Institute of Biology
Rhoda-Erdmann-Haus

HUMBOLDT-UNIVERSITÄT · ZU BERLIN ·

June 2019

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Dear colleagues,
members and students of the Institute of Biology,

I am very grateful to those in the institute taking initiative in preparing this brochure. The brochure increases the visibility of the institute both within and outside the university by providing an outline of the diverse scientific activities of the Institute of Biology at our university.

Our institute is one of the most competitive and highest performing institutes within the Humboldt-Universität zu Berlin. Our level of extramural funding ranks highest among all institutes, and we compete nationally with the best. We actively participate in German Research Foundation-sponsored clusters of excellence, collaborative research centers, often providing the speaker of the consortium, graduate schools, priority programs and research units, and with numerous individual projects. This success is particularly impressive considering a dramatically increased number of students and the insufficient financing of our university. In spite of the continuously decreasing teacher-to-student ratio, the Institute of Biology has maintained its focus on experimental and practical instruction for all students.

Turning to current and prospective students interested in studying biology, I encourage you to use this brochure as an overview of the institute's activities in education and research. I hope that the information provided here will be a stimulus for the decision of prospective students to begin and/or continue their studies at the Humboldt-Universität zu Berlin.

In the past two years we have been integrating our institute into the new Faculty of Life Sciences. The Institute of Biology together with agricultural and horticultural sciences as well as the Institute of Psychology, is now in a position to benefit from the new possibilities for interdisciplinary research and teaching.

I extend, again, my thanks to all those who have participated in the preparation and implementation of this brochure. To the managing directory and the Council of the Institute of Biology, to all members of our university, who are supporting our efforts, and particularly to all members of the Institute of Biology, I sincerely wish continued success and gratification in all teaching and research activities.

Bernhard Grimm
Dean of the Faculty of Life Sciences

Dear Readers,

This brochure presents a brief overview of the science being conducted in Institute of Biology.

We hope that it provides an insight into the biological research at the Humboldt-Universität zu Berlin, with our goal being to inform interested readers, ranging from colleagues and students to the informed public about the research that we conduct.

This presentation is meant only to be a snapshot rather than a comprehensive catalogue of our work. Research is by nature dynamic and ever changing. We would be delighted if this brief insight would spark the interest of the reader and initiate contacts leading to a deeper understanding of the life sciences. We especially encourage students, to take this opportunity to step outside the lecture hall and become acquainted with the breadth of scientific research in our institute.

This brochure mirrors the diverse research topics and methods employed by our scientists. This diversity describes our research more accurately than a simple listing of the scientific disciplines found in the institute. Irrespective of the scientific questions under investigation, our research as a whole reflects a common interest in uncovering the multifaceted complexity of life. We are proud that our institution is internationally recognized at the highest level and that the Institute of Biology has played an important role in raising the Humboldt-Universität zu Berlin to the status of a university of excellence.

I wish everyone an enjoyable experience discovering the diversity of our institute.

Michael Brecht
Managing Director of the Institute of Biology,
Legislative periode 2018 - 2019

History of biology – a brief review of institutes and disciplines

When the University of Berlin was founded in 1810, chairs in biology were set up, which drew on the tradition of different pre-university institutions: the Prussian Society (1700) or Academy (1744) of Sciences with its Botanical Gardens at Schöneberg, first mentioned in 1679, the “Theatrum anatomicum” from 1713 and the “Naturalienkabinett” founded in 1716. Other important biological collections originated from the public ”Collegium medico-chirurgicum” (1723) and the Berlin Society of Naturalists (“Gesellschaft naturforschender Freunde zu Berlin”, 1773). The first biologists of the university, the botanist Carl Ludwig WILLDENOW (1765-1812) and the zoologist Hinrich LICHTENSTEIN (1780-1857) were closely connected with these organizations.

The first biologists of the Berlin University, the zoologist Hinrich LICHTENSTEIN (copper plate before 1822) and the botanist Carl Ludwig WILLDENOW (copper plate 1802), (picture archives of the author).

The chairs of botany and zoology were established in the Faculty of Philosophy, independent of each other and of medicine, already in 1810 – a very progressive idea at a time when both disciplines were generally regarded as medical domains or combined in a single “philosophical” chair for natural history. Heinrich LINK (1767-¬1851), who succeeded WILLDENOW in 1815, re-integrated botany temporarily into the Faculty of Medicine, while the botanists Friedrich Gottlob HAYNE (1763-1832) and Carl Sigismund KUNTH (1788-1850) held the original position. KUNTH and LINK were followed by Alexander BRAUN (1805-1877) in 1851. In the era of BRAUN and Wilhelm PETERS (1815-¬1883), who replaced LICHTENSTEIN in 1858, botany and zoology developed on a large scale. By 1880 comparative anatomy and morphology, systematics, biogeography, floristics, and faunistics were flourishing and had initiated great expeditions. Julius MEYEN (1804-1840), Hermann SCHACHT (1814-1864) or Robert CASPARY (1818-1887) as well as Christian Gottfried EHRENBERG (1795-1876) had done pioneer work in microscopy, whereas Hermann KARSTEN (1819-1908), Nathanael PRINGSHEIM (1823-1894) or Leopold KNY (1841-1916) were already working in plant physiology. The advancing differentiation of biological topics led to the introduction of independent chairs for general and systematic botany (1878) and zoology (1884). This development reached most universities only more than 70 years later!

The first professors for systematic botany August Wilhelm EICHLER (1839-1887) well-known for his flower-diagrams and, in particular, Adolf ENGLER (1844-1930) opened the golden age of plant taxonomy and geography in Berlin. ENGLER transferred the Botanical Gardens from Schöneberg to Dahlem (1898-1904). A new Botanical Museum followed (1906). In 1921, Ludwig DIELS (1874-1945) succeeded ENGLER.

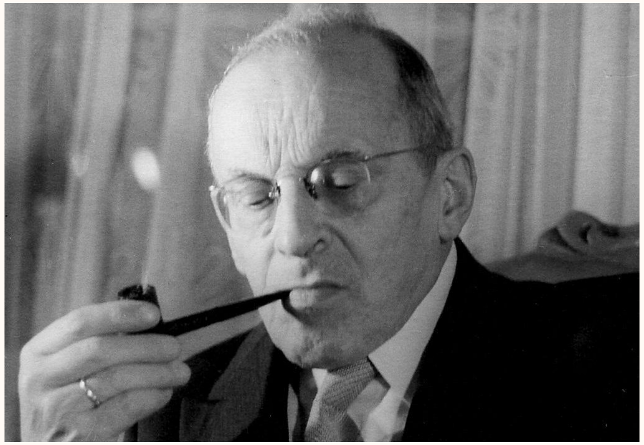
In general botany, microscopic studies dominated research for a long time. The first chair-holder Simon SCHWENDENER (1829-1919), who came to Berlin in 1878, and his successor (1910) Gottlieb HABERLANDT (1854-1945) founded physiological plant anatomy combining structural and functional research. A new and modern Plant Physiological Institute was built at Dahlem in 1913 where HABERLANDT formulated one of the first hormone theories in botany. In 1924 Hans KNIEP (1881-1930), an expert for the life cycles of fungi, was appointed. Kurt NOACK (1888-1963), who held the position from 1931 to 1956, became a pioneer of plant biochemistry.

Zoological anatomy and physiology especially rooted in the Faculty of Medicine where Karl Asmund RUDOLPHI (1771-1832), Johannes MÜLLER (1801-1858) and Karl REICHERT (1811-1883) lectured, and Oscar HERTWIG (1849-1922) set up a special “Anatomical-biological Institute” (1892). MÜLLER had created one of the most influential schools of scientific zoology with such distinguished graduates as the co-founder of the cell theory Theodor SCHWANN (1810-1882), the pioneer of electrophysiology Emil DUBOIS-REYMOND (1818-1892) and Ernst HAECKEL (1834-1919).

A new chapter in the history of zoology at Berlin commenced in 1884 when Franz Eilhard SCHULZE (1840-1921) constituted a Zoological Institute and Karl MÖBIUS (1825¬-1908) got a second chair (1888) as the head of the Zoological Museum. Both institutions were housed in the new Museum for Natural History (1888) and developed to centres of morphological, systematic and geographical research. At the end of the 19th century comparative morphological studies turned to development-physiological and cytological experiments and phylogenetic considerations – the main topics of HERTWIG and Karl HEIDER (1856-1935) who followed SCHULZE in 1917. After a period of zoogeography and ecology, the research fields of Richard HESSE (1868-1944), who directed the Zoological Institute from 1926 to 1935, Friedrich SEIDEL (1897-1992) again preferred development-physiological themes. The institute repeatedly brought forth leading zoologists with new concepts, such as proto-zoology by Fritz SCHAUDINN (1871-1906) or comparative and experimental sensory physiology and behavioural biology by Hansjochem AUTRUM (1907-2003), Erich VON HOLST (1908-1962) and Günter TEMBROCK (1918-2011), respectively.

Throughout the 19th century the Zoological Museum had only three directors. After MÖBIUS retired in 1905, the position was held by August BRAUER (1863-1917), Willy KÜKENTHAL (1861-1922), Carl ZIMMER (1873-1950) and Hanns VON LENGERKEN (1899-1966). They extended the building, reorganized the collections and exhibitions and were supported by a rising number of custodians, among them famous specialists like the spongiologist Walther ARNDT (1891-1944) who was murdered by the Nazi regime, the mammal-expert Hermann POHLE (1892-1982) or the ornithologist Erwin STRESEMANN (1889-1972).

The post-war reconstruction and revival of the Berlin University was soon affected adversely by the beginning East-West conflict. The biological institutes suffered particularly. By 1949, the Humboldt-University had lost all its botanical institutions in Dahlem, a West-Berlin district. An Institute for General Botany directed by the plant physiologist Konrad RAMSHORN (1909-1978) and an Institute for Special Botany headed by the taxonomist Walter VENT (1920-2008) were re-established in 1960. The general botanists were accommodated at disperse zoological, agricultural and veterinary departments, whereas the special botanists settled at the arboretum of the former Späth company at Baumschulenweg.



The zoologists maintained their traditional buildings, but met severe personnel problems when the new chair-holders at the Zoological Museum and Institute, Werner ULRICH (1900-1977) and Konrad HERTER (1891-1980), moved to the Free University in Dahlem. The situation of the museum consolidated, when in 1951 the taxonomist Alfred KAESTNER (1901-1971), and then, after the deep cut of the Berlin Wall in 1961, the evolutionary biologist Konrad SENGLAUB (* 1926) were appointed, while the Zoological Institute went through a long phase of temporary solutions until the morphologist and cell biologist Kurt ERDMANN (1907-1980) could be won in 1958.

In 1968 the historically grown institutes were united in a “Section of Biology” with different divisions. Although training plant physiology became a priority, behavioural biology, biophysics, biochemistry, genetics and ecology were important fields.

When Germany was reunited in 1990, these directions formed the foundations of the Institute for Biology, as it was named in 1994. Chairs in microbiology, physiology of microorganisms, biochemistry of plants, cytology, molecular cell biology and molecular parasitology were added reflecting the impact of modern concepts. Animal physiology, behavioural physiology, sensory physiology as well as applied botany and comparative biology are represented in the institute by groups engaged in active research.

The close contacts to the nearby Museum of Natural History is one of the major advantages linking wealth of knowledge in systematic biology and the invaluable collection at this site to programs in research and education. In 1995, an “Innovationskolleg” for theoretical biology was founded and its three groups add another unique and attractive asset to the department.

Figures 3, 4, and 5
The botanist Kurt NOACK (photo 1953), the zoologist Kurt ERDMANN (photo about 1960) und the geneticist Ursula NÜRNBERG (photo 1966) led the Branch of Biology after 1945 and contributed substantially to revive and stabilize the field at Humboldt University in a critical time (picture archives of the author).

Sources:

Beiträge zur Entwicklung der Biologie in der Geschichte der Berliner Universität. Wiss. Ztschr. Humboldt-Univ. Berlin, Math.-Nat. Reihe, 34 (1985), H. 3/4.
Höxtermann, E.: Die Biologen der Humboldt-Universität zu Berlin zwischen Illusion und Wirklichkeit (1945 bis 1968). In Girnus, W., K. Meier (Hrsg.): Die Humboldt-Universität Unter den Linden 1945 bis 1990. Zeitzeugen, Einblicke, Analysen. Leipzig: Universitätsverlag 2010, 277-294.

Prof. Dr. Ekkehard Höxtermann, Berlin

THE FOUNDATION OF THE UNIVERSITY

The Humboldt-Universität zu Berlin was founded in 1810 and is considered the “mother of all modern universities“. This reputation is thanks to the university concept established by the scholar and statesman Wilhelm von Humboldt.[1] In February 1809, he took responsibility for education and training in the Ministry of the Interior. He made an application to the King to found the University of Berlin, on July 24, 1809: “The department dares, to apply respectfully to his Royal Majesty:

1. To set up a plan for the establishment of a university in Berlin, that should take the already-extant scientific institutes and museums in Berlin, the Medical Academy, and the Academy of Sciences and Arts, and unify them under the aegis of the department for education and training. And to proceed at once to execution of the plan, as soon as the administration of the necessary revenues will be possible“.[2] From 1828, the University of Berlin was named Friedrich-Wilhelms-University, after its founder, the Prussian king Friedrich Wilhelm III.

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[1] Geschichte der Humboldt-Universität zu Berlin

[2] Markschies, Christoph (2010) Wilhelm von Humboldt, Antrag auf Errichtung der Universität Berlin. Gründungstexte, S.243-250

THE SINGLE-CELLED ORGANISM FROM NORTH CAMPUS

In the new research building of the Institute of Biology, the “Green Amoeba“, seven working groups are cooperating, surrounded by the historic campus.

The North Campus is always worth visiting. Many Berliners know that an architectural and landscape-gardening gem is hidden in the center of Berlin. Now a new building is located on the site of the former Faculty of Veterinary Medicine: the “Green Amoeba“. This is what the biologists lovingly call their new research and laboratory building on Philippstraße, which is officially known as the Rhoda-Erdmann-Haus and was formally inaugurated on 11 October 2016.

The nickname is no accident. The building has an amorphous shape, and its metal façade includes three different shades of green. “We all feel very comfortable here. I think the building has character and it differs in a good way from the many gray research buildings, which are functional but not very attractive,“ says Christian Schmitz-Linneweber, a Professor of Molecular Genetics who has moved into the new building with his working group. A total of seven research groups are conducting research on molecular and cell biology here, alongside two junior research groups from the Institute of Biology.

Another peculiarity of the house is that the roof houses no technology. As the building is a protected monument, the huge cooling plants were banished to the basement. There are also different culture rooms for growing the bacteria, yeasts and plants that the scientists need for their work. A bright spot is the atrium, which features public art. The work of Kathrin Wegemann extends over three floors and symbolizes a loose cluster of cells. The large, black spots change color as temperatures fluctuate. Additionally, the building will house a sculpture of its patron, Rhoda Erdmann.

The new building, designed by the Stuttgart-based architecture firm BodamerFaber and financed and built by the Federal State of Berlin, enabled the Humboldt University to vacate a building at Chausseestraße 117, thereby eliminating high rental payments. “We used to work in a third back courtyard, which no one else ever ventured into. Now we are more centrally located and rub shoulders with other working groups,“ reports Schmitz-Linneweber.

The object of the construction planning was not only the new building, but also an adjacent historical building, which once served as a horse clinic and is now prosaically called “Haus 9”. The northern part was built in 1836 by Ludwig Ferdinand Hesse as a medical horse clinic; the southern part in 1874 by Julius Emmerich as an extension of the horse clinic. The building had to be gutted from the ground up. Only the historical façades remain and have been restored according to the specifications for monument preservation. “Haus 9” is the realm of students. On the ground floor are five rooms with work spaces for trainees. The attic, which had to be completely replaced due to its poor condition, accommodates lounges and workplaces for students. The new roof was financed by the university - the Senate building measure did not provide for the reconstruction.

The façade design of the “Green Amoeba“ is a counterpoint to the many clinker façades on North Campus. “On the site, three architectural styles are particularly striking: early and late classicism and modernism,“ says Theodor Hiepe, a connoisseur of the campus. He held the Chair of Parasitology from 1961 to 1995 and has been conducting research on site for over 55 years.

The jewel of the property is unquestionably the anatomical theatre for animals - designed by Carl Gotthard Langhans at the same time as the Brandenburg Gate. “At first, the dome was built on a gentle hill, which has meanwhile completely disappeared through the construction activities all around,“ reports Hiepe. The building in the early classical style was inaugurated in 1790 on the occasion of the foundation of the Royal Veterinary School.

Under the pressure of animal diseases and the mass death of cattle and horses during the Seven Years‘ War, and ultimately for reasons of competition – since veterinary schools had already been established in Lyon, Alfort, Vienna and Dresden - King Friedrich II commissioned the establishment of a school of animal medicine. Friedrich‘s personal physician, Christian Andreas Cothenius, was entrusted with the preparation of the concept, structure and function of a veterinary medical and research institute. For financial reasons, Cothenius‘s plans could not be realized immediately. The construction was then carried out under Friedrich Wilhelm II.

The Reuß Garden, a nine-hectare plot of land then situated just outside Berlin’s north-western city gate, was selected as the site.

Since the beginnings of the veterinary school, much water has flowed through the South Panke River (it is also dry at times), which winds its way through the garden from north to south. The clinic, institute, stable and residential buildings were built and partly demolished again. Despite rapid urban development, the garden area, including its historical paths, has been preserved largely intact until today.

In addition to the Langhans and Gerlach buildings, the latter of which is currently under restoration, a further building constructed according to the plans of a famous Berlin architect, Karl Friedrich Schinkel, is located on the protected site. The three-winged classicist construction with its court of honor at Luisenstraße 56 was built by Ludwig Ferdinand Hesse in 1840 on the occasion of the 50th anniversary of the veterinary school. The main building of the veterinary school served as a place to study and live. On the protruding center piece there are six medallions with modeled heads in two rows. “These are the twelve apostles of animal medicine, famous veterinarians or supporters of animal welfare, including Aristotle as a symbolic figure,“ explains Hiepe.

The main building on Luisenstraße was used during GDR times by the Ministry of Foreign Affairs, and later by other state institutions. A one-meter high wall separated the building on the garden side from the Faculty of Veterinary Medicine. The moment of reconquest arrived in January 1990. “Scientists and students had occupied the building and reclaimed it,“ Hiepe recalls of the time when his position changed from dean to squatter. The story had a happy ending when the building was returned to the Humboldt University in June on the occasion of the 200th anniversary of the faculty. The Faculty of Veterinary Medicine, however, was merged with the Free University, contrary to the recommendations of the Berlin Science Council, and integrated into it.

Today, the HU‘s Faculty of Life Sciences, including the Institute of Biology, is located on North Campus, and also cooperates with the Charité. This interaction has historical roots. “During the period of the Royal Veterinary Faculty from 1887 to 1934, both institutions worked closely together and established comparative medicine worldwide.“ The fact that the boundaries between human and animal medicine were fluid is also shown by the fact that the Institute of Pathology for Animal Medicine, “Haus 14”, was built from 1882 to 1884 on the initiative of the physician and pathologist Rudolf Virchow.

Another building should not go unmentioned: the modest “Haus 10” represents modernism. It was built in the Bauhaus style in the 1920s. This was the site of the pharmacy and the training forge. The building is located in the immediate vicinity of “Haus 22”, the Rhoda Erdmann Building.

Ljiljana Nikolic
Communication and Publications
Office of Press and Public Relations

WHO WAS RHODA ERDMANN?

The new research building of the Institute of Biology is named after the scientist Rhoda Erdmann (1870 - 1935), a biologist, cell researcher and co-founder of experimental cell biology in Germany. From 1903 to 1908 she studied zoology, botany and mathematics at the universities of Berlin, Zurich, Marburg and Munich. She was one of the first female doctoral students in Germany, where women were officially allowed to study after 1900. After graduation, she worked with Robert Koch at the Institute for Infectious Diseases.

Due to the poor working conditions for female scientists in Germany, she immigrated to the US in 1913 and initially worked at the Rockefeller Institute in New York, then at Yale University in New Haven. She returned to Berlin in 1919 and habilitated on 28 July 1920 as the second woman in zoology at the Faculty of Philosophy at the University of Berlin. In 1923 she moved to the Faculty of Medicine, where she was appointed an associated staff professor in 1929. She was the first woman to lead a scientific institute, the "Institute for Experimental Cell Research".

Image: Professor Rhoda Erdmann at the Laboratory of the State Library of Berlin - PK manuscript department, collection of portraits,Portr. Slg / Med. Kl / Erdmann, Rhoda, No. 4 License: CC-BY-NC-SA

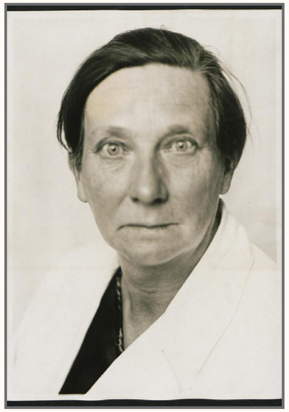


Image: University professor Dr. Rhoda Erdmann, 60 years: Head of the Department of Experimental Cell Research at the Charité of Berlin... Berlin State Library - PK manuscript department, collection of portraits, Portr. Slg / Med. Kl / Erdmann, Rhoda, No. 2 License: CC-BY-NC-SA

In 1925 Rhoda Erdmann founded the journal "Archive for Experimental Cell Research", which she edited until her death. In addition, she was involved in the founding of the international Society for Experimental Cytology and three congresses.

In the spring of 1933 she was denounced and imprisoned by the Gestapo for two weeks. It was only thanks to international protests, including from the US, that she was released relatively quickly. Several of her students had to emigrate; she was forced to retire and to leave her institute.

She died after a long illness on 23 August 1935.
Her international recognition is emphasized in an obituary in "Nature" (No. 136, Oct. 1935).

Source: Wikipedia, Mrs. Annette Vogt.

The artist Anna Franziska Schwarzbach, who created the bust of Rhoda Erdmann, at its unveiling. Photo: Ralph Bergel

The Rhoda-Erdmann bust, created by the Berlin artist Anna Franziska Schwarzbach, was unveiled on the 5th of July 2017 in the Rhoda Erdmann Building of the Faculty of Life Sciences at the Humboldt-Universität zu Berlin (HU).

Schwarzbach emphasized: "I am always fascinated by the clarity, the perseverance, the patience and the sincerity with which women like Rhoda Erdmann have made their way in a male-dominated environment. Their paths are full of obstacles, yet they continue undaunted. Rhoda Erdmann's courage, her upright attitude, her civil courage are exemplary."

Rhoda Erdmann (1870-1935) was one of the first female professors at the University of Berlin. In 1924, she was appointed as an extraordinary professor without tenure, and in 1929 she became an tenured extraordinary professor. She endured a difficult journey to recognition for her extraordinary work as a scientist. She is one of the founders of modern cell biology, wrote textbooks, was the founder and editor of the international journal "Archive for Experimental Cell Research". She was founder of the Association of German University Students and general secretary of the International Society for Experimental Cytology, an organisation which she also co-founded, until her death at the age of 64.

Schwarzbach previously won the competition for the Lise-Meitner memorial in the HU courtyard of honour. With the unveiling of the Rhoda-Erdmann bust, we honour another outstanding scientist from the Humboldt-Universität zu Berlin.

Teaching offer of the institute of biology

Range of studies at the institute for biology:

Bachelor of Science Undergraduate (B.Sc.)	Biology mono-(single-subject) bachelor Biology combination bachelor for teacher training only Biophysics mono-(single-subject) bachelor
Master of Science Graduate (M.Sc.)	Molecular life sciences Organismic biology and evolution Biophysics Computational neuroscience [in cooperation with the Technische Universität Berlin (responsible)]
Master of Education	Biology, focus on „vocational schools“ or „integrated secondary schools and grammar schools“

Structural facts undergraduate programmes:

Standard period of study	6 terms, 3 years
Total scope	180 credits
Mono-bachelor	one field of study, academic study amount biology or biophysics 160 credits
Combi-bachelor	only for teacher training, two fields of study, core subject biology 113 credits (combination with chemistry or physics only) or second subject biology 67 credits

Structural facts graduate programmes:

Standard period of study	4 terms, 2 years
Total scope	120 credits

All study programmes at the Humboldt-Universität zu Berlin include a special range of free elective modules (at least 10 credits) for interdisci-plinary studies.

Detailed information course catalogue Humboldt-Universität zu Berlin: https://www.hu-berlin.de/en/studies/counselling/course-catalogue/Standardseite?set_language=en

Student counselling:

Biology	Prof. Dr. Matthias Hennig lehre-und-studium@biologie.hu-berlin.de
Biophysics	Dr. Peter Müller peter.mueller.3@rz.hu-berlin.de
Teacher training	Prof. Dr. Annette Upmeier zu Belzen annette.upmeier@biologie.hu-berlin.de

Facts and numbers:

Admission and places (academic year 2018/19)

Study programme	Places	Admission (1. term)
Biology mono-bachelor	190	winter only
Biology core subject	60	winter only
Biology 2nd subject	45	winter only
Biophysics mono-bachelor	50	winter only
Biophysics M.Sc.	free	free
Computational neuroscience M.Sc.	15	winter only/ TU only
Molecular life sciences M.Sc.	50	winter and summer
Organismic biology and evolution M.Sc.	free	free
Biology M.Ed.	free	winter only

Applications and enrolments winter term 2018/19

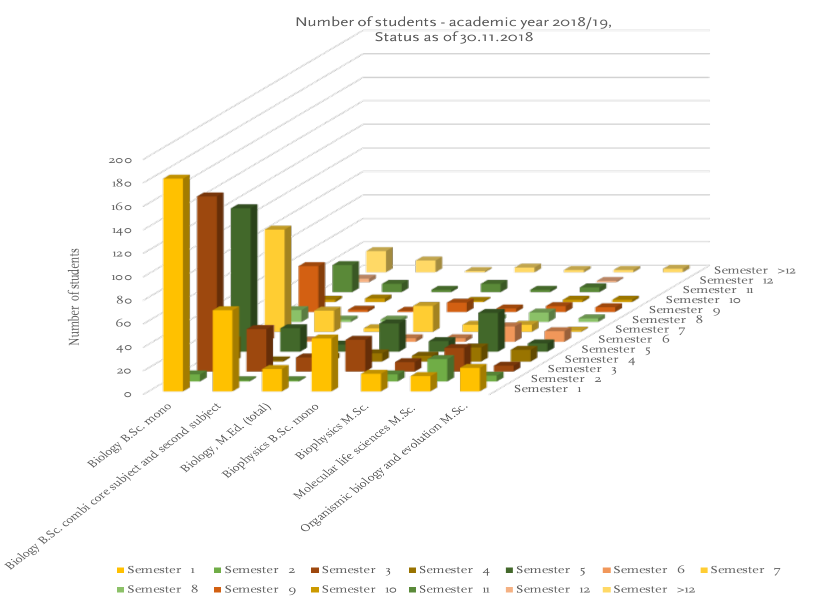
Study programme	Appl.	Enrolments
Biology B.Sc. mono	1352	179
Biology B. Sc. combi core subject	406	69
Biology B.Sc. combi 2nd subject	2072	43
Biophysics B.Sc. mono	219	45
Biophysics M.Sc.	28	15
Computational neuroscience M.Sc.	163	16
Molecular life sciences M.Sc.	79	10
Organismic biology and evolution M.Sc.	48	20
Biology M.Ed. (total)	77	53

Graduates (status 30.01.2019)

Study programme	Summer term 2018	Winter term 2017/18
Biology bachelor (total)	40	73
Biophysics B.Sc. mono	9	6
Biophysics M.Sc.	5	13
Molecular life sciences M.Sc.	23	29
Organismic biology and evolution M.Sc.	9	6
Biology M.Ed. (total)	13	21

Number of students – academic year 2018/19 (status 30.11.2018)

Study programme	Σ	Semester												
		1	2	3	4	5	6	7	8	9	10	11	12	>12
Biology B.Sc. mono	669	181	6	149	18	122	11	87	10	39	2	23	3	18
Biology B.Sc. combi core subject and second subject	170	69	1	36	1	20	1	18	2	2	3	7		10
Biology, M.Ed. (total)	51	19	1	12	4	6		3	2	1		2		1
Biophysics B.Sc. mono	148	45		27	7	24	3	22		8	1	7		4
Biophysics M.Sc.	62	15	6	8	5	9	3	6	3	3		2		2
Molecular life sciences M.Sc.	138	13	19	20	12	33	13	6	8	5	2	4	1	2
Organismic biology and evolution M.Sc.	69	20	5	5	10	7	9	1	3	4	2			3
Computational neurosciences M.Sc. (academic year 2017/18): Total: 56, 1. semester 17, >1. semester 39														



The number of students in the Computational neurosciences programme is not shown in the figure as it is not available for the academic year 2018/19.

Biophysics

FRANZ BARTL

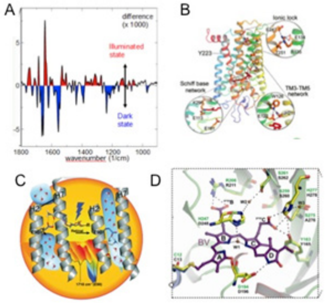
Biophysical chemistry
https://www.biologie.hu-berlin.de/de/gruppen/biophyschem_portal/
Description of the projects:

The topic of the research group “Biophysical Chemistry“ is the investigation of reaction mechanisms of various photoreceptors with spectroscopic methods, particulary with UV/ Vis and static and time resolved FTIR spectroscopy in the time range from ns to seconds. In order to improve the spectroscopic performance we also develop new advanced spectroscopic techniques.

We focus on three types of photoreceptors: Vetrebrate rhodopsin, channelrhodoposins and phytochromes. In the case of vertebrate rhodopsin we concentrate on the light induced activation and deactivation and on the mechanism of G-protein binding, since many severe eye diseases are linked to deviations in these processes caused by mutations of the receptor.

Channelrhodopsins are light-gated ion channels that are widely used in optogenetics, since they allow the precise control of neuronal activity by light.

Phytochromes are photoreceptors in plants and bacteria. They are bimodal photoswitches that control important physiological processes such as flowering, greening and seed germination with the potential to control cellular processes by light. An exact understanding of the reaction mechanisms of channelrhodopsins and phytochromes on a molecular level is of utmost biological and medical relevance and the prerequisite for a specific design for optimized optogenetic tools and broader applications.



A: FTIR difference spectrum of light induced rhodopsin activation. We use this technique to identify proton transfer reactions and related structural changes that occur during rhodopsin activation mediated by microswitch domaines (B), specific amino acid residues that play an essiential role in photocycle of channelrhodopsin (C) and protonation dynamics in the chromophore binding pocket of phytochromes (D).

Selected publications:

R. Kazmin, Rose, A., Szczepek M., Elgeti, M., Ritter E., Piechnik, R., Hofmann, K.P., Scheerer, P., Hildebrand P. and F. J. Bartl, Activation pathway of human rhodopsin: The activation pathway of human rhodopsin in comparison to bovine rhodopsin, J. Biol. Chem. 2015, 290, 20117 – 27

J. Kuhne, Eisenhauer, K. Ritter, E., Hegemann, P., Gerwert, K., and F. Bartl. „Early formation of the ion-conducting pore in Channelrhodopsin-2”, Angew. Chem. Int. Ed. Comm., 2015, 16, 4953-7

F. V. Escobar, Piwowarski P., Salewski, J., Michael N., Lopez M. F.,Rupp A.,Scheerer P., Bartl, F. J., Frankenberg-Dinkel N., Siebert F., Mroginski M. A., and P. Hildebrandt. „ A protonation-coupled feedback mechanism controls the signaling process in bathy phytochromes” Nature Chemistry, 2015, 5, 423 – 30

Contribution to research networks

Collaborative Research Center (CRC)1078:
Proteins are key players for many physiological processes such as mass transport, immune defense, blood clotting and communication between cells and environment. Thus the exact knowledge of protein function is of direct biological and medical relevance. Some established aspects of protein function are the key lock principal, substrate binding induced fit and protein- cofactor interactions. The central research goal of the SFB 1078 is to identify and understand a new key principal in protein science, namely the control and coordination of complex protein function by protonation dynamics. In this CRC (Project B05) we investigate the function of channelrhodopsins and phytochrome on a molecular level by UV/ Vis and FTIR differenece spectroscopy.

BMBF Project: Single-Shot-Spectrometer for time-resolved simultaneous Vis and IR measurements (BMBF ist 05K16KH1). The aim of this project is the set-up of a novel end-station at the IRIS-beamline of BESSY II for simultaneous, microsecond time-resolved infrared (IR)- and UV/ Vis spectroscopy of non-cyclic or slow-cycling systems. Such measurements are extremely difficult in the IR region since existing techniques for timescales of few ms or below require that the systems to be investigated are strictly cyclic with a fast photocycle, which is not the case, for example, for vertebrate rhodopsin or several channelrhodopsin mutants. The setup uses the unique properties of synchrotron radiation in combination with modern focal-plane array detectors to achieve a so far unreached performance for Single-Shot measurements.

Biophysics

ATHINA ZOUNI

Biophysics of the photosynthesis
https://www.biologie.hu-berlin.de/de/gruppenseiten/photobiophys
Description of the projects:

The base for oxygen photosynthesis in green plants, algae and cyanobacteria are two major membrane protein complexes, photosystem I (PSI) and photosystem II (PSII), which are built up of numerous subunits. The oxygen in the atmosphere is produced by a light-induced oxidation of water in PSII. The water oxidizing complex (WOC), which holds a Mn_4CaO_5-cluster, is catalyzing the reaction: $2\ H_2O \rightarrow O_2 + 4\ e^- + 4\ H^+$. Our main objective is the determination of the mechanism of the water splitting in PSII. This requires the identification of the substrate-water-molecules as well as the amino acid side chains and their protonation status in defined oxidation states of the WOC. This project includes the following fields: i) growing of PSII-crystals, ii) X-ray diffraction measurements of PSII-crystals (Dobbek, HU Berlin) at the synchrotron (BESSY), iii) Dynamic X-ray diffraction measurements (Fig. 1): these consist of femtosecond time resolution using a free (space) electron laser (XFEL) and simultaneous measurement of the oxidation status of Mn - ions in the Mn_4CaO_5-cluster with X-ray emission spectroscopy (Stanford, USA), as well as iv) examination of the protons at the WOC achieved through neutron diffraction measurements in macrocrystals (Oak Ridge, USA).

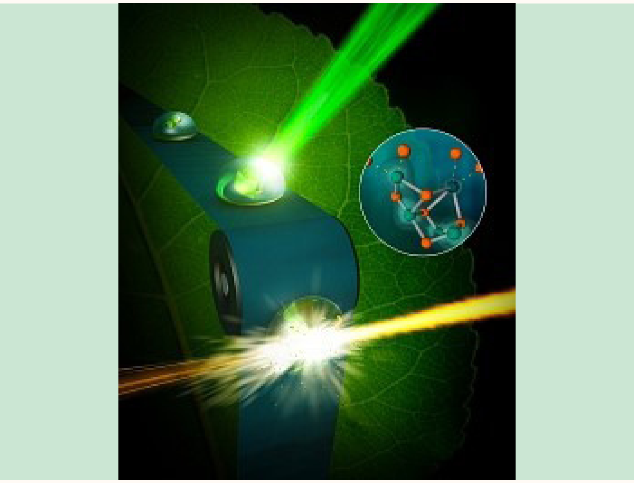


Figure 1: Femtosecond XFEL measurements at room temperature (LCLS-Stanford, USA) on our generated Photosystem II microcrystals at ca. 2.0 Å resolution. Hereby, the structures of the intermediates of Kok's photosynthetic water oxidation clock could be elucidated (Ref. Kern et al., Nature, 2018).

Selected publications:

Zhang, M., Bommer, M., Chatterjee, R., Hussein, R., Yano, J., Dau, H., Kern, J., Dobbek, H., Zouni, A. (2017) Structural insights into the light-driven auto-assembly process of the water-oxidizing Mn_4CaO_5-cluster in photosystem II. eLife;6:e26933. DOI: 10.7554/eLife.26933.

Kern, J., Chatterjee, R., Young, I. D., Fuller, F. D., Lassalle, L., Ibrahim, M., Gul, S., Fransson, T., Brewster, A. S., Alonso-Mori, R., Hussein, R., Zhang, M., Douthit, L., de Lichtenberg, C., Cheah, M. H., Shevela, D., Wersig, J., Seuffert, I., Sokaras, D., Pastor, E., Weninger, C., Kroll, T., Sierra, R. G., Aller, P., Butryn, A., Orville, A. M., Liang, M., Batyuk, A., Koglin, J. E., Carbajo, S., Boutet, S., Moriarty, N. W., Holton, J. M., Dobbek, H., Adams, P. D., Bergmann, U., Sauter, N. K., Zouni, A., Messinger, J., Yano, J., and Yachandra, V. K. (2018). Structures of the intermediates of Kok's photosynthetic water oxidation clock. Nature doi:10.1038/s41586-018-0681-2.

Contribution to research networks

CRC 1078 projekt A5 (Zouni/Dobbek): Structural basis of proton release from the water oxidizing complex in cyanobacterial photosystem II. Key aspects of this project are: improvement of the structure of PSII-crystals, static and dynamic X-ray diffraction measurements in combination with other spectroscopic methods, neutron diffraction measurements of macrocrystals.

Cluster of Excellence "Unifying Systems in Catalysis" projekt C3.3 (Zouni): „Assembly and disassembly of Photosystem II". Our focus is the determination of the light-induced composition and decomposition of the Mn_4CaO_5-cluster in the water oxidizing reaction in PSII (ref. Zhang et al, eLife, 2017) by using the XFEL method. Development of artificial catalysts.

Cluster of Excellence "Unifying Systems in Catalysis" project B2.2 (Zouni): "Coupled biocatalytic reactions". The ultimately goal of the project is to generate light-triggered enzymatic activity of different membrane protein supercomplexes in solution to serve as a template for artificial applications.

Federal Ministry of Education and Research (BMBF) projekt (Zouni/Lisdat): Basistechnologisches Forschertandem. Nutzung von Sonnenenergie für die Bioelektrokatalyse - Entwicklung von Bioelektrodenstrukturen für die Synthese". In this project deals with the isolation, stabilization, modification and assembly of photosystems and photosystem-componets in hybrid-assemblies for photobiocatalysis.

Biophysics

ANDREW PLESTED
Heisenberg professorship

Cellular biophysics

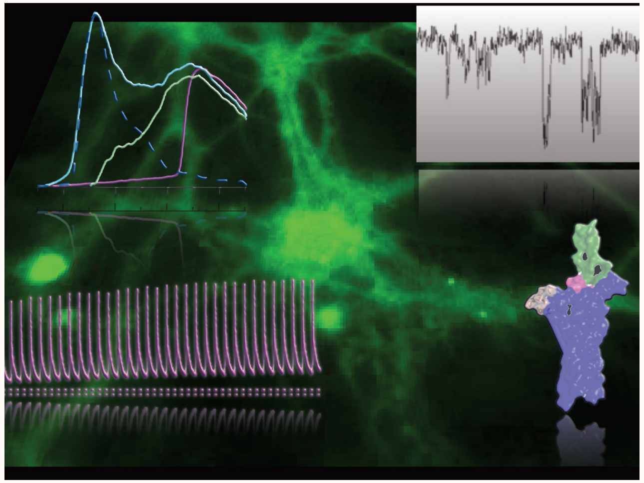
http://www.leibniz-fmp.de/research/molecular-physiology-and-cell-biology/research-groups/plested/mnbo.html

Description of the projects:

In the Cellular Biophysics group, we study glutamate receptors and other components of fast synaptic transmission. Synapses are the basic unit for recognising sensory stimuli and for processing information in the brain. They are also likely to be amongst the substrates for storing memories.

We use electrophysiology, structural biology and optical methods to elucidate the activation of glutamate receptors, which are the key responders at the postsynaptic membrane. We also perform computational simulations to bring these results together and generate new hypotheses in order to understand receptor activation at the most fundamental level. Finally, to understand synaptic transmission better in situ, we work to bring enzymes and receptors under the control of light, and also to engineer proteins that can act as reporters of neurotransmission.

In different parts of the brain, synapses have distinct functions that are reflected by their molecular diversity. Receptors appear to be regulated by a large number of factors from both inside and outside the cell, ranging from ions to small molecules, enzymes, associated proteins and physical features like cellular scaffolds. Therefore, one of our major goals is to understand how receptor composition and properties determine synaptic transmission. This work naturally extends to understanding how synaptic responses change over short and long timescales in response to activity and input.



Collage showing (clockwise from top left): spectral FRET of glutamate receptor complexes, single channel recording, model of Stargazin and superactivation of an AMPA receptor. Background is a hippocampal neuron expressing a glutamate sensor.

Selected publications:

Baranovic J and Plested AJR (2018) Auxiliary Proteins keep AMPA receptors compact during activation and desensitization eLife DOI: 10.7554/eLife.40548.

Yu A†, Salazar H†, Plested AJR*, Lau AY* (2018) Neurotransmitter funnelling optimises glutamate receptor kinetics Neuron 97:139-149 †These authors contributed jointly. *Corresponding authors.

Riva I†, Eibl CE†, Volkmer R, Carbone AL*, Plested AJR* (2017) Control of AMPA receptor activity by the extracellular loops of auxiliary proteins eLife †These authors contributed jointly. *Corresponding authors.

Contribution to research networks

ERC Consolidator Grant “GluActive”. With the support of the European Research Council, we investigate glutamate re-ceptor activation at the most fundamental level.

DFG Major instrumentation initiative „Inovative, Experimental Optical Microscopes for Research“. A Modular Dual 2-Photon Microscope for Multimodal Optogenetics, Synapse Biophysics and Beyond. https://www.dfg.de/service/presse/pressemitteilungen/2018/pressemitteilung_nr_59/index.html

Cluster of Excellence NeuroCure. Within the NeuroCure Cluster of Excellence, a joint project of the federal and Berlin state governments, we pursue neuroscience research with scientists based at the Charite Universitätsmedizin and institutes throughout Berlin.

The Einstein Center for Neurosciences Berlin. This center is funded by the State of Berlin. Its goals include promoting integrative neuroscience research and providing junior neuroscientists with an exemplary interdisciplinary education.

CRC/TR 186. The DFG-funded Transregio 186 spans Heidelberg and Berlin. In this context we work with Peter Hegemann to investigate calcium-dependent enzymes and plasticity in neurons.

Research group (FG) 2518 “Dynion“ Dynion is a research group funded by the DFG with members drawn from throughout Germany. Its members study ion transport across membranes in a tight collaboration between ion channel biophysicists and computational biology experts.

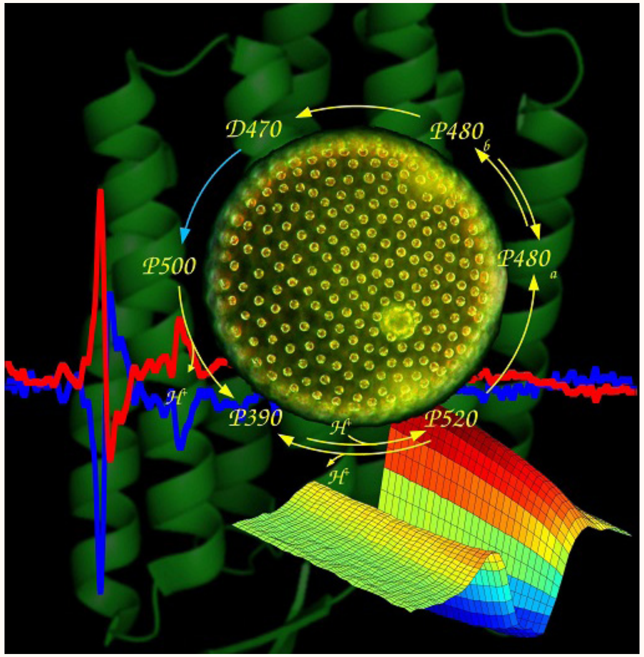
Biophysics

PETER HEGEMANN
Hertie professorship for
Neurosciences

Experimental biophysics
https://www.biologie.hu-berlin.de/de/gruppenseiten/expbp/home

Description of the projects:

No other biological macromolecules can be characterized as well and comprehensive as photosynthesis protein-complexes and sensory photoreceptors on time scales ranging from fs to minutes (10^{-15} s to 10^{2} s). Our research group studies the structure-function relation of sensory photoreceptors from algae, fungi and bacteria. Based on electrophysiological studies on the unicellular alga *Chlamydomonas reinhardtii* we predicted that the eyespot of the alga contains directly light-activated ion channels that after light absorption cause extremely fast depolarization of the plasma membrane. In 2001 we identified theses proteins and named them Channelrhodopsins (ChRs). We characterized these novel photoreceptors by a variety of biophysical methods and engineered many variants with altered absorption, kinetics and ion selectivity. These ChRs are now widely applied in the neurosciences for depolarization and activation of selected neurons in large neuronal networks - as for example the mouse brain - with unprecedented precision in time and space, a technology now established as *Optogenetics*. In parallel, we study photoactivatable enzymes with flavin- or rhodopsin-based light-sensing modules to control cellular second messengers cAMP and cGMP non-invasively with light. Recently we returned to Chlamydomonas and established gene targeting technology for deletion and modification of all 18 sensory photoreceptors in hope to understand the network of light sensing in the context of the living alga in its ecological environment.



Collage with the green alga *Volvox globator*, photocycle of a light-activatable channelrhodopsin, 3D-structur in the back, FTIR-difference spectrum (red/blue) and transient absorptions changes.

We work as an interdisciplinary international team with biochemical and biophysical methods as light scattering, electrophysiology, imaging, time resolved Uv/Vis and FTIR spectroscopy, protein crystallization on the steadily improving atomistic understanding of sensory photoreceptors.

Selected publications:
Greiner, A., Kelterborn, S. et al. (2017) Targeting of Photoreceptor Genes in *Chlamydomonas reinhardtii* via Zinc-finger Nucleases and CRISPR/Cas9. Plant Cell 29(10):2498 - 2518.

Scheib, U. et al. (2018) Rhodopsin-cyclases for light-induced cGMP & cAMP production and 2.3 Å structure of an adenylyl cyclase domain. Nature Comm. 9(1):2046.

Bernal-Sierra Y-A. et al. (2018) Potassium channel-based optogenetic silencing. Nature Comm. 9:4611.

Contribution to research networks (Selection)

Cluster of Excellence „Unifying Systems in Catalysis“ and Einstein-Center of Catalysis. We study histidine-kinase-rhodopsins and light-modulated enzymes with flavin-based and Phytochromelight sensors. https://www.unisyscat.de/research-units/signal-controlled-multicomponent-catalysis.html

CRC 1078 Protonation dynamics in protein function. Analysis of natural and artificial customized light-activated ion channels and pumps.

CRC/TR 186 Molecular switches for temporal and special regulation of cellular signaling processes. We collaborate with Andrew Plested on the development of Ca-selective light-gated ion channels for application in neuronal systems.

Einstein-Centers for Neuroscience and DFG Priority program 1926 „Next Generation Optogenetics“. We develop in collaboration with B. Rost, Charité, light-activated pumps and channel for application in cell compartments.

ERC-Advanced Grant
Characterization of rhodopsin-guanylyl-cyclases, as members of a so far uncharacterized rhodopsin family.

Within the EU Network “Stardust” we work on Channelrhodopsins with increased K^+-selectivity.

Within NEUROCURE we work on Analysis and optogenetik configuration of bimodal switchable animal rhodopsins.

Biophysics

N. N.

Optogenetics/ Optobiology
http://www.

Description of the projects:

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Selected publications:

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Contribution to research networks

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Biophysics

ENRICO KLOTZSCH
Junior professorship

Experimental biophysics
https://www.biologie.hu-berlin.de/de/gruppen/jpexpbp_portal/
Description of the projects:

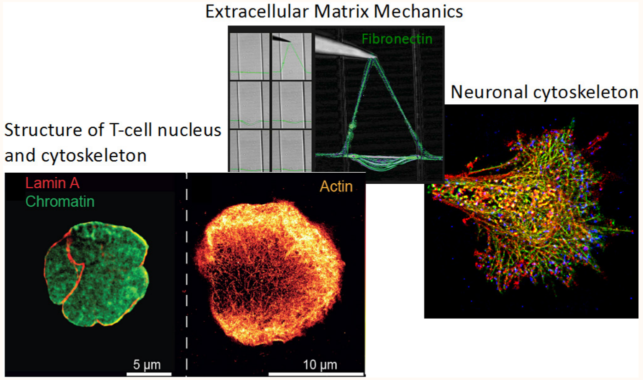
Structure - not only on the molecular level – defines function. Our group aims in bridging the gap between structural and cell biology, particularly to decipher the mechanical aspects of how cells sense and react to their environment. This includes asking how cells employ forces to probe the interaction to other molecules such as receptor-ligand interactions to switch biochemical function, i.e. T-cell activation, migration or their interaction with the extracellular matrix. Furthermore we investigate how these insights can be exploited for biomedical applications.

We use state-of-the-art single molecule microscopy techniques such as super-resolution microscopy, AFM and optical tweezer to gain insights into general aspects of mechanobiology, membrane biophysics, neurobiology and immunology.

Selected publications:

Fibronectin forms the most extensible biological fibers displaying switchable force-exposed cryptic binding sites. E Klotzsch, ML Smith, KE Kubow, S Muntwyler, WC Little, F Beyeler, D Gourdon, BJ Nelson, V Vogel (2009), Proceedings of the National Academy of Sciences 106 (43), 18267-18272.

Superresolution microscopy reveals spatial separation of UCP4 and FoF1-ATP synthase in neuronal mitochondria. E Klotzsch, A Smorodchenko, L Löfler, R Moldzio, E Parkinson, GJ Schütz, EE Pohl (2015), Proceedings of the National Academy of Sciences 112 (1), 130-135.



Left: Super-resolution Microscopy is applied to nuclear and cytoskeletal structure of an activated T-cell.

Top: Mechanical properties of single fibronectin fibers are tested using microelectrical mechanics sensors in combination with confocal microscopy.

Right: 3-color super-resolution microscopy is employed to investigate the structure of growth cones.

Contribution to research networks

Australian Government
Australian Research Council

Council - Defining the spatial and temporal regulation of neurite branching: The project is in collaboration with Prof. Dr. T. Fath at UNSW Sydney. The overarching aim of this project is to use super-resolution microscopy to decipher the role of the actin cytoskeleton-associated protein tropomyosin in cell extension of nerve cells (neurons) which is essential for establishing neuronal networks in vitro and in vivo.

HFSP - Mechanical regulated gene expression during T-cell activation: Dr. Klotzsch together with Dr. Ries (EMBL Heidelberg) got awarded the Human Frontiers Science Program Young Investigator Award this project will be carried out at ETH Zurich, Switzerland, where Dr. Klotzsch holds a second affiliation. The spatial organization of chromatin is of key importance for gene expression and maintenance. Different from stem cell differentiation, during T-cell activation gene regulation happens on a much faster timescale, as the immune response is critical for the bodies defense mechanism. A likely regulatory mechanism for this is the chromatins' 3D structure and its interaction with nuclear lamina.

Here we will study how mechanical forces `ultimately regulate gene expression. We hypothesize that mechanical force triggers structural/conformational changes of nuclear lamina network; hence genes encoded in chromatin proximal to lamina can be up/downregulated. We propose to develop new Super-Resolution Microscopy and live-cell imaging technologies and combine them with single cell transcriptomic and epigenetic markers in a correlative approach to resolve the 3D structure of lamina associated chromatin domains and their dynamics during T-cell activation.

Biophysics

ANDREAS HERRMANN

Molecular biophysics
https://www.biologie.hu-berlin.de/de/gruppen/molbp_portal/standard
Description of the projects:

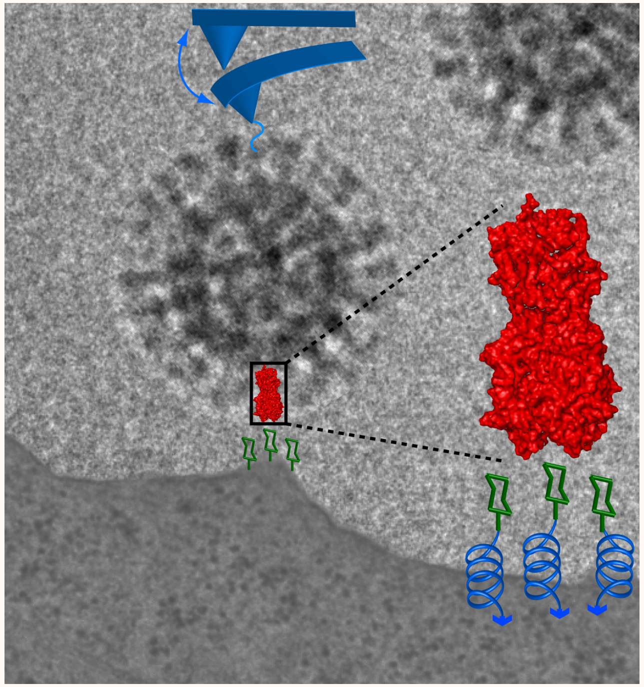
The Molecular Biophysics lab investigates molecular mechanisms of host cell entry, assembly and budding of enveloped viruses, for example of Influenza, Hanta and Ebola viruses. For this purpose, several spectroscopic methods as well as high and super resolution microscopy approaches are applied which allow investigations of single infected living cells and single viruses.

In collaboration with innovative companies in the Berlin area complex biophysical methods for studies of virus-host cell interactions are adapted and developed.

Selected publications:
Sieben, C., Kappel, C., Zhu, R., Wozniak, A., Rankl, C., Hinterdorfer, P., Grubmüller, H., Herrmann, A. (2012) Influenza virus binds its host cell using multiple dynamic interactions. Proc Natl Acad Sci U S A. 109:13626-13631.

Lauster, D., Glanz, M., Bardua, M., Ludwig, K., Hellmund, M., Hoffmann, U., Hamann, A., Böttcher, C., Haag, R., Hackenberger, C., Herrmann, A. (2017) Multivalent Peptide-Nanoparticle-conjugates for Influenza Virus Inhibition. Internat. Ed. Angewandte Chemie, 56, 5931-5936.

Sperber, H.S., Welke, R.-W., Petazzi, R.A., Bergmann, R., Schade, M., Shai, Y., Chiantia, S., Herrmann, A.*, Schwarzer, R.* (2019) Self-association and subcellular localization of Puumala JHantavirus envelope proteins. Sci. Rep., 2019 Jan 24;9(1):707. doi: 10.1038/s41598-018-36879-y (*corr. authors)



Combined experimental and simulated approach used to characterize attachment of influenza A virus to host cells at molecular level. Binding is accomplished between the viral hemagglutinin (red) and the sialic acid terminated glycans on the cell surface (green). Intact viruses attached to an Atomic Force Microscopy (AFM) cantilever were bound to the cell surface. Retraction of the cantilever until bond failure revealed the size of the underlying force. The approach allows to characterize virus-cell binding in a set-up that mimics the biological situation very closely. This was extended by force probe MD simulation, where a `virtual spring´ is attached to the ligand which is then pulled out of the HA binding pocket

Taken from Dr. Christian Sieben

In joint projects with chemists, physicists and virologists we unravel the 3D structure and physical properties of viral proteins and develop/patent multivalent antiviral drugs.

Contribution to research networks

CRC 765
Multivalence as chemical organization and action principle: New architectures, functions and applications

- Development of multivalent antiviral drugs.

EU Infect-ERA: HantaHunt - Structure and function analyses of the Hantavirus envelope glycoproteins and their role in virus assembly, virus entry and immune recognition, as novel targets for antiviral treatment (coordinator)
Role of viral spike proteins in assembly of Hanta viruses

International Graduate Training Program (IRTG) IRTG 2290: Crossing Boundaries: Molecular Interactions in Malaria.

- Develop curative and prophylactic drugs against Plasmodium infections.

https://www.allianceberlincanberra.org/

IRI Life Sciences: The IRI for the Life Sciences at the Humboldt University is a collaborative research institute founded in collaboration with the Charité Hospital and the Max-Delbrück-Centrum for Molecular Medicine with the goal of bridging theoretical and quantitative experimental approaches at multiple scales of biology, from molecules to cells to organisms and populations.

Biophysics

EDDA KLIPP

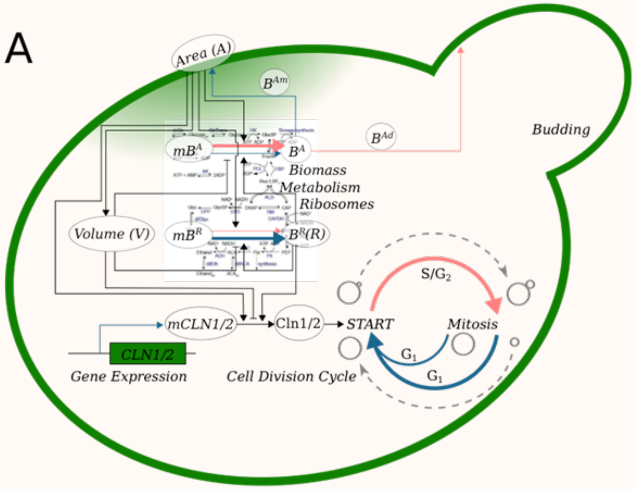
Theoretical biophysics
https://rumo.biologie.hu-berlin.de/tbp/index.php/en//

Description of the projects:

How does a cell optimaly respond to stress? Which enzymes determine the fluxes through a metabolic network? What is the contribution of different ion channels to ion fluxes? How do single cells communicate during mating? What is the role of osmotic pressure during the cellular growth process?

To answer such question about the regulation of cellular processes, the research group of Theoretical Biophysics develops dynamic mathematical models. The methods comprise the description with ordinary and partial differential equations, the theory of dynamic systems, parameter estimation based on different types of experimental data as well as sensitivity analyses. In addition, we apply discrete network models, agent based or rule based modeling approaches as well as game theory.

The yeast *Saccharomyces cerevisiae* is our most important model organism. Here, we also measure experimentally the dynamics of gene expression or markers for cell cycle progression in single cells and cell populations, for example with fluorescence microscopy and in microfluidics systems. In close collaboration with experimental groups we also develop mathematical models for host-pathogen interactions or for the regulation of metabolism in cancer cells.



Schematic of important processes for the growth of yeast cells: nutrient uptake over the cellular membrane and synthesis of biomass within the cell volume together determine the coordination between progression of cell cycle and the growth of the cell.

Taken from Spiesser et al. FEBS J (2012)

Selected publications:

Klipp E, Liebermeister W, Wierling C, Kowald A. 2016. Systems Biology. A Textbook. (second revised edition) Wiley-Blackwell, Weinheim, 504 p., ISBN: 978-3-527-33636-4.

Gerber S, Fröhlich M, Lichtenberg-Fraté H, Shabala S, Shabala L, Klipp E. (2016) A Thermodynamic Model of Monovalent Cation Homeostasis in the Yeast Saccharomyces cerevisiae. PLoS Comput Biol. 12(1):e1004703.

Contribution to research networks

Research Training Group (RTG) 1772
Computational Systems Biology

CRC/TR 175: The Chloroplast as Central Coordinator of Acclimation in Plants. In collaboration with 18 participating project partners, the astonishing role of chloroplasts as sensors and signal emitters in acclimation processes is being analysed. The consortium of these partners is predominantly using quantitative biological tools in their aim to show the complexity of chloroplast functions in acclimation to temperature and light changes.

TRR 175

BMBF 031A303C – SysToxChip:
Design of multi-organ chips to test toxicities of xenobiotics on human liver and kidney.

SPONSORED BY THE
Federal Ministry of Education and Research

EU Marie Curie Network 642836 : Protein Factory - Engineering of New-Generation Protein Secretion Systems.

MARIE CURIE ACTIONS

EU Marie Curie Network 675585 SymBioSys: Systematic Models for Biological Systems Engineering Training Network.

MARIE CURIE ACTIONS

Einstein-Stiftung Network “Single molecule RNA biology - dynamics and function of RNA from transcription to degradation” http://www.iri-lifesciences.de/en/EinsteinNetzwerk.html.

EINSTEIN Foundation.de
Einstein Stiftung Berlin
Einstein Foundation Berlin

Botany

KURT ZOGLAUER

Botany and Arboretum
https://www2.hu-berlin.de/biologie/arboretum/
Description of the projects:

The research group “Botany and Arboretum“ has two different research subjects.

Picture: Heidrun Kostial, working group Botany and Arboretum

Selected publications:
Zoglauer K, Behrendt U, Rahmat A, Ross H & Taryono (2003) Somatic embryogenesis – the gate to biotechnology in conifers. Pp. 175-202 in: Laimer M & Rücker W (eds.) Plant Tissue Culture 100 years since Gottlieb Haberlandt. Springer, Wien.

Köhler E (2014) Buxaceae. Pp. 1-124 in: Greuter W (ed.) Flora de la República de Cuba, Series A: Plantas Vasculares, Fascículo 19: Buxaceae, Lauraceae, Theophrastaceae. Koeltz Scientific Books, Königstein.

Picture: Heidrun Kostial, working group Botany and Arboretum

The group “Plant developmental biology“ (the labs are mainly located in Berlin, Invaliden-str.) works on fundamental problems and applications of somatic embryogenesis in plant species wich are difficult to propagate by clonal methods, first of all economically important conifers, e.g. Larix and Abies species and hybrids, but also orchid species of horticultural interest. The group “Systematic Botany“ (at Späth-Arboretum of the Humboldt-Universität in Berlin-Baumschulenweg) works on the diversity, systematics, morphology and evolution of plants with a taxonomic focus on seed-free vascular plants and a geographic focus on tropical Africa and the Caribbean. The group is involved in the compilation of large tropical Floras. Further tasks include public environmental education and and plant conservation.

Contribution to research networks

Dendromax: Development and introduction of biotechnological procedures for breeding, production and application of high performing varieties of selected tree species, FNR. Basing on the results of traditional forest tree breeding new biotechnological breeding strategies and procedures will be developed and applied to create high-yielding varieties of Larix hybrids, Abies hybrids, Douglas fir and Aspen.

OptiTanne: Development, Testing and Evaluation of a technological process for clonal mass propagation, plantlet development and clone evaluation in *Abies nordmanniana*, BMBF.
In Abies nordmanniana and other attractive Abies species specific methods of clonal mass propagation via somatic embryogenesis will be developed and tested to create clonal varieties for christmas tree production and ornamental uses.

Klonidee: Development of new biotechnologically based breeding and production methods for Lady slipper orchids (*Cypripedium, Paphiopedilum*), BMBF.
Lady slipper orchids, mainly oft he genera *Cypripedium* and Paphiopedilum have a high horticultural and economical importance as exclusive and long-living ornamentals for outdoor and indoor cultivation. Traditional horticultural techniques of clonal mass propagation are inefficient or impossibl. In *Cypripedium* somatic embryogenesis has sucessfully been applied for the development of clonal varieties and shall now be applied to tropical species and hybrids.

Comité Cientifico Nacional para la Flora de Cuba: There are about 6.500 species of vascular plants on Cuba, more than half of them being en-demics. „Flora de Cuba“ is the first inventory ever of this diversity, which is being made accessible to researchers and decision makers through detailed taxon descriptions and deter-mination keys. The project is being coordinated by the Botanical Garden and Botanical Museum Berlin-Dahlem.

Comité de Rédaction de la
Flore d’Afrique centrale:
“Flore d’Afrique centrale“ records about 12.000 species of vascular plants occurring in the Democratic Republic of Kongo, Rwanda and Burundi, making this diversity accessible to researchers and decision makers for the first time by providing detailed taxon descriptions and determination keys. This flora project is being coordinated by the Botanic Garden Meise (Belgium).

Botany

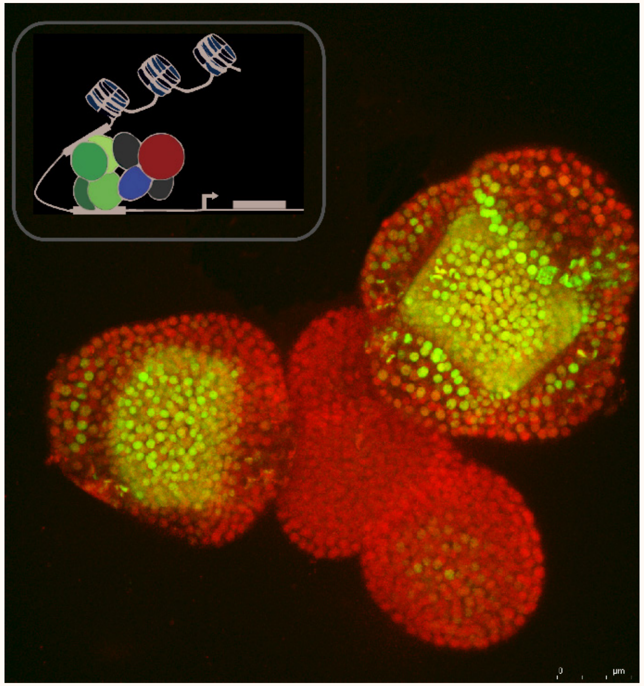
KERSTIN KAUFMANN

Plant cell and molecular biology
https://www2.hu-berlin.de/biologie/flower/

Description of the research area:

Plants are able to generate new organs and distinct cell types throughout their life cycle. This fascinating property relies on the function of stem cells that are localized in so-called meristems in shoot and root. Our research is centered on the question, how cell and organ differentiation is encoded in the genome, and how this code is read and executed - depending on growth stage of the plant and on environmental factors.

Our model system is flower development in the model plant *Arabidopsis thaliana* and its closest relatives. We study the functions of homeotic transcription factors. These factors form higher-order protein complexes to specify the distinct organ types in the flower: sepals, petals, stamens and carpels. We characterize gene-regulatory networks and the interplay with epigenetic mechanisms in transcriptional regulation. Furthermore, we are interested how generegulatory networks diversified during plant evolution.



Large image: Expression of a GFP-labelled floral homeotic transcription factor in a young floral meristem in *Arabidopsis*. Small image: Model of a complex of floral homeotic proteins and cofactors, which simultaneously bind to two genomic DNA sites and thereby regulate target gene activity.

Selected publications:

Kaufmann, K., A. Pajoro and G.C. Angenent: Regulation of transcription in plants: mechanisms controlling developmental switches. Nature Reviews Genetics, Dec 2010. 11(12): p. 830-842.

Pajoro A., P. Madrigal, J.M. Muiño, J.T. Matus, J.Jin, M.A. Mecchia, J.M. Debernardi, J.F. Palatnik, S. Balazadeh, M. Arif, D.S. Ó'Maoiléidigh, F. Wellmer, P. Krajewski J.L. Riechmann, G.C. Angenent and K. Kaufmann: Dynamics of chromatin accessibility and gene regulation by MADS-domain transcription factors in flower development. Genome Biology. 2014. 15:R41.

Contribution to research networks

DFG-ANR-Project:
(Collaboration with Francois Parcy and Chloe Zubieta, CNRS Grenoble). Within the framework of this collaboration, the interactions between key-regulatory transcription factors controlling early flower development and chromatin will be investigated.

Sofja-Kovalevskaja project of the Alexander-von-Humboldt-Stiftung. This projects investigates mechanisms of gene regulation in plant development. We use flower development in *Arabidopsis thaliana* and closely related species as a model system.

TR Berlin-Heidelberg „Mitosis“

ERA-CAPS proposal: The Genetic Basis for Robusntess in Flowering Plants. Collaborative project proposal with Brendan Davies, Leeds University (UK), Karin Koehl, MPI-MP Potsdam-Golm and Hansjoerg Stampfl, Austrian Institute of Technology (AUT)

IRTG 2403: Dissecting an reengineering the regulatory genome.

Professorship

PLACEHOLDER
Tenure Track professorship

Systematic botany and biodiversity
https://www.

Description of the projects:

Selected publications:

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Botany

BERNHARD GRIMM

Plant physiology

https://www.biologie.hu-berlin.de/en/gruppenseiten-en/plantphys

Description of the projects:

The Department of Plant Physiology works on several aspects of modern molecular physiology and cell biology in plants. Multiple methods and techniques of biochemistry, genetics, molecular and cell biology are applied in research and training programs for students and young academics. We are interested in the unique properties and functions of plant cells, such as the primary metabolism, pigment biosynthesis and photosynthesis in plastids and focus our efforts on exploring the metabolic control of tetrapyrrole biosynthesis. We study the intracellular communication between the nucleus and the two main plant organelles, plastids and mitochondria, in particular the tetrapyrrole-mediated signalling of plastids. A further research area is the regulation of sucrose transport.

Greenhouse

Impressions of the greenhouse. on the roof. Tobacco plants. Photo: Andreas Richter

The Department of Plant Physiology contributes with several courses to the teaching programme organized by the Institute of Biology. “Basics of Plant Physiology” including lectures and a practical course are offered in the Bachelor programme, while in the Masters programmes “Molecular Life Sciences” and “Organismic Biology and Evolution” lectures and training courses in “Plant Molecular Biology”, “Confocal Laser Scanning Microscopy”, “Photosynthesis” and “Plant Transformation Techniques” are scheduled. They are combined with specialized lectures and seminars in photosynthesis, stress physiology, signal transduction and hormone physiology for advanced students. Students and PhD students report about their experimental work in the weekly progress seminar of the Department of Plant Physiology.

Selected publications:

Wang P, Liang FC, Wittmann D, Siegel A, Shan SO, Grimm B. Chloroplast SRP43acts as a chaperone for glutamyl-tRNA reductase, the rate-limiting enzyme intetrapyrrole biosynthesis. Proc Natl Acad Sci U S A. 2018 Apr10;115(15):E3588-E3596. doi: 10.1073/pnas.1719645115.

Brzezowski P, Ksas B, Havaux M, Grimm B, Chazaux M, Peltier G, Johnson X,Alric J. The function of PROTOPORPHYRINOGEN IX OXIDASE in chlorophyllbiosynthesis requires oxidised plastoquinone in Chlamydomonas reinhardtii. CommunBiol. 2019 May 3;2:159. doi: 10.1038/s42003-019-0395-5.

Contribution to research networks

Cubes Circle BMBF Project, An interdisciplinary team of researchers of the Life Science Faculty and industrial partners. Mission of the Project: In the future, food production will be based on connected and standardized production modules communicating with each other. Together they form the CUBES Circle.

CRC/TR 175: The Chloroplast as Central Coordinator of Acclimation in Plants. In collaboration with 18 participating project partners, the astonishing role of chloroplasts as sensors and signal emittors in acclimation processes is being analysed. The consortium of these partners is predominantly using quantitative biological tools in their aim to show the complexity of chloroplast functions in acclimation to temperature and light changes.

Research group 2092 Term from 2014 to 2020: Biogenesis of thylakoid membranes: Spatio-temporal organization of photosynthetic protein complex assembly.

Priority program 1710: Dynamics of Thiol-based Redox Switches in Cellular Physiology.

Professorship

PLACEHOLDER
Junior professorship

Physiology of plant cell organelles
https://www.

Description of the projects:

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Selected publications:

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Contribution to research networks

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Didactics

ANNETTE UPMEIER ZU BELZEN

Biology education
https://www2.hu-berlin.de/biologie/biodidaktik

Description of the projects:

Biology Education is the science of learning and teaching biological content knowledge and inquiry methods. The main research focus is the modeling and measuring of pupils', students' and teachers' competencies in the area of scientific reasoning (BMBF-KoKoHs). The research questions are dealt with methods of empirical social research. We apply these in experimental intervention studies in which we investigate the effectiveness of teaching units as well as teaching and learning material. The transfer of the outcomes of this international basic research into school practice takes place through several publications, training courses and the Humboldt-ProMINT[1] -Kolleg, in which the STEM-disciplines contribute to development research in the project „Schülerlabore als Lehr-/Lernlabore“ (Deutsche Telekom Stiftung).

Scientific expertise as a demand of schools, universities and educational administration, is addressed in the structured doctoral programme ProMINTion through its central aim to promote junior scientists in the STEM-education.

Picture: Bernd Prusowski Exhibitions from a specialist collection.

Selected publications:
Upmeier zu Belzen, A., Krüger, D. & van Driel, J. (Hrsg.) (in press).Towards a Competence-based View on Models and Modeling in Science Education. Book Series: Models and Modeling in Science Education. Springer.

Upmeier zu Belzen, A., Alonzo, A., Krell, M. & Krüger, D. (in press). Learning progressions and competence models in science education – a comparative analysis. Selected Papers from the ESERA (European Science Education Research Association) 2015 Conference. Springer.

Meister, S., Zimmerman, C. & Upmeier zu Belzen, A. (2018). Visualizing pre-service biology teachers‘ conceptions about population dynamics in ecosystems. Science Education Review Letters, 2018, 7-12. https://doi.org/10.18452/19423.

Contribution to research networks

Modeling and Measuring Competencies in Higher Education- validations and methodical innovations: (KoKoHs, http://www.kompetenzen-im-hochschulsektor.de). Within the framework of the BMBF research program, the scientific transfer project is responsible for the national and international, interdisciplinary cross-universities coordination of research projects in the area of validation and methodical innovation of “Modeling and Measuring Competencies in Higher Education- validations and methodical innovations“. In co-operation with Freie Universität Berlin, Ko-WADiS[2] was one of 23 in the first phase and ValiDiS[3] is currently one of 15 projects funded in the second phase with a total volume of around EUR 1.5 million.

Digital STEM education of the future: technology-based - adaptive -critical: „The future of STEM learning“ - In cooperation with the universities of Kiel, Koblenz-Landau, Würzburg and Kaiserslautern, Humboldt-Universität zu Berlin will develop innovative concepts for STEM education in the digital world from autumn 2018 onwards and integrate them into the education and training of STEM teachers. The Telekom Foundation is supporting the project with € 1.6 million.

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[1] Mathematics, Engeneering, Natural Science, Technology

[2] Evaluating the development of scientific literacy in teacher education

[3] Competence modelling and assessment: Validation of the test score interpretations of a scientific reasoning test

Microbiology, molecular biology and biochemistry

MARC ERHARDT

Bacterial physiology
http://www.baktphys.hu-berlin.de
Description of the projects:

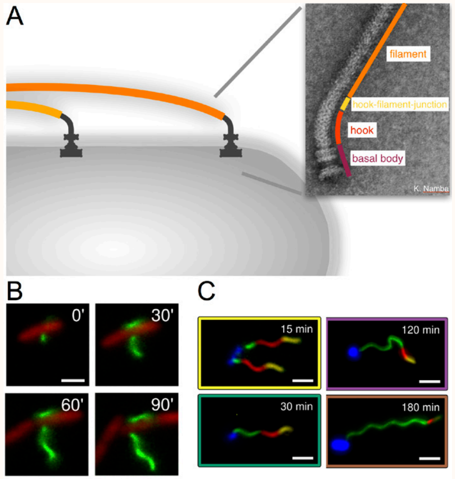
Salmonella are motile pathogens that employ multiple virulence factors to cause gastrointestinal infections. Flagella are the primary motility organelle of bacteria and allow the pathogens to reach the preferred site of infection. The evolutionary-related injectisome is responsible for injection of toxins into eukaryotic host cells.

However, the regulatory mechanisms that control the biosynthesis of these systems, as well as the molecular details of the assembly and protein export function of the flagellum and injectisome remain largely obscure. Accordingly, these self-assembling nanomachines are attractive model systems that allow us to address fundamental research questions in bacterial physiology and microbial pathogenesis.

We thus pursue the following main research questions:

1. What is the role of flagella and bacterial motility in the infection process?
2. How does *Salmonella* regulate its gene expression profile to adapt to diverse and hostile environments inside the host?
3. What are the molecular mechanisms of flagellum assembly and the type-III protein secretion process?

We address these research questions in a hypothesis-driven approach using a combination of sophisticated bacterial genetics and genetic engineering, biochemistry and live-cell microscopy techniques.



Self-assembly of the bacterial flagellum. (A) Schematic illustration (left) and electron micrograph image (right) of bacterial flagella. (B) Real-time imaging of the assembly of flagellar filaments (green) of Salmonella (red) using Total Internal Reflection Fluorescence (TIRF) microscopy. (C) Muli-color labelling of the bacterial flagellum allows to analyze the growth dynamics of flagellar filaments.

Selected publications:

I. Spöring, V. A. Martinez, C. Hotz, J. Schwarz-Linek, K. L. Grady, J. M. Nava-Sedeno, T. Vissers, H. M. Singer, M. Rhode, C. Bourquin, H. Hatzikirou, W. C. Poon, Y. Dufour, M. Erhardt. Hook length of the bacterial flagellum is optimized for maximal stability of the flagellar bundle. PLOS Biology (2018) vol. 16 (9) e2006989.

F. D. Fabiani, T. T. Renault, B. Peters, T. Dietsche, E. J. C. Galvez, A. Guse, K. Freier, E. Charpentier, T. Strowig, M. Franz-Wachtel, B. Macek, S. Wagner, M. Hensel, M. Erhardt. A flagellum-specific chaperone facilitates assembly of the core type-III export apparatus of the bacterial flagellum. PLOS Biology (2017) vol. 15 (8) e200226.

T. T. Renault, A. O. Abraham, T. Bergmiller, G. Paradis, S. Rainville, E. Charpentier, C. C. Guet, Y. Tu, K. Namba, J. P. Keener, T. Minamino, M. Erhardt. Bacterial flagella grow through an injection-diffusion mechanism. eLife (2017) 10.7554/eLife.23136.

Contribution to research networks

DFG: In collaboration with David Blair (University of Utah, USA) and Morgan Beeby (Imperial College London, UK), we study the assembly and function of the core type-III protein export apparatus of the bacterial flagellum.

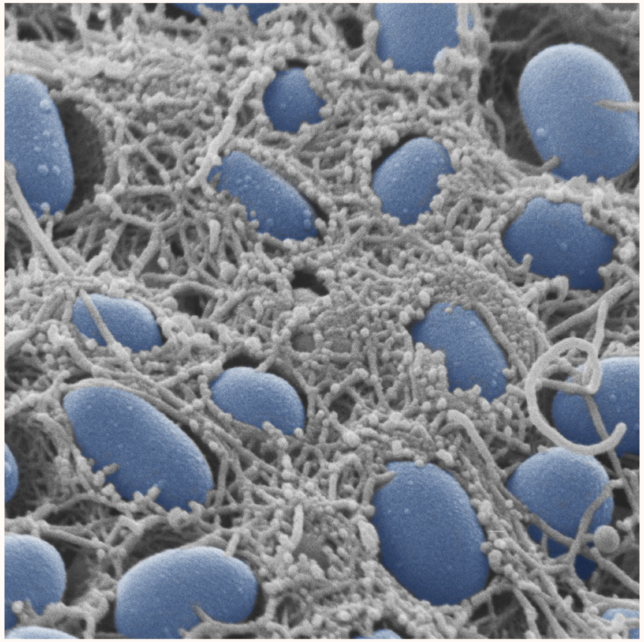
Microbiology, molecular biology and biochemistry

REGINE HENGGE

Microbiology
https://www.biologie.hu-berlin.de/de/gruppenseiten/mikrobiologie/hengge
Description of the projects:

Bacteria have not only colonized our entire planet but also the human body. We need them to remain healthy, we use them in biotechnology, but some can also make us sick. Almost anywhere bacteria grow in biofilms – surface-associated aggregates of billions of communicating bacterial cells encased in an extracellular matrix. This protective matrix consists of polysaccharides (such as cellulose) and amyloid protein fibres that are structurally related to Alzheimer plaques. When hidden away in their biofilms, bacteria can survive antibiotics and our immune system is powerless against them. As a consequence, biofilms can grow for instance in wounds or on medical implants, which leads to chronic infections that cannot be treated with antibiotics.

In the Hengge group, we investigate the molecular mechanisms that control the formation of the components of the extracellular matrix and the highly complex biofilm architecture in response to the different environmental conditions that bacterial cells experience within a biofilm. These processes are studied in the enteric bacterium Escherichia coli, which exists in harmless commensal, but also in highly pathogenic variants. A major focus of our research are the molecular processes by which the signaling molecule c-di-GMP drives biofilm formation in almost all bacteria. As a major goal we also want to identify and understand the mechanisms of action of anti-biofilm compounds of natural origin that may be used together with antibiotics to prevent or combat chronic infections or in some instances my even replace antibiotics.



Scanning elecronmicroscopic image of the surface of a biofilm of *E. coli* (cells are false-coloured in blue, extracellular matrix in grey)

Selected publications:

Thongsomboon, W., D.O. Serra, A. Possling, C. Hadjineophytou, R. Hengge and L. Cegelski (2018) Phosphoethanolamine cellulose: a naturally produced chemically modified cellulose. Science 359: 334-338.

Herbst, S., M. Lorkowski, O. Sarenko, T.K.L. Nguyen, T. Jaenicke, and R. Hengge (2018) Transmembrane redox control and proteolysis of PdeC, a novel type of c-di-GMP phosphodiesterase. EMBO J. 37: e97825.

Klauck, G., D.O. Serra, A. Possling, and R. Hengge (2018) Spatial organisation of different sigma factor activities and c-di-GMP signalling within the 3D landscape of a bacterial biofilm. Open Biol. 8: 180066.

Contribution to research networks

Excellence Cluster „Matters of Activity". Within this interdisciplinary cooperation between the humanities, natural and technical sciences as well as design and architecture, we analyze the architecture and morphogenesis of bacterial biofilms as an example of „active matter".

DFG Priority program 1617: "Phenotypic Heterogeneity and Sociobiology of Bacterial Populations". Here, deterministic and stochastic molecular control processes are studied that generate heterogeneous extracellular matrix composition and distribution within bacterial biofilms.

DFG Priority program 1879: "Nucleotide Second Messenger Signaling in Bacteria" (Coordinator: R. Hengge). Within this priority programme, we focus on the molecular mechanisms of signal perception and transduction based on synthesis, activity and degradation of the second messenger c-di-GMP in the regulation of biofilm formation.

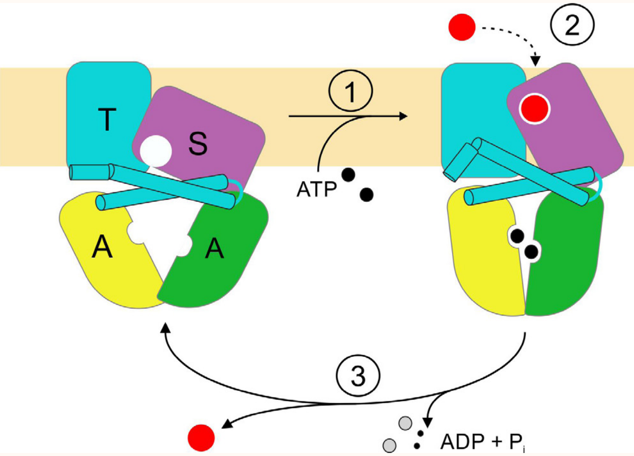
Microbiology, molecular biology and biochemistry

THOMAS EITINGER

Microbiology
https://www.biologie.hu-berlin.de/de/gruppenseiten/mikrobiologie/eitinger

Description of the projects:

“Energy-coupling factor (ECF)“ transporters were described only recently as a novel type within the large family of ATP-binding cassette (ABC) transporters in a collaborative effort of researchers from Russia, The Netherlands, the U. S. and our group. They are widespread in bacteria and archaea and mediate uptake of vitamins, transition metal ions and other micronutrients. In many gram-positive human pathogens with reduced biosynthetic capacities, ECF-type vitamin transporters are essential for growth within the host. As a focus of our current work we aim at understanding the dynamics of the unprecedented transport cycle of ECF transporters that includes rotation of an integral membrane protein by almost 90 ° within the membrane. To this end purified transporters are reconstituted in lipid nanodisks and the individual processes during substrate translocation are investigated by biochemical and biophysical techniques. This work is supported by the Deutsche Forschungsgemeinschaft and done in collaboration with groups within and outside Berlin.



Model for the transport cycle of heterooligomeric „energy-coupling factor (ECF)“ transporters. Two molecules of ATP are bound by the ATPase dimer (A) on the cytoplasmic side of the membrane in step 1. Scissors-like reorientations of three coupling helices within the membrane-bound T component result in a rotation of the substrate-binding S component. As a consequence, the substrate-binding pocket is accessible from outsite (step 2). Reorientation of the S component upon ATP hydrolysis leads to substrate release into the cytoplasm. (Modified after Finkenwirth, F., ..., Eitinger, T. 2015. Journal of Biological Chemistry 290:16929-16942, doi: 10.1074/jbc.M115.654343).

Selected publications:

Rodionov, D.A., P. Hebbeln, A. Eudes, J. ter Beek, I.A. Rodionova, G.B. Erkens, D.J. Slotboom, M.S. Gelfand, A.L. Osterman, A.D. Hanson and T. Eitinger. 2009. A novel class of modular transporters for vitamins in prokaryotes. J. Bacteriol. 191:42-51.

Finkenwirth, F., M. Sippach, H. Landmesser, F. Kirsch, A. Ogienko, M. Grunzel, C. Kiesler, H.-J. Steinhoff, E. Schneider, and T. Eitinger. 2015. ATP-dependent conformational changes trigger substrate capture and release by an ECF-type biotin transporter. J. Biol. Chem. 290:16929-16942.

Contribution to research networks

Dynamics of subunit interactions in ECF transporters (in progress): In a collaborative effort funded by the DFG the unusual substrate-translocation mechanism of ECF transporters including rotation of a membrane protein by almost 90 degrees, is investigated by biochemical (reconstitution of purified transporter complexes in nanodiscs) and biophysical methods (fluorescence techniques, pulse EPR). Collaborators: A. Herrmann, E. Schneider (within HU), H.-J. Steinhoff (University of Osnabrück).

Mechanism of metal-specific ECF transporters (begin in 2017, funded by the DFG): ECF transporters for Ni^{2+} and/or Co^{2+} ions harbor additional subunits involved in metal-loading onto the S components or metal release. The interactions of those subunits with metal ions and with the core transporters will be analyzed by biochemical and biophysical techniques (Co^{2+}-EPR, pulse EPR upon spin labeling, NMR) and structure analyses. Collaborators: A. Lange, B. Martins, E. Schneider (within HU); H.-J. Steinhoff (University of Osnabrück).

Inhibition of ammonia emissions from manure through inhibition of nickel uptake into microbial cells: (estimated start in 2017) The focus of this work is part of the ManUREA technology project funded by the Danish Ministry of Environment and Food and coordinated by H. Karring, University of Southern Denmark. It aims at a reduction of ammonia evaporation caused by urease activity in (pig) manure. Since ureases contain nickel ions at their active site, inhibition of bacterial nickel uptake is a promising strategy towards this goal. Collaborator: H. Karring (University of Southern Denmark).

Microbiology, molecular biology and biochemistry

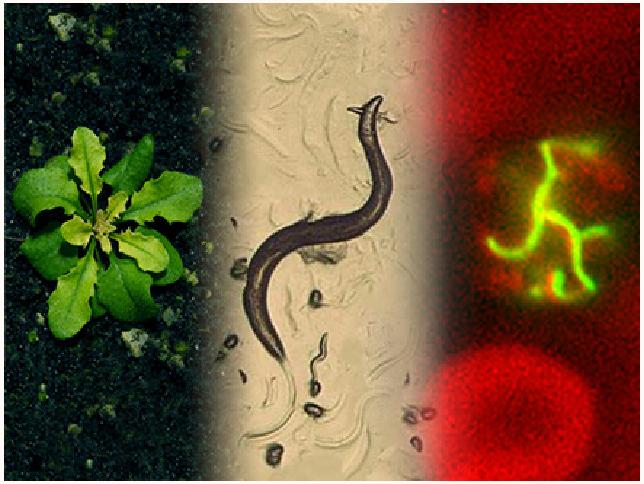
CHRISTIAN
SCHMITZ-LINNEWEBER

Molecular genetics
https://www.molgen.hu-berlin.de/
Description of the projects:

Mitochondria and chloroplasts, originating from an endosymbiotic event that took place more than a billion years ago, provided the foundation for the successful evolution of eukaryotic cells. The genome of these organelles has shrunk dramatically over time, and only a few of their genes remain. These, however, are essential for photosynthesis. So far, determination of the regulation of gene expression of these genes has only been successful in a small number of cases.

The Molecular Genetics team has made it their objective to identify the nuclear-encoded factors, which participate in gene regulation of organelles. We are focusing on RNA binding proteins (RBPs), the function of which we determine by means of reverse-genetic, biochemical as well as high-throughput RNA biological analysis tools. Our investigations concentrate on RBPs that are veritable regulators of organellar gene expression.

Moreover, we analyse organellar RNA binding proteins (RBPs) in *Plasmodium*, the pathogen of malaria. Furthermore, we pay special attention to the role of non-coding RNAs as regulators of organellar gene expression in *Plasmodium*, but also in organelles of a variety of other eukaryotic organisms.



Left: Bleaching mutant of a chloroplastid RNA Binding protein in *Arabidopsis thaliana* after cold treatment. Middle: The nematode *C. elegans* as a model for ageing. Right: Double staining of mitochondria of the malaria pathogen of the mouse with a constitutive GFP marker and an RFP-tagged HPR protein imported into mitochondria. Image: Carola Rocks

Selected publications:

Hillebrand A, Matz JM, Almendinger M, Müller K, Matuschewski K, Schmitz-Linneweber C Identification of clustered organellar short (cos) RNAs and of a conserved family of organellar RNA-binding proteins, the heptatricopeptide repeat proteins, in the malaria parasite.Nucleic Acids Res. 2018 Nov 2;46(19):10417-10431. doi: 10.1093/nar/gky710.

Kupsch C, Ruwe R, Gusewski S, Tillich M, Small I, Schmitz-Linneweber C (2012) Arabidopsis chloroplast RNA binding proteins CP31A and CP29A associate with large transcript pools and confer cold stress tolerance by influencing multiple chloroplast RNA processing steps. Plant Cell. 2012 Oct;24(10):4266-80.

Zoschke R, Nakamura M, Liere K, Sugiura M, Börner T, and Schmitz-Linneweber C. (2010) An Organellar Maturase Associates with Multiple Group II Introns. Proc Natl Acad Sci USA 107:3245-3250.

Contribution to research networks

CRC/TR 175: The Chloroplast as Central Coordinator of Acclimation in Plants. In collaboration with 18 participating project partners, the astonishing role of chloroplasts as sensors and signal emittors in acclimation processes is being analysed.

European Union (EU) Consortium: Ageing with elegans. Ageing with elegans is a project funded by the European Commission under the Horizon 2020 Research and Innovation programme. The consortium, based on the research of 13 research groups, endeavours to establish the nematode Caenorhabditis elegans (C. elegans) as a model for an enhanced understanding of the factors responsible for healthy ageing.

Priority program 1935: Targets and functions of the chloroplast ribonucleoproteins CP33A and CP33B are analyzed to decode their mode of protein-RNA interactions within a consortium of RNA biologists interested in deciphering RNP codes.

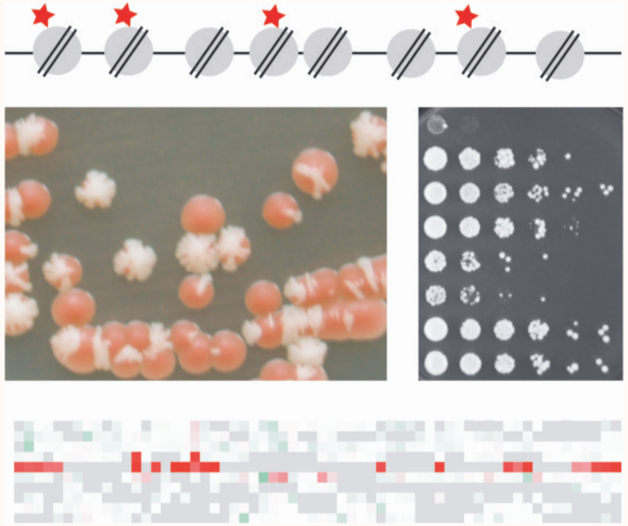
IRTG 2290: Analysis of a novel family of organelle-directed RNA binding proteins in Plasmodium falciparum. The project combines RNA biochemistry and experimental genetics towards a systematic analysis of Plasmodium organellar RNA metabolism.

Microbiology, molecular biology and biochemistry

ANN EHRENHOFER-MURRAY[1]

Molecular cell biology
https://www.biologie.hu-berlin.de/de/gruppenseiten/cellbio
Description of the projects:

Eukaryotic cells organize their DNA in the cell nucleus into a structure called chromatin, which ensures the correct segregation of the genetic material during cell division. At the same time, chromatin regulates the access of DNA during gene expression, replication and DNA repair. Differences in chromatin packaging determine when and where genes are expressed and which gene regions are constantly repressed by heterochromatin (gene silencing). We investigate how the basic elements of chromatin, the histones, are posttranslationally modified by enzymes (for instance acetylation and methylation) and how this alters the binding properties of other chromatin binding factors that regulate chromatin function. We have identified histone modifications on the centromeric histone variant CENP-A and have shown how they regulate the recruitment of the inner kinetochore to the centromeric chromatin. Furthermore, we are studying how modifications on RNA like cytosine-5-methylation and queuosinylation modulate RNA function. As model systems, we use two microorganisms, *Saccharomyces cerevisiae* (baker's yeast) and *Schizosaccharomyces pombe* (fission yeast). Molecular insights into epigenetic chromatin regulation are important in order to identify therapeutic possibilities for the treatment of diseases that can benefit from epigenetic drugs.



Impressions from the research of the group Molecular Cell Biology. Top: Cartoon of chromatin with histone modifications (stars). Middle left, colonies of *S. cerevisiae* showing variegation of colony color. Middle right, Serial dilutions of *Saccharomyces cerevisiae* strains for the determination of growth characteristics on different nutritional sources. Bottom, tRNA methylome of *Schizosaccharomyces pombe*

Selected publications:
Anedchenko EA, Samel-Pommerencke A, Tran Nguyen TM, Shahnejat-Bushehri S, Pöpsel J, Lauster D, Herrmann A, Rappsilber J, Cuomo A, Bonaldi T, Ehrenhofer-Murray AE. (2019) The kinetochore module Okp1^{CENP-Q}/Ame1^{CENP-U} is a reader for N-terminal modifications on the centromeric histone Cse4CENP-A. EMBO J. 2019 Jan 3;38(1). pii: e98991.

Müller M, Legrand C, Tuorto F, Kelly VP, Atlasi Y, Lyko F, Ehrenhofer-Murray AE. (2019) Queuine links translational control in eukaryotes to a micronutrient from bacteria. Nucleic Acids Res. 2019 Feb 1.

Müller M, Samel-Pommerencke A, Legrand C, Tuorto F, Lyko F, Ehrenhofer-Murray AE. (2019) Division of labour: tRNA methylation by the NSun2 tRNA methyltransferases Trm4a and Trm4b in fission yeast. RNA Biol. 2019 Mar;16(3):249-256.

Contribution to research networks

Priority program SPP 1784:
Chemical Biology of native Nucleic Acid Modifications: This consortium studies chemical modifications on DNA and RNA molecules and investigates their biological function in an interdisciplinary approach using chemical, biochemical and molecular genetics methods.

EPITRAN - European Epitranscriptomics Network Epitran (COST Action CA16120):
This COST action fosters the development of the emerging field of epitranscriptomics in Europe. By understanding the role of RNA modifications in physiology and pathology, novel and powerful disease biomarkers and drug targets will be identified.

IRI Life Sciences: The IRI for the Life Sciences at the Humboldt University is a collaborative research institute founded in collaboration with the Charité Hospital and the Max-Delbrück-Centrum for Molecular Medicine with the goal of bridging theoretical and quantitative experimental approaches at multiple scales of biology, from molecules to cells to organisms and populations.

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[1] Photo credit: Einstein-Stiftung/ Castagnola

Microbiology, molecular biology and biochemistry

LEONIE RINGROSE

Quantitative biology of the eukaryotic cell

https://www.biologie.hu-berlin.de/de/gruppen/eukaryquantbio_portal

Description of the projects:

We work on epigenetic regulation by the Polycomb (PcG) and Trithorax (TrxG) groups of proteins. Together with transcription factors, these proteins ensure genome- wide transcriptional fidelity. The PcG and TrxG proteins work antagonistically on several hundred developmentally important target genes, to maintain repressed (PcG) or active (TrxG transcription states. Mutations or aberrant expression of these essential proteins can lead to developmental defects and cancer.

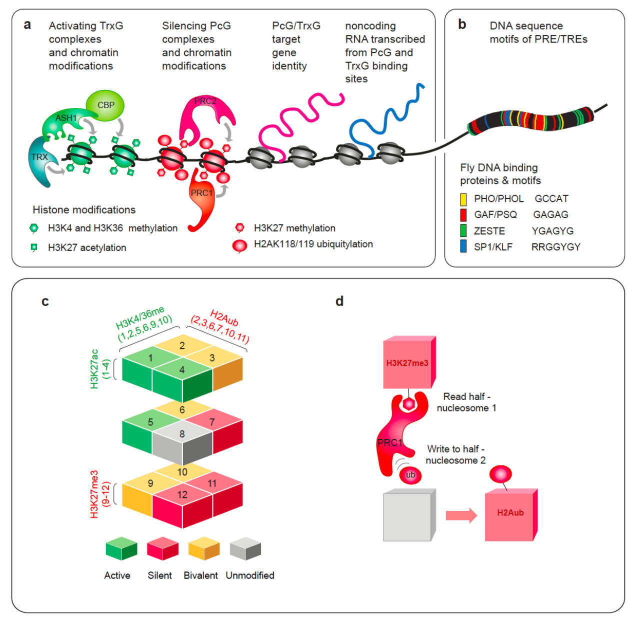
We use a combination of quantitative live imaging, mathematical modeling, and molecular and developmental biology in the fruit fly Drosophila melanogaster and in mammalian cell culture. We aim to understand in quantitative terms, how the PcG and TrxG proteins interact with their chromatin targets.

Selected publications:

Ringrose, L. (2017). Epigenetics and Systems Biology. 1st Edition. Academic Press. (ISBN 9780128030752)

Ringrose, L., (2017). Noncoding RNAs in Polycomb and Trithorax Regulation: A Quantitative Perspective. Annu Rev Genet 51: 385-411 (PMID 28934594).

Sneppen, K and Ringrose, L. (2019). Theoretical analysis of Polycomb- Trithorax biochemistry predicts that poised chromatin is robustly bistable and minimally bivalent. Nature Communications, *in press*.



Polycomb and Trithorax group proteins are epigenetic re-gulators. a) many features are conserved in flies and mammals. b) the DNA sequence motifs of binding sites are not conserved. c), d) 73 publications on Polycomb/ Tritho-rax biochemistry were formalised into a mathematical mo-del (see Sneppen and Ringrose, 2019).

Contribution to research networks

DFG Project grant: Investigation of the role of GTGT motifs in fly and mouse Polycomb/ Trithorax Response Elements and their non-coding RNAs.

European Union: H2020
Marie Sklodowska-Curie Innovative Training Network (4 Million EUR). „PEP-NET: Predictive Epigenetics“- Fusing Theory and Experiment
Coordinator: L. Ringrose. Grant no. 813282.
H2020 MSCA ITN „PEP-NET“: 15 Phd positions across Europe are funded by this Innovative Training Network. 3 PhDs will join the IfB at HU. The aim is to train students in theory, experiment, and transferable skills to answer basic and applied questions in epigenetics. www.ringroselab.com

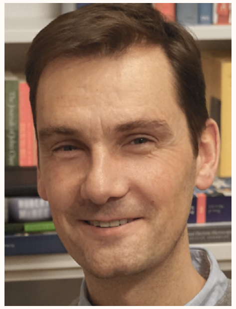
IRI Life Sciences: The IRI for the Life Sciences at the Humboldt University is a collaborative research institute founded in collaboration with the Charité Hospital and the Max-Delbrück-Centrum for Molecular Medicine with the goal of bridging theoretical and quantitative experimental approaches at multiple scales of biology, from molecules to cells to organisms and populations.

Research grant:
VW-Stiftung Experiment!. (120.000 EUR)

RTG 2424: CompCancer - Computational Methods in Oncology: Towards Personalized Medicine in Cancer. Bioinformatics and computational models will be used to address fundamental and applied problems in cancer.

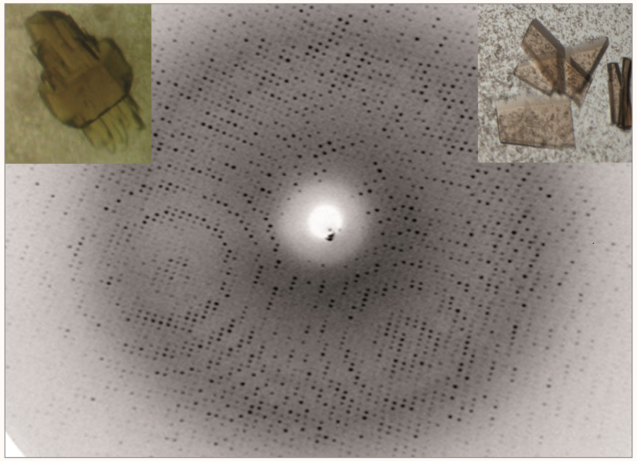
Microbiology, molecular biology and biochemistry

HOLGER DOBBEK



Structural biology and biochemistry
https://www.biologie.hu-berlin.de/en/gruppenseiten-en/struktbio
Description of the projects:

Several bacteria and archaea are able to use carbon monoxide, carbon dioxide and several pollutants as energy- or carbon source. Complex metalloenzymes allow the microorganisms converting these unreactive molecules within the mild cellular environment, where in a chemistry lab precious metals and high pressures and temperatures would be needed. How metalloenzymes achieve this remarkable efficiency is hardly understood. We combine methods from protein biochemistry, molecular and structural biology to investigate molecular energy conversions. We want to understand how catalytic processes work and how the catalytic strategies of enzymes evolved over time. Our results will help to develop new (bio-)catalysts for the energy efficient use of carbon monoxide and carbon dioxide, as well as for the degradation of pollutants.



X-ray crystallography allows determining the detailed architecture of metalloenzymes. The diffraction of X-rays at protein crystals (upper left and right) is recorded (middle) to calculate the distribution of electrons.

Selected publications:
Fesseler J, Jeoung JH, Dobbek H. How the [$NiFe_4S_4$] Cluster of CO Dehydrogenase Activates CO_2 and NCO-. Angew Chem Int Ed Engl 2015; 54, 8560-8564.

Bommer M, Kunze C, Fesseler F, Schubert T, Diekert G, Dobbek H. Structural Basis for Organohalide Respiration. Science. 2014; 346, 455–458.

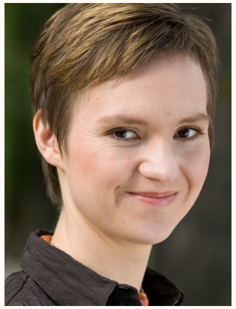
Contribution to research networks

Cluster of Excellence "Unifying Systems in Catalysis" (UniSysCat): Together with part-ners from TU and FU Berlin, we are in¬vestigating how metalloenzymes converting CO_2, CO, O_2, H_2O can be coupled to each other achieve novel energy-efficient reactions. Thereby we want to analyze common principles and differences between coupled synthetic and biological catalysts and to develop novel bio-chemo-hybrid catalysts activating small molecules.

Priority program 1927: Iron-Sulfur for Life. In the priority program "Iron-Sulfur for Life" we investigate how homologues ATPases from bacteria and archaea assemble the Ni-, Fe- and S-containing active site metal clusters of CO_2- and CO-converting enzymes. We could show that the incorporation of Ni in the metal centers depends on ATP and want now to elucidate the mechanism of metal insertion.

CRC 1078 projekt A5 (Dobbek/Zouni): Proton dynamics in protein function. Together with the group of Athina Zouni (HU), we investigate the structural basis of water oxidation and proton dynamics in photosystem II. Photosystem II catalyzes the light-dependent oxidation of water at a Ca-, Mn-, O-containing metal cluster – the central reaction in oxygenic photosynthesis.

Theoretical biology



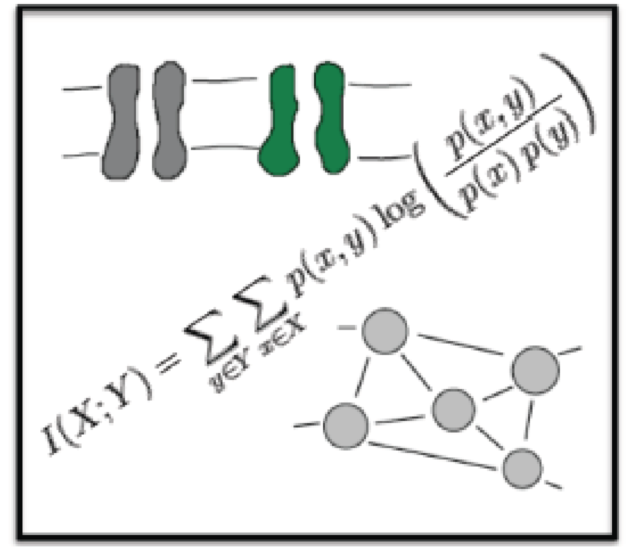
SUSANNE SCHREIBER
Bernstein Award for Computational
Neuroscience

Computational neurophysiology

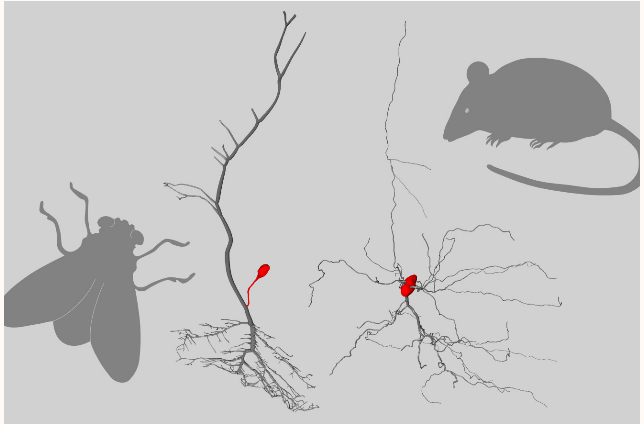
http://www.neuron-science.de

Description of the projects:

Our brain exhibits an astonishingly versatile functional repertoire and can solve the most difficult problems with extraordinary reliability. At the heart of these achievements lies the coordinated activity of a vast number of neurons. This activity is, on the one hand side, determined by the connectivity of cells in local networks and, on the other hand side, by the intrinsic properties of the neurons involved.



Our research approach is based in theoretical methods and mathematical modeling at the level of single cells and neuronal networks.



In typical insect neurons, the cell body is externalized, whereas it is located more centrally between the dendrites and axon in many vertebrate neurons. Our mathematical modeling demonstrates that these constellations, respectively, benefit an energy-efficient signal transfer within the neuron.

The aim of our research group is to uncover the impact of cellular properties (such as the dynamics of ion channels or cellular morphology) on the mechanisms that govern neural information processing as well as their relevance for the behavior of neurons in networks. Our approach to the problem is theoretical, including computer simulations and mathematical modeling. In addition, we cooperate with vertebrate and invertebrate experimental labs to put predictions derived from our mathematical models to test. Often, we like to view the biological system from an evolutionary perspective, allowing us to better understand how evolutionary constraints (like the robustness to temperature variations or limited energetic resources) have shaped neural system design and to derive general principles.

Selected publications:
Hesse J, Schreiber S (2015): Externalization of neuronal somata as an evolutionary strategy for energy economization. Current Biology, 25(8), R324-R325; doi:10.1016/j.cub.2015.02.024.

Roemschied FA, Eberhard MJB, Schleimer J-H, Ronacher B, Schreiber S (2014): Cell-intrinsic mechanisms of temperature compensation in a grasshopper sensory receptor neuron. eLife 2014;3:e02078.

Contribution to research networks

Bernstein Center for Computational Neuroscience (BMBF): The Bernstein Centers fosters the interdisciplinary exchange of neuroscientific research labs interested in mathematical modeling of neuronal processes.

bccn berlin

Bernstein Award (Federal Ministry of Education and Research): In this project our lab investigates the influence of cell-specific electrophysiological and morphological properties on neural processing and coding.

SPONSORED BY THE
Federal Ministry
of Education
and Research

Research groups in the neurosciences (Federal Ministry of Education and Research): Here, we focus on the temperature dependence of neuronal processing. We identify and analyze mechanisms of robust information processing as well as deviations from robustness that are relevant in pathology.

Research Training Group 1589 "Sensory Computation in Neural Systems" (DFG): This graduate school ensures a structured education of PhD students in the field of Computational Neuroscience and offers students a platform for interactions across Berlin universities.

GRK
Sensory Computation
in Neural Systems

Einstein Center for Neurosciences Berlin: The Einstein Center offers students in the neuroscience graduate programs of Berlin a broad education in the neurosciences and fosters interdisciplinary, collaborative research.

EINSTEIN
ZENTRUM
Neurowissenschaften

Group

PLACEHOLDER

Title of the group
https://

Description of the projects:

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Selected publications:

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Contribution to research networks

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Theoretical biology

MICHAL OR-GUIL

Systems immunology

https://www.biologie.hu-berlin.de/de/gruppenseiten/sim

Description of the projects:

The Systems Immunology Lab focuses on translational antibody research in joint projects with aca-demic, clinical and industry partners. Its primary objectives are to better the understanding of anti-body action during immune responses as well as to exploit antibody binding signatures for diagnostic purposes.

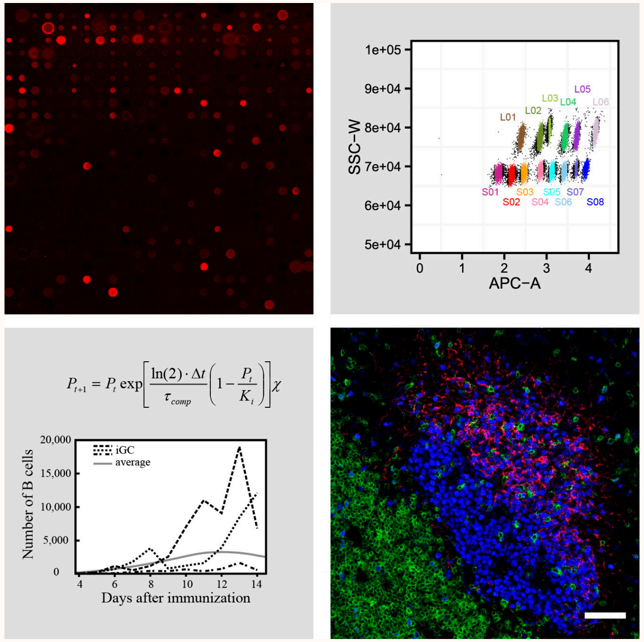
Past accomplishments of the Lab include i) the development of data analysis tools for assessment of antibody binding properties and evaluation of immunoassays, and ii) the development of an all-in-one tool for biomarker extraction, validation and diagnostic application.

In addition, the Systems Immunology Lab takes a leading role in forwarding and applying Systems Medicine approaches. As part of the e:KID consortium, it currently seeks to improve personalized immunosuppressive medication following kidney transplantation.

Selected publications:

Or-Guil, M., and Faro, J. (2014). A major hindrance in antibody affinity maturation investigation: we never succeeded in falsifying the hypothesis of single-step selection. Front. Immunol. 5, 237.

Wittenbrink, N., Klein, A., Weiser, A.A., Schuchhardt, J., and Or-Guil, M. (2011). Is there a typical germinal center? A large-scale immunohistological study on the cellular composition of germinal centers during the hapten-carrier-driven primary immune response in mice. J. Immunol. 187, 6185–6196.



The Systems Immunology Lab at a glance (clockwise): Detail of a peptide array serum antibody sig-nature; data-driven discrimination of bead populations in flow cytometry data of their 14-plex mix; confocal microscopy image of a murine splenic germinal center; and mathematical simulation of the growth kinetics of B-cell populations in germinal centers.

Contribution to research networks

e:KID (e:Med, BMBF)
e:KID is a collaborative project involving clinical departments, research institutes, biometrics departments, translational, and industrial partners. The aim of e:Kid is to establish and validate a systems medicine model for quantification of complication risks after kidney transplantation that shall ultimately aid early-stage personalized therapy. To achieve such a model, a broad range of genetic, post-translational (protein, epigenetic) as well as cellular parameters are examined and used in a large clinically well-characterized cohort of patients (Harmony study, DRKS-ID: DRKS00000452).

e:Med
SYSTEMS MEDICINE

FlowPep (ZIM, BMWi)
FlowPep is a research alliance of the Systems Immunology Lab and the two Berlin-based SMEs, Bio-syntan GmbH and PolyAn GmbH. The alliance aims at developing a procedure to measure antibody-peptide interactions in a multiplex bead assay. The procedure, which is referred to as PepOnBeads, bundles biomarker extraction, validation and clinical application in an all-in-one tool.

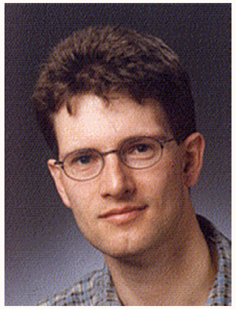
ZIM
Zentrales Innovationsprogramm Mittelstand

SPONSORED BY THE
Federal Ministry of Education and Research

StratMarker (GIF - German-Israeli Foundation for Scientific Research and Development)
In collaboration with the Ofran Lab of Systems Biology and Functional Genomics (lead by Yanay Ofran, Bar Ilan University, Israel), the Systems Immunology Lab seeks to develop and implement new strategies for optimization of peptide biomarkers in serological diagnostics. The development strategy includes both experimental and bioinformatics methods.

GIF
German-Israeli Foundation for Scientific Research and Developme

Theoretical biology



RICHARD KEMPTER

Theory of neural systems
https://itb.biologie.hu-berlin.de/~kempter/

Description of the projects:

The research group ,‘Theoretical Neuroscience“ is interested in the neural basis of learning and memory. Research involves the biophysical modeling and mathematical analysis of synapses, neurons, and neural systems. Theoretical approaches and computer simulations are used to study synaptic short- and long-term plasticity, the dynamics of single neurons, and the interaction of neurons in recurrently coupled networks. We are particularly fascinated by mechanisms that control the development and functional stability of neural circuits. One of the key goals is to unravel how such systems remain susceptible to learning, and, at the same time, maintain a robust balance against instabilities. Understanding the mechanisms that prevent neural tissue from developing pathological activity patterns will also help to uncover origins of functional brain illnesses and lead to practical implications for designing remedial therapies. Model systems are the hippocampus and the early auditory system.

Selected publications:
E. T. Reifenstein, C. L. Ebbesen, Q. Tang, M. Brecht, S. Schreiber, and R. Kempter. Cell-type specific phase precession in layer II of the medial entorhinal cortex. J. Neurosci. 36:2283-2288, 2016.

C. Leibold, A. Gundlfinger, R. Schmidt, K. Thurley, D. Schmitz, R. Kempter. Temporal compression mediated by short-term synaptic plasticity. Proc. Natl. Acad. Sci. USA 105, 4417-4422, 2008.

Schaltkreis-Mechanismen der Phasenpräzession: Experiment und Theorie: Die neuronale Aktivität von Orts-und Gitterzellen in der hippokampalen Formation zeigt eine systematische Beziehung zum Theta-Rhythmus des EEGs: Wenn das jeweilige Ortsfeld durchquert wird, verschiebt sich der Zeitpunkt der Aktionspotenziale gegenüber dem Theta-Rhythmus, d. h. die Aktionspotenziale „präzessieren“. Diese sognannte Phasenpräzession ist eines der am meisten untersuchten Phänomene in den systemischen Neurowissenschaften. Nach wie vor besteht kein Konsens wie Phasenpräzession entsteht. Frühere Arbeiten zur Phasenpräzession zeigten, dass sich zwar leicht Modelle generieren lassen, aber der Ausschluss von Modellen an vier miteinander verwobenen Problemen scheitert. (ist TP vom SPP 1665; evtl. weglassen)

Contribution to research networks

Research Training Group 1589: Sensory Computation in Neural Systems. The Research Training Group “Sensory Computation in Neural Systems“ combines techniques and concepts from computational neuroscience, systems neurobiology, and machine learning, in order to specifically address sensory computation. Experimentalists and theoreticians join forces and educate young scientists.

3-year research project: Delineating and testing a microcircuit model of parahippocampal phase precession. The project is funded by the German Research Foundation (Deutsche Forschungsgemeinschaft, DFG) within the Priority Program 1665 (Schwerpunktprogramm) “Resolving and manipulating neuronal networks in the mammalian brain – from correlative to causal analysis”. The project will start in November 2016. Collaborators are Prof. Michael Brecht (Humboldt-Universität zu Berlin), Prof. Dietmar Schmitz (Charité), and Prof. Richard Kempter (Humboldt-Universität zu Berlin).Further details can be found at [http://www.spp1665.de/projects_2_delineating.html.](http://www.spp1665.de/projects_2_delineating.html)

Zoology

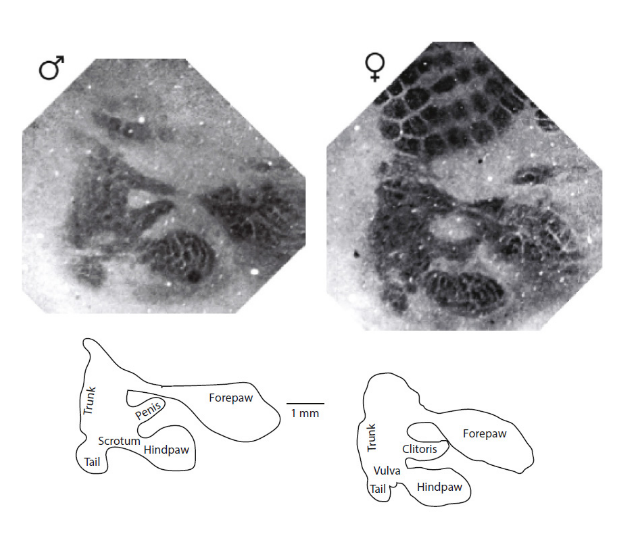
MICHAEL BRECHT

Animal physiology/
systems neurobiology and neural computation
https://www.activetouch.de
Description of the projects:

Our research group is active in the field of neuronal basis of behavior with a focus on two major questions:

1. Which circuits underlie spatial memory?
2. Which circuits evoke social behaviors in the forebrain?

To answer both questions, our research group develops new research methods, i.e. techniques for intracellular measurements, or so-called juxtacellular measurements, in freely behaving animals. Using such methods, we study the structure-function relationships in the mammalian brain. In the paper of Ray et al., 2014 we described a highly ordered circuit in the spatial memory. We focus on such approaches also when we investigate the socio-sexual information processing; i.e. in the paper of Lenschow et al., 2016 we described the genital representation in the rat somatosensory cortex. Although the external genitals show a marked sexual dimorphism, the neuronal representation is sexually monomorphic (see Figure).



Lenschow et al. Figure: Anatomical maps of male (left) and female (right) bodies in the neocortex of the rat; body maps are revealed by a stain for metabolic activity (Cytochrome oxidase histochemistry). Maps were interpreted by alignment to physiological recordings (bottom drawings). Qualitative and quantitative analysis of such maps revealed a sexual monomorphism of cortical genitals.

Selected publications:
Lenschow C, Copley S, Gardiner JM, Talbot ZN, Vitenzon A, Brecht M (2016) Sexually Monomorphic Maps and Dimorphic Responses in Rat Genital Cortex. Curr Biol. 26(1):106-13.

Ray S, Naumann R, Burgalossi A, Tang Q, Schmidt H, Brecht M (2014): Grid-layout and Theta-modulation of Layer 2 Pyramidal Neurons in Medial Entorhinal Cortex. Science 343(6173):891-6.

Contribution to research networks

Bernstein Center for Computational Neuroscience (BCCN Berlin): The BCCN Berlin is a joint research center of Charité, Humboldt-Universität zu Berlin, and Technische Universität Berlin. The newly founded “Interdisciplinary Center Computational Neuroscience“ (ICCN) of Humboldt-Universität zu Berlin is supporting the BCCN Berlin.

bccn
berlin

Research Unit CRC 665: Developmental Disturbances in the Nervous System. In this special research unit, we analyse together with colleagues from institutions all over Berlin the development of the nervous system.

SFB 665
developmental disturbances in the nervous system

Cluster of Excellence NeuroCure: In this Berlin-wide cluster of excellence, we coordinate and jointly develop the neuroscientific research.

NeuroCure
Exzellenzcluster

The Einstein Center for Neurosciences Berlin: This center is funded by the State of Berlin and it focuses on various research topics, i.e. a core area is the interdisciplinary training of young neuroscientists.

EINSTEIN ZENTRUM
Neurowissenschaften

German Center for Neurodegenerative Diseases (DZNE): In this research association we investigate alterations of memory circuitry during neurodegenerative processes.

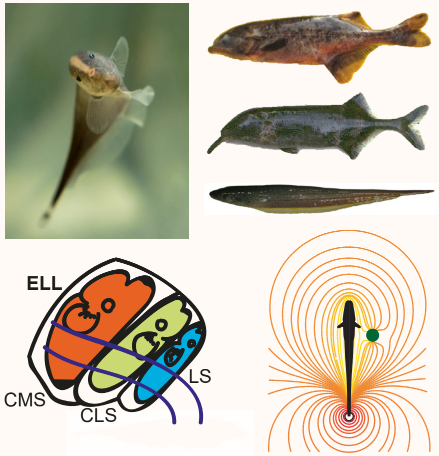
DZNE
Deutsches Zentrum für Neurodegenerative Erkrankungen
in der Helmholtz-Gemeinschaft

Zoology

RÜDIGER KRAHE

Behavioural physiology
https://www.biologie.hu-berlin.de/en/gruppenseiten-en/vhphysiol
Description of the projects:

All animals have sense organs that relay information on the organism's environment and its own body to the brain, where the information is then analysed. The Behavioural Physiology Lab studies the mechanisms used by the nerve cells in the brain with which sensory information is processed. To understand these mechanisms, it is essential to understand the tasks they have to perform in the animal's natural life, under natural environmental and behavioural conditions. This is important as sensory systems have been shaped in the course of evolution to function under these conditions. Therefore, our group uses on the one hand neurobiological methods to study sensory information processing; on the other hand, we use a multitude of approaches to decipher the selection pressures acting on sensory processing mechanisms. This includes, for example, behavioural observations and experiments in the lab as well as in the animal's natural habitat, phylogenetic analyses and experiments on the energetics of sensing. Specific topics addressed by our group are sensory processing by topographic maps in the brain, neuromodulation and energetics of sensory processing, and the effects of biotic and abiotic environmental factors on the acquisition of sensory information.



The sensory system we study is the electrosensory system of weakly electric fish. These nocturnal tropical fish produce weak electric fields and sense perturbations of the self-generated electric field caused by objects in their environment (see snapshot of the isopotential lines on the bottom right). In addition, they use their electric discharges for communication with conspecifics in aggressive and courtship encounters. The bottom-left panel depicts three parallel topographic maps of the electrosensory body surface that are found in the hindbrain. The two fish on the top right are African mormyrid fish, the other two are Central and South American gymnotiform fish. A big experimental advantage of studying this particular sensory system is the ease with which electric signals in water can be measured and reproduced.

Selected publications:

Henninger J, Krahe R, Grewe J, Kirschbaum F, Benda J (2018) Statistics of natural communication signals observed in the wild identify important yet neglected stimulus regimes in weakly electric fish. J Neurosci 38: 5456-5465.

Picq SC, Alda F, Bermingham E, Krahe R (2016) Drift-driven evolution of electric signals in a Neotropical knifefish. Evolution 70: 2134-2144.

Fotowat H, Harrison RR, Krahe R (2013) Statistics of the electrosensory input in the freely swimming weakly electric fish, Apteronotus leptorhynchus. J Neurosci 33: 13758-13772.

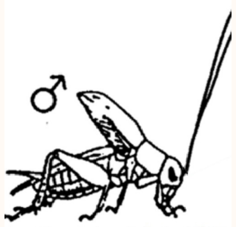
Contribution to research networks

Fonds de Recherche du Québec - Nature et Technologies: Projet de recherche en équipe: La nage et la perception sensorielle: Effets de l'hypoxie et de la contrainte thermique sur la performance et l'acquisition d'information sensorielle chez les poissons. In this collaboration with colleagues at McGill University in Montreal, Quebec, we study the consequences of low oxygen levels and rising temperature in freshwater systems on the energy budget, swim performance and acquisition of sensory information in fish.

Secretaría Nacional de Ciencia, Tecnología e Innovación: Evolución del microbioma asociado a los peces eléctricos y sus campos eléctricos a diferentes escalas biológicas. Together with colleagues from the Republic of Panama and the University of Massachusetts Boston, we investigate microbiome evolution in conjunction with the evolution of the electric signals of weakly electric fishes.

Zoology

MATTHIAS HENNIG



ringer Science+Business Media New York 2013
cyclopedia of Computational Neuroscience,
)I 10.1007/978-1-4614-7320-6_321-1
atthias Hennig, Bernhard Ronacher©
ditory Processing in Insects
th permission of Springer

Behavioral physiology/ neuroethology
https://www.biologie.hu-berlin.de/de/gruppen/verhaltensphys1_portal/standard

Description of the projects:

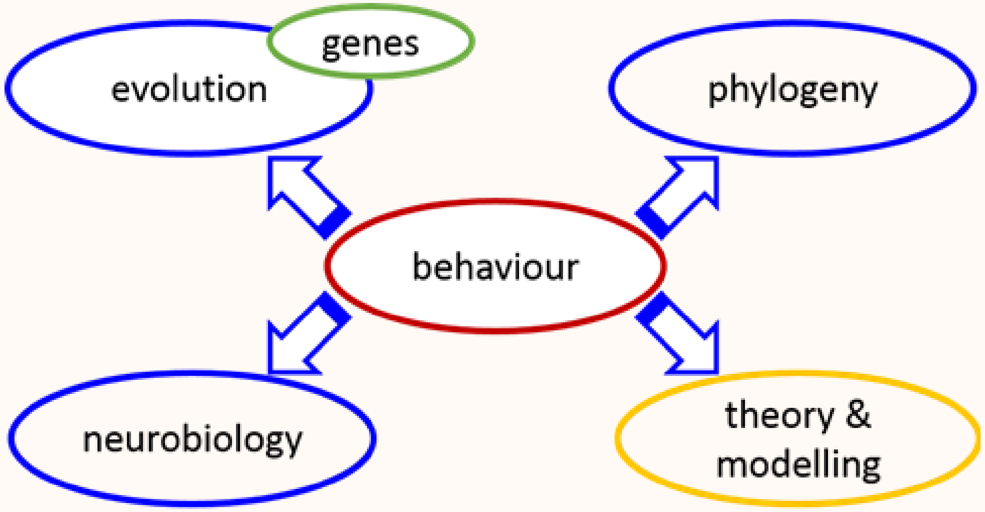
Neuroethology asks how animals sense the world and how they use this information for motor control and behaviour. Our research focusses on the algorithms of sensory processing and motor control of acoustic communication in crickets. By a comparative approach we also investigate the evolution of behaviour and its neuronal and genetic basis.

An advantage of insects as research objects stems from the relative ease by which their behaviour can be quantified and the activity of single neurons and small neural networks can be recorded. Our techniques encompass a range of behavioural and electrophysiological approaches. A suite of computer-controlled set-ups with high through-put technology allows us to quantify the behaviour and acoustic choice behaviour for many individual crickets in a short time.

Selected publications:

Hildebrandt KJ, Benda J, Hennig RM (2015) Computational themes of peripheral processing in the auditory pathway of insects. J Comp Physiol A 201:39-50.

Gabel E, Gray DA, Hennig RM (2016) How females of chirping and trilling field crickets integrate the ‚what‘ and ‚where‘ of male acoustic signals during decision making. J Comp Physiol A, DOI: 10.1007/s00359-016-1124-x.



Acoustic communication behaviour in crickets lies at the center of research for comparative research in several disciplines of biology, from theoretical to neurobiological questions to evolution, phylogeny and genes.

Contribution to research networks

DFG grant: decision making in crickets: choice behaviour and neuronal control. Female crickets evaluate several attributes in a male’s acoustic signal during long distance communication and their decision for mate choice behavior. Here we investigate how different sensory cues are integrated to arrive at a decision for a particular song signal of a male cricket.

Leibniz Association: in collaboration with the Museum für Naturkunde: GenArt: functional genomics of biological speciation. How do genes contribute to evolution and speciation? In the GenArt-project this question is examined for several animal groups, from electric fish to grasshoppers and crickets using behavioural phenotyping and NGS-technologies.

Zoology

YORK WINTER

Cognitive neurobiology
https://www.winterlab.org/

Description of the projects:

Our research focuses on the cognitive abilities of animals in the context of economic decision making while foraging. For the behavioral phenotyping of lab animals (in particular, of mice and rats) used as models of neurological and psychiatric diseases we operate a core facility for behaviour analysis available to researchers from Berlin and outside.

With our in-group engineering team we develop automation technology to make possible the fully automatic analysis of behavior.

York Winter mentors University start-up teams on their quest to successful independence, and as an entrepreneur has been a founder himself.

„Lab“-mouse (*Mus musculus*).

We use the same approaches for behavioral research in the wild to investigate the rules of decision making of free-living nectar-feeding bats.

Investigations of the cognitive mechanisms of decision making: Nectar-feeding bat (Glossophaga commissarisi) hovering in front of a flower of the bat-pollinated *Mucuna holtonii* in Costa Rica.

Selected publications:
Nachev, V., Stich, K. P., Winter, C., Bond, A., Kamil, A., & Winter, Y. (2017). Cognition-mediated evolution of low-quality floral nectars. Science, 355(6320), 75–78. https://doi.org/10.1126/science.aah4219.

Rivalan, M., Winter, Y., & Nachev, V. (2017). Principles of Economic Rationality in Mice. Scientific Reports, 7, 17441. https://doi.org/10.1038/s41598-017-17747-7.

Kaupert, U., Thurley, K., Frei, K., Bagorda, F., Schatz, A., Tocker, G., Rapoport, S., Derdikman, D., & Winter, Y. (2017). Spatial cognition in a virtual reality home-cage extension for freely moving rodents. Journal of Neurophysiology, 117(4), 1736–1748. https://doi.org/10.1152/jn.00630.2016.

Contribution to research networks

CRC 1315: Mechanisms and disturbances in memory consolidation: From synapses to systems. In this collaborative research center (CRC), we aim to address fundamental problems by bringing together researchers working on converging principles and mechanisms thought to underlie memory consolidation in the many different participating brain areas, and working across different species, from flies to birds, rodents, and humans.

Berlin School of Mind and Brain
An interdisciplinary center for cooperation and training focusing on central questions about the human mind. This includes perception and consciousness, language, learning and memory as well as neuro-psychiatric diseases. Tackling these questions requires collaboration between various disciplines, such as philosophy, linguistics, computer science, psychology, and neuroscience.

Cluster of Excellence NeuroCure
NeuroCure is a cluster of excellence funded through the Excellence Initiative and located at the Charité – University Medicine Berlin, the Humboldt-University and the Free University Berlin. Its research focus is in neuroscience. The interdisciplinary research network focuses on the translation of insights from basic science research to clinical application.
https://neurocure.de/animal-outcome-unit-206.html

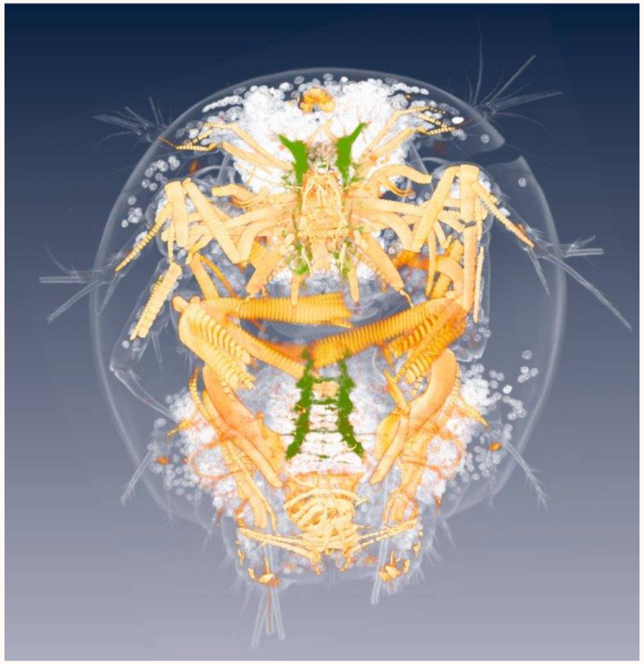
Zoology

GERHARD SCHOLTZ

Comparative zoology
https://www.biologie.hu-berlin.de/de/gruppenseiten/compzool

Description of the projects:

Comparative zoology deals with the interface of development and evolution of arthropods and metazoas. Comparative morphological, embryological and molecular investigations are performed as the basis for phylogenetic analyses including the reconstruction of evolutionary transformation. A central focus is the analysis of cell genealogy and its evolution at critical points in development. Further focal points are the comparative evolutionary analysis of complex morphological patterns of the nervous system, muscles, sex organs as well as deformities of arthropods. Further, comparative zoology together with the arts and sciences aid in understanding the theoretical concept of homology, evolutionary development biology as well as analytical morphology.



Three dimensional reconstruction of the central nerve system (green) and the muscles (yellow) of the naupilus larva of a copepod (Copepoda). Picture: Dr. H. Hein

Selected publications:

Scholtz, G., Staude, A. & Dunlop, J.A. (2019) Trilobite compound eyes with crystalline cones and rhabdoms show mandibulate affinities. Nature Communications 10: 2503.

Liu, Y., Scholtz, G. & Hou, X. (2015) When a 520 million-year-old Chengjiang fossil meets a modern micro-CT – a case study. Scientific Reports 5: 12802.

Brenneis, G. & Scholtz, G. (2014) The ‚Ventral Organs‘ of Pycnogonida (Arthropoda) are neurogenic niches of late embryonic and post-embryonic nervous system development. PLoS One 9(4): e95435.

Contribution to research networks

Structural flexibility of the optical design of the cornea of arthropods: the cuticula of the arthropods is a multifunctional biological composite material composed of chitin filaments imbedded in a protein matrix. We compare the cuticle structure of the eye and the rest of the body of different arthropods with different complex eye types. The aim of the project is to clarify the fine structure of the cuticle cornea and how it influences the optical characteristics of a complex eye.

Zoology

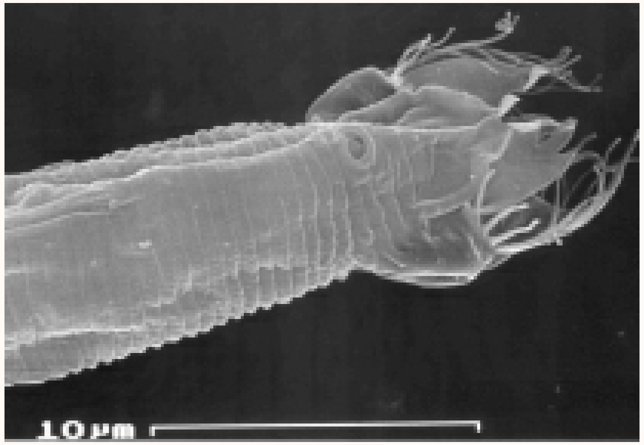
LILIANE RUEß

Ecology
https://www.biologie.hu-berlin.de/de/gruppenseiten/oekologie

Description of the projects:

The science ‚ecology‘ has gone a long way since the time when biologists used botanist‘s vasculum, lenses and butterfly net to investigate the interactions between flora and fauna. Today, the working group ‘ecology’ combines classical morphological and taxonomical approaches with a wide spectrum of modern biochemical tools to investigate soil ecosystems. The diverse group of soil nematodes (threadworms) is in our special interest, predominantly their density and biodiversity as well as their function in the micro-food web. Thereby, nematodes serve as entry-level indicators for soil health.

Due to the difficulty of access and the small size of the organisms, the soil has remained a ‘black box’ for quite a long time. With the help of fatty acids and stable isotopes we make the processes in this cryptic habitat visible. For example microbial biomass and community structure are determined by analysis of phospholipid fatty acids. Most importantly, we have established fatty acids as trophic biomarkers in soil. With this biochemical fingerprint we investigate the energy and nutrient flow in the soil food web. In other words, we are addressing the question “You are what you eat?”



Wilsonema otophorum, a frequent bacterial feeder in soil.

Selected publications:
Kuehn, J., Richter, A., Kahl, T., Bauhus, J., Schöning, I., Ruess, L. (2018). Community level lipid profiling of consumers as a tool for soil food web diagnostics. Methods in Ecology and Evolution 9, 1265-1275.

Pausch, J., Kramer, S., Scharroba, A., Scheunemann, N., Butenschoen, O., Kandeler, E., Marhan, S., Riederer, M., Scheu, S., Kuzyakov, Y., Ruess, L. (2016). Small but active - pool size does not matter for carbon incorporation in belowground food webs. Functional Ecology 30, 479-489.

Contribution to research networks

Exploratories for large-scale and long-term functional biodiversity research: The Biodiversity Exploratories are a German Science Foundation funded research project (DFG Priority programme 1374). Three exploratories serve as open research platform for all biodiversity and ecosystem research groups of Germany. The main objectives are to understand the role of biodiversity for ecosystem processes and the impact of land use and management on biodiversity.

N_2O emissions as response of process-related soil microbial activity to different irrigation and nitrogen fertilization regimes in potato cropping: This is a research collaboration with the Department for Bioengineering of the Leibniz Institute for Agricultural Engineering and Bioeconomy. The objective of the DFG funded project is to reveal the microbial-mediated processes behind N_2O emissions depending on the irrigation-fertilization practice in agriculture.

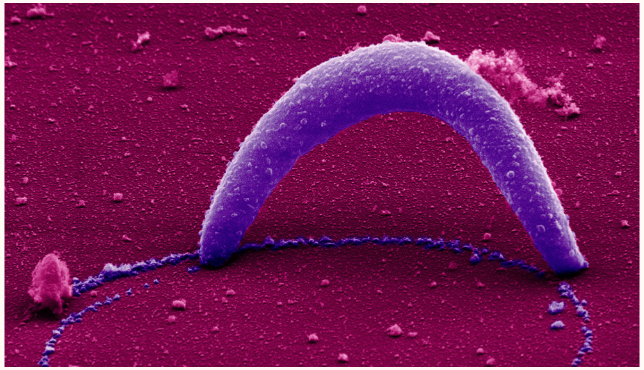
Soil fauna - Key to Soil Organic Matter Dynamics and Modelling (KEYSOM): This COST action ES1406 brings together biogeochemists and soil ecologists to develop a research network for improved SOM models by implementing the role of the soil fauna as a basis for sustainable soil management. We contribute by supporting research exchange and education of young scientists, e.g. via access to modern analytical techniques.

Zoology

KAI MATUSCHEWSKI

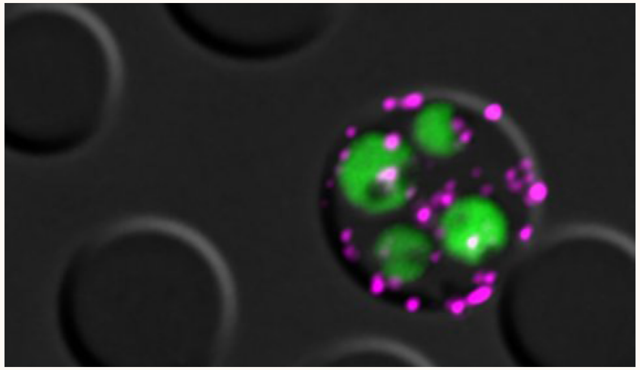
Molecular parasitology
https://www.biologie.hu-berlin.de/de/gruppenseiten molpara/
Description of the projects:

Parasites are eukaryotic pathogens that infect virtually every free-living organism. They are causative agents of important, and often poverty-associated, infectious diseases and one of the most pressing global threats to human health and fragile economies in the tropics. During parasite/host co-evolution parasites adopted complex mechanisms of efficient transmission, immune evasion, and chronic infection. A hallmark is a hard-wired developmental program that encompasses tailor-made extracellular and intracellular parasite stages and stage conversion during host switch. A better molecular understanding of the mechanisms that drive parasite/host interactions and the complex life cycle is a prerequisite for novel evidence-based control strategies.



Plasmodium sporozoite, the infectious stage of malaria parasites.

In the Department of Molecular Parasitology parasites that cause malaria, toxoplasmosis and wildlife infections are studied using molecular, experimental genetics and biochemical approaches. Insights from the clinically silent liver phase of Plasmodium infections permit previously unrecognized opportunities to attenuate the parasite prior to malaria symptoms and provide the host with a decisive immunological advantage. Systematic reverse genetic studies of the metabolic flexibility of Toxoplasma open new perspectives for curative drugs. Phylogenetic studies of closely related parasites in native and afrotropical wild animals contribute to an informed evaluation of complex ecosystems and biodiversity.



A sexual replication inside erythrocytes causes all symptoms and pathology associated with malaria.

Selected publications:
Matz J.M., Watanabe M., Falade M, Tohge T, Hoefgen R., Matuschewski K. (2019) Plasmodium para-aminobenzoate synthesis and salvage resolve avoidance of folate competition and adaptation to host diet. Cell Rep., 26: 356-363.

Schaer J., Perkins S.L., Ejotre I., Vodzak M.E., Matuschewski K., Reeder D.M. (2017) Epauletted fruit bats display exceptionally high infections with a Hepatocystis species complex in South Sudan. Sci. Rep. 7: 6928.

Petersen W., Stenzel W., Silvie O., Blanz J., Saftig P., Matuschewski K., Ingmundson A. (2017) Sequestration of cholesterol within the host late endocytic pathway restricts liver-stage Plasmodium development. Mol. Biol. Cell 28: 726-735.

Contribution to research networks

Research Training Group 2046: Parasite Infections from experimental models to natural systems. Employing genetically attenuated and transgenic parasites antigen-specific immune responses are investigated to reliably predict sustained anti-malaria vaccine efficacy.

IRI Life Sciences: The IRI for the Life Sciences at the Humboldt University is a collaborative research institute founded in collaboration with the Charité Hospital and the MDC with the goal of bridging theoretical and quantitative experimental approaches at multiple scales of biology, from molecules to cells to organisms and populations.

Interdisciplinary Centre for Infection biology and Immunity (ZIBI) Graduate School Berlin: The interdisciplinary centre for infection biology and immunity (ZIBI) was founded in 2005 at the Humboldt's university to Berlin. It bundles up the activities of the free university, Humboldt's university and external-university institutions in the area of the infection biology and immunity.

International Graduate Training Program IRTG 2290: Crossing Boundaries: Molecular Interactions in Malaria. (Spokesperson and P. I.) The Berlin-Canberra alliance addresses fundamental issues in malaria through an International Research Training Program (IRTG 2290). Molecular insights into Plasmodium infections can generate novel evidence-based strategies to develop curative and prophylactic drugs, and immunization strategies that elicit lasting protection against the disease. https://www.allianceberlincanberra.org/

Zoology

JOHN A. NYAKATURA

Morphology and the history of forms

http://nyakaturalab.com/

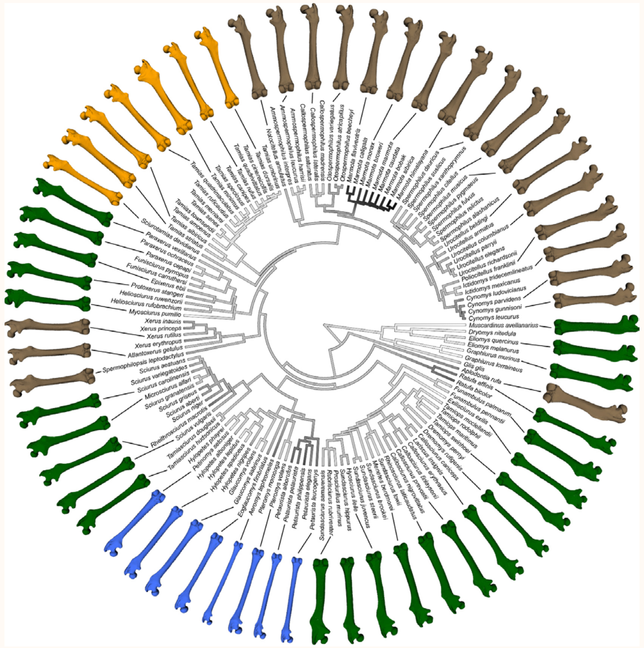
Description of the projects:

Our team focusses on the functional morphology and evolution of land-living vertebrates. Collection-based approaches, experimental approaches and field work are integrated to study form-function relationships on an organismic level in the context of evolution. Our current projects are all concerned with mammals, but this may change in the future. Currently, we work on sciuromorph rodents, callitrichid primates, and xenarthrans. In clade-wide analyses we study the structures that make up the postcranium such as bones and muscles. Especially bones are readily available in scientific collections and offer several layers of analysis including the overall shape and the internal structure. On the experimental side, we conduct non-invasive motion analyses to study function in vivo and to ultimately be able to correlate a given morphology with a specific function. We gather important ecological data on locomotor behaviour in field studies. Any insight into the form-function relationship of extant species can potentially also be used to better understand fossil material. To this end, we also employ simulation of extinct forms and their function in collaboration with roboticists and experts for computer animation.

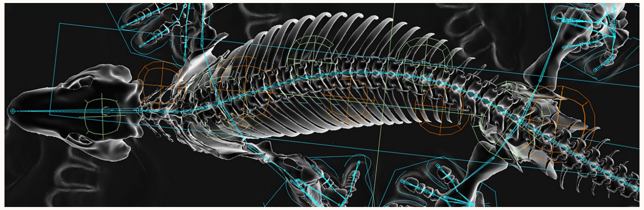
Selected publications:

Nyakatura, JA et al. 2019. Reverse engineering the locomotion of a stem amniote. Nature 565, 351-359.

Mielke, M. et al. 2018. Trabecular architecture in the sciuromorph femoral head: allometry and functional adaptation. Zoological Letters 4, 10.



Shape evolution and diversity of sciuromorph (squirrels and their kin) femora. Body mass is indicated by how dark the phylogeny is shown. Colors of femora indicate lifestyles (green: arboreal, yellow scansorial, blue gliding, brown fossorial). Image: Jan Wölfer.



A simulation study of an early tetrapod. Screenshot.

Contribution to research networks

Excellence Cluster „Matters of Activity: Image Space Material“. The Cluster of Excellence will explore materials’ own inner activity, which can be discovered as a new source of innovative strategies and mechanisms for rethinking the relationship between the analog and the digital. Our team’s interest is i) in the material form and function of tessellated biomaterials such as armadillo armour and ii) in visualization strategies of multimodal 3D imaging data.

Einstein Foundation: „Einstein Circle – Science and Culture“. The Einstein Circle »Science & Culture« aims to dissolve the border between the material and the virtual that separates humanities and natural sciences for creating a common field in human and material sciences through the design of new objects and practices of interdisciplinary research. This research field connecting science and culture will also include medicine, human-centred computing, data sciences, biomaterial sciences and engineering, architecture, history of arts and sciences, and product design.

Research grants:

On adaptation: an integrative study of jumping behaviour and functional morphology in callitrichid primates as model systems (DFG NY 63/2-1). The project will exemplarily analyse biological adaptation in callitrichid primates as model systems. It aims to identify similarities and differences in hind limb morphology and link these with in-vivo analyses of jumping behaviour in the lab and in the field in order to gain insight into the locomotor evolution of the group. Several levels of investigation will be integrated in the project: structure, function, performance, and behaviour.

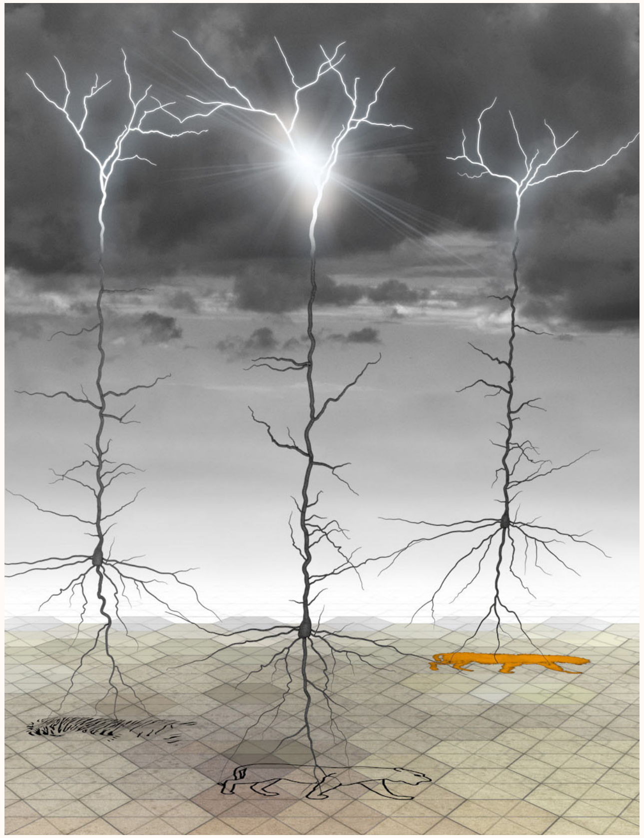
Zoology

MATTHEW LARKUM

Neuronal plasticity
https://www.projekte.hu-berlin.de/en/larkum/

Description of the projects:

A basic feature of intelligent systems like the cerebral cortex is the ability to freely associate aspects of perceived experience with an internal representation of the world and make predictions about the future. We are interested in the computational power of single neurons and their contribution to cortical function. Our main hypothesis is that the extraordinary performance of the cortex derives from an associative mechanism built in at the cellular level to the basic neuronal unit of the cortex - the pyramidal cell (Larkum, 2013). The mechanism is robustly triggered by coincident input to opposite poles of the neuron, is exquisitely matched to the large and fine scale architecture of the cortex and is tightly controlled by local microcircuits of inhibitory neurons targeting subcellular compartments. We are currently testing this hypothesis ("BAC firing") on many levels using a variety of research techniques including multiple dendritic patch-clamp recordings in vitro, extracellular electrophysiological techniques, calcium imaging, somatic and dendritic patch-clamp recordings in vivo, two photon imaging (in vitro and in vivo), rodent behavioural experiments and optogenetic approaches.



Schematic representation of a hypothesis on the function of cortex based on the active dendritic properties of pyramidal neurons in layer 5. The properties afford the pyramidal neurons with the ability to associate expectation with data to achieve a coherent percept. Adapted from Larkum (2013): A cellular mechanism for cortical associations (see publication #1). Copyright: Thomas Splettstoesser, www.scistyle.com

Selected publications:

Larkum, M. (2013) A cellular mechanism for cortical associations: an organizing principle for the cerebral cortex. Trends in Neurosciences 36: 141-151.

Palmer, L.M., Shai, A.S., Reeve, J.E., Anderson, H.L., Paulsen, O., Larkum, M.E. (2014) NMDA spikes enhance action potential generation during sensory input. Nature Neuroscience 17: 383-390.

Contribution to research networks

Cluster of Excellence Neurocure: NeuroCure is a cluster of excellence funded through the Excellence Initiative and located at the Charité – University Medicine Berlin, the Humboldt-University and the Free University Berlin. Its research focus is in neuroscience.

European Research Council – "Active dendrites and cortical associations": With support from an advanced grant of the ERC, we are investigating dendritic NMDA spikes and their effect on cognitive function.

Human Brain Project – "Context Sensitive Multisensory Object Recognition": Our goal with this EU funded project is to investigate the dendritic mechanisms for context-sensitive amplification of feedback information.

CRC 1315: Mechanisms and disturbances in memory consolidation: From synapses to systems.

Junior groups

PAWEL ROMANCZUK

Collective information processing

http://lab.romanczuk.de/

Description of the projects:

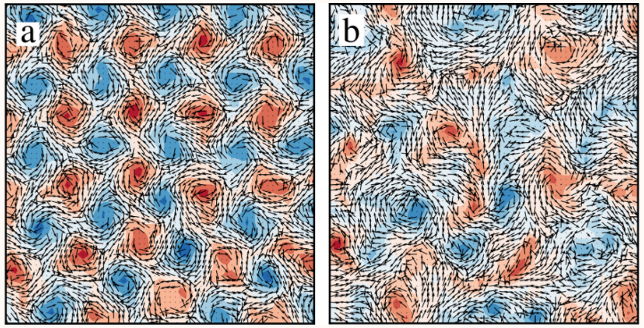
The Emmy Noether group “Collective Information Processing“ at the Department of Biology (Institute of Theoretical Biology), associated with the Bernstein Center for Computational Neuroscience, is headed by Dr Romanczuk. The primary focus of our research is the development and analysis of mathematical models of collective behavior which take into account individual sensory perception. The combinaton of theory and modelling in close collaboration with experimental partners, aims at exploring the fundamental properties and constraints of sensory perception on collective motion and decision making within animal groups. The main focus of the modelling are vision mediated interactions with locusts swarms and fish schools as experimental model systems.

Selected publications:

Landgraf, T., Bierbach, D., Nguyen, H., Muggelberg, N., Romanczuk, P., & Krause, J. (2016). RoboFish: increased acceptance of interactive robotic fish with realistic eyes and natural motion patterns by live Trinidadian guppies. Bioinspiration & Biomimetics, 11(1), 015001. http://doi.org/10.1088/1748-3190/11/1/015001

Guttal, V., Romanczuk, P., Simpson, S. J., Sword, G. A., & Couzin, I. D. (2012). Cannibalism can drive the evolution of behavioural phase polyphenism in locusts. Ecology Letters, 15(10), 1158– 1166. http://doi.org/10.1111/j.1461-0248.2012.01840.x.

Under water snapshot of a *Poecilia sulphuraria* school at the surface of a stream in Teapa/Mexico.



Dynamical structure formation in active matter systems. Velocity fields and vorticity for collective behavior of self-propelled agents: (a) regular vortex arrays; (b) active turbulence (from [Grossmann et al, Phys. Rev. Lett. 113, 2014]).

Contribution to research networks

Cluster of Excellence: „Science of Intelligence“ (SCIoI), (Principal Investigator). Understanding intelligence is one of the great scientific challenges of our time. Yet in spite of extensive research efforts spanning many scientific disciplines, our understanding of intelligence remains fragmented and incomplete. The Cluster of Excellence Science of Intelligence (SCIoI) aims to identify the principles of intelligence to fundamentally advance our understanding of intelligence as a whole – be it human, animal, individual, collective or artificial. www.scienceofintelligence.de

Emmy Noether programme: Within the scope of the Emmy of Noether programme promotes the German Research Foundation (DFG) prominent up-and-coming researchers with the aim to attain early scientific independence. Within this programme Dr Romanczuk works on the project “Collective Information Processing - From Individual Sensory Inputs to Swarming and Collective Decision Making“.

Cooperation and Collective Cognition Network (CoCCoN), Princeton University and Humboldt Universität zu Berlin: The networks brings together scientist from a broad range of disciplines, such as biology, psychology, sociology, economics and applied math. It provides an interdisciplinary environment for collaborative study of cooperation and collective cognition in human and animal systems. A particular focus is the promotion of direct exchange between empirical and theoretical research.

Junior groups

NATALIA TSCHOWRI

Cyclic di-nucleotide signalling in bacterial differentiation and antibiotic production
https://www.biologie.hu-berlin.de/de/gruppenseiten/mikrobiologie/tschowri_group/research/index.html
Description of the projects:

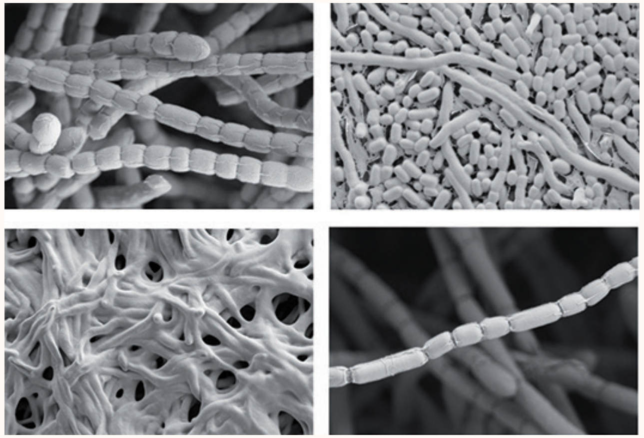
In 2016, Vereinigung für Allgemeine und Angewandte Mikrobiologie (VAAM) selected *Streptomyces* as the Microbe of the Year (Fig. 1). These multi-talented bacteria have already been awarded the Nobel Prize twice: 1952 for the synthesis of the antibiotic Streptomycin and 2015 for the production of the anti-parasitic agent Ivermectin. They also produce anti-fungals, anti-cancer substances and immunosuppressants and represent the most abundant and important source of bioactive compounds for medical, veterinary and agricultural use.

The synthesis of these secondary metabolites is genetically and temporally tightly interlinked with the developmental life cycle of streptomycetes. This life cycle includes the transition from hyphal growth to sporulation (Fig. 2) and is controlled by the signalling molecules cyclic di-nucleotides. The research of Natalia Tschowri focuses on the question how and via which molecular mechanism(s) cyclic di-GMP and cyclic di-AMP regulate morphological and physiological differentiation processes in Streptomyces bacteria.

Selected publications:
Tschowri N, Schumacher MA, Schlimpert S, Chinnam NB, Findlay KC, Brennan RG, Buttner MJ. Tetrameric c-di-GMP Mediates Effective Transcription Factor Dimerization to Control Streptomyces Development. Cell, 2014 Aug 28;158(5):1136-47.

Tschowri N. Cyclic Dinucleotide-Controlled Regulatory Pathways in Streptomyces. Review. J. Bacteriol, 2016 Jan;198(1):47-54.

Streptomyces are Microbe of the Year 2016 (VAAM)



Scanning electron micrographs of *Streptomyces* in different developmental stages.

Contribution to research networks

Emmy Noether programme: The Emmy Noether Programme (DFG) supports researchers in achieving independence at an early stage of their scientific careers. Within this programme, Natalia Tschowri works on the project “Cyclic di-GMP in the control of multicellular differentiation in antibiotic-producing bacteria Streptomyces”.

Priority Programme SPP 1879: Within the DFG-funded Priority Programme “Nucleotide Second Messengers Signaling in Bacteria” (coordinator Prof. Dr. Regine Hengge, HU-Berlin). Natalia Tschowri works on the project “The role of cyclic di-AMP and a novel cyclic dinucleotide in differentiation and stress survival of Streptomyces spp.”.

Junior groups

DAVID GARFIELD

Evolutionary biology

https://www.garfieldlab.org/

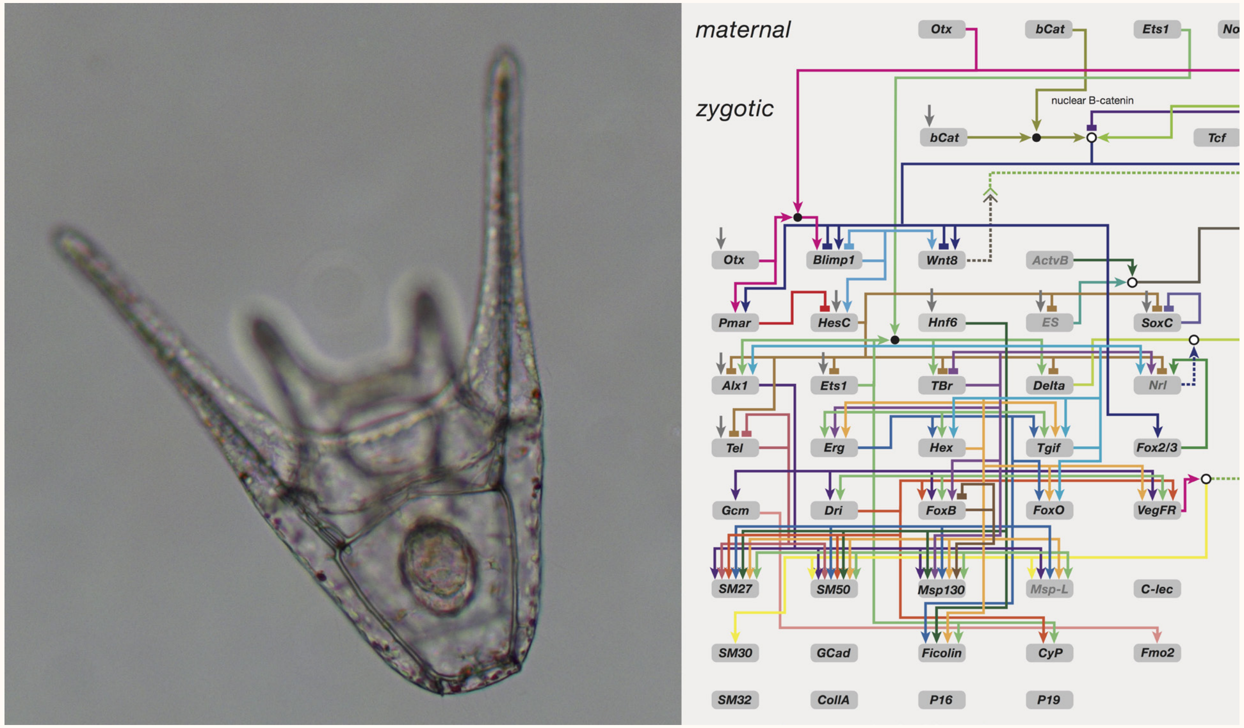
Description of the projects:

A fundamental tenet of Darwinian evolution is that differences between species develop from variation within species. Our work hems closely to this principle by using population genetics and comparisons between closely related species to understand the mechanisms by which natural selection shapes embryonic development and, ultimately, organismal form. Our lab focuses specifically on the mechanisms underlying the evolution of developmental gene expression using a variety of genomics tools. In our deployment of these tools, we work closely with other Berlin-based groups to bring cutting-edge tools normally associated with biomedical research to bear on problems in Evolutionary Biology. As part of our research mission, we also help to develop tools from Evolutionary Biology, in particular population genetics, to help biomedical researchers better understand and identify mutations associated with human disease.

Selected publications:

Zichner T., DA Garfield, et al.. Impact of genomic structural variation in Drosophila melanogaster based on population-scale sequencing. Genome Research. 2013. 23: 568-579.

Garfield, DA et al.. The impact of gene expression variation on the robustness and evolvability of a developmental gene regulatory network. PLoS Biology. 2013. 11: e1001696.



Sea urchin larvae of different species are easily identified by the shape of their skeletons. We examine changes in the expression and sequence of interacting genes to understand how selection has shaped this diversity of forms.

Contribution to research networks

IRI for the Life Sciences: The IRI for the Life Sciences at the Humboldt University is a collaborative research institute founded in collaboration with the Charité Hospital and the Max-Delbrück-Centrum for Molecular Medicine with the goal of bridging theoretical and quantitative experimental approaches at multiple scales of biology, from molecules to cells to organisms and populations.

IRTG 2403: Dissecting an reengineering the regulatory genome. In an alliance between Berlin institutions (led by Humboldt University) and Duke University, the DFG-funded international research training group (IRTG2403) aims to teach the next generation of researchers a quantitative understanding of genome function and gene regulation within the context of biological systems. https://www.regulatory-genome.org/

ERC Starting Grant: „evolSingleCellGRN - Constraint, Adaptation, and Heterogeneity: Genomic and single-cell approaches to understanding the evolution of developmental gene regulatory networks".

Junior groups

RALF STEUER

Metabolic network analysis

https://itb.biologie.hu-berlin.de/wiki/groups/steuer/start

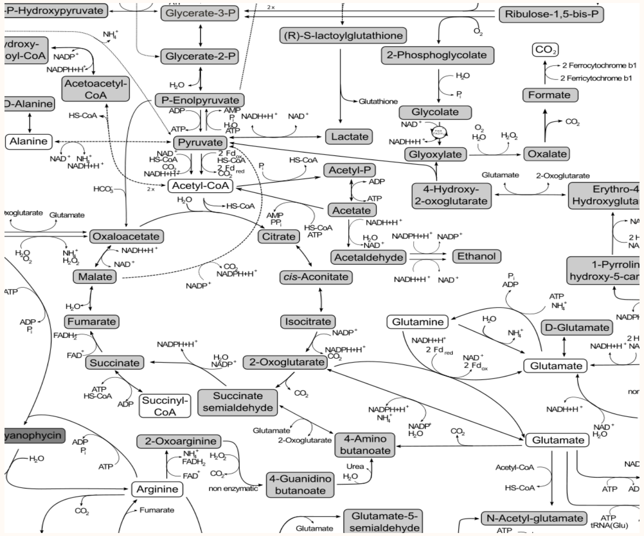
Description of the projects:

The evolution of oxygenic photosynthesis was one of the most important metabolic innovations on this planet and has influenced the Earth's geochemistry like no other biological process. The focus of our research is to understand cyanobacterial phototrophic growth using a combination of experimental analysis and mathematical modeling. We seek to describe cyanobacterial growth as an interplay of different cellular processes, such as light harvesting, electron transport, cellular metabolism, the circadian clock, among others, that together give rise to cellular growth. We thereby seek to bridge the gap between knowledge-driven research and applications in green biotechnology. Predictive mathematical models of phototrophic growth have manifold direct applications, such as for the identification of suitable intervention strategies to increase the yield of desired products and to optimize commercially viable cultivation conditions.

Selected publications:

Westermark S and Steuer R (2016) Toward Multiscale Models of Cyanobacterial Growth: A Modular Approach. Front. Bioeng. Biotechnol. 4:95. doi: 10.3389/fbioe.2016.00095.

Knoop H, Gründel M, Zilliges Y, Lehmann R, Hoffmann S, Lockau W, Steuer R. (2013) Flux balance analysis of cyanobacterial metabolism: the metabolic network of Synechocystis sp. PCC 6803. PLoS Comput Biol. 9(6):e1003081. doi: 10.1371/journal.pcbi.1003081.



Excerpt of a cyanobacterial metabolic "route map". One of our research projects is to reconstruct the biochemical repertoire of diverse cyanobacteria. Genome-scale metabolic reconstructions are the outcome of an iterative process that involves literature research, sequence comparisons, integration of high-throughput data and targeted biochemical tests. The reconstruction of the cyanobacterium Synechocystis sp. PCC 6803 encompasses approximately 700 reactions and describes the biochemical pathways from carbon fixation to the synthesis of cellular building blocks (Figure: Knoop et al., 2013)

As scientific mentor of the EXIST Business Start-Up Grant "CellDeg", the research group was involved in studying cultivation of cyanobacteria at very high cell densities (Picture: CellDeg GmbH).

Contribution to research networks

Research Training Group 1772 Computational Systems Biology

EXIST Business Start-Up Grant "CellDeg" (FKZ 03EGSBE291, 2015-2016), supported by the German Federal Ministry for Economic Affairs and Energy. The aim of the grant was to develop innovative technology for high-density cultivation of cyanobacteria. In 2016 the spin-of company CellDeg GmbH was founded.

e:Bio - Modul III - CyanoGrowth -"The architecture of phototrophic growth" (2013-2017). The core funding for the research group is provided by the German Federal Ministry of Education and Research as part of the "e:Bio –Innovationswettbewerb Systembiologie" [e:Bio – systems biology innovation competition] initiative (reference: FKZ 0316192).

Federal Ministry of Education and Research e:Bio CYANOSYS II: Systems Biology of Cyanobacterial Biofuel Production (2013-2016). Together with 6 academic partners and the industrial partner Algenol Biofuels Deutschland GmbH, we developed novel metabolic strategies to synthesize renewable fuels in cyanobacteria.

Junior groups

BENEDIKT BECKMANN

Molecular infection biology
http://www.beckmannlab.de/

Description of the projects:

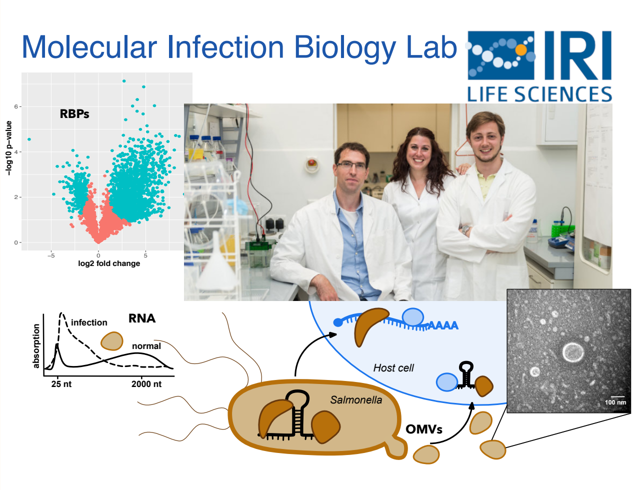
We are using classical molecular biology methods in combination bioinformatics to investigate RNA-protein interactions and its impact on infection to understand the post-transcriptional response of pathogen & host cell upon infection. Applying state-of-the-art systems biology approaches such as mRNA interactome capture, we analyse how *Salmonella* Typhimurium infection changes (m)RNP composition in macrophage host cells and the bacterium itself.

During infection, bacteria 'inject' effector proteins into the host cell which hijack cellular defense pathways of innate immunity and allow the pathogen to survive in macrophages and other cell types. It remains unclear if RNA-binding proteins (RBPs) are among these effectors. We are searching for such cross-species RNA-protein interactions and we are interested to learn if such bacterial RBPs are also able to interfer with the hosts' posttranscriptional response to the infection.

Selected publications:

Beckmann BM*, Hoch PG*, Marz M, Willkomm DK, Salas M and Hartmann RK. A pRNA-induced structural arrangement triggers 6S-1 RNA release from RNA polymerase in Bacillus subtilis. EMBO J (2012); 31(7):1727-38.

Beckmann BM*, Horos R*, Fischer B, Castello A, Eichelbaum K, Alleaume A-M, Schwarzl T, Curk T, Foehr S, Huber W, Krijgsveld J and Hentze MW. The RNA-binding proteomes from yeast to man harbour conserved enigmRBPs. Nature Communications (2015); 6:10127.



"Molecular Infection Biology Group. Our lab is investigating RNA-protein interactions with potential roles during infection of human cells by the bacterium *Salmonella* Typhimurium. On the picture: Benedikt Beckmann, Erika Urdaneta, Davide Figini."

Contribution to research networks

IRI for the Life Sciences: The IRI for the Life Sciences at the Humboldt University is a collaborative research institute founded in collaboration with the Charité Hospital and the Max-Delbrück-Centrum for Molecular Medicine with the goal of bridging theoretical and quantitative experimental approaches at multiple scales of biology, from molecules to cells to organisms and populations.

Junior groups

SIMONE REBER

Quantitative biology

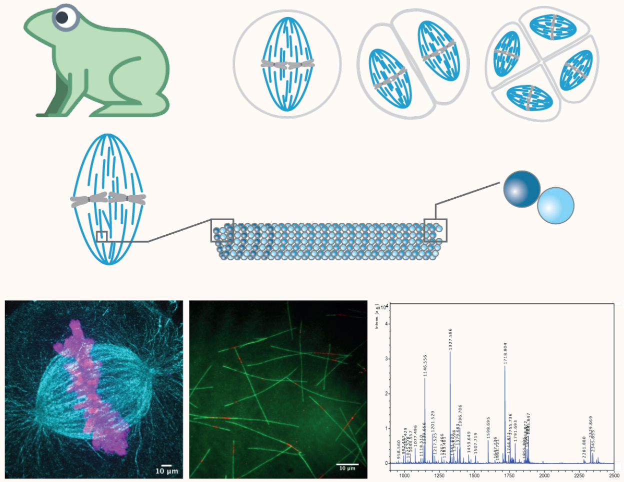
http://www.thereberlab.com/

Description of the projects:

The Quantitative Biology Lab is an international team with backgrounds in biology, biochemistry, physical medicine, and mathematics. Our goal is to elucidate the biochemical and biophysical principles that underlie the self-organization and scaling of subcellular organelles. Each cellular organelle carries out a distinct function, which is not only related to its molecular composition, but in many cases also to its size. The mitotic spindle for example must be large enough to span sufficient distance to physically separate chromosomes into two opposite halves of the cell. In particular, we wish to understand the organizational principles that determine the size and the shape of the metaphase spindle. To understand the higher-order structure and dynamics of the metaphase spindle we need to study and link processes on several hierarchical length scales spanning a size range from single molecules to cells.

Selected publications:
Kapoor et al., MTrack: Automated Detection, Tracking, and Analysis of Dynamic Microtubules. Sci Rep. 2019 Mar 7;9(1):3794.

Camargo Ortega et al., The centrosome protein AKNA regulates neurogenesis via microtubule organization. Nature. 2019 Mar; 567(7746):113-117.



How do cells engineer size and geometry?
Overview thereber.lab

Contribution to research networks

IRI for the Life Sciences: A collaborative research institute founded in collaboration with the Charité Hospital and the Max-Delbrück-Centrum for Molecular Medicine with the goal of bridging theoretical and quantitative experimental approaches at multiple scales of biology, from molecules to cells to organisms and populations.

IRTG 2290: A German-Australian International Research Training Group "Crossing Boundaries: Molecular Interactions in Malaria".

Princeton-Humboldt Strategic Partnership Grant on „How to Shape Living Structures" with Prof. Petry at the Department of Molecular Biology, Princeton University.

DFG grant on „A Quantitative Force Map of the Mitotic Spindle". The goal of this research proposal is to understand the way in which cells engineer micrometerscale structures. In particular, we aim to understand how different force generating systems collectively define the shape of the metaphase spindle.

iNext funded by the Horizon 2020 programme of the European Union on „How do cells engineer mesosclae structures".

MATTHIAS KÖNIG

Systems medicine of the liver
https://itb.biologie.hu-berlin.de/wiki/groups/koenig/start

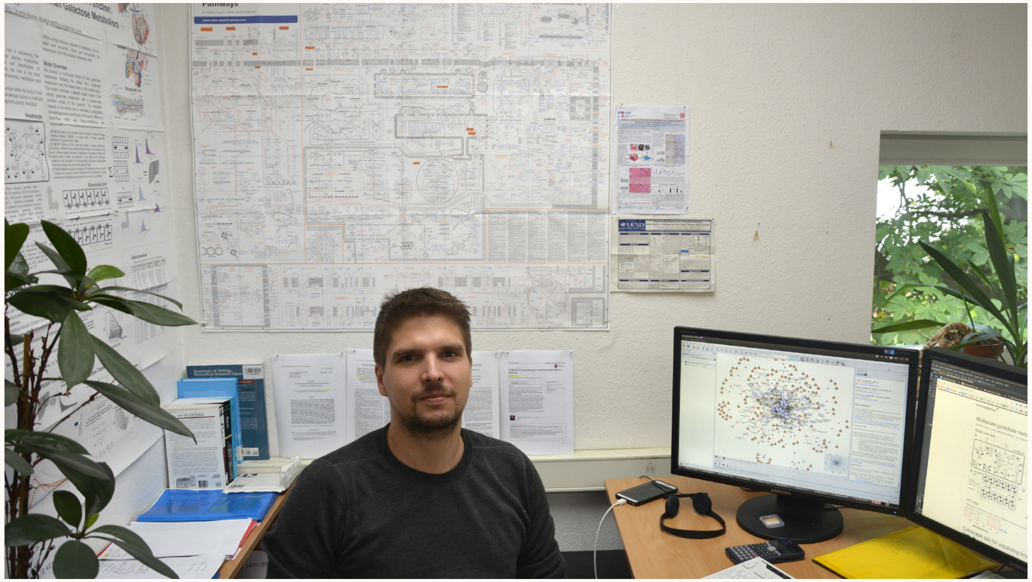
Description of the projects:

The liver is the metabolic hub of the body with a central role for metabolic homeostasis and detoxification of drugs and xenobiotics. The quantification of this liver function is indispensable to determine the functional status of the liver (e.g. in liver transplantation and resection), the alterations due to liver impairment and alteration (e. g. in liver disease like cirrhosis), or the success of interventions (e. g. medication).

Within the research network LiSyM we investigate with computational models of the liver which factors and processes influence hepatic function from the single cell, over the tissue up to the whole organ. We analyse the role of metabolism, perfusion and structure for liver function, and gain insights in the biological mechanisms underlying liver function.

A central objective is the development of a multiscale-model of the liver for the improved evaluation of quantitative liver function tests in the clinics. The model will be personalized using clinical and imaging data, as well as information about gender, age, bodyweight and height providing means for the individual evaluation of liver function tests.

More information under www.livermetabolism.com.



Mathematical modeling of liver metabolism and analysis of metabolic networks of the liver. The developed computational models are personalized and applied for the individual prediction of liver function.

Selected publications:

König M., Bulik S. and Holzhütter HG. Quantifying the Contribution of the Liver to the Homeostasis of Plasma Glucose: A Detailed Kinetic Model of Hepatic Glucose Metabolism Integrated with the Hormonal Control by Insulin, Glucagon and Epinephrine PLoS Comput Biol. 2012 Jun;8(6):e1002577. Epub 2012 Jun 21. [PubMed].

König M. and Holzhütter HG. Kinetic Modeling of Human Hepatic Glucose Metabolism in T2DM Predicts Higher Risk of Hypoglycemic Events in Rigorous Insulin Therapy J Biol Chem. 2012 [DOI 10.1074/jbc.M112.382069].

Contribution to research networks

BMBF: LiSyM Junior Group – Multi-scale models of the liver for personalized liver function tests. Central objective is the identification of key processes of disease progression based on mathematical modeling applying the systems biology research approach in clinical liver research.

Junior groups

PLACEHOLDER

Title of the group:

https://_________

Description of the projects:

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Selected publications:

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Contribution to research network

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List of special professorships

FMP LEIBNIZ FORSCHUNGSINSTITUT FÜR MOLEKULARE PHARMAKOLOGIE

Adam Lange
Structure and dynamics of biomolecules
e-mail: alange@fmp-berlin.de

IGB LEIBNIZ-INSTITUT FÜR GEWÄSSER-ÖKOLOGIE UND BINNENFISCHEREI

Werner Kloas
Endocrinology and department of ecophysiology and aquaculture at the Leibniz-Institute of Freshwater Ecology and Inland Fisheries
e-mail: werner.kloas@igb-berlin.de

IGZ LEIBNIZ-INSTITUT FÜR GEMÜSE- UND ZIERPFLANZENBAU

LEIBNIZ-INSTITUT FÜR ZOO- UND WILDTIER-FORSCHUNG

Emanuel Heitlinger
Ecology and evolution of molecular parasite-host interactions
e-mail: emanuel.heitlinger@hu-berlin.de

MAX DELBRÜCK CENTER FOR MOLECULAR MEDICINE IN THE HELMHOLTZ ASSOCIATION

Markus Landthaler
RNA biology and posttranscriptional regulation
e-mail: markus.landthaler@mdc-berlin.de

Achim Leutz
Cell differentiation and tumorigenesis
e-mail: aleutz@mdc-berlin.de

Uwe Ohler
Computational regulatory genomics
e-mail: Uwe.Ohler@mdc-berlin.de

Ana Pombo
Transcriptional regulation and genome architecture
e-mail: Ana.Pombo@mdc-berlin.de

Thomas Sommer
Intracellular proteolysis
e-mail: tsommer@mdc-berlin.de

MUSEUM FÜR NATURKUNDE BERLIN

Jörg Fröbisch
Paleobiology and evolution
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Development and evolution
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Johannes Vogel
Biodiversity and public science
e-mail: johannes.vogel@mfn-berlin.de

ROBERT KOCH INSTITUTE

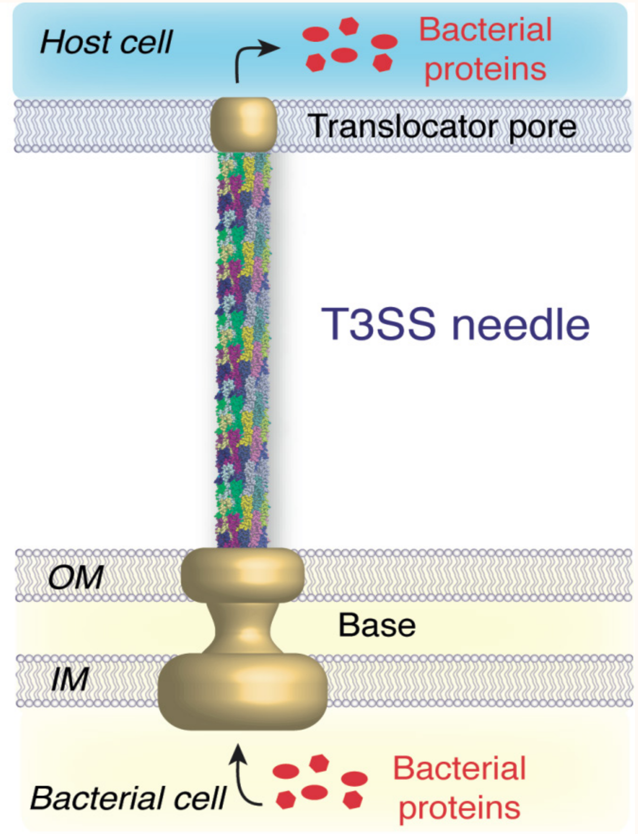
Dirk Brockmann
Complex systems
e-mail: dirk.brockmann@hu-berlin.de

Special professorship

ADAM LANGE

Structure and dynamics of biomolecules
http://www.igzev.de/mitarbeiter-listenansicht/?id=116
Description of the projects:

We study protein structure and dynamics using nuclear magnetic resonance in the solid state (solid-state NMR) and a variety of other biophysical methods. In the last decade, solid-state NMR has emerged as a powerful technique in structural biology as it gives access to structural information for systems that are insoluble or do not crystallize easily. Furthermore, the technique allows for the characterization of chemical details (e.g. protonation of side chains) and functionally important protein dynamics. For solid-state NMR investigations, samples are placed in a strong superconducting magnet (external field up to 20 T, i.e. ~400,000 times stronger than the earth's magnetic field), spun rapidly (up to 100,000 rotations per second; magic-angle spinning), and probed by radio waves. In our group, one focus is on bacterial nanomachines that are involved in infection processes. Furthermore, we characterize membrane proteins in a lipid bilayer environment, for instance non-selective cation channels and rhomboid intra-membrane proteases. Last but not least we continue to develop new solid-state NMR methods.



Schematic representation of the type III secretion system. The structure of the needle was determined by our group using a combination of solid-state NMR, electron microscopy, and computer modeling [Loquet et al., *Nature* 2012, and *Acc Chem* Res 2013].

Selected publications:
S. K. Vasa, L. Lin, C. Shi, B. Habenstein, D. Riedel, J. Kühn, M. Thanbichler, and A. Lange, β-Helical architecture of cytoskeletal bactofilin filaments revealed by solid-state NMR, PNAS, 112 (2015), E127-E136.

P. Fricke, V. Chevelkov, M. Zinke, K. Giller, S. Becker, and A. Lange, Backbone assignment of perdeuterated proteins by solid-state NMR using proton-detection and ultrafast magic-angle spinning, Nature Protocols, in press.

Contribution to research networks

ERC Starting Grant: 3D structures of bacterial supramolecular assemblies by solid-state NMR. (Project acronym: assemblyNMR; Grant agreement no.: 337490).

Special professorship

WERNER KLOAS

Endocrinology and department of ecophysiology and aquaculture at the Leibniz-Institute of Freshwater Ecology and Inland Fisheries
https://www.igb-berlin.de/kloas

Description of the projects:

The main interest is to understand and unravel the endocrine functions of aquatic vertebrates e. g. fishes and amphibians and their impacts on physiology affecting reproduction, development, behavior and metabolism. Endocrine research is used as basis for application in ecotoxicology and sustainable aquaculture. One emerging threat in ecotoxicology are the so-called endocrine disruptors (ED), synthetic and natural compounds disrupting normal endocrine functions, revealing impacts on reproduction, behavior and development. The introduction of amphibians as model organisms to study ED is one of the major tasks being accomplished by a broad range of endocrinological research tools. Sustainable aquaculture of fishes has many facets triggered by endocrine systems such as reproduction, development and stress, the latter one associated with animal welfare. All these aspects of sustainable aquaculture are focusing on recent research in the context of integrating aquaculture and horticulture by using our innovative aquaponic system ("tomatofish") in order to contribute to food security.

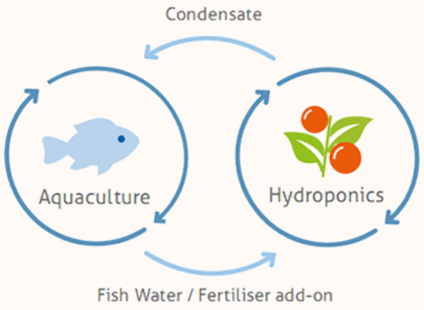
Zuarbeit Ifb-01.pdf

Selected publications:
Kloas W, Groß R, Baganz D, Graupner J, Monsees H, Schmidt U, Staaks G, Suhl J, Tschirner M, Wittstock B, Wuertz S, Zikova A, Rennert B 2015. A new concept for aquaponic systems to improve sustainability, increase productivity, and reduce environmental impacts. Aquaculture Environment Interactions 7: 179-192.

Ziková A, Lorenz C, Hoffmann F, Kleiner W, Lutz I, Stöck M, Kloas W 2017. Endocrine disruption by environmental gestagens in amphibians - A short review supported by new in vitro data using gonads of Xenopus laevis. Chemosphere 181:74-82.

Contribution to research networks

Project leader of the EU-project INAPRO (Innovative aquaponics for professional application 5.9 Mill. €; 1.1.2014-30.6.2018) focusing on aquaponics, a sustainable food production technology that couples fish production and soilless vegetables production in one system.



The double recirculation system provides optimised conditions for the fish and plant part independently from each other to increase the productivity of both.

The project develops production scaled INAPRO aquaponic facilities to demonstrate resource efficient, thus contributing remarkably to the 21st century's global food security.

Special professorship

PLACEHOLDER

Integrative biodiversity discovery
http://www.

Description of the projects:

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Selected publications:

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Contribution to research networks

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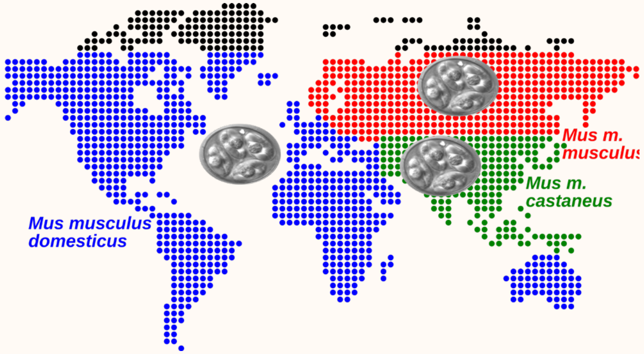
Special professorship

EMANUEL HEITLINGER

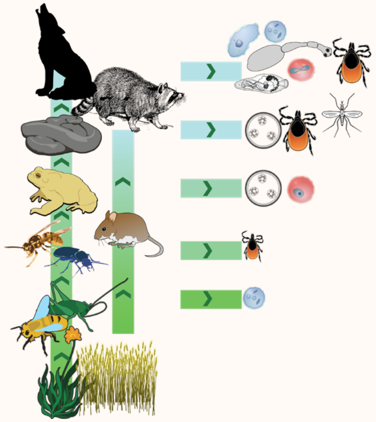
Ecology and evolution of molecular parasite-host interactions
https://www.biologie.hu-berlin.de/de/gruppenseiten/ecoevolpara/
Description of the projects:

We use the hybrid zone of the two subspecies of the house mouse, which often determines population structure of parasites, as a natural laboratory for adaptations and coevolution. Wild house mice (and their laboratory strain cousins) are an approachable model host in both the field and the laboratory.



Geographic distribution of subspecies of the house mouse and their parasites

As our main parasite model we use protozoans of the genus Eimeria, which features host specific parasites. Eimeria is the largest genus in the phylum Apicomlexa (a phylum also containing human pathogens *Plasmodium* spp. *Toxoplasma gondii*). My group tests coevolution: reciprocal adaptation of *Eimeria* and the house mouse.



Parasites in a schematic food chain

It is often necessary to go beyond a „one host one parasite“ system to infer adaptation. We want to include the whole parasite community of a host species and its ecology in the analysis. To this end we develop DNA-sequencing based high throughput methods to investigate non-invasive samples (i.e. fecal samples) for the presence and abundance of eukaryotes (the eukaryotic biome) and its correlation with the bacterial microbiome.

We develop wet-lab approaches (primers and probes) and solutions for bioinformatic data analysis to make full use of the generated information. We aim to construct host-parasite links and food webs and to test the influence of this integrative ecosystem features on animal species and whole ecosystems.

Selected publications:
Totta Ehret, Simone Spork, Christoph Dieterich, Richard Lucius and Emanuel Heitlinger (2017) Dual RNA-seq Reveals No Plastic Transcriptional Response Of The Coccidian Parasite Eimeria falciformis To Host Immune Defences. BMC Genomics 18(1):686.

Emanuel Heitlinger , Susana C Ferreira, Dagmar Thierer, Heribert Hofer and Marion L East (2017) The intestinal eukaryotic and bacterial biome of spotted hyenas: the impact of social status and age on diversity and composition. Frontiers in Cellular and Infection Microbiology 7, 262.

Contribution to research networks

As part of the Leibniz-Institute for Zoo and Wildlife Research (Leibniz-IZW) we contribute to study the diversity of life histories and evolutionary adaptations and their limits (including diseases) of free-ranging and captive wildlife species, and their interactions with people and their environment in Germany, Europe and worldwide.

As part of the Berlin-Canberra alliance we addresses fundamental issues in malaria through an International Research Training Program (IRTG 2290). We want to contribute to molecular insights into Plasmodium infections, which we hope can generate novel evidence-based strategies to develop curative and prophylactic drugs, and immunization strategies that elicit lasting protection against the disease.

As part of GRK 2046 we help to install a cutting edge and integrative curriculum to educate “next-generation” parasitologists. We train graduates in molecular approaches and organismic studies. In accordance with the “One Health” concept different parasite infections are studied from the biological, medical, and translational perspectives.

IRTG2290 and GRK 2046 are both funded by DFG. In addition DFG funding is received for the projects described above in collaboration with with colleagues from the University of Edinburgh (Konrad Lohse) and the Czech Academy of Sciences (Joelle Gouy de Bellocq, Jaroslav Pialek und Stuart Baird).

Special professorship

MARKUS LANDTHALER

RNA biology and posttranscriptional regulation
https://www.mdc-berlin.de/landthalerlab

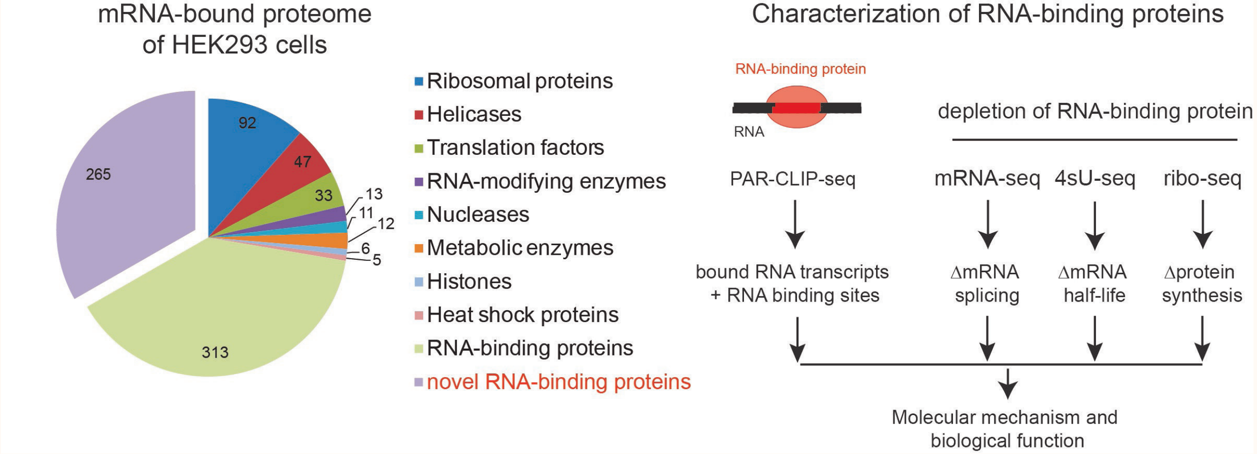
Description of the projects:

Regulation of gene expression takes place at multiple steps along the life cycle of an mRNA molecule from transcription to protein translation. These processes are regulated mainly by RNA-binding proteins that recognize cis-regulatory elements on transcripts, to form ribonucleoprotein (RNPs) complexes with mRNAs. The structure and dynamics of RNPs define the spatial and temporal mRNA transcript abundance. It is evident that the combination of RNP-mediated regulatory events has a direct impact on protein isoform diversity and abundance, suggesting that mRNA is an important source of biological variation.

The Landthaler lab is interested in system-wide understanding of posttranscriptional regulation in mammalian cells in response to changes in their immediate environment. To this end, the lab uses biochemical and transcriptome-wide approaches to study protein-mRNA interactions in combination with high-throughput expression studies.

Selected publications:
Milek M, Imami K, Mukherjee N, De Bortoli F, Zinnall U, Hazapis O, Trahan C, Oeffinger M, Heyd F, Ohler U, Selbach M, Landthaler M. (2017) DDX54 regulates transcriptome dynamics during DNA damage response. Genome Research 27,1-16.

Wessels HH, Imami K, Baltz A, Small S, Selbach M, Ohler U#, Landthaler M#. (2016) The early fly embryo mRNA-bound proteome. Genome Research 26, 1000-1009.



Arbeitsbereich_1.jpg

Contribution to research networks

Marie Curie International Training Network “RNAtrain” (rnatrain.ku.dk/): The network focuses on the functions of non-coding RNAs (ncRNAs) in multidisciplinary projects in the context of development, differentiation and disease. The projects span from the identification of ncRNAs in selected model systems, over functional annotation of ncRNAs to a range of biochemical and genetic functional analyses.

Research Training Group 1772: Computational Systems Biology (http://www.berlin-csb.de/). The goal of this graduate school is the development of new theoretical concepts and their application to current problems in cell biology. The research focuses on reverse engineering of biological networks, understanding of cellular variability, adaptation mechanisms in biological networks and regulatory mechanisms mediated by RNA molecules.

Federal Ministry of Education and Research e:Med CaRNAtion: This project includes the analysis of splice factor function and regulation as a basis for therapeutic decisions and the development and evaluation of splice directed therapeutics in engineered heart muscle from patient derived differentiated iPSCs towards personalized diagnosis and therapy.

Priority program 1935: This Priority Programme aims to “decipher the mRNP code” of eukaryotes. Researchers from disciplines as diverse as systems biology, biochemistry, structural biology and bioinformatics develop methods allowing insight into the composition of mRNPs and their function in specific cellular settings of gene expression.

Special professorship

ACHIM LEUTZ

Cell differentiation and tumorigenesis

https://www.mdc-berlin.de/leutz

Description of the projects:

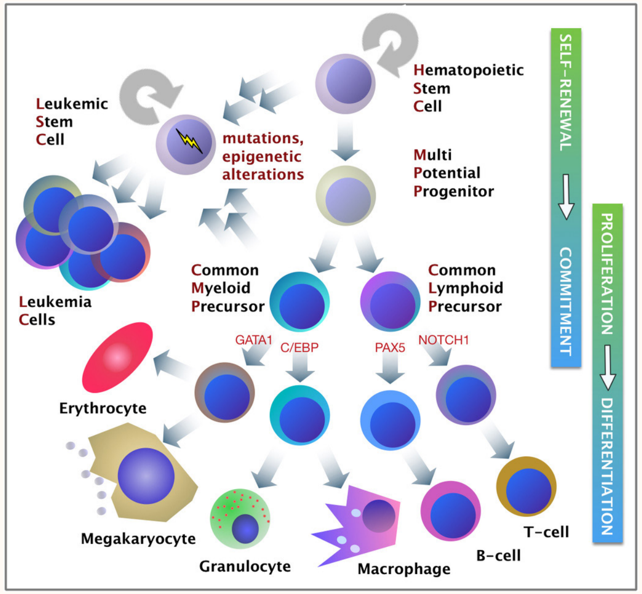
A set of hematopoietic transcription factors controls self renewal, cell lineage commitment, and differentiation of innate immune cells, including granulocytes and macrophages. Dysregulation of such essential transcription factors may cause leukemia. The CCAAT enhancer binding proteins alpha and beta (C/EBP α,β) are pioneer factors that specify cell fate and proliferation by regulating gene expression and the structure of chromatin.

Selected publications:

Dittmar, G., Hernandez, D. P., Kowenz-Leutz, E., Wolf, J., Reimer, U. and Leutz, A. (2019) PRISMA: Protein Interaction Screen on Peptide Matrix Reveals Interaction Footprints and Modifications-Dependent Interactome of Intrinsically Disordered C/EBPβ. iScience, 13:351-396. https://doi.org/10.1016/j.isci.2019.02.026

Mildner, A., Schonheit, J., Giladi, A., David, E., Lara-Astiaso, D., Lorenzo-Vivas, E., Paul, F., Chappell-Maor, L., Priller, J., Leutz, A., Amit, I., Jung, S. (2017) Genomic Characterization of Murine Monocytes Reveals C/EBPbeta Transcription Factor Dependence of Ly6C- Cells. Immunity, 46:849-862e7, 10.1016/j.immuni.2017.04.018.

Cirovic, B., Schönheit, J., Kowenz-Leutz, E., Ivanovska, J., Klement, C., Pronina, N., Begay, V., Leutz, A. (2017) C/EBP-Induced Transdifferentiation Reveals Granulocyte-Macrophage Precursor-like Plasticity of B Cells Stem Cell Reports, 8: 346-359; 10.1016/j.stemcr.2016.12.015.



Scheme of hematopoiesis and leukemogenesis. Hematopoietic stem cells (HSC, on the top) can self renew (circular grey arrow) and give rise to multi-potential progenitors (MPP) that commit to different lineages, as indicated. Progenitor and precursor populations represent highly proliferative transit amplifying populations that generate functionally differentiated blood cells. Genetic accidents (mutations and epigenetic alterations) affecting key transcription factors that direct normal commitment and differentiation cascades (e.g. C/EBP, as indicated) may cause leukemic conversion (= cancer of the blood).

C/EBP α,β are also involved in the leukemic conversion of hematopoietic progenitors. C/EBP α,β are heavily decorated with signal dependent post-translational modifications (PTM). Experimental abrogation of distinct PTM alters both, the C/EBP α,β interactome and regulatory capacity in hematopoiesis. Accordingly, a *"PTM-Indexing Code"* determines essential C/EBP α,β functions and our research focuses on the molecular mechanisms involved. We employ targeted mouse genetics, experimental hematopoiesis, genetic engineering of somatic cells in vitro, proteomics, and biochemistry to disclose the gene regulatory, epigenetic, and the pathologic functions of C/EBP α,β.

Contribution to research networks

CRC/TRR 167: Development, function and potential of myeloid cells in the central nervous system (NeuroMac) Berlin-Freiburg, Teilprojekt B11. Project title: Function of C/EBPs in monocytes, macrophages and microglia.A combination of mouse genetic and proteomic approaches to decipher C/EBP mediated neuroimmune functions during healthy and inflammatory conditions.

Special professorship

UWE OHLER

Computational regulatory genomics
https://ohlerlab.mdc-berlin.de

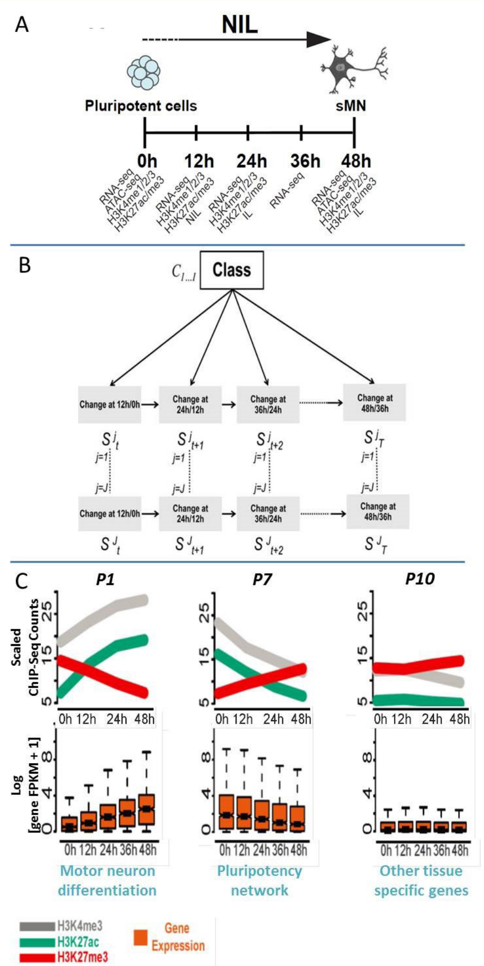
Description of the projects:

The expression of genes is a multi-step process that is tightly controlled on several levels — a large number of protein and RNA factors and DNA and RNA sequence elements enable the precise regulation of interacting gene products. In multicellular organisms, this complexity is not achieved by increasing numbers of parts, i. e. genes, but instead by the more intricate regulation of the parts.

It is a key challenge to decipher these complex regulatory networks, and how they enable the development of complex organisms with many cell types that carry out different functions despite the same genome. To this end, we use high-throughput genomics approaches to generate quantitative data and develop computational methods that use diverse sources of molecular information; we frequently frame questions as classification problems and apply machine learning approaches to make testable predictions.

Selected publications:
Velasco S, Ibrahim MM, Kakumanu A, Garipler G, Aydin B, Al-Sayegh MA, Hirsekorn A, Abdul-Rahman F, Satija R, Ohler U, Mahony S, Mazzoni EO. A Multi-step Transcriptional and Chromatin State Cascade Underlies Motor Neuron Programming from Embryonic Stem Cells. Cell Stem Cell. 20:205-217, 2017.

Calviello L, Mukherjee N, Wyler E, Zauber H, Hirsekorn A, Selbach M, Landthaler M, Obermayer B, Ohler U. Detecting actively translated open reading frames in ribosome profiling data. Nat Methods 13:165-70, 2016.



(A) To understand developmental processes at the molecular level, high-throughput experiments can determine detailed information on gene regulation. Here, embryonic stem cells are converted to motor neurons via the expression of three transcription factors (NIL: Ngn2, Isl1, Lhx3), and the changes of transcription factor binding, chromatin accessibility, histone modifications, and gene expression are profiled from 0-48 hours. (B) Computational models can be used to determine patterns in the data. Here, promoters of genes are clustered by means of a probabilistic model that takes genome-wide data across multiple time points as input. (C) The resulting clusters fell into three broad classes, up-regulated, down-regulated, and constant, and are composed of genes with different functions [Velasco et al, 2017].

Contribution to research networks

IRTG2403: Dissecting and re-engineering the regulatory genome. This international research training group connects Berlin institutions led by HU with Duke University in the US. Combining experiments and computation, its aim is to teach PhD researchers a quantitative understanding of genome function and regulation within the context of developmental systems.

CRC/TR 175: The Chloroplast as Central Coordinator of Acclimation in Plants. Plants continuously acclimate to changes in their environment. Within their cells, chloroplasts sense environmental changes and control cellular responses. Our consortium aims to discover how plants translate changes in light and temperature into cellular responses and to identify the central molecular switches behind this process.

BMBF de.NBI German Network for Bioinformatics Infrastructure: RNA Bioinformatics Center. de.NBI is a national infrastructure providing comprehensive, high-quality bioinformatics services to users in life sciences research and biomedicine. Together with groups in Freiburg and Berlin, we are coordinating the RNA-focused efforts within the network.

Research Training Group 1772: Computational Systems Biology.This graduate training program aims at the development and application of new theoretical concepts of systems biology.

Priority program 1935: At all stages of their life, messenger RNAs interact with trans-acting factors, including proteins and non-coding RNAs, to form ribonucleoproteins (RNPs). Participating groups develop and apply methods allowing insight into the composition of mRNPs, how they are assembled and remodelled, and how they function in specific cellular settings.

Special professorship

ANA POMBO

Transcriptional regulation and genome architecture
https://www.mdc-berlin.de/pombo

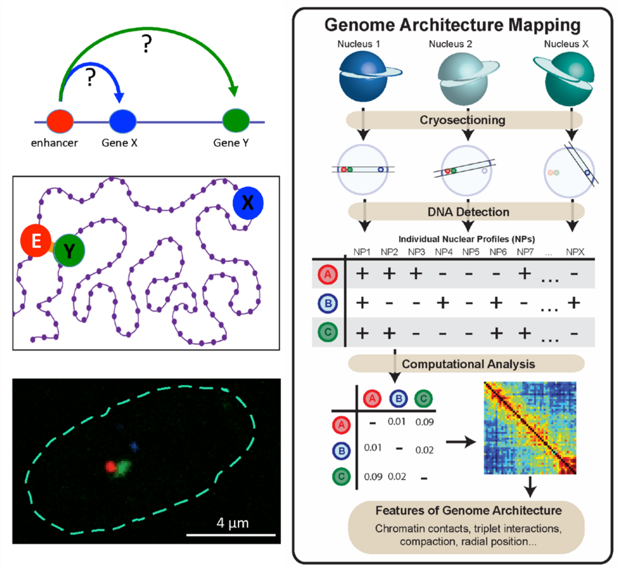
Description of the projects:

We investigate the interplay between gene regulation and three-dimensional genome architecture, towards defining the principles of genome function. We study multiple levels of regulation from the local action of transcription factors, the role of Polycomb repression and RNA polymerase II regulation, to the long-range mechanisms of gene regulation through chromatin looping between non-coding regulatory DNA sequences (enhancers) and genes. We develop new technologies to map the 3D chromatin folding, namely Genome Architecture Mapping (GAM).

Selected publications:
Skourti-Stathaki N*, Torlai Triglia E, Warburton M, Voigt P, Bird A, Pombo A* (2019) R-loops enhance Polycomb repression at a subset of developmental regulator genes. Molecular Cell 73, 1–16.

Beagrie RA, Scialdone A, Schueler M, Kraemer DC, Chotalia M, Xie SQ, Barbieri M, de Santiago I, Lavitas LM, Branco MR, Fraser J, Dostie J, Game L, Dillon N, Edwards PAW, Nicodemi M, Pombo A (2017) Complex multi-enhancer contacts captured by Genome Architecture Mapping. Nature 543, 519-524.

Barbieri M, Xie SQ, Torlai Triglia E, Chiariello A, Bianco S, de Santiago I, Branco MR, Rueda D, Nicodemi M, Pombo A (2017) Active and poised promoter states drive folding of the extended HoxB locus in mouse embryonic stem cells. Nature Structural Molecular Biology 24, 515–524.



	NP1	NP2	NP3	NP4	NP5	NP6	NP7	...	NPX
A	+	+	+	-	-	-	+	...	-
B	+	-	-	+	-	+	-	...	+
C	+	+	-	-	-	+	+	...	-

	A	B	C
A	-	0.01	0.09
B	0.01	-	0.02
C	0.09	0.02	-

Long-range gene regulation. (left) Enhancer regulation works at large genomic distances, often through physical interactions with distant genes. Microscopy image shows and example of a 3-way contact between genomic regions separated by 15Mb. (right) We developed Genome Architecture Mapping, an orthogonal approach to map 3D genome structure (see Beagrie et al. 2017).

We have identified a complex network of non-random contacts that involve enhancers and active genes which span whole chromosomes and are cell-type specific. We currently study the functional role of these contacts in neuronal cell types, the embryo, and genomic rearrangements associated with congenital disease.

Contribution to research networks

Cluster of Excellence NeuroCure.
Within the NeuroCure Cluster of Excellence, a joint project of the federal and Berlin state governments, we pursue neuroscience research with scientists based at the Charite Universitätsmedizin and institutes throughout Berlin.

Einstein BIH Visiting Fellowship to Mario Nicodemi, Pombo (PI). Understanding chromatin folding and gene regulation in disease associated genomic rearrangements. Support for visits of Prof. Nicodemi, and support for 1 postdoc and 1 student at the Pombo lab. Role: PI

European Union: H2020
MSCA-ITN-ETN PepNet Ringrose (PI) Innovative Training Network (ITN) Predictive Epigenetics: fusing theory and experiment. Sub-project: Investigating long-range chromatin contacts during early cell fate decisions in the mouse embryo. European funding for a network of early career fellowships in a pan-European consortium. Role: Co-PI.

EU: LifeTime FET Flagship:
The LifeTime Initiative (Founding member) 2018 - present

IRTG 2403: Dissecting an reengineering the regulatory genome. Sub-project: Single cell approaches to identify chromatin architecture. Funding for joint PhD training program between the Humboldt University of Berlin and Duke University (US). Role: Co-PI

NIH 4D-Nucleome consortium;
1U54DK107977-01 Ren/Murre (PIs)
08/01/2015 –07/31/2020 4D Nucleome, NIH, USA, San Diego Center for 4D Nucleome
Research Role: Co-PI

Priority program 2202: Spatial Genome Architecture in Development and Disease. German DFG funding for a pan-German consortium. Sub project: Cell-state specific 3D genome architecture in heterogeneous cell populations of the brain.
Role: Co-coordinator and co-PI

Special professorship

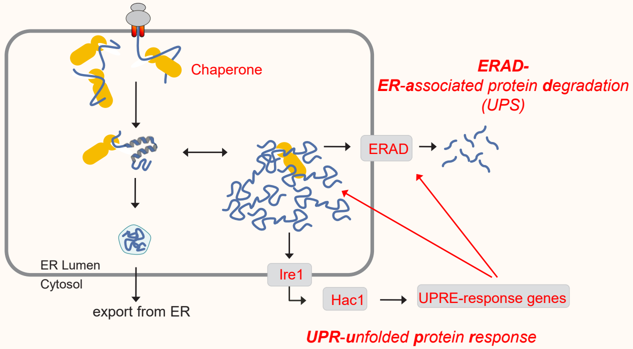
THOMAS SOMMER

Intracellular proteolysis

https://www.mdc-berlin.de/sommer

Description of the projects:

In all cells, both newly synthesized and pre-existing proteins are constantly endangered by misfolding and aggregation. The accumulation of such damaged proteins perturbs cellular homeostasis and provokes aging, pathological states, and even cell death. To avert these dangers, cells have developed compartment-specific protein quality control (PQC) strategies that include proteolytic digestion. Central to the understanding of PQC pathways is the Ubiquitin Proteasome System (UPS).



Protein homeostasis in the Endoplasmic Reticulum (ER). Proteins transported into the ER associate with molecular chaperones and only correctly folded proteins can leave the ER for their final destinations. Misfolded proteins are retained in the ER and are either subjected to re-folding, or are dislocated from the ER for destruction by the Ubiquitin Proteasome System (UPS). The UPR measures the content of misfolding in the ER, signals it to the nucleus, and up-regulates chaperones and UPS components of the ERAD branch.

Our work focuses on how specific combinations of Ubiquitin Conjugating (E2) enzymes and Ubiquitin Ligases (E3) selectively recognize and dispose aberrant proteins without affecting correctly folded polypeptides. Our analysis includes biochemical and biophysical approaches, molecular and genetic analysis, structural investigations (in cooperation), and proteome-wide screens. We work in vitro, in yeast, in cell culture systems, and in *C. elegans* and Zebrafish (both in cooperation). Our results have implications for a wide variety of diseases like cancer, cardiovascular diseases, and neurodegeneration.

Besides biochemical approaches with purified components we use yeasts or cell culture systems as experimental tools.

Selected publications:

Kniss, A., Schuetz, D., Kazemi, S., Pluska, L., Spindler, P.E., Rogov, V.V., Husnjak, K., Dikic, I., Güntert, P., Sommer, T., Prisner, T.F., and Dötsch, V. (2018) Chain assembly and disassembly processes differently affect the conformational space of ubiquitin chains. Structure 26, 249-258.

Weber, A., Cohen, I., Popp, O., Dittmar, G., Reiss, Y., Sommer, T., Ravid, T., and Jarosch, E., (2016) Sequential poly-ubiquitylation by specialized conjugating enzymes expands the versatility of a quality control ubiquitin ligase. Mol. Cell 63, 827-839.

Contribution to research networks

DFG grant: Investigation of mixed ubiquitin chains and chain conformations (Professor Volker Dötsch and Professor Thomas Sommer). Ubiquitination is an essential post-translational modification regulating widespread intracellular processes in eukaryotic cells. Covalent modification of target molecules with ubiquitin is not a simple on-off information like phosphorylation, but can occur in several distinct modes. A key question in the field is to understand how the ubiquitin code is generated and how it is decoded by downstream acting factors. Versatility of the ubiquitin code is achieved by different types of modifications of target proteins: They can either be modified with single ubiquitin molecules at specific sites (mono-ubiquitination), with multiple ubiquitin molecules at several sites (multi mono-ubiquitination) or with various forms of polyubiquitin chains. Chains of different linkage type are associated with different functions.

Federal Ministry of Education and Research GIF grant: (T. Ravid (Hebrew University) and T. Sommer) Understanding Ubiquitin Ligases. Function In Erhomeostasis – A Possible Entry Point For Future Intervention.

Special professorship

JÖRG FRÖBISCH

Paleobiology and evolution
https://www.museumfuernaturkunde.berlin/de/taxonomy/term/234/joerg.froebisch
Description of the projects:

The origin and early evolution of amniotes, the clade that includes all fully terrestrial tetrapods, led to major changes in the structure and hierarchy of terrestrial vertebrate ecosystems, including the evolution of high-fiber herbivory, entirely new locomotor strategies such as climbing and flying, and ultimately the evolution of more complex terrestrial ecosystems and the modern trophic pyramid. The research of my lab focuses on the patterns of diversification, phylogeny, and paleobiology of early amniotes. The application of a number of different approaches combines paleontological fieldwork with modern techniques (3D-imaging) and quantitative methods to shed new light on the initial diversification patterns of amniotes, the evolution of key innovations and body plans, the evolution of vertebrate ecosystems, as well as the impact of mass extinction events on terrestrial ecosystems, with the focus on their vertebrate fauna.

Selected publications:
Brocklehurst, N., Day, M. O., Rubidge, B. S., and Fröbisch, J. (2017) Olson's Extinction and the latitudinal biodiversity gradient of tetrapods in the Permian. – Proceedings of the Royal Society B 284: 20170231.

Brocklehurst, N., Dunne, E., Cashmore, D., and Fröbisch, J. (2018) Physical and environmental drivers of Paleozoic tetrapod dispersal across Pangaea. – Nature Communications 9:5216.

Skeleton of the early mammal relative Suminia getmanovi from the upper Permian Kotel'nich locality (260 Ma), Russia; from the collection of the Paleontological Institute, Russian Academy of Science, Moscow.

Contribution to research networks

Sofja Kovalevskaja Programme: "Early Evolution and Diversification of Synapsida". The Sofja Kovalevskaja Award, granted by the Alexander von Humboldt Foundation and funded by the Federal Ministry of Education and Research, is granted to young exceptionally promising researchers from abroad in recognition of outstanding academic achievements to establish their own research groups in Germany. This research focuses on the patterns of morphological and ecological diversification, phylogeny and paleobiology of one of the two major clades of amniotes, the Synapsida, the clade that ultimately led to the evolution of mammals, utilizing a number of different approaches, combining paleontological fieldwork with modern techniques (3D-imaging) and quantitative methods.

DFG-grant: "Late Paleozoic Tetrapod Biogeography". The late Palaeozoic represents a crucial period in the evolution of terrestrial vertebrate ecosystems when more complex community structures with intricate trophic hierarchies were established. Here we test certain hypotheses regarding the early patterns of tetrapod biogeography through time with quantitative biogeographic methods.

DFG-grant: "Anatomy, Ecology and Ontogeny of Mesosaurs using 3D-Imaging Technologies". Mesosaurs are a unique and very specialized vertebrate group, representing the first fully aquatic amniotes, exclusively known from the early Permian of southern Gondwana. Here we investigate the detailed anatomy, taxonomy, ontogeny, phylogeny and functional morphology of mesosaurs using modern 3D imaging technologies from CT data.

Special professorship

NADIA FRÖBISCH

Development and evolution
https://www.naturkundemuseum.berlin/en/einblicke/mitarbeiter/nadia.froebisch
Description of the projects:

The research focus in the N. Fröbisch lab is on the evolution and development of amphibians. Due to their 350 Ma long evolutionary history, their enormous diversity in extinct and extant ecosystems as well as their impressive ontogenetic plasticity amphibians lend themselves particularly well for an integrative research program. In my lab we combine paleontological, developmental and morphological approaches whereas individual aspects build upon each other with the aim to integrate the genetic basis of developmental processes, the anatomy of extinct and extant organisms, and their interaction with the (paleo)ecosystem. Currently we focus on the early evolution of modern amphibians, limb development and regeneration, and cell size evolution in amphibians.

Selected publications:
Fröbisch, N. B., C. Bickelmann, J. C. Olori & F. Witzmann (2015) Deep-time evolution of regeneration and preaxial polarity in tetrapod limb development. Nature, 527, 231.

Fröbisch, N. B. & N. H. Shubin (2011) Salamander limb development: Integrating genes, morphology, and fossils. Dev. Dyn., 240, 1087.

Zwei fossile Dissorophoiden, *Micormelerpeton* (größeres Tier) und *Apateon* (kleineres Tier), von der Stammlinie der modernen Amphibien. Unteres Perm (290 MA), Saar-Nahe Becken; aus der Sammlung des Museums für Naturkunde.

Contribution to research networks

Universidade de São Paulo
Brasil

Universidade de São Paulo (USP) and the Humboldt-Universtät zu Berlin (HU) Strategic Partnership Initiatives "Evolution of limb reduction and regeneration in salamanders". The research program surrounds a hallmark in tetrapod body plan evolution – the limb. We aim to investigate the evolution and development of limb diversity in salamanders, using an integrative approach that combines phylogenetic mapping of autopodial morphology with analyses of molecular signatures. The Partnership Initiative with Prof. Tiana Kohlsdorf (Universidade de São Paulo) provides funds for travel and exchange to facilitate transfer of skill and initiate joint funding applications and student supervisions.

Emmy Noether-Programm
DFG Deutsche Forschungsgemeinschaft

Emmy Noether Program "Amphibian origin(s) and evolution through deep time: integrating the fossil record, morphology, and development": The DFG Emmy Noether program supports scientists in establishing an independent research group and provides funding for the group leaders as well as PhD students and associated costs for 5 years. The project takes an integrative approach and entails approaches from vertebrate paleontology, morphology and evolutionary developmental biology to understand the evolution of modern amphibians (frogs, salamanders and caecilians). Currently two PhD projects as well as a technical assistant are supported through the project.

DFG grant "The evolution of regenerative capacities in tetrapods considering extant and fossil taxa". Among modern four legged vertebrates only salamander can regenerate their limbs fully and repeatedly throughout their entire life and much research effort is invested to understand the underlying molecular program largely based on the axolotl. This project investigates patterns of regeneration in different salamander taxa and at various ontogenetic stages using a histological approach as well as comparative transcriptomics to gain a broad evolutionary perspective on limb regeneration across taxa and geologic time scales. One PhD project is currently funded through the project.

Special professorship

HANNELORE HOCH

Systematic zoology and entomoloy
http://www.naturkundemuseum-berlin.de
https://orcid.org/0000-0001-6439-9645
Description of the projects:

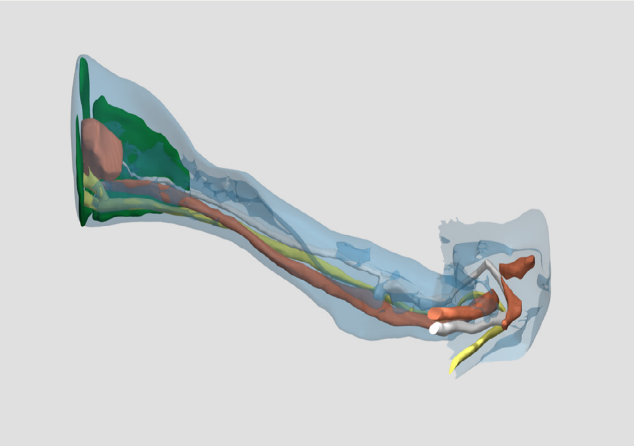
Our research focuses on the taxonomy, systematics and evolutionary biology of insects, especially the Hemiptera which contain numerous species of significant ecological and economic importance. We are interested in the processes underlying the evolution of biodiversity as well as in all aspects of Hemipteran biology, including descriptive and functional morphology, mating behaviour, sensory structures, ecology, adaptation to extreme habitats such as caves. Apart from classical comparative morphology, we apply laser-vibrometry to record the surface-borne vibrational signals which play an important role in mate recognition in species of small body-size, and 3D-reconstructions based on high-resolution µCT data to better understand select organs in their organismic context. Since the diversity of the Hemiptera is vast and still unsufficiently documented, we are contributing formal descriptions of Hemiptera species new to science.

Selected publications:
Hoch, H., Wessel, A., Asche, M., Baum, D., Beckmann, F., Bräunig, P., Ehrig, K., Mühlethaler, R., Riesemeier, H., Staude, A., Stelbrink, B., Wachmann, E., Weintraub, P., Wipfler, B., Wolff, C. & Zilch, M. 2014. Non-sexual abdominal appendages in adult insects challenge a 300 million year old bauplan. – Current Biology 24(1): 16-17.

Wessel, A., Hoch, H., Asche, M., von Rintelen, T., Stelbrink, B., Heck, V. Stone, F.D. & Howarth, F.G. 2013: Founder effects initiated rapid species radiation in Hawaiian cave planthoppers. - PNAS 110 (23): 9391-9396.

Celebenna thomarosa Hoch & Wessel, 2011, a planthopper species (Fulgoromorpha: Cixiidae) from Sulawesi, displaying a newly discovered sensory structure of yet unknown function.

Bennini: Habitus



3D reconstruction of the lateral abdominal sensory and secretory appendage organ, or LASSO.

Bennini: Lasso 3D

Contribution to research networks

Zuse Institut Berlin
http://www.zib.de/projects/reconstruction-and-visualization-anatomical-structures-insects High-resolution synchrotron µCT allows the study of insect anatomy in a non-destructive way, even of delicate structures such as the nervous system. This is particularly important for rare specimens. However, the high resolution of the images as well as the complex anatomical structures of insects represent a challenge for segmenting and visualizing the specimens. In this project, we try to address these challenges, especially to support comparative visualization.

International Biotremology Initiative
https://eventi.fmach.it/biotremology2018/
The International Biotremology Initiative aims to bring together the community studying vibrational communication in all animal taxa to strengthen collaborations, to develop new ideas and research, and to form a strong supportive network for the emerging field of Biotremology.

Special professorship

JOHANNES MÜLLER

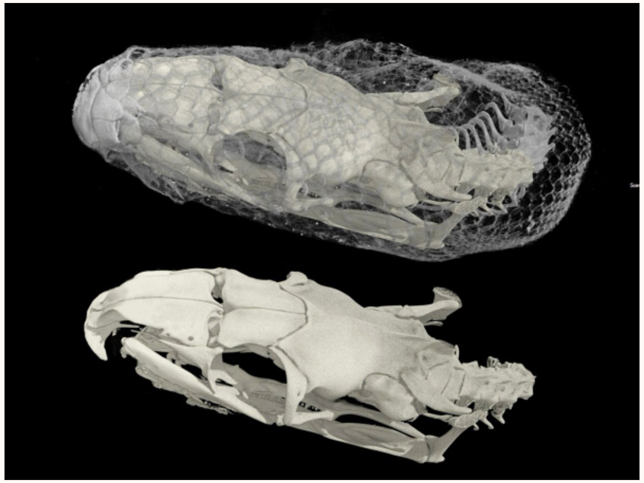
Paleozoology

https://muellerlaboratory.wordpress.com/

Description of the projects:

The research of my lab concentrates on fossil and extant terrestrial vertebrates, particularly lizards and snakes, but also mammals. We are especially interested in the underlying causes of evolutionary diversification, both at the taxic and morphological levels and at variable temporal scales. Our research projects involve extinct and extant systems, for which we employ phylogenetic, paleontological, molecular, and ecological methods. We have a special focus on 3D visualization and computed tomography (CT), and we use these techniques for both qualitative and quantitative studies of phenotypic evolution. Geographically we mostly focus on Europe and Africa, but recently also started studying systems in North America and Australia.

One major topic of my lab's research is the evolution of novel body plans, and in which way ecological factors contributed to their origin. We especially look at snake-like body forms using various clades of squamate reptiles as model systems, thereby also asking questions about the stability of developmental constraints under different eco-evolutionary scenarios. This research has also led us into general questions about the relationship between development and ecomorphological convergence. We usually approach these issues using personally generated, large-scale phenotypic 3D datasets of both fossil and extant species, as well as a solid phylogenetic foundation that we increasingly complement by phylogenomic sequencing.



Digital image of the skull of a sandboa snake (genus *Eryx*), with and without skin, as derived from computed tomography. One of the main tasks of our CT facility is to generate large-scale databases of phenotypic diversity, with special focus on reptiles and mammals, which are then used for macroevolutionary analyses.

Our second major topic involves the evolution of terrestrial vertebrate communities through time, where we put special focus on changes in trait diversity and phylogenetic composition. We are particularly interested in how Neogene and Quaternary global cooling and associated environmental changes affected community evolution, eventually resulting in the patterns seen today. Along these lines we also look into very recent phenotypic trait changes at the population and species levels, and to what extent anthropogenic influence, including climate change, may have played a role.

Selected publications:

Müller, J., Hipsley, C. A., Head, J. J., Kardjilov, N., Hilger, A., Wuttke, M. & Reisz, R. R. (2011): Eocene lizard from Germany reveals amphisbaenian origins. Nature 473: 364–367.

Hipsley, C.A., Müller, J. (2017): Developmental dynamics of ecomorphological convergence in a transcontinental lizard radiation. Evolution 71: 936–948.

Contribution to research networks

Berlin-Brandenburg Institute of Advanced Biodiversity Research (BBiB): BBIB is a flexible institution of four universities and five non-university institutes (all members of the Leibniz Association). Its main objective is to provide the required knowledge to tackle the fundamental, global challenge of rapid biodiversity change. https://www.bbib.org/home.html.

BMBF: Bridging in Biodiversity Science (BIBS). The BIBS project focuses on 'rapid transitions of ecological systems' as one of the most pressing challenges in biodiversity research. Work packages within BIBS are designed to study the entire chain of causes, mechanisms and consequences of rapid transitions across different ecosystems and spatio-temporal scales. The results will be collated in an overall synthesis, with conceptual publications intended for the scientific community, policy makers and the general public.

Geo.X: Geo.X is the research network for geosciences in Berlin and Potsdam. It bundles the comprehensive geoscientific expertise in Berlin and Potsdam by bringing together 9 partners from universities and non-university research institutions. https://www.geo-x.net/en/.

Special professorship

JOHANNES VOGEL

Biodiversity and public science
https://www.museumfuernaturkunde.berlin/de/taxonomy/term/234/johannes.vogel
Description of the projects:

Leading and developing the Museum für Naturkunde - Leibniz Institute for Evolution and Biodiversity Science, its staff and networks (local to global). The museum is a globally active research institute in geo- and biosciences, collections development and public engagement with science. Personal research interests are: role of museums in science and society; public engagement with science; open science; citizen science; national and international science policy; biodiversity; plant evolutionary biology.

Prof. Johannes Vogel is

- Director General of Museum für Naturkunde - Leibniz Institute for Evolution and Biodiversity Science. Globally active research institute in geo- and biosciences, collections development and public engagement with science.
- Chair of Open Science Policy Platform (OSPP), EU Commission.
- Deputy chair of German Bioeconomy Council/ Bioökonomierat der Bundesregierung.
- Chair of European Citizen Science Association (ECSA).
- Chair of Leibniz-Verbund Biodiversität (LVB).

Selected publications:
Turnhout, E., Bloomfield, B., Hulme, M., Vogel, J. & Wynne, B. 2012. Conservation policy: Listen to the voices of experience. Nature, 488, 454–455, doi:10.1038/488454a .

Wheeler, Q. D., Knapp, S., Stevenson, D. W., Stevenson, J., Blum, S. D. , Boom, B. M., Borisy, G. G., Buizer, J. L., De Carvalho, M. R., Cibrian, A., Donoghue, M. J., Doyle, V., Gerson, E. M., Graham, C. H., Graves, P., Graves, S. J., Guralnick, R. P., Hamilton, A. L., Hanken, J., Law, W., Lipscomb, D. L., Lovejoy, T. E., Miller, H., Miller, J. S., Naeem, S., Novacek, M. J., Page, L. M., Platnick, N. I., Porter-Morgan, H., Raven, P. H., Solis, M. A., Valdecasas, A. G., Van Der Leeuw, S., Vasco, A., Vermeulen, N., Vogel, J., Walls, R. L., Wilson, E. O. & Woolley, J. B. 2012: Mapping the biosphere: exploring species to understand the origin, organization and sustainability of biodiversity. *Systematics and Biodiversity* 10: 1-20. DOI: 10.1080/14772000.2012.665095.

Contribution to research networks

Centre for Anthropological Research on Museums and Heritage (CARMAH): Within the Institut für Europäische Ethnologie of Humboldt-Universität CARMAH aims to deepen understanding of the dynamics and potentials of museums and heritage in the contemporary world. It looks globally to identify and analyze the significant social, cultural and political developments facing museums and heritage today. http://www.carmah.berlin/.

Geo.X: Geo.X is the research network for geosciences in Berlin and Potsdam. It bundles the comprehensive geoscientific expertise in Berlin and Potsdam by bringing together 9 partners from universities and non-university research institutions. https://www.geo-x.net/en/.

Berlin-Brandenburg Institute of Advanced Biodiversity Research (BBiB): BBIB is a flexible institution of four universities and five non-university institutes (all members of the Leibniz Association). Its main objective is to provide the required knowledge to tackle the fundamental, global challenge of rapid biodiversity change. https://www.bbib.org/home.html.

Leibniz-Verbund Biodiversität (LVB): The Leibniz-Verbund Biodiversität (Leibniz Research Alliance on Biodiversity) pools competencies and resources of 20 institutes in order to develop solutions for the conservation and sustainable use of biodiversity through interdisciplinary research. They are members of the Leibniz Association. http://www.leibniz-verbund-biodiversitaet.de/en/start/.

European Citizen Science Association (ECSA): ECSA is a non-profit association set up to encourage the growth of the Citizen Science movement in Europe in order to enhance the participation of the general public in scientific processes, mainly by initiating and supporting citizen science projects as well as performing research on citizen science. https://ecsa.citizen-science.net/.

Biodiversity Wall at the entrance of the exhibition hall Evolution in Action at Museum für Naturkunde Berlin. This four metres high and twelve metres wide installation displays 3,000 animals from a wide range of habitats. (Copyright: Museum für Naturkunde Berlin)

Special professorship

DIRK BROCKMANN

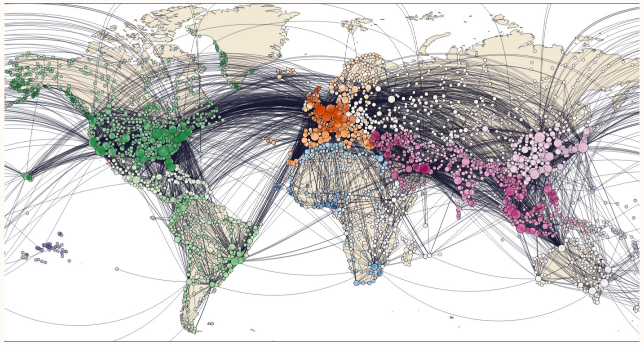
Complex systems
http://rocs.hu-berlin.de/

Description of the projects:

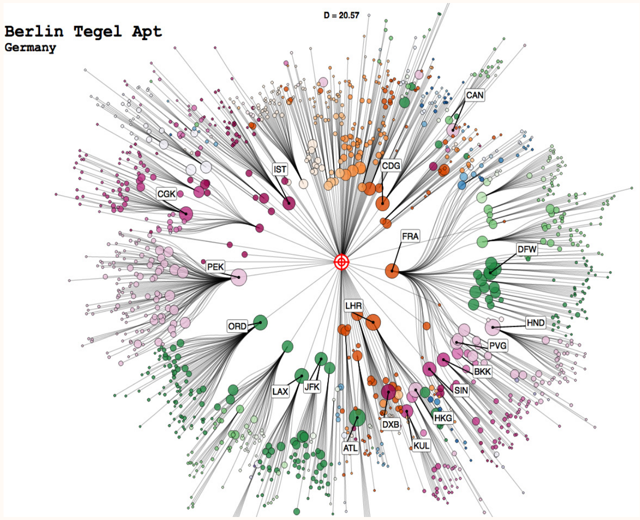
Our research is focused on the development of mathematical and computational models for complex dynamical phenomena in the life-sciences. A core area of our work is understanding dynamical processes that that mediated by network structures for example the global spread of emergent infectous diseases such as Zika, Ebola pandemic influenza and related phenomena. We also study disease dynamics in populations for example in inter-individual contact networks. One of the key questions we aim to address is what statistical and topological features of the underlying network shapes specific aspects of the spreading process. To answer these questions we develop theoretical methods and computational algorithms that try to reveal structures that are typically hidden in the complexity of connections in a network. We also develop quantitative forecast systems that are being applied in epidemic predictions. We connect different disciplines in our work following a trans-disciplinary approach, integrating methods from theoretical physics, computer science, biology, social sciences, and complex network theory.

Selected publications:
Dirk Brockmann & Dirk Helbing, The hidden geometry of complex, network-driven contagion phenomena, Science 342, 1337. (2013)

Dirk Brockmann, Lars Hufnagel, Theo Geisel, The scaling laws of human travel, Nature 439, 462. (2006)



The global air-transportation network is the foundation of computer simulations that aim at predicting the global spread of emergent infectious diseases.



Complex network theory can identify the most probable spreading routes.

Contribution to research networks

Institute of Scientific Interchange (ISI):
External Faculty, Institute of Scientific Interchange, Turin. Analysis of complex social and biological networks and computational epidemiology.

Contribution to research networks

Robert Koch Institute: Head of the project group Computational Epidemiology at the Robert Koch Institute.
The Robert Koch Institute is the federal Public Health Institute for Germany responsible for epidemiological surveillance of notifiable infectious diseases and prevention.

IRI Life Sciences: The IRI for the Life Sciences at the Humboldt University is a collaborative research institute founded in collaboration with the Charité Hospital and the MDC with the goal of bridging theoretical and quantitative experimental approaches at multiple scales of biology, from molecules to cells to organisms and populations.

Affiliated Faculty, Northwestern Institute on Complex Systems (NICO): NICO was founded in 2004 aimed at basic research on complex systems randing from computer science social science to biology and the life sciences. NICO is host to a broad range of young scientists and follows a trans-disciplinary research philosophy.

Cooperation and Collective Cognition Network (CoCCoN), Princeton University and Humboldt Universität zu Berlin: The networks brings together scientist from a broad range of disciplines, such as biology, psychology, sociology, economics and applied math. It provides an interdisciplinary environment for collaborative study of cooperation and collective cognition in human and animal systems, with the main research focus being behavioral contagion and the role of social norms on collective behavior. Hereby, analogies and differences between bio-ecological and socio-economical systems shall be discussed. A unique feature of the network is the direct exchange between empirical and theoretical research, which enables a close connection between mathematical modeling and experimental observation of relevant processes.

Professor Emeritus

PETER HAMMERSTEIN

Evolution of organismic systems

https://itb.biologie.hu-berlin.de/wiki/groups/peter/start

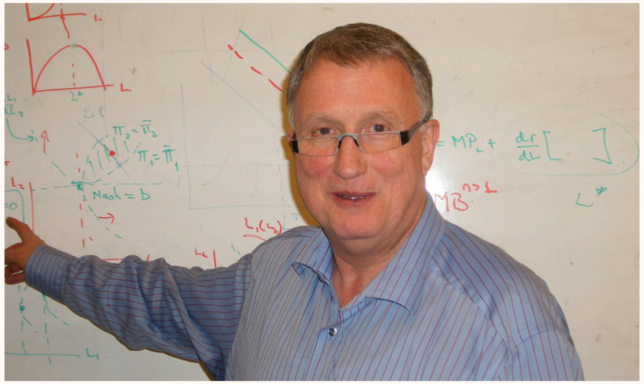
Description of the projects:

The group participated in the founding of the ITB and belongs since 1996 to this joint endeavor of the Institute of Biology and the Charité. We address problems in theoretical evolutionary biology and study with the help of mathematical models how different evolution-related processes shape the 'design' of organisms.

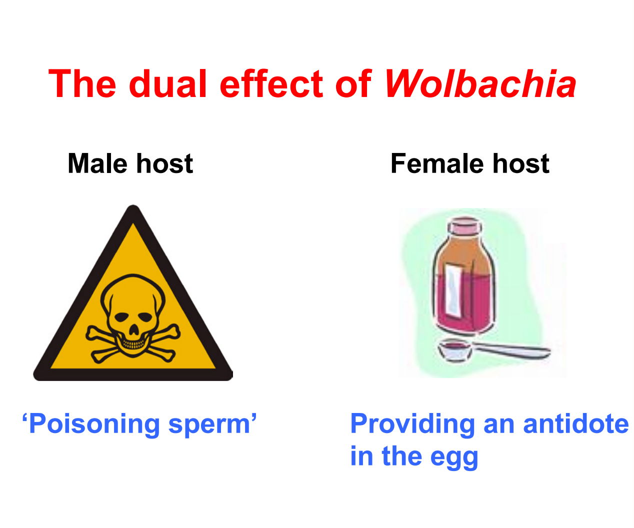
At the conceptual level we focus on links between thought in biology and economics. These links manifest themselves, for example, in the theory of 'biological markets' – a theory that examines 'trade' between microbes and plants or animals, animals and plants, etc. We are generally trying to identify economic principles in nature and use evolutionary game theory to model conflict and cooperation at both the genetic and organismic level. In particular, we study intracellular bacteria (*Wolbachia* and Cardinium) that are known as 'master manipulators' of host reproduction and development and, additionally, as factors of host speciation. Our research topics include themes from evolutionary medicine (e. g., the genetic mother-offspring conflict) and anthropology (e. g., drug-seeking behavior).

Selected publications:
Hammerstein, P. & Noë, R. (2016). Biological trade and markets. Philosophical Transactions of the Royal Society B, 371: 20150101.

Hammerstein, P., ed. (2003). Genetic and Cultural Evolution of Cooperation. Cambridge, MA: MIT Press.



The whiteboard as the laboratory: Development of mathematical models in theoretical biology.



Wolbachia and other cytoplasmically inherited bacteria often modify the reproduction of their hosts selfishly and with 'strategic finesse'. We analyze such parasitic manipulations using the tools provided by evolutionary game theory.

Contribution to research networks

The Leverhulme Trust: International Research Network: A Darwinian framework for phenotypically integrating genetic and epigenetic cues. Developing an integrative theory of evolution that encompasses genetic, epigenetic and cultural modes of inheritance.

External Faculty of the Santa Fe Institute New Mexico, U. S. A. Modeling non-linear dynamics in biology, psychology and economics.

International Max Planck Research School on the Life Course: Studying the evolution of social learning and its emerging effects at the population level, such as bubbles on financial markets.

Berlin School of Mind and Brain: Analyzing the effect of drugs on the mesolimbic dopamine system from an evolutionary ecology perspective and taking an anthropological view on drug-seeking behavior.

Association of Members of the Wissenschaftskolleg zu Berlin (Chairperson since 1995). Natural sciences and humanities in dialogue.

Interdisciplinary centre for infection biology and immunity (ZIBI) Graduate School Berlin (Research in Infection Biology and Immunology) Evolutionary medicine: Studying the role of microchimerism and thyroid disease in the – still largely ignored – evolutionary conflict between mother and fetus.

Professor Emeritus

WOLFGANG UCKERT

Molecular cell biology and genetic therapy
https://www.mdc-berlin.de/uckert
Description of the projects:

Adoptive T cell therapy (ATT) to treat cancer requires the generation of antigen-specific T lymphocytes (T cells), which are able to recognize and eradicate tumor cells. While the use of tumor-infiltrating lymphocytes showed some therapeutic success for selected tumor entities, the utilization of T cells which are genetically engineered to express antigen-specific T cell receptors (TCRs) or chimeric antigen receptors (CARs) paves the way for a broader application of ATT. Our group focuses on different aspects of ATT:

1. Isolation and molecular cloning of TCRs and CARs that target tumor-specific antigens and are suitable tools for clinical studies.
2. Modification of T cells with genes encoding TCRs and CARs for their application in ATT to treat tumor-, virus-, and autoimmune diseases.
3. Development of pre-clinical mouse models to analyse the therapeutic efficacy of genetically engineered T cells and development of safety moduls to avoid side effects in ATT.
4. Optimization of viral and non-viral vector systems for the efficient genetic in vitro- and in vivo-engineering of T cells.

Selected publications:
Bunse, M., Bendle, G. M., Linnemann, C., Bies, L., Schulz, S., Schumacher, T. N., Uckert W. (2014). RNAi-mediated TCR knockdown prevents autoimmunity in mice caused by mixed TCR dimers following TCR gene transfer. Molec. Ther. 22 (11): 1983-1991.

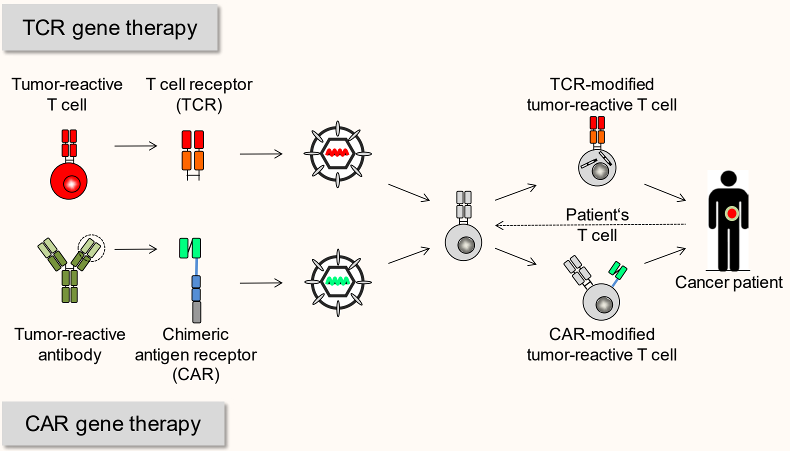
Leisegang, M., Kammertoens, T., Uckert, W*., Blankenstein, T*. (2016) Targeting human melanoma neoantigens by T cell receptor gene therapy. J. Clin. Invest. 126 (3): 854-858, (*equal contribution).

Contribution to research networks

CRC/TR 36: Principles and application of adoptive T cell therapy. In two projects of this consortium we are working on safety aspects of ATT using TCR-engineered T cells (A12) and support other groups to generate TCR and CAR gene-modified T cells (Z1).

CRC 650: Cellular approaches to a suppression of unwanted immune reactions. In this consortium we redirect the antigen specificity of regulatory T cells by transfer of TCR and CAR genes.

Berlin Institute of Health Collaborative Research Grant: Targeting sumatic mutations in human cancer by T cell receptor gene therapy.
In this consortium we characterize the sensitivity and specificity of TCRs isolated from transgenic mice (cooperation with T. Blankenstein, Max Delbrück Center for Molecular Medicin (MDC) and Hans Schreiber, University of Chicago) and analyse their ability to reject established tumors in pre-clinical mouse model.



Schematic presentation of TCR- and gene therapy. T cells of a cancer patient were isolated and engineered with TCR- or CAR genes, wich are able to specifically recognize and destroy tumor cells. TCR- or CAR modified tumor reactive T cells were expanded and reinfused into the cancer patient.

Professor Emeritus

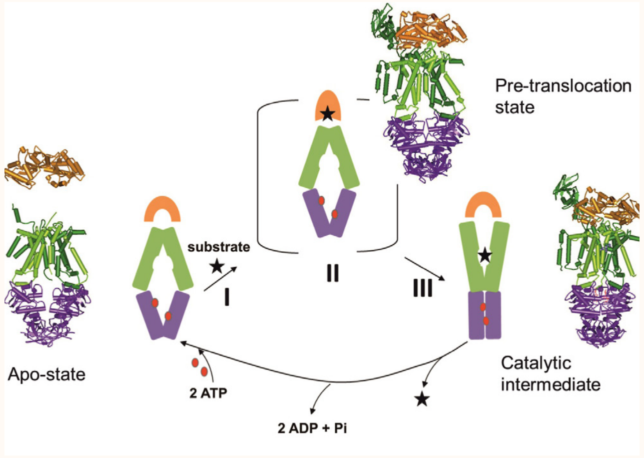
ERWIN SCHNEIDER

Physiology of the microorganisms

https://www2.hu-berlin.de/biologie/baktphys/
Description of the projects:

Structure and mechanism of canonical ABC import systems in prokaryotes

The family of ABC („ATP-Binding Cassette“) transport systems comprises an extremely diverse class of membrane transport proteins that couple the energy of ATP hydrolysis to the translocation of solutes across biological membranes. Members of this family not only accomplish the uptake of nutrients but are involved in a large variety of processes, such as signal transduction, protein secretion, drug and antibiotic resistance, antigen presentation, bacterial pathogenesis and sporulation. ABC transporters have been identified in organisms belonging to each of the three major kingdoms of life (bacteria, archaea and eukarya, including man), and thus might be considered as an ancient proteinaceous device for solutes to pass a lipid bilayer against a concentration gradient. We study the structure and function of canonical (binding protein-dependent) ABC importers from various bacteria and archaea by molecular biological, biochemical and biophysical means.



Model of the Transportzyklus‘ of ABC-import systems (type I)

Selected publications:
Böhm, S., Licht, A., Wuttge, S., Schneider, E., and Bordignon, E. (2013) Conformational plasticity of the type I maltose ABC importer. Proc Natl Acad Sci (USA) 110, 5492-5497.

Yu, J., Ge, J., Heuveling, J., Schneider, E., and Yang, M. (2015) Structural basis for substrate specificity of an amino acid ABC transporter. Proc Natl Acad Sci (USA) 112, 5243-5248.

Contribution to research networks

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Former professorship

PHILIPP FRANKEN

Molecular phytopathology

[http://www. Forschungsstelle für gartenbauliche Kulturpflanzen](http://www.Forschungsstelle für gartenbauliche Kulturpflanzen)

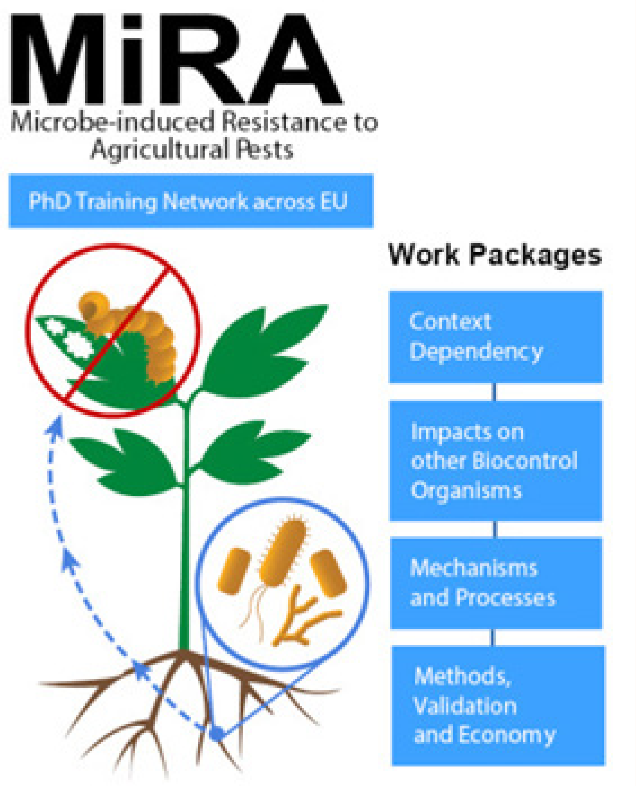
Description of the projects:

Philipp Franken established during the last three years the Erfurt Research Station of Horticultural Crops (FGK) which has started its activities by January 2019. This research station compromises four groups working on topics of horticultural practice using methods of modern biosciences. The group ‘Plant-microbe interactions in sustainable plant production’ is engaged in questions about the impact of the plant genotype on the composition of endophytic microbe populations and on the success of the application of beneficial microbes. The FGK is administratively implemented in the Faculty of Landscape Architecture, Horticulture and Forestry at the University of Applied Sciences Erfurt and closely cooperating with the Friedrich Schiller University in Jena, where Philipp Franken occupies a chair on Molecular Phytopathology by June 2019.

Selected publications:

Wang M, Schäfer M, Li D, Halitschke R, Dong C, McGale E, Paetz C, Song Y, Li S, Dong J, Heiling S, Groten K, Franken P, Bitterlich M, Harriso MJ, Paszkowski U, Baldwin IT (2018) Blumenols as shoot markers for root symbiosis with arbuscular mycorrhizal fungi. eLife 7: e37093.

Bui VC, Franken P (2018) Acclimatisation of Rhizophagus irregularis enhances Zn tolerance of the fungus and the mycorrhizal plant partner. Frontiers in Microbiology 9: 3156.



The Marie Skłodowska-Curie Innovative Training Network MiRA

Contribution to research networks

MiRA: Microbe induced Resistance to Agricultural pests, a ‘Marie Skłodowska-Curie Innovative Training Network’, 2017-2021. Plants are intimately associated with a diversity of beneficial microorganisms in their root zone, some of which can enhance the plant’s resistance to insect pests. Thus, the use of Microbe-induced Resistance (MiR) to reduce pest losses in agriculture has emerged as a highly promising possibility to improve crop resilience and reduce use of harmful pesticides. European companies have therefore started to develop and market beneficial microbes. However, MiR appears to be strongly context-dependent, with reduced benefits under certain biotic and abiotic conditions and in some crop varieties. Further, it is a challenge to deliver and ensure stable associations of beneficial microbes and plants, and avoid undesired effects on beneficial insects. Thus we absolutely must improve our understanding of MiR mechanisms and context-dependency, in order to improve context stability of MiR and promote the use of MiR for crop protection. Our MiRA project will train 15 ESRs in basic and applied research on context-dependency of MiR, mechanisms, and impacts on plant performance and other biocontrol organisms. We will use this understanding to improve our ability to predict the effectiveness of MiR under different conditions, to select plant and microbial strains with improved context-stability, and to develop better methods for the formulation of microbial inoculants and their application in agriculture. Finally, we will analyse economic prospects and constraints for MiR development and use. To achieve these goals, we have assembled a consortium of 11 academic institutions and 6 companies, including microbial inoculant producers and agricultural advisors, with complementary skills in basic and applied research and innovation. Our ESRs will be trained within this multi-sectoral interdisciplinary network for a future career in research, product and service development in European horticulture and agriculture, pushing boundaries in European research and innovation.

Former professorship

KRISTINA KÜHN

Plant molecular cell biology
https://www.biologie.uni-halle.de/institutsbereich_pflanzenphys/zellphysiologie/mitarbeiter/

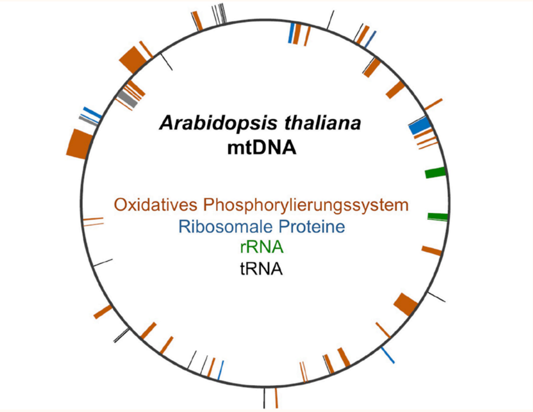
Description of the projects:

Plant cells possess two energy-converting organelles of endosymbiont origin: Mitochondria are the site of cellular respiration whereas chloroplasts transform light energy through photosynthesis. Both organelles possess their own vestigial genome. Correct expression of the latter is indispensable to plant energy metabolism, development and growth.

Left: Arabidopsis plants with impaired mitochondrial function (12 plants, middle and left) display developmental retardation when compared with wild-type plants that have fully functional mitochondria (4 plants on the right).

Right: Mitochondria can be enriched from plant extracts through density gradient centrifugation. In the centrifuge tube shown, they form a whitish band close to the bottom of the tube.

Our research group uses the model organism *Arabidopsis thaliana* in order to investigate the biogenesis and function of plant mitochondria. Much of our work focuses on transcription and further steps of mitochondrial genome expression, on the biogenesis of the oxidative phosphorylation system, and on mechanisms that regulate mitochondrial biogenesis according to a plant's needs. Owing to evolutionary links between the transcriptional machineries in mitochondria and chloroplasts, we are additionally interested in mechanisms of chloroplast genome transcription. Our research employs a variety of methods in molecular biology, genetics, cell biology, biochemistry and physiology.



The mitochondrial genome (mtDNA) of Arabidopsis can be displayed as a circular map. It codes for several subunits of the oxidative phosphorylation system, the ribosomal RNAs, a few ribosomal proteins, and several tRNAs.

Selected publications:

Kühn, K., Obata, T., Feher, K., Bock, R., Fernie, A.R., and Meyer, E.H. (2015). Complete mitochondrial complex I deficiency induces an upregulation of respiratory fluxes that is abolished by traces of functional complex I. Plant Physiol. 168, 1537-1549.

Kühn, K., Richter, U., Meyer, E.H., Delannoy, E., Falcon de Longevialle, A., O'Toole, N., Börner, T., Millar, A.H., Small, I.D., and Whelan, J. (2009). Phage-type RNA polymerase RPOTmp performs gene-specific transcription in mitochondria of Arabidopsis thaliana. Plant Cell 21, 2762-2779.

Contribution to research networks

CRC/TR175: The Chloroplast as Central Coordinator of Acclimation in Plants. In collaboration with 18 participating project partners, the astonishing role of chloroplasts as sensors and signal emittors in acclimation processes is being analysed. The consortium of these partners is predominantly using quantitative biological tools in their aim to show the complexity of chloroplast functions in acclimation to temperature and light changes.

Initiative "Plant Mitochondria In New Light"
Several coordinated projects run by German-based research groups are investigating plant energy metabolism, with a focus on the biology of mitochondria in photosynthetic cells.

Former junior groups

MARCUS KRANTZ

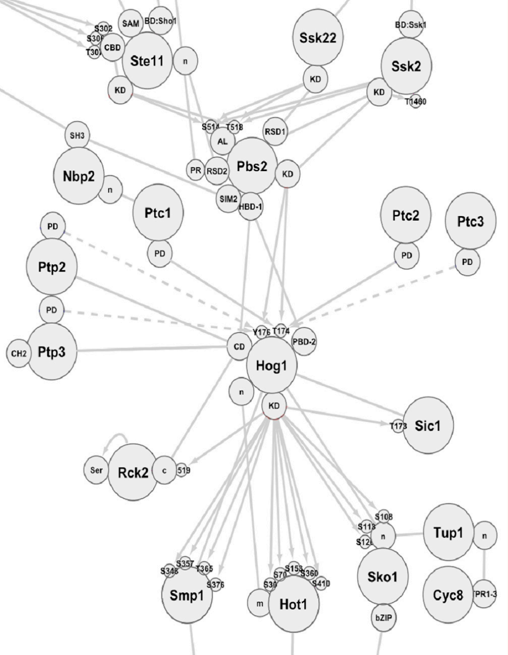
The molecular basis of cellular decision making
https://www2.hu-berlin.de/biologie/theorybp/index.php?goto=r_rxn
Description of the projects:

The objective of our project is to understand how cells take decision. To understand cellular decision making, we need to understand the molecules that sense, transmit and process information in the cell. These molecules interact in networks that play pivotal roles in health and disease: They monitor the state of the cell and its surrounding, and control key cellular processes. Failure in these networks leads to some of the most important diseases our health care system faces, including cancer and type II diabetes, and if we can understand these networks in detail they would provide excellent targets for pharmaceutical intervention. However, these networks are highly complex and difficult to understand without relying on computer simulations. Furthermore, the knowledge we have from experiments are often sparse.

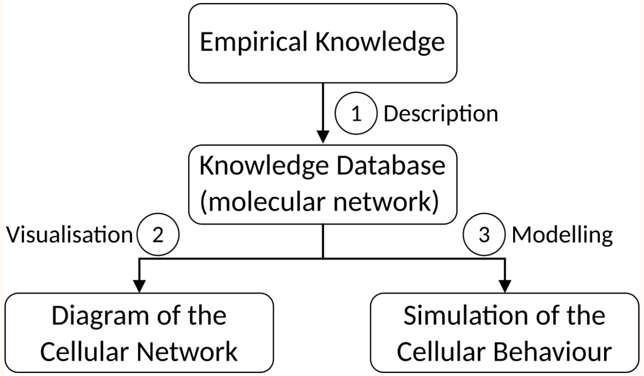
Selected publications:
Lubitz T, Welkenhuysen N, Shashkova S, Bendrioua L, Hohmann S, Klipp E, Krantz M (2015) Network reconstruction and validation of the Snf1/AMPK pathway in baker's yeast based on a comprehensive literature review, npj Systems Biology and Applications 1. doi:10.1038/npjsba.2015.7.

Tiger CF, Krause F, Cedersund G, Palmér R, Klipp E, Hohmann S, Kitano H, and Krantz M (2012) A framework for mapping, visualisation and automatic model creation of signal transduction networks. Mol Syst Biol, 2012. 8: 578. doi: 10.1038/msb.2012.12.

To tackle these problems, we develop methods to describe these networks at the level of detail that they are known from empirical data, to visualise this information, and to turn the knowledge into computational models. These models can be used to simulate the network function in order to better understand how the interplay between components and processes shapes cellular decision making.



The knowledge we have about the decision making processes corresponds to a network of components that the cells use to transmit and process information. In this case, the components are proteins that transmit information by binding to and/or modifying each other. We can capture this information at the resolution it is known, down to the role of specific parts of the proteins. However, to understand cellular decision making, we need to know more than the pairwise relationship between components: We need to understand how the different parts and processes in the network interact to shape a system level function.



To tackle these challenges, we develop methods at three levels. First, a language that makes it possible to formalise – exactly and efficiently – the molecular knowledge we have about these cellular networks from empirical data. Second, we design methods for visualisation that makes this knowledge easily accessible for users. Third, we develop a software that can convert the knowledge base into computational models that can be used to simulate the decision making process. Together, these methods make it possible (1) to formalise a detailed description of these networks into a knowledge base, (2) to visualise the network, as well as to use the knowledge base (3) to generate models for computational analysis of the network.

Contribution to research networks

e:Bio CELLEMENTAL:
This project is supported by BMBF within the e:Bio initiative as the junior research group e:Bio CELLEMENTAL – Beschreibung, Abbildung und Modellierung zellulärer Netzwerke anhand empirischer Daten (FKZ0316193).

Interdisciplinary Centre for Educational Research

ANNETTE UPMEIER ZU BELZEN

https://zentrum-bildungsforschung.hu-berlin.de/de/izbf/standardseite

Description of the projects:

Board of Directors: Annette Upmeier zu Belzen, Matthias Ziegler, Florian Waldow

Current key foci of the Centre are to deal theoretically and empirically with research questions in the interdisciplinary context as well as to present the results of research to the efforts to improve education systems, education processes and teaching and learning material both in Germany and within international cooperation programs or organizations. Under this objective, a group of researchers from 30 member groups of the humanities, social sciences and natural science disciplines will develop and continually improve new, methodologically demanding forms of cooperation in complementary theoretical and methodological orientation. The Centre will intensively promote the qualification of young academics in the field of educational research, e.g. through the participation in structured doctoral programs, and the offer of teaching in the already established bachelor's and master's degree courses as well as in new training possibilities such as the professional scientific training.

Members:
DIPF - Deutsche Institut für Internationale Pädagogische Forschung
Sabine Reh

IQB - Institut zur Qualitätsentwicklung im Bildungswesen
Petra Stanat

Erziehungswissenschaften
Malte Brinkmann
Marcelo Caruso
Katja Eilerts
Matthias Jerusalem
Thomas Koinzer
Sigrid Blömeke
Rita Nikolai
Detlef Pech (Director PSE)
Hans Anand Pant
Aiga von Hippel
Florian Waldow
Andrä Wolter

Fachdidaktiken
Anka Bergmann
Stephan Breidbach
Andreas Filler
Michael Kämper van den Boogaart
Stefan Kipf
Lutz Küster
Nils Pinkwart
Burkhard Priemer
Marcel Robischon
Bettina Rösken-Winter
Katja Schmitt
Rüdiger Tiemann
Annette Upmeier zu Belzen
Matthias Ziegler

Rehabilitationswissenschaften
Vera Moser

Contribution to research networks

Since 2012, the Professional School of Education (PSE) and the IZBF have invited internationally renowned scientists to the Humboldt-Universität zu Berlin as part of the Biodiversity and public science "Fritz Karsen-Chairs".
This alliance will lead to the widest possible cooperation between the Fritz-Karsen-Chairs and various persons of the Humboldt-Universität zu Berlin involved in teacher education. All members of the IZBF and the PSE - such as students, young scholars and lecturers - shall profit from the activities of the guests. This can be reached by realizing joint research applications and projects, publications or seminars, but also by offering additional workshops and lectures.

List of Fritz Karsen-Chair:
Angela Brew, Macquarie University, 2017
Jan van den Akker, Universität Twente, 2017
Itesh Sachdev, (University of London), 2016
Anne West (London School of Economics), 2015
Jan van Driel (Leiden University – Graduate School of Teaching), 2014
Alicia Alonzo (Michigan State University), 2014
Markku Jahnukainen (Universität Helsinki), 2013
Christian Greiffenhagen (University of Manchester), 2012
Kevin Miller (University of Michigan), 2012
Kai Cortina (University of Michigan), 2012
Ken Frank (Michigan State University), 2012

Contacts by the Fritz Karsen-Chair since 2012:
Leiden University
London School of Economics
Macquarie University
Michigan State University
University of Helsinki
University of London
University of Manchester
University of Michigan
University of Twente

Integrative Research Institute of Life Sciences

ANDREAS HERRMANN
SPEAKER

https://www.iri-ls.hu-berlin.de/en

Description of the projects:

IRI Life Sciences was founded in 2013 by HU together with Charité and MDC as a mechanism for fostering collaborative, interdisciplinary basic research on medically relevant issues and for shaping the intellectual and structural environment of the HU's Campus Nord with the goal of stimulating self-supporting collaborative research programs. As a catalyst for these efforts, the founding institutions agreed to install and fund new research groups at the level of professors and independent young research group leaders, which together form the core of IRI Life Sciences. The aim of this scientific core, and the IRI as a whole, is to study complex biological systems using a mixture of quantitative experiments and theory. This scientific aim is promoted by common scientific interests, a commitment to open collaborations, and the shared use of equipment. These collaborations are facilitated by the fact that all three institutions lie in close physical proximity to one another, to the IRI core groups, and to the IRI office. The efforts are inspired by a long tradition of successful scientific collaboration between these institutions, in particular in the field of mathematical biology and Systems Biology since the late 1970's.

Members:

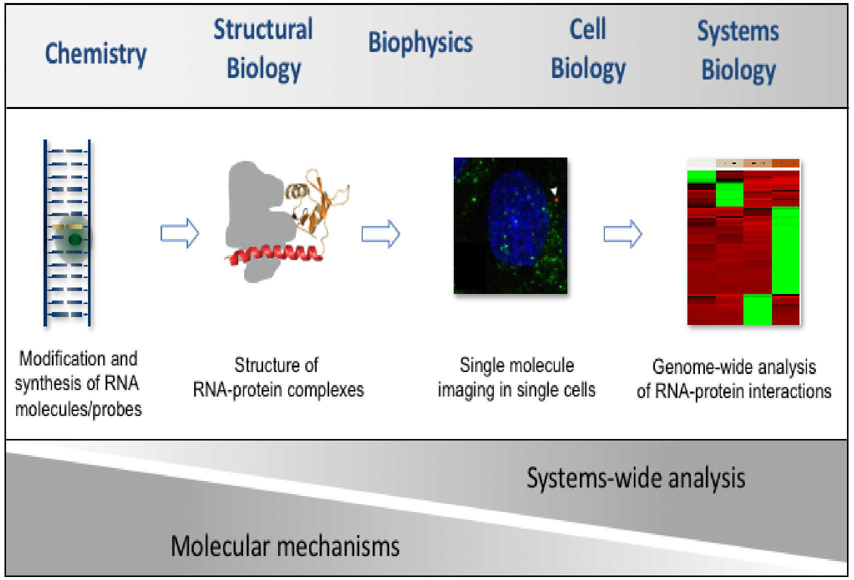
IRI Network Groups

Michael Brecht
Dirk Brockmann
Georg Duda
Ann Ehrenhofer-Murray
Christian Hagemeier
Hanspeter Herzel
Edda Klipp
Kai Matuschewski
Uwe Ohler
Nikolaus Rajewsky
Christian Rosenmund
Clemens A. Schmitt
Christian Schmitz-Linneweber
Matthias Selbach
Christine Sers
Thomas Sommer

IRI Core Groups

Benedikt Beckmann
Nils Blüthgen
David Garfield
Markus Landthaler
Simone Reber
Leonie Ringrose

Michaelis Menten building harbouring the IRI Life Sciences



The IRI coordinated the research network "Single Molecule RNA Biology - dynamics and functions of RNA from transcription to degradation" funded by the Einstein foundation with nine groups from the Humboldt Universität zu Berlin, the Freie Universität Berlin and the Max-Delbrück-Center for Molecular Medicine - Berlin Institute for Medical Systems Biology. Copyright: Einstein-Netzwerk / Speaker: Prof. Dr. Andreas Herrmann

Institute for Theoretical Biology (ITB)

HANSPETER HERZEL

Theoretical chronobiology

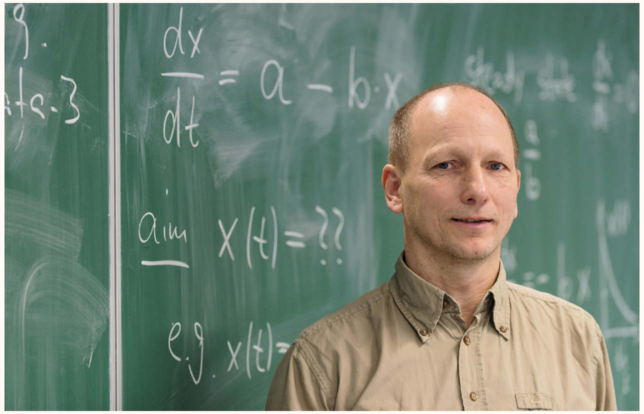
https://itb.biologie.hu-berlin.de/wiki/groups/herzel/start

Description of the projects:

The group was established within the Institute for Theoretical Biology (ITB) in 1996 and belongs to the Charité and the Humboldt University Berlin. We apply methods from dynamical systems, data analysis and bioinformatics to address biomedical questions. Examples are voice production, heart dynamics, DNA periodicities, gene regulation, T-cell differentiation and circadian rhythms.

1st symposium "Theoretical Chronobiology" on our campus in 2014.

Together with the experimental groups we investigate the generation and synchronization of circadian rhythms on different levels: (i) Modeling intracellular feedback regulation in the core clock oscillator (ii) Studying the entrainment, synchronization and splitting of SCN neurons (iii) Bioinformatic analysis (high-throughput data, promoter studies, epigenetics) of phase- and tissue specificity of clock-controlled genes (iv) Entrainment phase control based on oscillator theory.



Teaching mathematical modeling of gene regulation.

Selected publications:

Lehmann R Machné R Herzel H (2014) The structural code of cyanobacterial genomes. Nucleic Acids Res., 42:8873-83.

Westermark PO, Herzel H (2013) Mechanism for 12 hr rhythm generation by the circadian clock. Cell Reports, 3:1228-1238.

Abraham U, Granada A, Westermark PO, Heine M, Kramer A, and Herzel H (2010) Coupling governs entrainment range of circadian clocks. Mol. Syst. Biol., 6:438.

Contribution to research networks

CRC/TR 186: Molecular Switches: Spatio-temporal Control of Cellular Signal Transmission. We study molecular switches for generation of circadian rhythms in mammals (with Achim Kramer) and in Neurospora (with Michael Brunner).

DFG Priority program 2041: Computational Connectomics .We study the circadian clock in cockroach by combining electrophysiological long-term recordings (together with Monika Stengl, Kassel), time-series analysis and modeling.

RTG 2424: CompCancer - Computational Methods in Oncology: Towards Personalized Medicine in Cancer. Together with Nils Bluethgen (coordinator) and Christine Sers links between circadian rhythms and oncogenic signaling are explored using bioinformatics and computational models.

Research Training Group 1772: Computational Systems Biology. PhD students in this program apply bioinformatics and modeling to develop new theoretical concepts and their application to current and future problems in cell biology.

"German - USA Collaborations in Computational Neuroscience" Together with Erik Herzog (Washington University) we study the synchronization and entrainment of neurons in the suprachiasmatic nucleus.

List of Research Training Groups

at Humboldt-Universität Berlin

Graduate Centre Life Sciences

https://hu.berlin/lewi-docs

The Graduate Centre Life Sciences is the central service facility for all current and prospective doctoral candidates at the Faculty of Life Sciences. It offers information on the admission to doctoral studies, further education, networking and counselling during the doctoral study period, as well as support for all doctoral students at the end of their doctoral degree programme.

The Graduate Centre Life Sciences is the contact point for all current and prospective doctoral candidates at Humboldt-Universität zu Berlin in Agricultural Science, Biology, Biophysics, Horticultural Science and Psychology.

The further education courses offered by the Graduate Centre Life Sciences are primarily targeted at doctoral candidates who are not enrolled in a structured doctoral degree programme. At the same time, the Graduate Centre is the networking point for all doctoral degree programmes and their doctoral candidates at our Faculty. In this way, the Graduate Centre Life Sciences promotes networking between all doctoral candidates at the Faculty of Life Sciences.

DFG-Research Training Groups - with Humboldt-Universität as co-ordinator

GRK 1772: Computational Systems Biology

http://www.berlin-csb.de/

Patterns in the relationship of the structure, dynamics and function of biological systems are investigated in this group. Its work is aimed at developing new theoretical concepts and their application to current problems of cellular biology. It is to contribute to a better understanding of biological phenomena and processes. At the same time the interpretation of biological data is to be further improved and the development of new experimental and practice related research strategies to be promoted.

IRTG 2290: Crossing Boundaries: Molecular Interactions in Malaria

https://www.allianceberlincanberra.org/

Malaria is caused by single-celled parasites known as Plasmodium, which are transmitted by the bite of the Anopheles mosquito. Some basic principles of the progress of the disease and parasite-host interactions are still not understood. The German-Australian International Research Training Group "Crossing Boundaries: Molecular Interactions in Malaria" will therefore investigate the molecular mechanisms of Plasmodium infections as a basis for strategies to develop new drugs and immunisations for improved malaria treatment and prevention.

DFG-Research Training Groups - Humboldt Contributions

GRK 1589: Sensory computation in neural systems

http://www.bccn-berlin.de/Graduate+Programs/?languageId=1

Computational Neuroscience is a relatively recent field of research which is well known for its interdisciplinary approach. It is a field in which experimental neuroscientists cooperate with theoreticians in order to reach a better understanding of the functional principles of the brain. Hypotheses concerning neural systems are translated into mathematical language and then tested in computer simulations. Applications of the procedure range from an improved treatment of neuronal disorders through the brain computer interface up to the development of neuro-prostheses and intelligent machines and robots.

GRK 2046: Parasite Infections: From Experimental Models To Natural Systems

http://www.vetmed.fu-berlin.de/en/einrichtungen/sonstige/grk2046/index.html

With a steady increase due to drug resistance, global warming and increasing international travel, parasitic diseases are distributed worldwide in human and animal populations. The RTG aims to install a cutting edge and integrative curriculum to educate "next-generation" parasitologists. In an interdisciplinary approach, graduates are trained in molecular approaches, cellular interactions and organismic studies on key parasites of model organisms, free-ranging animals and humans. The research topics focus on four parasite groups: Plasmodium, Toxoplasma, Giardia and helminths. In accordance with the "One Health" concept the different parasite infections are studied from the biological, medical, and translational perspectives.

Appendix 1 page 1

Projects promoted from the
German research committee

Collaboration Research Center (CRC)

CRC/TRR 167: Development, function and potential of myeloid cells in the central nervous system (NeuroMac)

CRC/TR 175
The Chloroplast as Central Coordinator of Acclimation in Plants.

CRC/TR 186
Molecular Switches: Spatio-temporal Control of Cellular Signal Transmission.

CRC 650
Cellular approaches to a suppression of unwanted immune reactions.

CRC 665
Developmental Disturbances in the Nervous System.

CRC 765
Multivalence as chemical organization and action principle.

Collaboration Research Center (CRC)

CRC 1078: Protonation dynamics in protein function.

CRC 1315: Mechanisms and disturbances in memory consolidation: From synapses to systems.

Cluster of Excellence

„Matters of Activity: Image Space Material“

„NeuroCure“

„Science of Intelligence“ (SCIoI)

“Unifying Systems in Catalysis“

Appendix 1 page 2

Projects promoted from the
German Research Committee

Emmy Noether programme

Amphibian origin(s) and evolution through deep time: integrating the fossil record, morphology, and development.

Collective Information Processing - From Individual Sensory Inputs to Swarming and Collective Decision Making.

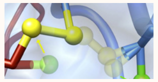
Cyclic di-GMP in the control of multicellular differentiation in antibiotic-producing bacteria Streptomyces.

Priority programs

1374
The Biodiversity Exploratories.

1617
Phenotypic Heterogeneity and Sociobiology of Bacterial Populations.

1710
Dynamics of Thiol-based Redox Switches in Cellular Physiology.



1784
Chemical Biology of native Nucleic Acid Modifications.

1879
Nucleotide Second Messenger Signaling in Bacteria.

1926
Next Generation Optogenetics.

1927
Iron-Sulfur for Life.

Priority programs

1935
This Priority Programme aims to “decipher the mRNP code” of eukaryotes.

2041:
Computational Connectomics.

2202: Spatial Genome Architecture in Development and Disease.

Appendix 1 page 3

Projects promoted from the
German research committee

Research grants

„A Quantitative Force Map of the Mitotic Spindle“.

Analysis of coupling between substrate binding and ATP hydrolysis in canonical homo- and heterodimeric amino acid ABC import systems.

Anatomy, Ecology and Ontogeny of Mesosaurs using 3D-Imaging Technologies.

Decision making in crickets: choice behaviour and neuronal control.

DFG-ANR-Project: (Collaboration with Francois Parcy and Chloe Zubieta, CNRS Grenoble).

DIP grant: Challenging the Ubiquitin Proteolytic Signal - Novel Modes of Modification and Recognition.

Dynamics of subunit interactions in ECF transporters (in progress).

Late Paleozoic Tetrapod Biogeography.

Mechanism of metal-specific ECF transporters (begin in 2017, funded by the DFG).

On adaptation: an integrative study of jumping behaviour and functional morphology in callitrichid primates as model systems (DFG NY 63/2-1).

Research grants

Investigation of the role of GTGT motifs in fly and mouse Polycomb/Trithorax Response Elements and their non-coding RNAs.

Schaltkreis-Mechanismen der Phasenpräzession: Experiment und Theorie.

Structural flexibility of the optical design of the cornea of arthropods.

The evolution of regenerative capacities in tetrapods considering extant and fossil taxa.

Research groups

FOR 1341
Barrel Cortex Function.

FOR 2092
Biogenesis of thylakoid membranes: Spatiotemporal organization of photosynthetic protein complex assembly.

Research group (FG) 2518 “Dynion“
Dynion is a research group funded by the DFG with members drawn from throughout Germany.
Its members study ion transport across membranes in a tight collaboration between ion channel biophysicists and computational biology experts.

Appendix 1 page 4

Projects promoted from the
German research committee

Research Training Groups

RTG 2424: CompCancer - Computational Methods in Oncology: Towards Personalized Medicine in Cancer.

RTG 1772
Computational Systems Biology

IRTG 2290: Crossing Boundaries: Molecular Interactions in Malaria.

IRTG 2403: Dissecting an reengineering the regulatory genome.

Other

N_2O emissions as response of process-related soil microbial activity to different irrigation and nitrogen fertilization regimes in potato cropping.

Appendix 2 page 1

Projects promoted from the Federal Ministry of Education and Research (BMBF)

Basistechnologisches Forschertandem: Nutzung von Sonnenenergie für die Bioelektrokatalyse - Entwicklung von Bioelektrodenstrukturen für die Synthese.

Bernstein Award (Federal Ministry of Education and Research).

Bernstein Center for Computational Neuroscience.

Bridging in Biodiversity Science (BIBS). The BIBS project focuses on 'rapid transitions of ecological systems' as one of the most pressing challenges in biodiversity research.

Cubes Circle.

Design of multi-organ chips to test toxicities of xenobiotics on human liver and kidney.

e:Bio CELLEMENTAL: This project is supported by BMBF within the e:Bio initiative as the junior research group.

e:Bio - Modul III - CyanoGrowth -The architecture of phototrophic growth.

e:Bio CYANOSYS II: Systems Biology of Cyanobacterial Biofuel Production (2013-2016).

eBio: ViroSign - Influenza Systems Virology - Molecular Signatures of Permissive Virus Infection (coordinator).

e:KID (e:Med, BMBF)
e:KID is a collaborative project involving clinical departments, research institutes, biometrics departments, translational, and industrial partners..

EXIST Business Start-Up Grant "CellDeg" (FKZ 03EGSBE291, 2015-2016). Projects promoted from the Federal Ministry of Economic Affairs and Energy (BMWi).

FlowPep
FlowPep is a research alliance of the Systems Immunology Lab and the two Berlin-based SMEs, Bio-syntan GmbH and PolyAn GmbH.

German Network for Bioinformatics Infrastructure: RNA Bioinformatics Center. de.NBI

GIF grant: Understanding Ubiquitin Ligases. Function In Erhomeostasis – A Possible Entry Point For Future Intervention. (T. Ravid (Hebrew University) and T. Sommer)

Klonidee: Development of new biotechnologically based breeding and production methods for Lady slipper orchids (*Cypripedium, Paphiopedilum*).

LiSyM Junior Group – Multi-scale models of the liver for personalized liver function tests.

Modeling and Measuring Competencies in Higher Education- validations and methodical innovations.

OptiTanne: Development, Testing and Evaluation of a technological process for clonal mass propagation, plantlet development and clone evaluation in *Abies nordmanniana*.

Single-Shot-Spectrometer for time-resolved simultaneous Vis and IR measurements (BMBF ist 05K16KH1).

Appendix 3 page 1

Projects promoted by the
European Union (EU)

Consortium: Ageing with elegans.

Human Brain Project: Context Sensitive Multisensory Object Recognition.

LifeTime FET Flagship:
The LifeTime Initiative

iNext funded by the Horizon 2020 programme of the European Union on „How do cells engineer mesosclae structures“.

INAPRO (Innovative aquaponics for professional application 5.9 Mill. €; 1.1.2014-30.6.2018) focusing on aquaponics, a sustainable food production technology that couples fish production and soilless vegetables production in one system.

Marie Curie Network 642836: Protein Factory - Engineering of New-Generation Protein Secretion Systems.

Marie Curie Network 675585: SymBioSys: Systematic Models for Biological Systems Engineering Training Network.

Marie Sklodowska-Curie Innovative Training Network (4 mEUR). „PEP-NET: Predictive Epigenetics“- Fusing Theory and Experiment

„Stardust“

ERC-Advanced Grants

Active dendrites and cortical associations.
Matthew Larkum

ERC Consolidator Grant “GluActive”
Andrew Plested

“MERA“ mechanism of enzyme rhodopsin activation.
Peter Hegemann

ERC Starting Grant: 3D structures of bacterial supramolecular assemblies by solid-state NMR. (Project acronym: assemblyNMR; Grant agreement no.: 337490).
Adam Lange

ERC Starting Grant: „evolSingleCellGRN - Constraint, Adaptation, and Heterogeneity: Genomic and single-cell approaches to understanding the evolution of developmental gene regulatory networks“.
David Garfield

Appendix 4 page 1

Other research projects

Affiliated Faculty, Northwestern Institute on Complex Systems (NICO)

Association of Members of the Wissenschaftskolleg zu Berlin

Berlin-Brandenburg Institute of Advanced Biodiversity Research (BBiB).

Centre for Anthropological Research on Museums and Heritage (CARMAH)

Berlin School of Mind and Brain

Bernstein Center for Computational Neuroscience (BCCN Berlin)

Comité Cientifico Nacional para la Flora de Cuba

Comité de Rédaction de la Flore d'Afrique centrale

Cooperation and Collective Cognition Network: Princeton University und Humboldt-Universität zu Berlin

Council - Defining the spatial and temporal regulation of neurite branching: The project is in collaboration with Prof. Dr. T. Fath at UNSW Sydney.

Dendromax: Development and introduction of biotechnological procedures for breeding, production and application of high performing varieties of selected tree species, FNR.

Einstein-Center Neurocure: The Einstein Center offers students in the neuroscience graduate programs of Berlin a broad education in the neurosciences and fosters interdisciplinary, collaborative research.

„Einstein Circle – Science and Culture".

Einstein-Stiftung Network: Single molecule RNA biology - dynamics and function of RNA from transcription to degradation.

ERA-CAPS proposal: The Genetic Basis for Robustness in Flowering Plants.

European Citizen Science Association (ECSA)

External Faculty of the Santa Fe Institute New Mexico, U. S. A.

Fonds de Recherche du Québec - Nature et Technologies: Projet de recherche en équipe: La nage et la perception sensorielle: Effets de l'hypoxie et de la contrainte thermique sur la performance et l'acquisition d'information sensorielle chez les poissons.

Geo.X: Geo.X is the research network for geosciences in Berlin and Potsdam.

German Center for Neurodegenerative Diseases (DZNE).

Human Frontier Science Program: Mechanical regulated gene expression during T-cell activation.

Humboldt-Princeton Strategic Partnership Grant: How to Shape Living Structures Mesoscale Self-Organisation of Non-Membrane Bound Cellular Structures.
Inhibition of ammonia emissions from manure through inhibition of nickel uptake into microbial cells.

Initiative: Plant Mitochondria In New Light.

Appendix 4 page 2

Other research projects

Interdisciplinary centre for infection biology and immunity (ZIBI).

Institute of Scientific Interchange (ISI): External Faculty, Institute of Scientific Interchange, Turin.

International Biotremology Initiative

Interdisciplinary Centre for Educational Research (IZBF)

International Max Planck Research School on the Life Course.

IRI Life Sciences

Leibniz-Verbund Biodiversität (LVB): The Leibniz-Verbund Biodiversität (Leibniz Research Alliance on Biodiversity) pools competencies and resources of 20 institutes in order to develop solutions for the conservation and sustainable use of biodiversity through interdisciplinary research.

Leibniz-Institute for Zoo and Wildlife Research (Leibniz-IZW)

Marie Curie International Training Network “RNAtrain”.

NIH 4D-Nucleome consortium; U54DK107977-01: PIs Ren/Murre (co-PIs Pombo, Nicodemi, Dudko, Hu) Nuclear Organization and Function Interdisciplinary Consortium: San Diego Center for 4D Nucleome Research.

National Institutes of Health (NIH).

Professional School of Education (PSE)

Digital STEM education of the future: technology-based - adaptive -critical: „The future of STEM learning“.

Robert Koch Institute: Head of the project group Computational Epidemiology at the Robert Koch Institute.

Secretaría Nacional de Ciencia, Tecnología e Innovación: Evolución del microbioma asociado a los peces eléctricos y sus campos eléctricos a diferentes escalas biológicas.

Sofja-Kovalevskaja project of the Alexander-von-Humboldt-Stiftung. This projects investigates mechanisms of gene regulation in plant development.

Sofja Kovalevskaja Programme: “Early Evolution and Diversification of Synapsida”.

StratMarker (GIF - German-Israeli Foundation for Scientific Research and Development): In collaboration with the Ofran Lab of Systems Biology and Functional Genomics (lead by Yanay Ofran, Bar Ilan University, Israel).

The Leverhulme Trust: International Research Network: A Darwinian framework for phenotypically integrating genetic and epigenetic cues.

Universidade de São-Paulo (USP) and the Humboldt-Universität zu Berlin (HU) Strategic Partnership Initiatives “Evolution of limb reduction and regeneration in salamanders”.

University of Southern Denmark

Zuse Institut Berlin

Appendix 4 page 3

Other research projects

COST- European Cooperation in Science and Technology

EPITRAN - European Epitranscriptomics Network Epitran (COST Action CA16120)

Soil fauna - Key to Soil Organic Matter Dynamics and Modelling (KEYSOM)

Prizewinners of the Humboldt Prize
at the Institute of Biology
Master‘s

With the Humboldt‘s prize excellent scientific works are appreciated by students as well as by up-and-coming researchers and up-and-coming researcher‘s scientists of the Humboldt‘s university to Berlin.

Master’s

2007
Arthur Guljamow
Identification and characterization of eukaryote-like actin and profilin in Microcystis aeruginosa PCC7806

2012
Robert Ohlendorf
From Dusk till Dawn: One-Plasmid Systems for light regulated Gene Expression

2013
Johannes Vierock
Schnelles Flicker Gating des Modellkaliumkanals KcsA

2017
Falk Mielke
Verbesserung der Methodik bei der vergleichenden Gestaltanalyse von Knochen in evolutionsbiologischen Fragestellungen

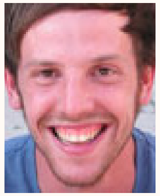
diploma

2001
Sandra Wohlgemuth
Wegintegration bei der Wüstenameise *Cataglyphis fortis*: Einfluss der dritten Dimension auf die Distanzmessung

2003
Sebastian Schelenz
Untersuchung schneller Einfrierprozesse beim Aufprall auf gekühlte Oberflächen

2010
Franziska Schneider
Modifikationen an Volvox-Kanalrhodopsin 1 zur Verbesserung von Expression und Farbverschiebung

2011
Wolfgang Giese
Numerische Behandlung einer linearen Reaktions-Diffusions-Gleichung mit einer Anwendung in der interzellulären Kommunikation bei Hefezellen



Appendix 5 page 2

Prizewinners of the Humboldt Prize
at the Institute of Biology
Doctoral theses

Doctoral theses

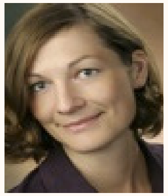
2004
Tim Gollisch
The Auditory Transduction Chain: Identification of the Functional Modules Involved in Sound Encoding

2008
Melanie Braig
Rolle der Histonmethyltransferase Suv39h1 in zellulärer Seneszenz und Ras-induzierter Lymphomgenes

2009
Henning Sprekeler
Slowness Learning: Mathematical Approaches and Synaptic Mechanisms

2011
Stephan Schlickeiser
In vitro und in vivo Charakerisierung tolerogener dendritischer Zellen

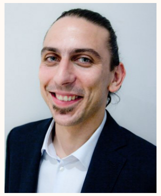
2012
André Berndt
Mechanismus und anwendungsbezogene Optimierung von Channelrhodopsin-2



Charlotte Giesen
ICP-MS and Elemental Tags for the Life Sciences

2014
Franziska Schneider
Design and electrophysiological characterization of rhodopsin-based optogenetic tools

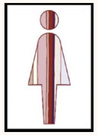
2016
Hannes Ruwe
PPRs and cpRNPs: RNA-binding proteins required for global RNA stabilization in plant organelles Untersuchung schneller Einfrierprozesse beim Aufprall auf gekühlte Oberflächen



2017
Andreas Sven Richter
Charakterisierung des physiologischen Einflusses der Phosphorylierung von GENOMES UNCOUPLED 4 (GUN4) auf die Tetrapyrrolbiosynthese und Untersuchung der retrograden Kommunikation zwischen Plastiden und Zellkern

2018
Helene Schmidt
Large-scale circuit reconstruction in medial entorhinal cortex

Appendix 6 page 1
Figures and facts



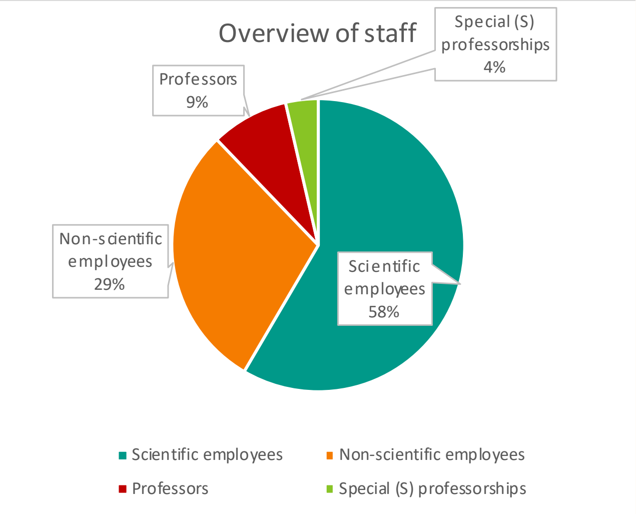
Employees (in total), of which: 361

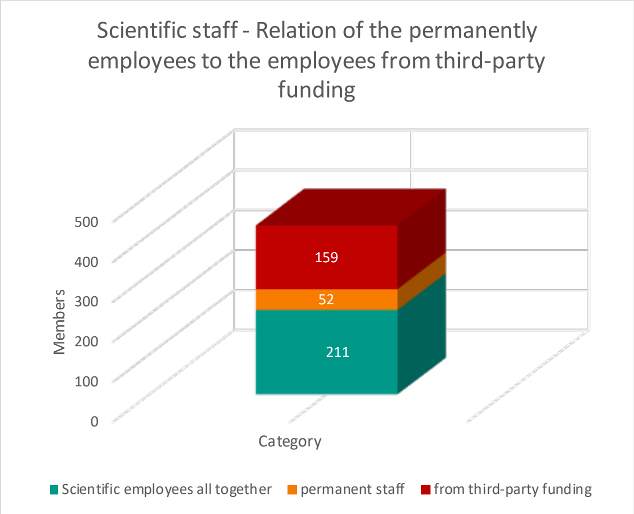
195	women

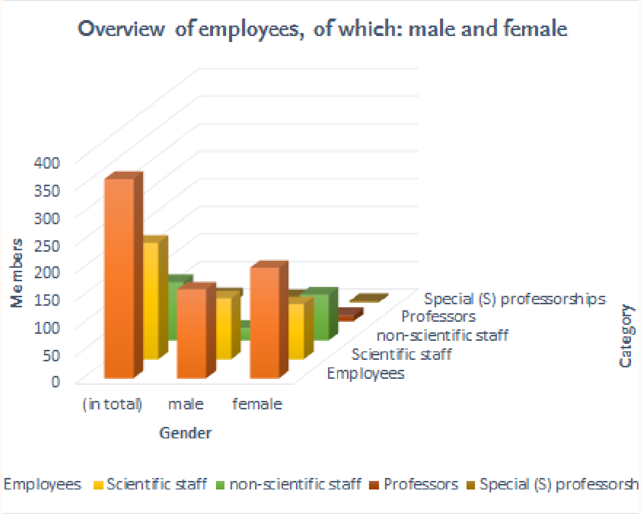
including: *1)

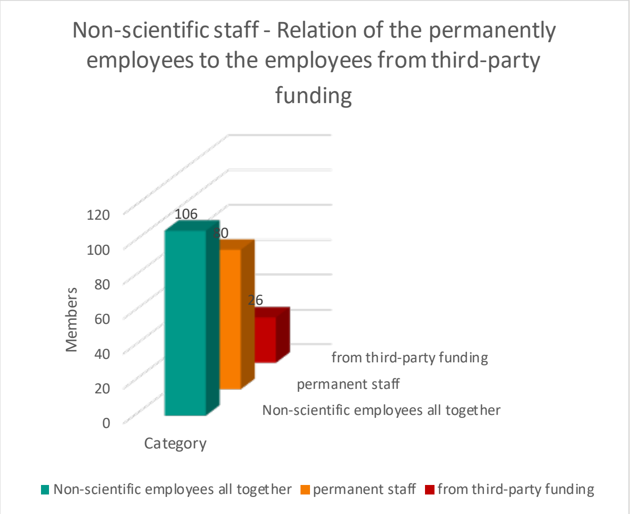
211	Scientific employees, of which: *2)
100	female
52	permanent staff
159	from third-party funding
106	Non-scientific employees, of which:
83	female
80	permanent staff
26	from third-party funding
44	Professors, of which
12	female
13	Special (S) professorships, of which:
3	female

*1) „head count“, not full-time equivalents
*2) including professors
Status, as of 01.02.2019


Overview of staff


Scientific staff - Relation of the permanently employees to the employees from third-party funding


Overview of employees, of which: male and female


Non-scientific staff - Relation of the permanently employees to the employees from third-party funding

Appendix 6 page 2

Figures and facts
Expenditure of funding from third party sources

Ongoing priority topics

Cluster of Excellence
Cluster „Matters of Activity: Image Space Material“
Cluster „Neurocure“
Cluster „Science of Intelligence“
Cluster „Unifying Systems in Catalysis“

Collaborative Research Center
CRC/TRR 167, 175, 186
CRC 650, 665, 765, 1078, 1315

Eurpean Research Council
MERA: Mechanism of Enzyme Rhodopsin Activation
EU contribution: EUR 2 398 750
Starting Grant: 3D structures of bacterial supramolecular assemblies by solid-state NMR.

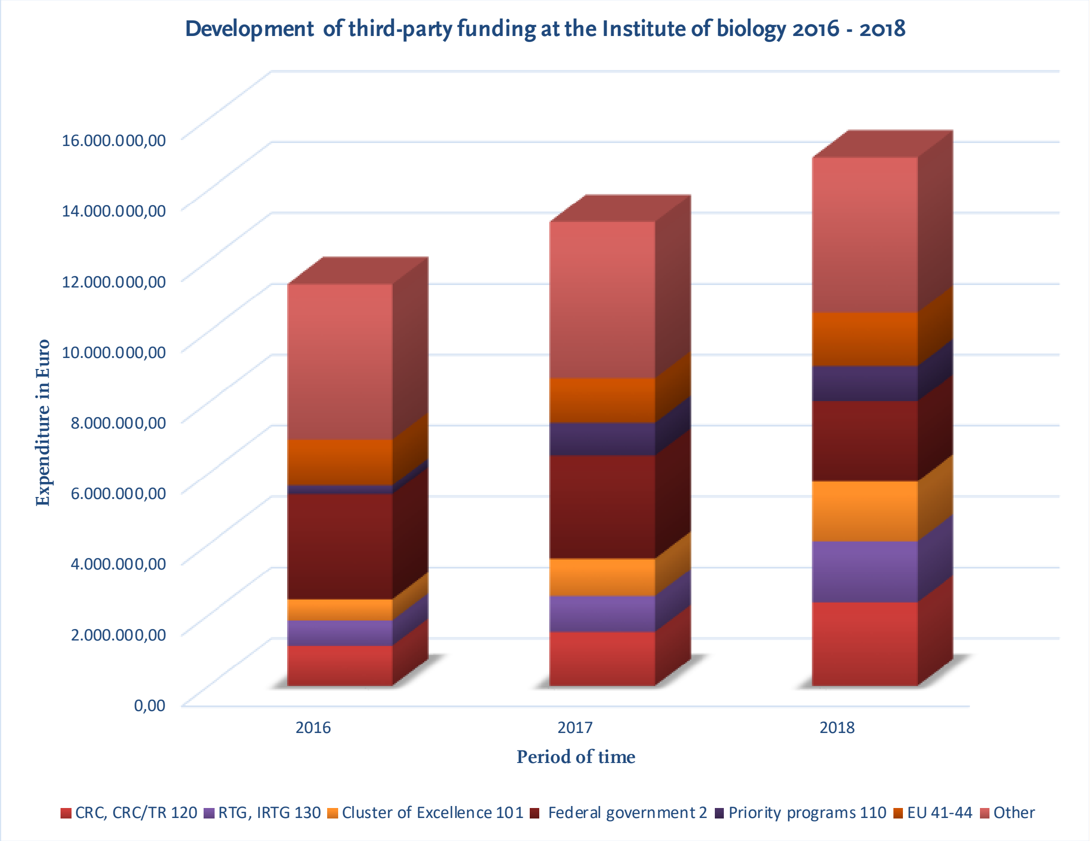
Priority programs
1374, 1530, 1617, 1710, 1784, 1879, 1926, 1927, 1935, 2041

Research groups
FOR 1341, 2092, 2518

Research training groups
Graduate Center Life Sciences
1589, 1772, 2046, IRTG 2290, IRTG 2403, RTG 2424

Development of third-party funding at the Institute of biology 2016 - 2018

Period of time	CRC & CRC/TR	Research Training Groups	Cluster of Excellence	Federal government	Priority programs	EU	Other
2016	1.136,2	711,98	594,75	2.967,1	247,8	1.291,9	4.392,6
2017	1.523,75	1.010,19	1.060,2	2.908,3	920,6	1.263,2	4.409,64
2018	2.356,95	1.725,3	1.690,9	2.256,6	1.001,39	1.505,95	4.375,4


Development of third-party funding at the Institute of biology 2016 - 2018

Appendix 7

Concluded doctoral theses

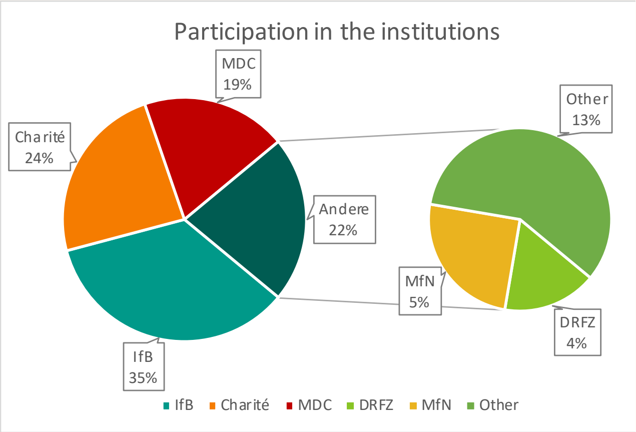
2016

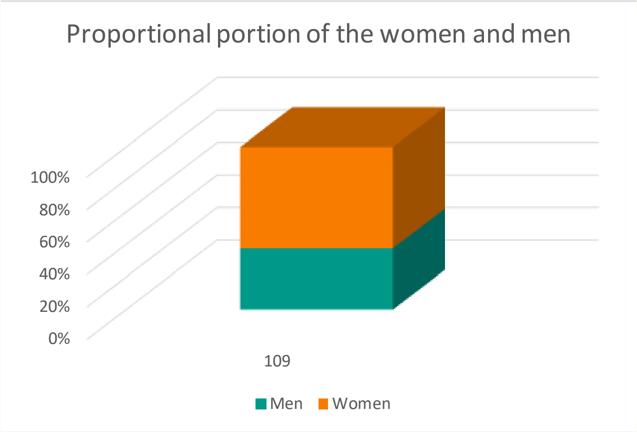
(in total): 109 concluded doctoral theses
of

38 in the institute of biology
26 in the Charité
21 in the Max-Delbrück-Centrum
4 in the DRFZ
6 in the Museum für Naturkunde
14 Other

of 62% Women
38 % Men

German citizens 76%
Different citizens 24% (from 15 Nations)





2015

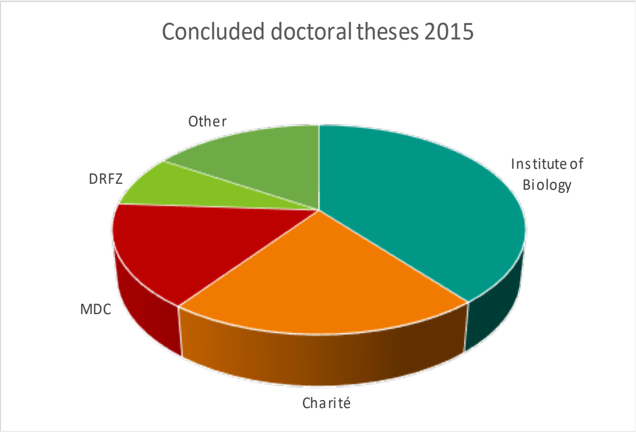
(in total): 125 concluded doctoral theses
of

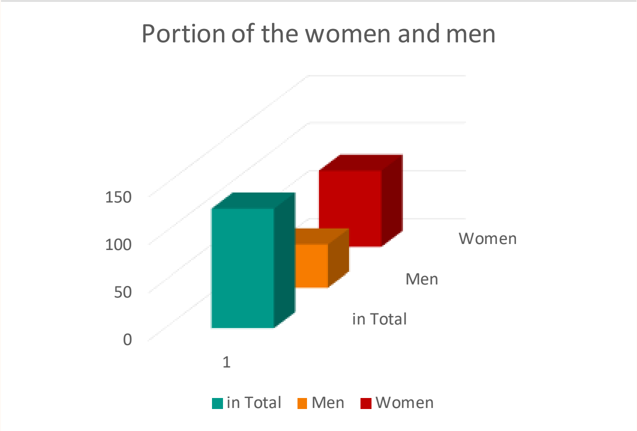
49 in the institute of biology
26 in the Charité
20 in the Max-Delbrück-Centrum
10 in the DRFZ

20 Other

of 64% Women
36% Men

German citizens 70%
Different citizens 30% (from 24 Nations)





Appendix 8

The institute council of the institute of biology
Legislative periode 2018 - 2020


Edda Klipp
Executive Director


Christian Schmitz-Linneweber
Deputy Director 2019 - 2020


Michael Brecht
Animal physiology/
systems neurobiology and
neural computation


Kerstin Kaufmann
Plant cell and
molecular biology


Rüdiger Krahe
Behavioural physiology


Kai Matuschewski
Molecular parasitology


John Nyakatura
Morphology and
the history of forms


Thomas Eitinger
Microbiology


Pawel Romanczuk
Collective information
processing

Josta Hamann
Molecular cell biology


Heidemarie Schneider
Plant physiology

Franziska Eberhardt
Student council


Sinah Noemie Pecina
Student council

Appendix 9

Student council (FSI) at the Department of Biology (IfB)

https://fachschaften.hu-berlin.de/de/fsbio

Description of the projects:

The FSI Biology consists of voluntary members from the bachelor and master program in biology and biophysics who have not been elected. Our goals are to promote and improve communication between students and professors, working groups and academic administration, to simplify the beginning of the study for new students and to provide a platform for exchange regarding matters of university politics, science and social life. Therefore, FSI members participate in various committees of department and faculty, where they support the concerns and needs of students and, to do so in an efficient and successful way, try to communicate with the students as much as possible. Besides, the FSI organises the weekend trips, the first organisational lectures and a tour around the campus for new students as well as various events in collaboration with students from other programs in the faculty.

Dies Academicus

The FSI allows students to take immediate influence on university politics and education. Student representatives, together with professors and scientific employees, are part of the committee for teaching and learning (“Kommission für Lehre und Studium” = KLS), where study regulations are being written and discussions on problems with study programs are enabled. Furthermore, both the department board and faculty committee involve student representatives who advocate students’ rights and interests at the department.

To facilitate networking and communication within the faculty, students of all three departments (Albrecht Daniel Thaer-Institute of agricultural and horticultural sciences, department of psychology and department of biology) manage together the student café, which welcomes students from every program within the faculty to relax and chat and is the location for many events.

All students are welcomed to join our weekly meeting. Place and time for each semester can be found on our website (https://fachschaften.hu-berlin.de/de/fsbio). If you have problems affecting a wider range of students, ideas and suggestions or questions about university politics, events, participation and more, please feel free to contact us (fsbio.hu-berlin@gmail.com).

New student hangout on Campus North opened

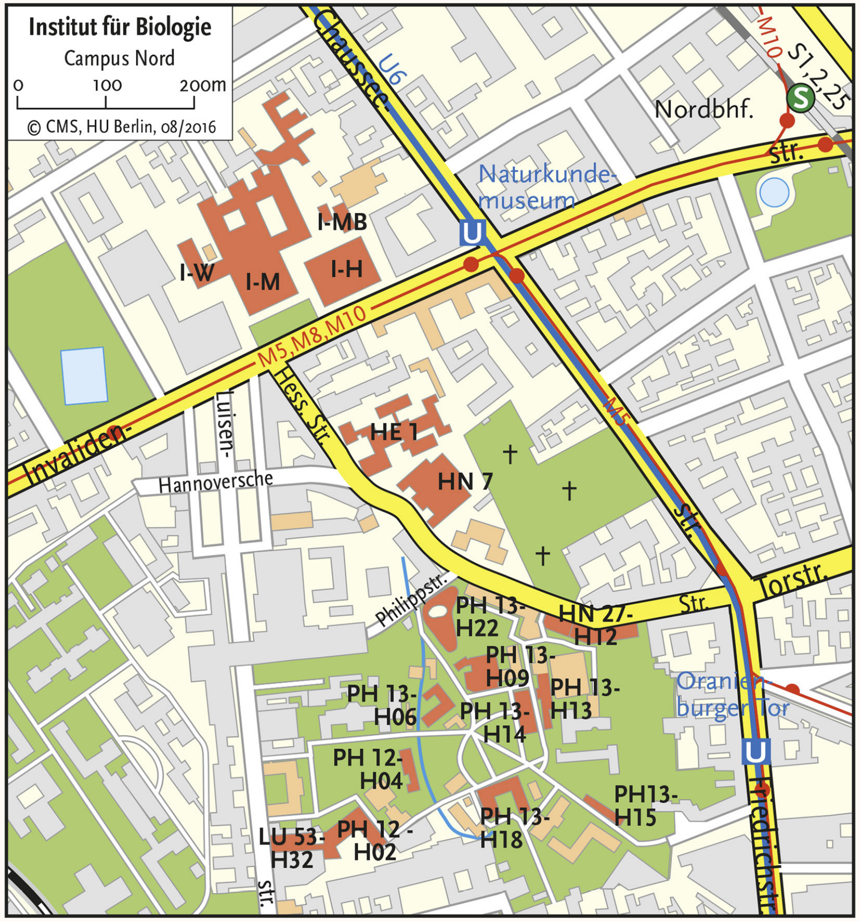
Haus 19 is open to all faculty students who enjoy chatting, getting to know each other, and other student activities. „It is a small building project for the technical department, but a great one for the life science faculty“, said Prof. Dr. med. Bernhard Grimm, Dean of the mentioned faculty, on the occasion of the opening of Haus 19 on Campus Nord on February 19, 2018.

The opening of the new student café „Flora Soft“

The historic brick house is the new home of the self-managed student café „Flora Soft“, which previously had been accomodated in Invalidenstraße 42. It is also the first meeting place for students on Campus North. After the detailed refurbishment for 500,000 euros - directed by the technical department - it is no longer apparent that sheep and pigs were formerly housed in the building. Now, there is a large recreation room, a tea kitchen, a storage room, and sanitary facilities. The cross-institutional „Flora Soft“ looks back on a long-standing tradition. The area of the café in Invalidenstraße had to be abandoned in 2017, as the lecture hall 10 and adjoining areas had to be renovated. The scaffolding is still up due to the weather; the exterior renovation can only be done at warmer temperatures.
(Author: Ljiljana Nikolic)

Appendix 10

Outline map of Campus Nord
Sites of Department of Biology



Dipl.-Ing. Marc Winkelbrandt, Abt. Digitale Medien des CMS der HU

HE 1
University library
Hessische Str. 1-2

HN 7
Cafeteria of the north campus
Hannoversche Str. 7

I-M
Museum für Naturkunde
Invalidenstr. 43

I-MB
Department of Biology, Biophysics
Invalidenstr. 42 (Main building
and central block)
Invalidenstr. 43 (im MfN)

I-H
Department of Psychology
Albrecht Daniel Thaer-Institute
of Agricultural and Horticultural
Sciences
Department of Biology, Office
Faculty of Life Sciences
Residence of the deanery
Main building
Invalidenstr. 42

HN 27 - H 12
Department of Biology
Albrecht Daniel Thaer-Institute
Hannoversche Str. 27

LU 53- H 32
Department of Biology
Albrecht Daniel Thaer-Institute
Luisenstr. 53

PH 13- H 06
Bernstein Center für Computational
Neuroscience Berlin
Philippstr. 13

PH 13- H 09
Department of Biology
Philippstr. 9

PH 13- H 13
Department of Biology
Philippstr. 13

PH 13- H 14
Department of Biology
Philippstr. 14

PH 13- H 15
Department of Biology
Philippstr. 15

PH 13- H 18
Michaelis Menten building
Department of Biology
Philippstr. 13

PH 13- H 22
Rhoda Erdmann building
Department of Biology
Philippstr. 13

PH 12- H 02
Department of Biology
Philippstr. 12

PH 12- H 04
Ostertaghaus/ Tieranatomisches
Theater
Philippstr. 12

Appendix 11 page 1

Glossary

ABC	ATP-binding cassette
AFM	Atomic Force Microscopy
ATT	Adoptive T cell therapy
BAC firing	Simulation of Backpropagation Activated Calcium spike
BBiB	Berlin-Brandenburg Institute of Advanced Biodiversity Research
BCCN	Bernstein Center for Computational Neuroscience
BESSY II	BESSY II offers extremely brilliant synchrotron light pulses in the terahertz range to the visible spectrum all the way to hard X-rays, with an emphasis on the soft X-ray range. At each of the beamlines‘ experimental stations, researchers are able to adjust wavelength, polarization, and photon energy so as to examine their samples at spatial resolutions in the nanometer range (10^{-9} meters). In addition, the ultrashort light pulses offer insights into the dynamics of ultrafast reactions in the femtosecond range (10^{-15} seconds).
BIBS	Bridging in Biodiversity Science
BIH	Berlin Institute of Health
BMBF	Federal Ministry of Education and Research
BMWi	Federal Ministry of Economic Affairs and Energy
cAMP	Cyclic adenosine monophosphate
CARMAH	Centre for Anthropological Research on Museums and Heritage
CARs	Chimeric antigen receptors
cGMP	Cyclic guanosine monophosphate
ChRs	Channelrhodopsins
CoCCoN	Cooperation and Collective Cognition Network
CT	Computed tomography
CRC	Collaborative Research Center
CRISPR	Clustered Regulary Interspaced Short Palindromic Repeats
DFG	German Research Foundation
DNA	Deoxyribonucleic acid
DZNE	German Center for Neurodegenerative Diseases
ECF	Energy-coupling factor
EC	Cluster of Excellence
ECSA	European Citizen Science Association
ERC	European Research Council
EU	European Union
FTIR	Fourier-transform infrared spectroscopy
GAM	Genome Architecture Mapping
GFP	Green fluorescent protein
GIF	German-Israeli Foundation for Scientific Research and Development)
GRK	Research Training Group
HFSP	Human Frontier Science Program
HSC	Hematopoietic stem cells
ICCN	Interdisciplinary Center Computational Neuroscience
IRI	Integrative Research Institutes
IRTG	International Research Training Group
ISI	Institute of Scientific Interchange
ITB	Institute of Theoretical Biology
KoKoHs	Modeling and Measuring Competencies in Higher Education – Validation and Methodological Innovations
Ko-WADis	Evaluating the development of scientific literacy in teacher education
LVB	Leibniz-Verbund Biodiversität
MDC	Max Delbrück Center for Molecular Medicine in the Helmholtz Association
MPP	Multi-potential progenitors
NICO	Northwestern Institute on Complex Systems
.PcG	Polycomb

Appendix 11 page 2

Glossary

ProMINTion	The Graduate School "ProMINTion" is part of the Humboldt-ProMINT-Kolleg, an inter disciplinary institution for teacher education in mathematics, informatics and the natural sciences at Humboldt-Universität zu Berlin
PQC	Protein quality control
RBPs	RNA binding proteins
RNAs	Ribonucleic acids
RNPs	Ribonucleoproteins
RTG	Research Training Group
STEM-disciplines	Academic disciplines of science, technology, engineering and mathematics
SENACYT	Secretaría Nacional de Ciencia, Tecnología e Innovación:
SIP	Stable isotope probing
TCRs	T cell receptors
TIRF	Total Internal Reflection Fluorescence
TrxG	Trithorax
UniSysCat	Unifying Systems in Catalysis
UNSW	University of New South Wales
UPS	Ubiquitin Proteasome System
USP	Universidade de São Paulo
ValiDiS	The goal of project ValiDiS is to gather validity evidence for the test score interpretations of a scientific reasoning test for preser vice science teachers.
UV/Vis	UV/VIS spectroscopy
VAAM	Association for General and Applied Microbiology
WOC	Water oxidizing complex
ZIBI	Interdisciplinary centre for infection biology and immunity
ZMNH	The Center for Molecular Neurobiology Hamburg

Appendix 12

Sources

Beiträge zur Entwicklung der Biologie in der Geschichte der Berliner Universität. Wiss. Ztschr. Humboldt-Univ. Berlin, Math.-Nat. Reihe, 34 (1985), H. 3/4.
Höxtermann, E.: Die Biologen der Humboldt-Universität zu Berlin zwischen Illusion und Wirklichkeit (1945 bis 1968). In Girnus, W., K. Meier (Hrsg.): Die Humboldt-Universität Unter den Linden 1945 bis 1990. Zeitzeugen, Einblicke, Analysen. Leipzig: Universitätsverlag 2010, 277-294.
Prof. Dr. Ekkehard Höxtermann, Berlin

Markschies, Christoph (2010) Wilhelm von Humboldt, Antrag auf Errichtung der Universität Berlin. Gründungstexte, S.243-250.

Wikipedia, Mrs Annette Vogt.

Images

Bernd Prusowski. Exhibitions from a specialist collection.

Carola Rocks, HU Berlin. Links: Bleichende Mutante eines chloroplastidären RNA Bindeproteins in Arabidopsis thaliana nach Kältebehandlung. Mitte: Der Fadenwurm C. elegans als Alterungsmodell. Rechts: Doppelfärbung von Mitochondrien des Malariaerregers der Maus mit einem GFP Marker und einem in das Organell importierten HPR Proteins.

CellDeg GmbH. As scientific mentor of the EXIST Business Start-Up Grant “Cell-Deg“, the research group was involved in studying cultivation of cyanobacteria at very high cell densities.

Dipl.-Ing. Marc Winkelbrandt. Abt. Digitale Medien des CMS der HU.

Dr Christian Sieben. Combined experimental and simulated approach used to characterize attachment of influenza A virus to host cells at molecular level. Binding is accomplished between the viral hemagglutinin (red) and the sialic acid terminated glycans on the cell surface (green).

Dr H. Hein. Three dimensional reconstruction of the central nerve system (green) and the muscles (yellow) of the naupilus larva of a copepod (Copepoda).

Einstein-Netzwerk. The IRI coordinated the research network “Single Molecule RNA Biology - dynamics and functions of RNA from transcription to degradation“ funded by the Einstein foundation with nine groups from the Humboldt Universität zu Berlin, the Freie Universität Berlin and the Max-Delbrück-Center for Molecular Medicine - Berlin Institute for Medical Systems Biology.

Hilmar Baumgarten. Eröffnung des neuen Studentencafés „Flora Soft“. Prof. Dr. Bernhard Grimm, Alexander Bäsmann, Student und einer der Koordinatoren des „Flora Soft“ und Ute Richter-Sepke, Referatsleitung Baumanagement / Bauprojekte, Technische Abteilung HU.

Jan Wölfer. Shape evolution and diversity of sciuromorph (squirrels and their kin) femora. Body mass is indicated by how dark the phylogeny is shown. Colors of femora indicate lifestyles (green: arboreal, yellow scansorial, blue gliding, brown fossorial).

Joao Fonseca, Ringrose group. Live imagining of a fluorescently labelled Polycomb protein in a living Drosophila embryo. IMBA, Vienna, unpublished.

Julia Legen, HU Berlin. *Arabidopsis thaliana*, the thale cress.

Knoop et al. Excerpt of a cyanobacterial metabolic „route map“. (2013).

Museum für Naturkunde Berlin. Biodiversity Wall at the entrance of the exhibition hall Evolution in Action at Museum für Naturkunde Berlin. This four metres high and twelve metres wide installation displays 3,000 animals from a wide range of habitats.

Professor Rhoda Erdmann at the Laboratory of the State Library of Berlin - PK manuscript department, collection of portraits,Portr. Slg / Med. Kl / Erdmann, Rhoda, No. 4 License: CC-BY-NC-SA.

Ralph Bergel. The artist Anna Franziska Schwarzbach, who created the bust of Rhoda Erdmann, at its unveiling. July 2017.

Spiesser et al. Schematic of important processes for the growth of yeast cells: nutrient uptake over the cellular membrane and synthesis of biomass within the cell volume together determine the coordination between progression of cell cycle and the growth of the cell. FEBS J (2012).

Stephanie Gathmann, HU Berlin. Localisation of a plastid RNA binding protein using immunofluorescence.

Thomas Splettstoesser. Schematic representation of a hypothesis on the function of cortex based on the active dendritic properties of pyramidal neurons in layer 5. The properties afford the pyramidal neurons with the ability to associate expectation with data to achieve a coherent percept. Adapted from Larkum (2013): A cellular mechanism for cortical associations (see publication #1). www.scistyle.com.

University professor Dr. Rhoda Erdmann, 60 years: Head of the Department of Experimental Cell Research at the Charité of Berlin... Berlin State Library - PK manuscript department, collection of portraits, Portr. Slg / Med. Kl / Erdmann, Rhoda, No. 2 License: CC-BY-NC-SA.

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