

Research Activities at the Maria Curie-Skłodowska University

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1 Introduction

Maria Curie-Skłodowska University in Lublin (UMCS) is the largest public university in Poland, located on the eastern side of the Vistula River. This is an institution deeply rooted in the region. Since 1944 UMCS has been acting as a cultural and opinion-forming factor in the region and has made a significant contribution to building its knowledge-based economy.

The scientific and research potential of the university is growing. UMCS encompasses 13 faculties, 22 research institutes and many supporting central units. Almost 3 000 employees make up the academic community of the University. More than 100 patents prove its commercialization potential. UMCS can boast of, among others, a modern Institute of Informatics, the Centre for Functional Nanomaterials at the Faculty of Chemistry and the Media and Art Incubator. Together with four research and scientific units, the Analytical and Program Centre for Advanced Environmentally Friendly Technologies ECOTECH-COMPLEX has been established, equipped with innovative laboratories and high-quality equipment, including high-field magnetic resonance scanner.

UMCS also maintains active relations with foreign research centres. A significant event in 2017 was the establishment of the Polish-Chinese Research Centre Green Pharmaceuticals (green pharmacy), which is the first Polish-Chinese research institution of this type.

A strong focus is put on Early Stage Researchers' development. The University offers PhD programmes at three Doctoral Schools: the Doctoral School of Humanities, Social Sciences, and Quantitative and Natural Sciences. In 2019 the Young Researchers Council was created to comprehensively support young researchers in their scientific career development. In 2017, UMCS received the HR Excellence in Research Logo, awarded by the European Commission. It confirms that we create the best working conditions for scientists and provide transparent recruitment rules and an appropriate space for the development of science, in line with European standards.

UMCS in a nutshell:

- 13 faculties
- nearly 80 fields of studies
- over 250 specializations
- over 16 000 students
- more than 250 000 graduates
- about 1 800 international students
- over 100 research groups, including both student and doctoral organisations
- 209 agreements on scientific and educational cooperation with international partners
- ca. 2 500 publications per year published by UMCS-based researchers
- 15 scientists from UMCS are listed in the TOP 2% Scientists, the prestigious ranking of the world's most influential people in science.

2 Research Landscape

Researchers at UMCS conduct their scientific activities in 23 research disciplines, including formal and natural sciences, social sciences, arts and humanities. The research is conducted both at individual institutes and multidisciplinary centres, such as:

- **Optical Fibre Technology Laboratory (LOFT)**, which is a well-recognized research facility experienced in the production of telecommunications, special and photonic fibres. The Laboratory has a full technological line for the production of optical fibre, including preform preparation and fibre extraction equipment.¹ The Laboratory's research team have been engaged in numerous R&D projects over years, such as:
 - ACPHAST 4R: support for researchers who have a conceptual breakthrough and would like to implement their prototype (or some components for their prototype) using mature photonics technologies. This project is supported by the EU (GA no. 825051).²
 - ACPHAST 4.0: support for European companies that want to boost the innovation of their projects with photonics. This project is supported by the EU (GA no. 779472).³
- **Analytical Laboratory**, which is a facility at the Institute of Chemical Sciences, conducting analyses for scientific, research and didactic projects, as well as issuing scientific or analytical expert opinions commissioned by external companies and individuals.
- **ECOTECH-COMPLEX Analytical and Programme Centre for Advanced Environmentally-Friendly Technologies**, which is open to cooperation with businesses, other research institutions as well as distinguished scientists wishing to conduct research with the use of its state-of-the-art scientific and research equipment.

¹ The research team on photonics has been one of the founders of the Lublin Upland of Photonic Technology dedicated to the promotion and further development of photonic and optical fibre technologies.

² <https://www.actphast.eu/en/what-is-actphast>

³ <https://www.actphast.eu/en/what-is-actphast>

The Centre's mission is to create unique conditions facilitating the conduct of scientific research and the provision of high-quality industrial research services by highly qualified, interdisciplinary research teams working in the following key areas: health, ecology, food, and agriculture. The Centre houses the following laboratories:⁴

- Chromatographic Analysis Laboratory and NMR/LC-NMR-MS Laboratory
 - Protein Bioengineering Laboratory
 - Bio-crystallography Laboratory
 - Laboratory of Geohazard Management and Spectral Spatial Analysis
 - Laboratory of Genomics, Transcriptomics and Proteomics
 - Ultra-High Field Magnetic Resonance Lab
 - Optical Polymers Laboratory.
- **Video Game Research Centre**, which conducts research into video and computer games, as well as cyber culture and digital media,
 - **UMCS Centre for Eastern Europe**, which analyses the problems of Eastern Europe in the geographical, political, historical and civilizational context,
 - **UMCS Centre for Climate Change and Environment Research**, (CeReClimEn Centre) established in 2021 as a platform for interdisciplinary, interinstitutional and international cooperation, operating as a consortium that brings together leading scientific institutions from Poland and abroad interested in conducting joint scientific research and undertaking promotional and educational activities in the field of climate and environmental changes (including, inter alia, climate reconstruction, climate change modelling, analysis of social, economic and political effects of climate change),
 - **Centre for Artificial Intelligence and Computer Modelling**, tasked with implementing research and developmental activities as well as commercialization of the results of scientific and research work in the area of AI use.

3 Outstanding Research

Below we list the main achievements of UMCS in research collaboration (projects). These projects involve all research disciplines represented at the University, which testifies to the quality of each individual research institute and the interdisciplinary potential of UMCS as a whole:

- **REINITIALISE** (GA no. 952357, twinning programme): aimed at strengthening and stimulating scientific excellence and the innovation capacity of UMCS in the design and use of digital technologies in the health sector in compliance with the ethical principles.⁵
- **GOLD** (GA no. 101006873): aimed at growing lignocellulosic crops on contaminated sites and producing sustainable biofuels with no risk of indirect land use change, while removing soil pollutants and ultimately reclaiming those lands for agriculture.⁶

⁴ <https://www.umcs.pl/en/ecotech-complex-en.htm>

⁵ Project website: <https://www.reinitialise.eu/>, Project coordinator: Prof. Ilona Biernacka-Ligieza: ilona.biernacka-ligieza@mail.umcs.pl

⁶ Project website: <https://www.gold-h2020.eu/>, UMCS Team Coordinator of: Prof. Małgorzata Wójcik: malgorzata.wojcik@mail.umcs.pl

- **SWATNET** (GA no. 955620, MSCA ITN Programme): aimed at establishing a PhD training network in the field of forecasting solar activity and space weather with cutting-edge and interdisciplinary research techniques.⁷
- **DARIAH-LAB** (Digital Research Infrastructure for the Arts and Humanities): aimed at building an infrastructure with hardware and software tools using state-of-the-art technological solutions and integrated digital resources from various fields of the humanities and arts.⁸
- **ACPHAST**: a unique one-stop-shop solution for supporting photonics innovation, currently 2 ACTPHAST projects are in progress to support innovation with photonics.
- **Xanthophylls in the Retina of the Eye**: aimed at examining the role of retina xanthophylls to obtain crucial information that can be used in the development of therapies for age-related macular degeneration.
- **Molecular Spectroscopy for BioMedical Studies**: aimed at obtaining precise information on molecular mechanisms responsible for formation of supramolecular structures of AmB, which can be responsible for toxic side effects of the antibiotic.

4 From Research to Innovation

For many years, Maria Curie-Skłodowska University has been one of the leading drivers for socio-economic growth of Lublin and the region. This claim is supported by outstanding achievements in R&D projects implementation as well as commercialization of our research results. As an example, the number of orders accepted in the 2021/2022 academic year was 527, an almost 30% increase over the previous academic year's results.

Out of concern for the welfare of bees and the whole society, **WAXO**, a mobile laboratory detecting contamination of natural bee products has been created. The invention received a prestigious award at the International Exhibition of Inventions Prix Eiffel 2022 (the gold medal of the French Federation of Inventors (FFI), the French Association of Inventors – Europe France Inventeurs (EFI) and the Haller Pro Invention Foundation), and a special award of the Toronto-based International Society of Innovators and New Technologies (TISIAS).⁹

At the Institute of Education, NeuroEduLab, an innovative and interdisciplinary brain neuroimaging laboratory has been established under the project “The Use of Near-Infrared Spectroscopy (NIRS) in Neuropedagogy and Neuropsychology for Prevention and Treatment of Selected Lifestyle Diseases and Improvement of the Quality of the Education System”, equipped with a functional near-infrared spectroscopy system (fNIRS).

Researchers from the Institute of Chemical Sciences have worked on smart polymer varnish based on acrylates (photoluminescent paint composition that absorbs visible

⁷ Project website: <https://swatnet.eu/>, UMCS Team Coordinator: Prof. Krzysztof Murawski: krzysztof.murawski@mail.umcs.pl

⁸ Project website: <https://lab.dariah.pl/en/>, UMCS Team Coordinator: Dr Kamil Filipek: kamil.filipek@mail.umcs.pl

⁹ WAXO was invented by UMCS researchers: Prof. Mariusz Gagos, Dr Marek Pietrow and Dr Jan Wawryszczuk. For more information, see: <https://www.umcs.pl/pl/o-waxo,20615.htm>

radiation). The invention was awarded with the Gold Medal at the International Invention and Innovation Fair INTARG 2022.

5 Involvement of Students

Students and PhD students are involved in research activities since the beginning of their academic career. At UMCS there are around 100 scientific clubs (including also the Scientific Club of UMCS Doctoral Schools) for students (with over 4 500 students actively engaged).¹⁰

The UMCS Rector's Council allocates funds for the implementation of scientific, educational, cultural, artistic and sport projects. There are also special funds dedicated for scientific clubs and student/doctoral organizations registered at UMCS. Each year numerous grant proposals are submitted by students (see Figure 1).

Students and doctoral students are provided with special research scholarships awarded for academic achievements in a given academic year (Rector's scholarships). They are awarded based on great academic performance, individual scientific achievements, including the initiation or implementation of a research project related to the field of study conducted at UMCS, number of publications in scientific journals or participation in scientific conferences at which students presented papers, participation in research projects carried out by UMCS (1st year of PhD studies) or implementation of research tasks financed by other entities.

Students also conduct research that is funded externally. Since 2016, students at UMCS have implemented 12 research projects (financed by the Polish Ministry of Education and Science) with a total budget of almost PLN 500,000.

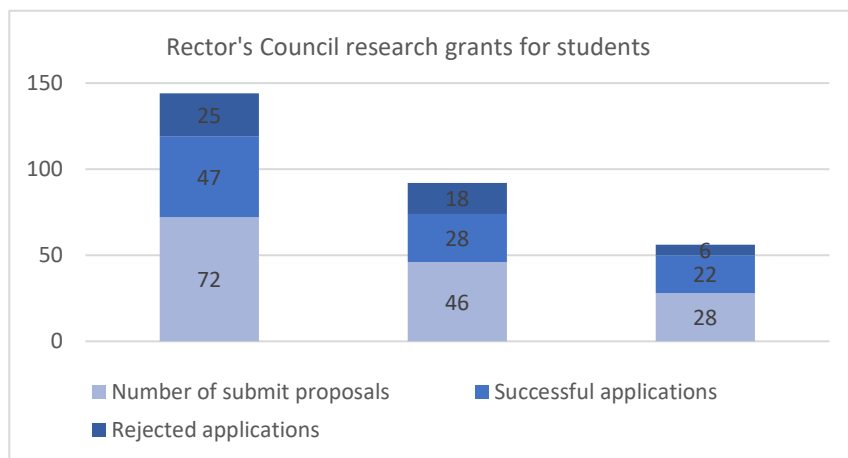


Figure 1. Number of Rector's Council grants for scientific clubs in the period 2019-2023: 2019/2020, 2022, 2023¹¹

¹⁰ Data provided by the Centre for Education and Study Services.

¹¹ Data provided by the Centre for Education and Study Services.

6 The vision of research cooperation within ATHENA

Active in a wide range of disciplines, involving the arts and humanities, social sciences, as well as formal and natural sciences, Maria Curie-Skłodowska University is a unique institution within the ATHENA network. This gives the network an opportunity to apply for inter- and multidisciplinary projects focusing on societal aspects.

The ATHENA research priorities such as Artificial Intelligence, Information & Communication Technologies, Digital Society & Digital Arts, Health & Food Technologies are strongly connected to the expertise of researchers at UMCS and the priority research areas of the University and the Lublin Region.¹² Cooperation with research centres and institutes in terms of joint research projects implementation, infrastructure sharing and R&D activities will be supported by our International Cooperation Centre.

The cooperation in cosmetic science could be another strategic cooperation priority with researchers at UMCS. At the Institute of Chemical Sciences there is a research group very actively cooperating internationally within cosmetology.¹³ The cooperation can involve both education (joint summer schools, BIPs) and research (projects, sharing facilities). Another priority is photonics, particularly in view of the well-developed high-tech infrastructure at UMCS. LOFT UMCS is internationally recognized for its applied research in the field of optical fibres technology and is also uniquely involved in industry innovation projects in Poland and Europe. LOFT UMCS has more than 40 years of experience in implementing technology innovation projects.

References

- [1] Power of Relations folder: <https://www.umcs.pl/en/umcs-folder-power-of-relations,24572.htm>
- [2] International research projects database: <https://projektybadawcze.umcs.pl/en/international/search/?dobrepraktyki=realizowane>
- [3] Ecotech-Complex website: <https://www.umcs.pl/en/ecotech-complex-en.htm>

¹² The Lublin 2030 Strategy envisages the city as:

- “creative, academic and entrepreneurial”,
- “green and sustainable in terms of urban planning”,
- “open, multigenerational and socially engaged”,
- “creative, open and hospitable”
- and “metropolitan”.

For more information, see: <https://lublin.eu/en/lublin-4-all/news/the-lublin-2030-strategy,164,1413,1.html>

¹³ Headed by Prof. Konrad Terpilowski: konrad.terpilowski@mail.umcs.pl