

Variable stars classification based on photometric data from the Pi of the Sky project

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Plan

- Basic information about variable stars
- Analysis of photometric data in „the Pi of the Sky” project
- Classification of variable stars
- Results

Variable stars

- Stars that change brightness over time
- Over 30 000 variable stars are known and catalogued, and many thousands more are suspected to be variable
- Two kinds of variable stars:
- The variability is being caused by physical changes in the star or stellar system (intrinsic)
- Variability is due to the eclipse of one star by another or the effect of stellar rotation (extrinsing)

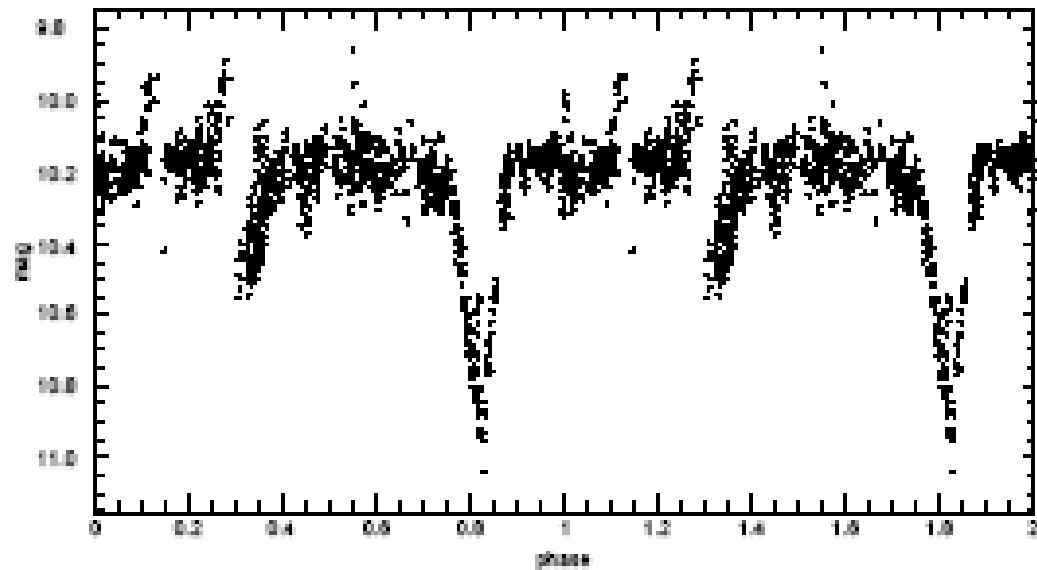
Eclipsing binaries

- These are binary systems of stars with an orbital plane lying near the line-of-sight of the observer. The components periodically eclipse one another, causing a decrease in the apparent brightness of the system as seen by the observer.
- When this happens the total light received from the system is reduced.
- The primary minimum occurs when the component with the higher surface luminosity is eclipsed by its fainter companion.

Eclipsing binaries: Algol (AE)

- The prototype is Algol- beta Persei
- Component stars have a spherical or slightly ellipsoidal shape
- Period between minima is constant or near-constant
- Periods ranging from about five hours to 30 years and light amplitudes may reach several magnitudes

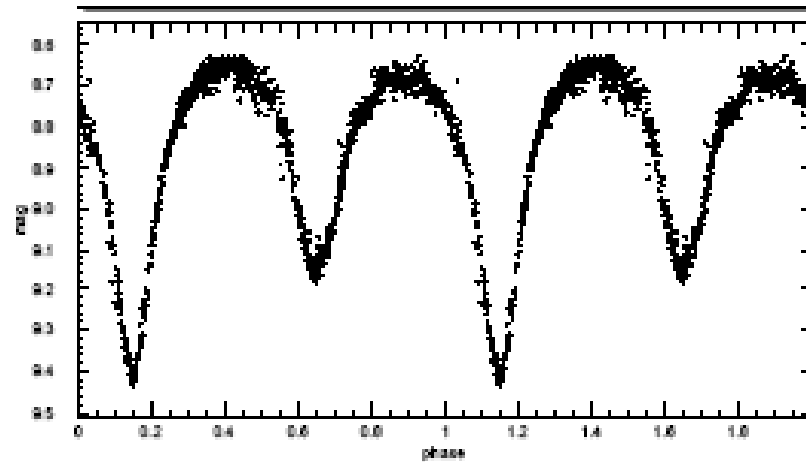
Algol (EA)



Eclipsing binaries: Beta Lyrae (EB)

- These are close binary systems having ellipsoidal components
- Impossible to specify exact times of onset and end of eclipses
- Secondary minimum is observed, its depth usually being smaller than that of the primary minimum
- Periods mainly longer than 1 day, light amplitudes usually smaller than 2 mag

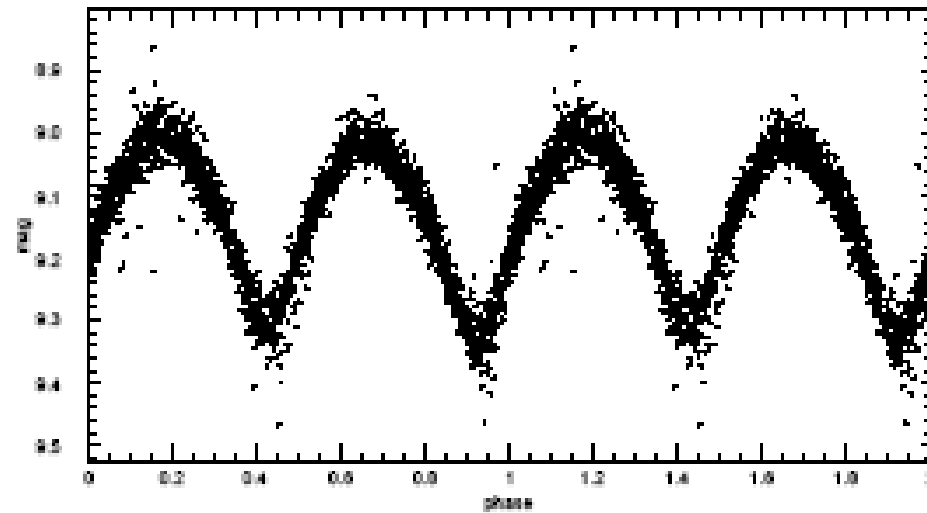
Beta Lyrea type (EB)



Eclipsing binaries: W UMa (EW)

- Consist of ellipsoidal components almost in contact
- Impossible to specify the exact times of onset and end of eclipses from light curves
- Secondary minima are almost equal or differ insignificantly
- Periods shorter than 1 days
- Light amplitudes usually < 0.8 mag

W UMa (EW)



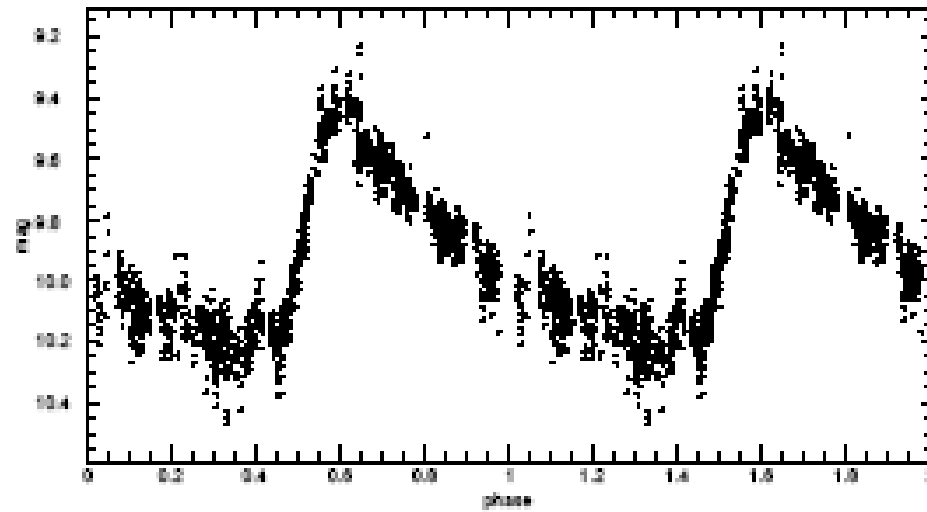
Pulsating stars:

- Change of brightness is being caused by periodic expansion and contraction of their upper layers
- The pulsations may be radial or nonradial
- Radially pulsating star remains spherical in shape

Pulsating stars: Delta Cephei (DCEPS)

- Variability is due to pulsation of the star
- Rise to maximum is quicker than subsequent decline to minimum
- Period: 1-50 days
- Amplitudes: 0.2-2 mag

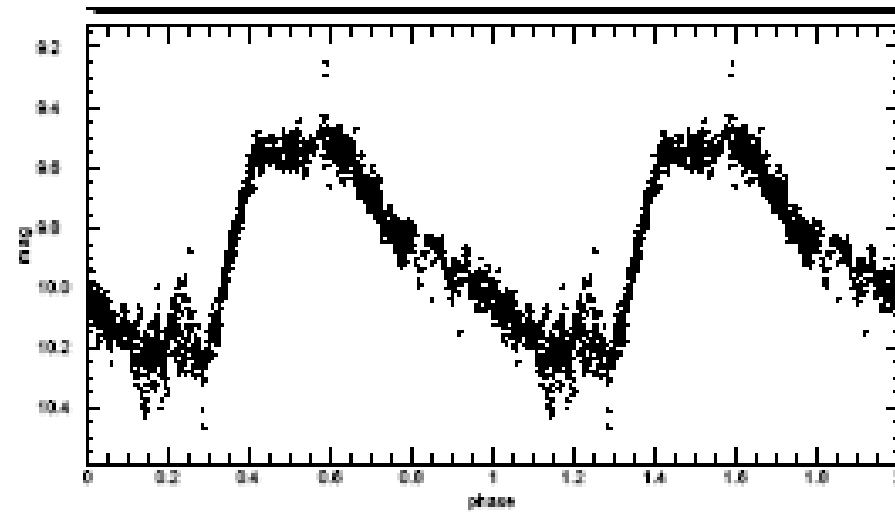
Delta Cephei (DCEPS)



Pulsating stars: W Virgins (CW)

- 1.5 magnitudes fainter than type I and have a mass of less than 1 solar mass, so that they are clearly at a different evolutionary stage
- They also have a distinctive light curve with a bump on the decline side
- Period: 0.8-35 days
- Amplitudes: 0.3-1.2 mag

W Virgins (CW)

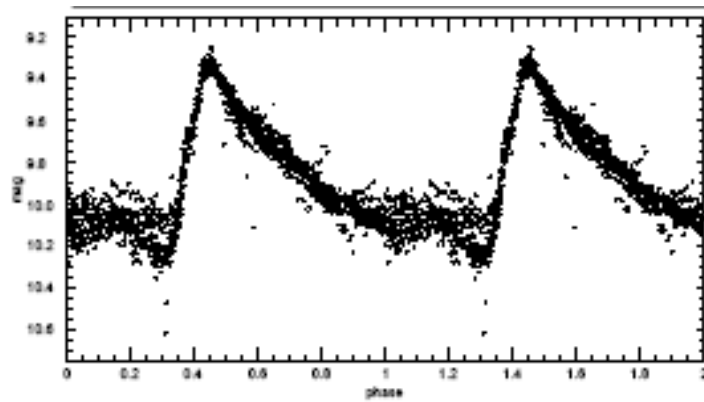


Pulsating stars: RR Lyrae

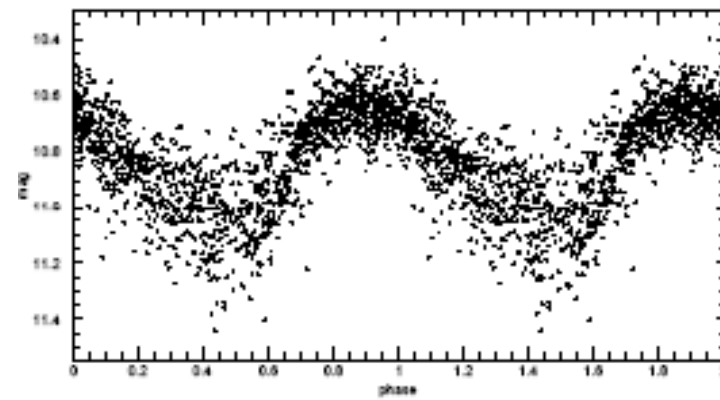
- Called short – period cepheids
- RRab:
 - Asymmetric light curves
 - Period: 0.3- 1.2 days
 - Amplitudes: 0.5-2 mag
- RRC:
 - Nearly symmetric, sometimes sinusoidal light curves
 - Period from 0.2 to 0.5 days
 - Amplitudes not greater than 0.8 mag

RR Lyrae

- RRab:



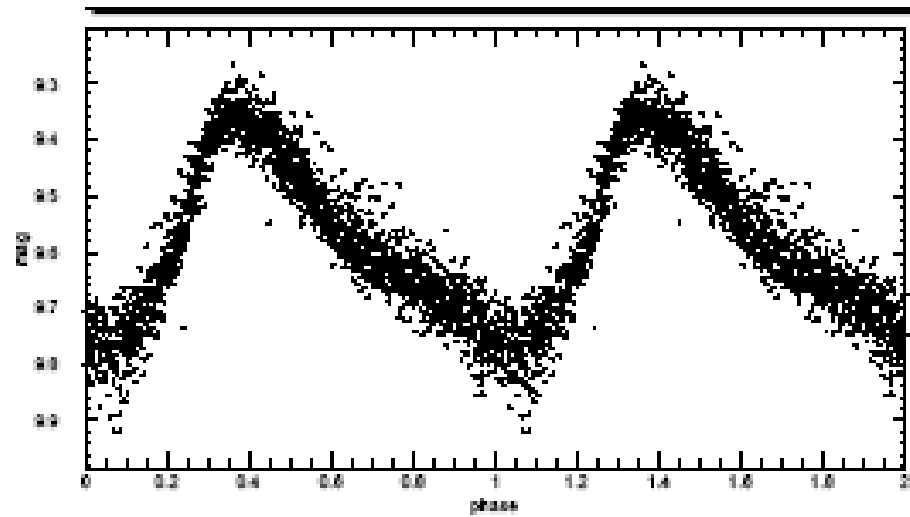
- RRc:



Pulsating stars: Delta Scuti (DSCT)

- DSCT stars are representatives of the galactic disk (flat component)
- Amplitude and period of the fluctuations can vary greatly
- Period: 0.01- 0.2days
- Amplitudes: 0.003-0.9 mag

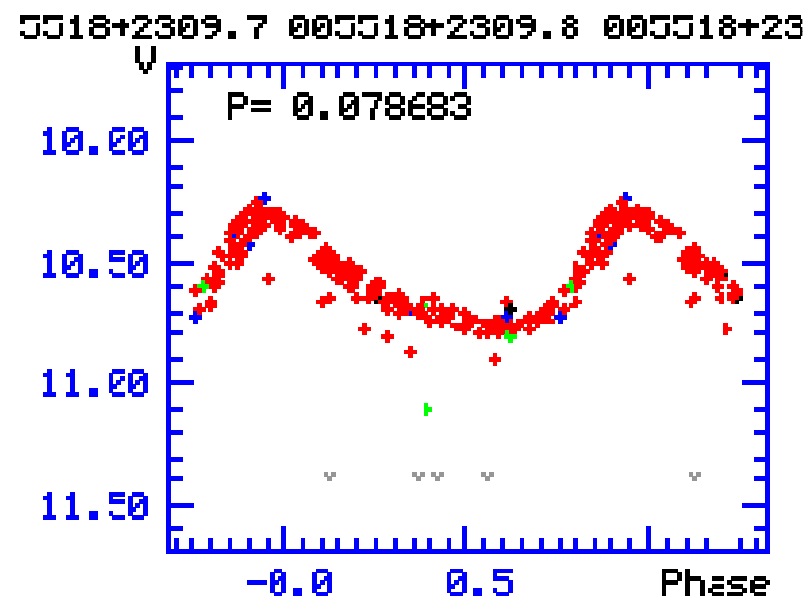
Delta Scuti



Pulsating stars: Beta Cephei (BCEPS)

- The majority of these stars probably show radial pulsations, but some display nonradial pulsations
- Multiperiodicity is characteristic of many of these stars
- Period: 0.1-0.6 days
- Light amplitudes: 0.01-0.3 mag

Beta Cephei



Taken from **The ASAS Catalogue of Variable Stars**:
<http://www.astrow.edu.pl/asas/?psect=acvs&page=details&id=005518+2309.9>

Searching for variability

- Data from 2006-2007
- 10,8 mln stars
- 1 mld number of measurements
- AoV algorithm (Schwarzenberg-Czerny 1989)
- Analysis stars with statistic Θ larger than 120 and number of observational points larger than 200

Classification

- 1,5 mln stars were analyzed
- 2 000 stars were accepted with statistic value larger than 120
- Only 638 was classified as the variable stars
- For 137 stars period was longer than 10 days
- The AoV algorithm often (specialty for W UMa) returned half period instead of the full one
- Types of variability were determined by visual inspection of light curves



The End