Recent Developments of Variable Star Observing at South America

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Abstract

Since the creation of the Variable Star Section of LIADA (Latin American Astronomical League) in later 1982, the development of variable star research, in co-operation between amateur and professional astronomers, was significant. Several meetings, including workshops and symposia, were devoted to variable star observing since that time.

Several discoveries, fruitful observing campaigns and publications of research results were collected and the main purpose of this review is the detailed explanation of this evolution and the analyses of the future developments, mainly due to the controversy about the real value of visual observations.

1. Brief history

The study of star brightness measurements in South America has started during the second half of the XIX century, with the settlement of several observatories in Argentina (Cordoba National Observatory) and Peru (Boyden Station).
Argentine President D. F. Sarmiento went to U.S. and there he met the very known astronomer Benjamin A. Gould and together planned the idea of building an observatory in the southern hemisphere, precisely on a hill close to Cordoba city, in mid Argentine territory.
Gould came, in 1871, to South America and established the observatory. With theatre binoculars he started to make the very first atlas and catalogue of stars of the southern skies called Uranometria Argentina, that was also the start of the brightness measurement in our region. Further, the Cordoba Durchmusterung, the extension to –90° for that of Argelander, settled the base of a full sky visual photometric base.
The settlement of the Harvard Southern Boyden Station in Arequipa, Perú, in 1879, was another starter point for the study of variable stars, in the southern hemisphere. With plates taken in Arequipa several important discoveries were achieved, like the period-luminosity relationship, by Henrietta Leavitt and Ejnar Hertzprung.
Since that time, stellar variability became an important research target.
During the XX Century, specifically during 1940s and 1950s, the activity in Argentina was very important and several observers became important contributors.
In 1942, Bernard Dawson from La Plata discovered Nova Puppis 1942 (CP Pup), the brighter southern nova during the XX Century.
Carlos Seggers became the Argentine´s record man during 1950s. Nowadays, he has a crater named after him.
The photoelectric photometry starts at La Plata and Cordoba during the fifties. A Latin-American organization was born in 1958, the LLADA which had a variable stars' commission, leaded by Seggers, and other observers from Argentina, Brazil, Chile, Peru and Uruguay.
During sixties, amateur groups grew and several records were achieved. The record man during this time was Mario Vattuone who remains until nowadays in spite of having passed away at the end of 70s.
During the eighties, in opportunity of the meeting to reorganize the old Latin-American League of Astronomy (LLADA), which gives life to the LIADA, at Montevideo, Uruguay, in December 1982, variable stars study was one of the most interesting topics for the people. Then, the Variable Star Section was born at the same meeting.

LIADA is formed by amateur and professional astronomers devoted to every part of Astronomy. Among them, there is an outstanding group of variable star observers, the Variable Star Section of LIADA.
The Section publishes some of its results in BARM (the former name of Universo) and Universo, that is the official publication of LIADA.
The observations were accumulated since that time, but most of them are only in paper and there are not too much in the computer database.
The number of observers has decreased strongly during the nineties, and the enthusiasm for the variable stars appeared to decline, even though two Latin-American Symposia have taken place.
Since 1998, the number of active observers has started to grow up again because of the important role of Internet as a communicative medium. Brazil, Uruguay, Venezuela and other countries have begun the development of an important activity that has increased the number of observers.
The interaction between amateurs and professionals has also increased and there are several progresses in diverse fields of variable star research.

2. Meetings

As I have explained in the previous section, the Variable Star Section of LIADA was founded during LIADA´s 1982 meeting. After this meeting we have had several others, including Variable Star Latin-American Symposia, in 1992 (Montevideo, Uruguay), 1993 (Campinas, Brazil), 1999 (Santa Fe, Argentina) and recently in Asunción, Paraguay (2001). Let me show you some pictures of these events.

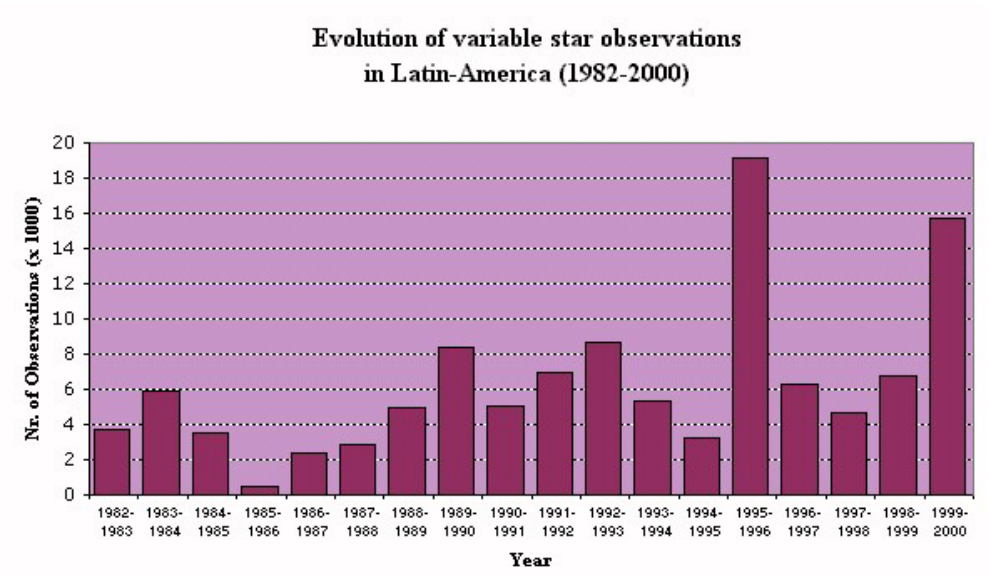
The usual activities during meetings (specially during Symposia) are the following:

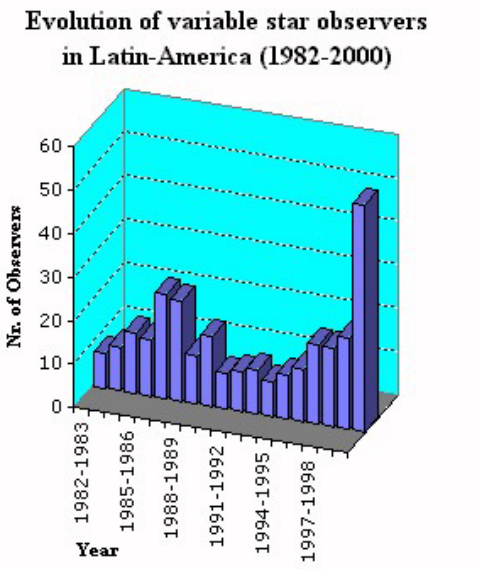
1. Workshop for beginners (including observing sessions)
2. Workshop for advanced observers
3. Paper sessions

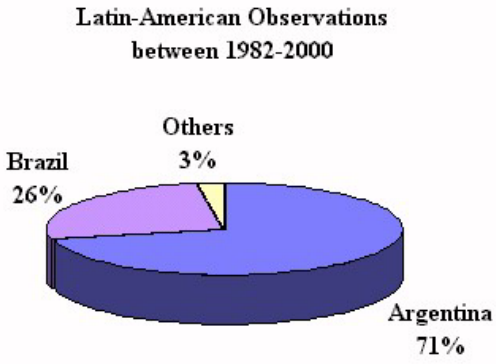
4. Panels
    a. Amateur –Professional partnerships
    b. CCD techniques
    c. Instrumentation

3. Observational activities

Let me show you the evolution of observational activity in Latin-America between 1982 and 2000. The graphs has been elaborated based on observations reported to AAVSO database. The first graph shows the number of variable star observations per year. The second one, the number of observers contributing, per year. The third one shows the composition of the contribution with observations in terms of Latin-American countries.







Let me share with you three comments. In the first graph, the peak in 1995/1996 fiscal year is spurious because more than one observer had to report observations from the previous year during this year. Then we must realize that the number of observations must be spread between

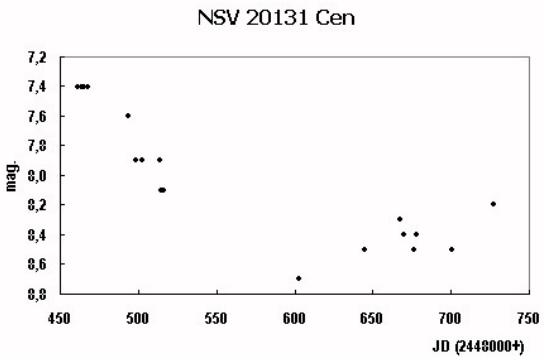
the two periods. The number of Latin-American observers contributing to AAVSO database shows two clear increases due to Supernova 1987 and the bright nova Velorum 1999. It is evident, from the third graph that Argentina has the leadership in the contribution with observations to AAVSO database from Latin-American countries. It is important to remark that Astronomy in Argentina has been an important activity since 1871. Nowadays, the activity in Brazil is growing strongly.

4. Discoveries

Several discoveries were carried out by Latin American observers. Let me divide these discoveries into visual and CCD ones. We can start with the visual discoveries.

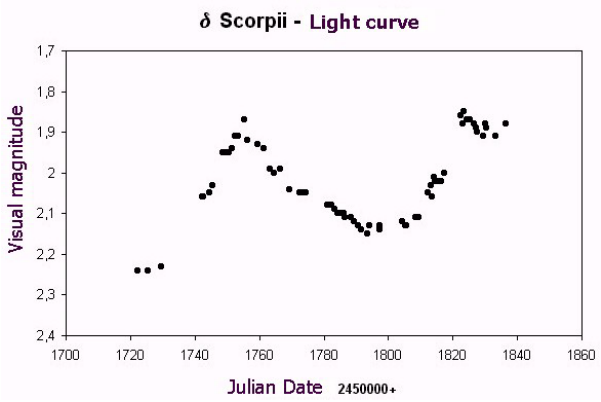
NSV 20131 Cen

This star, first detected by Funes Municipal Observatory, was visually observed during 2 years (1990-1991). Its light curve is shown here using observations from Funes Municipal Observatory. The discovery was reported by Arquiola (1992).



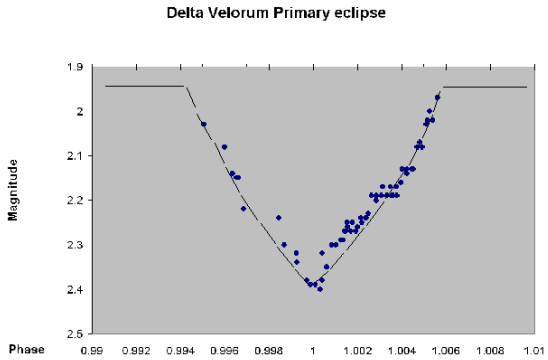
δ Scorpii

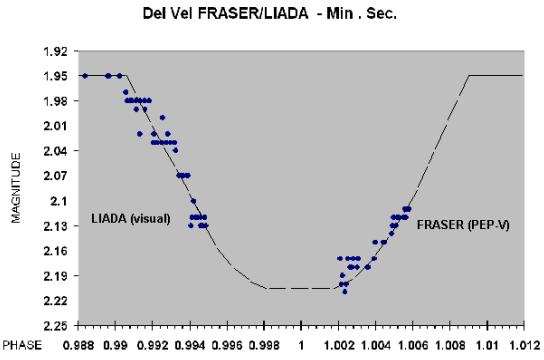
The discovery of the variability of the bright GCAS star δ Sco was only visually achieved. Here we show the light curve during 2000, when the amazing increase of brightness had happened. The results were published by Otero, Frazer and Lloyd (2001).



δ Velorum

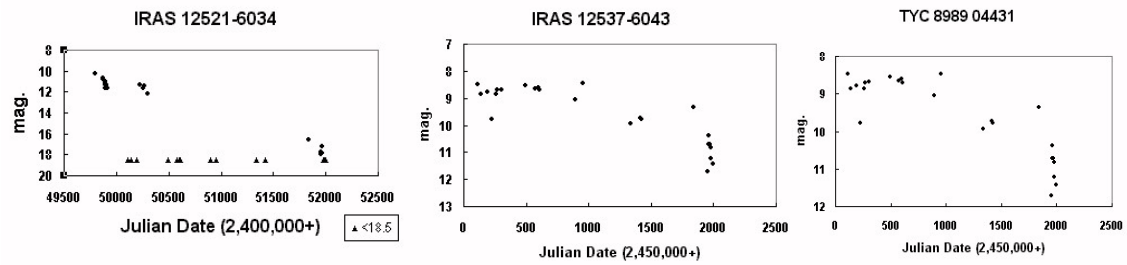
This eclipsing binary is another instance for the important role of visual observations. The discovery was carried out by Sebastián Otero (visually) and NASA´s Galileo spacecraft. The star shows primary and secondary eclipses and with the visual and photoelectric observartions, Otero was able to determine the elements of the light curve for this star. The figures show the primary and secondary eclipses folded curves.
The results were published by Otero, Fiesler and Lloyd (2000).

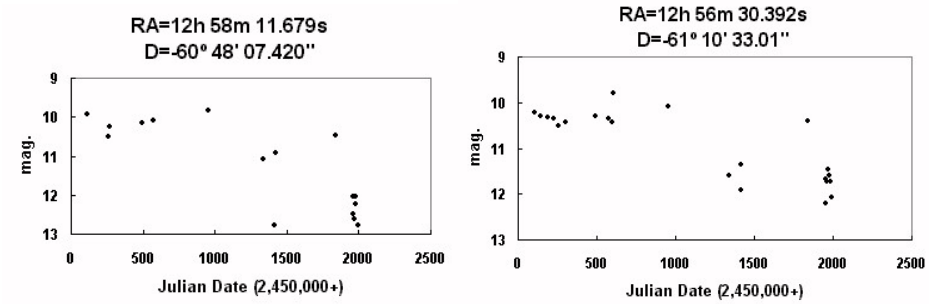




New suspected variables with CCD

Let me show you the light curves of five suspected variables discovered using unfiltered CCD camera at Cristo Rey Amateur Observatory reported by Buso (2001).





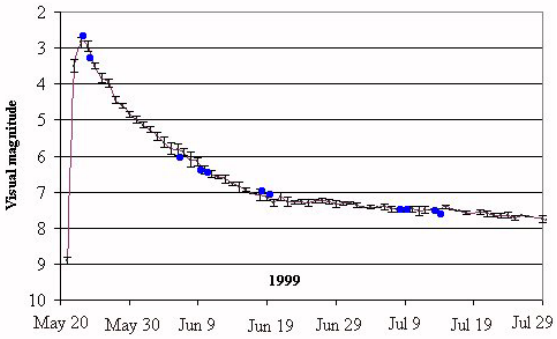
5. Observational results

Let me share with you some observational results of several campaigns carried out by LIADA.

Novae

V382 Velorum = Nova Velorum 1999

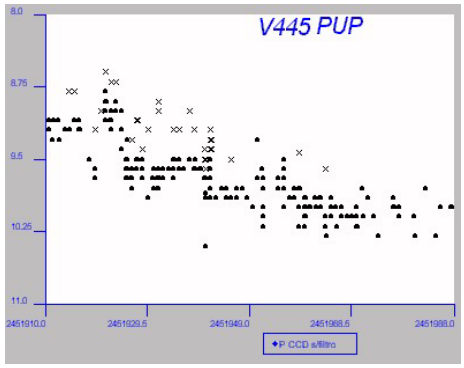
The observational campaign of this nova was developed during 1999 with a total of 591 observations from 44 observers from Argentina, Brazil, Peru and Uruguay.
The image shows the error bars of visual observations compared with PEP V (in blue).



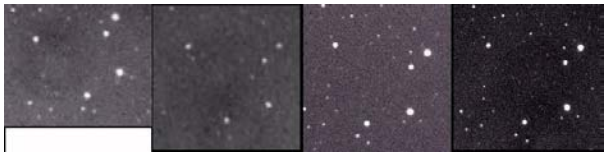
The paper with the results was published by García (2000).

V445 Puppis = Nova Puppis 2000

One of the recent contributions is the campaign of the interesting star V445 Pup. We have 312 observations from 26 observers from Argentina, Brazil, Spain, Venezuela and Uruguay
This is the light curve: the black dots are visual observations, the x are CCD unfiltered measurements.



The images are CCD unfiltered from Venezuela observers.



The paper with the results was published by García (2001).

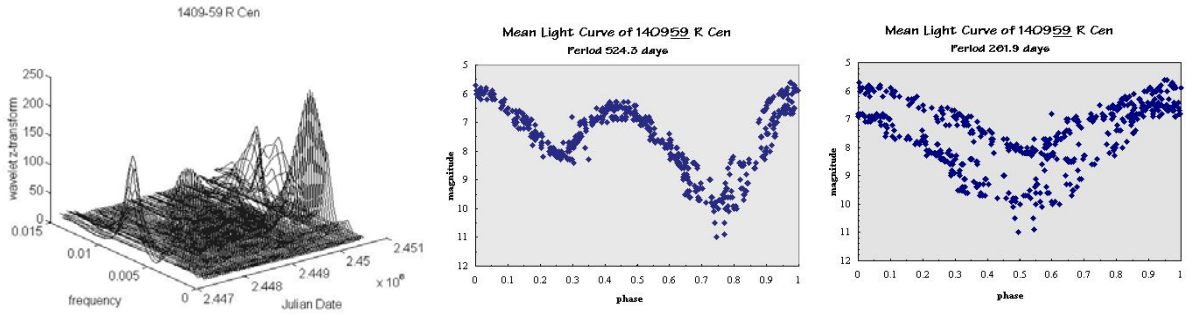
Dwarf novae and R CRB stars

Several alerts were detected and communicated by LIADA´s observers.
The stars involved were VW Hyi, OY Car, RY Sgr, etc.

Miras and SR

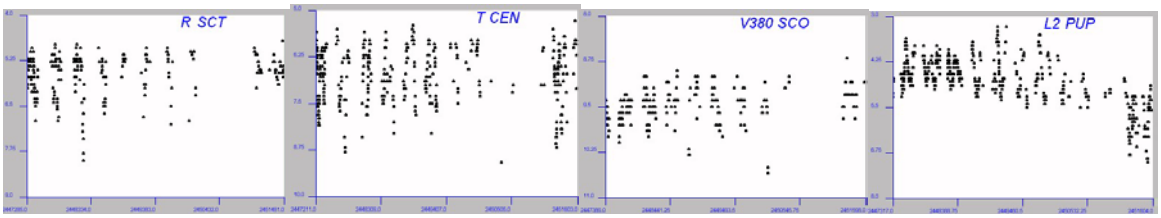
R Centauri

The variable star R Cen is one of the few double maximum red giant Miras.
We have performed a long term variability analysis and we have found that the period is getting shorter and the amplitude is going smaller. Results were published by García and Dominguez (1997). Here we have the weighted wavelet Z-transform for the observations and two mean light curves showing the double maximum and the long term variations.



Several other stars

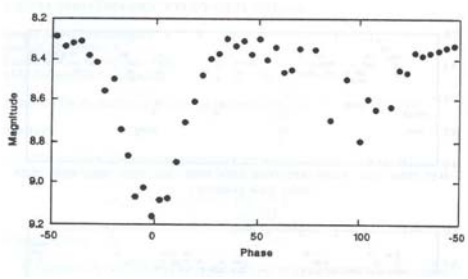
Let me show you some light curves from the database of the Variable Star Section of LIADA.



Eclipsing Binaries

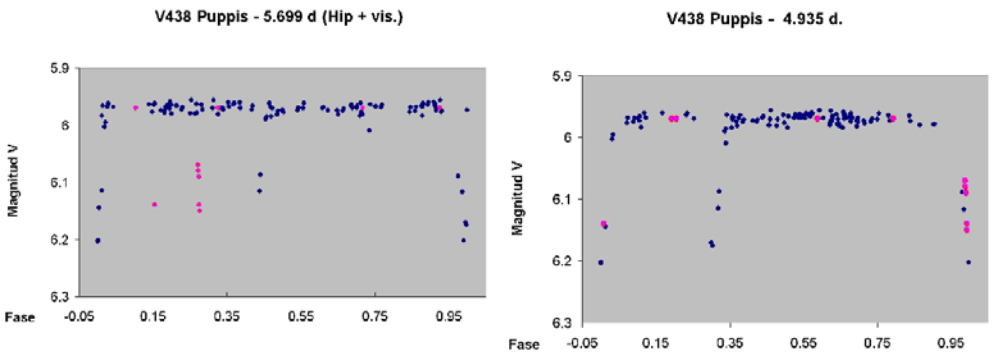
W Crucis

With W Crucis, the work was the determination of a precise period and type of variability (β Lyrae). The results were published by Dominguez (1994). Here we have the mean light curve.



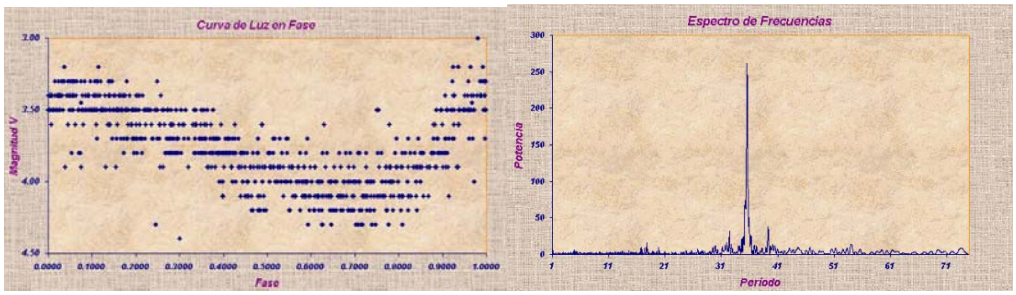
Eclipsing variables from Hipparcos

Comparing visual observations with other form Hipparcos Otero has found a better period.
To be published by Otero (2001).



l Carinae

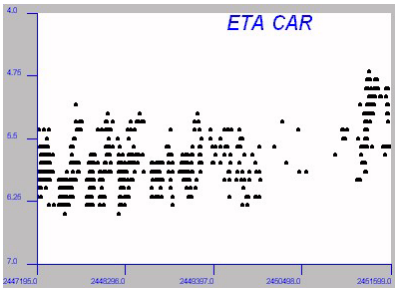
Long term periodicity analysis of this bright Cepheid were carried out by Dominguez (2000). Here we can see the folded light curve and the power spectrum of the time series analyses from this paper.



6. Amateur-Professional partnerships

We have several instances about this kind of partnerships, but I would like to show you four of them:

Continuous monitoring of the unique supermassive star η Carinae in collaboration with astronomer Dr. Mónica Villada (Cordoba Observatory, Argentina). Some of the observations were used in the paper by Davidson et al. (1999). The figure shows the observations during the latest years of this star as they are archived in the database of the Variable Star Section of LIADA.



A recent study about V393 Carinae: CCD observations made by amateur astronomers and reductions and analyses done by professionals gave rise to the detection of period variation in this δ Scuti star. The paper with the results was published by García et al. (2001).

The other is a planned interaction between Dr. Olga Pintado (Consejo Nacional de Investigaciones Científicas y Tecnológicas – CONICET, Argentina) and a group of amateurs using CCD with interferential filters, to be held next year, working on peculiar stars.

The detection of an increase in brightness of the Be star ω Canis Majoris visually detected by Enzo de Bernardini and Sebastian Otero (both LIADA observers) and the campaign of simultaneous observations with astronomers from ESO published by Štefl et al. (2001).

7. The future ...

The expectations for the future for the variable star research in Latin-America are very hopeful. The way for doing good Science at the Variable Star Section of LIADA shall pass by the following milestones established during its latest meeting

- Digitalising old observations
- Building good charts
- Acquiring good sequences

- Encouraging continuous monitoring and surveys
- Encouraging visual observers
- Applying new equipment
- Encouraging Amateur-Professional partnerships

We expect to show you better Science during the next International Conference on Variable Star Research.

Acknowledgements

I would like to acknowledge with thanks the Scientific Organizing Committee and the authorities of the Instituto Copérnico for their support for my participation in the meeting. Also I would like to thank Sergio Dominguez, Sebastián Otero, Federico García and María José Mundet for their support in several parts of the compilation of this review.

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