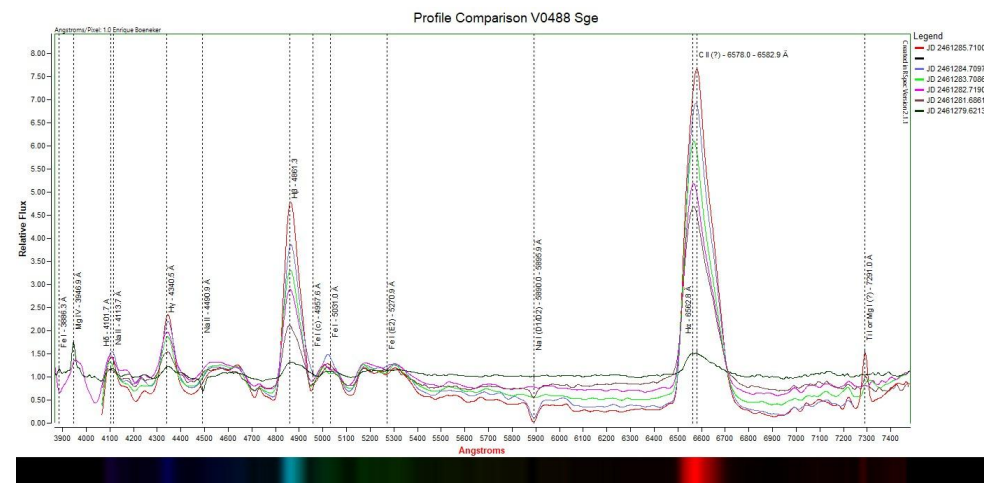
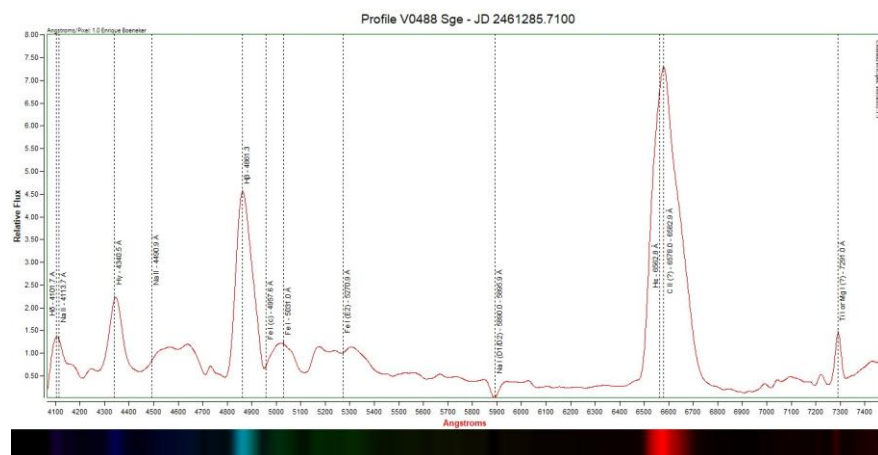
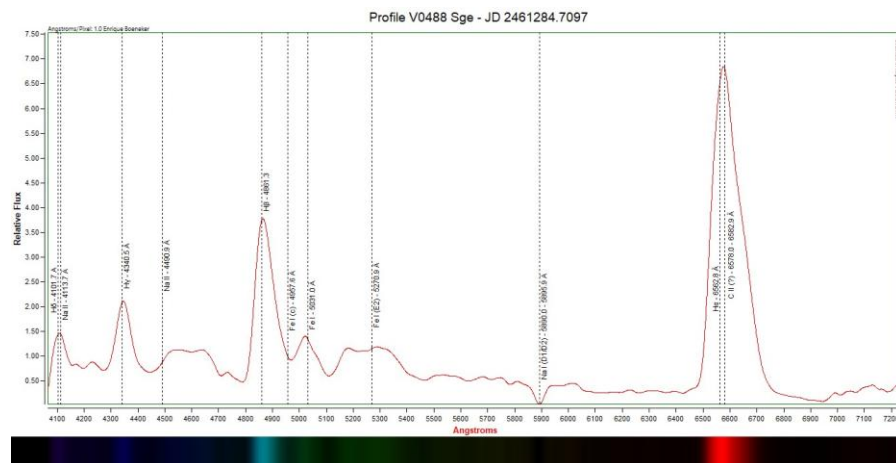
This study also aims to encourage observers to continue contributing to the AAVSO with their photometric and spectroscopic observations. As expressed in SSH2010, it is important to follow up V0488 Sge and other novae at least once they reach quiescence. Professional telescopes on the ground or in space cannot go so far.

V0488 Sge shows an interesting metallicity level and a shell expanding at a considerable velocity. The WD component of this system might have a mass closer to the Chandrasekhar limit.

The results in this study are limited and may be inaccurate, so they should not be taken at face value.

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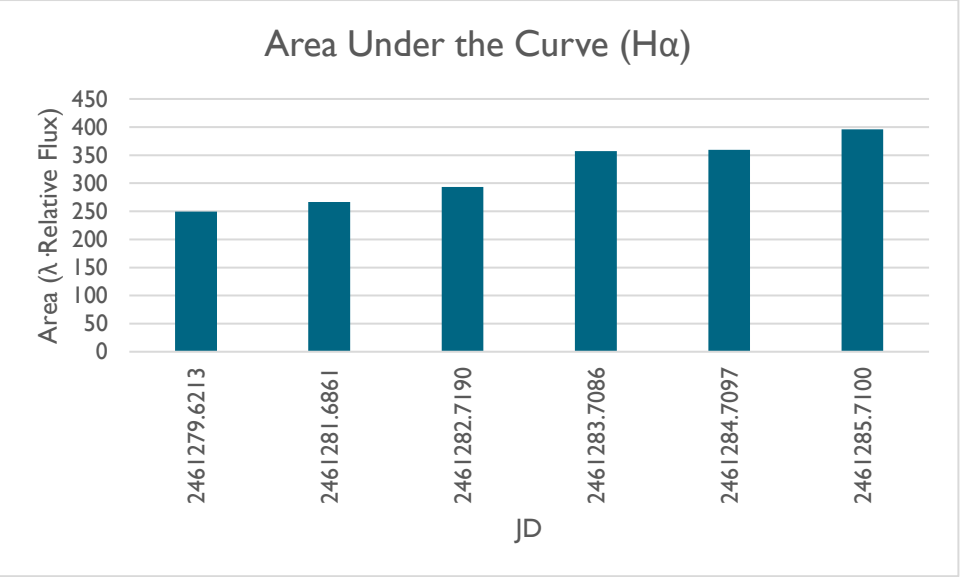


Figure 9

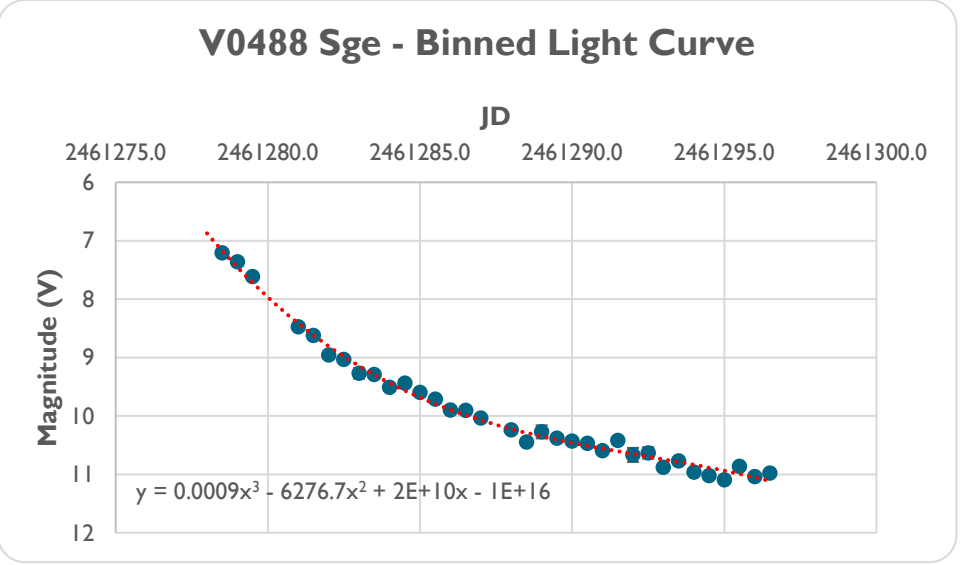


Figure 10

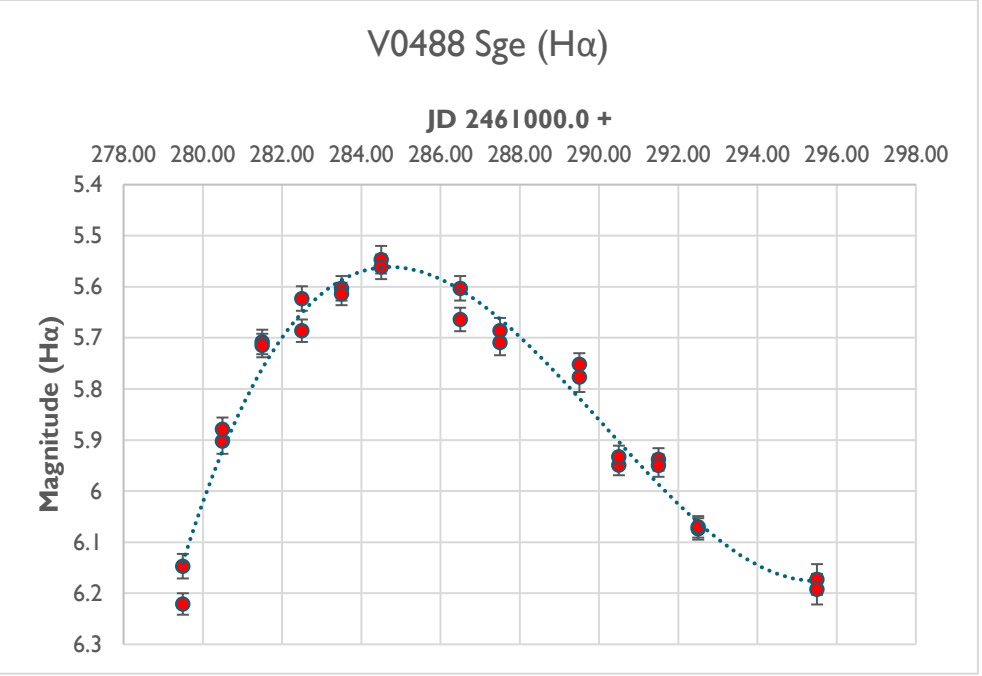


Figure 11

TABLES

Brady 1 Site & Telescope Characteristics	
Latitude	31.546934
Longitude	-99.38194444
Altitude asl	475 m
Telescope	Askar 103APO
Apperture	103 mm
Focal Length	700 mm
Focal Ratio	6.8
Design	Apochromatic refractor
Mount	ZWO AM5N
Electronic Filter Wheel	ZWO EFW 8 position
Filters	BVRI SHO
Diffraction grating	SA200
Camera	ZWO ASI533MM-Pro
Pixel size	3.76 μm
Pixel array	3008 x 3008
FOV	0.93° x 0.93°

Table 1

Spectroscopy Exposure Times		
JD	Time per frame (s)	Total time (s)
2461279.6213	240	1200
2461281.6861	240	1200
2461282.7190	300	1500
2461283.7086	360	1800
2461284.7097	480	2400
2461285.7100	600	3000

Table 2

Photometry Exposure Times				
Filter	JD	Frame Exposure Time (s)	Check star	Comp star
Johnson B	2461281.708	4	UCAC4 542-101940	UCAC4 544-101892
Johnson V	2461281.708	2	UCAC4 542-101940	UCAC4 544-101892
Johnson B	2461282.791	6	UCAC4 542-101940	UCAC4 544-101892
Johnson V	2461282.791	4	UCAC4 542-101940	UCAC4 544-101892
Johnson B	2461283.786	8	UCAC4 542-101940	UCAC4 544-101892
Johnson V	2461283.786	5	UCAC4 542-101940	UCAC4 544-101892
Johnson B	2461284.787	10	UCAC4 542-101940	UCAC4 544-101892
Johnson V	2461284.787	6	UCAC4 542-101940	UCAC4 544-101892
Johnson B	2461285.788	20	UCAC4 542-101940	UCAC4 544-101892
Johnson V	2461285.788	6	UCAC4 542-101940	UCAC4 544-101892

Table 3

Explosion Shell V∞ Approximation														
Spectrum JD	Reference Star (HD 182919)			Target Star (V0488 Sge)										
	λ (ref)	Δλ (ref)	R(ref)	H α (peak)	H β (peak)	FWHM (inst)	H α FWHM	H β FWHM	FWHM (meas.)	FWHM (corr)	V (H α)	V (H β)	V ∞	Uncert.
2461279.6213	3968.0	58.00	68.41	6577.20	4870.80	83.67	120.40	89.90	105.15	63.69	2902.98	3919.99	3411.48	719.13
2461281.6861	3968.0	47.60	83.36	6567.60	4858.70	68.53	118.20	82.70	100.45	73.44	3352.25	4531.30	3941.77	833.72
2461282.7190	3967.0	47.30	83.87	6566.60	4860.00	68.12	119.00	78.60	98.80	71.56	3267.01	4414.23	3840.62	811.21
2461283.7086	3962.0	45.30	87.46	6568.00	4861.80	65.34	115.40	78.20	96.80	71.42	3259.87	4403.89	3831.88	808.94
2461284.7097	3963.0	39.30	100.84	6576.60	4863.90	56.73	121.70	70.50	96.10	77.57	3536.07	4781.21	4158.64	880.45
2461285.7100	3963.5	53.80	73.67	6580.30	4862.40	77.66	123.50	72.70	98.10	59.94	2730.66	3695.41	3213.03	682.18
											App. V∞	3732.91	789.27	

Table 4