CONFERENCE BOOK

INTEGRAL/BART WORKSHOP

2023

22 - 26 May 2023

Carlsbad, Czech Republic

The open LaTeX template, AMCOS_booklet, used to as template for this booklet is available at

https://github.com/maximelucas/AMCOS_booklet

Prepared by Martin Urban for IBWS conference/workshop.
https://www.ibws.cz

Contents

INTEGRAL/BART Workshop

IBWS is a successful series of international workshops dedicated to all aspects of high-energy astrophysics and supporting ground-based experiments (e.g. robotic telescopes). Within this framework, the detailed programme reflects the scientific interests of the participants, as there are no invited talks, but contributions are submitted by the conference participants.

Originally, the IBWS (INTEGRAL/BART) workshops focused on the work of the High Energy Astrophysics group (at that time dominated by young research fellows and students) at the Astronomical Institute of the Academy of Sciences of the Czech Republic and relevant national and international collaborators in the field, with intensive student participation. In the early years, these activities focused on the ESA INTEGRAL satellite and related ground-based robotic telescopes, such as the small robotic telescope BART at the Ondrejov Observatory.

Today, the IBWS workshops promote regional collaboration in galactic and extragalactic high-energy astrophysics, both experimental and theoretical, with an emphasis on the interface between satellite projects and ground-based experiments (e.g. robotic telescopes). We continue to emphasise the broad participation and presentation of students and young researchers.

This year's held the 17th INTEGRAL/BART Workshop.

Organising committee

Veronika Maršíková	Rigaku Innovative Technologies Europe s.r.o.
Martin Urban	Czech Technical University in Prague
Ondřej Nentvich	Czech Technical University in Prague
René Hudec	Astronomical Institute of the Czech Academy of Sciences & Czech Technical University in Prague

Scientific committee

René Hudec	Astronomical Institute of the Czech Academy of Sciences & Czech Technical University in Prague
Martin Jelínek	Astronomical Institute of the Czech Academy of Sciences
Vladimir Karas	Astronomical Institute of the Czech Academy of Sciences
Thorsten Döhring	Technische Hochschule Aschaffenburg
Karl Mannheim	Universität Würzburg
Joern Wilms	Friedrich-Alexander-Universität Erlangen-Nürnberg
Franco Giovannelli	INAF-Istituto di Astrofisica e Planetologia Spaziali
Klaus Schilling	Zentrum für Telematik e.V.
Zsolt Bagoly	Eötvös University
Norbert Werner	Masaryk University

Topics

GRB Gamma-Ray Bursts & Robotic Telescopes

Gamma Ray Bursts studies with emphasis on follow-up observations by robotic telescopes. Transient astronomy in general, flaring, flashing and transient astrophysical objects and methods and techniques for their analyses including real-time image processing.

HEA High Energy Astrophysics

Both theoretical as well as observational (satellite-based as well as ground-based) aspects of high energy (X-ray and gamma-ray) and very high energy astrophysics, both galactic and extragalactic, gamma-ray bursts and time-domain astronomy.

SAT Small satellites for astrophysics & Instrumental session

All aspects of small satellites (pico, nano, micro, CubeSats), projects presentations, and scientific payloads for these satellites. Satellite projects for High Energy astrophysics in general. Rocket experiments. Ground-based support for satellite projects and high energy astrophysics – robotic telescopes, data analyses.

Icons

 **Talk**  **Poster**

Time schedule

Monday, 22 May

18:30–22:00	**Welcome reception** **U Šimla** **(see Map in Conference Book p. 42)**

Tuesday, 23 May

09:00–09:15	**Registration**		

Session chair: Rene Hudec

09:15	**Opening workshop and Welcome notes**		
09:15–09:25		**Andrea Pfeffer Ferklová**	Welcome from the Mayor of Carlsbad
09:25–09:35		**Miroslav Spurný**	Director of Carlsbad Observatory: Spaceport at the Observatory
09:35–09:45		**Rene Hudec**	IBWS Introduction and Historical Background
09:45–10:30	**GRB**	**Franco Giovannelli**	The contribution of robotic telescopes to the knowledge of our Universe
10:30–10:50	**Coffee break**		

Session chair: Martin Jelinek

10:50–11:10	**GRB**	**Jan Štrobl**	Autonomous robotic telescopes in Ondřejov: BART, D50 and the others.
11:10–11:30	**GRB**	**Ronan Cunniffe**	Engineering and maintaining remote instruments on a budget
11:30–12:00	**GRB**	**Peter Kroll**	Proposal of Sky Monitoring with Subsecond Cadence
12:00–12:20	**GRB**	**Sergey Karpov**	Impact of satellite glints on the search of rapid transients with ZTF and LSST sky surveys
12:20–13:40	**Lunch**		

Session chair: Peter Kroll

13:40–14:00	**GRB**	**Rene Hudec**	Long term follow-up coverage of Gaia alert sources
14:00–14:20	**GRB**	**Sandor Pinter**	High-redshift galaxy cluster candidate from Subaru HSC photometric redshifts
14:20–14:40	**GRB**	**Istvan Racz**	Estimating GRBs' cosmological distances
14:40–15:00	**GRB**	**Martin Jelinek**	GRB 210306A: cooling break shifting towards the optical band
15:00	**End of Gamma-Ray Bursts & Robotic Telescopes**		
15:00–16:20	**Coffee break + Poster Session**		

Session chair: Franco Giovannelli

16:20–16:45	**HEA**	**Norbert Werner**	Radio-mechanical AGN feedback in giant elliptical galaxies
16:45–17:25	**HEA**	**Gabriel Török**	Probing dense matter in rapidly variable X-ray sources
17:25–17:55	**HEA**	**Karl Mannheim**	Nuclear line emission due to low-energy cosmic rays
17:55	**End of Day**		

18:30–22:00	**Dinner** **U Šimla** **(see Map in Conference Book p. 42)**

Wednesday, 24 May

09:00–09:10	**Registration**		
		Session chair: Lorenzo Natalucci	
09:10–09:50	**HEA**	**Franco Giovannelli**	A Journey to understand our Universe
09:50–10:10	**HEA**	**Rene Hudec**	X-ray astrophysics as secondary science with ESA/China SMILE satellite
10:10–10:25	**Coffee break**		
		Session chair: Gabriel Török	
10:25–10:55	**HEA**	**Lorenzo Natalucci**	AHEAD2020, Integrating Activities for the High Energy Astrophysics Domain
10:55–11:15	**HEA**	**Rene Hudec**	Comparison of ESA Gaia BP/RP spectra with LDS (Low Dispersion Spectroscopy) photographic sky surveys.
11:15–11:35	**HEA**	**Debora Lančová**	Puffy accretion disk - optically thick, sub-Eddington and stable
11:35–11:50	**Coffee break**		
		Session chair: Istvan Racz	
11:50–12:10	**HEA**	**Nicolas Zalot**	Cyclotron resonant scattering features of GX 301-2
12:10–12:30	**HEA**	**Katrin Berger**	Spectral features of the High Mass X-ray Binary System 4U 0115+63
12:30–12:50	**HEA**	**Amy Joyce**	Varying height and outflow velocity of X-ray corona in AGN NGC1365
12:50–14:00	**Lunch**		

Session chair: Peter Friedrich

14:00–14:20	**HEA**	**Vladimir Karas**	X-ray timing of accreting neutron stars: Czech contribution to eXTP science
14:20–14:40	**HEA**	**Bendegúz Koncz**	Investigating star formation in Illustris TNG galaxy mergers
14:40–15:10	**HEA**	**Wladislaw Schulga**	Long-Term Jet-Kinematics of Blazars in the TANAMI Sample from Combination with Archival VLBA Data
15:10–15:25	**Coffee break**		

Session chair: Vladimir Karas

15:25–15:55	**HEA**	**Vojtěch Šimon**	Perspectives of the soft X-ray observing the Galactic center region with the LOBSTER-EYE monitor
15:55–16:15	**HEA**	**René Šprňa**	Modeling of iron line profiles emitted by accreting relativistic compact object.
16:15–16:35	**HEA**	**Berenika Čermáková**	Simulations of Very High Energy Cosmic Rays Propagation from the Galactic Center
16:35	**End of High Energy Astrophysics**		
16:35–16:50	**Coffee break**		

Session chair: Jakub Ripa

16:50–17:20	**SAT**	**Norbert Werner**	QUVIK: Quick Ultra-Vlolet Kilonova surveyor
17:20–17:40	**SAT**	**Pavel Vančura**	SpacePix3: SoI MAPS Detector for Space Radiation Monitoring
17:40–18:00	**SAT**	**Enrico Bozzo**	The THESEUS mission and the new INTEGRAL online data anlysis system/product gallery

18:15–21:30	**Visit to Karlovy Vary Observatory (optional)** **(see Conference Book p. 43)**

Thursday, 25 May

Session chair: Norbert Werner

09:15–09:30		**Richard Pavlica**	Recent space project examples in Czech Republic
09:30–10:00	**SAT**	**Vladimír Dániel**	VZLUSAT2 CubeSat for EO, GRB and space environment monitoring
10:00–10:20	**SAT**	**Jakub Ripa**	GRBAlpha and VZLUSAT-2 CubeSats Observing Gamma-Ray Transients
10:20–10:40	**SAT**	**Marianna Dafčíková**	Space weather effects at LEO as experienced by GRBAlpha
10:40–11:25	**Coffee break + Poster section**		

Session chair: Vladimír Dániel

11:25–11:45	**SAT**	**Robert Filgas**	Deep space mission REMEC for GCR monitoring
11:45–12:10	**SAT**	**Ezequiel J. Marchesini**	The HERMES and SpIRIT constellation: design and development of the payloads
12:10–12:30	**SAT**	**Asen Christov**	FSUA - actuator development for the LISA mission of ESA
12:30–12:50	**SAT**	**Filip Münz**	Attitude effects on observations with cubesats in gamma-ray domain
12:50–14:00	**Lunch**		

14:00–22:00	**Conference trip** **(see Conference Book p. 44)**

Friday, 26 May

Session chair: Vratislav Šálený

09:00–09:20	**SAT**	**Robert Filgas**	Radiation spectrometer HardPix
09:20–09:40	**SAT**	**Martin Urban**	Timepix3: Influence of temperature on radiation measurements
09:40–09:55	**Coffee break**		

Session chair: Robert Filgas

09:55–10:15	**SAT**	**Veronika Stieglitz**	Design and testing of a simplified Kirkpatrick-Baez optics
10:15–10:40	**SAT**	**Peter Friedrich**	X-ray test and calibration of the Einstein Probe Follow-up X-ray telescope
10:40–11:00	**SAT**	**Vladimír Tichý**	Optical tests of prototype lobster eye X-ray optics for nano-satellite missions
11:00–11:15	**Coffee break**		

Session chair: Ronan Cunniffe

11:15–11:35	**SAT**	**Ondrej Nentvich**	PyXLA (Python X-ray-tracing for Lobster-eye Application)
11:35–11:55	**SAT**	**Vladimír Tichý**	LOPSIMUL: Quick Numerical Simulator of Multi-Foil Reflective Optical System
11:55–12:25	**SAT**	**Vratislav Šálený**	UptimAI: a revolutionary approach to system design smart optimization
12:25	**End of Small satellites & Instrumental session**		

12:25–12:40	**Franco Giovannelli**	Concluding Remarks of the IBWS 2023
12:40–12:55	**Rene Hudec**	Concluding address

13:00	**Lunch**

13:00	**End of workshop**

Last updated on May 16, 2023.
The latest version can be found at: `https://www.ibws.cz`

Engineering and maintaining remote instruments on a budget

GRB

Ronan Cunniffe
Fyzikální ústav AV ČR, Czech Republic

Ideal locations for astrophysics instruments tend to be remote and inhospitable - expensive to reach and with features such as extreme weather, extreme terrain, invasive wildlife, and no electronics supply shops. After many maintenance missions to our robotic telescopes in Argentina, Chile and La Palma, the FRAM team has (mostly) figured out how to prepare for them, how to do them, and (slowly) how to build installations that don't require quite so many of them. We discuss what we've learned along the way, from component choice and why testing is never enough through remote troubleshooting and mission preparation to carrying out the mission itself.

The contribution of robotic telescopes to the knowledge of our Universe

GRB

Franco Giovannelli
INAF-Istituto di Astrofisica e Planetologia Spaziali, Italy

In this talk I will discuss the importance of small telescopes for the advancement of knowledge of our Universe. The use of robotic telescopes scattered all over the world is fundamental. The results obtained complement those obtained with medium and large telescopes and with both small and large space experiments. Because of the limited time and my limited knowledge I will be forced to discuss some topics, important in my opinion, but which obviously do not pretend to permeate the entire field of astrophysics. However, I would like to remark the contributions of robotic telescopes to the knowledge of High Energy phenomena.

Long term follow-up coverage of Gaia alert sources

GRB

Rene Hudec
ASU AV CR & CVUT, Czech Republic

The robotic telescopes at the Ondrejov Observatory provide long-term optical multi-color coverage for selected 25 Gaia alert triggers located in the northern sky hemisphere. I will present and briefly discuss examples of selected results, mostly unpublished, obtained with these devices. In addition to that, I will present and discuss the potential of large historical photographic plate archives located around the globe as sources of both photometric as well as spectroscopic data able to allow really long-term study of photometric and spectroscopic evolution for astrophysical sources in general and for Gaia alert sources in particular. Some of these databases were digitized and provide online access.

GRB

GRB 210306A: cooling break shifting towards the optical band

Martin Jelinek
ASÚ AV ČR, Czech Republic

We present the light curve of GRB 210306A with data starting 40s after the satellite trigger. Based on the available optical and X-ray data, we interpret the lightcurve as a relativistic fireball which exhibits passage of a cooling break through the observational gap between optical and X-ray band together with an early energy injection. . . . . .
. . . . . .

GRB

Impact of satellite glints on the search of rapid transients with ZTF and LSST sky surveys

Sergey Karpov
Institute of Physics, Czech Academy of Sciences, Czech Republic

We assess the impact of satellite glints – rapid flashes produced by reflections of a sunlight from flat surfaces of rotating satellites – on current and future deep sky surveys such as the ones conducted by the Zwicky Transient Facility (ZTF) and the Vera Rubin Observatory Legacy Survey of Space and Time (LSST). In addition to producing a large number of streaks polluting the images, artificial satellites and space debris also generate great amount of false alerts hindering the search for new rapid astrophysical transients. To investigate the extent of this problem, we perform an analysis of single frame events detected by ZTF in more than three years of its operation, and assess the fraction of them related to artificial satellites. In particular, we separate a subset of repeated flashes that produce multiple events per frame located along a common path, and analyze the properties of satellites that generate them, their brightness distritution and the properties of individual flashes, which are as short as fractions of seconds. We also propose an algorithm for detection of these events in the alert streams from modern survey, and describe its implementation in FINK alert broker.

Proposal of Sky Monitoring with Subsecond Cadence

GRB

Peter Kroll
Sonneberg Observatory, Germany

Sky monitoring needs to trade-off time resolution against limiting magnitude, usually leading to exposure times of some seconds or tens of seconds. Consequently, photometric information in the range below seconds remains largely undetected.

We propose a scheme of sky monitoring using CMOS cameras to improve cadence aiming at exploring the sky in the subsecond region without relinquishing fainter stars. Optical systems could even be operated without any mechanical drives reducing costs and processed in a way similar to TDI mode. Of course, data handling would be a challenge of processing, storage and compression.

We sketch the benefits of such a monitoring from meteors to high energy events.

Peter Kroll Sonneberg Observatory

High-redshift galaxy cluster candidate from Subaru HSC photometric redshifts

GRB

Sandor Pinter
University of Public Service, Hungary

To better understand the phenomena of Gamma-Ray Bursts in high-redshift host galaxies we have to know not only the distance of the host galaxy itself from us but the location of the host in its own galaxy cluster. Recent theories linked long GRBs to galaxies with rapid star formation or starburst, thus we except GRBs are more frequent in midcluster galaxies where tidal interactions between gas-rich galaxies are more likely to occur. Using different statistical and machine learning methods on deep Subaru Hyper Suprime-Cam observations we are giving constraints on photometric redshifts of a galaxy cluster to place one of these host galaxies in their local environment.

GRB

Estimating GRBs' cosmological distances

Istvan Racz
University of Public Service, Hungary

Several thousand gamma-ray bursts have been observed but only ∼600 events have known distances. We analyzed the tendency of GRB observations, and unfortunately we found that the number of redshift measurements are significantly decreasing. Numerous papers have shown huge structures in the Universe based on GRBs, but we need spatial position for a magnitude more GRBs to explore the connection between the GRBs' and classical cosmological structures. We examined the distribution of the GRBs' distances, to give an estimation on the distances of those GRBs which have no measured redshifts. The GRB catalogs contain more than 100 physical parameters among which there can be parameters dependent on cosmological distance. We are showing a possible method to estimates the distances of Swift GRBs from their observed parameters.

GRB

Autonomous robotic telescopes in Ondřejov: BART, D50 and the others.

Jan Štrobl
ASÚ AV ČR, Czech Republic

Autonomous robotic telescopes in Ondřejov (Czech Republic) have been developed and used since 2001. They are primarily used for gamma-ray burst research, but they are also used for long-term monitoring of various high-energy sources in the optical field and also for intensive observation within campaigns. They also function as the ground segment of the INTEGRAL and GAIA satellites. The telescopes use the RTS2 robotic telescope control system and, due to their availability, are intensively used as its development environment. We will briefly present the actual state and results of the telescopes BART (SBT), D50 and also our contribution to the FRAM telescopes.

Ten years of Sonneberg Wide Angle Survey - overview and outlook

GRB

Peter Kroll
Sonneberg Observatory, Germany

The former photographic sky patrol at Sonneberg observatory, called "Sonneberger Himmelsüberwachung (SHU)", started 1956 and managed to get a full coverage of the nightly sky in two passbands down to magnitude 14 at every clear night. With 14 wide angles cameras (55/250) in parallel 188k images were taken on plates covering northern sky down to -33°. The worldwide end of glass plate production and staff reduction in the mid '90s made it necessary to switch to sheet films and reduce the number of cameras to 8.

A follow-up program titled "Sonneberg Wide Angle Survey" (SOWAS) using a fullframe digital consumer DSLR and a 360mm f/4.5 Zeiss Tessar was started in March 2013. For a growing number of defined fields the operator W. Fürtig took up to now more than 53k images.

At the beginning of 2023 a new DSLR was installed and some changes concerning data retrival, archiving and access are still in progress. Future main topics within the SOWAS programm will be improvements in automated data processing and accessibility to the data products (images and derived data). Hardware extensions for greater sky coverage and different passbands are also planned.

Mario Ennes, Walter Fürtig, Eberhard Splittgerber Sonneberg Observatory

Gamma-Ray Bursts' redshift distribution's dependence on their duration

GRB

Sandor Pinter
University of Public Service, Hungary

Gamma-ray bursts (GRBs) are distant, extremely energetic, short (about 0.1-1000 sec) cosmic transients, which could sample the whole observable Universe. Two of the Gamma-Ray Bursts' important properties are the duration and the distance of the burst. We analyzed these two important quantities of the phenomena. We mapped their two-dimensional distribution and explored some suspicious areas. As it is well known the short GRBs are closer than the others, hence we search for parts in the Universe where the GRBs duration differs from the others. We also analyze whether there are any range in the duration where the redshifts are differing.

GRB

Redshift dependence of GRBs' observed parameters

Istvan Racz
University of Public Service, Hungary

GRBs are extremely energetic short cosmic transients. Due to their huge energy output in a short time they can be observed at very large cosmological distances. Actually, they sample the whole observable Universe. As a consequence of their large distances, their observed duration, fluence and peak flux depend on the redshift. In the reality, however, this dependence can be observed only in the case if the intrinsic variance of these quantities in comoving frame do not exceed significantly that coming from different redhifts of the GRBs. Nevertheless, it is an important question whether the redshift dependence of the observed quantities could be extracted from the observational data. Using a training set consisting of GRBs having measured physical parameters and redshifts we are looking for the effect of the redshift on the observed data, using techniques available in multivariate data analysis. Creating a 3D parameter space from duration, fluence and Peak flux, we define partitions in the distribution of data points and compare the redshift distributions within these partitions. Partitioning will be made by some hierarchical clustering algorithm and cutting the obtained agglomeration tree at different places to get partitions of different numbers. The distributions of redshifts within the partitions, obtained in this way, will be compared to see if there is any difference in redshift distribution between partitions at all.

GRB

Thirteen years of experience in designing habitats for extreme environments

Vratislav Šálený
Brno University of Technology, Czech Republic

A gradually built heritage in designing habitats or means to ensure the life of astronauts in inhospitable extreme environments will be presented, from habitat studies to the design of simple demonstrators to a prototype of the very advanced European habitat S.H.E.E. (Self-Deployable Habitat for Extreme Environments). Given the focus of the conference, the concept of a lunar base for 10 astronauts (LB10) with a robotic astronomical telescope will be discused in more detail, focusing on the architectural design of a lunar habitat with an astronomical observatory. During the work on the habitat designs cooperation with international partners such as International Space University, COMEX, LIQUIFER Systems Group, Space Applications Services and Spaceinnovations has been established.

Spectral features of the High Mass X-ray Binary System 4U 0115+63

HEA

Katrin Berger
Dr. Karl Remeis Sternwarte Bamberg & Erlangen Center for Astroparticle Physics, FAU, Germany

High Mass X-ray Binary Systems (HMXBs) provide us with the opportunity to study matter under extreme physical conditions, e.g. strong magnetic fields. One of the best studied HMXBs is the system 4U 0115+63, that consists of a neutron star and its optical counterpart the Be-star V635 Cas. Observed spectra and light curves of this system contain well understood features, such as cyclotron resonant scattering features (CRSFs), and components, as for example the so-called „10keV feature“, whose origin is still a matter of current debate. In my talk I want to introduce the source 4U 0115+63 and highlight its exceptional spectral and timing features to show what we can still learn from this system.

A Journey to understand our Universe

HEA

Franco Giovannelli
INAF-Istituto di Astrofisica e Planetologia Spaziali, Italy

It is evident that a “Bridge between the Big Bang and Biology" exists. Thus in my talk I will disuss the main pillars substaining this bridge without claiming the completeness. These pillars can be described by using different experimental approaches. One of these is the Multifrequency Astrophysics which is a part of an interdisciplinary approach to the knowledge of the physics of our Universe. Indeed, as clearly demonstrated in the last decades, only with the multifrequency observations of cosmic sources it is possible to get nearly the whole behaviour of a source and then to approach the physics governing the phenomena that originate such a behaviour. I will provide several examples that marked the continuous evolution on the knowledge of the physics of our Universe.

X-ray astrophysics as secondary science with ESA/China SMILE satellite

HEA

Rene Hudec
ASU AV CR & CVUT, Czech Republic

We will present and discuss the feasibility of X-ray astrophysics with ESA/China SMILE satellite, namely the study of celestial X-ray targets as a secondary science for the onboard wide-field X-ray telescope SXI and related Czech participation in the mission. The Solar wind Magnetosphere Ionosphere Link Explorer, or SMILE, is a joint mission between the European Space Agency (ESA) and the Chinese Academy of Sciences (CAS). SMILE aims to build a more complete understanding of the Sun-Earth connection by measuring the solar wind and its dynamic interaction with the magnetosphere. SMILE is scheduled for launch end 2024. After launch, it will enter a highly-inclined elliptical orbit that will take it nearly a third of the way to the Moon at apogee.

Comparison of ESA Gaia BP/RP spectra with LDS (Low Dispersion Spectroscopy) photographic sky surveys.

HEA

Rene Hudec
ASU AV CR & CVUT, Czech Republic

Blue (BP) and Red (RP) Photometer low-resolution spectral data is one of the exciting new products in ESA satellite Gaia Data Release 3 (Gaia DR3). The Gaia „photometric mode“ RP/BP generates ultra-low-dispersion prism spectra of celestial sources. The LDS (Low-Dispersion Spectroscopy) astrophysics was evolved and performed at numerous observatories (many in US) between ca 1909 and ∼1980. Mostly LDS with Schmidt telescopes was performed (plates with objective prism). These data were used in the past for various projects e.g. QSO, emission line and Halpha surveys, star classifications, etc. but little used after ∼1980. Today knowledge among astronomers is very limited. I will show that these data can be used e.g. for the redshift estimation and study of High z Universe)

Varying height and outflow velocity of X-ray corona in AGN NGC1365

HEA

Amy Joyce
Dr. Karl Remeis Sternwarte Bamberg and Erlangen Center for Astroparticle Physics (ECAP), FAU, Germany

X-ray reflection spectroscopy is an invaluable tool used to study the effects of strong gravity in the innermost regions of AGN. The corona is the primary source of hard X-rays and emits isotropically, irradiating the accretion disk. In the lamppost model, the corona is modeled as a compact source above the black hole, on its rotation axis. The hard X-rays are reprocessed or "reflected" by the disk; the most prominent feature of this reflection in the X-ray spectrum is the iron Kα emission line at $\sim$6.4 keV. In sources where reflection takes place close to the black hole, this line and the whole reflected spectrum are broadened by relativistic effects. These effects are described by the 'relxill' model which can then be used to measure parameters such as the spin of the black hole and the geometry of the corona. Radiation that has been reflected and returned to the disk, called returning radiation, is also now taken into account in this model. We fit this model to multiple simultaneous XMM-Newton and NuSTAR observations of NGC 1365 and find that changes in time-resolved spectra can be explained by changing height and outflow velocity of its corona.

X-ray timing of accreting neutron stars: Czech contribution to eXTP science

HEA

Vladimir Karas
Astronomical Institute, Czech Academy of Sciences, Czech Republic

eXTP will be a Chinese X-ray satellite mission currently in development in international collaboration with European partners, to be launched in late 2020s. We report on our simulation results performed in Opava and Prague, where the advanced timing capabilities of the satellite have been assessed for bright X-ray binaries that contain an accreting neutron star and exhibit quasi-periodic oscillations. As an example, explicit formulae for non-geodesic orbital epicyclic and precession frequencies and their simplified practical form that allow for an expeditious application of the universal relations determining the NS properties are obtained and studied. The relativistic Lense-Thirring precession frequency in the innermost parts of the accretion region can vary by more than one order of magnitude across neutron stars with different viable equations of state.

HEA

Investigating star formation in Illustris TNG galaxy mergers

Bendegúz Koncz
Eötvös Loránd University, Hungary

Dwarf galaxies are the probable sources of the hot intra-cluster medium, a subject of a series of recent X-ray discoveries. Galaxy interaction trigger may lead to high star formation rates in these galaxies, that can lead to multiple core collapse supernovae and hot gas ejection. We studied the star formation rate history of merging galaxies in the IllustrisTNG 100-1, cosmological, magneto-hydrodynamical simulation focusing on mergers where one of the galaxies is a dwarf.

We investigated the star formation rate and mass evolution of the dwarf galaxies (progenitor), their merger companions (next progenitor) and their descendants at cosmological timescales with the use of the simulation's merger trees. We processed different merger trees testing the robustness of our method is robust and found that the results are consistent. Our results show that a high fraction of galaxy mergers is connected to superclusters, especially at lower redshifts.

I will present our methodology and the comparison of three different merger trees, including the mass and star formation rate history of the merging galaxies.

HEA

Puffy accretion disk - optically thick, sub-Eddington and stable

Debora Lančová
Institute of Physics, Silesian University in Opava, Czech Republic

We present results of general relativistic radiative magnetohydrodynamic simulations of sub-Eddington optically thick accretion on a stellar mass black hole with a mildly sub-Eddington luminosity. We find the accretion flow stabilized by magnetic field, with a puffed-up optically thick region, resembling a warm corona surrounding denser disk core. We analyze the inner structure and properties of the puffy disk. A widely accepted picture of an accretion flow in a soft spectral state X-ray binary system of a geometrically thin disk structure much alike the classic analytic solution of Shakura and Sunyaev is confronted with the puffy disk model . Despite the fact that the analytic models are troubled by instabilities and miss important aspects of physics such as magnetic fields, they are successfully used as a framework for interpreting observational data through continuum spectral fitting, which we compare with results obtained fitting the synthetic spectra of the numerical simulation results.

Nuclear line emission due to low-energy cosmic rays

HEA

Karl Mannheim
Universität Würzburg, Germany

The spectrum of low-energy cosmic rays (LECRs) is poorly known, but bears important consequences for the ionization of the interstellar medium (especially in giant molecular clouds) and for the light-element abundances resulting from spallation reactions. Our undstanding of LECRs will be greatly advanced with the Compton Spectrometer and Imager (COSI) scheduled for launch in 2027. Using the Germanium-detector onboard this NASA Small Explorer Mission, theoretical predictions of nuclear line and continuum emission will be possible in the MeV range at a sensitivity which is significantly improved compared to the still active ESA Mission INTEGRAL. Accurate predictions for LECR-induced MeV spectra can be obtained from self-consistent particle acceleration models constrained by the independently observable ionization rate and the MeV-to-TeV continuum spectrum. Recent theoretical studies of nuclear de-excitation line spectra produced by low-energy cosmic rays show that these emissions represent an irreducible background at MeV energies, that young supernova remnants may show detectable fluxes of nuclear lines, and that some peculiar abundance patterns can be explained by accelerated particles.

AHEAD2020, Integrating Activities for the High Energy Astrophysics Domain

HEA

Lorenzo Natalucci
INAF/Istituto di Astrofisica e Planetologia Spaziali, Italy

AHEAD2020 is the EU Research Infrastructure for the High Energy Astrophysics domain, funded as advanced community by the Horizon 2020 program. One main goal is to develop new branches of science as well to integrate activities with the newly born multimessenger astronomy, boosted by the discovery of gravitational waves and cosmic neutrinos and of their first high energy counterparts. This is being achieved by a new large community of high energy astronomers, gravitational wave and astroparticle scientists. Along the road paved until recently, we keep strengthening the theoretical efforts, also building up on the results of the observations of multimessenger sources; and continue opening the best infrastructures for data analysis of high-energy space and ground observatories as well as key infrastructures for on-ground test and calibration of space instrumentation. Technological developments focus on the improvement of selected detectors, optics devices and advanced analysis tools for the benefit of future space missions, with more emphasis on the observation of the new transient Universe. AHEAD2020 supports the community via grants for collaborative studies, dissemination of results, and promotion of workshops and a strong public outreach package. It also contributes to the benefit of society and to the growth of the European technology market, with specific studies of devices for cultural heritage, material composition and environmental (seismic) monitoring, as well as the creation of a new generation of researchers.

Long-Term Jet-Kinematics of Blazars in the TANAMI Sample from Combination with Archival VLBA Data

Wladislaw Schulga
Institut für Theoretische Physik und Astrophysik Universität Würzburg, Germany

TANAMI (Tracking Active Galactic Nuclei with Austral Milliarcsecond Interferometry) is the largest and longest-running VLBI monitoring program in the southern hemisphere. Observations are done with the Australian Long Baseline Array (LBA) at 2.3 GHz, 8.4 GHz and 22.3 GHz. Starting in 2010, the TANAMI program originally monitored Active Galactic Nuclei (AGN) exclusively south of -30 degrees declination. Since 2020, the program has been expanded to cover the entire southern sky. One of the newly added sources is the TeV-emitting high-peaked BL Lac object AP Lib. This source was previously observed with the Very Long Baseline Array (VLBA) at 15 GHz from 1997 to 2012 as part of the MOJAVE program. Using a jet-kinematical model derived from these VLBA data, we predict the jet structure of AP Lib at the time of the first new TANAMI observation at 8.4 GHz to compare these with the real observational data. Deviations between predicted and observed 2020 jet structure might be indicative of accelerating or decelerating jet motions, which are predicted in structured-jet models to explain the apparent discrepancy between Doppler factors derived from radio and gamma-ray observations of high-peaked BL Lac objects (the so-called Doppler Crisis). The results of this pilot analysis will be used to assess the prospects and limitations for a systematic larger-scale combination of new TANAMI data with archival VLBA data for the full sample.

Probing dense matter in rapidly variable X-ray sources

Gabriel Török
Institute of Physics, Silesian university in Opava, Czech Republic

Accreting neutron stars (NS) represent ideal laboratories for studying the effects of general relativity and matter with (super)nuclear densities. Their radiation poses an attractive subject of multidisciplinary research, and X-rays represent perhaps its most important band. So far large amount of lightcurves and spectra have been obtained and numerous information has been extracted. However, many fundamental questions remain unanswered, especially the nature of superdense matter and its equation of state. It is expected that the rapid variability of a large group of galactic sources, manifested as high-frequency quasiperiodic oscillations, may help to resolve this question. We briefly discuss the current state of knowledge in this area. Focusing on recent progress, we also outline some implications for future X-ray missions.

Radio-mechanical AGN feedback in giant elliptical galaxies

HEA

Norbert Werner
Masaryk University, Czech Republic

Most galaxies comparable to or larger than the mass of the Milky Way host hot, X-ray emitting atmospheres and central radio sources. Hot atmospheres and radio jets and lobes are the ingredients of radio-mechanical active galactic nucleus (AGN) feedback. We will present recent results based on radio and X-ray observations, which indicate that in massive early-type galaxies the central radio sources are mostly switched on and their mechanical jet power correlates strongly with the black hole mass. We will discuss the consequences of these results for our understanding of accretion, jet formation, and the evolution of massive galaxies.

Cyclotron resonant scattering features of GX 301-2

HEA

Nicolas Zalot
Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany

The High Mass X-ray Binary (HMXB) system GX 301-2 is a prominent X-ray source, whose X-ray spectrum contains a cyclotron resonant scattering feature (CRSF), which probes the neutron star's magnetic field. The line shows pulse-phase variability around 35 keV. Recently, a new cyclotron line at 50 keV has been observed, which shows no pulse-phase variability. The origin of this cyclotron line is of high interest, as it allows to draw conclusions about the line-forming regions of the system. In my talk I discuss both the phase-averaged and -resolved analysis of a recent NuSTAR observation during the pre-periastron flare. I focus on both cyclotron lines and their phase-variabilities as well as possible conclusions regarding the nature and line-forming regions of both CRSFs.

Simulations of Very High Energy Cosmic Rays Propagation from the Galactic Center

HEA

Berenika Čermáková
Universität Würzburg, Germany

According to the standard model of shock acceleration of Galactic Cosmic Rays (GCRs), protons and nuclei can be accelerated to relativistic energies at Supernova Remnants. It is currently unknown, however, if Supernova Remants are sufficiently strong as a population to explain the entire GCR flux up to the PeV energies. Here, we consider SagA*, the supermassive black hole located at the Galactic Center, as a powerful Pevatron. Black holes could accelerate protons by an ultra-efficient mode of the Penrose process (Tursunov at al., PRD D 104, 084099; 2021). We model the propagation and energy losses of relativistic protons accelerated at the putative Galactic Center Pevatron to obtain the associated high-energy emissions. The results allow constraining the Penrose-type acceleration mechanism from the Galactic Center black hole SagA*.

HEA

Perspectives of the soft X-ray observing the Galactic center region with the LOBSTER-EYE monitor

Vojtěch Šimon
Astronomical Institute ASCR, Czech Republic

Using a CubeSat-like satellite, we show the lobster-eye (LE) monitor's perspectives and observing plan. This instrument is important because it is able to provide wide-field X-ray imaging. We present the possibilities of monitoring the Galactic center region in the soft X-ray energy (a few keV) bands. The reason is that many X-ray binaries concentrate in the bulge surrounding the center of our Galaxy. Several such binaries are expected to be present in our monitor's field of view (a square of about 5×5 degrees). We show the long-term activity of the examples of X-ray binaries located in this region.

HEA

Modeling of iron line profiles emitted by accreting relativistic compact object.

René Šprňa
Institute of Physics, Silesian university in Opava, Czech Republic

We develop an effective technique of calculation of spectra containing broadened relativistic iron line emitted from the vicinity of accreting weakly magnetized compact object. We constitute and investigate a complex model including the presence of radiation of the disk, spreading layer and neutron star (NS) surface. Within our approach, we can study the influence of individual components of the system on the resulting spectral profiles. Apart from radiation of these objects, we include the related obscuration effects in a fully self consistent way. We also include the oblateness of the rapidly rotating NS and consider the shape to be spheroid described by the results of numerical modelling including plausible up-to-date equation of states (Eos). We conclude that consideration of a different NS EoS for NS with a given mass and spin frequency may result in very different spectral signatures.

Rapid variability of X-ray flux in accreting neutron stars

HEA

Kateřina Klimovičová
Institute of Physics, Silesian university in Opava, Czech Republic, Czech Republic

Following previous research on epicyclic oscillations of accretion disks around black holes and neutron stars (NSs), a new model of high-frequency quasi-periodic oscillations (QPOs) has been proposed. The so-called Cusp Torus (CT) model deals with oscillations of fluid in accretion tori. It has been expected that the model should provide better fits of the NS QPO data compared to the widely discussed relativistic precession (RP) model. We derive a handful approximative analytic formula which well reproduces the model's predictions on the QPO frequencies (based on outputs of research described in "Oscillation of fluid accretion disks around neutron stars" poster). For a particular choice of a single parameter, our formula provides frequencies predicted by the CT model. For another value, it provides frequencies predicted by the RP model. We briefly illustrate the application of our simple formula on several NS sources and confirm the expectation that the CT model provide bettter fits of data then RP model. Moreover, we show that inferred masses of rotating NS sources agrees with those given by up-to-date NS equation of state.

Investigating star formation in nearby interacting galaxies

HEA

Bendegúz Koncz
Eötvös Loránd University, Hungary

We are investigating how interaction between galaxies in the local Universe triggers star formation, both globally and in different regions of the galaxies. We highlight two examples where one of the interacting galaxies is significantly smaller. We look at combined spectrographic and photometric data both at visible and at high energy wavelengths to look for tracers of intense star formation and obtain metallicities. Comparing the calculated star formation surface densities and metallicities to isolated galaxies gives us a hint on how star formation and the composition of the interstellar material evolved through the interaction. Resolving the nearby galaxies shows how differently the two galaxies change due to the interaction, and at the same time, it makes possible to identify local star-forming regions with different characteristics.

Oscillations of fluid accretion disks around neutron stars

HEA

Monika Matuszková
Institute of Physics, Silesian University in Opava, Czech Republic

We examine the influence of quadrupole moment (q) of a slowly rotating neutron star (NS) on the oscillations of the non-geodesic fluid flow in the innermost region of accretion disks. The previously developed analytical methods relevant to the pressure supported accretion tori are for the first time fully applied under the assumption of the background of Hartle - Thorne geometry. We provide practical formulae determining frequencies of disk oscillations and precessions. These can be used to model high frequency quasi-periodic oscillations (QPOs) observed in accreting NS X-ray sources (an application is described in "Flux variability of accreting neutron stars" poster).

The THESEUS mission and the new INTEGRAL online data anlysis system/product gallery

SAT

Enrico Bozzo
University of Geneva, Switzerland

In this talk we will present the THESEUS mission, which is currently in competition within the context of the ESA 2021 medium-size mission calls. THESEUS, transient high energy sky and early universe surveyor, has been designed to dramatically advance our knowledge on the early Universe thanks to the exploitation of gamma-ray bursts. It will also provided an unprecedented deep monitoring of the soft X-ray sky in strong synergy with many of the large facilities operating in the late 2030s. In the same talk, I will also present the recent online analysis system that has been developed for the INTEGRAL high energy mission and the associated product gallery, both targeting usage by a broad community.

FSUA - actuator development for the LISA mission of ESA

SAT

Asen Christov
Institute of Physics CAS, Czech Republic

The LISA mission of the ESA is planned for 2036 and is aiming at detecting gravitational waves in space at lower frequencies than the ground observatories. It will consist of three satellites in a triangular constellation with distances between them of 2.6 million kilometers, forming the arms of an laser interferometer. We will present the development of an opto-mechanical component, the Fiber Switching Unit Assembly (FSUA), for the satellites' optical benches. This device will be responsible for switching between the main and redundant lasers in case of failure. In order to comply with the strict requirements of the mission a novel mechanism is being developed based on the piezo slip-stick drive.

SAT

Space weather effects at LEO as experienced by GRBAlpha

Marianna Dafčíková
Masaryk University, Czech Republic

GRBAlpha is a 1U CubeSat which aims to demonstrate the performance of a newly developed gamma-ray detector for future CAMELOT mission. Being on a low Earth polar orbit, GRBAlpha frequently passes through the Van Allen radiation belts. These regions are very dynamic and their shape is predominantly determined by the interplanetary conditions which are subject to solar activity. As the Sun is headed to its maximum and more CubeSats are launched to LEO every year, it is crucial to have a proper understanding of how space weather affects the LEO environment. In this talk I will present the effects observed by GRBAlpha, and discuss the possibility of an X1 solar flare destroying one of two radio transceivers on-board GRBAlpha.

SAT

VZLUSAT2 CubeSat for EO, GRB and space environment monitoring

Vladimír Dániel
Czech Aerospace Research Centre, Czech Republic

The work presents the Czech multipurpose satellite VZLUSAT2 mission, development and flight experiences. The 3U CubeSat carries Earth Observation (EO) payload based on Commercial Off The Shelf (COTS) components, GRB detector for online monitoring of gamma ray bursts and instruments for space environment monitoring – CdTe Timepix, Space Dosimetry System Demonstrator (2SD) and HAL2 for volatiles measurement. The necessity of high maturity AOCS system is discussed and solutions to reach high GSD are presented. The spacecraft carries two EO imaging systems, one with GSD 40m and second with GSD 400m. The experiences and results from one year of operation will be presented. Sample images from different continents were done and will be presented together with GRB measurements and solar flares gamma transients.

SAT

Deep space mission REMEC for GCR monitoring

Robert Filgas
IEAP Czech Technical University in Prague, Czech Republic

The Radiation Environment Monitor for Energetic Cosmic rays (REMEC) is one of the missions selected by ESA in the frame of Czech ambitious missions programme to conduct phase 0, A, B studies of missions built and operated by Czech companies and research organizations. REMEC is a microsatellite proposed to be placed outside of Earth's magnetosphere in Sun-Earth L2 point where it will precisely measure and monitor the flux, composition and direction of cosmic radiation with energies from 10 MeV/n to 10 GeV/n. The main scientific payload is the novel magnetic spectrometer Pix.PAN based on Timepix4 technology, complemented by HardPix Timepix3-based radiation monitor. REMEC will study properties of galactic cosmic rays, provide new input to improve current SEP physics models and monitor penetrating particles presenting a serious hazard for long term human space travel and lunar habitation.

Radiation spectrometer HardPix

SAT

Robert Filgas
IEAP Czech Technical University in Prague, Czech Republic

HardPix is a miniature radiation monitor based on the Timepix3 sensor and developed for space application by the Institute of Experimental and Applied Physics, Czech Technical University in Prague (IEAP CTU). Its low volume (<0.1 U), mass (<150 g), power consumption (∼2 W) and cost make it ideal even for small cubesats and networks of space weather monitoring satellites. Thanks to the built-in onboard processing it can provide particle identification, energy spectra, flux and dose rates using minimum data transfer rates. It is building upon the space heritage of SATRAM, our radiation monitor onboard ESA Proba-V satellite celebrating 10 years of ongoing operation in space this year, as well as REM units onboard ISS. Space agencies and commercial companies are already showing interest in HardPix, one unit will be launched onboard D-Orbit ION satellite in June 2023 and two units will be part of ESA's European Radiation Sensors Array (ERSA) onboard Lunar Gateway, with several more missions already in preparation.

X-ray test and calibration of the Einstein Probe Follow-up X-ray telescope

SAT

Peter Friedrich
Max Planck Institute for Extraterrestrial Physics, Germany

The Follow-up X-ray telescope (FXT) is one of the instruments on board of the Einstein Probe (EP) satellite of the Chinese Academy of Sciences (CAS) due for launch in late 2023. The EP mission is dedicated to the study of the time-domain high-energy astrophysics, using a Lobster-eye based wide field telescope, complemented by an eROSITA-like optics for follow-up observations. MPE has provided hardware and its test facilities as part of a European contribution to Einstein Probe by ESA, and in addition the eROSITA flight spare mirror assembly as the second FXT module. Three FXT mirror assemblies – structural-thermal, qualification and flight models – have been manufactured. All were acceptance tested with X-rays and then equipped with X-ray baffles for stray-light rejection, followed by environmental tests and subsequent X-ray performance tests. The final tests of qualification model, serving as a flight spare, and flight model included an X-ray calibration at various photon energies ranging from about 0.3 to 8 keV. All tests were performed at MPE's test facilities: the laboratory for vibration and thermal-vacuum testing, and the PANTER X-ray facility. Reported are the setups and the results of the respective test sequences, focusing on the qualification and flight mirror assemblies. After delivery to China, all mirror assemblies were subjected to complementary measurements in the X-ray test facility of the Institute for High Energy Physics of CAS.

The HERMES and SpIRIT constellation: design and development of the payloads

SAT

Ezequiel J. Marchesini
OAS-INAF Bologna, Italy

HERMES (High Energy Rapid Modular Ensemble of Satellites) is a space-borne mission based on a constellation of six nano-satellites flying in a low-Earth orbit (LEO). The 3U CubeSats, to be launched mid-2024, host miniaturized instruments with a hybrid Silicon Drift Detector/GAGG:Ce scintillator photodetector system, sensitive to X-rays and gamma-rays in a large energy band. The HERMES constellation will operate in conjunction with the Space Industry Responsive Intelligent Thermal (SpIRIT) 6U CubeSat, to be launched in late 2023. SpIRIT is an Australian-Italian mission for high-energy astrophysics that will carry in a Sun-synchronous orbit an actively cooled HERMES detector system payload. The projects are funded by the Italian Ministry of University and Research and by the Italian Space Agency, and by the EU Horizon 2020 Research and Innovation Program under Grant Agreement No. 821896. HERMES will probe the temporal emission of bright high-energy transients such as Gamma-Ray Bursts (GRBs), ensuring a fast transient localization (with arcmin-level accuracy) in a field of view of several steradians exploiting the triangulation technique. HERMES intrinsically modular transient monitoring experiment represents a keystone capability to complement the next generation of gravitational wave experiments. The HERMES and SpIRIT scientific case, payload design, integration and test, will be outlined, emphasizing the innovative technical solutions adopted to in the detector design.

Attitude effects on observations with cubesats in gamma-ray domain

SAT

Filip Münz
Masaryk University, Faculty of Science, Czech Republic

Our simple gamma-ray detectors (of nippon-hungarian design) are gaining flight heritage on board of GRBAlpha and VZLUSAT-2 cubesats. The former having only passive (and rather inefficient) attitude control we observe many signs of its movement in its sensors, radio transmission and above all in signal from the detector. Modeling detector response can help to disentangle these modulations on fast transient events. VZLUSAT-2's dataset is much more scarce yet but its twin detectors and attitude control set an essential milestone on the path towards GRB localizing missions of cubesat constelations. Lessons learnt from the reconstruction of incomplete data will be an important input to the planned GRBBeta mission.

PyXLA (Python X-ray-tracing for Lobster-eye Application)

SAT

Ondrej Nentvich
Czech Technical University in Prague, Czech Republic

The X-ray sky is full of interesting events that can be observed by a space telescope. Due to the small field of view of X-ray telescopes, typically less than 1°, it is necessary to use wide field optics such as lobster-eye type, which can observe up to 180°. I will present the newly developed ray-tracing simulator PyXLA (Python X-ray-tracing for Lobster-eye Application), which is mainly designed to verify the properties of Lobster-eye optics. It is possible to design a 1D or 2D type in Schmidt or Angel arrangement. Since the X-ray sky is rich in transient, variable and flaring triggers, it is possible to include a theoretically unlimited number of sources to reflect the real situation that the instrument is supposed to observe.

GRBAlpha and VZLUSAT-2 CubeSats Observing Gamma-Ray Transients

SAT

Jakub Ripa
Masaryk University, Faculty of Science, Department of Theoretical Physics and Astrophysics, Czech Republic

I will present the detector performance and science results from GRBAlpha, a 1U CubeSat mission, which is a technological pathfinder to a future constellation of nanosatellites monitoring gamma-ray bursts (GRBs) called CAMELOT. GRBAlpha was launched in March 2021 and operates on a 550km altitude sun-synchronous orbit. GRBAlpha has already detected 26 GRBs (long and short), flashes from soft-gamma repeater SGR 1935+2154 and several solar flares. It has detected extraordinarily bright GRB 221009A, which was the most intense GRB ever recorded in the 55 years history of GRB science. Recently, it also detected exceptionally bright GRB 230307A. More than two years after the launch, the detector performance is good and the degradation of the SiPM photon counters remains at an acceptable level. The same detector system, but double in size, was launched in January 2022 on VZLUSAT-2 (3U CubeSat) and it has also detected many GRBs, activity of SGR 1935+2154, SGR 1806-20 and solar flares. This proves that nanosatellites can be used for routine detection of gamma-ray transients.

SAT

Design and testing of a simplified Kirkpatrick-Baez optics

Veronika Stieglitz
Max Planck Institute for Extraterrestrial Physics, Germany

Beside Wolter I X-ray optics, which are used at most in currently operating X-ray space telescopes, there exist also other optical designs and their usability for space observations is still the matter of studies. This article covers preliminary testing results of an optical module which is based on a modified Kirkpatrick-Baez optics. This X-ray optics, consisting of four sub-modules, was assembled in Prague and tested at the PANTER test facility of MPE afterward. The sub-modules use different reflective coatings, in part developed by our research group, on complementary flat mirrors, which approximate the shape of a Kirkpatrick-Baez optical design. In this contribution we summarise the design of the optical modules, the details of applied coating layers, and the X-ray characterisation results at the PANTER test facility.

SAT

LOPSIMUL: Quick Numerical Simulator of Multi-Foil Reflective Optical System

Vladimír Tichý
Vladimír Tichý, Czech Republic

A software called LOPSIMUL is presented. The main advantage of LOPSIMUL is very high computational rate. LOPSIMUL is intended for simulation of multi-foil optical systems, particularly Schmidt or Anglel lobster eye. These systems are intended mainly for X-rays. Various systems derivated of lobster eye can be simulated by LOPSIMUL, too. Kirkpatrick-Baez system can be simulated with limitations. LOPSIMUL contains few reflectivity models. Any reflectivity model can be imported to LOPSIMUL in a form of look-up table. Lopsimul draws focal image and $\times$ and y profiles. Focal image as well as profiles can be exported. LOPSIMUL calculates FWHM, effective collecting area and other principal results.

SAT

Optical tests of prototype lobster eye X-ray optics for nano-satellite missions

Vladimír Tichý
Vladimír Tichý, Czech Republic

As lobster eyes can be manufactured in various scales, they are possible to be used on nano-satellites. Therefore, a prototype module of such optics has been developed. The prototype is designed so that the entire telescope consisting of the optics and a detector fits 3 standard CubeSat units. The module is one-dimensional, however second module providing focussing in the second axis can be added. New manufacturing technology of this module is used. The module has been tested using visible light that is possible because glass plates coated by gold are used as mirros. The focal image and corresponding FWHM is compared with results of simulations.

Timepix3: Influence of temperature on radiation measurements

SAT

Martin Urban
Czech Technical University in Prague, Czech Republic

Although the Timepix series of radiation pixel detectors have been successfully used for several years, including several space applications, their characterisation is still not well described, and the influence of environmental conditions on their measurement results is not well documented. In space applications, the temperature change is one of the most significant environmental effects on the detector. The characterisation of the detector and the description of its temperature dependencies are essential to minimise the distortion of the measured data. This contribution deals with the description of the detector temperature influence on the radiation energy measurement and presents the proposed energy spectrum compensation methods.

SpacePix3: SoI MAPS Detector for Space Radiation Monitoring

SAT

Pavel Vančura
Faculty of Nuclear Sciences and Physical Engineering, Czech Republic

Radiation in space is a potential risk to human health and electronic systems. Spacepix-3, the successor of Spacepix-2 (used on VZLUSAT-2 satellite), is a high voltage monolithic active pixel sensor (HV-MAPS) ASIC capable of measuring flux and distinguishing between types of radiation, protons, electrons, and ions. SpacePix3, improved version of the former SpacePix2, features 64 $\times$ 64 pixels matrix with a pixel pitch of 60 µm and a total sensitive area of 3.84 $\times$ 3.84 mm^2. Analog signals from pixels are digitized by 32 10-bit column ADCs with successive approximation register (SAR). The total power consumption is 43 mA from a 1.8 V power supply. Sensor diodes are biased at -150 V. Special Spacepix-3 functions are backside channel signal processing, SPI/LVDS readout modes, hit trigger output, debugging features, thermometer, radiation-hardened, multichip operation, and analog pixel output. Chip is implemented in 180 nm SoI technology. The next mission with SpacePix3 ASICs is the first Czech satellite LVICE2 planned to be launched in 2027.

QUVIK: Quick Ultra-VIolet Kilonova surveyor

SAT

Norbert Werner
Masaryk University, Czech Republic

We present the results of a feasibility study for a UV space telescope on a 110kg small-satellite with a moderately fast repointing capability and a real-time alert communication system that has been proposed in response to a call for an ambitious Czech national mission. The mission, which has been approved for and is undergoing a detailed feasibility study shall measure the brightness evolution of kilonovae, resulting from mergers of neutron stars in the UV band and thus it shall distinguish between different explosion scenarios. Between the observations of transient sources, the satellite shall perform observations of other targets of interest.

UptimAI: a revolutionary approach to system design smart optimization

Vratislav Šálený
Brno University of Technology, Czech Republic

The UptimAI software platform will be presented. The suite of analytical tools embedded in this platform combines state-of-the-art technologies for sparse data analysis, uncertainty quantification, statistical modeling and smart optimization. The unique algorithms used make it possible to extract maximum information from sparse (small) data sets. The platform's probabilistic algorithms offer a completely new insight into the statistical influence of each parameter, individually and in combination, on the entire system under analysis. It allows to optimize the system design for a wide range of conditions while eliminating critical scenarios. Use cases of this platform in space research and industry will be demonstrated. The UptimAI software platform was incubated within ESA BIC Prague and is used in the design process by large space partners such as Thales Alenia Space.

Prospects of Plate Archive Photometric Calibration by GAIA SED Fluxes

Maryam Raouph Lashkami
Philipps-University Marburg, Germany

In this study, we are working on improving the photometric calibration of astronomical photo plates. We selected the sky patrol of the largest German digitized photographic plates archive located at Sonneberg Observatory, Thuringia which comprises about 300,000 plates. Carrying out tasks in the digitization workflow of photo plates which contain the extraction of sources on direct images, astrometric calibration, and photometric calibration is implemented using an open-source python package (PyPlate). Due to the difference in terms of color sensitivity in the photo plates' emulsion response, there are offsets in zero points, which are very hard to determine and to remove from light curves, especially when combing data from different photo plate series. The newly released Gaia DR3 dataset contains the mean low-resolution spectra (SED) with full sky coverage complete down to magnitudes of $G < 17.6$ mag covering the optical to near-infrared wavelength range [330, 1050] nm. By applying the GaiaXPy tool we are able to calculate the Gaia determined brightness of stars in the photo plates' color systems for use in the photometric calibration. The result of the study is to obtain a consistent astrometric and, for the first time, photometric calibration of the Sonneberg plates and those of other archives such as APPLAUSE.

IBWS Introduction and Historical Background

Rene Hudec
ASU AV CR & CVUT, Czech Republic

I will give a short introduction and historical background to the IBWS INTEGRAL BART conference. Originally, the IBWS (INTEGRAL/BART) workshops focused on the work of High energy astrophysics group (at that dime dominated by young research fellows and students) in the Astronomical Institute of the Academy of Sciences of the Czech Republic and relevant national and international collaborators from the field, with intensive student participation. During the early years, these activities were focused on the ESA INTEGRAL satellite and on the related ground-based robotic telescopes, e.g. the small robotic BART telescope at the Ondrejov Observatory. Nowadays, the IBWS workshops promote regional collaboration in galactic and extragalactic high-energy astrophysics, both experimental as well as theoretical, with an emphasis on the interface between satellite projects and ground-based experiments (e.g. robotic telescopes). We continue our emphasis on wide participation and presentations of students and young research fellows.

Recent space project examples in Czech Republic

Richard Pavlica
5M s.r.o., Czech Republic

The aim of presentation are examples of Czech industrial companies and its Space projects and cooperation on these project between industrial entities and with academia.

Concluding Remarks of the IBWS 2023

Franco Giovannelli
INAF-Istituto di Astrofisica e Planetologia Spaziali, Italy

In this talk I will discuss the main results presented during this workshop. I would like to stress the participation of so many youg people that can secure the continuty of research in different fields of astrophysics. Particular emphasis will be devoted to the active participation of young Czech colleagues, leaded by Professor René Hudec. The participation of Czech institutions in numerous international programmes, many of which within the European Space Agency, is astonishing. Also not to be overlooked is the participation in micro-satellite programs by students from Czech universities. This fact is encouraging for the correct continuation of science which must be marked by the transmission of experiences of the "notable" professors to their young students.

Concluding Address

Rene Hudec
ASU AV CR & CVUT, Czech Republic

List of Participants

Katrin Berger	Germany
Enrico Bozzo	Switzerland
Asen Christov	Czech Republic
Ronan Cunniffe	Czech Republic
Marianna Dafčíková	Czech Republic
Vladimír Dániel	Czech Republic
Robert Filgas	Czech Republic
Peter Friedrich	Germany
Franco Giovannelli	Italy
Rene Hudec	Czech Republic
Adolf Inneman	Czech Republic
Martin Jelinek	Czech Republic
Jakub Jon	Czech Republic
Amy Joyce	Germany
Vladimir Karas	Czech Republic
Sergey Karpov	Czech Republic
Kateřina Klimovičová	Czech Republic
Bendegúz Koncz	Hungary
Peter Kroll	Germany
Debora Lančová	Czech Republic
Karl Mannheim	Germany
Ezequiel J. Marchesini	Italy
Veronika Maršíková	Czech Republic
Monika Matuszková	Czech Republic
Filip Münz	Czech Republic
Lorenzo Natalucci	Italy

Ondrej Nentvich	Czech Republic
Richard Pavlica	Czech Republic
Sandor Pinter	Hungary
Ladislav Pína	Czech Republic
Istvan Racz	Hungary
Maryam Raouph Lashkami	Germany
Jakub Ripa	Czech Republic
Wladislaw Schulga	Germany
Ladislav Sieger	Czech Republic
Veronika Stieglitz	Germany
Vladimír Tichý	Czech Republic
Gabriel Török	Czech Republic
Martin Urban	Czech Republic
Pavel Vančura	Czech Republic
Norbert Werner	Czech Republic
Nicolas Zalot	Germany
Berenika Čermáková	Germany
Vojtěch Šimon	Czech Republic
René Šprňa	Czech Republic
Eva Šrámková	Czech Republic
Jan Štrobl	Czech Republic
Vratislav Šálený	Czech Republic

Useful Information

Emergencies

There are several important numbers:

112 The Single European Emergency Call Number
158 Police of the Czech Republic
155 Emergency medical services
150 Fire and rescue service of the Czech Republic

In case you are in an emergency situation or witness such a situation and do not know where exactly you are, report your **location** using the **six-digit number** on the nearest street **lighting pole** to the emergency services.

Internet connection

Wi-Fi will be available during the conference.

SSID:
PASS:

Social Events

- **Welcome reception**
  - 18:30–22:00
  - **U Šimla**
  - Závodní 19/1, Dvory, 360 06 Karlovy Vary
- **Tuesday dinner**
  - 18:30–22:00
  - **U Šimla**
  - Závodní 19/1, Dvory, 360 06 Karlovy Vary
- **Observatory of Karlovy Vary with light refreshments**
  - see Conference Book p. 43
- **Conference trip with dinner**
  - see Conference Book p. 44

Regional library

Závodní 378/84, 36006
Karlovy Vary - Dvory

- Conference venue

U Šimla

Závodní 19/1, 36006
Karlovy Vary - Dvory

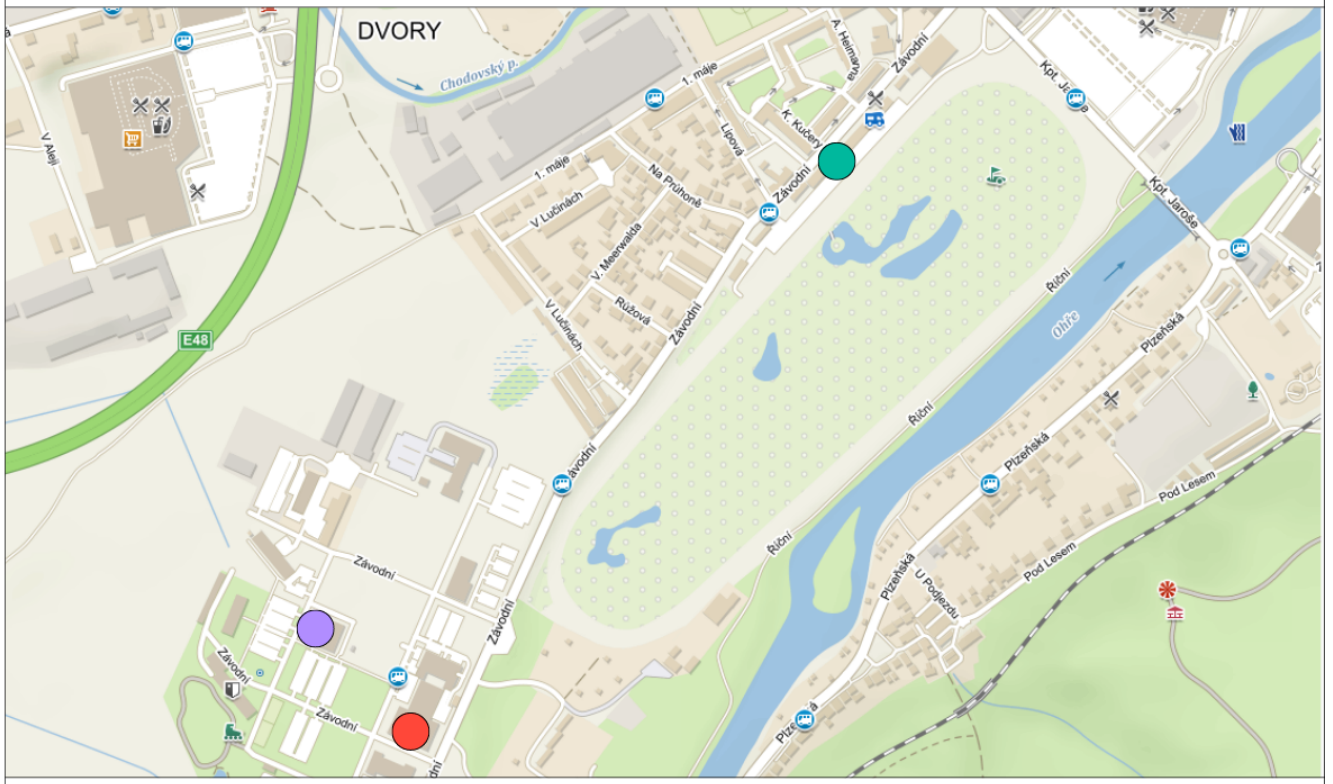
- Welcome dinner
- Tuesday dinner

Cantina La Fresca

Závodní 391/96c, 36006
Karlovy Vary - Dvory

- Lunch

MAP



Regional library | U Šimla | Cantina La Fresca

Observatory of Karlovy Vary

Wednesday 24 May	
18:10	**Meeting place:** In front of the entrance to the Karlovy Vary Regional Library (*conference venue*)
18:15	Departure to the Observatory
20:00 - 21:30	Individual return by shuttle

Bečov and Teplou Castle and St. Maurus's shrine

Thursday, 25 May	
14:00	**Meeting place:** In front of the entrance to the Karlovy Vary Regional Library (*conference venue*)
14:15	Departure to Bečov
15:00 - 17:30	Tour of the castle followed by a visit to the St. Maurus's shrine
17:30 - 22:00	Conference dinner in the botanic garden
22:30	Arrival to Karlovy Vary

The castle complex at Bečov was founded in the early 14th century by the lords of Osek who owned it along with the surrounding demesne for almost two hundred years. The castle experienced its most significant development under the Pluhs of Rabštejn in the late 15th century and in the first half of the 16th century. The original Gothic castle occupies the highest position on the hilltop, it was improved with stone portals and mural paintings during a Renaissance remodelling. The courtyard of the castle is surrounded by a quadrangular chapel tower, as well as the Pluh Palace and stables. Below the castle there is an 18th-century palace whose central section dates back to the Renaissance period. Proposed 19th century adjustments to plans by Romantic architects Josef Zítek and Josef Mocker were only implemented to a minimal extent.

The tour will introduce you to a unique Romanesque goldsmith's priceless relic - shrine of St. Maurus. The accompanying exhibition takes you through the history of this jewel and at the end of the tour you can quietly enjoy the beauty of the Romanesque goldsmith. Come with us on a journey in the footsteps of the reliquary of St. Maur!

Partner Institutions and Sponsors

Astronomický ústav AV ČR

The Czech Academy of Sciences

Strategy AV21

Top research in the public interest

Rigaku

Leading With Innovation

KarlovyVARY

THIN FILM TECHNOLOGICAL SERVICE

VESMÍR PRO LIDSTVO

INTEGRAL/BART workshop

22 - 26 May 2023

Carlsbad, Czech Republic

ibws.cz