



Major studies and research projects

The Faculty consists of: the Marian Smoluchowski Institute of Physics, the Astronomical Observatory and the Cluster of Departments of Applied Computer Science.

Research at the Institute of Physics, one of the largest scientific facilities in Poland, covers a wide range of subjects: from research on the micro-world (elementary particle physics, nuclear, atomic, molecular and solid state physics, as well as nanotechnology) to research on cosmology. The research also represents several areas of multidisciplinary character, i.e. biophysics, cognitive science, econophysics, etc.

The most important research areas include:

- **Processes occurring in the Universe.** The scientists from the Astronomical Observatory focus their attention on studying the processes in the Universe observed on a variety of time and energy scales. This research is realised through observations in the full electromagnetic spectrum, as well as through theoretical investigations.

- **Intelligent computer systems and their applications.** Research conducted by the Cluster of Departments of Computer Science scholars encompasses problems that combine issues of both hardware and software. The research is relevant to a large number of disciplines, from humanities (sociology, psychology), through chemistry, biology, medicine, modelling and visualisations of problems in physics, to a wide range of topics in engineering.

- **FAIR (Facility for Antiproton and Ion Research in Europe).** It is one of the world's greatest scientific enterprises, in which researchers from the Institute of Physics partake. Experiments prepared at FAIR will provide complementary information about unknown states of matter and about the early evolution of the Universe.

- **Research on the fundamental interactions.** Physicists from the Faculty participate in research on fundamental interactions at the European CERN laboratory. In 2013, the Institute of Physics became a member of the research team of the ATLAS experiment at the LHC (Large Hadron Collider).

Research and investment projects:

The world-class level of research conducted at the Faculty is demonstrated by the increasing number of research grants obtained not only by experienced researchers, but also by young scientists (from around 40, 120, and 110 grants realised, respectively, in 2005–2007, 2008–2010, and 2011–2013). This concerns both national and international projects.

As a result of the "ATOMIN - Atomic Scale Science for Innovative Economy" investment project, which has increased the research potential of the Faculty in an unprecedented manner, the Faculty can now compete with other facilities located around the world having equal status.

The Marian Smoluchowski Kraków Research Consortium "Matter-Energy-Future," in which the Faculty participates, was recognised in 2012 by being awarded a Leading National Research Centre (KNOW) status. The Consortium creates a strong interdisciplinary research centre in the field of physical sciences.

In 2013, as a result of an evaluation of Polish research facilities that was based on scientific achievements, research potential and material results of research activity, the Faculty was awarded the highest A+ category (a rating given to 3% of the best scientific units in Poland) in the field of science and engineering.



Collaboration

The participation of Faculty scientists in the BOREXINO ("Boron Solar Neutrino Experiment") project is an example of broad international collaboration. During the realisation of the project, scientists obtained direct confirmation of the occurrence of geoneutrinos. It also allowed for the most precise measurement of the velocity of neutrinos emitted at CERN. The acquired results are of fundamental importance for astrophysics, particle physics and geophysics.

Another enterprise of this kind is research conducted by means of the LOFAR ("Low Frequency Array") equipment/radiotelescopes. It concerns the physics of the Earth's ionosphere, interstellar plasma, neutron stars and galactic nuclei. Other research that deserves attention is conducted within the Polish part of the consortium for the Cherenkov Telescope Array (CTA) project, which concerns high-energy cosmic ray particles that were produced as a result of stellar explosions, generated inside galactic nuclei, or remained from the early Universe.

Scholars

Prof. Andrzej Budkowski – a physicist who devotes special attention to the surface phenomena of macromolecular systems. Prof. Budkowski is the author of the basic works on thin films of polymer blends. Together with his research group, he investigates the formation processes of organic nanolayers and micropatterns for solar cells, electronics, and biomedical coatings. His research group recently became engaged in two large European projects concerning the construction of biosensors that detect diseases (PYTHIA) and dangerous foods (FOODSNIFFER).

Prof. Elżbieta Richter-Wąs – works in the area of theoretical physics in the field of phenomenology of elementary particle interactions, e.g. high energy electron-positron and proton-proton collisions. She is a co-author of recognised Monte Carlo programs used for comparing precise experimental analyses with theoretical predictions. Prof. Richter-Wąs is a member of the team conducting the ATLAS experiment at the LHC accelerator at CERN, the coordinator of the research on the Higgs boson discovery signatures in the LHC experiments, and a co-author of the article on the discovery of the Higgs boson.

Prof. Maciej Ogorzałek – an IT scientist who conducts research on the applications of computational intelligence in biomedical data processing and aiding diagnostics. His second area of interest is new computational methods for the design of next-generation microelectronic systems. He is an author of over 280 articles, and a laureate of the Master programme of the Foundation of Polish Science. He exercises many functions in various international scientific organisations. He has been a member of Academia Europaea since 2012.

Prof. Michał Ostrowski – an astronomer with a wide range of interests, who specialises in the field of high energy astrophysics. He has authored a number of fundamental works on cosmic ray particle acceleration in shockwaves, as well as on the research of relativistic jets from active galaxies. He is in charge of the Faculty's part of the consortium for the gamma-ray astronomy project "Cherenkov Telescope Array," which is of critical importance for the studies of the Universe. He participates in the work of international councils and expert committees, including the ASPERA ("ASTroParticle European Research Area") and APPEC ("Astroparticle Physics European Coordination") scientific advisory committees.

Achievements

Among the achievements which Faculty scientists take pride stands the lung-imaging method that utilises polarised ^3He . The Faculty achieved great success (in collaboration with the John Paul II Hospital in Kraków) in obtaining human lung images by using magnetic resonance for the first time in Poland.

Another success is the construction of the Polish optical atomic clock. A next-generation clock, using ultra-precise lasers for frequency measurements in laser-cooled atoms, is being created in a cooperation with the Atomic, Molecular and Optical Physics National Laboratory (FAMO).

The Cracow School of Theoretical Physics, which has been organised annually for more than fifty years, reviews new results of scientific research in particle physics. The list of its speakers includes Nobel laureates. Proceedings are published in *Acta Physica Polonica B*, issued by the Institute of Physics, a journal that is on the Institute for Scientific Information list.

Science enthusiasts are continually attracted by the Faculty's scientific accomplishments and the Faculty's enterprises designed to popularise science, including physics labs and workshops, popular-scientific lectures, Physics Academy, Evenings with the Stars, and Radio Observations of the Milky Way.



JAGIELLONIAN UNIVERSITY
IN KRAKÓW

Specialisation

- Experimental and Theoretical Physics
- Elementary Particle Physics
- Atomic and Molecular Physics
- Nuclear Physics • Solid State Physics • Biophysics
- Nanotechnology
- Astronomy • Applied Computer Science



THE FACULTY OF PHYSICS, ASTRONOMY AND APPLIED COMPUTER SCIENCE

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