

Field: Physics/ Astrophysics

Planning Group Members:

***Frank Goehmann, University of Wuppertal
Sakura Takeda, Nara Institute of Science and Technology***

**Session Topic:
*Spintronics***

Spintronics -- towards the control and utilization of the electronic spin in solids

'Spintronics' is a fashionable term in semiconductor physics. It stands for a whole plethora of diverse attempts to control the spin degree of freedom of the electron and to utilize it for the processing of information. The search for spintronic devices and the investigation of the mechanisms that enable us to manipulate the spins of electrons inside semiconductors are triggered by the fact that the conventional technique, based on the manipulation of only charges and on switching on and off currents, is gradually approaching its physical limits. The performance of computers probably cannot be improved at the same rates as in the past, unless the hardware will be built on new principles. Here the utilization of the spin degree of freedom is a promising candidate. Adding it to conventional electronic devices or using it alone has the potential advantages of nonvolatility, increased integration densities, decreased electric power consumption and increased data processing speed.

Spintronics is a cutting edge topic in semiconductor physics with many physicists busily working on it and with a high economical potential. Its progress might change our world as drastically as the invention of MOS-FET technology. For these reasons the subject was chosen.

The goal of this session is to give an overview over the current activities in the field, reaching from an introduction into the basic physical ideas involved, over the problem of performing spin resolved measurements of electron densities and detecting spin polarized currents up to the problem of building new devices.

Our speakers are distinguished young scientists who significantly contributed to the development of the field. Takaaki Koga is professor for nanoelectronics at Hokkaido University. He investigates the nature of the spin of the elementary charge carriers in semiconductor nano structures experimentally. He will show us newly discovered fundamental spin dependent phenomena which possibly can be used in future spintronic devices. John Schliemann is professor for theoretical physics at the University of Regensburg. He will give us a general introduction into the field and will explain how spin-orbit coupling and band-structure may conspire in producing the so-called intrinsic spin Hall effect which, after a theoretical prediction in 2003, was recently observed and which can be utilized in order to generate spin polarized currents inside a semiconductor without applying an external magnetic field. Markus Morgenstern is professor for experimental physics at the University of Aachen. In 2004 he received the Walter Schottky price of the German Physical Society for his work on scanning tunneling spectroscopy in semiconductors. He also works on spin polarized scanning tunneling spectroscopy and will report us on the recent progress in these fields and the possibility of a combination of both. Yuzo Ohno is professor for nanoelectronics and spintronics at Tohoku University. He demonstrated the possibility of spin injection and spin control in semiconductors which are key elements for developing practical spintronic devices. He will describe the current status and the prospects of spintronics.