For immediate release
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BREAKTHROUGH DISCOVERY IN A SEMICONDUCTOR CHIP
- International team observes the Spin Hall Effect -

An international team announced it has discovered a new physical phenomenon, the Spin Hall Effect, in an ultra-thin conducting layer embedded within a semiconductor chip. The team is formed by physicists Dr. Jörg Wunderlich and Dr. Bernd Kaestner from the Hitachi Cambridge Laboratory, U.K., Prof. Tomás Jungwirth from the Institute of Physics of the Academy of Sciences of the Czech Republic and the University of Nottingham, U.K., and Prof. Jairo Sinova from Texas A&M University, U.S.A.

The observation brings a new member to one of the most recognized families of phenomena in physics and microelectronics - the Hall effects. The older members (Ordinary, Anomalous, and Quantum Hall Effects) have shaped our fundamental understanding of metals and semiconductors, and are utilized in numerous devices for sensing magnetic field, internal magnetization in conductors, or as the electrical resistance standard. The Spin Hall Effect enriches the family by providing unprecedented means for magnetizing semiconductors by electrical voltage. This puts a new twist and expands the horizon of spintronics technologies which few years ago revolutionized the computer memory industry and which so far utilized the naturally magnetized metals.

The spin Hall effect was first predicted in 1971. Here the moving electrons, which carry with them a tiny magnet called the "spin," collide with impurities and these collisions generate opposing magnetizations at the conductor's edges. Despite its intriguing ramifications, the theory disappeared into virtual obscurity until 1999, when it was rediscovered and further elaborated.

Four years later, two independent teams, one including Sinova and Jungwirth, proposed a novel mechanism called the Intrinsic Spin-Hall Effect in which similar magnetization occurs without the need for collisions. The prediction touched off a theoretical firestorm upon the origin of the effect.

As the heated debate raged on, Wunderlich and Kaestner developed a new type of device to measure magnetization at each side of a high-mobility ultra-thin conducting layer embedded within a semiconductor chip using built-in light-emitting diodes.

Armed with this novel tool, Wunderlich and Kaestner teamed with Jungwirth and Sinova to observed the Spin Hall Effect. Their findings will be featured in *Physics Today, February (2005) page 17* along with an independent and parallel observation of the effect in conventional bulk semiconductors. The more than 10 times larger signal detected in the Hitachi's device is attributed to the special layered design of the semiconductor chip that yielded operation in a regime close to the Intrinsic Spin Hall Effect.

For a full description of the work please see:

http://arxiv.org/abs/cond-mat/0410295; to be published in February in *Physical Review Letters vol. 94 (2005)*

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NOTES TO EDITORS:

About Hitachi Cambridge Laboratory
The Hitachi Cambridge Laboratory is a world leader in the development of nanoscale electronic devices, and has a track record of developing new device concepts based on the physics of electron transport in nanostructures. Outstanding achievements are the world-first demonstrations of single electron memory cells and single electron logic circuits. Recently, the Hitachi group has established a new hard disk drive company and is strongly focusing on new innovation technologies for future magnetic storage technologies. In this context, HCL focuses on the technological evaluation of concepts based on new effects and functionalities also in semiconductor spintronics.

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Institute of Physics of the Academy of Sciences of the Czech Republic
Institute of Physics of the Academy of Sciences of the Czech Republic is, with its more than 500 employees, the largest physical research institution in the country. The Institute is located in Prague and hosts a number of joined laboratories with several Czech universities and international research centers such as CERN. Although mostly focused on basic research activities in solid state and condensed matter physics, particle physics, optics, and high power systems, the Institute also runs a number of programs for training underfraduate and graduate students. For more information, please visit http://www.fzu.cz.

About The University of Nottingham
The University of Nottingham is one of Britain's leading universities for both teaching and research, with a total of 26 departments rated as 5* or 5 in the most recent independent Research Assessment Exercise.
The University has more than 30,000 students spread across four main campuses in Nottinghamshire, as well as recently opened overseas campuses in Malaysia and China.
League tables published by national newspapers in 2004 put The University firmly in the top ten of UK universities.

About Texas A&M university
*T*exas A&M University is a land-grant, sea-grant and space-grant institution located in College Station, Texas. The university's enrollment includes approximately 44,000 students studying for degrees in 10 academic colleges. *T*exas A&M University is dedicated to the discovery, development, communication, and application of knowledge in a wide range of academic and professional fields. Its mission of providing the highest quality undergraduate and graduate programs is inseparable from its mission of developing new understandings through research and creativity.

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