

Manual

Cepheus

Calculation for Eclipsing and Pulsating stars

Version 1-0-0

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Cepheus Software Manual

1. Introduction

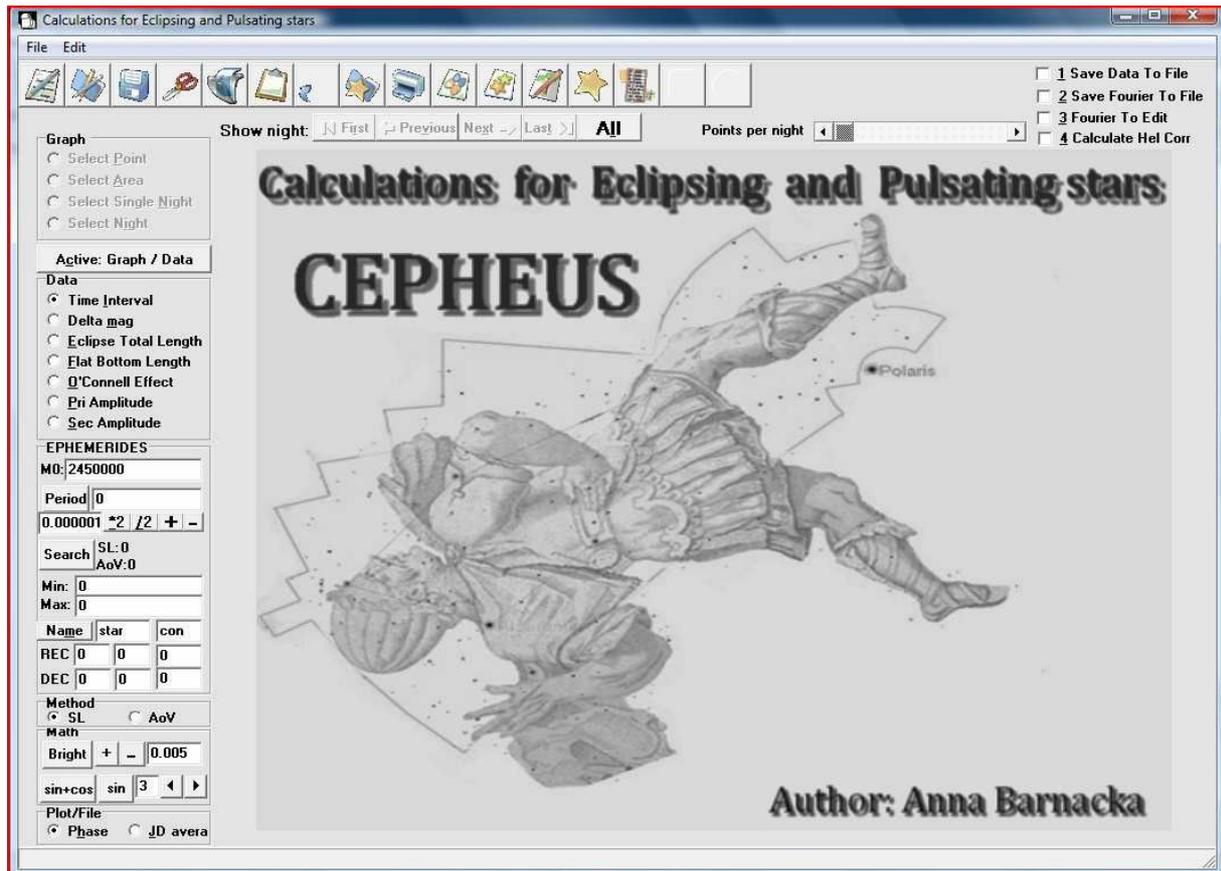


Figure 1: Cepheus Software

Cepheus Software was made to fast analysis of huge amount of data from database such as 'Pi of the sky' or ASAS. The name of software is an extension of an abbreviation CEP (Calculation for Eclipsing and Pulsating stars), of the convention CEP is an abbreviation of the constellation Cepheus. This name was also chosen because of the large number of the variable stars, which are in this constellation, and in view of the star δ Cephei, the prototype of Cepheids.

Binary files used by Cepheus are consisting of two columns. In the first one there should be observing time given in Julian days (JD, HJD) or phase, in the second one there should be the object's brightness registered at the moment of observation given in magnitude or the difference of brightness relative to the comparison star.

2. Toolbar

The overall appearance of the toolbar is visible at figure 2:



Figure 2: Toolbar

Description of each item of toolbar:

When you hover the mouse over an any icon from the toolbar the description is shown.

Table 1: Toolbar

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Icon	Description	Shortcut key	Concerns
	Making new notebook. If there was text earlier in the notebook pressing will clear it and create new one.	Ctrl + N	Notebook
	Opening the notebook made earlier. This icon allows us to open notes saved earlier and show it in the notebook to continue work.	Ctrl + O	Notebook
	Saving the content of the notebook in a text file	Ctrl + S	Notebook
	Cutting out the selected part of text.	Ctrl + X	Notebook
	Copying the selected text	Ctrl + C	Notebook
	Pasting to the notebook copied earlier text	Ctrl + V	Notebook
	Recalling operation made in the notebook	Ctrl + Z	Notebook
	Opening file to work. In file there should be two columns, the first one with time of observation and the second one with brightness observed in each part of time. The file extension is optional. Do not load program files, which aren't binary files or have format other than specified above.		Data
	Printing the current graph		Graph
	Saving the current graph as a bitmap. Before saving the graph there should be enter extension after a file's name.		Graph

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Icon	Description	Shortcut key	concerns
	Saving the graph or the graphic file with .emf or .wmf extension. Before saving the file you must specify its name with an extension.	n/a	Graph
	Copying of the current graph to the clipboard.	n/a	Graph
	Plotting data as a function of the phase. To do that it is necessary to enter the period in an appropriate box. If there is no change after pushing that button check if the period is in the right box.	n/a	Data
	Fourier analysis for the light curve of pulsating stars. Analysis will be done only if the period is entered. The best matching row will be automatically selected as last <i>sum of sines</i> for which all Fourier parameter values were bigger then errors.	n/a	Data
	Determining the moment of the minimum for a symmetric light curves. Icon will become active only if the range in which the minimum will be counted is selected. Range in which the minimum will be counted could be selected when you choose Select Area and click on two points which determine the range.	n/a	Data
	Total rejection of the selected part of a data. The range from which the observational data will be rejected can be selected when you choose Select Area and click on two points which determine the range. Rejection of the selected part of data for a selected star is possible only after loading the data and before plotting the data as a function of a phase for first time. After plotting the data as a function of a phase this option isn't available. Next rejection of the data points will be possible only after re-opening the data file.	n/a	Data

3. Viewing observation nights.

General scheme of icons intended for viewing each observation night:



Figure 3: Viewing observation nights.

If the opened data file has more than one observation night, program will let you view each night separately. Button **All** lets you to go back to a graph on which there are all observation points. The bar allows you to select minimum number of the observation points for which nights should be consecutively displayed.

As you move the bar and increase minimum number of the points you will see information how many nights meet the given condition.

4. Graph

The panel located on the figure below is used to select event/function which should be done after clicking the point on the graph.

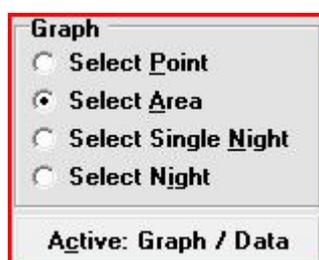


Figure 4: Graph panel

Function's descriptions:

Table 2: Graph functions.

Name	Event / function	Shortcut key
Select Point	When this box is selected, every click on any point on the graph will cause rejection of this point from further analysis and marking it with cross. Deselecting points is possible after coming back to all observation points on the graph. (after pressing All)	Alt + P
Select Area	When this box is checked the guides which are following the movement of the mouse appear on the graph. If this box is checked it is possible to select a range in which minimum will be determined or to reject points from selected period.	Alt + A
Select Single Night	To go back from the graph which shows data plotted in function of phase to the chosen night you should check this box and then click on the point which belongs to the night to which you want to go back. Point's color on the graph is the same for an every given night.	Alt + N
Select Night	This box is used to mark the night which brightness we want decrease or increase.	Alt + I

5. Data

The box **Active: Graph/Data** or shortcut key **Alt + C** is used to activate the data or the graph panel. Functions in this panel are used for a quick determination of the light curve parameters and to measure the time intervals or the brightness amplitude. They were also made for efficient execution of directories containing the light curve parameters.

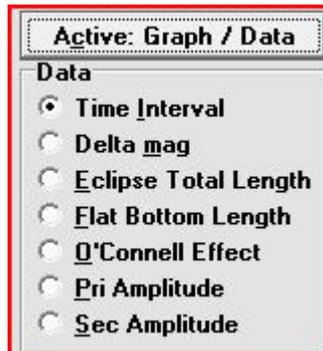


Figure 5: Data panel

After selecting successively two selected points on the graph results of the described functions goes to the notebook. Description of functions:

Table 3: Data functions

Name	Event / function	example	Shortcut key
Time Interval	Measuring a time interval between two successively selected points. dPh – the phase interval (is entered, when interval is measured on graph with phase on the x-axis) dt – the period of time between two points, which coordinates are given as X1, X2, Y1, Y2.	dPh: 0.563858524702901 dt: 0.175540999769032 (X1: 0.0556403198344348 X2: 0.619498844537336 -- Y1: 9.223 Y2: 9.181)	Alt + I
Delta mag	Measuring a difference of brightness between two successively selected points and entering to the notebook result as dmag and a coordinates of chosen points.	dmag: 0.462 (X1: 0.374346735734127 X2: 0.805095062006207 -- Y1: 9.514 Y2: 9.052)	Alt + M
Eclipse Total Length	Measuring duration of the minimum.	D (dPh): 0.399687139437012 dt: 0.12443099993667 (X1: 0.162346902417282 X2: 0.562034041854294)	Alt + E
Flat Botton Length	Measuring length of the flat bottom.	d (dPh): 0.277825782064246 dt: 0.0864930002980232 (X1: 0.22805400162473 X2: 0.505879783688976)	Alt + F
O'Connell Effect	Measuring an O'Connell's effect.	O'Connell Effect: 0.1739999999999999 (X1: 0.813253843444898 X2: 1.0289026436436 -- Y1: 9.051 Y2: 9.225)	Alt + O
Pri Amplitude	Measuring of the main minimum amplitude.	A1: 0.471 (X1: 0.423993241893752 X2: 0.785822351246275 -- Y1: 9.518 Y2: 9.047)	Alt + P
Sec Amplitude	Measuring amplitude of the secondary minimum.	A2: 0.32 (X1: 0.0212513772916134 X2: 0.384811818122781 -- Y1: 9.203 Y2: 9.523)	Alt + S

6. EPHEMERIDES

The panel located on the figure below contains boxes in which you can enter ephemerides of an each star. It is also possible to import them from the file `allstars.txt` included in the same directory where the data are entered. File has the defined format (number of bits is important!!!)

Example of the correct format.

```
RT And 2006 8.97 F8V+K1 EA/RS for ALL
23 11 10.1 +53 01 33 2000.0 0.06 0.0 0.6289286 2452500.3510 0.5
```

To import ephemerides from the file it is necessary to enter the name of the star in the box **star** and the name of constellation in the box **con** (letter case is important!) and then it is necessary to click on the box **Name** or use the shortcut key **Alt+m**. If the star isn't found, **no star** will be written in the notebook. If the period of the selected star isn't found, **no period** will be written in the notebook. If software can't open the file or the file wouldn't be in proper directory then **cannot found or open file** will appear in the notebook.

EPHEMERIDES		
M0:	2450000	
Period	0.311321	
	0.000001	*2 /2 + -
Search	SL: 8.613120 AoV: 83.006800	
Min:	0	
Max:	0	
Name	star	con
REC	0	0
DEC	0	0

Figure 6: EPHEMERIDES panel.

Instead of automatically importing ephemerides from the file it is also possible to enter each parameter manually or change the one entered beforehand.

Boxes' description:

M0: The numeric value 2450000 is entered automatically, this value can be changed any time. This box can be entered automatically after importing the ephemerides from the file.

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Period: in this box it is possible to write or change the written period. To make your work easier period's change cause plotting the data versus the phase automatically (if period is not zero). After the click on the **Period** box actually shown period is entered to the notebook. Change of the period causes also calculation and showing the value of length of the SL and AoV window which tell us more about the fitting period.

In the box below the box **Period** the value of step that determines possible changes of period is given. It use keys **+** or **-** to change the period's value. Each period can be also multiplied or divided using two keys ***2** or **/2**. Period could be also imported to the software clicking twice on the box.

In this panel it is also possible to find the best fit of the period in the range specified in the box **MIN** and **MAX**. Period is searched with the method of string length with in the steps given in box under the Period's button. (It is important to remember to keep step size not too small otherwise it will cause prolonged calculations)

Right ascension (successively: hh mm ss) and declination (successively: ° ` ") can be written in boxes REC and DEC.

7. Math

This panel let us to do two things – to change brightness of the chosen night with the constant value and fits *sum of sines and cosines* to the observation points.



Figure 7: Math Panel

To change brightness of the chosen night with the constant value, it is necessary to choose a night for which brightness we want to change. It could be done by choosing in the **Graph** panel box named **Select night** and then to click on the point in this night. In box next to buttons + and – there is a value of the adjusted brightness. This value can be changed. When you click on + or – then the appropriate change will be visible on the graph. Brightness change of the observation points from the chosen night will also cause change the string length and display it's new value, so it is possible to track the best points fit. After clicking on the **Bright** button the information about brightness change and about the night for which values were changed is put in the notebook.

To fit *sum of sines and cosines* it is necessary to write a period and then click on the **sin** or **sin+cos** button. In this way the sum in the fitting range which equal to the declared value in the box next to the **sin** button will be fitted. Range of the fit can be changed. If you use **sin+cos** or **sin** button from this panel, it will not automatically delete points for which error is greater than 2.5σ .

If you choose box from the right up corner of the program **3 Fourier To Edit** or use Alt + 3 then fitted Fourier parameters will be saved in the notebook. To save calculated Fourier parameters you have to select **2 Save Fourier To File** or use Alt + 2 shortcut.

8. Plot/File

In this panel you can choose if the data should be plotted on the graph as a function of phase or Mean Julian Date. You can also choose which data will be entered into the file after plotting data in function of phase and when the option: **1 Save Data To File** is chosen.



Figure 8: Plot/File Panel

9. Graph

After click on X or Y axis, the Y axis will be reversed. In the left up corner of the graph cursor's position is updated on-the-fly. In the upper part of the graph the name of the file from which data were read is given. **Color** button is used to change the color of the data reader which appears after choosing any option from the **Data** panel or after choosing **Select Area** from the **Graph** panel. Data reader is not saved on a the graph because it belongs to the different class of objects and it is just auxiliary lines.

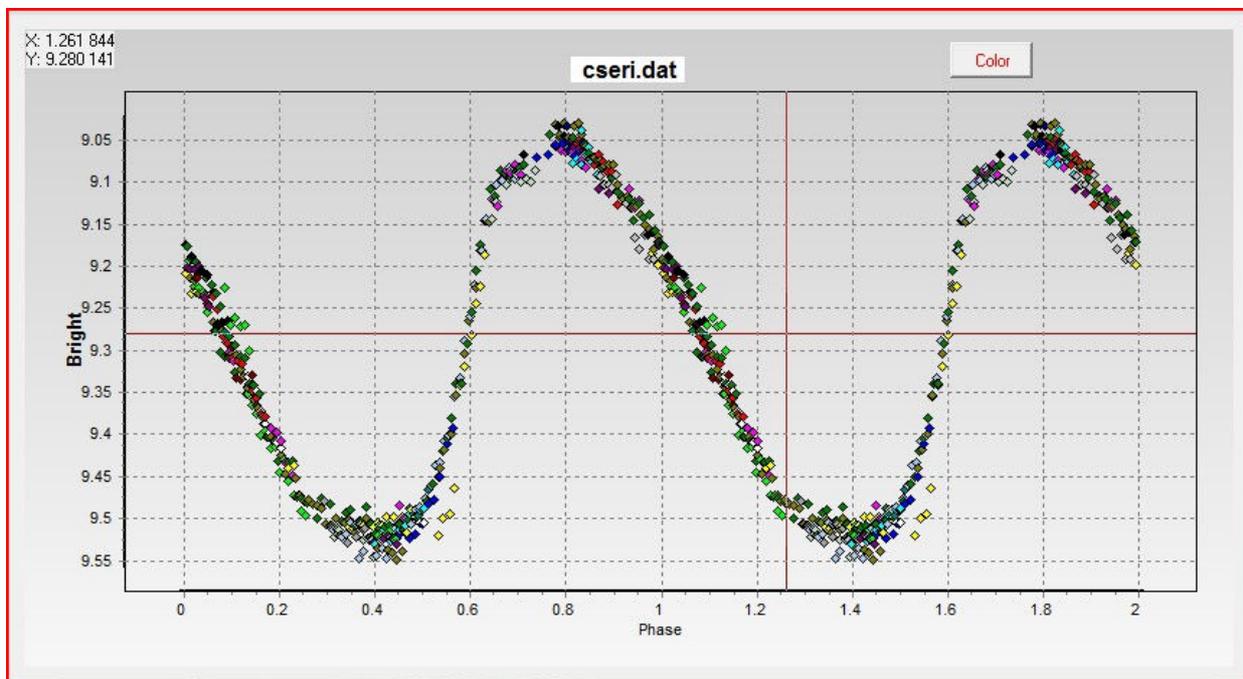


Figure 9: Graph

Appendix

There are none appendixes.

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