

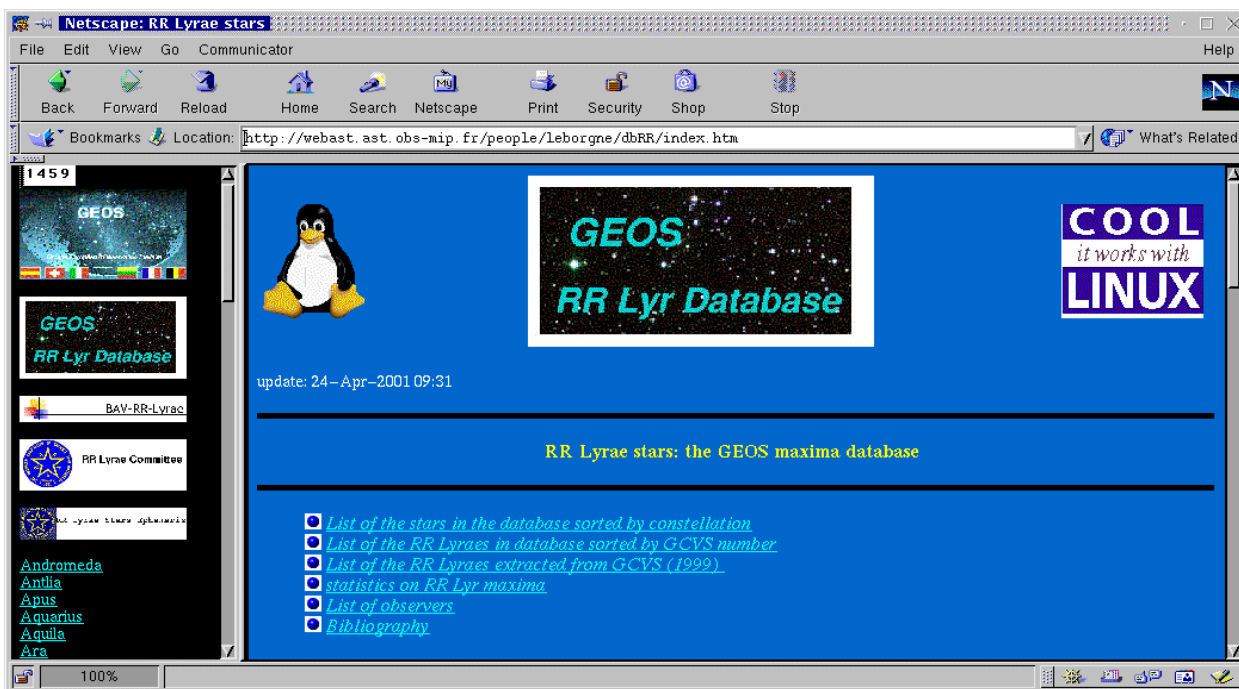
# The GEOS RR Lyr Database

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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.

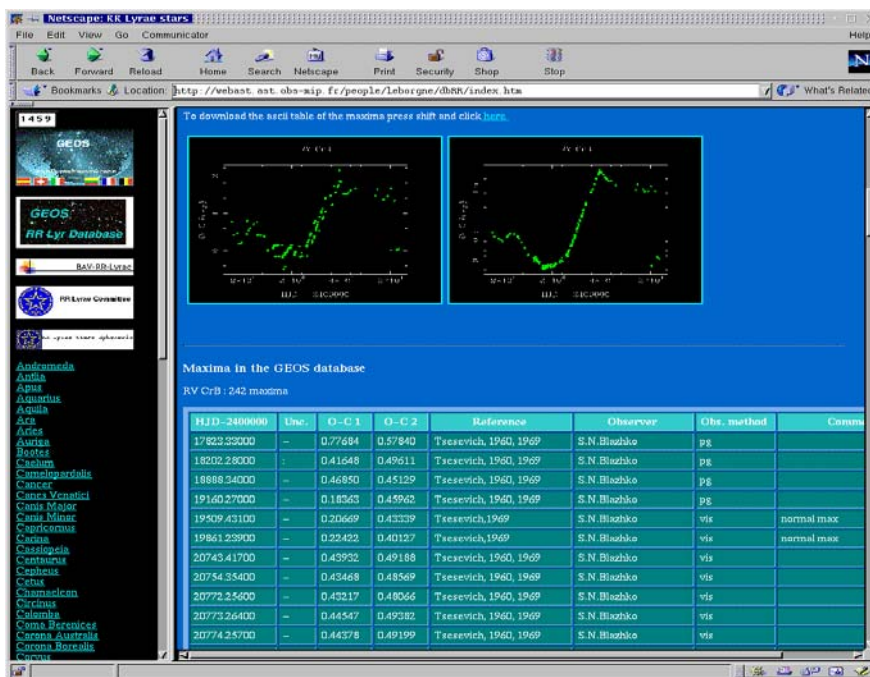


Figure 2. Example of a page of the GEOS database: the variations of the O-C of the maxima of RV CrB are displayed for 2 different elements. The oldest observations date back to December 1907.

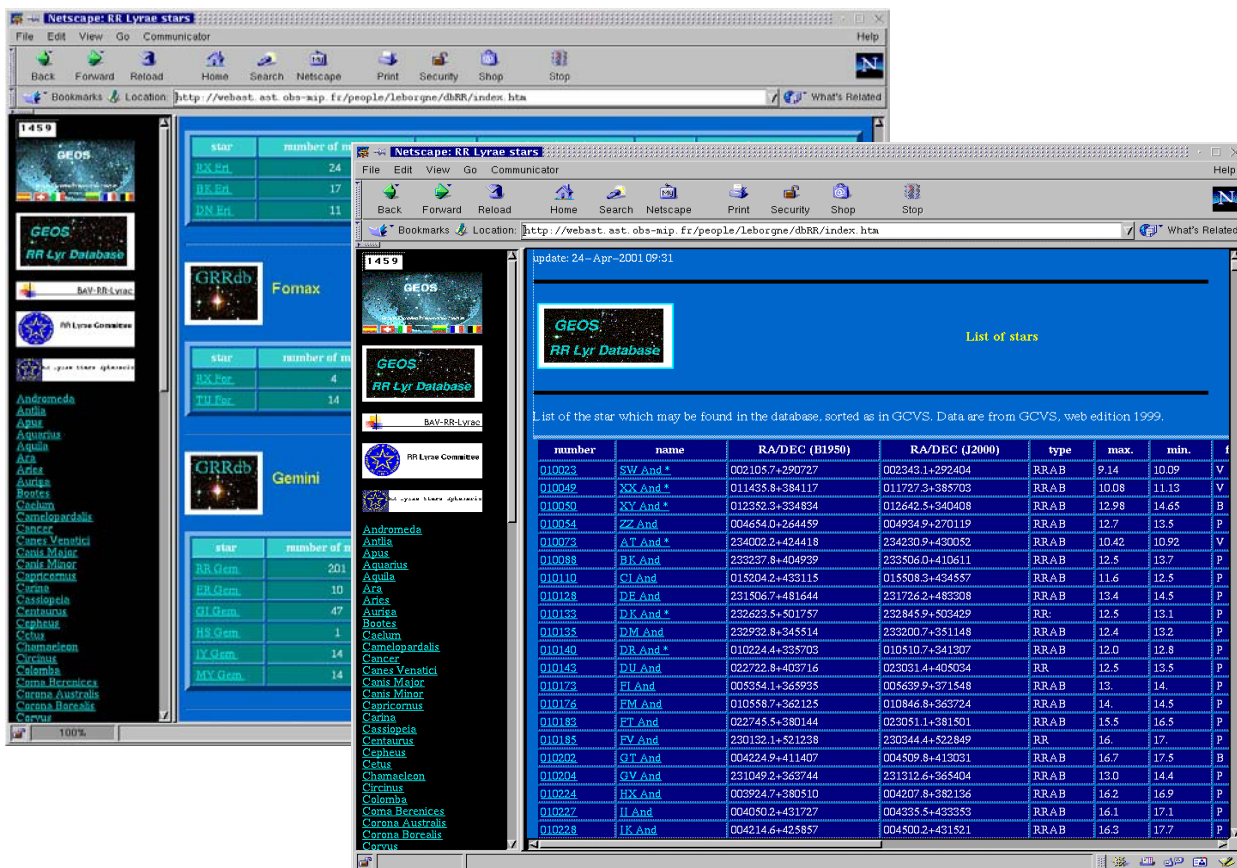


Figure 3, 4. Access to the data is done star by star from lists where stars are sorted by constellations, either with the number of maxima or characteristics with the GCVS.

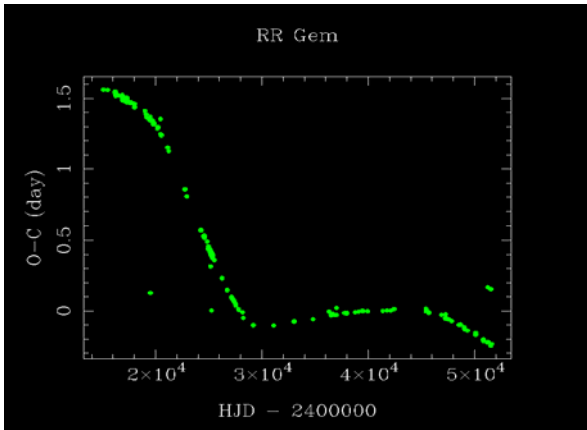


Figure 5. An example: RR Gem (O-C variations)

47262.38000	-	-0.05245	-	J.Aubaud	pg
47262.38300	-	-0.04945	GEOS unpublished	J.F.Le_Borgne	vis
47272.34110	-	-0.02411	GEOS unpublished	J.F.Le_Borgne	vis
47567.50700	-	-0.05999	AFOEV BULL 52,1	J.Aubaud	pg
47567.50700	-	-0.05999	-	J.Aubaud	pg
47839.65300	:	-0.07175	AFOEV BULL 55	J.Aubaud	pg
47839.65300	-	-0.07175	-	J.Aubaud	pg
48500.35350	-	-0.09878	Hipparcos,1997	Hipparcos	pe
48670.40400	-	-0.09721	Vandenbroere,1997	J.Vandenbroere	vis
49004.52400	-	-0.11543	Vandenbroere,1997	J.Vandenbroere	vis
49030.33700	-	-0.12762	Vandenbroere,1997	M.Benucci	vis
49311.62200	-	-0.13852	Vandenbroere,1997	J.Aubaud	pg
50095.49900	-	-0.15534	Vandenbroere,1998	J.Vandenbroere	vis
50097.47200	-	-0.16889	Vandenbroere,1998	J.Vandenbroere	vis
50813.39000	-	-0.20459	BAV Mitt 113	J.Gensler	vis
50813.39000	-	-0.20459	D0113	J.Gensler	vis

Figure 6. List of the maxima

**Data from GCVS (1988-1999):**

name RR Gem  
 equatorial coordinates equinox 1950 071822. +305842.; equinox 2000:  
 type RRAB  
 variation 10.62 11.99 IV  
 rising time (% P) 13  
 spectral type A9-F6

**Data from Hipparcos satellite:**

hip 35657  
 J2000 coordinates 07 21 33.53 +30 52 59.4  
 parallax (mas) -4.98  
 proper motion (mas/year) -1.24 0.67  
 type RRAB  
 variation 10.847 12.096  
 star name RR Gem  
 spectral type F2.5

**Light curve from Hipparcos satellite**

Elements available:  
[41357 20500 0.3973106000 GCVS4 \(Kholopov et al., 1988-1999\)](#) [O-C curve \(postscript file\)](#)

To download the ascii table of the maxima press shift and click [here](#).

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

**RR Lyrae database: statistics**

number of maxima according the method used

method	number of maxima
visual	7155
photographic	15932
ccd	612
photoelectric	1379
-	4766

Yearly rate of RR Lyr maxima observation over one century

Yearly rate of RR Lyr maxima observation over one century

Andromeda  
Antlia  
Apus  
Aquarius  
Aquila  
Ara  
Aries  
Auriga  
Bootes  
Caelum  
Camelopardalis  
Cancer  
Canes Venatici  
Canis Major  
Canis Minor  
Capricornus  
Carina  
Cassiopeia  
Centaurus  
Cepheus  
Cetus  
Chamaeleon  
Circinus  
Colomba  
Coma Berenices  
Corona Australis  
Corona Borealis  
Corvus

Bohlin K., 1924, AN 5292  
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[Busch H., 1973a, IBVS 754](#)  
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[Cester B., Todoran I., 1975, IBVS 1047](#)  
Chekanikhina O.A., 1973a, VS supp. 1, 481  
Chekanikhina O.A., 1973b, AC 748, 8  
Chicherov A.V., 1990, AC 1543, 15

**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  $15\text{mn}=0.01\text{day}=0.018 P$  (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

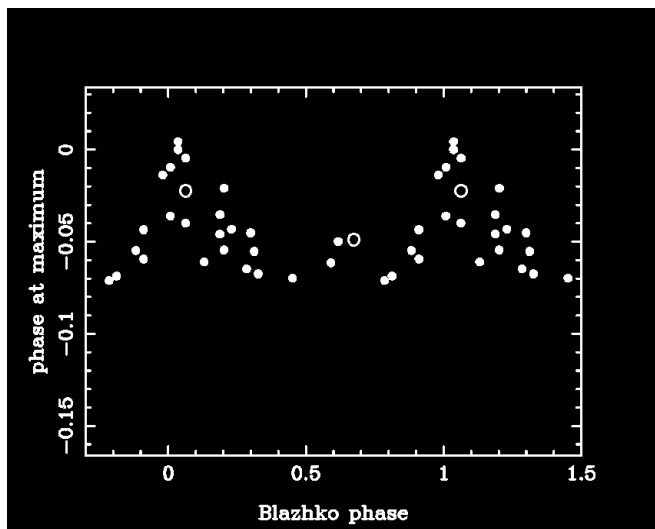
The O-C of the maxima are computed with the following elements for the main pulsation cycle, deduced from the 2000 observations:

$$51756.455 + 0.566819 E$$

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).



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

Figure 9. RR Lyr – Blazhko effect

### 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

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