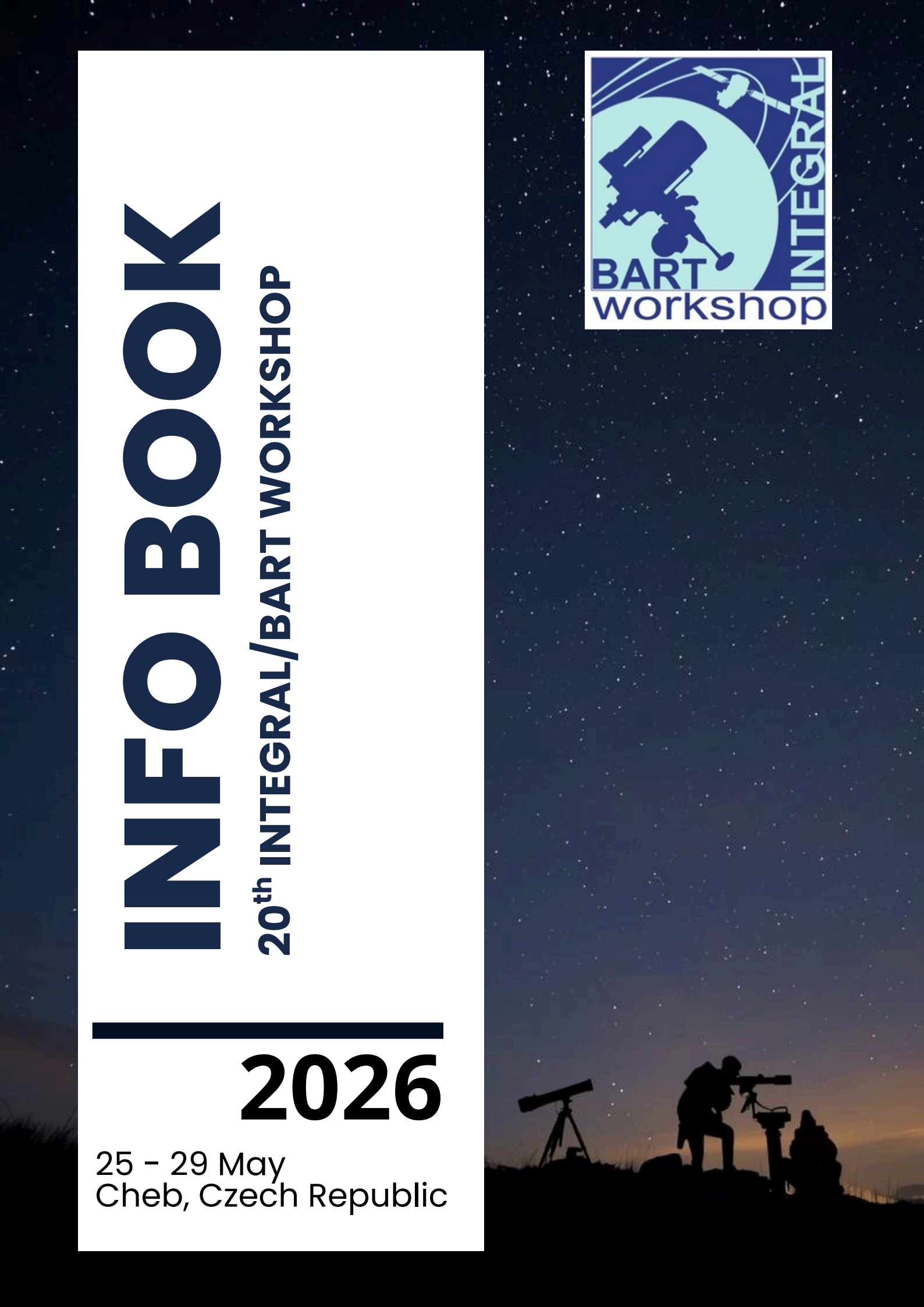
INFO BOOK

20th INTEGRAL/BART WORKSHOP

2026

25 - 29 May
Cheb, Czech Republic



Prepared for IBWS workshop
https://ibws.cz/
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CONTENTS

ABOUT

INTEGRAL/BART Workshop

IBWS is a successful series of international workshops dedicated to all aspects of highenergy 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 20th INTEGRAL/BART Workshop.

René Hudec

ABOUT

Organising committee

Rene Hudec, ASU CAS & CTU FEE, CZE
Elena Urbanová, ASU CAS, CZE
Martin Jelínek, ASU CAS, CZE
Filip Novotný, ASU CAS, CZE
Alžběta Maleňáková, ASU CAS, CZE
Vratislav Šálený, VUT Brno, CZE
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Klaus Schilling, Zentrum für Tel., DEU
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Franco Giovennelli, INAF Rome
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SESSIONS

RGRB Gamma-Ray Bursts & Robotic Telescopes

GRB

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

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

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.

HSF

Human Space Flights & AI in Space Applications

Human spaceflight technologies and experiments. Effects of the space environment on the human body. Space medicine and biomedicine. AI-driven healthcare, physiological monitoring, and multimodal data. In-flight operations and safety. AI-supported CAE for space applications design. Space architecture.

SCHEDULE

INV SAT HEA GRB HSF

Monday, May 25

Session Chair: René Hudec

14:00	**Registration**	
14:30	Welcome Notes	
14:40	**René Hudec**	IBWS Introduction and Historical Background
15:10	**Hendrik van Eerten**	Interpreting and modelling gamma-ray bursts and similar high-energy transients
15:40	**Coffee break**	

GRB Session I - Session Chair: Zsolt Bagoly

16:10	**Alžběta Maleňáková**	GRB optical afterglows: the first ten minutes
16:30	**Martin Jelínek**	Thermal electrons in an ultra-relativistic shock shape the optical afterglow of GRB 250702F
16:55	**Istvan Racz**	Synergizing Swift and VLT/X-shooter Observations
17:15	**Sergey Karpov**	The FRAM telescopes data archive
18 - 21	**Dinner**	

SCHEDULE

INV SAT HEA GRB HSF

Tuesday, May 26

GRB Session II - Session Chair: Mika Gelowicz

8:45	**Registration**	
9:00	**Welcome notes** **Štěpánka Černá, M.A., MBA** Member of the City Council and non-executive Councillor for Education and Physical Education of the City of Cheb Principal of the 6th Primary School in Cheb Member of the Regional Committee for Education, Training and Employment In 2025, she received the prestigious title "Principal of the Future 2024/25" **Antonín Jalovec, M.A. – Principal of Gymnázium Cheb** Former Mayor of Cheb	
9:20	**Filip Novotný**	Transient detection at the Ondrejov observatory
9:50	**Zsolt Bagoly**	Unified Sky Exposure Mapping of Gamma-Ray Bursts using Swift Data
10:10	**Coffee break**	

HEA Session I - Session Chair: Martin Jelínek

10:40	**Ondřej Pejcha**	Evolution of binary stars leading up to high-energy sources
11:10	**Jan Ebr**	Stars as probes of our own atmosphere
11:40	**Lunch**	

HEA Session II - Session Chair: Ondřej Pejcha

14:00	**Kunal Bhardwaj**	A photometric classifier for tidal disruption events in Rubin LSST
14:20	**Kateřina Klimovičová**	A systematic method for determining neutron star parameters from kilohertz quasi-periodic oscillations
14:40	**Dimitris Tsatsis**	An Updated Gamma-Ray Source Catalogue from INTEGRAL/SPI
15:15	**Coffee break**	

SCHEDULE

INV SAT HEA GRB HSF

Tuesday, May 26

HEA Session III - Session Chair: Istvan Racz

15:45	**Gabriel Torok**	Black hole spin and neutron star mass determined from rapid X-ray variability
16:15	**Kristína Novotná**	Constraining strange stars with astronomical observations
16:35	**Saurabh Mittal**	Contribution of Stellar flares to the 511 keV Galactic positron budget
16:55	**Mika Gelowicz**	Cosmological γ-γ Pair-Production Background
17:25	**Manja Zimmerer**	Determining the Contribution of Massive Stars and Classical Novae to the Radioactive Isotope 26 Al
18-21	**Welcome Reception**	

SCHEDULE

INV SAT HEA GRB HSF

Wednesday, May 27

HEA Session IV - Session Chair: Thomas Siegert

9:15	**Registration**	
9:30	**Tauseef Ahmad Zafar**	Detection of Compact Non-Dispersed Objects in Digitized Mt. Wilson Michigan Southern Sky Hα Survey Plates as Candidates for High-Redshift Sources
9:50	**Bendegúz Koncz**	Galaxy mergers history in the IllustrisTNG simulation
10:10	**Laura Eisenberger**	Observations of the dark matter halo of the Andromeda Galaxy with INTEGRAL/SPI
10:30	**Coffee break**	

HEA Session V - Session Chair: Gabriel Török

11:00	**Thomas Siegert**	Positron annihilation as an astrophysical messenger
11:30	**Tomohiko Oka**	Prospects for detecting nuclear de-excitation gamma rays from low-energy cosmic rays in the inner Galaxy
11:50	**René Šprňa**	Radial profiles of Fe K photoionization flux arriving from boundary layer
12:10	**Tristan Bouchet**	Spectro-polarization with INTEGRAL: application to Cygnus X-1
12:30	**Nóra Varga**	The Potential of the THESEUS Mission for Studies of Massive Young Stellar Objects

SCHEDULE

INV SAT HEA GRB HSF

Wednesday, May 27

HEA Session VI - Session Chair: Jan Ebr

12:50	**Lunch**	
14:00	**Dorota Rosinska**	Gravitational Wave Astronomy
14:35	**René Hudec**	Astrophysics with digitized archival astronomical photographic plates An Upgrade
14:55	**Vojtěch Šimon**	The variable recurrence times of outbursts in soft X-ray transients
15:15	**Coffee and Poster Session**	
16-18	**Planetarium**	
18-21	**Dinner**	

SCHEDULE

INV SAT HEA GRB HSF

Thursday, May 28

SAT Session I - Session Chair: Zsolt Bagoly

9:00	**Registration**	
9:20	**Vojtěch Šimon**	Astronomical observing with SXI/SMILE
9:45	**Jakub Kapuš**	CORVUS IOV: Demonstrating a Scalable ESA Pioneer CubeSat Platform
10:05	**Rudi Reinhardt**	Clearence Measurements with a Compton Camera
10:25	**Coffee break**	

SAT Session II - Session Chair: Tristan Bouchet

10:55	**Klaus Schilling**	Formations of Small Satellites Open Up New Application Fields
11:25	**Jan Peter Lommler**	From Hits to Data: Realizing COSI's potential with Machine Learning
11:50	**Lucia Krivanekova**	Stratospheric balloons as research platforms within the ASTRABAX project
12:10	**Vladimír Tichý**	Tests of Schmidt lobster eye based on new technology
12:30	**Jakub Kapuš**	Spacemanic Missions: Small Satellites for Space Weather, High-Energy Astrophysics and Amateur Radio
12:50	**Bendegúz Koncz**	LED testing strategy and optical optimalisation of the THESEUS Infrared Telescope's Calibration Unit
13:10	**Lunch**	
15-18	**Social Event, visit**	
18-21	**Conference Dinner**	

SCHEDULE

INV SAT HEA GRB HSF

Friday, May 29

SAT Session III - Session Chair: Sergey Karpov

9:15	**Filip Münz**	QUVIK Science Operations
9:40	**Michaela Ďuríšková**	Overview of the scientific results of CubeSat missions GRBAlpha and GRBBeta
10:00	**Ulvi Mehralijev**	Mathematical modelling of a piezoelectric accelerometer for aerospace application
10:20	**Coffee break**	

HSF Session I - Session Chair: Vratislav Šálený

10:50	**Adam Mikeš**	Modeling and Optimization of an Oxygen Mask for Aerospace Applications
11:10	**Vratislav Šálený**	Predicting Astronauts' Cognitive Performance on the ISS and on Earth
11:40	**Tomáš Koutník**	Probabilistic Optimization Modelling using AI in Aerospace Component Design
12:00	**Thomas Siegert**	Concluding remarks
12:20	**René Hudec**	20th IBWS Conference Concluding Address
12:40	Lunch	
14:00	End of the Conference	

LIST OF PARTICIPANTS

Name	Country
Zsolt Bagoly	Hungary
Štěpán Beran	Czech Republic
Kunal Bhardwaj	Czech Republic
Tristan Bouchet	Germany
Ondřej Chlopčík	Czech Republic
Jan Ebr	Czech Republic
Laura Eisenberger	Germany
Mika Gelowicz	Germany
Sayantan Gope	Czech Republic
Rene Hudec	Czech Republic
Martin Jelínek	Czech Republic
Jakub Kapuš	Czech Republic
Sergey Karpov	Czech Republic
Rebeka Gy. Kiss	Hungary
Kateřina Klimovičová	Czech Republic
Bendegúz Koncz	Hungary
Tomáš Koutník	Czech Republic
Lucia Krivanekova	Germany
Jan Peter Lommler	Germany
Alžběta Maleňáková	Czech Republic
Monika Matuszková	Czech Republic
Ulvi Mehraliyev	Czech Republic
Adam Mikeš	Czech Republic
Saurabh Mittal	Germany
Filip Münz	Czech Republic
Kristína Novotná	Czech Republic
Filip Novotný	Czech Republic

Name	Country
Tomohiko Oka	Germany
Ondrej Pejcha	Czech Republic
Istvan Racz	Hungary
Rudi Reinhardt	Germany
Dorota Rosinska	Poland
Klaus Schilling	Germany
Thomas Siegert	Germany
Vladimír Tichý	Czech Republic
Dimitris Tsatsis	Germany
Gabriel Török	Czech Republic
Gabriela Urbancová	Czech Republic
Elena Urbanová	Czech Republic
Nóra Varga	Hungary
Stanislav Vitek	Czech Republic
Tauseef Ahmad Zafar	Czech Republic
Manja Zimmerer	Germany
Hendrik van Eerten	United Kingdom
Michaela Ďuríšková	Czech Republic
Vojtěch Šimon	Czech Republic
René Šprňa	Czech Republic
Jan Štrobl	Czech Republic
Vratislav Šálený	Czech Republic

INVITED LECTURES

Evolution of binary stars leading up to high-energy sources

Ondřej Pejcha, CZE
Charles University

Many stellar high-energy sources are manifestations of one of the stages of binary star evolution. In this talk, I will discuss the astrophysical processes influencing binary star evolution such as mass transfer and the response of mass-losing and mass-accreting stars, formation of circumbinary medium, explosions, and violent events such as common envelope evolution, as well as their relation to end products such as gravitational wave sources. I will cover in greater detail two types of transient events: luminous red novae, which accompany stellar mergers and potentially hold the key to connecting many different evolutionary pathways , and classical novae, where recent GeV Fermi detections as well as ground, space, and interferometric observations suggest a much more complicated picture of mass ejection than previously thought.

INVITED LECTURES

Formations of Small Satellites Open Up New Application Fields

Klaus Schilling, DE
Zentrum für Telematik

Technology progress for small satellites allows self-organizing multi-satellite systems for observations. The satellite formation will be configured by miniature attitude and orbit control systems to optimize network properties. This potential is exploited in Earth observation regarding multi-perspective measurements. At the launch pad in California are currently multi-satellite missions from Würzburg, such as - TOM : 3 cooperating satellites to generate 3D surface images, - CuBy : 5 satellites with multi-spectral cameras for biomonitoring and geodesy applications. Transfer of such formation principles to support astronomical observations offer good potential for innovative distributed sensing methods and will be jointly further explored during this workshop.

INVITED LECTURES

Gravitational Wave Astronomy: Status and Prospects

Dorota Rosinska, PL
University of Warsaw, Poland

The first direct detection of gravitational waves on September 14th, 2015 originating from the merger of two stellar-mass black holes, opened an entirely new way of observing the Universe. The signal GW150914, not only marked the birth of gravitational wave astronomy but also provided the first evidence for the existence of binary black holes and validated general relativity in the strong-field regime, previously inaccessible to observation. For this groundbreaking discovery, the 2017 Nobel Prize in physics was awarded to key contributors from the LIGO–Virgo collaboration. Since then, over 300 gravitational-wave signals, predominantly from binary black hole coalescences, have been observed leading to major breakthrough discoveries. In this talk, I will review the key results from the first decade of gravitational-wave observations, with emphasis on their implications for astrophysics, fundamental physics and cosmology and present prospects for future detectors.

INVITED LECTURES

Stars as probes of our own atmosphere

Jan Ebr, CZE

FZU - Institute of Physics, Czech Republic

The FRAM robotic telescopes started as experimental tools for atmospheric monitoring at astroparticle observatories over two decades ago. Over time, both their purpose and methods have greatly changed, sometimes following unexpectedly twisting paths. The original design target of the FRAM at the Pierre Auger Observatory was the measurement of wavelength dependence of aerosol extinction using photoelectric measurements of bright stars. After this has proven prohibitively difficult, the program re-focused on rapid cloud detection along the apparent trajectory of interesting cosmic ray showers - and during these observations, the breakthrough method of aerosol measurement using wide-field photometry was developed, leading to the expansion of the FRAM project to support the upcoming Cherenkov Telescope Array Observatory. Eventually, we went full circle: using the exceptionally stable conditions at Roque de los Muchachos, we can now show that the wide-field method is actually the right way for the wavelength-dependence measurement. As this quantity is directly correlated with the size of the aerosol particles, we are here opening a new window for atmospheric physics at night, with possibly broad application far beyond simple atmospheric monitoring.

INVITED LECTURES

Interpreting and modelling gamma-ray bursts and similar high-energy transients

Hendrik van Eerten, UK
University of Bath, United Kingdom

The landscape of of high-energy astrophysical transients keeps expanding, owing to a long and growing list of successful space- and earth-based observatories gathering data across the broadband. A common thread connecting various phenomena from gamma-ray bursts and their afterglows to X-ray flashes and optical transients, is the release of fast-moving plasma producing some form of non-thermal emission. In order to understand the physics behind a given event, modelling therefore typically requires a combination of jet dynamics, radiative process modelling and a coherent framework to translate both to an observational prediction. In this presentation, I will describe a few recent transients where I have been involved in modelling (GRB 170817A, GRB221009A, GRB230307A, EP240408A, EP241021A). These will be used to illustrate the various approaches, both numerical and (semi-)analytical, that are taken in practice to interpret extreme transients.

HIGH ENERGY ASTROPHYSICS

HEA

A photometric classifier for tidal disruption events in Rubin LSST

Kunal Bhardwaj

Institute of Physics of the Czech Academy of Sciences, Czech Republic

ITidal disruption events (TDEs) occur when stars are torn apart by supermassive black holes, producing distinctive optical transients that are also promising electromagnetic counterparts to high-energy neutrinos and ultra-high-energy cosmic rays. The Vera C. Rubin Observatory's LSST will detect thousands of TDEs, motivating efficient photometric classifiers to distinguish them from supernovae, AGN, and superluminous supernovae. We developed a machine-learning pipeline that fits Gaussian processes (GPs) to multi-band light curves and feeds the resulting color, rise/fade time, and GP length-scale features into an XGBoost classifier optimized for high precision. Trained on the ELAsTiCC2 simulation, our classifier reaches up to 95% precision at ~72% recall, with post-peak colors as the dominant predictive features. We are now generalizing this pipeline to the MALLORN Challenge dataset and and adapting the feature set for early-alert classification on truncated light curves to enable timely multi-messenger follow-up.

Spectro-polarization with INTEGRAL: application to Cygnus X-1

Tristan Bouchet

Julius-Maximilians-Universität Würzburg, Germany

In this new era of high-energy spectro-polarimetry, our understanding of high-energy sources has the potential to be greatly improved. This is especially the case for Black Hole X-ray Binaries (BHXB), also known as Microquasars, for which many unresolved challenges remain. In particular acceleration mechanisms and how they relate to accretion-ejection processes. Combined with spectroscopy, polarization is a powerful tool to reveal the geometry of the system and the configuration of the magnetic fields. The persistent Microquasar Cygnus X-1 is particularly well suited for our analysis. In soft X-rays, the polarization is low and aligned with the general direction of the jet, while the polarization angle in the soft gamma-rays is found close to 70° away from the jet. We use a novel method to combine high-energy spectra and polarization of this bright source from 1 keV to 2 MeV in a single fit, including observations from IXPE, PoGO+, XL-Calibur, AstroSat, INTEGRAL/SPI and INTEGRAL/IBIS. Our study involves energy-dependent polarization models for both emission processes, in part inspired by similar studies on Blazars. Preliminary results already reveal new constraints about the non-thermal hard-tail origin (above 100 keV), in particular its high-energy spectral cut-off and the degree of order of the magnetic field.

HIGH ENERGY ASTROPHYSICS

HEA

Observations of the dark matter halo of the Andromeda Galaxy with INTEGRAL/SPI

Laura Eisenberger

University of Würzburg, German

The Andromeda galaxy (M31) is a promising target for the indirect search of dark matter (DM) due to its proximity and expected massive DM halo. It functions as test case for a Milky Way (MW) like galaxy as the isotropic emission from the MW halo itself cannot be detected with a coded mask telescope like INTEGRAL/SPI. MeV data can put strong limits on DM models from the MeV up to the TeV mass range since weakly interacting massive particles also produce a significant flux of secondary MeV photons from inverse Compton scattering and positron annihilation. We analyze the spectrum of M31 obtained with the SPI instrument to constrain DM models. From the 511 keV emission from positron annihilation, we estimate the pair production rate in M31 to derive a lower mass limit on thermal DM. We further constrain the parameter space for DM annihilation and decay into electron–positron pairs, and place limits on primordial black hole DM.

Cosmological γ-γ Pair-Production Background

Mika Gelowicz

Rheinische Friedrich-Wilhelms-Universität Bonn, Germany

The Cosmic Photon Background (CPB), an isotropic radiation field spanning the full electromagnetic spectrum, provides a potential source of positrons through photon–photon interactions (pair production). To model the CPB, it is decomposed into a set of gray-body components that evolve with redshift according to source-specific luminosity functions. The pair-production rate is obtained by integrating the angle- and energy-dependent cross section over the evolving photon field. The generated electron–positron pairs are then propagated to the present epoch ($z = 0$), accounting for cosmological expansion and energy losses in the intergalactic medium. The resulting photon emission is computed at each redshift and integrated along the line of sight to determine its contribution to the present-day Cosmic Gamma-Ray Background (CGB). The pair-production emissivity rises steeply from $\sim 2.0 \times 10^{-36}$ s^{-1} cm^{-3} at $z = 0$ to a peak of $\sim 1.8 \times 10^{-31}$ s^{-1} cm^{-3} at $z \approx 2.7$, followed by a decline at higher redshifts. This corresponds to a total cosmic pair-production rate of order 10^{54} positrons per second up to $z = 10$. The secondary emission from inverse Compton scattering of these pairs off the CPB yields a significant contribution to the CGB. In particular, in the 1–10 MeV energy range, this component may account for approximately 10–20% of the total observed gamma-ray background. These results indicate that cosmological γ–γ absorption sets a minimum level of secondary emission that must be included in models of the CGB, especially in the MeV regime.

HIGH ENERGY ASTROPHYSICS

HEA

Astrophysics with digitized archival astronomical photographic plates An Upgrade

Rene Hudec

ASU AV CR & CVUT, Czech Republic

Astrophysics with digitized archival astronomical photographic plates An Upgrade. In this contribution, I will present the recent status of the digitization of archival astronomical plate archives, both direct and spectral. Astronomical photoplates capture the state of the sky over the past 100+ years. Digitization allows modern algorithms to track variable objects, including transients of various types and those related to high-energy astrophysics targets, asteroids, and other unique phenomena that would otherwise remain forgotten in the archives, albeit representing important data sources for recent astrophysics. Despite of recent progress over last years, many plate archives still remain without digitization and hence with difficult access.

A systematic method for determining neutron star parameters from kilohertz quasi-periodic oscillations

Kateřina Klimovičová

Silesian University in Opava, Czech Republic

Confronting observational measurements with theoretical models of neutron star spacetimes presents several challenges. These are particularly pronounced due to the differences in the definitions of measurable physical quantities and the quantities commonly used to define the spacetime metric, with the dependence of these quantities on the neutron star equation of state playing a major role. Here, we make use of the universal relations between neutron star parameters that were previously found through empirical means. We demonstrate how these relations can be utilised to obtain neutron star parameters from observed kilohertz quasi-periodic oscillations, provided the neutron star spin frequency is known.

HIGH ENERGY ASTROPHYSICS

HEA

Galaxy mergers history in the IllustrisTNG simulation

Bendegúz Koncz

University of Debrecen, Hungary

Galaxy evolution over time remains unclear, with ongoing debate about how collisions affect star formation and metallicity. The role of the local environment shaped by the large-scale structure of the Universe in galaxy mergers may be significant, yet it has not been thoroughly examined. Using the IllustrisTNG cosmological simulation, we processed the catalog data and merger tree files of the TNG300-1 run. We calculated the average star formation rate (SFR) and stellar mass of galaxies over the redshift range $0 < z < 15$ to trace the cosmic star formation history and galaxy growth. We investigated the environments of galaxy mergers with a focus on local density within the cosmic web, and found that interactions with gas-rich dwarf galaxies can trigger a resurgence in gas supply, highlighting the importance of gas dynamics in sustaining star formation. We compared our results with recent JWST observations and identified differences in the star formation rate density (SFRD) history between simulations and observations, providing new insights into early galaxy formation and evolution. See Koncz et. al. Universe 2025, 11(9), 286.

Testing the Lense–Thirring interpretation of LF QPOs in neutron stars

Monika Matuszková

Silesian University in Opava, Czech Republic

Low-frequency quasi-periodic oscillations (LF QPOs) in neutron star (NS) X-ray binaries are commonly interpreted as manifestations of Lense–Thirring (LT) precession of the inner accretion flow. We test this hypothesis using models of geometrically thick accretion tori in the Hartle–Thorne spacetime, focusing on the source 4U 1608–52, for which both LF QPO frequencies and the NS spin are observationally constrained. By comparing predicted LT precession frequencies with those allowed by realistic NS models, we find that parameter combinations capable of reproducing the observed LF QPOs are not compatible with realistic NS configurations. In particular, such configurations imply stellar radii exceeding the innermost stable circular orbit, thereby limiting the maximum achievable precession frequency. We therefore conclude that a direct identification of LF QPOs with the fundamental LT precession frequency is not viable for this source. Instead, our results suggest that the observed variability may be associated with harmonics of the LT precession frequency, consistent with some earlier suggestions in the literature.

HIGH ENERGY ASTROPHYSICS

HEA

Contribution of Stellar flares to the 511 keV Galactic positron budget

Saurabh Mittal

University of Wuerzburg, Germany

The origin of the Galactic 511 keV positron annihilation line has been a mystery for five decades. One proposed explanation is positron production in stellar flares, motivated by the detection of the 511 keV line in solar flares and by the association of this emission with old stellar populations. In this work, we explore this scenario using two complementary approaches. First, we build a theoretical model to estimate the quasi-persistent 511 keV emission from flaring stars. Starting from solar flare observations, we construct empirical scaling relations between flare energy and 511 keV luminosity and extend them to Galactic stellar populations using flare-frequency-energy distributions for different spectral types. In parallel, we analyze INTEGRAL/SPI data in the 511 keV band using combinations of known point sources and simple spatial templates, such as disk and bulge components modeled as two-dimensional Gaussians. We also test alternative descriptions in which no bulge template is assumed and the emission is instead described by a disk component together with a population of globular clusters, scaled by their masses and distances. This ongoing work aims to assess whether stellar flares can plausibly account for the observed Galactic 511 keV emission.

Constraining strange stars with astronomical observations

Kristína Novotná

Silesian University in Opava, Czech Republic

Interest in strange stars has increased recently with the observations of HESS J1731-347. This source may be interpreted as a strange star with an estimated mass of ~0.77 $M_\odot$, and a radius of ~10.4 km. This light object, together with the observations of heavy pulsars with masses of ~2 $M_\odot$, challenges the equations of state over a wide parameter space. In this work we will study whether various astronomical observations of neutron stars can also be explained by strange stars. We will focus on the maximum mass currently observed and on tidal deformability, both of which serve as possible constraints on the equations of state of strange stars.

HIGH ENERGY ASTROPHYSICS

HEA

Prospects for detecting nuclear de-excitation gamma rays from low-energy cosmic rays in the inner Galaxy

Tomohiko Oka

JMU Würzburg, Germany

Galactic cosmic rays are widely believed to originate from shock acceleration in supernova remnants; however, observations of ionization rates in the interstellar medium (ISM) in the inner Galaxy suggest the presence of additional, potentially unknown, acceleration sources. Low-energy cosmic rays (LECRs) excite nuclei in the ISM, producing MeV gamma-ray line emission through subsequent de-excitation, and observations of this emission enable robust constraints on the LECR flux and its spatial distribution. We model the MeV gamma-ray spatial distribution using three-dimensional computation based on cosmic-ray spectra predicted by GALPROP. We then evaluate their detectability relative to non-thermal leptonic emission components and identify the locations where it can be detected by current and future MeV gamma-ray missions.

Evolution of binary stars leading up to high-energy sources

Ondřej Pejcha

Charles University, Czech Republic

Many stellar high-energy sources are manifestations of one of the stages of binary star evolution. In this talk, I will discuss the astrophysical processes influencing binary star evolution such as mass transfer and the response of mass-losing and mass-accreting stars, formation of circumbinary medium, explosions, and violent events such as common envelope evolution, as well as their relation to end products such as gravitational wave sources. I will cover in greater detail two types of transient events: luminous red novae, which accompany stellar mergers and potentially hold the key to connecting many different evolutionary pathways , and classical novae, where recent GeV Fermi detections as well as ground, space, and interferometric observations suggest a much more complicated picture of mass ejection than previously thought.

HIGH ENERGY ASTROPHYSICS

HEA

Positron annihilation as an astrophysical messenger

Thomas Siegert

JMU Würzburg, Germany

One of the major tasks of astrophysics is to understand the emission mechanisms of observed sources and regions in the sky. Only by pinpointing down these mechanisms, it is possible to derive physical parameters and learn about the evolution of astrophysical objects. Alas, many observations of high-energy phenomena are ambiguous, requiring more and orthogonal information. The nature of several sources, among others accreting X-ray binary systems, core-collapse and thermonuclear supernovae, cosmic-rays, stellar flares and potentially dark matter, all show signatures of positron production and annihilation. Utilising this underrated emission mechanism can shed light on unsolved problems in astrophysics and cosmology. In this talk, I will show examples of how we can learn from these gamma-ray signatures already now, and what might be possible in the context of new gamma-ray satellite missions, such as the accepted NASA mission COSI.

The variable recurrence times of outbursts in soft X-ray transients

Vojtěch Šimon

Astronomical Institute ASCR, Czech Republic

Since the typical lengths of the recurrence times Tc (cycle lengths) of outbursts in soft X-ray transients (SXTs) range from months to decades, X-ray monitors are needed to detect them and investigate their evolution. Evolution of Tc shows a complex curve with episodes of increase and decrease. Significant results can be obtained even when different monitors with various energy bands, available for the individual time segments (years or decades), are used (e.g., ASM/RXTE, MAXI/ISS, BAT/Swift). The character of the O-C curves of SXTs bears a striking similarity to that of dwarf novae observed in the optical band. It means that variations in Tc are large, but generally not chaotic, and long-term trends in the O-C curves can be resolved. Observing the variety of the X-ray evolution of dwarf novae is still limited by the low sensitivity of the current X-ray monitors.

HIGH ENERGY ASTROPHYSICS

HEA

Radial profiles of Fe K photoionization flux arriving from boundary layer

René Šprňa

Institute of Physics, Silesian university in Opava, Czech Republicc

In neutron star low-mass X-ray binaries, the boundary layer beneath the accretion disk is likely a major source of irradiation of the inner disk. Because this illuminating geometry differs from the compact corona usually assumed in relativistic reflection models, the radial profile of disk-incident flux may also depart from standard prescriptions. We investigate the illumination of a thin accretion disk by a latitude-dependent spreading layer on the surface of a weakly magnetized neutron star and find that the resulting radial dependence is well described by a smoothly broken power law, with parameters that depend systematically on the spreading layer geometry.

Iron line modeling of accreting neutron stars

René Šprňa

Institute of Physics, Silesian university in Opava, Czech Republic

Most models used to fit Fe-K lines in neutron star systems assume that such emission lines come from the accretion disk alone and neglect the presence of stellar surface. This simplification omits obscuration effects and possible iron line emission from the surface, where shear-heated material cools and spreads. Here, we present a relativistic model that incorporates both components consistently. Using full relativistic ray tracing code LSD, we compute photon trajectories from the disk and the neutron star surface. We demonstrate that neglecting the presence of the neutron star itself can lead to biased interpretations of relativistic iron emission line profiles. We show that such profiles are degenerated with pure disk emission for different disk parameters.

HIGH ENERGY ASTROPHYSICS

HEA

An Updated Gamma-Ray Source Catalogue from INTEGRAL/SPI

Dimitris Tsatsis

University of Wuerzburg, Germany

This project focuses on expanding the source catalogue derived from observations with the Spectrometer on INTEGRAL (SPI). While SPI has provided valuable insights into the gamma-ray sky, its current source catalogue remains limited by sensitivity constraints, background modeling challenges, and source confusion in crowded regions. The aim of this work is to improve source detection and characterization by applying enhanced data analysis techniques, including refined background estimation and optimized event selection. By systematically reprocessing archival data from the past 22 years of observation and incorporating longer exposure times, the project seeks to identify previously undetected or marginal sources and to improve the significance and localization of known ones. The resulting expanded catalogue will contribute to a more complete understanding of high-energy astrophysical populations and diffuse emission components, thereby maximizing the scientific return of the INTEGRAL mission.

Black hole spin and neutron star mass determined from rapid X-ray variability

Gabriel Török

Institute of Physics, Silesian University in Opava, Czech Republic

High-frequency quasi-periodic oscillations (QPOs) are observed in the X-ray variability of accreting black holes (BHs) and neutron stars (NSs). These oscillations provide some of the most compelling insights into the physics of accretion flows in strong gravity and the equation of state of dense matter in astrophysics. In this talk, we will discuss the implications of various QPO models for both groups of sources, with a particular focus on comparing two QPO models based on the precession of accreted matter. The first of these is the relativistic precession model, which associates QPO frequencies with the frequencies of general relativistic test particle motion in the vicinity of the innermost stable circular orbit. The second model makes the same QPO frequency assignment but considers fluid precession rather than particle precession. While it clearly matched the NS data better, we found that the fluid flow precession model implied a lower NS mass and was consistent with higher BH spins. Furthermore, by making use of the CompOSE library, we demonstrate that the fluid flow precession model, unlike the former model, is compatible with a wide range of neutron star equations of state. The NS mass implied by the model typically ranges from 1.7 to 2.1 solar masses.

HIGH ENERGY ASTROPHYSICS

HEA

Twin-Peak QPO in 4U 1608–52: Confronting Dense Matter Models with X-ray Observations

Gabriela Urbancová

Institute of Physics, Silesian University in Opava, Czech Republic

Twin-peak quasi-periodic oscillations (QPOs) observed in the X-ray variability of accreting neutron stars (NSs) offer a unique window into the physics of dense matter. We model QPO frequencies in the atoll source 4U 1608–52 using two precession-based models within the Hartle–Thorne spacetime framework, adopting the NS spin frequency of 620 Hz determined from X-ray burst measurements. Using 135 equations of state (EoSs) from the CompOSE library, we systematically confront a wide range of NS models with the observational data. Compared to the relativistic precession model, the fluid precession model clearly provides a better match to the data, while implying a NS mass that is approximately 10% lower. The favoured model constrains the NS mass to M = (1.8–2.0) Msun and the dimensionless spin parameter to j~0.2–0.4.

The Potential of the THESEUS Mission for Studies of Massive Young Stellar Objects

Nóra Varga

Eötvös Loránd University, Hungary

IThe detection and monitoring of high-energy emission from astrophysical sources provide key insights into energetic processes such as accretion, magnetic activity, and feedback in star-forming environments. Wide-field high-energy survey missions, such as the proposed THESEUS mission, are designed to perform repeated observations of large fractions of the sky, primarily targeting transient phenomena including gamma-ray bursts. As a consequence of their survey strategy, such missions also enable systematic, time-domain coverage in the soft X-ray regime, opening new opportunities for studying Galactic sources, including nearby star-forming regions and young stellar objects. We aim to assess the observability of nearby star-forming regions within the baseline survey strategy of wide-field high-energy missions and to explore how their temporal sampling can be used to characterize variability and feedback processes. In addition, we consider the synergy with ultraviolet facilities, such as ULTRASAT, which provide complementary constraints on stellar radiation fields and winds. By combining high-energy and UV time-domain coverage, it becomes possible to investigate the coupling between energetic processes in young stars and their impact on the surrounding interstellar medium.

Data mining in astronomical photographic archives with advanced IT methods

Tauseef Ahmad Zafar

Czech Technical University, Czech Republic, Czech Republic

We report on recent progress in the digitization of astronomical plate archives and the application of novel IT approaches, including machine learning methods, to these data. Astronomical photographic archives represent an extensive and largely untapped database of stellar, solar, and planetary observations, encompassing astrometric, photometric, and spectroscopic measurements accumulated over more than a century. These archives hold significant potential for a wide range of applications in modern astrophysics, including the study of long-term variability, detection of rare transient events, and identification of objects with peculiar spectra. We present results from visits to over 16 US institutions and numerous European, Mexican, and Chinese observatories, where plate samples were digitized using a transportable scanning device. We further describe the application of advanced computational techniques to digitized plates from the Sonneberg Observatory and the Henize Mt. Wilson Michigan Southern Sky Survey, demonstrating the feasibility of extracting new astrophysical findings from historical archival data.

Determining the Contribution of Massive Stars and Classical Novae to the Radioactive Isotope 26 Al

Manja Zimmerer

JMU Würzburg, Germany

The isotopes 26Al and 60Fe show short lifetimes (~ 106 yr) with respect to the time scales of Galactic evolution and are therefore used as messengers of ongoing nucleosynthesis and star formation in the Milky Way. The production of both isotopes is commonly associated with massive stars. They are thought to be ejected in their supernovae, and in the case of 26Al partially in the wind phase of the star. Because of their similar origin and lifetimes , the ratio 60Fe/26Al of their y-ray emission would be independent of the true location and distribution of their source, and yields a chance to test the outcome of stellar evolution models. The expected results of 60Fe/26Al for core-collapse supernovae, however, show discrepancies with measurements (Spyrou et al. 2024). This method only works, if 26Al and 60Fe have the same origin throughout the Galaxy. At the same time recent results from 26 Al measurements suggest a star formation rate (SFR) of $\gtrsim$ 5 M$\odot$/yr (Siegert et al. 2023), which exceeds other literature values. Classical novae are also believed to produce 26 Al, which, if the contribution is large enough, would decrease the SFR from the correlation of 26 Al with massive stars. We aim to determine the 26 Al mass as a function of Galactocentric radius and compare it with two Galactic chemical evolution (GCE) models (Vasini et al. 2025; Martinet et al. 2022) to estimate the contribution of (very) massive stars and classical novae. We are using 20 yr of INTEGRAL/SPI observations of the decay gamma-ray line at 1. 809 MeV to test different assumptions on the radial structure of 26 Al. We present the total mass, the Galactic distribution of the 26Al, and the relative contribution of 26Al assuming different Galactic 3D models. We find significant contributions from classical novae which exceed prior studies for all tested models. A larger contribution of 26Al from classical novae directly decreases the effective 60Fe/26Al ratio affects the interpretation as a probe of massive-star nucleosynthesis and would lower the SFR from 26Al y-ray measurements accordingly to 1-2 M$\odot$/yr

GAMMA-RAY BURSTS & ROBOTIC TELESCOPES

GRB

Unified Sky Exposure Mapping of Gamma-Ray Bursts using Swift Data

Zsolt Bagoly

Ludovika University of Public Service, Hungary

Using Preconditioned Spherical Generalized Additive Model for redshift completeness sky maps we study the spatial compatibility of Gamma-Ray Burst redshift subpopulations in the Swift GRB catalog. The redshifts of GRBs are measured using either rapid afterglow spectroscopy or delayed host-galaxy observations. We use several spherical spatial statistics, such as Monte Carlo log-likelihood permutation tests, Maximum Mean Discrepancy, the spherical Ripley's K-function, and the two-dimensional Fasano-Franceschini test, to measure the possible spatial differences. Our analysis finds no statistically significant difference between the two subpopulations. This result justifies the application of a combined GRB sky map during the reconstruction of the large-scale cosmological structures.

Testing CSR of GRB's spatial distribution

Zsolt Bagoly

Ludovika University of Public Service, Hungary

Complete spatial randomness (CSR) describes a point process whereby point events occur within a given study area in a completely random fashion. It is synonymous with a homogeneous spatial Poisson process. Such a process is modeled using only one parameter nu , i.e. the density of points within the defined area. According to observations, the angular distribution of GRBs follows this property within the limits of statistical inference. We studied the question, however, whether this property is also valid for a 3D space distribution consisting GRBs having measured redshifts. Slicing sample into quantiles by redshiftrhift we tested their CSR, separately.

Thermal electrons in an ultra-relativistic shock shape the optical afterglow of GRB 250702F

Martin Jelínek

Astronomicky ustav AVCR, Czech Republic

How efficiently does a relativistic collisionless shock accelerate electrons, and what fraction of the electron energy remains in a low-energy Maxwellian tail rather than being channelled into a non-thermal power law? These questions are central to shock physics in many astrophysical settings: pulsar wind nebulae, AGN jets, and the blast waves of gamma-ray bursts. Particle-in-cell simulations have predicted a partially-thermalized electron component at the forward shock for over fifteen years, but direct observational evidence has been lacking. On 2025 July 2, the Ondřejov D50 robotic telescope began observing GRB 250702F (z = 1.520) just 27.8 seconds after the Fermi/Swift trigger, providing continuous high-cadence optical coverage through the prompt-to-afterglow transition. After a bright flare of clearly internal-shock origin, a second component rises rapidly and turns over smoothly, decaying with a continuously steepening slope over more than 20 minutes (100 to 1400 s). At its steepest the decay is too fast for a forward shock, even though the component otherwise resembles one. Around 1400 s it transitions into a normal power-law afterglow. We interpret the steep decay as the synchrotron peak of the Maxwellian electron population sweeping through the optical band as the shock decelerates, following $\nu_{th} \propto t^{-3/2}$. A hybrid Maxwellian-plus-power-law forward-shock model fits the full optical evolution and yields a non-thermal energy fraction $\delta = 0.84 \pm 0.02$ and a characteristic Lorentz factor $\gamma_{th} \approx 900$ for the Maxwellian population. This is well above the bulk Lorentz factor $\Gamma_0 \simeq 160$. These observations provide direct optical evidence of a partially-thermalized electron distribution at a relativistic forward shock. GRB 250702F is a clean case: negligible host extinction, dense cadence, and an early start combine to constrain the intrinsic spectral slope directly, removing the degeneracy that complicates interpretation in most afterglows. The resulting constraints on the Maxwellian fraction and the non-thermal acceleration efficiency match what particle-in-cell simulations have been predicting since 2008.

The FRAM telescopes data archive

Sergey Karpov

Institute of Physics, Czech Academy of Sciences, Czech Republic

The FRAM robotic telescopes have been in operation for nearly two decades, producing a unique long-term dataset of wide-field sky images. The data includes observations of targeted astronomical sources, such as gamma-ray bursts, variable stars, and comets, as well as survey fields and atmospheric calibration images. The latter, although originally acquired for calibration purposes, also constitute a valuable serendipitous survey of the large regions of the sky. To make this dataset available to the scientific community in accordance with the FAIR principles - to make it Findable, Accessible, Interoperable, and Reusable - we have developed the FRAM Data Archive, a dedicated portal providing open access to more than six million images covering the whole sky. The archive allows users to search and retrieve original images, generate cutouts around specified sky positions, and access automatically derived photometric measurements for all objects detected in the images. We describe the architecture and current capabilities of the archive, including automated data ingestion and maintenance, calibration-frame production, astrometric calibration, photometric reduction, and generation of higher-level data products. We discuss the challenges associated with this heterogeneous long term dataset and outline possible applications in time-domain astronomy, archival searches, education, and public scientific use.

GRB optical afterglows: the first ten minutes

Alžběta Maleňáková

Astronomical Institute of the Czech Academy of Sciences, Czech Republic

The transition sharpness of the optical forward-shock onset in gamma-ray bursts (GRBs) has not been systematically quantified. I introduce a hyperbola parametrisation for afterglow light curves that measures the transition width logR at the onset peak, offering more stable MCMC convergence than standard smooth broken power laws. The method is applied to eight GRB afterglows: three events observed in detail with the D50, SBT, and FRAM at La Palma; three archival afterglows reprocessed from published data, including observations from BART, D50, and FRAM at Auger; and two further bursts from recent group work. A linear correlation between logR and p, the electron power-law index, is found across seven of these bursts: harder spectra correspond to sharper onset transitions. An errors-in-variables MCMC fit confirms a significant negative slope with small intrinsic scatter. The parametrisation provides a stable and extensible framework for characterising the afterglow onset across large archival samples.

GAMMA-RAY BURSTS & ROBOTIC TELESCOPES

GRB

Transient detection at the Ondrejov observatory

Filip Novotný

Masaryk University, Czech Republic

In the era of wide-field surveys such as the Zwicky Transient Facility and the Vera C. Rubin Observatory, the role of small robotic telescopes has shifted from discovery to follow-up observations of newly detected transients. Their scientific use depends on the ability to adapt observing strategies in real time as data are acquired. I present an automated pipeline for transient detection and follow-up optimisation developed for the D50 and SBT telescopes at the Ondřejov Observatory. The system integrates real-time photometric reduction (pyrt), presented at this conference before, with afterglow modelling, transient detection and alerts from other facilities. This approach has enabled early optical monitoring of several gamma-ray bursts and supernovae, including GRB 250702F (also discussed in the talk by Martin Jelínek).

Synergizing Swift and VLT/X-shooter Observations

Istvan Racz

University of Public Service, Hungary

This study presents a systematic analysis of the neutral hydrogen (NH) column density in Gamma-Ray Burst (GRB) environments by combining legacy data with the latest observations. We extend our previous analysis of the 2012–2017 high-resolution VLT/X-shooter spectroscopic data with the newest observations. The primary objective is to investigate the potential discrepancies between X-ray derived (from Swift/XRT) and optical Lyman-alpha column densities across a wide redshift range. By integrating the newest X-shooter measurements, we aim to refine the constraints on the redshift dependence of NH and investigate the role of photo-ionization and circumburst clearing effects. Our results provide critical calibration for future high-energy missions, such as THESEUS, highlighting the necessity of multi-wavelength approaches in understanding the interstellar medium of GRB host galaxies.

GAMMA-RAY BURSTS & ROBOTIC TELESCOPES

GRB

Statistical properties of Greiner's GRB table

Istvan Racz

University of Public Service, Hungary

The Jochen Greiner's GRB table represents one of the most comprehensive, although subjective, repository of Gamma-Ray Burst localizations, spanning several decades of observations from BeppoSAX to the latest missions like Swift, Fermi, and the Einstein Probe (EP). Due to the diverse nature of the instruments and localization procedures involved the statistical analysis of this dataset requires careful consideration of selection effects and instrumental biases. In this study, we perform a multi-dimensional statistical analysis of the Greiner table to uncover underlying patterns in the global properties of GRBs. By employing advanced statistical methods, we evaluate how the inclusion of various mission data affects the homogeneity of the catalog. Our results provide insights into the evolutionary effects of the GRB population and offer a critical assessment of the catalog's utility for cosmological studies. This work serves as a foundational statistical characterization of the dataset, supporting the synergy between legacy catalogs and future high-energy surveys.

Interpreting and modelling gamma-ray bursts and similar high-energy transients

Hendrik van Eerten

University of Bath, United Kingdom

The landscape of of high-energy astrophysical transients keeps expanding, owing to a long and growing list of successful space- and earth-based observatories gathering data across the broadband. A common thread connecting various phenomena from gamma-ray bursts and their afterglows to X-ray flashes and optical transients, is the release of fast-moving plasma producing some form of non-thermal emission. In order to understand the physics behind a given event, modelling therefore typically requires a combination of jet dynamics, radiative process modelling and a coherent framework to translate both to an observational prediction. In this presentation, I will describe a few recent transients where I have been involved in modelling (GRB 170817A, GRB221009A, GRB230307A, EP240408A, EP241021A). These will be used to illustrate the various approaches, both numerical and (semi-)analytical, that are taken in practice to interpret extreme transients.

SMALL SATELLITES & INSTRUMENTAL SESSION

SAT

Stars as probes of our own atmosphere

Jan Ebr

FZU - Institute of Physics, Czech Republic

The FRAM robotic telescopes started as experimental tools for atmospheric monitoring at astroparticle observatories over two decades ago. Over time, both their purpose and methods have greatly changed, sometimes following unexpectedly twisting paths. The original design target of the FRAM at the Pierre Auger Observatory was the measurement of wavelength dependence of aerosol extinction using photoelectric measurements of bright stars. After this has proven prohibitively difficult, the program re-focused on rapid cloud detection along the apparent trajectory of interesting cosmic ray showers - and during these observations, the breakthrough method of aerosol measurement using wide-field photometry was developed, leading to the expansion of the FRAM project to support the upcoming Cherenkov Telescope Array Observatory. Eventually, we went full circle: using the exceptionally stable conditions at Roque de los Muchachos, we can now show that the wide-field method is actually the right way for the wavelength-dependence measurement. As this quantity is directly correlated with the size of the aerosol particles, we are here opening a new window for atmospheric physics at night, with possibly broad application far beyond simple atmospheric monitoring.

Overview of the scientific results of CubeSat missions GRBAlpha and GRBBeta

Michaela Ďuríšková

Masaryk University, Czech Republic

GRBAlpha and GRBBeta are CubeSat missions equipped with gamma-ray detectors based on CsI(Tl) scintillators read out by silicon photomultipliers (SiPMs), primarily designed for the detection of gamma-ray bursts (GRBs). Masaryk University is strongly involved in the development, operation, and science case of these missions. GRBAlpha, a 1U CubeSat, was the first GRB-detecting satellite of this size. It was launched into low Earth orbit (LEO) in 2021 and operated successfully for more than four years, until June 9, 2025. During its mission, it detected more than 200 gamma-ray transients, of which approximately 124 were GRBs, including both long and short events. Among these were the most intense GRBs ever recorded, GRB 221009A, and the second brightest, GRB 230307A. GRBBeta, a 2U CubeSat integrated at Masaryk University and launched in 2024, continues to operate successfully and contribute to GRB detection and analysis. In addition to its gamma-ray detector, GRBBeta is equipped with a UV camera (LUVCam), sensitive in the near-ultraviolet range (240–310 nm), which serves as a technology demonstrator for the performance of the CMOS Gpixel GSENSE4040 imaging sensor in LEO. In this talk, I will present the scientific results obtained with GRBAlpha, as well as the latest results from GRBBeta, including LUVCam observations.

SMALL SATELLITES & INSTRUMENTAL SESSION

SAT

Spacemanic Missions: Small Satellites for Space Weather, High-Energy Astrophysics and Amateur Radio

Jakub Kapuš

Spacemanic CZ s.r.o., Czech Republic

Spacemanic has developed and operated a broad portfolio of small satellite missions spanning scientific, educational, and technology-demonstration objectives. This talk will provide an overview of selected missions focused on space weather, amateur radio experimentation, and gamma-ray burst detection, and will outline the common engineering and operational principles behind them. Particular emphasis will be placed on the mission architectures, payload functions, and the constraints imposed by nanosatellite platforms. The presentation will also discuss how these missions contribute to in-orbit validation, scientific data acquisition, and community engagement through compact and cost-efficient satellite systems. Together, they illustrate how small satellites can support a diverse range of objectives while remaining responsive to evolving scientific and technological needs.

CORVUS IOV: Demonstrating a Scalable ESA Pioneer CubeSat Platform

Jakub Kapuš

Spacemanic CZ s.r.o., Czech Republic

The CORVUS IOV mission is a 6U in-orbit validation flight of Spacemanic's CORVUS platform, developed under the ESA Pioneer Programme. The mission is designed to demonstrate the platform's modularity, scalability, and suitability for next-generation small satellite applications. It carries two demonstration payloads: a monochromatic camera for Earth observation and space-debris monitoring, and an SDR receiver for radio-environment measurements across multiple frequency bands. The talk will present the mission concept, platform architecture, and key subsystem features, including communications, power, onboard computing, and attitude control. It will also summarize the technical objectives of the IOV mission and discuss how CORVUS provides a flexible foundation for future EO, IoT, and technology-demonstration missions.

SMALL SATELLITES & INSTRUMENTAL SESSION

SAT

Characterization of COTS-based Ionizing Radiation Monitoring Systems for CubeSat Applications

Rebeka Gy. Kiss

University of Debrecen, Hungary

The increasing use of CubeSat platforms requires reliable and cost-effective radiation monitoring solutions. This work presents the development of a COTS-based ionizing radiation monitoring payload for small satellite applications, targeting continuous in-orbit environmental characterization without the use of expensive rad-hard components. The payload is designed within a modular CubeSat architecture and utilizes volatile and non-volatile memory elements as radiation-sensitive components. The measurement concept is based on correlating radiation flux with error rate variations, enabling indirect dosimetry. The work focuses on the system architecture, payload design, and the definition of calibration and testing procedures. The presentation introduces the developed payload concept and outlines its integration into a CubeSat platform, highlighting key design considerations and challenges relevant to university-led small satellite missions.

Development and Demonstration of a Low-Cost Hybrid AOCS for a Student-Built CubeSat

Rebeka Gy. Kiss

University of Debrecen, Hungary

This work presents a student-built 1U CubeSat project of the University of Debrecen, Hungary, based on the open-source LibreCube framework. The current phase focuses on the development and laboratory-level demonstration (up to TRL3) of core subsystems, with particular emphasis on the Attitude and Orbit Control System (AOCS). While the overall concept includes multiple student payloads. Due to the high cost of commercial space-grade actuators, the project focuses on the design and in-house development of key AOCS components, specifically magnetorquers and a reaction wheel. The proposed hybrid, low-cost AOCS integrates commercial-grade sensors (including magnetometers, MEMS gyroscopes, and sun sensors) with this custom actuator architecture. Validation is performed through simulation and laboratory measurements, including coil current characterization, magnetic dipole estimation, and sensor–actuator interaction analysis. The results demonstrate that a functional, low-cost AOCS can be realized and verified at laboratory level, providing a scalable foundation for future higher-TRL CubeSat development.

SMALL SATELLITES & INSTRUMENTAL SESSION

SAT

LED testing strategy and optical optimalisation of the THESEUS Infrared Telescope's Calibration Unit

Bendegúz Koncz

University of Debrecen, Hungary

We present the Phase B planning of the Transient High-Energy Sky and Early Universe Surveyor (THESEUS) Infrared Telescope's Calibration Unit, carried out during Phase A, with emphasis on LED-based calibration concepts and optical design considerations. The work outlines a structured testing strategy that combines individual device characterization with batch-level validation to ensure consistent and reliable performance. In parallel, we investigate how different LED configurations and mounting approaches influence the optical behavior of the system. Ray-tracing simulations are used to explore light propagation and assess potential systematic effects impacting calibration accuracy. By integrating planned experimental activities with simulation-driven studies, this work establishes a solid foundation for the development of a robust and well-characterized calibration unit in Phase B.

Stratospheric balloons as research platforms within the ASTRABAX project

Lucia Krivanekova

University of Applied Sciences Aschaffenburg, Germany

Stratospheric balloons are frequently utilized experimental platforms within various research domains including meteorology, radiation physics, and astronomy. Thereby, the balloon gondola can be adapted to withstand multiple conditions and environmental requirements, ranging from an elementary construction for school projects up to complex designs for scientific NASA missions. The project ASTRABAX ("Aschaffenburg Stratospheric Balloon Experiment") investigated the radiation exposures of biological cells and of biomaterials in the upper atmosphere during a series of three stratospheric balloon flights. The continuously enhanced multimodal platform allowed to accommodate numerous device configurations within the UV- and temperature-controlled gondola. Here we show insights into the construction process, including achievements, present limitations and potential areas for improvement. Furthermore, the characterization of the stratospheric radiation environment during the multiple flights with different cosmic ray dosimeters is presented. The results of the feasibility flights indicate the broadening potential for educational and research purposes where low costs, reduced work force, and 3D printing technology can enhance the implementation of experiments. An easy assembly facilitates the expeditious involvement of students in the fields of radiation research, astrophysics, modern materials, and astrobiology.

SMALL SATELLITES & INSTRUMENTAL SESSION

SAT

From Hits to Data: Realizing COSI's potential with Machine Learning

Jan Peter Lommler

Johannes Gutenberg-Universität Mainz, Germany

The Compton Spectrometer and Imager (COSI) is scheduled for launch in 2027. It will cover a bandwidth from 0.2 to 5 MeV with its four main goals of shedding light into the origin of galactic positrons , enhancing our knowledge of stellar nucleosynthesis, giving insight into the most extreme environments via polarization and probing the physics of multimessenger events. The baseline data-pipeline relies on optimized conventional methods, with substantial heritage from prior gamma-ray missions. These are amended with machine learning based alternatives developed by multiple groups in the collaboration. The talk gives an overview of the upcoming mission and the activities in Mainz aimed at helping COSI to reach its full potential.

MATHEMATICAL MODELLING OF A PIEZOELECTRIC ACCELEROMETER FOR AEROSPACE APPLICATION

Ulvi Mehraliyev

Czech technical university in Prague, Czech Republic

Accelerometers are devices that sense acceleration and transmit it as an electrical signal to measurement units. Recently, accelerometers have made an important contributionto several fields such as aerospace, space, health monitoring, and other industries.This study is dedicated to the mathematical modelling and development of a newly developed three-axis piezoelectric accelerometer for space applications based on LEO CubeSat missions. The modelling, development, and required simulations are carried out using COMSOL Multiphysics software. The main objective of this work is to develop an easily manufacturable, cost-effective, and sensitive three-axis piezoelectric accelerometer for attitude determination systems in low Earth orbit based space applications.

QUVIK Science Operations

Filip Münz

Zentrum für Telematik, Germany

QUVIK is a Czech-led project of a small UV space telescope that has been selected and funded to be launched in year30/31. Masaryk University will be primarily responsible for developing and running a Science Operation Center that has 2 main tasks: defining most scientifically valuable observation plan (taking into account constraints of Low Earth Orbit and the power budget) and creating the most performing data processing pipeline (with a very limited baseline of on-board data handling). Our experience of operations of small telescopes on ground (mostly run in automatized regime) is the principal ingredience in this development. First steps taken in the process closely supervised by ESA support team will be presented.

SMALL SATELLITES & INSTRUMENTAL SESSION

SAT

Clearence Measurements with a Compton Camera

Rudi Reinhardt

University of Wuerzburg, Germany

Clearance measurements of various rooms in nuclear power plants is an important step in the decommissioning of these facilities. Currently, wall sections are divided into 1 m² areas, and their gamma spectra are measured individually to detect possible contaminations with different radioactive isotopes. Of particular interest here are ^{137}Cs (662 keV) and ^{60}Co (1173 and 1332 keV). To simplify this process by measuring whole rooms at once, we are developing a Compton camera (Radiation Source Locator, RSL7) for these clearance measurements in collaboration with project partners from Hellma Materials, Brenk Systemplanung, the Fraunhofer Institute for Scientific and Technical Trend Analysis (INT), and the Johannes Gutenberg University of Mainz. Based on the COSIpy analysis framework, developed for the NASA-SMEX mission COmpton Spectrometer and Imager (COSI), we are developing the software also for the RSL7. This involves fitting the activity of different radionuclides of previously created 3D models of all components of a room (template fit). In this talk, I will show simulations of the Compton camera, the processing of the response, and the fitting process using simulated datasets.

Tests of Schmidt lobster eye based on new technology

Vladimír Tichý

Zentrum für Telematik, Germany

Results of tests of prototype of Schmidt lobster eye based on new technology are presented. Used new technological concept promises precise assembly of optical mirrors, which is the key aspect to obtain sharp focal image. This concept is subject of patent and utility model. Outer dimensions as well as focal length were chosen to allow this prototype be boarded on nano-satellite of CubeSat type. The prototype is designed for soft X-ray energies around 1keV. The module was tested using visible light, which is possible because glass plates coated with gold are used as mirrors. Focal image is taken by optical camera. FWHM is evaluated. The results show good accordance with simulations. It means that the technological concept offers precise assembly of optical mirrors, which is the key aspect to obtain sharp focal image.

SMALL SATELLITES & INSTRUMENTAL SESSION

SAT

Formations of Small Satellites Open Up New Application Fields

Klaus Schilling

Zentrum für Telematik, Germany

Technology progress for small satellites allows self-organizing multi-satellite systems for observations. The satellite formation will be configured by miniature attitude and orbit control systems to optimize network properties. This potential is exploited in Earth observation regarding multi-perspective measurements. At the launch pad in California are currently multi-satellite missions from Würzburg, such as - TOM : 3 cooperating satellites to generate 3D surface images, - CuBy : 5 satellites with multi-spectral cameras for biomonitoring and geodesy applications. Transfer of such formation principles to support astronomical observations offer good potential for innovative distributed sensing methods and will be jointly further explored during this workshop.

Astronomical observing with SXI/SMILE

Vojtěch Šimon

Astronomical Institute ASCR, Czech Republic

IWe show that a Soft X-ray Imager (SXI) onboard the ESA-CAS satellite SMILE will be able to observe various types of mass accreting compact objects in the universe. We show that mainly neutron stars accreting matter from their companions in X-ray binaries are promising targets for evaluating the possibilities of SXI in astronomical research. We present the typical features of the long-term activity of various X-ray binaries in the SXI/SMILE field of view. We also show that binaries with steady-state thermonuclear reactions on board accreting white dwarfs in the Magellanic Clouds are promising targets for SXI observations. We discuss how SXI can contribute to this branch.

Probabilistic Optimization Modelling using AI in Aerospace Component Design

Tomáš Koutník

UptimAI s.r.o., Czech Republic

.Design and optimization of components operating in complex environments typically face two main challenges: the high complexity of the problem requires investigation of a large number of design points, while multi-objective criteria complicate the search for optimal solutions. The presented optimization approach combines efficient AI-assisted surrogate modeling and statistical data analysis to accelerate exploration of the design space. By focusing on probabilistic ranges, the method improves robustness, uncertainty awareness, and engineering decision-making under complex multi-objective constraints. The proposed workflow also enables interactive visualization of trade-offs between competing objectives, supporting more informed engineering decisions. The presented case studies demonstrate the potential of this approach to reduce computational costs and overcome limitations of traditional optimization methods.

Modeling and Optimization of an Oxygen Mask for Aerospace Applications

Adam Mikeš

Brno VUT, Czech Republic

.In the operational environment of space missions, the boundary between peak performance and physiological failure may be defined by the efficiency of a single breath. Despite decades of development, respiratory dead space in oxygen masks such as the MBU-20/P oxygen mask could be a critical bottleneck under specific pressure regimes, leading to CO_2 rebreathing and a reduction in cognitive performance. This study addresses these challenges by reformulating classical fluid dynamics into a probabilistic optimization framework. A transient CFD approach is implemented to capture the full complexity of the breathing cycle. A key pillar of the research is the deployment of surrogate modeling via UptimAI, effectively bridging the gap between high-fidelity simulation and time-efficient design optimization within constrained development timelines. This approach enables high-resolution mapping of non-linear gas mixing phenomena and supports the identification of practically relevant design improvements. Preliminary results indicate specific geometric modifications of the mask that significantly enhance flushing efficiency, thereby ensuring a continuous supply of fresh breathing mixture to the pilot.

HUMAN SPACE FLIGHTS & AI IN SPACE APPLICATIONS

HSF

Predicting Astronauts' Cognitive Performance on the ISS and on Earth

Vratislav Šálený

Brno University of Technology, Czech Republic

Cognitive performance determines not only how astronauts and scientists work, but also how well we think, create, and make decisions. Even highly trained individuals experience measurable fluctuations in cognitive performance over time. This contribution presents the ICARUS ARMOR Next Gen experiment, prepared for a future International Space Station mission of Czech astronaut Aleš Svoboda, which aims to predict short-term cognitive performance based on the temporal sequence of monitored stressors. The measurement concept combines cognitive testing, physiological biosignals, and biochemical stress markers into a unified multimodal dataset. These data are used to develop a personalized AI-based surrogate model, conceived as an individual software tool capable of forecasting cognitive performance over the following hours to days. While the experiment is motivated by the extreme conditions of human spaceflight, the approach is directly relevant to everyday personal and professional life. Participants will gain insight into how their own cognitive performance evolves, what factors shape it, and how it may be predicted. Selected tools used for astronaut cognitive testing will be available for hands-on experience, with some already available or becoming accessible for personal use.

Optimizing Astronomical Imaging System Alignment Through Spatial PSF Analysis and Physics-Based Aberration Modelling

Sayantan Gope

Brno University of Technology, Czech Republic

Accurate Point Spread Function characterization is fundamental in image processing. This work presents a pipeline for decomposing the PSF in astronomical images into its constituent components: atmospheric seeing (Moffat function), optical aberrations (Zernike polynomials), and tracking error. As a preprocessing step, we developed a tool to minimize distortions from sensor tilt and field curvature in the camera setup. We then create a physics-based simulator that generates synthetic star fields with known distortion and aberration parameters, providing ground truth training data. Classical parameter estimation validates the forward model, while a machine learning stage is trained on the simulator output to recover distortion coefficients directly from observed stellar profiles, enabling automated PSF characterization for astronomical imaging systems.

OTHERS

IBWS Introduction and Historical Background

René Hudec

ASU AV CR & CVUT, Czech Republic

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 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 focussed 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.

20th IBWS Conference Concluding Address

René Hudec

ASU AV CR & CVUT, Czech Republic

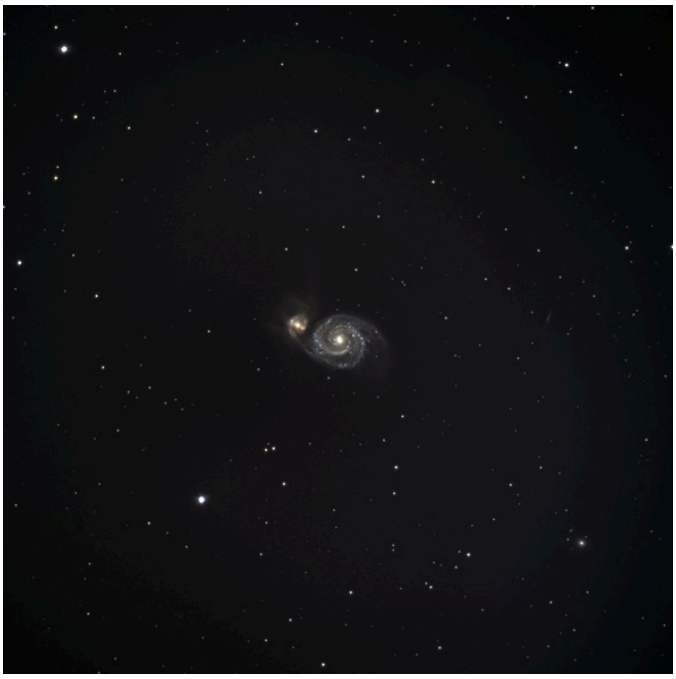
This will be the concluding address for the 20th IBWS conference including selected photographs taken during the event. We remind that the IBWS (INTEGRAL/BART) workshops originally focused on the work of High energy astrophysics group (at that dime dominated by young research fellows and students) in 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 focussed 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). At the conference there continued our emphasis on wide participation and presentations of students and young research fellows.

OTHERS

Astrophotography and Sky Observation

Štěpán Beran

I am an eighteen-year-old student, and my greatest hobbies are astronomy, astrophotography, and related engineering projects. I primarily photograph through a Celestron EdgeHD 8" telescope (often using the Hyperstar v4 reducer), usually under typical light-polluted skies. In my work, I focus on both deep-sky objects and objects within the Solar System. Here is a sample of my work.



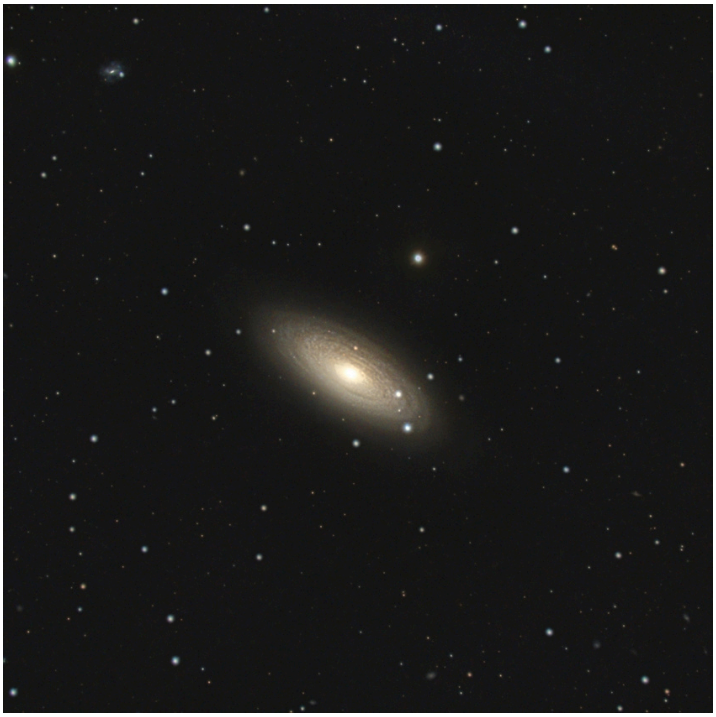
1M51 (Whirlpool Galaxy)
A well-known interacting galaxy in the constellation Canes Venatici. This year's image was captured using the Hyperstar v4 reducer.

Stephan's Quintet
A group of five galaxies, four of which are interacting with each other and form the gravitationally bound compact group HCG 92. It is a very faint and distant object (approximately 300 million light-years away).

OTHERS

Eastern Veil Nebula (NGC 6992/6995)
Shock waves from the expanding bubble (the Cygnus Loop) left behind by the explosion of an ancient supernova. Captured using narrowband filters to enhance the gas structures.

Comet C/2025 A6 (Lemmon)
A non-periodic comet with an orbital period of 1,350 years, captured at a distance of approximately 90 million kilometers from Earth (magnitude at the time of imaging: around +4 mag).



Flocculent Galaxy NGC 2841
A galaxy without well-defined spiral arms, characterized by a fragmented, patchy structure (a so-called flocculent galaxy).

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.

Social Event on Wednesday

We will visit the Planetarium in the building of the Gymnasium from 16:00 to 18:00 in two groups.

Please meet in the entrance hall of the Gymnasium.

USEFUL INFORMATION

Social Event on Thursday

Meeting point: 15:00 near the Infocenter in town. Address: Jateční 476/2, 350 20 Cheb.
The social event will be organized in two groups. One group will visit the trussers, while the second group will tour the city with a guide and the headmaster of the Gymnázium, A. Jalovec. At 16:15, the groups will switch tours.

Guided tour of historical roof trusses in Cheb

The discovery that the houses of Cheb in the historic city center hide such a treasure came about by chance. When people started talking about whether it would be possible to build apartments in the high attics of Cheb's burgher houses, the town hall commissioned a building-historical survey. As the experts walked through the individual houses, a path into the past unexpectedly opened up for them. What Cheb has under its roofs is a real unique piece that has been preserved in very good condition. There is no such set of roof trusses in Prague or even in Krumlov.

The building historian explained the uniqueness of the roof trusses by the interplay of several fortunate aspects. Above all, Cheb was a wealthy city in the past. So while in the 14th century, only one-story houses were built in the rest of the country, in Cheb, three-story houses with high roofs and large attics were already growing around the square. From the very beginning, the roofs were covered with burnt tiles to prevent water from leaking in. Cheb was also lucky that the last major fire raged here in 1270. After that, it never burned so much that most of the houses were reduced to ashes. The trusses are also very massive and sturdy. There has been a hypothesis that perhaps the builders of the time knew that the Cheb region was a seismically active area and so adapted the buildings to it.

No less important was the lack of money for the reconstruction of the houses on the square in the 1970s, when the monument was in danger of being destroyed, and last but not least, the fact that the city never sold these houses and, as their owner, allows tours to the public.

The Cheb trusses are a phenomenon whose significance goes beyond the borders of the republic and perhaps even Central Europe. In a small area here, we can find structures that were created in different time periods. There are so many of them that a historical atlas of trusses will be created here based on their passporting. Cheb also has the oldest truss in the Czech Republic, a dendrochronologically dated 1319 structure above the choir of the Franciscan church.

The tour lasts approximately an hour and a half. The tour has a limitation: Children from six years of age can participate, but must always be accompanied by a parent.
The tour is not wheelchair accessible.
The tour is more physically demanding.

USEFUL INFORMATION

Lunches and Dinners

Tuesday dinner will take place at Gymnázium Cheb. All other lunches and dinners will be held at ISS School, Obrněné brigády 6, 350 02 Cheb, on the 4th floor.
All catering will be provided by ISS school Cheb.

The meal options you selected can be found on a sheet of paper in case you are unsure about your choice.

Lunch and Dinner times

	Lunch	Dinner
Monday		**18:00**
Tuesday	**11:40**	**18:00**
Wednesday	**12:50**	**18:00**
Thursday	**13:10**	**18:00**
Friday	**12:40**	

USEFUL INFORMATION

Programme Overview

MONDAY

Welcome - René Hudec
GRB Session - Hendrik van Eerten, Alžběta Maleňáková, Martin Jelínk, Istvan Racz, Sergey Karpov

TUESDAY

GRB Session - Filip Novotný, Zsolt Bagoly
HEA Session - Ondřej Pjcha, Jan Ebr, Kunal Bhardwaj, Kateřina Klimovičová, Dimitris Tsatsis, Gabriel Torok, Kristina Novotná, Saurabh Mittal, Mika Gelowicz, Manja Zimmerer
Welcome Reception

WEDNESDAY

HEA Session - Dorota Rosinska, Tauseef Ahmad Zafar, Bendegúz Koncz, Laura Eisenberger, Thomas Siegert, Tomohiko Oka, René Šprňa, Tristan Bouchet, Nóra Varga, René Hudec, Vojtěch Šimon
Poster session, Planetarium

THURSDAY

SAT Session - Klaus Schilling, Jakub Kapuš, Rudi Reinhardt, Jan Peter Lommler, Vojtěch Šimon, Lucia Krivanekova, Vladimír Tichý, Jakub Kapuš, Bendegúz Koncz
Social Event
Conference Dinner

FRIDAY

SAT Session - Filip Münz, Michaela Ďuríšková, Ulvi Mehralijev
HSF Session - Adam Mikeš, Vratislav Šálený, Tomáš Koutník
Concluding Remarks - Thomas Siegert, René Hudec

IMPORTANT TIMES

MONDAY

14:00 - Registration - Gymnázium Cheb
14:30 - First talk
18:00 - Dinner - ISS School

TUESDAY

8:45 - Registration
9:00 - First talk
11:40 - Lunch - ISS School
14:00 - First talk of the afternoon
18:00 - Welcome Reception - Gymnázium Cheb

WEDNESDAY

9:15 - Registration
9:30 - First talk
12:50 - Lunch - ISS School
14:00 - First talk of the afternoon
15:15 - Poster Session - Gymnázium Cheb
16:00 - Planetarium - Gymnázium Cheb
18:00 - Dinner - ISS School

THURSDAY

9:00 - Registration
9:20 - First talk
13:10 - Lunch - ISS School
15:00 - Social Event - Town square near infocenter
18:00 Conference Dinner - ISS School

FRIDAY

9:15 - First talk
12:40 - Lunch - ISS School


INTEGRAL/BART workshop
25 – 29 May 2026
Cheb, Czech Republic
ibws.cz