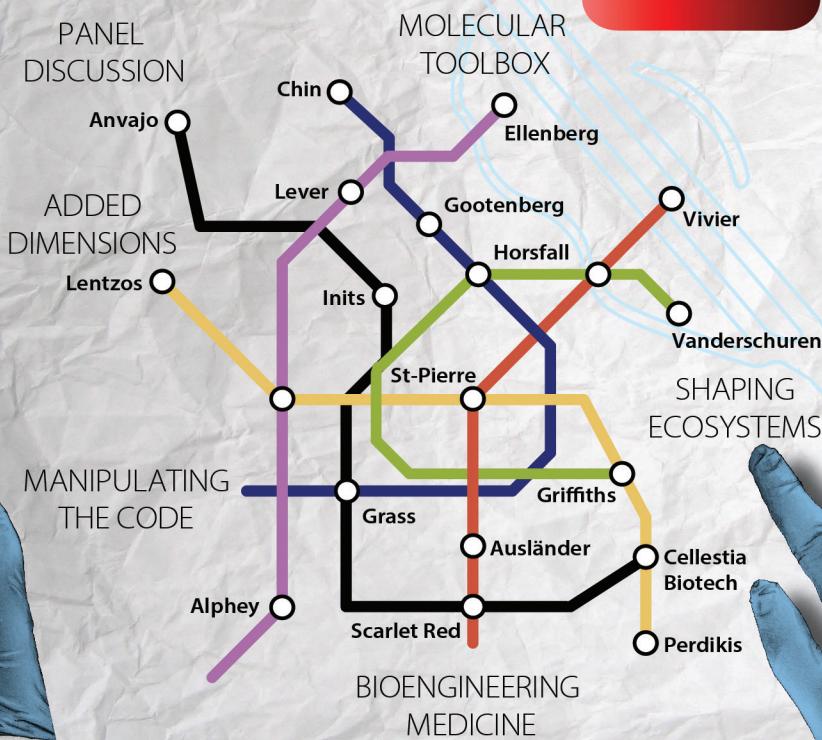


14th Vienna Biocenter PhD Symposium

3rd - 4th November 2016

MIND THE APP

Applications that Bridge Biology and Technology



Welcome to the VBC PhD symposium *MindTheApp!*

This year's symposium focuses on exploring the bidirectional bridge between technology application and scientific discovery. We have gathered exceptional researchers, with expertise in different fields, who have unconventionally applied technology to basic research or conceived an innovative application from a scientific finding. During the symposium, you will get a sneak peek into some exciting ways to make use of our molecular toolbox, how synthetic biology can be used to manipulate the genetic code, and how these findings can be applied to advancing medical care, crop management and bioremediation, as well as the potential risks that go hand-in-hand with such fast-paced biotechnological developments.

Alongside these great talks, we have organized an exciting panel discussion focused on building a start-up. Have you ever wondered if your brilliant idea could give rise to a company? Perhaps the panel discussion will give you some insights on how to go about this. Last but not least, we would like to celebrate the achievements of our institutes' PhD students!

The organizing committee



Top (Left to Right): Triin Laos (MFPL), Jillian Augustine (MFPL), Jasmin Taubenschmid (IMBA), Younes Redouane (IMBA)

Bottom (Left to Right): Madalena Reimao Pinto (IMBA), Tiffany Su (MFPL), Beata Mierzwa (IMBA), Johanna Fitz (IMP), Marina Martinic Kavur (IMP)

Welcome!



In biology we very much operate under the assumption that if we could only see things at cellular and molecular scale, we would be able to understand how life works, just as scientists in a microscopic submarine could travel through the human body in Richard Fleischer's 1966 science fiction movie "Fantastic Voyage". 50 years later this dream is beginning to become reality.

Super-resolution microscopy and cryo-electron tomography can now visualize molecular details within cells, deep sequencing and proteomic methods enable the analysis of entire genomes, transcriptomes and proteomes, and single-particle cryo-electron microscopy can reveal atomic structures of large molecular assemblies, to name just some of the techniques that have revolutionized life science research. The topic of this year's Vienna Biocenter PhD symposium is thus particularly important and of general interest. I would like to congratulate the Organizing Committee for being able to recruit such an outstanding group of world-class speakers and wish all participants an exciting meeting with lots of inspirations for new technological developments and applications.

Jan-Michael Peters, IMP Scientific Director



On behalf of all my colleagues at the GMI, I would like to welcome you to the VBC Student Symposium, which this year is devoted to the interface between technology and biology, a very fitting subject for a campus that hosts both basic research institutes and several biotech and start-up companies. The VBC PhD program is one of the glues that holds the campus together, and the student-organized symposium is an important aspect of this program. Year after year, highly successful symposia have been held, usually with a very interesting mix of speakers. This year looks to be no exception! Once again: welcome to Vienna, and I look forward to the talks.

Magnus Nordborg, GMI Scientific Director

Welcome!



A great welcome to all speakers and a big thank you to the organizers of this outstanding meeting. The PhD students have again chosen a very important and cutting edge topic bringing together the worlds of biology, medicine, and computer technologies. The technological advances in information technologies, communication, and also in biology – for instance in microscopy or genome engineering - have been absolutely mind-boggling, opening entirely new worlds of exploration and insights. These apparently disparate worlds have now started to converge, spawning new fields of research that can greatly benefit from each other. The idea that one can make DNA origamis or that DNA might one day become a storage tool for computing are just a few of the possibilities of the brave new worlds to come. It is also great to see that these issues will be discussed in an ethical context – after all, as Dostojeski already wrote in his classic “The brothers Karamasoff”: “every stick has two endings”.

Josef Penninger, IMBA Scientific Director



I would like to welcome you all to Vienna, on behalf of my colleagues at the Max F. Perutz laboratories, a creation of the University of Vienna and the Medical University. Our aim is to provide first class teaching and research, to prepare today's students for tomorrow's world. Nowhere is this more applicable than the topic of this year's symposium, Mind the App, which provides a glimpse of the future, where technology and biology serve each other, bridging the gap through clever design. As part of the education process, it is crucial than students are given the freedom to experiment from the earliest age, whether it be research, teaching or organizing a conference. The students are to be congratulated on an exemplary choice of speakers and we all look forward to lectures and discussions of methods that will surely enhance scientific discovery.

Graham Warren, MFPL Scientific Director

Welcome!



Welcome to the 14th Vienna Biocenter PhD Symposium "MindTheApp"! This year's symposium is about the dialogue between technology and scientific discoveries: what comes first? The organizing committee – composed only of PhD Students – has invited amazing speakers, who will share their perspectives on the nexus between technology and science.

Besides being an exciting Scientific Event this is an occasion where we celebrate the achievements of the amazing PhD Students at the Vienna Biocenter. In the closing session we will announce the winners of the VBC PhD and the Mattias Lauwers awards, and celebrate all students who completed their thesis work in the past academic year. Last but not least a big thank you to the organizing committee and a warm welcome to all participants, in particular those coming from other institutions/countries (133 international participants from 21 different countries): I wish you a great time at our campus and in Vienna.

Inês Crisóstomo, Scientific Training Coordinator

Download the App!

Check the program and abstracts on your phone

Google Play Store: MindTheApp



Awards

VBC PhD Award

Each academic year the Vienna Biocenter (VBC) PhD Awards are given to postgraduate students in acknowledgement of their outstanding PhD theses. The award was inspired by Renée Schroeder from the Max F. Perutz Laboratories and is supported by the research institutes involved in postgraduate education at the Vienna Biocenter. In the closing session we will announce the winners of the VBC PhD and the Mattias Lauwers awards, and celebrate all students who completed their thesis work in the past academic year.

Mattias Lauwers Award

The Mattias Lauwers Award will be given on an annual basis to the PhD student who gives the best VBC Monday seminar. The criteria for this award will reflect Mattias. He took great pride in his Monday seminars, always aiming to be the best. His talks were informative, interesting, accessible and he prepared for every conceivable question.



General Information

Registration

The registration desk is available on Thursday from 8:30am and is open for the whole day on both days. If you have any questions, do not hesitate to contact the registration desk or any of the organisers or volunteers (wearing black T-shirts with the "MindTheApp" logo).

Food and Drinks

Drinks and snacks will be served during the coffee breaks outside the IMP lecture hall. External participants will find two vouchers for lunch in their name badge. On Friday evening there will be a free dinner followed by a party in the IMP cafeteria for all attendees.

Sponsor Desks

We are very proud to be sponsored by such a wide variety of companies! Feel free to visit their stands, which are open all day on Thursday and Friday.

Visiting Vienna?

Free Vienna City maps can be picked up at the registration desk. For more information about Vienna visit the website: www.wien.info

Public Transport

The Vienna Biocenter is located in the 3rd district of Vienna and can be reached by multiple means of transport. The stop for bus, tram and S-Bahn (commuter train) is called "Sankt Marx".

Tram 71: Direction towards "Börse" takes you to the city centre in 10 to 15min and goes along the "Ring" (passing the main university building, city hall, Burgtheater, parliament, state opera).

Tram 18: Direction towards "Schlachthausgasse" leads you to the nearest U-Bahn (subway, U3) station called "Schlachthausgasse".

S-Bahn 7: Connects Sankt Marx with the airport (direction "Wolfsthal"). Trains are departing every 30min and it takes 30min to get to the airport.

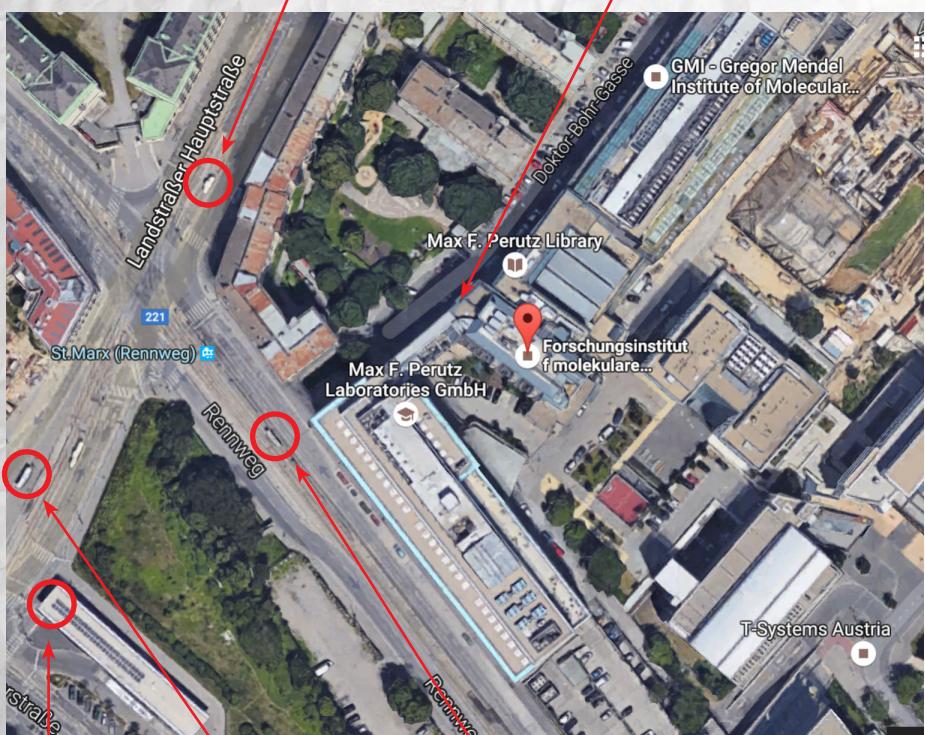
Bus 74A: Connection with city airport train (CAT, 16 min to airport), U-Bahn U3 & U4 at the stop "Landstrasse-Wien Mitte" (direction Stubentor).

More information: www.wienerlinien.at / Quando.app

Transport Map

Bus 74A
to Landstrasse / Wien Mitte

Dr Bohr Gasse 7
to PhD symposium



S-Bahn 7
to Airport

Tram 18
to Hauptbahnhof

Tram 71
to City Center

Programme

Thursday, November 3rd

08:30 – 09:30 Registration and Coffee

09:30 – 09:45 Opening Remarks

Session I: Molecular Toolbox

Chair: Marina Martinic Kavur

09:45 – 10:45 **Jan Ellenberg (Keynote Lecture)**

Systems biology of cell division using light microscopy

10:45 – 11:20 **Steve Lever**

Use of spider webs to determine the survival rate of filoviruses contained within aerosols

11:20 – 11:55 **Luke Alphey**

Genetic control of mosquitoes

11:55 – 13:15 *Lunch*

Session II: Manipulating the Code

Chair: Triin Laos

13:15 – 13:50 **Robert Grass**

Replacing T-Rex for data: Using fossilized DNA for the long-term storage of information

13:50 – 14:25 **Jonathan Gootenberg**

Beyond Cas9: Discovering single effector CRISPR tools

14:25 – 14:55 *Coffee Break*

14:55 – 15:55 **Jason Chin (Keynote Lecture)**

Reprogramming the genetic code

Panel Discussion

Chair: Beata Mierzwa

15:55 – 16:55 Anvajo (Germany)

Cellestia Biotech (Switzerland)

Identity Inside / TurboBeads / Haelixa (Switzerland)

INiTS (Austria)

ScarletRed (Austria)

16:55 – 18:00 Chat with Panelists

Programme

Friday, November 4th

Session III: Bioengineering Medicine

Chair: Madalena Pinto

- | | |
|---------------|--|
| 09:00 – 10:00 | Eric Vivier (Keynote Lecture)
Innate Lymphoid Cells: From discovery to clinical manipulations |
| 10:00 – 10:35 | Jean-Philippe Saint-Pierre
Designing bio-inspired materials for regenerative medicine |
| 10:35 – 11:10 | Simon Ausländer
Engineering of gene circuits for mammalian cell-based applications |
| 11:10 – 11:30 | <i>Coffee Break</i> |
| 11:30 – 12:30 | Serafeim Perdikis (Added Dimension)
Brain-Computer Interaction: Principles and clinical applications |
| 12:30 – 13:40 | <i>Lunch</i> |

Session IV: Shaping Ecosystems

Chair: Jillian Augustine

- | | |
|---------------|---|
| 13:40 – 14:40 | Hervé Vandeschuren (Keynote Lecture)
Stories from the lab, stories from the field: Advancing crop biotechnology |
| 14:40 – 15:00 | <i>Coffee Break</i> |
| 15:00 – 15:35 | Howard Griffiths
Can we, and should we, turbocharge photosynthesis to increase crop productivity? |
| 15:35 – 16:10 | Louise Horsfall
Microbes and metal nanoparticles |
| 16:10 – 16:30 | <i>Coffee Break</i> |
| 16:30 – 17:30 | Filipa Lentzos (Added Dimension) Chair: Jasmin Taubenschmid
The misuse of biology: Are you on your guard? |
| 17:30 – 18:30 | Mattias Lauwers Award, Graduation / VBC Awards Ceremony |
| 18:30 – 18:45 | Closing Remarks |
| 18:45 | <i>Dinner and Party</i> |



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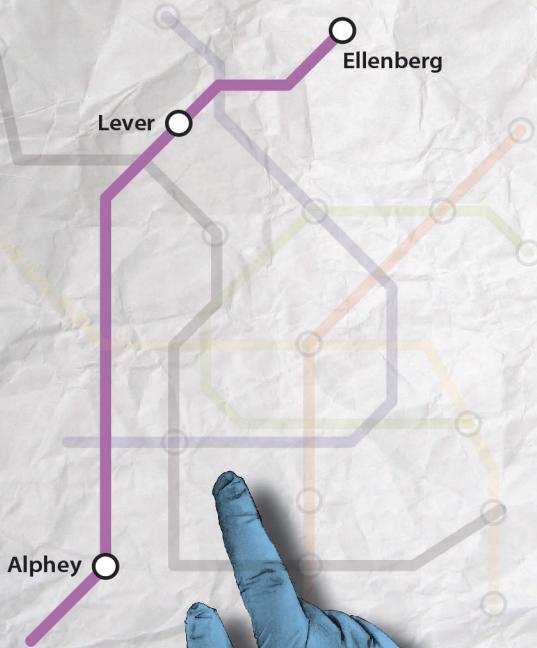
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SESSION I



MOLECULAR TOOLBOX





Jan Ellenberg

Cell Biology and Biophysics Unit,
EMBL, Heidelberg, Germany

KEYNOTE LECTURE

Systems biology of cell division using light microscopy

Cell division is fundamental to all life. In somatic cells it drives the continuous renewal of tissues, in the embryo the rapid proliferation of totipotent cells. We have developed advanced light microscopy tools to study both in a systematic and quantitative manner. Using systematic gene silencing by RNAi and subsequent phenotyping by high-throughput microscopy we have defined ~600 genes that are required for a human cell to divide faithfully during somatic mitosis. To understand the resulting dynamic protein networks and their orchestration in space and time, we have established an integrated systems biology workflow. After homozygous genome editing to tag all endogenous copies of a given mitotic protein fluorescently, we image its absolute abundance and subcellular distribution by calibrated 4D imaging relative to spatio-temporal landmarks. Computational image analysis and modeling allows us to align cell morphology in space and time to obtain a standard mitotic cell into which we can integrate all protein data. Using image parameterization and machine learning, we measure the dynamic subcellular localization as well as fluxes between subcellular compartments and structures, which enables predictions of protein clusters, the chronological order of their formation and disassembly, and the abundance of their subunits. Our integrated computational and experimental method is generic and makes many dynamic cellular processes amenable to dynamic protein network analysis. Light-sheet imaging has revolutionized our understanding of cell division during embryonic development in many biological model systems. Early mammalian development, however, remained inaccessible due to high light sensitivity and demanding culture requirements. A newly developed inverted high-throughput capable light-sheet microscope enabled the first *in toto* imaging of preimplantation mouse development from zygote to blastocyst. Using computational cell tracking, lineage tree reconstruction, and fate assignment, we revealed when fate determination happens and that chromosome segregation problems and aneuploidy is relatively common in mouse embryos.





Steve Lever

Defence Science and Technology
Laboratory (DSTL), Salisbury, UK

Use of spider webs to determine the survival rate of filoviruses contained within aerosols

The recent Ebola virus epidemic in West Africa has confirmed previous knowledge that filoviruses (Ebola virus and the closely related Marburg virus) are associated with high morbidity and mortality rates in humans. In addition, they are capable of human-to-human transmission, via infected material such as blood and other body fluids, and are believed to have low infectious doses for humans. Although Ebola virus is not naturally transmitted by the aerosol route, droplet spread may occur during an outbreak. In experimental model systems, filoviruses are able to infect via the respiratory route and are lethal at very low doses, but there is minimal information on how well filoviruses are able to survive within aerosol particles. There is also little known about how well filoviruses survive in liquids or on solid surfaces, which is important in the management of patients or samples that have been exposed to filoviruses. Understanding the ability to survive in an aerosol leads to better understanding of the hazard posed by pathogenic organisms and can inform decisions related to the control and management of disease outbreaks. Dstl have developed a method where aerosol droplets containing filoviruses can be captured using microthreads, in the form of spiders' webs, and the decay rates of different species of Ebolavirus and Marburgvirus were determined under different environmental conditions. In this presentation, data will be presented to show how the application of this technique has enabled the relative survival rate of filoviruses in aerosols and the potential infectivity of filoviruses to be determined.





Luke Alphey

The Pirbright Institute,
Woking, UK

Genetic control of mosquitoes

The rise in dengue over the past 50 years, together with recent outbreaks of chikungunya and Zika, has highlighted the lack of sustainable and efficient control of its primary vector *Aedes aegypti*. The development of genetic control has enabled the creation of possible alternative tools to traditional methods against mosquitoes either through population replacement or population suppression. We have developed synthetic genetic circuits to produce “genetically sterile” males of the target pest species. These sterile male mosquitoes (male mosquitoes do not bite or transmit disease) are released continually over a wide area to mate with the target pest population; death of progeny due to inheritance of the transgene leads to decline of the target population. A key feature is that the method is ‘self-limiting’; making it controllable, reliable and reversible, in contrast to methods where the genetic change needs to persist in the wild population. Genetic control strains based on this principle have now been developed for at least eight major insect pest species. Field trials for the lead *Aedes aegypti* strain, OX513A, have been successfully conducted in the Cayman Islands, Malaysia, Brazil and Panama. Target populations of this mosquito species were suppressed by over 90% relative to control populations, despite ongoing immigration from adjacent areas and differences in ecological and social settings. Public acceptance of the technology at the field sites has been good. Applications in agriculture and in conservation biology are also being actively considered.



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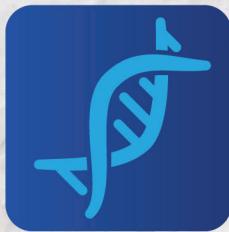


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SESSION II



MANIPULATING THE CODE



Bear 12.2016



Robert Grass

Department of Chemistry and Applied
Biosciences, ETH Zürich, Switzerland

Replacing T-Rex for data: Using fossilized DNA for the long-term storage of information

Some of the oldest information our society has access to is the genetic information of ancient species discovered in the DNA of fossil bone (up to 700'000 years old). However, DNA in solution or in our living bodies is a relatively vulnerable molecule, sensitive to light, radicals and even air (humidity). Inspired by the ancient samples we developed a chemical synthesis method for the fabrication of "Synthetic Fossils". This is a glass-like material, in which DNA is encapsulated, and in which DNA is as well protected as in the prehistoric specimens. Driven by the current developments in medical diagnostics, the cost of DNA synthesis (=writing) and sequencing (=reading) are rapidly decreasing, allowing us to envision DNA as a high-density medium for long-term information storage. Implementing a small prototype (ca. 100 kB of digital information) with error correction capabilities and simulation of long-term storage by accelerated aging, we were able to display the longevity of the data stored up to at least 1000 years. The discussion will also include the use of encapsulated DNA as tracers and as distributed sensors.





Jonathan Gootenberg

Department of Systems Biology,
MIT, Cambridge, USA

Beyond Cas9: Discovering single effector CRISPR tools

CRISPR-based molecular tools such as Cas9 have been quickly adopted into basic biology due to their re-programmability and ease of use. By expanding the CRISPR toolset to other effector proteins, we can discover new qualities such as novel PAM sequences, increased specificity, and RNA targeting. I will discuss methods for discovering and characterizing new CRISPR effectors, such as Cpf1 and the RNA-targeting effector C2c2.





Jason Chin

Centre for Chemical and Synthetic Biology,
Laboratory of Molecular Biology
(MRC-LMB), Cambridge, UK

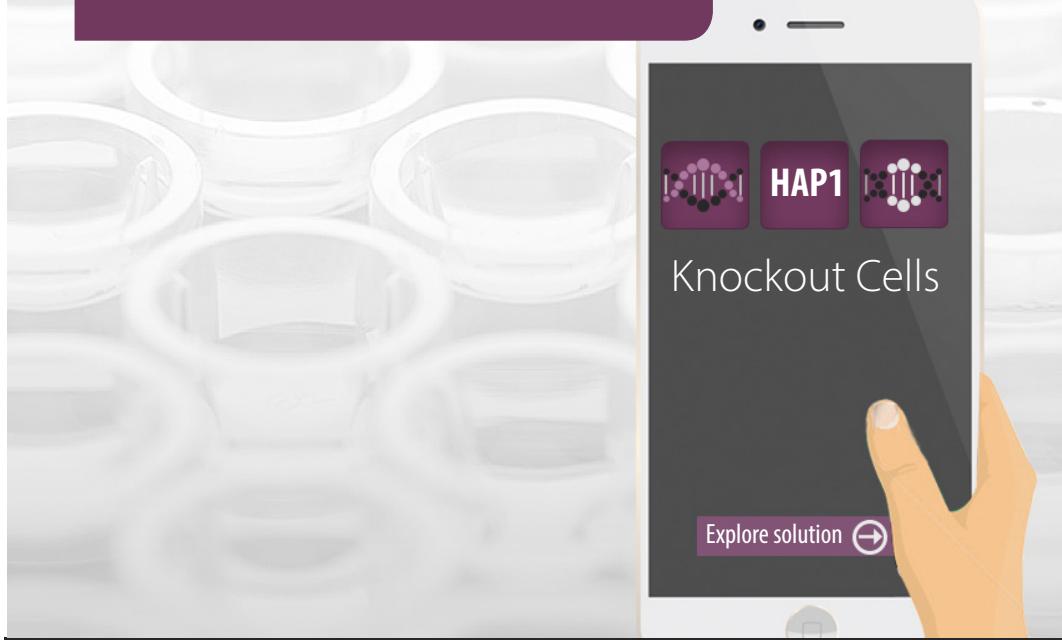
KEYNOTE LECTURE

Reprogramming the genetic code

The information for synthesizing the molecules that allow organisms to survive and replicate is encoded in genomic DNA. In the cell, DNA is copied to messenger RNA, and triplet codons (64) in the messenger RNA are decoded - in the process of translation - to synthesize polymers of the natural 20 amino acids. This process (DNA RNA protein) describes the central dogma of molecular biology and is conserved in terrestrial life. We are interested in re-writing the central dogma to create organisms that synthesize proteins containing unnatural amino acids and polymers composed of monomer building blocks beyond the 20 natural amino acids. I will discuss our invention and synthetic evolution of new 'orthogonal' translational components (including ribosomes and aminoacyl-tRNA synthetases) to address the major challenges in re-writing the central dogma of biology. I will discuss the application of the approaches we have developed for incorporating unnatural amino acids into proteins and investigating and synthetically controlling diverse biological processes, with a particular emphasis on understanding the role of post-translational modifications.



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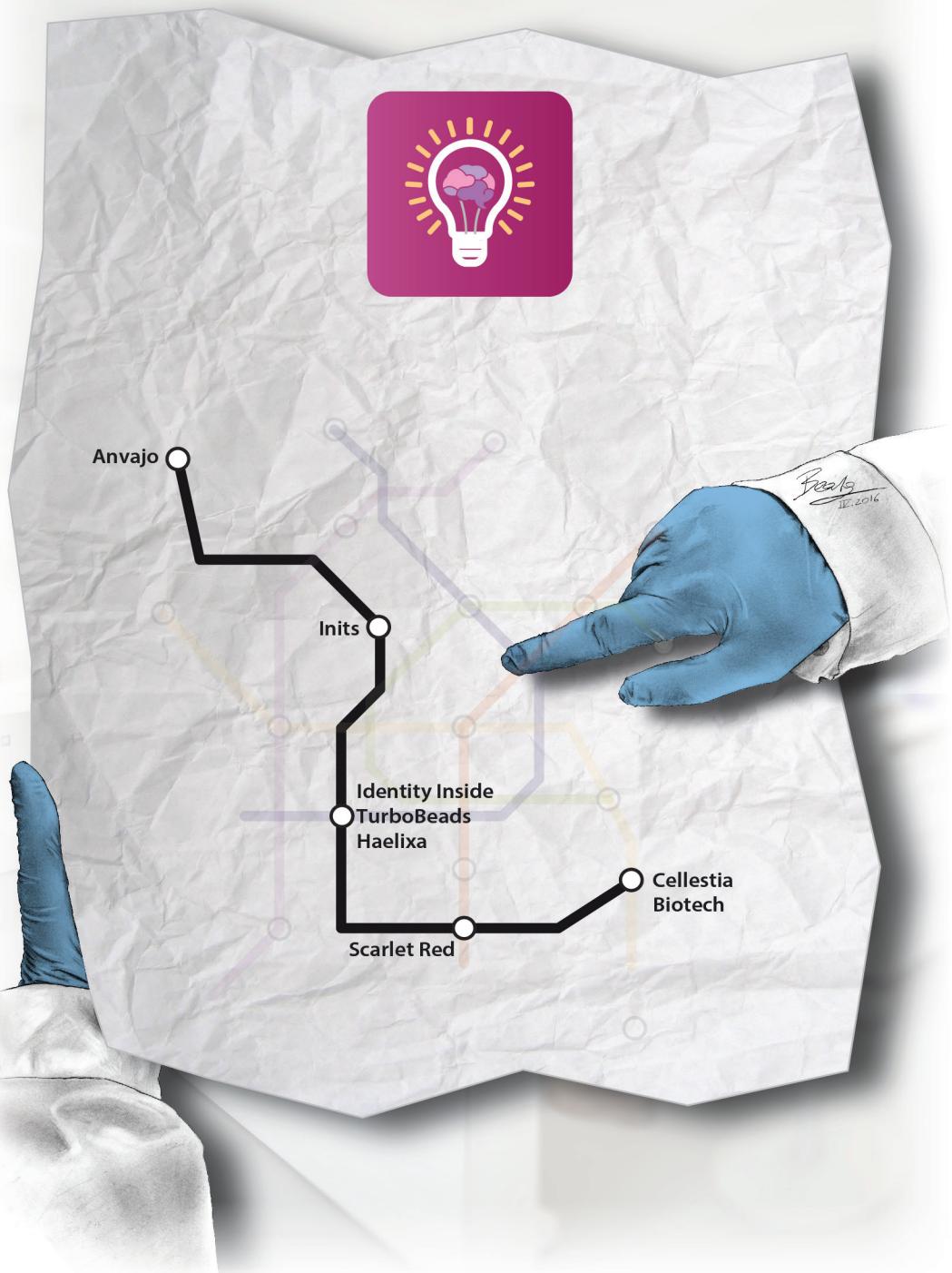
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PANEL DISCUSSION





Stefan Frädrich



Anvajo is a spin-off of the University of Technology Dresden and has developed a cutting-edge 'minilab' for home (1-drop) blood, urine, saliva and sperm testing, providing immediate results at laboratory-grade accuracy. Stefan Frädrich has started the development 5 years ago and has been supported by the TU Dresden and University Trondheim. The project has been funded by the EXIST Gründerstipendium previously and the company was then founded in January 2016, together with Stefan's co-founder and now CEO Verena Kretschmann. Anvajo has several fully running prototypes, has just conducted a first clinical validation trial and is currently raising a seed investment round.



Rajwinder Lehal



Celestia Biotech is a private biopharmaceutical company with strategic focus on anti-cancer drugs modulating the NOTCH signaling pathway. Celestia is actively engaged in the development of first-in-class mechanisms-based targeted therapeutics to address unmet medical needs, with an emphasis on oncology and immunological disorders.



Harald Schnidar



SCARLETRED is a digital health Startup standing for NextGen Dermatology. The Viennese company is honored as born global champion, with the app of the year award and proven in Silicon Valley as most disruptive MedTech newcomer. Yet after years in clinical research it is entering the global Dermatology market with its revolutionary product SCARLETRED®Vision. The CE approved medical device software platform is first in kind enabling standardized skin imaging and objective visual skin analysis. It unlocks novel Big Data, quantified-self and predictive analytics applications in a broad range of dermatologic conditions. The expert team of SCARLETRED works together with highly reputational partners and supplies the product under individual subscription model to demanding clients in health care and biopharma industry.



Robert Grass

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IdentityInside offers unique and personalized jewelry with a person's fossilized DNA inside, which can maintain its integrity for thousands of years - just as in a natural fossil!

TurboBeads makes chemically functionalized magnetic materials commercially available. TurboBeads are highly magnetic nanocarriers with covalent chemical functionalities on the surface, which allow fast and efficient separation from large liquid volumes.

Haelixa develops molecular tracers composed of encapsulated DNA sequences that can be mixed with any fluid and item, providing a unique fingerprint, which is easily identified and quantified even at very low levels.



Irene Fialka

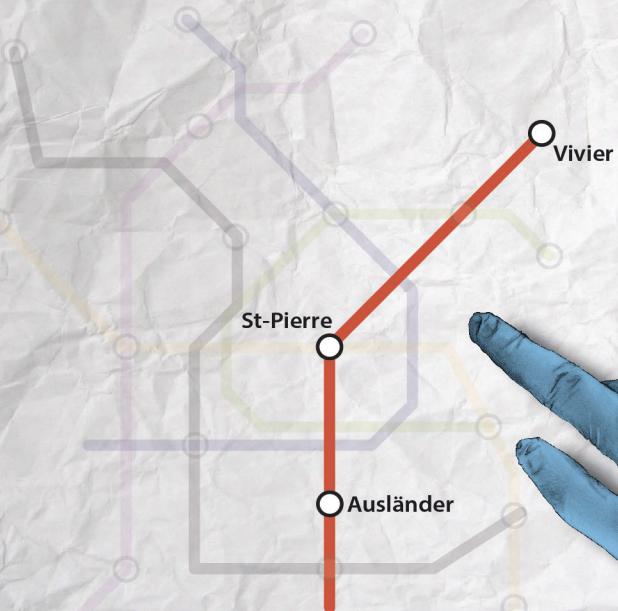
INiTS
Innovation into Business

INiTS is a business incubator designed to improve the rate of startup success in Vienna by helping young entrepreneurs conceive, launch and grow the next great company. During our intensive incubation program, startups receive hands-on support, resources, a network and an office space to bring them to the next level. INiTS has supported many successful startups since 2002 and was ranked best business incubator in German-speaking countries, 3rd best in Europe and 7th best worldwide (amongst 1,200) by UBI Index in Nov. 2015. INiTS' track record includes successes such as Dutalys, EMCOOLS, f-star, KiwiSecurity, Marinomed, mySugr, Radiant Minds, Shpock, S-target, Ubimet, Zoomsquare and many more in a broad range of industries. INiTS' 199 startups have raised over 230 Mio € of private capital (big license and exit deal volumes, such as 0,5 billion € that Roche paid for Dutalys, excluded) and 113 Mio € of additional public funds.

SESSION III



BIOENGINEERING MEDICINE



Roger
IE-2016



Eric Vivier

Centre d'Immunologie de Marseille-Luminy (CIML),
Faculty of Science Aix-Marseille University, France

KEYNOTE LECTURE

Innate Lymphoid Cells: From discovery to clinical manipulations

Innate Lymphoid Cells represent an emerging population of lymphocytes. ILCs include Natural Killer (NK) cells and three main subsets, ILC1, ILC2 and ILC3. In contrast to T and B cells, ILCs do not express antigen-specific receptors derived from gene rearrangements. Besides this major difference in their recognition repertoire, ILC and T cell subsets share striking similarities as ILC1, ILC2 and ILC3 are driven by T-bet, GATA-3 and ROR γ t transcription factors, and produce IFN- γ , IL-5/IL-13 and IL-17/IL-22 respectively. In addition, NK cells are driven by Eomes and T-bet, can be cytolytic and produce IFN- γ , inasmuch as CD8+ T cells. These common features led to suggest that ILCs might correspond to innate counterparts of T cells. Over the course of evolution, two highly parallel systems have thus emerged in which ILCs mimic the effector profile of T cell subsets. However, it is still unclear how the innate and adaptive immune systems integrate these two arms. We will review the emerging set of data showing that ILCs and T cells can exert redundant functions in nature in humans and in models of experimental disease in mice, and discuss how the overlapping functions of ILCs and T cells contribute to the robustness of immunity and hence to the fitness of the hosts.





Jean-Philippe Saint-Pierre

Faculty of Engineering, Department of Materials
Imperial College London, UK

Designing bio-inspired materials for regenerative medicine

The overarching goal of regenerative medicine is to restore tissue functions. In this talk, I will describe some of the recent advances made in The Stevens Group towards the development of novel biomaterials to achieve this goal. I will first discuss an array of projects aimed at improve osteochondral tissue regeneration with bio-inspired scaffold structures and functionalization innovations. Our work to induce cells to deposit collagen in a depth-dependent manner and to induce improved chondrogenesis via peptide-polymer conjugates, as well as hydrogels will be highlighted. In a second time, I will describe a first foray in the development of materials to mitigate tissue fibrosis. I will elaborate on our approach to identify extracellular matrix cues that are presented in response to protease released during inflammation and act as feedback loops to halt its deleterious effects and I will demonstrate how these specific biological cues can be used towards preventing tissue fibrosis. Finally, the ability to control topography and chemistry at the nanoscale offers exciting possibilities for stimulating growth of new tissue. Recent developments in this context will be discussed, with a focus on the development of nanoneedles that can be interfaced with tissues to modulate cellular responses towards *in vivo* tissue regeneration of large volumes of highly vascularized and hierarchically organized tissue.





Simon Ausländer

Department of Biosystems Science and Engineering, ETH Zürich, Switzerland

Engineering of gene circuits for mammalian cell-based applications

Synthetic gene switches provide mammalian cells the ability to fine-tune protein expression levels in an input-output relationship. Especially the design of gene switches responding to disease-related input molecules in the physiological concentration range offers great opportunities for cell-based biomedical applications. Customized mammalian cell lines engineered with such gene switches enables the detection of physiological amounts of immune cell-derived trigger molecules in human blood. Moreover, microencapsulated and implanted designer cells can also be used in cell therapy in order to autonomously detect disease states and produce a therapeutic response. The next generation of engineered mammalian cells advances from one-input to multi-input gene circuits that transform cells into sophisticated decision-making systems capable of performing complex information-processing tasks. Therefore, the components of multiple gene switches are connected to each other to build networks that follow input-programmable logic for advanced control of living cells. Post-transcriptional RNA controllers contribute to the design of large gene circuits by adding a new regulation layer and linking different transcriptional switches. In future, cells engineered with large gene circuits may logically respond to various disease-relevant input molecules at the same time thereby increasing the diagnostic precision as well as therapeutic intervention portfolio.





Serafeim Perdikis

Defitech Foundation Chair in Brain-Machine Interface (CNBI), École Polytechnique Fédérale de Lausanne (EPFL), Switzerland

ADDED DIMENSION

Brain-Computer Interaction: Principles and clinical applications

Brain-Computer Interface (BCI) technology has been established as the solution towards direct mind control by human individuals. Clinical BCI applications are the spearhead of the field and motor-disabled end-users have been shown to benefit from a variety of BCI prototypes for communication, assistive mobility, motor substitution and restoration, environmental control and, more recently, neurorehabilitation. Pre-clinical and real-world validation of current BCI prototypes are essential for identifying these principles that can alleviate the shortcomings in the state-of-the-art and maximize the added value of BCI applications. In this talk, I will provide an overview of such principles successfully applied by the CNBI laboratory of EPFL, as well as exemplary applications where those have been evaluated. Our laboratory develops non-invasive BCI systems based on electroencephalographic (EEG) signals and, thus, devoid of medical hazards, real-time, portable, relatively low-cost and minimally obtrusive. Our research is pushing forward asynchronous paradigms offering spontaneous, ecological interaction. Furthermore, we stand on the machine-learning way to BCI with emphasis on personalization and adaptability, coupled with mutual learning protocols, so that elaborate signal processing and pattern recognition methods are optimally combined with the user's learnable modulation of brain signals towards robustness and usability. Additionally, cognitive mental state monitoring is employed to shape or refine the interaction. Shared-control approaches allow smart, context-aware robotics to complement the BCI channel for fine-grained control and reduction of the user's mental workload. Last but not least, hybrid BCI designs exploit additional physiological signals to augment the BCI modality and enrich the control paradigm. The applicability and effectiveness of the aforementioned principles has been demonstrated in several exemplary applications evaluated with both able-bodied and motor-disabled end-users.



All you need for your RNA-Seq experiment



SESSION IV



SHAPING ECOSYSTEMS



Braaks
12. 2016



Hervé Vanderschuren

Department of Biology, Institute of Agricultural Sciences, ETH Zürich / University of Liège, Switzerland / Belgium

KEYNOTE LECTURE

Stories from the lab, stories from the field: Advancing crop biotechnology

The use of crop biotechnology is steadily increasing in the agrosystems of industrialized countries. Recent advances in genome editing are anticipated to further accentuate this trend. Given its potential for low input agriculture, there is a need to bring the benefits of crop biotechnology to developing and emerging countries. The challenge goes beyond the mere generation of transgenic crops because development and deployment of genetically engineered crops require local capacities and support from the authorities. In the recent years, we have used biotechnological approaches to improve cassava, the most important root crop in the tropics. Cassava production and processing suffer from several constraints, including viral diseases, drought and post-harvest deterioration. A better understanding of crop responses to biotic and abiotic stresses combined with genetic engineering approaches can be particularly instrumental to generate plants with improved traits. We have used Omics approaches to characterize cassava response to stresses and to subsequently implement biotechnological approaches for trait improvement. Smallholders and industries in cassava growing regions need traits such as resistance against cassava mosaic and brown streak diseases, prolonged shelf-life, drought tolerance, modified starch and improved nutritional content. Importantly those technologies should be implemented in local germplasm to secure impact for the local value chains. We actively collaborate with local institutions for technology transfer and assessment of cassava technologies in the field.





Howard Griffiths

Department of Plant Sciences,
University of Cambridge, UK

Can we, and should we, turbocharge photosynthesis to increase crop productivity?

A second green revolution is required for the sustainable production of foodstocks for a growing, increasingly urbanised population, at a time when farmers and food producers are faced with stagnating crop yields and an increasingly uncertain climatic conditions for crop growth. The world population also faces a crisis in terms of food consumption and health: in the developed world, 30% of food is wasted, whilst non-communicable diseases such as diabetes and coronary conditions are endemic; in the developing world, post-production food losses during storage, climatic instability and competition for potable water are already leading to local and national ethnic conflicts, disease and starvation. Whilst food redistribution could threaten economic stability, each kilo of cash crops could represent the export of around 250- 2500 kg (0.25 – 2.5 tonne) of scarce water resources from developing countries.

Against these dilemmas, several approaches have been suggested to enhance the efficiency of harvesting sunlight by crop plants, including the introduction of the C4 pathway into crops such rice, or explorations to transfer some form of an algal or cyanobacterial carbon concentrating mechanism into higher plants. The talk will present some of the fundamental insights recently into these processes, with a focus on the operation algal Chlamydomonas CCM, and progress made in expressing some of these associated components in a higher plant platform. We will also explore the tremendous advances in fundamental understanding associated with the research, the technical challenges and threats that could limit the applicability, in the context of global food security.





Louise Horsfall

University of Edinburgh, Scotland

Microbes and metal nanoparticles

Microorganisms have the potential to manufacture metallic nanoparticles, irrespective of the source of metal cations, and provide us with new particles with novel functions. To exploit this we are identifying and optimising genetic elements with an aim to increase nanoparticle production and control nanoparticle size and homogeneity; in effect standardising nanoparticle samples by using biology. Whilst developing this process we are exploring its application in the treatment of contaminated waste, water and land. For the former application we are working to remove copper from whisky distillery byproducts and for the latter application we are part of a larger collaboration aiming to financially incentivise land decontamination. After using phytoremediation to hyperaccumulate metal contaminants from the soil, plants are harvested, processed and used as a source of metals for bacterial nanoparticle synthesis. Both applications illustrate how synthetic biology might contribute to moving us towards a more circular economy.





Filippa Lentzos

Department of Social Science, Health and
Medicine, King's College London, UK

ADDED DIMENSION

The misuse of biology: Are you on your guard?

Trust in biologists is in a precarious position. Secrecy, safety breaches and controversial experiments are risking the reputation of biomedical science. At the same time, advances in biology and biomedicine are significantly eroding technological barriers to biological weapons. This lecture considers life scientists' essential part in strengthening the red line against the inadvertent and deliberate misuse of biology. It considers past biological warfare programmes to weaponize disease, the multilateral disarmament response to them, and the possibility of biological weapons use today.



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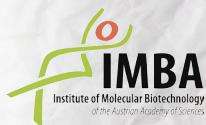
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Last but not least, a huge thank you to our amazing Volunteers!

Glimpse into the future

The VBC PhD symposium 2017 will take place on the 9th and 10th of November.

Find more information at www.vbc-phd-symposium.at

Molekularbiologie ist keine Hexerei

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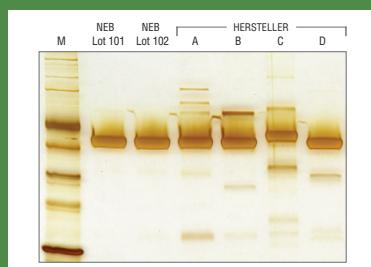
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