# AXRO 2017
## BOOK OF ABSTRACTS

# Contents

# THESEUS: a future key mission for multi-messenger astrophysics

*Lorenzo Amati*

The Transient High-Energy Sky and Early Universe Surveyor (THESEUS) is a space mission concept aimed at exploiting Gamma-Ray Bursts for investigating the early Universe and at providing a substantial advancement of multi-messenger and time-domain astrophysics. These goals will be achieved through a unique combination of instruments allowing GRBs and X-ray transients detection over a broad FOV (more than 1sr) with 0.5-1 arcmin localization, an energy band extending from several MeVs down to 0.3 keV and high sensitivity to transient sources in the soft X-ray domain, as well as on-board prompt (few minutes) follow-up with a 0.7 m class IR telescope with both imaging and spectroscopic capabilities. In addition to early Universe science, THESEUS will be perfectly suited for detecting, localizing, and identifying the electromagnetic counterparts to sources of gravitational radiation, which will be routinely detected in the late 20s / early 30s by next generation facilities like aLIGO/ aVirgo, eLISA, KAGRA, and Einstein Telescope. In particular, it will be able to detect and localize with an accuracy of  a few arcmin short GRBs produced by NS-NS or NS-BH mergers and provide their redshift, as well as detect, localize and characterize the associated NIR kilonova emission and the possible soft X-ray. THESEUS will thus provide an ideal sinergy with second and third generation GW detectors and with the large multi-wavelength observatories f the near future (e.g., LSST, ELT, SKA, CTA, ATHENA).

## The maximal spin of an accreting black hole - the 'Thorne' limit and the 'Aschenbach' effect

*Bernd Aschenbach*

The Kip Thorne limit for the spin of an accreting black hole is (the Kerr parameter) a=0.998, which is due to photons carrying away angular momentum. The Aschenbach effect describes a discovery that for the Kerr metric the otherwise monotonous increase of the velocity of a particle orbiting a spinning black hole with decreasing orbital radius is broken for a>0.9959. The orbital velocity runs through a decline and a minimum until it rises again, with decreasing orbital radius. Because of the similarity of these two limiting values of the spin I conjecture that the inner part of the accretion disk of such highly spinning black holes is unstable, with the result of outbursts and flares, which can come quasiperiodically with the expected epicyclic frequencies.

## On X-Ray orbital data from VZLUSAT-1 nanosatellite

*Tomáš Báča*

We present current results of X-Ray camera payload onboard nanosatellite VZLUSAT-1, the first Czech cubesat ever launched into Earth's orbit. Embedded hardware and software was designed from the ground up to allow real-time image processing, filtering and compressing of captured images onboard the 10 x 10 x 20 cm CubeSat. Together with miniature lobster-eye optics, the satellite can capture X-Ray photons from astronomical objects, mostly the Sun. The satellite was successfully launched on June 23rd, 2017 to a 510 km Sun-synchronous Low-Earth orbit. The embedded electronics onboard, for the X-Ray and gamma-ray telescope, utilizes the Timepix sensor which also serves as a dosimetric unit. Besides its primary mission, the payload successfully produces data for global maps of ionizing radiation in Low-Earth orbit. Currently, in November 2017 the sensor captured over 6000 images, most of which were successfully downloaded. We will discuss and interpret the measured data in the context of X-Ray astronomy and radiation mapping, which are inherently interconnected.

## Reflective optics for laboratory EUV and X-ray sources: creation of low temperature plasmas and detection of weak EUV signals

*Andrzej Bartnik*

X-ray or extreme ultraviolet (EUV) space telescopes are equipped with different kinds of specialized reflective optical systems. The systems are prepared for imaging of astrophysical objects located at extremely long distances. In laboratory arrangements similar optical systems can be utilized for X-ray/EUV imaging or formation of the X-ray/EUV radiation beams. The essential differences concern distances from radiation sources to the corresponding optical systems and intensities of the collected radiation. The distance to any astrophysical object can be regarded as infinity, distances in case of laboratory systems are short, of the order of meters or centimeters. Intensities of the collected radiation in laboratory systems are many orders of magnitude higher comparing to the astronomical telescopes. In this work investigations of low temperature photoionized plasmas (PP) with relatively high electron density were performed. Various experiments were performed using laser-produced plasma (LPP) EUV or soft X-ray (SXR) sources for creation of PP. The sources were based on three different laser systems with pulse energies ranging from 0.8 J to 500J and pulse duration $0.3 \div 10$ ns. The EUV/SXR ionizing radiation was focused using grazing incidence collectors based on multifoil, ellipsoidal or paraboloidal mirrors optimized for specific wavelength ranges. Ellipsoidal or paraboloidal collectors were also used in detection systems employed for measurements of weak EUV emission from the low temperature PP. Photoionized plasmas were produced by the focused ionizing radiation. Different gases were injected into the interaction region, perpendicularly to an optical axis of the irradiation system, using an auxilary gas puff valve. Irradiation of the gases resulted in ionization and excitation of atoms and molecules forming photoionized plasmas. Spectra in SXR/EUV range were measured using a grazing incidence, flat-field spectrograph (McPherson Model 251), equipped

with a 450 lines/mm toroidal grating and a home made spectrograph based on free standing transmission grating 5000l/mm. The UV/VIS spectra were measured using an Echelle Spectra Analyzer ESA 4000. The spectra were composed of spectral lines corresponding to radiative transitions in atoms, molecules, atomic or molecular ions. For analysis of the EUV spectra numerical simulations were performed, using a collisional-radiative PrismSPECT code. Parameters of the photoionized plasmas were estimated by fitting the spectrum obtained from the simulations to the experimental one. For computer simulations of the molecular spectra measured in the UV/VIS range a Specair code was employed. Apart from that, the electron temperatures of plasmas created in different gases were estimated employing a Boltzmann plot method.

## PANTER: The AHEAD X-Ray Optics Joint Research Activity in the Light of ATHENA

*Vadim Burwitz*

One of the important topics of the AHEAD joint research activity covers the characterization of the ATHENA silicon pore optics, as well as other optics technologies such as slumped glass, micropore, Kirk-Patrick Baez, and polished silicon optics. The other ATHENA related activity involves the planning, setting up and testing of the BEATRIX test facility for quickly checking the the optical performance of SPO modules just after production. This requires a performance characterization of a high quality optic with the parallel beam at PANTER generated by a specially developed zone plate. This high quality optic will then be used to verify the performance of BEATRIX facility. Status of the PANTER X-ray test facility, the measuring campaigns set-up and performed as well as the results obtained will be presented. Also an outlook on upcoming tests in the context of ATHENA and AHEAD will be given.

## Introduction of SFA onboard eXTP

*Yong Chen*

Spectroscopic Focusing Array (SFA) is an X-ray mirror array onboard the enhanced X-ray Timing and Polarization (eXTP) mission, which consists 9 nested Wolter I grazing-incidence mirrors with a focal length 5.25m. SFA is designed for simultaneous spectral and timing observations in an energy range of 0.5-10keV. The effective area is 5400 cm2@1keV, and the field of view is 12 arcmin in diameter. The angular resolution is less than 1 arcmin (Half Power Diameter, HPD). SFA uses silicon drift detector (SDD) array as the focal plane detector, the energy resolution is better than 180eV@6keV, the time resolution is 10 $\mu$s, and the dead time can be about 1%@1Crab.

## Optics development for ATHENA

*Max Collon*

Silicon Pore Optics (SPO), developed at cosine with the European Space Agency (ESA) and several academic and industrial partners, provides lightweight, yet stiff, high-resolution x-ray optics. This technology enables ATHENA to reach an unprecedentedly large effective area in the 0.2 - 12 keV band with an angular resolution better than 5". After developing the technology for 50 m and 20 m focal length, this year has witnessed the first 12 m focal length mirror modules being produced. The technology development is also gaining momentum with three different radii under study. In this talk we will report on the status of the optics development.

## LE X-ray Telescope for PSU Rocket Experiment

*Vladimír Dániel*

The design of Lobster Eye X-ray Telescope will be presented. The telescope is one of the payloads of Water Recovery X-ray Rocket (WRX-R) prepared by Pennsylvania State University (PSU). The telescope was designed, developed, tested and assembled to the WRX-R rocket during year 2017.

## Counterbalancing iridium coating stress for astronomical X-ray mirrors

*Thorsten Döhring*

High coating stress within applied iridium layers is able to deform thin mirror substrates. Advanced sputtering methods to overcome this potential problem for future astronomical X-ray telescopes are presented.

## X-ray polarization by reflection from accretion disc in AGN

*Michal Dovciak*

Theoretical computations showed that the reflection of X-ray radiation from the accretion disc in AGN should result in significant (detectable) polarization signals. Originating from a primary power-law coronal emission situated above the disc surface, X-ray photons are partially reprocessed by Compton scattering in the disc material and show a polarization level that heavily depends on geometry of scattering. In this contribution, we will examine the polarization in the lamp-post geometry scenario, where a compact patch of corona is positioned on the axis above the black hole. The relativistic effects due to strong gravity close to the central black hole and due to large velocities of accreting material will be shown together with the effect of initially polarised coronal emission.

## eROSITA Status

*Peter Friedrich*

The eROSITA X-ray telescope has been built by MPE from 2007 until 2016. Final environmental tests of the telescope have been performed by the end of 2016. Then, in early 2017, it has been shipped to Moscow, where it is going to be integrated on the SRG spacecraft. After the successful incoming inspection the tests of interfaces with the spacecraft systems begun and are still ongoing.

## Tracking the Elusive Lynx into the 2020 Astrophysics Decadal Survey

*Jessica Gaskin*

NASA's spectacular Chandra X-Ray Observatory was launched in 1999, and has since provided the astronomy community with an incredibly sharp view of the high-energy universe. In many ways, this keen view has become the expected norm that the community has grown to know and love. The focus of this talk is on the development of a concept study, funded by NASA, for a mission that will ultimately succeed Chandra. The Lynx telescope will maintain the fine angular resolution that the community has benefited from for so many years, but with the added advantage of significantly increased throughput and improved spectroscopy. An instrument suite that includes an imaging detector, a dispersive spectrometer, and a large-area X-ray microcalorimeter complements the high-angular resolution optical assembly. This observatory will answer some of the most pressing questions regarding the birth of the first black holes and their growth and assembly across cosmic time, the growth and evolution of the large-scale structure in our universe and the impact of feedback on all scales.

## The Athena mirror calibration plan

*Matteo Guainazzi*

In this talk I will present the Athena mirror (ground-based) calibration plan. It is based on a multi-tier strategy, aiming at building a database of measurements able to reproduce the behavior of the Athena telescope through a characterization of its elements, from the individual plates to the Mirror Assembly. I will also present updated predictions of effective area performance for the current Athena baseline mission profile.

## AXRO 10 years: Introduction and Historical Background

*Rene Hudec*

AXRO 10 years: Introduction and Historical Background will be shortly presented and discussed

## Spectral and polarimetric signatures of X-ray obscuration events in AGN

*Elias Kammoun*

X-ray eclipses of the innermost regions by distant clouds (associated to the broad line region and/or the molecular torus) have been detected in several local bright active galactic nuclei (AGN). Furthermore, X-ray emission in AGN is expected to be polarized due to reprocessing from the accretion disc and further distant material. Relativistic effects play a major role in the observed emission as general and special relativity will change both the spectral shape and the polarization signal according to the metric. Hence, occultation events will result in an asymmetric variability in the spectral and polarization parameters due to covering/uncovering parts of the disc with different spectral and polarization properties. High-quality spectra that will be provided by the next generation of X-ray telescopes, in addition to the upcoming X-ray polarimetric missions combined with the availability of relativistic X-ray spectral and polarimetric models of such occultation events, will allow us to perform a detailed modelling of these events in order to obtain accurate information on the nature and the geometry of the system. I will present in my talk theoretical predictions on the various spectral parameters inferred by studying such events using the KYN model for relativistic X-ray reflection in AGN. In addition, I will present the variability of polarimetric signature expected from such events considering various possible configurations of AGN structures and coronal properties taking into account the contribution of warm absorption, molecular torus and for various variability scenarios.

## Light rays, wave fronts, and X-ray flares in strong gravity

*Vladimir Karas*

Accretion onto black holes often proceeds via an accretion disc or a temporary disc-like pattern. Variability features observed in light curves as well as theoretical models of accretion flows suggest that accretion discs tend to be inhomogeneous - variety of substructures (clumps) emerge within the flow. Rapid orbital motion of individual clumps then modulates the observed signal in X-rays. Furthermore, changes of polarization the observed signal are expected as a result of general relativity (GR) effects. In this contribution we will summarize the basic equations to study light propagation near black holes and to derive the signal expected at detector. Two complementary approaches have been found useful: the approximation of light rays and the wave forms. Both are influenced by GR effects. We show that the profile of observed light curves of X-ray flares from the vicinity of galactic cores can help us to constrain the mass of the central supermassive black hole.

## Decoupling spatially confused X-ray emission in the NuSTAR data

*Roman Krivonos*

The Nuclear Spectroscopic Telescope Array (NuSTAR, Harrison et al., 2013) mission carries two co-aligned twin X-ray telescopes operating in a wide energy range from 3 to 78 keV, with angular resolution of 18" (FWHM). However, due to the wide wings of the NuSTAR PSF, the corresponding HPD reaches 60" (Madsen et al. 2015), which can lead to a spatial confusion of the X-ray sources. In two such cases, AGN and ULX in the nearby galaxy NGC 5643, and the Arches stellar cluster with a molecular cloud in the Galactic Center, we showed that using a simple technique of 2D image decomposition, one can carefully separate X-ray emission components, and extract their spectral information. In addition to that we utilized wavelet image decomposition to study the morphology of the extended emission of the Arches molecular cloud.

## The Wide Field Imager Instrument for Athena

*Norbert Meidinger*

ESA's next large X-ray mission Athena will be equipped with two focal plane cameras, a Wide Field Imager (WFI) and an X-ray Integral Field Unit (X-IFU). The WFI instrument is designed for imaging and spectroscopy over a large field of view, and high count rate observations up to and beyond 1 Crab source intensity. Both cameras share alternately a mirror system based on silicon pore optics with a focal length of 12 m and an unprecedented large effective area. Here I will describe the concept and the development of the WFI focal plane camera. The instrument employs DEPFET active pixel sensors, which are fully depleted, back-illuminated silicon devices of 450 $\mu$m thickness. These provide high quantum efficiency over the 0.2 keV to 15 keV range with state-of-the art spectral resolution and extremely fast readout speeds compared to previous generations of Si detectors for X-ray astronomy. The focal plane comprises a Large Detector Array (LDA) with over 1 million pixels of 130 um x 130um size, providing oversampling of the PSF of a factor >2 over the large (40'x40') Field of View, complemented by a smaller Fast Detector (FD) optimized for high count rate applications.

## Accreting black holes via X-ray polarimetry

*Romana Mikusincova*

In this talk I will summarise our polarization simulations for the X-ray binary GRS1915+105 in the thermal state with the aim to limit a black hole spin and inclination of the system. For this purpose, we simulate polarimetric properties of this source based on spectral observations. We create theoretical dependences of polarization angle and degree on energy with the numerical code for multicolour black body emission from accretion disks, KYNBB, developed at the Astronomical Institute of the Czech Academy of Sciences. Then we simulate observational data for the IXPE mission using Python package XIMPOL. Finally, we fit these data with the KYNBB using XSPEC and estimate the constraints on black hole spin and inclination given by the length of prospective observations.

## Thin films for multifoil X-ray optics

*Lenka Mikulickova*

We present multifoil X-ray optics with gold reflective thin films and the role of thin films in multifoil X-ray optics.

## Status of the AHEAD program for Integrating Activities in High Energy Astrophysics

*Lorenzo Natalucci*

Since 2015, AHEAD (Integrated Activities in the High Energy Astrophysics Domain) has provided a framework to bring together Europeś science community working in this highly competitive field. AHEAD is an ongoing project funded by the EU Horizon 2020 programme for Research Infrastructures, with a main goal to integrate efforts by the European science community and keeping them at the cutting edge of science and technology. AHEAD is offering funding opportunities, also open to participants outside Europe, for transnational visits, workshops and dissemination activities. The landmark for AHEAD is the future Large Observatory ATHENA, however, much effort is also devoted to the exploitation of current space missions, enhancing gamma-ray science and to the development of different types of optics technology for future missions exploitation.

## A Baker's Dozen: 13 Years of Swift

*John Nousek*

Swift continues to be the premier rapid response astrophysical observatory. I will describe our work on improved automation, and our experiences is scheduling up to 1400 targets in time scales of a few hours to pursue electromagnetic counterparts to gravitational wave and high energy astrophysical neutrinos.

## The Imaging X-ray Polarimetry Explorer (IXPE): Overview

*Stephen O'Dell*

The Imaging X-ray Polarimetry Explorer (IXPE) will expand the information space for study of cosmic sources, by adding polarization to the properties (time, energy, and position) observed in x-ray astronomy. Recently selected as a NASA Astrophysics Small Explorer (SMEX) mission, IXPE will be launched into an equatorial orbit in 2021. The IXPE mission will provide scientifically meaningful measurements of the x-ray polarization of a few dozen sources in the 2–8 keV band, including polarization maps of several of the x-ray brightest extended sources (pulsar wind nebulae, supernova remnants, and an active-galaxy jet). Keywords: X-ray astronomy, polarimetry, missions. Contact information (SLO): stephen.l.odell@nasa.gov; +1 256-961-7776.

## Progress in the development of X-ray optics made of glass for high-resolution and high throughput telescopes

*Giovanni Pareschi*

In this talk we will report on the development of X-.ray optics made of glass ongoing at the Brera Astronomical Observatory-INAF. The talk will focus on different approaches being pursued like the cold replication of thin segments for future high throughput missions (like the FORCE hard X-ray mission under study in Japan) and the direct polishing of monolithic shells , a possible solution for making the mirrors of the LYNS high angular resolution mission now investigated in USA.

## ART-XC/SRG overview and some results of ground tests of X-ray mirror system with focal plane detector

*Mikhail Pavlinsky*

ART-XC is a X-ray grazing incidence mirror telescopes array with operating energy range 5-30 keV on the Spectrum-Roentgen-Gamma (SRG) mission, that is currently scheduled for launch in 2018. This instrument was developed by the Space Research Institute (IKI) and the All-Russian Scientific Research Institute for Experimental Physics (VNIIEF). The NASA Marshall Space Flight Center (MSFC) has developed and fabricated flight models of X-ray mirror modules. The ART-XC instrument will conduct an all-sky survey simultaneously with another instrument of the SRG mission, eROSITA, which operates in a softer energy range 0.3-10 keV. We will present an overview of the technical features of the ART-XC and an update on the current status of the project.

## The Rugged Landscape of Core-Collapse Supernova Explosions

*Ondřej Pejcha*

The collapse of the core and the associated supernova explosion mark the end of life of most massive stars, but the mechanism of explosion is poorly understood and perhaps even unknown. Some of its puzzling features were recently observed in the statistics of supernova progenitors, explosion energies, nickel yields, and in the remnant neutron star and black hole mass functions. I will describe my theoretical studies of the supernova explosion mechanism, its dependence on the progenitor star structure, and the connection with observables. I will argue that successful explosions are intertwined with failures in a complex but well-defined pattern that is tied to the pre-collapse structure of the progenitor star. I will also present a new method to extract the supernova parameters from light curves and expansion velocities, and illustrate how to constrain the explosion mechanism in the future.

## Multifoil Optics tests at Panter facility

*Ladislav Pína*

The first tests of two types of MFO were done at Panter Facility. Test samples of multifoil optics with silicon foils/substrates were Kirkpatrick-Baez type. This optics was design for AHEAD project with long focal length. Other multifoil optics with glass foils/substrates was Lobster Eye optics with focal length around 1.5m. Complete device/instrument (including optics, Timepix detector and electronics) for NASA rocket experiments (REX) were also tested at Panter facility. These optics were measured at 3 different energies.

## Interdependency of sputtering conditions, microstructure and X-ray reflectivity for iridium coatings

*Probst Anne-Catherine*

Iridium belong to the materials used as reflective coatings for X-ray mirrors dedicated to investigations of astronomical X-rays in the photon energy range below 10 keV. During the development of reflective coatings for thin x-ray mirrors in lightweighted telescopes, we prepared iridium coatings by radio-frequency magnetron sputtering using different sputtering pressures. Transmission electron microscopy, atomic force microscopy as well as X-ray reflectometry were applied to clarify the interdependency between sputtering conditions, film microstructure, layer density and surface micro-roughness. Based on this information the expected X-ray reflectivity was evaluated. It was observed that the sputtering pressure strongly influences the film growth and the associated microstructure of iridium coatings and subsequently the expected X-ray reflectivity.

# Testing Isotropic Universe via Properties of Gamma-Ray Bursts Detected by Fermi / GBM

*Jakub Ripa*

The sky distribution of Gamma-Ray Bursts (GRBs) has been intensively studied for more than two decades. Most of these studies, test the isotropy of GRBs based on the sky number density distribution. We propose a new method which inspects the isotropy of the properties of GRBs such as their duration, fluences and peak fluxes at various energy bands and different time scales. The method was applied on the Fermi / Gamma-ray Burst Monitor data. We found a relatively significant feature near the Galactic coordinates approximately l = 30 deg, b = 15 deg and radius r = 20 - 40 deg with the inferred probability for the occurrence of such signal (in a random isotropic sample) to be less than a percent. However, more comprehensive analysis using different statistical tests and different samples show that the detected feature can be due to statistical fluctuations. Investigations on the updated Fermi / GBM sample as well as on the data sets of other instruments can clarify on the issue.

## The Soft X-ray Imager (SXI) on the SMILE mission

*Steven Sembay*

The Solar wind Magnetosphere Ionosphere Link Explorer (SMILE) is an innovative space mission dedicated to studying the impact of the solar wind on the Earthś magnetic environment. SMILE will use, for the first time, the technique of X-ray imaging to track the response of the magnetic boundaries and magnetospheric cusps to the solar wind input. At the same time SMILE will image the northern aurora in the UV and will monitor the conditions of the solar wind and plasma in the Earthś magnetic field with its in-situ package comprising an ion analyser and a magnetometer. SMILE is a joint development by the European Space Agency (ESA) and the Chinese Academy of Sciences (CAS) and is due for launch in 2021. This talk will summarise the latest status of SMILE with a focus on the Soft X-ray Imager (SXI) instrument.

## Ultra-precise focusing mirrors for Synchrotron and FEL application

*Frank Siewert*

This contribution will discuss the state of ultra-precise focusing and re-focussing mirrors in use at Synchrotron and FEL-sources to provide high flux of coherent photons for state of the art experimental end-stations. The focusing mirrors used in such cases are Kirkpatrick-Baez-mirrors of elliptical cylinder shape characterized by a residual figure error of a few nanometre rms. The mid- and high-spatial frequency error requires a micro-roughness of $< 0.2$ nm rms. The metrology used to characterize these optics is a limiting factor to manufacture such demanding optical elements and thus have to provide corresponding accuracy. The use of high resolution slope measuring deflectometry as applied for the operation of dedicated optical profilers like the Nanometer Optical Component Measuring Machine (NOM) enables to measure such optics with the required accuracy. We will report on results on the inspection of different type of mirrors of up to 950mm in length to be used under grazing incidence condition. The measurements were performed at the BESSY-II Optics Laboratory (BOL) of the Helmholtz Zentrum Berlin (HZB) by use of the BESSY-NOM. Achieved measurement results are used to optimize the mirror quality by use of deterministic surface finishing as well as to simulate the expected characteristics of the beamline performance.

## Studies of the long-term X-ray activity with the planned satellites

*Vojtech Simon*

We show the perspectives and ossibilities of observing the X-ray binary sources with the planned satellites. We pay attention to the long-term activity of these sources. Monitors of X-ray emission are important instruments for observing the activity on the long timescales (even of years). We show that the X-ray spectrum (especially its hardness) largely determines the observability of a given object (or a type of objects) with a monitor in the specific band. We show the perspectives of observing the outbursts in soft X-ray transients with the WFM monitor onboard eXTP, planned to observe in the 2-50 keV band. This large energy band and its energy resolution will enable to resolve the complex spectral changes which occur during the outbursts. We also show the perspectives of observing binary supersoft X-ray sources with the planned THESEUS and SMILE satellites, monitoring also in the very soft X-ray bands. These sources are unique (sometimes having the luminosity close to the Eddington limit) but they are usually not observable by the X-ray monitors because their X-ray emission is beyond the band used by the existing or previous monitors.

## AGN spectral states from simultaneous UV and X-ray observations by XMM-Newton

*Jiri Svoboda*

It is generally believed that the supermassive black holes in active galactic nuclei (AGN) and stellar-mass black holes in X-ray binaries (XRB) work in a similar way. Koerding et al. (2006) suggested that different types of AGN correspond to different spectral states of XRB. In our recent work, we extended their analysis by using data of higher quality - we used the whole XMM-Newton archive to extract a sample of about 1500 sources with high-quality simultaneous UV and X-ray measurements of AGN. The thermal disc component is estimated from the UV flux while the non-thermal flux is constrained from the measured 2-10 keV X-ray luminosity. Our results indicate that sources with the higher fraction of the X-ray flux tend to be radio-loud, have flatter X-ray spectra and UV spectrum inconsistent with the thermal accretion disc emission, as expected from the XRB hard state analogy, and vice versa for the soft states. Our study, therefore, provides an observational support to the hypothesis that accretion onto super-massive black hole work in a similar way as for the stellar-mass black holes in X-ray binaries, and that XRB and AGN follow similar evolutionary paths. This suggests that the AGN radio dichotomy of radio-loud and radio-quiet sources can be explained by the evolution of the accretion states.

## X-ray polarization as a tool to understand coronae in accreting sources

*Francesco Tamborra*

Up-scattering of low-energy photons by Inverse Compton on a hot gas of electrons (i.e. Comptonization) is an important mechanism in Astrophysics. In particular, in accreting sources such as X-Ray Binaries (XRBs) and Active Galactic Nuclei (AGN) this mechanism is believed to be responsible for their hard X-ray emission: soft photons produced by the accretion disc are Comptonized by a corona of hot electrons whose physical parameters and especially the geometry are not well known. Spectroscopical analysis alone is not able to discriminate between different geometries and parameters of the corona. In the context of this scenario we developed MoCA: a Monte Carlo code for Comptonization in Astrophysics which includes polarization. We are going to show how X-ray polarimetry can be the tool to understand coronae in accreting sources, especially in the light of the recently accepted NASA mission, IXPE.

## Affect of manufacturing inaccuracies to performances of lobster eye optics

*Vladimír Tichý*

Performances of lobster eye systems are affected by manufacturing inaccuracies. The mirrors are assembled with a finite accuracy and they are not ideally flat. It causes mainly decreasing of angular resolution. Mentioned manufacturing inaccuracies are simulated and results of ray-tracing simulations are presented. Resulting performances, namely the spatial resolution are calculated and the effect of manufacturing inaccuracies is evaluated.

## Analytical calculation and maximization of effective collecting area of lobster eye optics

*Vladimír Tichý*

Effective collecting represents one of principal parameters of optical systems. The common requirement is to obtain as large effective collecting area as it is possible. The analytical method of calculating effective collecting area (length) and its maximisation is presented. The results are applicable for a Schmidt as well as for an Angel lobster eye.

## Rapid X-ray variability and properties of compact stars (two decades after RXTE's launch)

*Gabriel Torok*

The Rossi X-ray timing explorer, which operated from 1995 to 2012, has provided a large amount of NS data. Timing analysis of the X-ray flux in more than a dozen NS systems reveals outstanding correlations between frequencies of two characteristic peaks present in the high-frequency part of the power-density spectra. We discuss a simple analytic relation that well reproduces these correlations. We outline a possible physical interpretation of the relation's parameters and explore the impact of the obtained results in a broader context.

## Optics development for ATHENA

*Giuseppe Vacanti*

Silicon Pore Optics (SPO), developed at cosine with the European Space Agency (ESA) and several academic and industrial partners, provides lightweight, yet stiff, high-resolution x-ray optics. This technology enables ATHENA to reach an unprecedentedly large effective area in the 0.2 - 12 keV band with an angular resolution better than 5". After developing the technology for 50 m and 20 m focal length, this year has witnessed the first 12 m focal length mirror modules being produced. The technology development is also gaining momentum with three different radii under study. In this talk we will report on the status of the optics development.

## Metrology challenges during installation of transport mirrors at European XFEL

*Maurizio Vannoni*

The European XFEL just came in operation last 1st of September. Some peculiarities of the Free Electron Laser gives us very high requirements about the specifications of the X-ray mirrors and how much care has to be used in the installation. In this talk, I will describe the procedure that we followed in the installation of the mirrors, the problems we discovered and the future challenges about better metrology and control of the optics will be introduced.

## Laser plasma EUV and SXR source based on a double stream gas puff target for testing and metrology applications of EUV/SXR optics: previous experiments and future plans.

*Przemyslaw Wachulak*

In the talk I would like to present applications of a compact, pulsed laser plasma EUV and SXR source, based on a double stream gas puff target, for testing and metrology of EUV and SXR mirrors. Such optics, most often used in short wavelength optical systems, is also very important nowadays for astronomical applications. Additionally, future plans will be presented, related to the development of a dedicated system, which will be based on such source, for diagnostics of grazing incidence mirrors in the EUV and SXR spectral region.

# Development of soft X-ray telescope optics for EP mission

*Zhanshan Wang*

The Einstein Probe (EP) mission, which aims at discovering transients and monitoring variable objects in 0.5-4 keV X-rays, is a small scientific satellite dedicated to time-domain high-energy astrophysics. EP will employ a large instantaneous field-of-view (60° x 60°) X-ray telescope (WXT), along with moderate spatial resolution (FWHM  5) and energy resolution. It will also carry a follow-up observation X-ray telescope (FXT) with a smaller field-of-view - capable of much larger light-collecting power and better energy resolution than the main survey telescope. In this presentation, we present the optical design and simulations of the FXT, which include the optimized structure parameters of the FXT and its focusing capabilities. The FXT will employ conically-approximated Wolter-I geometry with a focal length of 2 m, and thin glass mirrors with 100 mm in length and 0.3 mm in thickness, which consists of 66 shells tightly-nested with the diameters range from 80 mm to 250 mm. Based on such a kind of configuration, the effective area can be 245 cm2 at 1 keV and 196 cm2 at 4 keV, with an image quality to be approximately 55 in half-power diameter (HPD), and with a field of view (FOV) to be approximately 30, theoretically. The segmented mirrors that form these layers are formed by thermally slumping glass substrates coated with some metal layers for enhanced reflectivity in the interested energy region. In order to force the overall shape of the nominally cylindrical substrates to the appropriate conic form, an over-constraint method was used to assemble the mirrors to a telescope prototype. We will present optical performance on the EP optics and the current status of the telescope.

## The Lobster Eye Point Spread Function

*Richard Willingale*

The PSF of the lobster eye optic has the well know cruciform shape with a central focused spot and cross-arms. This form is more difficult to characterise than the PSF of a conventional telescope and poses peculiar problems for the analysis of images produced by the lobster eye. I will discuss ways of characterising the PSF including a simple analytical model which matches the measured PSF produced by MCOs operating as a lobster eye and the simulated PSF produced by ray tracing. I will discuss how deformations in the MCOs influence the PSF and how the analytical model can be used in the analysis of images from an X-ray lobster eye telescope.

## The Design of FXT onboard EP

*Yan-Ji Yang*

The Follow-up X-ray Telescope (FXT) is one of the payloads onboard the Einstein Probe (EP) mission. It is designed to observe the transients and burst sources, triggered by the Wide Field X-ray Telescope (WXT), which is the other payload onboard EP. FXT uses a nested Wolter I X-ray telescope with the focal length of 1.6m, the same as them on the eROSITA satellite, which effective area is no less than 100 cm2@1.25keV on axis, and the field of view is 38 arcsec in diameter. The angular resolution is less than 2 arcmin (Half Power Diameter, HPD). FXT plans to use pnCCD provided by MPE as the focal plane detector, which energy resolution is better than 170eV@1.25keV.

## Inferring radiative efficiency of ULXs from X-ray luminosity function

*Wenda Zhang*

We calculate the population average radiative efficiency of Ultraluminous X-ray sources (ULXs) from observed X-ray luminosity function of High-Mass X-ray Binaries (HMXBs) in nearby star forming galaxies. We use the radiative efficiency to constrain the super-Eddington models, and find that a physical model in which the luminosity increase logarithmically with mass accretion rate above the Eddington can explain the observed XLF quite well. With this model, the observed X-ray luminosity function could be well fit by two populations with different Eddington luminosities and the fit yields reasonable physical parameters. The best-fit masses of the two populations are 1.15+0.71-0.41 and 15.47+4.01-2.60 solar masses, respectively. The former population is consistent with neutron star population, and stellar mass black holes with mass of 15.47+4.01-2.60 solar masses do not require extreme conditions to form.

## Soft x-ray and EUV metrology for space applications

*Paola Zuppella*

The knowledge and the control of the light polarization state in the VUV and EUV spectral regions play a fundamental role in space application, material science analysis and optical components development. We present an EUV spectroscopic ellipsometer facility for polarimetry in 90-160 nm spectral range. The system is a promising laboratory equipment suitable to characterize phase retarders, polarizers and other optics in the EUV region and to investigate the properties of thin films and optical coatings. A single layer aluminum mirror to be used as quarter wave retarder (QWR) has been fully characterized at Hydrogen Lyman–alpha, showing interesting properties for space applications.

## JEUMICO and TRILAMICO: Dimensions of successful Bavarian-Czech cooperation

*Thorsten Döhring*

In December 2017 the two projects JEUMICO (an acronym for "Joint European Mirror Cooperation") and TRILAMICO (standing for "Trilateral Mirror Collaboration") will end. Different aspects of this Bavarian-Czech collaboration between Aschaffenburg University and the Czech Technical University in Prague will be discussed. The multiple dimensions of this cooperation are scientific achievements, public relation measures, internationalization of education, financial aspects, intercultural differences, and also the actual political situation within Europe.

## KB X-ray Optics for Astrophysics: Recent Status

*Rene Hudec*

X-ray optics in KB (Kirkpatrick Baez) arrangement represent promising alternative to Wolter optics in common use. We will present some new results including KB module developed and tested within the EU AHEAD project.

## A Lobster-Eye/Coded Mask Hybrid Wide Field Imaging X-ray Telescope for Transient Sources

*Rene Hudec*

Paul Gorenstein, Harvard-Smithsonian Center for Astrophysics and Rene Hudec, Astronomical Institute, Academy of Sciences of the Czech Republic and CTU FEE in Prague The importance of detecting and identifying transient X-ray sources, which was already well understood, has increased following the 'Multi Messenger' gravity wave event of August 17, 2017. A point source of variable X-rays, gamma-rays, and visible light followed the gravity wave detected by LIGO. A very wide field X-ray imager with much more sensitivity and larger field of view than the RXTE ASM and MAXI is needed for future transient X-ray studies. The very large field of view focusing telescope will have to be a lobster-eye optic. We claim that a hybrid device which is a focusing lobster-eye optic in one dimension and a coded mask in the other dimension is better than current 2D lobster-eye telescopes for studying transients. For the same size aperture and focal length the hybrid will much more effective area and bandwidth. It will have more sensitivity except perhaps when the transient is very soft or occurs very close to a strong source. The angular resolution of the hybrid should be superior to the resolution that has been achieved so far by 2D lobster-eye telescopes made from thermally slumped channel plates. The hybrid should be relatively easy to fabricate as all the mirrors are identical, equally spaced thin glass or silicon flats.

## LE X-ray Optics for Astrophysics: Recent Status

*Rene Hudec*

X-ray optics in LE (Lobster Eye) arrangement represent important part of future X-ray wide field telescopes and monitors. We will present some new results in the design, development, tests and applications of LE X-ray optics with emphasis on astrophysics,.

## X-ray optics based on biomimetical principle

*Rene Hudec*

Some types of X-ray optics in recent study and development are based on biomimetics. We will give short overview inluding discussion whether the newly discovered multimirror animal eyes may also find applications in science in general and in X-ray astrophysics in particular,

## Image processing of historical astronomical plates

*Petr Skala*

Historical astronomical plates were main source of data for more than century. There are still hundreds of thousands plates which has never been processed by modern computers. There are some standard ways how to process images aplyable on astronomic plates. But also many specific metods that must be developed for processing of plates.

## Study of multiple layers coatings for X-ray mirrors

*Veronika Stehlikova*

This contribution presents the theoretical background for a coating campaign on multiple layers for X-ray applications and first results of prepared samples testing. Simulations using different overcoats were performed to improve the reflectivity properties of thin iridium coatings designed for X-ray optics focusing X-rays in the energy range up to 10 keV. Samples based on these simulations were prepared and will be tested considering the properties influencing the X-ray reflectivity, like layer homogeneity, density and surface micro-roughness. Furthermore coating stress has to be considered in the case of thin, lightweight X-ray mirrors. Preliminary results will be shown and discussed.

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