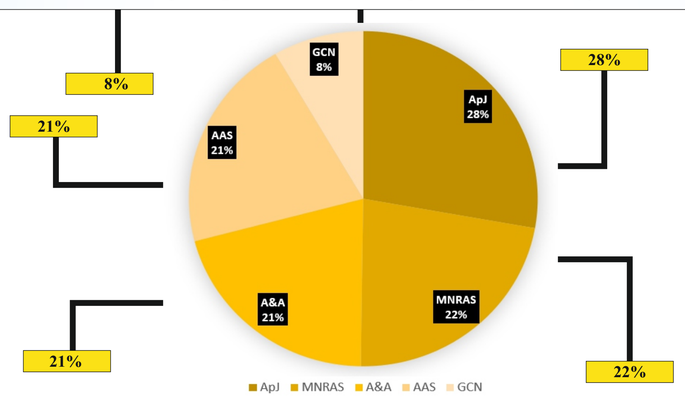
MODELING LIGHT CURVE

Percentage of publications in high-impact factor journals

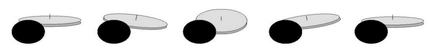


ApJ - The Astrophysical Journal
MNRAS - Monthly Notices of the Royal Astronomical Society
A&A - Astronomy & Astrophysics
AAS - American Astronomical Society
GCN - GRB Coordinates

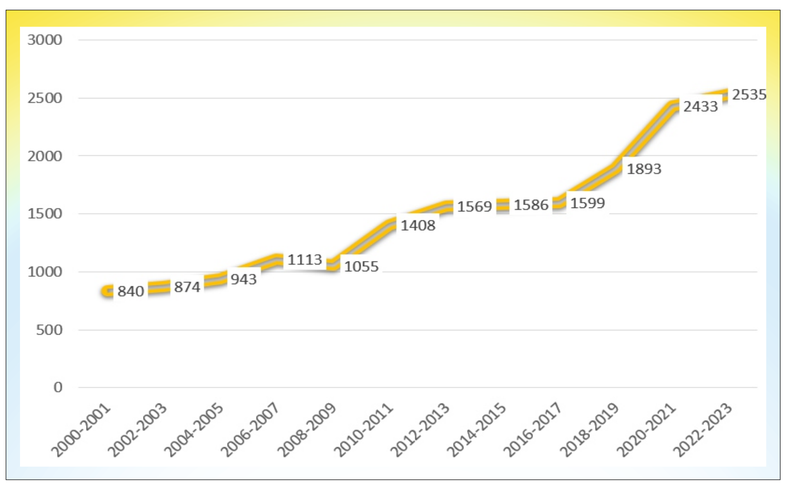
Q1

What is light curve modeling?

Light curve modeling is a technique in astrophysics and astronomy used to analyze and interpret the variations in the brightness of an astronomical object over time. A light curve is a graph of an object's brightness (or flux) as a function of time. Modeling this curve involves fitting theoretical predictions or computational simulations to observed data to derive physical or orbital properties of the object in question or to understand the underlying processes causing the observed variations.



Statistics of brightness curve modeling research from 2000 to 2023



Key Aspects of Light Curve Modeling:

Data Collection

Observations are made to record the brightness of an object over time, typically using telescopes equipped with photometric instruments.

Assy-Turgen Observatory

Location:
Assy-Turgen, Almaty region, Kazakhstan
Altitude: 2750 metres
Coordinates: 43°13'31"N 77°52'18"E

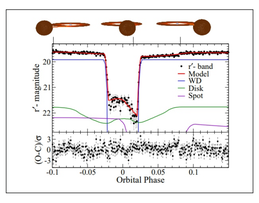
Tien Shan Astronomical Observatory

Location: Almaty, Kazakhstan
Altitude: 2750 metres
Coordinates: 43°03'27"N 76°58'17"E

Data Processing

The raw observational data is often subject to various sources of noise, including instrumental noise, atmospheric effects (for ground-based observations), and other artifacts.
This data is processed to remove or minimize these unwanted signals.

- IRAF
- MIDAS
- MaxIm DL



Echevarria, J. ; **Zharikov, S.** ; Mora Zamora, I.
The period bouncer system SDSS J105754.25+275947.5: first radial velocity study
MNRAS, Q1

Theoretical Models

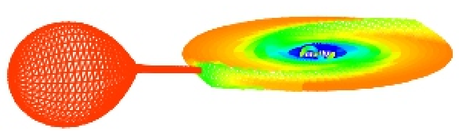
Based on known physical laws and principles, astronomers construct models to predict how the light curve of a particular object should appear under specific conditions.

Fitting & Analysis

The theoretical models are then fitted to the observed light curve data.
The fit's quality and the parameters derived from the best-fit model provide insights into the physical properties and phenomena causing the observed brightness variations.

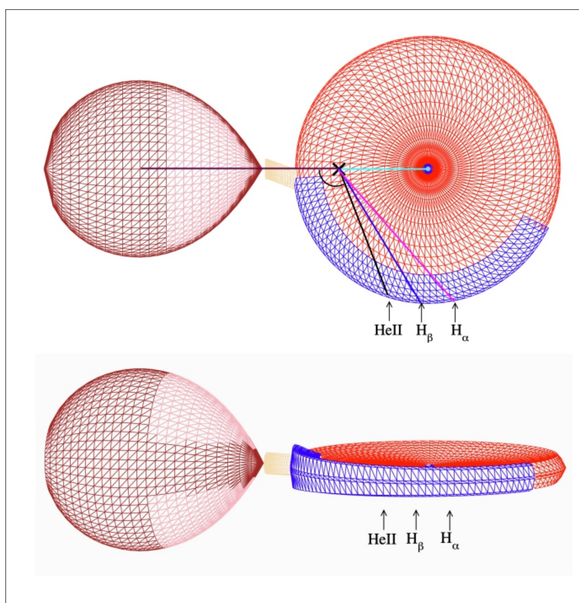
PROGRAMS FOR MODELING LIGHT CURVES

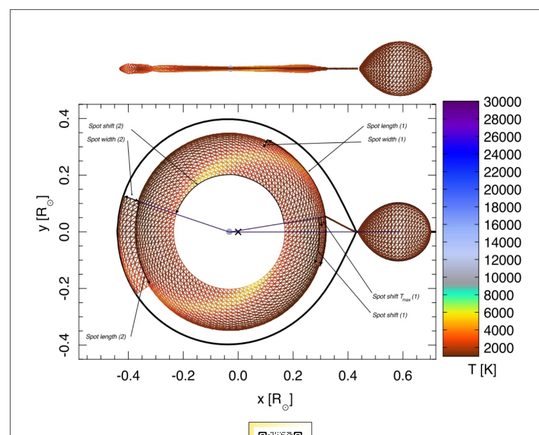
There are numerous software packages and tools available for modeling and analyzing light curves in astrophysics. The best tool often depends on the specific research objective and the type of data being analyzed.



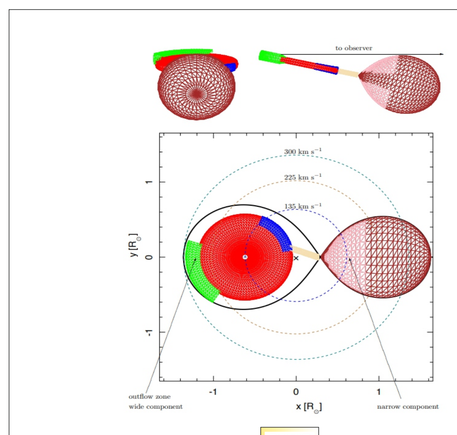
CV Lab

The modeling program CVlab serves as a kind of mathematical laboratory for researching binary star systems with accretion structures. It allows for the modeling and, through comparison with observational data, interpretation of results, identification, and study of the physical parameters of the investigated binary systems, and the peculiarities in the structures of their accretion disks. The method's advantage lies in accounting for accretion structures, parameterizing the nature of viscosity in disks, determining the conditions for the emergence and dissipation of spiral structures, as well as density waves. The precession of accretion disks, potential sources of variability on different time scales, including stellar winds and effects related to the optical thickness of the disk, can also be formalized and described in the model.

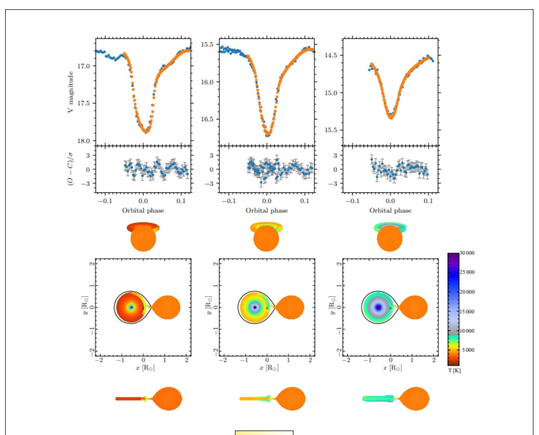




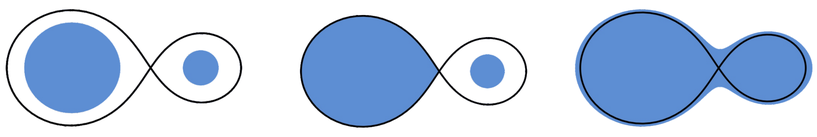
Amantayeva, A., **Zharikov, S.**, Page, K. L., Pavlenko, E., Sosnovskij, A., **Khokhlov, S.**, & **Ibraimov, M.** (2021).
Period bouncer cataclysmic variable EZ Lyn in quiescence
The Astrophysical Journal. – 2021. – Vol. 918. – No. 2. – P. 58. Q1



Subebekova, G., **Zharikov, S.**, **Khokhlov, S.** et al., 2020.
Structure of accretion flows in the nova-like cataclysmic variable RW Tri.
Monthly Notices of the Royal Astronomical Society, 497(2), pp.1475-1487



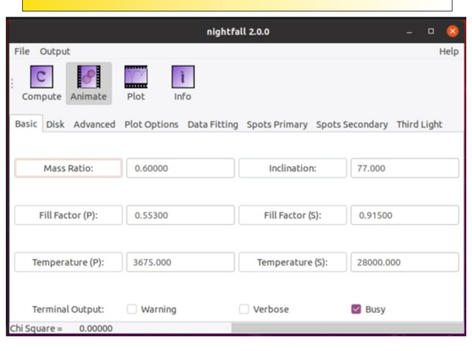
Jan Kára, **Sergey Zharikov,** Marek Wolf, **Ainash Amantayeva, Gulnur Subebekova, Serik Khokhlov, Aldiyar Agishev,** Jaroslav Merc
The Z Camelopardalis-type star AY Piscium: stellar and accretion disk parameters
The Astrophysical Journal, Volume 950, Number 1 (2023), 47

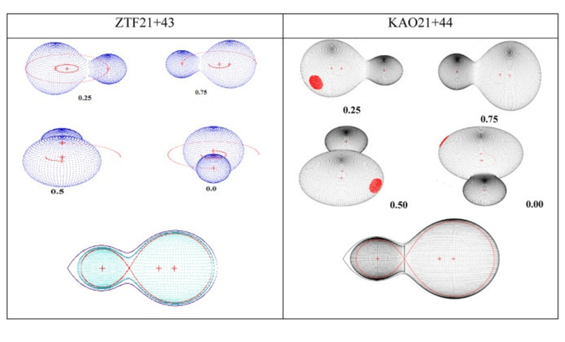


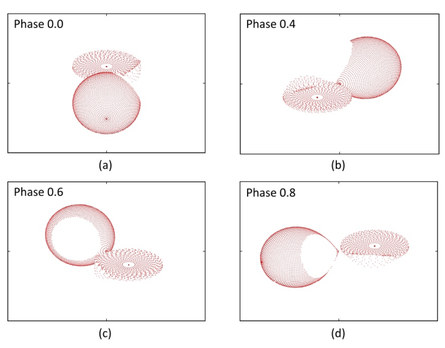
Nightfall

Nightfall is an astronomy application for fun, education, and science. It can produce animated views of eclipsing binary stars, calculate synthetic lightcurves and radial velocity curves, and eventually determine the best-fit model for a given set of observational data of an eclipsing binary star system. It is, however, not able to fry your breakfast egg on your harddisk. Nightfall comes with a user guide, and a set of observational data for several eclipsing binary star systems. New: It is possible now to load filter definitions (limb darkening coefficients, model atmosphere fluxes) for arbitrary filters from user supplied files.

Interface







Model the Light Curves:

By inputting parameters like the stars' radii, temperatures, and orbital details, users can generate theoretical light curves. This helps in understanding what might be observed.

Fit Models to Observational Data:

If astronomers have observational data from a particular eclipsing binary, they can use Nightfall to adjust the model parameters until the theoretical light curve matches the observed one. This process, known as light curve fitting, allows astronomers to derive accurate stellar parameters.

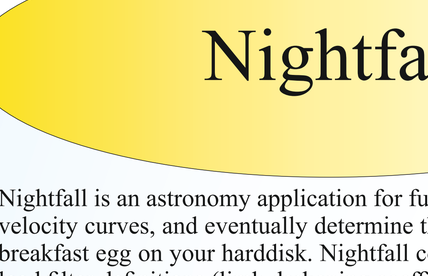
Visualize the Binary System:

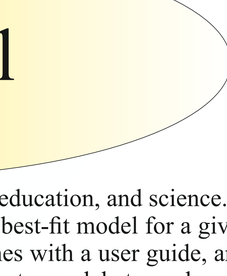
Nightfall provides visual animations of the binary star system, helping users conceptualize the spatial and orbital characteristics of the system.

PHOEBE

Phoebe is an open-source software package designed for modeling the light curves, radial velocity curves, and other observables of eclipsing binary star systems. It uses advanced techniques to allow for a detailed representation of the stars, including effects like limb darkening, reflection, and even potential distortions in the shape of the stars due to their close proximity to each other.

Statistics of PHOEBE research from 2000 to 2023





source: **SAO/NASA Astrophysics Data System (ADS)**

Interface

A new look at the YY CrB binary system
Somayeh Soomandar, Atila Poro
New Astronomy, Volume 105, article id. 102112

First Light Curve Study of the Low Mass Contact Binary V0610 Vir
Ailar Alizadehsabegh, František Lomoz, Atila Poro, Ata Narimani

HOW TO INSTALL?