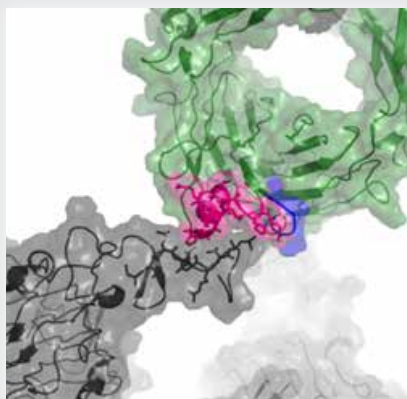
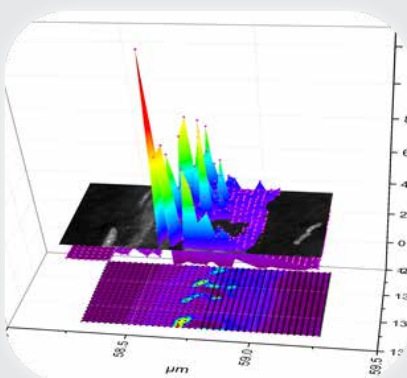
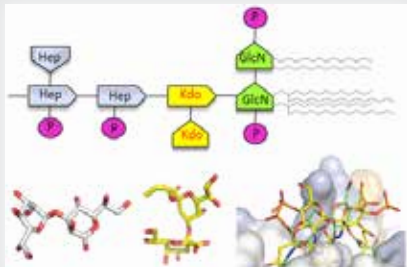
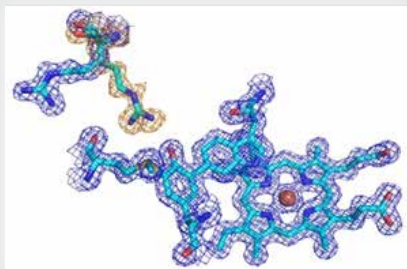


Report 2013-2015

Department of
Chemistry

Acknowledgements:

Support in data collection and proof-reading by
Univ. Prof. Paul Kosma,
ao. Univ. Prof. Iain B.H. Wilson,
ao. Univ. Prof. Paul Furtmüller, and
Dipl.-Ing. Hannelore Schopfhauser
is highly acknowledged.

Pictures thankfully were provided by department
members.

Imprint:

Publisher:

Department of Chemistry
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greenprint*
carbon positive printed



Printed according to criteria documents of the austrian Eco-Label
„printed products“ gugler*print, Melk, UWZ-Nr. 609, www.gugler.at

**University of Natural Resources
and Life Sciences, Vienna**
Department of Chemistry



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VIBT, Muthgasse 11 + 18, Vienna

Preface

Continuing a tradition since 1998, the Department of Chemistry presents a triennial summary of its activities covering the years 2013-2015. The time frame coincides with the corresponding period of the performance agreement ("Leistungsvereinbarungen") of the University of Natural Resources and Life Sciences, Vienna (BOKU) with the Federal Ministry of Science, Research and Economy (BMWFW).

Located in three buildings at two sites (Vienna and Tulln; respectively at the VIBT and UFT), about 140 persons in scientific, technical and administrative positions contribute to the excellent achievement of the department in research and teaching. The scientific areas deal with the biotechnology of proteins, all aspects of glycobiology and glycochemistry, the chemistry of renewable materials and their application in bio-economy and ultratrace analysis and fingerprinting of small molecules. The high competence in modern analytical analysis and the formidable instrumentation complete the palette of expertise. Our areas fit well into the competence fields of the university and are highly acknowledged by the international scientific community. In this report we present our research topics as well as an overview on the equipment which is nowadays the basis for state-of-the-art research.

Being a central unit for the theoretical and practical education in basic and advanced chemistry for nearly all bachelor and several master curricula of the university, the Department of Chemistry faces the challenge of an increasing number of students in spite of constant

resources. Furthermore the department is responsible for the organisation and success of the doctoral programme "BioToP", financed by the Austrian Science Fund (FWF). The adequate supervision of students at bachelor, master and doctoral level is of utmost concern of our staff.

Based on the success of the last years, we want to continue our high level of research and motivate a new generation of scientists to develop the broad field of chemistry with their curiosity and new ideas.

On behalf of the Department I want to thank all people and institutions of BOKU, cooperation partners and funding institutions for their continuous support and assistance.

A very big **THANK YOU** to all members of the Department! Our excellent performance in teaching and research is the product of many motivated and hard-working people.

Erika Staudacher
Head of Department



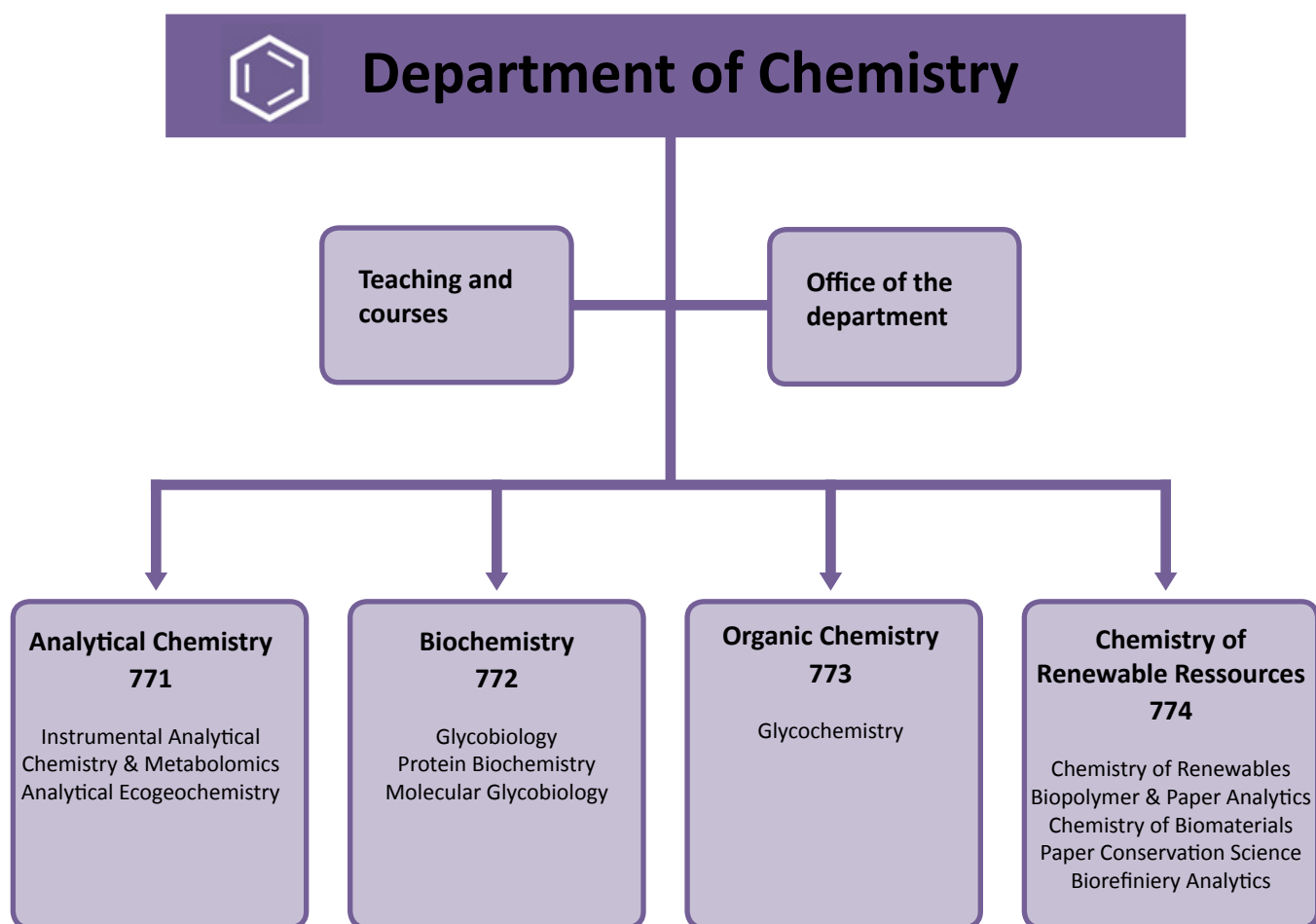
UFT, Konrad Lorenz Strasse 24, Tulln/Donau



Chapter 1

Mission Statement & Structure

The Department of Chemistry serves as a central unit in teaching basic and advanced chemistry within all curricula of the university. Research activities are focussed on the biotechnology of proteins and glycans, the chemistry of renewable materials and competence in state-of-the-art analytical instrumentation.



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* Names of persons who already left the department are printed in colour.

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Movers:



Gunda Koellensperger left the Division of Analytical Chemistry in March 2014 to take up a full professorship in Analytical Chemistry at the University of Vienna.

Tim Causon joined the Division of Analytical Chemistry in September 2014 as a senior scientist. His research interests concern separation science and mass spectrometry. Tim Causon is involved in the core facility Cellular Analysis at BOKU VIBT and is associate researcher at the Austrian Centre of Industrial Biotechnology (acib).



Christina Troyer has worked at BOKU as a senior lecturer since 2004. She joined the Division of Analytical Chemistry in September 2015 as a senior scientist for metabolomics, working mainly in the field of gas phase separations and mass spectrometry.

Markus Blaukopf obtained his PhD in 2011 within the Division of Organic Chemistry and continued his work in the framework of a third-party funded project on inhibitors of the heptose biosynthetic pathway, which was followed by a FWF Schrödinger fellowship at the University of British Columbia Vancouver.



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... we will never forget you



Dr. Manfred Schwanninger (1963-2013)

Manfred Schwanninger studied biotechnology at BOKU and completed both his master's and doctoral theses at the Institute of Chemistry. Manfred was an exceptional student, always digging very deep into the subject matter. His doctoral thesis signified the start of his work in the field of infrared spectroscopy of wood. Since graduating, he worked as a senior lecturer at BOKU. Although he was employed on the teaching staff, he had a strong interest and talent for research—which he conducted after completing his teaching duties; often till late in the night and at the weekend. Very early on, he recognised the power of spectroscopy in characterising the complex heterogeneous nature of wood and other biomaterials and deepened his understanding and use of infrared techniques in particular. He became a well-known specialist in the field of infrared spectroscopy and its application to biomaterial characterisation. During Christmas 2013 Manfred passed away after a short illness.



Dr. Katharina Pirker (1977-2015)

Katharina Pirker studied Technical Chemistry at the Vienna University of Technology. During her PhD thesis and the post-doctoral position at the Austrian Institute of Technology electron paramagnetic resonance (EPR) spectroscopy was already the central method of her research. Very soon she succeeded in getting her first stand-alone project by FWF followed by a Schrödinger fellowship that enabled her to go the University College London in order to learn the technique of site-directed spin-labeling in combination with pulsed EPR spectroscopy for the structural elucidation of proteins. Back in Austria in 2013 she joined the group of Christian Obinger and was granted with a Hertha Firnberg fellowship by FWF. In addition she succeeded in getting financed the first Q-band pulsed EPR machine in Austria. This opened an incredible prospect to her and she was very enthusiastic and full of ideas for future prospects. However, in autumn 2014 she was diagnosed with cancer and lost her fight against the disease in September 2015.



Dr. Thomas Kopelent (1959-2015)

The qualified pharmacist was till 1996 assistant at the Institute of Chemistry. Then he switched within the university to the rector's office dealing with strategic resources planning. After a short stay at University of Vienna in the same area, he succeeded his father in their pharmacy, the Mariatroster Apotheke "Zum heiligen Ulrich". Since the early 1990ies he was a very active member of the Johanniter's Ambulance in patient and organ transport as well as a teacher. All over the years he kept close contact with his friends at the department of chemistry and other departments of the university. We lost a reliable former colleague and a good friend.



Michael Kitzmüller (1989-2015)

Michael Kitzmüller studied Food Science and Biotechnology at BOKU and performed his master thesis in the group of Christian Obinger within the Christian Doppler Laboratory for Antibody Engineering. He designed and produced heterodimeric Fc proteins and Fcabs with great potential in the field of (bispecific) therapeutic antibodies. He was already planning the date for the defence of his master thesis and was accepted as PhD-student in the doctoral program BioToP, but in October 2015 he died due to a tragic accident.

Chapter 2

Divisions

Division of Analytical Chemistry

The areas of expertise of the Division of Analytical Chemistry comprise mass spectrometric method development and application for analysis of elements, stable isotope ratios, elemental species and molecules. The division consists of two collaborative research groups situated at the VIBT and UFT. The overall goal is the implementation of new, fit-for-purpose methodology in interdisciplinary projects and collaborations.

IACM: The research group “Instrumental Analytical Chemistry and Metabolomics” addresses separation science and mass spectrometry. The group performs elemental ultratrace analysis down to sub ng L⁻¹ concentrations via inductively coupled plasma mass spectrometry (ICP-MS) in clean room laboratories. Moreover, they combine efficient separation techniques, i.e. HPLC, CE and GC with ICP-MS for elemental speciation analysis. The research group implements method development into environmental projects (iron transport in the ocean, surface water analysis, platinum group elements and compounds), soil/plant research (root exudates, metal complexes in the rhizosphere, plant and microbial siderophores) and advanced wastewater treatment processes using ionic liquids. In the field of metabolomics, the group uses tandem mass spectrometers (LC-MS/MS and GC-MS/MS) for targeted quantification (metabolic profiling) of primary metabolites and intermediates in biological systems focussing mainly on biotechnological research and applications. In the same context, accurate mass time-of-flight systems (LC-TOFMS, GC-qTOFMS) is applied for development of non-targeted analysis together with highly sophisticated chemometric data analysis methods. IACM is addressing the emerging topic of ¹³C metabolic flux analysis by method development for measurement of accurate isotopologue and isotopomer ratios of selected metabolites in cell extracts.

After calculation of isotopologue fractions, these data are transferred to bioinformatic modeling of metabolic fluxes. In several projects, quantitative data are generated by advanced quantification strategies based on elemental labeling or isotope dilution mass spectrometry. Particular attention is devoted to the determination of measurement uncertainty and uncertainty budgeting.

VIRIS: The research of the “VIRIS Laboratory for Analytical Ecogeochemistry” focuses on the development and application of analytical methods (with a focus on elemental and isotopic mass spectrometry) to investigate biotic and abiotic matter and their interactions in ecosystems and across ecosystem boundaries. The research group is based on the award of the START prize of the FWF in 2004 to Thomas Prohaska. Since April 2011 the research group has conducted its research in the newly founded research laboratories of the BOKU at the UFT in Tulln.

The research group performs accurate elemental concentration measurements at ultratrace levels in environmental and biological matrices using ICP-OES and ICP-MS. In combination with a laser ablation system, images of the elemental content of solid samples are created in the μm-scale e.g. in biological tissues (e.g. bones, hair, organs or fish hard parts), environmental samples (e.g. plants or diffusive gradient in thin films (DGT)) or technological material. By using multi collector ICP-MS, accurate isotope ratio measurements of high precision are accomplished for e.g. B, Li, Mg, S, Sr, Hg, Pb or U isotopes. A multiple isotopic approach is used for the provenance determination of primary agricultural products and authenticity determination of food by ‘isotopic fingerprinting’. The isotopic systems are also applied for the study of ecosystem processes, e.g. to study S cycles in forest ecosystems, to trace anthropogenic contaminants, to monitor erosion or



Division of Analytical Chemistry at BOKU VIBT (IACM research group)





Division of Analytical Chemistry at BOKU UFT (VIRIS research group)

to study river connectivities or biological migration (e.g. to reveal the life history of a fish via its chemical composition of the otolith). Moreover, applications are found in the field of archaeometry and forensics. In the latter context, remains of Beethoven, Schiller and Mozart (hair, bone and teeth) were investigated to shed light into their living conditions. In combination with a laser ablation system, single particle analysis is accomplished for nuclear forensics in collaboration with the International Atomic

Energy Agency (IAEA). In addition, stable isotope spikes are applied to monitor environmental and biological processes. The combination of elemental and isotopic images along with other imaging information is accomplished in a key research of chemical imaging applying geographic information software. The research group has also a strong background in metrology in chemistry and acts as collaborator within certification exercises.

Division of Biochemistry

The Division of Biochemistry focuses on basic and applied research in the fields of Protein Biochemistry and Glycobiology. During 2013-2015 11 FWF stand-alone projects, a Christian Doppler Laboratory for Antibody Engineering and several other §27 projects have been conducted by members of this Division. Additionally, the Division of Biochemistry is responsible for the organization and the success of the FWF- and BOKU-financed international doctoral programme BioToP – Biomolecular Technology of Proteins.

The **Protein Biochemistry Group** (Christian Obinger and Paul Furtmüller) is active in two main fields:

(A) Bioinorganic chemistry and biochemistry of metal-containing oxidoreductases with a focus on heme enzymes like peroxidases, catalases, peroxidasins, chlorite dismutases and HemQ. Typical research questions in this field of molecular enzymology include (i) structure-function relationships and (un)folding pathways of metal-containing oxidoreductases, (ii) kinetics and thermodynamics

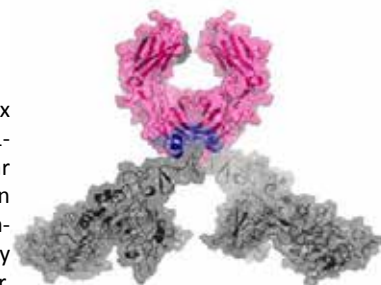
of electron transfer reactions, (iii) impact of the protein matrix and post-translational modifications of both the protein and/or the prosthetic group(s) on catalysis and (iv) elucidation of mechanisms of reactions mediated by these enzymes.

(B) Protein engineering and design with a focus on the development of therapeutic biologics either based on antibodies and antibody fragments or novel binder of alternative scaffolds. In particular, the group focused on engineering of structural loops of constant domains (Fc) of IgG1 molecules in order to introduce additional binding sites (Fcab design). Various strategies to improve (i) the conformational and thermal stability of these proteins

Overall and active site architecture of a novel bacterial dimeric chlorite dismutase, a heme enzyme that catalyses the conversion of chlorite to chloride and O₂.



Crystal structure of a complex between an engineered IgG1-Fc (Fcab) with two extracellular domains of Her2 (depicted in grey). Her2 is an integral membrane protein which is highly overexpressed in breast cancer.



and (ii) the library design for selection of Fcabs have been developed. Additionally, the group succeeded in solving X-ray structures of Fcabs and Fcab-antigen complexes. This research took place within the Christian Doppler Laboratory for Antibody Engineering (2009-2016) which is headed by the Protein Biochemistry Group (see Chapter 3).



The group is equipped with two multi-mixing stopped-flow machines from Applied Photophysics that allow monitoring of (bio)chemical reactions by UV-vis, fluorescence and circular dichroism spectroscopy in the millisecond time scale.

Established methods and techniques in the Protein Biochemistry Group include recombinant protein production in *Escherichia coli*, *Pichia pastoris*, mammalian lines (HEK

and CHO), site-directed mutagenesis, random mutagenesis and directed evolution strategies, protein library design, yeast display and screening of libraries by fluorescent activated cell sorting (FACS). Several biophysical methods are well established including (time-resolved) circular dichroism, fluorescence, UV-vis, FTIR- and resonance Raman spectroscopy, static light scattering, electron paramagnetic resonance spectroscopy, multimixing stopped-flow spectroscopy, spectro-electrochemistry (Ottle cell), differential scanning calorimetry and isothermal titration calorimetry.

Scientific highlights of the Protein Biochemistry Group include (i) the discovery of novel bacterial halogenating peroxidases with posttranslationally modified and covalently bound heme, (ii) elucidation of structure and function of pentameric and dimeric chlorite dismutases, (iii) characterization of the homotrimeric multidomain human enzyme peroxidase, which represents an important player in the extracellular matrix formation; (iv) development of protocols for the elucidation of the stability landscape and for stability engineering of proteins, and (v) improvement of the modular antibody technology for the design of Fcabs.

In the field of **Glycobiology** the groups **Glyco-bio-analysis** (Erika Staudacher and Fritz Altmann) and **Molecular Glycobiology** (Iain Wilson) are interested in the biosynthesis and biological role of protein-glycans from all kingdoms of life. Glycosylation of proteins is the most complex post-translational modification and its biological functions – the so called “glycocode” – remain to be fully deciphered. Oligosaccharides on secreted proteins differ

by the number and position/linkage of several different sugar residues, which needs highly capable analysis in the form of liquid chromatography and mass spectrometry.

The **Glyco-bio-analysis Group** (Erika Staudacher and Fritz Altmann) operates a high-resolution ESI-Q-TOF mass spectrometer (Bruker, Maxis G4) (as partner of the EQ-VIBT GmbH) and an ion-trap with CID and ETD capabilities.

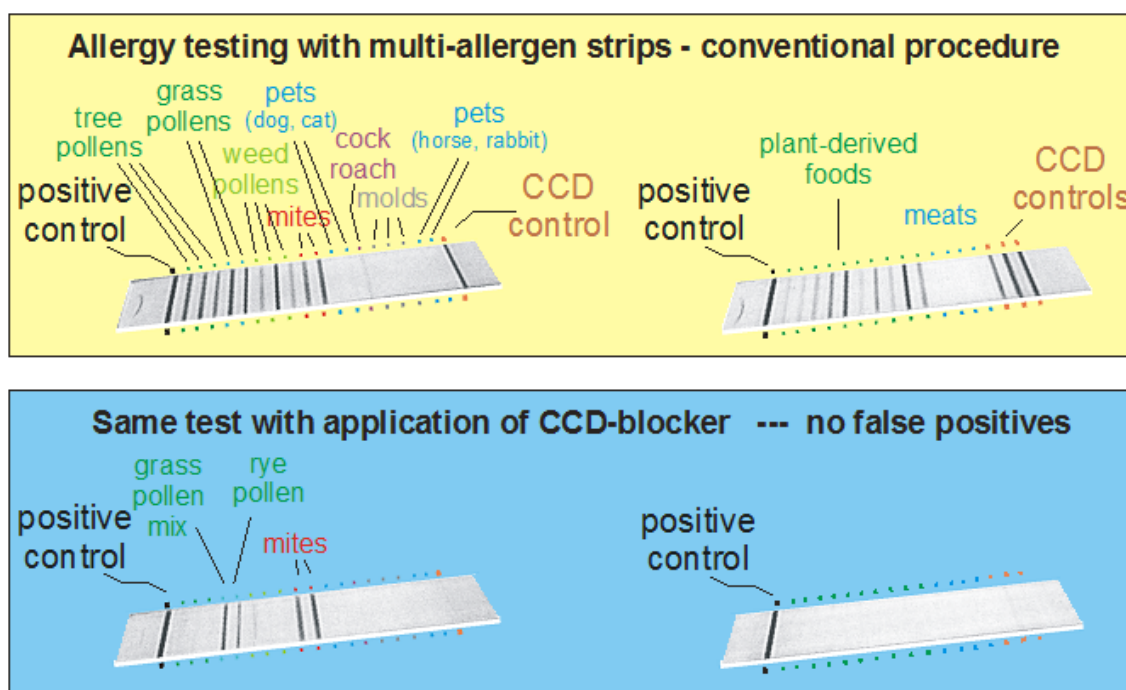


Illustration of the effect of blocking irrelevant IgE-binding to carbohydrate determinants for the reliability of allergy diagnosis.



A large part of the Glyco-bio-analysis group in a somewhat untypical working environment.



ity (Bruker, amaZone Speed ETD) plus the necessary nano- and capillary HPLC systems. The high resolution, mass accuracy and sensitivity allow answering an infinite variety of analytical problems such as protein identification via peptide mapping, de novo sequencing of peptides, mass determination of intact proteins, quantitative proteomics and – at the heart of their competence – glycoprotein and N- and O-glycan analysis.

The group develops methods for a true isomer-sensible glycan analysis using this modern LC-MS equipment to the best. Reference glycans are synthesized using recombinant glycosyltransferases. Most efforts are dedicated to pharmaceutically relevant glycoproteins.

An important field of research of this group is glyco-immunology. The sugar residues on glycoproteins of different species often exhibit “foreign” structures and are thus immunogenic. Allergens of pollens, insect venoms or vegetable foodstuff glycans contribute to IgE binding – a phenomenon that contributes considerably to apparent cross-reactivity in serum-based allergy diagnosis. The group developed a simple, cheap and robust means of eliminating these false positive measurements and tries - together with a company – to validate and spread this straight-forward approach towards better allergy diagnosis in diagnostic practice.

Given the variety of the roles of glycans in host-pathogen interactions, where sugars are receptors or defense

shields against the host immune system, there is need for more research with “exotic” organisms. One focus of the group is protein glycosylation in snails (more exactly gastropods). Another still rather unexplored area is the biosynthesis and function of plant O-glycans. The research with plant O-glycans arose with increasing use of plants as expression systems that demands a better understanding of these post-translational modifications via a combination of analytical, biological and immunological techniques.

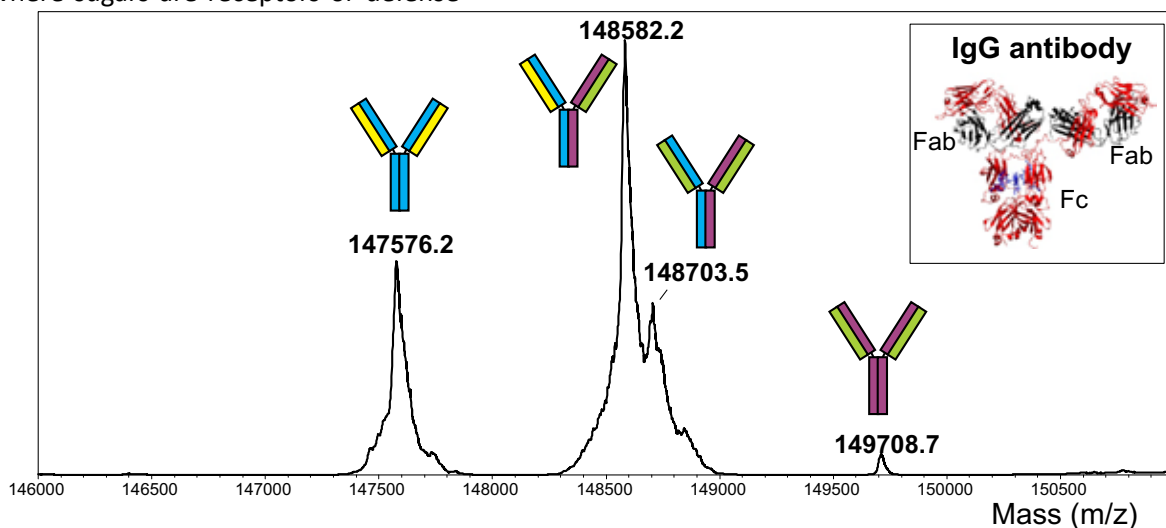


Biomphalaria glabrata

Scientific highlights of the Glyco-bio-analysis Group include

(i) cloning of the first plant $\alpha 1,3$ -fucosyltransferase, which enabled the generation of plant lines producing non-immunogenic glycoproteins including the highly visible anti-EBOLA drug ZMAPP, (ii) first steps worldwide in the molecular glycobiology of molluscs, (iii) development of the concept of retention-time based N-glycan analysis making use of recombinant glycosyltransferases, (iv) introduction of a polyvalent competitive inhibitor counter-acting the obscuring effect of anti-carbohydrate IgE in allergy diagnosis, and (v) elucidation of the structure of an immunomodulatory bacterial polysaccharide with potential as a drug against irritative bowel disease.

Mass spectrometry of a bispecific antibody.



FWF-Fellows

In the last three years the Division of Biochemistry was very successful in the acquisition of stand-alone projects by FWF fellows. This includes three postdocs from the Protein Biochemistry Group and three postdocs from the Molecular Glycobiology Group.



Marcel Zamocky



Michael Traxlmayr

Marcel Zamocky investigates structure-function relationships of novel so-called hybrid-type heme peroxidases, which are found in fungi including phyto- and ichthyopathogens but also several animal- and human pathogens.

Katharina Pirker was granted with a Hertha Firnberg fellowship by FWF. Her project aimed at the investigation of the dynamics of catalytic amino acids in the heme proteins catalase-peroxidase and chlorite dismutase by means of pulsed electron paramagnetic resonance spectroscopy.

Michael Traxlmayr was granted with an Erwin Schrödinger fellowship and has developed a novel binder scaffold based on a small, highly stable protein from a hyperthermophilic organism. It can be used in the molecular context of several approaches in cancer therapy including intracellular targeting applications.



Alba Hykollari, Martin Dragosits, Katharina Paschinger - three FWF fellows of the Molecular Glycobiology Group.

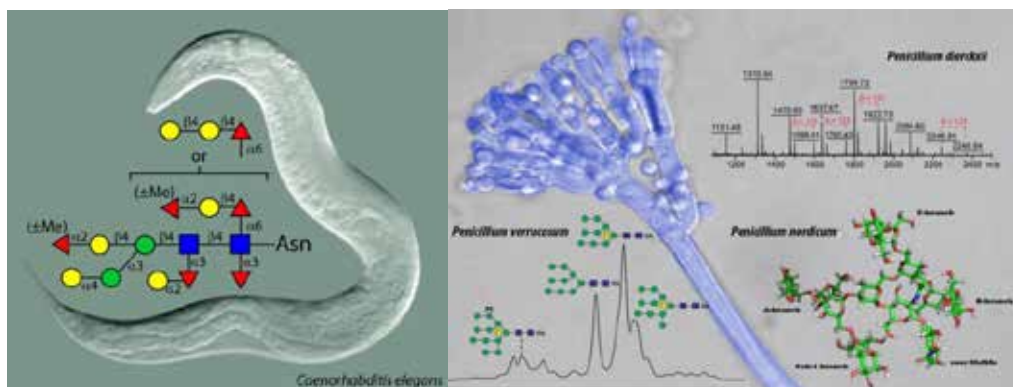
Katharina Paschinger employs mass spectrometry to examine N-glycans from a variety of sources including nematode parasites and marine animals. The project aims at a deeper understanding on the N-glycan epitopes in these organisms to unveil the evolutionary key protein modifications at the transition and emergence of vertebrates.

Alba Hykollari works with the slime mold *Dictyostelium discoideum* and the amoeba *Acanthamoeba* as well as with fungi and investigates the biosynthesis and distribution of phosphate-containing N-glycan epitopes in these organisms including methylphosphate and phosphoethanolamine.

Martin Dragosits is analyzing the effects of glycosylation deficiency on the stress resistance and evolvability of the industrial yeast *Pichia pastoris*. Upon combining long-term cultivations and various -omics approaches, the impact of environmental factors on the stability and genomic changes will be investigated.

The **Molecular Glycobiology Group** (Iain Wilson) encompasses the use of molecular biological, cell biological, enzymological and glycomic methods to understand the types, basis and importance of glycoconjugates in a range of systems. The group is particularly interested in the biosynthesis and developmental roles of protein glycosylation in various model organisms, especially *Drosophila*, *Dictyostelium* and *Caenorhabditis*, as well as in various parasitic worms, fungi, molluscs and protists. Seeking parallels between model and parasitic organisms in addition to determining the unique nature of parasite glycomes constitute a major part of the work.

In order to uncover the “secrets” of these not so primitive organisms, knock-out strategies are utilised in order to study the effect of gene deletions on glycan biosynthesis and the resulting glycomes in model organisms. Thereby, a major focus is on N-glycomic analyses with HPLC, MALDI-TOF MS, MS/MS and chemical/enzymatic digestions; the group also has a tradition in glycoenzymology and, over the years, has identified unusual glycosidases and glycosyltransferases. The interactions of lectins (carbohydrate-binding proteins) with glycans are also of interest, as are new approaches to generate glycan arrays. The group is a part of the GlycoPar Marie-Curie Initial Training



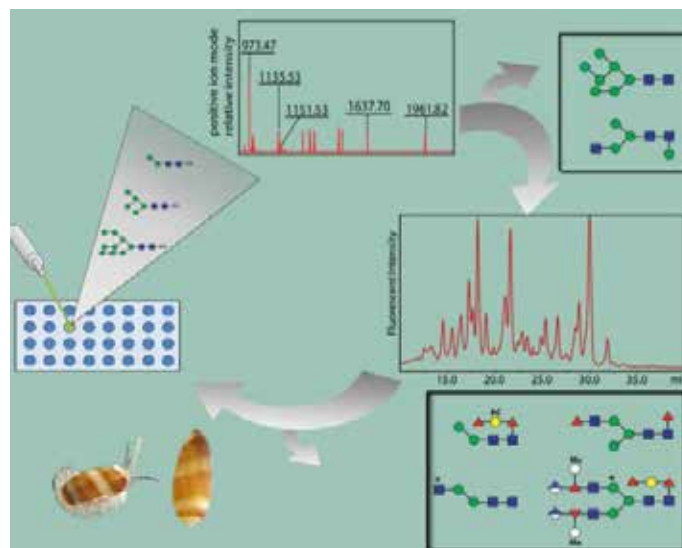
Example data and structure of N-glycans from nematodes and fungi.



Network, whose members specialise in various aspects of protein glycosylation of parasitic organisms.

Scientific highlights of the Wilson Group include recent publications in 'top' proteomics journals (e.g. Molecular & Cellular Proteomics as well as a "Paper in Forefront" in Analytical & Bioanalytical Chemistry) describing the isomeric and isobaric complexities of the protein-linked glycans of a range of organisms including nematodes, molluscs and fungi.

Glycomic approach for analysis of N-glycans from a marine snail.



Division of Organic Chemistry

The main research topic of the Organic Chemistry division is focused on the role of carbohydrates in eliciting or modulating the adaptive as well as the innate immune response against pathogenic microorganisms. In particular we are interested in the immunochemistry and structural biology of complex carbohydrates from viruses, bacteria, parasites and plants.

This endeavour requires basic studies of carbohydrate-protein interactions including antibodies, receptors and lectins on a molecular level using well-defined synthetic ligands and neoglycoconjugates. Key questions are investigated within national and international cooperations in the fields of crystallography, molecular biology, biochemistry, enzymology and immunobiology. Additionally we target the biosynthetic pathways by preparing biosynthetic intermediates such as nucleotide-activated sugars as well as potent inhibitors that might interfere with the assembly of these cell-wall glycans.

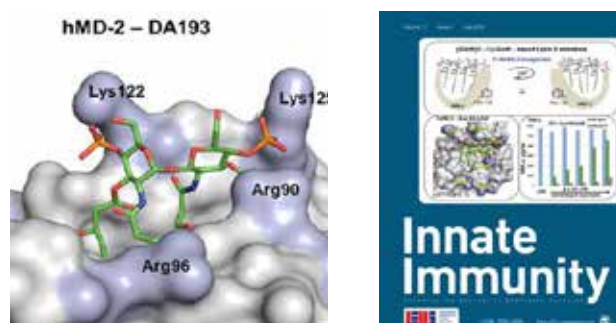
Bacterial cell-wall carbohydrates, termed lipopolysaccharides (endotoxins) from Gram-negative bacteria such as *Escherichia coli*, *Acinetobacter*, *Burkholderia* and *Chlamydia* are our main target molecules.

A long term goal is seen in the development of glycan-based tools for diagnostic and therapeutic applications e.g. by contributing to novel antimicrobial and anti-sepsis drugs. Resistance against antimicrobial drugs has become a major problem in clinical practice, and thus, the underlying mechanisms need to be overcome by the design and development of suitable compounds either via novel modes of action or by restoring sensitivity to common antibiotics as well as by supporting the innate immune response. One basic hypothesis is built on the fact that incomplete lipopolysaccharide molecules are quickly recognized and cleared by the immune system without killing the beneficial bacteria in the digestive tract.

Scientific highlights:

Lipid A chemistry

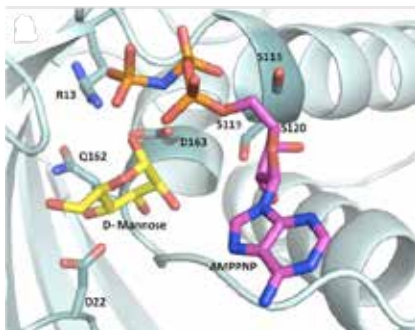
Major accomplishments have been achieved in the design and bioactivity of conformationally constrained lipid A mimetics, which were developed as a novel compound class with superior antagonistic as well as agonistic properties.



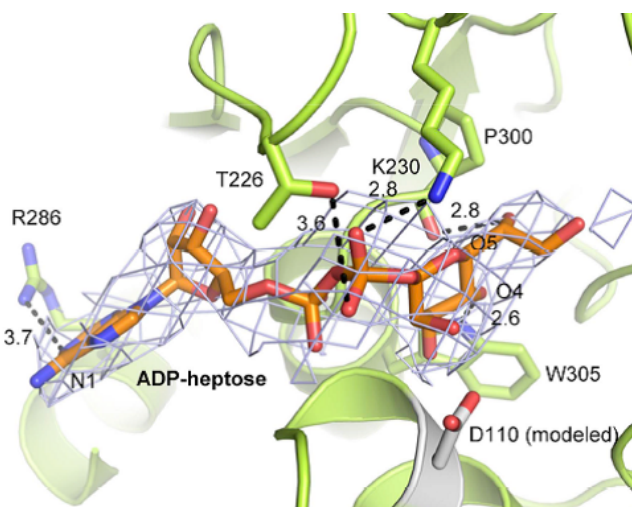
Molecular model of a trehalose-based Lipid A mimetic in the binding site of hMD-2 (left) and cover photo of *Innate Immunity* (J. A. Garate et al. 2015)

Compounds derived from a β GlcN-(1 $\rightarrow$ 1)- β GlcN scaffold revealed excellent antagonistic activities by inhibiting the LPS-induced inflammatory signaling and hold promise as novel anti-inflammatory and anti-sepsis drugs. The challenging synthesis of anomERICALLY linked glycolipid-phosphoester derivatives could be successfully completed for the Lipid A structure of *Burkholderia cepacia*, causing virulent infections in patients with cystic fibrosis. The publication was rated as a hot paper in Chemistry - European Journal.

Mannose and substrate analog AMP-PNP in the binding pocket of WcbL (M. Vivoli et al. 2015)



Bacterial autotransporter proteins from enterotoxigenic *E. coli* are abundantly substituted with heptose residues, and for the first time a crystal structure using synthetic ADP heptoses as substrates could be obtained.



ADP D-glycero-D-manno-Heptose complexed to the binding site of TibC (Q. Yao et al, 2014)

Significant progress in structural and functional analysis of a bacterial ADP-heptosyl transferase (WaaC) was achieved by Markus Blaukopf during his stay as a Schrödinger Fellow in the lab of Stephen Withers (University of British Columbia, Vancouver)



Markus Blaukopf

The expertise in heptose chemistry is also involved in a joint cooperation with the Medical University of Vienna in studying the physiological and metabolic role of a sedoheptulose-phosphate kinase, which fine-tunes aerobic and anaerobic glycolysis.

Division of Chemistry of Renewable Resources

The Division "Chemistry of Renewable Resources" is concerned with the structure, identification, and chemistry of natural products. Having a background in synthetic and mechanistic organic chemistry, the research addresses current topics from the borderline region of natural product chemistry and organic, polymer as well as analytical chemistry.

The division regards itself as one of the central units of BOKU for research in the fields of renewable resources and biorefineries. Resulting from the chair of Wood, Pulp and Fiber Chemistry, newly added in 2005 to the Division of Organic Chemistry, the unit became a separate division in 2012.

Over the past several years, the Division has developed into an internationally renowned center for chemistry of renewable resources, pulp & paper, and biorefinery chemistry. This is reflected by several indicators: the fact that the highest scientific awards in these fields were given three times to group leaders of the Division – two times the Hayashi Jisuke International Cellulose Award

in 2007 and 2012, and the Anselme Payen Award of the American Chemical Society in 2014 –, the integration into an extensive network of active international cooperation with leading institutions, and the involvement in the organization committees of the most important conference series in these fields: the International Symposium on Wood, Fiber and Pulping Chemistry [ISWFPC], the European Workshop on Lignocellulosics and Pulp [EWLP], and the International Cellulose Conference [ICC]. The Division represents an attractive target for visiting scientists and visiting professors (23 and 14, respectively, staying for one semester or more, in the past seven years). The Division's group leaders are active in the editorial boards of numerous relevant journals, and the heads are moreover engaged in prestigious advisory functions, such as the University Council of Shinshu University, Japan, the University Council of Aalto University, Helsinki, Finland, and the National Finnish Bioeconomy Council.

With regard to the scientific topics, the Division attempts to cover the field of chemistry of renewable resources



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and biorefineries as comprehensively as possible, which is also reflected in a considerable width of the research topics. The classical areas cellulose chemistry, pulping and bleaching, paper and fiber chemistry and analysis, as represented by the division heads Thomas Rosenau and Antje Potthast, are well established and internationally highly esteemed. The same applies to the fields of antioxidant and vitamin E chemistry and applications in medicinal and polymer chemistry; two vitamin E-based medications for treatment of intestinal diseases have been approved for use in Europe and in the US in 2009 and 2011. Since about 2011, the fields of lignin chemistry, analysis and utilization have been advanced in order to keep up with international developments and to complement the well-established cellulose research side. Two group leaders have recently obtained their *venia docendi* in biomaterial chemistry (Falk Liebner, 2015) and paper conservation science (Ute Henniges, 2015), which both represent two rapidly developing fields within the division's research portfolio. Another habilitation in the field of biorefinery analysis is ongoing (Stefan Böhmdorfer).

The research area **“Biopolymer and Paper Analytics”** (Antje Potthast) covers the whole range of analytical issues related to lignocelluloses and polysaccharides. This includes both the application of established analytical tools to different species and tasks and development of new analytical methodology. Special focus is given to advanced cellulose and lignin analytics and their advancement and function in different facets of modern lignocellulose science. Size-exclusion chromatography (SEC) with multiple methods of detection is the central tool in this endeavor, running on independent lines for routine analytics and special analytical tasks, respectively. SEC is combined with different fluorescence labelling techniques that allow recording of functional groups, substituents or special moieties not only as sum parameter but as profiles along the molar mass distribution. These methods are apt to monitor oxidative changes in cellulosic substrates occurring as a consequence of processing, environmental stress or aging. Research on lignin focuses on the development of fast analytical tools to characterize natural and

technical lignins in order to support questions related to quality and function-property relationships. High throughput purification and model compound studies are equally important in that context.

Conversion of the renewable biopolymers cellulose, hemicellulose and lignin into novel value-added products is the main focus of the research area **“Biomaterials Chemistry”** (Falk Liebner). Non-energetic utilization of lignin encompasses projects such as the conversion of technical lignins or ligneous raw materials into environmentally friendly humus substitutes or water-storing hydrogels which can be used for large-scale rehabilitation of degrad-

Habilitation

“Biopolymer Material Chemistry” **Dr. Falk Liebner**



Falk Liebner studied and graduated in chemistry at the Technical University of Dresden, Germany (1983-1988). Following employment at the Chemiewerk Nünchritz and TU Dresden (1988-1993, research assistant), he obtained his doctorate in the field of synthetic bio-organosilicon chemistry under supervision of Prof. Klaus Rühlmann (1993, *summa cum laude*). After having joined BOKU in 2006, he was awarded a tenure-track position in 2011. This position has been successfully completed with defending his habilitation thesis in February 2015 and the *venia docendi* for the field of “Biopolymer Material Chemistry”. In the past years, his dedication was to build-up a small research team (BMC Biopolymer Material Chemistry group), as integrative part of the Division of Chemistry of Renewable Resources. Main target of his research is to develop novel (functional) materials from renewable resources employing specific molecular and supramolecular properties inherent to biopolymers. Tailoring of biopolymer-based hydrogels, aerogels and carbon aerogels for tissue engineering, bio-sensing, slow release of bio-active compounds, high-performance thermal insulation, true volumetric displays or electrochemical applications can be regarded as key expertise in this respect and includes topics, such as generation of dual porosity in surface-charged cellulose II aerogels, reinforcement of ultra-lightweight aerogels by percolating networks of biocompatible polymers, transparent cellulosic aerogels from nematic liquid-crystalline suspensions of nanofibrillated cellulose derivatives, homogeneous grafting of alloyed core/shell or carbon quantum dots onto the large internal surface of cellulosic aerogels, or lignin-derived mesoporous carbon aerogels for super-capacitors or proton exchange membranes in fuel cells.



ed soils. Chemical activation and fixation of carbon dioxide by different systems, among them lignoid structures and quinones, are also studied. Research in the field of cellulose modification is dedicated to the synthesis of ultra-light-weight cellulose aerogels in different application scenarios, such as bone replacement materials or true volumetric displays. Advanced techniques in chemical engineering, such as supercritical drying, ultrasonic activation or micro-wave-mediated derivatization are employed.

The research area **“Science in Paper Conservation”** (Ute Henniges) deals with a broad variety of issues related to the preservation of cultural heritage on paper. This group applies analytical methods and chemistry similar to those of the other research areas in the division. The big difference, however, consists in the changed perspective from utilization and modification of raw materials towards the preservation of historic material with the aim to transfer it to future use. “Science in Paper Conservation” is meant to bridge the gap between applied conservation and fundamental research: general studies from pulp and paper industry cannot easily be translated into the treatment approaches in conservation ateliers. Specific questions ranging from aging mechanisms of blank and printed paper, non-destructive and/ or low-cost analysis, best practice approaches, and underlying degradation



mechanisms that have to be answered to design appropriate treatment sequences for historic objects need to be studied and established in cooperation between conservators and chemists.

The research area **“Biorefinery Analytics”** (Stefan Böhmdorfer) is concerned with the chemical characterization of plant biomass, especially in complex mixtures as they are formed in biorefinery approaches. Plant biomass is a particularly complex mixture of a broad range of compounds with very heterogeneous properties. Therefore, specialized methods have to be developed for each analytical problem. When current technologies are insufficient to answer the question, methods need to be developed further. The focus lies in this regard, on high-performance thin layer chromatography hyphenated to mass spectrometry (HPTLC-MS), bioactivity screening on HPTLC plates or selective fluorescence labelling. Exemplary sample materials include extracts from leaves and bark, essential oils, mono- and oligosaccharides, non-cellulosic polysaccharides, secondary metabolites of plants and fungi and natural antioxidants.

Habilitation

“Paper conservation science”

Dr. Ute Henniges



Ute Henniges studied conservation of paper-based cultural heritage at the Stuttgart State Academy of Art and Design in Stuttgart (Germany) from 1999-2003 to become a paper conservator. After finishing her degree, she worked as paper conservator with PAL Preservation Academy GmbH Leipzig. In 2005, she started her PhD studies at the Department of Chemistry at the University of Natural Resources and Life Sciences, Vienna (BOKU). Her PhD thesis that she defended in 2008 focussed on cellulose characterization by fluorescence labelling and gel permeation chromatography: Description of degradation processes, evaluation of stabilisation procedures and development of a non-destructive methods. Since 2008 she works as research assistant at BOKU University with a focus on science in paper conservation, such as paper conservation bleaching. In addition she has contributed to research projects with industrial partners, mostly from pulp and paper industry. In November 2015 she defended her habilitation thesis entitled “Paper Conservation Science: How paper conservation can benefit from advanced methods in paper analytics”.

Nuclear Magnetic Resonance (NMR) Spectroscopy

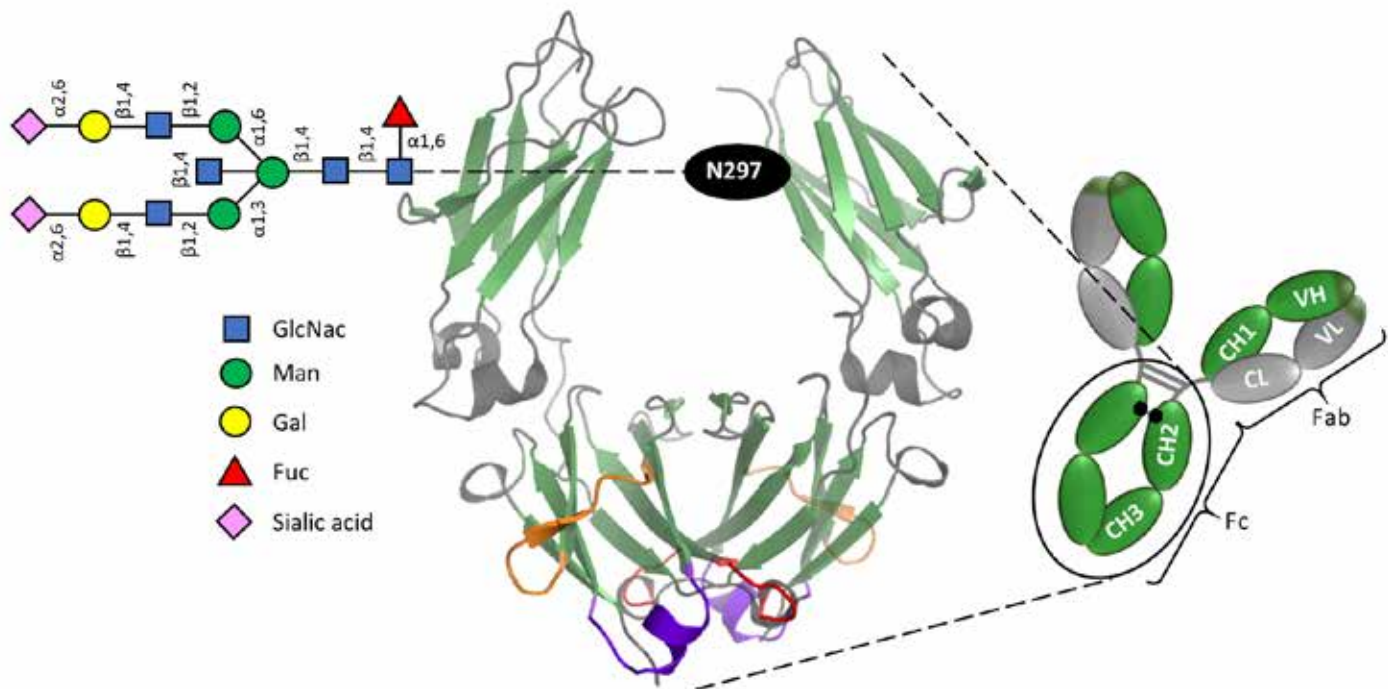
(Markus Bacher) is concerned with structure elucidation of organic molecules and the analysis and research characterization of complex mixtures. By using state-of-the-art one- and multidimensional homo- and heteronuclear experiments, structure elucidation, conformational analysis or purity check of synthesized products or isolated plant metabolites are performed as well as measurements of reaction kinetics and analysis of complex mixtures, such as natural and technical lignins, cellulose and polysaccharide degradation mixtures and biorefinery fractions. According to demand, various other techniques such as measurements of heteronuclei other than ^{13}C , experiments at variable temperatures, quantitative estimation of different functional groups or diffusion experiments are performed. For the characterization of insoluble materials or experiments in solid state, a second 400 MHz magnet is available. Gel-like samples, such as many polysaccharides, carbohydrates, lignin derivatives or aerogels, can be investigated with the hr-mas probe (high resolution magic angle spinning), whereas for solids and crystalline organic compounds all variants concerning cp-mas (cross polarization magic angle spinning) are placed at disposal.

Christian Doppler Laboratory for Antibody Engineering

With F-star's Modular Antibody Technology introduced by Florian Rüker from the Department of Biotechnology of BOKU an innovative and highly promising technology has become available which allows the introduction of additional binding sites into antibodies and antibody frag-

ments by engineering the non-CDR (i.e. structural) loops of constant or variable domains. At the Department of Chemistry particular emphasis was laid on the so-called Fcab (Fc with antigen binding properties) format. Within the CDL an integrated set of approaches to enhance the stability and folding of Fcabs was developed. The engineered domains were characterized and used as scaffolds for the design of Fcab libraries. By further systematic evaluation of distinct amino acid positions on the structural loops for randomization and/or elongation new generations of Fcab libraries were designed that outperform the original domains in aspects such as structural tolerance to the mutations as well as expression characteristics. Moreover, the first high resolution crystal structures of Fcabs and Fcab-antigen complexes could be obtained, which - together with complementary biochemical and biophysical studies on Fcab-antigen interaction in solution - will additionally have a strong impact in the design of the next generation of this promising mAb format.

Within the last seven years, two Postdocs, 3 PhD students, two (half-time) technicians and seven master students were employed as part of this CDL at the Department of Chemistry.



Schematic representation of the Fc domain of human immunoglobulin G1 (IgG1-Fc) which represents the basis for the design of Fcabs. IgG1 is composed of two heavy and two light chains, with the Fab region carrying the antigen binding sites and the Fc part. The homodimeric Fc part comprises the CH2 and CH3 domains, where β strands are depicted in green, and α helices and random coils are shown in grey. In Fcabs the C-terminal loops of the CH3 domain of IgG1-Fc are engineered to allow antigen binding. Those loops are colored in red (AB-loop), orange (CD-loop) and purple (EF-loop). The asparagine at position 297 carries the glycan.



Christian Doppler Laboratory for Advanced Cellulose Analysis and Chemistry

Cellulose is the most abundant natural and renewable polymer. Another superlative is its importance as a natural product, both with regard to its economic value and to the breadth of its applications. It is the basis of whole industrial branches, such as the paper industry and major parts of the textile industry. With the increasing focus on natural resources and sustainability issues, also cellulose has undergone a surge of interest both from the academic viewpoint and the industrial perspective.

In addition to the classical cellulose chemistry which is mainly connected with large-scale pulping, bleaching and paper-making / fibre-making techniques, current cellulose research is directed towards an “advanced understanding and advanced applications of this most important biore-source” (Panel of the 2nd International Cellulose Conference, 2007). This includes the following “hot” scientific topics of the Christian Doppler-Laboratory for Advanced Cellulose Chemistry and Analytics:

- Molecular-level characterization of celluloses beyond the classical sum parameters.
- Advanced understanding of cellulose swelling and dissolution on a molecular basis.
- Highly functionalized cellulosic products taking advantage of the intrinsic properties of the polymer in combination with modern modifying reagents.
- Advanced understanding of cellulose degradation and aging as the basis to extend lifecycles and maintain the value of historic cellulosic products and cultural heritage.

The CD lab, which started its work in 2008 for a period of seven years, is placed in the framework of an active scientific environment at the Department of Chemistry / Division of Chemistry of Renewable Resources at BOKU Vienna and is embedded in a network of active national and international cooperation within the scientific cellulose community.

FLIPPR° - Future Lignin and Pulp Processing Research

Products made from renewable resources carry the potential to solve pressing global issues in the field of climate and resource issues. The pulp and paper industry - as one of the main industries of Austria and main users of wood as an important renewable resource - is playing a key role. The collaboration between BOKU (Department of Chemistry, Division of Chemistry of Renewable Resources), Graz University of Technology (Institute of Paper and Pulp Technology) and the University of Graz (Wege-ner Institute) was recommended by a two-stage, highly competitive selection process to promote the K-project FLIPPR° (Future Lignin and Pulp Processing Research) to develop the scientific basis of optimized material use for novel products and by-products of cellulose production (in different manufacturing processes). With BOKU as the academic lead organization and Thomas Rosenau from the Division of Chemistry of Renewable Resources as the scientific coordinator, the project brings together the four major Austrian pulp & paper companies, Mondi, Sappi, Zellstoff Pöls and Norske Skog, in a concerted effort to optimize the “classical” products, pulp and fibres, and to find new utilization ways for the hitherto neglected second major product of wood biorefineries, lignin. This, however, requires major analytical efforts before utilization paths can be taken. The four-year project, started in 2013, is planned to enter a second four-year phase afterwards.

FLIPPR°



Members of the Department are also actively involved as key researches and project leaders in other consortia such as the **Austrian Centre of Industrial Biotechnology (ACIB)** and **Wood Kplus**, respectively, as well as in the joint project “Cellular Analysis” within the **EQ-VIBT** core facilities.

In addition, several groups participate in international networks:



The Division of Chemistry of Renewable Resources is one of only three European Institutions that have been integrated - since 2010 as a full member - into the **Global Center of Excellence in Fiber Science (gCoE-FS)**, a network of scientifically leading institutions in this field headed by Shinshu University, Japan. In the framework of the gCoE, the Japanese Ministry of Science and Academy of Science have approved a doctorate programme „Fiber Science“, which will accept 10 international candidates per year for a period of 10 years, thus educating 100 scientists in different fields of modern fibre science. Starting with 2015, the PhD candidates will visit BOKU for a 2-weeks' excursion, filled with lectures, visits to two companies and workshops. The lectures are presented by group leader from BOKU and Shinshu University, and are also open to general BOKU PhD students. Collaboration between BOKU and Shinshu University is also active beyond the Fiber Science doctorate school: the two institutions are linked by a Memorandum of Understanding which has already been renewed for the third time in 2014, and which has already produced a vivid exchange of students and staff on all levels.



SHINSHU
UNIVERSITY



2014 - New strategies against parasites: The Initial Training Network “**Parasite Glycobiology and Anti-Parasitic Strategies**” of the European Commission (FP7-PEOPLE-2013-ITN) combines 12 academic and 4 commercial partners for the training of parasitologists. The partners are from Portugal, Spain, Germany, Switzerland, United Kingdom, Sweden and Austria. The Austrian partner is Iain Wilson and the employed Experimental Researcher is Jorick Vanbeselaere.

EPNOE – European Polysaccharide Network of Excellence

To organize and integrate the European scientific community in order to promote the use of polysaccharides as industry feedstocks for the manufacturing of advanced multifunctional materials is the mission of the European Polysaccharide Network Association (EPNOE). Applications of these materials pertain to the pulp and paper industries, fibres, textiles, construction and packaging materials as well as to hygiene and medical fields.



European Polysaccharide
Network Of Excellence



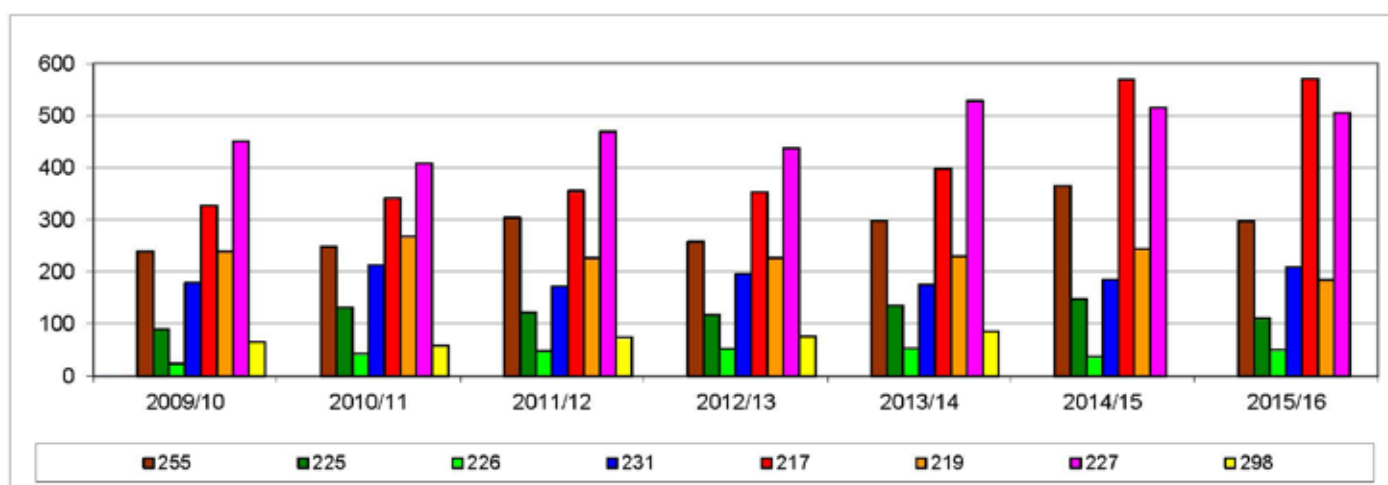
Chapter 4

Teaching

Bachelor and Master Programmes

The Department offers compulsory courses in 7 out of 8 bachelor study programmes of BOKU: *Food Science and Biotechnology* (217), *Forestry* (225), *Wood- and Fibre Technology* (226), *Environment and Bioresources Management* (227), *Environmental Engineering* (231), *Agricultural Sciences* (255) as well as the expiring programme

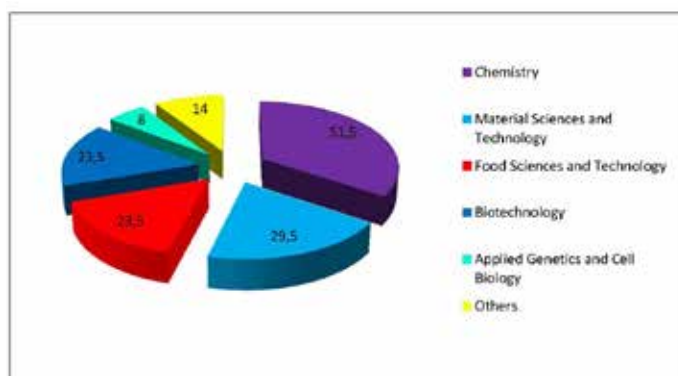
Viticulture, Oenology and Wine Economic (298). Just the bachelor programme *Landscape Architecture and Landscape Planning* (219) does not contain courses in chemistry. BOKU is an attractive and fast growing university with an increasing numbers of students.



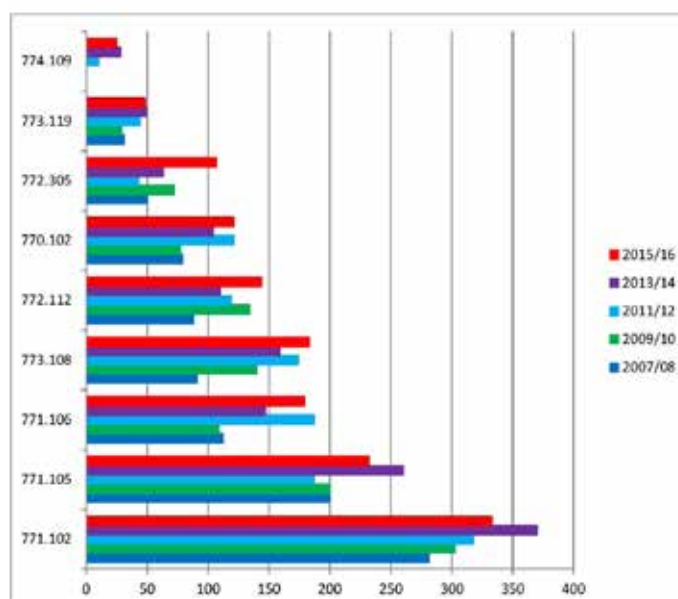
First year students (winter semester) in the different bachelor programmes.

Especially the bachelor programme Food Science and Biotechnology, where the department is responsible for about one third of the total course offer, was increasing dramatically during the last years. This was and is a challenge in the laboratory courses in terms of space, equipment and supervision capacity. Many laboratory courses have to run in multiple parallel groups which have to be jointly scheduled with courses of the Department of Biotechnology and the Department of Applied Genetics and Cell Biology in order to optimise the use of facilities and

limit the time demand on students. About 30 students choose the Department of Chemistry for their bachelor thesis every year.



Bachelor programme Food Science and Biotechnology. Compulsory course offers in ECTS by department.



Number of participants in laboratory courses of the department.

Bachelor thesis completed

2013

BÄRNTHALER Philipp Michael, BECK Jürgen, BREY Charlotte Ulrike, CHVATAL Katharina, CSARMAN Florian, EILENBERGER Christoph, FINK Mathias, FIRLINGER Luzia, GRANDITS Alexander Michael, HAGER Fiona Franziska, HEISENBERGER Clemens Johannes, HODZIC Selma, HOLZSCHUSTER Isabella, HUBER Anita, IMAMOVIC Selma, KALENDER Marie, KANTNER Viktoria, KRONDORFER Herbert, MULAI Elona, PALKOWITSCH Thomas, QUINTUS Roland, REISINGER Florian, SCHAUDY Erika, SCHMIDT Daniel, SEJFIC Meliha, STADLBAUER Daniel, URTEIL Jonathan, VOGLER Tina Maria, WAGNER Magdalena Maria, ZARBL Günther;

2014

BOOS Julia Alicia, BARTH Patricia, CAPRAZ Klemens Tümay, FABSTZ Viktoria, FALKENSTEINER David, FRANZMAYR Sandra, GANAUSER Elke, GEIGER Patrick, GRABNER Isabell, GRUBER Daniela, KNAUS Ulrike-Maria, KOPP Julian, KRAUTWASCHL Paul Stefan, LIN Grace Chiaen, LOIBL Julian, MUSL Oliver, NEUMANN Eva, NIEDERWIESER Jakob, NOVAK Katharina, PRASNIKAR Nina, ÖHLKNECHT Christoph, SCHWARZ Hubert, STEINACKER Thomas, VASILJEVIC Vidica, WEISS Yasmin, ZWICKL Nikolaus;

2015

BANNAUER Peter, BRUNNER Dominik, DÜRKOP Nora, FABIAN Philipp, FLÖCKNER Lukas, GRITSCH Sebastian, GRUBER Manuel, GRUBER Markus Leopold, HACKNER Stefan, HELM Barbara, HOBIGER Viola, JOCHER Leo, KRAMMER Julia, KLINGER Carina, KOFLER Kerstin, KOUDRIACHOVA Anastassia, KUBEK Matthias, LEDERMÜLLER Sebastian, NENDWICH Dominik, PASTERER Dominik, ROITHER Bernhard, SCHAPFL Barbara, SCHOBER Michael, SCHWAIGER Lorenz, TARNOCZI Nicole, TAUPE Philip, WEBER Andreas, WOLFSBERGER Dominik, ZULEHNER David, ZYUNKINA Maryna;

At the master level, compulsory courses are offered in the programmes *Biotechnology* (418) and *Material and Energetic Exploitation of Renewable Raw Materials* (471) and elective courses in those two and in *Natural Resources Management and Ecological Engineering* (416), *Wood technology and Management* (426), *Environmental Sciences – Soil, Water and Biodiversity* (449) and *Food science and technology* (417).

The courses cover characterisation (structure and functionality of bioproducts) as well as an introduction into bioanalytical techniques (Biospectroscopy, NMR, mass spectrometry, GPC of biopolymers). Students doing their master thesis at the department are integrated into scientific projects and learn – besides specific methods and background of the topic – the framework of research and the basics how a laboratory runs.

In total the department offers 69 different courses, which account for 172 semester hours (one semester hour = one hour per week during the whole semester of approximately 14 weeks). Some of the courses are held both in winter as well as in summer semester, some of the courses (nearly all compulsory laboratory courses) need to be held in several parallel groups which results in a teaching load of approximately 335 semester hours.

27 (62 semester hours) courses are held in English. 5 lectures are available on the video-platform and 34 courses are present on the e-learning platform of the university (BOKUlearn).

For detailed information on the courses offered by the department see appendix D.



Master thesis completed

2013

CERVICEK Magdalena - Transgenerational marking of common carp (*Cyprinus carpio* L.) using a strontium isotope double spike

DALLABERNARDINA Pietro - Synthesis of β GlcN(1 $\leftrightarrow$ 1) α GlcN scaffold as a precursor for anti-endotoxic lipid A mimetics (University of Padua)

DERLER Angelika - Novel glycosyl donors of Kdo

EINHORN Lukas - Specific determination of hinge disulfide connectivity region of recombinant human Fabs by the development of a generic homogeneous time-resolved fluorescence (HTRF) immuno assay

GANCI Aristide Paolo - Development of a LC-MS/MS method for the detection of polypeptide antibiotics

HOLZLECHNER Matthias - General unknown screening of whisky via LC-TOFMS

KOTIPALLI Govinda - Synthetic routes to lipid A mimetics based on α,α -1,1'-disaccharide scaffold (University of Leipzig)

LOBNER Elisabeth - Characterization of stabilized variants of a Her2-binding Fcab

LORENZ Karin - The role of Stat1 α and Stat1 β in response to interferon and *Listeria monocytogenes*

MEREITER Stefan - Glycan Interactions in Amoebae (University of Vienna)

NICOLUSSI Andrea - Mechanism studies on a eukaryotic secreted catalase-peroxidase from *Magnaporthe grisea*

OBERLERCHNER Josua - Characterization of oligomeric cellulose derivatives

ORTMAYR Karin - Quantitative Analysis of NADP⁺ and NADPH in Yeast

PREIMS Marita - Analysis of snail proteins for lectin function against plant derived glycans

SCHEDL Andreas - Analysis of volatile wound exudates

SCHUSTER Catrin - Reductive post-treatments after oxidative bleaching (State Academy of Art and Design Stuttgart, Germany)

SETZ Martina - An improved random mutagenesis PCR protocol for application in directed evolution of antibodies

SMOLLE Linda - Metabolic profiling with GC-MS: A novel approach to the GC-MS analysis of sugar phosphates

SVEHLA Elisabeth - The influence of weed pollen glycosylation on IgG-binding

TEGL Gregor - Development of novel thioglucosyl donors for the synthesis of natural product glucosides

WAGNER Michael - Nanofibrillation of cellulose

ZIPFEL Barbara - Novel methodological approaches for the accurate and rapid analysis of elemental impurities in pharmaceutical products according to USP 232/233

2014

EDENHOFER Eva - Cloning, expression and purification of human peroxidase 1 constructs

GABRIEL Stefan - Paving the way for a binding site selection of Wnt-transcription factors: expression of truncated Lef1 and Lef- β -catenin fusion proteins and the establishment of a method to multimerize the selected binding sites.

GANGL Klarissa - Autochthony in the early medieval settlement of Thunau/Kamp? A question explored by 87Sr/86Sr isotope ratios using MC ICP-MS

KÖBEL Anna - Enzymatic treatment of milled aspen wood

KROISZ Daniela - Recombinant expression and biophysical characterization of the human IgE high-affinity receptor Fc ϵ R1a

MAYBACHL Ernst - Synthesis and antiproliferative activities of novel integrin antagonists (FH Campus Wien)

MEIER Franziska Sophie - Pellet off-gassing during storage: The impact of storage conditions and type of source material

MOTZ Marcus - Eukaryotic intracellular catalase-peroxidases

SCHÜTZ Georg - Functional characterization of a novel bacterial peroxidockerin with homology to human heme peroxidases

SCHWAIGER Michaela - Isolation, purification and quantification of sedoheptulose from *Sedum maximum*

THALLER Patricia - Method development: Determination of polysorbate 80 using high performance liquid chromatography coupled with evaporative light scattering detection

2015

BASAS Michael - Kovalente Modifikation von Allergenen im Latex (TU Wien)

ECKMAIR Barbara - Comparative Glycomics

FISCHHUBER, David - Preparation and reinforcement of dual-porous cellulose aerogels for biomedical applications (FH Wiener Neustadt)

GÖRITZER Kathrin - Human epidermal growth factor receptor 2: Recombinant expression, purification and interaction studies with Fcabs

HANDLER Lisa-Sophie - Potential of IgG1-Fc libraries improved by stability-biased amino acid distributions for selection of Fcabs

KIRCHMAIER Leo - The challenge of multi-elemental quantification by LA-ICP-MS. Evaluation of in-house prepared co-precipitated hydroxy apatite (HAp) as optimized external matrix-matched calibration standards for elemental quantification in bony hard parts of freshwater fish using LA-ICP-MS

KIRCHMAIER Leo - Hard facts about hard parts. Comparison of the elemental composition of hard parts (otoliths, scales, fin rays, vertebrae and eye lenses) of freshwater fish

KORB Elke - Purification and characterization of β -galactosidase from *Arion lusitanicus*

KRÄMER Maria - Complex calciumphytate treatment on papers contaminated with iron ions prior to hydrogen peroxide bleaching (State Academy of Art and Design Stuttgart)

LIU Fang - Encapsulation based on renewable materials

MARTINZ Gudrun - Synthesis of mono- and disaccharide ligands related to secondary cell wall polymer of *Paenibacillus alvei* containing pyruvate-substituted β -D-mannosamine residues (University of Vienna)

MEYER Fabienne - Volatile organic compounds in collections of drawings and prints. An assessment with reference to the collection of Karl Friedrich Schinkel at the Kupferstichkabinett Berlin (Stuttgart, Germany)

PLAPPERT Sven - Oxidative modification of cellulose as an approach towards (semi-)transparent films and aerogels

RAMSPACHER Andrea - Design of heterodimeric IgG-Fc proteins

RENTERIA Katharina - Quantifizierung von benzo[A]pyren, chrysen, benzo[A]anthracen und benzo[B]fluoranthren in konventionell geräucherten Bauch- und Karreespeckwaren mittels HPLC-FLD sowie deren Beeinflussung durch den jeweiligen Fett-, Eiweiß- und Wassergehalt und der Platzierung der Probe innerhalb der Räucherammer

ROHATSCHKE Andreas - Disinfection of Enterobacteria phage MS2 by chlorine dioxide as related to the tailing phenomenon

SCHREIEDER Veronika - Wirksamkeitsverbesserung von Mückenabwehrmitteln durch den Einsatz von Cyclodextrinen

SÜTZL Leander - Analysis of resinous residues

VÖLKEL Laura - Untersuchung von Nanocellulosen für einen Einsatz zur lokalen Papierstabilisierung (University of Applied Sciences and Arts Hildesheim/Holzminde/Göttingen, Germany)

Doctorate studies completed

2013

AHN Kyujin – Sustainability of mass deacidification of library objects

BAE Narkhyun - *In vitro* and *in vivo* study of deamidating enzymes through proteomic analysis: Focus on Asparaginase, Glutaminase and Transglutaminase 2

EBNER Gerald - Modification of sustainable resources and their applications

HOLLAUS Ralph - Synthesis of 4-amino-4-deoxy- β -L-arabinose modified Lipid A structures corresponding to *Burkholderia* Lipopolysaccharide

IRRGEHER Johanna - Strontium isotope ratios as tracers of biological migration

RAMPLER Evelyn - Quantitative mass spectrometric assays for yeast characterization

SYED JAAFAR Sharifah Nabihah - Utilization of biomass in biorefinery approaches

TAUS Christopher - Identification, molecular cloning and characterization of the first mollusc glycosyltransferase involved in O-glycan biosynthesis

WANG Huiqing - Cellulose and cyanoethyl - cellulose aerogels for photoelectric applications (Beijing Institute of Technology)

2014

ADANITSCH Florian - Synthesis of novel alpha, alpha-Trehalose type Lipid A mimetics for investigation of the TLR4 mediated innate immune response

GERRIT Hermann - Mass spectrometry based assays in the field of preclinical metallodrug research

GUERRASIO Raffaele - Development of a mass spectrometry based analytical platform for ^{13}C -metabolic flux analysis experiments

HASENHINDL Christoph - Library design for functional engineering of IgG1-Fc by experimental and computational means

HOFBAUER Stefan - Mechanisms of catalysis and inhibition of chlorite dismutase

KLAVINS Kristaps - LC-MS analysis of metabolomics in yeast

KLINGER Karl Michael - Current biorefinery scenarios: Studies into ammoxidation of lignocellulosic material and periodate oxidation of cellulose

LUCINI Chantal – Enzymes involved in glycan processing in gastropods

NEUMANN Laura – Isomer specific analysis of N-glycans as a prerequisite for understanding biological functions at the examples of influenza A virus receptors and mouse brain glycoproteins

STEFANOVIC Bojan - Mechanism for cellulose modification - degradation and surface modification

2015

BUCHACHER Tanja - Infection of human monocytes and monocyte-derived macrophages with the intracellular pathogen *Chlamydia pneumoniae*

CHU Dinh Binh - Mass spectrometry based methods for analysis of phosphorus related compounds in biological samples

DIETRICH Sylvia Helga Marija - Novel bispecific SEED antibodies with specific light chain pairing

GRUBER Clemens - Proteomics of *Pichia pastoris*

HELL Johannes – Advanced analytical strategies for in depth characterisation of wheat bran fractions

HETTEGGER Hubert – Modifizierung von Biopolymeren zur Verbesserung der Wundheilung

KURZ Simone – Glycosylation of invertebrates: Approaches to study the glycomes of lower eukarotes

NAGAWA Christine Betty - Zusammensetzung und biologische Aktivität von Pflanzenextrakten und ätherischen Ölen aus Uganda

PIRCHER Nicole- Tailoring of cellulosic aerogels for biomedical applications

POKORNY Barbara – Synthesis of *Acinetobacter* lipopolysaccharide ligands (TU Wien)

RAGAB Tamer - Chemical characterization and biological activities of native and chemically modified products extracted from agricultural wastes (Benha University, Egypt)

SILLER Martin – Oxidative Modifizierung cellulosischer Fasern

SOUDI Monika - Phylogenetic, structural and functional characterization of human peroxidase 1

THADER Andreas - Synthesis and application of N-glycan standards for PGC-LC-ESI-MS- based qualitative and quantitative glycomics

WINDWARDER Markus - Electron-transfer dissociation mass spectrometry for revealing protein O-glycosylation fine structure



Besides individual doctorate studies in the programme H788 Doctoral studies of Natural Resources and Life Sciences with the degree Dr. nat. techn., BOKU offers a structured PhD programme (BioToP) which is organised and chaired by the Department of Chemistry (see below). Furthermore the department is partner in doctorate programme "Fiber Science" with Shinshu University, Japan (see below). With respect to doctorate studies, the policy of the Department is to attract qualified students also from other chemistry departments in Austria and abroad, but also to jointly supervise PhD theses with other groups in Austrian and foreign laboratories. Although being fully supervised by the department, these are not listed in the statistics of the university (10-15 per year).



BioToP

(Biomolecular Technology of Proteins, <http://biotop.boku.ac.at>) is the most extensive and the only FWF-approved and –funded doctoral programme at the BOKU. It is headed and coordinated by Christian Obinger and Christa Jakopitsch from the Division of Biochemistry of the Department of Chemistry. The international doctoral programme BioToP integrates research in the field of modern recombinant protein science and technology (from gene to product). It is a joint project of the Departments of Applied Genetics and Cell Biology, Biotechnology, Chemistry, Food Sciences and Technology, Material Sciences and Process Engineering, and Nanobiotechnology. The unique combination of basic and applied research provides both an excellent infrastructure and the critical scientific mass for an interdisciplinary research and study programme. BioToP offers a comprehensive and up-to-date training in four research areas, namely (i) analysis, design and engineering of proteins, (ii) biosynthesis, post-translational modifications and trafficking of (recombinant) proteins, (iii) expression systems and cell factories,

and (iv) bioinformatics and molecular modelling. BioToP provides an integrated educational platform and a custom-designed curriculum that includes dedicated lecture courses, seminars and hands-on-training on special methods and instruments in all four areas. Weekly doctoral seminars and journal clubs, annual retreats as well as presentations at international conferences stimulate the discussion between PhD-students, supervisors and the scientific community. In the first funding period (2010-2014) 52 students (29% international; 61% female) were selected by a competitive and transparent admission procedure. Funding came from the FWF (14 students), BOKU (7 students) and third-party funds (31 students). In this period, visibility and dissemination of scientific achievements by BioToP students was accomplished by more than 110 SCI publications, 195 presentations (60 oral and 135 poster) at international meetings, 4 special BioToP sessions at international conferences and the special issue 'BioToP' of the Biotechnology Journal. More than half of the students (65%) performed at least one research stay abroad. Based on permanent internal (e.g. thesis committee meetings, evaluation of lectures and courses, curriculum committee activities) and external monitoring (e.g. by the Scientific Advisory Board) the programme is continuously revised to cope with new developments in the field. In October 2014, the programme was positively evaluated by the FWF and in 2015 the second funding period started (2015-2018). Currently (as per March 2016) BioToP consists of a faculty of 14 Principal Investigators and 14 Associated Faculty Members, that support the Principal Investigators in both research and education. 60 students (52% female; 44% international) are enrolled in BioToP. Funding comes from the FWF (14 students), BOKU (9 students) and third-party funds.

The long-term goal is to establish a postgraduate study programme with competitive selection and quality criteria for all PhD students in the field of protein sciences and technology at BOKU.



Christa Jakopitsch



Christian Obinger

Annual Retreat 2013



Further Teaching

Several staff members are also engaged in teaching activities at Colleges of Higher Education (Fachhochschule) such as FH Biotechnical Processing at Tulln (www.tulln.fhwn.ac.at) and FH Bioengineering in Vienna (www.fh-campuswien.ac.at) with lectures and courses being offered in evening hours, weekends and holiday seasons in the latter case.

In addition to lecturing at these Polytechnics by staff members, public lectures and seminars are held. Regularly, members of the department take part in the teaching



TrainMiC®

is an European programme for life-long learning about metrological requirements of ISO/IEC-17025 for chemical and bio-analytical measurements in a large number different sectors. Thomas Prohaska and Stephan Hann are authorized trainers and organize courses on annual basis.

of foreign universities (2014: State Academy of Art and Design, Stuttgart, Germany; Hanoi University of Science, Hanoi, Vietnam), summer schools (International Summer School "Plant and Fish Biodiversity in Danube Delta", a CASEE Network event) or joint courses ("Chemistry and Technology of Renewable Resources", together with the Technical University Graz and Aalto University, Finland, "Quality Assurance in the Chemical Laboratory").



"Quality Assurance in the Chemical Laboratory"

is offered by the University of Leoben as a post graduate course. The course is chaired by Prof. Wolfhard Wegscheider, who is Professor of General and Analytical Chemistry at the University of Leoben and chair of EURACHEM. In the framework of the course Stephan Hann teaches "Documentation requirements of EN ISO 17025 and EN ISO 17020". The 3-day module covers the contents of a quality assurance manual. As a practical exercise a quality audit of an accredited laboratory is performed.

Quality Assurance

At the department level, experienced staff is responsible for coordinating and performing teaching including lecturing, laboratory courses and examinations. Due to lab-space and time limitations, the organization of laboratory courses for the students of *Food- and Biotechnology* has to be tightly scheduled jointly with the Department of Biotechnology and the Department of Applied Genetics and Cell Biology (DAGZ). Several senior lecturer positions are allocated to the department by the university, who are responsible for the internal organization of the first- and second-year laboratory courses. Further support comes from tutorial assistantships mostly given to experienced students, as well as master or PhD students at the department. Even with increasing activities using e-learning and on-line tools, university assistants have to spend considerable time in the preparation and supervision of lab courses including oral examinations and corrections of protocols.

The quality of lectures and lab courses is routinely being evaluated by students, the results are open to the public and serve as a means for quality control. Evaluations by the students are taken very seriously. Although the use of this assessment instrument by the students is declining, reports reveal a high appreciation of the teaching performance of the department by the community of undergraduates.

Teaching quality is a concern of all lecturers of the department. Courses in didactics, new teaching methods, e-learning and exam preparation are a valuable part of their qualification.

The department participates regularly in external evaluations and audits, for example such as the "Quality Audit 2014" by the AQ, Agentur für Qualitätssicherung und Akkreditierung, Austria.



Chapter 5

Awards



SC Mag. Elmar Pichl (BMWf) and Univ.Prof. Dr. Paul Kosma

2013 - On October 23rd **Paul Kosma** received the

“Großes Silbernes Ehrenzeichen für Verdienste um die Republik Österreich”.

This high state honour was awarded in recognition of his excellent research. His well-known research group, specialising in the field of glycochemistry, was established in 1980, whose output since then has encompassed more than 200 peer reviewed publications and several patents. He was key to establishing the very successful research area of cellulose chemistry at the BOKU.

- **Thomas Prohaska** – President of the Chemical Physical Society (CPG) 2013
- **Michael Traxlmayr** – ÖGMBT Dissertation award 2013
- **Takashi Hosoya** – JSPS post-doctoral grant
- **Kyujin Ahn** – SAPPI-award 2014 of the Austrian paper industry
- **Jean-Baptiste Farcet** – Schlögl-award 2014 by the Austrian Academy of Sciences



- **Christoph Hasenhindl** – ÖGMBT Dissertation award 2014
- **Johanna Irrgeher** – Loschmidt Award 2014 by the Austrian Chemical Physical Society
- **Stephan Hann** – Best Paper Award 2015 of the “Cooperation on International Traceability in Analytical Chemistry” for the paper Guerrasio R., Haberhauer-Troyer C., Steiger M., Sauer M., Mattanovich D., Koellensperger G., Hann S., Measurement uncertainty of isotopologue fractions in fluxomics determined via mass spectrometry. *Analytical and Bioanalytical Chemistry* (2013) 405(15):5133-5146.



2013 - **Alba Hykollari** received the

Theodor Körner Preis

for research on N-glycan epitopes of filamentous fungi. Since 1953 this prize is given annually to promising successful young scientists or artists.

2013- **Petra Viehauser** (chemistry), **Manfred Schwaninger** (chemistry) und **Andreas Schildberger** (ZID) received a

Teaching award

for the movie “Safety in the Chemistry Lab” (with German and English subtitles). You find it at <http://www.boku.ac.at/zid/themen/media-services/videoproduktionen-der-boku/>



Thomas Rosenau was awarded the 2014

“Anselme Payen Award”

to honor and encourage his extraordinary achievements in the field of cellulose chemistry concerning the molecular mechanisms that lead to discoloration cellulose and his pioneering work to elucidate cellulose dissolution on an atomic level. Anselme Payen is known for isolating and naming the carbohydrate cellulose for the first time. The Anselme Payen Award is given by the Cellulose and Renewable Materials Division of the American Chemical Society to honor and encourage outstanding professional contributions to the science and chemical technology of cellulose and its allied products. It is the most prestigious and internationally recognized award in the field of cellulose research and wood chemistry.



- **Department of Chemistry** - blood donation award 2014



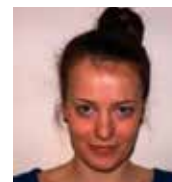
- The paper “Anti-endotoxic activity and structural basis for human MD-2/TLR4 antagonism of tetraacylated lipid A mimetics based on β GlcN(1-1) α GlcN scaffold” by Garate J.A., Stockl J., del Carmen Fernandez-Alonso M., Artner D., Haegman M., Oostenbrink C., Jimenez-Barbero J., Beyaer R., Heine H., Kosma P. and Zamyatina A. was chosen as cover story of Innate Immunity.



- **Barbara Pokorny** – Buchanan Memorial Prize 2015
- **Sven Plappert** – Science Award (2nd prize) of the Rotary Club Tulln 2015
- **Hubert Hettegger** – Science Award (2nd prize) of the Rotary Club Tulln 2015

Awards for Posters and short talks

- **Sophie Gangl** – European Geosciences Union, Vienna 2013
- **Leo Kirchmaier** – European Geosciences Union, Vienna 2013
- **Josua Oberlerchner** - 13th European Workshop on Lignocellulosics and Pulp Conference (EWLP) in Sevilla/Spain
- **Josua Oberlerchner** - High-Performance Thin Layer Chromatography Symposium in Lyon/France 2014
- **Elisabeth Lobner** - European Congress on Biotechnology – ECB16 Edinburgh, United Kingdom 2014
- **Bernhard Gasselhuber** - European Biological Inorganic Chemistry Conference – EuroBIC12 Zürich, Switzerland 2014
- **Simone Kurz** – Annual Meeting of the Austrian Association of Molecular Life Sciences and Biotechnology (ÖGMBT) 2014 (short talk)
- **Stefan Hofbauer** – Annual Meeting of the Austrian Association of Molecular Life Sciences and Biotechnology (ÖGMBT) 2014
- **Elisabeth Svehla** – Annual Meeting of the Austrian Association of Molecular Life Sciences and Biotechnology (ÖGMBT) 2014





Leopold März was awarded for his extraordinary achievements in the scientific activity and output in relation to the Danube Region with the 2015

„Danubius Award“.

The Danubius Award was created in 2011 by the Institute for the Danube Region and Central Europe (IDM) and the Austrian Federal Ministry for Science, Research and Economy (BMWFW). Leopold März supported the development of academic institutions in the Danube region as president of the Danube Rectors' Conference and as longtime deputy chair of the IDM.

- **Andreas Thader** – 13th Bratislava Symposium on Saccharides, Bratislava 2014
- **Martina Paumann-Page** - Travel award for the 9th International Human Peroxidase Meeting Cologne Conference 2015

- **Alba Hykollari** – Annual Meeting of the Austrian Association of Molecular Life Sciences and Biotechnology (ÖGMBT) 2014



- **Kristaps Klavins** - ASAC JunganalytikerInnen-Preis 2014

- **Karin Ortmayr** – ASAC JunganalytikerInnen-Preis 2015 (best talk)



- **Thomas Zweckmair** – 18th International Symposium for Wood, Fiber and Pulping Chemistry (ISWFPC) 2015



- **Irina Sulaeva** – 18th International Symposium for Wood, Fiber and Pulping Chemistry (ISWFPC) 2015

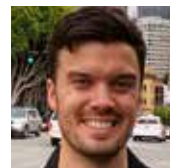
- **Slavica Koprivica** - 18th International Symposium for Wood, Fiber and Pulping Chemistry (ISWFPC) 2015 (best talk)

- **Hubert Hettegger** - 18th International Symposium for Wood, Fiber and Pulping Chemistry (ISWFPC) 2015 (best talk)



- **Hubert Hettegger** – Spring Meeting of the American Chemical Society (ACS) (best talk)

- **Tim Causon** – 42nd International Symposium on High Performance Liquid Phase Separations and Related Techniques 2015



- **Christine Opper** – European Winter Conference on Plasma Spectrochemistry, Münster 2015

- **Andreas Zitek** – European Winter Conference on Plasma Spectrochemistry, Münster 2015



- **Alessio Borio** – 18th European Carbohydrate Symposium, Moscow 2015

Chapter 6

Instrumentation

NMR infrastructure

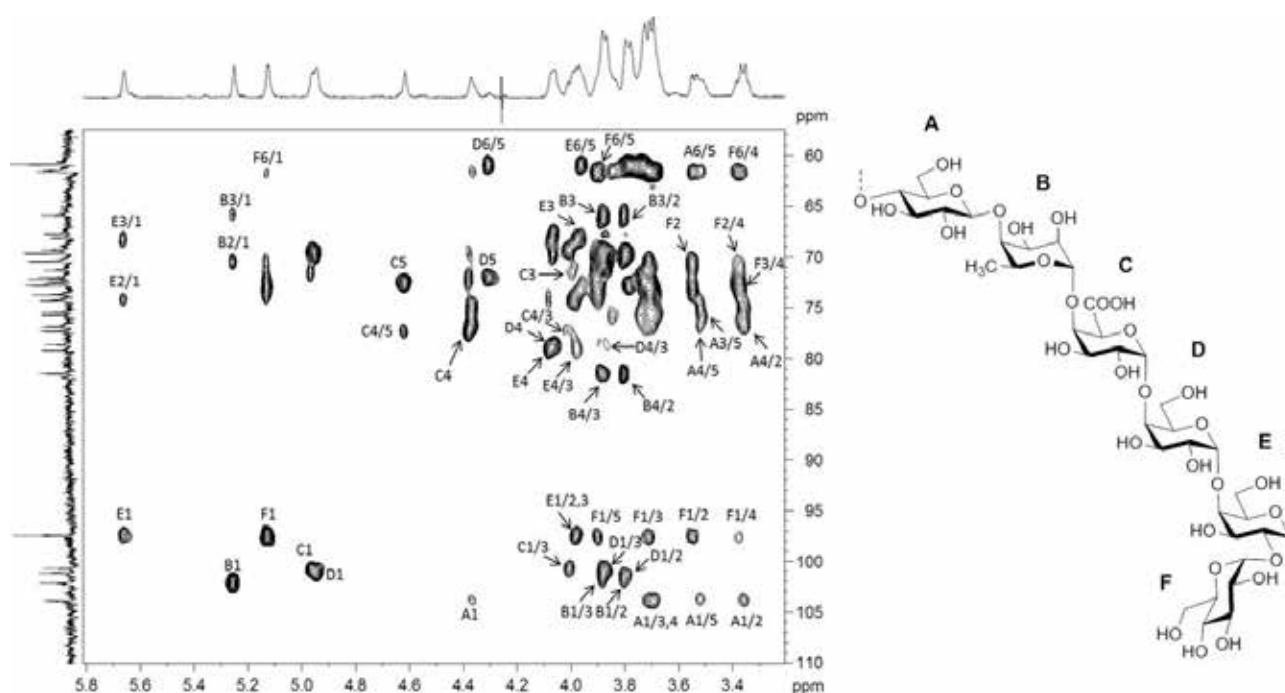
The Division of Organic Chemistry and the Division of Chemistry of Renewables operate four NMR cryomagnet systems at different magnetic fields (600 MHz, 2 x 400 MHz, 300 MHz). NMR spectroscopy can be done either in solution using deuterated solvents (**liquid state NMR** @ all systems) as well as with gel-like or solid compounds (**solid state NMR** @ 400 MHz), which requires a different hardware equipment. The NMR facilities require dedicated and specialized staff and regular maintenance to supply liquid N₂ and liquid He. NMR spectroscopy is also available as analytical service for in-house collaborations as well as for external customers.

By using state of the art one- and multidimensional homo- and heteronuclear experiments in the liquid state, structure elucidation, conformational analysis or purity check of synthesized products or biological samples is done as well as measurements of reaction kinetics, analysis of complex mixtures such as plant metabolites, bacterial and parasite glycans and technical lignins or cellulose derivatives. According to requirements additional techniques like measurements of heteronuclei other than ¹³C, such as ³¹P or ¹⁵N, experiments at variable temperatures, diffusion experiments and many more are performed.

As an example, the structure elucidation of an exopolysaccharide from *Bifidobacterium longum* subsp. *longum*



He-refill of the 600 MHz magnet



HSQC and HMBC correlations, ¹H and ¹³C projections and structure of the repeating unit from a *Bifidobacterium* exopolysaccharide

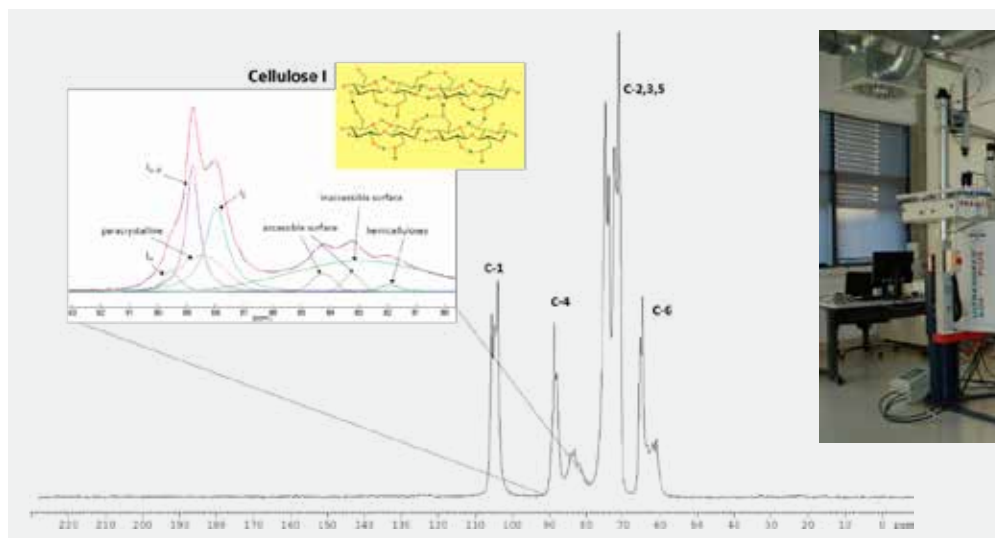




Andreas Hofinger-Horvath

35624TM is shown. Based on the evidence of nmr parameters in conjunction with additional analytical data, the structure of the acid-treated polysaccharide was elucidated. The combination of HSQC and HMBC experiments allowed to establish the composition of the hexasaccharide repeating unit, including linkage sites and anomeric configuration of the constituent sugars.

For the characterization of nonsoluble materials one of the 400 MHz magnets is equipped for solid state NMR. Gel-like samples like many carbohydrates or aerogels can be investigated with the hr-mas probe (high resolution magic angle spinning) whereas for solids all variants concerning cp-mas (cross polarization magic angle spinning) is the method of choice.



Determination of crystallinity index of cellulose I by solid state NMR.



400 MHz instrument located at UFT

Mass Spectrometry

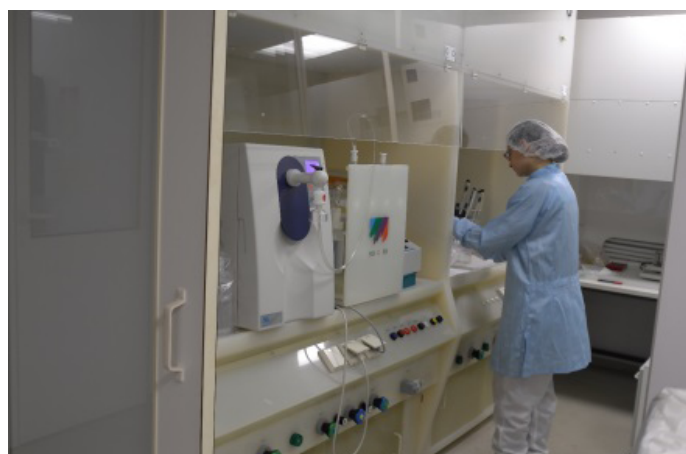
Elemental and molecular mass spectrometry at the Division of Analytical Chemistry

The Division of Analytical Chemistry is one of Austria's best equipped mass spectrometry laboratories. This is due to the availability of both high-end elemental and isotope ratio mass spectrometers (ICP-MS) and molecular mass spectrometers (LC-MS, GC-MS) within one institution.

Single collector ICP-MS systems

(multiple quadrupole and sector field ICP-MS)

The single collector ICP-MS systems in the division are used in the context of elemental ultra-trace analysis of a multiple variety of samples both at the VIBT Vienna and the UFT Tulln.



Anna Rathgeb in the class 10000 clean lab for ultra-trace analysis



Data interpretation of the laser data of the life history of a fish (A. Tchaikovsky, T. Prohaska, A. Zitek, J. Irrgeher)

MC ICP-MS

(multicollector inductively coupled plasma mass spectrometer, Nu Plasma HR)

The instrument is a specific mass spectrometer dedicated to the investigation of isotope ratios with ultimate precision. A large number of chemical elements show a distinct variation in their natural isotopic composition. (MC) ICP-MS is one of the major techniques in analytical ecogeochemistry and allows for the accurate determination of the natural variation of the isotopic composition of most elements of the periodic table of the elements. The major focus of the VIRS laboratory lies on the determination of Li, B, Mg, Si, S, Cl, Ca, Sr, Hg, Pb and U isotopes.

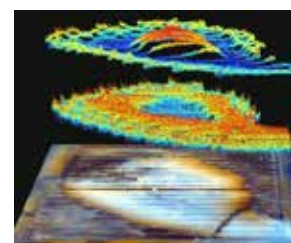


MC ICP-MS (Nu Plasma HR, Nu instruments, Wrexham, UK)

Laser ablation system

(NWR193, ESI, Ferment, CA, US)

A fine focused laser beam can be used to ablate material directly from a solid sample surface with a resolution down to 2 μm . The ablated material is transported in-line to an elemental or isotopic mass spectrometer and allows therefore for the elemental and isotopic mapping of solid surfaces.



Multi layer isotopic and elemental chemical image of the surface of a fish otolith (2 mm diameter)

Molecular mass spectrometry is performed within the EQ-VIBT core facility "Cellular Analysis" using a LC-TOFMS and GC-QTOFMS accurate mass system for non-targeted analysis and a LC-MS/MS and GC-MS/MS system for quantification.

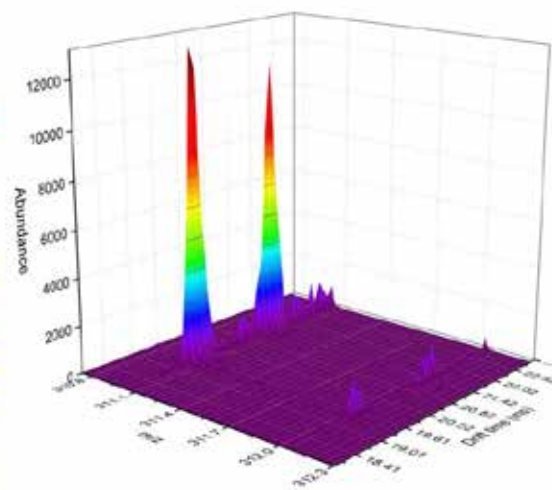
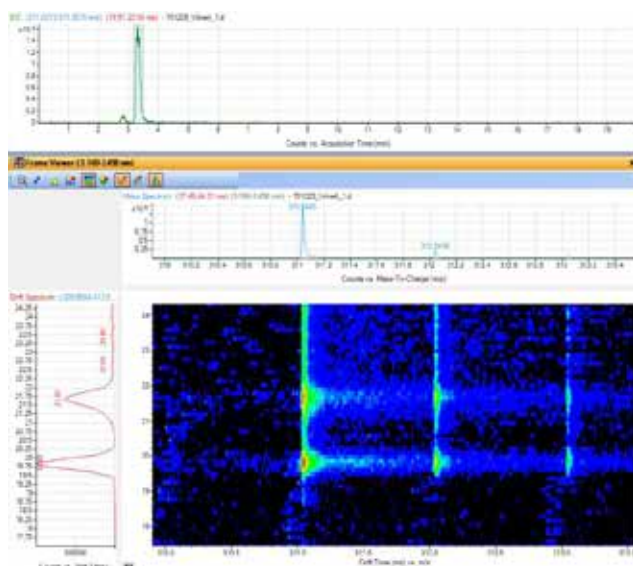
LC-IM-QTOFMS

(Liquid chromatography ion mobility quadrupole time-of-flight mass spectrometry system, Agilent 6560 IM-QTOF)

Recently, the installation of a new time-of-flight mass spectrometer with drift-tube ion mobility functionality was carried out. This state-of-the-art instrument allows routine high-resolution Q-TOF mass spectrometric detection for HPLC, while the ion mobility functionality can be used as an optional online separation device (IM-QTOF), or also nested within an HPLC $\times$ IM-QTOFMS combination



4-dimensional information (i.e. retention time, drift time, accurate mass and intensity) obtained from a LC-IM-QTOFMS measurement.



enhancing separation selectivity without increasing the analysis time. The additional separation selectivity added by drift time measurements enables the separation of structural isomers having the same mass and retention time. The instrument is being used primarily in the field of metabolomics including significant collaboration with two other universities (Vanderbilt University and Pacific Northwest National Laboratory) to establish international consensus on instrument performance, reproducibility and accuracy of IM-TOFMS results.

Mass spectrometry at the Division of Biochemistry

MALDI-TOF MS

Matrix-assisted laser-desorption/ionisation time-of-flight mass spectrometer (MALDI-TOF MS): the Bruker Autoflex Speed (installed in 2012) is the latest of this type of instrument in the department (the first one arrived in 1998). A particular focus is on 'off-line' HPLC-MS-based glycomics, which means that glycans from various sources are chromatographically separated before spotting onto a metal target, which is then introduced into the MALDI-TOF MS for analysis including MS/MS fragmentation in positive and negative ion modes. Having this instrument 'on-site' was key to nearly twenty publications published by the Molecular Glycobiology group (head: Iain Wilson) in the last three years, but also supports work by other research groups within the Department. To be highlighted in particular are recent publications in 'top' proteomics journals (especially three published in *Molecular & Cellular Proteomics* in 2015; IF over 6) describing the isomeric and isobaric complexities of the protein-linked glycans of a range of organisms including nematodes, molluscs and fungi; such studies would not have been possible in such fine detail without this instrument, indicating its importance for the discovery of unexpected glycan epitopes.



LC-IM-QTOFMS in the new lab at the BOKU EQ VIBT core facility "Cellular Analysis"



Tim Causon and the LC-IM-QTOFMS in the new lab at the BOKU EQ VIBT core facility "Cellular Analysis"



Iain Wilson and the MALDI-TOF MS

Bio-mass spectrometry

Since 2012 we operate a **high-resolution ESI-Q-TOF mass spectrometer** (Bruker, Maxis G4) (as part of the EQ-VIBT GmbH) and an **ion-trap with CID and ETD capability** (Bruker, amaZon Speed ETD) plus the necessary **nano- and capillary HPLC systems**. The high resolution, mass accuracy and sensitivity allow to answer an infinite variety of analytical problems such as protein identification via peptide mapping, de novo sequencing of peptides, mass determination of intact proteins, quantitative proteomics and – at the heart of our competence – glycoprotein and N- and O-glycan analysis. These capacities are regularly drawn on by other groups from BOKU and from companies, mostly the small and medium enterprises.



The Maxis G4 at the time of installation (left) and fully installed with a nano-flow LC attached (right).

Other Techniques

HPTLC

Determining the chemical composition of a biomass sample requires the application of several analytical methods. At the NAWAROS group, automated High Performance Thin Layer Chromatography (HPTLC) has proven to be outstandingly suitable for the analysis of renewable resources and complex compound mixtures as they occur in biorefinery streams.

Due to its open and accessible setup, changing the separation parameters is very simple in HPTLC, which allows to study also very complex, contaminated or solid-laden samples within short analysis times. Since the analytes are directly accessible on the plate, selective derivatisa-

tion is straightforward and any surface scanning method can be used as detection mode. Accuracy of the automated HPTLC techniques is fully comparable to those of HPLC methods. With atmospheric pressure ionization methods, such as DESI MS (Direct Electrospray Ionization Mass Spectrometry), mass spectra of the separated compounds can be recorded directly off the plate. Even the growth inhibition of microorganisms can be used as specific detector for bioactive compounds (“bioautography”) and the reproducible and quantitative analysis of mono-, di-, and oligosaccharides, anthocyanins and fungal metabolites is routinely performed.



Surface analysis with ambient ionization techniques

Ambient ionization techniques, such as DESI-MS (desorption electrospray ionization mass spectrometry) and PS-MS (paperspray mass spectrometry) typically require only very limited sample preparation for obtaining mass resolved information from sample surfaces. The DESI ion source comprises a spray capillary within a nebulizer capillary spraying an aqueous solvent on an insulated sample surface, producing charged secondary microdroplets which are transported into the mass spectrometer.

We use the techniques mainly for the surface analysis of natural and chemically modified lignocellulosic materials. It allows a direct mass-spectrometric profiling of the surface under ambient conditions (no drying, no vacuum).

In DESI-MS-imaging every pixel contains the whole spectral information of the m/z -scan range selected. Applying appropriate statistical tools such as principle component analysis (PCA) as well as multivariate curve resolution (MCR) considerably simplifies the workflow for identifying spatially important features within the hyperspectral data-set to be used for the rapid profiling of aging phenomena on paper surfaces important in preservation science, the success of chemical modifications, surface hydrophobicity/hydrophilicity and other parameters.



Molecular weight determination of biopolymers

The broad variety of natural and modified biopolymers that are studied in the Division of Chemistry of Renewable Resources ranges from all types of native and technical lignins over different polysaccharides in plants and algae to a broad variety of cellulosic materials, pulps and papers. One important descriptor – perhaps the most important one – of natural polymers or oligomers is their molar

mass and its characteristic distribution.

To determine those parameters, several independent Size Exclusion Chromatography (SEC) and Asymmetric Flow Field-Flow Fractionation (AF4) lines with different setups are available, using refractive index (RI), fluorescence, UV, viscosity, evaporative light scattering (ELS) and multi-angle laser light scattering detection (MALLS). Based on the differences among the natural polymers, the chromatography lines run in different eluants. While the arrangement is flexible with respect to the attached detectors and solvents used, the three most important analytical set-ups that are routinely used are dedicated to a) cellulose analysis in *N,N*-dimethylacetamide / lithium chloride by SEC, b) aqueous polysaccharides in buffer solution separated by SEC or AF4 and c) lignin analysis in dimethylsulfoxide/lithium bromide separated on SEC columns. All systems are equipped with MALLS detectors as a means of absolute molecular weight determination.



Supercritical Fluid Equipment

The equipment purchased in 2012 allows for separation, extraction, purification, sterilization, and modification of biopolymers and their processing to respective (composite) materials using all common supercritical fluid technologies, such as supercritical fluid extraction (SFE), supercritical antisolvent precipitation (SAS), rapid expansion of supercritical solutions (RESS), particles from gas saturated solutions (PGSS), impregnation, foaming, or $scCO_2$ drying of highly sensitive, ultra-lightweight open-porous materials.



Purification of hemi-cellulose from residual lignin using $scCO_2$ antisolvent precipitation.



Different types of ultra-lightweight cellulosic aerogels partly covalently equipped with alloyed core/shell quantum dots.

Chapter 7

International Activities

Incoming

Fulbright Professor

John Ralph

*University of Wisconsin,
Madison, USA*



John Ralph received his chemistry degree from Canterbury University, New Zealand, and his PhD from the University of Wisconsin at Madison, USA. He was research scientist at the Forest Research Institute (F.R.I.), Rotorua, New Zealand, and became the Scientific Head of Research Laboratory for Nuclear Magnetic Resonance Spectroscopy at the University of California at Berkeley, CA, USA. After twenty years as research chemist at the USDA-ARS, U.S. Dairy Forage Research Center at Madison, he became full professor at the Department of Biochemistry at the University of Wisconsin at Madison, USA. Since 2008 he is the scientific advisor of the 'Improved Plant Biomass' project at the Great Lakes Bioenergy Research Center. His areas of professional expertise are general plant cell wall chemistry and biochemistry, lignin biosynthesis including pathway delineation, lignin chemistry, cell wall transgenics, and solution-state NMR, particularly of cell wall components, especially lignins and other methods for wall structural analysis. He is the 2005 Elected Fellow of the American Association for the Advancement of Science (AAAS), and recipient of the 2013 Anselme Payen Award of the American Chemical Society. In 2013 he spent 9 month as Fulbright Visiting Professor at BOKU, Division of Chemistry of Renewable Resources, helping to establish state-of-the-art lignin and plant cell wall analysis by NMR and setting the analytical foundation of the lignin analysis platform which has rapidly progressed since then.

Visiting Professors appointed by the Senate of BOKU

Alfred D. French

*U.S. Department of
Agriculture and University
of New Orleans,
Louisiana, USA*



Alfred (Al) Dexter French graduated from Arizona State University before becoming a research chemist and group leader at the US Department of Agriculture, Agricultural Research Service, New Orleans, USA. Apart from this he holds several Adjunct Professorships in Physical Chemistry, among them at the University of New Orleans, USA. His work was recognized by the Anselme Payen Award of the American Chemical Society (ACS) in 2009, and the ACS fellowship in 2010. Since more than 10 years he is Editor-in-Chief of the ACS journal "Cellulose". His core professional areas are computational carbohydrate chemistry, molecular modelling of carbohydrates and diffraction crystallography, which he developed over more than 45 years. His lecture at BOKU, as a visiting professor at the Division of Chemistry of Renewable Resources in 2013, addressed similar topics: "Understanding Carbohydrates and Cellulose with Computation and Crystallography". The start of the cooperation with Al French dates back to the beginning of this millennium, with collaboration in the field of crystalline cellulose model compounds. From this time on, many common projects and publication in the field of cellulose structure, cellulose aging and cellulose swelling and dissolution have followed.



Adriaan van Heiningen

*Forest Bioproducts
Research Institute,
University of Maine, USA*



With an education in chemical engineering at State University of Groningen, Netherlands and a PhD in the same field from McGill University Montreal, Canada, Adriaan van Heiningen is currently professor and J. Larcom Ober Chair at the Department of Chemical Engineering, University of Maine, Orono, ME, USA. At the same time he acts as Visiting Research Professor at the Department of Forest Products Technology, Helsinki University of Technology, Espoo, Finland. He has more than 30 years of expertise in chemical engineering aspects of pulp and paper processes, in particular those of wood pulping, pulp bleaching, and recovery of spent kraft pulping chemicals. Internationally regarded as one of the fathers of “Integrated Forest Products Refineries” which produce transportation fluids, chemicals and biomaterials besides pulp, paper and wood products, he presented a lecture series “Pulping and bleaching chemistry as a basis for the forest biorefinery” as BOKU guest professor in 2014, invited by the Division of Chemistry of Renewable Resources. Before that assignment, Adriaan van Heiningen has been a cooperation partner of the division for more than 10 years.

Petra Mischnick

*Faculty of Life Sciences,
TU-Braunschweig,
Germany & Department
of Fibre and Polymer
Technology,
KTH Stockholm, Sweden*



Petra Mischnick studied chemistry at Hamburg University where she also received her PhD. The topic of her habilitation “Analytical Characterization of Polysaccharides and Polysaccharide Derivatives by means of Chemical, Enzymatic, and Mass Spectrometric Methods”, also at Hamburg University, remained her field of work and expertise since then. In 1998 she became Full Professor at the Department of Food Chemistry, TU Braunschweig and is Affiliated Professor at KTH Stockholm, Sweden, since 2012. Petra Mischnick is especially active in the German Chemical Society. Her lecture as BOKU visiting professor at the Division of Chemistry of Renewable Resources in 2015 (“Polysaccharides and their derivatives: preparation and structure analysis”) focused on substituent and substituent distribution analysis of cellulose derivatives. The collaboration with Petra Mischnick dates back more than 15 years.

Ilkka Kilpeläinen

*Department of Chemistry,
University of Helsinki,
Finland*



Ilkka Kilpeläinen received his master degree in organic chemistry and his PhD from the University of Helsinki. He was head of the National biological NMR laboratory in Finland and professor at the University of Oulu, Finland, before becoming Full Professor for Organic Chemistry at University of Helsinki. His focus is on cellulose solvents, in particular ionic liquids, as well as NMR spectroscopy in polysaccharide chemistry. As BOKU visiting professor at the Division of Chemistry of Renewable Resources in 2014, he held a lecture entitled “Novel biorefinery approaches and analysis of their product streams” in which he focused on analytical aspects of biorefineries, in particular separation and analysis of complex product streams in biorefineries and analysis of single components contained. Host and guest institute have been collaborating in the field of cellulose solvents and NMR spectroscopy for more than 5 years.

Akira Isogai

*Department of
Biomaterial Sciences,
Graduate School of
Agricultural and Life
Sciences, University of
Tokyo, Japan*



Akira Isogai is Full Professor at the Department of Biomaterials Science, Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan. He received his degrees from the same university and returned to there as assistant professor after a post-doctoral stay at the Institute of Paper Chemistry, Appleton, WI, USA, and as associate professor after a two-year research visit at the Forest Products Laboratory, USDA, Madison, WI, USA. Akira Isogai is famous for his contributions to paper chemistry and for the application of TEMPO oxidation in cellulose chemistry. He is the 2015 recipient of the Anselme Payen Award of the American Chemical Society. In 2015, he was BOKU visiting professor at the Division of Chemistry of Renewable Resources, presenting a lecture entitled „Current cellulose chemistry“. Akira Isogai has been a cooperation partner of the Division since 2008, and was engaged several times in staff exchange between the two institutes.

Gerardo Vasta

*University of Maryland
School of Medicine,
Baltimore, USA*



Prof. Vasta is a well-known expert on the biology of galectins and other carbohydrate-binding proteins from both vertebrates and invertebrates. His laboratory focuses on molecular, biochemical, structural, and functional aspects of protein-carbohydrate interactions relevant to immunity and early development: Function/structure/evolution of innate immune mechanisms in vertebrates (model organisms: zebrafish, amphibians, and mouse), and invertebrates (model organisms: mollusks and tunicates); Role of protein carbohydrate interactions in early development and cancer (zebrafish, mouse, and human); Biochemical, molecular and genomic approaches to the study of recognition, signalling, and mechanisms for intracellular survival of protistan parasites (model system: *P. marinus* and its host, the eastern oyster *Crassostrea virginica*). During his two week stay in May 2015, fitting into the role of the VIBT as a ‘Glycocluster’, he held a lecture course on ‘Protein-carbohydrate interactions in innate immunity’ and a research seminar on ‘Protein-carbohydrate interactions in innate immunity: from a sweet tooth to the Trojan horse’.

Invited Lecturers

Masao Ikaeda-Saito, Tohoku University, Japan
Richard Cummings, Emory University, USA
Ron Hokke, Leiden University, Netherlands
Stefan Oscarson, University College Dublin, Ireland
Anne Dell, Imperial College London, UK
Vlad Panin, Texas A&M University, USA
Michela Tonetti, University of Genoa, Italy
Ben Appelmelk, Vrije Universiteit Amsterdam, Netherlands
Vladimír Křen, Academy of Sciences, Prague
Bernard Henrissat, CNRS - Aix Marseille University, France
Steven Keller, Miami University, Ohio, USA
Ulla Letinois, DSM Kaiseraugst, Switzerland
Lloyd Donaldson, Scion, Rotorua, New Zealand
Georgios Toskas, Technol. Educ. Inst., Piraeus, Greece

Alain Dufresne, Grenoble Institute of Technology, France
Shigehiko Suzuki, Shizuoka University, Japan
Linda Stiber Morenus, Library of Congress, Washington DC, USA
Henry Bock, Watts University Edinburgh, UK
Dan Aoki, Nagoya University, Japan
Orlando Rojas, Aalto University, Finland
Alistair King, University of Helsinki, Finland
Uwe Rinner, Johannes Kepler University Linz, Austria
Christian Jäger, Bundesanstalt für Materialforschung und -prüfung, Berlin, Germany
Luca Bertoli, now BOKU
Matija Strlic, University College London, UK



Guest Scientists

Adam Nagy, Corvinus University Budapest, Hungary
Jozsef Lenart, Corvinus University Budapest, Hungary
Aline Dörrbau, Hochschule Fresenius Idstein, Germany
Karel Folens, University of Ghent, Belgium
Francesca Bonetto, Università Ca' Foscari, Italy
Jozsef Elgyutt, Slovakian Academy of Sciences, Nitra, Slovakia
Britta Bookhagen, Universität Potsdam, Germany
Antonia Leeb, Naturhistorisches Museum Wien, Austria
Lea Luisa Klement, Naturhistorisches Museum Wien, Austria
Valentina Lyubomirova, University of Sofia, Bulgaria
Bart Decuyper, Ghent University, Belgium
Mariana Ortega Garcia, Nova Analítica, Brazil
David Jaime Cocovi Solberg, University of the Balearic Islands, Majorca, Spain
Corinna Friedrich, FH Coburg, Germany
Yehuda Benayahu, Tel Aviv University, Israel
Denis Schlorke, University of Leipzig, Germany
Jörg Flemmig, University of Leipzig, Germany
Zoltán Pálkás, National Institute of Oncology, Hungary
Caroline Noyon, Université Libre de Bruxelles, Belgium
Kate Royle, Imperial College London, UK
Jana Gau, University of Leipzig, Germany
Sara Zaccaron, Università Ca' Foscari Venezia, Italy and Johns Hopkins University, USA
Huiqing Wang, Technical University Hefei, China
Ane Stéfano Simionato, Universidade Estadual de Londrina, Brazil
Ana Kramar, University Belgrade, Serbia

Enhkijargal Budjav, University Ulaanbaatar, Mongolia
Eva Hummert, Staatliche Akademie der bildenden Künste Stuttgart, Germany
Christine Mugumya Kyarimpa, Makerere University and Kyambogo University, Kampala, Uganda
Iina Solala, Universität Aalto, Finland
Kristina Druceikaite, University Vilnius, Lithuania
Catrin Schuster, Staatliche Akademie der bildenden Künste, Stuttgart, Germany
Yasmine Kerber, FH Bern, Switzerland
Alexander Tischer, TU Dresden, Germany
Leticia Mercedes Carbajal Galán, École nationale supérieure de chimie de Clermont-Ferrand, France
Julien Jaxel, Nancy, France
Laura Völkel, HAWK Hildesheim, Germany
Lucy Arianie, Universitas Tanjungpura, West Kalimantan and West Java, Indonesia
Natalia Valchuck, Arkhangelsk State Technical University, Russia
Lim Seng Joe, National University of Malaysia, Malaysia
Fereshteh Fadavi, University of Tehran, Iran
Jordan Perrin, Grenoble Institute of Technology, France
Sinah Lee, Dongguk University, Seoul, South Korea
Noora Mäkelä, University of Helsinki, Finland
Thomas Netscher, DSM Kaiseraugst, Switzerland
Myung-Joon Jeong, Seoul, South Korea
Ferenc Firtha, Corvinus, University of Budapest, Hungary
Yehuda Benayahu, Tel Aviv University, Israel
Lukas Perkans, University of Bayreuth, Germany

International Programme Exchanges

Dalma Radványi, Corvinus University of Budapest, Hungary (Erasmus training programme)
Anikó Németh, Corvinus University of Budapest, Hungary (Erasmus training programme)
Maria Elena Laugier, University of Genoa, Italy (Erasmus training programme)

Katarzyna Karozewska, Gdansk University of Technology, Poland (Erasmus training programme)
Zuzana Pakanova, Slovak Academy of Sciences, Slovakia (ÖAD scholarship)
Karell-Roberto Peréz Labrada, University Habana, Cuba (EULA-scholarship)

Outgoing - Lectures, Teaching and Research

Andreas Zitek - CASEE Network event: International Summer School „Plant and Fish Biodiversity in Danube Delta“
Coordinator: University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca (USA, MV Cluj-Napoca)
Stephan Hann - Hanoi University of Science, Hanoi, Vietnam
Stephan Hann – University of the Balearic Islands
Thomas Prohaska – University of Singapore, Singapore
Thomas Prohaska, Andreas Zitek – Eg / Selenge river excursion, Mongolia
Stefan Hofbauer – Università di Firenze, Dipartimento di Chimica “Ugo Schiff”, Italy

Bernhard Gasslhuber – IBMB-CSIC, Barcelona, Spain
Simone Kurz – CCRC, University of Georgia, USA
Friedrich Altmann – Mainz, Deutschland
Carmen Jiménez-Castells, Erika Staudacher, Iain Wilson – RIKEN, Tokyo, Japan
Monika Soudi – Christchurch School of Medicine & Health Sciences, University of Otago, Christchurch, New Zealand
Irene Schaffner – University of Modena and Reggio Emilia, Italy
Christoph Hasenhindl – Center for Genomic Regulation (CRG) Barcelona, Spain
Andrea Nicolussi - University of Modena and Reggio Emilia

ia, Italy

Elisabeth Lobner, Irene Schaffner – Oak ridge National Laboratory, Tennessee USA

Alba Hykollari – Berlin, Germany

Iain Wilson – Department of Biochemistry, University of Cambridge, United Kingdom

Shi Yan – Nanjing Agricultural University, China

Shi Yan – Soochow University, China

Shi Yan – Guangzhou Institute of Geochemistry, Chinese Academy of Sciences, China

Barbara Eckmair, Jorick Vanbeselaere, Iain Wilson - 4th Austria/Japan Seminar on Comparative and Developmental Glycobiology, Split, Croatia

Jorick Vanbeselaere – Ludger Ltd., Oxford, UK

Barara Pokorny – Research Center Borstel, Germany

Paul Kosma – University College Dublin, Ireland

Paul Kosma – University of British Columbia, Vancouver
Paul Kosma – University of Victoria, British Columbia, Canada

Florian Adanitsch, Markus Blaukopf – COST Training school, Madrid, Spain

Johannes Hell – SCION Rotorua, New Zealand

Thomas Zweckmair – Purdue University, USA

Thomas Zweckmair – Polysaccharide course, ÅboAkademi, Turku, Finland

Ute Henniges – State Academy of Art and Design, Stuttgart, Germany

Thomas Rosenau – Shinshu University, Japan

Hubert Hettegger – STSM Catania, Italy

Markus Bacher – Bruker NMR-Meeting, Kassel, Germany

Josua Oberlerchner, Katharina Paschinger, Thomas Zweckmair – Bruker MALDI-Meeting, Kassel, Germany

Organisation and Co-Organisation of Conferences

2013

- LPS-Meeting BOKU Sept 2013
- 11/2013: 100 Jahre Massenspektrometrie, November 26, Universität Wien
- EGU General Assembly 2013 (co-organized) April 2013
- DIN ISO meeting “Quality control for mass deacidification”, October 16-17, Tulln
- COST FP0109 Meeting, March 25, Tulln
- RR 2013, June 19-22, St. Petersburg, Russia
- SciSki Seminar, March 18-20, Zauchensee
- ICOM-CC Graphic Document Group Interim Meeting, April 17-19, Vienna
- 2nd International Conference on Biomedical Engineering and Biotechnology (iCBEB 2013), October 11-13, Wuhan, China
- 3rd Austria-Japan Joint Seminar on Comparative and Developmental Glycobiology, Tokyo, Japan

2014

- 18th Austrian Carbohydrate Workshop, February 13, BOKU
- OxyZymes 2014 (July 1-4, BOKU) – *see box*
- Minisymposium on Glycomics, Glycochemistry and Glycobiology September 5, BOKU
- European Workshop on Lignocellulosics and Pulp (EWLP), June 2014, Sevilla, SPAIN,
- European Japanese Cellulose Workshop, October 2014, Berlin, Germany
- ASAC JunganalytikerInnenforum 2014, Tulln



Oxizymes 2014





Minisymposium on Glycomics, Glycochemistry and Glycobiology



In July (July 1-4) the International Conference OxiZymes was organized by the Protein Biochemistry Group at BOKU. OxiZymes covered recent developments of basic and applied aspects of oxidoreductases with focus on flavoenzymes, heme proteins and copper-dependent enzymes. Around 200 participants from 20 different nations attended the meeting and discussed the phylogeny, physiology and recombinant production of these biocatalysts, as well as structure-function relationships together with novel methods in protein engineering and design. New biotechnological applications as biocatalysts and biosensors as well as in the field of bioremediation were presented. The meeting was preceded by a special BioToP session that allowed students from the doctoral programme BioToP to present their research in front of an international audience.

2015

- Challenges in metabolomics analysis at EUROANALYSIS 2015, Bordeaux, France
- Hyperspectral Imaging Workshop, BOKU
- Doc Day, Tulln, Austria
- Austria-Taiwan Joint Seminar on “Interdisciplinary views on Climate Change Issues for the Development of Future Perspectives”, Taipei, Taiwan
- 18th International Symposium on Wood, Fiber and Pulp Chemistry (ISWFPC 2015)- *see box*
- 4th Austria-Japan Joint Seminar on “Comparative and Developmental Glycobiology”, Split, Croatia
- European Japanese Cellulose Workshop, Berlin, Germany

ISWFPC 2015

September 2015, the International Symposium on Wood, Fiber and Pulping Chemistry (ISWFPC) was going to Austria for the first time, being hosted at BOKU by the Division of Chemistry of Renewable Resources. The ISWFPC is one of most renowned and well-established conferences in the area of lignocellulosic renewable materials and is held every other year at a different continent. We welcomed more than 300 researchers from 21 countries all over the world, who gave 96 oral talks and presented 200 posters. Preceded by a pre-conference on analytical techniques at the Tulln UFT facilities, the main symposium took place in the Muthgasse venue from September 9th to September 11th, 2015. To underline the focus on renewable materials and their sustainable use, the 18th ISWFPC was held under the auspices of the label ÖkoEvent issued by Umweltberatung der Stadt Wien.



ISWFPC 2015

Chapter 8

Outreach Activities

Besides research articles in scientific journals, we communicate our results to the public via print media and contributions to broadcasts, TV and films. In addition, projects, guided tours, visits and workshops with schools are offered.

Print media

Articles in Presse, Standard, Wiener Zeitung, NÖN, Falter, Falstaff, FWF-Journal, Technopol-ecoplus Brochure, such as "Woher kommt der Fisch", "Woher der Fisch geschwommen kam?", "Repräsentation des Themas der Analytischen Ökgeochemie am Department für Chemie der BOKU-UFT", "Alpenlachs: Neue Methode der Herkunftskontrolle", "VIRIS – hochpräzise Isotopenanalytik am Standort Wien – Was Fische mit der Menschheitsgeschichte zu tun haben", Thomas Prohaska – START-Project: "Chemische Analytik: Eiskaltes Labor in der Jurte", "Neue Therapie Wege im Visier – Forscher entdeckten den Mechanismus zur Entstehung von Multipler Sklerose", "Papier aus Österreich", "Report WPF / UFT Nawaros", "FLIPPR", "Nachwachsende Rohstoffe – Grüne Chemie der Zukunft", "Report ISWFPC", "Chemie NAWARO".

Sustainicum resources

(<http://www.sustainicum.at/>)

The Sustainicum-project aims to advance topics in university teaching that are relevant to sustainability from the perspective of diverse disciplines. For this purpose a platform was developed where a variety of different types of resources can be collected and displayed. The Division of Analytical Chemistry contributes to the platform with different projects. Bee-o-monitor - A show-hive has been installed in Tulln and provided with sensors (weight, temperature, humidity, frequency meter for tone and vibration of the bees, and IR camera) to observe the hive externally via a web based platform and to use the data to explore a living colony of bees.



Sparkling Science project "CSI: Trace Your Food"
(<http://csi-traceyourfood.boku.ac.at>)



Sparkling science is a programme from the Austrian the Federal Ministry of Science, Research and Economy (BMWFW) to promote collaboration of research institutions with schools. Pupils of all levels of education are actively involved in the research process. The thematic focus of the project Classroom Science Interaction "CSI: TRACE your FOOD" conducted the VIRIS lab of the Division of Analytical Chemistry is the systematic determination of unique chemical fingerprints in food from different regions in Austria for the unambiguous determination of origin.

Broadcast, TV and film

- Interviews in ORF radio Ö1 "Bio-Chemikalien", "Bio-raffinerien", "Nawaros"
- "Isotopentest beim Fisch", TV story 31. 01. 2014 in *Heute konkret (ORF)*
- "Herkunftsnachweis von Kaviar" TV story 25. 11. 2014 in *Salzburg Heute (ORF)*
- Film portrait Thomas Prohaska - BMWF
- "Reportage Generation Zukunft - Talente und Träume" *Servus TV* 2015
- Science Film Festival 2015 - organized by the non-profit organization sf² in collaboration with BOKU, the Austrian Academy of Sciences and the Museum of Natural History, Vienna with a science film competition, workshops, presentations and discussions.

Events for schools

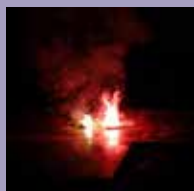
- School visit and workshop for BRG St. Pölten (related to sparkling science project) 03. 12. 2013
- Sustainicum project 'Beeomonitor' – see box
- Sustainicum projects "SIFIM" and "FishPOP: virtual fish population"
- Science Booster – the mobile Research-bus
- iTEC – FLUGTAG: Presentation of the iTEC Cycle 5, project „Science Booster“ in the classroom of the future, 26. 06. 2013, Bundesgymnasium und Bundesrealgymnasium Klosterneuburg
- Cellulose-path together with Tulln



- Lectures at schools
- Lectures at the University for children (Kinderuniversität)
- Participation at the 1st ChemiecAMP – “Am Puls der Forschung” for interested pupils 2.-4.9.2015, organised by Verband der Chemielehrer Österreichs und Fachverband der chem. Industrie Österreichs
- Three days of school internship Tage Schülerpraktikum – Nov 2015
- Sparkling Science Project - CSI: TRACE your FOOD - see box
- Annual Christmas-lecture - see box
- Participation in the “Week of Chemistry” organised by the Society of Austrian Chemists - see box
- Contribution to 70-years Food and Biotechnology, BOKU 2015
- Round table discussions, ÖVAF, Bios Science

The Magic of Chemistry

Continuing an almost 10-years-old tradition, the Division of Chemistry of Renewable Resources invites audience every year in Advent time to a spectacular experimental lecture themed “The Magic of Chemistry”, or simply “Christmas lecture”. In 2014, more than 300 spectators of all ages followed this invitation to the UFT Tulln University and Research Center to watch three dozens of the most stunning experiments presented by the multinational research team of the NAWARO Division, staff members of the BOKU institute of Wood Science and Technology, pupils of the Bundesgymnasium Tulln and kids of the Lower-Austrian “Technology Kids” Initiative. Different from previous shows which were usually embedded into a fantasy story especially aiming at children, this time the secrets of many experiments were unveiled and relations to historical events were pointed out. Professor Liebner who guided through the programme talked about the glowing of fireflies, the visualization of traces of blood, the reasons leading to dust explosions or the phenomenon of hands that can be immersed in liquid nitrogen without being injured. There was also great interest to learn how Haribo bears can be forced to dance, why banknotes can burst into flames without burning to ash or how “elephant’s toothpaste” can be mixed.



Others

- Contribution to the anthropologic exhibition of the Museum of Natural History ‘Evolution of humans’, 2013
- Long Night of Research - The Division of Chemistry of Renewable Resources contributes every year to the Long Night of Research offering two experimental stands. While one stall invited the visitors of all ages to test their normal olfactory functions for a variety of natural and synthetic aromas, the other one, particularly dedicated to kids, was intended to impart knowledge about the chemical secrets of magic inks that change their color or appear/disappear only upon heating. The Division of Analytical Chemistry provides knowledge about food provenance and authenticity achieved with modern analytical techniques and inspires the visitors with interactive stations.
- Science party 2013, Tulln

Week of Chemistry

The BOKU-contribution

to the Austrian “Week of chemistry” was organised by the Department of Chemistry. During two days (September 29-30, 2015)

the guests received an introduction into “Chemistry and Health”, “Chemistry and Medicine”, “Chemistry and Environment” and “Chemistry and Renewable Resources”. In 21 short talks scientists of the university presented their research area and its applicability into every day’s life.



Chemie und Gesundheit

Schimmelpilzgifte in unserer Nahrung - *Franz Berthiller*

„Reizenden“ Lebensmittelallergenen auf der Spur -

Sabine Baumgartner

Von Bienen, Blumen und falschen Allergiediagnosen -

Friedrich Altmann

ESL-Milch – wollen KonsumentInnen tatsächlich „länger frische“

Milch? - *Helmut Mayer*

Chemie und Medizin

Warum müssen wir Schwermetalle essen – die Rolle von Metalloproteinen im Stoffwechsel - *Christian Obinger*

Engineering novel antibody biologics - *Florian Rüker*

Magnetic biomedical nanoparticles - *Erik Reimhult*

Massenspektrometrie von Glykanen und Proteinen

- *Clemens Gruber*

Süßer Schmuck tierischer Zellen - *Katharina Paschinger*

Pichia, eine Hefe als Werkzeug und Modell in der Biochemie -

Martin Dragosits

Metabolomics – die Jagd nach kleinen Molekülen im Stoffwechsel

- *Christina Troyer*

Bye, bye Antibiotika, what’s next? - *Paul Kosma*

Chemie und Umwelt

Chemie des Bodens - *Barbara Hinterstoisser*

Was ist geschehen? Antworten auf Fragen von gestern und heute

mit Hilfe moderner Isotopenanalytik - *Thomas Prohaska*

Synthese und Charakterisierung von Nano-Laternen -

Eva Sinner

Analytik von Nanoskopischen Materialien am Beispiel von

Nano-Laternen - *Tim Causon*

Stoffkreisläufe sichtbar gemacht: Nanolaternen im Einsatz in der

Abfallwirtschaft - *Marion Huber-Humer*

Chemie und Nachwachsende Rohstoffe

Warum Holz genial ist – eine molekulare Betrachtung -

Barbara Hinterstoisser

Chemie in der Papierrestaurierung - *Ute Henniges*

Bioraffinerie - was aus Pflanzen alles werden kann -

Stefan Böhmendorfer

Cellulose ist überall - das Alltagspolymer - *Antje Potthast*

Was wird, wenn das Erdöl alle ist? Die Zukunft nachwachsender

Rohstoffe - *Thomas Rosenau*

Chapter 9

Management and Administration

The members of the Department of Chemistry see their duties mainly in teaching and research. However, to make these run properly, much time has to be spent with administration issues. Members of the department are representatives in local university committees and boards and cover legal commitments. They are members of national and international boards, editors and reviewer for international journals and members of evaluation committees.

University administration

- One out of two BOKU departments involved in the 2014 audit of the university.
- Contribution to the topic 'Transdisciplinarity' in the course of the sustainability strategy of the BOKU
- Member of the animal protection commission according to §21 of the Austrian animal experiment law 2012
- Members in habilitation commissions
- Contributions to department evaluations (DAGZ, WAU, IFA, Nano-Bio)
- Members of appointment commissions for honorary doctorates

Members in university committees and boards:

Andreas Hofinger-Horvath:

- Member of the curricula committee for doctoral studies
- Member of the curricula committee Food and Biotechnology

Paul Kosma:

- Member of the curricula committee Food and Biotechnology

Christian Obinger:

- Speaker of doctorate programme BioToP
- Study programme coordinator for BOKU doctorate
- Deputy of the Vice Rector in BOKU Committee for Research
- Deputy member of the curricula committee Food and Biotechnology

Thomas Rosenau:

- Member of the Senate

Erika Staudacher:

- Dean of Studies
- Member of the quality assurance group

Michaela Zeiner:

- Deputy member of the curricula committee Food and Biotechnology

National scientific community services

- Member of the Austrian Science Fund – Kuratorium (Iain Wilson)
- Christian-Doppler-Society Board member (Paul Kosma)
- Member of the Supervising/Strategy Board WOOD (Paul Kosma)
- Member of the Austrian Agency for Scientific Integrity (Paul Kosma)
- Project evaluations (ÖAD, Science Advisory Board Lower Austria)
- Member of the Commission for geosciences of the Austrian Academy of Sciences (Thomas Prohaska)
- Member of the managing board of the Young Academy of the Austrian Academy of Science (Thomas Prohaska)
- Deputy member of gene technology commission (Iain Wilson)
- Scientific Advisory Panel for work with genetically modified organisms in closed systems (Iain Wilson)

International scientific community services

- Editorial Board Memberships in peer-reviewed SCI-journals (Glycobiology, Glycoconjugate Journal, Journal of Biological Chemistry, Biochemical Journal, Archives in Biochemistry and Biophysics, Hydrogels, International Journal of Polymer Science, Holzforschung, Cellulose, Restaurator, Wood Science and Technology, Journal of Renewable Materials, Arkivoc, Current Organic Synthesis, Current Chromatography, The Open Macromolecules Journal, The Open Natural Products Journal, Current Organic Synthesis, Mini-Reviews in Organic Chemistry, Chemical and Biological Technologies for Agriculture, Innate Immunity, Journal of Wood Chemistry and Technology)
- Reviewer for SCI journals – several hundred per year
- Evaluator of international funding organisations (Deutsche Forschungsgemeinschaft DFG, Finland Science Fund, Swedish Science Fund FORMAS, Slovenian Science Fund ARRS, Canadian Research Council, National Science Foundation USA, US Department of Agriculture, US Department of Energy, USA, Netherlands Organisation for Scientific Research NWO, French CNRS, LeStudium France, Science Foundation Chile)
- Member of evaluation commissions for professorship and senior scientist appointments (Helsinki University, Finland; Aalto University, Finland; TU-München, Germany, University of Hohenheim, Germany; KTH



Stockholm, Sweden)

- Member of the advisory board of the International Carbohydrate Symposium 2016 (Paul Kosma)
- Representative of Austria in the International Carbohydrate Organization ICO (Paul Kosma)
- Representative of Austria in the European Carbohydrate Organization ECO (Paul Kosma)
- Representative of Austria in the International Glycoconjugate Organization (Iain Wilson)
- President (2011-2013) of the International Glycoconjugate Organization (Iain Wilson)
- Member of the university board Shinshu University, Japan (Thomas Rosenau)
- Implementation and maintaining of the website of the International Glycoconjugate Organization
- FAO consultant on the topic 'origin and migration of fish and fish products' (Andreas Zitek)
- Member of the IUPAC subcommittee on Isotopic Abundance Measurements and secretary at the IUPAC commission on Isotopic Abundances and Atomic Weights (Thomas Prohaska)
- Member of working groups of the European Safe-guards Research and Development Association (Thomas Prohaska)
- Advisory Board member of the Certification Advisory Panel of the European Commission, Joint Research Centre, Institute for Reference Materials and Measurements (Thomas Prohaska)
- Delegate at the European Commission TrainMiC programme (Thomas Prohaska)
- Member of the EURACHEM WG for education and training (Thomas Prohaska)

Department Representatives and Officers

First Aid

Markus Bacher
Angelika Derler
Hedda Drexler
Daniel Maresch
Barbara Nussbaumer
Christine Opper
Katharina Paschinger
Antje Potthast
Thomas Prohaska
Sonja Schiehser
Thomas Schmidt
Christina Steiner-Friedmann
Petra Viehauser
Alla Zamyatina
Michaela Zeiner

Safety

Stefan Böhmendorfer
Thomas Dalik
Andreas Hofinger-Horvath

Radiation

Erika Staudacher

Fire protection (Brandschutzwart)

Halimat Ahmatowa
Hedda Drexler
Ute Henniges
Alexander Hofinger
Philipp Mölk
Thomas Schmidt

Chemicals

Stefan Böhmendorfer
Andreas Hofinger-Horvath

Disposal

Christiane Gollner
Andreas Hofinger-Horvath
Sonja Schiehser

Biological Safety

Iain Wilson

Gases

Thomas Dalik

IT-Masteruser

Markus Blaukopf
Stephan Hann

Department report

Paul Furtmüller

Teaching

Andreas Hofinger-Horvath

Department homepage

Luzia Kneisz
Thomas Prohaska

Research

Christian Obinger

Laser safety

Thomas Prohaska

Ethics

Tim Causon
Sonja Schiehser

Internationalisation

Falk Liebner
Alla Zamyatina

Appendix A

Projects

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Already running 2013

Title: **Prognose über die Erholung der Böden vom Sauren Regen in Buchen (*Fagus sylvatica*) wäldern**

Project leader: **Berger Torsten Winfried (Institut für Waldökologie)**

Financing: FWF (2011-2016)

Grant amount: € 90.000,-

Title: **BOKU-Netzwerk zur Schad- und Naturstoffanalytik - Folgeprojekte**

Project leader: Hann Stephan; Köllensperger Gunda

Financing: Unternehmen (2006-2016)

Grant amount: € 400.000,-

Title: **Entwicklung der Analytik zur ¹³C-Stoffflussanalyse und Quantifizierung von Metaboliten in filamentösen Pilzen**

Project leader: Hann Stephan, Köllensperger Gunda

Financing: Firma Sandoz Kundl (2012-2015)

Grant amount: € 158.950,-

Title: **Ionische Flüssigkeiten als Extraktionsmittel für Schwermetalle**

Project leader: Hann Stephan

Financing: FWF (2012-2015)

Grant amount: € 35.000,-

Title: **Isotopenforschung in der Ökgeochemie**

Project leader: Prohaska Thomas

Financing: FWF (2012-2015)

Grant amount: € 9.099,-

Title: **Bergwerk Hallstatt: ISOwood-Herkunft von prähistorischem Holz**

Project leader: Prohaska Thomas

Financing: FWF (2011-2015)

Grant amount: € 354.858,-

Title: **Nahrungsökologie des Kormorans**

Project leader: Prohaska Thomas; Zitek Andreas

Financing: FWF (2011-2014)

Grant amount: € 54.556,-

Title: **Assessing the potential of isotopes and elements in different hard parts of freshwater fish species to determine origin and migratory patterns using laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS)**

Project leader: Prohaska Thomas; Zitek Andreas

Financing: FWF (2009-2013)

Grant amount: € 354.858,-

Title: **Core Facility Metabolomics in the Austrian Centre of Industrial Biotechnology (acib)**

Project leader: Hann Stephan

Financing: Austrian Centre of Industrial Biotechnology (2010-2019)

Grant amount: € 300.000,-

Title: **degIMMAT**

Project leader: Prohaska Thomas

Financing: NO Forschungs und Bildungs GmbH (2012-2015)

Grant amount: € 194.868,-

Title: **Metall-Mobilisierung durch Microbacteriaceae**

Project leader: Puschenreiter Markus (Institut für Bodenforschung)

Financing: FWF (2012-2015)

Grant amount: € 100.000,-

Title: **Ultrapurenanalyse mittels Massenspektrometrie mit induktiv gekoppeltem Plasma als Ionisationsquelle (ICP-MS)**

Project leader: Stingeder Gerhard Josef

Financing: own resources (1995-2020)

Grant amount: € 20.000,-

2013 - new

Title: **Element-Ultrapurenanalytik in der Ozeanographie (ULTRA-OCEAN)**

Project leader: Fischer Elisabeth; Hann Stephan;

Financing: FWF (2013-2016)

Grant amount: € 89.810,-

Title: **Lignin-Nanopartikel als Eisen-Komplexbildner im Ozean**

Project leader: Hann Stephan

Financing: FWF (2013-2016)

Grant amount: € 130.000,-



Title: **Verhalten von verkehrsemittemtem Platin in der Umwelt**

Project leader: Hann Stephan; Vitkova Marianna

Financing: FWF (2013-2015)

Grant amount: € 150.000,-

Title: **Forschungsförderung des Europäischen Metrologieprogrammes - Metrologie in der Metalloproteinanalytik / Metallomics**

Project leader: Köllensperger Gunda / Ortmayr Karin

Financing: EURAMET e.V., Bundesallee 100, 38116 Braunschweig, Deutschland (2013-2016)

Grant amount: € 76.782,-

2014

Title: **LC-MS Analyse von Bienenpollen aus städtischen und landwirtschaftlich genutzten Gebieten (BIENE)**

Project leader: Hann Stephan

Financing: Hochschuljubiläumsstiftung der Stadt Wien (2014-2015)

Grant amount: € 8.000,-

Title: **Accurate mass spectrometry at "core facility cellular analysis" – Subsection Metabolomics (BOKU EQ VIBT)**

Project leader: Hann Stephan

Financing: Vienna Business Agency (2014-2020)

Grant amount: € 1.200.000,-

Title: **Development of emerging methods in mass spectrometry based metabolomics (MASSSPECMET)**

Project leader: Hann Stephan

Financing: Austrian Centre of Industrial Biotechnology (2014-2015)

Grant amount: € 15.400,-

Title: **EVOLUTION DES MENSCHEN – MENSCH(EN) WERDEN: Archäometrische Erforschung der Linearbandkeramischen Skelettfunde der Sammlung des Naturhistorischen Museums Wien (ISOzahn)**

Project leader: Irrgeher Johanna

Financing: Hochschuljubiläumsstiftung der Stadt Wien (2014-2015)

Grant amount: € 5.600,-

Title: **Traisen.WieWasWarum? - Identifizierung und Wahrnehmung von Funktionen in Flusslandschaften und das Verstehen einzugsgebietsbezogener Prozesse am Beispiel der Traisen (Traisen.w3)**

Project leader: Poppe Michaela (Institut für Hydrobiologie)

Financing: FWF (2014-2016)

Grant amount: € 17.000,-

Title: **CSI-TRACE your FOOD! Herkunftsbestimmung von Nahrungsmitteln aus regionaler Produktion in Österreich anhand des Multielement- und Isotopenfingerabdrucks (CSI-TRACE your FOOD!)**

Project leader: Thomas Prohaska, Andreas Zitek

Financing: Bundesministerium für Wissenschaft, Forschung und Wirtschaft, Austria (2014-2017)

Grant amount: € 217.806,-

Title: **Isoscape Eg-Selenge, Mongolia**

Project leader: Zitek Andreas

Financing: Rutgers University, USA (2014-2016)

Grant amount: € 8.625,-

Title: **Wo wandert der Fisch in Wien? Innovative Methoden zur Untersuchung der Konnektivität von Fließgewässern in Wien und Wien-Umgebung**

Project leader: Zitek Andreas

Financing: Hochschuljubiläumsstiftung der Stadt Wien (2014-2015)

Grant amount: € 4.500,-

2015

Title: **Entwicklung und Anwendung von analytischen Methoden in der Ionenmobilitäts-Massenspektrometrie auf dem Gebiet Metabolomics (IMS)**

Project leader: Causon Tim, Hann Stephan

Financing: Agilent Technologies Österreich GmbH (2015-2017)

Grant amount: € 35.000,-

Title: **Element-Ultraspurenanalytik in der Ozeanographie (ULTRA-OCEAN)**

Project leader: Fischer Lisa, Hann Stephan

Financing: FWF (2015-2016)

Grant amount: € 89.810,-

Title: **Klimawandel – interdisziplinäre Perspektiven**

Project leader: Zehetner Franz (Institut für Bodenforschung)

Financing: FWF (2015-2015)

Grant amount: € 4.000,-

Title: **Föhrennadeln als Indikator für Luftverschmutzung in Wien — Bestimmung ausgewählter Spurenelemente**

Project leader: Zeiner Michaela

Financing: Hochschuljubiläumsstiftung der Stadt Wien (2015-2016)

Grant amount: € 7.000,-

Title: **Wo wandert der Fisch in Wien? Innovative Methoden zur Untersuchung der Konnektivität von Fließgewässern in Wien und Wien-Umgebung**

Project leader: Zitek Andreas

Financing: Hochschuljubiläumsstiftung der Stadt Wien (2015-2016)

Grant amount: € 4.500,-

Already running 2013

Title: **Produktion Glykan-Optimierter Biopharmazeutika in Pflanzen**

Project leader: Steinkellner Herta (DAGZ), Altmann Friedrich

Financing: FWF (2010-2017)

Grant amount: € 196.157,-

Title: **Strukturanalyse Glykan-Optimierter Biopharmazeutika in Pflanzen**

Project leader: Steinkellner Herta (DAGZ), Altmann Friedrich

Financing: FFG (2014-2017)

Grant amount: 132.000.-

Title: **TEAM-EPIC (Training Network for the Development of Bacterial ExoPolysaccharides for the treatment of Inflammatory Conditions)**

Project leader: Altmann Friedrich

Financing: EC (2012-2015)

Grant amount: € 174.000,-

Title: **Posttranslationale Modifikationen von Gehirnproteinen**

Project leader: Altmann Friedrich

Financing: FWF (2010-2013)

Grant amount: € 310.000,-

Title: ***E. histolytica*: Das Thioredoxin System als Angriffspunkt für Metronidazol**

Project leader: Altmann Friedrich (partner of M. Duchene, MedUni Wien)

Financing: FWF (2010-2013)

Grant amount: € 10.000,-

Title: **Comparative studies on chlorite dismutases**

Project leader: Furtmüller Paul

Financing: FWF (2012-2015)

Grant amount: € 303.660.-

Title: **NMR Charakterisierung des Rezeptors 24q3R**

Project leader: Coudeville Nicolas

Financing: FWF (2012-2016, since 2015 at BOKU)

Grant amount: € 254.142,-

Title: **Bäume für die Zukunft (TREES4FUTURE)**

Project leader: Hinterstoisser Barbara, Schwanninger Manfred

Financing: FWF (2011-2015)

Grant amount: € 74.531,-

Title: **Christian Doppler Labor for Antibody engineering – CDL-AE1, CDL-AE2,**

Project leader: Obinger Christian

Financing: CDL-Gesellschaft (2009-2016)

Grant amount: € 3.741.659,-

Title: **Doktoratskolleg plus “Biomolecular Technology of Proteins”**

Project leader: Obinger Christian

Financing: FWF/BOKU (2010-2018)

Grant amount: € 9.671.411,- (FWF: € 6.722.251,- BOKU: € 2.949.160,-)

Title: **Comparative Nematode Glycomics**

Project leader: Paschinger Katharina

Financing: FWF (2009-2015)

Grant amount: € 241.731,-

Title: **Recombinant glycosidases as tools in research**

Project leader: Rendić Dubravko

Financing: FWF (2011-2014)

Grant amount: € 359.383,- (about 70% BOKU, 30% VMU)

Title: **Fucosyl- and xylosyltransferases in gastropods**

Project leader: Staudacher Erika

Financing: FWF (2010-2015)

Grant amount: € 324.298,-

Title: **Glycogenomics of the opportunistic fungal pathogen *Aspergillus fumigatus***

Project leader: Wilson Iain

Financing: FWF (2010-2014)

Grant amount: € 201.452,-

Title: **Glycosylation of *Caenorhabditis elegans* (III)**

Project leader: Wilson Iain

Financing: FWF (2011-2014)

Grant amount: € 333.889,-

Title: **Development and exploitation of non-mammalian glycan microarrays**

Project leader: Wilson Iain

Financing: FWF (2011-2015)

Grant amount: € 406.910,-

Title: **Atypical heme peroxidase family**

Project leader: Zamocky Marcel

Financing: FWF (2011-2015)

Grant amount: € 263.703,-



2013 – new

Title: **Biochemistry of peroxidase**
Project leader: Obinger Christian
Financing: FWF (2013-2015)
Grant amount: 322.560,-

Title: **Glykoepitope von N-Glykanen in *Echinodermata***
Project leader: Paschinger Katharina
Financing: FWF (2013-2016)
Grant amount: € 348.012,-

Title: **Parasite glycobiology and anti-parasitic strategies (GlycoPar)**
Project leader: Wilson Iain
Financing: EU (2013-2017)
Grant amount: € 202.679,-

2014

Title: **The importance of glycosylation for microbial evolution**
Project leader: Dragosits Martin
Financing: FWF (2014-2017)
Grant amount: € 342.625,-

773 Organic chemistry

Already running 2013

Title: **Oxidative Modifizierung cellulosischer Materialien durch Strahlungseinflüsse (Radox-Cell)**
Project leader: Henniges Ute
Financing: Chalmers University in Gothenburg, Sweden (2011-2013)

Title: **Synthesis of Acinetobacter LPS ligands of collectins**
Project leader: Kosma Paul
Financing: FWF (2012-2016)
Grant amount: € 288.185,-

Title: **COST BM1003 Microbial cell surface determinants of virulence as targets for new therapeutics in cystic fibrosis**
Project leader: Kosma Paul
Financing: EU (2010-2014)
Grant amount: 4.100,-

Title: **Novel inhibitors of Heptose biosynthesis (HEP)**
Project leader: Kosma Paul
Financing: Mutabilis (Paris) (2011-2014)
Grant amount: € 551.612,-

Title: **Phosphorylated N-glycan epitopes in simple organisms**
Project leader: Hykollari Alba
Financing: FWF (2014-2017)
Grant amount: € 348.153,-

Title: **Design of affinity chromatography columns for specific apheresis**
Project leader: Obinger Christian
Financing: acib (2013)
Grant amount: € 98.000,-

Title: **Puls EPR der Dynamik katalytischer Aminosäuren in Hämenzymen**
Project leader: Pirker Katharina
Financing: FWF (2014-2017)
Grant amount: € 219.630,-

2015

Title: **Hybrid B heme peroxidases - mechanistic and structural insights in heme peroxidase family from thermophilic & mesophilic fungi**
Project leader: Zamocky Marcel
Financing: FWF (2015-2018)
Grant amount: € 283.322,-

Title: **Neue Materialien auf Basis von cellulosischen Aerogelen**
Project leader: Liebner Falk
Financing: Beijing Institute of Technology (BIT), China-Chinesische Akademie der Wissenschaften, China (2011-2013)
Grant amount: € 60.000,-

Title: **Das Erbe Schinkels – Vom Depot in den Diskurs**
Project leader: Potthast Antje
Financing: Bundesministerium für Bildung und Forschung, Deutschland (2010 - 2013)
Grant amount: € 24.000,-

Title: **for|muse**
Project leader: Potthast Antje
Financing: Europäische Kommission, Rue de la Loi, Brussels, Europäische Union, FP7 (2009-2013)
Grant amount: € 169.710,-

Title: **Memori**
Project leader: Potthast Antje
Financing: Europäische Kommission, Rue de la Loi, Brussels, Europäische Union, FP 7 (2012-2015)
Grant amount: € 189.611,-

Title: **Development and exploitation of non-mammalian glycan microarrays**

Project leader: Wilson Iain, Kosma Paul (cooperation-partner)

Financing: FWF (2011-2015)

Grant amount: € 406.910,-

Title: **Aminosugar modified Lipoid A and analogues**

Project leader: Zamyatina Alla

Financing: FWF (2009-2013)

Grant amount: € 342.877,-

Title: **Synthetic TLR4-MD-2 dependent endotoxin mimetics**

Project leader: Zamyatina Alla

Financing: FWF (2010-2015)

Grant amount: € 390.316,-

Title: **Heptose phosphate ligands**

Project leader: Kosma Paul

Financing: FWF (2010-2013)

Grant amount: € 282.099,-

2013 – new

Title: **Structure/function analysis of heptosyltransferase I (WaaC)**

Project leader: Blaukopf Markus

Financing: Schrödinger fellowship FWF (2013-2015)

Grant amount: € 140.180,-

Title: **EULA**

Project leader: Kosma Paul

Financing: EU (2013-2014)

Grant amount: Scholarship 18.000,-

Title: **Flow chemistry based strategies towards LPS sub-structures**

Project leader: Stanetty Christian

Financing: Schrödinger fellowship FWF (2013-2015)

Grant amount: € 114.652,-

2014

Title: **Synthesis of bacterial mimetics of HIV gp120 glycan epitopes**

Project leader: Kosma Paul

Financing: FWF (2014-2017)

Grant amount: € 355.005,-

Title: **Immobilization of Latex allergens**

Project leader: Kosma Paul

Financing: Semperit AG (2014-2016)

Grant amount: € 18.000,-

Title: **Molecular basis of binding interactions of pyruvylated cell wall polymers**

Project leader: Schäffer (DNBT) in coop. (Kosma)

Financing: FWF (2014-2017)

Grant amount: ~110.000 (part)

774 Chemistry of Renewable Ressources

Already running 2013

Title: **Extractives in native Ugandan herbal plants and wood (01.01.2012-31.12.2014)**

Project leader: Böhmendorfer Stefan

Financing: Austrian Development Agency (ADA) (2011-2014)

Grant amount: € 40.000,-

Title: **Modulare Bioraffinerie zur vollständigen stofflichen Verwertung von Lignocellulosen**

Project leader: Gindl-Altmutter Wolfgang, Liebner Falk, Mattanovich Diethard

Financing: FFG – Forschungsförderungsgesellschaft (2012-2014)

Grant amount: € 517.000,-

Title: **ENLIGMA: N-modifizierte Lignine als Basis für funktionelle Materialien**

Project leader: Liebner Falk

Financing: FFG – Forschungsförderungsgesellschaft (2012-2014)

Grant amount: € 140.400,-

Title: **CAP-BONE**

Project leader: Liebner Falk

Financing: FWF (2012-2014)

Grant amount: € 180.579,-

Title: **Analytics of lignocellulose effluents**

Project leader: Potthast Antje, Rosenau Thomas

Financing: BASF Ludwigshafen, Deutschland (2012-2016)

Grant amount: € 468.000,-

Title: **K plus WOOD**

Project leader: Thomas, Rosenau, Potthast Antje, Falk.

Liebner, Stefan Böhmendorfer

Financing: FFG – Forschungsförderungsgesellschaft, Bundesländer, Industriepartner (2011-2014, 2015 - 2023)

Title: **Chromophore und Alterung**

Project leader: Rosenau Thomas

Financing: FFG – Forschungsförderungsgesellschaft (2011-2014)

Grant amount: € 330.000,-



Title: **Christian-Doppler-Labor für "Moderne Cellulosechemie- und Analytik"**

Project leader: Rosenau Thomas, Potthast Antje

Financing: Christian Doppler Forschungsgesellschaft (CDG) (2008-2016)

Grant amount: € 2.628.001,-

Title: **European Polysaccharide Network of Excellence - Coordination and Support Action EPNOE-CSA**

Project leader: Rosenau Thomas

Financing: Europäische Kommission, Rue de la Loi, Brussels, Europäische Union (2012-2015)

Grant amount: € 12.840,-

2013 – new

Title: **Future Lignin and Pulp Processing Research (FLIP-PR)**

Project leader: Böhmendorfer Stefan, Gindl-Altmutter Wolfgang, Henniges Ute, Konnerth Johannes, Liebner Falk, Potthast Antje, Rosenau Thomas

Financing: FFG - Österreichische Forschungsförderungsgesellschaft (2013-2017)

Grant amount: € 2.389.000,-

Title: **Entfärbung, Hydrierung und Bleiche von Lignin**

Project leader: Böhmendorfer Stefan

Financing: FFG – Forschungsförderungsgesellschaft (2013-2017)

Grant amount: € 150.000,-

Title: **Chemische Modifizierung an Kurzfasern**

Project leader: Henniges Ute

Financing: FFG – Forschungsförderungsgesellschaft (2013-2017)

Grant amount: € 214.000,-

Title: **N-Modifizierung von Lignin**

Project leader: Liebner Falk

Financing: FFG – Forschungsförderungsgesellschaft (2013-2017)

Grant amount: € 193.576,-

Title: **Plattform für Ligninanalytik**

Project leader: Potthast Antje

Financing: FFG – Forschungsförderungsgesellschaft (2013-2017)

Grant amount: € 440.000,-

Title: **Chemische Modifizierung von Langfaserfraktionen**

Project leader: Rosenau Thomas

Financing: FFG – Forschungsförderungsgesellschaft (2013-2017)

Grant amount: € 150.000,-

Title: **Reinforcement of rubber material by novel cellulosic substrates**

Project leader: Rosenau Thomas

Financing Bridgestone (2013-2017)

Grant amount: € 149.000,-

2014

Title: **Tunable Films**

Project leader: Henniges Ute

Financing: ERA NET „Wood Wisdom“, FFG – Forschungsförderungsgesellschaft (2014-2016)

Grant amount: € 129.454,-

Title: **CelluCoat – Biobasierte Holzbeschichtungen mit Nanozelluloseverstärkung**

Project leader: Gindl-Altmutter Wolfgang, Rosenau Thomas

Financing: Gefördert durch: FFG – Forschungsförderungsgesellschaft (2014-2016)

Grant amount: € 214.000,-

Title: **Aerowood**

Project leader: Liebner Falk

Financing: ERA NET „Wood Wisdom“, FFG – Forschungsförderungsgesellschaft (2014-2016)

Grant amount: € 184.782,-

Title: **Vollständige Stoffliche Verwertung von Lignocellulosen (Lignorefinery)**

Project leader: Liebner Falk, Mattanovich Diethard

Financing: FFG – Forschungsförderungsgesellschaft and Universität für Bodenkultur Wien (2014-2017)

Grant amount: € 193.576,-

Title: **DokIn Holz, "Aging of woody materials"**

Project leader: Potthast Antje

Financing: BMWWF, St. Gobain-Isover GmbH, PAL (2014-2017)

Grant amount: € 120.000,-

Title: **Chromophores and cellulose aging (Chromophores II)**

Project leader: Rosenau Thomas

Financing: FFG – Forschungsförderungsgesellschaft (2014-2017)

Grant amount: € 111.700,-

Title: **DokIn Holz, "Cellulose II gels"**

Project leader: Rosenau Thomas

Financing: BMWWF, Lenzing AG (2014-2017)

Grant amount: € 165.000,-

2015

Title: **Auslöser und Angriffspunkte der Ascari-
dol-Wirkung in Leishmanien (Ascaridole)**

Project leader: Gille Lars (VetMed), Rosenau Thomas

Financing: FWF (2015-2018)

Grant amount: € 218.000,-

Appendix B

Publications

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Original articles and reviews in refereed journals

2013

Becerra-Castro, C., Kidd, P., Kuffner, M., Prieto-Fernandez, A., Hann, S., Monterroso, C., Sessitsch, A., Wenzel, W., Puschenreiter, M. (2013) Bacterially induced weathering of ultramafic rock and its implications for phytoextraction. *Appl Environ Microb* 79(17): 5094-5103.

Guerrasio, R., Haberhauer-Troyer, C., Steiger, M., Sauer, M., Mattanovich, D., Koellensperger, G., Hann, S. (2013) Measurement uncertainty of isotopologue fractions in fluxomics determined via mass spectrometry. *Anal Bioanal Chem* 405(15): 5133-5146.

Haberhauer-Troyer, C., Delic, M., Gasser, B., Mattanovich, D., Hann, S., Koellensperger, G. (2013) Accurate quantification of the redox-sensitive GSH/GSSG ratios in the yeast *Pichia pastoris* by HILIC-MS/MS. *Anal Bioanal Chem* 405(6): 2031-2039.

Hermann, G., Heffeter, P., Falta, T., Berger, W., Hann, S., Koellensperger, G. (2013) *In vitro* studies on cisplatin focusing on kinetic aspects of intracellular chemistry by LC-ICP-MS. *Metallomics* 5(6): 636-647.

Hinterwirth, H., Kappel, S., Waitz, T., Prohaska, T., Lindner, W., Lämmerhofer, M. (2013) Quantifying thiol ligand density of self-assembled monolayers on gold nanoparticles by inductively coupled plasma-mass spectrometry. *ACS Nano* 7(2): 1129-1136.

Irrgeher, J., Prohaska, T., Sturgeon, R.E., Mester, Z., Yang, L. (2013) Determination of strontium isotope amount ratios in biological tissues using MC-ICPMS. *Anal Methods UK* 5(7): 1687-1694.

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Appendix C

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Mechanisms of inactivation of human myeloperoxidase by hypochlorite

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Microbial cell surface determinants as targets for new therapeutics in cystic fibrosis COST BM-1003

Prof. Roman Jerala

National Institute of Chemistry, Ljubljana, Slovenia

Synthetic TLR4-MD-2 dependent endotoxin mimetics

Prof. Stephen Evans

University Victoria, Canada

Heptose phosphate ligands

PD Dr. Sven Müller-Loennies

Research Centre Borstel, Germany

Heptose phosphate ligands

Dr. Roger MacKenzie

NRC Ottawa, Canada

Heptose phosphate ligands

Prof. Miguel Valvano

Queens University Belfast, Ireland

Heptose phosphate ligands, COST BM-1003

Prof. James Head

University of Boston, USA

Synthesis of *Acinetobacter* LPS ligands of collectins

Prof. Dr. Edgar Selzer

Medical University of Vienna, Austria

Integrin antagonists

Prof. Dr. Johannes Stöckl

Institute of Immunology, Medical University of Vienna, Austria

Synthetic TLR4-MD-2 dependent endotoxin mimetics

Dr. Simon Ittig

Biocenter, University of Basel, Switzerland

Synthetic TLR4-MD-2 dependent endotoxin mimetics

Prof. Dr. Sylvia Knapp

Medical University of Vienna, CEMM, Austria

Synthetic TLR4-MD-2 dependent endotoxin mimetics

Prof. Dr. Johannes A. Schmid

Institute for Vascular Biology and Thrombosis Research, Medical

University of Vienna, Austria

Synthetic TLR4-MD-2 dependent endotoxin mimetics

Prof. Ralph Pantophlet

Simon Fraser University, Canada

Synthesis of bacterial mimetics of HIV gp120 glycan epitopes

Dr. Feng Shao

National Institute of Biological Sciences, China

ADP-heptosyl transferases

Prof. Dr. Pavel Kovarik

Max F. Perutz Laboratories, University of Vienna, Austria

Synthetic TLR4-MD-2 dependent endotoxin mimetics

Dr. Joe Ray Baxter

Round Lake, USA

NMR of Polysialic acid

Prof. Neill Ravenscroft

University Capetown, South Africa

NMR of Polysialic acid

Prof. Dr. Jesus Jimenez-Barbero

CIB CSIC, Madrid, Spain

Synthetic TLR4-MD-2 dependent endotoxin mimetics

Dr. Sonsoles Martin-Santamaria

Universidad CEU San Pablo, Spain

Synthetic TLR4-MD-2 dependent endotoxin mimetics

Prof. Nicholas Harmer

Department of Biosciences, University of Exeter, UK

Inhibitors of heptose biosynthesis

Prof. Rudi Beyaert

Dept. of Biomedical Molecular Biology, Ghent University, Belgium

Synthetic TLR4-MD-2 dependent endotoxin mimetics

Prof. Dr. Carsten Kirschning

University Duisburg-Essen, Germany

Synthetic endotoxin mimetics

Prof. Katherine A. Brown

Department of Chemistry, University of Texas at Austin, USA

Aminosugar modified Lipid A

Dr. Anthony de-Soyza

Institute of Cellular Medicine, Newcastle University, UK

Aminosugar modified Lipid A, COST BM-1003

Dr. Y. Yang and Prof. Leonore A. Herzenberg

Dept. of Genetics, Stanford University, USA

Aminosugar modified Lipid A (*Francisella*)

Dr. Arvand Haschemi

Medical University Vienna, Austria

Biochemistry and metabolism of sedoheptulose phosphate

Dr. Irma Schabussova

Medical University Vienna, Austria

Toxocara antigens



774 Chemistry of Renewable Ressources

Dr. Cyril Aymonier

Institut de Chimie de la Matière Condensée de Bordeaux CNRS
Synthesis and characterization of quantum dots for cellulose hybrid aerogels

Prof. em. Dr. Gerhard Banik

Professor emeritus at Stuttgart State Academy of Art and Design, Germany
Lecturer at the Institute of Chemical Engineering, University of Technology, Vienna
Conservational science, damage assessment of historic cellulosic objects

Prof. Dr. Wolfgang Bauer

Technical University, Graz
Pulp and paper

Univ.Prof. Dr. Thomas Bechtold

University of Innsbruck, Innsbruck
Chemical modification of cellulosic fibers, chemistry of crosslinking agents
Additional collaboration within the EPNOE (European Polysaccharide Network of Excellence), Fundamental Theme 2 "Disassembly of polysaccharides",

Dr. Agnes Blüher

Swiss National Library, Bern, Switzerland
Evaluation of mass deacidification, accelerated paper aging

Dr. Erica Brendler

TU Bergakademie, Freiberg, Germany
Amoxidized technical lignins and lignite

Prof. Dr. Irene Brückle

Staatliche Akademie der Bildenden Künste Stuttgart, Germany
Loan traffic of cultural objects, aging of paper, analytics

Prof. Dr. Richard Buchner

University of Regensburg, Germany
Dielectric relaxation spectroscopy, cellulose solvents, thermodynamics of solutions

Prof. Kimon Christanis

University of Patras, Greece
Coal-based artificial humus materials

Dr. Thomas Dietz

Degussa-Evonik, Germany
Bleaching chemistry, chromophores in cellulose

Dr. habil. Anne-Laurence Dupont

Centre de Recherches sur la Conservation des Documents Graphiques, Paris, France
Tideline phenomena in paper

Dr. Vince Edwards

United States Department of Agriculture
Peptide-modified cellulosic aerogels for diagnostic protease sensing

Prof. Dr. Tomoki Erata

Hokkaido University, Japan
Solid state NMR spectroscopy, special CPMAS NMR techniques

Dr. Sigrid Eyb-Green

Academy of Fine Arts, Vienna
Paper conservation

Dr. Erkki Ilari Filpponen

Aalto University
Development of novel quantum dot/cellulose hybrid material

Mag. Sigrid Eyb-Green

Academy of Fine Arts Vienna, Austria
Paper conservation

Prof. Dmitry Evtuguin

University of Aveiro, Portugal
Bleaching chemistry, chromophores in cellulose

Prof. Dr. Hans-Peter Fink

Fraunhofer Institut für Angewandte Polymerforschung, Potsdam-Golm, Germany
Molecular weight distributions of cellulose and starch

Prof. Dr. Alfred French

USDA Agricultural Research Service, New Orleans, USA
solid state structure of cellulose and cellulose model compounds; computational carbohydrate chemistry

Prof. Dr. Grégory Genta-Jouve

Université Paris Descartes, Paris
Thin layer chromatography

Prof. Dr. Lars Gille

University of Veterinary Medicine, Vienna, Austria
EPR spectroscopy, spin trapping, testing of antioxidants in biological model systems - tocopherol and ubiquinone chemistry

Dr. Anna Haberditzl

Landesarchiv Baden-Württemberg, Institut für Erhaltung von Archiv- und Bibliotheksgut
Mass deacidification of paper

Prof. (FH) Dipl. Rest. Ulrike Hähner

Hochschule für angewandte Wissenschaft und Kunst Hildesheim, Holzminden, Göttingen
Iron gall ink corrosion of paper (Savigny inheritance)

Prof. Dr. Dietmar Haltrich

University of Natural Resources and Life Sciences, Department of Food and Biotechnology, Vienna, Austria
Enzymatic modification of carbohydrates and celluloses

Dr. Merima Hasani

Chalmers University, Gothenburg
Cellulose modification

Mag. Christa Hofmann

Austrian National Library (ÖNB), Vienna, Austria
Conservation of paper, Iron gall ink corrosion

Prof. Bjarne Holmbom and Prof. Pedro Fardim

Åbo Academy, Turku, Finland
TOF-SIMS analysis of labeled celluloses and additional collaboration within the EPNOE (European Polysaccharide Network of Excellence), Fundamental Theme 2 "Disassembly of polysaccharides"

Prof. Dr. Akira Isogai

University of Tokyo, Graduate School of Agricultural and Life Sciences
Cellulose oxidation and analysis

Prof. Dr. Christian Jäger

Bundesanstalt für Materialforschung Berlin (BAM), Germany
Solid state NMR spectroscopy of celluloses and cellulose derivatives, special CPMAS NMR techniques

Dr. Myung-Joon Jeong

Dongguk University, Seoul
Cellulose and hemicellulose aerogels

Prof. Dr. Kanji Kajiwara

Shinshu University
Fiber technology, fiber modification

Prof. Dr. Byoung Muk Jo Kangwon

National University, Dept. of Paper Science and Engineering, Chuncheon, South Korea
Hanji paper restoration (Annales of the Joseon Dynasty)

Prof. Dr. Toshinari Kawada

Kyoto Prefectural University, Japan
Synthesis of (isotopically labeled) cellulose model compounds

Prof. Dr. Dieter Klemm

University of Jena and Polymet Jena eV., Germany
Characterization of bacterial cellulose

Prof. Dr. Ingrid Koegel-Knabner

TU München – Wissenschaftszentrum Weihenstephan, Germany
Solid state NMR spectroscopy of humic substances and soil

Prof. Dr. Mirjana Kostic

University of Belgrade, Faculty of Technology and Metallurgy
Oxidative fiber modification

Prof. Dr. Dominique Lachenal

Grenoble INP Pagora
Impact of bleaching on cellulosic pulp

Prof. Dr. Herman Mansur

Federal University of Minas Gerais, Brazil
Contributions to the development of biobased nanomaterials

Dr. Francesco Mazzini

Pisa University, Italy
Synthesis of phenolic antioxidants, isotopic labeling

Prof. Dr. Klaus Mereiter

Vienna University of Technology, Austria
X-ray crystal structure analysis, diffractometry

Prof. Dr. Petra Mischnick

University of Brunswick - Institute of Technology
Analysis of polysaccharide building blocks

Prof. Hideaki Morikawa

Shinshu University, Department of Functional Polymer Science, Japan
Intelligent fibers and functional textiles, fiber chemistry

Prof. Dr. Fumiaki Nakatsubo

Kyoto University, Japan
Synthesis of (isotopically labeled) cellulose by cationic ring opening polymerization,
Cellulose solvents,
Novel cellulose derivatives with non-classical functionalities and functions

Prof. Dr. Jean-Marie Nedelec

Institute of Chemistry, Clermont-Ferrand
Cellulosic aerogels for tissue engineering applications

Dr. Thomas Netscher

DSM Nutritional Products (formerly Roche), Switzerland
Chemistry of vitamin E and phenolic antioxidants

Prof. Satoko Okubayashi and Dr. Annalise Erhard

Kyoto Institute of Technology, Kyoto, Japan
Irradiation of pulp and paper

Dr. Soledad Peresin

VTT Finland
Hemicellulose and cellulose analysis and application

Prof. Dr. John Ralph

University of Madison-Wisconsin
Modification and characterisation of lignin

Prof. Dr. Hunter Renfrew

University of Manchester, School of Textiles, UK
Synthesis of reactive dyes fiber chemistry, chemistry of crosslinking agents

Prof. Tim Rypstra

University of Stellenbosch, South-Africa
Lignin, artificial humus materials

Prof. Dr. Bodo Saake

vTI-Institute for Wood Technology and Biology, Braunschweig, Germany
Gel permeation chromatography of celluloses and hemicelluloses

Prof.em. Dr. Hirofusa Shirai

Shinshu University, Department of Functional Polymer Science, Japan
Intelligent fibers and functional textiles, fiber chemistry



Dr. Keita Sakakibara

Kyoto University

Biocompatible cellulosic aerogels with well-defined polymer brushes

Prof. Dr. Herbert Sixta

Aalto University, Helsinki, Finland / Lenzing AG, Austria

Pulp and paper technology

Dr. Elisabeth Sjöholm

Innventia, Stockholm, Sweden

Gel permeation chromatography of celluloses

Prof. Dr. I. Smirnova

TU Hamburg-Harburg

Development of lignin-based aerogels and carbon aerogels

Prof. Amnon Stanger

Technion Haifa, Israel

Computational chemistry, quantum chemistry, electronic structure studies

Prof. Dr. Klaus Stolze

University of Veterinary Medicine, Vienna, Austria

Synthesis and NMR spectroscopy of spin traps, radical trapping reactions

Dr. Anna Sundberg

Åbo Akademi, Turku, Finland

Characterization of wood extractives by GC-MS

Dr. Tekla Tammelin

VTT Finland

Hemicellulose and cellulose analysis and application

Prof. Dr. Maija Tenkanen

University of Helsinki

Characterization of hemicelluloses

Prof. Dr. Yasumitsu Uraki

Hokkaido University, Japan

Chemistry of biomaterials

Prof. Dr. Tapani Vuorinen

Aalto University

Characterisation of cellulosic pulp

Prof. Dr. Carsten Werner

Max Bergmann Institut, Dresden, Germany

Medical testing of cellulose aerogels

Jun.Prof. Dr. Kai Zhang

Georg-August-University, Göttingen

Biopolymer-based hydro-, organo-, and areogels

Appendix D

Courses

Overview teaching-portfolio 2015/16

(Source: BOKU-online, Department site, <https://online.boku.ac.at>)

*semester hours = hours per week during the whole semester (approx. 14 weeks)

Abbreviations: PR, practical work; S, summer term; SE, seminar; VO, lecture; VS lecture with seminar; UE, practical course; W, winter term;)

770 - Courses

770150	W	Allgemeine Chemie	3	VO
770151	W	Allgemeine Chemie (UBRM)	3	VO
770100	W	Allgemeine und anorganische Chemie (AW)	2	VO
770113	W	Bachelorseminar	2	SE
770102	W	Chemische Übungen (AW)	4	UE
770113	S	Bachelorseminar	2	SE
770102	S	Chemische Übungen (AW)	4	UE
770101	S	Organische Chemie und Biochemie (AW)	3	VO

- 6 different courses (17 semester hours*)
- Two courses in winter as well as in summer semester -> 23 semester hours
- In English: 0

771 - Courses

771091	W	Advanced Analytical Techniques for Elemental Trace and Isotope Analysis (in Eng.)	2	VO	engl
771107	W	Allgemeine und Physikalische Chemie	4	VO	
771118	W	Chemisches Rechnen I	1	VU	
771004	W	Dissertantenseminar aus Analytischer Chemie	2	SE	
771101	W	Einführung in die Chemie	2	VO	
771102	W	Einführung in die Chemie Übungen	2	UE	
771106	W	Instrumentelle Analytische und Physikalische Chemie Übungen	6	UE	
771000	W	Isotopic tools for the investigation of the ecosystem (in Eng.)	1	VU	engl
771040	W	Masterseminar	2	SE	
771108	S	Analytische Chemie	4	VO	
771105	S	Analytische Chemie Übungen	7	UE	
771316	S	Chemisches Rechnen II	1	VU	
771319	S	Determination of provenance and authenticity of food and food products by modern analytical methods (in Eng.)	2	VS	engl
771004	S	Dissertantenseminar aus Analytischer Chemie	2	SE	
771101	S	Einführung in die Chemie	2	VO	
771304	S	Environmental Chemistry	3	SE	



771090	S	Holistische Wissenschaften - ein ganzheitlicher Wissenschaftsaspekt	1	VO	
771318	S	Instrumentelle Analytik - Wahlübungen	4	UE	
771317	S	Instrumentelle Analytik für Fortgeschrittene	3	VU	
771040	S	Masterseminar	2	SE	
771089	S	Metrology in Chemistry - the Science of Measurement (in Eng.)	1	VO	engl
771303	S	Umweltanalytik	2	VO	engl

- 19 different courses (50 semester hours*)
- Three courses in winter as well as in summer semester,
- Courses held several times: 771102 - 3 times, 771105 - 3 times, 771106 - 3 times -> 86 semester hours
- In English: 5 (9 semester hours)

772 - Courses

772327	W	Biochemical and Biotechnological Methods (Analytics Design) (in Eng.)	3	VU	engl
772312	W	Biochemie der Pflanzen	2	VO	
772112	W	Biochemische Übungen I	5	UE	
772305	W	Biochemische Übungen II	5	UE	
772326	W	Biochemisches Praktikum	3	PR	engl
772325	W	Biochemisches Seminar	2	SE	engl
772309	W	Biochemistry of Trace Elements (in Eng.)	2	VO	engl
772015	W	Dissertantenseminar aus Biochemie	2	SE	engl
772322	W	Genetic Model Organisms in Biotechnology (in Eng.)	3	VU	engl
772108	W	Grundlagen der Biochemie	3	VO	
772498	W	Improve your presentation skills I (in Eng)	2	SE	engl
772003	W	Masterseminar	2	SE	engl
772497	W	Scientific Writing (BioToP) (in Eng.)	2	SE	engl
772114	S	Biochemie des Stoffwechsels	3	VO	
772112	S	Biochemische Übungen I	5	UE	
772305	S	Biochemische Übungen II	5	UE	
772326	S	Biochemisches Praktikum	3	PR	
772300	S	Biophysical Chemistry (in Eng.)	2	VU	engl
772099	S	Blut und Blutgerinnung	1	VO	
772015	S	Dissertantenseminar aus Biochemie	2	SE	
772499	S	Improve your presentation skills II (in Eng.)	2	SE	engl
772311	S	Kinetics of Biochemical Reactions (in Eng.)	2	VU	engl
772003	S	Masterseminar	2	SE	engl
772304	S	Protein Chemistry and Protein Engineering (in Eng.)	3	VU	engl
772306	S	Proteomics (in Eng.)	2	VU	engl
772497	S	Scientific Writing (BioToP) (in Eng.)	2	SE	engl

- 20 different courses (52 semester hours*)
- Six courses in winter as well as in summer semester,
courses held several times: 772 112 - 10 times, 772305 - 6 times, 772325 - 2 times -> 137 semester hours
- In English: 14 (36 semester hours)

Every second year in addition the following courses are held:

772401		Basic Course I	3		engl
772404		Instructional Course IA	3		engl
772411		Instructional Course IIA	3		engl
772418		Journal Club	1		engl
772307		Glycobiology	2		Engl

773 - Courses

773803	W	Dissertantenseminar aus Organischer Chemie	2	SE	
773572	W	Masterseminar	2	SE	
773112	W	Organische Chemie für Lebensmittel- und Biotechnologen	3	VO	
773108	W	Organische Chemie Übungen	3	UE	
773119	S	Chemische Übungen	4	UE	
773111	S	Chemische Übungen für Kulturtechniker	3	UE	
773803	S	Dissertantenseminar aus Organischer Chemie	2	SE	
773310	S	Bioorganic Chemistry (every second year)	2	VO	engl
773311	S	Introduction into crystallography and NMR spectroscopy of proteins (in Eng.)	2	VO	engl
773572	S	Masterseminar	2	SE	
773316	S	Modern Methods in Structural Analyses (in Eng.)	3	VU	engl
773120	S	Organische Chemie	2	VO	
773108	S	Determination of provenance and authenticity of food and food products by modern analytical methods (in Eng.)	3	UE	

- 10 different courses (24 semester hours*)
- Three courses in winter as well as in summer semester, course held several times: 773108 - 12 times -> 58 semester hours
- In English: 3 (7 semester hours)

774 - Courses

774110	W	Biomaterialchemie	2	VO	
774314	W	Biopolymers for Sustainable Utilization (in Eng.)	2	VO	engl
774109	W	Chemie NAWAROS	1	UE	
774301	W	Chemie und Technologie nachwachsender Rohstoffe (in Eng.)	2	VO	engl
774326	W	Chemikalien aus Biomasse	2	VO	
774005	W	Current cellulose chemistry (in Eng.)	2	VO	engl
774404	W	Dissertantenseminar Nachwachsende Rohstoffe	2	SE	
774304	W	Masterseminar	2	SE	
774327	W	Polymerchemie und Technologie	2	VO	
774007	W	Quantum chemistry with as little mathematics as possible (in Eng.)	2	VO	engl
774322	S	Chemische Prozesse in Atmosphäre, Hydrosphäre und Geosphäre	2	VO	
774125	S	Chemische Technologie NAWAROS	2	VO	
774404	S	Dissertantenseminar Nachwachsende Rohstoffe	2	SE	
774304	S	Masterseminar	2	SE	
774305	S	Plant Polysaccharide Analysis (in Eng.)	2	VO	
774006	S	Structure and physical properties of polysaccharides (in Eng.)	2	VO	engl



- 14 different courses (27 semester hours*)
- Two courses in winter as well as in summer semester -> 31 semester hours
- In English: 5 (10 semester hours)

Courses of other departments with participation of lecturers from Chemistry:

941319	W	Zell- und Molekularbiologie	3	VO	
994401	W	Bio-Resources and Technologies	1	SE	engl
891117	S	Bachelorseminar	2	SE	
791024	S	Mikrofluidische Systeme für die chemische und biotechnologische Verfahrenstechnik	2	VS	
970308	W	Bioraffinerie und Produkte aus nachwachsenden Rohstoffen	1	VO	
891119	W	Utilisation of Renewable Materials (in Eng.)	2	SE	engl
970302	W	Naturstofftechnologien und –eigenschaften	3	PR	

Summary

In total 770-771-772-773-774 (without participation in other departments):

- 69 different courses (172 semester hours*)
- Due to multiple runs -> 109 courses (335 semester hours)
- In English: 27 (62 semester hours)

*semester hours = hours per week during the whole semester (approx. 14 weeks)

Abbreviations: PR, practical work; S, summer term; SE, seminar; VO, lecture; VS lecture with seminar; UE, practical course; W, winter term;