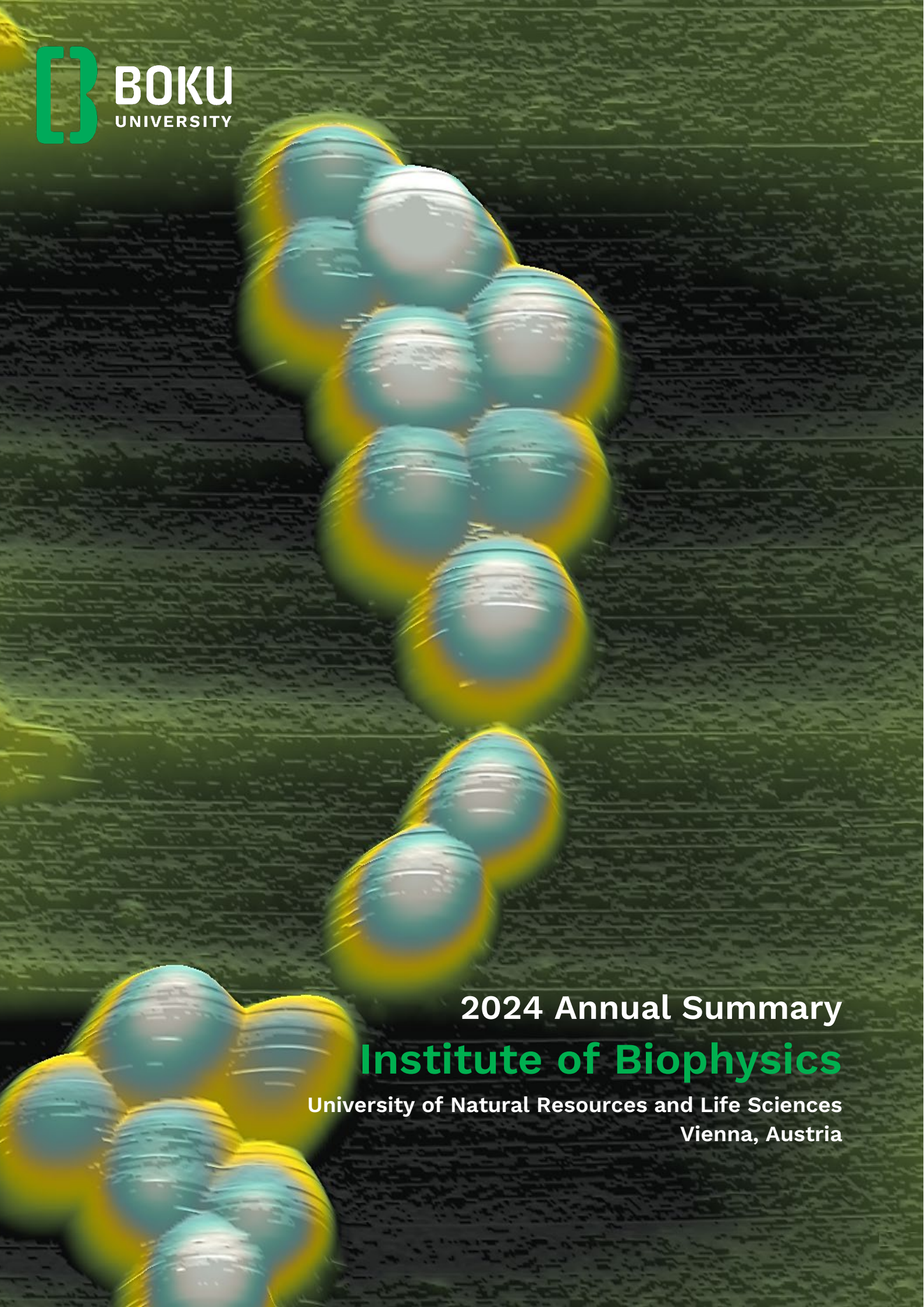

BOKU UNIVERSITY

2024 Annual Summary

Institute of Biophysics

University of Natural Resources and Life Sciences
Vienna, Austria

2024 Annual Report

Institute of Biophysics

Department of Bionanosciences
University of Natural Resources and Life Sciences Vienna (BOKU)
Austria

Foreword

2024 was a year full of surprises at both the department and university levels. It marked the final year of the Department of Bionanosciences, which had been active from October 2010 to December 2014. With the end of "nanothinny" at BOKU, Eva Ehmoser decided to join the Biotech department, while Erik and I chose to move to the Natural Science department.

As usual, 2024 was an excellent year for us. We published 15 articles and a book chapter, and made 13 contributions to conferences, workshops, seminars, and outreach media. Notburga, Jessica, and I also co-organized three scientific events. Additionally, we secured funding to support young researchers.

Continuing our tradition, our institute has welcomed external researchers from both national and international backgrounds, ranging from professors to master's students. This practice benefits our research efforts and aligns with BOKU's international strategy through our modest contributions. Even in its final year, the Department of Bionanosciences performed admirably.

The future remains uncertain. Our working philosophy differs from that of the former chemistry and materials department, and we are still unsure how resources will be redistributed, which will be crucial for our development. Additionally, we do not yet know how the new structure will impact our teaching. However, life is good, and every crisis presents an opportunity for change.

As always, I want to express my deepest gratitude to everyone who has supported us throughout 2024 with their hard work, dedication, and positive attitude. Thank you, and good night. Tomorrow never knows.

Jose L. Toca-Herrera

Institute members and visitors

- Univ. Prof. Dr. José L. Toca-Herrera (director)
- Dr. Wisnu Sudjarwo (Univ. Assistant, deputy director)
- Assoc. Prof. Dr. Notburga Gierlinger (group leader)
- Assoc. Prof. Rafael Benitez Suarez (University of Valencia)
- Dr. Sebastian Antreich (post-doctoral research assistant)
- Dr. Jessica Huss (post-doctoral research associate)
- Dr. Med. Michael Handler (PhD student, collaboration with Sports Univ. Innsbruck, Austria)
- Dr. Lukas Schrangl (Univ. Assistant)
- Dr. Nannan Xiao (post-doctoral research assistant)
- Mag. Amsatou Andorfer-Sarr (technical assistant)
- MSc. Jibao Chen (PhD student, collaboration Chinese Academy of Forestry)
- Mag. Jacqueline Friedmann (technical assistant)
- Mag. Valerie Wagner (technical assistant)
- MSc. Alexander Einschütz Lopez (PhD student)
- Msc. Klaudia Kobolova (PhD-CEEPUS student, Brno University of Technolog)
- MSc. Mahder Mekonnen (PhD student, OeAD grant)
- MSc. Luzia Petrosyan (PhD student, Collaboration with Polytechnic University of Valencia)
- MSc. Luis Ponce-Gonzalez (PhD student)
- MSc. Agnes Specht (PhD student, collaboration with Bayreuth University)
- MSc. Kateryna Trach (PhD student, collaboration with Palacký University in Olomouc)
- MSc. Giuseppe Tiloca (PhD student)
- MSc. Yudho Harjoyudanto (PhD student, OeAD grant)
- MSc. Victoria Beneder
- MSc. Paraskevi Charalambous
- BSc. Tobias Eder (MSc student)
- BSc Marin Milićević (MSc CEEPUS student, Univ. of Mostar)
- BSc Lidija Pejak (MSc-CEEPUS student, Univ. of Mostar)
- BSc. Daniel Tyrakowski
- Ansgar Schäfer (BSc student)
- Konstantinos Kounetas (apprentice)

Publications (SCI articles, reports, preprints, etc.)

1. **Hydrolyzable tannins are incorporated into the endocarp during sclerification of the water caltrop Trapa natans**
   J. C. Huss, S. J. Antreich, M. Felhofer, K. Mayer, M. Eder, A. C. Vieira Dias dos Santos, G. Ramer, B. Lendl, N. Gierlinger.
   Plant Physiology 194 (2024) 94
   Doi: 10.1093/plphys/kiad408

2. **Humidity-driven shape morphing enhances fog harvesting in porous cactus spines**
   Jessica C. Huss, Finn Box, Martin A. Grömmer, Sebastian J. Antreich, Tofayel Ahmmad Ovee, Jürg Schönenberger, David G. Williams, Notburga Gierlinger, Jean-François Louf, Kevin R. Hultine
   (under evaluation)

3. **Zygospore development of Spirogyra (Charophyta) investigated by serial block-face scanning electron microscopy and 3D reconstructions**
   S. Antreich, C. Permann, N. Xiao, G. Tiloca, A. Holzinger
   Frontiers in Plant Science 15 (2024) 1358974
   Doi: 10.3389/fpls.2024.1358974

4. **MicrobioRaman: an open-access web repository for microbiological Raman spectroscopy data**
   K. Soo Lee, Z. Landry, A. Athar, U. Alcolombri, P. Pramoj Na Ayutthaya, D. Berry, P. de Bettignies, J.-X. Cheng, G. Csucs, L. Cui, V. Deckert, T. Dieing, J. Dionne, O. Doskocil, G. D'Souza, C. García-Timermans, N. Gierlinger, K. Goda, R. Hatzenpichler, R. J. Henshaw, W. E. Huang, I. Iermak, N. P. Ivleva, J. Kneipp, P. Kubryk, K. Küsel, T. Kwon Lee, S. Sik Lee, B. Ma, C. Martínez-Pérez, P. Matousek, R. U. Meckenstock, W. Min, P. Mojzeš, O. Müller, N. Kumar, P. Halkjær Nielsen, I. Notingher, M. Palatinszky, F. C. Pereira, G. Pezzotti, Z.Pilat, F. Plesinger, J. Popp, A. J. Probst, A. Riva, A. A. E. Saleh, O. Samek, H. M. Sapers, O. T. Schubert, A. K. M. Stubbusch, L. F. Tadesse, G. T. Taylor, M. Wagner, J. Wang, H. Yin, Y. Yue, R. Zenobi, J. Zini, U. Sarkans, R. Stocker
   Nature Microbiology 9 (2024) 1152
   Doi:10.1038/s41564-024-01656-3

5. **Structure, Function, and Application of Self-Healing Adhesives from Mistletoe Viscin**
   S. D. George, E. Andraos, T. Priemel, N. Horbelt, G. Keiser, A. Kumar, C. Heiss, N. Gierlinger, P. Azadi, M. J. Harrington
   Advanced Functional Materials 34 (2024) 2307955
   Doi: 10.1002/adfm.202307955

6. **Microstructuring of Thermoresponsive Biofunctional Hydrogels by Multiphoton Photocrosslinking**
   Y. M. Morozov, F. Wiesner, J. J. Grün, M. Pertiller, S. K. Schmidt, N. Gisbert Quilis, C. Gusenbauer, B. Zbiral, J. L. Toca-Herrera, S. Klees, C. R. V. Thiagarajan, U. Jonas, J. Dostalek
   Advanced Functional Materials 34 (2024) 2315578
   Doi: 10.1002/adfm.202315578

7. **Effect of reduced feedback frequencies on motor learning in a postural control task in young adults**
   A. Marco-Ahulló, I. Villarrasa-Sapiña, J. Romero-Martínez, G. Monfort-Torres, J. L. Toca-Herrera, X. García-Massó
   Sensors 24 (2024) 1404 - Doi: 10.3390/s24051404

8. **Microplastics in Motion: Their Role in Cell Migration and Distribution During Cancer Cell Division**
   E. Brynzak-Schreiber; E. Schögl; C. Bapp; K. Cseh; V. Kopatz; M. A. Jakupec; A. Weber; T. Lange; J. L. Toca-Herrera; G. del Favero; W. Wadsak; L. Kenner, V. Pichler
   Chemosphere 353 (2024) 141463
   Doi: 10.1016/j.chemosphere.2024.141463

9. **Understanding the mechanism of polyethyleneimine-mediated cell disintegration and protein extraction in E. coli: the role of floc network formation and PEI molecular weight**
   A.Jurjevec; C. Brocard; G. Striedner; M. Cserjan-Puschmann, J. L. Toca-Herrera, R. Hahn
   Journal of Biotechnology 384 (2024) 29
   Doi: 10.1016/j.jbiotec.2024.02.016

10. **Test-retest reliability of putting related variables in medium-to-high handicap golf players**
    X. García-Massó, I. Villarrasa-Sapiña, N. Ortega-Benavent, S. Montalt-García, J.L. Toca-Herrera
    Scientific Reports 14 (2024) 11516
    Doi: 10.1038/s41598-024-62183-z

11. **Green AgNPs: Prospective Nanotools against neurodegenerative cell line model**
    V. De Matteis, S. Martano, P. Pellegrino, C. Ingrosso, D. Costa, S. Mazzotta, J. L. Toca-Herrera, R. Rinaldi, M. Cascione
    Ibrain 10 (2024) 123
    Doi: 10.1002/ibra.12157

12. **Advanced quantification of receptor–ligand interaction lifetimes via single-molecule FRET microscopy**
    L. Schrangl, V. Mühlgrabner, R. Platzer, F. Kellner, J. Wieland, R. Obst, J. L. Toca-Herrera, J. B. Huppa, G. J. Schütz, J. Göhring
    Biomolecules 14 (2024) 1001
    Doi: 10.3390/biom14081001

13. **Effects of meteorology on bike-sharing: Cases of 13 cities using non-linear analyses**
    I. Villarrasa-Sapiña, J.L. Toca-Herrera, M. Pellicer-Chenoll, K. Taczanowska, P. Rueda, J. Devís-Devís
    Cities 155 (2024) 105457
    Doi: 10.1016/j.cities.2024.105457

14. **Plasmon-Enhanced Multiphoton Polymer Crosslinking for Selective Modification of Plasmonic Hotspots**
    Y.i M. Morozov, N. Gisbert Quilis, S. Fossati, L. De Laporte, C. Gusenbauer, A. Weber, J. L. Toca-Herrera, F. Wiesner, U. Jonas, J. Dostalek
    Journal of Physical Chemistry C 128 (2024) 18641
    Doi: 10.1021/acs.jpcc.4c05936

15. **CD4+ T-cells create a stable mechanical environment for force sensitive TCR:pMHC interactions**
    L. Schrangl, F. Kellner, R. Platzer, V. Mühlgrabner, P. Hubinger, J. Wieland, R. Obst, J. L. Toca-Herrera, J. B. Huppa, G. J. Schütz, J. Göhring
    bioRxiv (2024)
    Doi: 10.1101/2024.12.18.629139

16. **Software for quantification of receptor–ligand interaction times via single-molecule FRET**
    L. Schrangl (2024)
    Available from: github.com/schuetzgroup/smfret-bondtime

17. **Measurement of Forces Acting on Single T-Cell Receptors**
    L. Schrangl, J. Göhring, F. Kellner, J. Huppa, G. Schütz
    In: C. Wuelfing, R. Murphy (editors)
    Imaging cell signaling. Humana New York, NY; 2024. p. 18.
    Doi: 10.1007/978-1-0716-3834-7_11

Conferences, seminars, schools, and workshops

Participation

Title: Fog and dew harvesting in cactus spines
Author(s): *J.C. Huss*
Seminar at the college of Chemical Engineering, Auburn University
AL (USA), 2024

Title: Humidity-driven shape morphing in cactus spines
Author(s): *J.C. Huss*
Conference: UK Plant Biomechanics Day (Sainsbury Laboratory)
Cambridge (UK), 2024

Title: Humidity-driven shape morphing in cactus spines
Author(s): *J.C. Huss*
CurvoBio Conference on curvature in biological systems (From nano to macro scales)
Warsaw (Poland), 2024

Title: Survival in the desert - how plants harvest fog droplets
Author(s): *J.C. Huss*
Modern analytical chemistry seminar at the Institute of Chemical Technologies and Analytics (TU-Vienna)
Vienna (Austria), 2024

Title: Scanning through plant surfaces: 3D-Raman imaging of epidermal peels of Arabidopsis arenosa
Author(s): *G. Tiloca, P. Charalambous, C. Bertel, G. Neuner, N. Gierlinger*
4th International Plant Spectroscopy Conference
Vienna (Austria), 2024

Title: Raman imaging of plant leaf cuticle adaptations in extreme alpine environment
Author(s): *G. Tiloca, N. Gierlinger*
28th International Conference on Raman Spectroscopy
Rome (Italy), 2024

Title: Surface Symphony: Orchestrating DPPC Monolayer behavior
Author(s): *W. Sudjarwo, J. L. Toca-Herrera*
Biophysics Austria Conference
Salzburg (Austria), 2024

Title: Unlocking the physical-chemical aspects of roasting and sonication effects on flaxseed gum extract in O/W emulsion for a sustainable food systems
Author(s): *E. M. Raoui, A. Einschütz Lopez, G. Subbiahdoss, A. Mistlberger-Reiner; J. L. Toca-Herrera, M. Pignitter*
19th Food Colloids Conference
Thessaloniki (Greece), 2024

Title: Mechanical forces in T cell receptor–ligand interactions
Author(s): *L. Schrangl, F. Kellner, R. Platzer, J. L. Toca-Herrera, J. Huppa, G. Schütz, J. Göhring*
Biophysics Austria Conference
Salzburg (Austria), 2024

Title: Surface Symphony: Orchestrating DPPC Monolayer Behavior
Author(s): *W. Sudjarwo, J. L. Toca-Herrera*
Biophysics Austria Conference
Salzburg (Austria), 2024

Title: Viscoelastic cell properties from AFM stress relaxation experiments
Author(s): *A. Weber, R. Benitez, J. L. Toca-Herrera*
73rd Annual Meeting of the Austrian Physical Society
Linz (Austria), 2024

T**itle:** Hydrophobic forces between surfaces: influence of salt
Author(s): *L. N. Ponce-Gonzalez, J. L. Toca-Herrera*
2nd edition InterNanoBioMed PhD School
Lecce (Italy), 2024

Title: (What is) Energy?
Author(s): *J. L. Toca-Herrera*
Seminars of the University Institute of Pure and Applied Mathematics (Polytechnic University of Valencia)
Valencia (Spain), 2024

Organization

N. Gierlinger, J. C. Huss. Member of the scientific board and co-organizer of the 4th International Plant Spectroscopy conference, held at BOKU Vienna (Austria) in 2024, September 24-27th

J. L. Toca-Herrera. Organizer of the first ACERA (Association of Spanish Scientist in Austria) meeting, held at BOKU Vienna (Austria) in 2024, June 14th

J. L. Toca-Herrera. Organizer of the 2nd edition International School of Medical Bionanotechnology and Nanomedicine (InterNanoBioMed), held at CNR Nanotec in Lecce (Italy) in 2024, October 3rd – 4th

Ongoing projects, national and international collaborations

General information about projects and research topics: https://forschung.boku.ac.at/de/department/iBIPH

Projects:

Puzzle Zellen aus Nussschalen: ein Abfallprodukt mit Potential für nachhaltige Materialien?
Funded by the European Commission (EU).
Project duration: 01.09.2023 - 28.02.2025.
PI: Notburga Gierlinger.

Adaptations for fog and dew harvesting in cactus spines.
Funded by the Austrian Science Fund (FWF) (DOI).
Project duration: 01.08.2022 - 31.07.2025.
PI: Jessica Huss.

Transpiration in heat.
Funded by the Austrian Science Fund (FWF).
Project duration: 01.11.2021 - 31.10.2025.
PI: Notburga Gierlinger.

Ice lacunae in plant tissues.
Funded by the Austrian Science Fund (FWF).
Project duration: 01.08.2021 - 31.07.2025.
PI: Notburga Gierlinger.

Assessment of Anthropogenic Impacts as an Approach to Fish Biodiversity Conservaton; the Case of River Awash, Ethiopia.
Funded by the Austrian Agency for Education and Internationalisation (OeAD).
Project duration: 01.10.2023 - 30.09.2026.
Grant holder: Mahder Mekonnen Shumi.
Supervisor: Jose L. Toca-Herrera.

Hierarchical polymer niches for improved cell adhesion.
Funded by the Austrian Science Fund (FWF).
Project duration: 01.11.2022 - 31.10.2026.
PI: Jose L. Toca-Herrera.

In-depth Study of Four Divisions of Microalgae and Their Response against Contaminants.
Funded by the Austrian Agency for Education and Internationalisation (OeAD).
Project duration: 16.03.2024 - 15.03.2027.
Grant holder: Yudho Harjoyudanto.
Supervisor: Jose L. Toca-Herrera.

Human ECM-based platform for anti-cancer drug testing – CARES.
Funded by the European Commission (EU).
Project duration: 01.11.2023 - 31.10.2027.
PI: Jose L. Toca-Herrera.

Limiting low temperatures for the tree xylem.
Funded by the Austrian Science Fund (FWF).
Project duration: 01.12.2024 - 30.11.2027.
PI: Notburga Gierlinger.

Main collaborations:

- **Assoc. Prof. Rafael Benítez**, Faculty of Economics, University of Valencia, Spain
- **Prof. Ingo Burgert**, Head of Institute for Building Materials ETH Zurich, Switzerland
- **Dr. Michaela Eder**, Max Planck Institute of Colloids and Interfaces, Potsdam, Germany
- **Prof. Wolfgang Gindl**, Institute for Wood technology and Renewable materials, BOKU Vienna, Austria
- **Assoc. Prof. Luis Millán González**, Dept. of Physical Education and Sport, University of Valencia, Spain
- **Prof. Anna de Juan**, Chemometrics group, University of Barcelona, Spain
- **Dr. Chartchai Krittanai**, Mahidol University, Institute of Molecular Biosciences, Thailand
- **A.o. Univ. Prof. Ursula Lütz-Meindl**, University of Salzburg, Cell Biology and Physiology Department, Salzburg, Austria
- **Prof. Shawn D. Mansfield**, University of British Columbia, Forest Sciences Centre, Vancouver, Canada
- **Prof. Gilbert Neuner**, University of Innsbruck, Institute of Botany, Unit Functional Plant Biology, Innsbruck, Austria
- **Prof. Georg Papastavrou**, Faculty of Biology, Chemistry, and Earth Sciences, University of Bayreuth, Germany
- **Prof. Gerald Striedner**, Institute of Bioprocess Science and Engineering, BOKU Vienna, Austria
- **Dr. Maria Vivanco**, CICbioGUNE, Spain