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NICOLAUS COPERNICUS ASTRONOMICAL CENTER

INVITES APPLICATIONS FOR ASTRONOMY AND ASTROPHYSICS PhD STUDIES AND RELATED FELLOWSHIP COMPETITIONS

The Nicolaus Copernicus Astronomical Center of the Polish Academy of Sciences (CAMK PAN) offers the opportunity to undertake doctoral studies leading to a PhD degree in astronomy and astrophysics. The research covers a broad range of topics pursued at CAMK PAN, including observational and theoretical astrophysics as well as cosmology. Our senior scientists participate in major international collaborations such as H.E.S.S., CTA, Hyper-Kamiokande, GADMC, DarkSide, LUMI-Q, VIRGO/LIGO/KAGRA, ET, and EGO, and are involved in instrumental projects for astronomical satellites including eROSITA, ARCUS, and ATHENA. CAMK PAN represents the Polish astronomical community in the SALT consortium, which operates an 11-m optical telescope in South Africa. The Center's scientists play leading roles in the BRITE scientific satellite project, dedicated to precise stellar brightness measurements, and in the ARAUCARIA project, focused on calibrating the cosmological distance scale. They also operate the Cerro Murphy Observatory in Chile and SOLARIS – a network of small robotic telescopes in the southern hemisphere dedicated to stellar astronomy, exoplanet searches, and quantum satellite communication.

The doctoral programme is carried out within the GeoPlanet Doctoral School, in which CAMK PAN is a leading institute. The programme lasts four years and begins on October 1, 2026. During this period, students are required to complete coursework and lectures (including interdisciplinary lectures), participate in seminars, and prepare their doctoral dissertation. All lectures and seminars are conducted in English. The regulations of the doctoral school, including the study programme, are available on the CAMK PAN website: https://www.camk.edu.pl/en/phd/. Students are based in Warsaw or Toruń, depending on the location of their supervisors. Students based in Warsaw may apply for accommodation in the student residence operated by the Center.

An information about the proposed research topics and their supervisors is attached to this announcement. **Candidates can apply for only one topic**. Before applying, candidates should contact their potential supervisors to obtain more details on the proposals. Candidates should read the recruitment regulations also available on the CAMK PAN website: https://www.camk.edu.pl/en/phd/.

Doctoral school students receive a scholarship for four years. The minimum amount is 3,466.90 PLN/month gross (approx. 3,077 PLN net) for the first two years and 5,340.90 PLN/month gross (approx. 4,740 PLN net) after a positive mid-term evaluation (years 3-4). Projects 1 and 2 are partly funded from National Science Center grants. Separate ranking lists will be created for these two projects. For projects 3-9, scholarship will be funded by the institute. The scholarship during the first year will amount to 5000 PLN/month gross (approx. 3795 PLN net). In subsequent years, a minimum scholarship is guaranteed, or the possibility of switching to a grant scholarship (if the supervisor obtains a grant). For projects 3-9 single ranking list will be created and only one position is available. See the project descriptions below for details.

The recruitment process will take place via an online application system available at:

form will open on March 9th

In the online system, choose "Register" and "Nicolaus Copernicus Astronomical Center, Polish Academy of Sciences". After giving your consents, you will be able to enter your data and upload your application documents and select a topic. After uploading the documents you should receive an email confirmation.

Candidates must submit a complete application, including:

1. The application for admission to the doctoral school together with GDPR statement (following this template).
2. A copy of their master's/university and bachelor's degree diplomas. In case master's degree diploma is not yet available, it must be provided before the candidate is admitted to the school.
3. A transcript of grades (Bachelor and Master Courses).
4. A Curriculum Vitae including an education and employment records, list of publications, information on involvement in scientific activities – membership in scientific groups/societies, participation in scientific conferences, internships and training, awards and distinctions.
5. A letter of motivation containing a short description of the candidate's interests and scientific achievements, and justification of the intention to undertake education at the Doctoral School.
6. English language certificate(s), if available.

All documents, including scans, must be in PDF format and submitted **by April 12th, 2026**.

In addition to application documents given above, at least one recommendation letter should be sent **directly by the referee** to: phdstudies@camk.edu.pl, **before the application deadline (April 12th).**

The Recruitment Board will select candidates for the interview, which will take place **May 11th-27th, 2026** (9 am – 4 pm, CET). Decisions about admission will be made by May 31st, 2026 and all the candidates will be notified by e-mail. For additional information contact the coordinator of the doctoral school, Dr. Radosław Smolec (smolec@camk.edu.pl) or the Center's secretary office (Mrs. Katarzyna Morawska, kasia@camk.edu.pl).

Warsaw, March 5th, 2026

Attachment: *Proposed topic of PhD thesis:*

Project 1

Subject: Accretion Discs and Outflow Phenomena in Accreting White Dwarf Binaries

Supervisor: dr Krystian Iłkiewicz (CAMK PAN; contact: ilkiewicz@camk.edu.pl), prof. Joanna Mikołajewska (CAMK PAN).

Accreting white dwarf binaries are interacting binary systems in which a white dwarf gains material from a companion star through mass transfer. Depending on the nature of the donor star and the rate of mass transfer, these systems can manifest in various forms, such as cataclysmic variables or symbiotic stars. They serve as valuable laboratories for studying fundamental astrophysical processes, including accretion, mass loss, and binary evolution. These systems are also linked to high-energy phenomena, such as nova eruptions, and are considered important progenitor candidates for type Ia supernovae and potential sources of gravitational waves.

The research will investigate the physical processes involved in mass transfer and angular momentum exchange between the binary components. Particular emphasis will be placed on the formation and evolution of accretion discs and their potential tilts and instabilities, as well as large-scale outflow structures such as jets, bow shocks, and nova shells. These features may serve as key tracers of how angular momentum is redistributed or expelled from the system.

The project is based on a collection of spectroscopic and photometric observations of a large sample of objects. The research will combine observational analysis with theoretical modeling, tailored to the specific interests of the PhD candidate. Possible directions include investigating how disc morphology influences angular momentum dynamics, identifying the mechanisms behind outflows, or assessing how these systems evolve over time and affect their environments.

The expected outcome is a deeper understanding of accretion physics and the long-term evolution of interacting binary systems. The findings may also address unresolved issues in binary population models and contribute to broader astrophysical questions, such as galactic feedback and the life cycle of compact stellar systems.

Location: Warsaw
Funding: Grant fellowship (National Science Center SONATA grant no 2024/55/D/ST9/01713) for 3 years: 5000 PLN/month, gross gross, before the mid-term evaluation (ca. 3795 PLN/month net; years 1-2), 6500 PLN/month, gross gross, after positive mid-term evaluation (ca. 4933 PLN/month net; year 3), followed by a scholarship under general regulations for the remaining period, up to a total of four years. Funding is available for travel to conferences/workshops/schools and computing equipment.
Note: A single position is available. A separate ranking list will be created for this topic.

Project 2

Subject: Generating Synthetic Observations of Star Clusters from Numerical Simulations

Supervisor: dr Abbas Askar (CAMK PAN; contact: askar@camk.edu.pl), prof. Mirosław Giersz (CAMK PAN).

Understanding the dynamical evolution, stellar populations, and structural properties of dense star clusters requires a close connection between detailed numerical simulations and observational data. This PhD project aims to bridge this gap by generating realistic synthetic observations of star clusters based on state-of-the-art numerical simulations of their evolution.

The successful candidate will develop and apply advanced tools to produce synthetic photometric datasets from outputs of MOCCA and direct N-body simulations. These datasets will be used to construct colour–magnitude diagrams, light curves, surface brightness profiles, and astrometric measurements. The synthetic observables will be systematically compared with real data from both ground- and space-based facilities, including the Hubble Space Telescope (HST), JWST and Gaia.

The synthetic observations will be used to investigate key astrophysical phenomena in dense star clusters, including binary stars, blue stragglers, multiple stellar populations, and compact object binaries. In addition, the project will explore how synthetic photometric and astrometric signatures can be used to infer the presence of subsystems of stellar-mass black holes as well as intermediate-mass black holes (IMBHs) in cluster centres.

This PhD project is part of a broader Polish National Science Centre (NCN) research project focused on linking simulations and observations of star clusters. The PhD student will work closely with the Principal Investigator (Dr. Abbas Askar) and a postdoctoral researcher developing complementary synthetic spectroscopic tools. In addition to developing synthetic observation pipelines, the student will gain hands-on experience in running, analysing, and interpreting numerical simulations of star cluster dynamical evolution.

Tasks description. The successful applicant will join a funded research team developing a comprehensive toolkit to produce and analyze realistic synthetic photometric observations from star cluster simulations and compare them with observational data. Specific responsibilities will include:

- Developing and automating pipelines to generate synthetic telescope images and extract photometric measurements from MOCCA and direct N-body simulation outputs.
- Simulating time-resolved observations to study stellar variability and orbital motions (e.g. eclipsing binaries, variable stars, and fast-moving stars).
- Analyzing synthetic data to determine global cluster properties, binary fractions and characteristics, internal structure, kinematics, mass functions, and mass segregation
- Comparing synthetic observables with available observational results for Galactic and extragalactic star clusters

- Contributing to the further development and validation of the MOCCA code, including systematic comparisons with direct N-body simulation
- Publishing scientific results in peer-reviewed journals and presenting findings at international conferences.

Requirements:

The main requirement for this position is possession of a valid MSc degree in astrophysics, astronomy, physics, or a related discipline by the start date of the project.

Doctoral scholarship will be awarded provided that the PhD student meets the doctoral scholarship requirements laid down in the Act on Higher Education and Science of 20 July 2018 throughout the performance period of the tasks in the project (except when education at the doctoral school is suspended).

Additional desired qualifications include:

- Good programming skills (e.g., Python, Fortran, C, or C++);
- Familiarity with star cluster dynamics, stellar or binary evolution, observational astronomy, or photometric techniques;
- Proof of English proficiency that demonstrates excellent writing and communication skills, sufficient to work effectively in an international research environment.

Experience with observing star clusters and/or analyzing star cluster data will be considered an asset.

Location: Warsaw
Funding: Grant fellowship (National Science Center SONATA grant no 2024/55/D/ST9/02585) for 3 years: 5000 PLN/month, gross gross, before the mid-term evaluation (ca. 3795 PLN/month net; years 1-2), 6500 PLN/month, gross gross, after positive mid-term evaluation (ca. 4933 PLN/month net; year 3), followed by a scholarship under general regulations for the remaining period, up to a total of four years. Funding is available for travel to conferences/workshops/schools and computing equipment.
Note: A single position is available. A separate ranking list will be created for this topic.

Project 3

Subject: Development of a Novel Electrostatic Focusing Readout for Large-Scale Hybrid Time Projection Chambers in Neutrinoless Double-Beta Decay Searches

Supervisor: dr Pedro Silva (Astrocent/CAMK PAN; contact: paocsilva@camk.edu.pl) and dr hab. Masayuki Wada (Astrocent/CAMK PAN; contact: masayuki@camk.edu.pl)

The search for neutrinoless double-beta decay ($0\nu\beta\beta$) is a central objective in neutrino physics, offering a unique window into the Majorana nature of neutrinos and the violation of lepton number. Among the different experimental approaches, gaseous Time Projection Chambers (TPCs) provide a distinctive advantage through their ability to reconstruct the detailed topology of β-electron tracks, enabling powerful background rejection based on event shape. Experiments such as NEXT have demonstrated the strength of this technique, achieving excellent energy resolution and topological discrimination. However, extending these capabilities to larger detector volumes remains a major technological challenge, particularly in terms of scalable, cost-effective charge readout.

Hybrid TPC concepts that combine charge and light detection represent a promising evolution of this approach. In particular, operation with Xe-doped Argon as an active medium offers an attractive balance between scalability, charge and scintillation characteristics, and the potential sensitivity to xenon-based double-beta decay isotopes. Compared to pure xenon gas TPCs, this approach has the potential to significantly reduce operational cost and complexity while retaining strong topological reconstruction capabilities. Nevertheless, current charge readout solutions based on high-density segmented readout planes or large-area optical readout systems require a rapidly increasing number of electronic channels as detector dimensions grow, leading to substantial cost, power, and integration challenges that limit their applicability to next-generation experiments. Additionally, extensive readout coverage introduces significant radiogenic backgrounds from the readout materials, further motivating the need for compact readout architectures.

This PhD project aims to address these limitations through the development of a novel large-area, charge-based readout strategy for hybrid TPCs. The core idea is to use electrostatic lensing to focus drifting ionization charge onto a reduced number of readout sensors, thereby decoupling spatial resolution from readout area. Additionally, by combining this approach with high-density charge readout solutions, as is the case of Timepix4 ASIC, we expect to achieve sub-millimetric spatial resolution and competitive energy resolution while drastically reducing channel count and overall readout cost when compared to existing solutions.

Aim. This project aims to establish a competitive alternative to existing large-area readout strategies, strengthening the physics reach of next-generation neutrino and rare-event search experiments.

The PhD student will play a central role in the full development cycle of this concept. Initially the student will contribute to the detector computational simulations, building upon existing software frameworks and analysis tools that will be adapted and extended to model electrostatic focusing structures, charge transport, and readout performance using GEANT4 interfaced with Garfield++.

Following the validation of the design through simulation and small-scale tests, an initial prototype based on a single Timepix4 chip will be constructed and experimentally characterized. Once the performance of this first demonstrator is established, the student will integrate a 3 × 3 (cm) matrix of Timepix4 chips and the corresponding readout electronics with the support of colleagues from IEAP/CTU in Prague (Czech Republic). The final objective of the project will be the demonstration and characterization of a scalable readout module with an active area of approximately 33×33 cm^2, providing a proof-of-principle for a modular, cost-effective charge readout suitable for future large-scale hybrid TPCs.

Location: Warsaw
Funding: By the institute, as set in the announcement.
Note: A single ranking list will be created for topics 3-9.

Project 4

Subject: Exploring Spectral Dynamics of Argon Scintillation from Scintillation Threshold to Breakdown Voltage in MPGD Structures

Supervisor: dr hab. Marcin Kuźniak (Astrocent/CAMK PAN; contact: mkuzniak@camk.edu.pl)
dr André Cortez (Astrocent/CAMK PAN; contact: acortez@camk.edu.pl)

Over the last decade, argon and xenon detectors have become central to direct Dark Matter searches and neutrino experiments due to their unique ionization and scintillation properties. In these detectors, high-purity noble gases act as both target and active medium, providing particle tracking and identification, including 3D event and energy reconstruction. Efficient collection and understanding of VUV scintillation photons are essential, yet the photon production mechanisms, wavelength spectra, and temporal evolution are not fully understood. This project will be conducted within the DRD1 Collaboration (WG3) targeting at characterization of electroluminescence-based amplification structures.

In this project we will perform time- and wavelength-resolved studies of argon scintillation in pure gas at 0.5–4 bar (LAr-equivalent), using MPGD structures (such as GEM, THGEM, and FAT-GEM structures with and without wavelength shifting capability), probing the scintillation emission mechanisms from threshold to breakdown voltage, using different setups.

As part of this work, we will assess the fast and late components of the emission originated from Ar, including the third continuum, previously unexplored with α and β sources, which dominates the early photon signal and offers new opportunities for particle discrimination. By revealing spectrally distinct scintillation features, this work aims to optimize amplification structures and enable novel particle identification techniques for experiments such as ARIADNE, GANESS, and DarkSide.

The selected PhD candidate will get familiar with detector instrumentation, assembly of experimental apparatus, testing, characterisation of optical amplification structures, data analysis (e.g. ROOT) and simulation (GEANT4). As a PhD candidate, you will be at the forefront of this exciting research frontier, contributing directly to the understanding of the scintillation signals produced in Dark Matter experiments. Your tasks will include the development and optimization of Monte Carlo simulations, assessing the impact of different amplification structures in the scintillation profile (emission wavelength, timing profile, optical gain, etc). Additionally, you will engage in preparatory hardware work and experimental testing, contributing to the design and execution of experiments aimed at characterizing the scintillation emission from different gases (noble plus additives) from scintillation threshold to breakdown using monochromators. Your efforts will validate simulation results and provide critical insights for improving detector performance. Furthermore, you will participate in data-taking campaigns within the DarkSide collaboration and perform comprehensive data analysis, including cross-checks and result validation in an international collaboration.

As part of your research, you will have opportunities for research stays at the Gran Sasso National Laboratory (LNGS) in Italy, one of the world's leading underground research facilities for astroparticle physics. These research stays will provide invaluable hands-on experience with the DarkSide experiment and allow collaboration with leading experts in the field. As a PhD candidate you will also be encouraged to present your research findings at major international conferences, providing the ground to showcase your work to the scientific community, gain professional recognition, and expand your professional network.

Desired skills

- Good programming skills in C++ and Python.
- A solid understanding of radiation detector principles.
- Familiarity with GEANT4 and ROOT (highly desirable but not mandatory).

If you are passionate about exploring the unknown and eager to contribute to one of the most exciting scientific endeavors of our time, we invite you to join us in unraveling the mysteries of Dark Matter with the DarkSide collaboration!

Location: Warsaw
Funding: By the institute, as set in the announcement.
Note: A single ranking list will be created for topics 3-9.

Project 5

Subject: Improved Slim Accretion Disc Models

Supervisor: prof. dr hab. Marek Abramowicz (CAMK PAN; contact: marek.abramowicz@physics.gu.se)

This project aims to refine Slim disc models by implementing a new, realistic viscosity prescription. Developed in 2026 by a collaborative team; including Abramowicz (CAMK/Opava), Brandenburg (Nordita), Horák (Prague), Lančová (CAMK/Opava), and Miller (Oxford), this prescription is derived from cutting-edge, high-resolution GRMHD supercomputer simulations of black hole accretion.

The student will be based at CAMK, with research stays at the Astronomical Institute in Prague, Oxford University, and Nordita in Stockholm. Additional collaborators include A. Sądowski (Warsaw), E. Szuszkiewicz (Szczecin), and R. Narayan (Harvard). As Slim discs remain among the most practically successful models in the field, this refinement represents a significant advancement in black hole accretion theory

Location: Warsaw
Funding: By the institute, as set in the announcement.
Note: A single ranking list will be created for topics 3-9.

Project 6

Subject: Monitoring X-ray Background from High Energy Particles on the Board of NewATHENA Mission

Supervisor: prof. dr hab. Agata Różańska (CAMK PAN; contact: agata@camk.edu.pl)

The main goal of this project is to predict the X-ray background radiation induced by high energy particles interacting with NewATHENA spacecraft and its payload. NewATHENA is the future flag ESA (European Space Agency) mission to observe hot and energetic Universe in X-rays. The actual background level is essential during each measurement made by both NewATHENA's science instruments: Wide Field Imager (WFI), and X-ray Internal field Unit (X-IFU) and must be carefully subtracted from the data. The proposed PhD topic is interdisciplinary, since in the broader context the predicted radiation serves as a science goal of the new monitor NAHEPaM (NewATHENA High Energy Particle Monitor) fully developed in Poland. Polish researchers and engineers, from CAMK PAN and NCBJ, have been invited to design and procure NAHEPaM and place it on NewATHENA telescope, in order to measure X-ray background at the same time as signal from astrophysical sources. The design and development of NAHEPaM has already begun, thus there is a need to create a team of scientists who will deal with future observations and the possible construction of the science ground segment of the monitor. Agata Rozanska, supervisor for this project, is a science principal investigator (PI) of the NAHEPaM. She is a member of NewATHENA scientific consortia of both instruments.

X-ray astrophysics always deals with high background radiation, that typically produces statistical error on the level of 5%. By placing NAHEPaM on the board of NewATHENA, we will be able to reduce the absolute knowledge error up to 2% due to simultaneous detection of both: source, and non-focused charge particle background count-rate. It was demonstrated, that GeV particle flux taken by EPHIN (Electron, Proton, Helium INstrument) on the board of SOHO (SOlar and Heliospheric Observatory) mission correlates tightly with non-Xray background measured by XMM-Newton satellite. This will be the starting point for doctoral student to define the observation plan of NAHEPaM.

Up to now, such monitor was never intentionally placed on any X-ray mission. Although NAHEPaM is not required for the launch of the NewATHENA mission, if it is successfully completed, it will be an excellent opportunity for Poland to place its first detector, built entirely by Polish entities, in space. The PhD will be carried out in collaboration with an international consortium composed of scientists from Italian Space Agency, INAF, Milano, and from University of Kiel, Germany. The doctoral candidate will have an opportunity to work in teams building space missions according to ESA standards.

Location: Warsaw
Funding: By the institute, as set in the announcement.
Note: A single ranking list will be created for topics 3-9.

Project 7

Subject: Radiative Pulsar Astrophysics

Supervisor: dr hab. Jarosław Dyks (CAMK PAN Toruń; contact: jinx@ncac.torun.pl)

The project aims at understanding the radiative properties of radio pulsars, with special focus on complex polarization effects observed in single pulse data, within the realm "beyond the rotating vector model". This is closely related to (and may involve) a study of temporal flux variability (eg. changes of pulsation modes) and average profile morphology.

The tasks are highly geometric and mostly involve special relativity and classical electrodynamics. Usually they involve matching some trial models to radio pulsar data, ie. the job involves both theory and data analysis.

The student will work in Toruń (a moderate size town located some 200 km north west of Warsaw).

Location: Toruń
Funding: By the institute, as set in the announcement.
Note: A single ranking list will be created for topics 3-9.

Project 8

Subject: Astrophysics of Luminous Compact Objects

Supervisor: prof. dr hab. Włodzimierz Kluźniak (CAMK PAN; contact: wlodek@camk.edu.pl)

Opportunity for PhD work in the group of Prof. Wlodek Kluźniak on the physics of accretion onto black holes and similar objects. The astronomical context includes ULXs, as well as supermassive black holes. Numerical radiative simulations of accretion, as well as semi-analytic work, have been successfully confronted with observations by past students.

Location: Warsaw
Funding: By the institute, as set in the announcement.
Note: A single ranking list will be created for topics 3-9.

Project 9

Subject: Identification, Confirmation, and Analysis of Binary Cepheids to Address Fundamental Astrophysical Problems

Supervisor: dr hab. Bogumił Pilecki (CAMK PAN; contact: pilecki@camk.edu.pl;
www: https://users.camk.edu.pl/pilecki/)

Nearly 15,000 classical Cepheids are currently known, mainly in the Milky Way and in the Magellanic Clouds and based on different studies a large fraction of them (about 80%) belong to binary or multiple systems. Yet, only a tiny fraction (about 0.1%) have been observed in eclipsing or double-lined spectroscopic binaries (SB2) systems, limiting the number of Cepheids with directly measured, geometry-based masses and radii.

The project is to identify, observe, confirm, and analyze the binary Cepheids with these properties. We will use the new method of detecting them, which already led to the detection and confirmation of 62 new SB2 Cepheids, among them 9 composed of two Cepheids and one of merger origin. Most of these binary Cepheids were found in the LMC, and now an extension to the SMC and the Milky Way is planned. Several types of studies are possible: 1) identification, observations, and RV data analysis, 2) spectroscopic analysis of the composite spectra, 3) evolutionary analysis, 4) pulsation analysis, or 5) a combination of those, and more. All of this will lead to a) a significant increase in the sample size of binary Cepheids of SB2 type with measured properties, b) an improvement of our knowledge on the origin and evolution of Cepheids, c) multiplicity and binary evolution of intermediate-mass stars, and d) the impact of binarity on period-luminosity relations.

Information about our related projects on Cepheids in binary systems can be found at https://users.camk.edu.pl/pilecki/?page=project.

Location: Warsaw
Funding: By the institute, as set in the announcement.
Note: A single ranking list will be created for topics 3-9.