

## Doctoral studies

From the very beginning of CAMK PAN, one of its major objectives has been to train new generations of scientists, able to lead international-level research. This goal is accomplished through competitive PhD program that we have been running continuously for more than 40 years now. The first PhD degree was awarded in 1980. The last PhD diploma that we issued holds the number 111 (as of November 2020). Starting with the academic year of 2019/2020, PhD students attend the GeoPlanet Doctoral School. The School comprises seven institutes of the Polish Academy of Sciences: the Institute of Geography and Spatial Organization, the Institute of Geology, the Institute of Geophysics, the Institute of Oceanology, the Center for Theoretical Physics, the Space Research Center, and CAMK PAN as the leader of the School. We offer degrees in astronomy, physics, and Earth and environmental sciences. Our students, while still based at specific institutes and tightly connected to research conducted therein, may attend interdisciplinary lectures, lectures on statistics, philosophy of science or workshops aimed at training communication, presentation or writing skills. During the last academic year (2019/2020), CAMK PAN hosted 43 PhD students that carried out research in nearly every branch of astrophysics.



>> One of Doctoral School meetings.

Image credit: Chandra Sekhar Saraf

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>> The premises of the Toruń branch of our institute (marked with a circle) are located in the historic center of the city in which Copernicus was born.

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# ACROSS THE UNIVERSE



## Research at the Nicolaus Copernicus Astronomical Center of the Polish Academy of Sciences

## The Nicolaus Copernicus Astronomical Center of the Polish Academy of Sciences

Established in 1978, the Nicolaus Copernicus Astronomical Center of the Polish Academy of Sciences (Polish acronym: CAMK PAN) is a leading astronomical institute in Poland. Its main subjects of research include: stellar astrophysics, binary systems, circumstellar matter, dense matter and neutron stars, black holes, accretion processes, structure and evolution of active galaxies, extrasolar planets and gravitational waves. CAMK PAN is involved in major international projects such as SALT, H.E.S.S., CTA and LIGO-Virgo observatories, and missions of Herschel, INTEGRAL, Fermi and Athena satellites. Institute headquarters in Warsaw house the control station of the first Polish astrosatellite mission BRITE. An autonomous unit of CAMK PAN, AstroCeNT, conducts high quality interdisciplinary R&D projects related to searches for dark matter and studies of gravitational waves. Our newest initiative is Observatory Cerro Armazones (OCA), being erected in Chile next to the construction site of the European 40-m ELT telescope. OCA will be dedicated to precise calibration of distance indicators and measuring of the Hubble constant.



>> Aerial view of the Copernicus Astronomical Center in Warsaw

## Instrumental projects

The construction site of OCA is located in one of the best spots for ground based astronomical observations – Atacama Desert in Chile, about 110 km south of the city of Antofagasta, next to the Cerro Armazones mountain. On the summit of Cerro Armazones the Extremely Large Telescope is currently being constructed by the European Southern Observatory - a really exclusive neighborhood! In April 2020 CAMK PAN signed a contract with Austrian company ASA Astrosysteme to deliver telescopes to the OCA observatory. Beside a smaller, 0.8 m telescope, the delivery includes a big 1.5 m class telescope – the biggest optical telescope ever operated by the Polish institution.

Recently one of the biggest and most prestigious scientific grants in the world - an ERC Synergy grant was awarded to significantly expand OCA, and in particular to build an even bigger (a 2.5m class) telescope. Apart from OCA, CAMK PAN maintains SOLARIS – a network of small robotic telescopes located in Australia, South Africa and Argentina, and coordinates the Polish involvement in the Southern African Large Telescope (SALT). We also contribute to the High-Energy Stereoscopic System of large Cherenkov telescopes (H.E.S.S.) in Namibia, and are taking part in the multinational project CTA (Cherenkov Telescope Array) - the next generation ground-based observatory for gamma-ray astronomy at very-high energies.



>> Cerro Armazones Observatory in front of the Extremely Large Telescope (an artist's impression).  
Image credit: M. Górski

## Advanced Virgo, the European gravitational-wave observatory

Gravitational waves – minute distortions of spacetime caused by the movement of astrophysical objects, such as black holes and neutron stars – allow us to study areas that are not accessible to electromagnetic waves. The Virgo group at CAMK PAN is a part of the Polish Consortium of the Virgo Project. Virgo closely collaborates with the US LIGO gravitational wave observatory. The duo will soon be joined by the Japanese KAGRA observatory, enabling to locate precisely sources of gravitational signals on the celestial sphere and to identify them in the electromagnetic domain. Researchers from CAMK have full and unrestricted access to the global LIGO-Virgo detector network worth about 1 billion US dollars.

At CAMK PAN various analyses of signals from astrophysical sources are performed, involving theoretical studies and development of new methods of data analysis based on high-performance computing, machine learning and artificial intelligence. We also contribute to the concept of the European Einstein gravitational wave observatory that will be sensitive enough to detect any coalescence of two intermediate-mass black holes in the entire universe, to explore the physics of black holes, and to detect thousands of neutron star coalescences per year.



>> Aerial view of the Advanced Virgo detector, located in Cascina, near Pisa (Tuscany, Italy).  
Image credit: The Virgo Collaboration