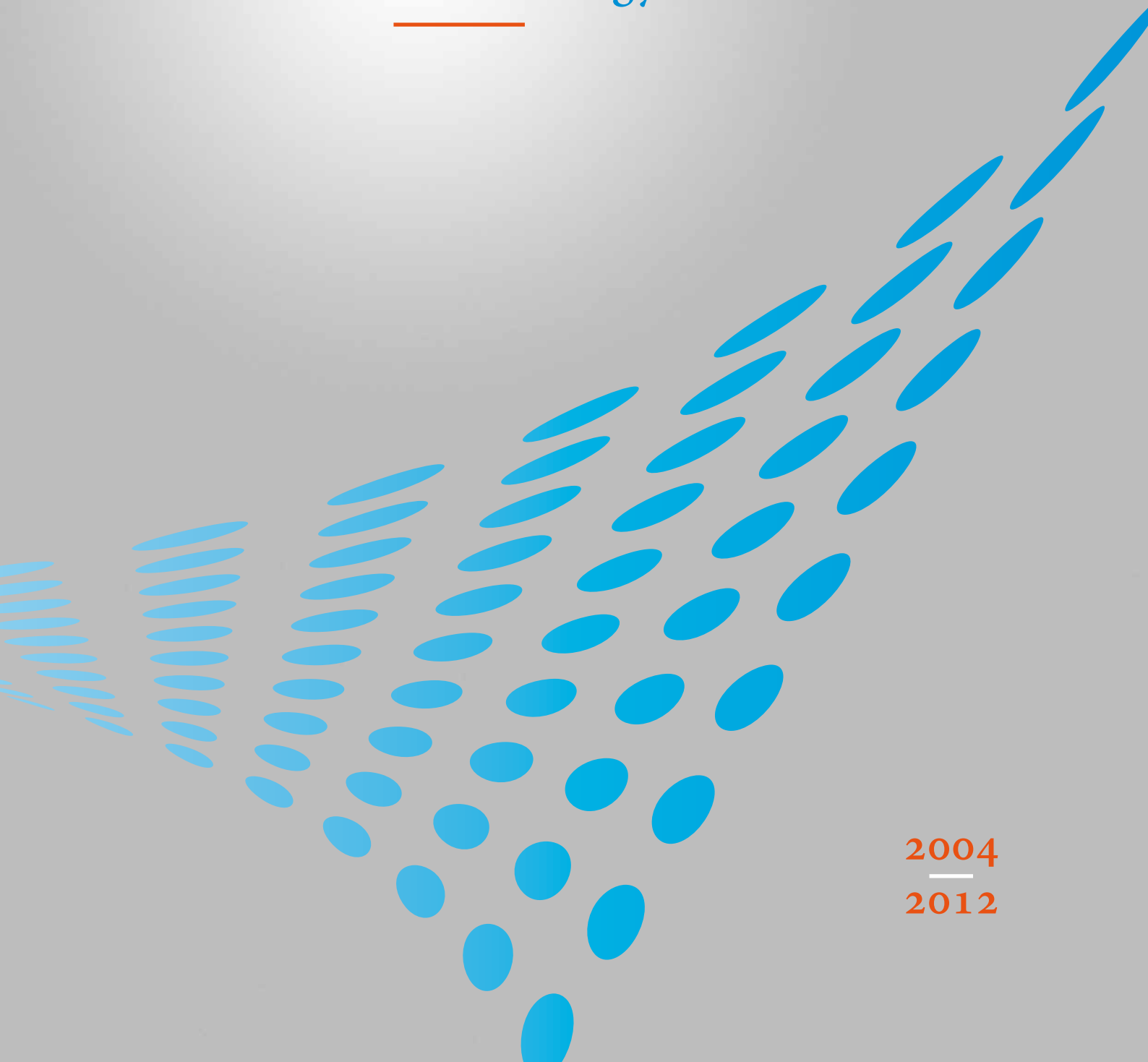
International Doctorate Program

NanoBioTechnology

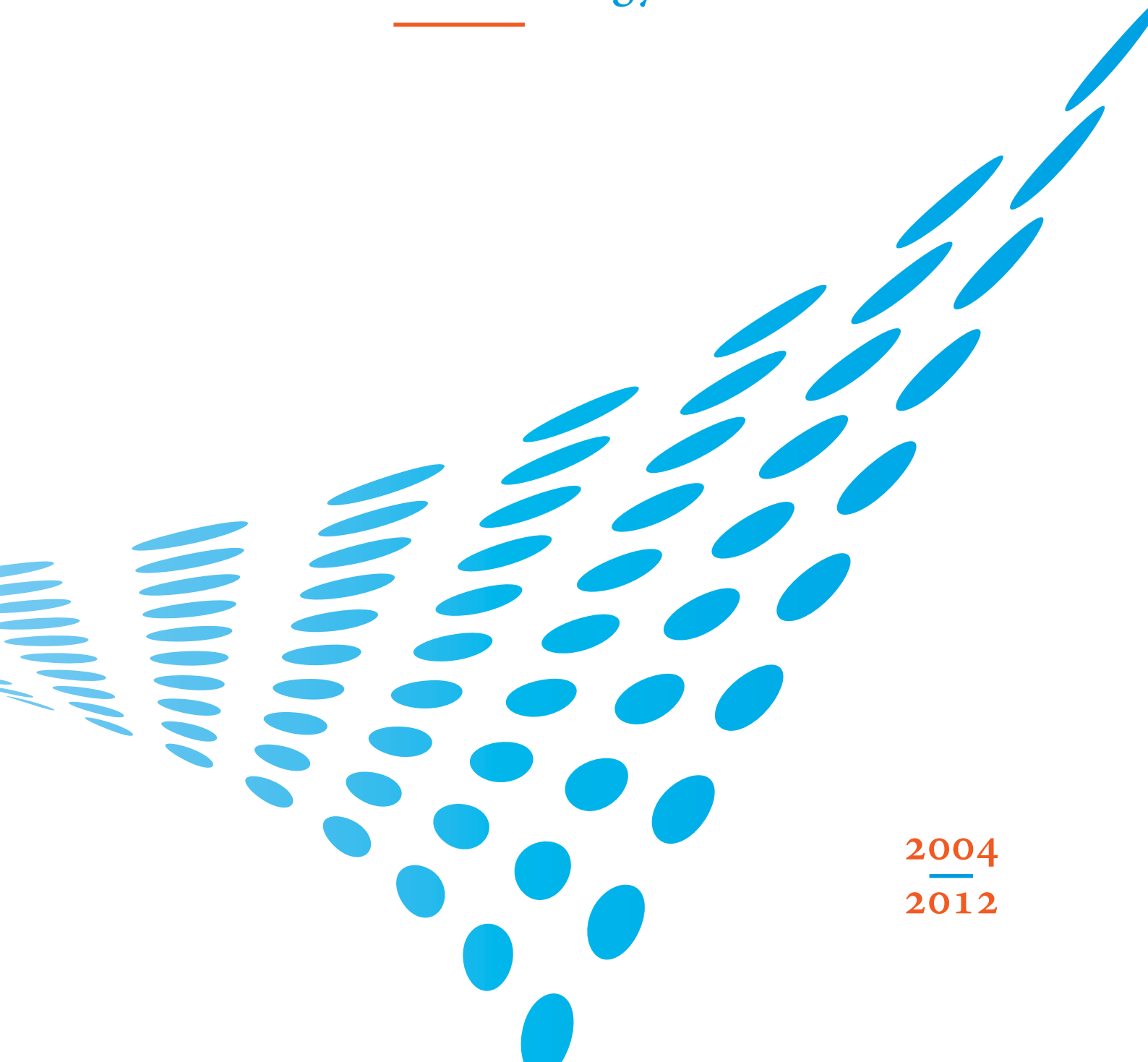


2004

2012

International Doctorate Program

NanoBioTechnology



2004

2012

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PREFACE

In 2004 "nanobiotechnology" was considered a venturous, if not much-hyped, dream that nanotechnology applied to biological molecules could possibly produce something worthwhile. The graduate program Internationales Doktorandenkolleg "NanoBioTechnology" (short IDK-NBT) was intended to make this idea a reality, to educate young students to broaden their minds and to create a place of communication between the disciplines of biology, chemistry and physics.

Eight years later we are astonished by how much has been achieved. DNA nanoconstructs evolved into powerful platforms capable of creating functional machinery by design. Complex proteins like polymerases are studied at the single-molecule level with the help of nanotechnology, and novel materials with nanoscale architecture can be synthesized to build smart drug-carrier systems or to enhance the efficiency of energy-converting devices. Besides these tremendous scientific developments to which the IDK was able to contribute, the graduate program most of all entered new territory in graduate education. When the Bavarian government advertised for applications for the Elitenetzwerk Bayern (ENB), the focus of the graduate program was on three ideas: (i) supporting the best, (ii) creating a network of interdisciplinarity and (iii) creating innovative forms of graduate education. Today it is hard to imagine that structured PhD programs were essentially non-existent at the time. This is all more the reason to appreciate the structures and practices built up within the IDK. The co-supervisor system, the lecture series and soft skills training have been initiated and improved over the years. In collaboration with the GraduateCenter^{LMU}, an international recruitment using an online application tool was established and successfully used in the last few years.

One of the outstanding results of the IDK is the fact that students actively participated in shaping the program. The IDK established the annual election of student representatives who – jointly with the IDK board – organized most of the IDK events. The names of those who participated in the organization of workshops and who took the lead in individual events are too numerous to be listed here. The student-organized summer school at Aiterbach became legendary, as it consisted entirely of students. Only a few hand-picked senior scientists from abroad were admitted to coach during the presentation sessions. The exciting workshops IDK "Energy and Innovation" and "Bionanoscience – from basics to interdisciplinarity" were also initiated by the IDK students themselves.

The Elitenetzwerk Bayern has always attached importance to interdisciplinary networking. Our IDK indeed reached out within the ENB. Examples are the workshop in Irrsee together with the "Macromolecular Systems for Nanoscience – Chemistry, Physics and Engineering Aspects" Master program from the University of Bayreuth or the rather "intercultural" but very successful events with the IDK "Textualität in der Vormoderne".

This final report highlights many of these activities: events, publications, awards and distinctions. We believe they speak for themselves. Yet the reader can only catch a glimpse of the enthusiasm and vivid spirit that we have experienced over the years. These valuable experiences both in scientific workshops and in intercultural events and soft-skills training have an impact on the careers of our alumni and – together with happy memories – will hopefully make them proud of having been a part of the IDK. Indeed many of the IDK alumni have already achieved academic positions in a variety of international laboratories or have taken up responsible positions in industry.

We would like to thank all who have supported the IDK. First of all, Marilena Pinto, who – more than any program manager – became the soul of the IDK. She provided invaluable help for our international students on getting started in Munich, invited them to informal get-togethers over lunch and prepared each event with carefully and thoroughly.

We are also much obliged to the former and present CeNS managers, (in order) Eva Natzer, Marie-Christine Buluschek (née Blüm) and Susanne Hennig, who have helped to connect the IDK to the Center for NanoScience. Moritz Ehrl administered the IDK for the first few years and has since served as a member of the selection committee. The work of our IDK selection committee was highly appreciated. Our thanks go to Dietmar Martin, Moritz Ehrl, Lukas Schmidt-Mende, Matthias Schneider, and Patrick Cramer for putting a lot of work and effort into the "quest for the best". We would also like to thank Isolde von Bülow, head of the GraduateCenter^{LMU}, for her support over the last few years. Last but not least, we are grateful to the Bavarian State Ministry of Sciences, Research and the Arts for initiating the ENB and providing financial support.

The IDK's active years will sadly end in October 2012, but its impact on graduate education at the Center for NanoScience is exceptional. We hope that some of the achievements of the IDK will live on and that future graduate students will also find a home in scientific education programs and will be supported by structured graduate institutions.

Joachim Rädler & Christoph Bräuchle
Spokesman & Vicespokesman
of the International Doctorate Program
NanoBioTechnology

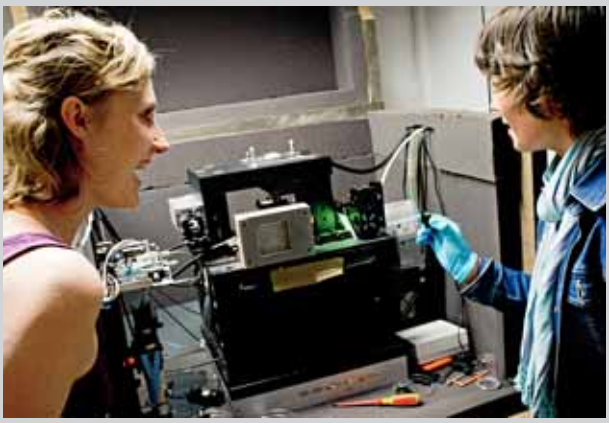
STUDENTS' COMMENTS

"The IDK has been a wonderful support during my studies. The talks, workshops, summer-schools, get-togethers etc. remind me of our roles in the wider scientific community and how we all contribute. The close network of the IDK is like a family and it is one of the most important aspects of the IDK. The IDK just brings it to another level and it's well worth the investment. I hope to see the ideas and values of the IDK continue for the future students."

Brian Tuffy (Ireland)

"I feel like IDK is my family here in Munich. People share not only scientific knowledge but also life to each other. We join lectures, workshops and sometimes even have fun (go out for Oktoberfest and Christmas market)."

Hsin-Yi Chiu (Taiwan)



"The IDK helped me to get in contact with a lot of people from all over the world. On the one hand a lot of foreign students are participating in the IDK events and workshops. On the other hand the IDK enabled me to join international conferences and workshops every year. This allowed for fruitful collaborations and connections in the worldwide "Origin of Life" community. I improved my organization and communication skills by being one of the IDK's student representatives for one year. This gave me the opportunity to work together with the exceptional IDK's administration team and the marvelous IDK students on planning and realizing the exciting and successful IDK events in the year 2011. Summarized, being an IDK member exceeded my expectations in a graduate program by far and was not only fun but also a great way to meet new scientists, methods and sciences."

Christof Mast (Germany)

STUDENTS' COMMENTS

"IDK was a great place to broaden scientific horizons."

Kulpreet Singh Virdi (India)

"The IDK did not only offer many immediately useful workshops, it also encouraged to look beyond: perspectives for the future, research ethics, the bigger picture – just to give an idea. Most important of all, however, was that it brought together people from different scientific backgrounds and encouraged scientific exchange among different research communities."

Cornelius Weig (Germany)

"The chance to be a member of the IDK is an opportunity that I am very appreciative of. From the start I noticed that all IDK students with their various cultural backgrounds and needs are encouraged to be actively involved in the program. Having the opportunity to develop your own ideas and to take part in decision making made the IDK stand out to me. Numerous workshops have covered and communicated a broad range of relevant topics. I would recommend the cordial and inspiring atmosphere I have got to know in this structured program to everyone who is considering a PhD."

Carolin Leonhardt (Germany)

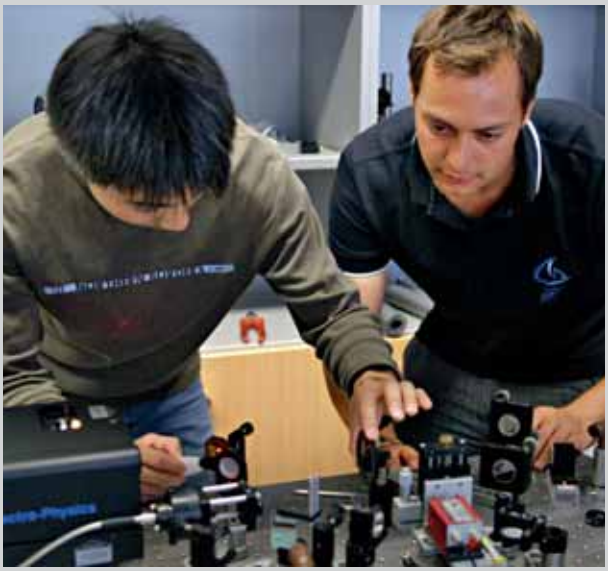
"The IDK gave me the opportunity to work and learn in a highly interdisciplinary environment. Especially as a biologist I appreciated the different points of views and angles that physicists and chemists use to approach and solve biological questions."

Christine Schmidt (Germany)

STUDENTS' COMMENTS

"Extracurricular activities ('Hochseilgarten', swimming, sports, music and dancing); Summer Schools (fun with other IDK students, possibility to practice talking in front of a friendly group, learn about diverse research fields by talks from other IDK students, discuss scientific tasks with IDK students from very different fields, guest speakers from industry and academia, dialogue with experienced people from industry and academia), workshops such as: paper writing, 'Science in a Nutshell' (to learn more about different research fields in a very friendly environment), 'Energy and Innovation'; meet people from various nations and learn about their nationality…"

Ilka Kriegel (Germany)



"IDK enabled me to do my PhD exactly in the field I have always wanted to do. Courses and workshops give me the opportunity to expand not only my professional but also personal skills. It is worth pointing out that the IDK program associates great and valuable people and, as a part of CeNS, creates a wonderful network between young and experienced scientists."

Agata Michna (Poland)

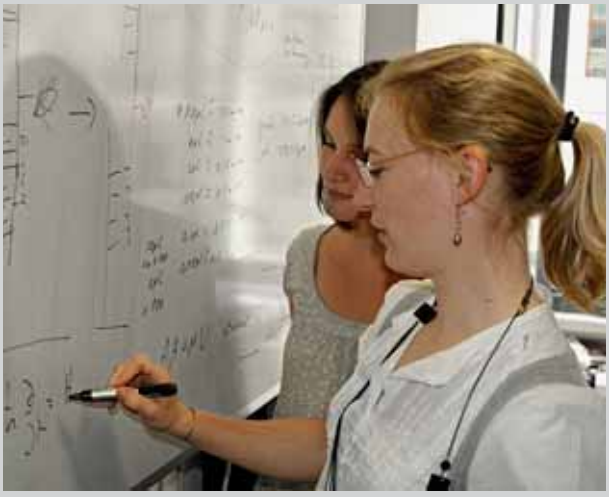
"The participation in the IDK-NBT introduced me in a highly interesting network with a wide range of events where scientific exchange was possible. This networking also provided many interactions with the PhD students of other groups and created a stimulating atmosphere with discussions and new ideas for my PhD work."

Melari Davies (Germany)

SUPERVISORS' COMMENTS

"As one of the official supervisors, I was extremely pleased with the agenda and finally the outcome of the IDK! Not only did I observe that the PhD candidates were oustandingly motivated and well connected, also the broad range of subjects together with the networking efforts of the IDK were extremely helpful and fertilizing. I strongly believe that the IDK cadre of students did benefit from the school but also made friends and important network connections that will last for a lifetime! I also always enjoyed lecturing for the IDK! It does not happen very often to meet such a highly motivated and interested crowd in a lecture. Many memories of inspiring discussions and countless cups of coffee tell their own stories!"

Prof. Achim Wixforth (Augsburg University)



"The success of the IDK was strongly related to the interactions between Germans and international scientists of various research backgrounds, specifically due to their interdisciplinary projects that promoted fruitful discussions. The IDK students within my group have improved not only their own research but that of their fellow students. They have been a great addition to my group from the beginning and have had a vital role in its success. It has been a pleasure to work with them as they have been very active group members. As member of the selection committee it was great to see how the number of excellent applicants increased from year to year."

Prof. Lukas Schmidt-Mende (University of Konstanz, until 2011 LMU Munich)

SUPERVISORS' COMMENTS

"The IDK provided a great opportunity for the students to network and create their own structure of scientific interactions. For example, using techniques of the neighbouring labs became even more simple to incorporate into our own research since the students knew each other so well already through the IDK program. But most importantly, the international scope and mindset of the students was much enhanced and actively explored. Thanks to the IDK, the PhD students are much more exposed to the international science landscape and are now very well prepared for the postdoc level in the future. IDK showed again that networking at the PhD level is very effective to promote science!"

Prof. Dieter Braun (LMU Munich)

"IDK has been a visionary undertaking that is firmly grounded on interdisciplinarity and scientific excellence. What is exceptional about IDK is the combination of structure and flexibility at just the right dose. IDK has been rigid were rigidity is required – like in the selection process – and flexible where flexibility is key – for example in the student's curriculum and scientific activities. By keeping the focus on research, IDK has nurtured creativity and the students' attraction to science in a very efficient and successful way. In addition, soft skills of the students have been strengthened by special programs and joint group activities, which they wouldn't have had access to otherwise. IDK has been a talent hotbed for "high potentials" from all over the world, giving them a scientific home base from which they can grow and thrive. Our groups have benefited a lot from IDK – both with respect to personal, financial and logistic support with minimal bureaucratic burdens, as well as the interdisciplinary, multicultural spirit it has brought along with it."

Prof. Bettina Lotsch (LMU Munich and MPI for Solid State Research) and Prof. Christina Scheu (LMU Munich)

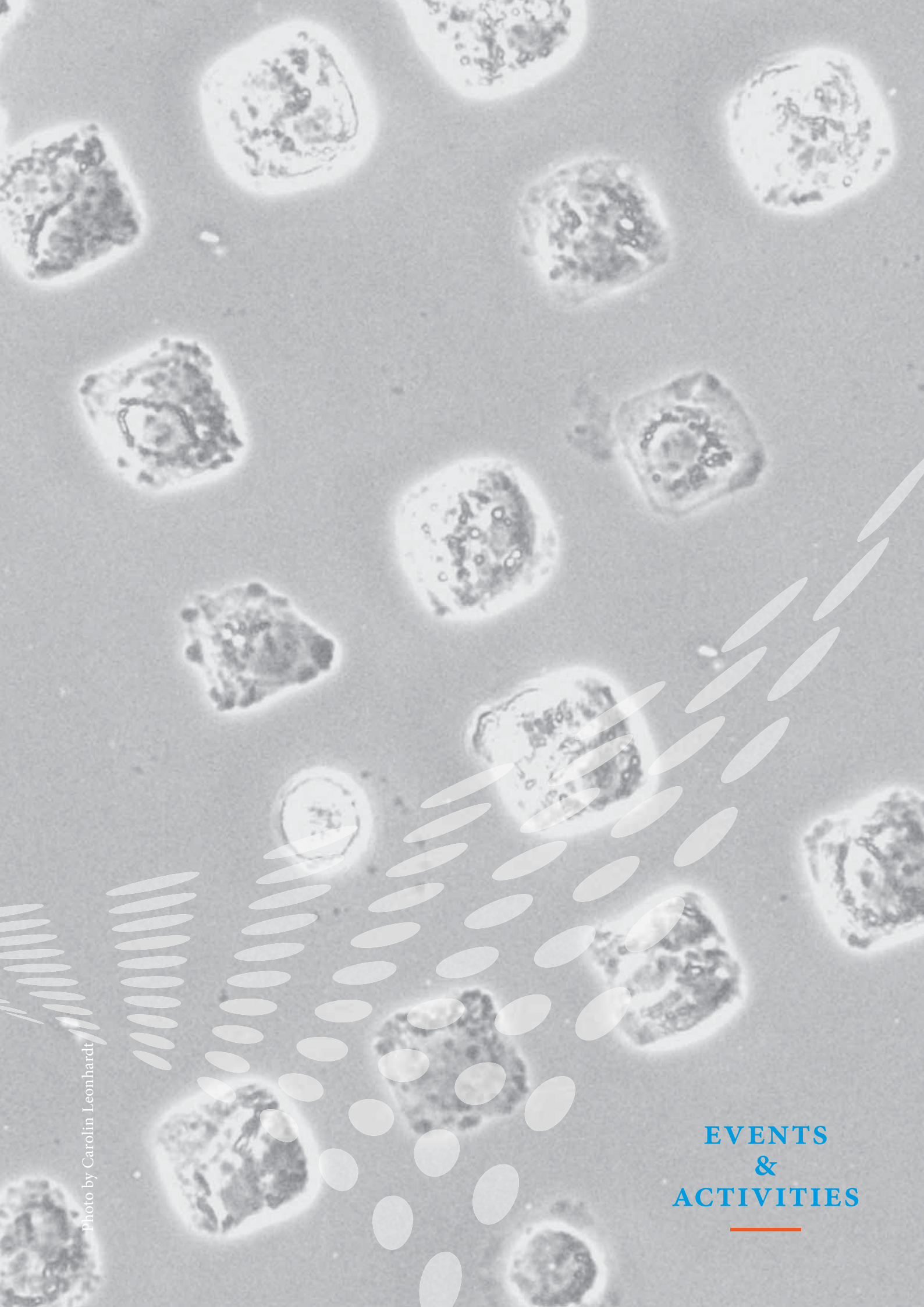


Photo by Carolin Leonhardt

EVENTS & ACTIVITIES

EVENTS & ACTIVITIES

Graduate training was at the core of the IDK NanoBioTechnology. During the first funding period, regular events like the IDK lecture series or the summer school were established. During the second funding period, these activities were further complemented by student-driven events like special workshops and soft-skills seminars. The accompanying social program with networking lunches, welcome events and much more helped to create a strong team spirit among the members of the IDK.

The Quest for the Best – Selection Workshops

An overview of the history of Munich and a "practical introduction" to the traditions and customs of Bavaria during a dinner in one of the famous beer halls – this was the traditional start of the two-days selection workshops of the International Doctorate Program NanoBioTechnology during the second funding period 2008–2012. Every year, excellent candidates from all over the world were chosen from numerous applicants using strict criteria. They then had to convince not only their potential project leaders but also the selection committee of their skills and talents to gain one of the 12 scholarships from the Elite Network of Bavaria (ENB).

After the online application deadline and preselection according to formal criteria, the documents of the most promising 10–20 % of the candidates were forwarded to the respective project leaders. After telephone interviews, the project leaders chose the best candidates for their project and these candidates received an invitation to the selection workshop in Munich.

In the selection workshops, on average the 25 most promising candidates presented the results of their master's theses in poster sessions and answered numerous questions from the members of the selection committee. They also had the chance to discuss their research with other candidates and to talk to the current members of the IDK-NBT. In addition, each participant had to successfully pass an interview with her/his respective project leader and she/he was also given a laboratory tour and had the opportunity to talk to the members of the project leader's group.

The selection procedure, especially the introduction of the online application tool offered by the GraduateCenter^{LMU}, was constantly improved and has become appreciated by project leaders and applicants. It will now serve as a best-practice model for future application rounds coordinated by CeNS.

Figure 1 Poster session at the selection workshop 2010.

Welcome Events

At the annual Welcome Events in October, newly accepted PhD students got the opportunity to meet and mingle with the other members of the IDK. The IDK spokesman welcomed all new members, the IDK program manager then spoke about the structure of the program and gave practical hints. In addition, the CeNS manager informed the students about the scope and range of events on offer at the Center for NanoScience. Most importantly, the IDK members elected their student representatives on this occasion.

Figure 2 New IDK members present themselves at the Welcome Event 2009.

NanoBiotech Lecture Series

Every semester, a monthly lecture on nanobioscience topics held by researchers from CeNS and invited guests preceded the CeNS colloquium. The aim was to provide all IDK students with a good overview of recent developments in nanoscience and to broaden their horizons beyond their individual research fields. Topics covered a wide range of current issues in nanobiosciences, e.g., Nanoimaging and Manipulation on the Single Molecule Basis, Nanomachines and Molecular Motors, Nano-Semiconductor Devices and Quantum Phenomena, NanoDevices in Medicine and Cell-Biology, Function and Construction of Biological Nanosystems, Synthesis and Construction of Nanoscale Materials, Nanofluidics and Biological NanoSystems.

The lectures were recorded and made available online for members of the IDK and CeNS.

Summer Schools

The annual IDK-NBT Summer Schools were a great success in terms of their scientific and social program. One of the first highlights was the 2005 Summer School "NanoBioTechnology and Management" in cooperation with the LMU Entrepreneurship Center in Tutzing. Selected speakers with backgrounds in research, business or politics gave inspiring talks. Furthermore, there was ample opportunity for discussions between students and speakers. In the second funding period, about 20 PhD students from the IDK gathered annually in Aiterbach at Lake Chiemsee for three days of intense scientific discussions and networking. During the summer schools, every participant gave a short presentation about his/her research. The varied research fields of the IDK members led to profoundly diverse talks. Diversity was further enhanced by the fact that some of the participants were in their final year, while others had just started their dissertations. This was a true challenge, since the IDK-NBT members had to prepare their talks for an interdisciplinary audience as well as for an audience whose members were at different stages of their PhDs. The format of the talks promoted lively discussions which often continued until late into the night. In addition to the students' presentations of their research, guest speakers (e.g., Professor Georg Seelig, Washington in 2011 or Prof. Dr. Jörg Bewersdorf, Yale in 2010) were invited to talk about their current research. In more informal discussions, guest speakers as well as CeNS members were asked to give the students insights into their professional careers. These intensive and open discussions gave the IDK students ideas about their future career paths and made an important contribution to the school. Thanks to the students' questions, discussions and active engagement as well as the excellent preparation by the student representatives, the summer schools became an important annual event at the IDK.

Figure 3–5 Participants at the Summer Schools 2010 and 2011 in Aiterbach.

Workshops

The IDK students were actively involved in suggesting and organizing workshops on various topics, from "Data analysis" to "Energy and innovation" or "Water – a manifold challenge". A selection of three successful workshops is presented here.

Science meets Humanities

In September 2010, the first meeting of the IDK-NanoBioTechnology (NBT) and the IDK "Textualität in der Vormoderne" took place as a joint exploratory workshop by the doctoral students. To get to know each other, the students decided to talk about their research in a "speed dating" format, i.e. two people talking to each other for five minutes and then swapping partners, so that at the end of the afternoon each NBT-member had spoken to a member of the other IDK. Afterwards, the two IDKs gathered to learn more about the topics of "NanoBioTechnology" and "Textualität in der Vormoderne". A lively discussion about the risks of nanotechnology and about the relevance of the humanities followed. The evening ended with animated conversations between the members, coordinators and spokesmen of the different IDKs and a lot of ideas for interesting topics for further joint projects.

Figure 6 Scientific Speed Dating at the "Science meets Humanities" workshop.

In December 2010, both IDKs met again to organize a lecture evening with renowned speakers from the fields of natural sciences and literature. The popular LMU professor Harald Lesch from the Department of Astrophysics (who is also a famous TV presenter) and the well-known LMU professor Peter Strohschneider from the Department of German Medieval Studies (who is also a former president of the German Council of Science and Humanities) gave talks on the subject of "Politics and Science". Following the presentations, the audience asked questions and discussions started about the interconnectivity of science and politics. The event, which attracted over 100 listeners, demonstrated that interdisciplinary talks can generate a lot of interest.

Figure 7 Prof. Harald Lesch talking about "Politics and Science".

Energy and Innovation

The enormous changes with respect to how we handle and consume energy and the impact on the environment are of great concern not only to scientists, but to all responsible citizens. In April 2011, the PhD students of the IDK-NBT doctorate program initiated and organized a discussion event with experts from relevant fields to get a deeper insight into the technical, economic and social preconditions necessary for the creation of a truly sustainable energy supply system. The workshop "Energy and Innovation" brought together four specialists from different fields and more than fifty junior researchers from CeNS for an evening of intense discussions. The

Figure 8 Group discussion at the "Energy and innovation workshop".

workshop started with stimulating ignition talks by the invited speakers on "Between organisation and technology: Innovation in the energy system" (Prof. Thomas Hamacher), "Printed solar cells – Cutting costs through innovation" (Prof. Christoph Brabec), "Renewable Energies in Rural Distribution Systems" (Dr. Rupert Schöttler), and on the Munich-based DESERTEC project Clean Power from Deserts (Tobias Grimm). In order to discuss the specific topics in more detail, the participants then divided into four groups for an intense 30-minute exchange with the individual speakers.

The final highlight of the evening was a panel discussion led by Prof. Joachim Rädler in which questions from the audience, such as whether more financial support is needed for the "energy revolution", why research in the field of energy storage is still neglected, whether one needs centralized solutions and/or local energy production and how the renewable energy sector changes the job market for young researchers, were debated. Discussions were then continued at a welcome reception lasting till late in the evening.

Bionanoscience – from Basics to Interdisciplinarity

At the IDK Summer School 2011, the idea for a workshop to get a general understanding of topics covered within the IDK was born. Due to the high number of active and committed IDK members an organizing committee was quickly formed, and volunteers for the presentation of selected topics were easily found. The four talks were gave either a sound practical insight based on the speakers' experience ("Microfluidics") or a broad, general overview of the topic, like "Principles of cell and molecular biology", "The Phenomenon of fluorescence and its most common applications" and "Mechanisms underlying solar cells" along with cutting edge solutions in that field. For the seven speakers, the workshop was a great opportunity to present their area of expertise in a form that could be easily understood by a general audience. The workshop was also open to all CeNS associates and generated a lot of interest. More than 40 participants took part and made the workshop a true success.

Transferable Skills

The IDK offered a rich portfolio of transferable skills workshops, on average two per year. Topics ranged from "Writing dissertations", "Project management" or "Self-management" to "Paper writing", "Grant applications" and "Presenting in English". The workshops were complemented by the various workshopd offered by of the Elite Network and the Graduate Center^{LMU}. Great importance was placed on entrepreneurial skills which were taught in seminars like "Entrepreneurship", "Introduction to economics" and "Patent law".

Networking Lunches

The CeNS-IDK-NIM Networking Lunches took place on the last Friday of every month during the semester, right before the IDK Lecture Series, either in Großhadern or Innenstadt. The CeNS and the NIM team took turns in cooking delicious homemade food like Schinkennudeln, Chili con carne or vegetable soup. IDK students seized the opportunity to mix and mingle and joined the lunch for lively discussions and fruitful networking. As a direct result it brought together groups with different backgrounds and therefore kept the spirit of interdisciplinarity alive.

Figure 9 Bionanoscience workshop.

Figure 10 Networking lunch at the Chemistry Department.

Final Symposium

In July 2012, IDK members, supervisors, IDK alumni and guests from the Center for Nano-Science gathered for a final IDK event in Herrsching at Lake Ammersee. The symposium started with opening remarks about the Doctorate Program from IDK Spokesman Prof. Joachim Rädler, who was followed by the head of the coordination office of the Elite Network, Dr. Beate Lindner, and Dr. Isolde von Bülow, head of the GraduateCenter^{LMU}. Prof. Helmut Grubmüller (MPI for Biophysical Chemistry Göttingen), a member of the Advisory Board of the IDK, then gave a fascinating opening lecture about "Energy barriers and driving forces of tRNA translocation through the ribosome" and made more general comments on setting-up, managing and continuing PhD programs.

Figure 11 IDK spokesman Prof. Joachim Rädler.

The following three sessions covered three different research fields represented within the IDK: DNA nanotechnology, protein nanotechnology and photovoltaic/solar cells. Despite their different scientific backgrounds, all speakers had something in common: They were all connected to the IDK, be it as IDK supervisors (Prof. Thomas Bein, Prof. Lukas Schmidt-Mende, Prof. Philip Tinnefeld), as IDK alumni (Prof. Tim Liedl, Dr. Hanna Engelke) or as a member of the selection committee (Prof. Dietmar Martin). In addition, IDK members Stephan Heucke, Kamila Klamecka and Ida Pavlichenko gave interesting insights into their work. The poster session in the afternoon provided further opportunities for scientific discussions.

Figure 12 Discussions during the poster session.

On the second day, the participants divided into three groups for soft-skills workshops on "How to deal with difficult situations" and "Working in teams". The day finished with a remarkable and often very amusing intercultural workshop in which international IDK members presented special topics about their home countries Poland, Iran, Canada, Russia, Kosovo, Ukraine, Taiwan or Bavaria.

The last day of the symposium was dedicated to a workshop: "Ethics: dilemmas faced in science and technology". This part of the symposium was organized in collaboration with members of the Bioethics Research Training Group from the University of Tübingen. The introductory talks provided a solid basis for the intense discussions during the three breakout sessions. The symposium finished with a session on "The Future of the IDK – what should be preserved?" with IDK members, IDK management and the IDK spokesman. All participants agreed that, in addition to the interdisciplinary scientific exchange within the IDK, numerous structural achievements of the program should be continued.

Figure 13 Participants of the Intercultural workshop.

Social Events

The IDK members regularly gathered for social activities such as biking and hiking trips. A popular annual event was meeting at the Christkindlmarkt for a Glühwein. Fun places like Nockherberg and Oktoberfest were also frequented by groups of IDK students.

Figure 14–15 IDK members at the Oktoberfest and during a hiking trip.

IDK – The Next Generation

During the two IDK funding periods, more and more PhD students decided to have a baby at the beginning of their academic career. In the last three years, the IDK-NBT has celebrated the birth of nine babies. At the IDK-NBT-Elternstammtisch, organized by program manager Marilena Pinto, young IDK mothers met with IDK members at the end of their pregnancies and discussed issues related to parenthood and work-life balance.

Childcare is a very important issue for all working parents, as it is tough to find a place for your child in Munich. The chance of getting a place in a municipal day nursery is very low, and private day nurseries can cost up to 800–1200€. Therefore, PhD students who also are members of the NIM Excellence Cluster profit greatly from NIM's financial support. Luckily, all of the children are now in day nurseries. Those who have grandparents living nearby profit from that to a great extent, especially as a valuable fall back option in case of illness etc.

All of the PhD students present at the Elternstammtisch went back to work after 8–10 months. An important criterion for a successful return to the PhD is the support of the scientific advisor. Parents need to have the possibility to re-organize themselves and their time in order to work effectively. As a positive example, the PhD students mentioned flexible working hours they were granted by their supervisors. In addition, they also received other kinds of support, e.g., the purchase of a playpen in case the child has to be taken along to work.

All PhD students were glad to be back at work. As much as they enjoyed the intense time with their children at home, they appreciated their successful return to their PhD. At the beginning it might be

Figure 16 IDK member Katja Falter with Antonia, Frauke Mickler, Julia Blechinger with David, Judith Megerle with Julius, Uta Wienken, IDK program manager Marilena Pinto and IDK member Melari Davies (from left to right).

hard adjust to being back at work, especially when you start working for just one or two days per week. On the other hand, the young mothers as well as their supervisors reported that they now work more effectively. The most attractive scenario for the IDK mothers would be flexible hours for both parents, either full- or part-time. Ideally, both partners should share responsibilities by both working 75% of full-time hours.

The IDK juniors are the best evidence that IDK members felt comfortable and protected in the doctorate program and in their chairs and therefore felt it was worth taking on the challenge of having a baby during their PhD. The IDK shares Judith's happiness with Julius and Jana, Gerke's with Tjaard, Jonas's with Tamo, Uta's with Paula, Katja's with Antonia, Julia's and Ondrej's with David, Martin's with Lotte, Frauke's with Lasse and Melari's with John Luca and wishes the present and the next generation of the IDK all the best for the future.

Figure 17 IDK juniors 2012.

The IDK Student Representatives

From 2008 onwards, student representatives were elected annually by all IDK members. The student representatives played a central role in the success of the IDK. They planned and organized the summer schools and other activities like workshops or the final symposium. They also formed a constant link between IDK members and IDK management. The IDK Spokesman, IDK Program Manager and the CeNS Managing Director express their sincere gratitude to the IDK Student Representatives. Without their unfailing enthusiasm and dedication the success of the program would never have been possible.

Figure 18 Sebastian Geiger, Julia Schmitz and Judith Megerle were the first IDK student representatives in 2008 and organized the first summer school in Aiterbach and a workshop together with the Master program "Macromolecular Systems for Nanoscience ".

Figure 19 Julia Blechinger and Philip Severin (IDK student representatives 2010). Both of them successfully organized the summer school 2010 and coordinated two very fruitful events together with the IDK "Textualität in der Vormoderne".

Figure 20 Ingo Stein, Ilka Kriegel and Christof Mast (IDK student representatives 2011). They were the organizing committee for the very productive workshop "Energy and Innovation" as well as for the summer school 2011.

Figure 21 Kamila Klamecka, Marcus Otten and Sushi Madhira (student representatives 2012). They played a big part in organizing the program for the IDK Final Symposium, especially the Intercultural Workshop and the workshop on "Ethics & Science".

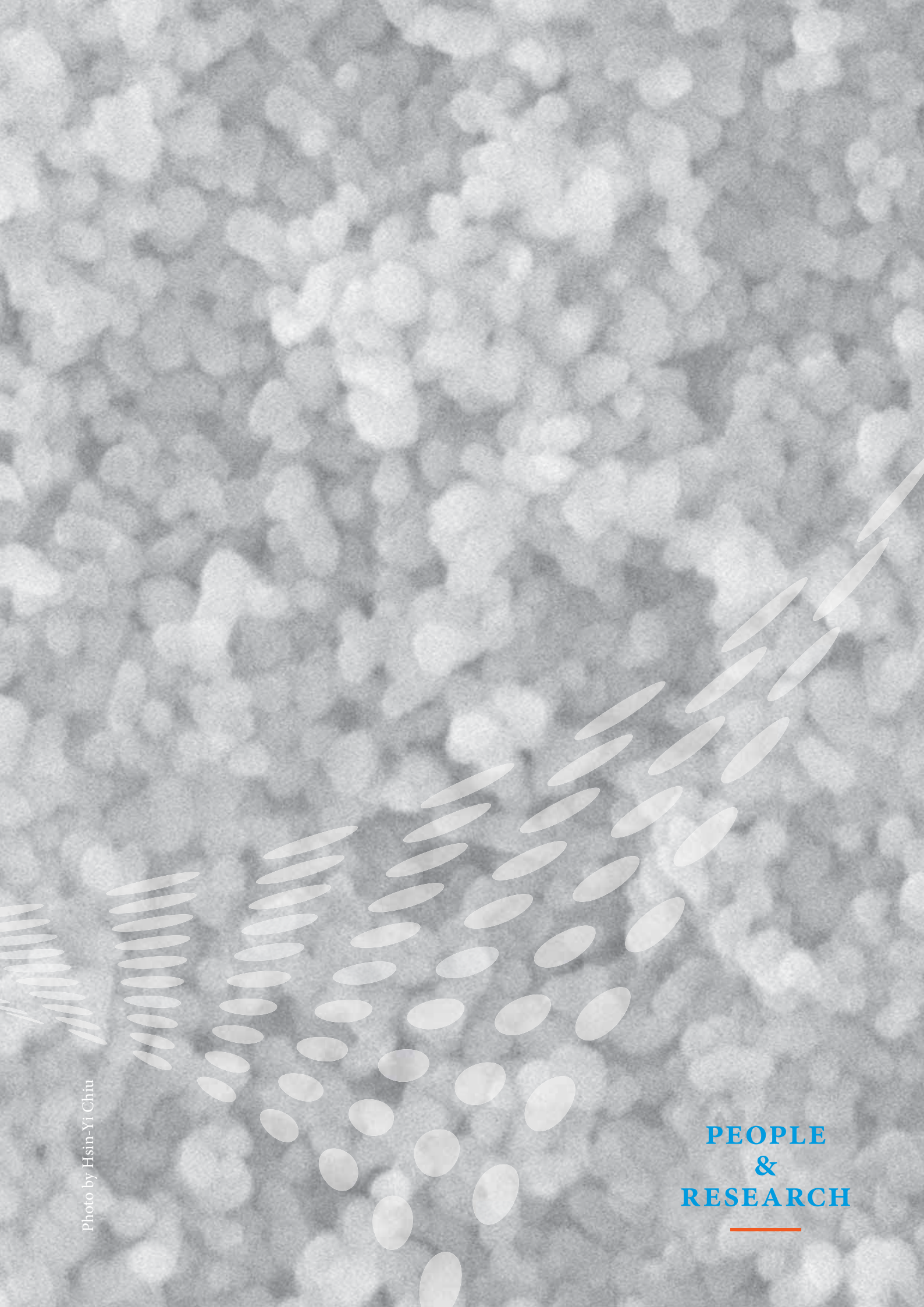


Photo by Hsin-Yi Chiu

PEOPLE & RESEARCH

PEOPLE & RESEARCH

IDK members worked on a wide range of cutting-edge topics within the field of nano(bio)sciences. This diversity paved the way for fruitful research cooperations between PhD students from different groups. Here, the PhD projects of IDK members in 2012 are presented.

A Thermal Trap for DNA Replication

Christof Mast

Hallmarks of living matter are the replication of genetic molecules and their active storage against diffusion. I implemented both in a nonequilibrium environment using an IR Laser to create a temperature gradient and pump a DNA-polymerase solution all optically. The resulting fluid flow both drives the DNA replicating PCR reaction while concurrent thermophoresis accumulates the replicated 86 base pair DNA in bulk solution. In this hydrothermal pore-like system we also explore how polymerization reactions are influenced by the length selectivity of the thermal trap.

F.M. Weinert, C.B. Mast, and D. Braun:
"Optical fluid and biomolecule transport with thermal fields"
Phys Chem Chem Phys. 13 (21): 9918–28 (2011)

C.B. Mast and D. Braun:
"Thermal Trap for DNA Replication"
Phys. Rev. Lett. 104, 188102 (2010)

C.B. Mast, N. Osterman, and D. Braun:
"Disequilibrium First: The Origin of Life"
Journal of Cosmology 10, 3305–3314 (2010)

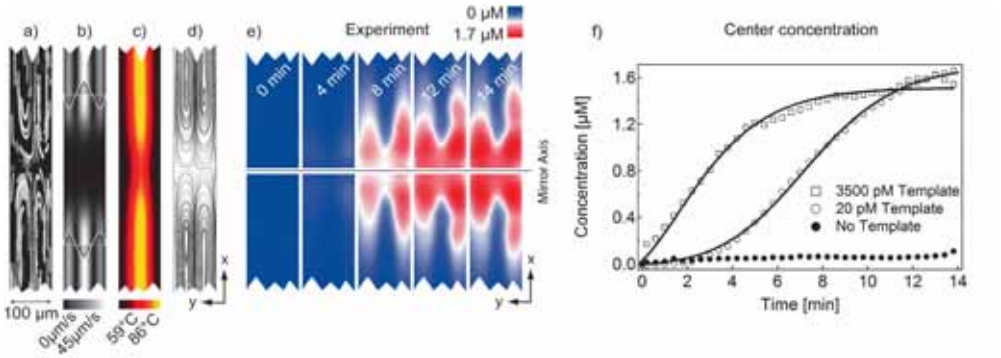


Figure 1 (a) In the chamber center, the convection flow was tracked with 1 µm particles. The chamber averaged flow speed is 45 µm/s. (b) The corresponding flow profile for the finite element simulation. (c) The temperature profile was measured by the temperature dependent fluorescence of the dye BCECF. (d) Molecular trajectories by the superposition of fluid flow and thermophoresis. (e) Accumulation of PCR product by convection and thermophoresis, visualized by SYBR Green fluorescence. (f) Center concentration over time fits with a convolution of the exponential time characteristics of the trap with the sigmoidal concentration increase of DNA by PCR. Delays of replication due to different template concentrations allows to infer the DNA replication doubling time with $\tau = 50s$.

2011	IDK Student Representative
since 2009	PhD student at LMU (Physics Department) Supervisor: Prof. Dieter Braun
2008–2009	Diploma Thesis in Prof. Dieter Braun's group (LMU)
2003–2009	Studies in Physics at LMU

Biofunctionalized Mesoporous Silica Nanoparticles for Biomolecule Delivery

Hsin-Yi Chiu

My research project aims at delivery of nanobodies into living cells by using colloidal mesoporous silica nanoparticles. Nanobodies are single-domain antibody fragments derived from the antibodies of camelid species. These single-domain antibody fragments are much smaller than normal antibodies but they process the same antigen-binding capability with the original heavy-chain antibody and are very stable. Owing to the unique structure and functional properties, nanobodies are popular in applications of therapeutic treatments, monitoring and modulating protein function in living cells, and biochemical studies. While fusing nanobodies with fluorescent proteins (so called chromobodies), we can use them as a tool for bioimaging to detect protein localization and dynamic function in living cells. However, the efficiency of delivering nanobodies directly into living cells is pretty low (only about 1~2%). Colloidal mesoporous silica (CMS) nanoparticles are a promising drug delivery carrier thanks to their large pore volume, large surface area, good stability in aqueous solution, and tunable size in the range of nano-scale. By using CMS nanoparticles as the delivery vehicle for nanobodies, we hope to enhance the efficiency of nanobodies delivery, and further develop a convenient, useful system for bioimaging applications.

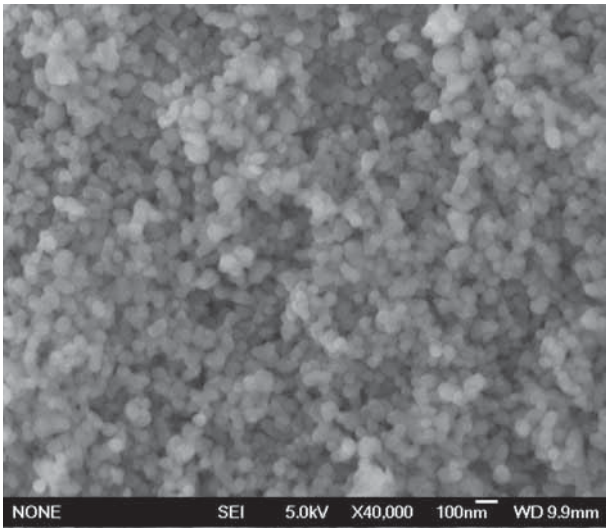


Figure 1 Scanning electron micrograph of unfunctionalized colloidal mesoporous silica nanoparticles. Average particle size is about 60 nm.

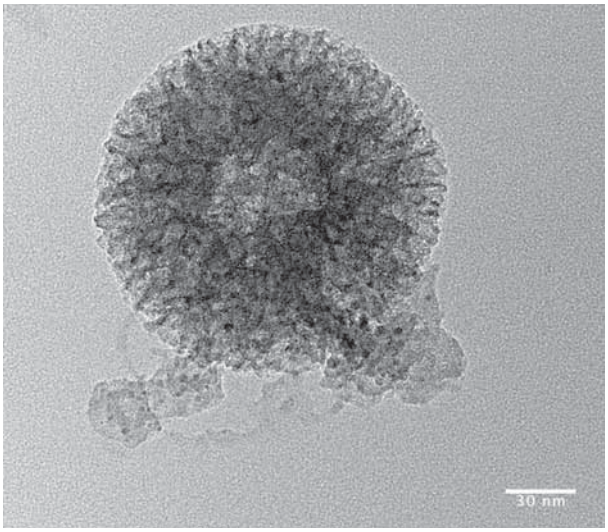


Figure 2 Transmission electron micrograph of unfunctionalized colloidal mesoporous silica nanoparticle. Mesopores can be clearly seen inside the particle.

since 2011 PhD student at LMU (Chemistry & Biology Department)
Supervisors: Prof. Thomas Bein and Prof. Heinrich Leonhardt

2009–2011 Research Assistant in Chemical Engineering, National Tsing Hua University, Hsinchu, Taiwan

2007–2009 M.Sc. Materials Science and Engineering, National Tsing Hua University, Hsinchu, Taiwan

2003–2007 B.Sc. Chemical Engineering, National Tsing Hua University, Hsinchu, Taiwan

Mechanisms of Gene Expression on a Single Molecule Level: From Nucleosome Remodeling to Transcription Initiation

Barbara Treutlein

Eukaryotic gene expression begins with transcription of genomic DNA into messenger RNA, carried out by the multi-subunit enzyme RNA polymerase II (Pol II) with the help of numerous transcription factors. Transcription initiation requires recruitment of Pol II to the promoter DNA by bound transcription factors, however accessibility to genomic DNA is hindered due to its compaction into nucleosomes. Therefore, cells have evolved a set of ATP-hydrolyzing enzymatic complexes, chromatin remodelers, that reposition nucleosomes, thereby providing regulated access to the underlying DNA.

My thesis focuses on understanding the molecular mechanisms of transcription initiation and nucleosome remodeling. Since both processes are characterized by large conformational changes and a high flexibility of nucleoprotein complexes, standard high-resolution structural methods are hindered and instead, direct visualization in real time is required as provided by single molecule techniques. In the first part of my work, I used single molecule fluorescence resonance energy transfer (smFRET) experiments, Nano-Positioning System (NPS) analysis and x-ray crystallographic information to determine the three-dimensional architecture of a minimal Pol II open promoter complex (OC) consisting of promoter DNA, TBP, Pol II and general transcription factors TFIIB and TFIIF. The results uncovered large overall structural changes during the initiation-elongation transition and an intrinsically dynamic nature of the Pol II OC.

In the second part, I applied the same experimental approach to determine the location of the three constituting domains of chromatin remodeler Chd1 in a Chd1-nucleosome complex that exhibited intrinsic dynamics. The NPS results allowed me to construct a preliminary model of the Chd1-nucleosome complex.

Furthermore, I used smFRET to follow in real time the structural dynamics of nucleosomal DNA during Chd1 catalyzed repositioning. FRET time trajectories revealed gradual and bidirectional translocation of nucleosomal DNA by Chd1 and the data allowed me to propose a model for the remodeling mechanism of Chd1, which involves formation and propagation of a DNA loop.

B. Treutlein, A. Muschielok, J. Andrecka, A. Jawhari, C. Buchen, D. Kostrewa, F. Hög, P. Cramer and J. Michaelis:
"Dynamic architecture of a minimal RNA Polymerase II open promoter complex"
Molecular Cell 46, 136–146 (2012)

B. Treutlein and J. Michaelis:
"Direct Observation of Single RNA Polymerase Processing through a Single Endogenous Gene in a Living Yeast Cell"
Angew. Chem. Int. Ed. 50, 9788–9790 (2011)

J. Andrecka, B. Treutlein, M. Izquierdo Arcusa, A. Muschielok, R. Lewis, A. Cheung, P. Cramer and J. Michaelis:
"Nano positioning system reveals the course of upstream and nontemplate DNA within the RNA polymerase II elongation complex"
Nucleic Acids Research 37, 5803–5809 (2009)

J.A. Huffman, B. Treutlein and U. Pöschl:
"Fluorescent biological aerosol particle concentrations and size distributions measured with an ultraviolet aerodynamic particle sizer (UV-APS) in Central Europe"
Atmos. Chem. Phys. Discuss. 9 (2009)

S. Schuy, B. Treutlein, A. Pietuch and A. Janshoff:
"In situ synthesis of lipopeptides as versatile receptors for the specific binding of nanoparticles and liposomes to solid supported membranes"
Small 4 (7), 970 (2008)

since 2007	PhD student at LMU (Chemistry Department) Supervisor: Prof. Jens Michaelis
2007	Diploma Thesis, Johannes-Gutenberg-Universität Mainz
2006–2007	Studies in Chemistry at the Universität Mainz
2004–2005	Research Assistant in Prof. Ronald Cohen's lab, UC Berkeley, USA
2001–2004	Studies in Chemistry, Eberhard-Karls-Universität Tübingen

Analysis and Kinetic Modeling of DNA Methyltransferases *In Vivo*

Brendan Osberg

We consider nucleosomes and transcription factors as one-dimensional particles along the longitudinal axis of the DNA molecule and analyze both the equilibrium distribution of these particles, as well as dynamic processes of the same.

Equilibrium distributions elucidate features of chromatin structure and binding mechanics, allowing one to infer characteristics of gene organization. For example, 5 qualitatively distinct groups of genes within a species of yeast have shown distinct specific binding preferences, and we propose well-positioned proteins as a vehicle for distinct physiological behaviour. We also address a more fundamental physical question to regarding potential landscapes for one-dimensional fluids from the distributions (a well-known 'inverse problem').

Recent experimental data has also emerged showing time-evolving behaviour of the genome with reduced histone densities. We use this data to validate our dynamic models, with implications on time-correlated cooperation of transcription factors, and 'filling rates' of the cell genome within the cell-cycle – an application of the one-dimensional 'car parking' problem.

The manner in which these genes dynamically coordinate the positioning of their histones and transcription factors has implications on DNA compaction as well as the control of gene expression.

K. Brewer, B. Osberg, S. Beyea, R. D'Arcy, G. Stroink:
"Is 4.0 Tesla MRI Advantageous for Current Source Localization of Weak Magnetic Fields?"
ICS 1300 (Biomagnetism) (2007)

B. Osberg:
"For your first born child: an ethical defence of the exploitation argument against commercial surrogacy."
Penn Journal of Bioethics (2006)

since 2009	PhD student at LMU (Physics Department) Supervisor: Prof. Ulrich Gerland
2007–2009	M.Sc. University of Waterloo, Canada
2001–2007	B.Sc. Honours Physics, Dalhousie University, Canada

Enzymes at Soft Interfaces

Bernhard Fichtl

Catalysis is a dominant topic in both basic research and industry. Over 40 Nobel Prizes, more than in any other field, have been awarded on the topic. Biological catalysts, enzymes, are the key players in biochemistry and essential to maintaining the energy household of the cell. While methods to study enzymes in action are very evolved, the control of these reaction by physical means is poorly understood. At least one important reason originates from the fact that biological systems are, to a large extent, two-dimensional assemblies with most enzymes confined at soft interfaces (e.g. lipid-membranes). Standard 3D methods can therefore not efficiently access the enzymes' environment.

In my project I am striving to develop novel tools of microscopic scale which enable understanding and control of enzyme catalysis at man-made interfaces. The first step will be the investigation of catalytic reactions under native conditions. By mechanical, thermal and electrical manipulation I am going to identify the optimum reaction conditions. Afterwards the enzymes will be transferred on a piezoelectric chip, which allows the generation of surface acoustic waves. These waves induce lateral density patterns in the enzymes environment and thus facilitate the physical manipulation of the catalytic rate.

since 2011	PhD student at University of Augsburg (Physics Department) Supervisors: Prof. Achim Wixforth (Augsburg) & Prof. Matthias Schneider (Boston)
2011	Temporary Consultant at Siemens Management Consulting
2011	Diploma thesis in Prof. Achim Wixforth's group, University of Augsburg
2009	Studies in Physics at the Université Bordeaux, France
2005–2011	Studies in Physics at the University of Augsburg

Live Cell Analysis with the Molecular Force Assay

Uta Wienken (née Steinbach)

Surface receptors and their interactions are in focus of biomedical research as they play a fundamental role in signal transduction and are involved in cancer development and progression.

In my PhD thesis I apply the Molecular Force Assay (MFA) on living cells to investigate the binding properties of such receptors in their physiological environment. The method relies on the well-established principle of the molecular force assay (MFA) that was so far only applied on molecules immobilized on surfaces. It is an ensemble measurement that analyzes binding forces of receptor-ligand interactions on a single molecule level by directly comparing the binding force of interest to a known reference interaction. Reference and probe are clamped in series between two surfaces. When separating the surfaces, the molecular complex with the weaker bond is more likely to rupture. A fluorescent label at the reference complex indicates the outcome of the experiment. This highly parallel method ensures to measure specific binding of a cell surface receptor to its ligand by exertion of a certain reference force that exceeds the strength of unspecific interactions. Thus, the introduced assay is a promising method that is not only capable of screening for various receptors on the membrane of a certain cell line in one experiment but also information about the mechanical properties of those interactions.

D. Ho, J.L. Zimmermann, F.A. Dehmelt, U. Steinbach, M. Erdmann, P. Severin, K. Falter, and H.E. Gaub:
"Force-driven separation of short double stranded DNA"
Biophysical Journal 97, 3158–3167 (2009)

J. Morfill, J. Neumann, K. Blank, U. Steinbach, E.M. Puchner, K.E. Gottschalk, and H.E. Gaub:
"Force-based analysis of multidimensional energy landscapes: application of dynamic force spectroscopy and steered molecular dynamics simulations to an antibody fragment-peptide complex"
J Mol Biol 381 (5), 1253–1266 (2008)

since 2009 PhD student at LMU (Physics Department)
Supervisor: Prof. Hermann Gaub

2008–2009 Diploma Thesis in Prof. Hermann Gaub's group (LMU)

2003–2009 Studies in Physics at LMU

The Influence of Fluctuations on Pattern Formation in Biological Systems

Ben Klünder

My PhD thesis focuses on the molecular mechanisms of developmental processes in microscopic biological systems. In my recent project we aim to identify the fundamental mechanisms of cell polarization which allow cells to define a unique symmetry axis for cellular processes such as cell division. To this end, we consider yeast as one of the best studied model systems in biology and study how changes of molecular details affect the properties of cell polarity. The project takes place together with the group of Roland Wedlich-Söldner from the MPI of Biochemistry in Martinsried and allows us to compare our model predictions with experiments.

B. Klünder and A. Pelster:
"Systematic semiclassical expansion for harmonically trapped ideal Bose gases"
Eur. Phys. J. B 68, 457–465 (2009)

B. Klünder, A. Pelster, and R. Graham:
"Critical Temperature of Dirty Bosons"
Proceedings of the 9th International Conference: Path Integrals – New Trends and Perspectives, World Scientific, 421 (2008)

since 2008 PhD student at LMU (Physics Department)
Supervisor: Prof. Erwin Frey

2005–2006 Studies in Physics at Loughborough University, UK

2002–2007 Diploma in Physics at Universität Duisburg-Essen

Possible Effects of Low-Dose Ionising Radiation to Nucleus Carrying Cells in Blood

Agata Michna

Today, the demand for faster, more cost-effective and more sensitive analysis methods particularly in the area of DNA and protein analysis is more palpable than ever before. In this case innovative and advanced technologies providing reliable information are highly required. An example of such sophisticated technologies are miniaturized laboratory analysis systems also known as "lab-on-a-chip" systems (LOC). Such microsystems, and in particular those based on microfluidic devices, enable new ways to direct experimentation towards biological and medical research. LOC systems enable performing reliable, accurate and reproducible analysis even if applied to very small amount of relevant sample material. Application of those systems gains increasing importance in clinical research, e.g. in radiobiology. The research purpose of my PhD project is to develop an assay to understand alterations of the microenvironment of cellular systems after low dose irradiation by using multifunctional lab-on-a-chip device for time-resolved multiparameter analysis.

since 2011	PhD student at Helmholtz Zentrum and Universität Augsburg Supervisors: PD Dr. Stephan Thalhammer (Helmholtz Zentrum München) and Prof. Achim Wixforth (Univ. Augsburg)
2006–2011	M.Sc. Automatic Control & Robotics, Politechnika Śląska, Gliwice, Poland
2009–2010	M.Sc. Biotechnology, Silesian University of Technology, Gliwice, Poland
2005–2009	B.Sc. Biotechnology, Silesian University of Technology, Gliwice, Poland

Long Term Observation of Cells in Micro-Structures

Farzad Sekhavati

In this project, we are developing a microstructured platform to trap non-adherent cells in a small volume. The microstructure is made of PEG-DA or PDMS which are proven to be non-toxic to the cells. The device geometry and surface properties are optimized for long-term observation of stem-cell development and differentiation. We concluded that micro-trenches with width of 15–20 µm and length of 80 µm are suitable for the observation up to two generations.

The model cell line is MEL (Mouse erythroleukemia) cells with some similar physical properties to stem-cells. Phase-contrast microscopy and fluorescent microscopy are used as two imaging techniques for long-term observation. In the project we expect to observe the differentiation of stem-cell after second generation and be able to track down the mother cell. The parallel observation in large quantity of single cell compartment enables us to get statistically relevant data to be able to describe the stochastic phenomenon of stem-cell differentiation. Next step would be to continue the experiment for several more generations and build the differentiation tree of each stem-cell.

J. Männik, F. Sekhavati, J.E. Keymer and C. Dekker:
"Bacteria in submicron channels and microvalves"
Proc 14th International Conference on Miniaturized Systems for Chemistry and Life Sciences Groningen, 3–7 October 2010, 1376–1378 (2010)

since 2011	PhD student at LMU (Physics Department) Supervisor: Prof. Joachim Rädler
2010–2011	PhD student at LMU (Geosciences Department)
2009–2010	M.Sc. Erasmus Mundus Nanoscience and Nanotechnology, Delft University of Tech. (TUD), Delft, The Netherlands
2008–2009	M.Sc. Erasmus Mundus Nanoscience and Nanotechnology, Chalmers University of Tech. (CTH), Gothenburg, Sweden
2005–2008	Double Major in Physics, Amirkabir Uni. of Tech., Tehran, Iran
2003–2008	B.Sc. Mech. Eng. Amirkabir Uni. of Tech. (AUT), Tehran, Iran

Optical Properties of Copper Chalcogenide Nanocrystals for Photovoltaic Application

Ilka Kriegel

In recent years semiconductor nanocrystals turned out to be promising building blocks for photovoltaic applications. Their high absorption cross-section enables efficient light harvesting and makes them interesting for application in solution processable solar cells. For low cost solar cell devices it is of interest to investigate new classes of materials besides the strongly investigated nanocrystals CdSe and CdTe. Copper based chalcogenides, such as $Cu_{2-x}S$, $Cu_{2-x}Se$, and $Cu_{2-x}Te$, appear to hold potential for such technologies because of the large abundance of the elements. Indeed, it has already been shown that Cu_2S/CdS nanocrystal solar cells reach efficiencies of 1.6%. My work comprises the investigation of the optical properties of copper chalcogenide nanocrystals with respect to their applicability in photovoltaic.

I. Kriegel, C.Y. Jiang, J. Rodriguez-Fernandez, R.D. Schaller, D.V. Talapin, E. da Como, J. Feldmann:
"Tuning the Excitonic and Plasmonic Properties of Copper Chalcogenide Nanocrystals"
J of the Am. Ch. Soc. 134 (3), 1583–1590 (2012)

I. Kriegel, J. Rodríguez-Fernández, E. Da Como, A.A. Lutich, J.M. Szeifert, and J. Feldmann:
"Tuning the Light Absorption of Cu1.97S Nanocrystals in Supercrystal Structures"
Chem. of Mat. 23, 1830–1834 (2011)

M. Hallermann, I. Kriegel, E. Da Como, J.M. Berger, E. von Hauff, J. Feldmann:
"Charge transfer excitons in polymer/fullerene blends: the role of morphology and chain conformation"
Adv. Funct. Mater. 19, 3662–3668 (2009)

2011	IDK Student Representative
since 2009	PhD student at LMU (Physics Department) Supervisor: Dr. Enrico Da Como
2007–2009	M.Sc. in Advanced Materials Sciences (joint international Elite Graduate Program offered by TUM, University of Augsburg and LMU
2004–2007	B.Sc. in Molecular Science, Friedrich-Alexander-Universität, Erlangen/Nürnberg

Cellular Interactions of Artificial Gene Vectors studied by Highly-Sensitive Fluorescence Microscopy

Frauke Mickler (née König)

Gene therapy is a promising approach to treat or cure diseases on a molecular level by the specific insertion of genes into individual cells of the human body. This insertion can be achieved by viral or non-viral, synthetic gene vectors. In order to optimize the efficiency and safety of these gene vectors for future clinical application a detailed understanding of their uptake mechanism into the cell and their intracellular trafficking is essential.

In my PhD project I study the cellular internalization of non-viral gene vectors by live-cell imaging with highly sensitive fluorescence microscopy. With the help of this powerful technique the fate of single nanoparticles can be followed in real time, from the first contact with the cell surface, to the trafficking inside the cell and finally the delivery of the DNA to the cell nucleus. Thereby detailed information about the impact of the particle composition on the uptake kinetics as well as the main barriers for efficient gene delivery can be gained. In particular the effect of different tumor specific targeting ligands will be analyzed in my PhD project in order to improve the selective gene therapy of cancer cells in the human body without severe side effects. The experiments are done in collaboration with the groups of Professor Ernst Wagner and PD Dr. Manfred Ogris (Pharmacy Department, LMU) and the group of Professor Kazunori Kataoka (University of Tokyo, Japan).

C. Zhu, M. Zheng, F. Meng, F.M. Mickler, N. Ruthardt, X. Zhu, Z. Zhong:
"Reversibly shielded DNA polyplexes based on bioreducible PDMAEMA-SS-PEG-SS-PDMAEMA triblock copolymers mediate markedly enhanced nonviral gene transfection"
Biomacromolecules 13 (3), 769–78 (2012)

F.M. Mickler, L. Möckl, N. Ruthardt, M. Ogris, E. Wagner and C. Bräuchle:
"Tuning Nanoparticle Uptake: Live-Cell Imaging Reveals Two Distinct Endocytosis Mechanisms Mediated by Natural and Artificial EGFR Targeting Ligand"
Nano Lett. 12 (7), 3417–3423 (2012)

F.M. Mickler, Y. Vachutinsky, M. Oba, K. Miyata, N. Nishiyama, K. Kataoka, C. Brauchle, and N. Ruthardt:
"Effect of integrin targeting and PEG shielding on polyplex micelle internalization studied by live-cell imaging"
J. of Contr. Release 156 (3), 364–373 (2011)

(under her maiden name Frauke König:)
H. Dietz, T. Bornschlögl, R. Heym, F. König, and M. Rief:
"Programming protein self-assembly with coiled coils"
New J Phys 9, 424 (2007)

since 2009	PhD student at LMU (Chemistry Department) Supervisor: Prof. Christoph Bräuchle
2008	M.Sc. Thesis in Prof. Matthias Rief's group (TUM)
2007	Internship at the University of British Columbia, Vancouver, Canada
2006	B.Sc. Thesis at the Institute of Virology (TUM)
2003–2008	Study of Biochemistry at the TUM

Origin of Noise and Alignment in Driven Particle Systems

Christoph Weber

The collective motion of animal groups like flocks of birds, schools of fish or herds of wildebeests are fascinating spectacles in nature. One reason might be the emergence of dynamic patterns that often extend over length scales much larger than the size of the individuals. From a theoretical point of view, dense individuals driven by an intrinsic force belong to a broad class of systems, known active fluids. Depending of the system considered, activity could be of various origins. On the micrometer scale exemplary systems that belong to the class of active fluids are self-propelled (swimming) bacteria, bio-filaments driven by molecular motors, or vibrated granules. Interestingly, all active systems share certain properties: they all are far from equilibrium, and show coherent motion accompanied by patterns on large length scales. From a theoretical point of view, the following question concerning active fluid systems naturally arises: Which physical principle selects which pattern, and why?

Throughout my PhD I concentrate mostly on two systems: the high density motility assay, where actin filaments move across a 2d lawn of molecular motors, and round granules that move due to collisions with a vibrating substrate. Interestingly, at sufficiently high densities both systems give rise to collective patterns such as waves or swirls. We aim to understand what determines the system's ordering capabilities, the alignment between the constituents, and where the noise in the system comes from. In order to answer these questions, we use numerical approaches and borrow concepts from non-linear dynamics and pattern formation, as well as kinetic theory.

V. Schaller, C. Weber, B. Hammerich, E. Frey, A.R. Bausch:
"Frozen steady states in active systems"
PNAS 108, 19183–19188 (2011)

B. Meier, A. Zielinski, C. Weber, D. Arcizet, S. Youssef, T. Franosch, J.O. Rädler, D. Heinrich:
"Chemical cell trapping in controlled alternating gradient fields"
PNAS 108, 11417–11422 (2011)

V. Schaller, C. Weber, E. Frey, A.R. Bausch:
"Polar Pattern Formation: Hydrodynamic coupling of driven filaments"
Soft Matter 7 (7), 3213–3218 (2011)

V. Schaller, C. Weber, C. Semmrich, E. Frey, A.R. Bausch:
"Polar patterns of driven filaments"
Nature 467, 73–77 (2010)

since 2009	PhD student at LMU (Physics Department) Supervisor: Prof. Erwin Frey
2007–2008	Diploma Thesis in the group of Prof. Erwin Frey
2003–2008	Diploma in Physics, LMU

Using Variational Matrix Product State to Study Quantum Impurity System

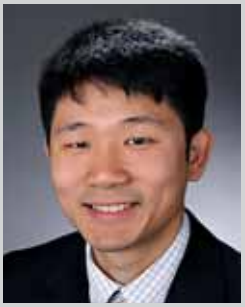
Cheng Guo

My PhD project is to use DMRG, which is an accurate and versatile numerical method in computational condensed matter physics, to study the dynamics of dissipative quantum systems. A Dissipative system is a system coupled to an environment which exchanges energy and matter with it. Classical examples are cyclones and life. Quantum effects become important at the nanoscale and sometimes play the key role. Those dissipative system governed by quantum mechanics are called dissipative quantum systems. A very good theoretical understanding of them is not only very important in quantum theory but also will help experimentalists and engineers to devise future nanoscale and quantum based applications.

C. Guo, A. Weichselbaum, J. von Delft, M. Vojta:
"Critical and Strong-Coupling Phases in One- and Two-Bath Spin-Boson Models"
Phys. Rev. Lett. 108, 160401 (2012)

C. Guo, A. Weichselbaum, S. Kehrein, T. Xiang, J. v. Delft:
"Density matrix renormalization group study of a quantum impurity model with Landau-Zener time-dependent Hamiltonian"
Phys. Rev. B 79, 115137 (2009)

C. Guo:
"Thermodynamic Analysis of Solar Sails"
College Physics 24, 62 (2005)



since 2008 PhD student at LMU (Physics Department)
Supervisor: Prof. Jan von Delft

2004–2008 M.Sc. at the Institute of Theoretical Physics, Chinese Academy of Sciences (ITP, CAS), Beijing, China

2000–2004 B.Sc. at Nanjing University of Information Science and Technology, China

Role of DNA Conformation in Gene Regulation

Leila Esmaeili Sereshki

Essentially all the biological functions of DNA rely on site-specific DNA-binding proteins finding their targets (cognate sites), and therefore searching through mega bases of non-target DNA in a very efficient manner. The most prominent example is the process of gene regulation, during which a particular binding protein needs to find its specific binding sequence on the DNA. We analyze the polymeric conformations of DNA molecules under topological constraints, such as looped DNA or DNA-knots. These polymeric degrees of freedom of a DNA chain also influence the search of DNA binding proteins for their specific binding site on the DNA, a prerequisite to genetic regulation. We are interested in generic aspects of search strategies, in particular, the effect of scale-free search mechanisms. These provide searching agents with a means to escape the central limit theorem and avoid oversampling, which is the major shortcoming of Brownian search strategies in one and two dimensions. Our studies on search go hand in hand with the investigation of anomalous stochastic processes such as Lévy flights and subdiffusion.

M. Neek-Amal, G. Tayebirad, M. Molayem, M.E. Foulaadvand, L. Esmaeili Sereshki, A. Namiranian:
"Ground state study of simple atoms within a nanoscale box"
Solid State Communications 145, 594 (2008)

2008–2012 Doctoral Thesis at TUM (Physics Department)
Supervisor: Prof. Ralf Metzler

2005–2007 M.Sc. Condensed Matter Physics, Shahid Beheshti University
Tehran, Iran

2000–2004 B.Sc. Theoretical Solid State Physics, Alzahra University
Tehran, Iran

Dynamics of Nucleosomal Arrays -Single Molecule Studies and Super Resolution Optical Microscopy

Katarzyna Krzemien

Examination of the structure and dynamics of nucleosome arrays is the focus of my PhD thesis. The complete information about living organisms is contained in DNA. The DNA storage mechanism has to fulfil two opposing functions: a high compaction of DNA and fast access to the genomic information. DNA storage in eukaryotic cells exhibits several levels of compaction and one important structural feature is the so called chromatin fibre. In vitro, different structures of chromatin fibres, depending on the nucleosome repeat length, the presence of linker histones and the ion concentration in the fibre environment, were proposed but none of them is unambiguous. Dynamic changes between low and highly condensed chromatin are still an open question.

My project will focus on the protein engineering and establishment of novel protein-labelling strategies for STORM and STED measurements and single molecule FRET measurements. My first approach will be to label each histone octamer in the chromatin fibre to use it for both STORM and STED measurements. Using STORM microscopy will hopefully let me see the structure of the fibre with high resolution (up to 20 nm). To observe dynamic changes in fibre conformation (due to changing salt conditions or remodeler activity) I will also use STED microscopy. Finally, I am planning to use single molecular FRET measurements to have a close look at single beads in chromatin, their positions and movements. This approach requires site-specific labelling, since chromatin fibres have a complex and repetitive structure, introduction of labels at specific positions within will be difficult, nevertheless not impossible.

I believe that the unique combination of single molecule FRET with super resolution microscopy will enable me to not only directly observe chromatin structure, but also to look at the dynamic changes. This innovative approach will clearly show me the details of the chromatin structure, removing the existing uncertainties in the field of DNA compaction and will help to better understand the control of basic DNA processes like transcription, replication, recombination and repair of the genome.

since 2011 PhD student at LMU (Chemistry Department)
Supervisor: Prof. Jens Michaelis

2010 ERASMUS Internship, Prof. Jens Michaelis (LMU)

2009–2010 M.Sc. Industrial Biotechnology, Silesian University
of Technology, Gliwice, Poland

2009–2010 Master Thesis Maria Skłodowska-Curie Memorial Institute,
Gliwice, Poland

2005–2009 B.Sc. in Industrial Biotechnology, Silesian University
of Technology, Gliwice, Poland

Binding and Conformational Changes of Von Willebrand Factor under Shear

Svenja Lippok

VWF is a polymeric protein that is essential for blood coagulation. It can be found as multimers with variable numbers of dimeric subunits showing size-dependent functionality. Protease ADAMTS13 which regulates the shape of the VWF size distribution is a key-regulator of VWF function.

We measure the size distribution of recombinant EGFP-VWF immediately after synthesis as well as during its post-processing in the blood vessel. The polymerization process and the kinetics of ADAMTS13 cleavage are analyzed and the functionality of ADAMTS13 in blood plasma of both healthy people and patients with a VWF related-disease are monitored using fluorescence correlation spectroscopy (FCS).

FCS is based on a confocal fluorescence setup and can be used to analyse the dynamics of macromolecules by detecting the intensity time trace of fluorescent molecules diffusing in and out of the small optical confocal volume. It allows for measuring hydrodynamical radii and particle concentrations in buffer as well as in more complex media like blood plasma.

In blood vessels, increased shear rates are observed close to ruptured vessel walls. As a consequence VWF polymers are stretched and thereby activated. These conformational changes generated by shear flow are the second important regulation mechanism of VWF function.

We intend to develop a closed microliter shear cell combining a SAW chip with a microfluidic device and build up a two-focus FCS both to measure the degree of uncoiling of large multimers and to relate shear-induced changes to VWF functionality such as binding events.

S. Lippok, S.A.I. Seidel, S. Duhr, K. Uhland, H.-P. Holthoff, D. Jenne, and D. Braun:
"Direct Detection of Antibody Concentration and Affinity in Human Serum Using Microscale Thermophoresis"
Anal. Chem. 84, 3523–3530 (2012)

H. Engelke, S. Lippok, I. Dorn, R.R. Netz, and J.O. Rädler:
"FVIII Binding to PS Membranes Differs in the Activated and Non-Activated Form and Can Be Shielded by Annexin A5"
J. Phys. Chem. B 115 (44), 12963–12970 (2011)

since 2010	PhD student at LMU (Physics Department), Supervisor: Prof. Joachim Rädler
2009–2010	Diploma Thesis in the group of Prof. Dieter Braun, LMU
2006–2010	Diploma in Physics, LMU
2007–2008	Erasmus scholarship, Universidad de Sevilla, Spain
2004–2006	Studies in Physics, TUM

Analysis and Kinetic Modeling of DNA Methyltransferases *In Vivo*

Katrin Schneider

Maintaining the DNA methylation pattern over many cell divisions is crucial for proper cell function in mammals. Misregulation of this process is involved in cancer formation. The key protein in this process is the maintenance DNA methyltransferase 1 (Dnmt1), an essential epigenetic factor that reestablishes methylation of hemimethylated CpG sites generated during DNA replication in S phase.

Central goal of my PhD project is to elucidate the cell cycle dependent regulatory interactions modulating the function of Dnmt1 and associated factors and investigate how they act together in vivo in a mechanistic network. I will address this with complementing cutting-edge bioimaging techniques, including 3D super-resolution microscopy and fluorescence recovery after photobleaching (FRAP) in combination with novel kinetic modeling approaches. For the latter purpose I aim to develop integrated acquisition and evaluation tools for systematic higher-throughput analyses of such interaction networks.

C. Bönisch, K. Schneider, S. Pünzeler, S.M. Wiedemann, C. Bielmeier, M. Bocola, H.C. Eberl, W. Kuegel, J. Neumann, E. Kremmer, H. Leonhardt, M. Mann, J. Michaelis, L. Schermelleh, S.B. Hake:
"H2A.Z.2.2 is an alternatively spliced histone H2A.Z variant that causes severe nucleosome destabilization"
Nucleic Acids Research doi: 10.1093/nar/gks26 (2012)

M.C. Cardoso, K. Schneider, R.M. Martin, H. Leonhardt:
"Structure, function and dynamics of nuclear subcompartments"
Curr Opin Cell Biol 24, 79–85 (2012)

T. Lebold, A. Schlossbauer, K. Schneider, L. Schermelleh, H. Leonhardt, T. Bein, C. Bräuchle:
"Controlling The Mobility Of Oligonucleotides In The Nanochannels Of Mesoporous Silica"
Advanced Functional Materials 22, 106–112 (2012)

G. Pichler, P. Wolf, C.S. Schmidt, D. Meilinger, K. Schneider, C. Frauer, K. Fellinger, A. Rottach, H. Leonhardt:
"Cooperative DNA and histone binding by Uhrf2 links the two major repressive epigenetic pathways"
J Cell Biochem 112, 2585–93 (2011)

since 2010	PhD student at LMU (Biology Department) Supervisor: Prof. Heinrich Leonhardt
2008–2009	Diploma Thesis in Prof. Heinrich Leonhardt's group (LMU)
2004–2009	Biology studies at LMU

Mechanical Properties of DNA Nanostructures

Daniel Schiffels

We are interested in designing functional DNA devices using the DNA origami method, which will present a powerful new approach to the development of tools for cellular and molecular biological studies. In particular, we study the mechanical properties of various kinds of DNA nanotubes, including how their stiffness is affected by adding external helices or changing circumference. The persistence length of these structures can be engineered to be anywhere between only a few hundred nanometers up to hundreds of micrometers. We use stiff DNA nanotubes to align thousands of fluorophores in a linear fashion to measure fluorescence anisotropy. From the anisotropy, we can distinguish different DNA-fluorophore binding modes: intercalator, groove-binder or loose attachment.

T. Wang, D. Schiffels, S. Martinez Cuesta, D. Kuchnir Fygenson, N.C. Seeman:
"Design and Characterization of 1D Nanotubes and 2D Periodic Arrays Self-Assembled from DNA Multi-Helix Bundles"
JACS, 134 (3), 1606–1616 (2012)

R. Schreiber, S. Kempter, S. Holler, V. Schüller, D. Schiffels, S.S. Simmel, P.C. Nickels, T. Liedl:
"DNA Origami-Templated Growth of Arbitrarily Shaped Metal Nanoparticles"
Small 7 (13), 1795–1799 (2011)

since 2010	PhD student at LMU (Physics Department) Supervisor: Prof. Tim Liedl
2009–2010	Diploma Thesis, University of California Santa Barbara, USA
2006–2007	Erasmus year, Universidad de Sevilla, Spain
2004–2010	Physics studies at LMU

Single-Molecule Multi-Color FRET Technique to Explore Protein Folding

Sushi Madhira

Biophysical processes at the cellular level are best understood when no ensemble average distorts the overall picture, but rather single molecules are investigated sequentially.

Foerster or Fluorescence resonance energy transfer (FRET) measured between a single donor fluorophore and a single acceptor fluorophore is an ideally suited technique to measure distances and dynamics at single-molecule level. Though single-pair FRET is a powerful tool to study biological molecules undergoing intra- and inter-molecular interactions, it is restricted to only one measurable distance per molecule of interest. Owing to this limitation, it cannot reveal intricate details of the global conformational changes during complex biomolecular interactions which are multi-dimensional. For large complexes, using multi-color FRET schemes helps reporting about conformational changes in separate domains of the macromolecule in real time and provides a more comprehensive picture.

In order to expand the single-molecule FRET to study complex molecular interactions, I have assembled a Four-Color Total Internal Reflection Fluorescence (TIRF) Microscope system which allows to measure distances between four fluorophores and thus gives insight into complex molecular dynamics. My research objective is to study DNA-Polymerase interactions and Dynamics of Protein Folding (Chaperones) by employing different multi-color FRET schemes and evaluation tools for systematic higher-throughput analyses of such interaction networks.

since 2012	IDK Student Representative
since 2010	PhD student at LMU (Chemistry Department) Supervisor Prof. Don Lamb
2010	Master's Project at Nanotechnology Division of Indian Oil Corporation Ltd., R&D Centre, Faridabad, India
2005–2010	M.Sc. (Hons.) Chemistry (Integrated Dual Degree) and BA of Engineering (Hons.) in Computer Science, BITS-Pilani, K.K. Birla Goa Campus, India

Highly Absorbing Solar Cells with Metallic Nanostructures

Ricky Dunbar

The efficiency of solar cells can be improved by increasing the amount of solar energy absorbed by the semiconductor layer. For organic solar cells however, it is generally preferable to use only thin layers (<100 nanometres wide) of semiconductor material. In this project, novel nanostructures are being developed for use in organic/hybrid solar cells. These structures will be designed to both increase the absorption of solar energy and to assist free charge carrier production. The light absorbing effectiveness of these nanostructures will be simulated numerically, and the optimised structures will be constructed and then characterised using the instruments here in the laboratory.

R.B. Dunbar, H.C. Hesse, D.S. Lembke, and L. Schmidt-Mende:
"Light-trapping plasmonic nanovoid arrays"
Phys. Rev. B 85 (3), 035301 (2012)

J. Weickert, R.B. Dunbar, H.C. Hesse, W. Wiedemann, and L. Schmidt-Mende:
"Nanostructured Organic and Hybrid Solar Cells"
Adv. Mater. 23 (16), 1810–1828 (2011)

Y. Jiao, C. Peng, F. Guo, Z. Bao, L. Schmidt-Mende, R.B. Dunbar, J. Yang, Y. Qin, and Z. Deng:
"Facile Synthesis and Photocatalysis of TiO2 Hollow Spheres Consisting of {116}Plane-oriented Nanocrystallites"
J. Phys. Chem. C 115, 6405–6409 (2011)

R.B. Dunbar, T. Pfadler, and L. Schmidt-Mende:
"Highly absorbing solar cells – a survey of plasmonic nanostructures"
Opt. Express 20, A177-A189 (2012)

2008–2012	Doctoral Thesis at LMU/Universität Konstanz (Physics Department) Supervisor: Prof. Lukas Schmidt-Mende
2007	Honours in Bachelor of Science, University of Adelaide, Australia
2004–2006	B.Sc. (Space Science and Astrophysics), University of Adelaide, Australia

Single-Cell Gene Expression Dynamics

Carolin Leonhardt

Non-viral gene delivery is of growing interest for gene therapy applications and basic research. My PhD project aims to quantitatively study the delivery of plasmid DNA (pDNA), messenger RNA (mRNA) and small interfering RNA (siRNA) to cells. Using time-lapse fluorescence microscopy and fluorescent reporter proteins the intensity levels of numerous cells after transfection with pDNA/mRNA/siRNA are monitored. In order to allow for high-throughput automated image analysis, micro-patterning techniques to structure cell growth substrates with islands of cell-adhesive proteins are used. Gene expression levels, the timing of expression onset/knockdown and kinetic rates are analyzed using image analysis techniques as well as kinetic rate models to gain insight into the processes underlying artificial gene-transfer. All observed parameters are quantitatively analysed at the single-cell level. This single-cell approach reveals the stochastic behaviour of cells that would be obscured in ensemble measurements.

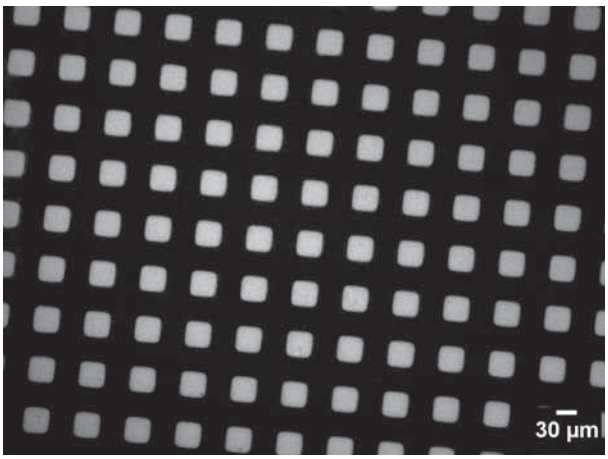


Figure 1 Micro-structured cell growth substrate. Fibronectin-coated islands promote cell adhesion and are separated by areas that are rendered cell-repellent (by coating them with PLL-g-PEG). For better visibility, flurorescently labeled fibronectin was used here.

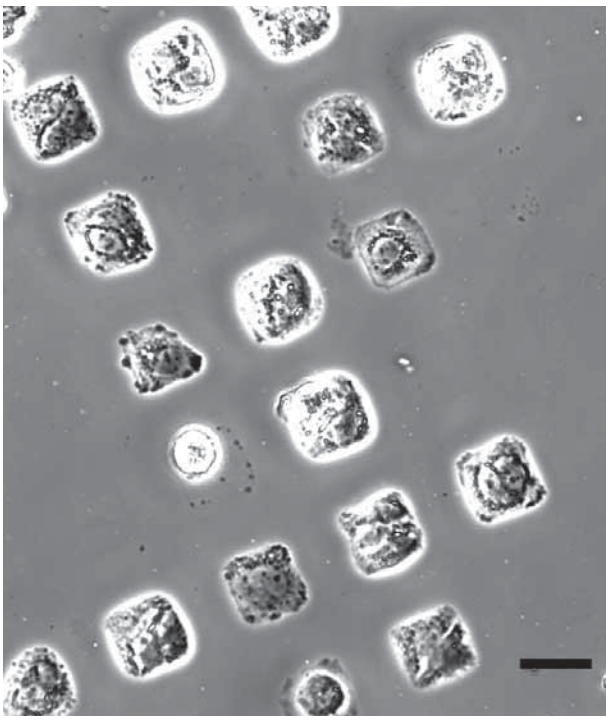


Figure 2 Epithelial cells on a micro-structured cell growth substrate. Restriction of cell growth to defined adhesive islands facilitates high-throughput, automated image-analysis. (Scale bar 35 µm)

since 2009	PhD student at LMU (Physics Department) Supervisor: Prof. Joachim Rädler
2007–2008	Diploma Thesis in Prof. Hermann Gaub's group (LMU)
2007	Diploma in Physics, Universität Heidelberg
2005–2006	Foreign Language Assistant, Lyon, France
2004–2005	Studies in Physics, University of Edinburgh, UK
2001–2004	Studies in Physics, Ruprecht-Karls-Universität Heidelberg

Integrated Sensing Platform Based on Stimuli-Responsive Photonic Crystals

Ida Pavlichenko

The goal of this project is to develop a compact, reliable, easy-to-fabricate and cheap system able to detect various physical stimuli, as well as chemical and biological analytes, to be used in a wide range of biological and biomedical sensing applications (e.g., detection of chemical, biological poisoning agents, environmental monitoring, medical diagnostics, food monitoring). The approach is based on the utilization of 1D photonic crystals (Bragg stacks), where a tunable optical filter changes its refractive properties when in contact with an analyte of interest, and the change can be detected by means of measuring the reflection or transmission of a known light source. The solution proposed here makes use of organic materials used as light emitting/absorbing layers integrated with the photonic crystals. The light emission of an embedded optical polymer is tuned by the analyte-dependent optical behavior of the filters and reabsorbed by an integrated organic photodiode. The proposed detecting system is a stand-alone sensing platform, composed of two main parts, a tunable light emitting device (TLED) and a light-detecting device. The TLED itself is composed of different parts: either Bragg stack or a tunable cavity, which provide increased sensitivity to an analyte and/or the environmental changes such as temperature, humidity, electric felds etc., and a light emitting source fabricated on a transparent substrate. In a further embodiment, a microfluidic channel could be integrated on one side of the stack, where an analyte in a fluid will again induce changes in the optical system. Additionally, the environmental change can be time and spatially resolved with a resolution of a CCD camera, thus enabling a potential application as an imaging sensor.

I. Pavlichenko, A.T. Exner, M. Guehl, P. Lugli, G. Scarpa, B.V. Lotsch:
"Humidity-Enhanced Thermally Tunable TiO2/SiO2 Bragg Stacks"
J. Phys. Chem. C 116, 298–305 (2012)

B.V. Lotsch, I. Pavlichenko:
"Colour from Structure"
The Irish Times (Atomium Culture) 2012, *El Pais*, (Sociedad, Atomium Culture) (2012)

I. Pavlichenko, A.T. Exner, P. Lugli, G. Scarpa, B.V. Lotsch:
"Tunable Thermoresponsive TiO2/SiO2 Bragg Stacks Based on Sol-Gel Fabrication Methods"
J. Intell. Mater. Struct. doi: 10.1177/1045389X12453970 (2012)

O.V. Novozhilov, I.V. Pavlichenko, N.V. Demchenko, A.I. Buzin, N.G. Vasilenko, A.M. Muzafarov:
"Multiarm Polydimethylsiloxane Stars Based on High Generation Dendrimers"
Russ Chem B+ 59 (10), 1909–1917 (2010)

since 2011	Member of Max-Planck-Institut für Festkörperforschung, Stuttgart
since 2010	PhD student at LMU (Chemistry Department) Supervisor: Prof. Bettina Lotsch
2007–2010	Diploma Thesis at the Institute of Synthetic Polymer Materials, RAS, Russia
2004–2010	Diploma in Physics, M.V. Lomonosov Moscow State University, Russia

Analysis of Protein-Nucleic Acid Interactions by Means of the Molecular Force Assay

Katja Falter

The Molecular Force Assay (MFA) is a technique to characterize receptor-ligand interactions by comparing the molecular complex in question to a known reference interaction. The two molecular bonds are linked in series between two surfaces. Retracting one of the surfaces applies a force to the molecular construct until the weaker one of the two complexes ruptures with higher probability. Since these two molecular bonds are similar in their binding strength, the MFA is very sensitive to small changes of the bond stability. Thus, the MFA can resolve a single mismatch in a 30 bp DNA duplex and characterize ligands with dissociation constants ranging from the pM to mM regime.

In my diploma thesis, I implemented aptamers, small nucleic acid sequences selected to bind their ligand with high specificity, in the MFA and analyzed the binding behavior to their ligand. The formation of the ligand-aptamer complex leads to a reorganization of the structure and to an increase of the mechanical stability compared to the reference duplex, which allows detection and determination of the dissociation constant. The multiplexing capabilities of the current assay enables the measurement of 16 different systems on one chip and makes the application of force-based aptamer sensors in diagnostics possible.

One part of my PhD project deals with the binding and cleaving behavior of the protein Dicer. Dicer binds un-specifically to double-stranded RNA molecules and cuts them into pieces of 19–22 bp of length. Since Dicer also cleaves microRNA molecules from their precursor, a process called microRNA maturation, it plays an essential role in eukaryotic cells. MicroRNAs are short, single-stranded RNA molecules (around 20 bp) that can bind to mRNAs without complete complementarity and influence protein translation. As a proof-of principle, I implemented a RNA-aptamer into the MFA and showed that I can detect and quantify Dicer activity. Adding the appropriate ligand blocks Dicer and demonstrates an interesting new approach to interfere with the microRNA pathway.

The second part of my PhD thesis is concerned with the interaction of transcription factors and different DNA sequences. The MFA allows to test one transcription factor against 20 different DNA sequences in a one-shot experiment or vary the reference sequence in order to gain quantitative information about the binding strength. The results help to increase our understanding of gene regulation.

K. Falter, H.E. Gaub:
"Quantifizierung biomolekularer Wechselwirkungen im Parallelformat"
BIOSPEKTRUM 6, 662 (2011)

D. Ho, K. Falter, P. Severin, H.E. Gaub:
"DNA as a force sensor in an aptamer-based biochip for adenosine"
Anal. Chem. 81 (8), 3159–3164 (2009)

D. Ho, C. Dose, C.H. Albrecht, P. Severin, K. Falter, P.B. Dervan, H.E. Gaub:
"Quantitative detection of small molecule/DNA complexes employing a force-based and label-free DNA-microarray"
Biophys J. 96 (11), 4661–4671 (2009)

D. Ho, J. Zimmermann, F. Dehmelt, U. Steinbach, M. Erdmann, P. Severin, K. Falter, H.E. Gaub:
"Force-driven separation of short double stranded DNA"
Biophys J. 97, 3158–3167 (2009)

since 2009	PhD student at LMU (Physics Department) Supervisor: Prof. Hermann Gaub
2008	Associate Intern at McKinsey & Company for three months
2007–2008	Diploma Thesis in the group of Prof. Hermann Gaub, LMU
2006	Working Student at the MPI for Psychiatry, Munich
2005–2006	M.A. in Physics at Boston University, Boston, USA
2002–2008	Studies in Physics at LMU

Photoactivity of Carbon Nitride Materials

Brian Tuffy

My work investigates new materials for photocatalysis, primarily looking at the potential of carbon nitride (CN) and CN hybrid materials for use in photoreactions such as the reduction of volatile organic compounds and water splitting. Carbon nitrides are a simple, cheap and old material which show great promise for today's nanomaterials and energy research. The overall idea is to simply and cheaply harness the suns energy to do chemical work.

These materials potentially offer an ideal energy source for the future where passive, large scale and efficient energy is converted to a useable form, wheather stored as chemical energy as in water splitting to hydrogen and oxygen or directly creating electrical current in new photovoltaic devices. Another application suited to this easily synthesised material is the large scale environmental clean-up of toxins.

The scientific study of these materials also provides interesting opportunities. With various bonding configurations proposed, there is a need for more experimental evidence to highlight the optical and electrical properties available in these materials. My initial aim is to screen a variety of CN based materials for their photoactivity including hydrogen/oxygen production from water and reduction of carbon dioxide, eventually optimising and tuning the materials for performance. This project is done in collaboration with the chemistry and physics departments at LMU and the project will now move to the Max Planck Institute for Solid State Research Stuttgart.

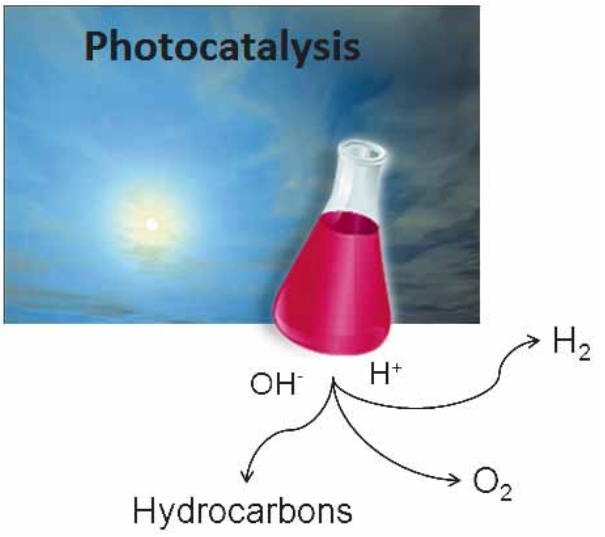


Figure 1 Photocatalysis Concept: Using sunlight to create hydrogen and oxygen from water or forming other hydrocarbon fuels.

since 2011	Member of Max-Planck-Institut für Festkörperforschung, Stuttgart
since 2010	PhD student at LMU (Chemistry Department) Supervisor: Prof. Bettina Lotsch
2008–2010	M.Sc. in Physics at Trinity College Dublin, Ireland
2006	Five months study in Wesleyan University, Middletown, USA
2004–2008	B.Sc. in Applied Physics at Dublin City University, Ireland

Structural Analysis of Human Mitochondrial RNA Polymerase "at work"

Kathrin Schwinghammer

Mitochondria are responsible for the metabolic energy production of organisms in form of ATP. These cellular "powerstations" are also involved in a variety of other catabolic and anabolic reactions or in apoptotic regulation. In mammals, many diseases are suggested to be linked to mutations in the mitochondrial genome which is transcribed by the mitochondrial RNA polymerase (RNAP). Based on the recently published structure of human mitochondrial RNAP (Ringel et al., Nature 2011) my PhD project focuses on the structural elucidation of this enzyme in its functional states during the mitochondrial transcription cycle by X-ray crystallography. Structural analysis of the mitochondrial RNAP in combination with RNA/DNA oligonucleotides or in complex with transcription factors can reveal the regulatory mechanisms of the individual stages during transcription of the mitochondrial genome (e.g., pre-initiation, initiation, elongation, termination). In a more long term view the deeper understanding of the unique features of transcription by mitochondrial RNAP assists the future design of more effective mitochondrial-targeting and antiviral drugs.

AL. Starosta, H. Qin, A. Mikolajka, GY. Leung, K. Schwinghammer, KC. Nicolaou, DY. Chen, BS. Cooperman, DN. Wilson:
"Identification of distinct thiopeptide-antibiotic precursor lead compounds using translation machinery assays"
Chem Biol. 16 (10), 1087–96 (2009)

since 2011	PhD student at LMU (Biochemistry Department) Supervisor: Prof. Patrick Cramer
2010	Research Intern in the Lab of Ass. Prof. Howard C Hang, Rockefeller University, New York City, USA
2008–2010	M.Sc. Biochemistry, LMU
2005–2008	B.Sc. Chemistry and Biochemistry, LMU

Ring Polymers – Dynamics and Behaviour in Fluid Flows

Philipp Sebastian Lang

In this project we focus on the behaviour of semi-flexible and stiff ring polymers using both numeric and analytic methods. We determined the relaxation dynamics, which deviate from those of linear filaments, as there exists an additional linear scaling regimes after the t^(3/4) regime. As expected even in the two qualitatively similar regimes quantitative differences arise. We use the knowledge on the relaxation to study the tumbling dynamics of ring polymers in a shear flow in terms of the dimensionless Weissenberg number Wi, and compare the results to those known for the linear case.

To model more complex flows and hydrodynamic interations we attempt to couple a polymer simulation with an SRD.

The mechanics of the bacterial cytoskeleton: Only in the last decade the existence of the bacterial cytoskeleton was discovered. In this project we focus on the actin-homolog MreB, which is known to build actin like filaments, but interestingly shows a helix-like localization in the cell. We attempt to determine the influence of this localization on the mechanics of the system and hope to contribute to determining a possible adhesion to the cell wall.

since 2010	PhD student at LMU (Physics Department) Supervisor: Prof. Erwin Frey
2004–2010	Diploma in Physics at the LMU

Genome-Wide ChIP Profiling of the Yeast Transcription Machinery

Michael Lidschreiber

I use chromatin immunoprecipitation coupled with DNA microarray hybridization (ChIP-on-chip) and massive parallel DNA sequencing (ChIP-seq) to study RNA polymerase (Pol) II transcription *in vivo*. These methods are used to determine in a genome-wide assay how proteins interact with DNA to regulate gene expression. To investigate the transcription cycle, we determined genome-wide occupancy profiles for Pol II, its phosphorylated forms, and transcription factors in growing yeast. By this we could determine the order of recruitment of factors to transcribing polymerase. Binding behavior of transcription factors and phosphorylation patterns of Pol II allowed us to infer possible functions of so far uncharacterized factors and phosphorylations, respectively. Future ChIP and gene expression analysis in mutant backgrounds will allow us to study the role of individual factors during the transcription cycle in more detail.

A. Mayer, M. Heidemann, M. Lidschreiber, A. Schreieck, M. Sun, C. Hintermair, E. Kremmer, D. Eick, P. Cramer:
"CTD tyrosine phosphorylation impairs termination factor recruitment to RNA polymerase II"
Science 336 (6089), 1723–5 (2012)

T. Niederberger, S. Etzold, M. Lidschreiber, K. Maier, D. Martin, H. Fröhlich, P. Cramer, A. Tresch:
"MC EMiNEM Maps the Interaction Landscape of the Mediator"
PLoS Comput Biol. 8 (6): e1002568. (2012)

A. Mayer, A. Schreieck, M. Lidschreiber, K. Leike, D.E. Martin, P. Cramer:
"The spt5 C-terminal region recruits yeast 3' RNA cleavage factor I"
Mol Cell Biol. 32 (7), 321–31 (2012)

A. Mayer, M. Lidschreiber, M. Siebert, K. Leike, J. Söding, P. Cramer:
"Uniform transitions of the general RNA polymerase II transcription complex"
Nature Struct. Mol. Biol. 17, 1272–1278 (2010)

since 2008	PhD student at LMU (Biochemistry Department) Supervisor: Prof. Patrick Cramer
2008	Master Thesis Biochem. in Prof. Jörg Nickelsen's group (LMU)
2007	Master Thesis Bioinformatics at the Conway Institute of Biomolecular & Biomedical Research (UCD, Dublin), in collaboration with Prof. Mewes' group (Helmholtz Zentrum, München)
2005–2008	M.Sc. Biochemistry and M.Sc. Bioinformatics at TUM & LMU
2002–2005	B.Sc. Bioinformatics at TUM & LMU

Crosstalk between DNA Methylation and Histone Modifications

Garwin Pichler

DNA methylation and histone modifications play a central role in the epigenetic regulation of gene expression and cell differentiation. DNA methyltransferase 1 (Dnmt1) is the most ubiquitously expressed DNA methyltransferase and is essential for maintaining DNA methylation patterns during semi-conservative DNA replication and DNA repair. The fidelity and processivity of this process is crucial for genome stability and is based on the specific recognition of hemimethylated CpG sites emerging at the replication forks. Remarkably, a variety of proteins have been reported to interact with Dnmt1, regulating the activation, stabilization and recruitment of Dnmt1 to specific sites and regions. During my PhD thesis, I focused on the Dnmt1-interacting proteins Uhrf1 and Uhrf2 and developed methods to study the functional characteristics of these factors and their role in maintaining DNA methylation.

G. Pichler, A. Jack, P. Wolf and S.B. Hake:
"Versatile Toolbox for High Throughput Biochemical and Functional Studies with Fluorescent Fusion Proteins"
PLoS ONE 7 (5), e36967 (2012)

G. Pichler, H. Leonhardt, U. Rothbauer:
"Fluorescent protein specific Nanotraps to study protein-protein interactions and histone-tail peptide binding"
Methods in Molecular Biology 911 (2012)

W. Qin, H. Leonhardt, G. Pichler:
"Regulation of DNA methyltransferase 1 by interactions and modifications"
Nucleus 2 (5), 392–402 (2011)

G. Pichler, P. Wolf, C.S. Schmidt, D.K. Meilinger, K. Schneider, C. Frauer, K. Fellinger, et al.:
"Cooperative DNA and histone binding by Uhrf2 links the two major repressive epigenetic pathways"
J Cell Biochem. 112 (9), 2585–93 (2011)

A. Rottach, C. Frauer, G. Pichler, I.M. Bonapace, F. Spada, H. Leonhardt:
"The multi-domain protein Np95 connects DNA methylation and histone modification"
Nucleic Acids Res. 38 (6), 1796–1804 (2010)

2008–2012	Doctoral Thesis at LMU (Biology Department) Supervisor: Prof. Heinrich Leonhardt
2008	Master Thesis in Dr. Roland Wedlich-Söldner's group, MPI Martinsried
2006–2008	M.Sc. Biochemistry, LMU
2003–2006	B.Sc. Chemistry and Biochemistry at LMU

Development and Application of High-Throughput Methods to Screen for Protein Interactions

Kamila Klamecka

State-of-the-art technology allows for not only visualising but also manipulating with single molecules. In our lab, Atomic Force Microscope (AFM) combined with TIRF microscope has been successfully used for Single Molecule Cut and Paste (SMC&P), a technique allowing to pick up, transfer and deposit single molecules of DNA. AFM cantilever serves here as a handle for precise manipulation with individual DNA strands. Force hierarchy is crucial to successful and efficient molecule transfer and deposition: the binding of the molecule to the handle needs to be stronger than to depot area and at the same time weaker than that at the target area. I am striving to expand the SMC&P technique over the world of proteins. I employ nanobodies (smallest functional antigen-binding proteins) to specifically bind GFP (Green Fluorescent Protein). With this strategy – based solely on GFP binding and thus entirely free of additional protein tags or chemical modifications – transfer of virtually any GFP-fused protein will become possible. Robustness of this approach stems from the availability of substrates (proteins of interest), which already exist as GFP-fusions in cell biology and biochemistry-focused labs. This only supports the motivation of using nanobody-SMC&P to print desired patterns of protein arrays.

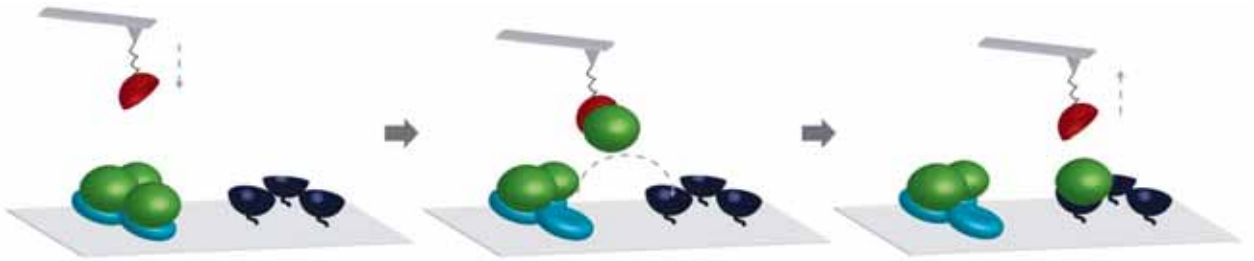


Figure 1 Schematic drawing of Nb-SMC&P principle.

since 2012	IDK Student Representative
since 2009	PhD student at LMU (Physics and Biology Department) Supervisors: Prof. Hermann Gaub, Prof. Heinrich Leonhardt
2009	Lab internship at FORTH Hellas, Heraklion, Greece
2008–2009	Master Thesis in Nanotechnology in Prof. Adam Patkowski's group, Adam Mickiewicz University in Poznan, Poland
2007–2008	Master Thesis in Biotechnology in Dr. Andreas Dahl's group, MPI for Molecular Genetics, Berlin and Prof. Ryszard Slomski's group, Poznan University of Life Sciences, Poland
2006–2007	Studies at the University of Copenhagen, Denmark
2003–2009	M.Sc. Nanotechnology, Adam Mickiewicz University, Poland
2003–2008	M.Sc. Biotechnology, Poznan University of Life Sciences, Poland

In Vivo Kinetics and Thermophoresis

Maren Reichl (née Funk)

Binding constants are expected to be very different *in vivo* than *in vitro*. Interactions with competitive binding partners in the complex fluid of the cytoplasm are encountered everywhere in biological systems and only partially reproducible *in vitro*. Thus it is necessary to develop new techniques to measure binding affinities directly inside living cells. My research project is to develop such a technique using novel vertical thermophoresis, the movement of particles and molecules in a vertical temperature gradient. The detection is via TIRF microscopy.

M. Hofstetter, J. Howgate, I.D. Sharp, M. Funk, M. Stutzmann, H.G. Paretzke, and S. Thalhammer:
"Real-time X-ray response of biocompatible solution gate AlGaN/GaN high electron mobility transistor devices"
Applied Physics Letters 96 (9), 092110 (2010)

M. Funk, S.J. Parkin, A.B. Stilgoe, T.A. Nieminen, N.R. Heckenberg, and H. Rubinsztein-Dunlop:
"Constant power optical tweezers with controllable torque"
Optics Letters, 34 (2), 139–141 (2009)

M. Funk, S.J. Parkin, T.A. Nieminen, N.R. Heckenberg, and H. Rubinsztein-Dunlop:
"Vaterite twist: Microrheology with AOM controlled optical tweezers"
In Com. Light & Opt. Forces III 7227, 72270D. SPIE. (2009)

S.J. Parkin, R. Vogel, M. Persson, M. Funk, V.L. Loke, T.A. Nieminen, N.R. Heckenberg, and H. Rubinsztein-Dunlop:
"Highly birefringent vaterite microspheres: production, characterization and applications for optical micromanipulation"
Optics Express 17 (24), 21944–21955 (2009)

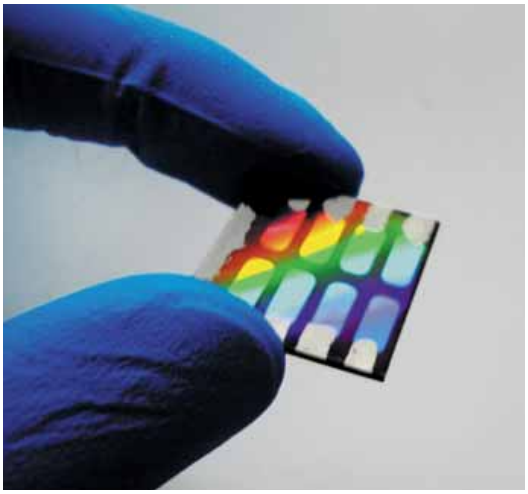
T. Asavei, S. Parkin, M. Persson, R. Vogel, M. Funk, V. Loke, T. Nieminen, H. Rubinsztein-Dunlop, and N. Heckenberg:
"Engineering optically driven micromachines"
In Optical Trapping and Optical Micromanipulation V 7038, 703816. SPIE (2008)

since 2010	PhD student at LMU (Physics Department) Supervisor: Prof. Dieter Braun
2009–2010	Diploma Thesis at the Helmholtz Centre Munich and the Walter Schottky Institute at TUM
2008	Research Semester, University of Queensland, Australia
2004–2010	Studies in Biophysics, TUM

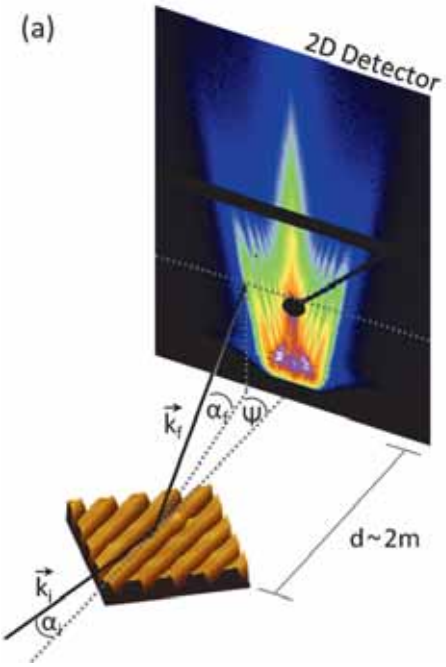
Structured Interfaces for Thin Film Organic Photovoltaics: Device Performance and Structural Analysis with Advanced Scattering Methods

Claudia Palumbiny

Precise control of the heterojunction morphology in thin films is one of the key issues for the improvement of organic photovoltaic (OPV) devices. Interdigitated interfaces of the organic material on the nanoscale provide ideal charge extraction pathways for separated charge carriers. Structured surfaces of the selective electrode on the lower microscale further allow for the enhancement of the optical absorption of the thin film components due to light trapping. Two different ways of artificial structuring are under investigation: Using hard templates as stamps, nanostructured organic layers can be realized on ITO support. Precise control of the process facilitates the control of the template dimensions. Alternatively, a novel imprinting routine for polyethylenedioxy-thiophene:polystyrene-sulphonate (PEDOT:PSS) is studied as it is widely used as a selective intermediate electrode in OPVs blocking the electrons and collecting the holes. Thereby, master molds with nanoscale channels are used for the temperature and pressure assisted imprinting routine. The shape of the imprinted structures is easily tunable by the concentration of an additional plasticizer. Depending on the structure dimensions the device efficiency of OPVs can be increased this way. This improvement is addressed to additional optical diffraction at the PEDOT:PSS gratings leading to increased optical absorption due to light trapping.



J. Weickert, C. Palumbiny, M. Nedelcu, T. Bein, L. Schmidt-Mende:
"Controlled growth of TiO_2 nanotubes on conducting glass"
Chem. Mater. 23 (2), 155–162 (2011)



J. Weickert, H. Sun, C. Palumbiny, H.C. Hesse, L. Schmidt-Mende:
"Spray-deposited PEDOT:PSS for inverted organic solar cells"
Sol. Energ. Mat. Sol. Cells 94, 2371 (2010)

since 2011	PhD student at TUM (Physics Department) Supervisor: Prof. Peter Müller-Buschbaum
2010	Research stay at the University of Oxford, UK
2009–2010	Diploma Thesis (LMU)
2004–2010	Study of Physics at LMU

Nanoparticles and Human Health – Development and Application of an Experimental Strategy to Estimate Cytotoxicity of Nanoparticles

Julia Blechinger

Due to a rising amount of nanoparticles (NPs) in the environment leading to a constant exposure of the human body, NP uptake via our airways system, gastro-intestinal tract and skin is unavoidable. As NPs are able to penetrate physiological barriers they enter our blood and lymphatic vessel system which is covered by endothelial cells (ECs). These cells sense all intravascular physiological and artificial components. Moreover they play an essential role in controlling inflammation, coagulation, blood flow and blood pressure. Hence it is crucial to know the precise effect of NPs on these cells.

In my PhD project I developed an experimental strategy to quantify cellular nanoparticle uptake and to characterize uptake pathways and cytotoxicity of silica nanoparticles. In a first step silica nanoparticles which are very similar to commercially used particles but are visible with fluorescence microscopy methods were synthesized and characterized. Further on we developed the ImageJ macro "Nano_In_Cell_3D" which allows quantifying nanoparticle uptake into living cells by confocal fluorescence microscopy. This ImageJ macro was used to assess and compare nanoparticle uptake into HeLa and HUVEC cells. Furthermore nanoparticle uptake pathways and the cytotoxic impact of SiO_2 nanoparticles on both cell lines were investigated. We could show that the cytotoxic impact of 310 nm SiO_2 nanoparticles correlates with the nanoparticle uptake into HUVEC and HeLa cells.

Additional experiments aimed on characterizing a microfluidic system which was designed for live-cell imaging applications. This microfluidic system will be used in the sequel of this project to establish a blood flow like microfluidic flow on top of the ECs and therefore to mimic in vivo conditions.

Further on, the interaction of nanoparticles with lipid vesicles as a model system for the cell membrane was addressed. We could show that nanoparticles influence the morphological behavior of lipids, most probably because they change the mechanical properties of the latter.

The project is funded by the DFG priority program (SPP 1313) "Bio-Nano-Responses". The experiments were done in collaboration with the groups of Prof. A. Reller (synthesis and characterization of nanoparticles), Prof. A. Wixforth and Dr. M.F. Schneider (Lab on a Chip systems, micro and nanofluidics), PD Dr. S.W. Schneider (endothelial cell biology, cytotoxicity) and Prof. I. Hilger (cytotoxicity).

J. Blechinger, R. Herrmann, D. Kiener, F.J. García-García, C. Scheu, A. Reller, C. Bräuchle:
"Perylene-labeled silica nanoparticles: synthesis and characterization of three novel silica nanoparticle species for live-cell imaging"
Small 6 (21), 2427–2435 (2010)

T. Lebold, L.A. Mühlstein, J. Blechinger, M. Riederer, H. Amenitsch, R. Köhn, K. Peneva, K. Müllen, J. Michaelis, C. Bräuchle, and T. Bein:
"Tuning single-molecule dynamics in functionalized mesoporous silica"
Chem. Eur. J. 15, 1661–167 (2009)

F. Westerlund, P. Nordell, J. Blechinger, T.M. Santos, B. Norden, and P. Lincoln:
"Complex DNA binding kinetics resolved by combined circular dichroism and luminescence analysis"
Journal of Physical Chemistry B 112 (21), 6688–6694 (2008)

2010	IDK Student Representative
since 2007	PhD student at LMU (Chemistry Department) Supervisor: Prof. Christoph Bräuchle
2007	Master Thesis in Prof. Christoph Bräuchle's group (LMU)
2006	Internship at Chalmers University of Technology, Gothenburg, Sweden
2002–2007	Chemistry studies at LMU

Electronic Structure of [Ca2Nb3O10] Nanosheets as Envisaged by Valence Electron Energy Loss Spectroscopy and Density Functional Theory

Kulpreet Singh Virdi

With recent advances in nanotechnology, the size of components in modern day devices is ever decreasing. Concomitantly, a number of novel nanostructures have been synthesized which break the general norms of 3D crystals, for example graphene. A succinct understanding of these materials by conventional optical methods is limited by the wavelengths of light waves. Electron beams on the other hand provide greatly superior spatial resolution which makes it possible to investigate nanostructures up to atomic scales. Electron energy loss spectroscopy (EELS), which can be carried out in a transmission electron microscope (TEM) helps in ascertaining the electronic structure.

My doctoral thesis deals with usage of electron microscopy to understand the structure and electronic properties of Dion-Jacobsen Phase Potassium calcium niobate perovskite and its 2D nanostructure. We use EELS to ascertain the band-gap and dielectric function of this bulk structure. For a better understanding of the dielectric function tensor density functional theory (DFT) based calculations are also used. Subsequently, these techniques are employed to ascertain the structure and properties of 2D calcium niobate perovskite sheets.

These nanosheets which have been recently synthesized are not well understood from a fundamental standpoint. We have attempted to ascertain the structure and electronic properties of these sheets. A better understanding of the band-gap and related properties of these novel 2D nanosheets would help in finding suitable avenues for application.

In addition, I have used electron microscopy to understand a number of other nanostructures. Firstly, I have used electron microscopy to understand the morphology of the active layer in organic solar cells. Secondly, I have used TEM to understand the physical morphology of the adeno viruses used as gene vectors, and how it modifies with a polymer coating which enhances gene delivery. I have also used electron microscopy to understand the structure of metal organic frameworks employing electron diffraction.

A. Abdellah, K. Singh Virdi, R. Meier, M. Döblinger, P. Müller-Buschbaum, C. Scheu, P. Lugli, G. Scarpa:
"Successive Spray Deposition of P3HT/PCBM Organic Photoactive Layers: Material Composition and Device Characteristics"
Adv. Funct. Mat. Article DOI: 10.1002/adfm.201200548 (2012)

S.C. Junggeburth, K. Schwinghammer, K.S. Virdi, C. Scheu, B.V. Lotsch:
"Towards Mesostructured Zinc Imidazolate Frameworks"
Chemistry – A European Journal 18 (7), 2143–2152 (2012)

A. Vetter, K.S. Virdi,S. Espenlaub,W. Rodl, E. Wagner, P.S. Holm, F. Kreppel, C. Scheu, C. Spitzweg, M. Ogris:
"Chemical Modification of the Adenovirus Capsid for Enhanced Viral Uptake into Target Cells"
Human Gene Therapy 21 (9), 1193–1193 (2010)

since 2009	PhD student at LMU (Chemistry Department) Supervisor: Prof. Christina Scheu
2008	Master Thesis in the group of Dr. K.C. Hari Kumar, IIT, India
2007	Guest Student Worker at Bergische Universität Wuppertal
2004–2009	Bachelor and Master of Technology (Dual Degree) in Metallurgical and Materials Engineering, IIT Madras, India

DNA Origami as a Tool for Single-Molecule Fluorescence Studies

Ingo Stein

My area of interest is focused on the development and application of advanced fluorescence microscopy techniques, especially for multicolor excitation and detection of single molecules. For example, the concept of alternating laser excitation (ALEX) can be used to investigate the structure and stoichiometry of dye-labeled molecules, by using FRET (Fluorescence Resonance Energy Transfer) as a "nanoscopic ruler".

Employing the DNA origami technique, introduced by Paul Rothemund in 2006, to build structures on the nanometer scale by DNA self-assembly can be directly applied to single-molecule fluorescence spectroscopy. A rigid DNA origami block was designed as a calibration ruler for single-molecule FRET measurements. In another project a DNA origami rectangle was used as a breadboard on which alternative FRET pathways could be visualized by a 4-color FRET approach witch alternating laser excitation (see figure).

Additionally I am interested in understanding the intrinsic properties of fluorescent molecules, which can be seen as a crucial prerequisite for any fluorescence microscopy technique. For instance the understanding and control of the blinking behavior of fluorescent dyes has shown to be beneficial for novel approaches to super-resolution imaging, e.g. "Blink Microscopy".

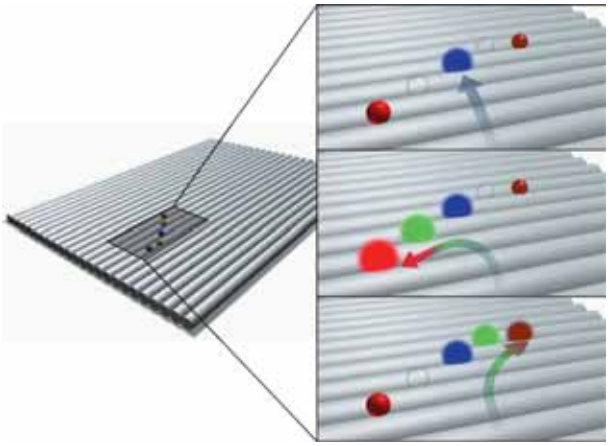


Figure 1 A DNA origami rectangle is used as breadboard for a spectroscopic network: the alternative FRET pathways are mediated by a green "jumper" dye that guides the light from the blue input dye to either the red or IR output. (Stein et al. JACS 2011)

G.P. Acuna, M. Bucher, I.H. Stein, C. Steinhauer, A. Kuzyk, P. Holzmeister, R. Schreiber, A. Moroz, F.D. Stefani, T. Liedl, F.C. Simmel, P. Tinnefeld:
"Distance Dependence of Single-Fluorophore Quenching by Gold Nanoparticles Studied on DNA Origami"
ACS Nano 6 (4), 3189–3195 (2012)

I.H. Stein, S. Capone, J.H. Smit, F. Baumann, T. Cordes, and P. Tinnefeld:
"Linking Single-Molecule Blinking to Chromophore Structure and Redox Potentials"
ChemPhysChem, 13 (4), 931–937 (incl. cover feature) (2012)

I.H. Stein, C. Steinhauer, and P. Tinnefeld:
"Single-Molecule Four-Color FRET Visualizes Energy-Transfer Paths on DNAOrigami"
JACS, 133 (12) (incl. cover figure) (2011)

I.H. Stein, V. Schüller, P. Böhm, P. Tinnefeld, and Tim Liedl:
"Single-molecule FRET ruler based on rigid DNA origami blocks"
ChemPhysChem 12 (3), 689–695 (2011)

I.H. Stein, P. Tinnefeld:
"Single-Molecule FRET & Super-Resolution: DNA Nanostructures Organize Dyes for Nanophotonic Apps"
GIT Imaging and Microscopy 3 (2011)

J. Vogelsang, C. Steinhauer, C. Forthman, I.H. Stein, B. Person, T. Cordes, P. Tinnefeld:
"Make them Blink: Probes for Super-Resolution Microscopy"
ChemPhysChem 11 (12), 2475–2490 (2010)

B. Person, I.H. Stein, C. Steinhauer, J. Vogelsang and P. Tinnefeld:
"Correlated movement and bending of nucleic acid structures visualized by multicolor single-molecule spectroscopy"
ChemPhysChem, 10 (9–10), 1455–1460 (2009)

T. Cordes, I.H. Stein, C. Forthmann, C. Steinhauer, M. Walz, W. Summerer, B. Person, J. Vogelsang and P. Tinnefeld:
"Controlling the emission of organic dyes for high sensitivity and superresolution microscopy"
Proc SPIE, 7367:73671D (2009)

2009–2012	Doctoral thesis at LMU (Physics Department) Supervisor: Prof. Philip Tinnefeld
2011	IDK Student Representative
2008–2009	Diploma thesis in Prof. Philip Tinnefeld's group (LMU)
2006	Studies at the Department of Physics at the University of Colorado at Boulder, USA
2003–2009	Physics studies at LMU

Single Molecule Spetroscopy on Hsp90

Christoph Ratzke

My project focuses on the investigation of the chaperone Hsp90 with single molecule spectroscopy. Hsp90 is a very frequent chaperone which can maintain cellular integrity after heat shock. In addition, it has important functions in the unstressed cell like processing of proteins that are involved in signal transduction and cell proliferation. Since some of these proteins are involved in the formation of cancer Hsp90 became an important drug target.

Investigations of Hsp90 done in bulk so far let assume that the mechanism this protein is quite complex. Since ensemble measurements result only in average values we observe Hsp90 on the single molecule level which allows to estimate distributions of values, rare events and the estimation of single rate constants even in complex systems. The main goal of my work is the investigation of the interaction of Hsp90 with different ligands. To detect interaction events we use the fluorescence resonance energy transfer between fluorophores that have been attached to Hsp90 and its ligand. Upon binding of the ligand an energy transfer between the two labels takes place which leads to a change in the energy of the emitted fluorescence light. Detecting this change one obtains the binding dynamics.

With this technique I want to investigate the binding of ATP and different cochaperones which modify the function of Hsp90. In future I am especially interested in the interplay between different binding partners.

C. Ratzke, F. Berkemeier, and T. Hugel:
"Hsp90's mechano-chemical cycle is dominated by thermal fluctuations"
PNAS 109, 161–166 (2012)

C. Ratzke, M. Mickler, B. Hellenkamp, J. Buchner and T. Hugel:
"Dynamics of heat shock protein 90 C-terminal dimerization is an important part of its conformational cycle"
PNAS 107 (37), 16101–6 (2010)

M. Mickler, M. Hessling, C. Ratzke, J. Buchner and T. Hugel:
"The large conformational changes of Hsp90 are only weakly coupled to ATP hydrolysis"
Nature Structural & Molecular Biology 16, 281–286 (2009)

since 2008	PhD student at TUM (Physics Department) Supervisor Prof. Thorsten Hugel
2006–2008	M.Sc. Biochemistry (TUM)
2005–2006	B.Sc. Biochemistry, TUM
2003–2005	Undergraduate studies in Biochemistry, Universität Regensburg

Supported Lipid Bilayers as pH Responsive Cover of Silica Nanoparticles

Claudia Bellomo

NanoBioTechnologv is one of the most promising Nanotechnology fields and its tools could improve significantly current clinical-biological practice, thus leading to much more specific disease treatments in the next future. In this scenario, lots of efforts about nanoparticles setting up as drug delivery systems are made. In my PhD project I want to study Supported Lipid Bilayer (SLB) coating of Silica Nanoparticles in order to create a smart drug delivery tool. SLB-Silica nanoparticles will be supposed to release inner cargo upon exogenous stimuli as a trigger, in order to optimize drug release at target site and, at the same time, avoid unwanted premature drug release effects. SLB surface functionalization approaches will also be established, in order to increase Silica Nanocarriers specificity towards cell lines/tissues of interest.

D. Vergara, C. Bellomo, X. Zhang, V. Vergaro, A. Tinelli, V. Lorusso, R. Rinaldi, YM. Lvov, S. Leporatti, and M. Maffia:
"Lapatinib/Paclitaxel polyelectrolyte nanocapsules for overcoming multidrug resistance in ovarian cancer"
Nanomedicine 2011 Nov 16. [Epub ahead of print]

V. Vergaro, F. Scarlino, C. Bellomo, R. Rinaldi, D. Vergara, M. Maffia, F. Baldassarre, G. Giannelli, X. Zhang, YM. Lvov, and S. Leporatti:
"Drug-loaded polyelectrolyte microcapsules for sustained targeting of cancer cells"
Adv Drug Deliv Rev. 63 (9), 847–64 (2011)

since 2011	PhD student at LMU (Chemistry Department) Supervisor: Prof. Thomas Bein
2010	Master Thesis at National Nanotechnology Lab CNR-Nano. University of Salento, Lecce, Italy
2008–2010	M.Sc. Medical Biotechnology & Molecular Medicine, University of Bari, Italy
2005–2008	B.Sc. Healthcare & Pharmaceutical Biotechnology, Bari, Italy

The Role of Nascent Messenger RNA in Coordination of the Transcription Cycle

Carlo Bäjen

I am mainly interested in gene transcription and regulation in yeast, specifically focusing on interactions between (i) transcription factors (TFs), (ii) splicing factors, and (iii) further regulatory complexes (i.e. Ccr4-Not), which contain RNA recognition domains, and the nascent mRNAs. For that reason I am establishing cutting-edge assays, such as photoactivatable ribonucleoside-enhanced crosslinking and immunoprecipitation (referred to as PAR-CLIP; Hafner et al., 2010), ChIP Exo (Pugh, 2011), and RNA-Sequencing using next-generation sequencing (NGS) technologies, to obtain TF-binding motifs and all information we are interested in. Resulting data will be compared and correlated to existing data sets generated through ChIP-chip experiments, genome-wide occupancy profiles (Mayer et al., 2010), and dynamic transcriptome analysis (DTA); a new non-perturbing metabolic RNA labeling assay (Miller et al., 2010). These studies are expected to reveal significant insights into further complex interactions in biological systems.

since 2010	PhD student at LMU (Biochemistry Department), Supervisor: Prof. Patrick Cramer
2010–2011	Patent engineer, Fernuniversität Hagen
2010	Master student, Rockefeller University, New York, USA
2008–2010	M.Sc. Engineering, Environmental and Biotechnology, Management Center Innsbruck, Austria
2004–2008	Dipl.-Ing. (FH) Environmental Technology/Biotechnology, Hochschule Mittweida

Optical Spectroscopy of Hybrid Metal-Organic Nanostructures

Lidiya Osinkina

Noble metal nanoparticles (NP), upon excitation with electromagnetic fields, exhibit plasmon oscillations, which under resonant conditions result in field enchancement around the particle. This in turn can change optical properties of molecules attached or situated close to the particle. The effect is even stronger when two NPs are brought in the vicinity of each other (plasmonic coupling) or when non-spherical geometries are used (nanostars, nano-bipyramids etc). The general aim of my project is to study optical properties of such hybrid nanostructures consisting of noble metal NPs and biological molecules, in particular proteins, attached to them. Experiments are performed both with nanostructures fixed to the surface and freely moving in solution. To control movement of the nanostructures in the second case, touchless and efficient manipulation technique called "optical tweezers" is applied.

V. Faessler, C. Hrelescu, A.A. Lutich, L. Osinkina, S. Mayilo, F. Jäckel, J. Feldmann:
"Accelerating fluorescence resonance energy transfer with plasmonic nanoresonators"
Chem. Phys. Lett. 508, 67–70 (2011)

L. Osinkina, M. Markström, O. Orwar, A. Jesorka:
"A Method for Heat Stimulated Compression of (poly(N-isopropylacrylamide) Hydrogel Inside Giant Unilamellar Vesicles"
Langmuir 26 (1), 1–4 (2010)

J. Baran, L. Dolgov, T. Gavrilko, L. Osinkina, G. Puchkovska, H. Ratajczak, Y. Shaydyuk, A. Hauser:
"Effect of clay surface modification on the structure and electro-optical properties of liquid crystal/clay nanocomposites"
Philosophical Magazine 87 (28), 4273–4285 (2007)

since 2009	PhD student at LMU (Physics Department) Supervisor: Prof. Jochen Feldmann
2007–2009	M.Sc. in "Nanoscale Science and Technology" Chalmers University of Technology, Sweden
2002–2007	Diploma in Physics, National University of Kyiv-Mohyla Academy, Ukraine

Microfluidic Protein Chips for Single-Molecule Studies

Marcus Otten

The production of bioethanol from biomass, e.g. corn, is currently in conflict with our nutritional needs. The conversion of lignocellulose to fermentable sugars is limiting the use of other biomass, such as wood and waste, in the production of biofuels. Although, nature has produced a stunning machinery for this process: A range of bacteria present cellulosomes on their membranes. These protein complexes consist of multiple enzymes arranged on a scaffold and are able of fast decomposition of lignocellulose in all kinds of biomass, including wood and waste. By adapting the single-molecule cut-and-paste technique, I aim to assemble these protein complexes one-by-one with nanometer precision, forming synthetic cellulosomes. The cantilever tip of an atomic force micropscope can be used to pick up and transfer single molecules with high precision. Therefore, a microfluidic chip is developed for parallel *in vitro* expression of a high number of proteins within small distances. This chip can serve as the depot area, where single proteins, such as cellulases, are picked up for deposition on the target scaffold. The cut-and-paste technique is based on a binding force hierarchy, which enables specific uptake and deposition of these proteins. Assembly of synthetic cellulases will help investigate and compare enhanced enzymatic activities of cellulosomes for the production of biofuels.

since 2012	IDK Student Representative
since 2010	PhD student at LMU (Physics Department) Supervisor: Prof. Hermann Gaub
2009–2010	Diploma Thesis in Dr. Doris Heinrich's group (LMU)
2007–2008	Studies of Physics and research project on cell mechanics, Harvard University, Cambridge, USA
2004–2007	Studies of Physics at the LMU

Mesoscopic Hydrodynamic Simulations of Active Biological Systems

Cornelius Weig

When we dive headlong into the water, we drift for a while before the viscous water brings us to a halt. A bacterium in contrast, would come to an immediate halt within microseconds. Swimming strategies at these low Reynolds numbers must therefore be quite different from what we are used to. Nature has devised cunning swimming strategies with screw-like or beating motion of flagella. Inspired by these effective propulsion mechanisms, I study how these could be adapted and used in artificially designed swimmers. Micro-fabrication has already succeeded to build ever smaller swimmers, however only in small numbers. Using the self-assembly potential of DNA origami it will be possible to fabricate artificial swimmers in large numbers.

Beyond the mere mechanism of propulsion, the interaction of swimmers is a controversial topic. It is not completely understood how different swimmers sense each other. That they do interact is however undisputed, as synchronization of cilia and swimmers such as sperm is widely observed. Having advanced simulation techniques and computational resources available, I can address these questions from a numerical point of view.

C. Weig and T.A. Enßlin:
"Bayesian analysis of spatially distorted cosmic signals from Poissonian data."
Monthly Notices of the Royal Astronomical Society 409, 1393–1411 (2010)

T.A. Enßlin and C. Weig:
"Inference with minimal Gibbs free energy in information field theory."
Physical Review E 82, 051112 (2010)

since 2010	PhD student at LMU (Physics Department) Supervisor: Prof. Erwin Frey
2009–2010	Diploma thesis at the Max-Planck Institute for Astrophysics
2006–2007	Physics Studies at Queen's University Belfast, Ireland
2003–2009	Physics Studies at LMU

Elucidating Virus Uptake and Fusion by Single Virus Tracing

Dorothee Schupp

My research focuses on the entry pathways of Herpes simplex virus (HSV-1). Herpes is a latent disease, more than 90% of the population are considered to be carriers of the virus. Neither an effective medication nor a potent vaccination is available yet.

By means of single virus tracing – a method developed in the group of Prof. Bräuchle – I will study the entry of HSV in different cell lines in real time within a group of researchers. The observation of the entry of single virus particles in living cells and their intracellular transport requires highly sensitive microscopial techniques. This project is conducted in close collaboration with Prof. Sodeik of the Hannover Medical School.

It has been described that the entry pathways of this virions are cell type dependent. Two general pathways are implicated in HSV-1 entry: via direct fusion with the plasma membrane or endocytosis followed by fusion with a neutral as well as an acidic endosome.

In my project I will investigate those processes in detail in terms of internalization, intracellular transport as well as cell-to-cell spread of the virus particles.

2007–2012	PhD student at LMU (Chemistry Department) Supervisors: Prof. Don Lamb, Prof. Christoph Bräuchle
2004–2005	Studies at Ecole Nationale Supérieure de Chimie de Lille, France
2002–2007	Studies of Chemistry, Eberhard-Karls Universität Tübingen

Single Molecule Investigations of Large Oriented Silica Nanoporous Channel Systems

Melari Davies

Nanoporous materials have a large variety of applications in everyday life (e.g. ion exchange with Zeolites in detergents), in chemical industry (e.g., catalysis and molecular sieving) and high-tech devices (e.g., drug-delivery and biosensors). In all these applications highly ordered and large domains of channels as well as a high mobility of molecules in these channels is of paramount importance.

In my PhD I will investigate the formation of large ordered silica nanochannels in combination with UV Lithography and PDMS stamping techniques. The orientation of the channels will be indicated by the pathways of single fluorescent dye molecules in such structures and the resulting trajectories. In addition, these experiments will reveal the dynamic properties of single molecules in such guest-host systems. Whereas Terrylene derivatives (TDI) will be used as highly fluorescent dye molecules for the characterization of the structures, DNA, RNA and other biomolecules will be investigated in the following work. In these experiments it is intended to apply electric fields in order to control the movement of the molecules and eventually allow a separation according to charge and size. Such new applications will be the focus of the future work during my PhD.

M. Davies, A. Wochnik, F. Feil, C. Jung, C. Bräuchle, C. Scheu, and J. Michaelis:
"Synchronous Emission from Nanometric Silver Particles through Plasmonic Coupling on Silver Nanowires"
ACS Nano 6 (7), 6049–6057 (2012)

B. Ruehle, M. Davies, T. Lebold, C. Bräuchle, and T. Bein:
"Highly Oriented Mesoporous Silica Channels Synthesized in Microgrooves and Visualized with Single Molecule Diffusion"
ACS Nano 6 (3), 1948–1960 (2012)

G. Battagliarin, M. Davies, S. Mackowiak, C. Li, and K. Müllen:
"Ortho-Functionalized Perylenediimides for Highly Fluorescent Water-Soluble Dyes"
ChemPhysChem 13 (4), 923–6 (2012)

M. Davies, C. Jung, P. Wallis, T. Schnitzler, C. Li, K. Müllen and C. Bräuchle:
"Photophysics of New Photostable Rylene Derivatives: Applications in Single Molecule Studies and Membrane Labelling"
ChemPhysChem, Special Issue 12 (8), 1588–1595 (2011)

M. Davies, S. Goette, P. Klüfers and T. Schwarz:
"Methyl 4,6-O-benzylidene-2,3-dideoxy-3-hydroxyimino-a-D-erythro-pyranoside methanol solvate"
Acta Crystallographica E63, o4765 (2007)

since 2010	PhD student at LMU (Chemistry Department) Supervisor: Prof. Christoph Bräuchle
2009	Master Thesis in Prof. Christoph Bräuchle's group (LMU)
2007–2009	M.Sc. Chemistry at LMU
2004–2007	B.Sc. Chemistry at LMU

Imaging of Optoelectronic Properties of Organic Thin Films in a Field-Effect Transistor Geometry by Scanning Photocurrent Microscopy (SPCM)

Christian Westermeier

Organic thin films of small aromatic molecules exhibit semiconductor properties which make them promising candidates for innovative electronic devices, such as organic field-effect transistors (OFET), photovoltaics (OPV) or light emitting diodes (OLED). We employ thermal deposition techniques in ultra high vacuum, the most controlled way of producing thin films. The morphology of these thin films such as grain orientation, grain size distribution and dislocation densities are supposed to influence the electronic properties substantially. Thus, a main focus of our work is to correlate structural aspects with electronic transport properties.

The primary objective of my PhD project is local characterization of micro- and nanostructured p- and n-conducting organic layers by imaging with a focused laser beam. For this purpose, we use local illumination by laser scanning techniques with submicron resolution to measure the spatially resolved photoresponse, reflection, luminescence and micro-Raman scattering. These local investigations are performed on thin films and heterojunctions arising from self organization of laterally processed organic materials in a field-effect transistor geometry. The gained results help to understand the crucial relation between the real structure and optoelectronic properties of organic thin films and their emerging interfaces.

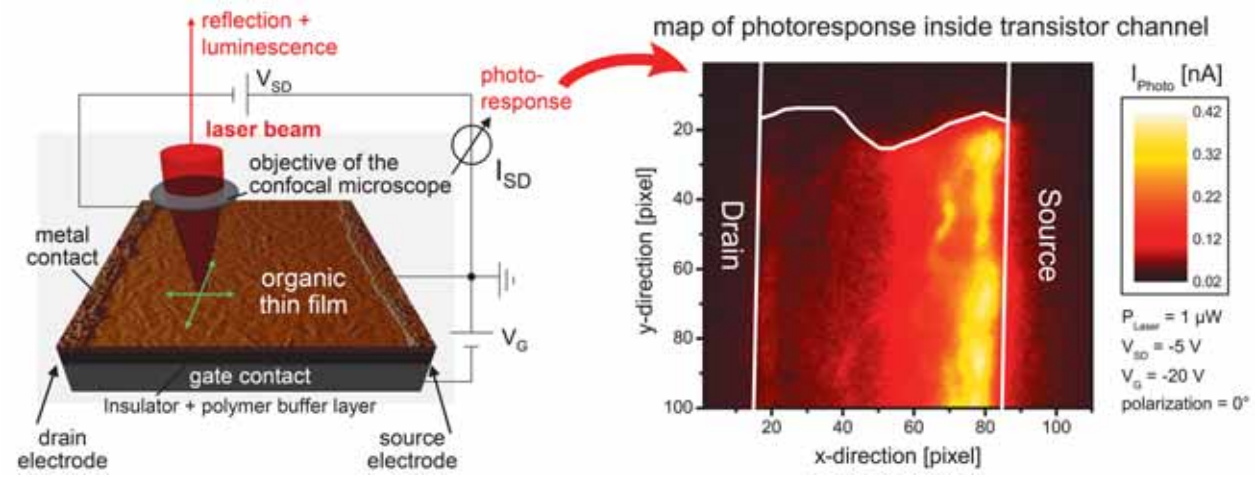


Figure 1 Scanning photocurrent microscopy allows for spatially resolved analysis of organic electronic devices. Here, a focused laser beam is scanned across the channel of a thin film transistor providing local excitation with submicron resolution. In addition to optical measurements, the change of the source-drain current caused by local illumination can be detected in dependence on the position of laser excitation. For illustration, an image of this photoresponse inside a transistor channel is shown on the right.

since 2010	PhD student at LMU (Physics Department) Supervisor: PD Dr. Bert Nickel
2009–2010	Diploma Thesis in PD Dr. Bert Nickel's group (LMU)
2007–2010	Studies in Physics at LMU
2006–2007	Erasmus student at University of Surrey, Guildford, UK
2004–2007	Studies in Physics at the Ruhr-Universität Bochum
2003–2004	Medical studies at the Ruhr-Universität Bochum

Modulation of DNA-Mechanics via Methylation and Transcription Factors

Philip Severin

One of the key advantages of the Differential Force Assay in comparison to other force spectroscopy methods like AFM or optical tweezers is the possibility to probe an ensemble in the order of a billion Molecular Force Balances (MBFs) per experiment. A MFB consists of two receptor-ligand-systems, which are connected in series and marked by a fluorescent dye. Because of the setup of the experiment in molecular scale every probed MFB presents still a single molecule force measurement. As a consequence one gets an enormous statistic in each experiment. This allows to resolve smallest differences of the molecular stability of two receptor-ligand-systems, like to distinguish a single SNP mismatch in a 30 base pair long DNA double strand. Based on this principle it was possible to detect different kinds of DNA-binding molecules in a range of dissociation constants from mM to pM.

Another key advantage is the possibility to parallelize the experiment: this means that different kinds of MFBs are probed in one experiment on separate spots. By means of a novel setup, which was developed in the scope of my Diploma Thesis, it was shown that an area of 5 micrometer x 5 micrometer is sufficient for a quantitative measurement. This area is comparable to the spot size of recent microarrays. Like microarray technology has spread into many areas by combining it with other techniques, a combination of both techniques could allow a quantitative genome-wide screening of DNA-binding molecules. The crucial advantage of the MFB in comparison to other methods is that no protein-specific antibodies or epitope tagged proteins are needed. In these other techniques the proteins must be directly detected by markers. In our approach the protein-DNA complex is detected by the change of the mechanical stability of the DNA.

My interest in this PhD project is to develop this combined setup of MFB and microarray for the screening of the binding-properties of transcription factors to varying DNA-sequences and under different solvent conditions. This would allow to get a better understanding in the field of gene regulation.

P.M.D. Severin, H.E. Gaub:
"DNA-protein binding force chip."
Small DOI: 10.1002/smll.201201088 (2012)

M. Strackharn, S.W. Stahl, P.M.D. Severin, T. Nicolaus, H.E. Gaub:
"Peptide-antibody complex as handle for single-molecule cut & paste"
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P.M.D. Severin, X. Zou, H.E. Gaub, K. Schulten:
"Cytosine methylation alters DNA mechanical properties"
Nucleic Acids Research 39 (20), 8740–8751 (2011)

P.M.D. Severin, D. Ho, H.E. Gaub:
"A high throughput molecular force assay for protein-DNA interactions"
Lab Chip 11, 856–862 (2011)

D. Ho, K. Falter, P. Severin, H.E. Gaub:
"DNA as a force sensor in an aptamer-based biochip for adenosine"
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"Force-driven separation of short double stranded DNA"
Biophys J. 97, 3158–3167 (2009)

D. Ho, C. Dose, C.H. Albrecht, P. Severin, K. Falter, P.B. Dervan, H.E. Gaub:
"Quantitative detection of small molecule/DNA complexes employing a force-based and label-free DNA-microarray"
Biophys J. 96 (11), 4661–4671 (2009)

2010	IDK Student Representative
2008–2012	PhD student at LMU (Physics Department) Supervisor: Prof. Hermann Gaub
2007–2008	Diploma Thesis in Prof. Hermann Gaub's group (LMU)
2006	Research Project at University of British Columbia, Canada
2002–2008	Study of Physics at LMU

The Role of DNA Modifications in Pluripotency and Differentiation

Christine S. Schmidt

In mammals, DNA methylation plays important roles in the epigenetic control of gene expression during development and differentiation and it is crucial for maintaining genomic stability. The functional significance of DNA methylation has been mainly inferred from genomic methylcytosine profiles in a limited selection of cell types and developmental stages and very little is known about how DNA methylation and DNA methyltransferases (Dnmts) actually affect transcription programs during cellular differentiation. During my PhD thesis, I elucidated the role of DNA methylation and Dnmts in pluripotency and during differentiation. Using an in vitro differentiation system which recapitulates early developmental processes in mammalian embryos – the differentiation of embryonic stem cells (ESCs) to embryoid bodies (EBs) – I determined genome-wide expression profiles of severely hypomethylated ESCs and EBs lacking one or several members of the Dnmt family and assayed their potential to transit in and out of the ESC state. Furthermore, I investigated whether Uhrf2, a protein shown to interact with Dnmts, is involved in maintaining DNA methylation patterns and developed methods to map and quantify the newly discovered 6th base of the genome, 5-hydroxymethylcytosine.

S. Bultmann, R. Morbitzer, C.S. Schmidt, K. Thanisch, F. Spada, J. Elsaesser, T. Lahaye, H. Leonhardt:
"Targeted transcriptional activation of silent oct4 pluripotency gene by combining designer TALEs and inhibition of epigenetic modifiers"
Nucleic Acids Res. doi: 10.1093/nar/gks199 (2012)

G. Pichler, P. Wolf, C.S. Schmidt, D. Meilinger, K. Schneider, C. Frauer, K. Fellinger, A. Rottach, H. Leonhardt:
"Cooperative DNA and histone binding by Uhrf2 links the two major repressive epigenetic pathways"
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"Characterization of PvuRts1I endonuclease as a tool to investigate genomic 5 hydroxymethylcytosine"
Nucl. Acids Res., 39, 5149–56 (2011)

A. Szwagierczak, S. Bultmann, C.S. Schmidt, F. Spada, H. Leonhardt:
"Sensitive enzymatic quantification of 5-hydroxymethylcytosine in genomic DNA"
Nucl. Acids Res. 38, e181 (2010)

since 2008	PhD student at LMU (Biology Department) Supervisor: Prof. Heinrich Leonhardt
2007–2008	Diploma thesis at the "National Cancer Institute, NIH", Bethesda, Maryland, USA
2006	ERASMUS student, University of Barcelona, Spain
2002–2008	Studies of Biology at the University of Würzburg

Nanostructured Interfaces for Hybrid Solar Cells

Jonas Weickert

My research project focuses on fabrication of different TiO_2 morphologies and their application in hybrid solar cells. In-depth analysis of physical processes like charge separation, transport and recombination should provide insight into fundamental working principles of next-generation solar cells. Limitations should be identified to infer pathways towards highly efficient hybrid devices. Design rules concerning the ideal morphology should be revealed and might be applicable also for fully organic solar cells.

The project is carried out in collaboration with the groups of Prof. Christina Scheu (LMU Munich), Prof. Thomas Bein (LMU Munich) and Prof. Judith MacManus-Driscoll (University of Cambridge).

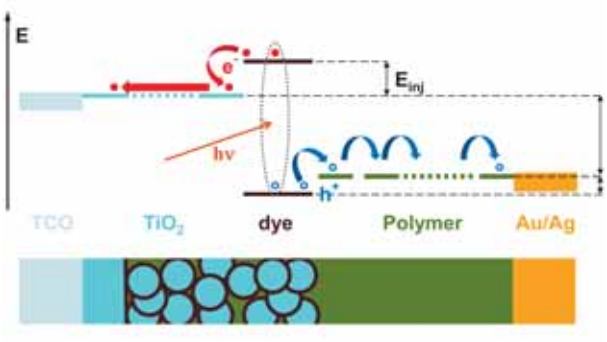

Figure 1 Geometry of a typical hybrid solar cell comprising a film of mesoporous TiO_2 covered with a monolayer of dye molecules and infiltrated with a hole conducting conjugated polymer.

A. Wisnet, M. Thomann, J. Weickert, L. Schmidt-Mende, C. Scheu:
"Nanoscale investigation on large crystallites in TiO_2 nanotube arrays and implications for high-quality photodiodes"
J. Mater. Sci. 47, 6459 (2012)

H. Sun, J. Weickert, H.C. Hesse, L. Schmidt-Mende:
"UV light protection through TiO_2 blocking layers for inverted organic solar cells"
Sol. Energ. Mat. Sol. C. 95, 3450 (2011)

J. Weickert, F. Auras, T. Bein, L. Schmidt-Mende:
"Characterization of Interfacial Modifiers for Hybrid Solar Cells"
J. Phys. Chem. C 115, 15081 (2011)

M. Al-Hussein, H.C. Hesse, J. Weickert, L. Dössel, X. Feng, K. Müllen, L. Schmidt-Mende:
"Structural Properties of the Active Layer of Discotic Hexabenzocoronene/Perylene Diimide Bulkhetero Junction Photovoltaic Devices: The Role of Alkyl Side Chain Length"
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H.C. Hesse, J. Weickert, C. Hundschell, X. Feng, K. Müllen, B. Nickel, A.J. Mozer, L. Schmidt-Mende:
"Perylene sensitization of fullerenes for improved performance in organic photovoltaics"
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J. Weickert, R.B. Dunbar, H.C. Hesse, W. Wiedemann, L. Schmidt-Mende:
"Nanostructured Organic and Hybrid Solar Cells"
Adv. Mater. 23 (16), 1810–1828 (2011)

J. Weickert, C. Palumbiny, M. Nedelcu, T. Bein, L. Schmidt-Mende:
"Controlled Growth of TiO_2 Nanotubes on Conducting Glass"
Chem. Mater. 23 (2), 155–162 (2011)

J. Weickert, H. Sun, C. Palumbiny, H.C. Hesse, L. Schmidt-Mende:
"Spray-deposited PEDOT:PSS for Inverted Organic Solar Cells"
Sol. Energ. Mat. Sol. C. 94, 2371 (2010)

H.C. Hesse, J. Weickert, L. Dössel, X. Feng, K. Müllen, L. Schmidt-Mende:
"Discotic Materials for Organic Solar Cells: Effects of Chemical Structure on Assembly and Performance"
Sol. Energ. Mat. Sol. C. 94, 560 (2010)

since 2010	PhD at LMU (Physics Department) Supervisor: Prof. Lukas Schmidt-Mende (now Universität Konstanz)
2009–2010	Diploma Thesis in Prof. Lukas Schmidt-Mende's group (LMU)
2007–2008	Studies in Statistics (Vordiplom 2008), LMU
2006–2009	Studies in Physics, LMU
2004–2006	Studies in Physics, FAU Erlangen

Modified Messenger RNA and its Application in Bone Tissue Engineering

Mehrije Ferizi

The focus of my work will be the preparation of "SNIM RNA" (stabilized, non-immunogenic messenger RNA) as a novel therapeutic entity for transcript therapies. In brief, chemically modified ribonucleotides are used to prepare "SNIM RNA". Further these molecules are going to be optimized in terms of stability, non-immunogenicity and in terms of protein production level when transfected into target cells. The optimization is based on a biological selection procedure; establishing optimized nanotechnological delivery systems, such as magnetofection, for the molecules in cell culture. Magnetofection is defined as nucleic acid delivery under the influence of a magnetic field acting on nucleic acid vectors that are associated with magnetic nanoparticles.

First preliminary transfections studies of SNIM RNA in two different cell types using magnetofection were already performed. Until now the results show different expression profiles. On the one hand transfection studies with the magnetic lipoplexes using SM4-31 as transfection reagent demonstrated significant dose-dependent improvement of the target protein expression after magnetofection. On the other hand transfections studies with NIH 3T3 cells using Dmrie-C instead of SM4-31 showed an improvement after 96h using the same nanotechnological delivery system. For that purpose further studies regarding formulation, binding affinity and internalization has to be investigated.

In the next step the best molecules in terms of long-term expression and in acting less immunogenic are going to be selected. Afterwards mesenchymal stem cells are transfected with these molecules by magnetofection to induce osteogenic differentiation. Finally the differentiated stem cells are loaded into different biomaterials first and then tested in the animal model we select.

since 2011	PhD student at TUM (Medical Department) Supervisor: Prof. Christian Plank
2009	Diploma Thesis in the groups of Prof. Ernst Müllner (FH Campus Wien) and Prof. Achim Krüger (TUM)
2004–2009	Diploma (FH) in Biotechnology, FH Campus Wien, Austria

Single Molecule Cut-and-Paste in Zero-Mode-Waveguides

Stephan Heucke

My research interest lies in the manipulation of light by metallic nanostructures and their application in enzymological research.

After starting my PhD with fundamental research on metamaterials, arrays of sub-wavelength metallic resonators designed to have artificial optical properties, I soon decided to join Prof. Gaub's group, where these powerful possibilities can be applied in biological research.

Here I am working on zeromode-waveguides (ZMW). These are sub-wavelength nano-holes in opaque metal films. Their dimensions are designed so that light cannot be guided through these apertures. However, due to the wavelike nature of light and plasmonic coupling to the metal, the incident light penetrates into the holes for just a few nanometers thus creating a very small illuminated volume at the hole's bottom. This illuminated volume is 1000 times smaller than any focal volume created by conventional optical lenses. So when used in fluorescence microscopy as observation volume, illuminated ZMWs also allow to observe single-molecules at label concentrations 1000 times higher. These concentrations had previously been out of reach for fluorescence techniques and so ZMWs have opened up new possibilities in research and technology. One example thereof is a ZMW-based technique for DNA-sequencing, called SMRT, that belongs to the most promising in that rapidly evolving area.

My particular aim is to establish a method where the nanoscopic tip of an atomic-force microscope (AFM) can be used to perform mechanical manipulations in ZMWs. On the one hand, this extends the applications for ZMWs to the field of force-spectroscopy and on the other hand- in return – allows the precision and potential of an AFM to be used to further characterize and improve ZMWs.

Together in a team of colleagues, we recently managed to observe fluorescent binding of a substrate to an enzyme force-activated by the AFM in a ZMW. In another experiment, we were able to use the AFM like a nanoscopic tweezer and transport single molecules into a ZMW. This technique called single molecule cut-and-paste (SMCP) can be used to overcome the key challenge with ZMWs: the immobilization of exactly one molecule of interest in their center.

Currently we are using SMCP to deposit fluorescently labeled DNA at designated positions within the waveguides to probe their heterogenic field distribution and get a better understanding thereof.

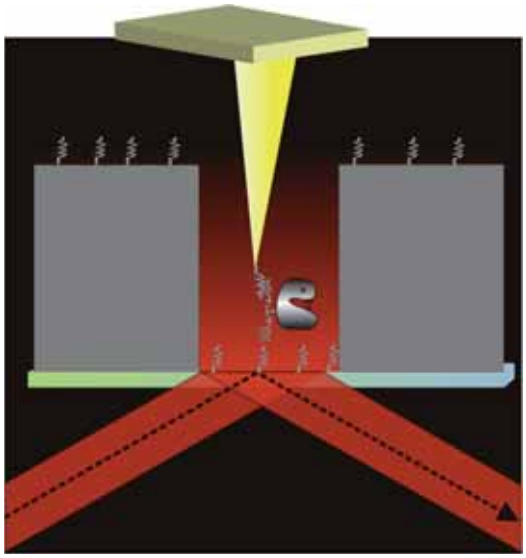


Figure 1 Single molecule cut-and-paste of a single enzyme into a zeromode-waveguide.

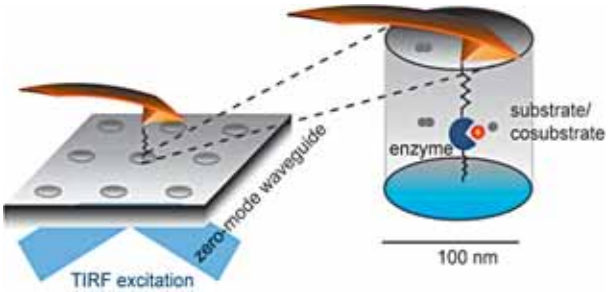


Figure 2 Schematic drawing of an experiment combining fluorescence- and force-spectroscopy of a force-activated enzyme.

D. Pippig, S. Heucke, K. Klamecka, S. Kufer, P.M. Severin, S. Stahl, M. Strackharn, and H. Gaub:
"Single molecule cut and paste for protein based functional assembly"
European Biophysics Journal with Biophysics Letters 40, 221 (2011)

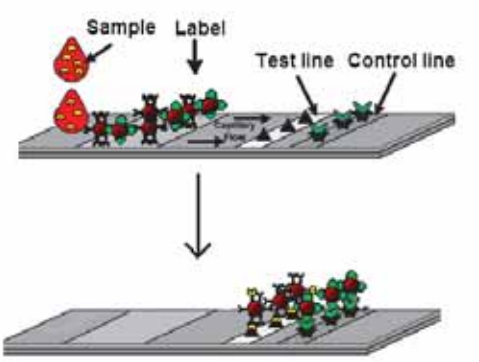
G. Acuna, S. Heucke, F. Kuchler, H. Chen, A. Taylor, and R. Kersting:
"Surface Plasmons in Terahertz Metamaterials"
Optics Express 16 (23), 18745–18751 (2008)

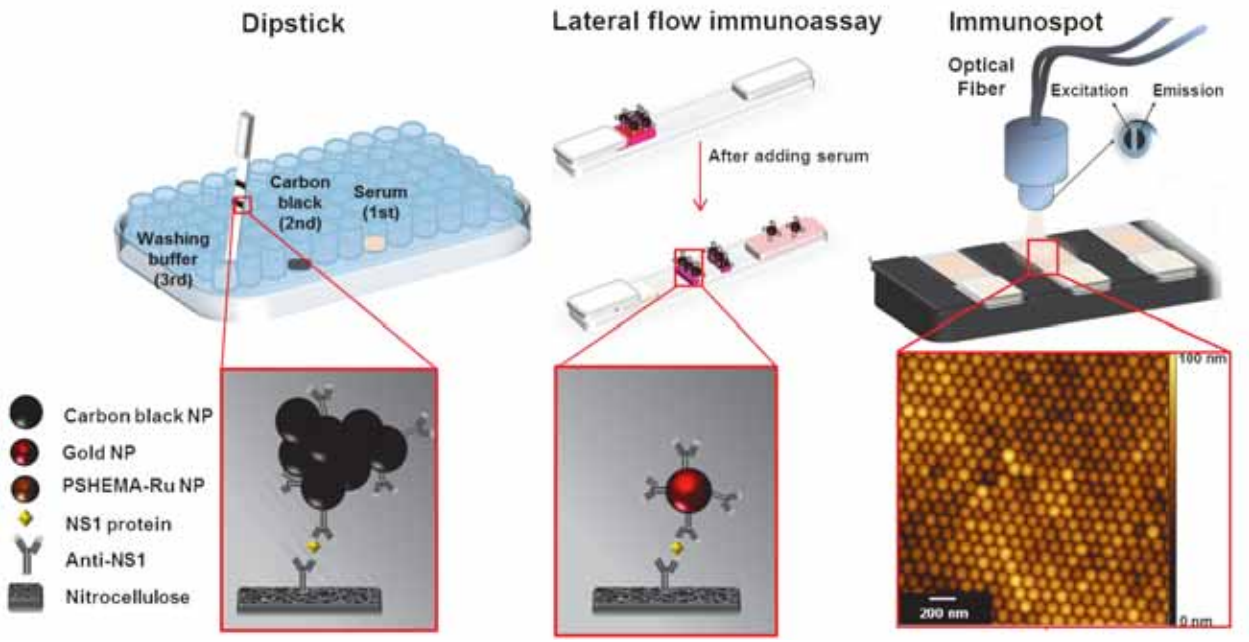
since 2009	PhD student at LMU (Physics Department) Supervisor: Prof. Hermann Gaub
2007–2009	PhD student at LMU (Physics Department) Supervisor: Prof. Roland Kersting
2006–2007	Master Thesis in the group of Professor Ifor D.W. Samuel
2006–2007	M.Sc. Program in Physics at the University of St Andrews, UK
2003–2006	Diploma in Physics at LMU

Development of a Microfluidic Diagnostic Detection Device

Elisângela Moura Linares

In emerging and developing countries, there is a necessity for new health technology development for diagnosing diseases that allow assessment of individuals at point-of-care. Based on this challenge, my project aims to develop cheap devices which detect human pathogens or track environmental related pathogens affecting developing countries. These devices are based on lateral flow immunoassay (LFIA) which follows the same principles of ELISA test. LFIA consists of multiple layer membranes with pre-loaded specific antibody and it is actuated by capillary forces. The detection system is based on real-color changes and can determine analytes at very low concentrations exploring nanotechnology tools. The advantage of this device is that it is simple, fast to use and low cost when manufactured in large scale. It is capable of being performed by unskilled operators and it provides rapid and reliable results when applied to a wide variety of point-of-care or field use applications, requiring no instrumentation or extrinsic reading assistance.





E.M. Linares, L.T. Kubota, J. Michaelis, S. Thalhammer:
"Enhancement of the detection limit for lateral flow immunoassays: evaluation and comparison of bioconjugates."
Journal of Im. Methods 375 (1–2), 264–270 (2012)

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"Electrostatic contributions in the increased compatibility of polymer blends."
Langmuir 27 (24), 15199–15205 (2011)

M.M. Rippel, E.M. Linares, F.C. Bragança, L.F. Valadares, F. Galembeck:
"Electrostatic adhesion: an effective mechanism for rubber adhesion and blending."
Journal of Adhesion Science and Technology DOI: 10.1163/016942411X579993 (2011)

E.M. Linares, M.M. Rippel, F. Galembeck:
"Clay platelet partition within polymer latex blend films: an EFTEM study"
ACS Appl. Mater. Interf. 2 (12), 3648–3653 (2010)

E.M. Linares, L.F. Valadares, C.A. Silva, C.A. Rezende, F. Galembeck:
"Molecular mapping by low-loss-energy EFTEM imaging"
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L.F. Valadares, E.M. Linares, F.C. Braganca, F. Galembeck:
"Electrostatic adhesion of nanosized particles: the cohesive role of water"
Journal of Physical Chemistry C 112, 8534 (2008)

E.M. Linares, L.P. Trombeta, A.B. Moreira, P. Sotomayor, L.T. Kubota:
"A fluorescence spot test for salicylate determination"
Analytical Letters 40, 573 (2007)

E.M. Linares, M.M. Rippel, F. Galembeck:
"Clay platelet partition within polymer latex blend films: an EFTEM study"
ACS Appl. Mater. Interf. 2 (12), 3648–3653 (2010)

since 2009	PhD student at Helmholtz Zentrum and LMU Supervisors: PD Dr. Stephan Thalhammer (Helmholtz Zentrum München) and Prof. Jens Michaelis (LMU)
2007–2009	M.Sc. Physical Chemistry, University of Campinas, Brazil
2007–2008	B.Sc. Technological Chemistry, University of Campinas, Brazil
2003–2006	B.Sc. Chemistry, University of Campinas, Brazil

A Study of Global Networks of mRNA Degradation Pathway

Mai Sun

The mRNA levels of genes in the cell are regulated both by transcription and RNA degradation. My project is focused on the study of the regulation on RNA degradation. In all tested organisms tested, RNA degradation is a prevalent activity. There are three major classes of intracellular RNA-degrading enzymes (ribonucleases or RNases). The RNases encoded by the genome often have overlapping activities, making redundancy a general feature of RNA degradation systems. With some important exceptions, mutation of a single RNA degradation enzyme does not generally result in a complete block to RNA degradation in either eukaryotes or bacteria. This redundancy presumably enhances the overall efficiency and robustness of degradation pathways.

In my research, I have optimized the adapted RNA labeling protocol of Dölken et. al. in yeast and collaborate with the bioinformaticians in Achim Tresch's group using the unpublished algorithm to calculate genome-wide the RNA half-lives, in wild type as well as in different mutants. Also, with an unpublished normalization method, we can now deal with the global RNA level dynamic changes. With the help of bioinformaticians, we are still trying to improve our method to get more precise RNA half-life data.

A. Mayer, M. Heidemann, M. Lidschreiber, A. Schreieck, M. Sun, C. Hintermair, E. Kremmer, D. Eick, P. Cramer:
"CTD tyrosine phosphorylation impairs termination factor recruitment to RNA polymerase II"
Science 336 (6089), 1723–5 (2012)

B. Schwalb, D. Schulz, M. Sun, B. Zacher, S. Dümcke, D.E. Martin, P. Cramer, A. Tresch:
"Measurement of genome-wide RNA synthesis and decay rates with Dynamic Transcriptome Analysis (DTA)"
*Bioinformatic*s, bts052 doi: 10.1093/bioinformatics/bts052 (2012)

M. Sun, B. Schwalb, D. Schulz, N. Pirkl, S. Etzold, L. Larivière, K.C. Maier, M. Seizl, A. Tresch, P. Cramer:
"Comparative dynamic transcriptome analysis (cDTA) reveals mutual feedback between mRNA synthesis and degradation"
Genome Res. 22, 1350–1359 (2012)

M. Sun, L. Lariviere, S. Dengl, A. Mayer, P. Cramer:
"A tandem SH_2 domain in transcription elongation factor Spt6 binds the phosphorylated RNA polymerase II CTD"
J Biol Chem. 285 (53), 41597–603 (2010)

S. Dengl, A. Mayer, M. Sun, P. Cramer:
"Structure and in vivo requirement of the yeast Spt6 SH_2 domain"
Journal of Molecular Biology 389 (1), 211–225 (2009)

C. Yi-Hung, M. Sun, P. Knochel:
"LiCl-Mediated Preparation of Functionalized Benzylic Indium(III) Halides and Highly Chemoselective Palladium-Catalyzed Cross-Coupling in a Protic Cosolvent"
Ang. Chemie Int. Edition 48 (12), 2236–2239 (2009)

since 2009	PhD student at LMU (Biochemistry Department) Supervisor Prof. Patrick Cramer
2007–2009	M.Sc. Biochemistry, LMU
2006–2007	Studies in Biochemistry, Freie Universität Berlin
2001–2005	B.Sc. Biology, Beijing Normal University, China

Covalent Organic Frameworks: Thin Films and New Structures

Maria Lohse

Covalent Organic Frameworks (COFs) are highly porous crystalline materials exclusively made out of light elements. COFs can be synthesized by co-condensation of boronic acids with polyalcohols resulting in porous networks. In the case of two-dimensional layered structures the network is held together in the third dimension by π-stacking. Their high thermal stability, high surface area with permanent porosity and tunable pore size make COFs interesting materials for gas storage, separation and catalysis as well as sensing applications. Recently, photoactive COFs with high charge carrier mobilities have been reported. Using electroactive organic building blocks in COF synthesis, conductive networks can be obtained. This may lead to potential applications of these materials in photovoltaic devices.

The aim of my PhD thesis is to develop conductive covalent organic frameworks with high surface areas. Special focus lies in the development of thin ordered COF films and the measurement of their charge carrier mobility.

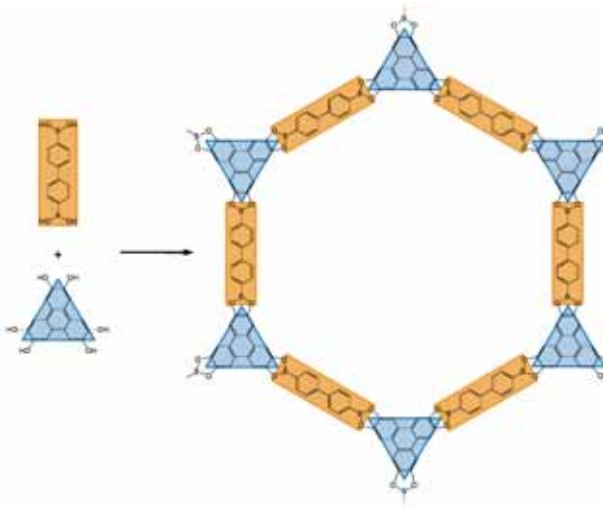


Figure 1 A covalent organic framework built up by triangular and linear building blocks. Boronic acids and polyalcohols co-condense to form a 2-dimensional hexagonal network of boronate esters.

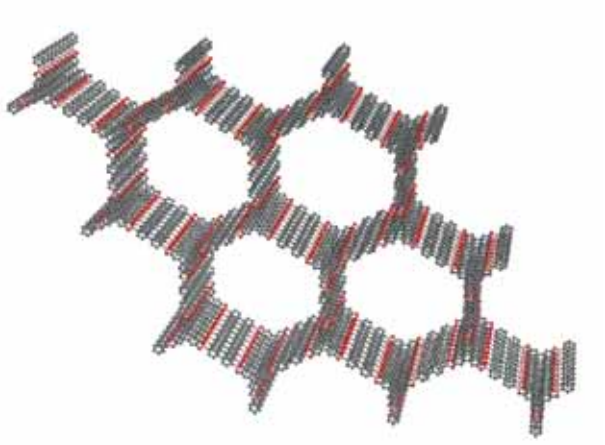


Figure 2 π-stacking between the network layers leads to 1D pores with uniform diameter.

A.S. Münch, M.S. Lohse, S. Hausdorf, G. Schreiber, D. Zacher, R.A. Fischer, F.O. R.L. Mertens:
"Room temperature preparation method for thin MOF-5 films on metal and fused silica surfaces using the controlled SBU approach"
Microporous Mesoporous Mater. 159, 132–138 (2012)

since 2011	PhD student at LMU (Chemistry Department) Supervisor: Prof. Thomas Bein
2010	Diploma Thesis, TU Bergakademie Freiberg
2009	Research Project in the group of Prof. Signe Kjelstrup; NTNU Trondheim, Norway
2005–2010	Diploma in Chemistry at the TU Bergakademie Freiberg

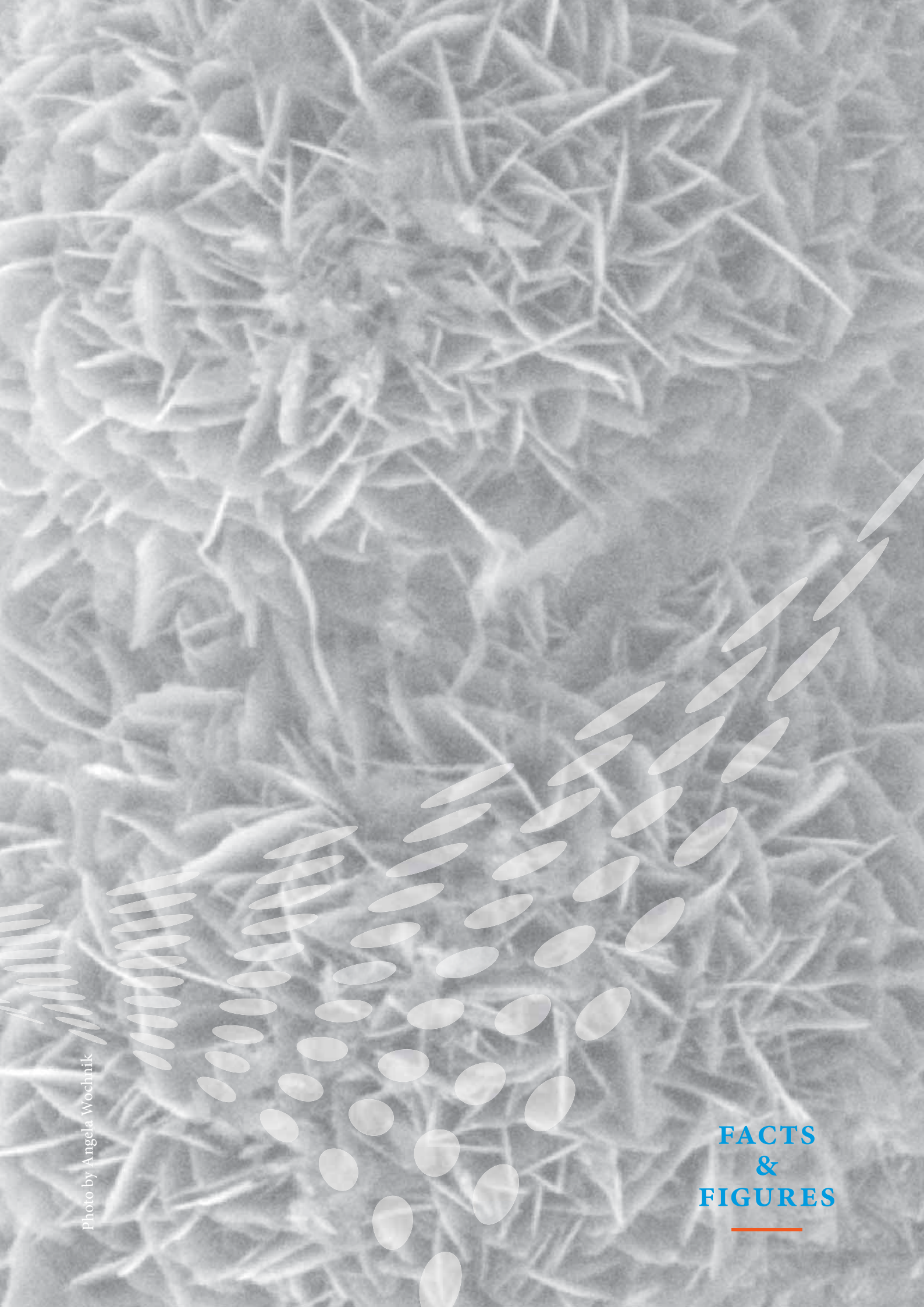


Photo by Angela Wochnik

FACTS & FIGURES

FACTS & FIGURES

Recruitment

IDK-scholarships were announced internationally, e.g., in online recruitment portals, *Science* or *Nature Jobs* and by e-mail and poster announcements. With the introduction of the GraduateCenter^{LMU} online application tool in the second funding period, the world-wide call for applications attracted even wider interest than in the years before: in 2008, about 100 applications by mail or e-mail reached the IDK, while in 2009 more than 270 candidates submitted online applications.

Due to the increase in applicants' numbers, acceptance rates decreased from 80% to only 8% of all applicants between 2004 and 2011 (→ *Chart 1*). This trend was accompanied by a constant increase in the number of female applicants. Remarkably, female applicants were, on average, more frequently accepted than male applicants (→ *Chart 2*).

The portion of international applicants was significant. On average, two thirds of all applications came from Asia, and almost 35% of the applicants were from India. The percentage of German applications that reached the IDK was around 11%. Interestingly, the percentage of non-German European applicants increased between 2008 and 2011: from below 7% in 2008 to more than 11% in 2011 (→ *Chart 3*).

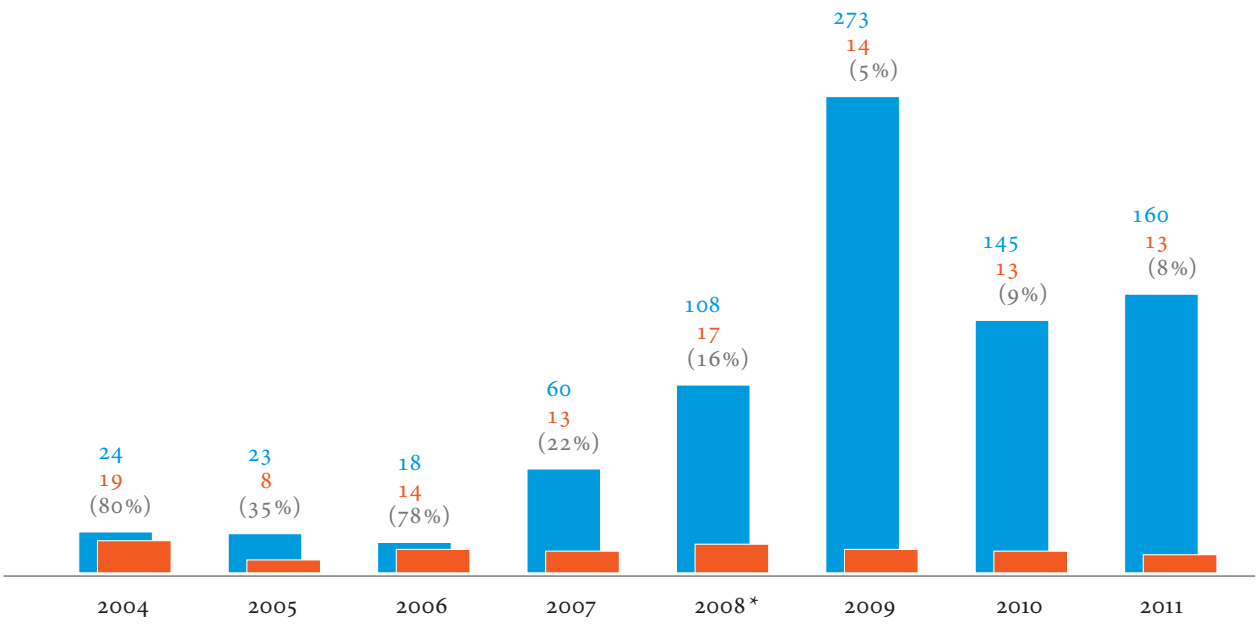
Funding

The IDK offered 12 PhD scholarships provided by the Elite Network of Bavaria. Most of the IDK members (65%) were funded by IDK scholarships for up to one year. After this time, funding was provided by the individual research groups. Some of the international students (7% of all IDK members) were financed for up to three years by the IDK. A substantial number of doctoral students (28%) were funded completely by their individual research groups throughout their doctorate.

IDK Members

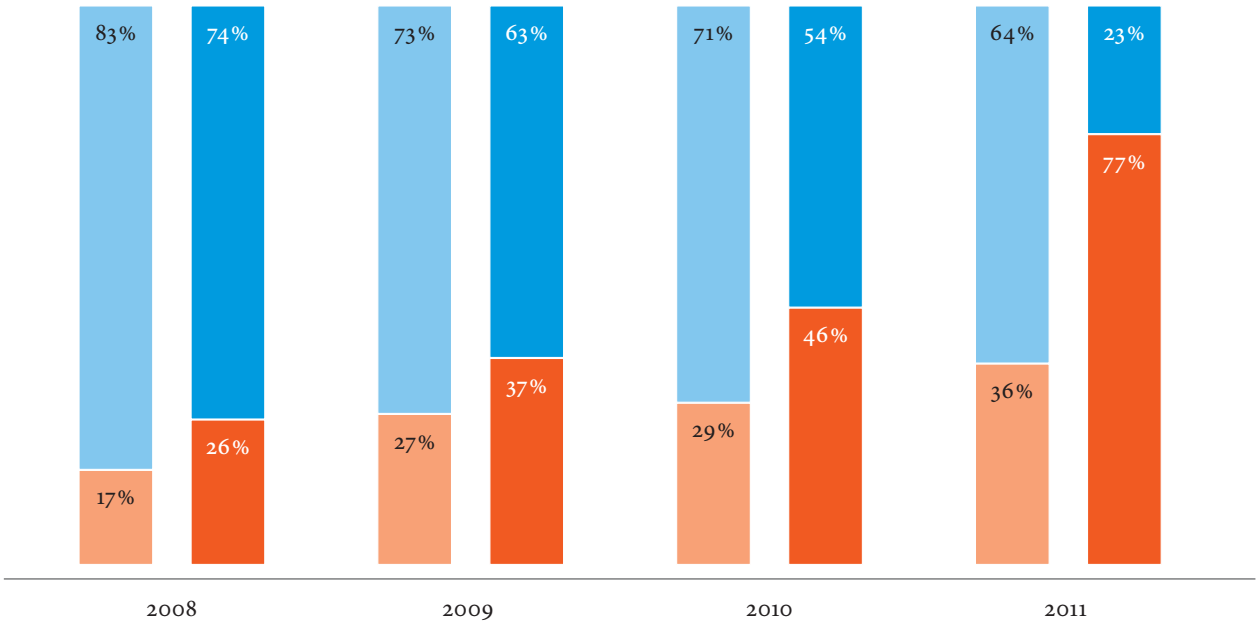
Between 2004 and 2012, the IDK NanoBioTechnology accepted a total of 111 doctoral students. On average, the IDK had 40 active members at any time. Most of them were affiliated with LMU Munich, and 10% worked in CeNS members' groups at TU München, Augsburg University or the Helmholtz

Chart 1 – Applicants–Admissions Ratio



* Introduction of online application platform.

Chart 2 – Applicants' Gender (Second Funding Period)

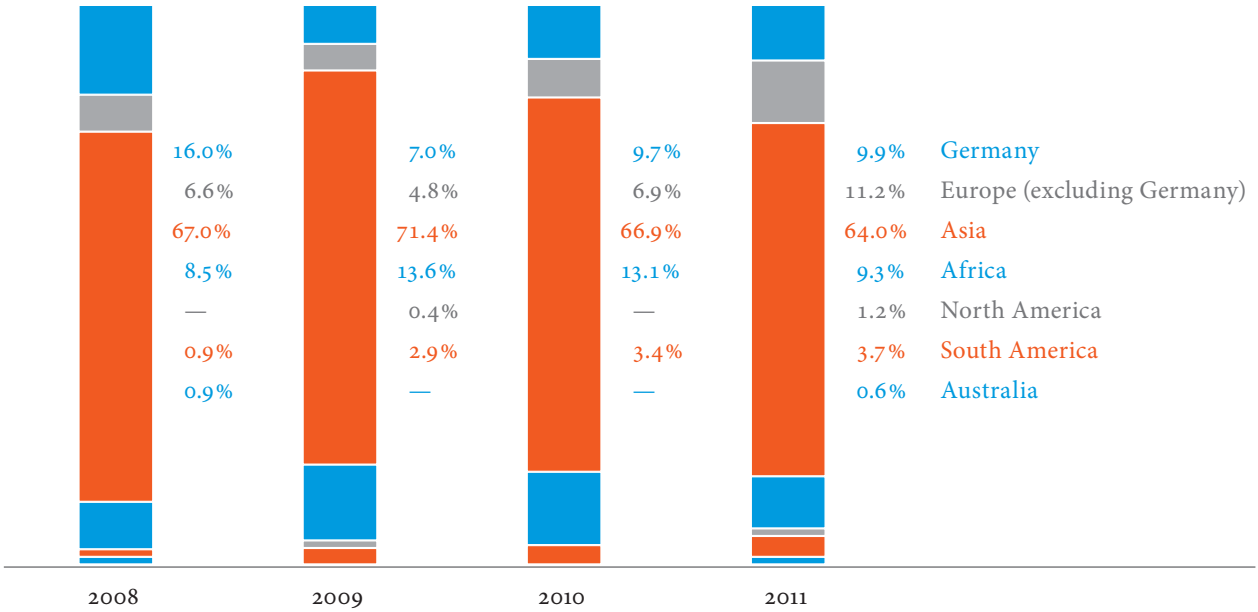


Zentrum München (→ *Chart 4*). In line with the interdisciplinary focus of the doctorate program, 57% of the members were affiliated with the Physics Department, 27% with Chemistry, 8% with Biochemistry, 5% with Biology, 3% with Geosciences, and 1% with the Medical Faculty.

The proportion of female students constantly increased from 21% in 2004 to 55% in 2012 (→ *Table 1*). This upward trend reflected the substantial increase in the number of female applicants over the last four years (→ *Chart 2*).

About 30% of all IDK members were of foreign origin. The percentage of IDK members of foreign origin rose from 21% in 2004 to 33% in 2012. Most of the international doctorate students came from European countries, followed by Asian countries (→ *Table 2*).

Chart 3 – Applicants' Origin (Second Funding Period)



Outcome

Doctorates

Between 2005 and 2012, 65 IDK students earned a doctorate (→ *Chart 6*). A high portion of IDK members received oustanding grades (→ *Chart 5*). This success reflects the efforts of the doctorate program to carefully select and optimally support ambitious and talented students.

Publications

The impressive research output of the IDK is documented by a large number of publications. In total, about 400 research papers were published between 2004 and 2012 by IDK students being first authors or coauthors. On average, every IDK member published 4 papers, of which 2 were first-author publications. A few IDK members published up to 14 research papers and up to 10 first-author publications.

65 papers were published in high-ranking journals with an Impact Factor above 10, such as *Science*, *Nature* or *Cell*, but also more specific journals like *Nature Materials, Nature Nanotechnology, Angewandte Chemie International Edition, Nano Letters, Nature Methods, Nature Structural & Molecular Biology* or *Advanced Materials*. About 50 papers had several IDK authors, underlining the intensive collaboration between the IDK members.

A list of the publications of all the IDK alumni can be found on page 71. Publications of IDK members in 2012 are listed with their research profiles (page 20–62).

Career Paths

A substantial number of the IDK graduates chose to continue their academic career paths (→ *Chart 7*) with a postdoc position, often in renowned international laboratories, such as those in Oxford, Harvard, Santa Barbara, Berkeley, Barcelona or Cold Spring Harbor. Three IDK alumni now hold positions as professors and four are junior group leaders, underlining the scientific success of the doctorate program.

IDK graduates also successfully pursue careers in industry (e.g., at BMW, Heraeus, Wacker, Linde, Carl Zeiss SMT, Novartis), in IP management or in business consulting. In addition, two companies (STS Nanotechnology and Komoot GmbH) were founded by IDK alumni.

Awards

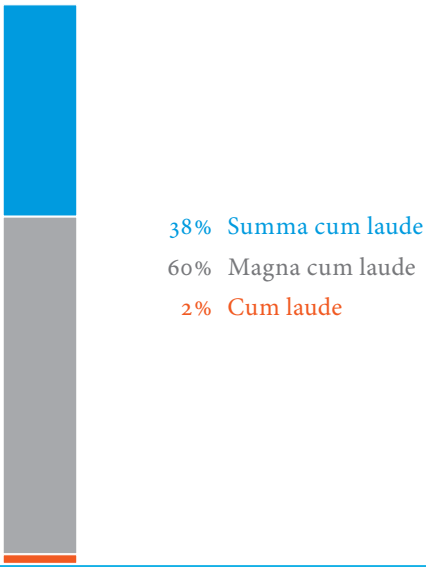
The success of the IDK members is further demonstrated by the impressive number of awards that they received (→ *Table 3*). In particular, the numerous winners of the annual CeNS publication award (awarded since 2006) represent the culture of collaborative research projects which led to joint publications by two or more CeNS groups.

FACTS & FIGURES

Chart 4 – Host Institutions (2004–2012)

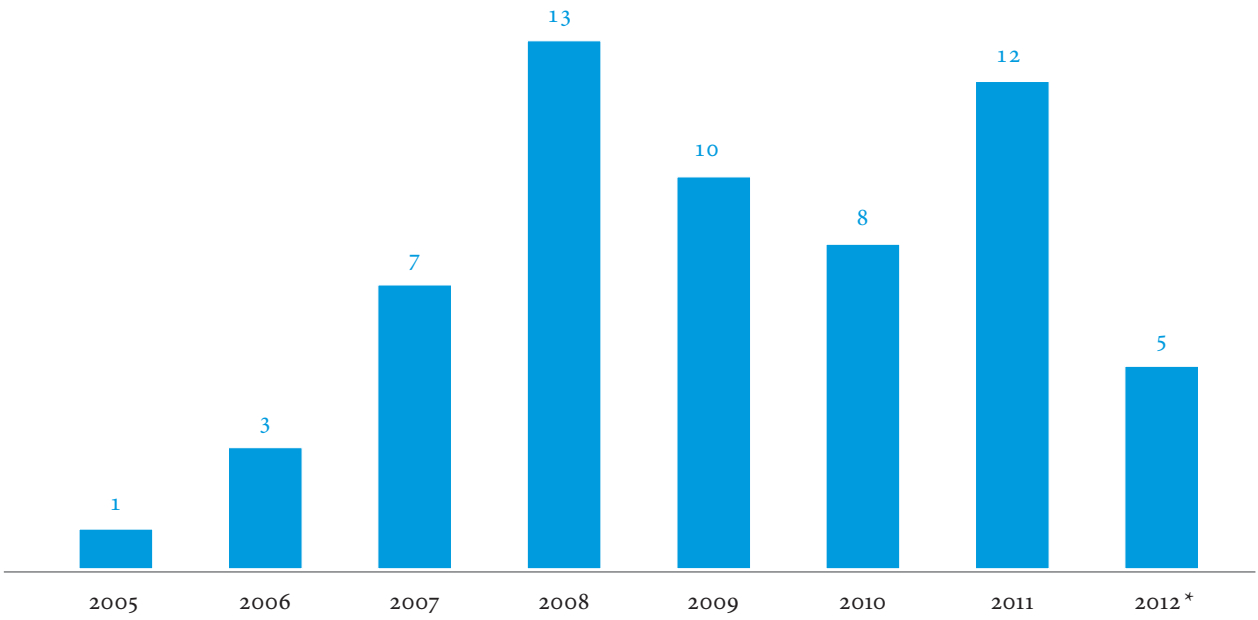
% based on 111 IDK members.

Chart 5 – Grades



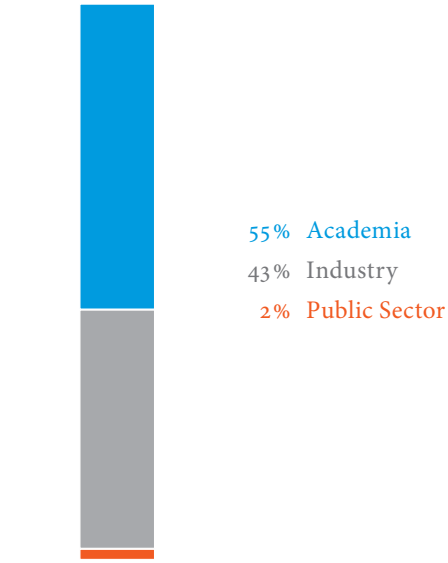
% based on 59 IDK graduates' grades.

Chart 6 – Number of Theses Completed



* Until June 2012.

Chart 7 – Career Paths



% based on 53 alumni's career entry after graduation.

Table 1 – IDK Members' Gender Ratio (2004–2012)

Gender	%
Female	37
Male	63

Table 2 – IDK Members' Origin (2004–2012)

Origin	IDK members
Asia[1]	8
Australia	2
Europe (except Germany)[2]	20
Germany	79
North America (Canada)	1
South America (Brazil)	1

1 China, India, Iran, Taiwan, Turkey.
2 Austria, Croatia, Czech Republic, Ireland, Italy, Poland, Romania, Russia, Spain, The Netherlands, Ukraine.

Table 3 – Selected Awards (2005–2012)

Year	Awards
2005	**Scientific Award BMW Group** Hendrik Dietz
2006	**CeNS Publication Award** Hendrik Dietz, Ferdinand Kühner
	Chorafas-Award Hendrik Dietz
2007	**Römer Award of the Departments of Chemistry & Biochemistry at LMU Munich** Johanna Kirstein, Claus-Dieter Kuhn
	CeNS Publication Award Klaus Becker, Johanna Kirstein, Tobias Reichenbach, Stefan Schiefer
2008	**Deutscher Studienpreis of the Körber Foundation** Hendrik Dietz
	Römer Award of the Departments of Chemistry & Biochemistry at LMU Munich Joanna Andrecka, Peter Schlüsche, Stephan Wörmke
	CeNS Publication Award Joanna Andrecka, Hendrik Dietz, Sebastian Geiger, Johanna Kirstein, Claus-Dieter Kuhn, Tim Liedl, Judith Megerle, Jan Neumann, Elias Puchner, Moritz Ringler, Uta Steinbach
2009	**Attocube-WITTENSTEIN Research Award** Elias Puchner
	CeNS Publication Award Joanna Andrecka, Julia Blechinger, Timo Lebold, Adam Muschielok, Elias Puchner, Christoph Ratzke, Anna Sauer, Thomas Sobey, Christian Steinhauer
2010	**Römer Award of the Departments of Chemistry & Biochemistry at LMU Munich** Sebastian Geiger, Adam Muschielok
	CeNS Publication Award Carina Frauer, Franz-Joseph Kaiser, Michael Lidschreiber, Christof Mast, Jürgen Neumann, Anna Sauer, Martin Sikor, Christian Steinhauer, Christoph Weber
2011	**Römer Award of the Departments of Chemistry & Biochemistry at LMU Munich** Anna Sauer, Johann Szeifert
	CeNS Publication Award Matthias Höller, Ingo Stein, Christian Steinhauer, Christoph Weber, Jonas Weickert
	CeNS Publication Award Melari Davies, Florian Feil, Ilka Kriegel, Timo Lebold, Frauke Mickler, Katrin Schneider, Ingo Stein, Christoph Weber

Alumni's Research Publications (2004–2012)

Joanna Andrecka

J. Michaelis, A. Muschielok, J. Andrecka, W. Kügel, J. Moffitt:
"DNA based molecular motors"
Physics of Life Reviews 6, 250–266 (2009)

J. Andrecka, B. Treutlein, M. Izquierdo Arcusa, A. Muschielok, R. Lewis, A. Cheung, P. Cramer and J. Michaelis:
"Nano positioning system reveals the course of upstream and nontemplate DNA within the RNA polymerase II elongation complex"
Nucleic Acids Research 37, 5803–5809 (2009)

J. Andrecka, R. Lewis, F. Brueckner, E. Lehmann, P. Cramer, J. Michaelis:
"Single-molecule tracking of mRNA exiting from RNA polymerase II"
PNAS 105, 135–140 (2008)

A. Muschielok, J. Andrecka, A. Jawhari, F. Brückner, P. Cramer and J. Michaelis:
"A nano-positioning system for macromolecular structural analysis"
Nature Methods 5, 965–971 (2008)

M. Dziedzicka-Wasylewska, A. Faron-Gorecka, J. Andrecka, A. Polit, M. Kusmider, Z. Wasylewski:
"Fluorescence studies reveal heterodimerization of dopamine d(1) and d(2) receptors in the plasma membrane"
Biochemistry 45 (29), 8751–9 (2006)

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A. Hohner, J. Bayer and J.O. Rädler:
"Wormlike lipid/DNA micelles in a non-polar solvent"
Eur. Phys. J. E 21 (1), 41–48 (2006)

J. Bayer, J.O. Rädler, R. Blossey:
"Chains, Dimers and Sandwiches: Melting Behaviour of DNA Nanoassemblies"
Nano Letters 5 (3), 497–501 (2005)

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Appl. Phys. Lett. 95 (14), 143101 (2009)

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"Anisotropic optical emission of single CdSe/CdS tetrapod heterostructures: Evidence for a wavefunction symmetry breaking"
Phys. Rev. B 77, 153303 (2008)

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"Phenylene-Ethynylene Macrocycles as Model Systems of Interchromophoric Interactions in Pi-Conjugated Macromolecules"
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E. Da Como, K. Becker, J. Feldmann, J.M. Lupton:
"How strain controls electronic linewidth in single beta-phase polyfluorene nanowires"
Nano Letters 7 (10), 2993–2998 (2007)

D. Soujon, K. Becker, A.L. Rogach, J. Feldmann, H. Weller, D.V. Talapin, J.M. Lupton:
"Time resolved Förster energy transfer from individual semiconductor nanoantennae to single dye molecules"
J. Phys. Chem. C (Letter) 111, 11511 (2007)

K. Becker, P.G. Lagoudakis, G. Gaefke, S. Höger and J.M. Lupton:
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Angew Chem Int Ed 46, 3450–3455 (2007)

M.J. Walter, J.M. Lupton, K. Becker, J. Feldmann, G. Gaefke, S. Höger:
"Simultaneous Raman and fluorescence spectroscopy of single conjugated polymer chains"
Phys. Rev. Lett. 98, 137401 (2007)

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"Photosynthese in neuem Licht"
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Nature Mat. 5, 777 (2006)

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"On-chain fluorenone defect emission from single polyfluorene molecules in the Absence of Intermolecular Interactions"
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	Dr. Jan Neumann	2007–2011	Prof. Kay-Eberhard Gottschalk
	Dr. Jürgen Neumann	2006–2009	Prof. Achim Wixforth

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	Brendan Osberg	2009–2012	Prof. Ulrich Gerland
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	Marcus Otten	2010–2012	Prof. Hermann Gaub
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	Dr. Stefan Schiefer	2004–2007	PD Dr. Bert Nickel
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	Dr. Michael Schlierf	2005–2008	Prof. Matthias Rief
	Dr. Peter Schlüsche	2004–2007	Prof. Christoph Bräuchle
	Dr. Christine Schmidt	2009–2012	Prof. Heinrich Leonhardt
	Dr. Julia Schmitz	2005–2008	Prof. Hermann Gaub, Prof. Kay-E. Gottschalk
	Katrin Schneider	2010–2012	Prof. Heinrich Leonhardt
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	Dr. Thomas Sobey	2006–2010	Prof. Friedrich Simmel

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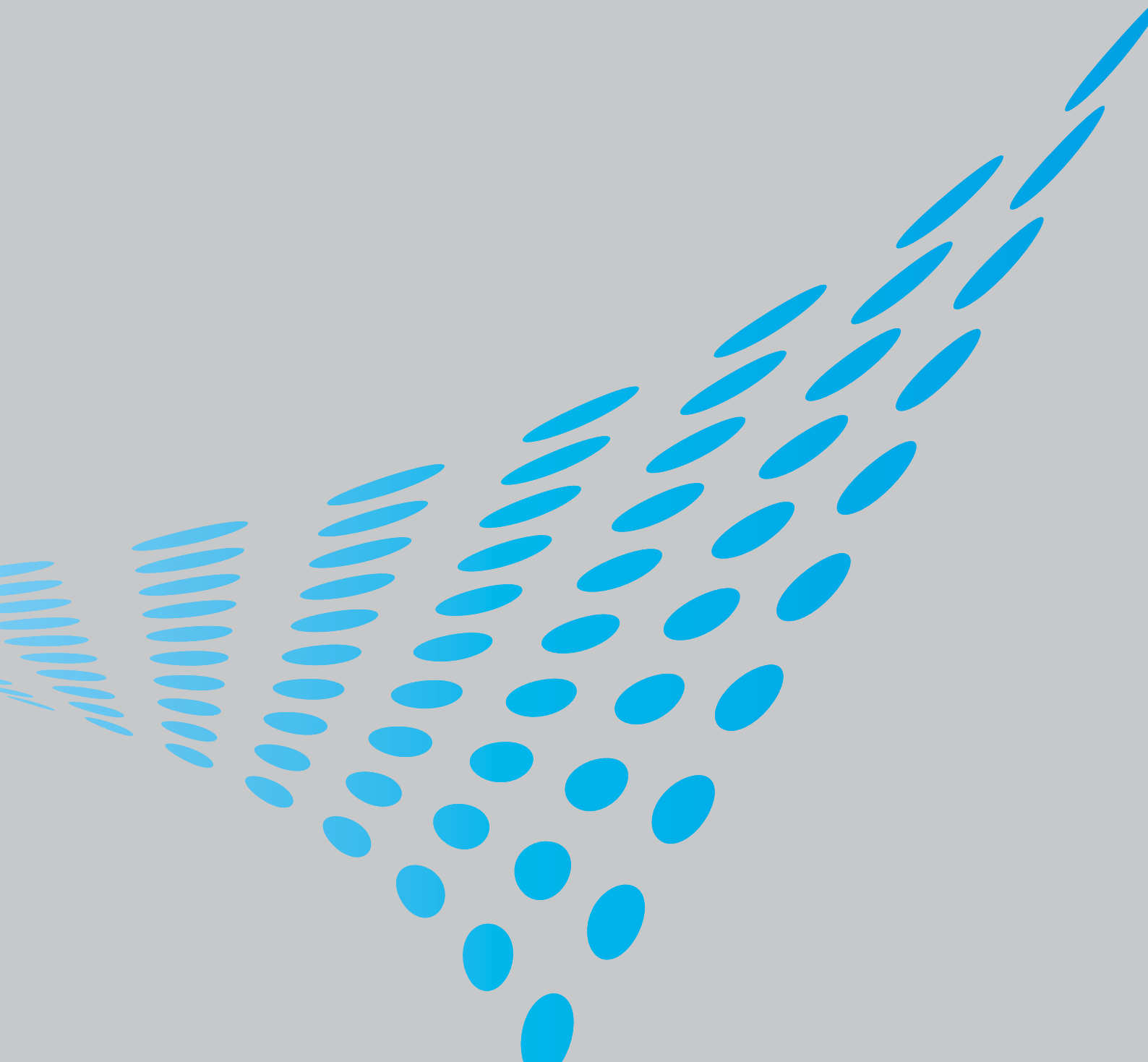

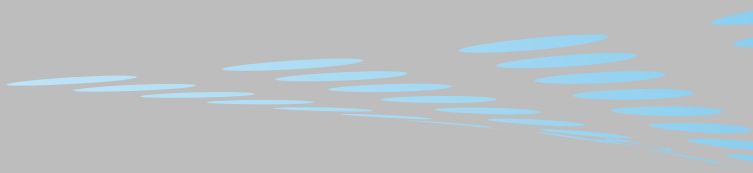

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