

# CeBiTec – Quarterly

## Winter 2019 / 2020



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### **13<sup>th</sup> CeBiTec Symposium: Multi-Step Syntheses in Biology & Chemistry – An International Young Investigator Conference**

In the Center for Interdisciplinary Research (ZiF) at Bielefeld University the 13<sup>th</sup> International CeBiTec Symposium on “Synthetic Pathways in Biology & Chemistry – An International Young Investigator Conference” was held from December 2 to 4, 2019. This symposium was jointly organized by members of the biocatalysis research groups headed by Prof. Dr. Harald Gröger (Chemistry and CeBiTec) and Prof. Dr. Volker Wendisch (Biology and CeBiTec). In connection with their current DAAD-funded collaboration

projects with Osaka University and Chiba University, respectively, also many researchers from these institutions in Japan participated. At this conference, in total more than 60 researchers from academia and industry exchanged their views and information on current developments in the fields of tailor-made biocatalyst design and applications thereof, combination of biocatalysis and chemocatalysis as well as synthetic biology towards multi-step syntheses from both, an academic and industrial perspective. A further focus of this symposium was on emerging trends in chemistry and biotechnology with relevance also for the field biocatalysis, for example, flow-chemistry, machine learning and self-automation. As this symposium was dedicated to young

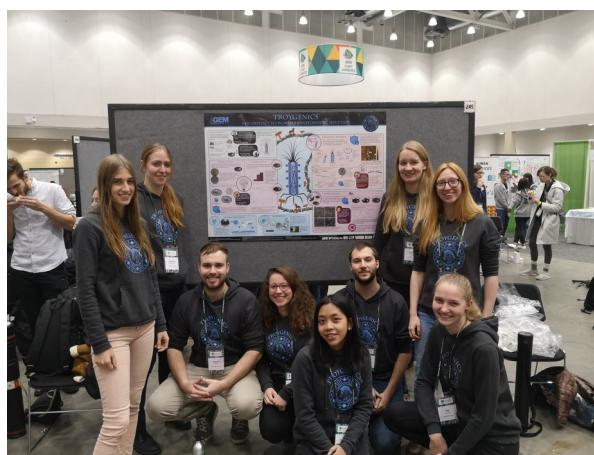
scientists with the intention to provide them with a platform to present their latest results, a major part of the lecture program consisted of presentations from young researchers with more than 20 out of 27 lectures. The keynote lectures were given by Prof. Dr. Shuji Akai (Osaka University) on the combination of metal and enzyme catalysis, Jun.-Prof. Dr. Matthias Höhne (University of Greifswald) on protein engineering of transaminases, Prof. Dr. Julia Frunzke (Research Centre Jülich/University of Düsseldorf) on engineering of *Corynebacterium glutamicum* strains, Dr. Daniel Fitzpatrick (University of Cambridge) on integrated control strategies and internet enabled tools for flow chemistry, and Prof. Dr. Hiroaki Sasai (Osaka University) on the development of chiral *spiro*-bis(isoxazoline) ligands for asymmetric chemocatalysis. The lecture program was complemented by three poster sessions with 20 poster contributions. In addition, the following young scientists were awarded with poster prizes: Hettiarachchige D. P. Wathsala (Osaka University) and Andreas S. Klein (Research Centre Jülich/University of Düsseldorf) received the two poster prizes sponsored by the scientific journal *Catalysts*, and Ann-Christin Moritzer (Bielefeld University) was awarded a poster book prize donated by the scientific publisher WILEY-VCH. In addition to sharing exciting research contributions in the lecture and poster sessions, the conference participants enjoyed the intensive networking and stimulating discussions during the conference days at the ZiF and at the conference dinner.



(H. Gröger)

## The CeBiTec iGEM Jubilee Team Successful at the Finals in Boston

Another successful iGEM year is over and the 10<sup>th</sup> CeBiTec team won a gold medal at the finals in Boston once again. Last years project was aimed at eukaryotic cells, especially eukaryotic pathogens like fungi. By modifying the *Escherichia coli* bacteriophage M13, a transformation shuttle should be developed. The so called Troygenics form an easily adaptable but at the same time safe platform system to transform simple eukaryotic cells like the model organism *Saccharomyces cerevisiae*.



Besides winning a gold medal, this project attracted a lot of interest at the Jamboree in Boston. The team and the project were nominated for several special awards like the track prize in “foundational advance”, which honours the best project, the prize for best hardware and the prize for the best new basic part. Additionally, the team was awarded with a special nomination in the field of biosafety and biosecurity for outstanding efforts to make the Troygenics as safe as possible.

Another award the team brought home was the prize for best measurement. With this prize the development and establishment of a novel iGEM standardization method for the measurement of red fluorescing proteins was honoured.

All in all, the iGEM team Bielefeld-CeBiTec 2019 was able to continue the series of success the first team started ten years ago in 2010.

But, apart from the prizes and the medals, nine young students had the chance to improve their lab skills, learn about project management, grow with their self-determined tasks and gain insight in real scientific work. Finally, they were able to represent the CeBiTec among very prestigious universities all around the world.

(J. Opgenoorth, iGEM team Bielefeld-CeBiTec)

### **teutolab-Academy Systems Biology 2019**

From October 14 to 18, 2019, the *teutolab*-academy titled “Systems Biology – Biological Experimentation and Mathematical Modelling” took place at the students laboratory *teutolab*-biotechnology at Bielefeld University. The project week was aimed at particularly interested and motivated high school students.

For a week, the 20 participants dealt with systems biology. The main topic was a highly intensive examination of the *lac* operon. In a growth experiment, the influence of the presence or absence of various sugars on the bacterial growth and the activity of different genes were investigated. Furthermore, the enzyme activity was determined photometrically. With the collected data,  $V_{max}$  and  $K_m$  could be determined. In addition, there was a bioinformatic analysis of the collected data. Individual aspects of the *lac* operon were modelled and simulated with the software CellDesigner.



The students were given a direct insight into the research field of systems biology through laboratory tours and lectures. At the end of the week, a final symposium was held to present the student’s results.

The academy was financially supported by the Joachim Herz Foundation, Hamburg. The next *teutolab*-academy will take place during the autumn holidays of 2020 and we would be happy to welcome more listeners to the symposium.

(A. Wenzel)

### **Distinguished Lecture by Bärbel Friedrich**



An inspiring talk with the title “Contribution of bioenergy to the supply of CO<sub>2</sub> neutral energy sources” was given by Prof. em. Dr. Bärbel Friedrich from the Humboldt University (Berlin) in the CeBiTec Distinguished

Lecture Series on January 13, 2020. The large audience in the lecture-hall of the Center for Interdisciplinary Research (ZiF) consisted of scientists and students from a pleasing broad range of disciplines. Prof. Friedrich presented data about the energy consumption in Germany, the application and innovation of different sources and about their future perspectives with a focus on biomass-derived bioenergy, wind energy and photovoltaic. Furthermore, she commented on perspectives of advanced techniques aiming at the efficiency improvement of photosynthesis by molecular engineering as well as at the development of artificial photosynthesis devices as CO<sub>2</sub> neutral produced fuel sources. After the lecture, Prof. Friedrich answered questions to the audience during a stand-up reception.

(S. Weidner)

### **The CeBiTec Welcomes Cooperation Partners from Palacký University in Czech Republic**

In the context of the Research Group Linkage Programme a collaborative project has been funded by the Alexander von Humboldt Foundation between the research groups of Prof. Dr. Karsten Niehaus (Biology and CeBiTec) and

Prof. Dr. Jozef Šamaj from Palacký University in Czech Republic. Prof. Šamaj and other members of the Department of Cell Biology at Palacký University, Prof. Dr. Miroslav Ovečka, Dr. Olga Šamajová and Assoc. Prof. Tomáš Takáč, paid a visit to CeBiTec from September 16 to 19, 2019, to attend the project workshop and meeting. The main focus of this workshop was to give the collaboration partners insight into the non-imaging metabolomics, as well as MALDI-MS imaging, that are well established at CeBiTec. On September 16, Prof. Šamaj in the CeBiTec Colloquium presented the study on interplay between mitogen-activated protein kinases (MAPKs) and cytoskeleton carried out with advanced microscopy. In the course of the stay, the guest researchers made also a visit to the Department of Biomolecular Photonics (Prof. Dr. Thomas Huser, Bielefeld University) and to the *Max Rubner-Institut* in Detmold, presenting further possibilities for the long-term collaboration.

(K. Niehaus)

## Tracing evolution of a complex trait using constraint-based modelling

Evolution of complex traits such as C4 photosynthesis by definition occurred in the past, in this case more than 8 million years in the past, and is thus inaccessible to traditional experimental methods. However, by encoding the trait in models which then can be optimized for different scenarios, we can test for likely pathways which evolution took. Dr. Mary-Ann Blätke (*Leibniz-Institut für Pflanzengenetik und Kulturpflanzenforschung in Gatersleben*) and Prof. Dr. Andrea Bräutigam (Biology and CeBiTec) decided to encode the ancient trait, typical C3 photosynthesis, in a constraint based model (also sometimes called FBA models). This work recently has been published in eLIFE. These models require a map of metabolism, defined inputs and defined outputs to be built. It also requires constraints based on current biological knowledge for example, one can fix the flux through a particular

pathway or make a reaction irreversible. A computer is then asked to find a path through the metabolic map that connects inputs to outputs. There will be many possible paths and hence the solution space is enormous. That is why the model is optimized for particular objectives, for example, it is optimized for resource use. This optimization will compel the algorithm to find the shortest path and hence the path which uses the smallest number of enzymes through the model. You could also optimize for energy use or in fact any objective which you can think of.

Our goal in the project was to learn under which conditions C4 is predicted by a constraint based model. After building a single cell C3 model we doubled it to two cells and connected them by transport reactions. We used the constraints to mimic ecological conditions under which we know C3 photosynthesis is preserved in nature. The model predicted C3 photosynthesis. We then modified the constraints to conditions present in habitats in which C4 plants are successful. Under these conditions the model predicted C4 photosynthesis. We observed this prediction not only under C limitation but also under general resource limitation indicating that there are two alternative selective pressures under which C4 could have evolved. With the model in hand, we could also modify additional conditions such as N availability, light availability and distribution in the leaf, and water availability. Using these variations in conditions, we were able to trace the particular C4 cycles with changes in enzymes catalyzing the cycle reactions under various conditions. The model suggested that changes in light and light distribution cues different types of C4 cycles.

Constraint-based modeling thus is a tool which allows us to peer into the past and understand under which conditions particular metabolic pathways evolve. Despite their complexity, eucaryotic systems are as accessible as prokaryotic systems to this powerful method. All data including all programs are provided with the

original publication to enable re-use and re-analysis of our data with minimal effort. This application of FAIR principles will create added value.

eLife 2019;8:e49305 doi: [10.7554/eLife.49305](https://doi.org/10.7554/eLife.49305)  
(A. Bräutigam)

### **Start of the EFRE Project *Interprofessionell von Anfang an: Biologie – Technik – Gesundheit* in the *teutolab*-biotechnology Students Laboratory**

In autumn, a new project started in the *teutolab*-biotechnology. With the project titled *Interprofessionell von Anfang an: Biologie – Technik – Gesundheit* (Inter-professional from the beginning: Biology – Technology – Health) the students laboratory *teutolab*-biotechnology reacts to the stronger orientation of Bielefeld University towards medical and biomedical contents.

Over the next two and a half years, new MINT (mathematics, informatics, natural sciences, technology) educational and experimental courses will be developed in the field of biomedicine. These courses reflect curricular content and are developed in coordination with institutions from the regional health industry. By contextualizing case studies and job descriptions, these courses contribute not only to MINT education but also to career and study orientation for young people.

An important part of the project is cooperation with the experiMINT students laboratory at Bielefeld University of Applied Sciences. Together with experiMINT, cooperative MINT educational offers are being developed which will take place in both students laboratories. While *teutolab*-biotechnology focusses on biomedical contexts, experiMINT covers the topics of medical and health technology. In November, all project participants met at the CeBiTec for the project kick-off. Cooperative offerings will take the form, for example, of joint project weeks, joint teacher training courses and joint project courses. The

new offers are aimed at pupils of all school types from *Mittelstufe* (from 7<sup>th</sup> class) up to *Gymnasiale Oberstufe* (up to Q2).

In total, up to eight new biomedical experimental offers will be created in *teutolab*-biotechnology, which cover relevant topics from medical diagnostics and medical research (e.g. pathogen diagnostics, characterisation of enzymatic therapeutics, cancer genetics, DNA sequencing with Nanopore technology). The first offers will be tested and evaluated as early as summer 2020.

This project is funded by EFRE (*Europäischer Fonds für regionale Entwicklung*). Other sponsors are the Joachim Herz Foundation in Hamburg and the Andreas-Mohn and Doris-Wolff Foundations in Bielefeld.

(M. Panhorst)

### **de.NBI Project Prolonged until End of 2021**

 The German Network for Bioinformatics Infrastructure (de.NBI) has been funded by the Federal Ministry of Education and Research (BMBF, *Bundesministerium für Bildung und Forschung*) since March 2015 and celebrates its fifth anniversary in February.

The joint project with 42 partners from all over Germany offers bioinformatics tools, workflows, training courses, and a federated cloud, which provides compute capacity to researchers in life sciences. Bielefeld University hosts two major components of the network. The central coordination of the network is headed by Prof. Dr. Alfred Pühler and apl. Prof. Dr. Andreas Tauch (both CeBiTec), and the Bielefeld part of the Bielefeld Giessen Resource Center for Microbial Bioinformatics in Biotechnology and Medicine (BiGi) is led by Prof. Dr. Jens Stoye (Faculty of Technology and CeBiTec). BiGi is also a location of the de.NBI Cloud.

The whole network has now been prolonged until the end of 2021 and both Bielefeld projects receive

substantial additional funding, which will strengthen the CeBiTec's reputation in bioinformatics. In the next project phase the Central Administration Office has the task to implement an ELIXIR (European life-sciences Infrastructure for biological Information) Germany coordination office to manage the German ELIXIR node and to get stronger involved in the development of bioinformatics at the European level. In the next months several new positions need to be staffed with bioinformaticians, life scientists interested in bioinformatics, and computer scientists with focus on cloud computing. BiGi has received further funding of around 1.5 million euros for hardware to upscale the de.NBI Cloud.

<https://www.denbi.de/>  
(T. Dammann-Kalinowski)

## CeBiTec Christmas Party

A few days before the fourth Sunday of Advent the entrance hall of the G building was once more the setting for the CeBiTec Christmas party. The hall was nicely decorated with a real Christmas tree, quite some lights and also a flying Santa Claus that looked benevolently at the party from above. Numerous participants from the CeBiTec groups enjoyed background music provided by Daniel Wibberg and very late in the night also from diversified playlists. The *Glühwein* as well as the *Kinderpunsch* were found to be very tasty for those who like it. However, these Christmas drinks were complemented by various soft drinks and cold beer including *Kölsch* – a must since the party was organised by the members of the GGP (Genetics and Genomics of Plants) team. In addition to traditional German Christmas cookies like *Spekulatius* and *Dominosteine* as well as some salty stuff there was finger food in various

implementations, prepared by many of the inhabitants of the G building (a big thanks for all donations!); this buffet was very well perceived by all participants. We look back to a successful end-of-the-year event with lots of fun, scientific and not that scientific discussions and would like to thank all who contributed and showed up!



(B. Weisshaar)

## Upcoming Events

- ▶ September 14 – 15, 2020 | Landwirtschaftszentrum Haus Düsse, Bad Sassendorf  
7<sup>th</sup> CeBiTec Retreat
- ▶ September 21 – 23, 2020 | Center for Interdisciplinary Research (ZiF), Bielefeld University  
10<sup>th</sup> International CeBiTec Research Conference (ICRC) on Advances in Industrial Biotechnology
- ▶ further events are announced on the [CeBiTec web page](#)

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