OPEN EUROPEAN JOURNAL ON VARIABLE STARS
November 2007 http://var.astro.cz/oejv ISSN 1801-5964

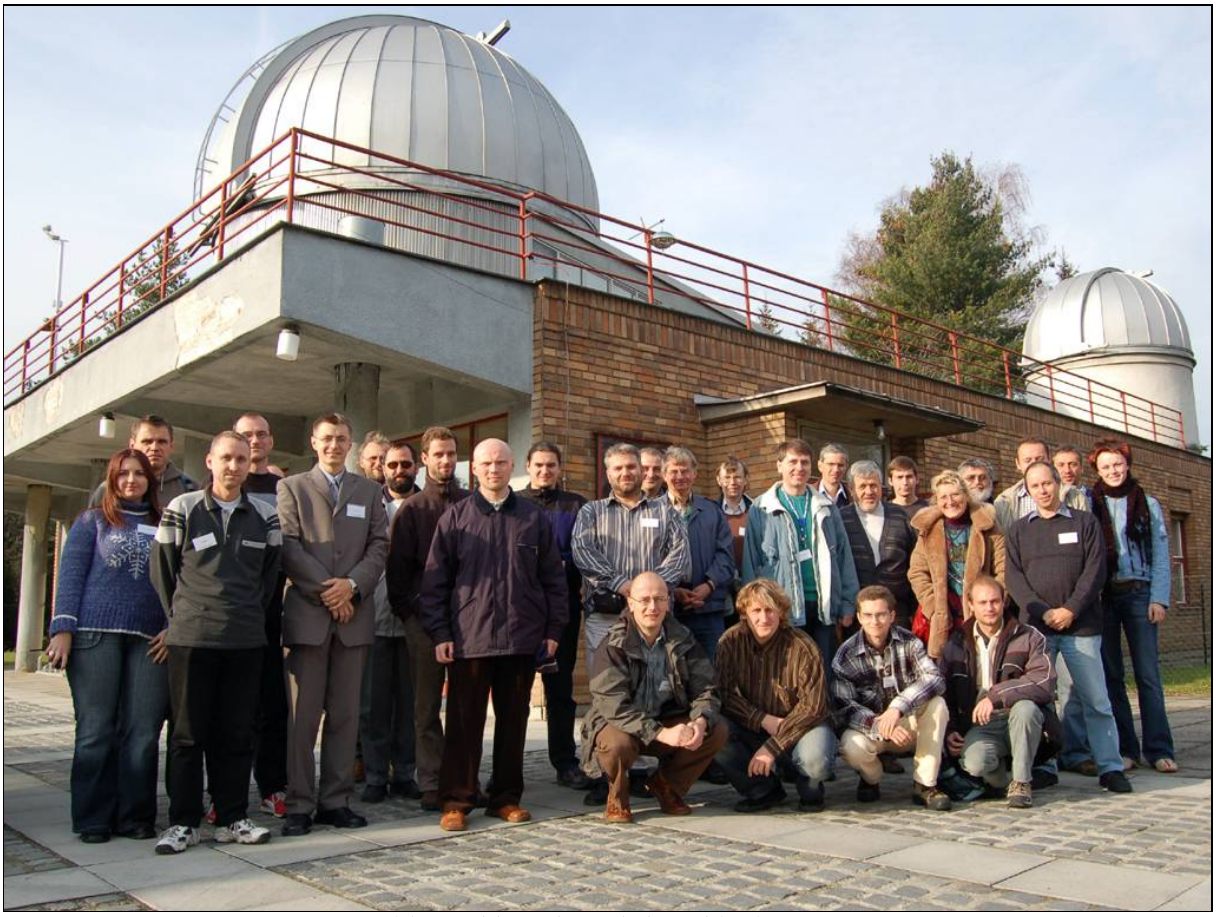
Variable Star Section of Czech Astronomical Society and Valašské Meziříčí Observatory

Proceedings of the 38th Conference on Variable Stars Research

Valašské Meziříčí Observatory, Czech Republic, EU

17th – 19th November 2006,

Chief editor **Luboš Brát**



Participants of the conference in front of the observatory

CONTENT

INTRODUCTION

The 38th Conference on Variable Stars Research was hold by Variable Star Section of Czech astronomical society and Valašské Meziříčí Observatory from 17th until 19th November 2006. Our november conferences are unique meetings between professional and amateur astronomers – variable star observers and researchers. This year's - 38th conference was aimed to looking for new, recent and attractive observing programs for variable star observers and most of entries in this proceedings is concerned in this topic.
There has sounds almost thirty of talks during the conference, however here is only nine of them given in this proceedings. Many authors didn't provide us their papers and some of them has non-scientific nature. Papers are sorted in alphabetical order according to paper's title.
Let me thanks to all of authors for their talks and posters and to all participants for their contribution to discussion!

in Pec pod Sněžkou, 29th October 2007

Luboš Brát
- proceedings editor and chief of SOC

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Astronomical Plate Archives and Amateur Variable Stars Researchers

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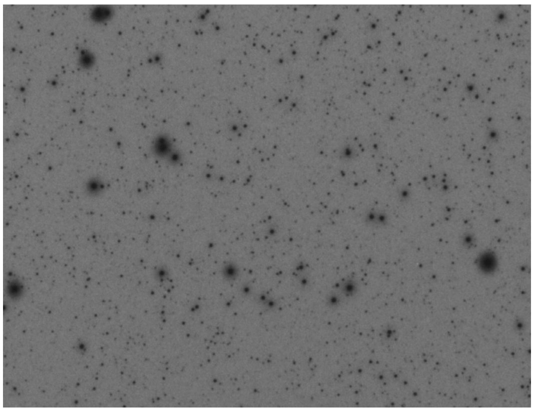
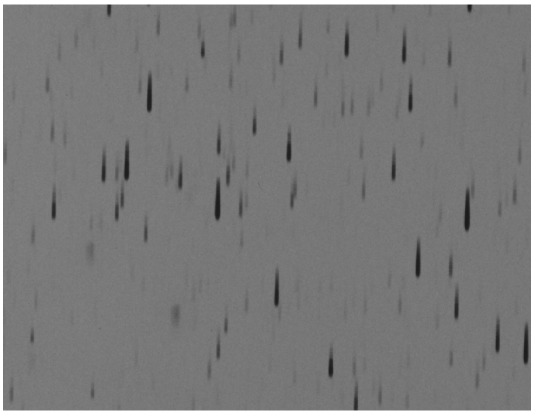
1. Introduction

There are nearly 3 millions astronomical plates in worlds plate collections (Hudec, 1999). They can cover more than 100 year in time and hence represent unique database for analyses of variable objects including variable stars. The use of scanners, powerful computers and innovative software allows the effective data evaluation for the first time.





2. The scientific use of plate archives

The large time coverage and partly good sampling (sometimes more than 1000 data points for particular objects in one plate archive) together with typical limiting magnitudes 12 to 16 (sometimes even better) makes the astronomical plate archives unique data source for all astrophysical variable sources within these magnitude limits, including wide range of variable star research (Hudec, 1999).

3. Main astronomical plate collections

In this section I will briefly describe and discus the selected major plate collections. They mostly describe archives where I have got the opportunity of scientific analyses.

3.1. Harvard College Observatory

Part of Harvard-Smithsonian Center for Astrophysics, Cambridge, MA, USA. Nearly 600 000 glass plates – worlds largest plate collection (at Harvard called PLATE STACKS). Operated for investigations of variable stars. In the first half of 20th century, the field of variable stars was dominating at HCO but fully disappeared afterwards mostly due to the personal (Director) change. This collection is characterized by many different series with various quality and various parameters. Plates were taken between 1885-1990, i.e. for more than 100 years, unfortunately interrupted after 1990.

Limiting magnitudes: 8-18

Instrumentation available:
- Astrometry scanner
- Flatbed scanner
- CCD camera

Preferences:
- almost continuous (however with some interruptions) time coverage for over 100 years
- very large number of plates. Worlds largest plate collection.
- northern and southern coverage with deep limiting magnitudes in some series

Drawbacks:
- only part of observing logs available as a file
- lack of equipment. There was almost no investment for several tens of years.
- only about 50 per cent of the plates are filled according to their celestial coordinates, the remaining plates are boxed according to their numbers, making most of analyses rather laborious and time consuming.
- a significant fraction of the old plates (~ 1890-1910) is of poor or even very poor quality, not exceeding lim mag 9-11
- the plates are mostly of very various and varying quality, even in the same serie, since there were frequent objective and emulsions changes with very limited records in the observing logs
- the time period 1976-1990 is covered by a small number of plates only. The sampling per area is usually no more than 1 plate/month.

3.2. Sonneberg Observatory, Germany

Nearly 270 000 glass plates and plan films with mostly northern but also limited southern coverage. Plates have been taken since 1928 without interruptions and the program is still running. Europe's largest and second worlds largest plate collection.

Limiting magnitudes: 12-15 sky patrol, 15-17 astrographs, 17-18 Schmidt camera plates

Instrumentation available:
- plate scanner
- high-speed plate scanner
- plate Iris photometer
- plate photometer -in museum
- Zeiss blinkmicroscope
- many small plate microscopes
- large Zeiss microscopic device for transmitted and reflected light microscopy at high magnification with attached camera
- profilometer
- COMESS astrometric machine
- Flatbed scanners

Advantages:
- continuous coverage for over 70 years
- high and stable quality of most of the plates
- objective and emulsion changes are infrequent-long series taken under stable conditions
- still operated
- very precise plate centers - important for blinking
- plates filled according to celestial coordinates
- easy access and manipulation with plates: plates without envelopes in boxes, very suitable for use of large numbers of plates
- reasonably good equipment and other background and service

- there are plates taken with very good sampling (one per hour) for the selected regions of the sky allowing to search for rapidly changing objects
- plate catalogues available as file
- majority of plates already scanned

Drawbacks:
- searching software not yet fully free available

3.3. Ondřejov Observatory, Czech Republic
Nearly 110 000 glass plates and plan films of standard dimensions of 9 x 12 cm. Tessar cameras (38 x 38 deg) until 1975, Opton Distagon Fish Eye camera - FOV 180 degrees diameter - since 1975. Spectral plates 24 x 24 cm.

Limiting magnitudes: 4 mag fixed cameras FE, 6 mag fixed cameras Tessar, 11-13 mag guided cameras Tessar, 8-11 mag guided cameras FE

Instrumentation:
- microdensitometer
- simple CCD based scanner
- Ascorecord (astrometric machine)
- simple and large microscopes
- flatbed scanner

Advantages
- continuous coverage for more than 50 years
- very large sky coverage, 50 % of visible sky for Tessar cameras and 100 % for FE cameras
- very long exposure times and hence monitoring coverage
- large number of observing stations (11)
- still in operation
- plate catalogue available as a file for majority of the plates
- searching program available

Drawbacks:
- only part (~30 %) of the plates pointed, others fixed with stars as trails
- limiting magnitudes low, between 4 and 13
- different plate centers for Tessar plates (they have fixed centers in horizontal coordinates)

3.4 Bamberg Observatory, Germany
Nearly 40 000 plates taken for variable stars. Northern sky 20 000 plates, southern sky 20 000 plates.

Limiting magnitude: 9-13 northern plates, 14-17 southern plates

Instrumentation:
- blinkmicroscope
- simple plate microscope
- Iris plate photometer
- Flatbed plate scanner

Advantages:
- complete and high quality (Gevaert and Kodak emulsions) coverage of the southern sky, typically 100-250 plates for southern positions. One of best and most complete SOUTHERN SKY coverage!
- plates filled according to celestial coordinates
- plate catalog as a file

Drawbacks: -

3.5 Cambridge RGO, England

Nearly 80 000 various glass plates taken by various telescopes for various, sometimes very special, purposes (e.g. proper motions). Moved from RGO in London. Time period 1889-1984. Limiting magnitudes: 6-15

Instrumentation:

- simple plate microscope

Advantages:

- suitable for some special studies requiring multiple exposures on the same plate (e.g. investigation of rapid variability and flares on timescales of minutes, flare stars etc)
- very long time coverage for almost 100 years

Drawbacks:

- difficult access to plates: plates are stored in large and heavy boxes
- probably no access at present due to closing of the RGO: the archive is located without access at some place in London
- very various quality and variety of plates
- some of the plates are affected by (invisible) vignetting
- large number of plates taken for very special purposes with limited general use
- almost no devices available
- no plate catalog as file, no searching software

3.6 Leiden Observatory, The Netherlands

Nearly 37 000 glass plates taken for variable star investigations between 1897 and 1981. A significant fraction of the plates was taken in South Africa. Additional plates are located in Johannesburg.

Limiting magnitudes: 12-17

Instrumentation:

- blinkmicroscope

Advantages:

- selected fields are covered by high quality Franklin Adams Plates: large FOVs (20 x 20 cm plates, 10 x 10 degrees) , high quality (sharp images up to the plate edges), good limiting magnitudes (16). About 16 000 such plates are available, more are located in Johannesburg. 31 selected Franklin Adams fields located near the Galactic plane are covered by these plates

Drawbacks:

- limited instrumentation available (destroyed)
- no plate catalogue as file, no searching software

3.7 ROE Edinburgh, Scotland

Nearly 17 000 very high quality Schmidt plates taken by the UKSTU in Siding Springs, Australia. Different color filters, spectral plates with objective prism. Glass plates and planfilms. Only southern sky coverage.

Limiting magnitude: 19-23

Instrumentation:

- Zeiss blinkmicroscope
- SUPERCOSMOS advanced microdensitometer/scanner
- simple plate microscopes
- Polaroid camera (use charged)

Advantages:

- very high quality and deep limiting magnitude of plates
- plates taken with different filters and spectral prism plates
- very good support and service
- plates info available via Internet
- searching software via www form
- still operating

- photolab available for copies
- mailing of the plates and films allowed and possible, but expensive (hundreds of dollars).

Drawbacks:
- plates are very large (34.5 x 34.5 cm) and very thin resulting in difficult manipulation especially for non experienced users (danger of damage)

3.8 TLS Tautenburg, Germany
Nearly 9 300 glass plates taken with the large Schmidt camera, FOV 3.3 x 3.3 degrees, 51.4"/mm.

Limiting magnitudes: 16-20

Instrumentation:
- plate scanner

Advantages:
- good limiting magnitude
- still operating, although at a low rate
- plate catalogue available as a file via ftp
- searching software available (although not yet via www)

Drawbacks:
- relatively small number of plates
- not negligible fraction of the plates is of poor and/or reduced quality (focussing etc)
- limited instrumentation

3.9 Bologna University Observatory, Bologna, Italy
Nearly 15 000 plates taken for various purposes, mostly variable stars research

Limiting magnitudes: 8-16

Instrumentation:
- simple plate microscope

Advantages:
- reasonable good limiting magnitudes and numerous plates for particular positions

Drawbacks:
- very small FOV cca 1.5 deg
- very limited instrumentation
- no plate information/catalogue as file yet

3.10 Klet Observatory, Czech Republic
Nearly 14 000 glass plates taken for asteroid searches and investigations. Taken by 63 cm Maksutov camera, FOV 5 x 5 degrees

Limiting magnitudes: 15-17

Instrumentation:
- Zeiss blinkmicroscope
- COMESS Zeiss astrometric machine

Advantages:
- searching software (but not freely available)
- good limiting magnitudes over FOVs of 25 square degrees
- plate catalogue as file

Drawbacks:
- many various plate centers (asteroid investigations)

3.11 Others plate collections

- Hamburg Bergedorf Observatory, Germany ~ 35 000 plates incl. spectral plates with 18 mag limit
- Heidelberg-Koenigstuhl Observatory, Germany 10 000 plates
- Odessa Observatory, Ukraine 80 000 plates VS patrol
- Dushanbe Observatory ~ 40 000 meteor plates ?
- Sternberg Institute Moscow, Russia 41 000 plates
- Asiago Observatory Italy, 35 000 plates
- Tatranska Lomnica Observatory, Slovak Republic 12 000 plates
- Konkoly Observatory Budapest, Hungary, 12 000 plates
- Bucharest Observatory, Romania 12 000 plates
- Palomar Observatory USA 40 000 plates
- Pulkovo Observatory, Russia 52 000 plates
- Swathmore Observatory, Pennsylvania USA 100 000 plates
- Tonantzintla Observatory, Mexico 10 000 plates
- Mt Kanobili Observatory, Georgia 60 000 plates
- Uccle Observatory Belgium 15 000 plates
- Byurakan, Armenia 40 000 plates
- Charlottesville, Virginia USA 165 000 plates
- Krym Observatory, Ukraine 10 000 plates
- ESO Garching Germany 25 000 plates
- Hoher List, Germany 11 000 plates
- Kitt Peak, AZ USA 17 000 plates
- Flagstaff AZ USA 12 000 plates
- and many amateur collections, some of them quite numerous

3. Plates and amateur astronomers

In some plate archives, the amateur astronomers were regular guests and they contributed mostly to analyses of variable stars directly on the plates, applying the eye estimate method. In frequent cases even scientific publications have been published based on these analyses, such as those in Mitteilungen Veraenderliche Sterne.

Recently, the wide digitization of astronomical plates at numerous plate archives allows the converting of plate archives to parts of virtual observatory, as well as the easy transfer of the scanned data to other places, and hence the analyses of objects on home computers. The peculiarities of the photographic emulsion are however to be taken seriously into account, including the non-linearity and in some cases particular color system. If this is taken into account, the analyses of variable stars on astronomical archival plates can yield results with errors within 0.1 to 0.3 magnitude range, in some cases even better, depending on the quality of the data, magnitude of the object, and used method.

Despite of extended efforts, the full program software package for automated analyses of scanned plate data is not yet available. Various small parts are however available and can be applied to the data analyses. The easy and fast method of eye estimation on the monitor screen is still to be checked whether can provide reasonable data in some particular cases. Volunteers are welcome to take part in this.

Acknowledgements

Scientific analyses on astronomical plate archives have been partly supported by the Grant Agency of the Academy of Sciences of the Czech Republic, project A3003206, by the project GA CR 205/05/2167, and by the ESA PECS Project 98023 (analyses and identification of INTEGRAL gamma-ray sources).

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November 2007 OPEN EUROPEAN JOURNAL ON VARIABLE STARS
http://var.astro.cz/oejv ISSN 1801-5964

The ESA Gaia Mission and Variable Stars

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Abstrakt (IN CZECH)
Představujeme cíle nadcházejících pozorování družicí ESA Gaia. Jde zejména o velmi přesnou astrometrii, ale důležitou roli bude hrát i fotometrie a nízkodisperzní spektroskopie mimořádně velkého souboru objektů různých druhů, a to včetně proměnných hvězd až do 20. magnitudy. Předpokládá se, že během pětiletého pozorování se podaří získat kolem 100 měření daného objektu. Pro takový objekt tak bude k dispozici současně fotometrie, spektroskopie i astrometrie.

1. Introduction

Gaia is a cornerstone astrophysical mission of the European Space Agency ESA, see http://astro.estec.esa.nl. It is a global space astrometry mission. Its goal is to make the largest, most precise map of our Galaxy by surveying an unprecedented number of stars - more than a thousand million.

Gaia is a mission that will conduct a census of one thousand million stars in our Galaxy. It will monitor each of its target stars about 100 times over a five-year period, precisely charting their distances, movements, and changes in brightness. It is expected to discover hundreds of thousands of new celestial objects, such as extra solar planets and failed stars called brown dwarfs. Within our own Solar System, Gaia should also identify tens of thousands of asteroids.

Gaia will measure the positions, distances, space motions, and many physical characteristics of some one billion stars in our Galaxy and beyond. For many years, the state of the art in celestial cartography has been the Schmidt surveys of Palomar and ESO, and their digitized counterparts. Gaia will provide the detailed 3D distributions and space motions of all these stars, complete to 20th magnitude. The measurement precision, reaching a few millionths of a second of arc, will be unprecedented. This will allow our Galaxy to be mapped, for the first time, in three dimensions. Some millions of stars will be measured with a distance accuracy of better than 1 per cent; some 100 million or more to better than 10 per cent.

Gaia's resulting scientific harvest is of almost inconceivable extent and implication. It will provide detailed information on stellar evolution and star formation in our Galaxy. It will clarify the origin and formation history of our Galaxy. The Gaia results will precisely identify relics of tidally-disrupted accretion debris, probe the distribution of dark matter, establish the luminosity function for pre-main sequence stars, detect and categorize rapid evolutionary stellar phases, place unprecedented constraints on the age, internal structure and evolution of all stellar types, establish a rigorous distance scale framework throughout the Galaxy and beyond, and classify star formation and kinematical and dynamical behaviour within the Local Group of galaxies.

Gaia will pinpoint exotic objects in colossal and almost unimaginable numbers: many thousands of extra-solar planets will be discovered (from both their astrometric wobble and from photometric transits) and their detailed orbits and masses determined; tens of thousands of brown dwarfs and white dwarfs will be identified; tens of thousands of extragalactic supernovae will be discovered; Solar System studies will receive a massive impetus through the detection of many tens of thousands of new minor planets; near-Earth objects, inner Trojans and even new trans-Neptunian objects, including Plutinos, may be discovered.

Gaia will follow the bending of star light by the Sun and major planets over the entire celestial sphere, and therefore directly observe the structure of space-time (the accuracy of its measurement of General Relativistic light bending may reveal the long-sought scalar correction to its tensor form). All this, and more, through the accurate measurement of star positions.

2. Gaia and Variable Star Research

It is obvious that, with the above briefly described performance, the Gaia will provide valuable inputs to various research fields of recent astronomy and astrophysics including field of variable stars. Most of the variable stars research will be perfomed within the Gaia Variability Coordination Unit CU7.

For variable star science, there will be several advantages provided by Gaia. First, this will be the deep limiting magnitude of 20, much deeper than most of previous studies and global surveys. For example, no detailed statistics of variable stars has been investigated for magnitudes fainter than mag 18.

Secondly, the time period covered by Gaia observations i.e. 5 years, will also allow some studies requiring long-time monitoring, recently provided mostly by astronomical plate archives and mostly small or magnitude-limited sky CCD patrols. But perhaps the most important benefit of Gaia for the variable star studies will surely be the fine color resolution. This will allow some detailed studies involving analyses of color and spectral changes not possible before.

The details of variable stars studies have been recently evaluated and are described in more detail mostly by the dedicated sub-workpackages within the workpackage Specific objects studies within the Gaia CU7.

3. Participation of Ondřejov HEA team

The participation of High Energy Astrophysics group at the Astronomical Institute of the Academy of Sciences of the Czech Republic in Ondřejov focus on Gaia CU7 Variability Processing Unit with R. Hudec being a member of Gaia CU7 team. Two sub-work packages within the Specific object studies on cataclysmic variables and optical counterparts of high energy sources have been proposed, evaluated, accepted, and allocated to be managed by R. Hudec. Additional participation is expected in image processing – recently this includes algorithms designed of scanned Schmidt spectral plates (simulation of Gaia data and variability studies based on spectro-photometry).

The further participation represents direct participation in Gaia CU7 DPC Data Processing Center (DPC) as a natural continuation of participation in INTEGRAL ISDC. This includes participation in software development in a team, and Java and object oriented programming as a natural extension of participation in INTEGRAL ISDC (since 1997).

Another participation is represented by Robotic Telescopes run with the same RTS2 operating software: BART, BOOTES1, BOOTES2, BOOTES-IR, FRAM, WATCHER, 50cm CCD Telescope (from 2007). Also small and private observatories are expected to attend.

Participants/Collaborators include the following institutions:

- Astronomical Institute, Academy of Sciences of the Czech Republic Ondřejov, Group of High Energy Astrophysics
- Czech Technical University, Prague
- Students of Department of Informatics, Charles University, Prague
- Industrial partner: BBT Institute, Czech Republic
- Reflex sro, Czech republic
- Sonneberg Observatory, Germany
- Astronomical Institute of the Slovak Academy of Sciences, Slovak Republic
- Safarik University Košice, Faculty of Science, Slovak Republic

4. The spectral power of Gaia and spectral variability studies

The Gaia telescopes offer unique variability studies based on low dispersion spectra, i.e. the energy resolution of recorded star images. In this context, the application of algorithms developed for digitized astronomical archival plates may be important for Gaia.

The novel algorithms for automated analyses of digitized spectral plates have been recently developed by informatics students and are suitable for

- Automated classification of spectral classes
- Searches for spectral variability (both continuum and lines)
- Searches for objects with specific spectra
- Correlation of spectral and light changes

- Searches for transients

The archival spectral plates taken with objective prisma offer the possibility to simulate the Gaia low dispersion spectra and related procedures such as searches for spectral variability and variability analyses based on spectro-photometry. In recent development, we focus on sets of spectral plates of the same sky region covering long time intervals with good sampling.

5. Conclusion

The Gaia mission of European Space Agency ESA will contribute essentially to scientific studies and physical understanding of optical counterparts of high-energy sources and of cataclysmic variable stars and related objects. The variability studies based on low-energy spectra are expected to provide unique novel data and may use algorithms recently developed for automatic analyses of digitized spectral Schmidt plates.

Acknowledgements

We acknowledge the support provided by the Grant Agency of the Academy of Sciences of the Czech Republic, No. A3003206, and the grant 205/05/2167 of the Grant Agency of the Czech Republic. The DPC activities represent continuation of the INTEGRAL ISDC participation supported by ESA PECS Project 98023.

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OPEN EUROPEAN JOURNAL ON VARIABLE STARS
November 2007 http://var.astro.cz/oejv ISSN 1801-5964

First Results of CCD and Photoelectric Photometry on Astronomical Observatory at Kolonica Saddle

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Abstrakt (IN CZECH)

V tomto príspevku prezentujeme súčasný stav pozorovacej techniky na Astronomickom observatóriu na Kolonickom sedle (ďalej KO), prvé výsledky CCD fotometrie, testy fotoelektrického fotometra a celkovú koncepciu pozorovateľského komplexu na KO.

Introduction:

Astronomical Observatory of Odessa National University (AO ONU, Ukraine) and Vihorlat Astronomical Observatory (VAO, Slovakia) participate on new astronomical observatory named Kolonica Observatory (KO), which is located at the Kolonicke Sedlo in north east of Slovakia. The location of the observatory is:
latitude=48D 57'N, longitude=22D 16'E and its altitude is 465m above sea level.
The biggest telescope installed at observatory, named Vihorlat National Telescope (VNT) has diameter 1m and now it is the biggest astronomical instrument in Slovakia. It is placed in 5 m dome, which motion is synchronized with the motion of the telescope tube. Observational instruments could be installed in two focuses, Cassegrain and Nasmyth. The Cassegrain focus is equipped by the high speed two-star photometer which was constructed in AO ONU. The Nasmyth focus is in preparation at this time and it is planned for CCD multicolor photometry and/or for spectroscopy. The guiding of the telescope is realised by CCD through 30 cm Ritchey-Chrétien telescope or could be applied also as the third channel of the photometer for sky background or reference star measurements.
KO is now a full featured astronomical complex with complete infrastructure and accomodation for about 20 persons in its area. It is used for astronomical observations as well as for educational purposes covering winter and summer schools for young astronomers from local region and practical excercises for students of astronomy at Šafarik University in Košice.
The main observational program is focused to eclipsing binary, cataclysmic and symbiotic stars research. The work is realizing within the program context and standards of the global asteroseismic networks DSN (Delta Scuti Network) and WET (Whole Earth Telescope).

The layout of the observatory:

The schematic layout of the observatory is shown in Figure 1. The description of the buildings is given:
1. Main Building, 2. Dome of VNT, 3. New pavilion of small telescopes, 4. Observing platform, 5. Old pavilion 6. Observing point, 7. Meteo station, 8. Hilton – accommodation 9. Lux – accommodation, 10.Garde – accommodation, 11. Plechovica – accommodation, 12. External toilets, 13. Wood store, 14. Store, 15. Summer dinning-room, 16. Workshop – wagon, 17. Artificial lake, 18. Sun clocks, 19. Entrance gate – up, 20. Entrance gate – down, 21. Road, 22. To the seismic station 200m, 23. To the magnetic station - 90m

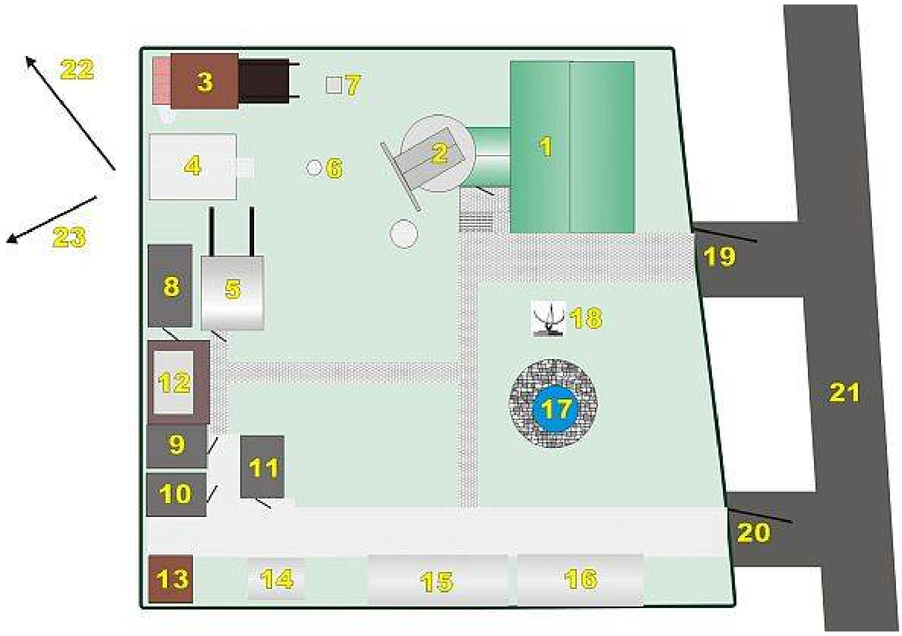

Figure 1: Schematic layout of the observatory

Figure 2: View on observatory in winter

More detailed description of the observatory, as well as available astronomical tools is presented at the Observatory website: http://www.astrokolonica.sk.

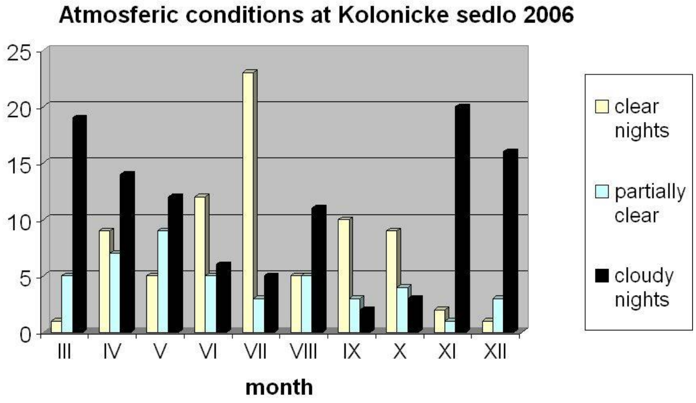

Figure 3: Statistics of observational conditions in 2006

Atmospheric conditions:

Atmospheric conditions are relatively good in spite of low altitude, in comparison with other places in Slovak Republic. About 100 nights per a year are usable for a photometry. The average seeing is about 2.5'' in the best nights. Statistics of observational conditions in 2006 is depicted in Figure 3.

Instrumentation:

The main telescope of the observatory is Vihorlat National Telescope (VNT). Its optical layout is shown in Figure 4. and main characteristics are given in Table 1. The view to VNT in dome is given on Figure 5.
Optical system is corrected by two lenses situated in front of the secondary mirror.
The guiding of the system is installed on the 30 cm Ritchey-Chretien telescope. It was developed by Martin Myslivec and id provided by Mintron CCD camera.

Table 1: Main characteristics of VNT

Optical system	Modified Argunov – Faschevsky
Main mirror shape	spherical
Diameter of the main mirror	1 m
Diameter of the secondary mirror	0.3 m
Effective focal length:	9 m
Length from the main mirror to secondary	2.03 m
Field of view FOV	0.5°
FOV diameter in focal plane	78 mm
Scale of FOV	0.043 mm/arcsec

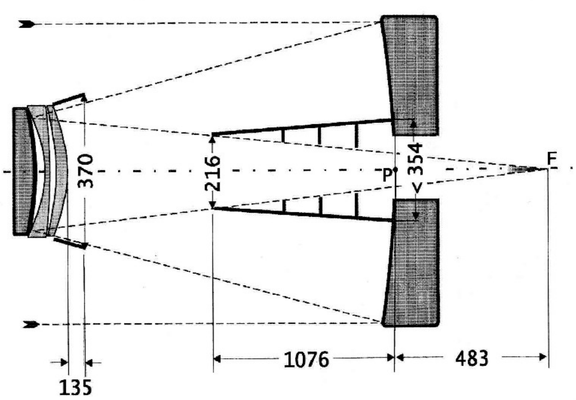

Figure 4: Optical layout of VNT

Figure 5: VNT in dome

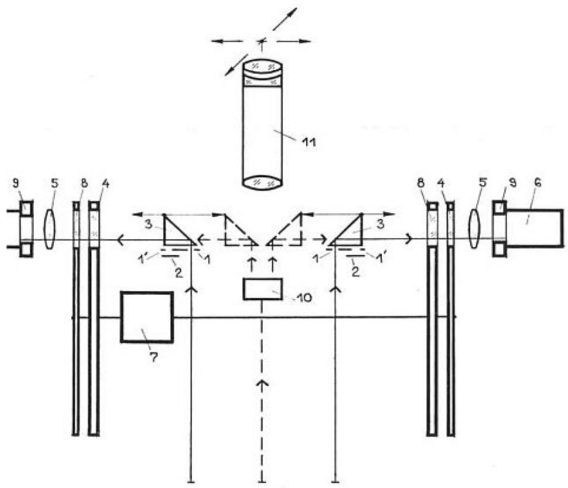

Figure 6: Optical scheme of two star photometer

The Cassegrain focus of the telescope is equipped by the high speed two-star photometer, which was constructed in AO ONU. Optical scheme of this instrument is shovn in Figure 6. The description of the this instrument is given: 1 - diaphragm (6 different diameters), 1´- diaphragm for sky measurement, 2 – cover automatically uncover diaphragm 1 or 1´, 3 – mirrors reflecting the light to the photomultiplier, 4 – filter wheel, 5 - Fabry lens 6 – photomultiplier, 7 – simultaneous turning of filter wheels, 8 - neutral filter, 9 – photomultiplier cooling, 10- mechanical displacement of mirrors 3, 11- microscope

In Table 2 we give descriptions of other telescopes used at observatory. Meade DSI Pro cameras with Sony® ExView HAD™ Monochrome CCD Sensor with 510 x 492 pixels are used with these telescopes.

Table 1. Characteristics of other telescopes used at KO.

	Pointer	*Chermelin*	*Hugo*	*Púpava*
Optical system	Ritchey-Chrétien	Newton	Newton	Newton/Cassegrain
Diameter [mm]	300	300	265	280
Focal lenghth [mm]	2400	1500	1360	1500/3500
Mount	Fork equatorial	Alt/Az	German equatorial	German equatorial
Constructor (telescope/mount)	AO Odessa	AO Odessa / CVUT Prague	AO Odessa / Uniwersal Poland	Uniwersal Poland / AO Odessa
Exploitation	Autoguiding of VNT	Automated monitoring of cataclysmic variable stars (future)	CCD photometry – times of minima of eclipsing variable stars	Time series color CCD photometry of cataclismic variable stars

First CCD light curves statistics

- First CCD measurement in KO was made on 07 April 2006.
- Camera Meade DSI Pro on Lichtenckencker telescope 150 mm from 07 April to 09 May 2006.
- Camera on Púpava telescope 285 mm from 12 May 2006.
- Actually 3 CCD cameras on Hugo, Púpava telescopes and 400 mm telephoto lense.
- Few night we try the CCD camera also on the VNT.
- From 01 April to 31 October 2006 we observe in 87 nights.
- We have collected 91 times of minima in 47 eclipsing binaries.
- We have observed superoutbursts of SU UMa type stars IY UMa, V419 Lyr, CI UMa, RXSJ053234, VY Aqr, V844 Her. The last one was first visually discovered by Dubovský.
- We take part in CBA campaigns on stars V603 Aql and V Sge.
- Totally we take **53641** images.
- We have published two papers in OEJV at this time and few other paper are in preparation

First test of two-stars photoelectric photometer:

The photometer was finished during the summer stage of experts from Odessa. We have not suitable software for managing the observation to these days. We made only observations in one filter (V) with few sky observations. The first measurement was performed on 28th October 2006. We have observed primary minimum of DI Peg. Resulting light curve is shown on Figure 7. We have to note that this observations was done with no autoguiding and we pointed only manualy with CCD camera mounted on 30cm pointer.

Observing program of KO:

Observing program of KO is pointed to variable stars research. Historically, the first observations were visual estimates of the minima times of eclipsing binaries. Later the physical variables were included. The observations were made mainly during summer campaigns and astronomical practical exercises for young astronomers. CCD observations started after permanent observer arrival in March 2006. Actually the photoelectric photometry is in testing regime. The future development of observing activities will be done according to following table. There is an alternative to install the spectrograph into the Nasmyth focus of VNT.

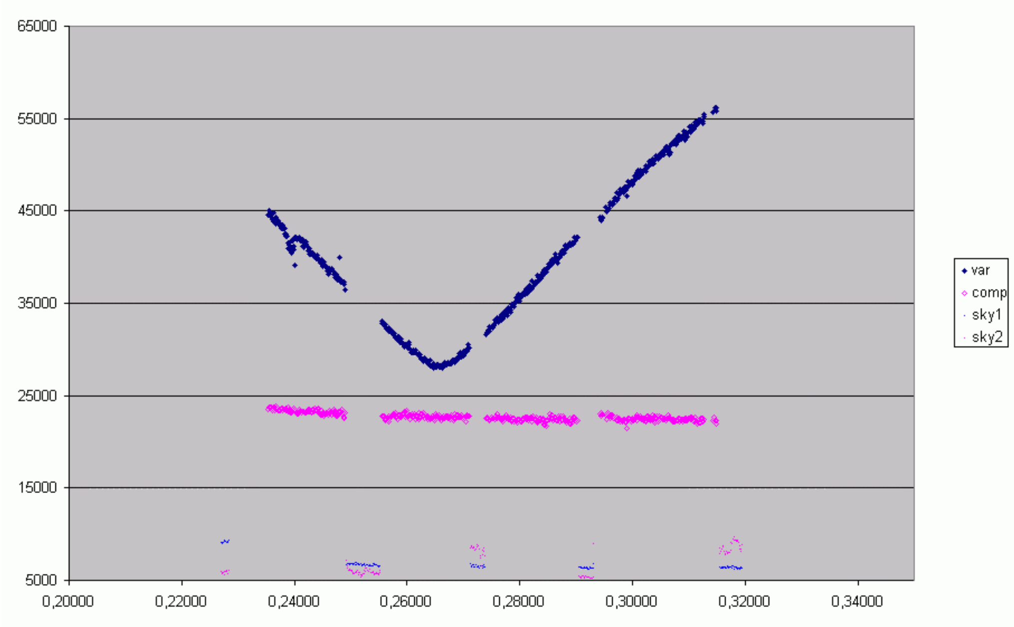

Figure 7: First light curve of two star photometer on VNT. Eclipse of DI Peg, 28th October 2006

Table 3. Observing program of KO

Observed objects	Equipment	Actual situation
Asteroseismology Flickering in CVs Fine effects on light curves of EBs	VNT + photometer	Testing observations with photometer
Four color photometry of faint variables	VNT + CCD camera BVRI	Nasmyth focus of VNT (in preparation)
Monitoring of faint CVs	Chermelin + CCD	
High speed photometry of CVs	Púpava + CCD	Observing
Times of minima of EBs with strange O-C	Hugo + CCD	Observing
Times of minima of EBs	400 mm telephoto lens + CCD	Observing
Monitoring of bright CVs	Newton 20cm visually	Until now using Chermelin telescope
Semi regular variables Be stars Symbiotic variables EBs without known elements	Newton 20cm visually Somet binocular DB binocular	Observing

Acknowledgments:

– Grant of Safarik University VVGS 10/2006
– Grant of Slovak Research and Development Agency LPP-0049-06.

OPEN EUROPEAN JOURNAL ON VARIABLE STARS
November 2007 http://var.astro.cz/oejv ISSN 1801-5964

How Can Amateur Astronomers and Small Observatories Contribute to Recent Astrophysics

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1. Introduction

In this contribution examples of projects of recent astrophysics with possible participation on small and amateur observatories are presented and briefly discussed. We focus on high-energy astrophysics sources.

2. High-energy sources and their optical emission

The majority of high-energy sources are also sources of optical emission and the multispectral analyses are important for their physical understanding.

3. Categories of objects suggested for small and amateur obserbatories

The following object categories can be studied by optical astronomers with small and moderate telescopes.

- X-ray and gamma-ray sources (LMXRB, HMXRB)
- OTs and OAs of GRBs, incl orphan OTs
- Blazars/AGN
- Others & Satellite Campaigns
- Cataclysmic Variables and related objects, especially those related to ESA projects INTEGRAL and Gaia

Due to large amplitudes of the light variations of essentials fraction of these objects, and due to satisfactory optical magnitudes of some of them, also small telescopes and cameras may play an important role in this program.

For example, for the gamma-ray sources detected by the ESA INTEGRAL satellite, nearly half of them are brighter than magnitude 15, and most of them are brighter than mag 20. This means that even for the gamma-ray sources, their counterparts are accessible in optical domain also by small aperture telescopes.

Follow-up optical observations of gamma ray bursts (GRB)

The GRBs are rare and cannot be predicted hence we need a network to get a better chance to observe them. There are different weather, darkness, technical conditions on particular observing sites so everybody has the chance to catch the optical transient for a gamma ray burst as the first.

The nature of GRBs still remains puzzling, but now most of physicists believe that the objects are at cosmological distances and represent to the most energetic explosions in the universe (10^51 ergs i.e. 10^44 watts, or even more).

The observed rate of GRBs is roughly one per day and they came from unpredictable positions on the sky. Their sky distribution is completely isotropic.

There was enormous progress in the GRBs observations in the last years. The X-ray as well as optical and radio afterglows of GRB have been detected and investigated. However, much more observations are still needed to explain completely their nature. It seems to be that the multispectral observations - including optical imaging and photometry - is the right way how to approach the problem. There is evidence that at lest some GRBs may generate bright optical transients, brighter than mag 12, in few case even brighter, and hence are accessible by small telescopes.

At present, the data about detected GRB (position and time) are distributed generally by the GCN Network (GRBs Coordinates Network, formerly BACODINE) operated at the NASA GSFC. They distribute data by email of different accuracy and at different delays after the times of GRBs.

What is needed: optical camera and/or telescope with CCD kamera, Field of View (FOV) of order of 0.2 to 2 deg. In all cases, the deepest possible limiting magnitude should be obtained.

Everybody having the WF camera (FOV more than 3 deg) with lim mag 12 or better, camera with FOV of order of 1 - 3 deg with lim mag 13 or better, and a telescope with FOV of order of 10 min and lim mag of 14 or better can contribute valuable new data.

The first observation should be performed immediately after obtaining the GRB information. It should be immediately followed by the second observation to prove the reality of objects detected. The absolute minimum of observations are these two innitial images followed by the two comparison images taken a few hours later for comparison.

However, more dense observations are strongly encouraged. In general, we expect that there may be two - possibly different - types of optical emmisions, the first being the direct optical counterpart to the GRB, and the second being the delayed optical afterglow caused by the interaction of expanding relativistic fireball shell with interstellar matter. Hence, dense optical observations are required at least for the first hours after the time of GRB.

Standard BVRI filters should be used if possible especially with CCD imaging, although unfiltered images may be also of some value. With regard to the maximum efficiency of the CCD, the R or V filters can be considered as the standard ones.

The obtained images should be carefully investigated for all types of optical activity inside the GRB error boxes, i.e. both for new and variable objects (stars). The best technique how to do it is to blink the obtained images either by software (for CCD frames) or by blink microscope (for photographs). The data should be processed immediately to avoid any delays since, in the case of positive finding, this information should be provided to larger telescopes to perform deep investigations of these candidates.

However, if you have no possibility to evaluate the data and/or you need an assistence and service, contact us and we will try to help.

AGN/blazar monitoring
Extended optical investigations of GRB positions have provided information on large optical flares with underlying faint AGNs at these positions. In all of these cases, the light amplitude of the flares was 10 mag or even more. This is similar to what is observed for the recently detected optical afterglows for GRBs. There have been also found AGN candidates at the positions of some GRBs.

Further, many of the AGNs and blazars are optically violent, showing many types of variability and also large amplitude flares but their light curves are generally undersampled so far. Hence a better monitoring is extremely necessary to better understand the physical processes in these objects.

We have selected a list of AGNs/blazars for detailed optical monitoring. Most of them are optically very violent and many of them can be easily accessed even by small telescopes.

Two types of optical observations are necessary:

A) Simultaneous and quasisimultaneous observations for satellite campaigns or during high activity state of the object.
In both of this cases, you will be informed. Then the more dense sampling (photometry) is welcomed, at least one point per night, but more is better. For CCD observers, R filter should be preferred.

B) Standard monitoring of selected objects

Standard monitoring to follow the optical evolution of the object. One observation per week could be enough, but again, more dense light curve will be better. For CCD observers, R filter should be preferred.

4. Data policy
It is our aim to do the final data evaluation and publication jointly. Everybody contributing to the data will be added to the list of co-authors of all of the publications and presentations.

5. Information for newcomers

All new collaborators are welcomed. Let us know all the information we need: names, addresses and telephone numbers of contact persons, the exact geographic position of the observatory, list of telescopes to be used within the program including their apertures, detector types, focal lengths, FOVs, limiting magnitudes, typical exposure times.

We will then add your email address to the distribution list. If no email is available, please suggest an alternative method of communication.

For recent list of objects to be observed please contact the author.

OPEN EUROPEAN JOURNAL ON VARIABLE STARS
November 2007 http://var.astro.cz/oejv ISSN 1801-5964

Investigation of Cataclysmic variables and related objects with the INTEGRAL satellite

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Abstrakt (IN CZECH)

Představujeme a diskutujeme vybrané výsledky našeho výzkumu kataklyzmických proměnných a jim příbuzných objektů, k němuž jsme použili data z družice ESA INTEGRAL. Tato pozorování se uskutečnila v rámci tzv. Core Programme. Pomocí této družice se nám podařilo studovat několik těchto objektů jak v daleké rentgenové oblasti, tak i v oblasti optické.

Abstract

Examples of the results of investigation of cataclysmic variables (CVs) and related objects with the ESA INTEGRAL satellite mostly within the Core Programme are presented and discussed. It is shown that the INTEGRAL satellite serves as an efficient tool to study these objects and that not only the onboard high-energy telescopes, but also the small optical camera OMC provide valuable scientific information.

Introduction

There are four co-aligned instruments onboard the INTEGRAL (The International Gamma-Ray Astrophysics Laboratory) satellite: (1) gamma-ray imager IBIS (15 keV–10 MeV, field of view 9 deg), (2) gamma-ray spectrometer SPI (12 keV–8 MeV, field of view 16 deg), (3) X-ray monitor JEM-X (3–35 keV, field of view 4.8 deg), and (4) optical monitoring kamera OMC (Johnson V-filter, field of view 5 deg) [1]. These experiments allow simultaneous observation in the optical, medium X-ray, hard X-ray, and gamma spectral region (or at least a suitable upper limit) for each CV in each scan or field, assuming that the object is inside the field of view. The basic codes of observations are as follows: (a) Regular (weekly) Galactic Plane Scans (GPS) ($-14^o<b_{II}<+14^o$), (b) Pointed observations (AO), (c) Targets of oportunity (ToO).

Cataclysmic variables (CVs) are binary systems in the phase of mass exchange. The number of known CVs in our Galaxy exceeds 1000 and still grows. They contain a compact object (white dwarf (WD)) which accretes matter from its Roche lobe-filling companion (so-called donor). The donor is usually a late type main-sequence star, but also rare cases where it is a subgiant or a WD are known (depending on the orbital period ranging from about 20 min to several days, mostly several hours). In most cases and spectral passbands, luminosity of CVs is dominated by the light originating from the transferring matter, not from the stellar components. CVs are extremely active in real time over a very broad range of time scales, from seconds to decades, not speaking about their evolutionary changes. This activity is directly related to the physical processes in the transferring matter and its accretion onto the WD. We will show that several CVs were successfully observed with several instruments onboard INTEGRAL.

In addition to cataclysmic variables (CVs), some symbiotic stars have been also detected by INTEGRAL. The symbiotic variables represent a heterogeneous group – they are often represented by a late-type giant transferring mass onto a compact object (WD or a neutron star) via a strong stellar wind or in some cases via Roche lobe overflow (more than 100 symbiotics are known). Most symbiotics are the long-period cousins of CVs and X-ray binaries. Dramatic variability on a large range of time scales (from less than a minute to years and decades) has been detected in these systems.

CVs, symbiotics, and INTEGRAL

In total, ~ 335 CVs brighter than 17.5 mag(V) at least during maxima of their long-term activity and located near the Galactic plane (within $-14^o < b_{II} <+14^o$) are contained in The Catalog and Atlas of CVs [5] (this number excludes classical novae brighter than 17.5 mag(V) only during explosion and steadily fainter than 17.5 mag(V) after return to quiescence).

Currently the best coverage is available for CVs lying toward the Galactic center. Some CVs far from the Galactic plane lie in the fields scheduled for pointed AO observations of other kinds of object. INTEGRAL is able to provide simultaneous information in the optical, medium X-ray, hard X-ray, and gamma spectral region (or at least a suitable upper limit) for each CV in each scan or field. Observation of the extreme (hardest) part of the bremsstrahlung spectrum (most sensitive to the temperature variations) represent important input for the physical analyses of these objects.

INTEGRAL is suitable for: (a) detection of the populations of CVs and symbiotics with the hardest X-ray spectra, (b) simultaneous observations in the optical and hard X-ray regions, and (c) long-term observations with OMC – including a search for rapid variations (OMC observations are possible also for systems bellow the detection limit in hard X-rays).

V1223 Sgr

This is the brightest CV seen by INTEGRAL so far. The object belongs to intermediate polars with accretion via disk. It is a bright X-ray source 4U 1849–31. It was successfully detected by IBIS and OMC in a state of brightness which we call a shallow low state. We determined hard X-ray spectra with energy as large as 60 keV and the relation between hard X-ray and optical flux. We found that they are stable during this state over an interval of 400 days. We determined the profile of the optical modulation with the orbital period for this state of activity using the OMC data. The flux estimated from 3-year IBIS survey was f(20 – 40 keV) = (12.3 +/- 0.3) x 10^{-4} photon/cm^2/s, using its approximate distance we obtain luminosity L (20 – 40 keV) = 2.4 x 10^{33} erg/s.

V1432 Aql

This is an example of desynchronized polar seen by the INTEGRAL IBIS telescope. We determined the flux in far X-rays to be f(15 – 40 keV) = (8.8 +/- 0.9) x 10^{-4} photon/cm^2/s and the corresponding luminosity L (15 – 40 keV) = 1.4 x 10^{32} erg/s.

V2400 Oph

This is an example of a diskless intermediate polar detected by the INTEGRAL IBIS gamma-ray telescope in the 20– 40 keV passband. The flux averaged over 3-year period is f(20 – 40 keV) = (6.0 +/- 0.2) x 10^{-4} photon/cm^2/s

GK Per

Example of intermediate polar, with very long Porb=1.99 days. It exploded as a classical nova in 1901 with fluctuations by ~1 mag after return to quiescence. Later these fluctuations developed into infrequent dwarf nova-type outbursts [8][9]. The observed X-ray (2.5 – 11 keV) spin modulation is 351 s (EXOSAT) during optical outburst [10]. The X-ray start can precede the optical start by up to 40 days [9].

The Interval between the two outbursts when the INTEGRAL observation was performed was 973 days. The IBIS observation started at a phase 0.42 of this period (measured since the previous outburst). Our observations show that the amount of matter arriving to the WD and the parameters of the X-ray emitting region on the WD remained almost the same during these phases of the quiescent intervals when compared with the previous observations. The measured flux f(25 – 40 keV) = (2.7 +/- 1.2) x 10^{-4} photon/cm^2/s and L (15 – 40 keV) = 4.6 x 10^{32} erg/s.

IX Vel

This is an example of the CV not detected in gamma-rays by IBIS, but with important information gained by the onboard OMC camera. We found that the amplitude of the flickering decreases with the long-term decrease of the brightness.

RS Oph

This is an example of a relatively bright symbiotic system observed by OMC but invisible in IBIS so far. The orbital period is 460 days, with the giant component underfilling its lobe. RS Oph is a system with a WD and is recurrent nova (five observed explosions) [11]. The quiescent optical brightness exhibits fluctuations (months and years) between magnitudes 11 – 12 mag(V), sometimes even 10 mag (V). The rapid optical variations with time scale of tens of minutes, similar to those often seen in short-period CVs have been also observed.

The OMC observations were performed in various orbital phases and at various levels of brightness (lower value ~11.35 mag(V)). Rapid variations of brightness have been detected: The largest peak-to-peak amplitude amounts to ~0.3 mag(V). The amplitude of flickering tends to increase with increasing mean level of intensity – this speaks in favor of the origin of both flickering and "constant" optical luminosity from the same source.

There is complicated relation between the amplitude of flare in flickering and its duration. The observed short time scale of flickering indicates that the most probable location is in the close vicinity of the WD (supported also by rapid variations of He II 4686 emission). All this contradicts the origin of flickering from the rotation of the magnetized WD. The results found here are quite discordant from the period of 81+/-2 min found by [12].

Results for CV observations with INTEGRAL and further perspectives

The succesfull observations of CVs by INTEGRAL provide a proof that CVs can be successfully detected and observed in far X-rays with INTEGRAL (for most CVs this represents considerably harder passbands than possible previously).

These results show that more CVs (and in harder passbands) will be detectable with increasing integration time. There is also an increasing probability of detecting the objects in outbursts, high and low states etc.

The simultaneous hard X-ray and optical monitoring of CVs (or at least suitable upper limits) can provide valuable inputs for better understanding of the physical processes and evolution of CVs as well as related objects. The long-term variability of CVs can be monitored – it will be increasingly even more valuable with increasing observing time. The INTEGRAL observations cover the gap between TeV energies (observed by Cherenkov telescopes, with tentative detections of some magnetic CVs) and X-rays observations by previous satellites.

Valuable OMC observations have been provided even for those CVs below the detection limit of IBIS and SPI (deeper insight into the activity of various types of CVs).

Acknowledgements

The International Gamma-Ray Astrophysics Laboratory (INTEGRAL) is an European Space Agency mission with instruments and science data center funded by ESA member states (especially the PI countries: Denmark, France, Germany, Italy, Spain, Switzerland), Czech Republic and Poland, and with the participation of Russia and the USA. This study was supported by the project ESA PECS INTEGRAL 98023 and partly by the grant 205/05/2167 of the Grant Agency of the Czech Republic.

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Photometry of the X-ray transient CI Cam – opportunity for CCD observers

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Abstrakt (IN CZECH)
Představujeme vybrané části analýzy fotometrických pozorování unikátního rentgenového transientu CI Cam (XTE J0421+560), jež pokrývají období po vzplanutí, které nastalo v roce 1998. Aktivita tohoto systému pokračuje i po skončení vzplanutí, i když má již podstatně menší amplitudu. Ukazujeme, že v současnosti vykazují změny jasnosti největší amplitudu ve filtru *I* (kolem 0,3 mag). Rovněž ukazujeme složité změny barevných indexů. Stručně uvádíme i fyzikální interpretaci. Rovněž jsme pátrali po rychlých změnách jasnosti. Lze vystopovat nejvýše velice malé fluktuace jasnosti s amplitudou kolem 0,02 magnitudy, které nastávají na časové škále asi jedné hodiny. Dlouhodobé změny jasnosti na časové škále týdnů a měsíců tak hrají rozhodující roli. Hlavním účelem tohoto článku je ukázat, k čemu všemu lze využít CCD měření získaná pomocí přístrojů dostupných i amatérským pozorovatelům, a upozornit na tento unikátní a přitom poměrně jasný objekt.

Abstract:
We present selected parts of an analysis of the photometric observations of the unique X-ray transient CI Cam (XTE J0421+560) which cover the interval after the 1998 outburst. The activity of this system continues even after this outburst, albeit with a considerably smaller amplitude. We show that, at present, the variations of brightness display the largest amplitude in the *I* filter (about 0.3 mag). We also show the complicated variations of the color indices and present a brief physical interpretation. We also searched for the rapid variations of brightness. The intranight variations appear to be very small, not larger than ~0.02 mag; the longt-term variations thus play the dominant role. The main purpose of this paper is to show that CCD data obtained by the instruments accessible also to the amateur observers can be very heplful in studying such an interesting, relatively bright and physically very important object, and to attract further observers.

1. Introduction
CI Cam (MWC 84) is the optical counterpart of the unique X-ray transient XTE J0421+560 (e.g. Frontera et al. 1998). The X-ray outburst was accompanied by a strong brightening in the optical (peak magitude *V*~9) and radio. It is usually interpreted either as a periastron passage of the compact object (Hynes et al. 2002) or as an instability of the disk around the compact object (Robinson et al. 2002). Recently, Šimon et al. (2006) discussed several possible scenarios and presented the arguments for the disk instability. The outburst occurred in an unusual system because the optical spectrum of CI Cam is classified as B[e] (e.g. Lamers et al. 1998). This outburst influenced both the photometric and spectroscopic properties of the system (e.g. Clark et al. 2000, Hynes et al. 2002). The compact object in the CI Cam binary is either a black hole (BH) or a neutron star (NS) (e.g. Robinson et al. 2002, Belloni et al.1999). The orbital period remains uncertain but Barsukova et al. (2005a, 2005b) claimed that it is 19.41 days.

The main purpose of this paper is to show what can be done with the CCD data and to attract further observers.

2. Observations and data collection
The Johnson *V* and Kron-Cousins *R* and *I* CCD images were obtained by the Maksutov telescope D=180 mm, focal ratio f:5.55, SBIG ST-6 camera, in the AI AS CR in Ondřejov (Czech Republic) in 1999–2004. The D=400 mm, f:4.25 telescope with the SBIG ST-7 camera and the *VRI* filters was used at the Brno Observatory (Czech Republic) in 1999–2000. Sets of one to five frames in each filter were usually obtained each night, with the typical exposure times 60–90 s. Searches for the intranight variations in *VRI* were carried out at several occasions. We added to our data those obtained by Barsukova et al. (2002, 2005b) and Henden & Sumner (2004).

The basic comparison star GSC 3723.54 with V=10.40 (star C1 in Fig.1) (Barsukova et al. 2002) was used in the Ondřejov and Brno observations. The brightness of this star in the R and I passbands was obtained from the stars C2 and C3 in Fig.1 which were measured on the Ondřejov and Brno CCD frames as the check stars calibrated by Henden (2002). The resulting magnitudes of GSC 3723.54 are R=9.97 and I=9.59.

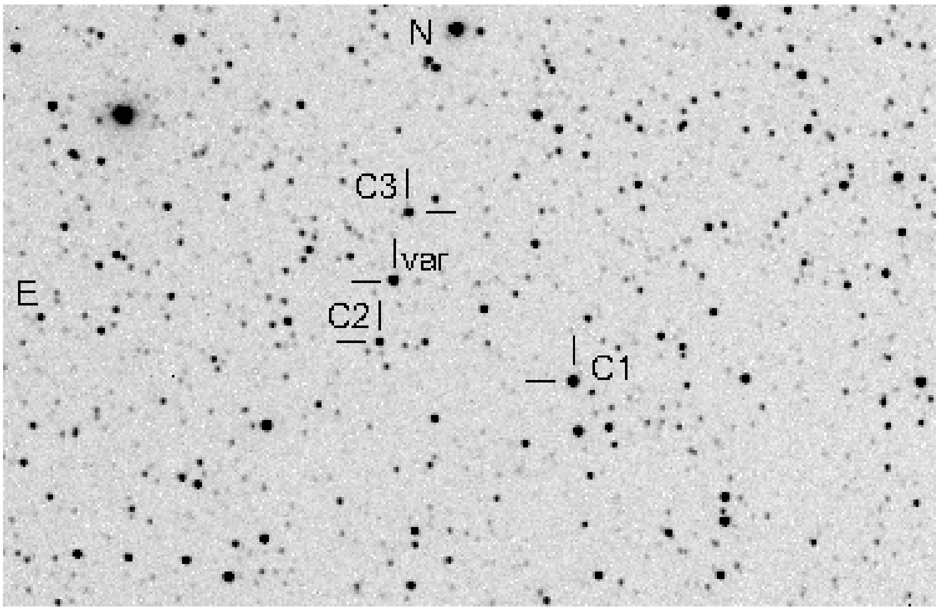

Fig.1: CCD image of the field of CI Cam in the R filter, obtained with the Maksutov telescope D=180 mm, f:5.55, SBIG ST-6 in the AI AS CR in Ondřejov on October 10, 2001, 21:33 UT. Exposure time was 90 s. The size of the image is 36 x 23 arcmin. North in up, East to the left. CI Cam is abbreviated as var. C1 is the comparison star while C2 and C3 are the check stars.

The fast photoelectric photometry was performed at the Loiano Observatory (Italy) at the Ritchey-Chretien f:8 focus of the 152 cm 'G.D. Cassini' telescope. We report a selection of the best observation runs.

3. Data analysis

Example of the photometric history of CI Cam in the V band is displayed in Fig.2. It captures the light curve after the outburst which occurred in 1998. We note the difference between the character of activity before and after the 1998 outburst. While the fluctuations with an amplitude of about 0.3 mag were common prior to 1998 (Bergner et al. 1995), a smooth profile with variations on the time scale of hundreds of days was observed in the post-outburst period.

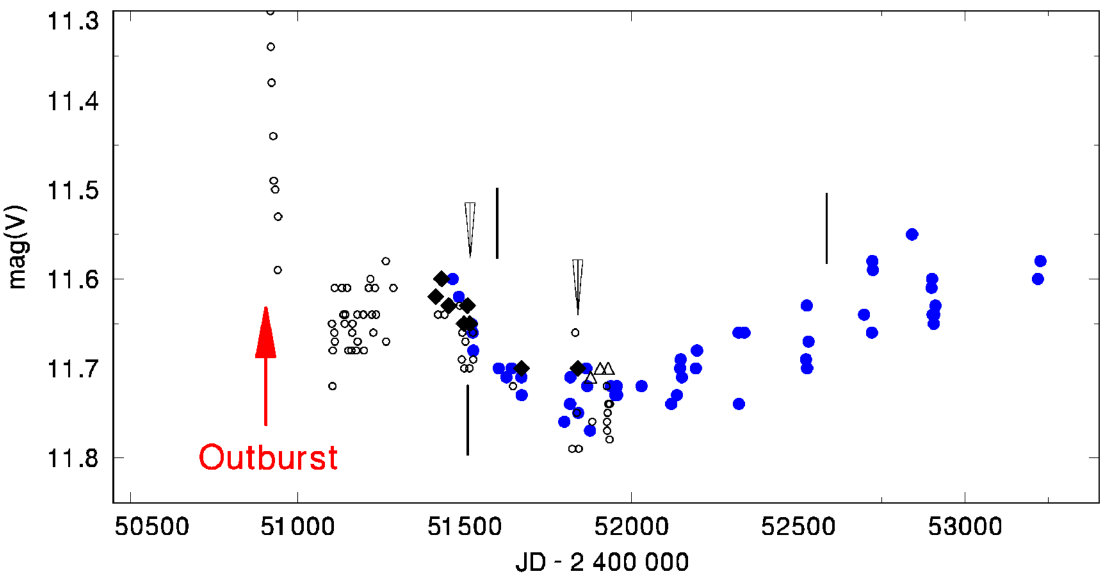

Fig.2: Part of the photometric history of CI Cam. The outburst maximum at *V*~9 is out of the scale. The vertical lines mark the epochs in which our fast photoelectric photometry was carried out while the open arrows denote the nights in which our dense series of *VRI* CCD images were taken. Adapted from Šimon et al. (2007).

3.1. Multi-color observations

As shown below, the *VRI* observations of CI Cam in the interval after the 1998 outburst are consistent during a single night either with a constant level of brightness or with only very small fluctuations. This suggests that the variations on the time scale of weeks and months were clearly dominant and that using a daily averages is thus meaningful (Fig.3). A careful investigation revealed that the *V* data for all the sets agree well. The *V* data by Barsukova et al. (2002) were used only for JD<2451300 because they displayed a larger scatter than the other sets in the remaining interval. Slight systematic differences were found for the *R* and *I* filters. The Ondřejov data were used as the reference ones because they were found to be in good agreement with those of Henden & Sumner (2004). The *R* and *I* Brno data were therefore interactively shifted by a constant with respect to the Ondřejov observations by ΔR= +0.07 mag and ΔI= +0.12 mag. The *R* band data of Barsukova et al. (2002) differed by -0.24 mag from the Ondřejov set; they were therefore corrected for this shift. We note that the spectrum of CI Cam contains numerous strong emission lines; the above-mentioned shifts may be attributed to the slightly different filters (Johnson *R* used by Barsukova et al. (2002) and Kron-Cousins *R* used by the remaining observatories), and to slight differences in the spectral sensitivity of the detectors.

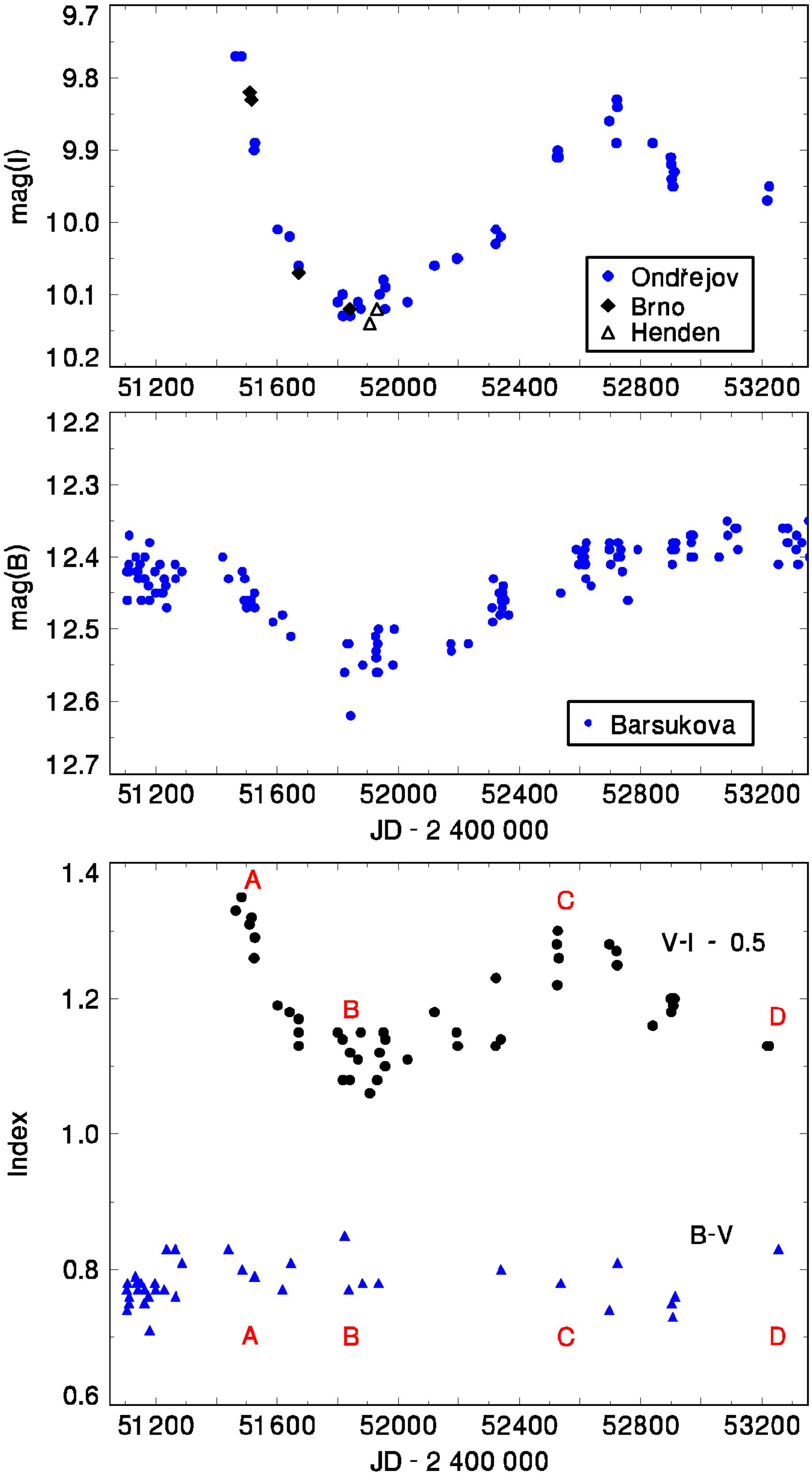

Fig.3: Examples of the light curves and color indices of CI Cam (daily means) in the post-outburst period (1998–2004). The outburst itself is out of the scale; its maximum occurred in JD 2450905. The labels A, B, C, D mark the important moments in the curves, used for the orientation in Fig.4. Adapted from Šimon et al. (2007).

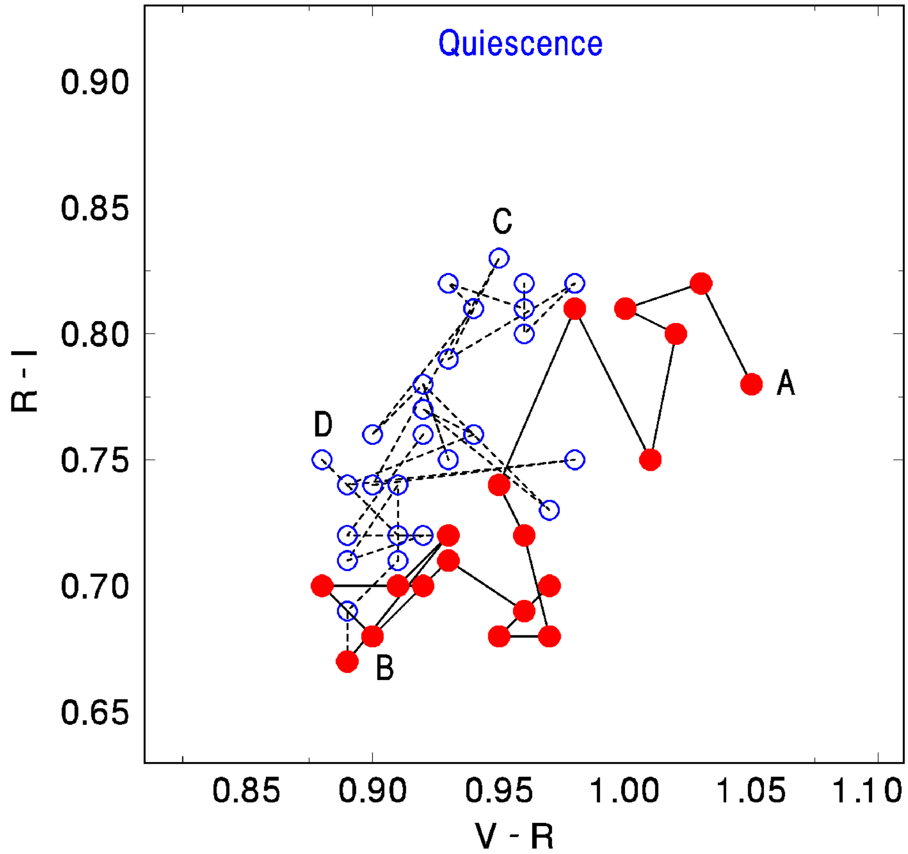

Fig.4: Example of the color-color diagram for CI Cam. The line connecting the points denotes the time evolution. The labels (A, B, C, D) mark the reference points in the appropriate color curves in Fig.3. The panel shows the color evolution of CI Cam after the outburst. Adapted from Šimon et al. (2007).

Examples of the color indices *B-V* and *V-I* vs. time are shown in Fig.3. The variations of *U-B* and *B-V* were mostly uncorrelated with those of *V-R, R-I* and *V-I*. Changes of the colors with the variations of the brightness display a hysteresis in the profile of *V-R* between the segment A-B and B-C. Although it is less prominent in *R-I*, it is more or less mirror-reversed with respect to *V-R*. On the other hand, this hysteresis is reduced in *V-I*.

An example of the color-color diagram is displayed in Fig.4. Notice the hysteresis in the profile of the *V-R* vs. *R-I* variations in quiescence. It was also found that the changes in *V-I* are largely decoupled from those of *B-V*; the influence of the variations of Hα is excluded here because this line falls into the *R* band. Also the amplitude of the *V-I* changes was found to be considerably larger than that of *B-V*.

3.2. Fast photometry

Fast *V* band photometry performed at the Loiano Observatory (an example in Fig.5a) covered various states of the post-outburst activity, especially the decline from a bump (Fig.2). Since this photometry was performed only to search for periodicities, no effort to determine the magnitude of the two objects (CI Cam and the comparison star) and to correct for the different sensitivity of the two beams was made.

The dense series of the *VRI* observations obtained at the Brno Observatory, able to detect the fluctuations on the time scale of about a minute, were found to be consistent with a constant level of brightness in all three filters (Fig.5b).

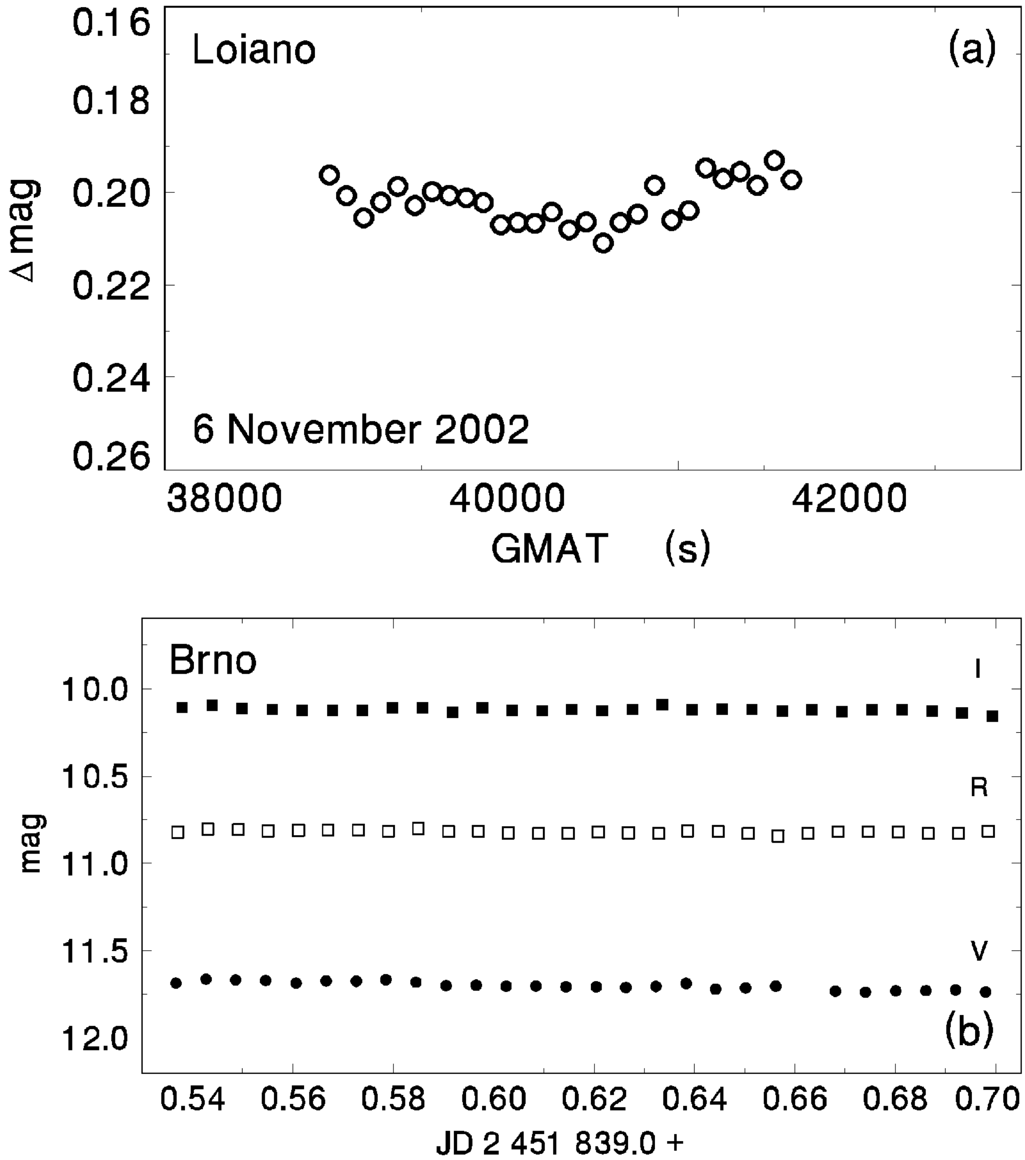

Fig.5: (a) Fast photoelectric observations of CI Cam. The abscissa is the Greenwich Mean Astronomical Time (GMAT), measured in seconds with the starting point at 12:00 UT; starting point at 12:00 UT of November 6, 2002 (JD 2452585.0). The ordinate is the difference of magnitude between CI Cam and the comparison star. No calibration was made. The data binned with 100 s are plotted. Adapted from Šimon et al. (2007). (b) The series of *VRI* CCD measurements obtained in Brno.

4. Discussion

The light changes after the outburst: Our photometric observations of the unique X-ray binary CI Cam show that its complicated optical/near-IR activity was still continuing after the 1998 outburst, albeit with lower amplitudes. Nowadays, the most prominent variations are observed in the *I* band, with a decreasing amplitude toward the *V* (and *B*) passband. Our long-term light curves display smooth profiles in the form of bumps on the time-scale of months – this is different from the pre-outburst fluctuations observed by Bergner et al. (1995). The outburst lead to the suppression of the night-to-night variations.

Color variations in quiescence: We argue that the variations of the optical/near-IR continuum significantly contribute to the color changes both in outburst and in quiescence after the 1998 event. The reason is that, as regards the sense of the time variations, the profiles of the changes of the *V-R*, *R-I* and *V-I* indices in quiescence are similar to each other. Dominant line(s) changes would be expected to give rise to rather independent variations of the indices. Fig.3 shows that the changes in *V-I* are largely decoupled from those of *B-V*.

We interpret a hysteresis in a part of the profile of the *V-R* vs. *R-I* variations (Fig.4), and the mirror-reversed shifts of the *V-R* and *R-I* vs. the *I* mag in quiescence in terms of the contribution of the very strong Hα emission with respect to the combination of the neighboring continuum and weaker emission lines.

We propose that the fact that the variations of *U-B* and *B-V* are largely decoupled from those in *V-R*, *R-I* and *V-I* in quiescence can be explaied if a division of the dominant contributions of the superimposed spectral components occurs in the *V* filter: free-free emission from the wind and/or the envelope dominating in the red region (Clark et al. 2000), and the (pseudo)photospheric emission of the mass-donating B[e] star dominating in the blue region.

A cycle of 1100 days was suggested by Barsukova et al. (2002) for the profile of the smooth photometric changes of CI Cam after the 1998 outburst. Our longer time series indeed displays two *R* band maxima separated by about 1350 days. However, since the smooth brightness variations started only after the 1998 outburst, it would be premature to ascribe them to a true cycle. Nevertheless, cycles of a comparable length are observed in some B[e] stars (see Miroshnichenko (1998) for a review), so CI Cam would not be unique in this respect.

Fast photometry: An examination of the differential magnitude of CI Cam revealed intranight variations in four nights. An example is shown in Fig.5a. These changes have the form of bumps or flickering on the time scale of about an hour. The period search on the individual observation runs by the code Period 98 (Sperl 1998) did not reveal significant periodicities in the range of 0.02–1000 sec. We find low-amplitude (~0.02 mag) intranight variations of CI Cam in four nights in the post-outburst period; they have a form of bumps on the time scale of about an hour. These results are more or less consistent with those obtained by Clark et al. (2000) and Barsukova et al. (2002) and help us cover various epochs of the post-outburst activity (Fig.2). They show that the smooth variations of brightness without any coherent intranight changes started immediately after the 1998 outburst (Fig.2). Long-term activity on the time scales of weeks and months thus plays the dominant role in the activity of CI Cam at present.

5. Conclusion

We inform on selected results of our photometric study of the unique binary system CI Cam over several years after its 1998 outburst. We show the impact of the outburst on the photometric behavior of CI Cam. We also show that the long-term variations dominate the observed activity at present. The intranight variations appear to be very small, not larger than ~0.02 mag. We show that CCD data obtained by the instruments accessible also to the amateur observers can be very heplful in studying such interesting and physically important objects.

Acknowledgements:

The support by the grant 205/05/2167 of the Grant Agency of the Czech Republic and the project ESA PRODEX INTEGRAL 90108 and ESA PECS project 98023 is acknowledged.

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OPEN EUROPEAN JOURNAL ON VARIABLE STARS
November 2007 http://var.astro.cz/oejv ISSN 1801-5964

Reliability of the INTEGRAL OMC optical data

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Abstract:

Our effort has been devoted to the analysis of INTEGRAL OMC data. We judged the reliability of the OMC optical data. The data proved to be sufficient for some individual optically variable objects and the analysis can hence leads to publishable results.

Eclipsing binary V1011 Cyg is a very good example. Quality of the optical data allowed us to analyse the model of this Algol-type binary. The temporary version of our model shows two interesting features of the phased light curve. The first is unequal flux before and after the primary minimum. The depth of the primary minimum is 0.5 mag and the difference of the brightness in the maximum before and after minimum is 0.1 mag. The second is shift of the secondary minimum to the phase 0.51. Luminosity ratio is 1.59. Our model will be finished in the beginning of the year 2007. (Model of the eclipsing binary V1011 Cyg, Sobotka, P., Zasche, P., 2007, OEJV, in preparation).

Optical OMC data are much more useful when put together with other sky surveys. We studied comparison between OMC photometric data and surveys V filtered data and we conclude that they are in very good agreement. Good examples are unique variable star XX Oph (Sobotka 2004) and the long periodic pulsating star GS Gem. The OMC data combined with surveys data show that GS Gem is double periodic star with periods P_0=1125 days P_1=137 days. Theoretically derived period ratio from literature does not agree with our results. The relevant article is ready, but we are waiting for the spectra. (GS Gem is a double periodic semiregular star, Sobotka, P., Ladra, J., Brát, L., Dubovský, P.A., IBVS 2007, in preparation.)

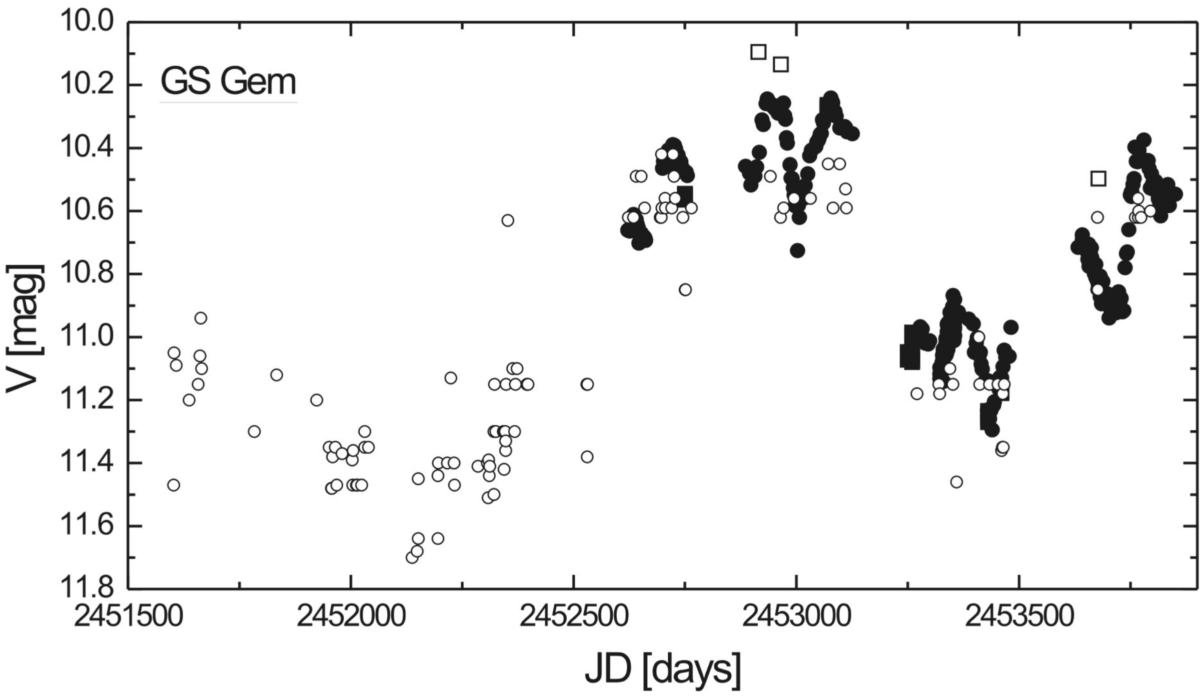

Figure 1: Light curve of GS Gem from 2000 to 2006. Filled circles represent CCD V-filtered observations of ASAS-3 (Pojmanski 2002), filled squares are CCD V-filtered INTEGRAL OMC (Mas-Hess et al. 2003)) observations, the TASS (Droege 2002) magnitudes are plotted as open squares, while visual observations of the MEDUZA group are shown as open circles.

We also used OMC data to help analyze optical behavior of 45 variable stars observed by the Czech MEDUZA group. We found many discrepancies with the General Catalogue of Variable Stars GCVS (Kazarovets et al. 2006).. In some cases, first ever light elements were derived. Thus, OMC helps to see light changes mostly in pulsating variables in great detail. We compared current photometric data with visual estimates made by amateur astronomers. (Šindelář, L., Brát, L., 2007)

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OPEN EUROPEAN JOURNAL ON VARIABLE STARS
November 2007 http://var.astro.cz/oejv ISSN 1801-5964

The Virtual Observatory and its Benefits for Amateur Astronomers

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The contemporary astronomical instruments have been producing the unprecedented amount of data. The largest part of this "data avalanche" is being produced by deep all-sky surveys yielding terabytes of raw data per night. Such a great data volumes can hardly even been reduced by automatic pipelines running on supercomputer grids but it is impossible to exploit fully their content by a small group of professional astronomers in the interested research teams. New tools for collaborative work with heterogeneous data sets spread over distant servers are being developed in the framework of the Virtual Observatory (VO). As many VO resources are freely available on the Internet, a new opportunity opens for the amateur astronomers to do professional research using these tools in an Internet browser on a moderately fast connection. We give short overview of current and future sky surveys producing data on a millions of targets - hence the term Megasurveys, and we introduce the basic principles of Virtual Observatory and its current applications.

Megasurveys

The astronomy at the beginning of 21st century is mostly characterized by the avalanche of data being produced by the large CCD mosaics at even small telescopes, hundreds of spectra per exposure on multi-object spectrographs or 3D data cubes from radio telescope arrays. Considerably higher speed of telemetry and the effective on-board compression makes the current astronomical satellites the large contributors to data archives as well. There is, however, another source of TB size data sets that is not so obvious - the theoretical models of various physical processes (stellar evolution models, galaxy interaction, cosmological evolution...) run on supercomputers and their distributed networks. Let's have a look at the most important sky surveys that could be of particular interest of the amateur astronomers:

Sloan Digital Sky Survey (SDSS)

The 2.5m telescope at the Apache point, New Mexico, USA, harnessed with the set of thirty 2kx2k CCD chips (organized in six groups with five colour filters each) and multi-object spectrograph with 640 fibres [http://www.sdss.org/background/telescope.html] has collected in first five years the 5-colour photometry of more than 215 millions objects and about 1.1 million of low resolution spectra (R=3000, 3200-9200 A), among them 150 thousands stars, 675 thousands galaxies, 90 thousands quasars and more than 12 thousands objects of unknown class [http://astro.ncsa.uiuc.edu/catalogs/dposs] .

DPOSS

Digital Palomar Sky Survey with the extension of Southern sky is the one of the primary sources for creating optical star finding charts [http://astro.ncsa.uiuc.edu/catalogs/dposs] .

Infrared surveys

The most cited infrared surveys are 2MASS [http://astro.ncsa.uiuc.edu/catalogs/2mass/index.jsp] and DENIS [http://cdsweb.u-strasbg.fr/denis.html] as a result of the 5-year project of monitoring the sky on 1-m class telescopes from Chile in multiple NIR ranges.

Microlensing surveys

Specialized, originally microlensing surveys OGLE and MACHO as well as MOA and planet hunting project WASP [http://www.cv.nrao.edu/fits/www/yp_survey.html] are due to its nature the fine source of precise photometric light curves of many millions of objects.

Space observatories and radiotelescopes

Although the archives of well-known satellite observatories like Chandra, HST, Spitzer, ISO, IUE, XMM-NEWTON, INTEGRAL and many others have been already opened or will be opened in near future to public, the nature of its data and the lack of final science-ready products make them rather cumbersome for the amateurs. The same concerns the raw radio telescopes data, although there are already science-ready surveys available.

The History of Virtual Observatory

To handle effectively the data avalanche, the new research infrastructure had to be established just at the very beginning of 21st century. The astronomers were inspired by facilities common in the research of elementary particles (the technology behind the huge particle accelerators). The key issue there is the decentralization of data storage, joining the computer power in a seamless way using the GRID architecture and providing on-site high level service requiring only exchange of results not raw data among nodes in distinct research centres [http://www.gridbus.org/papers/WeavingGrid.pdf]. The result of the introduction of the so called Open Grid Service Architecture (OGSA) [http://www.globus.org/alliance/publications/papers/ogsa.pdf] in astronomy lies in the heart of the European leading project of Virtual Observatory – ASTROGRID [www.astrogrid.org] .

The need of the effective exploration of the SDSS data led in 2000 to the establishing the US founded project called NVO (National Virtual Observatory) [www.us-vo.org] . In the framework of NVO the basic infrastructure was devised for the queries on distributed servers, cross-matching catalogues and exchanging images of sky at required coordinates. The so called SkyNode servers with copies of SDSS archives were installed worldwide to evenly distribute the requests for archive access from various places [http://skyserver.org/mirrors] .

The Virtual Observatory ideas were met quickly at CDS Strasbourg. The experience with bibliography and catalogue databases led to the recognition of importance of separation of data itself from meta-data (semantic description of variables). Hence the VOTable standard using the UCDs was established. Soon the well-known services like SIMBAD, VIZIER and ALADIN were quickly changed in its back-end part to VO-compatible services allowing better interoperability of CDS databases with external sources in a seamless and scalable way [http://cdsweb.u-strasbg.fr/avo.htx] .

All major astronomical data centres in the world have been adopting the basic VO infrastructures in the newly developed applications and services and soon the international collaboration on VO standards has been established under the head of International Virtual Observatory Alliance (IVOA [www.ivoa.net]). The IVOA organizes IVOA Interoperability meetings twice a year to assure the standardization of data formats, protocols and query language in all current and future VO applications but its activity is based mostly on the voluntary work.

After six years the VO has presented its capabilities and powerful features in a number of projects in various fields of astronomy, like searching of brown dwarf candidates, discovery of obscured quasars, research of post-AGB stellar evolution, estimating fundamental cosmological parameters and many others. The amount of data planned to flow from future large telescopes and satellites (LSST, HERSCHEL, PLANCK, GAIA, ALMA, SKA) could be hardly effectively exploited without the VO infrastructure and ideas. All large projects today have to allocate about 30-50% of budget to the processing and data handling software, including the VO interface.

Basic principles of VO

The VO infrastructure is based on common data format - VOTable. It is a XML document describing the structure of a data table, the names and physical meaning of data variables (so called meta-data) using Universal Contents Descriptors (UCD) and data itself in form of ASCII or binary table and/or FITS file [http://vizier.u-strasbg.fr/doc/VOTable] .

The important aspect of VO - its orientation to (locally provided) services requires the dynamically updated list of available services, their descriptions and servers providing these services. This is provided by the distributed network of VO registries, working like the Domain Name Service servers (DNS) for Internet. Some of the URLs look like ivo://provider/collections.

For seamless exchange of data the VO developers were inspired by commercial business to business (B2B) infrastructure of Web Services (WS) using the protocol SOAP to exchange information in common format similar to HTTP transfered XML files. The service parameters are described by Web Services Description Language (WSDL). For access to most of the data, several VO protocols have been invented [www.ivoa.net/Documents] :

ConeSearch - for searching the vicinity of given position on sky in catalogues. It returns the VOTable with list of objects contained in circle (or square) of given size around particular coordinates.

Simple Image Access protocol (SIAP) returning the images in given format of given size of objects at given coordinates.

Simple Spectra Access Protocol (SSAP) returns spectra in given spectral range of object at given coordinates

Simple Line Access Protocol (SLAP) returns list of spectral lines from various line-lists placed around the particular wavelength/energy or in given spectral range.

For messaging of transient events (microlensing event, gamma ray burst, exoplanet transit) the XML message called **VOEvent** is replacing the astronomical telegrams. It has been used mainly for quick follow-up observations of the event by robotic telescopes as it is well-structured and thus machine readable.

For querying of archives the special language **ADQL** (Astronomical Data Query Language) has been developed which allows to limit the search to particular region around given position using word REGION. Most important is the keyword XMATCH for cross matching several catalogues with given level of statistical confidence (in sigmas).

VO-compatible applications

There is a couple of applications understanding various Virtual Observatory protocols or visualizing VOTables [http://www.ivoa.net/twiki/bin/view/IVOA/IvoaApplications] . Their number has been continuously increasing and more and more astronomical tools have been developed already with VO in mind, or the VO standards have been added to the legacy applications.

Probably the most interesting for amateurs is the **Aladin** applet and Java applications [http://aladin.u-strasbg.fr] recently augmented by **VOSpec** [http://esavo.esa.int/vospec] for preview of spectra. Quite important for analysis of spectra are also **SPLAT-VO** [http://star-www.dur.ac.uk/~pdraper/splat/splat-vo] and the quite complex analysis tool **SpecView** [http://www.stsci.edu/resources/software_hardware/specview] .

The identification of unknown sources in given sky image and estimating their magnitudes can be made easily with **WESIX** (a web based interface to famous SExtractor with cross matching interface). The user can even upload his own image [http://nvogre.phyast.pitt.edu:8080/wesix] for the private analysis.

New science with VO

The VO infrastructure allows not only work with huge distributed data sets (using the cross matching of large catalogues), but provides the efficient tools for multi-wavelength research. Thus a new yet unknown types of objects may be found (e.g the obscured quasars – Padovani et al. 2004) or very rare objects that escape the attention looking only in one spectral range, e.g. the post-AGB behaviour of stars - Tsalmantza et al.(2006) or brown dwarfs of L and T class (Solano et al. 2006). Another example of VO power is the **VOSED** – the Spectral Energy Distribution Builder that can estimate the bolometric magnitude of the object by direct integration of fluxes obtained by different instruments (from radio to gamma) [http://sdc.laeff.inta.es/vosed/index.jsp] .

Theoretical Virtual Observatory (TVO)

The current theoretical simulations of galaxy or cluster evolution or magneto-hydrodynamic models of plasma flows around AGN produce terabytes of data comparable by nature to the real observations. So it was quite obvious to use the VO infrastructure for handling this data. There is even the concept of the **Virtual Telescope** which "observes" the results of simulation with given blurring and PSF of a real telescope and then sophisticated methods of VO can be used to search for the similar image in real observation archive of given telescope. (see [http://cds.u-strasbg.fr/twikiDCA/pub/EuroVODCA/KickOff/Trieste_presentation.ppt]
or [http://www.laeff.inta.es/svo/Laeff/svo/Cervino_IA.ppt]).

Is VO the astronomy without telescopes?

The current astronomy has been gradually changing the concept of the astronomical observation. The most common practice today - writing a proposal, going to the telescope, observing there with a assistant, getting data, bring it home, reduce it, analyze and publish - will probably change soon mostly in the pattern: look at web using VO tools, play with data, analyze it, publish. Of course, the most important is to have the bright idea about the relations of some objects in Universe and ask the interesting questions pushing the knowledge of the mankind further. There is a number of aspects foreseeing the changes in the organization of observations:

9) More and more telescopes today are (at least partially) switching to service observation (executed by the staff on behalf of principal investigator, but without his/her presence)

10) Many telescopes operate in assisted (Keck) or full remote mode (e.g. Palomar P60 [http://www.astro.caltech.edu/~derekfox/P60]), there is a growing number of robotic telescopes (Liverpool 2m at La Palma [http://telescope.livjm.ac.uk]) even for spectroscopy observation (TSU 2m

[http://schwab.tsuniv.edu/t13.html] , STELLA [http://www.aip.de/stella]) according to given schedule .

11) Some large telescopes can work only according to fixed schedule due to their construction - e.g. SALT [http://www.salt.ac.za] or HET [http://www.as.utexas.edu/mcdonald/het/het.html] .

12) The quality of observation cannot be estimated immediately without going to some quick-look pipeline (e.g. interferometry, 3D spectroscopy). Even for the final reduction the astronomer has to trust the automatic pipelines, he cannot spend half year learning all the tricky behaviour of given instrument and setting the couple of parameters in various reduction tasks. Moreover, the pipelines provide the homogeneous sets of equally good (or bad) quality without the personal bias.

13) Almost all sources of massive data sets are publicly available after some short proprietary period (1 or 2 years) or immediately. There are projects expecting the data to go to public immediately after reduction (e.g. LSST [http://www.lsst.org]).

Summarizing all together we can imagine that most observations from future telescopes and satellites will go to the automatic pipelines and the results will be quickly available for anybody in VO. There is, however, still difference in attitude between survey telescopes and pointed observation (where usually the long proprietary period is applied), but this is expected to change as there is a lot of justifications confirming that collaborative effort in science is more rewarding for all participants than personal benefits of private usage of data - sitting on data, sometimes referred to as Data Jealousy .

VO - the opportunity for everyone

The important aspect of free data availability together with efficient VO infrastructure and sophisticated tools is the opportunity to overcome the phenomenon of Digital Divide [http://en.wikipedia.org/wiki/Digital_divide] . It says roughly that the economically strongest countries preserve their hegemony through the access to the advanced (mostly digital) technologies. Similar problems in astronomy (e.g. access to largest telescopes) may be circumvented by public available VO-compatible archives of these telescopes.

But it also means that an experienced amateur astronomer or student of astronomy with bright ideas may conduct important astronomical research at a professional level using the equal tools and data as the professional astronomer at highly-ranked institution.

VO and the astronomical community

The VO has already proved itself as a useful tool of current astronomical research but it is considered to be indispensable for the research conducted with future giant telescopes (and satellites). It has been gaining the wide acceptance of major funding agencies (NVO has been funded by NSF, ASTROGRID by PPARC, EURO-VO project by EU FP6) but also in the general astronomical community. At the IAU General Assembly in Prague (2006) there had been several days devoted to the examples of scientific exploitation of current VO and to the questions of astronomical data management in general. Most important issues were articulated in the Astronomer's Data Manifesto [http://arxiv.org/pdf/astro-ph/0701361] .

Conclusion

Despite many (yet unsolved) issues of the Virtual Observatory (e.g. privacy/openness of astronomical archives, the data quality control, problems of unique semantic descriptions) the VO has been in active development, it is gaining massive support and seem to be the efficient tool for coping with the data avalanche threatening otherwise to bury future astronomical research in the huge data mess. If used properly in open collaborative environment, it can boost our knowledge of universe considerably, especially in fields requiring large-scale statistics, investigation of extremely rare classes of objects, synoptic and multispectral research as well as comparison of huge databases of theoretical models with observations. The VO allows the data mining of distributed databases limited only by the phantasy of the researcher. So it is a excellent opportunity for involvement of amateur astronomers in the professional research as well.

Acknowledgments

This work was supported by grant GACR 205/06/0584 and EURO-VO DCA WP6.

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OPEN EUROPEAN JOURNAL ON VARIABLE STARS
November 2007 http://var.astro.cz/oejv ISSN 1801-5964

Visual and CCD observing of cataclysmic variables and related objects

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Abstrakt (IN CZECH):
Diskutujeme perspektivy a možnosti spojeného úsilí vizuálních a CCD pozorovatelů proměnných hvězd. Ukazujeme to na několika příkladech velice zajímavých a silně aktivních kataklyzmických proměnných a rentgenových dvojhvězd, jako je například GK Per nebo V Sge. Vhodná strategie při pozorování námi diskutovaných druhů objektů je zkombinovat velice husté pokrytí dlouhodobých změn jasnosti, které poskytují vizuální pozorování, s barevnými indexy a hledáním rychlých změn včetně orbitální modulace, jež umožňují CCD měření. Uvádíme i přednosti a nedostatky obou metod pozorování.

Abstract:
We discuss the perspectives and possibilities of joint effort of the visual and CCD observers of variable stars. We show it on several examples of very interesting and strongly active cataclysmic variables and X-ray binaries, e.g. GK Per or V Sge. A combination of the very dense coverage of the long-term variations of brightness, provided by visual observations, with the color indices and a search for rapid changes including the orbital modulation provided by the CCD measurements appears to be a suitable strategy of observation of these kinds of object. We also list the advantages and disadvantages of both methods of observation.

1. Introduction
More and more amateur observers have the possibility to obtain CCD observations of variable stars. One may thus ask whether visual observations still make sense. It is also desirable to search for a suitable and efficient strategy of the amateur CCD observing. We will show that a "symbiosis" of the visual and CCD observations gives us good perspective.

It is useful to start with a comparison of the visual and CCD observations.

Visual observations enable us to obtain very long time series, in some cases spanning about 100 years. This kind of observation provides a dense coverage of the long-term light changes. The typical precision of a single visual observation is about 0.1 mag. This enables us to carry out meaningful observations of objects with sufficiently large amplitudes (>1 mag). It is desirable to have observations of a given object which come from several observers. This will enable to assess the reality of the features on the light curve. It is also important to note that visual observations are suitable for the kind of the light variations which display relatively smooth light curves, or periodic phenomena. For example, flare stars (i.e. young M type stars) which display occasional fast, non-periodic flares are NOT suitable targets for visual observers because it would be hard to prove the reality of such flares on the visual light curves.

Generally, **CCD observations** are more precise (~0.01 mag) than the visual ones. Most CCD observations concentrate on important, but short phenomena like outbursts. Their time series are thus often short and fragmented, since CCD observers usually do not concentrate on obtaining long-term light curves. However, CCD observations have an important advantage – they allow us the observe in various filters, and so to follow the color variations which accompany the light changes. What is important, the CCD images can be stored and hence it is possible to re-measure them, for example if a comparison star proves to be variable or if a verification of the measured magnitude of the variable is needed. CCD observers can also follow rare and/or fast intranight non-periodic phenomena (e.g. flares, flickering) and, of course, the orbital modulation.

2. Examples of active objects
Let us show the power and perspectives of combining the visual and CCD observations of variable stars on some examples of cataclysmic variables and X-ray binaries. These kinds of object usually display strong activity on various time scales, from seconds to days, months and years. Usually the variations on the long time scales have a considerably larger amplitude (several magnitudes) than the rapid changes.

V Sge

is a unique, very active and relatively bright object (usually about 10.5–12.5 mag). It is an eclipsing binary with the orbital period of 0.514 d (Herbig et al. 1965). It is a super-soft X-ray source (Greiner & van Teeseling 1998), which is a unique, luminous subtype of cataclysmic variable. V Sge displays a strong activity in both the optical (e.g. Herbig et al. 1965, Šimon & Mattei 1999) and X-ray passbands (Greiner & van Teeseling 1998). It is also a representative of V Sge stars (Steiner & Diaz 1998).

An instructive comparison of visual and photoelectric observations is shown in Šimon & Mattei (1999, their Fig.1). Visual data allow us to create a densely covered long-term light curve while photoelectric data confirm the very complicated profile of this curve. Of course, CCD photometry can do the same and is more accessible to the amateurs. In addition, the photoelectric data provide us with the color indices which accompany the light changes. This can be seen in Fig.1ab which displays a part of the complicated activity including the rise from the low to the high state of the optical brightness. We can see that *B-V* decreases in the upper part of the transition. On the other hand, *U-B* remains constant (see Šimon & Shugarov (1999) and Šimon et al. (2001a) for more).

We note that it is desirable to correct the measured magnitude of V Sge for the light contribution of its close optical companion, especially when V Sge is in the low state of its activity. *UBV* magnitudes of this companion are given in Herbig et al. (1965).

The photoelectric and CCD data can be used also for the investigation of the relation between the long-term activity and orbital modulation. This approach can be seen in Fig.2 which uses the intensity scale instead of the magnitude scale. We note that the amplitude of the modulation is considerably lower in the high state than in the low state on the magnitude scale while it remains about the same in the intensity scale in both states (or even slightly increases in the high state). However, it can be readily seen that the profile of this modulation undergoes dramatic changes between the high and low state of the long-term activity. The largest changes of the profile of the modulation occur around the secondary minimum. While this minimum is almost absent in the low state, it becomes almost as deep as the primary one in the high state. More details can be found in the paper by Šimon et al. (2002).

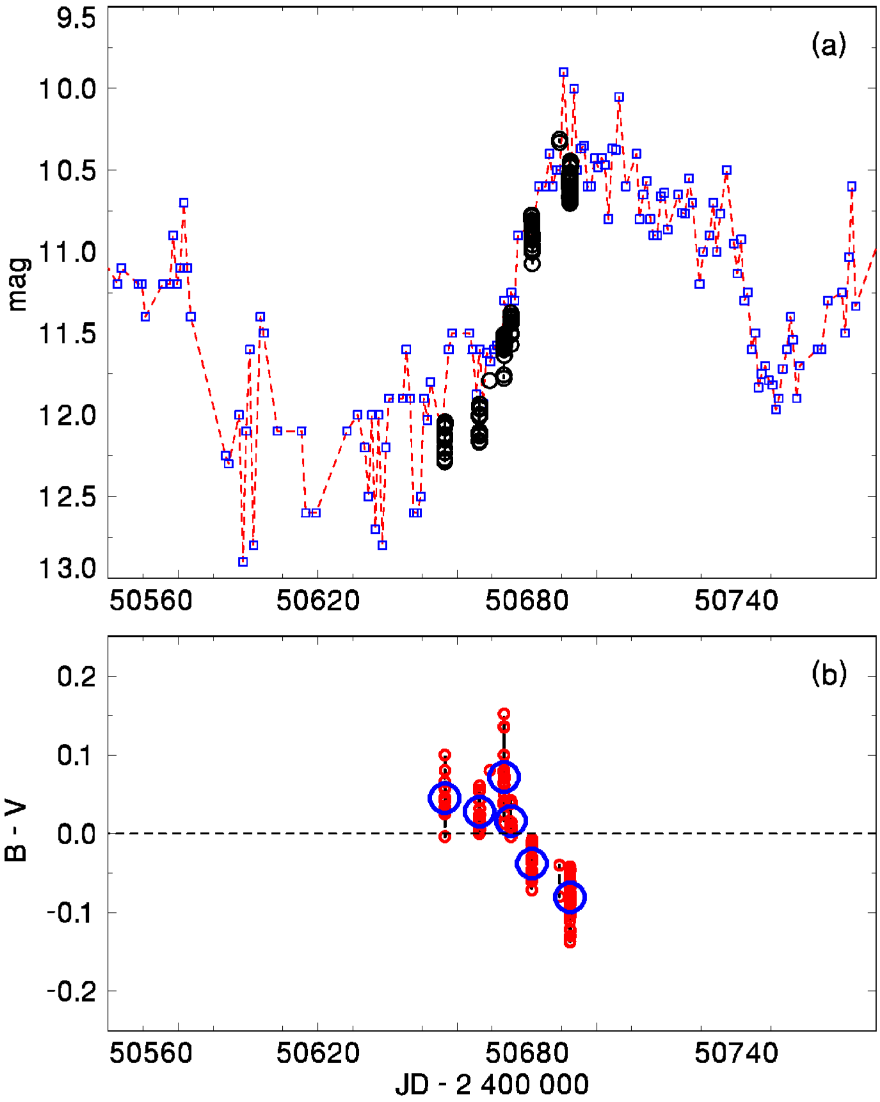

Fig.1: (a) A part of the long-term light curve of V Sge. The visual data (open boxes) provide us with the information on the long-term activity while the photoelectric measurements (open circles) were used for the investigation of the color variations during the rise from the low to the high state. (b) Evolution of the color index *B-V* during the rise from the low to the high state. The large open circles mark the nightly means while the small open circles denote the individual observations. Adapted from Šimon & Shugarov (1999).

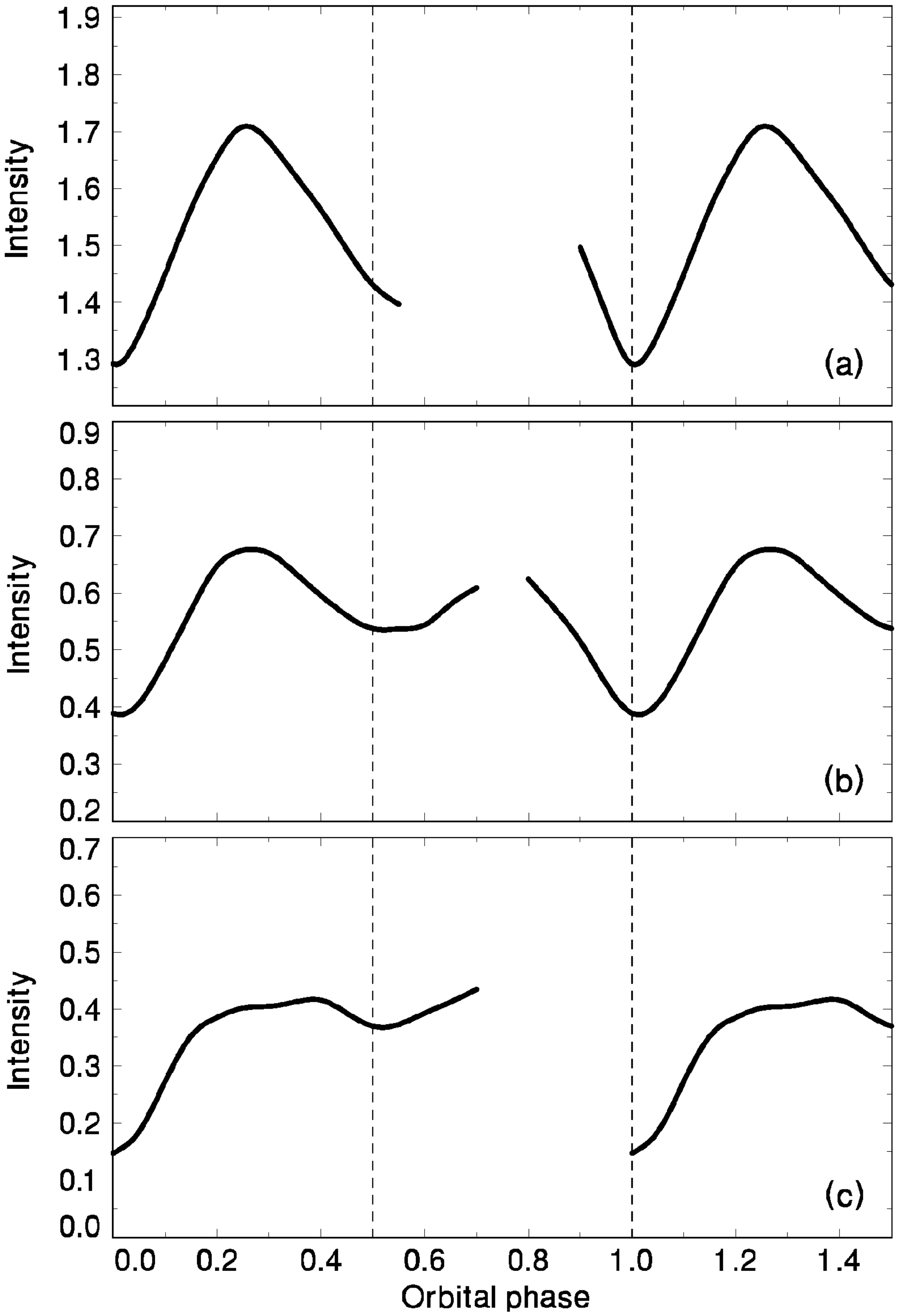

Fig.2: The mean profile of the orbital modulation in V Sge, determined from the photoelectric and CCD observations, sorted into three groups according to their long-term intensity and folded with the orbital period; (a) high state, (b) transition between the low and high state (or medium state), (c) low state. Most observations are in the *V* filter, only some data in Fig.a were unfiltered. In each panel, the orbital light curve is composed of several shorter data sets which were slightly shifted in intensity to minimize the scatter. The intensity is equal to unity at 11 mag (*V*) (this value roughly corresponds to the mean magnitude of the long-term light curve). Adapted from Šimon et al. (2002).

QR And

is a relatively bright optical counterpart of the supersoft X-ray source RX J0019.8+2156 (Beuermann et al. 1995). It varies between about 11.5 and 12.5 mag in the photographic passband (Greiner & Wenzel 1995). Since its color index *B-V* is always close to zero, the variations are roughly the same also in the visual passband. Both the orbital modulation with the period of 15.85 hr and long-term variations are observed. The profile of the orbital modulation resembles that of V Sge in its medium state (Fig.2b) and its amplitude is about 0.5 mag. More details can be found in Šimon et al. (2001b).

U Gem

is a well-known dwarf nova monitored by visual observers. Its orbital modulation with the period of 4.246 hr (e.g. Kraft 1962) undergoes dramatic variations between quiescence and outburst. The orbital modulation has a large amplitude (about 1 mag) in quiescence (e.g. Mumford 1964). It displays a broad bump with a deep eclipse on its declining branch. During outbursts, the eclipses are very shallow, with the depth of about 0.05 mag(*R*), and the bump is absent (Fig.3b). Fig.3a shows that the visual data define the profile of the outburst very well and enable us to determine the phase of this event covered by the CCD measurements.

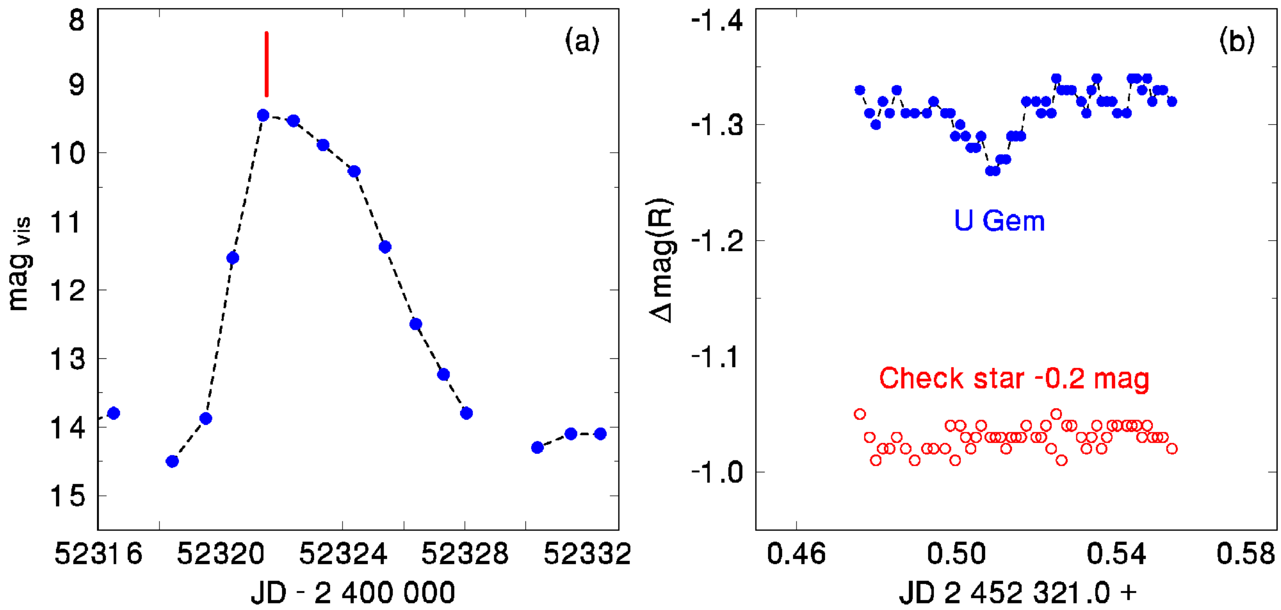

Fig.3: (a) The profile of the February 2002 outburst of U Gem. The circles represent the one-day means of the AFOEV visual observations. The vertical line marks the center of the *R* band CCD observation. (b) An example of the eclipse observed in the *R* band. The depth of the eclipse is only about 0.05 mag during outburst. The observations were obtained by Maksutov 180/1000 mm, SBIG ST-6 in the Astronomical Institute AS CR in Ondřejov. The exposure times were 90 sec. The relative magnitudes for both the variable and the check star with respect to the comparison star USNO-A2.0 1050-05472483 are shown. Adapted from Šimon (2003).

DO Dra

is an intermediate polar (e.g. Patterson et al. 1992), which means that its white dwarf has a magnetic field. This field disrupts the inner region of the accretion disk and the accreting matter thus flows onto its magnetic poles instead of the equator as is the case in non-magnetic cataclysmic variables. DO Dra is an optical counterpart of the X-ray source 3A 1148+719 (Patterson et al. 1982). It displays rare outbursts with an amplitude of about 5 mag from the quiescent level of about 15 mag (e.g. Šimon 2000b). DO Dra is active also during quiescence. Its brightness fluctuates on the time scale of days and weeks (Fig.4). Color indices are needed to identify the source and nature of these fluctuations, i.e. whether they are caused by the processes in the disk or in the mass-donating companion. Also color indices of the rare outbursts are needed to assess the relation of the outbursts in DO Dra to the outbursts in “ordinary“dwarf novae. DO Dra displays rapid variations during quiescence and outbursts (e.g. Patterson et al. 1992, Szkody et al. 2002) which are related to the rotation of the magnetized white dwarf. During outbursts, their full amplitude is about 0.1 mag(*V*) (Szkody et al. 2002). The spin period of the white dwarf is 529 seconds, but the observed periods can be also half this value. Even other similar periods appear, which is caused by a complicated distribution of the accreting matter in the binary.

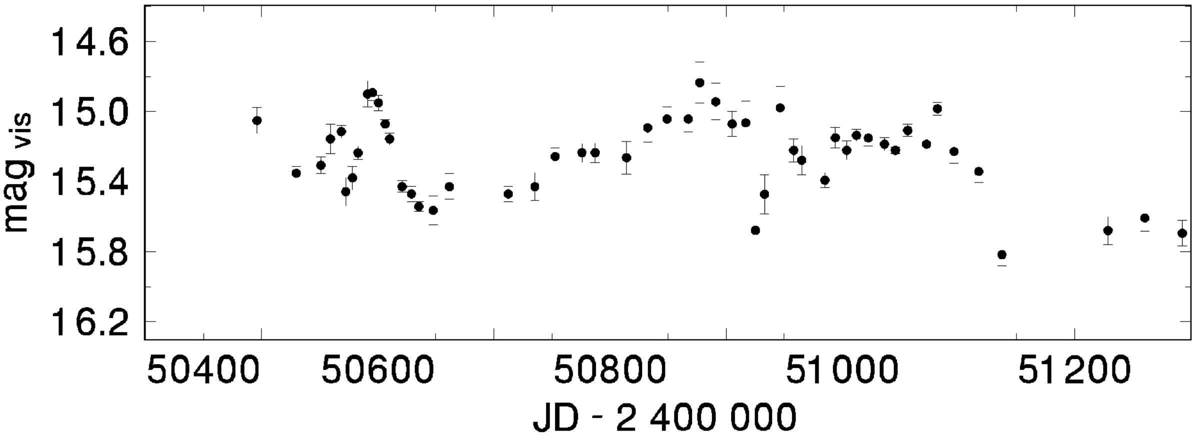

Fig.4: Example of the variations of the quiescent level of brightness in the intermediate polar and dwarf nova DO Dra. The points are bins mostly of seven visual observations, the bars represent their rms error. Adapted from Šimon (2000b).

CH UMa

is a dwarf nova with a long orbital period of 8.23 hours (Friend et al. 1990). It was identified with an *Einstein* X-ray source 1E1003+67 by Becker et al. (1982). CH UMa appears to exhibit several types of outburst (e.g. Šimon 2000a), which makes it a very interesting object for both visual and CCD observers. In addition, CH UMa appears to undergo variations of the brightness in quiescence (Fig.5) on the time scale much longer than the cycle-length of the outbursts. Moving averages of the visual data show smooth variations but it would be very desirable to confirm them by the CCD data and to resolve their finer structure. Also here, color indices are needed to identify the source and nature of these fluctuations, i.e. whether they are caused by the processes in the disk or in the mass-donating companion. Also color indices of the outbursts are needed.

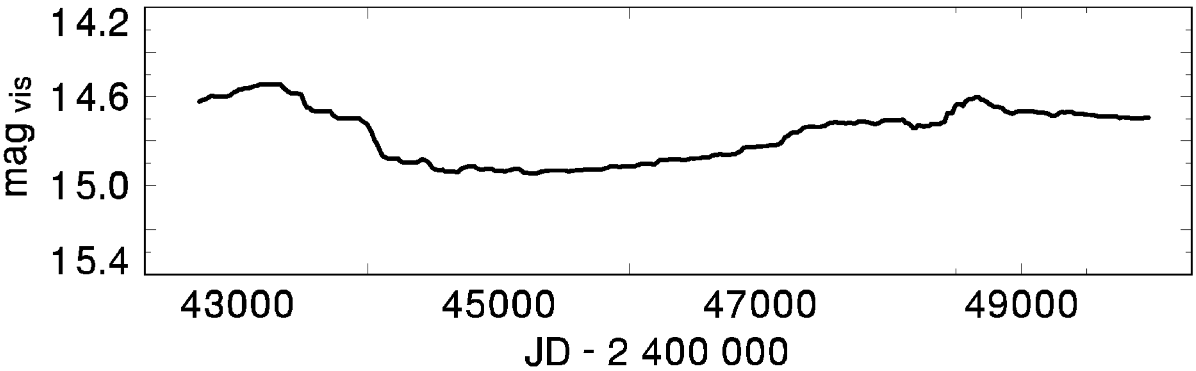

Fig.5: Two-sided moving averages of the quiescent level of brightness in the dwarf nova CH UMa. Adapted from Šimon (2000a).

GK Per

is a remarkable cataclysmic variable. It exploded as a very bright nova in 1901. After return to quiescence, it displayed irregular long-term variations of brightness. Later on, dwarf nova outbursts appeared from the quiescent level of about 13 mag(*V*). Nowadays, they recur about every three years and reach about 10.5 mag at maximum (Sabbadin & Bianchini 1983, Hudec 1981, Šimon 2002). Nowadays, the outburst lasts for about 70 days (Fig.6a). These optical outbursts are accompanied by X-ray outbursts, but with different profiles (e.g. Šimon 2002). Color indices undergo large changes during outburst. Generally they decrease considerably toward the maximum brightess of the outburst (e.g. Šimon & Velič 2001, Nogami et al. 2002). GK Per is an intermediate polar (Watson et al. 1985) (see above for explanation). Quasiperiodic variations which occur on the time scale of about 80 min during outburst (Fig.6b) are of a particular interest for CCD observers. The typical full amplitude of these variations is 0.1 – 0.3 mag and varies through the outburst. Morales-Rueda et al. (1996) interpreted them as a reprocessing off blobs of gas orbiting within the inner region of the accretion disk.

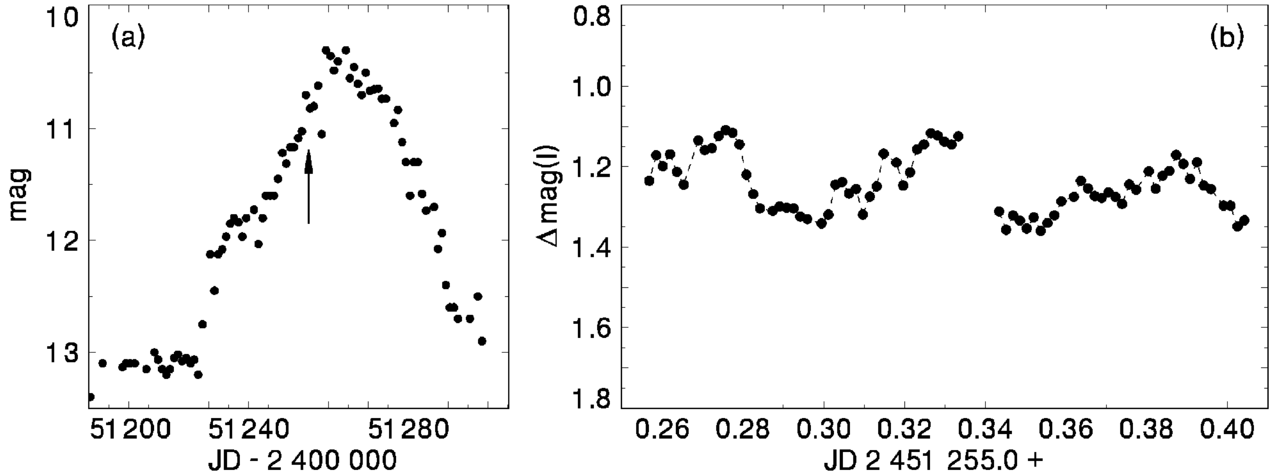

Fig.6: (a) Example of the outburst of GK Per (one-day means of the visual observations from the AFOEV database). The arrow marks the night when the series of CCD observations which capture the rapid variations was obtained. This series is displayed in (b). Adapted from Šimon & Velič (2001).

XTE J1118+480=KV UMa

is a so-called black hole soft X-ray transient. Such transients are some analogs of dwarf novae but they contain a mass-accreting neutron star or black hole instead of a white dwarf (e.g. Chen et al. 1997). The outbursts of these systems are caused by an instability of the accretion disk around the compact object. From time to time, this instability gives rise to a strong increase of the mass inflow of matter stored in the disk onto the compact object. This leads to a strong increase of the brightness of the disk (by several mag in the optical passand). The abbreviation 'soft X-ray transient' means that the object brightens enormously in X-rays during this outburst. Generally, outbursts of soft X-ray transients are observed relatively rarely, usually less than one per year appears to be bright enough to be observed in the optical region. However, when these outbursts occur, they become very attractive for the observers not only because of their unique nature, but also because they display complicated variations on various time scales. XTE J118+480 is one of the brightest soft X-ray transients in the optical passband and can serve as an example.

The profile of the optical outburst of XTE J1118+480 is defined by the visual observations while X-ray outburst was observed by the All Sky Monitor onboard the *RXTE* satellite (Uemura et al. 2002a, 2002b). Since the optical radiation comes from a large area of the disk while X-rays originate from the innermost region of the disk, a combination of the observations gives us a more complete information on the physical processes. This outburst was unusual because it was double – a short outburst followed by the main outburst. The evolution of the *R* band magnitude and color indices determined from the observations with a small monitoring CCD telescope during the main outburst are displayed in Fig.7. This outburst displayed a long phase (plateaux) during which the brightness remained almost stable. Also the color indices displayed a remarkable stability here. The color-color diagram of this outburst is shown in Fig.8 and allows us to compare the colors of XTE J118+480 with those of some cataclysmic variables and main-sequence stars. We can see that cataclysmic variables and soft X-ray transients display a broad range of colors.

Also rapid variations with the amplitude of about 0.1 mag were detected during the outburst of XTE J118+480 (Uemura et al. 2002b). These changes were interpreted as superhumps with the period of 0.170529 d (4.093 hr); they are caused by the ellipticity of the disk due to the tidal effects. Superhumps are only slightly longer that the orbital period (typically by about 1 percent). The amplitude of about 0.1 mag makes superhumps a suitable phenomenon for amateur CCD observers.

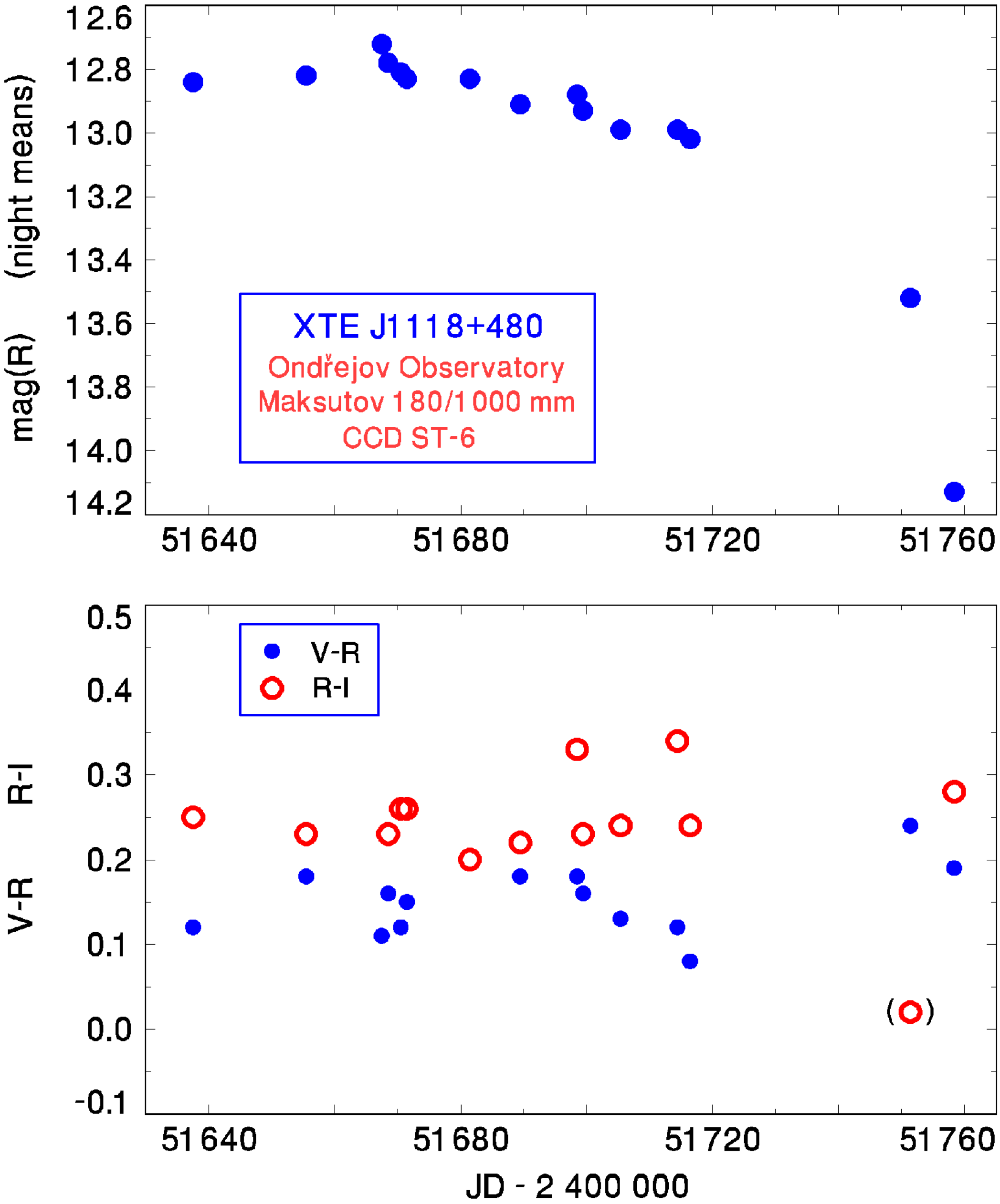

Fig.7: (a) The *R* band light curve of the outburst of XTE J1118+480 which occurred in 2000. The long-lasting plateaux and a rapid final decline of brightness are visible. (b) Evolution of the color indices. Notice that they remained almost constant during the plateaux. Their possible change during the final decline of outburst is unreliable because of unfavorable observing conditions (the object was visible only on the evening sky).

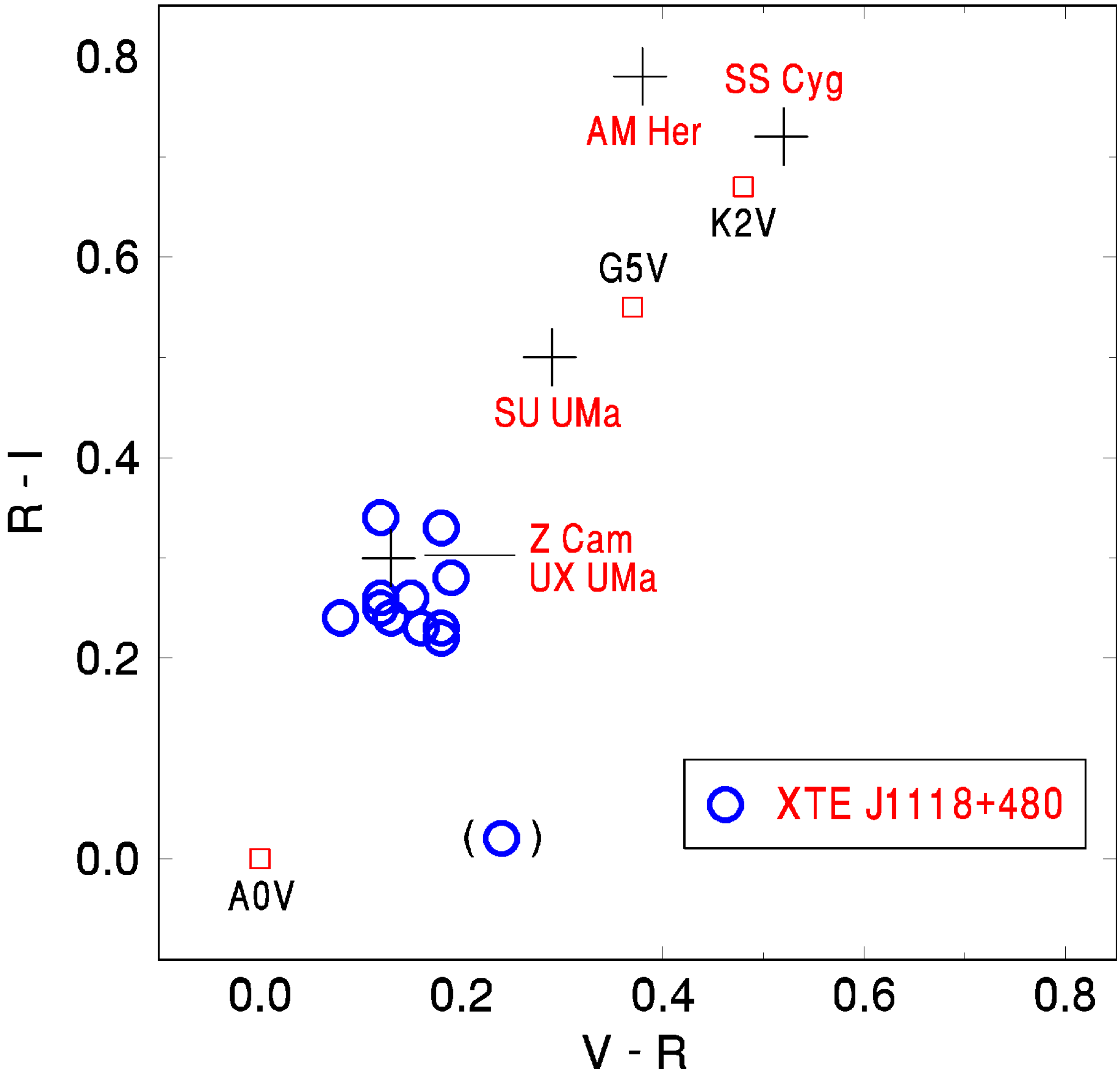

Fig.8: Color-color diagram which shows the comparison of the color indices of XTE J1118+480 with several cataclysmic variables and main-sequence stars. Notice that these objects occupy various regions of the color-color diagram.

3. Conclusion

We present a discussion of the perspectives of a joint effort of the visual and CCD observers of variable stars. We show that good strategy in observing this kind of object is to combine the dense coverage of the long-term variations provided by visual observations with the color indices and searches for the rapid, intranight variations (including the orbital modulation) provided by CCD measurements. We show this approach on several highly active cataclysmic and X-ray binaries which are suitable targets for these methods of observation. Of course, the objects listed in this paper serve only as examples – the number of suitable objects is much larger.

Acknowledgements:

This research has made use of observations from the AAVSO International database (Massachusetts, U.S.A) and the AFOEV database (operated at CDS, France). We thank the variable star observers worldwide whose decades of observations made this analysis possible. The support by the grant 205/05/2167 of the Grant Agency of the Czech Republic is acknowledged.

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