# The GEOS RR Lyr Database

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The GEOS RR Lyr database is a free access web database whose aim is to collect and make available data on RR Lyr stars. It presently contains close to 30000 times of maximum on 1700 different stars.

*http://webast.ast.obs-mip.fr/people/leborgne/dbRR*

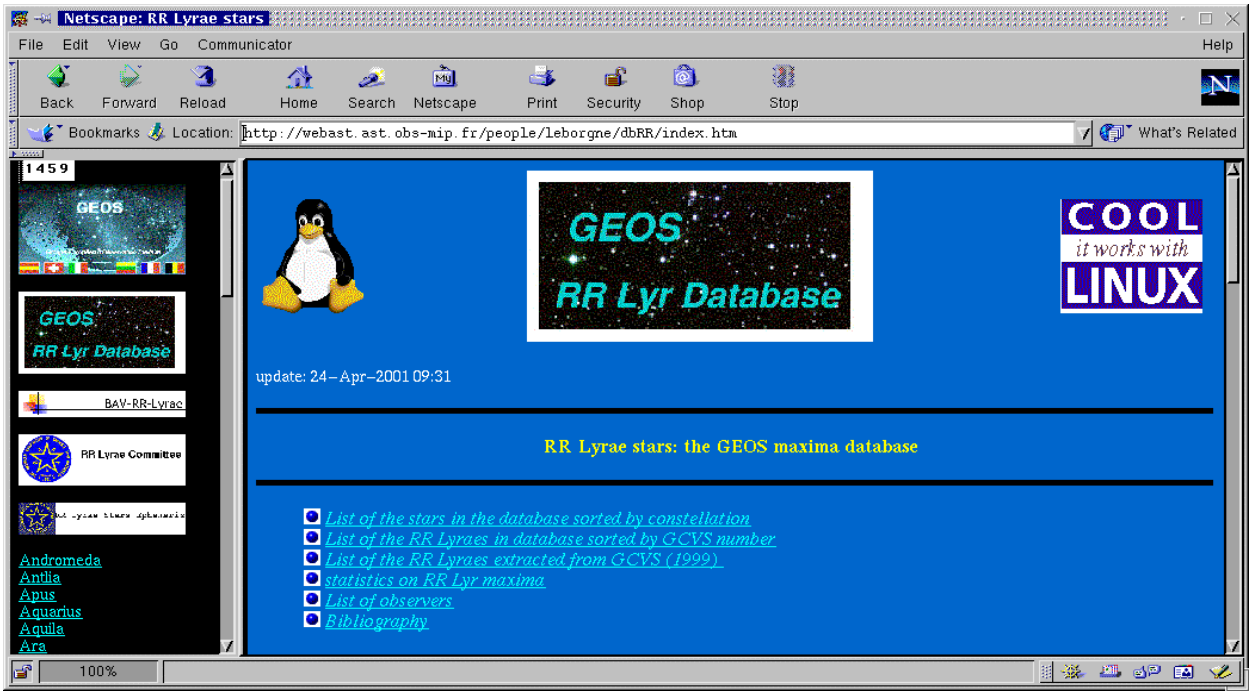


**Figure 1.** Title screen of the webpage of RR Lyrae stars database.

The GEOS RR Lyr database is intended to help observations and studies on RR Lyr stars. The stars concerned are field RRab and RRc. The web site of the GEOS RR Lyrae stars database is maintained by Jean-Francois Le Borgne (leborgne@obs-mip.fr). The database is hosted by the web site of the Laboratoire d'Astrophysique de l'Observatoire Midi-Pyrenees (Toulouse, France). The work of collecting data and sorting them is mainly done by Anton Paschke (Anton@Paschke.com) and Massimiliano Martignoni (maxmartignoni@inwind.it). Scanning and digitalizing old publications to recover precious data is done by Francesco Acerbi (acerbifr@tin.it). Recent data from GEOS observers are collected by Jacqueline Vanderbroere (j.vandenbroere@skynet.be) (GEOS RR Lyrae stars coordinator).

The data, dating back to the end of century XIX when the first RR Lyraes were discovered, can display the period changes. The reason of these period changes of RR Lyr pulsators is still unknown. It is then important to monitor the period variations of RR Lyraes and to make a catalogue of their behaviour to help understanding the phenomenon as V.P. Tsesevich ("RR Lyrae stars", 1969) made in a first attempt some thirty years ago. Apart from the secular period variations, RR Lyraes exhibit another not fully explained phenomenon: the so-called Blazkho effect, named after the russian astronomer who discovered it in his observations of RW Dra in 1907. This periodic modulation of the RR Lyr pulsations (periods from 20 to 200 days) may be also study with the aid of the database.

The data are collected in the literature or are submitted by the observers themselves.

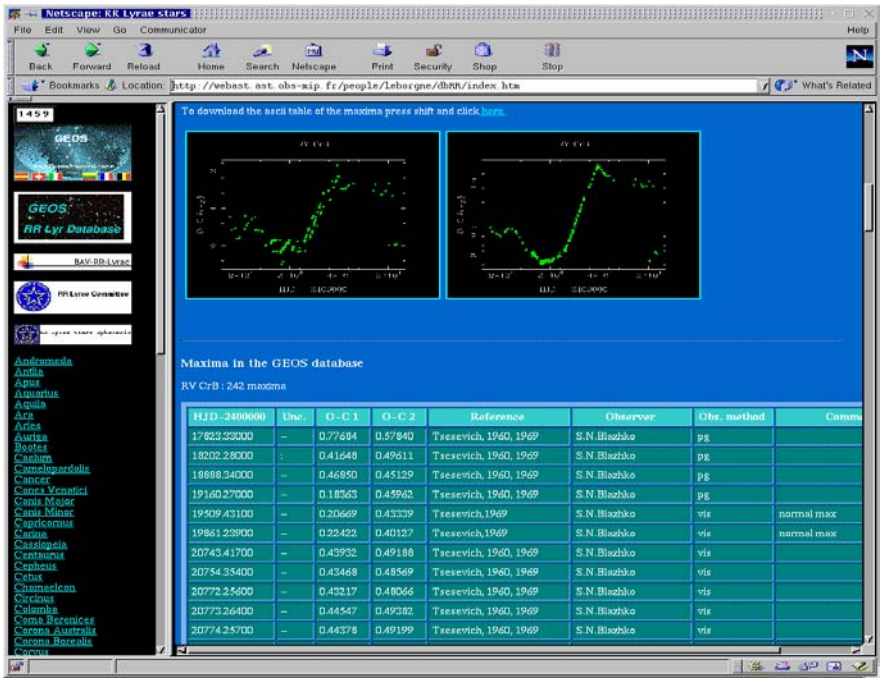


**Figure 2.** Example of a page of the GEOS database: the variations of the O-C of the maxima of RV CrB are displayed for 2 different elements. The oldest observations date back to December 1907.

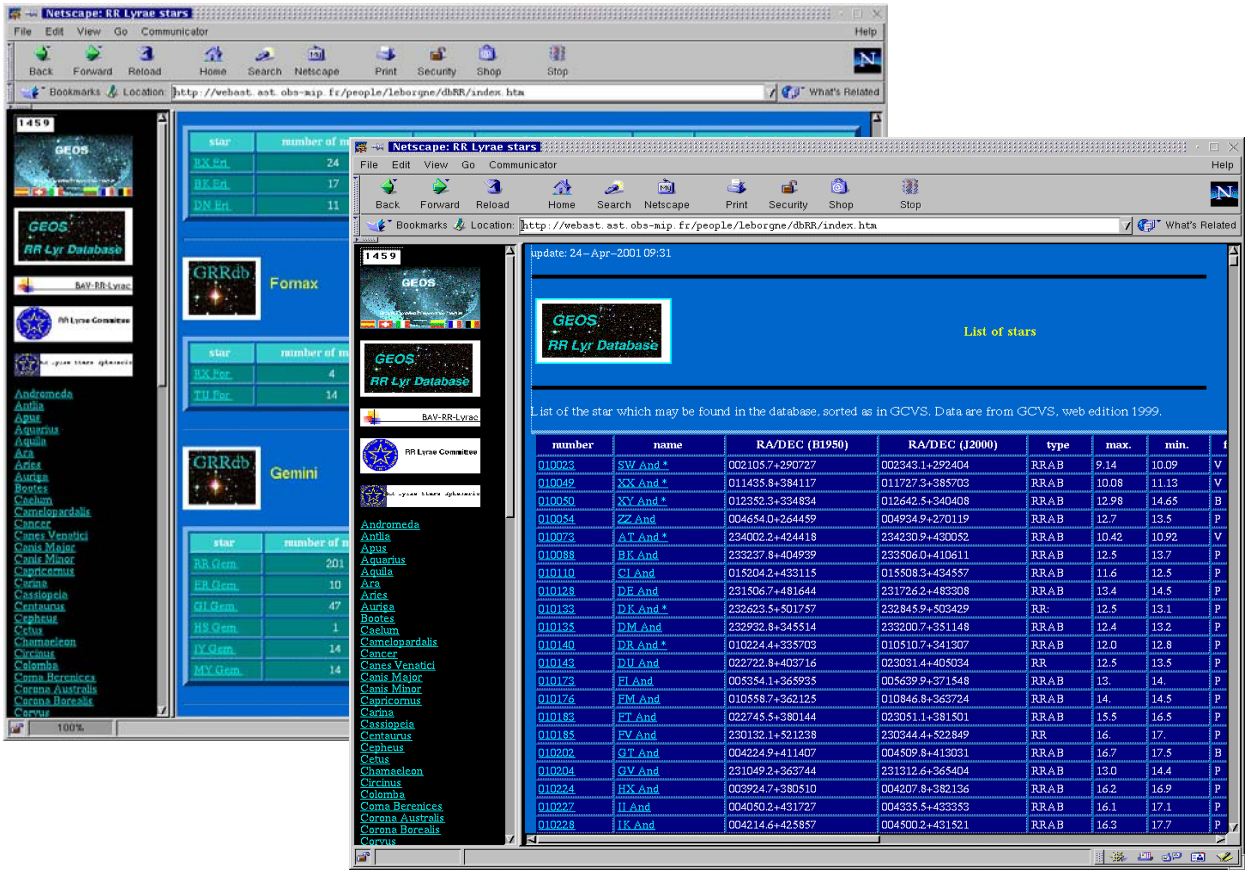


**Figure 3, 4.** Access to the data is done star by star from lists where stars are sorted by constellations, either with the number of maxima or characteristics from the GCVS.

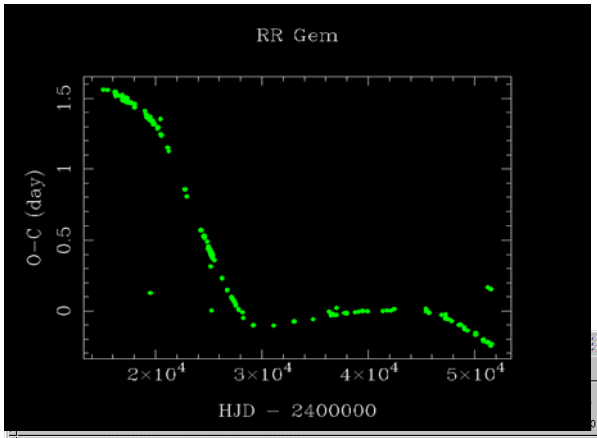


**Figure 5.** An example: RR Gem (O-C variations)

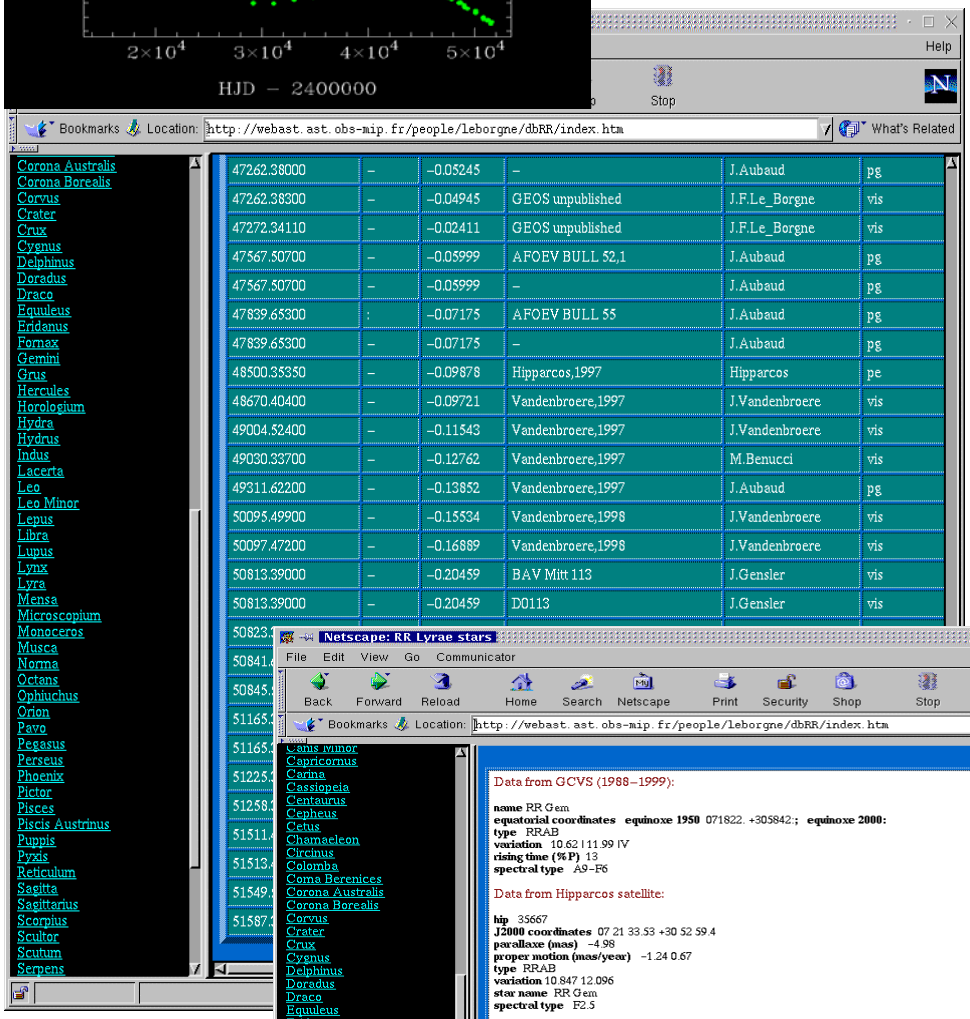


**Figure 6.** List of the maxima

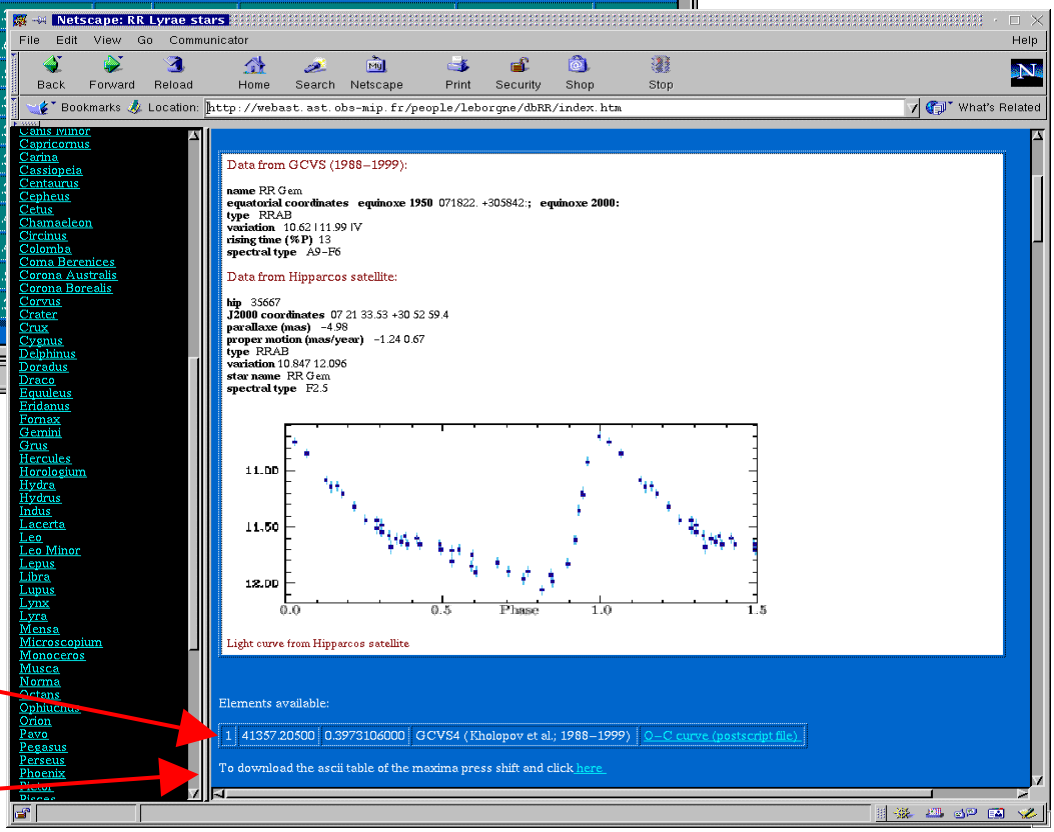


**Figure 7.** Data from GCVS and Hipparcos (when available) including the light curve

The elements used for O-C

Recover the list of maxima as an ASCII table

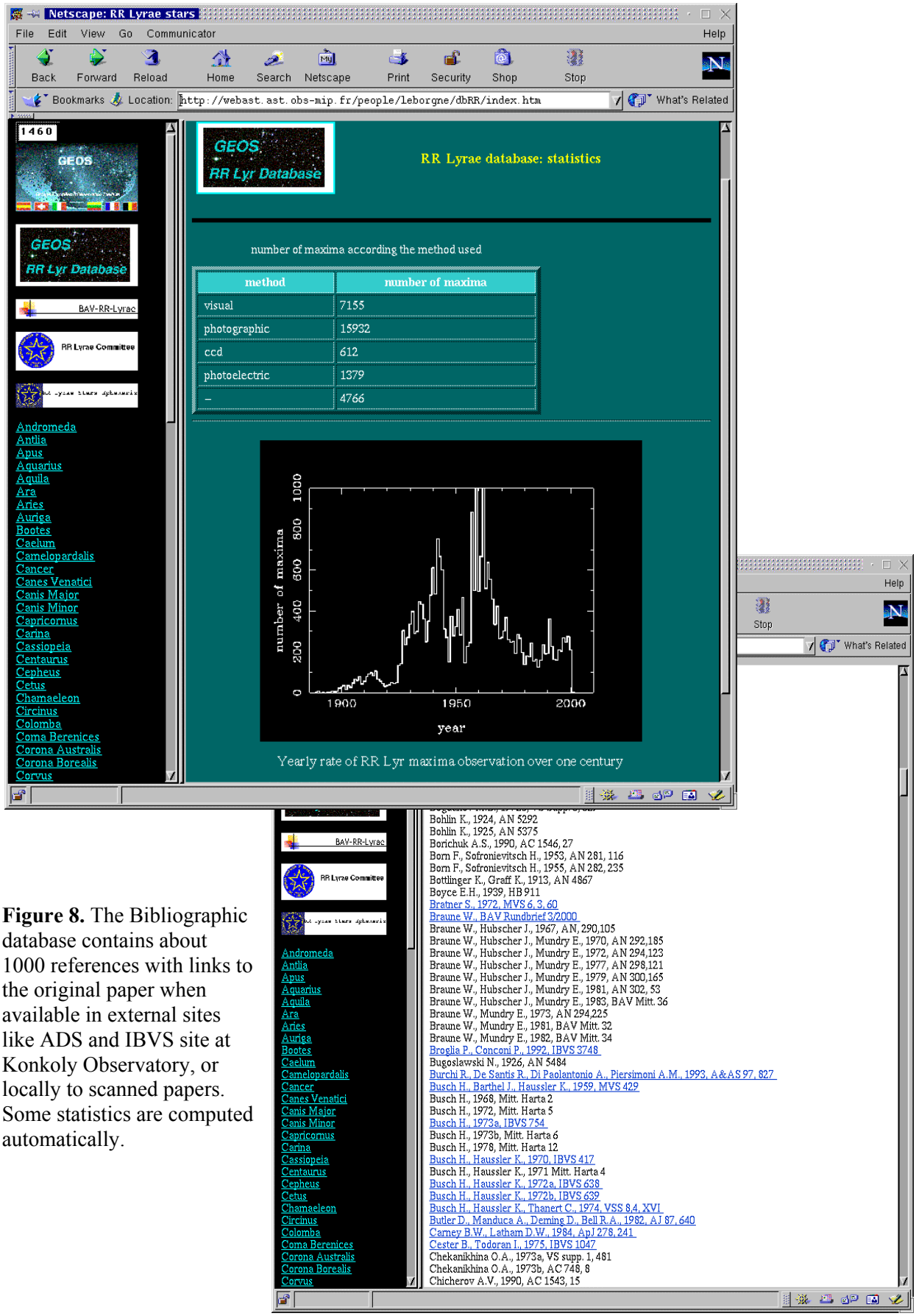


**Figure 8.** The Bibliographic database contains about 1000 references with links to the original paper when available in external sites like ADS and IBVS site at Konkoly Observatory, or locally to scanned papers. Some statistics are computed automatically.

## The GEOS-BAV RR Lyr 2000 campaign

The first RR Lyrae stars were discovered in the 1890'th and in july 1899 Williamina Fleming found RR Lyr itself. Astronomers observe these stars since one century and yet, despite a continuous effort on theory and modelling, the reasons of period changes of RR Lyr pulsators is still unknown. A few of them, if any, show constant period on a long time interval. The Blazhko effect, the periodic modulation of the period and/or the amplitude discovered in RW Dra in 1907, is still unexplained as well.

Merieme Chadid (ESO, Chile) and Denis Gillet (OHP, France) planned high spectral resolution and spectropolarimetric observations of RR Lyr itself in summer 2000 at Haute Provence Observatory and Pic du Midi Observatory, with the intention to study the Blazhko effect. They asked GEOS for collaboration in order to ensure a photometric follow up of the star. GEOS had to provide visual maximum timings and possibly CCD photometry of RR Lyr in the time interval June - August 2000. The campaign management was conducted by Anton Paschke.

Though it is difficult to look for the Blazhko effect in the amplitude of visually observed maxima, it is conceivable to seek it in the timings of the maxima: the uncertainty on well observed visual maxima is about 15mn=0.01day=0.018 P (RR Lyr) and the amplitude of O-C variations during the Blazhko cycle may reach up to 0.08 days, close to 2 hours.

GEOS and BAV observers joined the campaign. Unfortunately, summer 2000 had unfavourable weather in Europe. Furthermore, the elements assumed at the beginning of the campaign (42923.4193 + 0.56684E) were not correct. Despite these difficulties, 15 observers made about 1000 visual and CCD observations of RR Lyr which made this study possible.

| Observer | HJD | E | O-C | Phase | E | Phase |
|---|---|---|---|---|---|---|
| | Maximum (days) | Maximum | | (Blazhko cycle) | | |
| M. Dumont | 51697.471 | -104 | -0.035 | -0.061 | -1 | 0.591 |
| D. Dalmazio | 51705.401 | -90 | -0.040 | -0.071 | -1 | 0.785 |
| D. Dalmazio | 51709.378 | -83 | -0.031 | -0.055 | -1 | 0.882 |
| M. Dumont | 51710.509 | -81 | -0.034 | -0.059 | -1 | 0.910 |
| A. Paschke | 51713.369 | -76 | -0.008 | -0.014 | -1 | 0.980 |
| G. Maintz | 51714.490 | -74 | -0.020 | -0.036 | -1 | 0.008 |
| M. Dumont | 51714.490 | -74 | -0.020 | -0.036 | -1 | 0.008 |
| P. Jacquet | 51714.505 | -74 | -0.005 | -0.010 | -1 | 0.008 |
| M. Dumont | 51722.415 | -59 | -0.031 | -0.054 | -1 | 0.202 |
| A. Paschke | 51722.434 | -59 | -0.012 | -0.021 | -1 | 0.202 |
| S. Kuchto | 51726.388 | -53 | -0.026 | -0.045 | -1 | 0.299 |
| D. Dalmazio | 51747.347 | -16 | -0.039 | -0.069 | 0 | 0.813 |
| D. Dalmazio | 51751.329 | -9 | -0.025 | -0.043 | 0 | 0.910 |
| D. Dalmazio | 51756.455 | 0 | 0.000 | 0.000 | 0 | 0.036 |
| J.-F. Le Borgne | 51756.457 | 0 | 0.002 | 0.004 | 0 | 0.036 |
| A. Paschke | 51757.576 | 2 | -0.013 | -0.022 | 0 | 0.063 |
| D. Dalmazio | 51764.366 | 14 | -0.024 | -0.043 | 0 | 0.229 |
| D. Dalmazio | 51768.320 | 21 | -0.038 | -0.067 | 0 | 0.326 |
| G. Zepter | 51773.420 | 29 | -0.040 | -0.070 | 0 | 0.451 |
| A. Paschke | 51782.501 | 46 | -0.028 | -0.049 | 1 | 0.674 |
| K. Tikkanen | 51798.377 | 74 | -0.023 | -0.040 | 1 | 0.063 |
| M. Dumont | 51798.397 | 74 | -0.003 | -0.005 | 1 | 0.063 |
| K. Tikkanen | 51803.475 | 83 | -0.026 | -0.046 | 1 | 0.187 |
| M. Dumont | 51803.481 | 83 | -0.020 | -0.035 | 1 | 0.188 |
| K. Tikkanen | 51807.432 | 90 | -0.037 | -0.065 | 1 | 0.284 |
| M. Dumont | 51849.382 | 164 | -0.031 | -0.055 | 2 | 0.312 |
| K. Tikkanen | 51943.477 | 330 | -0.028 | -0.050 | 5 | 0.617 |
| K. Tikkanen | 51964.443 | 367 | -0.035 | -0.061 | 5 | 0.131 |

**Table 1.** 28 well defined maxima of RR Lyr resulted from the observations.

* CCD observations

The O-C of the maxima are computed with the following elements for the main pulsation cycle, deduced from the 2000 observations:

$$51756.455 + 0.566819\ E$$

while the Blazhko phase was determined with the following elements:

$$51755.0 + 40.812289\ E$$

The origin of the main pulsation cycle elements has been adjusted so that phase=0 corresponds to the most late maxima (maximum O-C). The Blazhko phase has been fixed to 0 for those maxima as well. The Blazhko effect period used here is the one used by Preston et al. (1965) in their classical work on RR Lyr Blazhko effect and determined by Fringant (1961).

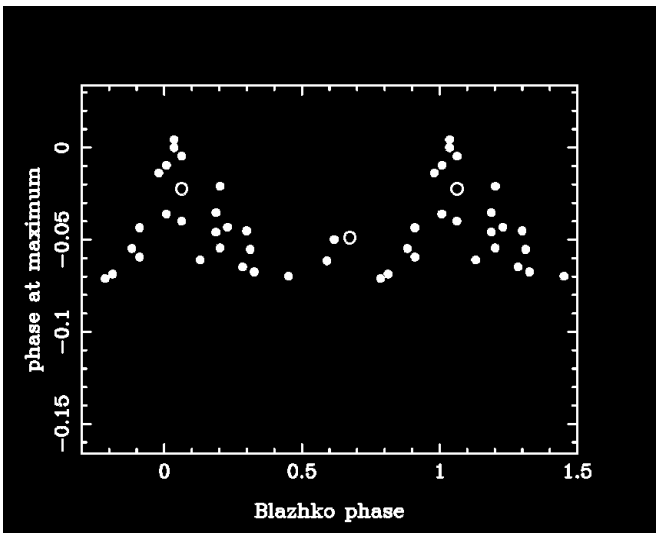


**Figure 9.** RR Lyr – Blazhko effect

A way to estimate the strength of the Blazhko effect of RR Lyr in 2000 is to compare our data to the classical observations by Preston et al. (1965) whose 1962 data showed the Blazhko effect at its maximum. For this, we adjusted Preston et al.'s main pulsational phase zero and Blazhko phase zero on ours. The result is shown on the figure below where Preston et al's data are plotted as green plus signs . The amplitude of the Blazhko effect of RR Lyr in 2000 seems to have been about half the amplitude it had in 1962. Note that in the Blazhko phases from 0 to about 0.4, the rate of period decrease seems to have been the same that in 1962

## Conclusion

Since 1965, RR Lyr has not been observed seriously. Preston et al.'s paper seems to have put an end to the hope to understand the complex behaviour of the pulsations of the RR Lyrae stars. The use of modern techniques, either for the observations and theory, might allow to progress in the field. In this context, the photometric monitoring of RR Lyr itself is important since it is, by far, the brightest star of its kind, allowing unique high resolution spectroscopic observations. The Blazhko effect has a behaviour which change from cycle to cycle so that RR Lyr deserves to be observed continuously either visually or with CCD on small telescopes.

## References

Fringant, A.-M., 1961, J. des Obs., 44, 165

Preston, G.W., Smak, J., Paczynski, B., 1965, ApJS, 12, 99