IHP – Innovations for High Performance Microelectronics
The IHP performs research and development in the fields of silicon-based systems, highest-frequency integrated circuits, and technologies for wireless and broadband communication. The focus of research at the institute is oriented towards issues relevant for business, resulting in applications for telecommunications, semiconductor and automotive industries, aerospace, telemedicine, and automation technologies. The institute has developed into an internationally recognized competence center for silicon-germanium technologies.

The strength of the IHP is evident in the scientific contributions to leading conferences around the world, by continuous success in attaining third-party funds and the steadily increasing number of international users of the Multi-Project Wafer and Prototyping Services. Along with the IHP staff’s exceptional competence, the cutting-edge modern technological equipment plays an important role in this success.

The IHP provides an important bridge between academia and industry. The Joint Labs with universities and universities of applied science in the Berlin-Brandenburg region have been particularly successful in this cooperation.

Seeing is believing. You are cordially invited to pay us a visit and see the power of the IHP for yourself.

Your

Prof. Wolfgang Mehr
Scientific Director
The Exchange of Information is the Motor of Today’s World

It seems as if the world is spinning at an ever-increasing pace. Distances are shrinking, moments become shorter. While astronauts perform an experiment in space, we can look over their shoulders. When our children are studying in a foreign country, we easily converse with them. Whether we work in the city, live in a little village, cruise the seas, or race from continent to continent in a jet, we do not miss a thing. Information accompanies us. Constantly. Everywhere. Television, computers, Internet, and cell phones are our constant companions. We are an integral part of the world and are continuously aware of what is moving the other parts.

A life without this rapid flow of information is no longer imaginable. We depend on the exchange of information for our daily routines, at work, and in our leisure time – and we are already dreaming of ever less complicated and ever faster connections, not only with distant friends and partners, but also with our immediate surroundings.
We Research and Develop Wireless Communication Technologies

If you want to transmit pictures quickly or download a movie in a flash, you need high-speed data transmission. Wireless and broadband communication allow for this speed. The IHP is researching and developing silicon-based systems, highest-frequency integrated circuits, and special technologies for these purposes.

The IHP’s research is structured vertically. The departments System Design, Circuit Design, Technology, and Materials Research represent their competences at various levels of the added-value chain and work together on projects in the framework of a uniform strategy.

One particular strength of the IHP is the realization of prototypes and small series with the fast SiGe BiCMOS technologies in IHP’s pilot line.

A long-term goal of the institute is to increase operating frequencies into the terahertz range, from the development and integration of innovative components and integrated circuits to the demonstration of systems for their application.
People, Facts and Figures

Semiconductor research has a long history in Frankfurt (Oder). The IHP was founded in the city in 1983. In 1991 it was re-established as a non-university institute in the legal form of a limited liability corporation (GmbH) and included in the so-called “Blaue Liste”, today known as the Leibniz Association.

In 1999 a new institution building was constructed in the Technologiepark Ostbrandenburg. It has more than 6,000 m$^2$ of utilizable space and a 1,000 m$^2$ class 1 clean-room with a full pilot line. A staff of approximately 250 persons from 20 different countries is employed at the institute. Of these, about 110 are scientists, primarily engineers and physicists.

The Scientific Director is Professor Wolfgang Mehr; Manfred Stöcker is the Administrative Director.

The IHP receives annual institutional grants of more than 15 million euros, provided equally by the Federal Republic of Germany and the State of Brandenburg. In addition, the institute obtains funding from national and European research programs and from its cooperations with industrial partners. The extent of this funding has been increasing every year and in 2008 went well over the mark of 11 million euros.

The institute has been able to modernize its infrastructure in the framework of investment projects promoted by the ERDF and, as a result, has been able to continuously adapt its research projects to the highest level.
System Design

Access to large volumes of information is becoming possible at any place, all the time. This requires faster and more reliable wireless transmission systems, which moreover consume less energy. That is why the IHP is working on systems with which data volumes of 10-100 gigabits per second can be transferred wirelessly over short distances. Software or movies can be transferred in seconds to a mobile device. In the long run, this is a matter of researching the limits of the achievable rate of transmission.

Other applications, for instance sensor networks, demand devices with an extremely low energy consumption, whose batteries should not require changing for years. Here we are working on intelligent methods for minimizing energy consumption at all levels, from the software to the hardware and from the system to technology.

To obtain wide acceptance by the users, wireless transmission must be secure and reliable. That is why we are working to constantly improve our already powerful security processors even further.
Circuit Design

Integrated circuits with high frequencies, high bit rates, and low power dissipation are the key to new systems for the IHP. These integrated circuits realize the transmit and receive function by means of data exchange with the environment.

Radio-frequency integrated circuits for high data rates will work with transmission and reception frequencies of 60 GHz to over 100 GHz because only there the bandwidths for high data rates are available. In the long run, the terahertz range is the target.

Simultaneously, radio-frequency integrated circuits with especially low energy consumption for wireless sensor networks are being developed.

Integrated circuits for fiber-optic supported systems for data transmission require ever-increasing transmission rates as a result of the increasing volume of data. Currently, circuit design is developing integrated circuits for fiber-optic systems with transmission rates of over 100 gigabits per second. Because the data must be converted into digital signals, work is also being done on giga-samples-per-second analogue-digital and digital-analogue converters.
More than Moore – with the Focus on Highest Frequencies

Technology

Semiconductor technologies are developing in the direction of a further reduction in the size of components as well as the integration of additional functions. The IHP’s activities are aimed in the second direction, also known as “More than Moore”. The most important additional components are the SiGe-heterobipolar transistors, with which IHP is currently attaining frequencies of up to 300 GHz.

The technology will be further enhanced to integrate additional functions and components with even higher frequencies up to the terahertz range.

The institute has a pilot line with 0.25 µm and 0.13 µm SiGe BiCMOS technologies. This line is used jointly for technological developments, numerous research projects with universities and other research institutions and as a service for industrial partners requiring the highest performance for a low number of units.
Materials Research

New device concepts and technologies increasingly demand the use of new materials in microelectronics. To research and integrate these is the primary function of the IHP’s materials research. The research work is performed in close cooperation with the technology department.

For instance, in recent years intensive work was performed on alternative insulator materials with high dielectric constants.

The focus of attention in the future will be on materials that will be used in components for the terahertz frequency range.
Joint Labs

To take better advantage of the basic research done at universities and colleges, some of the basic research is performed in close cooperation with regional university institutions in “Joint Labs”.

The institute has been operating a Joint Lab with the BTU Cottbus since 2000. Here, new basic concepts for integrated silicon-based light sources are being developed. A second focus is photovoltaics, whereby the IHP’s long years of experience in silicon materials research is being applied to increase the efficiency of solar cells.

There has been a Joint Lab with the TFH Wildau since 2006. The emphasis here has been on research work on photonics and new component concepts as well as joint education. A new Joint Lab with the TU Berlin focused on Silicon Photonics is currently established. Another Joint Lab will be built up in cooperation with the Humboldt University of Berlin.
Cooperations and Services

The IHP is an important and reliable partner for businesses. Cooperations range from the support of regional companies to the use of IHP know how by small and medium-sized companies to joint ventures with major corporations in the framework of bilateral contracts or national or European joint research projects.

The institute is an attractive partner for the education of high school and university students offering lectures and internships as well as support for theses.

The IHP provides services for industry, research facilities, and universities. The institute’s infrastructure and research results are available as well. Along with Multi-Project Wafer (MPW) Service & Prototyping or the manufacture of small serial production in the pilot line with the IHP’s fast SiGe BiCMOS technology, the institute also provides the transfer of technologies and technology modules, the use of processing steps, analysis, and high-frequency measurements.