International meeting on variable stars research

KOLOS 2015

Astronomical Observatory and Planetarium on Kolonica Saddle

Hotel Armales, Stakčín, Slovakia

Book of abstracts

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Session I. Astrocomplex on Kolonica Saddle, results of observations in 2015. Papers based on data collected at AO Kolonica Saddle

Kudzej, I.

Vihorlat Observatory, Humenné, Slovakia

From Kolos to Kolos

Dubovský, P. A.

Vihorlat Observatory, Humenné, Slovakia

Annual Report on Observational results of AO at Kolonica Saddle

Introductory presentation about observing program at Astronomical Observatory at Kolonica Saddle. Short overview of main observing campaigns during last year, most important results, interesting light curves, new publications based on observations at AO Kolonica Saddle.

Parimucha, Š.

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KoRoT - Kolonica Robotic Telescope

Session II. Variable stars research

Kosturkiewicz, E.

OA UAM Poznan, Poland

Spectroscopy of binary stars - first results and plans

Dimitrov, W.

Adam Mickiewicz University, Poznań, Poland

Spectroscopy of multiple stars with eclipsing component

Usenko, I.

Astronomical Observatory, Odessa National University, Ukraine

Spectral display of envelopes presence for Cepheids and non-variable yellow supergiants

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Spectroscopic view on the outburst activity of the symbiotic binary AG Draconis

Variations of the emission lines in the spectrum of the yellow symbiotic star AG Dra over about 14 years (1997–2011) have been studied, using more than 500 spectra obtained on the 1.5-metre telescope at Tartu Observatory, Estonia. The time interval covered includes the major (cool) outburst of AG Dra that started in 2006. Main findings can be summarized as follows: (i) cool and hot outbursts of AG Dra can be distinguished from the variations of optical emission lines; (ii) the Raman scattered emission line of O VI at λ 6825 almost disappeared during the cool outburst; (iii) lower excitation emission lines did not change significantly during the cool outburst, but they vary in hot outbursts and follow also orbital motion; (iv) similarity of variations in AG Dra and the prototypical symbiotic star Z And allows to suggest that a "combination nova" model proposed for the latter might also be responsible for the outburst behavior of AG Dra.

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Correlation analysis of photometric and spectroscopic data of symbiotic systems AG Dra and Z And

Symbiotic system AG Draconis is one of the best studied systems of its type. We performed a correlation analysis of photometric (UBV light curves) and spectroscopic (the equivalent widths, absolute fluxes and radial velocities of selected spectral emission lines) data of AG Dra. Similarities and differences of long-term behavior are discussed, as well as the probable presence of several mechanisms controlling outbursts of the system. We also present some consequences of level of correlation of data sets for principal component analysis (PCA). The results of cross-correlation analysis of data of AG Dra and prototypical symbiotic star Z Andromedae are also shown, our analysis showed the strong similarity of

photometric and spectroscopic behavior of these systems. This allows to suggest that a "combination nova" model proposed for Z And might also be responsible for the outburst behavior of AG Dra.

Zola, S.

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Finite exposure time effect in light curves of eclipsing binaries observed in LC Kepler mode

The Kepler mission Observations taken in the long cadence mode have a time resolution of about 30 minutes. We investigate how the long cadence binning influences the shape of eclipsing binaries light curves. A simulated light curve of contact binary exhibiting a flat bottom secondary minimum was applied for this purpose. We found the binning to cause a change in the variation amplitude and the shape of the minima. We modeled the simulated light curves corresponding to periods between 0.2 to 2 days with a code that does not account for binning and derived the parameters. By comparing them with the input ones, it turned out that only when the binary period is longer than about 1.4 days, the solutions derived with such a code would be accurate. Rigorous modeling of systems with shorter periods requires usage of codes which do account for phase smearing due to long exposure times.

Stachowski, G.

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Updates on BRITE ground-based support and other variable star observations at Mt. Suhora

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Period analysis of pulsating components in eclipsing binaries from Kepler database

We have analysed selected eclipsing binaries from Kepler Eclipsing Binary Catalog with suspected δ Scuti components. We used PHOEBE package to obtain basic parameters of binary systems and we have conducted period analysis of the pulsations followed by residual curve decomposition to primary and secondary components of the residual curve.

Gajdoš, P.

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Reanalysis of parameters of Kepler's exoplanets

We have verified parameters of Kepler's exoplanets published in exoplanet's database. We have found that parameters of many of analyzed planets are incorrect. We discuss possible causes of these discrepancies.

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Trend filtering algorithms

Ground-based observations of stars are affected by many systematic effects. These effects lower precision of photometric data enough to blur any low-amplitude variability of flux. Some of these effects are usually filtered by using differential photometry. However, systematic effects can be also dealt with by using correct filtering algorithms. By using such algorithms on data before applying methods of differential photometry can lead to achieving greater precision. We studied basic approaches to designing and applications of trend filtering algorithms in hope of achieving KEPLER-like precision in data gathered by ground-based observations.

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AO Serpentis - An unsolved mystery

AO Ser is an eclipsing binary of the Algol type. We have confirmed and investigated the recently-discovered pulsations. By modeling the light-curve obtained in five colours, we determined fundamental parameters of the binary components, their masses and the distance to AOSer. Our mass-ratio of the components is not consistent with previous estimates. We lso discuss the presence of the suspected third component.

Marsakova, V. I.

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Changes of light curve parameters of LPVs and classification of Miras and semiregular variables

The review of secular variations of light curve parameters such as period, amplitude, mean brightness of Mira-type and some semiregular variables is made as the result of our researches. The observations from AAVSO, AFOEV and VSOLJ databases were used for determination of these parameters in each pulsating cycle.

Several types of period variations for Mira-type variables were separated:

- progressive (continuous changes of the same sign),
- smooth cyclic at timescale approximately 17000–22000 days,
- switching of similar values of the period with saw-tooth O-C curves,
- small irregular period variations,
- effects of multiperiodicity.

The changes of other light curve parameters in each case are discussed.

We also proposed the methods for classification of Mira-type and some semiregular variables. These methods are based on the diagrams obtained by using the determination of the individual cycles parameters over a long period of time. Some multiperiodic variables can be classified as ones belonging to a transient type.

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Period changes of β Lyrae eclipsing-variables

The photometric data from AAVSO [1] and NSVS [2] databases and our own observations of the sample of Beta Lyrae eclipsing variables were used for building of light curves, determination and correction of periods. New moments of minima were determined and used for O-C analysis together with the data from BRNO [2] database of minima. Period changes were detected and classified. The mass transfer rates were obtained in the case of parabolic O-C changes. The model of the third body was suggested to

explain the periodic changes of the periods and the minimal masses of the third component as well as dependencies of these masses on orbital inclination were obtained.

1. AAVSO, http://www.aavso.org/

2. NSVS, http://skydot.lanl.gov/nsvs/nsvs.php)

3. BRNO, http://var.astro.cz/ocgate/

<u>Session III</u>. Other astrophysical areas, cosmology, nuclear physics, geophysics ...

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Dynamics of binary and triple asteroids

We studied the gravitational perturbations of the asteroids satellites orbits from the Sun, major planets, planetary satellites, central asteroids of asteroid systems, taking into account non-sphericity of the gravitational field. Also we studied orbits perturbation of asteroids satellites from the sunlight pressure.

Dynamics of considered systems we were investigated by numerical integration of the equations of motion by 15th order Everhart's integrator. The initial position vectors of the planets, asteroids and their satellites taken from numerical theory DE431.

As a result of our work, are obtained disturbances in the Kepler orbit of selected asteroids satellites depending on the time. Also we obtained conditions of disintegration of all currently known double and triple asteroid systems as a result of tidal perturbations of the major planets. Orbital, spin-orbital and spin-spin resonances for all known multiple asteroids systems were investigated. The dynamics and sustainability of the only known asteroid system with rings were considered.

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Visible properties of cosmic anti-string

We compare properties gravitational lensing infinite cosmic strings with positive and negative density of energy. It has been shown that strings with negative density of energy have features of the gravitational lensing. In particular it is shown that in the area where is a double images of a source from the string, from the anti-string the source image is absent. In other areas of the image from the string and the anti-string are shifted in the opposite sides. Also the effect microlensing is studied and various brightness curves are under construction. In case the diameter of a source is less than a "cut angle" by the anti-string the brightness curve decreases to zero. If one more, reduction of magnification factor occurs to some value. Effects strong and microlensing show that the basic feature gravitational lensing on the cosmic anti-string is reduction of intensity of a source.

In the final part the effect of weak gravitational lensing on the cosmic anti-string is considered. However in this case depending on parameters of model the anti-string can as to increase density of images near the anti-string and reduce, and at special selection of parameters of system the images shift in such a manner that their density does not change.

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Capabilities of the Space Situation Monitoring and Analysis System (SSMAS) of Ukraine to deal with space debris

There is the Space Situation Monitoring and Analysis System (SSMAS) in Ukraine which is being developed nowadays. The SSMAS can deal with space debris in LEO, MEO, HEO and GEO by providing end customers with data.

The SSMAS conducts prediction of close fly-bys (conjunctions) and warning about uncontrolled reentry of space objects. It will allow to avert disastrous effects.

The SSMAS conducts monitoring of space objects in GEO, discovers, determines and tracks them at geostationary arc which is visible from Ukraine (20º W - 70º E.). Besides, the SSMAS tracks them to maintain the zone catalogue.

Because of an ever-increasing amount of uncontrolled space objects, it is impossible to track continuously all space debris fragments. Therefore, the using of the Ukrainian SSMAS is a very important contribution to the common system of outer space surveillance.

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EDMOND - European database of videometeor orbits and spectra

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CoLiTec: research and development

Software for automated frames processing of asteroid surveys given as series of frames are necessary for the most effective astronomical observations.

This possibility is provided by the CoLiTec software that allows not only to detect asteroids, but also to perform astrometric and photometric measurements in real time with the visual confirmation of processing results, http://www.neoastrosoft.com.

Full reliability of the detection of moving objects is retained up to the lower limit of SNR equal to 3 units in case of a minimum series consisting of four frames, with no stars covering of asteroid.

CoLiTec has abilities for detecting very slow and very fast objects. Range of visible velocities of detected asteroids is from 0.7 to 40.0 pix./frame. For example, the fasters NEO is K12C29D asteroid (40.0 pix./frame) or the slowest object is ISON C/2012 S1 comet (0.8 pix./frame).

Some CoLiTec features are: automatic detection of faint moving objects (SNR> 2.5); working with very wide field of view (up to 10 degrees); auto calibration and cosmetic correction; fully automatic robust algorithm of astrometric and photometric reduction; automatic rejection of objects with poor observations; multi-threaded support for multi-cores systems and local network; processing pipeline managed by OLDAS (OnLine Data Analysis System).

CoLiTec software equipped with the modern viewer of obtained results with a user-friendly GUI. LookSky runs independently of the main program and it can be used for independent review of CoLiTec processing results when the main program is processing data. A mobile version of the viewer is also available. CoLiTec processing results can be monitored from anywhere in the world.

CoLiTec has assisted in making over 1,500 preliminary discoveries of asteroids, including 4 NEO, 21 Trojan asteroids of Jupiter and 1 Centaur. It has been used in about 600 000 observations, during which four comets (C/2010 X1 (Elenin), P/2011 NO1 (Elenin), C/2012 S1 (ISON), P/2013 V3 (Nevski)) were discovered.

By the overall results of 2011 and 2012, observatory ISON-NM, equipped with a 45-cm telescope and CoLiTec software, ranked 7th worldwide in both number of observations of asteroids and the number of their preliminary discoveries.

Pipeline for digital video processing was developed by CoLiTec Team. It is presented as a flexible platform for receiving, processing video with in any resolution, as well as easy integration of different modules required to improve image quality, delineation and recognition of moving objects in the video series.

The communication describes the new principles, cross-platform technologies that have been integrated since the last conference during creation of the new version of CoLiTec software. Also it describes improved quality control of the performed processing that has been revised.

Considerable attention was given for the astrometry and photometry improving with help of reserves for increasing measurement accuracy at the last year. Also possibility of individual binding astrometry and photometry reduction to telescopes for increasing observations accuracy was provided.

The comparative analysis of the accuracy was performed between the CoLiTec and Astrometrica software. The analysis showed the benefits of the CoLiTec software using with astrometry and photometry of asteroids in relation with Astrometrica using, especially when using wide field and low quality frames.

We are going to pay considerable attention for development of computational methods for research of parameters of intraframe and interframe processing. It will be necessary to increase measurements accuracy and sensitivity of already developed and implemented processing algorithms in CoLiTec software.

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Methods for identification of the digital frames and selection of reference stars on them

Requirements for accuracy of astronomical observations continue to rise. Coordinates determination of celestial objects is performed by relative method with using of reference stars. Method of the reference stars selection and methods for determining the position of objects on digital frames determine the accuracy of astronomical observations of stars.

The sets of frame measurements and stars catalog should be prepared to form the set of reference stars, that are corresponded to the investigated region of the celestial sphere. Pairs of these sets are identified by using of the following identification method:

- Common task of the identification the measurements of the frame and stars in the catalog is divided into the private ones;

- Preliminary selection of hypotheses of identification the measurements of frame and stars in the catalog is performed;

- Intragroup identification is reduces to the assignment problem that can be solved by the Hungarian method.

The purpose of the method of the reference stars selection is described below. Constants plates are formed on the base of the identification pairs of frame and catalog star measurements. They link coordinates of stars measurements in the coordinate system of the CCD frame and equatorial coordinate system. The rejection of a significant number of the identified pairs is performed after solving the problem of identification. This action is necessary to improve the accuracy parameters of estimates of the constants plates. Decisive statistic for the pairs rejection is the summary deviation between the estimates of the equatorial coordinates of identified "measurement-star" pair.

Also the estimation method of the accuracy parameters of estimates of reference stars coordinates on the digital frame was developed. The obtained results confirm efficiency and reliability of the developed method. The indirect confirmation of the efficiency of developed method of the digital frames identification and reference stars selection on them is a high accuracy parameters of the positional measurements of asteroids performed with the involvement of this method.

The computational method of the reference stars selection is used in the CoLiTec software for automated asteroids and comets discoveries on the series of CCD frames. Also the method of the reference stars selection provides high parameters of accuracy, as evidenced by results of the CoLiTec software.

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Development of software for publishing and data searching for virtual observatories

IVOA is an international alliance of national observatories. IVOA includes nineteen national and international projects of virtual observatory. The main purpose of IVOA is to cooperate archives of ground and space instruments. It will provide comfortable access to them for scientists, as well as providing astronomers with powerful researching mechanisms of observational data. The general tools for accessing information in IVOA are applications and services such as Astrogrid, Aladin, Topcat, SkyView. These tools allow users to work with surveys, directories and archives. Access to them will be provided according to IVOA standards.

UrkVO -Ukrainian Virtual Observatory - was created five years ago as a part of the national project.

CoLiTec Team created software for storage and publication of CCD-frames. Software allows you to archive and search frames by specified parameters (coordinates). External access to the storage is provided of its own web interface and can be accessed through Aladin. Software was implemented with using of VO technologies, including SIAP access protocol. It allows you to receive additional frames from external resources such as the SDSS and 2MASS. Currently, ISON-NM observatory is its main user and stores in open access on RINANU cluster about 50 000 frames taken from 2010.

In the collaboration with Vihorlatskiy observatory automatic frames loader was created. It's process consists of several stages. On the first step user loads the raw frames to the server via the web interface. These raw frames will be moderated before its processing. At this stage faulty and unsupported frames will be rejected. OLDAS system processes frames as soon as they will be downloaded successfully. This technique allows to greatly speed up processing and provides user immediate notification of emerging issues. Processed data will be stored in the database and can be published through SIAP protocol.

Further development of CoLiTec project as part of virtual observatory is focused on creation of the unique storage for light curves of variable stars and series of frames on which they were received.

According to IVOA recommendations for photometric data storage the existing software for the frames storage will be extended with light curves via cross-references. This allows user to receive all relevant information such as required frames, light curves or brightness measurements.

Integration with existing formats of photometric data representing is leading to create new solution that would allow to collect new formats from existing ones. This solution will provide flexibility and ability to convert values and it is based on subject mediators that will solve all of these challenges.

Access to obtained results will be provided via web interface and international catalogs of variable stars, such as Vizier, AAVSO, VSX and others.

Also the system of full photometry (objects brightness measurements on all frames) will be developed. Raw data for this system could be stored on our or another specified resources. This will solve new astronomical problems, find objects with properties that have not previously studied and make a lot of new discoveries.

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The computational method for brightness alignment of digital images

The purpose of this work is the alignment of the interference substrate on the large CCD frames without using of service (Master) frames (dark current frames – dark, noise reading frames – bias, «flat field» frames – flat). Some cases when it is impossible to get Master-frames or calibration of received image don't lead to the desired result, for example, in the presence of ambient light.

The images of celestial objects (stars and asteroids) on a separate frame are point, and with the atmosphere turbulence, can be presented as «blurred points». This background unevenness is presented as slowly varying brightness changes. Therefore, it seems appropriate to consider the frames processing in the frequency range, where the stars and asteroids are formed by high-frequency spectral components of the image and the background is the low-frequency components. In this case, in order to remove low-frequency background variations and to leave the unchanged high-frequency components of the image, it is necessary to perform high-pass filtering for the image.

Median filtering is a method for nonlinear image processing. It is effective if the pulsed noise is the limited set of peak values against of zeros. The median filter is implemented as a local processing procedure by sliding window with specified sizes that includes an odd number of image counts. The processing procedure consists of the readings which trapped in each position of the window, ordered by ascending values. The average count in the ordered list is called the median of this group. This median replaces the central count in window for the processed image. Thus a median filter suppresses the pulsed emission of the original image, if the area of the pulse signal is less than half of the filter's aperture area. Therefore, the frame can be obtained with only large structural components of the background after the frame filtering with median filter of appropriate size. Background unevenness will be compensated during subtracting it from the original frame.

Results of median and frequency filtering are comparable. They change the medium and standard deviation of the histogram of the frame background. Also these filters increase twice signal and noise ratio (SNR) of objects images, including dim. The examples of aligned images are provided.

Verbytskyy, S., Verbytskyy, A.

Production of equipment for observatories in Ukraine

The research of celestial objects continue to be relevant. Today observations of celestial objects is performed with help of telescopes equipped with special astronomical CCD cameras. Choice of instrument (telescope, mount, a CCD camera) and monitoring of its compliance with the modern needs are important for astronomical research.

The development, research and manufacture of telescopes and its mounts are established in Ternopil. The produced systems satisfy all modern requirements for the focus and guidance accuracy and fully automated.

Manufacturing is possible for the following tools with aperture from 200 to 600 mm, aperture ratio from 1:1 to 1:10, systems of Ritchey-Chretien, Hamilton, Newton, Zonnefeld etc. Installation of azimuthal and equatorial types with capacity from 50 to 500 kg, forklifts, half forklifts, germane and others. It is also possible the modernization and automation of existing astronomical systems including manufacturing worm pairs, the installation of automatic guidance system and its support, as well as various optical correctors for the optimization of the telescope according to the specific tasks. In addition, we are able to make automated astronomical dome with a diameter from 3 to 10 meters, with high immunity to atmospheric and climatic factors.

Session IV. Astrotourism and astronomical education in Carpathian region

Bury, R.,

, Poland

New projects for astrotourism in Carpathian region

Ďuriš, P.,

Dark Sky in Carpathian Mountain

P o s t e r   s e s s i o n :

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On the representation of magnetized gas structures during a mass transfer in Beta Lyrae system

Our spectral observations of the well-known massive close binary system β Lyrae were conducted on powerful telescopes such as 2.6-m and 6-m. Besides the other important scientific achievements in the context of this report should be highlighted the discovery and investigation of the magnetic field and also the study of the dynamics and structure of the accretion disk. Practically these data are not used in the publications of methodologically different studies β Lyrae that leads to inadequate interpretation of their results.

From this standpoint, it is interesting the statement of the significant contribution of the accretion disk radiation in the light curve of the system and the detection of hot regions on the disk rim during simulation of the light curve in a recent publication [1]. Two hot regions are located in the phases 0.80P and 0.40P covering respectively 30% and 10% of the disk rim with the temperatures that are 10% and 20% higher than the average on this disc. It was suggested that these shock regions could be formed by the collision of gas flows with disk in the process of mass transfer between components although proper argumentation was not provided.

This prompted us to contribute to interpretation of this and other facts from the standpoint of our research on the structure of magnetic field and accretion disc [2]. We have analyzed the data of absolute spectrophotometry, curves change of magnetic field, radial velocities and intensities of spectral lines with the orbital phases. The hot region on the rim disk in the phase 0.40P is explained naturally by the Coriolis force deflection of the main gas flow that is directed from a donor through a Lagrange point to the accretor's Roche lobe and with a further collision of this flow with the disk. By the way, it was shown with the help of absolute spectrophotometry β Lyrae [3]. However, this classical hydrodynamic explanation can not be suitable to a wide hot region of the disk rim that is observed at the phase 0.80P. The nature of this hot region on the accretion disk should have an entirely different interpretation.

The donor's magnetic field should be taken into account because at phases of about 0.80P its dipole axis is actually directed to an observer and the magnetic field lines are deflected towards disk of the accretor (see Fig. 1). The donor's magnetic field varies with the orbital phase approximately within 1kGs [4, 5]. The simulation showed that the configuration of the magnetic field of the donor is characterized by the fact that the axis of the dipole magnetic field is directed along the orbital phases 0.35-0.85P and is inclined at an angle of about 30 degrees to the orbital plane; and the center of the magnetic dipole is shifted from the gravity center of the donor towards the massive accretor to a distance 0.08 between the donor center and the center of mass of the binary system [4]. Thus, mass transfer reflecting the structure of the magnetic field of the donor must be more effective in the second quadrature, especially at the phases 0.85P when the pole of magnetic field on the surface of the donor is disposed significantly closer to the accretor. There are ample evidence that to have an understanding of this phenomenon as of the phenomenon of mass transfer, the formation of circumstellar gas structures and their dynamics and energetics that are regulated by magnetic field of the donor [2].

These features of the structure of the donor's magnetic field to make possible the process of mass transfer of the magnetized material in the second quadrature phases simultaneously with the mass transfer in phases of the first quadrature, where it is caused by mainly standard hydrodynamic picture. Well coordinated action forces involved in these processes creates original fan-shaped painting of mass transfer which wraps the accretor in both quadratures (see Fig. 1). Gas flows are directed towards the accretor and collides with the external edges of the half-arc of the rotating accretion disk which is inverted to the donor. Such accelerated flows of gas can warm this disk.

In particular, the wide hot region on the disk that is located in the phases near 0.80P could be formed by the collision with this disk of magnetized gas which is canalized by the donor magnetic field that is oriented in space in a certain way. The energetic effect based on the collision of gas with the disk is significantly strengthened by the counter rotation of the disk's outer edges towards the falling gas flows.

Therefore, mass transfer and circumstellar gas structures reflecting the structure of the donor's magnetic field are more effective in phases of 0.85P. The structure of the donor's magnetic field also is important in heating of the hotter region on the disk rim at phases of 0.40P. The specific configuration of the magnetic field of the donor explains why at rotation of the donor and the accretor around their common center of masses these hotter regions dominate on the accretion disk on the observer's eyesight line. As a result of the high-energy collisions of ionized plasma, which is canalized by donor's magnetic field, with the accretion disk is generated a scattering gas shell that partially masks the stars-components beyond the Lyman limit and entirely in the soft X-ray region [6, 7].

By the way, a solution to the problem of the real existence and the physical nature of so-called jet-like structures in the Beta Lyrae system can be found in the interaction of magnetic fields that are generated on the donor and on the accretor with its disk.
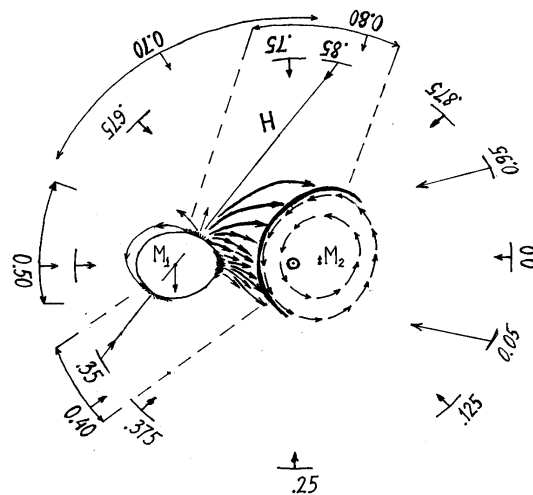

Fig. 1 Schematic model of the interacting binary system β Lyrae (view from above of the orbit plane): the bright B8III donor with mass of $M_1 = 2.9\ M\odot$ and accretor with mass of $M_2 = 13M_\odot$, that is wrapped by thick disk with pseudoatmosphere of A5III type. For the mass ratio of 0.223 the distance between the centers of the two components is $A = 58R_\odot$. With the observer's eyesight towards the center component are defined scopes of hot regions on disk in phases 0.40P and 0.80P (according to [1]) and other directions observation (0.0P phase corresponds to the center of the main eclipse in the binary system). The mass transfer from the donor up to the accretor (so-called fan structure of gas streams is designated by curved arrows) occurs both in the direction between gravitational centers of the two components along of the orbital phases 0.5-0.0P and in the direction of the magnetic field axis "H" along of the phases 0.35-0.85P. This leads to shock collisions and the appearance of "hot half-arc" on the accretion disk edge (thick line). The orbital phases 0.05P and 0.95P optimal projections of the disk edges (so-called satellite-disk) on donor are marked. In these phases in the spectrum of the system is clearly visible so-called satellite-lines with radial velocities of opposite signs (up to 250-270 km/s), reflecting the rotational effect of the disk. The satellite-disk size is marked by two rows of rounded arrows and the small circle within this satellite-disk is showing the center of mass of the binary system.

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On the spatial structure and the wave resonances in the Solar planetary system

The spatial organization of the Solar planetary system can be described by two interrelated kinematic algorithms of the single wave mechanism that is similar to the phenomenon of standing waves with length $\lambda/2$ (here: $\lambda = cP = 19.24$ AU, c is the speed of light and $P = 160$ min is a period of global oscillations of the Sun). The ordering for outer planets and dwarf planets can be represented in such wave form $a = n\lambda/2$ or $a = (2n+1)\lambda/4$ (where a is a semi-major axis and n is a whole number). In this manner their distances from the Sun are proportional to a quarter of the wavelength or else to a half of the wavelength (Jupiter - $\lambda/4$, Saturn - $\lambda/2$, Uranium - $2\lambda/2$, Neptune - $3\lambda/2$, Pluto - $4\lambda/2$, Eris - $7\lambda/2$). This algorithm also satisfies the conditions of the location of the most major transneptunian objects including comet families. The principle of the orbit ordering for inner planets can be expressed as $2\pi a = m\lambda'$ with the step $\lambda' = (1/12)\lambda/2$ and $m = $ 3, 6, 8, 12 for orbit lengths from Mercury to Mars that are the commensurable quantities with the length of standing wave $\lambda/2$ and its harmonics. Therefore, the spatial organization of the Solar planetary system could be formed in one physical process but in two interrelated kinematic algorithms of the one wave mechanism. These results are quite accurate and can be considered as empirical. It is important that the wave principles of structuring of the planets do not support the idea of the formation of the Solar planetary system in the form of power law including the law of Titius-Bode. Furthermore, it was revealed an explicit and unusual resonance of proper oscillations of the Sun and planets. Their global periods are virtually multiples to $kP/2$, where $k = $ 1, 2, 3. Since $\lambda = cP_0$, this result makes obvious signs of a quantization of the gravitational interaction of the Sun as a star and planets and confirms the length of the standing wave $\lambda_{sw} = \lambda/2$ as a factor in the structuring of planets in the Solar system. Wave and gravitational resonances put questions about their origin in the Solar system. Such interconnected findings should be considered as essential on the background of the current knowledge about the laws of structuring planets in the Solar and exoplanet systems.

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Photometry of asteroids and variable stars in Derenovka

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Spectroscopic view on the outburst activity of the symbiotic binary AG Draconis

Variations of the emission lines in the spectrum of the yellow symbiotic star AG Dra over about 14 years (1997–2011) have been studied, using more than 500 spectra obtained on the 1.5-metre telescope at Tartu Observatory, Estonia. The time interval covered includes the major (cool) outburst of AG Dra that started in 2006. Main findings can be summarized as follows: (i) cool and hot outbursts of AG Dra can be distinguished from the variations of optical emission lines; (ii) the Raman scattered emission line of O VI at λ 6825 almost disappeared during the cool outburst; (iii) lower excitation emission lines did not change significantly during the cool outburst, but they vary in hot outbursts and follow also orbital motion; (iv) similarity of variations in AG Dra and the prototypical symbiotic star Z And allows to suggest that a "combination nova" model proposed for the latter might also be responsible for the outburst behavior of AG Dra.

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On the origin of the Raman scattered O VI 1032 line during outbursts and quiescent phases of the symbiotic binary AG Draconis

Symbiotic binary AG Dra consists of a yellow giant and a white dwarf on a 550-day orbit. The hot accreting white dwarf ionizes a significant fraction of the wind from the giant. Such the binary environment, comprising energetic photons from the hot star and neutral particles from the cool giant, represents an ideal medium for scattering processes.

In our contribution we investigate the effect of Raman scattering of the O VI 1032A line photons on neutral atoms of hydrogen in the symbiotic binary AG Dra.

We found that the profile of the Raman scattered O VI 6825A line can be fitted with two Gaussian functions. Accordingly, we investigated the behaviour of their parameters (the position, maximum flux, FWHM and the corresponding total flux) as a function of the orbital phase and the level of the activity. Differences of some parameters as measured during quiescent and active phase suggest a significant variation of the ionization structure of the binary during different levels of its activity.

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Low mass ratio contact binaries with large, circumpolar spots: case of MT Boo and V2366 Cyg