

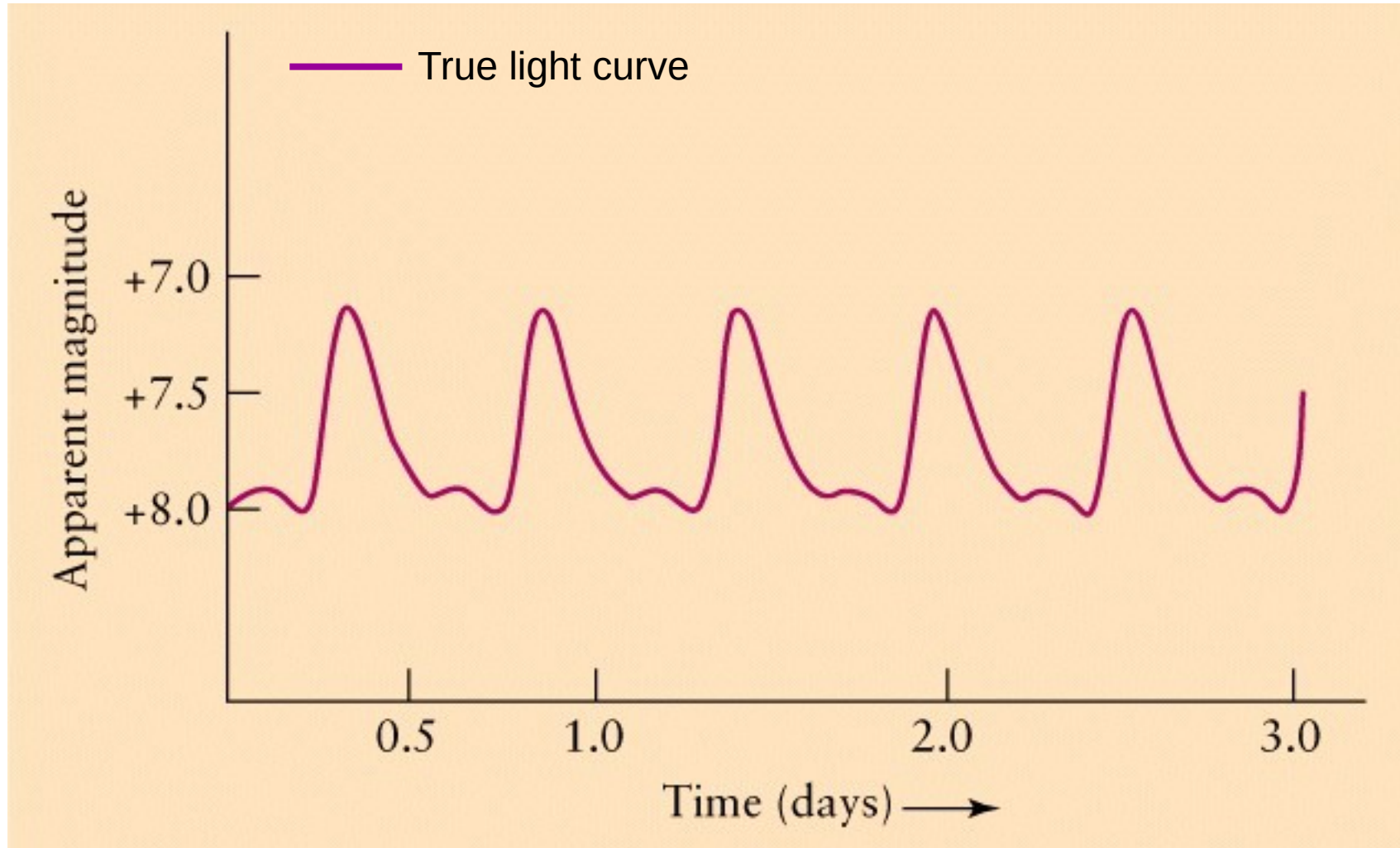
Time series analysis of variable stars



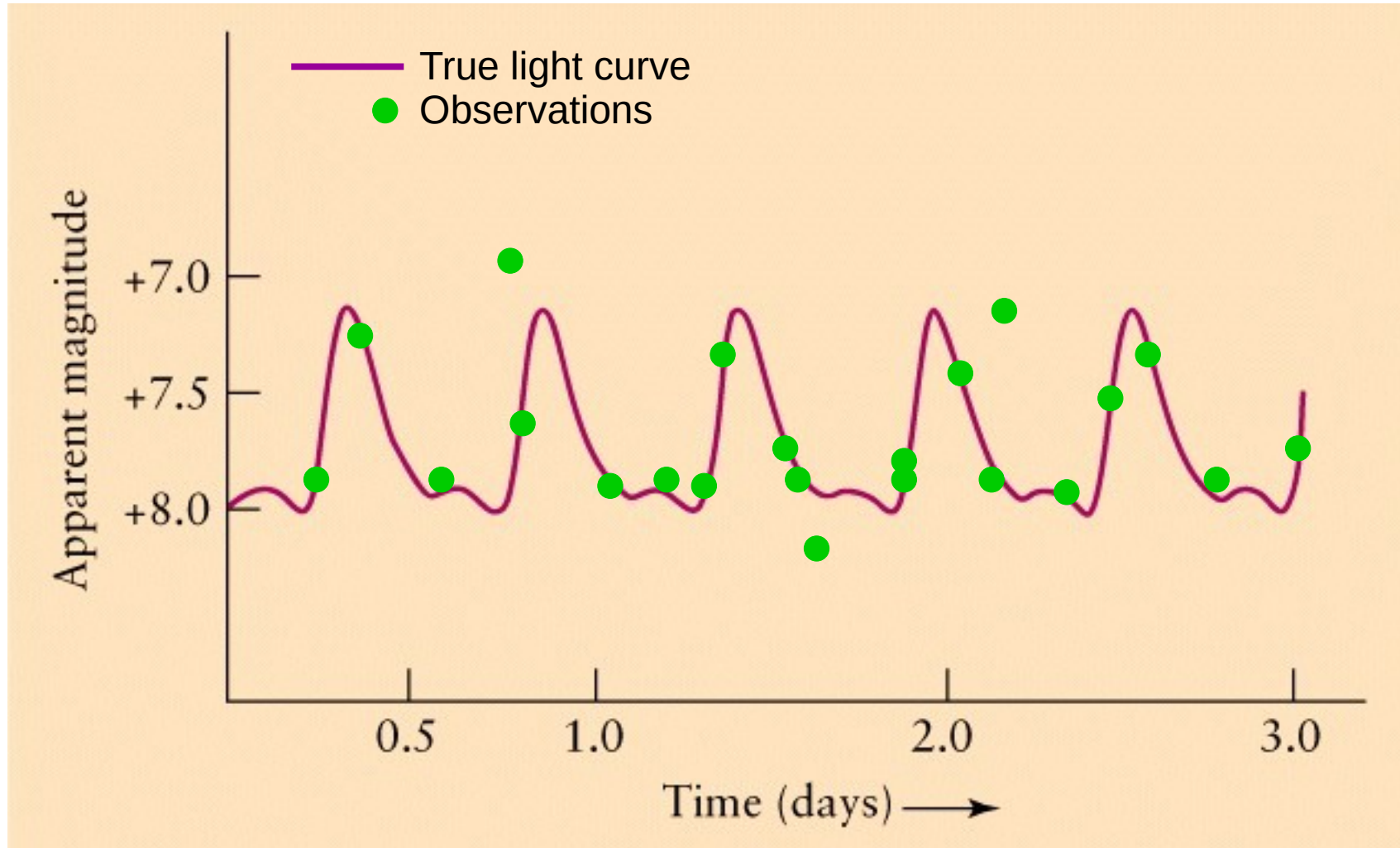
PhD school Lucchin, Agerola 2025
Vittorio Francesco Braga: vittorio.braga@inaf.it

What is a time series?

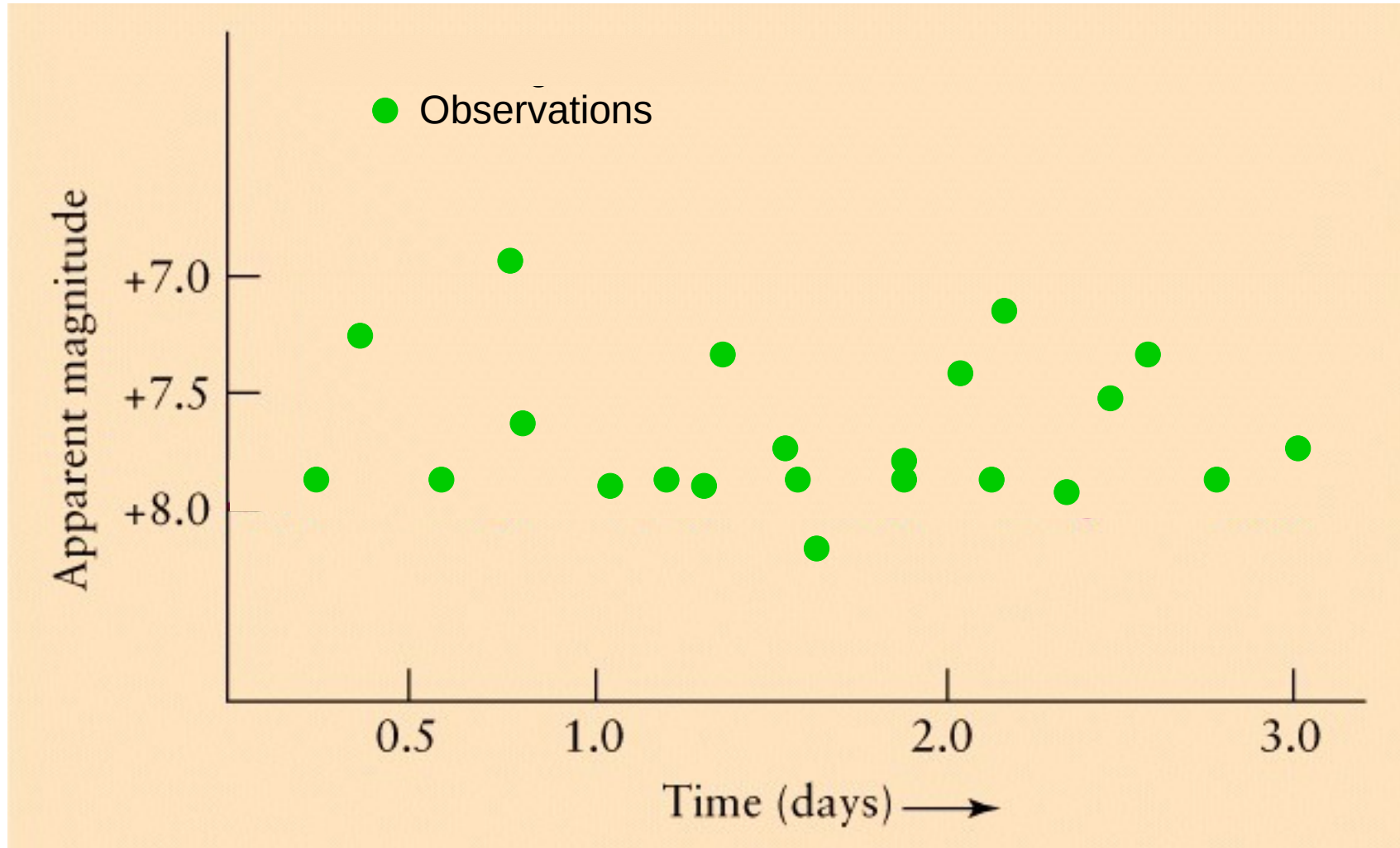
What is a time series?



What is a time series?



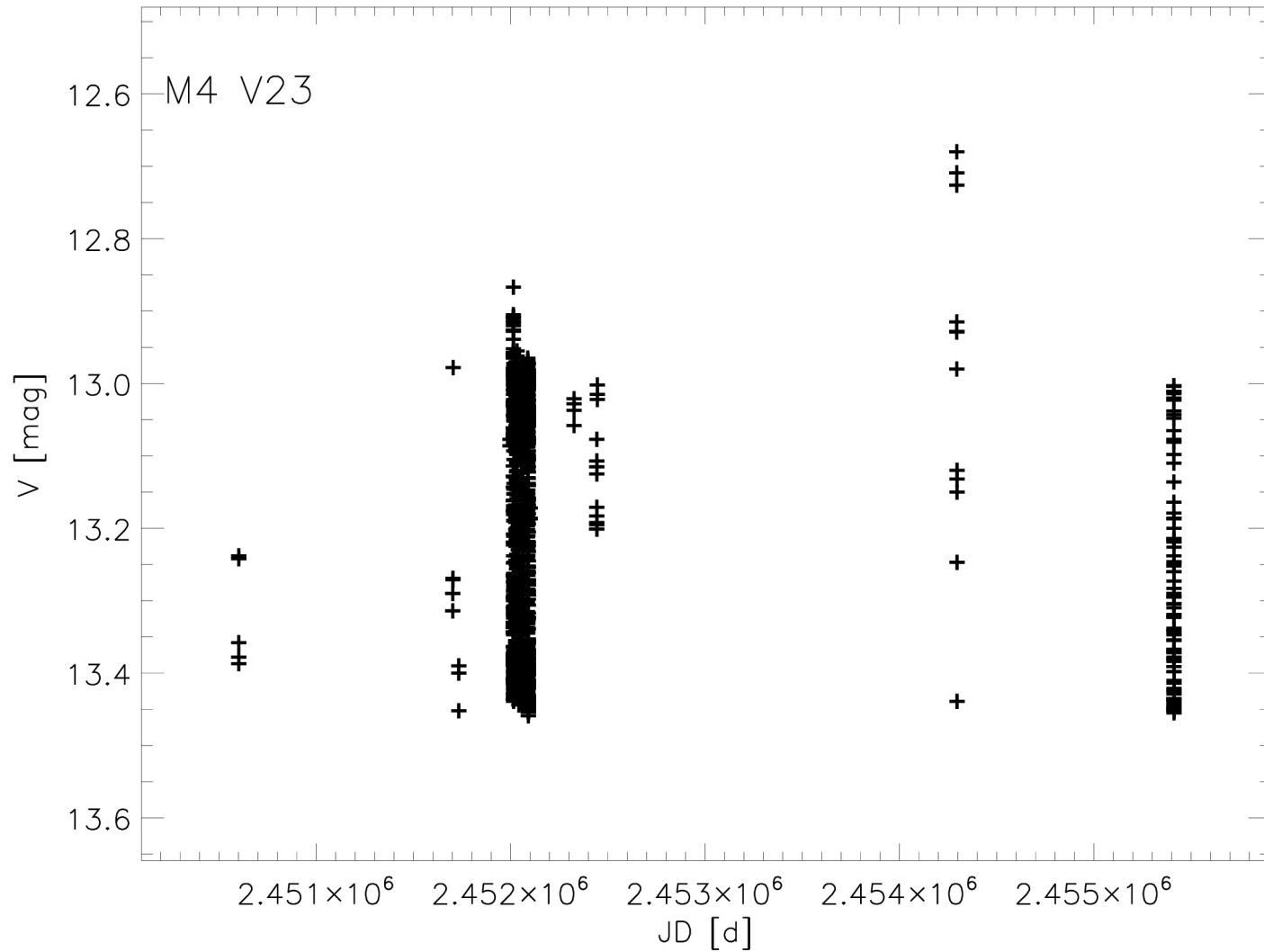
What is a time series?



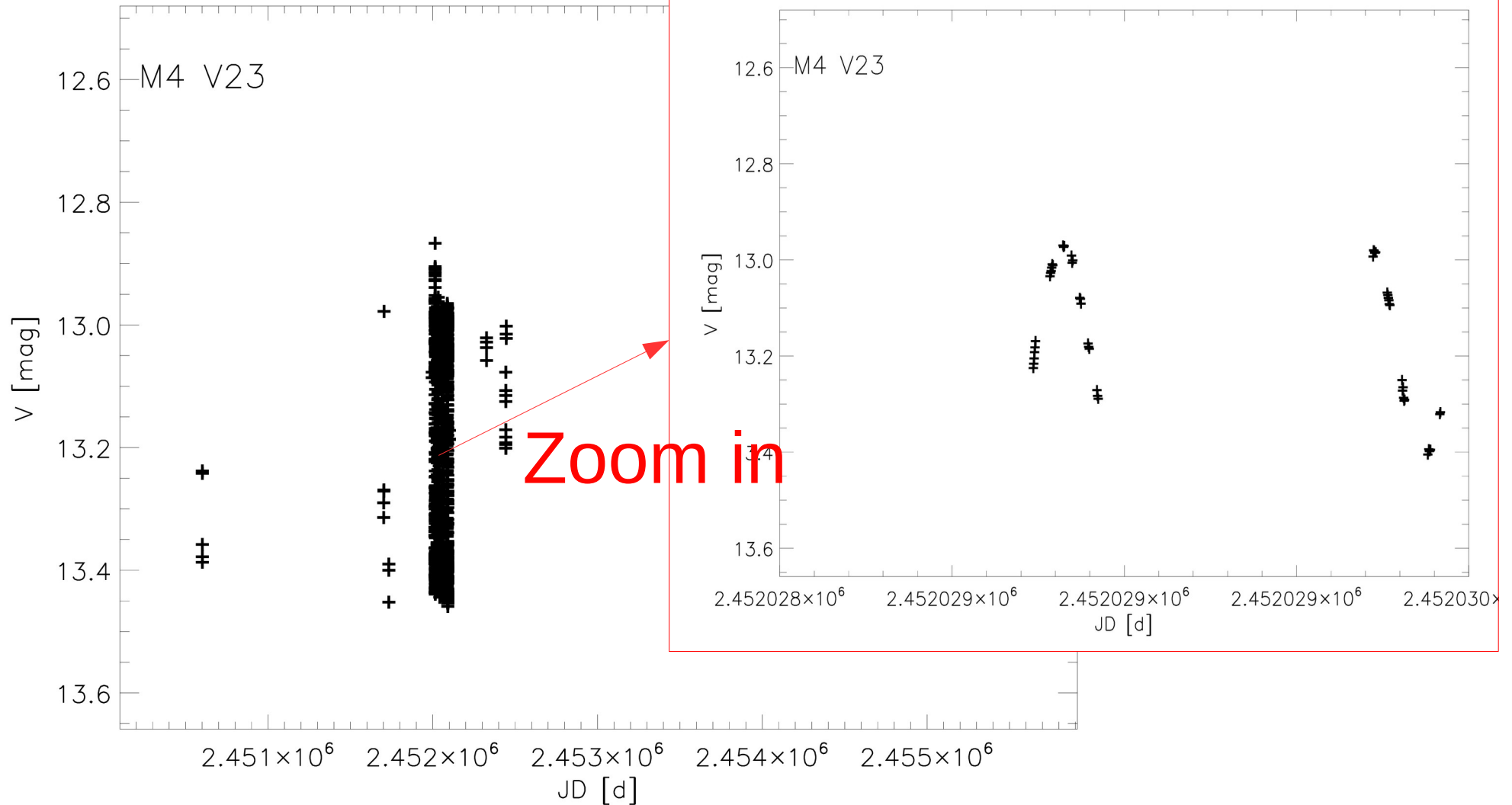
What is a time series?

mag	error	filter	JD	Dataset			
13.242	0.0146	1	1	2450601.7136	2.38	0.052	bond5:obj5105.als
13.238	0.0147	1	1	2450601.7144	2.44	0.083	bond5:obj5106.als
13.358	0.0148	1	1	2450601.7336	2.25	0.054	bond5:obj5204.als
13.378	0.0155	1	1	2450601.7547	2.44	0.078	bond5:obj5403.als
13.387	0.0169	1	1	2450601.7641	2.69	0.177	bond5:obj5503.als
13.086	0.0202	1	1	2451996.8152	3.54	0.006	bond7:obj5203.als
13.077	0.0240	1	1	2451996.8334	5.70	0.031	bond7:obj5207.als
13.265	0.0080	1	1	2452013.6910	3.70	1.338	danish:dfsc0086.als
13.296	0.0083	1	1	2452013.6921	3.19	1.252	danish:dfsc0087.als
13.337	0.0120	1	1	2452013.7073	4.98	1.385	danish:dfsc0099.als
13.330	0.0078	1	1	2452013.7081	3.52	1.304	danish:dfsc0100.als
13.330	0.0151	1	1	2452013.7090	5.85	0.894	danish:dfsc0101.als
13.336	0.0126	1	1	2452013.7098	5.12	1.135	danish:dfsc0102.als
13.343	0.0097	1	1	2452013.7107	3.96	0.851	danish:dfsc0103.als
13.344	0.0141	1	1	2452013.7115	5.38	0.699	danish:dfsc0104.als
13.345	0.0133	1	1	2452013.7124	5.30	1.063	danish:dfsc0105.als
13.364	0.0155	1	1	2452013.7131	4.32	1.149	danish:dfsc0106.als
13.389	0.0181	1	1	2452013.7393	5.89	0.429	danish:dfsc0115.als
13.408	0.0135	1	1	2452013.7427	3.00	0.693	danish:dfsc0116.als
13.389	0.0103	1	1	2452013.7456	3.15	0.863	danish:dfsc0117.als
13.374	0.0186	1	1	2452013.7490	7.57	0.645	danish:dfsc0118.als
13.376	0.0235	1	1	2452013.7510	8.52	0.479	danish:dfsc0119.als
13.379	0.0213	1	1	2452013.7529	8.32	0.618	danish:dfsc0120.als
13.382	0.0221	1	1	2452013.7548	8.29	0.518	danish:dfsc0121.als
13.379	0.0144	1	1	2452013.7567	6.49	0.770	danish:dfsc0122.als
13.309	0.0115	1	1	2452013.7977	3.22	0.633	danish:dfsc0140.als
13.219	0.0140	1	1	2452013.8094	3.91	0.546	danish:dfsc0150.als
13.176	0.0167	1	1	2452013.8113	6.98	0.523	danish:dfsc0151.als
13.162	0.0174	1	1	2452013.8133	7.27	0.611	danish:dfsc0152.als
13.143	0.0207	1	1	2452013.8152	8.02	0.575	danish:dfsc0153.als
13.128	0.0182	1	1	2452013.8171	7.45	0.601	danish:dfsc0154.als
13.114	0.0152	1	1	2452013.8190	6.78	0.708	danish:dfsc0155.als
13.028	0.0292	1	1	2452013.8642	6.13	0.594	danish:dfsc0174.als
12.979	0.0090	1	1	2452013.8776	2.71	0.254	danish:dfsc0185.als
12.957	0.0158	1	1	2452013.8792	6.33	0.430	danish:dfsc0186.als
12.960	0.0143	1	1	2452013.8809	5.89	0.433	danish:dfsc0187.als
12.960	0.0129	1	1	2452013.8826	5.46	0.402	danish:dfsc0188.als
12.961	0.0137	1	1	2452013.8843	5.47	0.325	danish:dfsc0189.als

What is a time series?



What is a time series?



How to get time series

How to get time series

Depends on what you want...



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General Catalog Query Engine

powered by Gator

Quick Guide

Tutorial

Catalog List

Process Monitor

Program Interface

CATALOG SELECTION: WISE ▼

AllWISE Database Select				
Selection	Descriptions	# Columns	# Rows	Information
☐	AllWISE Source Catalog	334	747634026	i
☒	AllWISE Multiepoch Photometry Table	48	42759337365	i
☐	AllWISE Reject Table	334	428787253	i
☐	AllWISE Atlas Metadata Table	349	18240	i
☐	AllWISE Frame Cross-Reference Table	6	21208389	i
☐	AllWISE Atlas Inventory Table	7	18240	i
☐	AllWISE Atlas Image Inventory Table	76	72960	i
☐	AllWISE Refined Pointing Information for the Single-exposure Images	23	2786053	i

WISE Mid-Infrared photometry

[FORNERS](#)
[Sky France](#)
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[Photometry Database](#)
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[Binary Stars Database](#)

ASAS-SN Variable Stars Database

THE OHIO STATE UNIVERSITY
COMMISSIONER OF ASTRONOMY

GORDON AND BETTY MOORE FOUNDATION
Making ASAS-SN light curves public is primarily funded by grants: GBMF5490 and GBMF10001

ALFRED P. SLOAN FOUNDATION
ASAS-SN is funded in part by the Alfred P. Sloan Foundation under grant G202114192

Using in Publications

When using ASAS-SN light curves in publications cite: Shappee et al. (2014) and either: (i) The ASAS-SN Catalog of Variable Stars I: Jayasinghe et al. (2018a) (ii) The ASAS-SN Catalog of Variable Stars II: Jayasinghe et al. (2018b), (iii) The ASAS-SN Catalog of Variable Stars III: Jayasinghe et al. (2019a), (iv) The ASAS-SN Catalog of Variable Stars V: Jayasinghe et al. (2020), or (v) The ASAS-SN Catalog of Variable Stars IX: Jayasinghe et al. (2021), or (vi) The ASAS-SN Catalog of Variable Stars X: Christy et al. (2022).

Database Updated: 08/10/2021 (Crossmatches to Gaia EDR3, TIC v8, and GALEX GPR7+ AIS added)

Search Light Curves

Right Ascension

Declination

Mean VMag

Min

Max

Amplitude

Min

Max

LMST Statistic

Min

Max

Class Probability

Min

Max

ASAS-SN or Other Name

Variable Type

None selected •

All selected (6) •

Radius (arcmin)

Period

Min

Max

Parallax/Error

Min

Max

Sort By

RA2000 •

Ascending •

☒ Show non-periodic variables
 ☒ Show variables without ASAS-SN classifications
 ☐ Show ASAS-SN Discoveries Only

Total Light Curves Found: **687,695**
 Can't find what you're looking for? Go to the [Live Computation Sky Patrol Page](#) or [Lookup by Name](#)

ASAS-SN optical photometry



[Downtime](#)
[24-26th March](#)
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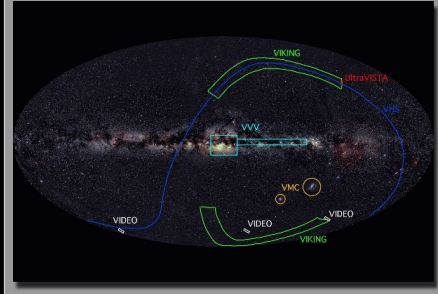
[Data Overview](#)
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[the Surveys](#)
[Coverage Maps](#)
[Schema browser](#)
[Data access](#)
[Login](#)
[Archive Listing](#)
[GetImage](#)
[MultiGetImage](#)
[Region](#)
[Freeform SQL](#)
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[Home](#) | [Overview](#) | [Browser](#) | [Access](#) | [Login](#) | [Cookbook](#) VSA

VSA - VISTA Science Archive

The VISTA Science Archive (VSA) holds the image and catalogue data products generated by VIRCAM on the Visible and Infrared Survey Telescope for Astronomy (VISTA). The primary contents of the archive originate from the VISTA Public Surveys. Survey science-ready catalogue data will be released in phases, while standard flat-file data products (both images and derived single passband catalogues) become available continually after routine observation and processing operations. Information on the various archive releases can be found on the [surveys page](#)

The history of archive releases, updates and bug fixes is recorded under the [release history](#) page. Users wishing to receive email announcements of such entries should subscribe to the VSA_Announcelist (contact vsa-support@roe.ac.uk).



Picture: Sky coverage of VISTA surveys, overlaid on a 2MASS image of the whole sky.
 Credit: VISTA

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VISTA Near-Infrared photometry



GaiaPortal DR3

Version 3.2.0

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Gaia DR3
Survey of Surveys

[Home](#) | [XMM Query](#) | [Gaia Only Query](#) | [Gaia Spec Tool](#) | [Data Models and Statistics](#)

Query Form
Query Result:

Reset Query Form

Search In

Gaia DR3 Main Table	Variable Objects	Non-single Objects	Extragalactic Objects	Epoch Data	Spectroscopy	Astrophysical Parameters
☐ None ☒ GaiaSource ☐ All Gaia DR3 Sources	☐ None ☒ VarSummary ☐ VarEpoch ☐ VarEcliptic ☒ VarRRLyrae ☐ VarLongPeriodVariable ☐ VarMagneticFieldCandidate ☐ VarShortTimeScale ☐ VarMicroQuasar ☐ VarRapidLightModulation ☐ VarOutbursting ☒ VarClassVarResult ☐ RRVarVarRRStatistics ☐ VarRRVarStatistics	☐ None ☐ GalaxyCandidates ☐ QSOCandidates ☐ NGCCandidates ☐ NGC101 ☐ NGC4038 ☐ NGC520Companion ☐ VarRCGalaxyBinary ☐ VarPlanetaryTransit ☐ VarPlanetaryTransit13mex2022	☐ None ☒ EpochPhotometry ☐ VarEpochMultiwavelength ☐ RRVarEpochRRLyrae	☐ RRParamSpectrum ☒ XParamSpectrum ☐ XParamSpectrum	☐ None ☒ AstrophysicalParameters ☐ AstrophysicalParametersSupp	

Gaia Optical photometry

And many others...

Gaia time series

Gaia portal at ASI:

<http://gaiaportal.asdc.asi.it/DR3/GODR3/query/form>

SSDC **GaiaPortal DR3** Version 3.2.0

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[Home](#) [XM Query](#) [Gaia Only Query](#) [Gaia Spec Tool](#) [Data Models and Statistics](#)

[Query Form](#) [Query Results](#) [Reset Query Form](#)

Search In

Gaia DR3 Main Table	Variable Objects	Non-single Objects	Extragalactic Objects	Epoch Data	Spectroscopy	Astrophysical Parameters
☐ None ☒ GaiaSource ☐ FPRcrowdedFieldSource	☐ None ☐ variSummary ☐ variCepheid ☒ variRRLyrae ☐ variLongPeriodVariable ☐ FPRvariLongPeriodVariable ☐ variShortTimescale ☐ variMsOscillator ☐ variRotationModulation ☐ variMicrolensing ☐ variClassifierResult ☐ FPRvariRadVelStatistics ☐ variRadVelStatistics	☒ None ☐ NSSAccelerationAstro ☐ NSSnonLinearSpectro ☐ NSStwoBodyOrbit ☐ NSSvimpFl ☐ variCompactCompanion ☐ variEclipsingBinary ☐ variPlanetaryTransit ☐ variPlanetaryTransit13june2022	☒ None ☐ GalaxyCandidates ☐ QSOcandidates ☐ FPRlensCandidates ☐ FPRlensObservation ☐ FPRlensOutlier ☐ variAGN	☐ None ☒ epochPhotometry ☐ variEpochRadialVelocity ☐ FPRvariEpochRadialVelocity	☒ None ☐ RVSmearSpectrum ☐ XPsummary ☐ XPsampledMeanSpectrum	☒ None ☐ AstrophysicalParameters ☐ AstrophysicalParametersSupp

Gaia only query

GaiaSource

VariRRLyrae for list_of_variables_RRab.dat

VariCepheid for list_of_variables_T2C.dat

epochPhotometry

Gaia time series

Gaia portal at ASI:

<http://gaiaportal.asdc.asi.it/DR3/GODR3/query/form>

Source

Single Source [List of Sources](#) To enable Random Sample, select only Gaia Source in Search-in box

Choose the query type

☐ No file

☐ Search in a Cone

☐ Search in a Coordinate Range

☒ Search by Gaia SourceID

Search Scope

The search is on all the selected catalogues (inner join).

The expected file format is a comma-separated-value file without header with each row consisting of:

One field, with the Gaia Source ID
(check the *Data Model and Statistics* tab for the sourceID format to be used)

Please note that the query will be run only on the first 50000 sources listed in the file.

Nessun file selezionato.

Please choose a file

list_of_variables_T2C.dat

list_of_variables_RRab.dat

Globular cluster omega Cen: has many RRLs plus a few T2Cs, all at the same distance.
A great laboratory for variable stars and stellar evolution (TRGB, [Fe/H] spread)



Gaia time series

Gaia portal at ASI:

<http://gaiaportal.asdc.asi.it/DR3/GODR3/query/form>

Define Output

Gaia DR3 Main Table

GaiaSource

☐ All Fields ☐ No Fields

- ☐ GaiaSource solutionId
- ☐ GaiaSource refEpoch
- ☐ GaiaSource DECerror

☐ GaiaSource designation

☒ GaiaSource RA

☐ GaiaSource parallax

☐ GaiaSource sourceId

☐ GaiaSource RAerror

☐ GaiaSource parallaxError

☐ GaiaSource randomIndex

☒ GaiaSource DEC

☐ GaiaSource parallaxOverError

RA

DEC

Variable Objects

variRRLyrae

Everything but the red one

☐ All Fields ☐ No Fields

- ☒ variRRLyrae solutionId
- ☒ variRRLyrae p1O
- ☒ variRRLyrae epochBP
- ☒ variRRLyrae epochRV
- ☒ variRRLyrae intAverageBP
- ☒ variRRLyrae averageRV
- ☒ variRRLyrae peakToPeakBP
- ☒ variRRLyrae peakToPeakRV
- ☒ variRRLyrae r21G
- ☒ variRRLyrae phi21G
- ☒ variRRLyrae numCleanEpochsG
- ☒ variRRLyrae zpMagG
- ☒ variRRLyrae numHarmonicsForP1BP
- ☒ variRRLyrae referenceTimeBP
- ☒ variRRLyrae fundFreq1Error
- ☒ variRRLyrae bestClassification

- ☒ variRRLyrae sourceId
- ☒ variRRLyrae p1Oerror
- ☒ variRRLyrae epochBPErr
- ☒ variRRLyrae epochRVErr
- ☒ variRRLyrae intAverageBPErr
- ☒ variRRLyrae averageRVErr
- ☒ variRRLyrae peakToPeakBPErr
- ☒ variRRLyrae peakToPeakRVErr
- ☒ variRRLyrae r21Gerr
- ☒ variRRLyrae phi21Gerr
- ☒ variRRLyrae numCleanEpochsBP
- ☒ variRRLyrae zpMagBP
- ☒ variRRLyrae numHarmonicsForP1RP
- ☒ variRRLyrae referenceTimeRP
- ☒ variRRLyrae fundFreq2
- ☒ variRRLyrae Gabsorption

- ☒ variRRLyrae pf
- ☒ variRRLyrae epochG
- ☒ variRRLyrae epochRP
- ☒ variRRLyrae intAverageG
- ☒ variRRLyrae intAverageRP
- ☒ variRRLyrae peakToPeakG
- ☒ variRRLyrae peakToPeakRP
- ☒ variRRLyrae metallicity
- ☒ variRRLyrae r31G
- ☒ variRRLyrae phi31G
- ☒ variRRLyrae numCleanEpochsRP
- ☒ variRRLyrae zpMagRP
- ☒ variRRLyrae numHarmonicsForP1RV
- ☒ variRRLyrae referenceTimeRV
- ☒ variRRLyrae fundFreq2Error
- ☒ variRRLyrae GabsorptionError

- ☒ variRRLyrae pError
- ☒ variRRLyrae epochGerr
- ☒ variRRLyrae epochRPErr
- ☒ variRRLyrae intAverageGerr
- ☒ variRRLyrae intAverageRPErr
- ☒ variRRLyrae peakToPeakGerr
- ☒ variRRLyrae peakToPeakRPErr
- ☒ variRRLyrae metallicityError
- ☒ variRRLyrae r31Gerr
- ☒ variRRLyrae phi31Gerr
- ☒ variRRLyrae numCleanEpochsRV
- ☒ variRRLyrae numHarmonicsForP1G
- ☒ variRRLyrae referenceTimeG
- ☒ variRRLyrae fundFreq1
- ☐ variRRLyrae fundFreq1HarmonicFile

Epoch Data

epochPhotometry

☐ All Fields ☐ No Fields

☐ epochPhotometry solutionId

☐ epochPhotometry sourceId

☐ epochPhotometry nTransits

☒ epochPhotometry LightCurveFile

Submit

epochPhotometryLightCurveFile

Reset Query Form

Gaia time series

Gaia portal at ASI:

<http://gaiaportal.asdc.asi.it/DR3/GODR3/query/form>

Define Output

Gaia DR3 Main Table

GaiaSource

☐ All Fields ☐ No Fields

☐ GaiaSource solutionId

☐ GaiaSource refEpoch

☐ GaiaSource DECerror

☐ GaiaSource designation

☒ GaiaSource RA

☐ GaiaSource parallax

☐ GaiaSource sourceId

☐ GaiaSource RAerror

☐ GaiaSource parallaxError

☐ GaiaSource randomIndex

☒ GaiaSource DEC

☐ GaiaSource parallaxOverError

RA

DEC

Variable Objects

variCepheid

☐ All Fields ☐ No Fields

☒ variCepheid solutionId

☒ variCepheid p1O

☒ variCepheid epochBP

☒ variCepheid epochRV

☒ variCepheid intAverageBP

☒ variCepheid averageRV

☒ variCepheid peakToPeakBP

☒ variCepheid peakToPeakRV

☒ variCepheid r21G

☒ variCepheid phi21G

☒ variCepheid numCleanEpochsG

☒ variCepheid zpMagG

☒ variCepheid numHarmonicsForP1BP

☒ variCepheid referenceTimeBP

☒ variCepheid fundFreq1Error

☒ variCepheid p2O

☒ variCepheid modeBestClassification

☒ variCepheid sourceId

☒ variCepheid p1Oerror

☒ variCepheid epochBPerror

☒ variCepheid epochRVerror

☒ variCepheid intAverageBPerror

☒ variCepheid averageRVerror

☒ variCepheid peakToPeakBPerror

☒ variCepheid peakToPeakRVerror

☒ variCepheid r21Gerror

☒ variCepheid phi21Gerror

☒ variCepheid numCleanEpochsBP

☒ variCepheid zpMagBP

☒ variCepheid numHarmonicsForP1RP

☒ variCepheid referenceTimeRP

☒ variCepheid fundFreq2

☒ variCepheid p2Oerror

☒ variCepheid multiModeBestClassification

☒ variCepheid pf

☒ variCepheid epochG

☒ variCepheid epochRP

☒ variCepheid intAverageG

☒ variCepheid intAverageRP

☒ variCepheid peakToPeakG

☒ variCepheid peakToPeakRP

☒ variCepheid metallicity

☒ variCepheid r31G

☒ variCepheid phi31G

☒ variCepheid numCleanEpochsRP

☒ variCepheid zpMagRP

☒ variCepheid numHarmonicsForP1RV

☒ variCepheid referenceTimeRV

☒ variCepheid fundFreq1Error

☒ variCepheid typeBestClassification

☒ variCepheid pfError

☒ variCepheid epochGerror

☒ variCepheid epochRPerror

☒ variCepheid intAverageGerror

☒ variCepheid intAverageRPerror

☒ variCepheid peakToPeakGerror

☒ variCepheid peakToPeakRPerror

☒ variCepheid metallicityError

☒ variCepheid r31Gerror

☒ variCepheid phi31Gerror

☒ variCepheid numCleanEpochsRV

☒ variCepheid numHarmonicsForP1G

☒ variCepheid referenceTimeG

☒ variCepheid fundFreq1

☐ variCepheid fundFreq1HarmonicFile

☒ variCepheid type2BestSubClassification

Everything but the red one

Epoch Data

epochPhotometry

☐ All Fields ☐ No Fields

☐ epochPhotometry solutionId

☐ epochPhotometry sourceId

☐ epochPhotometry nTransits

☒ epochPhotometry LightCurveFile

epochPhotometryLightCurveFile

Gaia time series

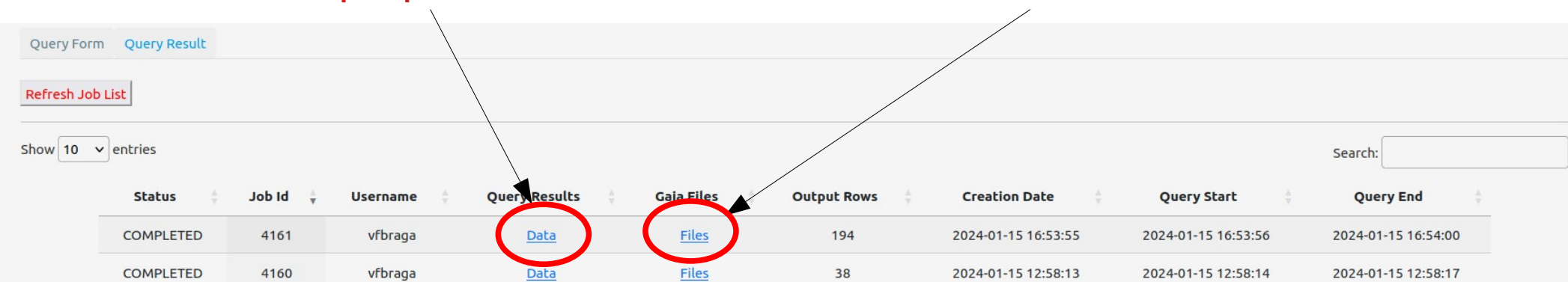
Gaia portal at ASI:

<http://gaiaportal.asdc.asi.it/DR3/GODR3/query/form>

You will get two files

Table of properties

Time series tar file



Query Form Query Result

Refresh Job List

Show 10 entries Search:

Status	Job Id	Username	Query Results	Gaia Files	Output Rows	Creation Date	Query Start	Query End
COMPLETED	4161	vfbraga	Data	Files	194	2024-01-15 16:53:55	2024-01-15 16:53:56	2024-01-15 16:54:00
COMPLETED	4160	vfbraga	Data	Files	38	2024-01-15 12:58:13	2024-01-15 12:58:14	2024-01-15 12:58:17

Gaia time series

Gaia portal at ASI:

<http://gaiaportal.asdc.asi.it/DR3/GODR3/query/form>

You will get two files

Table of properties

Time series tar file

Query Form

Query Result

Refresh Job List

Show

10

entries

Search:

Status	Job Id	Username	Query Results	Gaia Files	Output Rows	Creation Date	Query Start	Query End
COMPLETED	4161	vfbraga	Data	Files	194	2024-01-15 16:53:55	2024-01-15 16:53:56	2024-01-15 16:54:00
COMPLETED	4160	vfbraga	Data	Files	38	2024-01-15 12:58:13	2024-01-15 12:58:14	2024-01-15 12:58:17

The time series archive has a complicated structure: to unzip it, follow these steps from command line (unix):

```
tar --strip-components=7 -xvf result_*.list.tar
ls *zip | awk '{print "unzip "$1}' > unzip_files
source unzip_files
```

Gaia time series

Gaia portal at ASI:

<http://gaiaportal.asdc.asi.it/DR3/GODR3/query/form>

You will get two files

Table of properties

Time series tar file

Status	Job Id	Username	Query Results	Gaia Files	Output Rows	Creation Date	Query Start	Query End
COMPLETED	4161	vfbraga	Data	Files	194	2024-01-15 16:53:55	2024-01-15 16:53:56	2024-01-15 16:54:00
COMPLETED	4160	vfbraga	Data	Files	38	2024-01-15 12:58:13	2024-01-15 12:58:14	2024-01-15 12:58:17

The time series archive has a complicated structure: to unzip it, follow these steps from command line (unix):

```
tar --strip-components=7 -xvf result_*.list.tar  
ls *zip | awk '{print "unzip "$1}' > unzip_files  
source unzip_files
```

...or read through the data file: **epochPhotometry_epochPhotFile** gives the path to the time series

Gaia time series

Structure of a light curve file:

rpObsTime		rpFluxOverError		rpMag							
FluxError	bpFluxOverError	bpMag	rpObsTime	rpFlux	rpFluxError	rpFluxOverError	rpMag	photometryFlagNoisyData	variabilityFlagGReject	variabilityFlagBpReject	variabilityFlagRpReject
4.27118290784531	473.34903	13.252639482755896	1710.471504117257	94208.75491764495	152.97383553647464	515.8488	12.312667340888328	1	0	0	0
1.8965240828027	388.9086	13.483993949145619	1710.5455032302223	84968.99263554292	151.81718707639055	559.6797	12.424744327577358	1	0	0	0
.02125982247544	372.0365	14.05060935690214	1742.849102633857	58948.59294189628	118.16969869845126	498.84695	12.821711892965464	0	0	0	0
.06155658796604	361.9702	14.055511467603507	1742.9231036183241	56694.01760267621	117.21226109191105	483.68674	12.864052415616348	0	0	0	0
								0	0	1	1
9.83116593450933	563.2906	13.097701018903198	1913.626801013107	100162.66673230626	151.53473234613668	660.98816	12.246130804447318	1	0	0	0
6.33087158751565	471.93658	13.317347565881704	1913.7008153018307	91675.52197574612	145.20492890259604	631.35266	12.34226202266573	0	0	0	0
3.70414404379845	381.69977	13.844747177571048	1913.8769853517638	69771.27627769508	131.63974923768976	530.0168	12.638703832903754	0	0	0	0
								1	0	1	1
.56997426437657	343.3843	14.05970796422756	1926.8833673571673	56648.93156298144	119.55706401925225	473.82336	12.864916193179363	0	1	0	0
1.20051238006457	540.5431	12.80274380891083	1926.9573811232815	122718.44867010706	178.12688643214437	688.93835	12.025620859753817	1	1	0	0
2.8276379111259	841.20337	12.108703361099835	1927.13355348338	258469.6006326943	249.3578714121709	1036.5408	11.216871821688274	0	1	0	0
.31493468796963	379.01465	14.039180866527252	2022.4422393771292	64748.56204629118	121.1050504792458	534.6479	12.719820181329151	1	0	0	0
9.85449594101064	582.26904	13.142090488772451	2022.6923894413603	100926.00301195565	150.1164233735486	672.3182	12.237887815748286	0	0	0	0
.47802635547022	351.6433	14.058189907654729	2022.9425382135582	60261.8112992995	117.42236055353128	513.20557	12.797790048166888	1	0	0	0
.91922553146262	390.29147	14.024843644508083	2023.0165410218485	59935.780855085104	115.81529657577288	517.5118	12.803680081717953	0	0	0	0
1.73831480684558	552535	13.18336253759433	2023.192685953697	99222.60705624733	152.25655283320057	651.68036	12.256368916504918	0	0	0	0
4.46929337081541	468.77997	13.613647937806741	2023.2666885903955	79463.88101180292	133.40973530831076	595.6378	12.497471070761714	0	0	0	0
.0287155561006	370.96732	14.053642224619944	2023.442832964355	60146.66395113605	119.18951811514235	504.6305	12.799866640908952	1	0	0	0
.31107912941555	382.12338	14.00576982858021	2023.5168354464304	60704.279171239315	118.79859912970163	510.9848	12.789847234959375	1	0	0	0

Code to read time series: module read_gaialcv_dr3_gaiaportal in
gaia_lcvs_dr3.py (you will find also read_gaialcv_dr3_gaiaarchive for time
series downloaded from <https://gea.esac.esa.int/archive/>)

Code at:

<https://drive.google.com/file/d/16lr7gYxkaN2T2qk9Z6dmIXheENmVHZRt/view?usp=sharing>

Uncertainty on magnitude for each point: $2.5 / (\ln(10) * \text{rpFluxOverError})$

We are interested in the Rp band (RRLs do not obey PLs in G, Bp)

Take your time to inspect the whole time series (e.g., other bands)

Gaia table of sources

Structure of a source table file (RRLs):

variRrlyrae_sourcelD

variRrlyrae_pf

	userSourceID	variRrlyrae_solutionId	variRrlyrae_sourcelD	variRrlyrae_pf	variRrlyrae_p...	variRrlyra...	variRrlyrae_p...	variRrlyrae_e...	variRrlyrae_e...	variRrlyrae_e...	variRrlyrae_e...	variRrlyrae_e...	variRrlyrae_e...	variRrly...	variRrly...	variRrlyrae...	variRrlyra...	variRrlyrae...	variRrlyra...
87	6083720333287009792	375316653866487565	6083720333287009792	0, 49325	1, 07932E-5			1699, 31223	1, 52639E-5	1699, 29525	1, 45895E-5	1699, 29634	1, 12028E-5			14, 5797	0, 0187	14, 7963	0
25	6083698476167422848	375316653866487565	6083698476167422848	0, 50322	1, 58487E-5			1826, 63068	2, 24135E-5							14, 3915	0, 02875		0
89	6083721604597960832	375316653866487565	6083721604597960832	0, 50322	6, 40154E-6			1699, 40937	9, 05315E-6	1699, 39459	5, 68398E-6	1699, 39568	9, 10610E-6			14, 5027	0, 02207	14, 6624	0
78	6083714767009508224	375316653866487565	6083714767009508224	0, 51528	1, 19362E-5			1826, 49266	1, 68803E-5	1730, 70052	1, 52651E-5	1730, 68774	2, 39795E-5			14, 6512	0, 0371	14, 9424	0
30	6083700816927599872	375316653866487565	6083700816927599872	0, 51851	1, 74291E-5			1878, 88481	2, 46485E-5	1730, 6276	5, 79002E-5	1730, 72379	0, 000111			14, 6792	0, 03037	14, 6723	0
15	6083516438277274112	375316653866487565	6083516438277274112	0, 52133	5, 22868E-6			1699, 42927	7, 39446E-6	1699, 43116	1, 18849E-5	1699, 43333	9, 59494E-6			14, 5423	0, 02441	14, 7732	0
68	6083713117729004928	375316653866487565	6083713117729004928	0, 52334	1, 70941E-5			1699, 28064	2, 41747E-5	1699, 27834	1, 54218E-5	1699, 28419	2, 00252E-5			14, 6607	0, 03557	14, 8606	0
31	6083701194886450304	375316653866487565	6083701194886450304	0, 5485	3, 59616E-5			1878, 893	5, 08574E-5	1730, 74551	2, 02203E-5	1730, 25799	5, 89637E-5			14, 6331	0, 02246	14, 7072	0
53	6083704837024927360	375316653866487565	6083704837024927360	0, 55277	1, 76684E-5			1699, 18967	2, 49869E-5							14, 561	0, 02449		0
82	6083716343238319360	375316653866487565	6083716343238319360	0, 56444	8, 22519E-6			1826, 07356	1, 16322E-5	1730, 67891	1, 21774E-5	1730, 68747	1, 51942E-5			14, 5436	0, 01414	14, 8187	0
79	6083715003197937408	375316653866487565	6083715003197937408	0, 56476	3, 53116E-5			1826, 26755	4, 99382E-5	1730, 21273	1, 55582E-5	1730, 22186	2, 02979E-5			14, 4485	0, 0325	14, 6262	0
44	6083703153390905472	375316653866487565	6083703153390905472	0, 57418	1, 79615E-5			1826, 56808	2, 54015E-5	1730, 10974	1, 54003E-5	1730, 11155	1, 42486E-5			14, 4134	0, 04639	14, 604	0
86	6083720230207777536	375316653866487565	6083720230207777536	0, 57519	2, 92944E-6			1698, 99406	4, 14286E-6	1698, 99724	6, 19405E-6	1699, 00366	6, 64836E-6			14, 416	0, 00854	14, 6649	0
2	6083508814715809536	375316653866487565	6083508814715809536	0, 59286	2, 19543E-5			1826, 52515	3, 10480E-5	1730, 44869	1, 38118E-5	1730, 47426	2, 76247E-5			14, 4706	0, 0406	14, 7025	0
65	6083712632375036032	375316653866487565	6083712632375036032	0, 60234	1, 34673E-5			1699, 09723	1, 90456E-5	1699, 09516	1, 07566E-5	1699, 1266	1, 68836E-5			14, 3684	0, 04348	14, 6238	0
22	6083696144027918336	375316653866487565	6083696144027918336	0, 60468	1, 42391E-5			1699, 17622	2, 01372E-5	1699, 18142	6, 95803E-6	1699, 18574	9, 35523E-6			14, 4927	0, 05046	14, 7452	0
8	6083514106115158656	375316653866487565	6083514106115158656	0, 60828	6, 18274E-6			1699, 10658	8, 74371E-6	1699, 10933	1, 27174E-5	1699, 09418	3, 44305E-6			14, 3863	0, 05658	14, 6901	0
51	6083704592196499328	375316653866487565	6083704592196499328	0, 61558	8, 89573E-6			1699, 20349	1, 25805E-5	1699, 18802	1, 49788E-5	1699, 20655	3, 07243E-5			14, 453	0, 06249	14, 6193	0
37	6083702397477511424	375316653866487565	6083702397477511424	0, 61569	1, 30942E-5			1826, 0587	1, 85180E-5	1730, 04825	1, 04388E-5	1730, 08837	2, 99528E-5			14, 6358	0, 03157	14, 7504	0
38	6083702397500982016	375316653866487565	6083702397500982016	0, 61984	3, 43454E-5			1878, 43287	4, 85717E-5	1730, 31176	1, 63347E-5	1730, 31619	1, 70231E-5			14, 373	0, 04098	14, 3962	0
62	6083709093323257856	375316653866487565	6083709093323257856	0, 62034	4, 37452E-6			1699, 19835	6, 18651E-6	1730, 22606	1, 86835E-5	1730, 26133	7, 19616E-5			14, 3136	0, 04393	14, 5417	0
56	6083705932226710400	375316653866487565	6083705932226710400	0, 6217	1, 11642E-5			1699, 02467	1, 57886E-5	1699, 0219	1, 37655E-5	1699, 00638	4, 60702E-5			14, 4145	0, 02571	14, 6378	0
77	6083714732649408896	375316653866487565	6083714732649408896	0, 62732	9, 74399E-6			1699, 01647	1, 37801E-5	1699, 03875	9, 94440E-6	1699, 04321	1, 10452E-5			14, 3523	0, 02547	14, 6232	0

Gaia table of sources

Structure of a source table file (RRLs):

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variRrlyrae_pf

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25	6083698476167422848	375316653866487565	6083698476167422848	0, 50322	1, 58487E-5			1826, 63068	2, 24135E-5							14, 3915	0, 02875		0
89	6083721604597960832	375316653866487565	6083721604597960832	0, 50322	6, 40154E-6			1699, 40937	9, 05315E-6	1699, 39459	5, 68398E-6	1699, 39568	9, 10610E-6			14, 5027	0, 02207	14, 6624	0
78	6083714767009508224	375316653866487565	6083714767009508224	0, 51528	1, 19362E-5			1826, 49266	1, 68803E-5	1730, 70052	1, 52651E-5	1730, 68774	2, 39795E-5			14, 6512	0, 0371	14, 9424	0
30	6083700816927599872	375316653866487565	6083700816927599872	0, 51851	1, 74291E-5			1878, 88481	2, 46485E-5	1730, 6276	5, 79002E-5	1730, 72379	0, 000111			14, 6792	0, 03037	14, 6723	0
15	6083516438277274112	375316653866487565	6083516438277274112	0, 52133	5, 22868E-6			1699, 42927	7, 39446E-6	1699, 43116	1, 18849E-5	1699, 43333	9, 59494E-6			14, 5423	0, 02441	14, 7732	0
68	6083713117729004928	375316653866487565	6083713117729004928	0, 52334	1, 70941E-5			1699, 28064	2, 41747E-5	1699, 27834	1, 54218E-5	1699, 28419	2, 00252E-5			14, 6607	0, 03557	14, 8606	0
31	6083701194886450304	375316653866487565	6083701194886450304	0, 5485	3, 59616E-5			1878, 893	5, 08574E-5	1730, 74551	2, 02203E-5	1730, 25799	5, 89637E-5			14, 6331	0, 02246	14, 7072	0
53	6083704837024927360	375316653866487565	6083704837024927360	0, 55277	1, 76684E-5			1699, 18967	2, 49869E-5							14, 561	0, 02449		0
82	6083716343238319360	375316653866487565	6083716343238319360	0, 56444	8, 22519E-6			1826, 07356	1, 16322E-5	1730, 67891	1, 21774E-5	1730, 68747	1, 51942E-5			14, 5436	0, 01414	14, 8187	0
79	6083715003197937408	375316653866487565	6083715003197937408	0, 56476	3, 53116E-5			1826, 26755	4, 99382E-5	1730, 21273	1, 55582E-5	1730, 22186	2, 02979E-5			14, 4485	0, 0325	14, 6262	0
44	6083703153390905472	375316653866487565	6083703153390905472	0, 57418	1, 79615E-5			1826, 56808	2, 54015E-5	1730, 10974	1, 54003E-5	1730, 11155	1, 42486E-5			14, 4134	0, 04639	14, 604	0
86	608372023020777536	375316653866487565	608372023020777536	0, 57519	2, 92944E-6			1698, 99406	4, 14286E-6	1698, 99724	6, 19405E-6	1699, 00366	6, 64836E-6			14, 416	0, 00854	14, 6649	0
2	6083508814715809536	375316653866487565	6083508814715809536	0, 59286	2, 19543E-5			1826, 52515	3, 10480E-5	1730, 44869	1, 38118E-5	1730, 47426	2, 76247E-5			14, 4706	0, 0406	14, 7025	0
65	6083712632375036032	375316653866487565	6083712632375036032	0, 60234	1, 34673E-5			1699, 09723	1, 90456E-5	1699, 09516	1, 07566E-5	1699, 1266	1, 68836E-5			14, 3684	0, 04348	14, 6238	0
22	6083696144027918336	375316653866487565	6083696144027918336	0, 60468	1, 42391E-5			1699, 17622	2, 01372E-5	1699, 18142	6, 95803E-6	1699, 18574	9, 35523E-6			14, 4927	0, 05046	14, 7452	0
8	6083514106115158656	375316653866487565	6083514106115158656	0, 60828	6, 18274E-6			1699, 10658	8, 74371E-6	1699, 10933	1, 27174E-5	1699, 09418	3, 44305E-6			14, 3863	0, 05658	14, 6901	0
51	6083704592196499328	375316653866487565	6083704592196499328	0, 61558	8, 89573E-6			1699, 20349	1, 25805E-5	1699, 18802	1, 49788E-5	1699, 20655	3, 07243E-5			14, 453	0, 06249	14, 6193	0
37	6083702397477511424	375316653866487565	6083702397477511424	0, 61569	1, 30942E-5			1826, 0587	1, 85180E-5	1730, 04825	1, 04388E-5	1730, 08837	2, 99528E-5			14, 6358	0, 03157	14, 7504	0
38	6083702397500982016	375316653866487565	6083702397500982016	0, 61984	3, 43454E-5			1878, 43287	4, 85717E-5	1730, 31176	1, 63347E-5	1730, 31619	1, 70231E-5			14, 373	0, 04098	14, 3962	0
62	6083709093323257856	375316653866487565	6083709093323257856	0, 62034	4, 37452E-6			1699, 19835	6, 18651E-6	1730, 22606	1, 86835E-5	1730, 26133	7, 19616E-5			14, 3136	0, 04393	14, 5417	0
56	6083705932226710400	375316653866487565	6083705932226710400	0, 6217	1, 11642E-5			1699, 02467	1, 57886E-5	1699, 0219	1, 37655E-5	1699, 00638	4, 60702E-5			14, 4145	0, 02571	14, 6378	0
77	6083714732649408896	375316653866487565	6083714732649408896	0, 62732	9, 74399E-6			1699, 01647	1, 37801E-5	1699, 03875	9, 94440E-6	1699, 04321	1, 10452E-5			14, 3523	0, 02547	14, 6232	0

Structure of a source table file (T2Cs):

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variCepheid_pf

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2	6083702324458260864	201, 61343	-47, 47989	375316653866487564	6083702324458260864	4, 70009	0, 01705			1789, 11762	0, 02411	1700, 019	0, 01104	1700, 47557	0, 0118	
3	6083704596525326080	201, 8082	-47, 45864	375316653866487564	6083704596525326080	2, 27322	0, 00015			1694, 09705	0, 00022	1694, 08379	0, 00015	1694, 21566	0, 00027	
4	6083715900880633216	201, 56174	-47, 35413	375316653866487564	6083715900880633216	1, 34632	4, 413130E-5			1696, 80352	6, 241110E-5	1696, 75956	4, 059480E-5	1696, 73145	0, 00011	

Gaia table of sources

Structure of a source table file (RRLs):

variRrlyrae_sourceId

variRrlyrae_pf

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25	6083698476167422848	375316653866487565	6083698476167422848	0, 50322	1, 58487E-5			1826, 63068	2, 24135E-5							14, 3915	0, 02875		0	
89	6083721604597960832	375316653866487565	6083721604597960832	0, 50322	6, 40154E-6			1699, 40937	9, 05315E-6	1699, 39459	5, 68398E-6	1699, 39568	9, 10610E-6			14, 5027	0, 02207	14, 6624	0	
78	6083714767009508224	375316653866487565	6083714767009508224	0, 51528	1, 19362E-5			1826, 49266	1, 68803E-5	1730, 70052	1, 52651E-5	1730, 68774	2, 39795E-5			14, 6512	0, 0371	14, 9424	0	
30	6083700816927599872	375316653866487565	6083700816927599872	0, 51851	1, 74291E-5			1878, 88481	2, 46485E-5	1730, 6276	5, 79002E-5	1730, 72379	0, 000111			14, 6792	0, 03037	14, 6723	0	
15	6083516438277274112	375316653866487565	6083516438277274112	0, 52133	5, 22868E-6			1699, 42927	7, 39446E-6	1699, 43116	1, 18849E-5	1699, 43333	9, 59494E-6			14, 5423	0, 02441	14, 7732	0	
68	6083713117729004928	375316653866487565	6083713117729004928	0, 52334	1, 70941E-5			1699, 28064	2, 41747E-5	1699, 27834	1, 54218E-5	1699, 28419	2, 00252E-5			14, 6607	0, 03557	14, 8606	0	
31	6083701194886450304	375316653866487565	6083701194886450304	0, 5485	3, 59616E-5			1878, 893	5, 08574E-5	1730, 74551	2, 02203E-5	1730, 25799	5, 89637E-5			14, 6331	0, 02246	14, 7072	0	
53	6083704837024927360	375316653866487565	6083704837024927360	0, 55277	1, 76684E-5			1699, 18967	2, 49869E-5							14, 561	0, 02449		0	
82	6083716343238319360	375316653866487565	6083716343238319360	0, 56444	8, 22519E-6			1826, 07356	1, 16322E-5	1730, 67891	1, 21774E-5	1730, 68747	1, 51942E-5			14, 5436	0, 01414	14, 8187	0	
79	6083715003197937408	375316653866487565	6083715003197937408	0, 56476	3, 53116E-5			1826, 26755	4, 99382E-5	1730, 21273	1, 55582E-5	1730, 22186	2, 02979E-5			14, 4485	0, 0325	14, 6262	0	
44	6083703153390905472	375316653866487565	6083703153390905472	0, 57418	1, 79615E-5			1826, 56808	2, 54015E-5	1730, 10974	1, 54003E-5	1730, 11155	1, 42486E-5			14, 4134	0, 04639	14, 604	0	
86	608372023020777536	375316653866487565	608372023020777536	0, 57519	2, 92944E-6			1698, 99406	4, 14286E-6	1698, 99724	6, 19405E-6	1699, 00366	6, 64836E-6			14, 416	0, 00854	14, 6649	0	
2	6083508814715809536	375316653866487565	6083508814715809536	0, 59286	2, 19543E-5			1826, 52515	3, 10480E-5	1730, 44869	1, 38118E-5	1730, 47426	2, 76247E-5			14, 4706	0, 0406	14, 7025	0	
65	6083712632375036032	375316653866487565	6083712632375036032	0, 60234	1, 34673E-5			1699, 09723	1, 90456E-5	1699, 09516	1, 07566E-5	1699, 1266	1, 68836E-5			14, 3684	0, 04348	14, 6238	0	
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8	6083514106115158656	375316653866487565	6083514106115158656	0, 60828	6, 18274E-6			1699, 10658	8, 74371E-6	1699, 10933	1, 27174E-5	1699, 09418	3, 44305E-6			14, 3863	0, 05658	14, 6901	0	
51	6083704592196499328	375316653866487565	6083704592196499328	0, 61558	8, 89573E-6			1699, 20349	1, 25805E-5	1699, 18802	1, 49788E-5	1699, 20655	3, 07243E-5			14, 453	0, 06249	14, 6193	0	
37	6083702397477511424	375316653866487565	6083702397477511424	0, 61569	1, 30942E-5			1826, 0587	1, 85180E-5	1730, 04825	1, 04388E-5	1730, 08837	2, 99528E-5			14, 6358	0, 03157	14, 7504	0	
38	6083702397500982016	375316653866487565	6083702397500982016	0, 61984	3, 43454E-5			1878, 43287	4, 85717E-5	1730, 31176	1, 63347E-5	1730, 31619	1, 70231E-5			14, 373	0, 04098	14, 3962	0	
62	6083709093323257856	375316653866487565	6083709093323257856	0, 62034	4, 37452E-6			1699, 19835	6, 18651E-6	1730, 22606	1, 86835E-5	1730, 26133	7, 19616E-5			14, 3136	0, 04393	14, 5417	0	
56	6083705932226710400	375316653866487565	6083705932226710400	0, 6217	1, 11642E-5			1699, 02467	1, 57886E-5	1699, 0219	1, 37655E-5	1699, 00638	4, 60702E-5			14, 4145	0, 02571	14, 6378	0	
77	6083714732649408896	375316653866487565	6083714732649408896	0, 62732	9, 74399E-6			1699, 01647	1, 37801E-5	1699, 03875	9, 94440E-6	1699, 04321	1, 10452E-5			14, 3523	0, 02547	14, 6232	0	

Structure of a source table file (T2Cs):

variCepheid_sourceId

variCepheid_pf

	userSourceID	gaiaSource...	gaiaSource...	variCepheid_solutionId	variCepheid_sourceId	variCepheid_pf	variCepheid_p...	variCe...	variCe...	variCepheid_...	variCepheid_e...	variCepheid_...	variCepheid_e...	variCepheid_...	variCeph...	variCeph...
1	6083701332348843392	201, 65749	-47, 50709	375316653866487564	6083701332348843392	4, 42592	0, 00026			1816, 86529	0, 00037	1722, 83377	0, 00211	1718, 94645	0, 00284	
2	6083702324458260864	201, 61343	-47, 47989	375316653866487564	6083702324458260864	4, 70009	0, 01705			1789, 11762	0, 02411	1700, 019	0, 01104	1700, 47557	0, 0118	
3	6083704596525326080	201, 8082	-47, 45864	375316653866487564	6083704596525326080	2, 27322	0, 00015			1694, 09705	0, 00022	1694, 08379	0, 00015	1694, 21566	0, 00027	
4	6083715900880633216	201, 56174	-47, 35413	375316653866487564	6083715900880633216	1, 34632	4, 413130E-5			1696, 80352	6, 241110E-5	1696, 75956	4, 059480E-5	1696, 73145	0, 00011	

WARNING 1: sourceIds are LONG INTEGERS (“Int64” in python). Some programs may read them as INTEGERS and lose the real ID.

Gaia table of sources

Structure of a source table file (RRLs):

variRrlyrae_sourceId

variRrlyrae_pf

	userSourceID	variRrlyrae_solutionId	variRrlyrae_sourceId	variRrlyrae_pf	variRrlyrae_p...	variRrlyrae...	variRrlyrae_p...	variRrlyrae_e...	variRrlyrae_e...	variRrlyrae_e...	variRrlyrae_e...	variRrlyrae_e...	variRrlyrae_e...	variRrly...	variRrly...	variRrlyrae...	variRrlyraa...	variRrlyrae...	variRrlyrae...
87	608372033287009792	375316653866487565	608372033287009792	0, 49325	1, 07932E-5			1699, 31223	1, 52639E-5	1699, 29525	1, 45895E-5	1699, 29634	1, 12028E-5			14, 5797	0, 0187	14, 7963	0
25	6083698476167422848	375316653866487565	6083698476167422848	0, 50322	1, 58487E-5			1826, 63068	2, 24135E-5							14, 3915	0, 02875		
89	6083721604597960832	375316653866487565	6083721604597960832	0, 50322	6, 40154E-6			1699, 40937	9, 05315E-6	1699, 39459	5, 68398E-6	1699, 39568	9, 10610E-6			14, 5027	0, 02207	14, 6624	0
78	6083714767009508224	375316653866487565	6083714767009508224	0, 51528	1, 19362E-5			1826, 49266	1, 68803E-5	1730, 70052	1, 52651E-5	1730, 68774	2, 39795E-5			14, 6512	0, 0371	14, 9424	0
30	6083700816927599872	375316653866487565	6083700816927599872	0, 51851	1, 74291E-5			1878, 88481	2, 46485E-5	1730, 6276	5, 79002E-5	1730, 72379	0, 000111			14, 6792	0, 03037	14, 6723	0
15	6083516438277274112	375316653866487565	6083516438277274112	0, 52133	5, 22868E-6			1699, 42927	7, 39446E-6	1699, 43116	1, 18849E-5	1699, 43333	9, 59494E-6			14, 5423	0, 02441	14, 7732	0
68	6083713117729004928	375316653866487565	6083713117729004928	0, 52334	1, 70941E-5			1699, 28064	2, 41747E-5	1699, 27834	1, 54218E-5	1699, 28419	2, 00252E-5			14, 6607	0, 03557	14, 8606	0
31	6083701194886450304	375316653866487565	6083701194886450304	0, 5485	3, 59616E-5			1878, 893	5, 08574E-5	1730, 74551	2, 02203E-5	1730, 25799	5, 89637E-5			14, 6331	0, 02246	14, 7072	0
53	6083704837024927360	375316653866487565	6083704837024927360	0, 55277	1, 76684E-5			1699, 18967	2, 49869E-5							14, 561	0, 02449		
82	6083716343238319360	375316653866487565	6083716343238319360	0, 56444	8, 22519E-6			1826, 07356	1, 16322E-5	1730, 67891	1, 21774E-5	1730, 68747	1, 51942E-5			14, 5436	0, 01414	14, 8187	0
79	6083715003197937408	375316653866487565	6083715003197937408	0, 56476	3, 53116E-5			1826, 26755	4, 99382E-5	1730, 21273	1, 55582E-5	1730, 22186	2, 02979E-5			14, 4485	0, 0325	14, 6262	0
44	6083703153390905472	375316653866487565	6083703153390905472	0, 57418	1, 79615E-5			1826, 56808	2, 54015E-5	1730, 10974	1, 54003E-5	1730, 11155	1, 42486E-5			14, 4134	0, 04639	14, 604	0
86	608372023020777536	375316653866487565	608372023020777536	0, 57519	2, 92944E-6			1698, 99406	4, 14286E-6	1698, 99724	6, 19405E-6	1699, 00366	6, 64836E-6			14, 416	0, 00854	14, 6649	0
2	6083508814715809536	375316653866487565	6083508814715809536	0, 59286	2, 19543E-5			1826, 52515	3, 10480E-5	1730, 44869	1, 38118E-5	1730, 47426	2, 76247E-5			14, 4706	0, 0406	14, 7025	0
65	6083712632375036032	375316653866487565	6083712632375036032	0, 60234	1, 34673E-5			1699, 09723	1, 90456E-5	1699, 09516	1, 07566E-5	1699, 1266	1, 68836E-5			14, 3684	0, 04348	14, 6238	0
22	6083696144027918336	375316653866487565	6083696144027918336	0, 60468	1, 42391E-5			1699, 17622	2, 01372E-5	1699, 18142	6, 95803E-6	1699, 18574	9, 35523E-6			14, 4927	0, 05046	14, 7452	0
8	6083514106115158656	375316653866487565	6083514106115158656	0, 60828	6, 18274E-6			1699, 10658	8, 74371E-6	1699, 10933	1, 27174E-5	1699, 09418	3, 44305E-6			14, 3863	0, 05658	14, 6901	0
51	6083704592196499328	375316653866487565	6083704592196499328	0, 61558	8, 89573E-6			1699, 20349	1, 25805E-5	1699, 18802	1, 49788E-5	1699, 20655	3, 07243E-5			14, 453	0, 06249	14, 6193	0
37	6083702397477511424	375316653866487565	6083702397477511424	0, 61569	1, 30942E-5			1826, 0587	1, 85180E-5	1730, 04825	1, 04388E-5	1730, 08837	2, 99528E-5			14, 6358	0, 03157	14, 7504	0
38	6083702397500982016	375316653866487565	6083702397500982016	0, 61984	3, 43454E-5			1878, 43287	4, 85717E-5	1730, 31176	1, 63347E-5	1730, 31619	1, 70231E-5			14, 373	0, 04098	14, 3962	0
62	6083709093323257856	375316653866487565	6083709093323257856	0, 62034	4, 37452E-6			1699, 19835	6, 18651E-6	1730, 22606	1, 86835E-5	1730, 26133	7, 19616E-5			14, 3136	0, 04393	14, 5417	0
56	6083705932226710400	375316653866487565	6083705932226710400	0, 6217	1, 11642E-5			1699, 02467	1, 57886E-5	1699, 0219	1, 37655E-5	1699, 00638	4, 60702E-5			14, 4145	0, 02571	14, 6378	0
77	6083714732649408896	375316653866487565	6083714732649408896	0, 62732	9, 74399E-6			1699, 01647	1, 37801E-5	1699, 03875	9, 94440E-6	1699, 04321	1, 10452E-5			14, 3523	0, 02547	14, 6232	0

Structure of a source table file (T2Cs):

variCepheid_sourceId

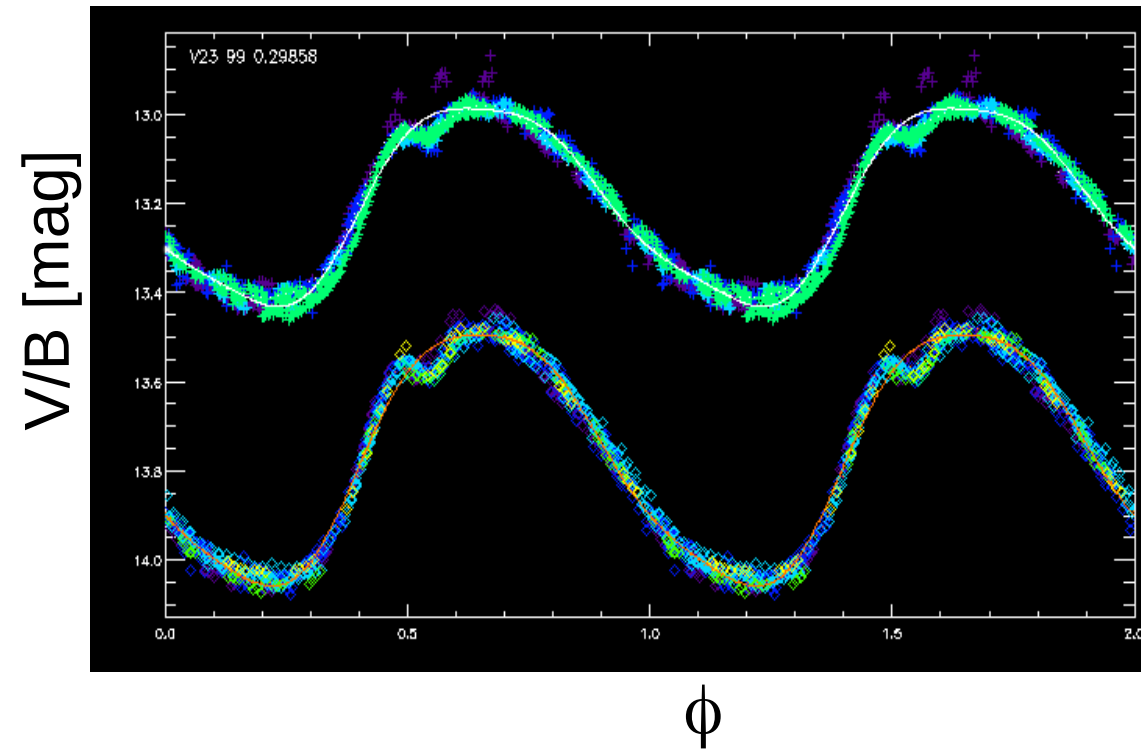
variCepheid_pf

	userSourceID	gaiaSource...	gaiaSource...	variCepheid_solutionId	variCepheid_sourceId	variCepheid_pf	variCepheid_p...	variCe...	variCe...	variCepheid_...	variCepheid_e...	variCepheid_...	variCepheid_e...	variCepheid_...	variCepheid_...	variCeph...
1	6083701332348843392	201, 65749	-47, 50709	375316653866487564	6083701332348843392	4, 47692	0, 00026			1816, 86529	0, 00037	1722, 83377	0, 00211	1718, 94645	0, 00284	
2	6083702324458260864	201, 61343	-47, 47989	375316653866487564	6083702324458260864	4, 70009	0, 01705			1789, 11762	0, 02411	1700, 019	0, 01104	1700, 47557	0, 0118	
3	6083704596525326080	201, 8082	-47, 45864	375316653866487564	6083704596525326080	2, 27322	0, 00015			1694, 09705	0, 00022	1694, 08379	0, 00015	1694, 21566	0, 00027	
4	6083715900880633216	201, 56174	-47, 35413	375316653866487564	6083715900880633216	1, 34632	4, 413130E-5			1696, 80352	6, 241110E-5	1696, 75956	4, 059480E-5	1696, 73145	0, 00011	

WARNING 1: sourceIds are LONG INTEGERS (“Int64” in python). Some programs may read them as INTEGERS and lose the real ID.

WARNING 2: some time series may have very few points (10 or less). These are not easily usable for fourier fitting. Check them.

Mean magnitude estimate

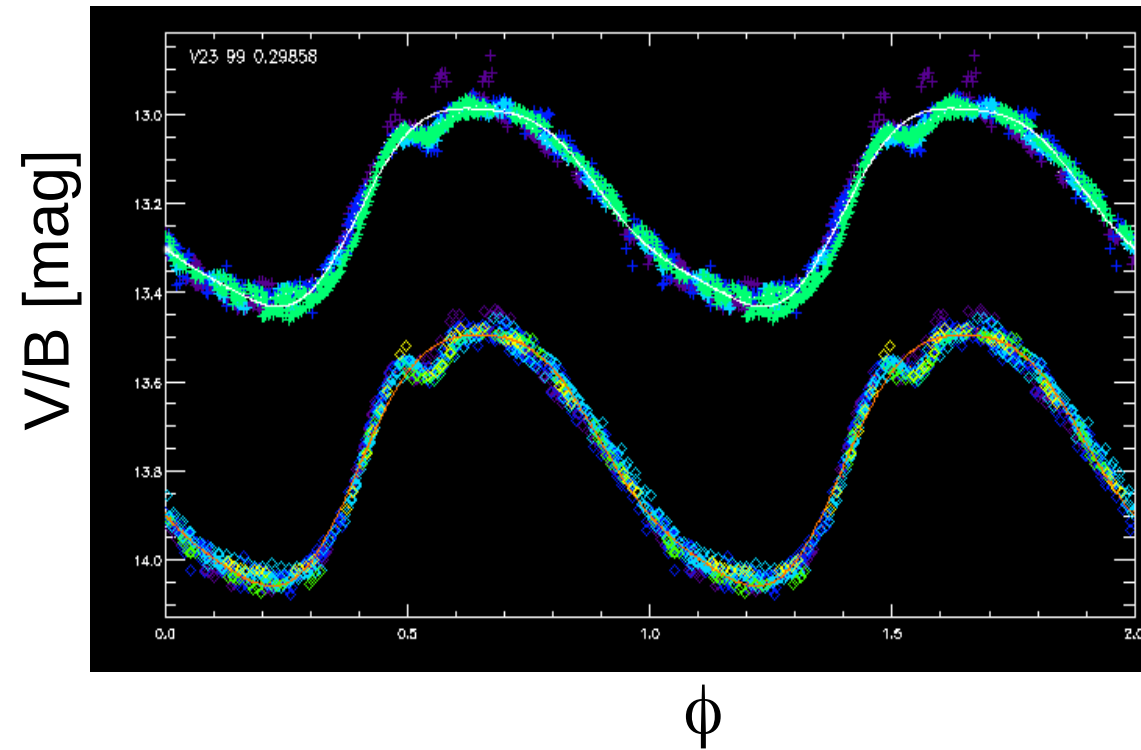


Phasing: fold the lightcurve with pulsation period

$$\phi_i = ((t_i - t_0)/P) \% 1$$

Remainder of the division by 1: just pick the decimal figures

Mean magnitude estimate



Either use the previous fit or calculate a new one of higher order (fits for period estimate are usually of low order for computational reasons)

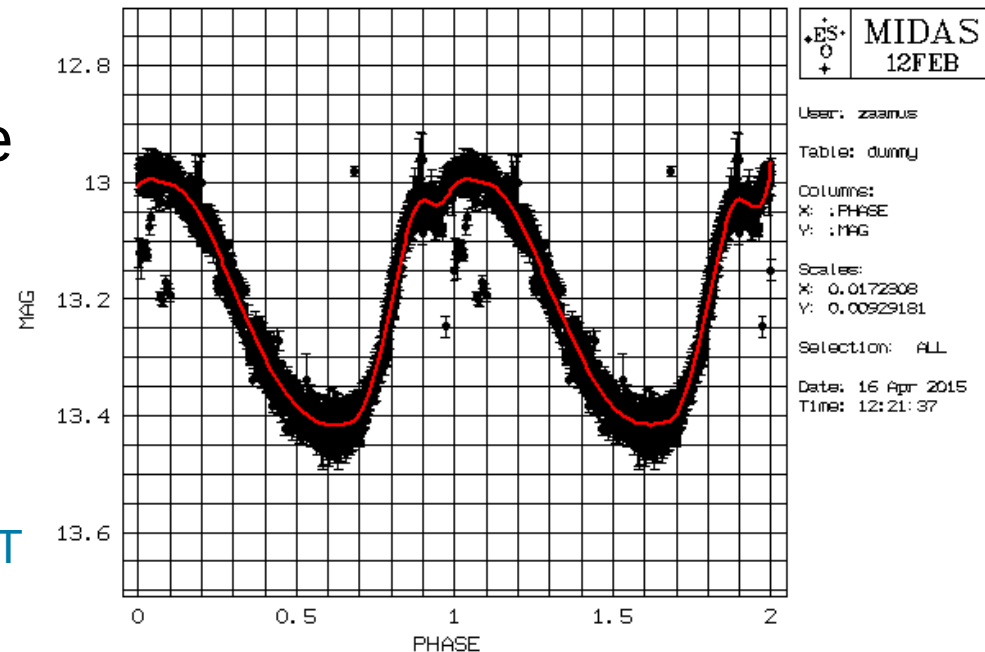
Code for fourier series fit

<https://drive.google.com/file/d/1ysZTIVAUuzP0NrTh95rvatcyk1gZNqdo/view?usp=sharing>

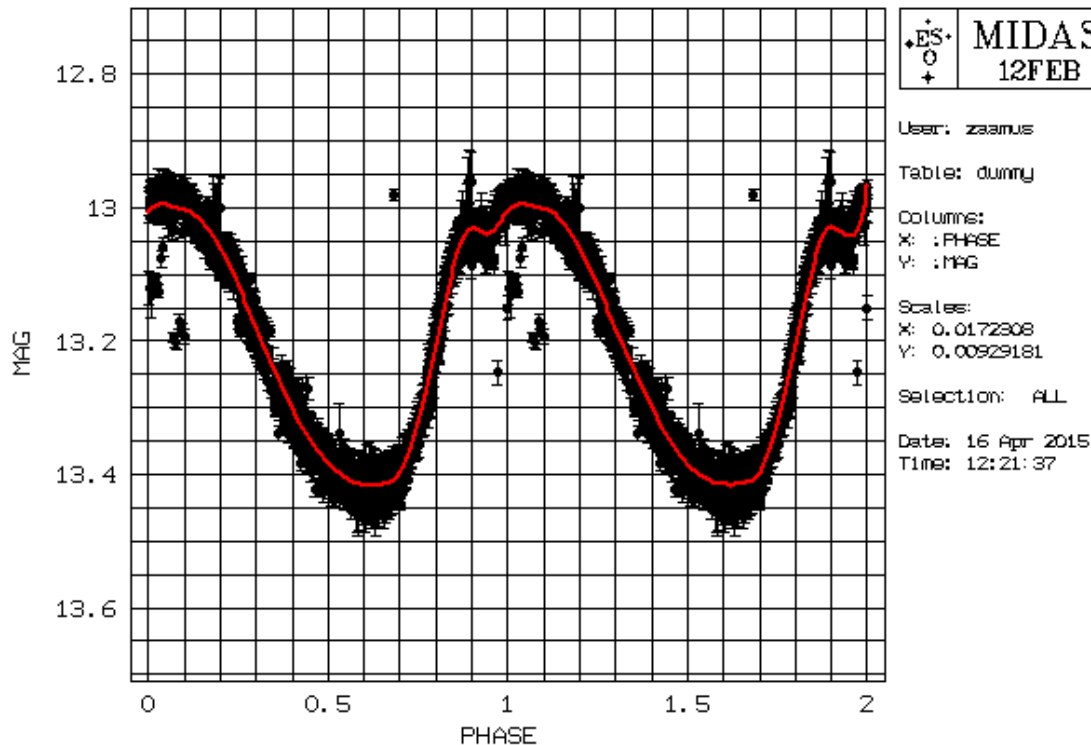
Phasing: fold the lightcurve with pulsation period

$$\phi_i = ((t_i - t_0)/P) \% 1$$

Remainder of the division by 1: just pick the decimal figures



Mean magnitude estimate



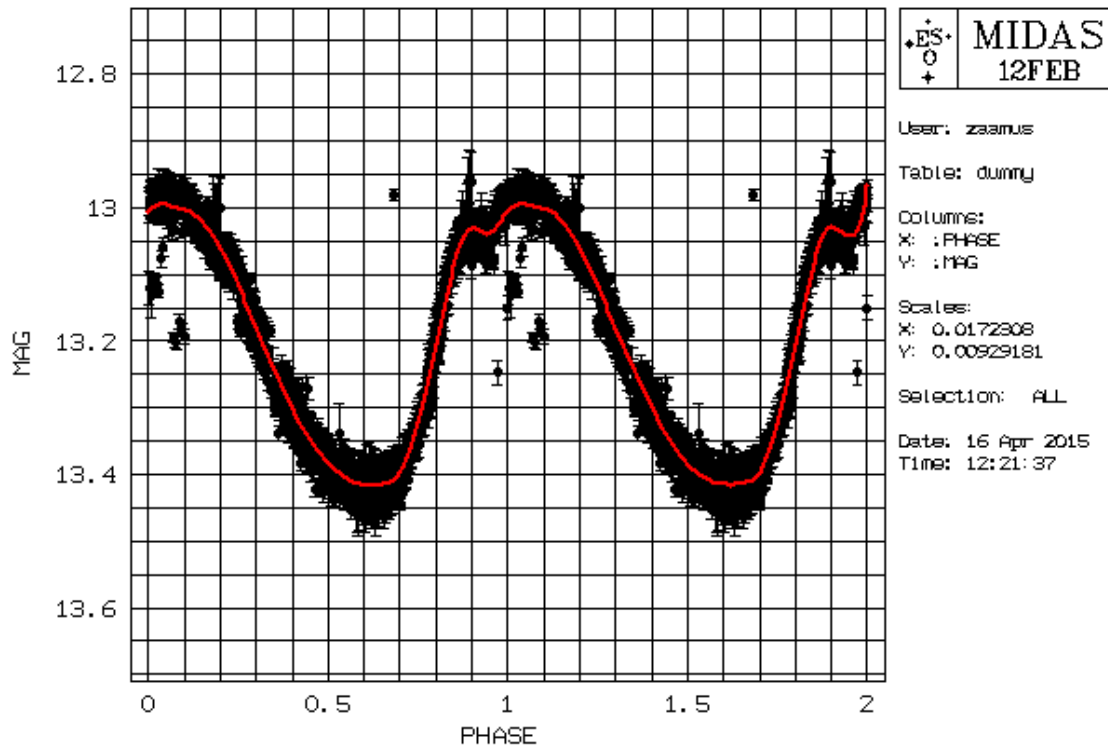
Mean magnitude is a logarithmic quantity --> **intensity** average over the cycle

One cannot calculate $\langle \text{mag} \rangle$ integrating the fit as it is: all the points of the fit must be converted to intensity

$$I_i = 10^{(-0.4 * \text{mag}_i)}$$

for each phase point of the fit (i)

Mean magnitude estimate



Mean magnitude is a logarithmic quantity --> **intensity** average over the cycle

One cannot calculate $\langle \text{mag} \rangle$ integrating the fit as it is: all the points of the fit must be converted to intensity

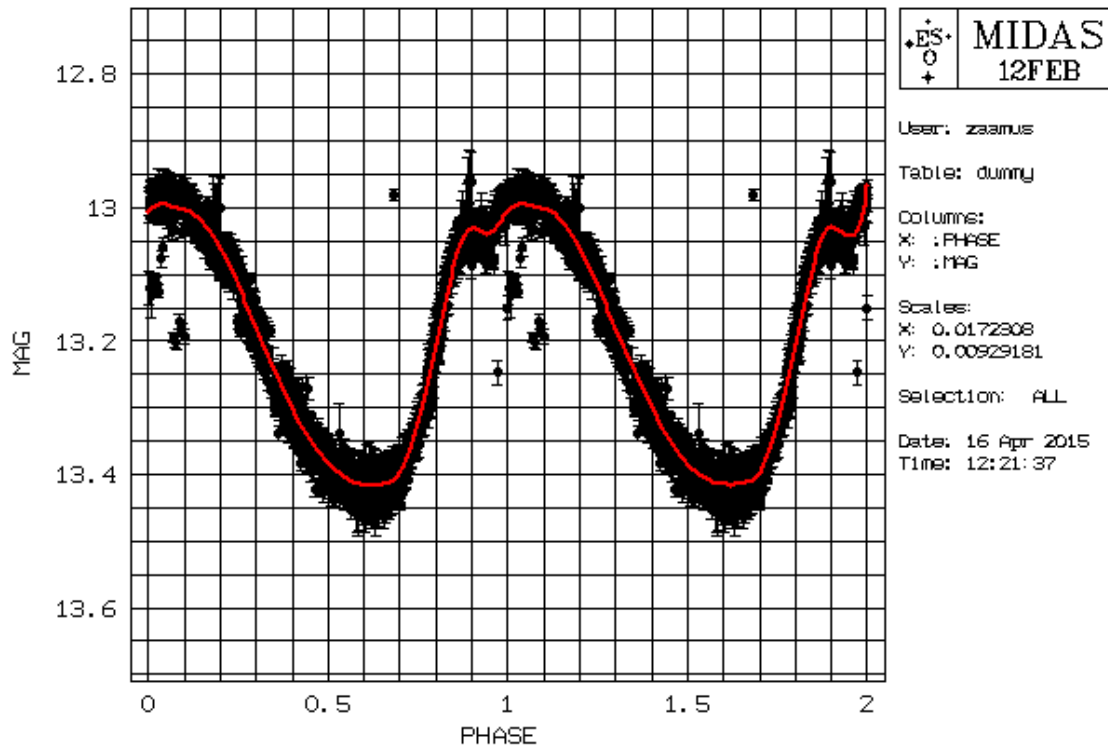
$$I_i = 10^{(-0.4 * \text{mag}_i)}$$

for each phase point of the fit (i)

Now you can calculate the mean intensity $\langle I \rangle$...

$$\langle I \rangle = (\sum_{i=1, \text{red}}^n (I_i)) / \text{red } n$$

Mean magnitude estimate



Mean magnitude is a logarithmic quantity --> **intensity** average over the cycle

One cannot calculate $\langle \text{mag} \rangle$ integrating the fit as it is: all the points of the fit must be converted to intensity

$$I_i = 10^{(-0.4 * \text{mag}_i)}$$

for each phase point of the fit (i)

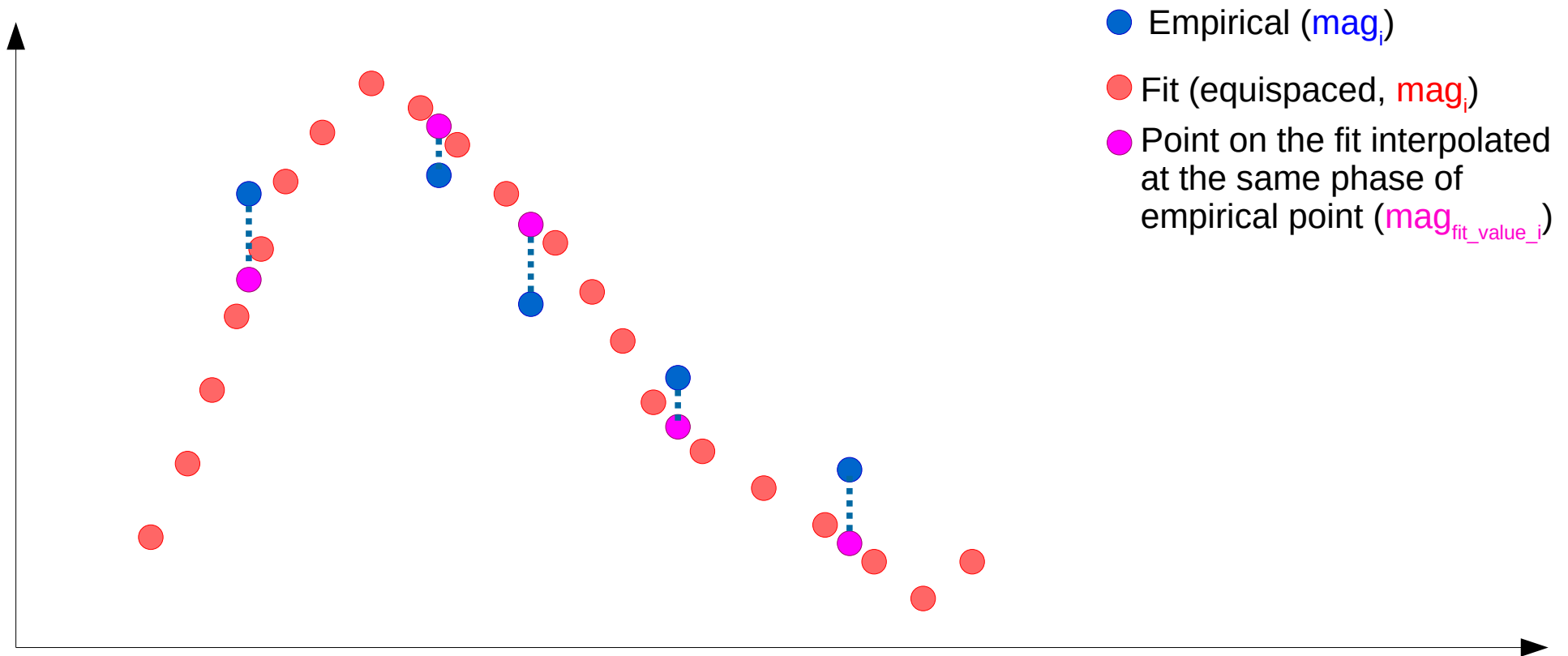
Now you can calculate the mean intensity $\langle I \rangle$...

$$\langle I \rangle = (\sum_{i=1, n} (I_i)) / n$$

... and convert back to magnitudes

$$\langle \text{mag} \rangle = -2.5 \log_{10}(\langle I \rangle)$$

Mean magnitude estimate

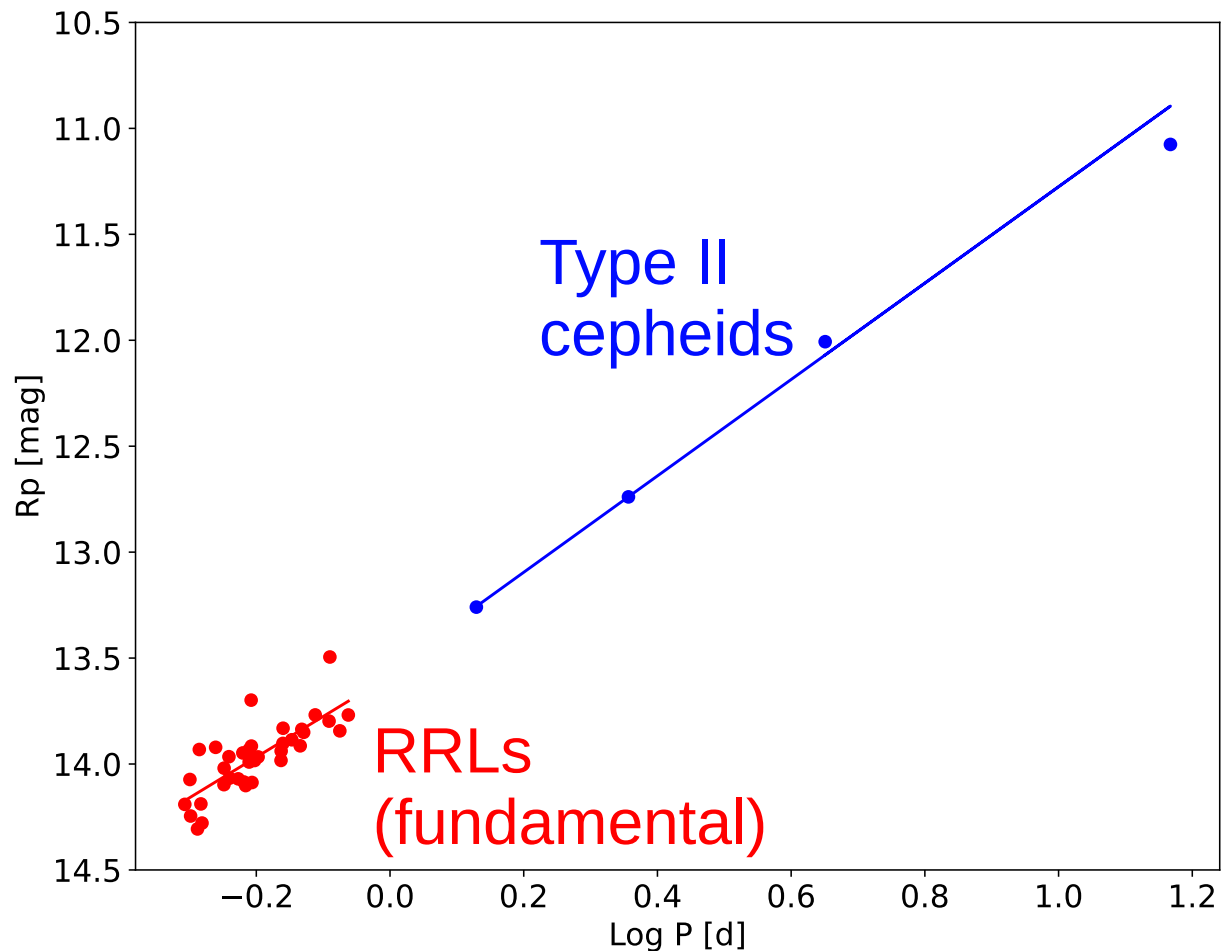


$$\text{err}\langle\text{mag}\rangle = (\sum_i (\text{mag}_i - \text{mag}_{\text{fit_value_i}})^2 / (n-1))^{1/2}$$

n : number of phase points

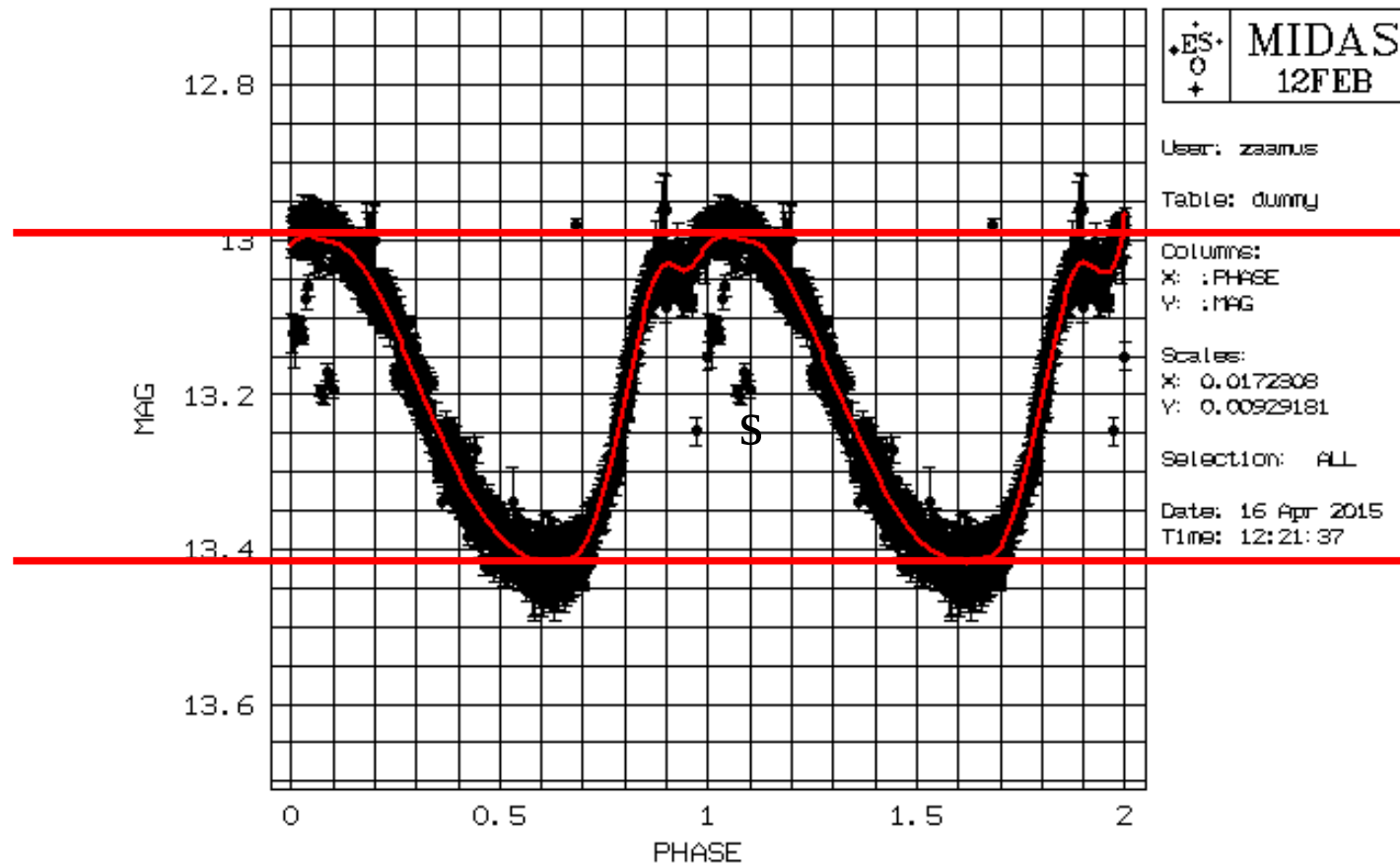
Empirical Period-Luminosity (PL) relations

With periods and mean magnitudes...



PL relations in ω Cen

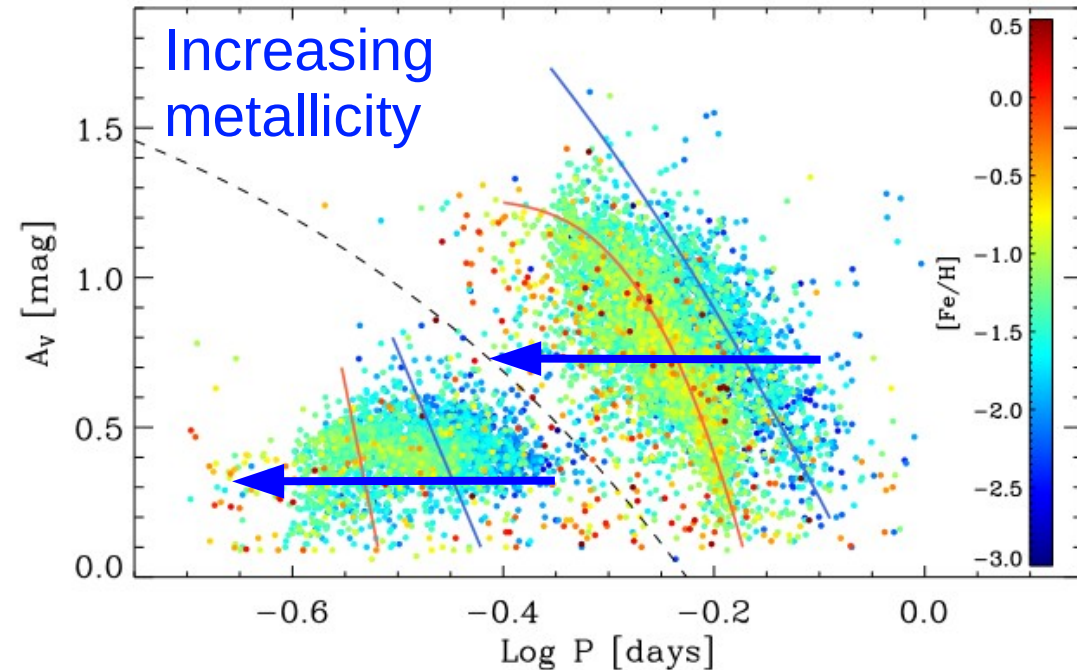
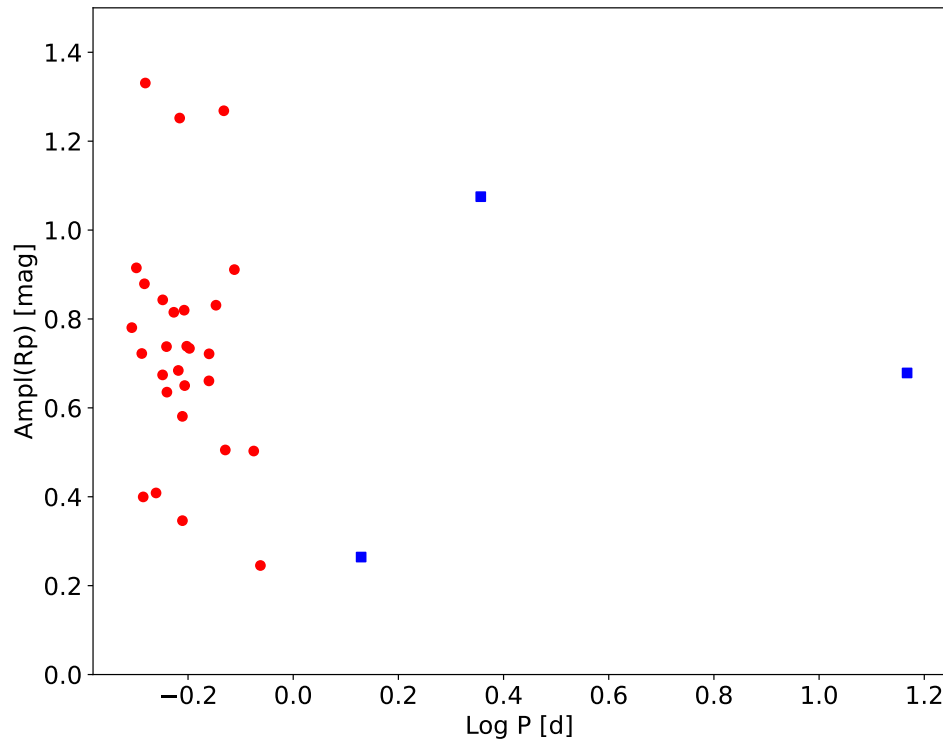
Amplitude estimate



$$\text{Ampl} = \text{max}(\text{fit}) - \text{min}(\text{fit})$$

$$\text{NOT } \text{max}(\text{data}) - \text{min}(\text{data})$$

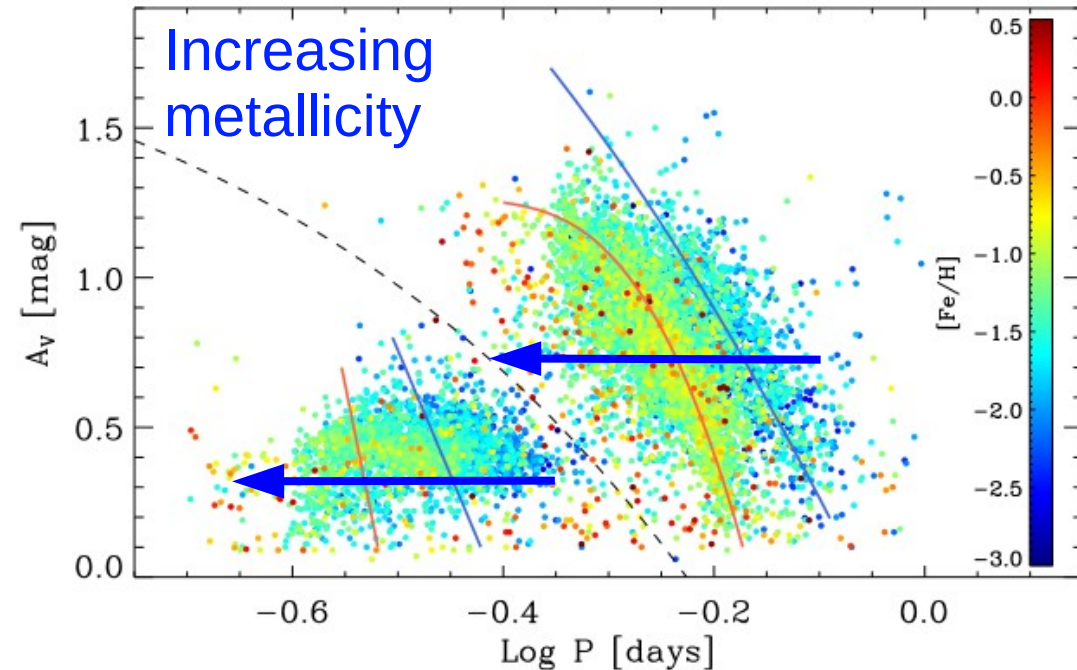
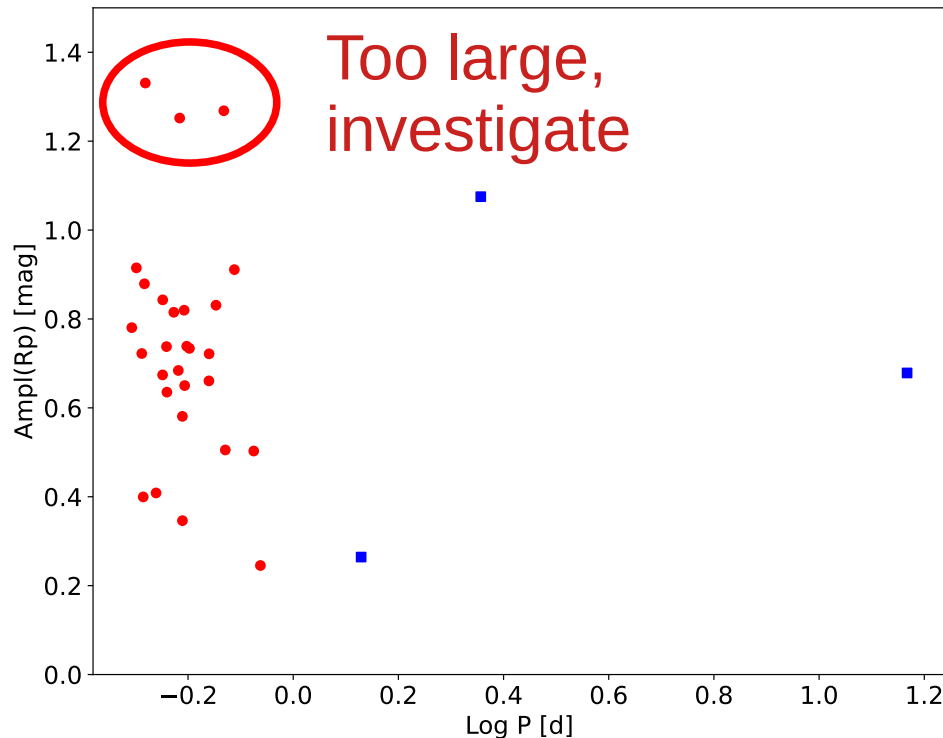
Bailey diagram



Fabrizio+(2021)

- Independent of distance and reddening
- Best way to separate R Rab / R Rc
- Sequences corresponding to different stellar populations
- Position depends on metallicity

Bailey diagram



Fabrizio+(2021)

- Independent of distance and reddening
- Best way to separate R Rab / R Rc
- Sequences corresponding to different stellar populations
- Position depends on metallicity

Good work