

Astronomical Institute of the Slovak Academy of Sciences

Slovak Astronomical Society

Hlohovec Observatory

Recent achievements of stellar astronomy



2007

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Invited talks and review papers:

Structure and Evolution of Cataclysmic Variable Stars

I.L.Andronov

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Accretion structures in cataclysmic variable stars are strongly dependent on the magnetic field of the white dwarf. These structures may be separated into few zones. The first zone is the transition zone between the Roche lobes of the white and red dwarfs. The accretion rate may be affected by the irradiation of the atmosphere and stellar spots near the inner Lagrangian point, minor variations of the orbital separation due to the presence of a third body and on the orientation of the magnetic field. The second zone is usually a ballistic part of the accretion stream, but may be an excretion outflow in the synchronizing polars, which causes the spin-orbital synchronization of the white dwarf at a time scale of 100-1000yrs with a subsequent “idling” and “swinging” of the orientation of the magnetic axis in respect to the line of centers. The third zone is a “hot spot”, a “hot line”/“spiral shock” or an “accretion curtain”. Next zone may be an accretion disk, and the last zone is an accretion column(s) or an accretion belt. According to the relative dimensions of the thread point, where the accretion stream/disk changes to a column, the cataclysmic variables are classified as “classical” (AM Her), “asynchronous” (BY Cam), “intermediate” (DQ Her) polars, dwarf Novae and Nova-like stars. These objects exhibit 92 types (for all sub-classes) variability from seconds to billion years, which are reviewed in this work. Some of these processes are studied in a frame of the “Inter-Longitude Astronomy” (ILA) project of monitoring, with 4 main sub-projects “Polar” (Gravimagnetic rotators), “Superhumper” (dwarf Novae and Nova-like binaries), “Stellar Bell” (Long-Period Variables) and “New variables”. The current main directions of the “Polar” part are: optical photopolarimetric monitoring of the classical (AM Her, QQ Vul), asynchronous (BY Cam, V1432 Aql) and intermediate (MU Cam, BG CMi, FO Aqr, AO Psc, V405 Aur, PQ Gem, RXJ 0630, RXJ 0740, RXJ 1803, RXJ2133) polars. The work is dedicated to Prof. Vladimir Platonovich Tsessevich (1907-1983).

Fast variability of cataclysmic binary stars

S.V.Kolesnikov, I.L.Andronov, N.M.Shakhovskoy

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Odessa National Maritime University, 65029 Odessa, Ukraine
Crimean Astrophysical Observatory, P/O Nauchny, 334413 Crimea, Ukraine

The emission of cataclysmic variables may be attributed to the three sources of emission: the red dwarf, the white dwarf and of the accretion structure. The photopolarimetric monitoring of the key objects has been carried out at the 2.6m (1-4 sec, wide R filter) and 1.25m (10-24 sec, simultaneous UBVR) telescopes of the Crimean Astrophysical Observatory since 1989. Some of the highlights are: the unprecedented UV Cet-type flare of AM Herculis; detection of polarization in HQ Aqr and V405 Aqr; dependence of the characteristics of variability of AM Her on wavelength with luminosity; detection of the shot noise in MV Lyr; detection of the two-component shot noise in AM Her which is interpreted by a fragmentation of the plasma blobs "spaghetti" in the magnetic field; a survey of the scalegrams and wavelet maps for more than a dozen cataclysmic variables at different stages of influence of the magnetic field onto accretion. The statistical method of determination of the effective colors and other characteristics of four components (mean, orbital/superhump, spin/flickering, observational noise) has been elaborated and applied to TT Ari, AM Her and other magnetic and non-magnetic variables. This method has been extended using the Principal Component Analysis (PCA) of the original/detrended multi-channel (UBVR) signals. The number of statistically significant principal components corresponds to a number of sources of variable emission with different spectral energy distributions and is different in different objects studied.

Gravitational excitation of oscillations in accretion discs around neutron stars

Stanislav Hledík, Zdeněk Stuchlík, Sushan Konar and John C. Miller

Silesian University in Opava, The Czech Republic

Abstract

High-frequency QPOs in neutron-star binary systems could be explained by models based on parametric or forced resonance between oscillation modes of the accretion disc around the neutron star and the relative rotational motion between the disc material and either the neutron star or the binary companion. Using Newtonian paradigm, the possibility of forced resonant phenomena being excited by means of gravitational perturbations coming from surface features on the neutron star and from the companion star is discussed in cases of two neutron-star surface features: an isolated crystalline "mountain" on the neutron-star surface, and symmetric magnetically-constrained accretion columns above the magnetic poles. We discuss the conditions under which either the surface features or the binary companion would be more relevant as an excitation mechanism.

The first photometric analysis of the short-period Algol DI Hydrae

V.N. Manimanis and P.G. Niarchos

Department of Astrophysics, Astronomy and Mechanics,
National and Kapodistrian University of Athens, Greece

Abstract

The first complete CCD light curves of the eclipsing binary system DI Hydrae with an A6 primary have been obtained in the B, V, R and I filters during four nights in January 2006 with the 1-meter Elizabeth telescope at the Sutherland site of the South African Astronomical Observatory, in South Africa. The light curves are analyzed with the W-D program in order to determine the geometrical and physical parameters of the system. The parameters are used to compute the absolute elements of the system.

Eclipsing Binary stars studies: present and future

P.G. Niarchos

Department of Astrophysics, Astronomy and Mechanics,
National and Kapodistrian University of Athens, Greece

Abstract

The importance of EBs studies in better understanding of stellar structure and evolution is underlined and the current methods of photometric and spectroscopic observations of these systems are briefly presented. Moreover, the impact of ground-based surveys and space missions on the study of EBs is also discussed.

Asynchronous polars

Elena Pavlenko

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Abstract

The magnetic cataclysmic variables (polars) are those systems where the orbital period of the white dwarf is synchronized with its spin period. However among ~70 polars known until now there is the exception of four asynchronous polars. They are V1500 Cyg, BY Cam, CD Ind and V1432 Aql. Investigation of these systems is very important because allows us to study the behavior of accretion stream in the slowly rotating magnetic field and leads to the determination of the white dwarf magnetic field configuration. The accretion geometry could vary at the definite phases of the orbital-spin beat (synodical) period, i.e, in dependence of the magnetic field orientation in respect to the accretion stream. The observational effects pointing to the change of accretion mode and accretion itself during the beat period as well as the magnetic field structure in some asynchronous polars are discussed.

Multiresonant models of QPOs in Black hole and neutron star systems

Zdeněk Stuchlík

Silesian University in Opava, The Czech Republic

Detailed study of TW Draconis

M. Zejda¹, Z. Mikulášek¹², M. Wolf³

1 Masaryk University, Brno, The Czech Republic

2 VŠB Technical University of Ostrava, The Czech Republic

3 Charles University, Prague, The Czech Republic

Abstract

Using recent spectroscopic and photometric observations we build a model of this very interesting eclipsing binary. Detailed study of the alternating changes in O-C values shows variations of orbital period of eclipsing pair as a result of mass transfer, relaxing processes maybe connected with the accretion disk for and the presence of the third body in the system.

Short talks and posters:

New variable stars in the fields of cataclysmic binaries. V1647 Aql

I.L.Andronov, L.L.Chinarova, V.Burwitz

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Max-Planck Institut fur Extraterrestische Physik, Garching, Germany

Astronomical Observatory of Mallorca, Costitx, Spain

As a by-product of the CCD photometry of cataclysmic variables, one may note a detection in the field of variable stars of other types. For discoveries, we use a method of the “artificial mean-weighted comparison star” described by Y.Kim, I.L.Andronov, Y.-B. Jeon (J. Astron. Space Sci 21(3), 191-209, 2004) and realized in the program MCV by I.L.Andronov and A.V.Baklanov (Astronomical School Reports, 5, N 1/2, 264-272, 2004). This method allows to improve accuracy of the comparison star typically by a factor of 1.3-2.4 as compared with an usual “Comparison+Check star” approach, and allows to detect/study variable stars in a field. One may note such nearby variables in

the vicinities of MU Cam, BY Cam, V884 Her, QQ Vul, EM Cyg, V603 Aql and other stars. We present results of unfiltered CCD-photometry of V1647 Aql (main target – the synchronizing polar V1432 Aql) obtained in 2005 in the Astronomical Observatory of Mallorca. The moments of minima have been determined using the method of “Asymptotic Parabolae” by V.I.Marsakova and I.L.Andronov (Odessa Astronomical Publications, 9, 128-131, 1996, <http://oap09.pochta.ru>), the orbital period and the initial epoch have been corrected.

Egyptian calendar

M. H. Bartolomejová

Slovak Astronomical Society, Tatranská Lomnica, The Slovak Republic

Abstract

The development of the Egyptian calendar is presented. The model and comparison with modern time measurement.

Observational program and the first results at the Kolonica Observatory

P. A. Dubovský

Kolonica Observatory, Humenné, The Slovak Republic

CCD Photometry Traps and Pitfalls

M. Chrastina

Masaryk University, Brno, The Czech Republic

Abstract

Photometry is one of the most important methods to investigate variable stars. The usage of CCD is increasing since the 90ties. Like other methods or detectors, if you want to achieve high precision of observation data and correctly interpret the obtained data, you must understand the CCD photometry very well. This presentation points out some chosen characteristics and not very commonly known problems attached to them.

Phase variation of some spectral characteristic of carbon Miras and LPV stars

Tomáš Gráf (1,3) and Zdeněk Mikulášek (1,2)

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- CZ-708 33 Ostrava-Poruba, The Czech Republic
2. Ústav teoretické fyziky a astrofyziky, Přírodovědecká fakulta
Masarykovy univerzity, CZ-611 37 Brno, The Czech Republic
3. Ústav fyziky, Filozoficko - přírodovědecká fakulta Slezské univerzity, Bezručovo
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Abstract

We investigate phase dependency of some spectral characteristics of 34 carbon Miras and LPVs. We introduce the quality of "pseudoequivalent width" and we assess its correlation with a classic equivalent width. A correlation between the equivalent width of the H alpha emission line and the equivalent widths of other spectral lines was discovered. The phase dependency of those qualities was also found. We discovered that the equivalent width of the H alpha emission line is phase-dependent and its changes are by one order bigger than the changes of the equivalent widths of other studied absorption lines. The investigation of the RV phase dependency of individual spectral lines led to a finding that, in contrast to other types of Miras, carbon Miras studied in this paper do not exhibit any obvious relation between the values RV of individual components of emission lines and photometric phase. Thus it is not possible to interpret the complicated profile of emission lines as a sum of two or three emission lines with a gaussian profile which are generated in the environments with different velocities, as was done by Woodsworth (1995) for classic Miras.

Southern America from A to U

L. Hric and M. H. Bartolomejová

Astronomical Institute, Tatranská Lomnica, The Slovak Republic
Slovak Astronomical Society, Tatranská Lomnica, The Slovak Republic

Abstract

Expedition from A means Argentina to U means Uruguay and 7 more countries with nature. Astronomy from Incas to nowadays planetaria.

RS Oph - photometric study one year after the outburst

L. Hric, E. Kundra, P. G. Niarchos and V.N. Manimanis

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Department of Astrophysics, Astronomy and Mechanics,
National and Kapodistrian University of Athens, Greece

Abstract

The long-term photometric study of the recurrent nova RS Oph is presented. The basic physical characteristics have been obtained using the statistical calibrations and the light curve secured in four colours since the outburst. Moreover the flickering activity study is discussed. The monitoring of flickering activity has covered the period since the

evolution of the light curve of the RN with no flickering variability up to day with very marked flickering variations. The possible source of the flickering is discussed.

Astronomy & Astrophysics in Indonesia

B. Indradjaja

Masaryk University, Brno, The Czech Republic

Abstract

Here I presented an overview of astronomy and astrophysics in Indonesia. What might be interesting are our location, the history of our main observatory, and finally the current field of researches there. These might be a good opportunity to make some research collaborations between European countries and Indonesia, especially in astronomy.

Astronomy at Masaryk university

J. Janík.

Masaryk University, Brno, The Czech Republic

Abstract

Short talk about current situation of Astronomy and Astrophysics at Masaryk university and hot news from MonteBoo Observatory.

On-line database of photometric observation of mCP stars – long-distance race

J. Janík.

Masaryk University, Brno, The Czech Republic

Abstract

Photometric catalogue of mCP stars has new functions and more data (compared with last year). Describe of catalogue, structure and aim of our work.

Identification of X-ray sources in optical region

M. Kocka, F. Hroch

Masaryk University, Brno, The Czech Republic

Abstract

Goal of our thesis is to find optical counterparts of selected X-ray and gamma sources measured by Integral and Swift space missions. Our work also provides basic measurement of short-term variations of sources in optical band, as well as its colour curve and light curve analysis.

SIWA 2007 Split International Winter school of Astrophysics.

T. Krejčová

Masaryk University, Brno, The Czech Republic

Abstract

My experience from winter school about Extrasolar planets and Astrobiology held in February in Croatia.

Do you know B[e] stars?

B. Kučerová

Masaryk University, Brno, The Czech Republic

The classification criteria for the stars with the B[e] phenomenon and their particular classes, will be presented. These stars are characterized by strong Balmer emission lines, narrow permitted and forbidden low-excitation emission lines of Fe II, Fe [II] and O [I], and especially a strong near to mid-IR excess.

ESO at the Kolonica – East-Southern Observatory

I. Kudzej

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The Light-Time Effect in the W UMa-type eclipsing binary FZ Ori

A. Liakos and P. Niarchos

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Abstract

New times of minima of the W UMa-type eclipsing binary FZ Orionis, obtained at the Athens University Observatory, have been used together with all reliable timings found in the literature in order to study the period variation and search for the presence of a third body in the system. Its O-C diagram is presented and apparent period changes are discussed with respect to possible Light-Time Effect (LITE) in the system. New improved LITE elements, orbital periods and minimum mass of potential third body are given.

The parameter selection for LC description

Martin Navrátil

Photometric Analysis and Parameters of a Cool Eclipsing Binary System DV Psc

Š. Parimucha

University of P. J. Šafárik, Košice, The Slovak Republic

Abstract

We analyse new BVRI photometric observations of DV Psc from 2005 and 2006 seasons. We determined new ephemeris of the system as well as its photometric parameters. In combination with spectroscopic observations we calculated absolute parameters.

The analysis shows that number, dimensions and locations of spots on the surface of the components are changed with time, which has a strong influence to light curves. System is detached, which assign DV Psc among close detached binaries systems with the shortest known period.

Discovery and 1-year observations of the new WZ Sge type star, SDSS J0804 with 11 rebrightenings.

Elena Pavlenko

Crimean Astrophysical Observatory, P/O Nauchny, 334413 Crimea, Ukraine

Abstract

The cataclysmic variable SDSS J080434.20+510349.2 (SDSS J0804) was first discovered in the outburst in 2006, March 3 as the star of 13th mag. During the outburst the system exhibited four types of variability: 1) the first series of the “early” 11 rebrightenings appearing every 2.548 days immediately after the main outburst finished; 2) the second series of the “late” rebrightenings appearing every 13 – 14 days with smaller amplitude than the first series, during the slow outburst decay; 3) superhumps during the main outburst and early rebrightenings; 4) orbital period during the late outburst decay. Thejbservational peculiarities of this system are discussed. The short

superhump and orbital periods together with rare recurrent time of outbursts and large amplitudes of the outbursts suggest SDSS J0804 to belong to the rare subclass WZ Sge type systems.

Extended Source Effect and Chromaticity in Two-Point-Mass Microlensing

Ondřej Pejcha and David Heyrovský

Institute of Theoretical Physics, Faculty of Mathematics and Physics, Charles University, The Czech Republic

Orbital period determination and wavelet analysis of QR And LC

K. Petřík, V. Karlovský

University of Trnava, Trnava, The Slovak Republic
Hlohovec Observatory, The Slovak Republic

Spectroscopy and photometry of V Sge in intermediate phase

K. Petřík, T. Pribulla

University of Trnava, Trnava, The Slovak Republic
Astronomical Institute, Tatranská Lomnica, The Slovak Republic

Eclipsing binaries by INTEGRAL OMC

P. Sobotka

Astronomical Institute, Ondřejov Observatory, The Czech Republic

Abstract

INTEGRAL satellite is not devoted on observations of eclipsing binaries, but Optical monitoring camera (OMC) has detected hundreds of them. More than 200 times of minima can be determined. In some cases, continuous light curves covering several cycles were obtained.

Accretion discs around us

G. Szász

Masaryk University, Brno, The Czech Republic

Abstract

Accretion discs are ubiquitous phenomenon in astrophysics usually connected with close binaries, active galactic nuclei and planetary system evolution. In this review, I will briefly discuss basic physical characteristics of various types of accretion discs in multiple dimension scales. I will also provide short description of available models and finally, I will point out actual theoretical and observational challenges in this field.

CCD photometry and spectra of variables in Valašské Meziříčí

L. Šmelcer

Valašské Meziříčí Observatory, The Czech Republic

Abstract

The paper describes photometry monitoring results of selected variable stars - T UMi (long period variable star), YY Her (symbiotic star), eclipse variable star IU Aur, nova V 2362 Cyg and gravitational lense case observation in Milky Way at GSC 3656 1328 star.

Stars occultations by the asteroids

L. Šmelcer

Valašské Meziříčí Observatory, The Czech Republic

Abstract

The paper describes additional observation program for variable star observers. We present process and result of two stars occultations by the asteroids observations (144 Vibia and 409 Aspasia) during 2006.

The chemistry of interstellar space

M. Uhlár

Silesian University in Opava, The Czech Republic

Abstract

Interstellar space is not empty, but contains gaseous and particulate mater that is concentrated into very large regions known as interstellar clouds. In the denser and cooler clouds, the gas is molecular and most of the molecules detected are organic in nature. Molecules play a fundamental role in interstellar clouds. The science where chemistry and astronomy overlap is known as astrochemistry.

Mt. John Observatory, New Zealand

M. Zejda

Masaryk University, Brno, The Czech Republic

Description of our short stay at Mt. John Observatory. Very preliminary results and pictures of a fascinating New Zealand countryside are presented.