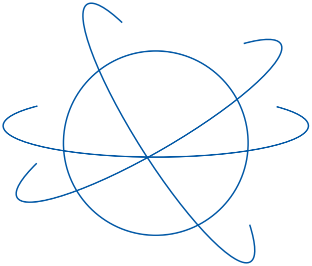
MagTop

Materials for green electronics and quantum information technology

The Centre is implementing a project entitled: "International Centre for Interfacing Magnetism and Superconductivity with Topological Matter". MagTop is conducting interdisciplinary research into materials science, nanotechnology, semiconductor physics, magnetism and superconductivity. This way the scientists want to contribute to the development of new topological materials whose electronic states are resistant to disruptions. Such materials are regarded as the future of, i.a., energy-saving electronics or quantum information technology.



MagTop - International Centre for Interfacing Magnetism and Superconductivity with Topological Matter

Prof. Tomasz Dietl and Prof. Tomasz Wojtowicz

Semiconductors, magnetism, superconductors, topological matter, epitaxy, nanotechnology

Interdisciplinary research in the field of materials science, nanotechnology and semiconductor physics, as well as research into magnetism and superconductivity, which should contribute to the development of new topological materials.

An outstanding feature of the materials we are testing is the fact that new electronic states exist on their edges or surface, with a size several dozen thousand times smaller than the diameter of a human hair, and their properties, for example electrical conductivity, are resistant to deformations. This differentiates them from such nanostructures as graphene which would lose numerous of its properties if, for instance, it was crumpled – **Prof. Tomasz Dietl**.

These new topological materials may find extraordinary applications. There are high expectations related to their use in the production of, e.g., high-performance biological or chemical sensors, devices transforming heat into electric energy, or components allowing the development of spintronics, a new branch of electronics, facilitating a faster and more efficient data recording and processing

– **Prof. Tomasz Dietl**.

Prof. Tomasz Dietl (MagTop, Institute of Physics at the Polish Academy of Sciences (PAN), Advanced Institute for Materials Research, Tohoku University, Japan) – has won recognition for his pioneering research into ferromagnetic semiconductors and the development of methods for magnetic ordering and quantum location of carriers. This paved the way for the creation of a new area of science - semiconductor spintronics. Winner of the Humboldt Research Award, the Agilent Europhysics Prize, and the Foundation for Polish Science Prize for the development of the theory of diluted ferromagnetic semiconductors, and for the demonstration of new methods for controlling magnetization. Director of numerous research projects, including the ERC Advanced Grant. Member of the Polish Academy of Sciences, Polish Academy of Arts and Sciences (PAU), Warsaw Science Society (TNW), and Academia Europaea. Fellow of the Institute of Physics, UK, the American Physical Society, and the Japanese Society of Applied Physics.

Prof. Tomasz Wojtowicz (MagTop, Institute of Physics PAN) – specialising in the growth of nanostructures using the molecular beam epitaxy method (MBE). Together with his colleagues, he demonstrated the action of a new type of a spin transistor whose operation is based on the use of the internal momentum (spin) of electrons, and not their electrical charge as is the case in transistors which are currently in use. Prof. Wojtowicz greatly contributed to the study of diluted magnetic semiconductors and semiconductor nanowires. Winner of the Minister of Science Award (2013) for outstanding research achievements, "for the fundamental contribution into the development of molecular beam epitaxy and research into unique quantum structures with programmable spin properties." He was the leader of the prestigious Maestro Project at the National Science Centre. A Fulbright Alumnus.

The application of topology methods to the study of unusual states and phases of matter were awarded the Nobel Prize in Physics in 2016. Scholars are testing the possibilities of utilising the phenomena, and the ground-breaking papers on the issues, co-authored by MagTop researchers were published in prestigious journals, i.a. in *Physical Review Letters* (2017) and *Nature Physics* (2018).

Timo Hyart from MagTop took part in the interpretation of experiments on the so called “magic-angle” graphene, called the physical breakthrough of 2018. It is obtained by twisting two sheets of the material, made of a single layer of atoms. The electric current can flow through the obtained structure with zero resistance. It has magnetic properties which have not been observed before.

Interesting facts

International partners:
The University of Würzburg; Research Institute of Electrical Communication, Tohoku University, Sendai; Institute of Physics at the Chinese Academy of Sciences, Beijing.

Collaboration with enterprises:
VIGO System S.A. (infra-red detectors), PUREMAT Technologies Sp. z o.o. (ultra-pure elements), MeasLine Sp. z o.o. (measurement systems), KRIOSYSTEMEM Sp. z o.o. (cryogenic devices).

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