2022 Annual Summary

Institute of Biophysics

Department of Bionanosciences
University of Natural Resources and Life Sciences
Vienna, Austria

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Foreword

2022 went faster. Year of discussions with a (partly) new Rectorate about the consequences of the excellent evaluation of the department (in 2021) and how the evolution of the department is affected by financial cuts in academia and science. In addition, the three professors of the department had their individual evaluations.

Both aspects were important since my main goal is to establish "biophysics" at BOKU (the Institute of Biophysics did not exist at BOKU in 2010, nor was there a Biophysics lecture in the curriculum). After 12 years I still think that there is still a lot to be done at BOKU in the use of physics (and the instrumentation developed from it) as well as physical chemistry in biological systems and questions.

An example of the strategic discussions (ZV in February) was the loss of Dietmar Pum and the control on the electron microscopes. Between July and the end of the year we were able to solve both aspects. Also, in the ZV December the Rectorate reimbursed Notburga the money they saved from her salary (and thus bought a new laser). Finally, the requirement to change the name of the department could be achieved (it took 6 years) and since 2023 we are the Department of Bionanosciences.

2022 has not been the best year so far in quantitative terms but this should not affect the way we understand and do science. Short: 11 articles (and book chapters) and 8 contributions to conferences (workshops and seminars). This year we will be BOKU average (which is good) in the supervision of MSc and PhD students (BOKU does not consider officially the Erasmus students or the students who visit us as part of their PhD). Something to be happy and proud of are the two obtained FWF projects this year, with special mention to Jagoba and Jessica (who after her postdoc is leading her own project).

On department and BOKU level we still: i) manage laboratories that are constantly used by DBNS co-workers and "external" researchers, ii) participate in BOKU committees on leadership, teaching, research and

ethical issues (DLK, DokStuko, FachStuko, teaching spokesperson, ethics platform) and…

The institute will continue in the future to be involved in activities focused on the dissemination of science in all kinds of situations such as the "Kinder Uni" or the round table on Artificial Intelligence (organized in 2022 by the Cervantes Institute in Hamburg).

As usual, our institute has hosted 12 researchers (from professor to master's student). We should continue in this way. This is good for us on the research level and we support with our small contribution to the international strategy of BOKU. A great experience was having Francisco Blanco as a guest lecturer (BOKU visiting professor). I attended his lecture on the application of NMR in biological molecules as a student, and had a lot of fun (although I did not understand all the topics he explained). We should invite more visiting professors. They bring (new) knowledge and good humour. In addition, we had students from the "Höhere Bundeslehr- und Versuchsanstalt für chemische Industrie" (HBLVA) for the first time. Jasmina, Lola and Marlene did their diploma work (receiving help in the lab and in writing their final report from Amsatou, Hannah and Barbara).

An important event in 2022 was the retirement (after 40 years at BOKU) of Dietmar Pum. He is to be credited with many things. Among them I can highlight his research on S-layer proteins (from a physical perspective), his expertise in image analysis and electron microscopy (he was the first and last contact for all of us when we had a problem with it), and his teaching (students rated him very highly). I am sure he is enjoying his retirement, although he is very welcome to visit us and participate in our activities. From a strategic point of view, his retirement changes the structure. My vision here (partly supported by the Rectorate) is to reconvert his position into two research positions (no PhD) and to apply in the near future for a tenure track position.

In 2022 a lot of people finished work and left. Martin got a good job at Holzforschung Austria (Austrian Wood Society). Peter decided to learn something more "hands-on" related to a topic of great interest nowadays (alternative energies). Jagoba, who arrived in 2014, was instrumental in our research (either doing his own projects or helping our visitors) and went back home to work at Cidetec (a very good company I know since 2007) leading research and development. Juan Carlos got a postdoc in Madrid at CSIC (Consejo Superior de Investigaciones Científicas), where he will be looking at physical properties of viruses with AFM (from here we will support him if needed).

Andi (who has been awarded with the best doctoral thesis by BOKU) got a Marie Curie fellowship and decided to try his luck at University College London (in the lab of Prof. G. Charras).

2023 will be a transition year. So, no rush. A third generation of assistants and new students (PhD and MSc) will have to help with core biophysics topics new to BOKU. The teaching will also undergo changes (after Dietmar's retirement). So, no need to rush. Enjoy at work and try new things.

I want to thank all the people who have been with us for their work and dedication. As always, all the best to those who take a new path in their lives.

Thank you (and good night)

José L. Toca-Herrera

PD: In 2023 we will retake the Biophysics Breakfast. Notburga asked for it and I think it is a good opportunity to get “more” in touch with each other.

1. Institute members and visitors

- Univ. Prof. Dr. José L. Toca-Herrera (director)
- Ao. Univ. Prof. Dr. Dietmar Pum (deputy director, group leader)
- Assoc. Prof. Dr. Notburga Gierlinger (group leader)
- Assoc. Prof. Rafael Benitez Suarez (University of Valencia)
- Prof. Francisco Blanco Gutierrez (CSIC-Spain, BOKU-visiting professor)
- Assoc. Prof. Xavier Garcia Masso (University of Valencia)
- Assoc. Prof. Radostina Georgieva (Charite-Berlin, WTZ program)
- Assoc. Prof. Luis Millan Gonzalez (University of Valencia)
- Assoc. Prof. Miroslav Karabaliev (Trakia University, WTZ program)
- Prof. Stefano Leporatti (CNR-Nanotec, Lecce)
- Prof. Maja Turk Sekulic (University of Novi Sad, CEEPUS exchange)
- Dr. Jagoba J. Iturri (senior scientist)
- Dr. Wisnu Sudjarwo (univ. ass.)
- Dr. Sebastian Antreich (post-doctoral research assistant)
- Dr. Peter Bock (post-doctoral research assistant)
- Dr. Jessica Huss (post-doctoral research assistant)
- Dr. Med. Michael Handler (PhD student, collaboration with Sports Univ. Innsbruck, Austria)
- Dr. Martin Feldhofer (post-doctoral research assistant)
- Dr. Yaseen Mottiar (University of Helsinki)
- Dr. Boyana Paarvanova (Trakia University, WTZ program)
- Dr. Bilyana Tacheva (Trakia University, WTZ program)
- Dr. Andreas Weber (post-doctoral research assistant)
- Dr. Nannan Xiao (post-doctoral research assistant)
- Mag. Jacqueline Friedmann (tech. assistant)
- Mag. Amsatou Andorfer-Sarr (techn. assistant)
- MSc. Giuseppe Tiloca (PhD student)
- MSc. Oriane Morel (PhD student)
- MSc. Nadia Sasani (PhD student)
- BSc. Elisabeth Schögl (MSc student, collaboration with University of Vienna)
- BSc. Victoria Beneder (MSc student)
- BSc. Tobias Eder (MSc student)
- BSc. Sophia Horak (MSc student, collaboration with Roma Tre University)
- BSc. Pascal Tomasella (MSc-Erasmus student, University of Catania)
- BSc. Barbara Zbiral (MSc student)
- Tatiana Tyshchuk (BSc student, collaboration with Vetmeduni Vienna)
- Hannah Blaschka (apprentice)

- Jasmina Kadhim (student internship, HBLVA)
- Lola Schwager (student internship, HBLVA)
- Marlene Zaussinger (student internship, HBLVA)

2. Articles and book chapters

Publications (SCI articles)

1. *S. J. Antreich, J. Huss, N. Xiao, A. Singh, N. Gierlinger.*
The walnut shell network: 3D visualisation of symplastic and apoplastic transport routes in sclerenchyma tissue.
Planta 256 (2022) 49

2. *Permann, N. Gierlinger, A. Holzinger*.
Zygospores of the green alga Spirogyra: new insights from structural and chemical imaging.
Front. Plant Sci. 13 (2022) 1080111

3. *N. Lingg, A. Daxbacher, D. Womser-Matlschweiger, D. Pum, J. Beck, R. Hahn*.
Alkaline treatment enhances mass transfer in Protein A affinity chromatography.
J Chromatogr A. 1673 (2022) 463058

4. *Pfeifer, E. K. Ehmoser, S. K. M. R. Rittmann, C. Schleper,D. Pum, U. B. Sleytr, B. Schuster.*
Isolation and Characterization of Cell Envelope Fragments Comprising Archaeal S-Layer Proteins.
Nanomaterials 12 (2022) 250

5. *J. C. Gil-Redondo, J. Iturri, Y. Trueba, M. Benito-Leon, R. Perez-Sen, E. G. Delicado, J. L. Toca-Herrera, F. Ortega.*
Nucleotide-Induced Nanoscale Changes in the Mechanical Properties of Rat Cerebellar Astrocytes: Selective Stimulation and Blocking of the Purinergic Receptor P2X7.
Int. Mol. Sci. 23 (2022) 11927

6. *J. C. Gil-Redondo, A. Weber, J. L. Toca-Herrera*.
Measuring biological materials mechanics with atomic force microscopy 3 - Mechanical unfolding of biopolymers.
Microsc Res Tech. 85 (2022) 3025

7. *J. C. Gil-Redondo, A. Weber, B. Zbiral, M. dM. Vivanco, J. L. Toca-Herrera*.
Substrate stiffness modulates the viscoelastic properties of MCF-7 cells.
J. Mech. Behav. Biomed. Mater. 125 (2022) 104979

8. *M. Jain, A. Weber, K. Maly, G. Manjaly, J. Deek, O. Tsvyetkova, M. Stulić, J. L. Toca-Herrera, M. F. Jantsch.*
A-to-I RNA editing of Filamin A regulates cellular adhesion, migration and mechanical properties.
FEBS J. 2022; 289(15):4580-4601

9. *K. Schmidt, S. Hageneder, B. Lechner, B. Zbiral, S. Fossati, Y. Ahmadi, M. Minunni, J. L. M; Toca-Herrera, JL; Reimhult, E; Barisic, I; Dostalek, J*.
Rolling Circle Amplification Tailored for Plasmonic Biosensors: From Ensemble to Single-Molecule Detection.
ACS Appl. Mater. Interfaces 14 (2022) 5501

10. *Weber, R. Benitez, J. L. Toca-Herrera.*
Measuring biological materials mechanics with atomic force microscopy 4 - Determination of viscoelastic cell properties from stress relaxation experiments.
Microsc Res Tech. 85 (2022) 3284

11. *Weber, D. Tyrakowski, J. L. Toca-Herrera.*
Power Laws Describe Bacterial Viscoelasticity.
Langmuir. 38 (2022) 15552

Non-SCI publications

12. *Weber, M. dM. Vivanco, J. L. Toca-Herrera.*
Application of self-organizing maps to AFM-based viscoelastic characterization of breast cancer cell mechanics.
bioRxiv (2002), https://doi.org/10.1101/2022.12.03.518961

Books / Book chapters

13. *Zbiral, A. Weber, J. L. Toca-Herrera.*
Measuring Mechanical Properties of Breast Cancer Cells with Atomic Force Microscopy.
In: Maria dM. Vivanco (Ed.), Mammary Stem Cells: Methods and Protocols (Methods in Molecular Biology) 20 (2022) 2471. Humana Press, New York, NY. ISBN 978-1-0716-2192-9

3. Conferences, seminars, workshops and schools

AUTHOR: *E. Brynzak-Schreiber, E. Schögl, K. Cseh, V. Kopatz, A. Weber, J. L. Toca-Herrera, M. A. Jakupec, L. Kenner, V. Pichler*
TITLE: Accumulation and effects of micro- and nanoplastics in colon carcinoma cells (poster)
CONFERENCE: First Vienna Summit on Microplastics and Health
PLACE: Vienna (Austria) 2022

AUTHOR: *J. C. Gil-Redondo, A. Weber, B. Zbiral, J. L. Toca-Herrera*
TITLE: Accumulation and effects of micro- and nanoplastics in colon carcinoma cells (poster)
CONFERENCE: 8th International Iberian Biophysics Congress
PLACE: Bilbao (Spain) 2022

AUTHOR: *K. Taczanowska, M. T. Pellicer-Chenoll, P. Serra-Ano, J. L. Toca-Herrera, L. M. Gonzalez*
TITLE: National parks in social media – content analysis of German speaking Twitter community (poster)
CONFERENCE: 7th International Symposium for Research - Protected Areas facing the Biodiversity Crisis
PLACE: Vienna (Austria) 2022

AUTHOR: *A. Weber, R, Benitez, J. L. Toca-Herrera*
TITLE: Viscoelastic cell properties from AFM stress relaxation experiments (poster)
CONFERENCE: Biophysics Austria Meeting
PLACE: Strobl (Austria) 2022

AUTHOR: *B. Zbiral, A. Weber, M dM Vivanco, J. L. Toca-Herrera*
TITLE: Changes in nuclear morphology correlate with invasiveness in breast cancer cells (poster)
CONFERENCE: 27th Congress of the European Society of Biomechanics
PLACE: Porto (Portugal) 2022

AUTHOR: *J. L. Toca-Herrera*
TITLE: Biomechanics of the judo throw uchi-mata (oral)
CONFERENCE: Seminar of the Faculty of Physical Activity and Sports Sciences of the University of Valencia
PLACE: Valencia (Spain) 2022

AUTHOR: *J. L. Toca-Herrera*
TITLE: Biophysics research at BOKU (oral)
CONFERENCE: Seminar at ICMUV (Faculty of Physics, University of Valencia)
PLACE: Valencia (Spain) 2022

COORDINATOR: *J. L. Toca-Herrera*
TITLE: Inteligencia Artificial. Revolución tecnológica: nanotecnología y robots al servicio del ser humano (Technological revolution: nanotechnology and robots in the service of humans)
CONFERENCE: Round table on cultural and scientific issues of the Cervantes Institute
PLACE: Hamburg (Germany) 2022

3. Ongoing projects, national and international collaborations, and student supervision

Accepted / Ongoing projects

- ICEPLANT - Eislakunen in pflanzlichen Geweben (Ice lacunae in plant tissues), FWF, N. Gierlinger (PI)
- PLANTHEAT - Transpiration bei Hitze , Transpiration during heat), FWF (Austrian Science Fund), N. Gierlinger (PI)
- SPIN - Anpassungen von Kaktusdornen zur Nebel- und Tauaufnahme (Adaptations of cactus spines to absorb fog and dew), FWF (Austrian Science Fund, Sprit program), J. Huss (PI)
- HIPONICA - Hierarchische Polymernischen für verbesserte Zellanhaftung (Hierarchical polymer niches for improved cell attachment), FWF (Austrian Science Fund), J.L. Toca-Herrera (PI), J. Iturri (co-PI)

National / International collaborations

- Assoc. Prof. Rafael Benítez, Univ. of Valencia, Faculty of Economics. Spain
- Prof. Ingo Burgert, ETH Zurich, Switzerland
- Dr. Michaela Eder, Max Planck Institute of Colloids and Interfaces, Potsdam, Germany
- Assoc. Prof. Luis M. González, Univ. of Valencia, Dept. of Physical Education and Sport, Spain
- Dr. Chartchai Krittanai, Mahidol University, Institute of Molecular Biosciences, Thailand
- Prof. Michael Jantsch, Department of Cell and Developmental Biology, Medical University of Vienna, Austria
- Prof. Anna de Juan, Chemometrics group, University of Barcelona, Spain
- A.o. Univ. Prof. Ursula Lütz-Meindl, Department of Cell Biology and Physiology, University of Salzburg, Austria
- Prof. Shawn D. Mansfield, Forest Sciences, University of British Columbia, Canada

- Prof. Gilbert Neuner, Institute of Botany, University of Innsbruck, Austria
- Ass. Prof. Verena Pichler, Department für Pharmazeutische Chemie, University of Vienna, Austria
- Prof. M. Schneider, Institute biopharmacy and pharmaceutical technology, University of Saarland, Germany
- Prof. Gerald Streidner, Department of Biotechnology, BOKU, Austria
- Dr. Maria Vivanco, CICbioGUNE, Spain

Student supervision

PhD

- Sebastian Antreich: A nut worth cracking: Shell development of the walnut (Juglans regia) and other shelled fruits.
- Nadia Sasani: Tracing biotic and abiotic stress reactions on the micro-level in softwood tracheids and cuticles.
- Nannan Xiao: Characterization of fruit shells from the soft to hard state on the micro and nanoscale.

MSc/Diploma/Training/Erasmus

- Lilian Mira Kaufman: New materials based on waste: bacterial cellulose from kombucha production blended with walnut shells.
- Sophia Horak: Application and characterization of nanoparticle-based multifunctional coatings on painted surfaces.
- Pascal Tomasella: Graphene oxide-based surfaces to fight biocontamination.