



# LIGHT CURVES Phase Diagrams





## LIGHT CURVES - Phase Diagrams

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### Overview

In the study of light curves, there will be times where you are able to capture an entire period of variability in the course of one sitting/measurement.

However, the reality is that this will not be the case. Examples include: Sun position, Sun rise, weather, equipment, length of variability period, etc....

Phase plots, through folding data, provide a way for us to discover a light curve from multiple measurements.



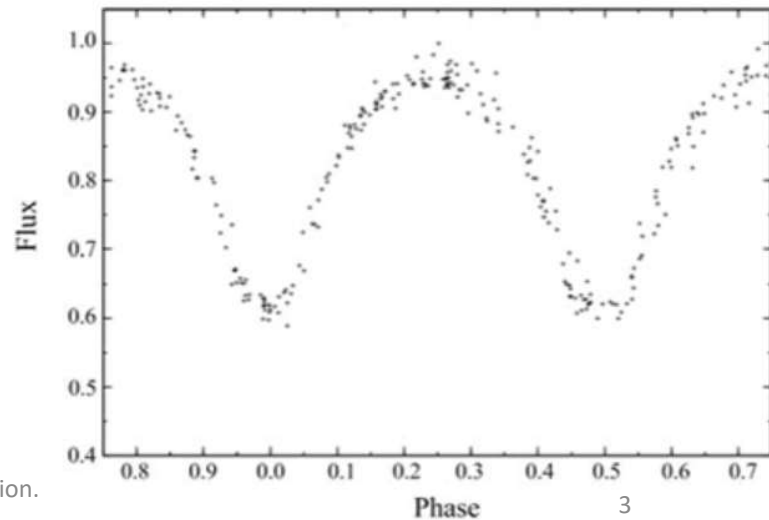
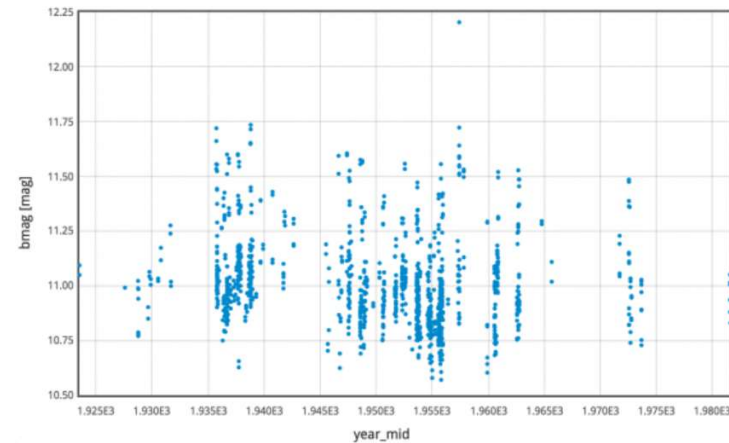
## LIGHT CURVES - Phase Diagrams

### Phase Diagrams/Plots

Sometimes a light curve is evident in a short period of time. In other cases, Phase Plots are needed when the data is suspected to be periodic over longer periods of time.

Phase plots contain data that is “folded” to fit within a mathematically defined/determined period. These are often referred to as folded light curves.

If an incorrect period is chosen, the resulting phase plot will appear “messy”. In this case, a different period is selected, and the data is re-folded. This process is repeated until a “clean” phase plot is constructed. Note that for a phase plot, the x-axis will not be time like on a light curve, but instead represent the phase from 0 to 1 (in practice the values maybe slightly more or less and even possible show two fully cycles in order to show the full features of the object).





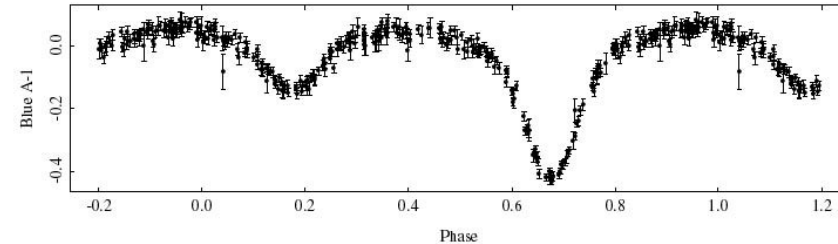
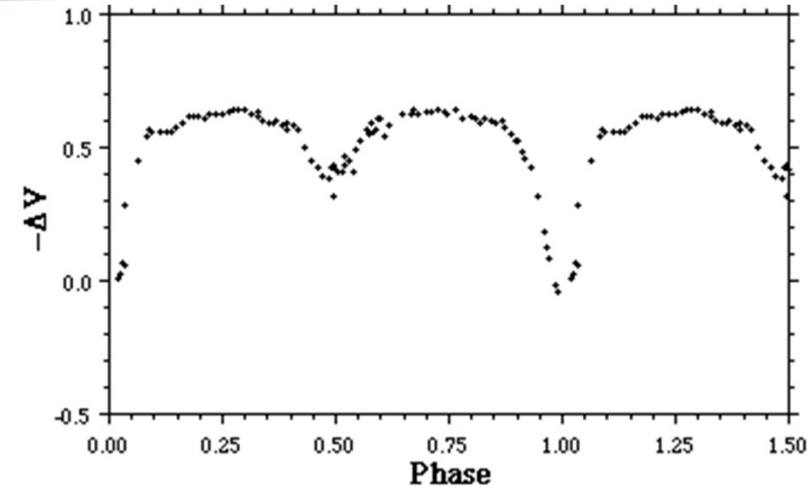
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### Folded Data

When a star varied regularly in its brightness, the period of variability may be readily obvious and thus determined.

When this is not the case, a light curve can be created by 'folding' the data points at this period, the light curve of the variable star becomes built up.

In each plot, the vertical axis gives the magnitude of the star at each observation. The horizontal axis gives the 'phase' of the light curve, where the phase runs from 0 (start of the period) to 1 (end of the period). The data points mark the magnitude of the star when it was observed and the vertical ticks indicate the estimated errors on each magnitude estimate.





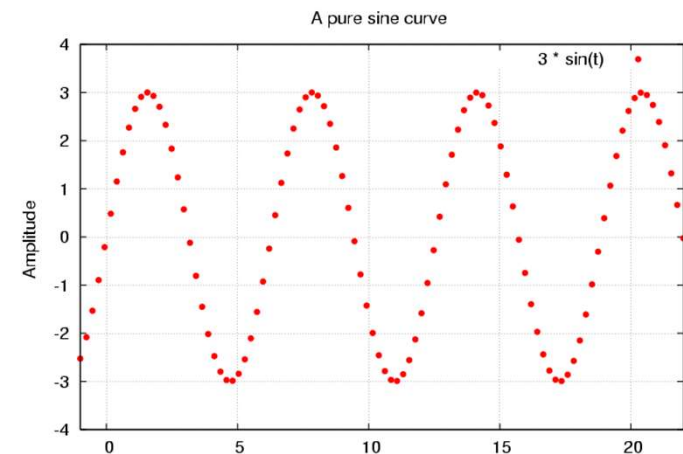
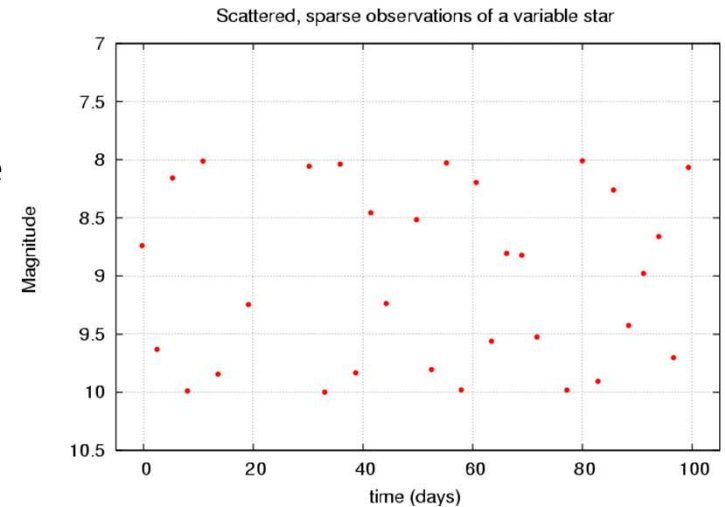
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### Determining a Phase Plot

If you knew in advance the variation of a particular object, you could acquire a good light curve fairly easily by measuring the brightness of the object every hour or so over the course of a few periods, you would have a fabulous record of the variability of the object.

In reality, images of whole fields of stars are taken at random times, often weeks apart. Computer programs are needed to identify individual stars on the images and search for periodic behavior.

Computer programs are used to look for periodic variations in the data by picking a period, and then tests to see whether the brightness variations agree with that period. If not, it tries an incrementally larger period.





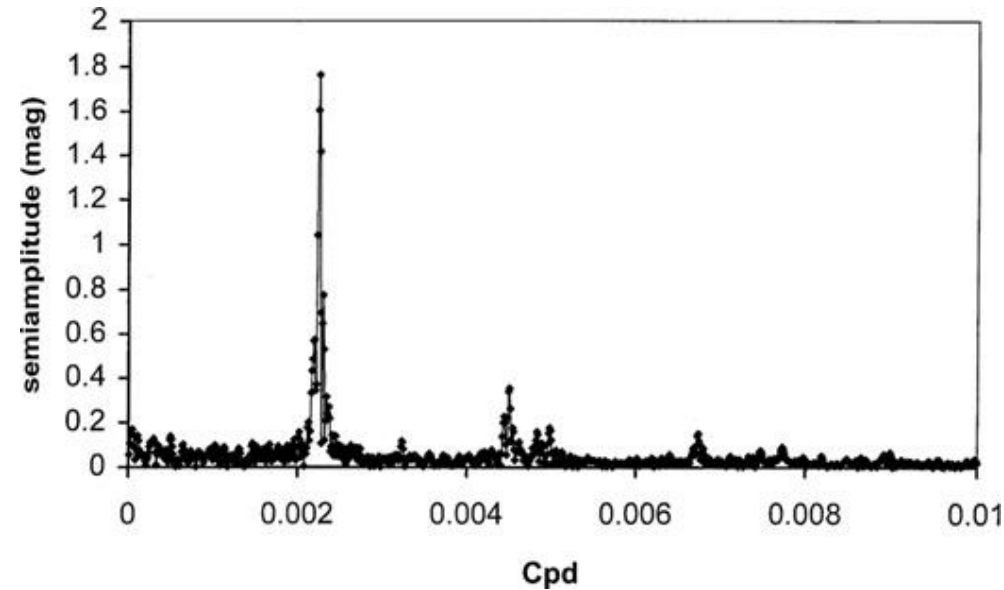
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### Determining a Phase Plot

Eventually, the computer either outputs the best period for the data, or decides that the brightness variations are not periodic.

If the brightness variations are periodic, all the data are time shifted to mimic the scenario in which the observations were made in one period.

This is called "phasing" the data, and provides the most information about subtleties in brightness variations.

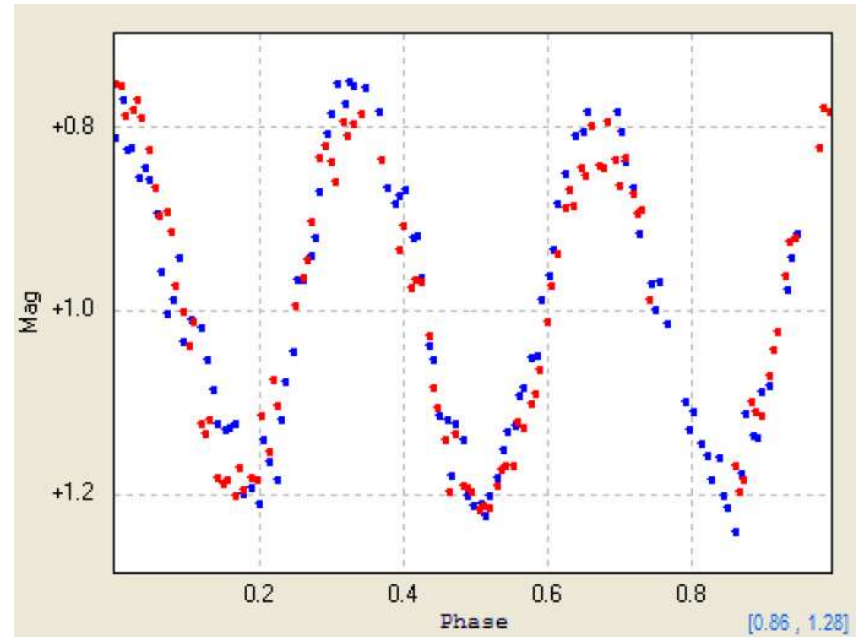




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### In Use

A *Peranso* Phase Window is used for drawing a phase diagram. A phase diagram or folded light curve is a plot of the object's magnitude versus its phase (typically between 0 and 1).



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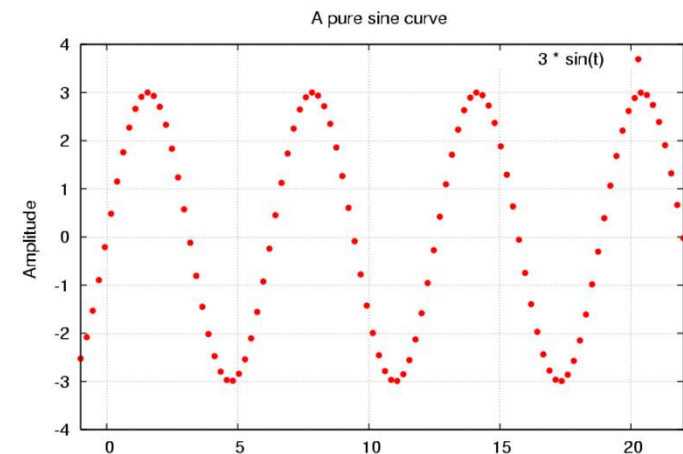
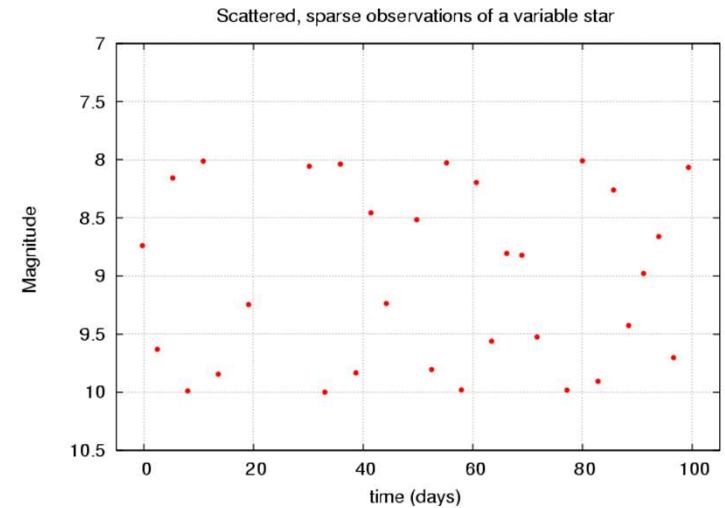
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### Summary

Phase Plots use Folded Data and are the most common plots of a star's variability that you will encounter.

This is because the periods can be lengthy or the entire period was not able to be observed due to: the Sun, clouds, equipment, etc.

Folding data into a phase plot allows us to have a useful chart from which to study a variable star.







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***Questions?***