APPLICANT'S CURRICULUM VITAE

CONTACT

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PERSONAL INFORMATION

Address: Národní 1088, Úpice, 542 32, Czech Republic

Place and date of Birth: Vrchlabí, 4.8.1977

DISCIPLINE AND A START DATE OF DOCTORAL STUDIES

Discipline: Theoretical Physics and Astrophysics

Date of admission: 28.7.2011

Date of registration: 28.7.2011 (Term: 1, Year: 1)

POSITIONS

PhD study at Department of Theoretical Physics and Astrophysics, Faculty of Science, Masaryk University Kotlářská 2, 611 37 Brno, CR

Astronomical Institute of the Academy of Sciences of the Czech Republic, v.v.i., Freckle 298 251 65 Ondřejov, CR (25% duty)

EDUCATION AND QUALIFICATION FOR ADDRESSING THE PROPOSED PROJECT

2011 – Present: Doctoral study program: Theoretical Physics and Astrophysics, Faculty of Science, Masaryk University

June 2011: Master degree obtained in program Theoretical Physics and Astrophysics (Spec.: Astrophysics), Faculty of Science, Masaryk University

2006–Present: Expansion of specialization – courses on Faculty of Informatics, Masaryk University: Machine Learning and Data Mining, LaTeX, UNIX; UNIX – Programming and System Management I–II

November 2008: Bachelor degree obtained in program: Applied Physics (Spec.: Astrophysics), Faculty of Science, Masaryk University

2000: Certified Specialist (DiS) degree obtained in program: Computer Science, SPŠE Pardubice

1992 – 1996: Secondary school: COP Hronov

BASIC QUALIFICATION FOR THE PROPOSED PROJECT:

10+ years of experience with programming; 8+ years of experience with UNIX; 5+ years of experience with databases; 3+ years of experience in leading development team; working in international team.

WORK EXPERIENCE, INTERNSHIPS, SOLVED PROJECTS

Academic year 2010/2011: Master thesis: *Virtual Observatory & Data Mining*
Supervisor: RNDr. Petr Škoda, CSc.; Successfully defended in June 2011 (grade A).

- Development of Spectral Data Mining process for Be stars candidates.
- Performed Astronomical Data Mining experiments using Virtual Observatory protocols.
- Processed 200 000 spectra.

May 2011: Joint Workshop and Summer School:Astrostatistics and Data Mining in Large Astronomical Databases. La Palma, Canary Islands, Spain

June – September 2010: CERN Summer Student: Working on next generation collider CLIC[1] project

January 2010: EuroVO-AIDA[2] School 2010[3]

April 2008: IWSSP 2008[4]

Academic year 2007/2008: Bachelor thesis: *Data Mining from Astronomical Data*
Supervisor: Mgr. Filip Hroch, Ph.D.; Successfully defended in June 2008 (grade A).

- Semi-automatic process for spectral analysis and Blazars (AGN) discovery.

- Extended as project on Faculty of Informatics in course: Machine Learning and Data Mining[5]

2000 – 2006: Senior Developer, Oracle DBA: Infineon Technologies Trutnov, s. r. o. Working in Germany, USA and Malaysia. Passed many courses on PL/SQL, Oracle, C#, REFA, etc.

1999 Developer: ABB Trutnov, s. r. o.

AWARDS AND RESULTS OF RESEARCH ACTIVITIES – PUBLICATIONS

Vážný, J.: *Non-linear optimization of the CLIC FFS*; CERN, Geneva, Switzerland, Sept. 2010 [6]

Škoda, P.; Vážný, J.: *Data Mining of Be stars in VO*; Talk at IVOA Interoperability meeting KDD IG Session, Naples, 16th May 2011

Škoda, P.; Vážný, J.: *Data Mining of Be stars in VO*; Poster presented at the conference Astroinformatics 2011, 25-29th September 2011, Sorento, Italy

Škoda, P.; Vážný, J.: *Data Mining of Be stars in VO*; Poster will be presented at the conference ADASS 2011 Paris, France, 6-10 November

Vážný, J.: *Introduction into Astroinformatics*; Invited lecture on astronomical course, Vyškov 2011

OTHER RELEVANT INFORMATION

SKILLS AND QUALIFICATIONS

- Language skills: English (Advanced), Chinese (Basic knowledge)
- Administration and programming in UN*X Like OS
- Programming languages: Python, PL/SQL, C, C++, Fortran
- Command interpreters and script languages: Bash, Awk, Octave, GNU Gnuplot, LaTeX, Matlab
- Machine Learning and Data Mining skills

[1] The Compact Linear Collider (CLIC) electron-positron Linear Collider in the post-LHC era
[2] Astronomical Infrastructure for Data Access project
[3] International School on technologies of Virtual Observatory: http://cds.u-strasbg.fr/aidahandson2010/
[4] International Workshop on Stellar System Physics: http://astro.physics.muni.cz/iwssp2008
[5] This project has been proposed to present on a conference, but this was not realized because of my work for CERN
[6] CERN internal document. Result of my 3 month project during CERN Summer Student Program

Virtual Observatory & Data Mining: Astronomy for 21 century

Applicant: Jaroslav Vážný
Supervisor: RNDr. Petr Škoda, CSc.

Key words: Astroinformatics; Virtual Observatory; Data Mining; DAME; Machine Learning; Decision Trees; Neural Networks; Support Vector Machines

1 Objectives and original contribution of the project

From the dawn of its existence astronomy has been starving for data but in the last few decades the situation has changed and now we are facing data deluge of biblical proportions. The data are not just increasing in size but also in complexity and dimensionality [2]. Astroinformatics is the new field of science which has emerged from this technology driven progress. Virtual Observatory, Machine Learning, Data Mining, Grid Computing are just few examples of new tools available to scientists. The astronomers are not alone and particle physics, biology and other sciences are also in the vanguard of the data intensive science. This is great opportunity for interdisciplinary collaboration.

The general goal of the project is to demonstrate the power of new concepts and technologies of computers science in the context of astrophysics. This project is a part of my long-term effort. During my bachelor work I developed a process for discovering new candidates of Blazars (super-massive black hole at the center of an galaxy) and in my master thesis I utilized technologies of Virtual Observatory and Data Mining to find new Be stars (rare, extremely rapid rotating stars). My reviewers were prof. Giuseppe Longo and Dr. Massimo Brescia. They are main figures behind the DAME project, one of the most important Data Mining projects in current astrophysics, and they invited us to work on common project. Since my supervisor has two more computer science students we are now team with expertise in different ares. This multidisciplinary international collaboration will be the basis for my work. The first goal will be the implementation of the Decision Tree algorithm in the DAME framework and its utilization in astrophysical research.

The project Main "vision" is to create a joined astrophysical data mining project based on the DAMEWARE [7] infrastructure and other DAME[8] resources. The common work has two distinct aspects to be carried out:

1. Technological:

   the goal is the design and development of a supervised machine learning model, conceptually based on a classification tree (for instance a decision tree used in the data mining context), able to solve multi-class classification problems. The model must be scalable, i.e. having a robust efficiency to treat massive datasets, and with a sufficiently general behavior, i.e. able to digest both categorical and numerical data. An important aspect of the work is that such model must be fully integrated into the DAMEWARE and accessible by external users exclusively through its GUI (Graphical User Interface);

2. Scientific:

   the goal is to exploit the DAMEWARE and other resources (either available or new), of DAME Program to perform astrophysical data mining experiments with public data coming out from Virtual Observatory, large programs or other warehouses.

[7] DAME Web Application REsource
[8] DAta Mining & Exploration: general purpose, Web-based, distributed data mining infrastructure specialized in Massive Data Sets exploration with machine learning methods

2 Theoretical framework, applied methods and techniques, basic references

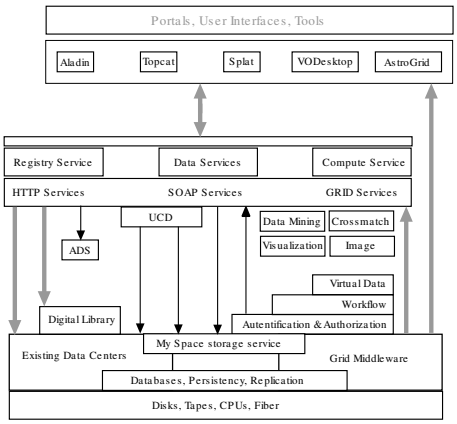
Data avalanche: Opportunity or disaster? There are two important trends in the current astronomical surveys:

- Size: The cumulative compressed data holdings of the ESO archive will reach 1 Petabyte by 2012 [5]. Projects like Large Synoptic Survey Telescope (LSST) will produce about 30 TB per night, leading to a total database over the ten years of operations of 60 PB for the raw data [3].
- Complexity: Modern surveys will cover the sky in different wave-bands, from gamma and X-rays, optical, infrared to radio. The ability to cross correlate these observations together may lead to new understanding of physical phenomenas [5].

Such an amount of data is not possible to transfer over the network. Data resources are heterogeneous, distributed and decentralized in their nature.

Virtual Observatory (VO) For handling of heterogeneous distributed data it is necessary to have the set of common standards and protocols as well as an authority encouraging their implementation. Such an authority is the International Virtual Observatory Alliance (IVOA). It currently comprises 19 VO programs from Argentina, Armenia, Australia, Brazil, Canada, China, Europe, France, Germany, Hungary, India, Italy, Japan, Russia, Spain, the United Kingdom, and the United States and inter-governmental organizations (ESA and ESO) [5]. Standards and specifications produced by IVOA can be obtained at `http://www.ivoa.net/`.

The Architecture is depicted on the figure. The level of abstraction goes from top to bottom. Starting with interfaces, used by people or applications to discover resources. The next level is the service layer implemented by standard protocols, followed by the hardware level where actual data are stored. This onion-like structure hides the complexity of the lower layer and provide data and meta-data to the higher layer. This concept is similar to TCP/IP [9] protocol.



The VO architecture is serviced oriented. Each service is autonomous with well defined boundaries. The very important aspect of VO implementation is the adoption of formats and protocols used in astronomy (FITS[10]) and Computer Science (XML [11] , Web Service [12] SOAP [13], REST[14]) for many years. In other words, VO does not try to reinvent the wheel but it stands on the shoulders of giants.

[9] TCP/IP (Transmission Control Protocol/Internet Protocol). The basic communication language or protocol of the Internet.
[10] Flexible Image Transport System is the standard astronomical data format endorsed by both NASA and the IAU
[11] Extensible Markup Language (XML) is a set of rules for encoding documents in machine-readable form.
[12] method of communication between two electronic devices over a network.
[13] Simple Object Access Protocol, is a protocol specification for exchanging structured information in the implementation of Web Services in computer networks.
[14] Representational State Transfer (REST) is a style of software architecture for distributed hyper-media systems such as the World Wide Web. Used in `www.youtube.com`

Data Mining Data Mining and related techniques are created exactly for such purposes. Used correctly, it can be powerful approach, promising scientific advance. On the other hand this field is very complex with dozens of different methods and algorithms. This form needs and opportunity for interdisciplinary cooperation with Data Mining experts. This can be very beneficial for both fields, providing astronomers with interesting methods for data analysis and computer scientist with the large amount of quality data.

Supervised Methods These methods are also known as predictive[1]. They rely on training set with known target property. This set must be representative. The selected method is trained on that set and the result is then used on data for which the target property is not known. Among supervised method are classification, regression, anomaly detection and others.

Decision Tree (DT) is an example of supervised classification. Based on final number of data $(x^{(1)}, x^{(p)})$ with known class $C_1, \ldots, C_m$ classifier is created, i.e. mapping f classifying any $x \in \mathcal{X}, f : \mathcal{X} \to \mathcal{Y}$, where $\mathcal{X}$ is a set of possible input vectors and $\mathcal{Y}$ is a set which values represent classes $C_1, \ldots, C_m$ (for example $\mathcal{Y} = 1, \ldots, m$). The model is constructed based on training set as a tree structure, where leaves represent classifications and branches conjunctions of features that lead to those classifications.

DAME (DAta Mining & Exploration) is an innovative, general purpose, Web-based, distributed data mining infrastructure specialized in Massive Data Sets exploration with machine learning methods. Initially fine tuned to deal with astronomical data only, DAME has evolved in a general purpose platform program, hosting a cloud of applications and services useful also in other domains of human endeavor. DAME is an evolving platform and new services as well as additional features are continuously added. The modular architecture of DAME can also be exploited to build applications, finely tuned to specific needs.

The DAME web application is a joint effort between the Astroinformatics groups at University Federico II, the Italian National Institute of Astrophysics, and the California Institute of Technology. DAME aims at solving in a practical way some of the DM problems, by offering a completely transparent architecture, a user-friendly interface, and the possibility to seamlessly access a distributed computing infrastructure. DAME adopts VO standards in order to ensure the long-term interoperability of data; however, at the moment, it is not yet fully VO compliant. This is partly due to the fact that new standards need to be defined for data analysis, DM methods and algorithms development. In practice, this implies a definition of standards in terms of ontology and a well-defined taxonomy of functionalities to be applied in the astrophysical use cases [4].

Reference

[1] N.M. Ball, R.J. Brunner, and R. Gregory. Data mining and machine learning in astronomy. *International Journal of Modern Physics D*, 19(7):1049–1106, 2010.

[2] N.M. Ball and D. Schade. The Long Range Plan for Canadian Astronomy: 2010-2020. *The Long Range Plan for Canadian Astronomy: 2010-2020*, 2010.

[3] J. Becla, A. Hanushevsky, S. Nikolaev, G. Abdulla, A. Szalay, M. Nieto-Santisteban, A. Thakar, and J. Gray. Designing a multi-petabyte database for LSST. *Arxiv preprint cs/0604112*, 2006.

[4] M. Brescia, S. Cavuoti, SG Djorgovski, C. Donalek, G. Longo, and M. Paolillo. Extracting knowledge from massive astronomical data sets. *Arxiv preprint arXiv:1109.2840*, 2011.

[5] RJ Hanisch and PJ Quinn. The international virtual observatory. *TheIVOA*, 24, 2010.

3 Time schedule and key milestones of the project

Academic Year	Milestones
2011/2012	Set up international (Czech-Italian) interdisciplinary (astrophysicists, computer scientists) team. Study DAME Architecture.
2012/2013	Implement Decision Tree into DAME. Testing on various scientific cases (Study of AGN, Galaxies, Be stars). Choosing main scientific goal.
2013/2014	Detailed analysis of chosen scientific goal.
2014/2015	Publish papers to international conferences and high impact factor international journals. Write a PhD dissertation using the project results and related topics.

During the all project stages: The applicant will participate in summer schools, conferences and workshops. Results obtained during the project solving will be published throughout all stages.

4 Institutions where the project will be implemented

- **The Institute of Theoretical Physics and Astrophysics**, Masaryk University in Brno
  Home institution of the PhD study
- **Astronomical Institute of the Academy of Sciences of the Czech Republic**
  Home institution of supervisor
- **The Faculty of Information Technology (FIT) at Brno University of Technology**
  Home institution of other PhD and bachelor students from the team
- **Department of Physical Sciences University of Napoli - Federico II**
  Home institution of DAME project

5 Expert consultants and their contribution to the project

RNDr. Petr Škoda, CSc., supervisor

- Staff researcher at Astronomical Institute of the Academy of Sciences

prof. Giuseppe Longo, DAME Principal Investigator (PI), consultant

- University Federico II
- Department of Physical Sciences
- Faculty of Sciences - University Federico II
- INAF - National Institute of Astrophysics
- INAF - Napoli
- INFN - National Institute of Nuclear Physics
- INFN - Napoli
- RIAA - National network Astr. & Astrophysics
- Accademia Pontaniana
- International Astronomical Union
- Meta Institute for Computational Astrophysics
- California Institute of Technology

Dr. Massimo Brescia, DAME Project Manager (PM), consultant

- Astronomer researcher at INAF OAC Napoli, since 2000
- Teacher of Astronomical Technologies, Faculty of Astrophysics & Space Science, University Federico II of Napoli, since 2007
- member of IAU, International Astronomical Union, since 2006
- Scientific Association with Dep. of Physics Sciences, University Federico II of Napoli, since 2007

6 Relation between the applicant's project and doctoral thesis

The project is tightly connected with and significantly extends the topic of PhD thesis: *Application of modern computer science in astronomy*. Results will available to the public through DAME interface and could be used outside astrophysics field.

7 Motivation for solving the project

The searching for effective collaboration between natural and computer science is one of the most important task of today's science. We are witnessing the genesis of multiple x-informatics (astro, bio, etc) sciences. This multidisciplinary cooperation is vital not only for scientists but also for the public. The born of World Wide Web[15] is nice example. And at the end, there is no such things like geology, chemistry or physics. There is just nature.

[15] Developed as documentation tool during LEP project at CERN

SUPERVISOR'S CURRICULUM VITAE

CONTACT

Name: RNDr. Petr Škoda, CSc.

Email: skoda@sunstel.asu.cas.cz

Office: Astronomical Institute of the Academy of Sciences

Telephone: +420-323-620361

POSITIONS

Regular member of staff of Stellar Dept. of Astronomical Institute

Since 2000 Member of IAU (participation in Spectroscopic Virtual Observatory)

Since 2006: Contact person for Virtual observatory in Czech Republic

EDUCATION AND ACADEMIC QUALIFICATION

1996: Received Ph.D. equivalent title CSc. (Candidatus Scientarum) in astrophysics, Astronomical Institute, PhD. thesis *Study of Physical Processes in Sparse Envelopes of Hot Stars* under supervision of Dr. Hadrava

1987–1989: Postgraduate student in Astronomical Institute of the Academy of Sciences (supervisor Dr. Kříž and Dr. Hadrava)

1987: Graduated with honors in astrophysics, Thesis *A Simple Model of HII regions*, supervisor Dr. Polechová and Dr. Hadrava

1982–1987: Faculty of Mathematics and Physics, Charles University (Dept. of Astronomy), Prague

BRIEF EMPLOYMENT HISTORY

1989–Present: Regular member of staff of Stellar Dept. of Astronomical Institute

MAIN RESEARCH ACTIVITIES

Astronomical Instrumentation and Techniques(Telescope control systems Optimization of observing and calibration recipes CCD spectra acquisition and processing)

Optical spectroscopy(Single-order and echelle spectra reduction Spectral analysis of (mainly hot) stars Fourier disentangling and Doppler tomography)

Astronomical data archives and Virtual Observatory

SELECTED PUBLICATIONS

Korčáková, D., Mikulášek, Z., Kawka, A., Kubát, J., Hornoch, K., Šarounová, L., Kušnirák, P., Hadrava, P., Wolf, M., Šlechta, M., **Škoda, P**., Dovčiak, M. & Libich, J. 2005, "Spectroscopic and Photometric Observations of SN 2004dj", *Informational Bulletin on Variable Stars*, 5605, 1

Šlechta, M., **Škoda, P.** 2005,"An Outburst detected in the spectrum of HD 6226", *Astrophys. Space Sci.*, 296, 179–182

Saad, S. M., Kubát, J., Hadrava, P., Harmanec, P., Koubský, P., **Škoda, P.**, Šlechta, M., Korčáková, D. and Yang, S., 2005, "Spectrum disentangling and orbital solution for κ Dra, *Astrophys. Space Sci.*, 296, 173–177

Chochol, D., Katysheva, N. A., Pribulla, T., Schmidtobreick, L., Shugarov, S. Y., **Škoda**, P., Šlechta, M., Vittone, A. A. and Volkov, I. M. 2005, "Photometric and spectroscopic variability of the slow nova V475 Sct (Nova Scuti 2003)", *Contributions of Observatory Skalnaté Pleso*, 35, 107–129

Walker, G. A. H., Kuschnig, R., Matthews, J. M., Reegen, P., Kallinger, T., Kambe, E., Saio, H. Harmanec, P., Guenther, D. B., Moffat, A. F. J., Rucinski, S. M., Sasselov, D., Weiss, W. W., Bohlender, D. A., Božić, H., Hashimoto, O., Koubský, P., Mann, R., Ruždjak, D., **Škoda, P.**, Šlechta, M., Sudar, D., Wolf, M. & Yang, S., 2005, " Pulsations of the Oe Star ζ Ophiuchi from MOST Satellite Photometry and Ground-based Spectroscopy", *Astrophys. J. Lett.*, 623, L145–148

Libich, J., Harmanec, P., Vondrák, J., Yang, S., Hadrava, P., Aerts, C., de Cat, P., Koubský, P., **Škoda, P.**, Šlechta, M., Uytterhoeven, K. and Mathias, P., 2006, "The new orbital elements and properties of ϵ Persei", *Astronomy and Astrophys.*, 446, 583–589

Frémat, Y., Lampens, P., Alecian, E., Balona, L., Catala, C., Goupil, M.-J., Torres, G. and **Škoda**, P., 2006,"Spectral separation of two pulsating non-single stars.",*Memorie della Societa Astronomica Italiana*, 77, 521–524

Chochol, D., Katysheva, N. A., Pribulla, T., Schmidtobreick, L. , Shugarov, S. Y., **Škoda, P.**, Šlechta, M., Vittone, A. A. and Volkov, I. M. 2006, "Multicolour Photometry and Spectroscopy of the Slow Nova V475 Sct (Nova Scuti 2003)", Chinese Journal of Astronomy and Astrophysics Supplement, 6, 137–142

Saad, S. M., Kubát, J., Korčáková, D., Koubský, P., **Škoda, P.**, Šlechta, M., Kawka, A., Budovičová, A., Votruba, V., Šarounová, L. and Nouh, M. I., 2006, "Observation of Hα, iron and oxygen lines in B, Be and shell stars", *Astron. Astrophys.*, 450, 427–430

Linnell, A. P., Harmanec, P., Koubský, P., Božić, H., Yang, S., Ruždjak, D., Sudar, D., Libich, J., Eenens, P., Krpata, J., Wolf, M., **Škoda, P.** and Šlechta, M., 2006, "Properties and nature of Be stars. 24. Better data and model for the Be+F binary V360 Lacertae", *Astron. Astrophys.*, 455, 1037–1052

Koubský, P., Harmanec, P., Yang, S., Netolický, M., **Škoda, P.**, Šlechta, M. and Korčáková, D. 2006, "Properties and nature of Be stars 25. A new orbital solution and the nature of a peculiar emission-line binary υ Sqr", *Astron. Astrophys.*, 459, 849–857

Ak, H., Chadima, P., Harmanec, P., Demircan, O., Yang, S., Koubský, P., **Škoda, P.**, Šlechta, M., Wolf, M., Bozić, H., Ruždjak, D. and Sudar, D., 2007, "New findings supporting the presence of a thick disc and bipolar jets in the β Lyr system", *Astron. Astrophys.*, 463, 233–241

Harmanec, P., Mayer, P., Prša, A., Božić, H., Eenens, P., Guinan, E. F., McCook, G., Koubský, P., Ruždjak, D., Engle, S., Sudar, D., **Škoda, P.**, Šlechta, M., Wolf, M. and Yang, S. 2007, "V379 Cephei: a quadruple system of two binaries", *Astron. Astrophys.*, 463, 1061–1069

Kubát, J., Korčáková, D., Kawka, A., Pigulski, A., Šlechta, M., **Škoda, P.**, 2007, "The Hα stellar and interstellar emission in the open cluster NGC 6910", *Astron. Astrophys.*, 472, 163–167

Škoda, P., 2007, "The Virtual Observatory and its Benefits for Amateur Astronomers", *Open European Journal on Variable Stars*, 75, 32–36

Škoda, P., Kubát, J. ,Votruba, V., Šlechta, M., Podskalský, Z. and Karták, M., 2007, "Nova Vulpeculae 2007", *Central Bureau Electronic Telegrams*, 1035, 1

Mikulášek, Z., Krtička, J., Henry, G. W. , Zverko, J., Žižňovský, J., Bohlender, D., Romanyuk, I. I., Janík, J., Božić, H., Korčáková, D., Zejda, M., Iliev, I. K., **Škoda, P.**, Šlechta, M., Gráf, T., Netolický,

M. and Ceniga, M. 2008, "The extremely rapid rotational braking of the magnetic helium-strong star HD 37776", *Astron. Astrophys.*, 485, 585–597

Škoda, P. 2009, "Identification of important VO spectral services benefiting from deployment on the Grid .",*Memorie della Societa Astronomica Italiana*, 80, 484–492

Hadrava, P., Šlechta, M., and **Škoda, P.** 2009, "Notes on disentangling of spectra. II. Intrinsic line-profile variability due to Cepheid pulsations",*Astronomy and Astrophysics*, 507, 397–404

Shore, S. N., Wahlgren, G. M., Genovali, K., Bernabei, S., Koubsky, P., Šlechta, M., **Škoda, P.**, Skopal, A., and Wolf, M. 2010, "The spectroscopic evolution of the symbiotic star AG Draconis. I. The O VI Raman, Balmer, and helium emission line variations during the outburst of 2006-2008",*Astron. Astrophys.*,510, A70

PEDAGOGICAL ACTIVITIES

Reviewer of attendant bachelor thesis
Supervisor of attendant Master's thesis
Supervisor of attendant PhD thesis
Seminars about technology of Virtual Observatory
Institute of Astronomy University of Vienna, March 2008
Institute of Astronomy, Bulgarian Academy of Sciences, Sofia, December 2009
Crimean Astrophysical observatory, Nauchnyi, September 2010

AWARDS AND RECOGNITIONS

OTHER RELEVANT INFORMATION

PARTICIPATION IN GRANT PROJECTS

1991–1993, GA ČSAV, 30318: "The Nature and Structure of the Circumstellar Matter in Binary Stars"

1998–2000, MŠMT: LB98251: "Public Information System of Astronomical Electronic Data", **Principal Investigator**

1998–2002, GA AVČR A3003805: "Spectroscopic Studies of Binary and Multiple Stars"

2002–2004, GAČR 205/02/0445: "Physics of Hot Stars and Stellar Systems with Hot Components"

2002–2004, GAČR 102/02/1000: "The Development of Ondřejov Echelle Spectrograph",

2003–2005, GAČR 205/03/0778: "Asymmetry of Be-Star Envelopes"

2004–2006, GAČR 205/04/1267: "Circumstellar Envelopes of Hot Stars"

2006–present, GAČR 205/06/0584: "The Precise High Dispersion Spectroscopy of Hot Stars", **Principal Investigator**

2006–present, EURO-VO DCA , supported by WP6

2007–present, ESA PECS 98058: "Czech Participation in the Gaia Project"