

Welcome to Baden-Württemberg

CONDUCTING
RESEARCH
IN THE LAND OF
THE FUTURE!



Baden-Württemberg

The German Southwest.

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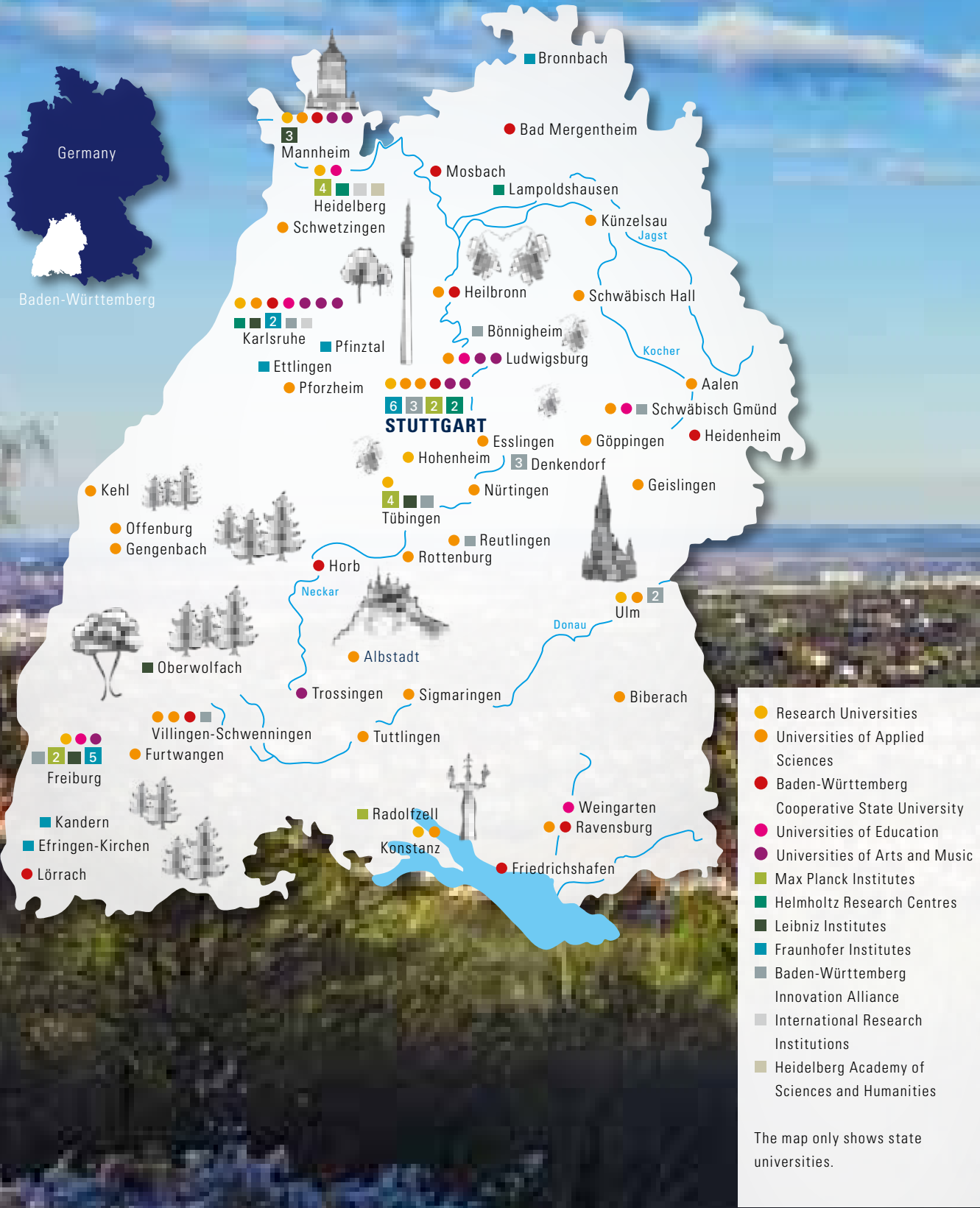
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Few other regions are home to so many research institutions.

42

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An aerial photograph of a city, likely Stuttgart, Germany, showing a dense urban landscape with many buildings and green spaces. The sky is bright blue with scattered white clouds. The text is overlaid on the upper portion of the image.

In Baden-Württemberg, nothing is done by halves. The prosperity, quality of life and readiness for the future that characterises Germany's southwest are all based on its global reputation for outstanding research. The state's universities and many research establishments guarantee the production of top-quality basic and applied research. The close ties between science and business have made Germany's southwest one of the world's most successful regions.



Baden-Württemberg

**THE HOME OF
RESEARCHERS, INNO-
VATORS AND GARAGE
INVENTORS**

Baden-Württemberg

A WEALTH OF NATURE, CULTURE AND PLEASURE





FOR BODY, MIND AND SOUL

35

MINERAL BATHS



NATURE AT ITS PUREST

2.4 %

OF ITS SURFACE AREA IS COVERED BY NATURE RESERVES



OUR BIG LAKE

536 km²

SURFACE AREA OF LAKE CONSTANCE



BW IS EASY TO GET AROUND

40,000 km

OF BIKE ROUTES



BEAUTIFUL VIEWS

1,493 m

THE HIGHEST MOUNTAIN – THE FELDBERG



BORDERLESS HIKING

around 50,000 km

OF HIKING PATHS



THE BEST LOCATION

2nd

LARGEST WINE-GROWING AREA IN GERMANY



HISTORY AT YOUR FINGERTIPS

59

STATELY HOMES, CASTLES, MONASTERIES AND GARDENS



FIRST-CLASS ART

more than 1,300

MUSEUMS

Baden-Württemberg quite simply has everything: a wealth of cultural and leisure opportunities, wonderful nature, diverse landscapes and the idyllic Lake Constance, bordered by three different countries. Baden-Württemberg is a great place to live, with a high standard of living and friendly people who love to share the good life with others.

Living in Baden-Württemberg

RECREATION, FUN AND RELAXATION

52 million
OVERNIGHT STAYS (2016)

*The largest beer festival and
funfair in Baden-Württemberg:
"VOLKSFEST" AT THE
CANNSTATTER WASEN*

*Germany's biggest
theme park:
EUROPAPARK IN RUST*

Baden-Württemberg has something for everyone, whether you are the sporty type, a culture vulture or a lover of nature. Whether you like mountain biking in the Black Forest, sailing on Lake Constance, relaxing in the thermal baths, attending high quality concerts and exhibitions, savouring vegan fast food or Michelin-starred cuisine – Baden-Württemberg has what you are looking for, and much more. In terms of surface area and population, it is Germany's third largest state.

But more traditional customs and festivals are also well-established, such as the annual "Heimattage" festival, the "Fischerstechen" fishermen's jousting tournament in Ulm, and the carnival parades. Or simply relax and enjoy one of the region's many spa and wellness facilities, such as in the beautiful town of Baden-Baden.

Baden-Württemberg is home to a vast range of different landscapes. In the west are the Black Forest and Rhine Valley and in the south are Lake Constance and the foothills of the Alps. Heading east is the Swabian Alb and in the north are the Hohenloher Plateau and Kraichgau.

NATURE AND TRADITION –
the Black Forest

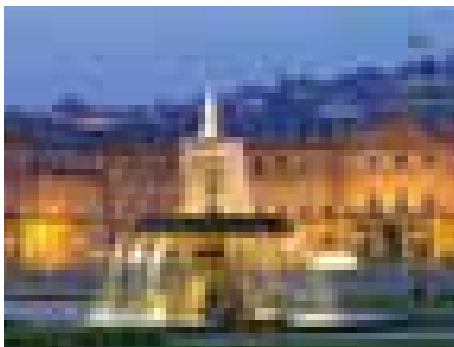


THE PERFECT PLACE TO RELAX –
on the shores of Lake Constance

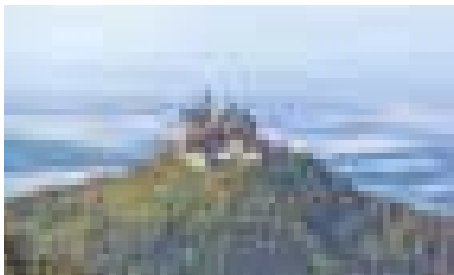


SPA, BEAUTY, WELLNESS –
where better than in Baden-Baden?

WHERE THE WORLD IS AT HOME –
170 different nationalities



ROMANTIC AND IDYLIC –
the Swabian Alb



Baden-Württemberg

RESEARCH IS OUR ECONOMY'S DRIVING FORCE



ONE OF GERMANY'S TOP BUSINESS REGIONS

2.2 %

ECONOMIC GROWTH (2016)

INVESTMENT IN THE FUTURE

€22.7 billion

FOR RESEARCH AND DEVELOPMENT
(2015)

FOCUS ON HEALTH

818

MEDICAL TECHNOLOGY COMPANIES

EXCELLENT GLOBAL POSITIONING

over 400

GLOBAL MARKET LEADERS

ENERGY TRANSITION

80 %

OF ENERGY FROM RENEWABLES
BY 2050

TRANSPORT PIONEERS

1886

INVENTION OF THE AUTOMOBILE

FIT AND HEALTHY

84 (women) & 79 (men)

LIFE EXPECTANCY

TOP INDUSTRIAL LOCATION

40 %

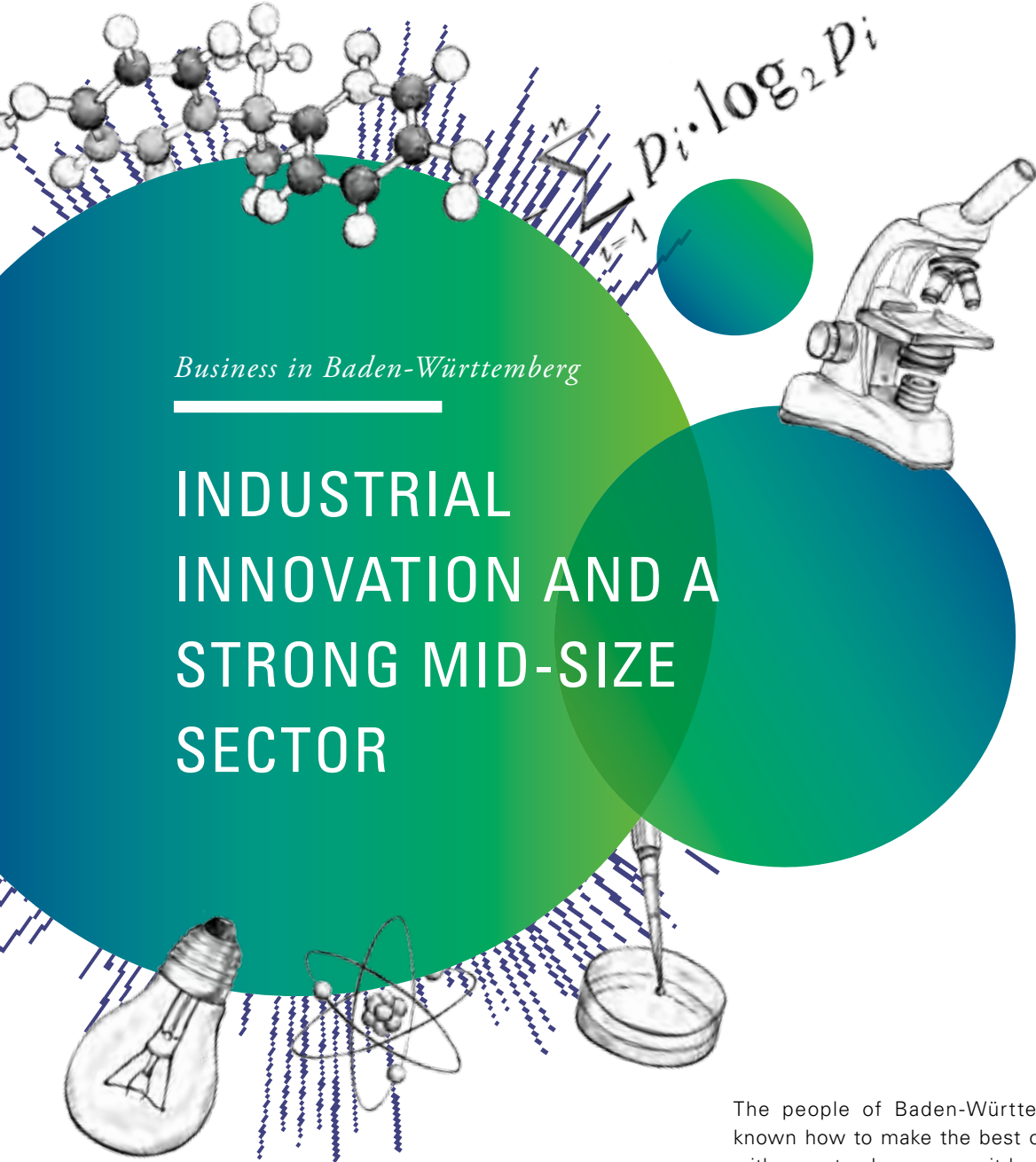
OF EARNINGS FROM MANUFACTURING

A HEALTHY ECONOMY

3.8 %

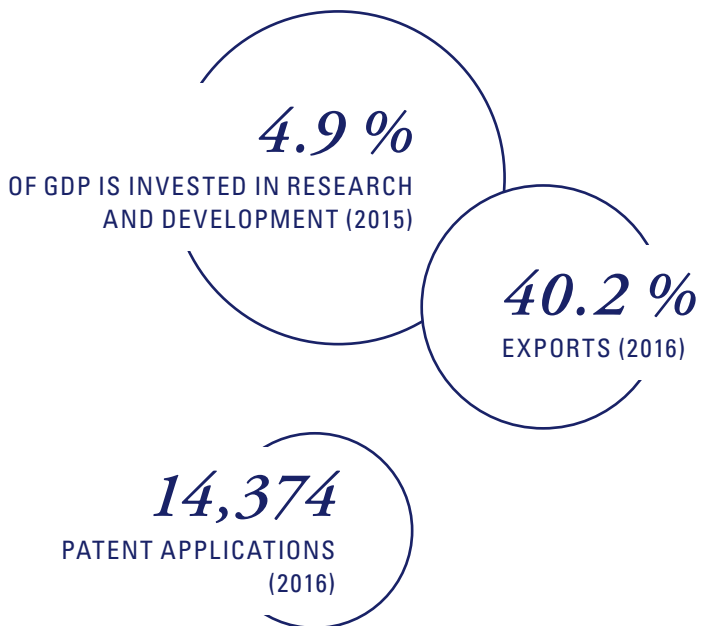
UNEMPLOYMENT RATE (2016)

This is where ideas are forged – and where the work is done to turn them into reality. Baden-Württemberg is one of the leading economic regions in Germany and Europe. It is home to major corporate groups such as Daimler, Porsche, Bosch, Festo and SAP, along with thousands of successful small and medium-sized enterprises (SMEs). It is a region of innovation, inventiveness, high productivity and low unemployment. The perfect place to start your career!



Business in Baden-Württemberg

INDUSTRIAL INNOVATION AND A STRONG MID-SIZE SECTOR



The people of Baden-Württemberg have always known how to make the best of things. As a region with no natural resources, it has always needed people with bright ideas. That is why innovation has become a tradition in Baden-Württemberg and how it has turned into Germany's largest exporter. Germany's southwest is Europe's most innovative region. No other region in the EU is comparable in terms of developing new products and processes. 4.9% of its GDP is invested in research and development (2015), making Baden-Württemberg the clear leader among all 78 regions in the EU. Nowhere else in Germany, the number of per capita patent applications is so high (132 patent submissions a year for a population of 100,000). Inventions from Baden-Württemberg have changed the world: the automobile – invented in 1886 – but also many everyday items such as lever-arch files, matches, photocopiers, rawl plugs, electric drills and even ski lifts.

Businesses in Baden-Württemberg provide funding for more than 100 endowed professorships at the state's universities. Many companies carry out their own first-rate research.

Until today, the birthplace of the automobile is dominated by the automotive industry. Vehicle manufacturers and their suppliers account for 30 % of industrial turnover, followed by engineering firms (20 %), the metals and electrical sectors (7 % each) as well as the chemical, pharmaceutical and optical industries, which all play an important part in Baden-Württemberg's economy.

INVENTORS AND TINKERERS –
Carl Benz, Robert Bosch, Artur Fischer to name but a few



AUTOMOTIVE GIANTS –
Daimler, Porsche & Audi




GLOBAL MARKET LEADERS –
Stihl, Trumpf, Kärcher & Co.



Baden-Württemberg

EXCELLENCE IN RESEARCH





NETWORKED

118


CLUSTER INITIATIVES AND NETWORKS



DISTINGUISHED NATIONWIDE

3

UNIVERSITIES OF EXCELLENCE



LEADING POSITION

26 out of 210

FUNDED GRADUATE SCHOOLS IN
BADEN-WÜRTTMBERG



DIVERSITY, BREADTH AND DEPTH

over 100

RESEARCH INSTITUTIONS



INDEPENDENT

65


JUNIOR PROFESSORSHIPS WITH
TENURE TRACK (2017)



THE NUMBER ONE

1st place

THE EU'S TOP REGION FOR INNOVATION
(2016)



INVESTMENT IN THE FUTURE

€5 billion

ALLOCATED TO SCIENCE, RESEARCH AND
THE ARTS IN THE STATE'S 2017 BUDGET



HIGH ENDOWMENTS

€200,000

BI-ANNUAL STATE RESEARCH PRIZE



GENEROUSLY FUNDED

up to €150,000

PER JUNIOR PROFESSORSHIP
(COMPETITIVE PROCESS)

Success does not come by chance: No other region in Germany offers such a wide range of educational establishments, non-university research institutions, universities and transfer centres, many of which are world leaders. In this way, Baden-Württemberg is one of Germany's top research locations and has a clear advantage over its global competitors.



Research in Baden-Württemberg

EXCELLENT PROSPECTS FOR RESEARCH

With its many excellent research institutions, Baden-Württemberg stands out from its global competitors. The state's research universities, universities of applied sciences and more than 50 institutes belonging to the Helmholtz Association, the Fraunhofer Society, the Baden-Württemberg Innovation Alliance and the Max Planck Society all make major contributions to basic and applied research. The state supports these establishments and institutions of higher education and contributes to their growth through investing in buildings and equipment. The Helmholtz Association, Fraunhofer Society and DLR also receive funding from the federal government. The institutes that carry out research closely linked to business needs contribute in particular to the development of new technologies and technology transfer. They build bridges between basic research and technical advances

in companies, open up new areas of technology for business and help firms to bring products and processes to market. Along with the transfer centres run by the Steinbeis Foundation for Economic Development and the Chamber of Commerce innovation consultants, they lie at the heart of technology transfer in Baden-Württemberg.

The state helps brilliant minds to pursue new ideas in order to ensure the region continues to innovate and grow. Outstanding academic work across all disciplines is recognised by the research prize awarded by the Ministry of Science, Research and the Arts. The prize money is the highest offered by any state in Germany. A total of 100,000 euros is awarded to one researcher in the area of basic research and one researcher in applied research.

Careers

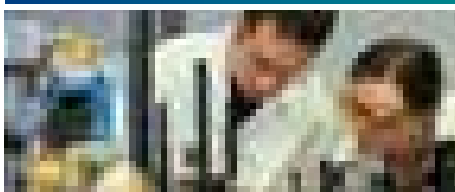
TO FIND OUT MORE ABOUT CURRENT VACANCIES AND RESEARCH PROJECTS, VISIT: WWW.BW-CAREER.DE/EN/HOME



The careers platform for academics and researchers www.bw-career.de/en/home offers a fast-track to success in Baden- Württemberg – with the latest vacancies at universities, research institutions and other interesting employers for those seeking academic careers.

EXCELLENT PERFORMANCE

University research



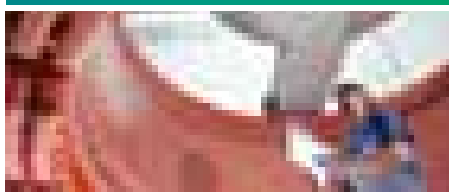
The nine traditional research universities out of the 70 institutions of higher education in Baden-Württemberg provide the cornerstone of university research. Here, research is carried out in almost every field:

- Engineering
- Humanities, social sciences
- Life sciences, natural sciences

The state's research universities regularly come out on top of rankings of research establishments. Within the framework of the federal and state governments' Excellence Initiative, 3 of Germany's 11 top research universities are based in Baden-Württemberg.

NATIONAL IMPORTANCE

Non-university research

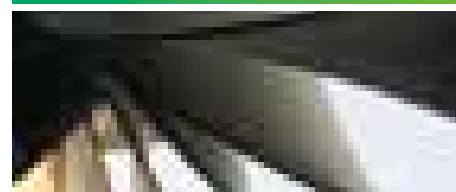


Few other regions in Europe are home to as many research institutions as Baden-Württemberg. They include:

- 3 centres belonging to the Helmholtz Association of German Research Centres (KIT, DKFZ, DLR with 2 locations and 6 institutes)
- 17 institutes and subinstitutes of the Fraunhofer Society
- 13 institutes of the Baden-Württemberg Innovation Alliance
- 12 institutes of the Max Planck Society
- 7 institutes of the Leibniz Association
- 9 German Health Research Centres
- European Molecular Biology Laboratory
- Heidelberg Academy of Sciences and Humanities

BUILDING SYNERGIES THROUGH NETWORKS

Research infrastructure



Baden-Württemberg stands out for its diverse range of partnerships among research universities, research institutions and companies.

- The state encourages work on important topics for the future, new technologies and clusters.
- Networks, research associations and clusters go far beyond the value chain. Each partnership of research stimulates interdisciplinary knowledge transfers.
- Exciting new research and development results are brought to market thanks to a large network for technology transfer and patent exploitation.



Research in Baden-Württemberg

STRATEGIC RESEARCH TOPICS

DFG & BWS

(DEUTSCHE FORSCHUNGSGEMEINSCHAFT
AND BADEN-WÜRTTEMBERG STIFTUNG)
WWW.DFG.DE AND
WWW.BWSTIFTUNG.DE/FORSCHUNG

*Baden-Württemberg
Ministry of Science,
Research and the Arts*

RESEARCH IN THE REGION FOCUSES ON AREAS
WITH CONSIDERABLE GROWTH POTENTIAL
FOR THE FUTURE. TO THIS END, IT HAS SPECIFIED
KEY AREAS OF RESEARCH.
WWW.MWK.BADEN-WUERTEMBERG.DE

Research in the research and business hub of Baden-Württemberg is focused on areas that provide the biggest growth potential for the future. These include green mobility, environmental technology, renewable energy and resource efficiency, health, information and communication technology and green IT. In some areas, Baden-Württemberg has set up state agencies to facilitate the transfer of knowledge and technology between researchers and businesses. They include BIOPRO BW, e-mobil BW, Leichtbau BW, Medien- und Filmgesellschaft BW and Umwelttechnik BW.

The state also supports a number of areas that are important for research. For example, its high-performance computing strategy includes all levels of high-performance computing in Baden-Württemberg and is coordinated with national and European strategies. The universities and non-university research institutions receive funding in the area of e-science. The aim is to build and develop an e-science infrastructure that is fit for the future.

Bioeconomy



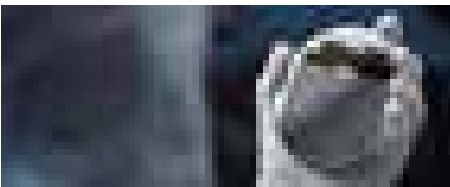
Main areas of research include: energy generation through biomethanol from waste water, microalgae for human diets, new chemical substances, and a skills network for sustainable, efficient biosynthesis.

Electromobility and lightweight vehicle engineering



In order to make electromobility more affordable and available for everyday use, research projects are looking at improving performance and range, reducing charging times, and achieving improved energy and cost efficiency in electric vehicles.

Energy



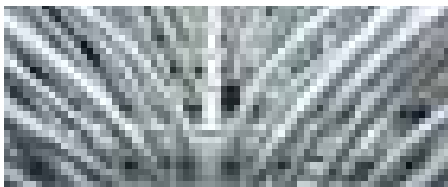
New storage technologies, regional self-supply of renewable energies, their integration in electricity generation and the cost-effective restructuring of the German energy system are some of the key areas of research.

Humanities and social sciences



The research focus lies on social policy issues, such as the inter-generational integration of migrants, international jurisdiction, the analysis of political communication and networked working environments.

Industry 4.0



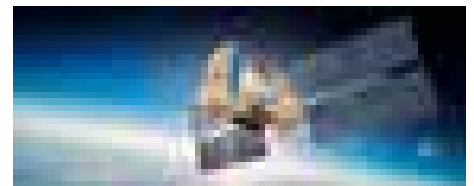
These research projects are looking at optimising machine communication, innovative control systems, a central IT platform and the largest research factory in Europe as a model for 4.0 production.

Lightweight engineering



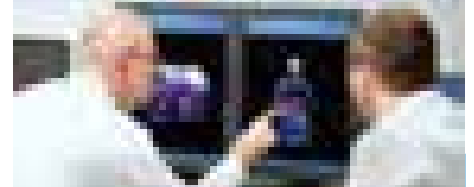
Reducing weight saves energy and money. In the field of lightweight and ultra lightweight engineering, researchers work on developing new materials that can be used in mechanical engineering, energy and automotive technology to save precious resources.

Aerospace engineering



The German Aerospace Center and other institutions are studying topics such as emission-free flying, alternative fuels, highly resistant fibres and reducing risk in air and space travel.

Medicine and medical technology



In Baden-Württemberg research is being carried out into the fastest nanoscope in the world, the very latest imaging methods, bio-electronic micro implants for the treatment of diabetes, and personalised medicine.

Research topic

BIOECONOMY

Over the last few years, the bioeconomy has heralded a social and economic paradigm shift. Renewable resources and new technologies are replacing fossil fuels to make the economy more sustainable and environmentally friendly. The Bioeconomy Baden-Württemberg research programme was set up to improve the strategic positioning of research institutions and accelerate the transfer of research findings into the economy.

BIO-METHANOL FROM WASTE WATER

At present, cleaning waste water requires significant amounts of electricity to remove organic pollutants from the water, which in themselves contain energy. As part of the ERWAS programme run by the German Ministry of Education and Research (BMBF), this is being tackled by the interdisciplinary Biomethanol joint research project. The energy contained in waste water should be exploited in order to increase the efficiency of waste water treatment. In addition, carbon dioxide (CO₂) and hydrogen (H₂) are to be extracted in a microbial electrolysis cell from the organic matter in the waste water and turned into methanol in a downstream catalysis process. Methanol is a fuel that is easy to store and transport, and it can also be used as a basis for further chemical synthesis.

UNIVERSITY OF FREIBURG

For more information visit: www.biomethanol.uni-freiburg.de

MICRO ALGAE FOR NUTRITION

Micro algae are an important source of protein for human and animal nutrition, but in the past they have been little used. They contain valuable ingredients that are useful for a wide range of products. As agricultural land around the globe shrinks, micro algae are particularly interesting as a source of raw materials for the bioeconomy because they can be cultivated in huge quantities. Hybrid products are of particular interest, in which animal proteins are partly replaced by substances derived from algae. Any residues of further industrial processing can then be used in animal feed. The aim of the research association is to select suitable micro algae, along with their cultivation, harvesting and processing. It also seeks to develop process chains for the manufacturing of quality products. The research association is part of the Bioeconomy Baden-Württemberg research programme, which has been funding around 50 research projects since 2014 in the areas of lignocellulose, biogas, micro algae and bioeconomy modelling. The focus has also been on sustainability as well as ethical evaluation and acceptance on the part of the consumer.

UNIVERSITY OF HOHENHEIM

For more information visit:

www.bioeconomy-research-bw.de/mikroalgen

NEW CHEMICALS FROM ALGAE

The demands made on chemicals and materials used in daily life are constantly increasing. They not only have to have improved features, but also be produced from renewable raw materials. This is where micro algae come in because they do not require fresh water or agricultural land, and their biomass can double in 24 hours. Their unique lipid composition makes them attractive for use in chemicals. This objective has been achieved by the University of Konstanz. A research group in the biology department has been growing partly genetically modified algae and extracting the oil. The existing chemical structures of the algae lipids are then catalysed into higher-order chemicals. The team has already managed to produce thermoplastic polyester from algae oil. The University of Konstanz is also studying a refining process for esters that are difficult to access.

UNIVERSITY OF KONSTANZ

For more information visit: www.forschung.uni-konstanz.de

SUSTAINABLE AND EFFECTIVE BIOSYNTHESSES

For the bioeconomy, it is essential for biotechnologists, chemists and engineers to work together on research. Ten working groups at the Universities of Stuttgart, Ulm and Tübingen and the Karlsruhe Institute of Technology have recognised this fact and formed a research cluster called "Sustainable and efficient biosyntheses", with a view to developing sustainable products and materials through the use of more efficient biosyntheses. Within this network, efficient biosynthesis technologies and processes for the production of terpenes such as L-menthol, new materials based on functional peptides and chemical primary products such as propene were developed on the basis of synthesis gas. The successful work of the research cluster has now been expanded to involve international collaboration in EU projects such as "EmPowerPutida" and "BIOOX".

UNIVERSITY OF STUTTGART

For more information visit: www.uni-stuttgart.de/chemie and www.bwbiosyn.de

Research topic

ELECTROMOBILITY AND LIGHTWEIGHT VEHICLE ENGINEERING

Electromobility is a key driver of the future in the automotive industry and an important component of sustainable mobility. Along with new vehicle designs, work is focused on developing new solutions in the areas of production, information and communication technology and energy use. Specifically in the birthplace of the automobile, these topics are of particular significance.

E-VOLUTION – EN ROUTE TO PERFORMANCE ELECTRIC VEHICLES

Customers have high expectations when it comes to performance, range, charging times and the practicality of electric vehicles. The focus of the e-evolution project is to bring together cutting-edge technology from all areas of e-vehicle research. As part of the Cluster Electric Mobility South-West, the BMBF-funded project integrates findings from a number of cluster projects in a demonstrator. A key element is raising the voltage level in order to achieve benefits in terms of performance, dimensions and weight. The project is also looking into three independent charging systems: inductive charging, direct voltage charging and charging via current inverters. The latter does not require a charging device, which leads to further weight and cost savings. The higher voltage level offered by direct voltage charging in particular has the potential to reduce charging times.

CLUSTER ELECTRIC MOBILITY SOUTH-WEST

For more information visit: www.emobil-sw.de

LIGHTWEIGHT BODYWORK FOR ELECTROMOBILITY

The BMBF SMiLE project (multi material lightweight engineering for electromobility) is developing new kinds of lightweight, multi-material bodywork for the special requirements of the electromobility sector. The focus of this project is the use of new materials and material combinations to reduce the weight of functional vehicle components to develop new design concepts for electric vehicles in composite construction. The aim is to develop innovative, functional bodywork using thermoplastic and Duromer fibre composites and non-ferrous metals. The mix of materials should be usable by a wide range of commercial processes and enable the integration of new methods of energy storage. SMiLE aims to provide a foundation for basic innovation that is suitable for many applications through the involvement of major names in the automotive and supplier sectors, along with universities and research institutions.

FRAUNHOFER INSTITUTE FOR CHEMICAL TECHNOLOGY (ICT)

For more information visit: www.ict.fraunhofer.de

EFFICIENT LITHIUM-ION BATTERIES

In electromobility, the battery cells used determine the vehicle's cost, life and range. So the aim of current research at the ZSW is to ensure that electric cars are safe, affordable and have an attractive range. Marketable lithium-ion cells are being developed using innovative materials for cathodes, anodes and electrolyte systems and optimised production processes. This is the research focus at the ZSW. Recently, a research group in Ulm managed to develop a new cathode material for high-power lithium-ion batteries with outstanding characteristics. The lithium-nickel-manganese oxide achieves up to 40 % higher density than previous materials and is also cheaper. It no longer uses expensive, rare cobalt and uses less nickel. It is also simple to produce. The development of a cheap and safe high-power battery that allows electric cars to drive for longer increases their range. Manganese oxide is easy to produce using current technology. The ZSW has already produced first high-quality samples in kilogram lots.

CENTRE FOR SOLAR ENERGY AND HYDROGEN RESEARCH BADEN-WÜRTTEMBERG (ZSW)

For more information visit: www.zsw-bw.de

NEW PRODUCTION CONCEPTS FOR ELECTRIC VEHICLES

The cost of vehicles is critical to the market success of e-mobility, and it is important to continue reducing manufacturing costs and improve their energy efficiency when in operation. The aim of the BMBF-funded project EFFECT 360° as part of the production innovation area in the Cluster Electric Mobility South-West is to increase the cost efficiency of electric vehicles through innovations in three areas: improved production processes, new drive technologies and energy-efficient operating strategies. The partners are studying methods for planning more efficient assembly lines on which electric, hybrid and conventional vehicles can be manufactured in a flexible, scalable and economic way. The project also includes work on an electric motor with a gear box that is optimised with regard to flexible production and energy-efficient operation.

CLUSTER ELECTRIC MOBILITY SOUTH-WEST

For more information visit: www.emobil-sw.de

Research topic

ENERGY

In Baden-Württemberg, energy research is approached in an interdisciplinary way touching on a number of different scientific disciplines, including natural sciences, engineering and environmental science. One of the most important research topics for the region is the development of renewable energy.

STORING ENERGY WITH POWER-TO-GAS TECHNOLOGY

The supply of solar and wind power into the electricity grid is subject to strong fluctuations. So a major challenge remains to be overcome before we can move to all energy being supplied from renewable resources: how to store electricity from renewable resources in order to meet the demands of industry and private households and not waste excess energy that is generated. "Power-to-gas" (P2G[®]) promises to provide a solution to this problem. The ZSW is developing technologies that convert excess green electricity into hydrogen and methane. Hydrogen and methane can be stored for months in large quantities in the natural gas grid without loss. This means that P2G[®] can use an existing infrastructure. Both gases can, if necessary, be converted back into electricity or used directly in fuel cells and natural gas vehicles. In this way, P2G[®] may make a key contribution to the energy transition in the transport sector and also to stabilising electricity supplies.

**CENTRE FOR SOLAR ENERGY AND HYDROGEN RESEARCH
BADEN-WÜRTTEMBERG (ZSW)**

For more information visit: www.zsw-bw.de

EE REGIONS: SOCIAL ECOLOGY OF SELF-SUFFICIENCY

Many districts and regions in Germany and other countries have set themselves the goal of becoming self-sufficient in renewable energies. The main focus of the BMBF-funded renewable energy "EE Regions" project was to work on areas of conflict concerning local self-sufficiency in renewable energy and to find solutions and conditions for success. Working with four municipalities and districts in Germany, including Schwäbisch Hall and Wolpertshausen in Baden-Württemberg, the focus was on how self-sufficiency in renewable energy could be achieved in a social and environmentally friendly way. By collaborating with stakeholders from the communities in an interdisciplinary way, it was possible to define the challenges and develop potential solutions. The project team also developed a roadmap to help other districts to organise their energy supplies in a fair and environmentally friendly way. Further case studies were used to check the results of the pilot districts and municipalities to see whether they could be transferred to other regions and potentially to other countries.

**CENTRE FOR RENEWABLE ENERGIES (ZEE) (ALBERT
LUDWIGS UNIVERSITY FREIBURG), DEPARTMENT OF
LANDSCAPE ECOLOGY AND VEGETATION SCIENCE
(UNIVERSITY OF HOHENHEIM)**

For more information visit: www.ee-regionen.de

OPTIMISING ENERGY SYSTEMS

How do we achieve cost-effectiveness and security of supply while still meeting ambitious climate protection goals when producing energy? In order to find answers to this question for a national energy system, it is necessary to carry out a study that includes all kinds of fuels, including renewable energies, and all sectors-electricity, thermal energy, transport. The Fraunhofer Institute for Solar Energy Systems (ISE) in Freiburg has developed a powerful calculation model that allows every element of the overhaul of national energy systems to be physically modelled and optimised. It calculates to the hour the secure supply of all consumers at all times. A recent study presents ways of optimising the costs involved in overhauling the German energy system that achieves the policy aims of reducing energy-related CO₂ emissions by at least 80 % by 2050.

FRAUNHOFER INSTITUTE FOR SOLAR ENERGY SYSTEMS (ISE)

For more information visit: www.ise.fraunhofer.de

ENERGY TRANSITION PLATFORM 2.0

The Energy Lab 2.0 is accelerating the energy transition, particularly by integrating renewable energies into electricity generation. It allows new approaches to stabilising the energy grid to be tested in close-to-real-life conditions. A network of facilities combines electric, thermal and chemical energy flows with new information and communication technology. The Energy Lab 2.0 project is at the heart of the energy research strategy of the Helmholtz Association. By 2018, it will create a simulation and control centre and a network of facilities for energy and technology at the Karlsruhe Institute of Technology (KIT), an electrolysis test centre at the Jülich Research Centre and a testing facility for power-to-heat concepts at the German Aerospace Centre in Stuttgart. This combined infrastructure is the first of its kind in Europe.

KARLSRUHE INSTITUTE OF TECHNOLOGY (KIT)

For more information visit: www.kit.edu

Research topic

HUMANITIES AND SOCIAL SCIENCES

Humanities and social sciences provide knowledge about cultural, economic and social developments in societies. They set basic principles for decisions on current issues and work to find solutions to future challenges. Whether theology, philosophy, political science, economics or sociology – every science is researching for the society of tomorrow. In Baden-Württemberg experts are working on social and political issues.

INTER-GENERATIONAL INTEGRATION OF MIGRANTS

Europe is seeing growing numbers of migrants and their families. How to integrate them into increasingly heterogeneous societies is a social challenge on the political agenda. Numerous indicators show that many European countries are facing difficulties with the integration of migrants and their families because of structural problems, social segmentation and cultural differences. But some countries can also tell success stories. The causes and mechanisms behind these varying results for different groups and countries and the differences in processes of intergenerational integration and their complex interplay is the subject of the “Children of Immigrants Longitudinal Survey”, conducted by the Department of General Sociology at the University of Mannheim. The project looks at the integration of second-generation migrants in Germany, the Netherlands, Sweden and the UK. It is the first fully standardized longitudinal survey on this subject to be carried out in Europe and it is funded by the NORFACE programme.

UNIVERSITY OF MANNHEIM

For more information visit: www.cils4.eu

INTERNATIONAL JURISDICTION AND DEMOCRACY

The establishment of international courts is one of the most striking developments of recent decades. It is linked to a qualitative change: international courts not only handle individual disputes but also work for judicial progress. So they need a democratic mandate. The project titled “In whose name? A public law theory of international jurisdiction in light of the democratic principle” develops an understanding of judicial decisions as an expression of official authority and examines the problems of their justification, because these actions are not based on a fully functioning legislative system and so law is uncoupled from politics. It also outlines strategies for actions and shows that the normal focus of the development of international jurisdiction is the people who bear it and the idea of the world citizen.

**MAX PLANCK INSTITUTE FOR COMPARATIVE
PUBLIC LAW AND INTERNATIONAL LAW**

For more information visit: www.mpil.de

A CONNECTED WORKING ENVIRONMENT

The increasing networking and digitalisation of the working environment means that work no longer has to take place in the workplace. The ubiquity of digital technologies has led to the phenomenon of ubiquitous working (UW). In April 2014, the ZEW launched a project funded by the Leibniz Association titled “Ubiquitous working: the challenges and opportunities of the networked working environment”. An interdisciplinary research network is making a theoretical and empirical study of the challenges and opportunities of UW during this three-year project. It will create and use a unique database at employer and employee level to examine the different aspects of UW from the perspective of the disciplines involved – economics, media psychology, occupational psychology, occupational medicine and sociology.

CENTRE FOR EUROPEAN ECONOMIC RESEARCH (ZEW)

For more information visit: www.zew.de/ubiwork2014

VISARGUE – ANALYSING POLITICAL COMMUNICATION

The BMBF-funded VisArgue project is developing automated procedures for analysing political communication in order to draw conclusions about the extent and effects of arguments in negotiations. This is particularly relevant with regard to new ways of dealing with conflicts between governments and citizens, as in recent years practised through consensus-oriented, deliberative and participative processes such as mediation and citizens’ forums. An interdisciplinary team of linguists, IT experts and political scientists is using an innovative combination of methods to automatically create general models of negotiations and make them immediately recognisable by means of a visual system.

UNIVERSITY OF KONSTANZ

For more information visit: www.visargue.uni-konstanz.de

Research topic

INDUSTRY 4.0

Industry 4.0 stands for the fourth industrial revolution – the linking of production with the very latest information and communication technologies. This means that the future of manufacturing is digital, highly automated and even more flexible and efficient. The smart, totally networked factory is one of the most important industrial developments of our time. Baden-Württemberg is supporting research projects to drive it forward.

RESEARCH FACTORY OF THE FUTURE

This area of research is working on fundamental changes to the principle of industrial manufacturing, including the replacement of the former assembly line principle with flexible, sustainable production as part of Industry 4.0. In future a smart, fully networked factory should be able to operate in a more sustainable and economic way. An extremely flexible production process can be individually adapted to meet the needs of volatile markets, demographic change and increasing numbers of variants. The assembly line of the future is automated and so flexible that new designs can immediately enter into production. The ARENA2036 project is developing a flexible type of production with logistics modules that goes beyond traditional assembly lines. Europe's largest research factory is combining humans and robots to create a model for Production 4.0.

The ARENA2036 research campus in Stuttgart represents a new form of collaboration in which different partners from the worlds of science and business come together under one roof to work on the future of production and lightweight engineering.

UNIVERSITY OF STUTTGART

For more information visit: www.arena2036.de

THE ENGINEERING PROGRAMME OF THE FUTURE

The Laboratory for Production and Information Management at the Baden-Württemberg Cooperative State University in Mosbach is a state-of-the-art model factory with real and virtual components and systems for simulating operational processes in production, logistics and customer service. The interplay between the engineering disciplines of electrical engineering, computer science and industrial engineering is taught in a cross-disciplinary way. The laboratory is also used to carry out joint research with corporate partners. For example, student projects have included expanding a mechatronics training system with an Android app for Bosch Rexroth, which offers the ability to control the plant and augmented reality features. Other sensors allow components to be identified using NFC tags, along with determining their position on the conveyor belt.

BADEN-WÜRTTEMBERG COOPERATIVE STATE UNIVERSITY, MOSBACH

For more information visit: www.mosbach.dbbw.de

VIRTUAL FORT KNOX – MARKET-PLACE FOR INDUSTRIAL APPS

Since 2012 the Fraunhofer IPA has been working on a secure IT platform for manufacturing firms, "Virtual Fort Knox" (VFK). This makes it possible to access production data via a range of apps for any end device. Unlike conventional applications where the IT infrastructure is local to the user, here machines communicate via an adapter with a service based on Cloud architecture. The user can access the information via any end device. This reduces the cost of setting up and maintaining an appropriate IT environment. It reduces start-up costs, so the initial barrier to using online tools is removed. In this way, VFK is contributing to the implementation of new Industry 4.0 concepts, linking digital approaches in production and developing new business models.

FRAUNHOFER INSTITUTE FOR MANUFACTURING ENGINEERING AND AUTOMATION (IPA)

For more information visit: www.virtualfortknox.de

PLUG AND WORK FOR INDUSTRY 4.0

In Industry 4.0, smart plant components, machines and IT systems are networked so that every part of the factory is kept informed about the necessary machinery and its capabilities. Current production software has to be manually adjusted or reprogrammed every time something changes. Software adjustments are needed

- because software is integrated into field devices that are connected via field buses such as sensors, actuators, drives and valves
- to the software that controls the machinery and plant, e.g., stored program controls (SPCs),
- to the information technology that is superimposed on the direct plant control systems. The objective of the IOSB's work is to expand the plug and work capability of software components linked to production and implement a universal interface based on open standards that are currently being used in industry.

FRAUNHOFER INSTITUTE OF OPTRONICS, SYSTEM TECHNOLOGIES AND IMAGE EXPLOITATION (IOSB)

For more information visit: www.plugandwork.fraunhofer.de

Research topic

LIGHTWEIGHT ENGINEERING

Saving weight, materials and energy is one of the key objectives of tomorrow's industries. New lightweight materials and production and design processes mean that costs can be reduced and added value generated. Baden-Württemberg is home to many skilled engineers in the area of production engineering, simulation and materials technology.

BUILDING A SMART SHELL TO SAVE RESOURCES

Solar radiation provides the potential for generating 10,000 times more energy than people actually need. But our material resources are limited. So one of the aims of ultra lightweight engineering is to push the limits of lightweight construction and replace materials with energy. A joint project between the Institute of System Dynamics (ISYS) and Bosch Rexroth AG at ILEK has resulted in the Stuttgart SmartShell, which covers an area of 10x10 metres with a shell that is just 40 mm thick. The SmartShell is based on an adaptive support structure. Three of the four support points can move around in all three directions thanks to hydraulic motors. This makes it possible to counter changing conditions – such as snow and wind – through deliberate movements reducing stress points in the shell which means that its stress state remains fairly uniform.

INSTITUTE OF LIGHTWEIGHT ENGINEERING (ILEK) AT THE UNIVERSITY OF STUTT GART

For more information visit: www.smartshell-stuttgart.de

NEW MATRIX SYSTEMS

The German Institute of Textile Research in Denkendorf, Esslingen University and nine partners from industry are working on the “FAST Matrix” project, which is developing a new process for producing fibre-strengthened composites with a thermoplastic matrix. The idea is to use new catalyst materials in a range of manufacturing processes in order to develop a lightweight material that can be recycled. The materials consist of fibres and the surrounding matrix material. Thermoplastic synthetic polyamides are used as the matrix in order to improve the manufacturing process. The material has low viscosity, can quickly and reliably moisten fibre surfaces and fill complex shapes of moulded components. The matrix only begins to harden when the fibres are completely enclosed. This is one of the most important prerequisites for optimum adhesion between fibre and matrix in high-tensile composites. The project is testing the suitability of various matrix systems for use in a range of production processes.

INSTITUTE OF TEXTILE CHEMISTRY AND CHEMICAL FIBRES OF THE GERMAN INSTITUTE FOR TEXTILE AND FIBRE RESEARCH DENKENDORF (ITCF)

For more information visit: www.itcf-denkendorf.de

SMART LIGHTWEIGHT ENGINEERING FOR THE CAR OF THE FUTURE

The vehicle of the future is lightweight. It uses very little energy. Manufacturing costs are lower because of savings on weight, components and energy. With its smart materials, fibre-strengthened plastics and new joining techniques, multi-material lightweight engineering provides everything that is needed in terms of innovative materials and designs for the cars of the future. Functional integration also has an important role to play. The ARENA2036 project is gathering, evaluating and prioritising complex carbon fibre laminate and fibre composite lightweight modules. It is drawing up fundamental guidelines for the evaluation and design of highly integrated components. The project is studying the integration of selected functions and will demonstrate its findings using the example of a multifunctional car base module.

The ARENA2036 research campus in Stuttgart represents a new form of collaboration in which different partners from the worlds of science and business come together under one roof to work on the future of production and lightweight engineering.

UNIVERSITY OF STUTT GART

For more information visit: www.arena2036.de

MACHINING IN LIGHTWEIGHT ENGINEERING

The multi-location SPANTEC-light joint project has been funded since 2012 by the state’s Centres of Applied Research at Universities of Applied Sciences programme and coordinated by the University of Aalen. It also involves the Universities of Mannheim and Ulm in consultation with businesses from the industry. The focus of the project is the use of machining technology with lightweight materials such as fibre composites and multi-material composites. Its use in plant and automotive engineering and energy technology produces savings in weight and energy and in this way can make a significant contribution to greater resource and energy efficiency. A particular focus of the project is the connection between the processing of materials and their later application characteristics.

UNIVERSITIES OF AALEN, MANNHEIM AND ULM

For more information visit: www.zafb-spantec.de

Research topic

AEROSPACE ENGINEERING

A key question in aerospace engineering is how to improve the flight characteristics of aeroplanes, helicopters, spacecraft and satellites still further – for example through the use of new aerodynamic components or alternative engines. The German Aerospace Center is located in Stuttgart, thus bringing the federal state's researchers close to their research source.

ALTERNATIVE AVIATION FUELS

Synthetic alternatives based on coal, natural gas or biomass should gradually replace the kerosine used in aviation fuels. These alternative fuels have the potential to help make aviation much more environmentally friendly. They can be produced in such a way that they are even superior to kerosine in terms of their environmental and technical credentials. The DLR Institute of Combustion Technology in Stuttgart is studying the characteristics of these new fuels and developing technologies and design tools to be able to use liquid and gaseous alternative fuels in gas turbine combustion chambers in a clean and efficient way. Working with its partners, the DLR is also carrying out test flights to find out how alternative fuels can reduce the impact of aviation on the climate.

GERMAN AEROSPACE CENTER (DLR)

For more information visit: www.dlr.de

ELECTRIC MOTORS – TODAY IN SMALL PLANES, TOMORROW IN SCHEDULED AIRLINES

Manned, electrically powered flight for small planes is possible. This has been demonstrated by the Institute of Aircraft Design at Stuttgart University. In 2011, the battery-operated e-Genius took its maiden flight. Since then, the e-Genius team has carried out test flights and set new records, making them the pioneers in the design of small commercial aircraft. They are demonstrating how electrically powered planes can be designed to be quiet, cheap, comfortable and environmentally friendly. However, the pure battery-driven motor design using limited energy density modern lithium-ion batteries cannot yet be scaled up for large aircraft. As in the automotive area, researchers at the IFB are using the e-Genius as a platform for testing hybrid drive systems and new integrated drive systems in order to prepare for the use of these new technologies in large aircraft.

IINSTITUTE OF AIRCRAFT DESIGN, UNIVERSITY OF STUTTGART (IFB)

For more information visit: www.ifb.uni-stuttgart.de/egenius

MATERIALS FROM CERAMIC FIBRES

The ITCF Denkendorf has many years of experience in researching and developing ceramic fibres. Its research focuses on oxide and non-oxide ceramic fibres. Each group has specific physical characteristics and its own fields of application. Ceramic fibres are high performance fibres. Single fibres have a diameter of just 10 µm. They are extremely strong, stiff and corrosion resistant at high temperatures. They are mainly used in ceramic matrix composites (CMCs). Unlike conventional ceramics, these extraordinary materials are particularly damage tolerant and resistant to extreme temperature changes. So CMCs are ideal for making the high-specification components used in the aerospace industry.

INSTITUTE OF TEXTILE CHEMISTRY AND CHEMICAL FIBRES OF THE GERMAN INSTITUTE FOR TEXTILE AND FIBRE RESEARCH DENKENDORF (ITCF)

For more information visit: www.itcf-denkendorf.de

PROTECTION FROM SPACE JUNK

Space junk presents a major threat to space travel. Debris orbits the earth at speeds of many kilometres a second and regularly impacts satellites and spaceships. In order to minimise the devastating effects of such space collisions, the Fraunhofer Institute for High-Speed Dynamics (EMI) is studying high-speed impacts in its impact testing facility, the only one of its kind in Europe. On the basis of these tests it is developing new materials and protective shields for spacecraft and is carrying out risk analyses to calculate the probability of collisions between this uncontrollable debris and telecommunications satellites and spacecraft. The institute is working with ESA and NASA and its research has already made a major contribution to safety in space.

FRAUNHOFER INSTITUTE FOR HIGH-SPEED DYNAMICS, ERNST MACH INSTITUTE (EMI)

For more information visit: www.emi.fraunhofer.de

Research topic

MEDICINE AND MEDICAL TECHNOLOGY

Research in the area of medicine and medical technology is looking at the causes of disease and how to make treatments more effective - using know-how from the medical field but also from other areas, such as engineering. Here too, Baden-Württemberg provides a healthy research environment.

THE WORLD'S FASTEST NANOSCOPE

The research team led by Stefan Hell at the German Cancer Research Center has been able to massively increase the recording speed of the ultra-high resolution optical microscope, the STED nanoscope. Hell received the Nobel Prize in 2014 for developing this ultra-high resolution optical microscope. He and his team recently demonstrated how it could for the first time take up to 1,000 pictures per second. This makes it possible to produce high resolution videos with time steps of milliseconds, for example of transport mechanisms in living nerve cells and of HIV particles entering the cell. This kind of high-speed imaging is important when processes occur so quickly that it requires a whole series of images to identify in detail what is happening. The systematic ongoing development of STED and related technologies and their application in medical research are the key objective of the Department of Optical Nanoscopy at the German Cancer Research Center in Heidelberg. Stefan Hell is also Director of the Max Planck Institute of Biophysical Chemistry in Göttingen.

GERMAN CANCER RESEARCH CENTER (DKFZ)

For more information visit: www.dkfz.de

PERSONALISED RADIATION ONCOLOGY

Despite the use of the latest methods of radiation treatment, today only around 50 % of all primary, locally advanced head and neck cancers can be treated effectively. One of the main causes of people's resistance to radiation is the large degree of biological heterogeneity within the tumour. In the ongoing research project "Personalised postoperative radiochemotherapy in head and neck tumours", the latest functional PET/MRT imaging methods are to be combined with special radiobiological analysis and tumour-specific genetic examinations. The aim of the project is to gain new insights into factors that affect how patients react to radiation therapy and to develop prediction models for anticipated treatment outcomes. The project is funded by the Centre for Personalised Medicine in Tübingen.

**UNIVERSITY OF TÜBINGEN,
TÜBINGEN UNIVERSITY HOSPITAL**

For more information visit: www.medizin.uni-tuebingen.de

MICRO IMPLANTS AGAINST DIABETES

Bioelectronic micro-implants can stimulate the nervous system locally and electrically and be used to treat pain, migraines and depression. It has also been shown to be effective against diabetes and high blood pressure. However, their development is still in the early stages. A research alliance made up of four institutes in the Baden-Württemberg Innovation Alliance (inn-BW) is now planning to take it further with its "innBW implant" project. The aim is to develop tiny, flexible, electrically charged implants with integrated sensors and actuators that are able to measure signals relating to disease and modulate them in a therapeutic way. They will mainly be used in treating metabolic disorders such as diabetes and in the diagnosis, treatment and rehabilitation of brain disorders.

**BADEN-WÜRTTEMBERG INNOVATION ALLIANCE,
NATURAL AND MEDICAL SCIENCES INSTITUTE,
AT THE UNIVERSITY OF TÜBINGEN (NMI)**

For more information visit: www.innbw.de

NEW MEDICAL IMAGING PROCESSES

In intensive care treatment, an ongoing challenge is how to adapt parameters relating to artificial respiration. With the aid of the radiation-free process of electrical impedance tomography (EIT), changes to electrical conductivity are used to produce images of pulmonary ventilation. This provides doctors with real-time feedback on the regional ventilation state of the lungs. This leads to reduced pulmonary damage caused by inappropriate respiration parameters. The aim of the current project is to increase image quality in order to make EIT images easier to interpret. To this end, sensor fusion approaches are being combined with new algorithms for image reconstruction and evaluated in studies with clinical partners.

**UNIVERSITY OF FURTWANGEN,
DEPARTMENT OF TECHNICAL MEDICINE (ITEM)**

For more information visit: www.item.hs-furtwangen.de



Research in Baden-Württemberg

UNIVERSITY RESEARCH

***Excellence Initiative**

3 OUTSTANDING UNIVERSITIES IN BADEN-WÜRTTEMBERG

Baden-Württemberg is one of Europe's leading regions for research, with a wide range of institutions and excellent prospects. Within the framework of the Excellence Initiative, three of Germany's eleven top research universities that have been recognised for their cutting-edge research are in Baden-Württemberg. They offer top-quality teaching, excellent facilities and a wide range of personalised services.

UNIVERSITY

EXCELLENCE INITIATIVE

GRADUATE ACADEMY | CLUSTER OF EXCELLENCE | IDEAS FOR THE FUTURE

GRADUATE SCHOOL

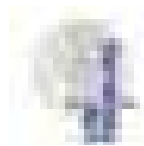
- Spemann Graduate School of Biology and Medicine

CLUSTERS OF EXCELLENCE

- BIOSS Centre for Biological Signalling Studies
- BrainLinks – BrainTools

GRADUATE ACADEMIES

- Heidelberg Graduate School of Fundamental Physics
- Heidelberg Graduate School of Mathematical and Computational Methods for the Sciences
- The Hartmut-Hoffmann-Berling International Graduate School of Molecular and Cellular Biology



The Albert Ludwigs University of Freiburg is one of Germany's oldest and most famous universities. The university's many research centres have an important role to play. They include centres for neuroscience, material science, medicine and law.

UNIVERSITY OF FREIBURG
www.uni-freiburg.de



The University of Heidelberg is Germany's oldest university and one of Europe's leading centres for research. Based on its broad spectrum of research, its four interdisciplinary areas of research are: the molecular and cellular biology foundations of life, creating structures and models in the material world, cultural dynamics in globalised worlds, and "self-regulation and regulation:

UNIVERSITY OF HEIDELBERG
www.uni-heidelberg.de



UNIVERSITY
EXCELLENCE INITIATIVE

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	<p>individuals and organisations". Together they build the core of Heidelberg's research strategy. The university places a priority on advancing excellent individual disciplines, encouraging dialogue across traditional disciplines and providing research results that are useful to society and business.</p>	<p>CLUSTERS OF EXCELLENCE</p> <ul style="list-style-type: none"> • Cellular Networks • Asia and Europe in a Global Context <p>IDEAS FOR THE FUTURE</p> <ul style="list-style-type: none"> • Realising the Potential of a Comprehensive University
 <p>UNIVERSITY OF HOHENHEIM www.uni-hohenheim.de</p>	<p>The University of Hohenheim is currently working on interdisciplinary research in the areas of bioeconomics, global food security and ecosystems and the health sciences. Central academic services, state institutes and laboratories allow interdisciplinary, joint research projects to be carried out in a hands-on way.</p>	
 <p>KARLSRUHE INSTITUTE OF TECHNOLOGY www.kit.edu</p>	<p>KIT is Germany's oldest technical university and the research university of the Helmholtz Association. It was created by merging the University of Karlsruhe with the Karlsruhe Research Centre. Its specialist areas of research include energy, mobility, information, elementary particle and astroparticle physics, climate and environment, man and technology, materials, structures and functions.</p>	<p>GRADUATE ACADEMIES</p> <ul style="list-style-type: none"> • Karlsruhe School of Optics and Photonics • Karlsruhe School of Elementary Particle and Astroparticle Physics
 <p>UNIVERSITY OF KONSTANZ www.uni-konstanz.de</p>	<p>The University of Konstanz takes an interdisciplinary approach to science. Key areas of research are cultural and decision-making studies, chemical biology and ecology, and molecular nanoscience and materials science. This young university has received awards for its approach to gender equality and its family-friendly structures, and it actively promotes careers in new areas of science.</p>	<p>GRADUATE ACADEMIES</p> <ul style="list-style-type: none"> • Konstanz Research School Chemical Biology • Graduate School of Decision Sciences <p>CLUSTER OF EXCELLENCE</p> <ul style="list-style-type: none"> • Cultural Foundations of Social Integration <p>IDEAS FOR THE FUTURE</p> <ul style="list-style-type: none"> • Model Konstanz – Towards a Culture of Creativity
 <p>UNIVERSITY OF MANNHEIM www.uni-mannheim.de</p>	<p>With its focus on business studies, economics and social sciences, the University of Mannheim is one of Germany's top research centres. Its courses have been ranked very highly for many years.</p>	<p>GRADUATE SCHOOL</p> <ul style="list-style-type: none"> • Graduate School of Economic and Social Sciences (GESS)
 <p>UNIVERSITY OF STUTTGART www.uni-stuttgart.de</p>	<p>The University of Stuttgart enjoys an outstanding position as an internationally renowned research institute with an interdisciplinary approach focusing on natural sciences and engineering. Its research areas include modelling and simulation technology, new materials, complex systems and communication, technology concepts, energy supply and the environment, mobility, product and production design, and design and technology for sustainable living.</p>	<p>GRADUATE SCHOOL</p> <ul style="list-style-type: none"> • Graduate School of Excellence Advanced Manufacturing Engineering <p>CLUSTER OF EXCELLENCE</p> <ul style="list-style-type: none"> • Simulation Technology
 <p>UNIVERSITY OF TÜBINGEN www.uni-tuebingen.de</p>	<p>The University of Tübingen stands for a 500-year tradition of research in humanities and social, natural and life sciences. It is home to a multitude of special research departments and five graduate academies. Its main areas of research include integrative neurosciences, translational immunology and cancer research, geological and environmental research, astrophysics, particle physics, quantum physics, education and media.</p>	<p>GRADUATE SCHOOL</p> <ul style="list-style-type: none"> • Learning, Educational Achievement and Life Course Development <p>CLUSTER OF EXCELLENCE</p> <ul style="list-style-type: none"> • Werner Reichardt Centre for Integrative Neuroscience <p>IDEAS FOR THE FUTURE</p> <ul style="list-style-type: none"> • Research – Relevance – Responsibility
 <p>UNIVERSITY OF ULM www.uni-ulm.de</p>	<p>As a research institution, it draws its strength from its close interdisciplinary collaboration. It specialises in research into trauma, ageing, quantum physics, energy storage, the interaction between man and machine and financial services.</p>	<p>GRADUATE SCHOOL</p> <ul style="list-style-type: none"> • International Graduate School in Molecular Medicine Ulm

UNIVERSITIES OF APPLIED SCIENCES

The universities of applied sciences (HAW) in Baden-Württemberg successfully take part in competitive programmes to gain research funding. They apply as individual universities or cooperate with partners from research and industry. In many research projects, the HAW work with companies in the region, particularly SMEs. Their research activities are practical and application-oriented, anchored in the region but part of global networks, and in line with international research and innovation strategies. On this basis they make a major contribution to the transfer of knowledge and technology in the knowledge and business hub of Baden-Württemberg.

The universities' research is supported by the Institutes for Applied Research, while the Baden-Württemberg Centre of Applied Research (BW-CAR) networks the research expertise in quality-assured research

topics nationally to create infrastructure synergies for high-level research.

As a strategic joint HAW project, Centres of Applied Research at Universities (ZAFH) have been set up to consolidate research structures in proven areas of competence. Strong research groups have provided the foundation for the establishment of 17 cooperative graduate programmes to encourage young academics in applied research, provide them with close supervision and structured doctoral studies in conjunction with the state's universities.

Subjects range from engineering, economics and the social sciences to the life sciences and integrate interdisciplinary topics such as mobility research, energy and environmental research and the interaction between man and machine.

INVOLVEMENT OF UNIVERSITIES IN BW-CAR RESEARCH TOPICS

	Aalen University of Applied Sciences	Albstadt-Sigmaringen University of Applied Sciences	Biberach University of Applied Sciences	Esslingen University of Applied Sciences	Freiburg University of Applied Sciences	Catholic Protestant University of Applied Sciences	Furtwangen University of Applied Sciences	Heilbronn University of Applied Sciences	Kerlsruhe University of Applied Sciences Freiburg	Kehl University of Applied Sciences	Konstanz University of Applied Sciences	University of Applied Sciences Public Management and Finance Ludwigsburg	University of Applied Sciences Public Administration Ludwigsburg	Mainheim University of Applied Sciences	Nürtingen-Geislingen University of Applied Sciences	Offenburg University of Applied Sciences	Pforzheim University of Applied Sciences	Ravensburg University of Applied Sciences	Reutlingen University of Applied Sciences	University of Applied Sciences Weingarten	University of Applied Sciences Forest Sciences Rottenburg	University of Applied Sciences Design Stuttgart	Stuttgart Media University Applied Sciences	Stuttgart Technical University Applied Sciences	Ulm University of Applied Sciences
Energy systems and resource efficiency	•	•				•	•	•	•			•	•	•	•	•	•	•	•		•	•	•		
Materials design and manufacturing	•					•	•	•				•	•	•	•		•								•
Technology for smart systems				•		•	•	•						•	•	•	•					•	•	•	
Information and communication systems						•	•	•						•	•								•	•	
Management, innovation and society				•	•	•	•	•	•		•		•	•	•	•	•	•	•			•	•		
Diagnostics and therapy	•	•	•			•							•												•
Interaction between man and machine	•				•	•	•	•	•		•					•						•	•		



BADEN-WÜRTTEMBERG COOPERATIVE STATE UNIVERSITY

The Baden-Württemberg Cooperative State University (DHBW) is unique in the way it combines theory and practice. With its accreditation as a university, the DHBW was awarded a joint research project. Research is oriented towards application and transfer, particularly in collaboration with partners in industry. They work together to develop innovative concepts, strategies and technologies and reflect professional and

specialist conditions in business, technology and social studies. Joint research offers partners a clear added value and improves the quality of teaching. In return, the DHBW is integrated into specialist networks. The DHBW's Research Support Centre also offers a comprehensive research service, from developing ideas and drawing up contracts right up to transfer and marketing.

BADEN-WÜRTTEMBERG COOPERATIVE STATE UNIVERSITY

www.dhbw.de

DHBW HEIDENHEIM

www.dhbw-heidenheim.de

DHBW HEILBRONN

www.heilbronn.dhbw.de

DHBW KARLSRUHE

www.dhbw-karlsruhe.de

DHBW LÖRRACH

www.dhbw-loerrach.de

DHBW MANNHEIM

www.dhbw-mannheim.de

DHBW MOSBACH

www.dhbw-mosbach.de

DHBW RAVENSBURG

www.dhbw-ravensburg.de

DHBW STUTTGART

www.dhbw-stuttgart.de

DHBW VILLINGEN-SCHWENNINGEN

www.dhbw-vs.de

UNIVERSITIES OF EDUCATION

With its six universities of education, Baden-Württemberg is the only state in Germany to offer this kind of specialist university for studying educational science. The universities of education also place a high priority on research. Research topics range from basic research into educational theory to application-oriented educational research across a broad range of disciplines, such as empirical teaching-learning research, studies of education at particular institutions, teaching methods and professionalisation. The universities of education are strong centres for educational research. The universities of education have as part of their mandate the right to award doctorates and habilitations and therefore shoulder

a large degree of responsibility for advancing new generations of academics in educational and methodological disciplines. An outstanding environment is offered by the unique disciplinary and interdisciplinary research programmes and the Graph joint graduate school.

The universities of education carry out research at national and international level and in conjunction with other universities and research institutions. Every year they receive millions of euros in external funding. Funding is provided by institutions such as the German Research Fellowship (DFG), the EU and the Federal Ministry of Education and Research (BMBF).

PH FREIBURG

www.ph-freiburg.de

PH HEIDELBERG

www.ph-heidelberg.de

PH KARLSRUHE

www.ph-karlsruhe.de

PH LUDWIGSBURG

www.ph-ludwigsburg.de

PH SCHWÄBISCH GMÜND

www.ph-gmuend.de

PH WEINGARTEN

www.ph-weingarten.de



Research in Baden-Württemberg

NON-UNIVERSITY RESEARCH

Few regions in Europe are home to as many research institutions as Baden-Württemberg. Major international and national research centres such as the European Molecular Biology Laboratory in Heidelberg and the German Cancer Research Center in Heidelberg exist alongside the Centre for Art and Media in Karlsruhe and numerous institutions belonging to famous research associations. These include 12 institutes of the Max Planck Society, 3 Helmholtz Association research centres and 17 Fraunhofer Institutes.

INSTITUTION



MAX-PLANCK-GESellschaft

MAX PLANCK SOCIETY

www.mpg.de

The Max Planck Society for the Advancement of Science e.V. is an independent, non-profit research organisation. Its institutes primarily focus on basic research in selected fields in natural sciences, humanities and social sciences, and their discoveries and findings provide a foundation for innovations that are important for business and society. It has produced more Nobel prize winners than any other research establishment in Germany, including Klaus von Klitzing and Christiane Nüsslein-Volhard. The research topics studied at the Max Planck Institutes complement the work of universities and other research institutions. Baden-Württemberg is home to eleven Max Planck Institutes and one sub-institute.

- Max Planck Institute for Astronomy, Heidelberg
www.mpia.de
- Max Planck Institute for Comparative Public Law and International Law, Heidelberg
www.mpil.de
- Max Planck Institute for Foreign and International Criminal Law, Freiburg
www.mpicc.de
- Max Planck Institute for Biological Cybernetics, Tübingen
www.kyb.mpg.de
- Max Planck Institute for Developmental Biology, Tübingen
www.eb.tuebingen.mpg.de
- Max Planck Institute for Solid State Research, Stuttgart
www.fkf.mpg.de
- Max Planck Institute of Immunobiology and Epigenetics, Freiburg
www.immunbio.mpg.de
- Max Planck Institute for Intelligent Systems, Stuttgart, Tübingen
www.is.mpg.de
- Max Planck Institute for Nuclear Physics, Heidelberg
www.mpi-hd.mpg.de/mpi

INSTITUTION

The Max Planck Society employs around 2,800 people in the state, including numerous researchers from all over the world. The Max Planck Institutes have a strong international network thanks to its many joint research projects with foreign partners.

- Max Planck Institute for Medical Research, Heidelberg www.mpimf-heidelberg.mpg.de
- Max Planck Institute for Ornithology, Radolfzell branch www.orn.mpg.de
- Friedrich Miescher Laboratory of the Max Planck Society, Tübingen www.fml.tuebingen.mpg.de



MAX-PLANCK-GESellschaft

INTERNATIONAL MAX PLANCK RESEARCH SCHOOLS (IMPRS)

www.mpg.de/en/imprs

Supporting the next generation of academics and scientists plays a key role in the research policies of the Max Planck Society. The International Max Planck Research Schools (IMPRS) are an important element in this. They offer structured doctoral programmes in innovative and interdisciplinary areas such as molecular biology, neuroscience, demographics, plasma physics, polymer research and IT. There are eleven of these Research Schools in Baden-Württemberg. They provide excellent conditions for gifted students from Germany and abroad to carry out their doctoral studies. Around half of the students are from abroad, and they can choose to complete their doctorates at universities in Germany or in their home country.

- Advanced Materials: From Microscopic Understanding to Functionality, Stuttgart www.imprs-am.mpg.de
- Astronomy and Cosmic Physics, Heidelberg www.mpia.de/imprs-hd
- Comparative Criminal Law, Freiburg www.imprs-cc.de
- From Molecules to Organisms, Tübingen www.imprs.tuebingen.mpg.de
- Cognitive & Systems Neuroscience, Tübingen www.neuroschool-tuebingen.de
- Molecular and Cellular Biology, Freiburg www.ie-freiburg.mpg.de
- Organismal Biology, Konstanz www.orn.mpg.de
- Precision Tests of Fundamental Symmetries, Heidelberg www.mpi-bd.mpg.de/imprs-ptfs
- Quantum Dynamics in Physics, Chemistry and Biology, Heidelberg www.mpi-bd.mpg.de/imprs-qd
- Retaliation, Mediation and Punishment, Freiburg www.remep.mpg.de
- Successful Dispute Resolution in International Law, Heidelberg www.ipr.uni-heidelberg.de

The Helmholtz Association employs 38,000 staff in 18 research centres with a focus on natural sciences, technology, medicine and biology. The researchers work on solutions to the main, most pressing problems of society, science and business. Their strategic, programmed research is focused on six areas: energy, earth and environment, health, matter, key technologies, aerospace and transport. With an annual budget in excess of 4 billion euros the Helmholtz Association is Germany's largest scientific organisation. With the KIT and the DKFZ, the largest biomedical research institute in Germany, two Helmholtz centres are based in Baden-Württemberg. Others have branches in the state: the six German Centres for Health Research with its nine locations and the DLR with two locations. The DLR carries out comprehensive R&D work in the areas of aerospace, energy, transport and safety. Baden-Württemberg is also home to the National Center for Tumour Diseases (NCT) in Heidelberg and the Helmholtz Institute for Electrochemical Energy Storage in Ulm (HIU).



HELMHOLTZ ASSOCIATION

www.helmholtz.de

- German Cancer Consortium (DKTK), Heidelberg, Tübingen, Freiburg www.dkfz.de/de/dktk
- German Cancer Research Center (DKFZ), Heidelberg www.dkfz.de
- German Center for Diabetes Research (DZD), Tübingen www.dzd-ev.de
- German Center for Cardiovascular Research (DZHK), Heidelberg, Mannheim www.dzdk.de
- German Center for Infection Research (DZIF), Heidelberg, Tübingen www.dzif.de
- German Aerospace Center (DLR), Stuttgart, Lampoldshausen www.dlr.de
- German Center for Lung Research (DZL), Heidelberg www.dzl.de
- German Center for Neurodegenerative Diseases (DZNE), Tübingen www.dzne.de
- Helmholtz Institute for Electrochemical Energy Storage (HIU), Ulm www.hiu-batteries.de/de
- Karlsruhe Institute of Technology (KIT), Karlsruhe www.kit.edu
- National Center for Tumour Diseases (NCT), Heidelberg www.nct-heidelberg.de



LEIBNIZ ASSOCIATION
www.leibniz-gemeinschaft.de

The Leibniz Association brings together 88 independent research establishments. Its research includes natural sciences, engineering, environmental science, economics, spatial planning, social sciences and humanities. The Leibniz Institutes focus on issues that are relevant to society, the economy and the environment. They carry out empirical and applied research, including in the umbrella Leibniz research associations, and are or support scientific infrastructures and offer research-based services. Seven Leibniz Association institutes are based in Baden-Württemberg.

- FIZ-Karlsruhe – Leibniz Institute for Information Infrastructure (FIZ), Karlsruhe
www.fiz-karlsruhe.de
- GESIS – Leibniz Institute of Social Sciences, Mannheim
www.gesis.org
- Institute for the German Language (IDS), Mannheim
www.ids-mannheim.de
- Leibniz Institute for Knowledge Acquisition Media (IWM), Tübingen
www.iwm-tuebingen.de
- Kiepenheuer Institute for Solar Physics (KIS), Freiburg
www.kis.uni-freiburg.de
- Mathematisches Forschungsinstitut (MFO), Oberwolfach
www.mfo.de
- Centre for European Economic Research, Mannheim
www.zew.de

Founded in 1949, the Fraunhofer Society works with international partners to advance applied research for the benefit of business and society.

It receives research contracts from industry, service companies and public bodies. The aim of its research activities is to transfer its findings into innovative products and services. The Fraunhofer Institutes also carry out their own initial research in order to have an influence on the development of the technology of the future. Research topics include health and the environment, protection and safety, mobility and transport, production and services, communication and knowledge and energy and raw materials. The Fraunhofer Institutes work together in institute associations and joint research projects and also work closely with external partners such as universities and other research institutions. In Baden-Württemberg the Fraunhofer Society is represented by 13 institutions, a field office and three project groups.



- Fraunhofer Institute for Applied Solid State Physics IAF, Freiburg
www.iaf.fraunhofer.de
- Fraunhofer Institute for Industrial Engineering and Organisation IAO, Application Centre for Solutions for Energy and IT Mobility Interfaces, Esslingen
www.iao.fraunhofer.de
- Fraunhofer Institute for Building Physics IBP, Stuttgart
www.ibp.fraunhofer.de
- Fraunhofer Institute for Chemical Technology ICT, Pfaffzettel
www.ict.fraunhofer.de
- Fraunhofer Institute for Interfacial Engineering and Biotechnology IGB, Stuttgart
www.igb.fraunhofer.de
- Fraunhofer Institute for High-Speed Dynamics, Ernst Mach Institute EMI, Freiburg, Kadern branch, Efringen-Kirchen sub-institute
www.emi.fraunhofer.de
- Fraunhofer Institute of Optronics, System Technologies and Image Exploitation IOSB, Karlsruhe and Ettlingen branches
www.iosb.fraunhofer.de
- Fraunhofer Institute for Physical Measurement Techniques IPM, Freiburg
www.ipm.fraunhofer.de
- Fraunhofer Institute for Manufacturing Engineering and Automation IPA, Stuttgart
www.ipa.fraunhofer.de
- Fraunhofer Institute for Solar Energy Systems ISE, Freiburg
www.ise.fraunhofer.de
- Fraunhofer Institute for Systems and Innovation Research ISI, Karlsruhe
www.isi.fraunhofer.de
- Fraunhofer Institute for Mechanics of Materials IWM, Freiburg branch
www.iwm.fraunhofer.de
- Fraunhofer Information Centre for Planning and Building IRB, Stuttgart
www.irb.fraunhofer.de
- Fraunhofer Institute for Silicate Research ISC, Würzburg, field office Bronnbach
www.isc.fraunhofer.de/bronnbach
- Fraunhofer Project Group for Automation in Medicine and Biotechnology PAMB, Mannheim
pamb.ipa.fraunhofer.de
- Fraunhofer New Drive Systems NAS project group, Karlsruhe
www.ict.fraunhofer.de/de/komp/nas.html
- Fraunhofer Lightweight Construction Technologies BTL project group, Stuttgart
www.ipa.fraunhofer.de/leichtbautechnologien.html



**BADEN-WÜRTTEMBERG
INNOVATION ALLIANCE**
www.innbw.de

In a region that is home to many mid-tier businesses, the Baden-Württemberg Innovation Alliance (inn-BW) plays an important role thanks to its targeted, applied research activities. innBW is an alliance of 13 independent applied research institutions with a total of 1,200 employees. The institutes target their research to meet the needs of business and the economy and focus on areas of technology that are important for them. With some 2,500 industry-related projects in key areas for the future, such as health and elderly care, sustainable mobility, energy and environmental technology, information and communication, innBW plays an important role in the state's technology transfer. The majority of its research is commissioned by small and mid-tier companies. For the development of new, innovative products, the focus is on materials and surfaces that are suitable for a range of technologies, micro-system technology/electronics, digitalisation, nanotechnology, biotechnology, photonics, production engineering and management systems. The Innovation Alliance has the key function of building bridges between basic research at universities and the technical advances taking place in industry. The directors of most of these institutes are also professors at universities or heads of university departments. This guarantees that a lot of knowledge and personnel exchange takes place between the independent research institutes and the universities. Undergraduates and post-graduates can also gain further qualifications for future work in industry by writing dissertations and doctoral theses that are relevant to current practical issues in industry.

- Hohenstein Institute for Textile Innovation (HIT), Bönningheim www.hohenstein.de
- Research Institute for Precious Metals and Metal Chemistry (fem), Schwäbisch Gmünd www.fem-online.de
- The FZI Research Centre for Information Technology at KIT, Karlsruhe www.fzi.de
- Hahn-Schickard, Freiburg www.hahn-schickard.de
- Hahn-Schickard, Stuttgart www.hahn-schickard.de
- Hahn-Schickard, Villingen-Schwenningen www.hahn-schickard.de
- Institute of Laser Technology in Medicine and Measurement Technology (ILM) at the University of Ulm, Ulm www.ilm-ulm.de
- Stuttgart Institute of Microelectronics (IMS CHIPS), Stuttgart www.ims-chips.de
- Institute of Textile Chemistry and Chemical Fibres (ITCF) at the German Institutes of Textile and Fibre Research Denkendorf (DITF), Denkendorf www.itcf-denkendorf.de
- Institute of Textile Technology and Process Engineering (ITV) at the German Institutes of Textile and Fibre Research Denkendorf (DITF), Denkendorf www.itv-denkendorf.de
- NMI Natural and Medical Sciences Institute, Universities of Tübingen, and Reutlingen www.nmi.de
- Centre for Management Research (DITF-MR) at the German Institutes of Textile and Fibre Research (DITF), Denkendorf www.ditf-denkendorf.de/mr
- Centre for Solar Energy and Hydrogen Research Baden-Württemberg (ZSW), Stuttgart, Ulm www.zsw-bw.de



**HEIDELBERG ACADEMY
OF SCIENCES AND
HUMANITIES**
www.badw-bw.de

The Baden-Württemberg Academy of Sciences is one of eight German Academies of Sciences. It is a learned society of eminent scientists and a modern non-university research institute that is currently involved in 20 projects. The Academy organises academic conferences and public lecture series and supports new generations of scholars.



**EUROPEAN MOLECULAR
BIOLOGY LABORATORY
(EMBL)**
www.embl.de

The EMBL, based in Heidelberg, was established in 1974 and is supported by more than twenty member states. Its core activities are: basic research in molecular biology, education, academic services, developing new research tools and methods, technology transfer and building life sciences networks throughout Europe.



**INSTITUTE FOR
TRANSURANIUM
ELEMENTS (ITU)**
[www.ec.europa.eu/
jrc/instituteslitu](http://www.ec.europa.eu/jrc/instituteslitu)

Founded in Karlsruhe in 1963, the ITU aims to provide a scientific basis for protecting against the dangers of highly radioactive materials. The Institute is part of the European Commission's Joint Research Centre (JRC).

EASY ENTRY TO AN ACADEMIC CAREER

Baden-Württemberg offers ambitious graduates, specialists and executives from around the world a wide range of exciting career opportunities. Alongside its many universities and research establishments, the region

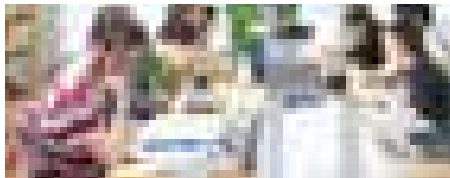
is also home to a great many companies that also conduct their own research. We have plenty of interesting jobs. These are ideal conditions for starting an academic career.

A STRUCTURED APPROACH TO DOCTORAL STUDIES *Doctorates and programmes*



In Baden-Württemberg there is a wide range of structured doctorate programmes, which generally make it possible to gain your doctorate in just three years. They involve a structured supervision and qualification concept and encourage doctoral students to get involved with the scientific community at an early stage. Most of them also offer opportunities for scholarships and employment at universities and research institutes. But it is also possible to study for traditional individual doctorates.

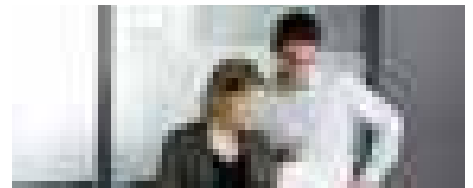
SPECIAL GRANTS *Funding programmes*



Baden-Württemberg offers a number of funding programmes, including the Junior Professor programme for young academics, a returning academics programme to support universities in Baden-Württemberg and a female professors programme for appointments of female academics.

JOBS ONLINE

Job seeking



Major companies and research institutions have their own careers pages where they publish job vacancies. The following links may also be helpful:

- www.bw-career.de/en/home
- www.bw-jobs.de
- www.academics.de
- www.research-in-germany.de
- www.gain-network.org
- www.duz-wissenschaftskarriere.de
- www.euraxess.com

Doctoral studies

FIND OUT MORE ABOUT DOCTORAL STUDIES IN BADEN-WÜRTTEMBERG AT:
WWW.BW-CAREER.DE/EN/HOME



FIND OUT MORE!

For more information on studying, conducting research, living and working in Baden-Württemberg, visit

www.bw-studyguide.de and www.bw-career.de/en/home.



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We're here to help.

Do you have questions about studying or conducting research in Baden-Württemberg? Are you looking for partners for knowledge-sharing or joint research projects, are you thinking about pursuing your academic career in Baden-Württemberg, or would you like to visit us to gain some first-hand impressions? Then Baden-Württemberg International is here to help: wissenschaft@bw-i.de

Baden-Württemberg International (bw-i) is the centre of competence of the German state of Baden-Württemberg for the internationalisation of business and science. We lend support to domestic and foreign companies, clusters and networks, research institutions and universities as well as to regions and municipalities by serving as the central first point-of-contact in all questions relating to internationalisation.

Baden-Württemberg International



Find out more!

Visit www.bw-studyguide.de and www.bw-career.de/en/home find out more about studying and conducting research in Baden-Württemberg.



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Baden-Württemberg

The German Southwest.