NOVA VELORUM 1999 (V382 VEL) FROM SOUTH AMERICA

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Abstract

Nova Velorum 1999—V382 Vel—was discovered on May 22, 1999, and, at visual magnitude 2.5, was the brightest nova in southern skies since Nova Puppis 1942. Observing campaigns to monitor the nova were immediately established by the variable star observing sections of the Latin American Astronomical League (LIADA) and the Brazilian Observational Network REA, both amateur astronomy organizations. 44 observers contributed 591 observations over 61 days. These observations have been reduced to daily means in order to measure the statistical quality of the data during the 1999 main observing window for the nova. The resulting light curve, with a standard error less than 0.05 magnitude, is shown. Also shown are two pre-discovery photographs of the nova, taken by Márcio Mendes and showing its dramatic rise in brightness in 24 hours.

1. Introduction

The Variable Star Section of the Latin American Astronomical League (LIADA) is an amateur group of visual variable star observers. They report their observations from Argentina, Uruguay, Peru, and Venezuela, in collaboration with the AAVSO and VSNET of the Variable Star Observers League of Japan (VSOLJ). The Brazilian Observational Network REA is another amateur group devoted to a wide range of observational activities, including variable star observing. The author is a member of REA and LIADA, and Publications Editor of LIADA.

Both groups detected the outburst of V382 Vel in the very early stages of its rise, during the night of May 22–23, 1999. The first observers on record were Renato Levai, from São Paulo, Brazil, and Antonio Padilla, from Rio de Janeiro, Brazil. Unfortunately for the other observers, there were clouds over much of Argentina and Uruguay during the first dark hours of the evening.

A campaign to monitor the nova was immediately established by LIADA and REA. 44 observers participated in the campaign and contributed 591 visual observations of the nova. Other highlights of the event were the pre-discovery photographs of the nova taken by Márcio Mendes, of Dois Corregos, Brazil. The photos were made just at the very beginning of the rise, during the night of May 20–21, and during the night of May 21–22, one night before the discovery.

The campaign ended in September 1999, when the star disappeared below the evening horizon for most southern observers.

2. The observations

The full set of 591 observations was obtained visually, except for two of the first three magnitudes of the rise, which are estimated photographic magnitudes.

The 44 observers from Argentina, Brazil, Peru, and Uruguay who contributed to the campaign are given in Table 1. The observers may belong to one or both of the organizations. For this reason, we have not made any distinction by observing group in the data.

The raw data from both groups (LIADA and REA) were plotted together with the means by day. The results are shown in Figure 1.

The light curve appears to be similar to that of CP Lacertae (Nova 1936), a prototype Na nova (according to Kholopov *et al.* 1985). See the light curve published by Payne-Gaposchkin (1954).

3. Photographs

The most important photographs taken by Latin American observers are those taken by Márcio Mendes prior to the Nova's discovery (Figures 2 and 3). Details of the photographs, taken on May 20.923 and May 21.944 UT, respectively, are given in the photo captions.

4. The quality of the observations

In order to verify the quality of the visual observations, we performed a statistical analysis based on the study of the distribution of the standard error of mean, which is obtained from the daily average of the visual estimates. The standard deviation, σ, is defined as follows:

$$\sigma = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n-1}} \qquad (1)$$

where x_i represents the individual estimate value for a certain day, $\bar{x}$ is the average of all the estimates of this day which is calculated as usual:

$$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n} \qquad (2)$$

and n represents the quantity of estimates for this day.

After σ has been calculated for each day, the standard error of the mean must be found. It is calculated by this formula:

$$\frac{\sigma}{\sqrt{n}} \qquad (3)$$

Figure 4 shows daily averages of the observations with their respective standard error bars compared with photoelectric V observations from Gilmore (1999). Figure 5 shows the distribution of the standard error of the mean.

From Figure 4 there is one interesting point: the fainter the magnitude, the smaller the error. One explanation for this phenomenon is: if you observe stars of about magnitude 3 or 4, the star is usually viewed with unaided vision and you have several comparison stars, but in a wide field. If you observe at magnitude 5 or 6, the star is now a binocular object and you usually do not have enough comparison stars in the same field of view as the target star. When the star is at magnitude 7 or 8, you have

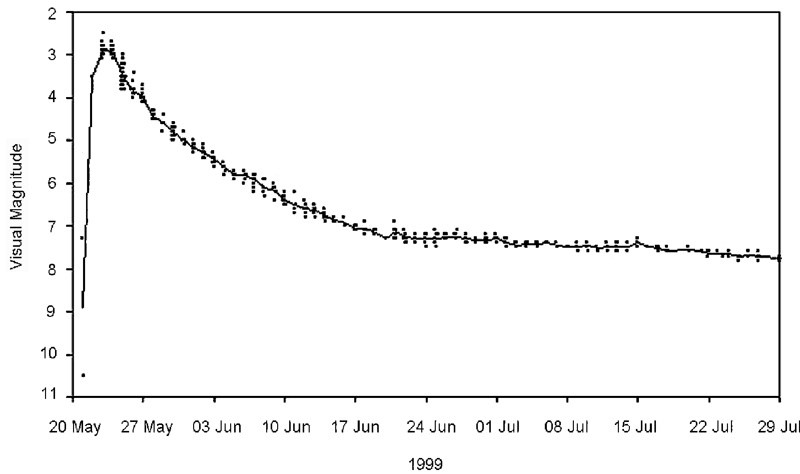

Figure 1. Light curve of V382 Vel. Points represent visual observations (raw data) from REA and LIADA observers. The line represents the mean values for each observing day.

a good number of stars in the field, with different colors and—almost—rather good photometric calibration, and this increases the accuracy of the magnitude estimated. Another possible explanation is the reddening of the nova.

Next, the average of the standard error $\overline{SE}_{\bar{x}}$ and its standard deviation $\sigma_{SE_{\bar{x}}}$ are obtained:

$$\overline{SE}_{\bar{x}} = 0.033$$

$$\sigma_{SE_{\bar{x}}} = 0.021$$

5. The absolute magnitude

Based on the light curve, we are able to obtain the characteristic values t_2 and t_3, the times for brightness decay by 2 and 3 magnitudes, respectively, below maximum. From Figure 1:

$$t_2 = 7 \text{ and } t_3 = 14 \tag{4}$$

These are in good agreement with the Schmidt-Kaler (1957) relationship:

$$\log t_3 = \log t_2 + 0.3 \tag{5}$$

Let us use the Schmidt-Kaler (1957) formula for the absolute magnitude:

$$M_0 = -11.8 + 2.5 \log t_3 \tag{6}$$

in order to obtain, from (4):

$$M_0 = -8.93$$

The uncertainty in the determination of t_3 is about 1 day. We can derive an error of about 0.07 in the absolute magnitude, because

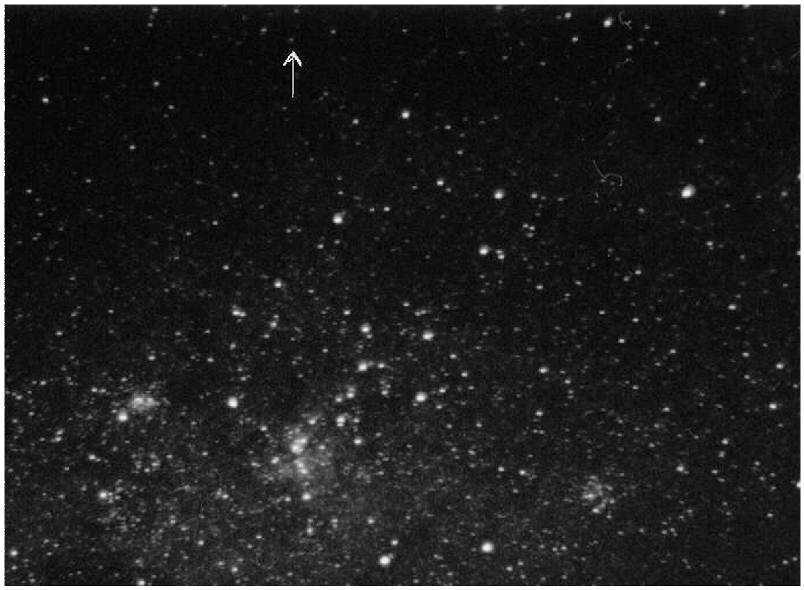

Figure 2. This photograph was taken previous to the Nova's discovery. Taken by: Márcio R. Mendes, Dois Corregos, Brazil. Date: 1999 May 20.923 UT. Equipment: Praktica MTL camera with a Pentacon f/1.8 50-mm lens. Exposure: 20 sec with fixed camera. Film: Fuji Super G Plus, ISO 800.

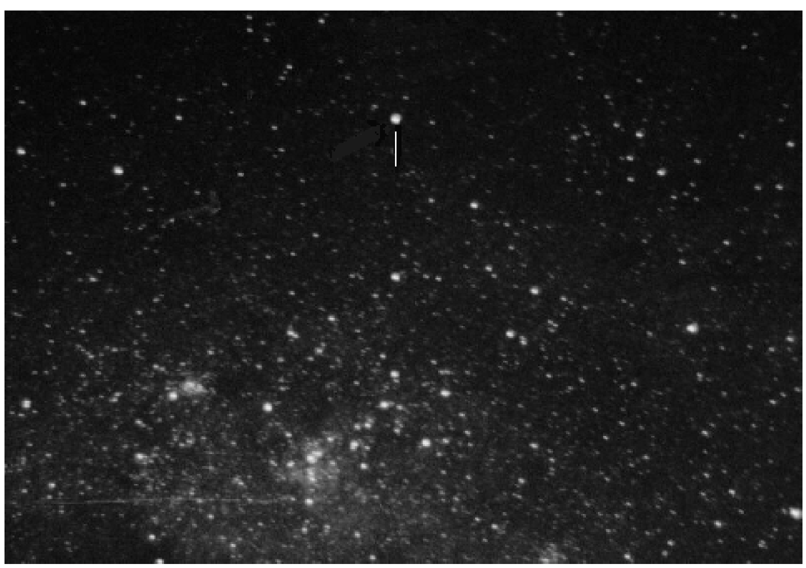

Figure 3. This photograph was also taken previous to the Nova's discovery and a day after the photo in Figure 2. Taken by: Márcio R. Mendes, Dois Corregos, Brazil. Date: 1999 May 21.944 UT. Equipment: Praktica MTL camera with a Pentacon f/1.8 50-mm lens. Exposure: 30 sec with fixed camera. Film: Fuji Super G Plus, ISO 800.

$$dM_0 = 1.086 \left(\frac{t_3}{dt_3}\right) \tag{7}$$

This value is in very good agreement with that from Della Valle *et al.* (1999), -8.7, based on spectroscopic analyses.

6. Conclusions

The quality of the estimates is excellent because the distribution of the standard error looks Gaussian. The error bars of the mean of Figure 4 are extremely small and they show a mean of 0.033 magnitude, whose standard deviation is about 0.021 magnitude. Thus, the error is between 0.012 and 0.054 magnitude.

The shape of the light curve, the t_2 and t_3 values, and the absolute magnitude, -8.93, of course, suggest that we are dealing with a fast nova of the Na type. See Figure 6.

7. Acknowledgements

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References

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Schmidt-Kaler, T. 1957, *Zeitschrift für Astrophysik*, **41**, 182.
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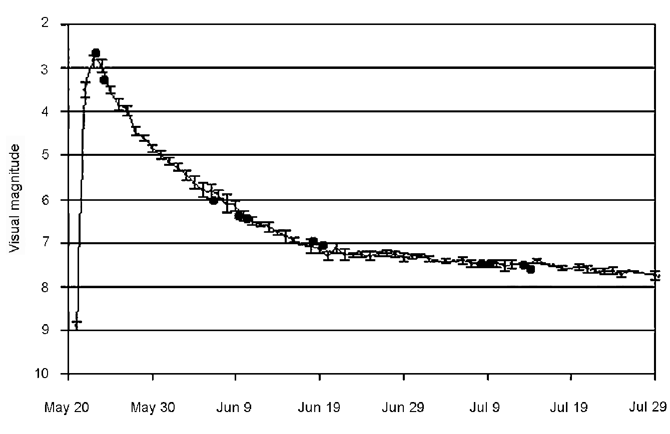

Figure 4. Light curve of V382 Vel daily averages with error bars from REA and LIADA observations, compared with photoelectric V magnitudes by Gilmore (shown as large points).

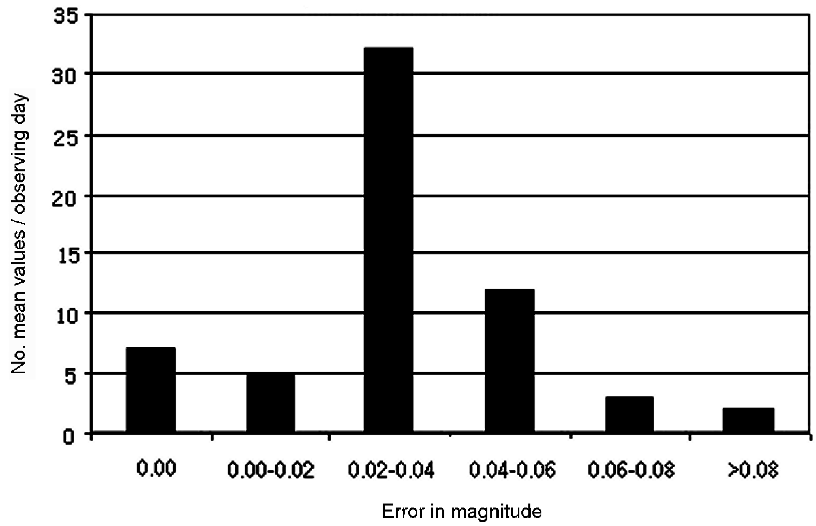

Figure 5. Distribution of the standard error of the mean for LIADA and REA observations of V382 Vel.

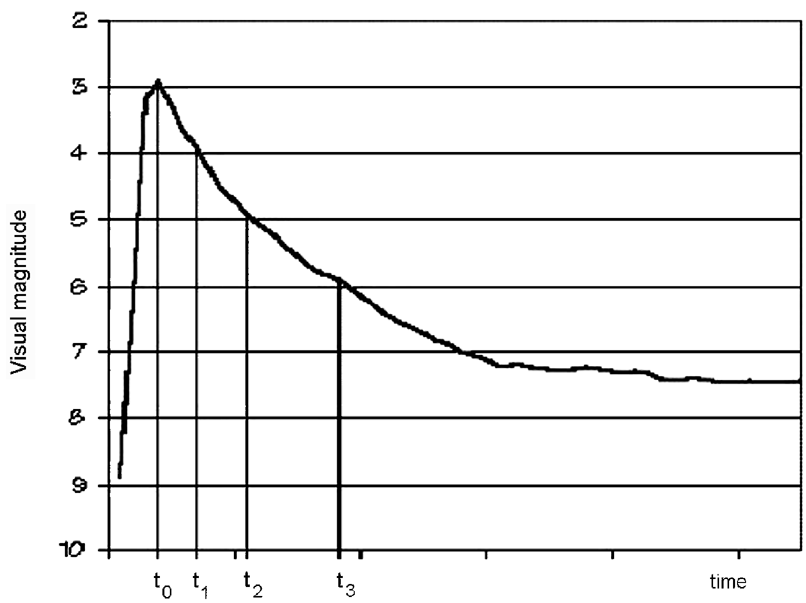

Figure 6. Schematic light curve of a type Na nova based on several curves given by Payne-Gaposchkin (1954). The points t_0, t_1, t_2, and t_3 represent the time where the star reaches the maximum itself, 1, 2, and 3 magnitudes below maximum brightness, respectively.

Table 1. LIADA and REA observers contributing to this campaign on V382 Vel.

Observer	*From*	*Number of Observations*
E. Salazar	Cuzco, Perú	62
M. R. Mendes	Dois Corregos, Brazil	60
J. García	Rama Caída, Argentina	59
A. S. Barros	Maceio, Brazil	51
H. C. Vital	Rio de Janeiro, Brazil	43
P. Pecorelli	Buenos Aires, Argentina	39
T. A. Napoleao	São Paulo, Brazil	35
A. Alves	Florianopolis, Brazil	32
W. Souza	São Paulo, Brazil	28
R. Caldas	Maceio, Brazil	20
A. Amorim	Florianopolis, Brazil	16
F. Garcia	Rama Caída, Argentina	16
A. Padilla	Rio de Janeiro, Brazil	15
J. Hodar	Campinas, Brazil	14
K. Soares	P. Prudente, Brazil	8
R. Salvo	Montevideo, Uruguay	8
M. Bain	São Paulo, Brazil	7
F. Hodar	Campinas, Brazil	7
J. Rodríguez F.	Montevideo, Uruguay	6
J. de S. Aguiar	Campinas, Brazil	6
A. C. Coelho	Brazilia, Brazil	5
P. Fernandes	Brazilia, Brazil	5
S. Lomonaco	Rio de Janeiro, Brazil	5
C. Colesanti	São Paulo, Brazil	4
F. Pfaffendorf	Wilde, Argentina	4
V. Trombotto	Almafuerte, Argentina	4
A. Bachi	Montevideo, Uruguay	3
F. L. Funari	São Paulo, Brazil	3
G. Otero	Montevideo, Uruguay	3
A. Risi	San Rafael, Argentina	3
D. Giraudi	Buenos Aires, Argentina	2
J. Halo	Montevideo, Uruguay	2
W. Kryzanowski	Montevideo, Uruguay	2
R. Levai	São Paulo, Brazil	2
C. Meluzzi	Goias, Brazil	2
N. Servachi	Montevideo, Uruguay	2
C. Brazil Jr.	São Paulo, Brazil	1
N. Cerruti	Montevideo, Uruguay	1
L. Duczmal	Belo Horizonte, Brazil	1
M. F. Lara	Nilopolis, Brazil	1
M. Mollaco	São Paulo, Brazil	1
P. J. Oliveira	Maceio, Brazil	1
J. M. Santander	San Rafael, Argentina	1
H. Tessi	Santa Fe, Argentina	1