Unterstützt von / Supported by

Alexander von Humboldt
Stiftung/Foundation

SCIENCE AND EDUCATIONAL CHALLENGES FACING EUROPE IN THE NEXT DECADE

On the occasion of the 250th anniversary of the birth of Alexander von Humboldt (1769–1859)

HERAUSFORDERUNGEN FÜR WISSENSCHAFT UND BILDUNG IN EUROPA IM NÄCHSTEN JAHRZEHNT

Zum 250. Geburtsjubiläum von Alexander von Humboldt (1769–1859)

PROGRAMME
AND BOOK OF ABSTRACTS

PROGRAMM
UND BUCH DER ZUSAMMENFASSUNGEN

Humboldt College Zagreb, October 10-11, 2019
Humboldt-Kolleg Zagreb, 10. bis 11. Oktober 2019

Title of the Original: Humboldt College SCIENCE AND EDUCATIONAL CHALLENGES FACING EUROPE IN THE NEXT DECADE, On the occasion of the 250th anniversary of the birth of Alexander von Humboldt (1769–1859), Zagreb, October 10-11, 2019

Authors/Editors: Mile Ivanda and Hrvoje Skenderović

Organised by: CROATIAN HUMBOLDT CLUB
Co-organizers: Croatian Academy of Science and Arts and University of Zagreb

Publisher: CROATIAN HUMBOLDT CLUB

Unterstützt von / Supported by

Alexander von Humboldt
Stiftung/Foundation

PROGRAMME / PROGRAMM

SCIENCE AND EDUCATIONAL CHALLENGES FACING EUROPE IN THE NEXT DECADE

On the occasion of the 250th anniversary of the birth of Alexander von Humboldt (1769–1859)

HERAUSFORDERUNGEN FÜR WISSENSCHAFT UND BILDUNG IN EUROPA IM NÄCHSTEN JAHRZEHNT

Zum 250. Geburtsjubiläum von Alexander von Humboldt (1769–1859)

Programme

Europe is facing major global transnational challenges that cannot be addressed by any single government or institution acting alone. These challenges, trans-institutional in solution, require collaborative actions among governments, international organizations, universities, non-governmental organisations and creative individuals. It is evident that the key role in these changes is to modernize science and education systems without which there would be no economic progress or the preservation of Croatian and European identity.

On the occasion of 250th birth anniversary of Alexander von Humboldt (1769–1859) and Croatian presidency of the European Union in the first half of 2020, Croatian Humboldt Club, University of Zagreb and Croatian Academy of Sciences and Arts joined to organize the Humboldt College conference dedicated to the science and educational challenges of Croatia and European Union for the next decade.

Within this conference, the Croatian Humboldt Club remembers the work of Alexander von Humboldt and pays tribute to the legacy of this cosmopolitan world scholar and highlights its relevance for today's science and education in modern Europe.

Croatian scientists will present their research financed by the Croatian Science Foundation. Several interesting examples from different fields will be presented, starting from medicine: the complex research pathway from the basic research to the clinical testing of the new drug will be described. Then the summary of the last five years work on the development of the commercial products in Zagreb's Biocenter will be presented as illustration of the progress in biotechnology. Researchers from the field of humanities shall introduce us to the topic whether Europe needs a multilingual science and education, on the literature between tradition and digitization, on the embodied mind as a shift away from classical cognitivism, etc. Recently Croatia has joined the associate memberships of the CERN - such new opportunity for the Croatian physics will be analyzed.

Very important issue for the science in Croatia is joining to European Union. New opportunities in financing of science appeared through European Structural and Investment Funds by foundation of the Centers of Excellence and Centers of Competence that allow the synergy effects of different research groups for more effective research, better focus on targeted issues and achievement of necessary conditions for commercialization of the scientific discoveries. High quality researchers who joined these centers and high level of their previous and current research projects will be described by an example of infectious disease research in Croatia and by the University of Zagreb's infrastructure for materials research improvement within the project Centre for Advanced Research of Complex Systems. The importance of materials research to the

economic development has been also recognized by number of presentations as the key technology advancement. Materials research has generated countless advances in areas such as electronics, information technologies, automotive and aerospace transportation, biomaterials, medicine, energy storage and nanotechnology. Materials present a topic that is both vast in scope and extreme in depth and are forecasted as an extremely fertile arena in the next decade for university research, education, economic development and entrepreneurial impact that spans the sciences, engineering, and is rapidly moving into medicine and agriculture.

The Croatia Humboldt Club has invited scientists from the European countries to present their respective fields of study about the problems and perspectives of science and education in relation to the labor market in Croatia and the European Union. A number of humboldtians, members of Academy, university professors, scientists and other prominent experts from Bulgaria, Macedonia, Serbia, Slovakia, Italia, Germany, USA and Croatia will participate in two roundtable discussions on the science and education challenges facing Europe in the next decade, i.e. how to integrate technology, health, and environment and how to improve education perspective for young scientists. Besides, our guests will present the broad spectrum of interesting themes from the biophotonics as a key technology for precision medicine to the security challenges and solution pathways framework using science and technology convergence paradigm that will offer a series of concrete and achievable solutions and promote the possibility of establishing contacts and networking in certain fields.

Programm

Europa ist mit großen transnationalen und globalen Herausforderungen konfrontiert, denen sich keine Regierung oder Institution im Alleingang stellen kann. Diese Herausforderungen, die nach trans-institutionellen Lösungen verlangen, bedürfen gemeinsamer Unternehmungen von Regierungen, internationalen Organisationen, NGOs, Universitäten und kreativen Einzelpersonen. Es liegt auf der Hand, dass der Modernisierung von Wissenschaft und Bildung eine Schlüsselrolle in den Wandlungsprozessen zukommt, da ohne diese Bereiche kein wirtschaftlicher Fortschritt und auch keine Wahrung kroatischer und europäischer Identität denkbar ist.

Zum 250. Geburtsjubiläum von Alexander von Humboldt (1769–1859) und in Verbindung mit dem kroatischen Vorsitz im Rat der Europäischen Union (Januar bis Juni 2020) gestalten der Kroatische Humboldtianer-Klub, die Universität Zagreb und die Kroatische Akademie der Wissenschaften und Künste im Format des Humboldt-Kollegs eine Konferenz über die Herausforderungen für Wissenschaft und Bildung in Kroatien und Europa im kommenden Jahrzehnt.

Im Rahmen der Konferenz möchte der Kroatische Humboldtianer-Klub an das Werk Alexander von Humboldts erinnern, das Erbe dieses kosmopolitischen Wissenschaftlers

von Weltrang ehren und seine Bedeutung für Wissenschaft und Bildung im Europa der Gegenwart aufzeigen.

Wissenschaftler aus Kroatien werden ihre von der Kroatischen Wissenschaftsstiftung unterstützten Projekte aus unterschiedlichen Forschungsbereichen vorstellen. Die Medizin eröffnet die Reihe: Ein Einblick in den komplexen Weg von der Grundlagenforschung bis zur klinischen Erprobung eines neuen Arzneimittels. Als Einblick in die Fortschritte der Biotechnologie wird die Entwicklung kommerzieller Produkte im Zagreber BIOCentar vorgestellt. Forscher aus dem Bereich der Geistes- und Kulturwissenschaften werden uns unter anderem folgende Fragenkomplexe näherbringen: Mehrsprachigkeit von Wissenschaft und Bildung in Europa; Literatur zwischen Tradition und Digitalisierung; das verkörperte Denken als Abkehr vom klassischen Kognitivismus. Seit kurzem ist Kroatien assoziiertes Mitglied des CERN – die neuen Chancen für die Physik in Kroatien werden analysiert.

Ein besonders wichtiger Umstand für die Wissenschaft in Kroatien ist der Beitritt zur Europäischen Union. Die Europäischen Struktur- und Investitionsfonds öffnen neue Möglichkeiten der Wissenschaftsfinanzierung durch die Gründung von Exzellenz- und Kompetenz-Zentren. Daraus ergeben sich Synergieeffekte für eine effektivere Forschung, eine bessere Fokussierung von Fragestellungen und die Schaffung erforderlicher Voraussetzungen für die Vermarktung wissenschaftlicher Entdeckungen. Zwei Beispiele sollen das Forschungsniveau dieser Zentren illustrieren: Ein Forschungsprojekt zu Infektionskrankheiten in Kroatien und die Infrastruktur der Universität Zagreb zur Verbesserung der Materialforschung im Rahmen des Projektzentrums für die Erforschung komplexer Systeme. Die Bedeutung der Materialforschung für die wirtschaftliche Entwicklung wird auch in einer Reihe von Präsentationen als Schlüsselgebiet der technologischen Entwicklung vorgestellt. Die Materialforschung hat unzählige Fortschritte in Bereichen wie Elektronik, Informationstechnologien, Automobil- und Luftfahrttransport, Biomaterialien, Medizin, Energiespeicherung und Nanotechnologie erzielt. Materialien stellen einen besonders umfangreichen und tiefgreifenden Themenkomplex dar. Es wird prognostiziert, dass dieser Komplex im nächsten Jahrzehnt eine äußerst fruchtbare Arena universitärer Forschung, der Bildung und wirtschaftlicher Entwicklung sein wird, der die Bereiche Wissenschaft und Ingenieurwesen betrifft und sich rasch in Medizin und Landwirtschaft weiter entwickelt.

Der Kroatische Humboldtianer-Klub hat Wissenschaftlerinnen und Wissenschaftler aus europäischen Ländern eingeladen, die ihre einschlägigen Forschungen zu Problemen und Perspektiven von Wissenschaft und Bildung in ihrem Verhältnis zum Arbeitsmarkt in Kroatien und der Europäischen Union vorstellen werden. Außerdem wird eine Reihe von Humboldtianern, Akademie-Mitgliedern, Universitäts-Professoren, Institutsforschern und anderen prominenten ExpertInnen aus Bulgarien, Nordmazedonien, Serbien, Slowakei, Italien, Deutschland, USA und Kroatien an zwei Rundtischgesprächen zu den Herausforderungen für Wissenschaft und Bildung in Europa des kommenden Jahrzehnts teilnehmen. Im Einzelnen geht es um die Integrationsmöglichkeiten von Technologie, Gesundheitswesen und Umwelt sowie um die Verbesserung der Bildungsperspektiven für den wissenschaftlichen Nachwuchs. Unsere Gäste werden außerdem ein breites

Spektrum interessanter Themen vorstellen – von der Biophotonik als einer Schlüsseltechnologie in der Präzisionsmedizin bis zu Lösungsansätzen im Bereich von Sicherheitsherausforderungen. Zur Anwendung kommt dabei ein Konvergenzparadigma von Wissenschaft und Technologie, dass zu einer Reihe konkreter und erreichbarer Lösungen führt und die Vernetzung bestimmter Wissenschaftsbereiche fördert.

Dr. Mile Ivanda

President, Croatia Humboldt Club

Präsident des Kroatischen Humboldtianer-Klubs

Scientific Committee / Wissenschaftliches Komitee:

- Dr. Mile Ivanda, Ruđer Bošković Institute, Zagreb (Chairmen/Vorsitzender)
- Prof. Dr. Ivo Barić, University of Zagreb / Universität Zagreb
- Prof. Dr. Pavo Barišić, Institute for Philosophy / Institut für Philosophie, Zagreb
- Prof. Emeritus Igor Čatić, University of Zagreb / Universität Zagreb
- Prof. Dr. Davor Dukić, University of Zagreb / Universität Zagreb
- Prof. Dr. Zoran Jašić, University of Zagreb / Universität Zagreb
- Prof. emer. Dr. Alojzije Jembrih, University of Zagreb / Universität Zagreb
- Prof. Dr. Zvonko Kovač, University of Zagreb / Universität Zagreb
- Prof. Dr. Ivan Malčić, University of Zagreb / Universität Zagreb
- Prof. Dr. Milan Pelc, Institute of Art History / Institut für Kunstgeschichte, Zagreb
- Prof. Dr. Ivica Picek, University of Zagreb / Universität Zagreb
- Dr. Hrvoje Skenderović, Institute of Physics / Institut für Physik, Zagreb
- Prof. Dr. Jurica Sorić, University of Zagreb / Universität Zagreb
- Dr. Marina Šekutor, Ruđer Bošković Institute, Zagreb
- Prof. Dr. Valerije Vrček, University of Zagreb / Universität Zagreb

Organiser / Veranstalter:

Croatian Humboldt Club / Kroatischer Humboldtianer-Klub

Co-organizers / Mitorganisatoren:

Croatian Academy of Science and Arts and University of Zagreb / Kroatische Akademie der Wissenschaften und Künste, Universität Zagreb

Conference languages: English and German

Tagungssprachen: Englisch und Deutsch

Thursday, 10. October 2019

Croatian Academy of Sciences and Arts (HAZU) / Kroatische Akademie der Wissenschaften und Künste, Strossmayerov trg 14, Large hall in the HAZU library / Großer Saal in der HAZU-Bibliothek

8:00 – 9:00	Registration / Registrierung
9:00 – 9:45	Greetings / Begrüßung: Mile Ivanda, President of the Croatian Humboldt Club / Präsident des Humboldt-Club Kroatien David Smith, Director of Ruđer Bošković Institute / Direktor des Ruđer Bošković Instituts Damir Boras, Rector of the University of Zagreb / Rektor der Universität Zagreb Velimir Neidhardt, President of the Croatian Academy of Sciences and Arts / Präsident der Kroatische Akademie der Wissenschaften und Künste Blaženka Divjak, Minister of Science and Education / Minister für Wissenschaft, Bildung Robert Klinke, Ambassador of the Federal Republic of Germany / Botschafter der Bundesrepublik Deutschland Kolinda Grabar Kitarović, President of the Republic of Croatia / Präsidentin der Republik Kroatien
9:45 – 10:00	Musical ensemble *IMPACT FACTOR* Songs: *Maybe, The Web, El Condor Pasa*
10:00 – 10:30	Representative of Alexander von Humboldt-Stiftung, Leiter der Abteilung Förderung und Netzwerk / Alexander von Humboldt Foundation, Head of the Promotion and Network Department ***Vortrag über die Alexander von Humboldt Stiftung / Lecture on the Alexander von Humboldt Foundation***
10:30 – 11:00	Pavo Barišić, University Department of Croatian Studies, University of Zagreb *Alexander von Humboldt als Weltwissenschaftler und Weltbürger / Alexander von Humboldt as a World Scientist and World Citizen*
11:00 – 11:15	Coffee break / Kaffee pause
	Keynote lectures / Keynote Vorträge Chair Pavo Barišić
11:15 – 11:45	Dario Vretenar, Croatian Academy of Sciences and Arts Zagreb and Faculty of Sciences, University of Zagreb *Competitive Research Funding in Croatia*

11:45 – 12:15	*Milena Žic Fuchs, Croatian Academy of Sciences and Arts Zagreb and The Faculty of Humanities and Social Sciences, University of Zagreb* *Missions and Horizon Europe: The Inter/Multi/Transdisciplinary Context*
12:15 – 13:30	Lunch / Mittagessen
	Chair Ivica Picek
13:30 – 13:55	Invited lecture / Eingeladener Vortrag: Blažeka Melić, Ruđer Bošković Institute, Zagreb, Croatia *CERN Membership as an Opportunity for Croatian Physics*
13:55 – 14:20	Invited lecture / Eingeladener Vortrag: Dubravko Kičić, Biocenter, Zagreb, Croatia *BIOcenter: First Five Years*
14:20 – 14:45	Invited lecture / Eingeladener Vortrag: Siegfried Gehrmann, University of Zagreb, Faculty of Teacher Education, Center for European Education, Croatia *Braucht Europa eine mehrsprachige Wissenschaft und Bildung*
14:45 – 15:00	Marina Ilakovac Kveder, Ruđer Bošković Institute, Zagreb, Croatia *How can Electron Paramagnetic Resonance Spectroscopy Contribute to Science and Education Challenges Facing Europe in the Next Decade*
15:00 – 15:15	Melita Šalković-Petrišić, Department of Pharmacology and the Croatian Institute for Brain Research, University of Zagreb School of Medicine, Zagreb, Croatia *Modelling of Sporadic Alzheimer's Disease and Testing of Oral Galactose as a Possible Therapeutic Strategy*
15:15 – 15:30	Coffee break / Kaffee pause
15:30 – 17:00	Roundtable I *Science does matter: How to integrate technology, health, and environment* Moderators: Valerije Vrček and Ivo Barić Participants: Zoran Hadži-Velkov, Makedonija; Branimir Jovančićević and Mirko Komatina, Serbia, Igor Čatić and Dubravko Kičić, Croatia

18:00 - 19: 30	A walking tour of Zagreb and the Strossmayer Gallery of Old Masters / Ein Rundgang durch Zagreb und die Strossmayer-Galerie alter Meister
19:30 – 21:30	Dinner / Abendessen

Junior scientist session (Small HAZU hall)

Nachwuchsforscher Sitzung (Kleine HAZU Saal)

	Junior Scientist Session Chair: Vesna Janicki
13:30 – 13:45	Vedran Đerek, Wallenberg Center for Molecular Medicine, Linkoping University, Norrkoping, Sweden *3D Micro- and Nano-Structuring for Opto-Bioelectronics*
13:45 – 14:00	*Vlatko Gašparić, Ruđer Bošković Institute, Zagreb, Croatia* *Photonic Nanojet of a Microsphere for Raman Scattering Enhancement*
14:15 - 14:30	Vesna Janicki, Ruđer Bošković Institute, Zagreb, Croatia *Micro and Nanostructuring Using Glass Poling and Electric Field Assisted Dissolution*
14:30 – 14:45	Nikola Baran, Ruđer Bošković Institute, Zagreb, Croatia *Sensing Properties of Nanostructured Porous Silicon*
14:45 – 15:00	Tomislav Lesičar, Institute of Applied Mechanics, Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb, Croatia *Advanced Computational Modelling of Complex Materials*
15:00– 15:15	Mihovil Bosnar, Ruđer Bošković Institute, Zagreb, Croatia *Modifying the Proximity Induced Spin Polarization of Graphene by the Electric Field*
15:15– 15:30	Coffee break / Kaffee pause

Friday, 11. October 2019

Croatian Academy of Sciences and Arts (HAZU) / Kroatische Akademie der Wissenschaften und Künste, Strossmayerov trg 14, Large hall in the HAZU library / Großer Saal in der HAZU-Bibliothek

8:00 – 8:30	Registrierung / Registration
	Keynote lectures / Keynote Vorträge Chair: Jurica Sorić
8:30 – 9:00	Mihael Grbić, Faculty of Science, University of Zagreb, Croatia *Centre for Advanced Research of Complex Systems - University of Zagreb, Croatia's Enhancement of Infrastructure for Material Research*
9:00 – 9:30	Slobodan Vukičević, Croatian Academy of Sciences and Arts Zagreb, Croatia and Medical faculty, University of Zagreb, Croatia *Clinical Testing of the New Drug "Osteogrow*"
9:30 – 10:00	Juergen Popp, Leibniz Institute of Photonic Technology, Jena, Germany *Biophotonics - a Key Technology for Precision Medicine*
10:00 – 10:15	Coffee break / Kaffee pause
	Keynote lectures / Keynote Vorträge Chair: Ivan Malčić
10:15 – 10:45	Alemka Markotić, Clinic for Infectious Disease, "Dr. Fran Mihaljevic", Zagreb, Croatia *European Structural and Investment Projects to Promote Excellence in Infectious Disease Research in Croatia: Centers of Excellence and Centers of Competence*
10:45 – 11:15	Ashok Vaseashta, Virginia Polytechnic Institute and State University, Manassas, Virginia, USA *Hybrid Security Challenges and Solution Pathways Framework Using Science and Technology Convergence Paradigm*
11:15 – 11:45	Zdravko Radman, Institute of Philosophy, Zagreb, Croatia *The Embodied Mind - A Shift Away from Classical Cognitivism*
11:45– 12:00	Coffee break / Kaffee pause
12:00- 13:30	Roundtable II *Young scientists in the next decade: education and chances* Moderator: Milan Pelc

	Participants: Yuri Kalvachev, Bulgaria; Marina Šekutor, Ivan Malčić, Mario Stipčević and Zoran Jašić, Croatia
13:30 – 14:15	*Lunch / Mittagessen*
	Chair Davor Dukić
14:15 – 14:30	Alojzije Jembrih, University Department of Croatian Studies, University of Zagreb, Croatia *Zur Rezeption der deutschen Jugendliteratur in Nordkroaten des 18. Jahrhunderts*.
14:30 – 14:45	Urška Perenič and Miran Hladnik, Philosophical Faculty Ljubljana, Slovenia *Slowenische Literaturwissenschaft zwischen Tradition und Digitalisierung*
14:45 - 15:00	Danko Bosanac, Adriatic Aerospace Agency, Zagreb, Croatia *Perspectives of Space technology in Croatia*
15:00 – 15:15	Dalibor Paar, Department of Physics, Faculty of Science, University of Zagreb, Croatia *STEM Education from Kindergarten to Lifelong Learning*
15:15 – 15:30	Mario Stipčević, Ruđer Bošković Institute, Zagreb, Croatia *Comparison of Croatian and US elementary school systems*
15:30 – 15:45	Roman Brajša, Faculty of Geodesy, University of Zagreb, Croatia *Solar Physics with Atacama Large Millimeter/Submillimeter Array (ALMA): Selected First Results*
15:45– 16:00	Coffee break / Kaffee pause
16:00 – 17:30	Poster Session
18:30 – 19: 00	Travel for dinner by bus to the town of Samobor (Restaurant “Kod Gabreka”) / Fahrt zum Abendessen mit dem Bus in die Stadt Samobor (Restaurant „Kod Gabreka“)
19:00 – 21:00	Dinner / Abendessen

Junior scientist session (Small HAZU hall)

Nachwuchsforscher Sitzung (Kleine HAZU Saal)

	Junior Scientist Session Chair: Sanja Tomić
14:15 – 14:30	Tana Tandarić, Ruđer Bošković Institute, Zagreb, Croatia: *Irreversible Inhibition of the MAO B Enzyme. A Computational Insight into the Inactivation Mechanism*
14:30 – 14:45	Fabio Franchini, Ruđer Bošković Institute, Zagreb, Croatia *Novel Characterizations of Classical and Quantum Many-Body Systems*
14:45 - 15:00	Lana Virag, Institute of Applied Mechanics, Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb, Croatia *Numerical Modelling of Vascular Disease Progression*
15:00 – 15:15	Ethem Mandić, Faculty of Montenegrin Language and Literature, Cetinje, Montenegro *Political Novel in South Slavic Context*
15:15 – 15:30	Vanja Marić, Ruđer Bošković Institute, Zagreb, Croatia *The Frustration of being Odd*
15:30 – 15:45	Sanja Tomić, Ruđer Bošković Institute, Zagreb, Croatia *Biological Relevance of Human Dipeptidyl Peptidase III*
15:45– 16:00	Coffee break / Kaffee pause

Unterstützt von / Supported by

Alexander von Humboldt
Stiftung/Foundation

LIST OF POSTERS
LISTE DER POSTER

1. **Jasna Alić, Nataša Burić and Marina Šekutor**
   Ruđer Bošković Institute, Zagreb, Croatia

   Diamondoids in supramolecular chemistry and nanotechnology

2. **Ana Babić Perhoč,[1,2] Jan Homolak,[1,2] Ana Knezović,[1,2] Jelena Osmanović Barilar,[1,2] Peter Riederer,[3,4] Melita Šalković-Petrišić[1,2,5]**
   [1]Department of Pharmacology, University of Zagreb School of Medicine, Zagreb, Croatia
   [2]Croatian Institute for Brain Research, University of Zagreb School of Medicine, Zagreb, Croatia
   [3]Center of Mental Health, Department of Psychiatry, Psychosomatics and Psychotherapy, University Hospital Würzburg, Würzburg, Germany
   [4]Department of Clinical Research and Psychiatry, University of Southern Denmark, Odense, Denmark
   [5]Scientific Centre of Excellence for Basic, Clinical and Translational Neuroscience, University of Zagreb School of Medicine, Zagreb, Croatia

   Therapeutic potential of orally administered galactose on cognitive and metabolic changes in two experimental models of Alzheimer's disease

3. **Lovro Basioli, Krešimir Salamon, Marija Tkalčević Sigrid Bernstorff, Maja Mičetić**
   Ruđer Bošković Institute, Zagreb, Croatia

   Analysis od 3D lattices of nanostructures by GISAXS

3. **Mateja Batelić and Mario Stipčević**
   Ruđer Bošković Institute, Zagreb, Croatia

   Improved circuits for a biologically-inspired random pulse computer

4. **Dražen Belina[2], Dorotea Bartoniček,[1] Višnja Ivančan,[3] Slobodan Galić,[4] Jasna Stoić Brezak,[5] Darko Anić,[2] Dražen Jelašić,[6], Ivan Malčić[1]**
   [1]Clinical Hospital Centre Zagreb, Department for pediatric cardiology, Zagreb, Croatia
   [2]Clinical Hospital Centre Zagreb, Department of pediatric cardiac surgery, Zagreb, Croatia
   [3]Clinical Hospital Centre Zagreb, Department of anaestesiology, Zagreb, Croatia
   [4]Clinical Hospital Centre Zagreb, Department of Intensive care, Zagreb, Croatia
   [5]Clinical Hospital Centre Zagreb, Departemnt of EUROTRANSPLANT, Zagreb, Croatia
   [6]Department of pathology, Medical Faculty of Zagreb, Croatia

   Heart Transplantation in Children in Croatia – Our First Exprience

5. **Marko Bermanec, Filip Kisić, Luka Korov, Matija Makoter i Stjepan Puljić**
   Adriatic Aerospace Agency, Zagreb, Croatia

   The project on the first Croatian satellite PERUN

6. **Nikola Biliškov, Igor Milanović, Ivan Halasz**
   Ruđer Bošković Institute, Zagreb, Croatia

   Single- and Bimetallic Amidoboranes - Solid-State Synthesis and Decomposition

7. **Damjan Blažeka, J. Car, Nikša Krstulović**
   Institute of Physics, Zagreb, Croatia

   Photocatalytic activity of ZnO nanoparticles synthesized by laser ablation in water

8. **Krešimir Bobaš**
   The Faculty of Humanities and Social Sciences, University of Zagreb, Croatia

   Darstellung der Geschichte in den Prosawerken von Miljenko Jergović

9. **Buljević Viktorija Ana,[1] Dasović Buljević Andrea,[1] Malčić Ivan[2]**
   [1]Clinical Hospital Centre Zagreb, Department for neonatology, Zagreb, Croatia
   [2]Clinical Hospital Centre Zagreb, Department for pediatric cardiology, Zagreb, Croatia

   Glenn procedure for Hypoplastic Left Heart Syndrom - should it be performed earlier? Results of a Croatian clinical epidemiological study

10. **Irena Ciglenečki,[1] M.Čanković,[1] M.Marguš,[1] I. Janeković,[2] S.Mateša,[1] T. Bakran-Petricioli,[3] D. Petricioli,[4] M. Detur-Sikirić[1]**
    [1]Ruđer Bošković Institute, Division for Marine and Environmental Research, Zagreb, Croatia
    [2]The University of Western Australia, Crawley WA 6009, Australia
    [3]Faculty of Natural Sciences, Univesity of Zagreb, Department of Biology, Zagreb, Croatia
    [4]D.I.I.V.d.o.o., za ekologiju mora, voda i podzemlja, Sali, Croatia

    Marine lake (Rogoznica) as a model for EcoSystem functioning in a changing environment

11. **Damir Dominko[1], V. Grigorev[2], Jure Demšar[2]**
    [1]Institute of Physics, Zagreb, Croatia
    [2]Institute of Physics, Johannes Gutenberg-University, Mainz, Germany

    Examples of collective states driven very far out of equilibrium

12. Sanja Dolanski Babić, Marin Kosović

School of Medicine, University of Zagreb, Croatia

The perspective of the course "Physics of Medical Diagnostics" for students of medicine (2016)

13. Sonja Durajlija Žinić

Ruđer Bošković Institute, Zagreb, Croatia

Strateški plan za uključenje Hrvatske u internacionalnu mrežu za bioinformatičko mapiranje repetitivne DNA i razvoj personalizirane medicine

14. Hrvoje Gebavi,[1] Vlatko Gašparić,[1] Davor Ristić,[1] Daniil Zhivotkov,[1] Dubravko Risović,[1] Hrvoje Skenderović,[2] Stefano Taccheo,[3] Joanna Borkowska,[4] Paweł Albrycht,[4] Sanja Vidaček[5], Mile Ivanda[1]

[1]Ruđer Bošković Institute, Zagreb, Croatia
[2]Institute of Physics, Zagreb, Croatia
[3]Swansea University, Swansea, United Kingdom
[4]Polish Academy of Sciences, Warsav, Poland
[5]Faculty of Food Technology and Biotechnology, Zagreb, Croatia

Prospective fibre-optic based sensors

15. Ivan Marić[1], Goran Dražić[2], Mile Ivanda[3,4], Tanja Jurkin[1], Goran Štefanić[3,4] and Marijan Gotić[3,4]

1Radiation Chemistry and Dosimetry Laboratory, Ruđer Bošković Institute, Bijenička c. 54, 1 000 Zagreb, Croatia
2National Institute of Chemistry, Hajdrihova 19, SI-1001, Ljubljana, Slovenia
3Molecular Physics and New Materials Synthesis Laboratory, Ruđer Bošković Institute, Bijenička c. 54, 10000 Zagreb, Croatia
4Center of Excellence for Advanced Materials and Sensing Devices, Research Unit New Functional Materials, Bijenička c. 54, 10000 Zagreb, Croatia

Impact of Fe(III) ions on the structural and optical properties of anatase-type solid solutions

16. Jan Homolak,[1,2] Ana Babić Perhoč,[1,2] Ana Knezović,[1,2] Jelena Osmanović Barilar,[1,2] Maja Relja,[3] Peter Riederer,[4,5] Melita Šalković-Petrišić[1,2,6]

[1]Department of Pharmacology, University of Zagreb School of Medicine, Zagreb, Croatia
[2]Croatian Institute for Brain Research, University of Zagreb School of Medicine, Zagreb, Croatia
[3]Department of Neurology, Clinical Hospital Centre Zagreb, University of Zagreb School of Medicine, Zagreb, Croatia
[4]Center of Mental Health, Department of Psychiatry, Psychosomatics and Psychotherapy, University Hospital Würzburg, Würzburg, Germany

[5]Department of Clinical Research and Psychiatry, University of Southern Denmark, Odense, Denmark
[6]Scientific Centre of Excellence for Basic, Clinical and Translational Neuroscience, University of Zagreb School of Medicine, Zagreb, Croatia

Mechanisms of nutrient-mediated effects of endogenous glucagon-like peptide -1 on cognitive and metabolic alterations in experimental models of neurodegenerative disorders

17. Mirko Husak,[1] Roman Brajša,[2] Dragan Špoljarić,[2] Aleksandar Mona Macko Puhek[3]
[1]Državna geodetska uprava, Varaždin, Croatia
[2]Faculty of Geodesy, Zagrebu, University of Zagreb, Croatia
[3]Treća osnovna škola Varaždin, Varaždin, Croatia

Bošković's determination of the solar rotation elements in 18th century using his own observations of sunspot's positions

18. Ivan Jakovac,[1] M. S. Grbić,[1] T. Cvitanić,[1] S. Paschen,[2] A. Prokofiev,[2] H. Mitamura,[3] T. Sakakibara,[3] M. Horvatić,[4] Y. Hosokoshi,[5] M. Požek[1]
[1]Faculty of Science, University of Zagreb, Croatia
[2]Institute of Solid State Physics, Vienna University of Technology, Austria
[3]Institute for Solid State Physics, University of Tokyo, Japan
[4]LNCMI-CNRS Grenoble, France
[5]Department of Physical Science, Osaka Prefecture University, Osaka

NMR and NQR study of magnetic field induced quantum criticality in strongly correlated systems Ce3Pd20Si6 and m-NO2PhBNO

19. Jurica Jurec, J. You, B. Rakvin, M. Jokić, D. Carić, Marina Kveder
Ruđer Bošković Institute, Zagreb, Croatia

Role of nuclear spectral diffusion as the measure of disorder in materials

20. Athanasios Chatzistavrakidis, Georgios Karagiannis and Peter Schupp
Ruđer Bošković Institute, Zagreb, Croatia

A unifying approach to EM dualization through graded geometry

21. Mateja Jagić, Markulin Lucija, Škiljaica Andreja, Miškec Karlo, Bauer Nataša, Dunja Leljak Levanić
Faculty of Science, Department of Biology, University of Zagreb, Croatia

Epigenetic flexibility of plants

22. Ivana Latković

The Faculty of Humanities and Social Sciences, University of Zagreb, Croatia

Slavic Studies Today: Local and Global Perspectives

23. Domagoj Leljak, Blaženka Melić i Monalisa Patra

Ruđer Bošković Institute, Zagreb, Croatia

Some features of bottom semileptonic decays in Standard Model and beyond

24. Stjepan Lugomer,[1] B. Farkas,[2] T. Szorenyi[2]

[1]Ruđer Bošković Institute, Zagreb, Croatia
[2]Department of Optics and Quantum Electronics, University of Szeged, Hungary

Eckhaus Instability for Surface-Tension Driven Hydrorhermal Waves in the Confined Laser-Matter Interaction

25. Stjepan Lugomer,[1] Aleksandar Maksimović,[1] G. Peto,[2] A. Toth,[2] E. Horvath[2]

[1]Ruđer Bošković Institute, Zagreb, Croatia
[2]Research Institute for Technical Physics and Material Sciences, Hungarian Academy of Sciences,P.O.B 49, H-1525 Budapest, Hungary

Nano-porosity and Mo surface formed by solitary plasma waves in laser-matter interaction

26. Lara Mikac, Marijan Gotić, Hrvoje Gebavi, Mile Ivanda

Ruđer Bošković Institute, Zagreb, Croatia

The Variety of Substrates for Surface-enhanced Raman Spectroscopy

27. Vlasta Mohaček Grošev[1], M. Đuroković[2], M. Škrabić[3]

[1]Division of Materials Physics, Ruđer Bošković Institute, Zagreb, Croatia
[2]Institute IGH d.d. Laboratory for binders and ecology, Zagreb, Croatia
[3]Department of Physics and Biophysics, School of Medicine, University of Zagreb, Croatia

Evolution of C-S-H phase in ordinary Portland cement with w/c ratio equal to ½ studied by Raman spectroscopy

28. Ana Najev[1], Damjan Pelc[1,2], Miroslav Požek[1]

[1]Department of Physics, Faculty of Science, University of Zagreb, Croatia
[2]School of Physics and Astronomy, University of Minnesota, Minneapolis, USA

NMR study of 89Y and 139La in perovskite Ti oxides

29. Ivan Pavić,[1] M. Bonković,[2] J. Šoda,[1] Mile Ivanda[3]

[1]Faculty of Maritime Studies, University of Split

[2]Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture, University of Split

[3]Ruđer Bošković Institute, Center of Excellence for Advanced Materials and Sensing Devices, Zagreb, Croatia

New Approach in Designing Raman Spectrometer with Variable Spectral Resolution

30. Dalibor Paar,[1] Stanislav Frančišković-Bilinski,[2] Nenad Buzjak,[3] Diana Mance[4]

[1]Department of Physics, Faculty of Science, University of Zagreb, Croatia

[2]Ruđer Bošković Institute, Zagreb, Croatia

[3]Department of Geography, Faculty of Science, University of Zagreb, Croatia

[4]Department of Physics, University of Rijeka, Croatia

Multidisciplinary research of vulnerable Dinaric karst with the aim of its protection and sustainable use

31. D. Petković Ramadža, T. Žigman, A. Škaričić, I. Bilandžija, I. Križić, K. Fumić, I. Barić

Department of Pediatrics, University Hospital Centre Zagreb, Kišpatićeva 12, 10000 Zagreb, Croatia

The newborn screening: Unpredictable reaches and challenging limits

32. Petar Pervan, V. Blažek Bregović, I. Fabijanić and V. Janicki

Ruđer Bošković Institute, Zagreb, Croatia

Electric field assisted dissolution of aluminum and silver compact layers

33. Danijela Petković Ramadža, Tamara Žigman, Ana Škaričić, Iva Bilandžija, Ivana Križić, Ksenija Fumić, Ivo Barić

University Hospital Centre Zagreb, Croatia

The newborn screening: Unpredictable reaches and challenging limits

34. Barbara Pem, Rinea Barbir, Krunoslav Ilić, Ivan Pavičić, Ivana Vinković Vrček

Institute for Medical Research and Occupational Health, Zagreb, Croatia

Challenges and obstacles to study nano-bio interface

35. Matej Peranić, Martin Lončarić, Anton Radman and Mario Stipčević

Center of Excellence for Advanced Materials and Sensing Devices (CEMS) Photonics and quantum optics research unit Ruđer Bošković Institute, Zagreb, Croatia

Experimental generation of quantum entanglement and testing fundamentals of quantum physics

36. Matea Raić, Lara Mikac, Zoran Mandić, Vedran Petrić and Mile Ivanda
Ruđer Bošković Institute, Zagreb, Croatia

Silicon as anode for lithium-ion batteries

37. Nikola Radić, P. Dubček, K. Salamon, Z. Siketić, M. Marciuš
Ruđer Bošković Institute, Zagreb, Croatia

Properties of Doped-Zno Thin Films Prepared By Magnetron Sputtering

38. Mario Rakić,[1] Austin W. Steinforth,[2] Andrey Mironov,[2] J. Gary Eden
[1]Institute of Physics, Zagreb, Croatia
[2]University of Illinois at Urbana-Champaign, USA

Laser resonators for different laser profiles and optical logic gates

39. Davor Ristić, Maurizio Mazzola, Andrea Chiappini, Cristina Armellini, Alphonse Rasoloniaina, Patrice Féron, Roberta Ramponi, Gualtiero Nunzi Conti, Stefano Pelli, Giancarlo C. Righini, Gilles Cibiel, Mile Ivanda and Maurizio Ferrari
Ruđer Bošković Institute , Zagreb, Croatia

SiO2-HfO2 coated spherical microresonators

***40.* Hrvoje Skenderović,[1] Nazif Demoli,[1] Denis Abramović,[1] Brana Jelenković,[2] Dejan Pantelić[2]**
[1]Institute of Physics, Zagreb, Croatia; [2]Institut of Physics, Zemun, Serbia

Holography and bio-inspired structures for surveillance

***41.* Marin Sapunar[1], Wolfgang Domcke[2], Nađa Došlić[1]**
[1]Ruđer Bošković Institute, Zagreb, Croatia
[2]Technical University of Munich, Garching, Germany

State specific analysis of excited electronic states in the nuclear ensemble approach

42. Mario Stipčević
Center of Excellence for Advanced Materials and Sensing Devices, Ruđer Bošković Institute, Zagreb, Croatia

Experimental generation of quantum entanglement and testing fundamentals of quantum physics

43. Kamran Syed and Mile Ivanda
Ruđer Bošković Institute, Zagreb, Croatia

Gas Sensors Based on Nano/Microstructured Organic Field-Effect Transistors

44. Davor Šakić,[1] Valerije Vrček,[1] Alexander Hildebrandt[2]

[1]Faculty of Pharmacy and Biochemistry, University of Zagreb, Croatia
[2]Technische Universität Chemnitz, Germany

Ferrocenyl lithium reacts with phthalimide. DFT study of the mechanism

45. Matej Šapina,[1,2,3] Karolina Kramarić,[1,2,3] Krešimir Milas,[1,2] Ivan Malčić[4,5]

[1]University hospital Osijek, Osijek, Croatia
[2]Medical faculty Osijek, Osijek, Croatia
[3]Faculty of dental medicine and health, Osijek, Croatia
[4]University hospital Zagreb, Zagreb, Croatia
[5]Medical faculty Zagreb, Zagreb, Croatia

Entropy and complexity measures of neaonatal heart rate variability

46. Ankica Šarić, Ines Despotović and Goran Štefanić

Ruđer Bošković Institute, Centre of Excellence for Advanced Materials and Sensing Devices, Zagreb, Croatia

Solvothermal synthesis of zinc oxide: A combined experimental and theoretical study

47. Nikola Šegedin,[1,5] Kristina Serec,[1,5] Valentina Karin-Kujundžić,[2,5] Petra Kejla,[3] Ljiljana Šerman,[2,5] Sanja Dolanski Babić[1,4,5]

[1]Department of Physics and Biophysics, School of Medicine, University of Zagreb, Croatia
[2]Department of Medical Biology, School of Medicine, University of Zagreb, Croatia
[3]Cinical Hospital Merkur, Zagreb, Croatia
[4]Science center of excellence for advanced materials and sensors, Research unit New functional materials
[5]Science center of excellence for reproductive and regenerative medicine, Research unit Biomedical research of reproduction and development (CERRM)

FTIR spektri humane DNA

48. Marko Škrabić, Maja Balarin, Ozren Gamulin

School of Medicine, University of Zagreb, Croatia

Assessment of embryo culture media metabolome by infrared and raman spectroscopy

49. Goran Štefanić

Ruđer Bošković Institute, Zagreb, Croatia

Structural and microstructural changes in the ZrO2-MgO system over the course of thermal treatment

50. Marija Tkalčević, Lovro Basioli, Krešimir Salamon, Sigrid Bernstrorff, Maja Mičetić
Ruđer Bošković Institute, Zagreb, Croatia
Tuning the optical and electrical properties of Ge quantum dot lattices by nitrogen presence

51. K. Tomić,[1] D. Iveković,[1] H. Vázquez,[2] F. Djurabekova,[2] A. Gajović,[1] P. Dubček,[1] Z. Siketić,[1] M. Jakšić,[1] M. Karlušić[1]
[1]Ruđer Bošković Institute, Zagreb, Croatia
[2]Department of Physics, University of Helsinki, Helsinki, Finland

Swift heavy ion irradiation of graphene: effects of the ion charge state

52. Mateja Toma, Davor Šakić, Jasmina Lapić, Senka Djaković, and Valerije Vrček
Faculty of Pharmacy and Biochemistry, University of Zagreb, Croatia

Organometallic derivatives of DNA bases

53. Daniil Zhivotkov,[1] Elena Romanova,[2] Davor Ristić,[1] Mile Ivanda,[1]
[1]Ruđer Bošković Institute, Center of Excellence for Advanced Materials and Sensing Devices, Laboratory for Molecular Physics and Synthesis of New Materials, Croatia
[2]Saratov State University, Russian Federation

Whispering Gallery Mode Microresonator for Ammonia Vapors Concentration Detection

54. Tamara Žigman, Danijela Petković Ramadža, Sand Huljev Frković, Ivo Barić,
University Hospital Centre Zagreb, Zagreb, Croatia

Challenges of application of modern genetic methods on life and health quality

BOOK OF ABSTRACTS
BUCH DER ZUSAMMENFASSUNGEN

SCIENCE AND EDUCATIONAL CHALLENGES FACING EUROPE IN THE NEXT DECADE

On the occasion of the 250th anniversary of the birth of Alexander von Humboldt (1769–1859)

HERAUSFORDERUNGEN FÜR WISSENSCHAFT UND BILDUNG IN EUROPA IM NÄCHSTEN JAHRZEHNT

Zum 250. Geburtsjubiläum von Alexander von Humboldt (1769–1859)

Unterstützt von / Supported by

Alexander von Humboldt
Stiftung/Foundation

BOOK OF ABSTRACTS

SCIENCE AND EDUCATIONAL CHALLENGES FACING EUROPE IN THE NEXT DECADE

On the occasion of the 250th anniversary of the birth of Alexander von Humboldt (1769–1859)

Diamondoids in supramolecular chemistry and nanotechnology

Jasna Alić, Nataša Burić, Marina Šekutor
Ruđer Bošković Institute, Zagreb, Croatia

Diamondoids are cage-like molecules that are highly stable and rigid, with a structure resembling the diamond crystal lattice. However, they have one significant advantage over diamond – diamondoids possess great capability for derivatization.1,2 Diamondoids differ in size and higher homologues can exist as different isomers but the smallest diamondoid is adamantane. Due to their remarkable features, diamondoids and their derivatives can find uses in many fields such as medicine,3 material science,2 nanotechnology,4,5 supramolecular chemistry, etc.6,7

Recent investigation has shown that diamondoid derivatives can be applied in nanotechnology as scaffolds for formation of nanowires only one metal atom wide.4 These diamantane derivatives can be anchored to metal surfaces by on-surface reactions and are capable of holding single metal atoms in place at defined distances. The result is a precise spatial control and formation of nanowires, which has important implications for electronic device down-sizing.

On the other hand, cationic diamondoid derivatives have the ability to form ultra-stable host-guest inclusion complexes, which have a potential as drug delivery vehicles.6,7 For example, the permethylated diamantane diammonium salt binds to cucurbit[7]uril host with an attomolar dissociation constant, making it a non-covalent system capable of rivalling the very stable avidin-biotin affinity pair ubiquitous in nature.6 Design of such high-binding biomolecular receptors contributes to the development of synthetic systems whose functions meet and exceed their biological counterparts.7

(1) H. Schwertfeger, A. A.Fokin, P. R. Schreiner, Angew. Chem. Int. Ed. 2008, 47, 1022–1036.
(2) M. A. Gunawan, J.-C. Hierso, D. Poinsot, A. A. Fokin, N. A. Fokina, B. A. Tkachenko, P. R. Schreiner, New J. Chem. 2014, 38, 28-41.
(3) L, Wanka, K. Iqbal, P. R. Schreiner, Chem. Rev. 2013, 113, 3516–3604.
(4) H-Y. Gao, M. Šekutor, L. Liu, A. Timmer, H. Schreyer, H. Mönig, S. Amirjalayer, N. A. Fokina, A. Studer, P. R. Schreiner, H. Fuchs, J. Am. Chem. Soc. 2019, 141, 315−322.
(5) D. Ebeling, M. Šekutor, M. Stiefermann, J. Tschakert, J. E. P. Dahl, R. M. K. Carlson, A. Schirmeisen, P. R. Schreiner, ACS Nano 2017, 11, 9459−9466.
(6) L. Cao, M. Šekutor, P. Y. Zavalij, K. Mlinarić-Majerski, R. Glaser, L. Isaacs, Angew. Chem., Int. Ed. 2014, 53, 988–993.
(7) D. Sigwalt, M. Šekutor, L. Cao, P. Y. Zavalij, J. Hostaš, H. Ajani, P. Hobza, K. Mlinarić-Majerski, R. Glaser, L. Isaacs, J. Am. Chem. Soc. 2017, 139, 3249–3258.

Therapeutic potential of orally administered galactose on cognitive and metabolic changes in two experimental models of Alzheimer's disease

Ana Babić Perhoč,[1,2] Jan Homolak,[1,2] Ana Knezović,[1,2] Jelena Osmanović Barilar,[1,2] Peter Riederer,[3,4] Melita Šalković-Petrišić[1,2,5]
[1]Department of Pharmacology, University of Zagreb School of Medicine, Zagreb, Croatia
[2]Croatian Institute for Brain Research, University of Zagreb School of Medicine, Zagreb, Croatia
[3]Center of Mental Health, Department of Psychiatry, Psychosomatics and Psychotherapy, University Hospital Würzburg, Würzburg, Germany
[4]Department of Clinical Research and Psychiatry, University of Southern Denmark, Odense, Denmark
[5]Scientific Centre of Excellence for Basic, Clinical and Translational Neuroscience, University of Zagreb School of Medicine, Zagreb, Croatia

Sporadic Alzheimer's disease (sAD) is associated with dysfunction of the brain insulin receptor signaling and decreased glucose metabolism and energy in the brain. Substances exerting effects at this level are being investigated as potential AD therapy. This study aimed to research oral galactose as a new therapeutic approach in experimental models of sAD (intracerebroventricular streptozotocin; STZ-icv rat model) and familial AD (fAD; transgenic Tg2576 mouse model). Our previous research found that oral galactose prevents the development of cognitive deficit in the STZ-icv model, and this study will examine the therapeutic effects of oral galactose in both models in early and late stages of the disease. Possible mechanisms of its therapeutic effect are investigated at the level of brain glucose metabolism and stimulation of glucagon-like peptide 1 activity, an incretin which stimulates insulin release and has its own neuroprotective activity.
80 male transgenic Tg2576 (TG) and wild-type (WT) mice (fAD model) and 80 rats treated with citric buffer (controls-CTR) or STZ intracerebroventricularly underwent 2-month oral galactose treatment (+GAL; 200 mg/kg/day) or tap water. In mice, GAL was initiated at the age of 5 (presymptomatic fAD) or 10 months (mild fAD), and in rats 1 (early sAD) or 4 months (medium-stage sAD) after STZ-icv treatment. After GAL treatment, animals underwent Morris-Water Maze (MWM) test and fluorodeoxyglucose PET-scan (FDG-PET). The level of active GLP-1 was measured by ELISA immunoassay in plasma samples. Data was analyzed by Kruskal-Wallis, followed by Mann-Whitney U test ($p<0.05$).
GAL treatment successfully improved STZ-induced cognitive deficit in the early sAD experimental model (-36% compared to STZ in MWM latency time, $p<0.05$), but failed to elicit any improvement in medium-stage sAD or either fAD models. FDG-PET in sAD showed mild decrement in glucose metabolism in the brain of STZ-treated rats compared to CTR in both stages (-3% early sAD; -12% medium sAD), which was increased (+14%; +38% respectively) by oral galactose treatment in STZ-icv rats. In fAD, FDG-PET demonstrated increased (+19.65%) and decreased (-17.70%) glucose uptake/metabolism in the whole brain of 7- and 12-month aged TG mice, which were normalized by galactose (decreased -13.90%/7-month and increased +32.09%/12-month aged TG+GAL mice) respectively. The level of active GLP-1 was found decreased in plasma of STZ-treated rats compared to the controls only in early-stage sAD (-51%, $p<0.05$) which was normalized by galactose treatment (+70%, $p<0.05$), whereas it remained unchanged in medium-stage sAD or either fAD models.
Oral galactose treatment has a potential to normalize previously developed cognitive deficits, glucose metabolism alterations and active GLP-1 levels disruptions in the early

STZ-icv rat model. However, only galactose-induced improvement in glucose brain metabolism was achieved in medium-stage experimental sAD and both stages of experimental fAD, whereas no cognitive improvement or active GLP-1 levels recovery was observed.
This work was funded by the Croatian Science Foundation (IP-09-2014-4639). Research was co-financed by the Scientific Centre of Excellence for Basic, Clinical and Translational Neuroscience (project "Experimental and clinical research of hypoxic-ischemic damage in perinatal and adult brain"; GA KK01.1.1.01.0007 funded by the European Union through the European Regional Development Fund).

Sensing Properties of Nanostructured Porous Silicon

Nikola Baran
Ruđer Bošković Institute, Zagreb, Croatia

The emergence of stricter environmental concerns, new energy sources, and the constant development of industrial process controls require a variety of sensors. The trend of miniaturisation requires components to be small, affordable, and energy-saving. Gas sensors often rely on porous materials due to their large specific surface area. While a range of different sensor architectures are already in use, many lack the energy-saving aspect. This research focuses on developing an organic vapour and gas sensors based on porous silicon. In addition to low energy consumption and small size, such sensors would have the added benefit of compatibility with now highly developed semiconductor production processes

Alexander von Humboldt als Weltwissenschaftler und Weltbürger

Pavo Barišić
University Department of Croatian Studies, University of Zagreb

Dieses Jahr werden zwei Jubiläen Alexanders von Humboldts (1769-1859) gefeiert, sein 250. Geburtsjahr und der 160. Todestag. Das wissenschaftliche Netzwerk, das die seinen Namen tragende Stiftung in mehr als 140 Staaten weltweit geflochten hat, wird diese Jubiläen wohl in vielen Ländern festlich begehen. Wie es Hermann Flohn berichtete, wurde schon sein 100. Geburtstag, also zehn Jahre nach seinem Tod, als ein international gefeierter Gedenktag vermerkt. In verschiedenen Städten weltweit, die er auf seinen geographischen Reisen besuchte, von Buenos Aires und Mexiko-Stadt, Chicago und San Francisco, Charleston und Philadelphia, über Alexandria und Moskau, bis Adelaide und Melbourne wurden Gedenkfeiern veranstaltet. Dieses Jahr wird in seiner Heimstadt

Berlin das Humboldt-Forum als an seine Ideen anknüpfende Kultureinrichtung eröffnet werden.
Die Gedächtnisfeier hat der Kroatische Humboldt-Klub als einen anregenden Anlass genommen, um das Augenmerk des weiteren Publikums auf die Bedeutung und Aktualität dieses berühmten und einflussreichen Weltwissenschaftlers und Weltreisenden im gegenwärtigen wissenschaftlichen Kontext zu lenken. In diesem Vortrag wird insbesondere auf drei thematische Zusammenhänge hingewiesen werden. Zuerst wird in Umrissen sein Lebens- und Bildungsweg im Licht des allgemeinen Tagungsthemas über Wissenschaft und Bildung vorgestellt. Danach folgt die Darstellung seines grandiosen wissenschaftlichen Entwurfs der Welt, des fünfteiligen Werkes über Kosmos, auf drei Bedeutungsebenen - kosmologisch als Weltall, global als planetarische Vernetzung und philosophisch als kosmopolitische Weltanschauung. Schließlich werden in der Präsentation die Hauptideen seines weltbürgerlichen Denkens und Wirkens näher beleuchtet.

Analysis of 3D lattices of nanostructures by GISAXS

Lovro Basioli,[1] Krešimir Salamon,[1] Marija Tkalčević,[1] Sigrid Bernstorff,[2] Maja Mičetić[1]
Ruđer Bošković Institute, Zagreb, Croatia

The application of the grazing-incidence small-angle X-ray scattering (GISAXS) technique for the investigation of three-dimensional lattices of nanostructures is demonstrated. Three types of materials considered are 3D lattices of simple ellipsoid nanoparticles, of core-shell nanoparticles and 3D meshes of intersecting nanowires. A successful analysis of three-dimensionally ordered nanostructures requires applying a suitable model for the description of the nanostructure ordering. Otherwise, it is possible to get a good agreement between the experimental and the simulated data, but the parameters obtained by fitting may be incorrect. It is demonstarted how the choice of the correct model for the description of ordering influences the analysis results.
[1] L. Basioli, K. Salamon, M. Tkalčević, I. Mekterović, S. Bernstorff and M. Mičetić; Application of GISAXS in the Investigation of Three-Dimensional Lattices of Nanostructures. Crystals 2019, 9, 479; doi:10.3390/cryst9090479

Improved circuits for a biologically-inspired random pulse computer

Mateja Batelić and Mario Stipčević
Ruđer Bošković Institute, Zagreb, Croatia

Abstract: We present improved circuits intended for building a universal computer based on Random Pulse Computing (RPC) paradigm, a biologically-inspired way of computation in which variable is represented by a frequency of a Random Pulse Train (RPT) rather than a logic state. The RPC we mention here is also known as "stochastic unipolar computation" in newer literature. Unlike in previous art, where randomness is obtained from electronics noise or a pseudorandom shift register while processing circuitry is deterministic, in our approach both variable generation and signal processing rely on the random flip-flop (RFF) whose randomness is derived from a fundamentally random quantum process. This offers advantage in better precision and faster calculation.

Heart Transplantation in Children in Croatia – Our First Exprience

Dražen Belina,[2] Dorotea Bartoniček,[1] Višnja Ivančan,[3] Slobodan Galić,[4] Jasna Stoić Brezak,[5] Darko Anić,[2] Dražen Jelašić,[6] Ivan Malčić[1]
[1]Clinical Hospital Centre Zagreb, Departmetn for pediatric cardiology, [2]Department of pediatric cardiac surgery2, [3]Department of anaestesiology,[4]Department of Intensive care, [5]Departemnt of EUROTRANSPLANT, [6]Department of pathology, Medical Faculty of Zagreb, Croatia

Introduction: Heart transplantation (HT) is an acceptable method of treating severe heart diseases in children when all other options have been exhausted. It is primarily intended for children suffering from cardiomyopathies, less often for children with severe arrhythmias and congenital heart defects. This method of treating children requires a multidisciplinary specialist cooperation and support in the child's home surroundings. Goal: The main goal is to present the development of Croatian paediatric transplantation cardiology. The secondary goal is to raise awareness on heart transplantations in children in order to motivate organ donations, it being the more limiting factor of the method.Results of study: The first heart transplantation in a child in Croatia was performed in 2011. Transplantation preparations have been performed in eleven children. Two of the children died while on the waiting list, one child was removed from the waiting list for recovery, and in eight of the children a transplantation was performed. Two of the eight died, one during transplantation and one in the early post transplantation period. All patients met the heart insufficiency criteria, four in stage C – status 2 and seven in stage D – status 1A and 1B. Of the initial eleven who met the HT criteria all had cardiomyopathies, eight dilated and three restrictive. In the dilated cardiomyopathy group of patients there were four with post myocarditic DCM, one idiopatic, one within the arrhythmogenic CM, one within an entity form called the Carvajal syndrome (ARVCM/LV), while one child had DCM in HLHS, but as an N-cCM. As for the two deceased before transplantation, one had post myocarditic DKM, and one had the Carvajal Syndrome. An infant who died immedaitely after transplantation had the Hypoplastic left heart syndrome with previous Norwood I and Norwood II (Glenn or PCPC) surgeries, and the indication was severe DKM caused by and within N-cCM. The deat occur because hiperaute celluar rejection(PhD). A fifteen-year-old boy with

arrhythmogenic DKM died in early postsurgical period due to RV failure (possible because acute cellular rejection). He had previously been subjected to a long-term conventional treatment and electrotherapy. Sex distribution (m, f) within the entire group (6:5) and within the TS group (4:4) was even. Mean age in heart transplantations was 84,8 months (22-167 months), and mean donor waiting period was 53 days (7-147 days). Kaplan-Meier curves for a six-year period indicate a 75% survival rate. The study describes numerous posttransplantation complications, immunosuppressive therapy, patient monitoring protocol and quality of life. A significant increase in quality of life is found according to the NHYA criteria (shift from 3-4 to 1-2) for all of patients.
Conclusion: Our Clinic has been performing heart transplantations since 2011. The success depends on the timely diagnosing and identifying of the terminal stage of the disease which also meets the transplantation criteria (PVR<6Wj, TPG <15mmHg), on public awareness and on the ability of doctors to recognize potential donors. The 75% six-year period survival rate of 75% testifies on the ability of our team to make such a complex medical step forward.

The project on the first Croatian satellite PERUN

Marko Bermanec, Filip Kisić, Luka Korov, Matija Makoter i Stjepan Puljić
Adriatic Aerospace Agency, Zagreb, Croatia

Single- and Bimetallic Amidoboranes - Solid-State Synthesis and Decomposition

Nikola Biliškov, Igor Milanović, Ivan Halasz
Ruđer Bošković Institute, Zagreb, Croatia

Amidoboranes, a family of B,N-containing compounds that are under a vivid consideration as potential chemical hydrogen containers, can be readily prepared by ball milling from ammonia borane and corresponding hydride(s).
However, details of the mechanistic pathways toward these materials are still not satisfactory recovered. By recovering the intermediates and other crucial elements of the synthesis, in-situ and real-time monitoring, by means of Raman spectroscopy and powder XRD, of uninterrupted mechanochemical preparations provides a unique insight into the mechanistic pathways. Here we illustrate the application of these techniques to preparation of several single- and bimetallic amidoboranes. This approach allowed real-time observation of key intermediate phases and a straightforward follow-up of the progress of the reaction, thus enabling a detailed interpretation of mechanistic pathways.

On the other hand, from the application point of view, it is crucially important to recover the mechanisms of solid-state thermally-induced decomposition of the obtained amidoboranes. Again, a number of techniques that enable in-situ monitoring of the relevant processes are applied. Here, these efforts will be presented, together with our ongoing results.

Photocatalytic activity of ZnO nanoparticles synthesized by laser ablation in water

Damjan Blažeka, J. Car, Nikša Krstulović.
Institut za Fiziku, Bijenička cesta 46, 10000 Zagreb

Due to high area/volume ratio, nanoparticles made of semiconductor material show enhanced photocatalytic activity on UV and visible light compared to bulk material. Pulsed laser ablation in liquid (PLAL) is very promising technique for production of colloidal nanoparticles from wide range of materials. PLAL has many advantages compared to chemical production and other methods: procedure simplicity, acceptable cost and time-consumtion, possibility of adjusting large number of parameters (laser wavelenght, number of pulses, pulse intensity and duration, focus position...) to obtain nanoparticles with desired features (size distribution, crystal structure, shape), and there is no undesired byproducts which are ecollogicaly unacceptable so nanoparticles and solution have high purity - therefore PLAL is called „green method“. In this paper, we examined dependence of photocatalytic degradation of different dyes (Methylene Blue, Rhodamine B, Methyl Orange) under UV-light on different concentrations of laser-synthesized ZnO nanoparticles in solution. Initial ZnO-NP solution is synthesized with laser ablation in water, using Nd:YAG laser at wavelength 1064 nm, pulse energy 300 mJ, pulse duration 5ns and rate 5Hz.

Perspectives of Space technology in Croatia

Danko Bosanac
Adriatic Aerospace Agency, Zagreb

Darstellung der Geschichte in den Prosawerken von Miljenko Jergović

Krešimir Bobaš
The Faculty of Humanities and Social Sciences, University of Zagreb

Im Rahmen dieser Dissertation wird untersucht, wie Geschichte in den Prosawerken von Miljenko Jergović dargestellt wird. Hierbei wird der Begriff „Geschichte“ mehrfach

gedeutet, als Schilderung sowohl persönlicher und familiärer als auch kollektiver und politischer, aber ebenfalls fiktive Einwände verzerrter Geschichte, die sich in Jergovićs Prosawerken unvermeidbar mit einer überprüfbaren, dokumentaristischen Erzählstrategie verweben. Dabei fungiert Jergovićs gesamtes Prosawerk ebenfalls eine Dokumentarität, weshalb es als eine gewisse Schnittstelle zwischen dem privaten und öffentlichen, zwischen Erinnerung und Historiografie angesehen werden kann, die ihren Platz in mehreren Epochen, Regimen und, nicht zuletzt, Staaten findet, beziehungsweise nach ihm sucht. Von Sarajevo Marlboro (1994) bis hin zu Die unerhörte Geschichte meiner Familie (2013) und neueren Texten erstreckt sich Jergovićs Bestreben, durch sein Werk mittels diverser Figuren, Orte und Geschehnisse aus der eigenen und allgemeinen Geschichte, die neue Wirklichkeit der Nachkriegszeit abzudecken, die sich über mehrere, einst gemeinsame, Sprachen, Gebiete und Kulturen erstreckt. Aufgrund dessen ist das Forschungsziel dieser Dissertation, mithilfe gängiger kultur- und literaturwissenschaftlicher Methodologie offenzulegen, auf welche Art und Weise Geschichte in ihrer mannigfaltigen Deutungsweise in Jergovićs Prosawerken dargestellt wird und welche ihre narratologische Rolle ist.
Schlüsselwörter: Miljenko Jergović; Geschichte; Narratologie; Nachkriegszeit.

Modifying the proximity induced spin polarization of graphene by the electric field

M. Bosnar, I. Lončarić, P. Lazić
Ruđer Bošković Institute, Zagreb, Croatia

We study the spin polarization that is induced in graphene when it is placed on top of a cobalt slab passivated by a layer of gold or platinum atoms by density functional theory. We are interested in possibility of changing the said spin polarization, especially at the ermi level, by applying the electric field to system. This would be interesting in spintronics for design of spin valves and logic gates.
It was shown that the passivation of the slab is necessary to prevent the formation of chemical bond between it and graphene, which prevents the electric field to change the spin polarization of graphene [1]. However, even though the previous work established that the electric field could change the spin polarization when the slab is passivated by graphene or hexagonal boron nitride, a device that would be based on this junction would be inefficient, because the doping of graphene on structure formation prevents small fields to make significant changes to spin polarization of graphene.
Therefore, we look for passivation layers that would also compensate for the unwanted charge transfer and make the proposed device efficient. We show not only that the passivation of the cobalt slab by monolayer of gold or platinum atoms can reduce the charge transfer, therefore improving efficiency of the proposed device, but also that interesting magnetic patterns are induced into graphene.

Solar physics with the Atacama Large Millimeter/submillimeter Array (ALMA): selected first results

R. Brajša
Hvar Observatory, Faculty of Geodesy, University of Zagreb, Kačićeva 26, 10000 Zagreb

The Atacama Large Millimeter/submillimeter Array (ALMA) located in Chile is used for solar observations. The main advantage of observing the Sun with ALMA is mapping of the solar chromosphere with an unprecedented spatial, temporal, and spectral resolution in the wavelength range between 0.3 mm and 8.6 mm. It can also be used as an approximately linear thermometer - the measured brightness temperature is directly proportional to the gas temperature of the observed structure or the continuum forming layer in the solar atmosphere. Formation height of the continuum radiation increases with increasing observing wavelength which enables very accurate measurements of the solar chromosphere's temperature as a function of height. The topic is important for solar physics, but it is important for stellar physics too, since the Sun is representative for the whole class of solar-like stars. The study has an observational and a modelling part. Within the observational part, data reduction is performed on data taken in 2015 and made publicly available in 2017. Models of various observed solar structures were developed and compared with actual ALMA observations. Radiation models are based on various contemporary solar atmosphere models with thermal bremsstrahlung as the dominant mechanism responsible for the emission at ALMA wavelengths. A comparison of observations and models provides precise constraints on plasma properties in the solar atmosphere. Fast-scan single-dish maps are used to characterise the Sun's millimetre radiation in comparison with the chromospheric and coronal emission seen at optical and EUV wavelengths, as well as with the magnetograms. A high degree of correlation was found for many structures and millimetre counterparts of active regions, sunspots, coronal bright points, and plages were identified. These results are analyzed in more detail using the interferometric measurements of small portions of the solar disc, including active regions.

Glenn procedure for Hypoplastic Left Heart Syndrom - should it be performed earlier? Results of a Croatian clinical epidemiological study

Viktorija Ana Buljević,[1] Andrea Dasović Buljević,[1] .Ivan Malčić[2]
Department for pediatric cardiology[2] and neonatology,[1] Clinical Hospital Centre Zagreb

Hypoplastic left heart syndrome (HLHS) has been a lethal congenital heart anomaly until the last four decades. Then Norwood performed the first surgery of the left ventricle bridging (Norwood operation) by establishing aortopulmonary connection (modified Blalock-Taussig anastomosis or right ventricle to the pulmonary artery anastomosis, so-

called Sano shunt), atrioseptectomy, and formation of neo-aorta. With two additional palliative surgeries - Glenn operation (partial cavo-pulmonary anastomosis -PCPC) and Fontan-Kreutzer operation (total cavo-pulmonary anastomosis (TCPC)), the right ventricle is enabled to take lifelong function as the systemic ventricle.
The incidence of HLHS in Croatia is 2.3% among all congenital heart defects, by national population study. Croatian clinical epidemiological study included 57 patients operated in a 12-year period with a total long-term survival of 54% by Kaplan-Meier's. The most vulnerable period for lethal outcome is between Norwood and Glenn operation in early infancy and accounts for 45.6% of all lethal outcomes. This suggests the need to shorten the time between the first two operations. Thus, avoiding the unexpected obstruction of systemically pulmonary anastomoses established during Norwood surgery would allow improving the survival of children with HLHS.

MARine lake (Rogoznica) as a model for EcoSystem functioning in a changing environment

Irena Ciglenečki,[1] Milan Čanković,[1] Marija Marguš,[1] Ivica Janeković,[2] Sarah Mateša,[1] Tatjana Bakran-Petricioli,[3] D. Petricioli,[4] Maja Dutour-Sikirić[1]
[1]Ruđer Boskovic Institute, Division for Marine and Environmental Research, Zagreb, Croatia
[2]The University of Western Australia, Crawley WA 6009, Australia
[3]Faculty of Natural Sciences, Univesity of Zagreb, Department of Biology, Zagreb, Croatia
[4]D.I.I.V.d.o.o., za ekologiju mora, voda i podzemlja, Sali, Croatia

The unique, highly eutrophic, and euxinic (anoxic water with free hydrogen sulphide in the water column) marine lake, Rogoznica Lake (RL) in the central Dalmatia (Middle Adriatic, 43o32'N 15o58'E) is selected as one of the important study site on the Adriatic Coast in the frame of the Croatian Science Foundation project MARRES-1717. This lake is considered as an extreme, naturally eutrophic system which senses all effects of the Adriatic atmospheric and sea conditions. Influence of these conditions due to the lake semi-closed nature might be several times stronger than in rest of the Adriatic. Our results show that RL is an ideal site to study processes that control the biogeochemistry of coastal potentially hypoxic-anoxic environment. Stratification and mixing of the water layers are directly influenced by the meteorological conditions i.e. balance between precipitation and evaporation, heat flux, as well as frequency of extreme weather events which are directly consequence of environmental, climate change. Such events strongly impact biogeochemistry and food-web interactions in the RL. In general, enclosed marine basins are exposed to the increased human activities from the coastal areas. Today eutrophication-related phenomena are closely related to environmental/climate changes. The integration of the long-term (from 1994 up to the present) data on physico-chemical conditions and ecological status, indicate that RL, in addition to its meromictic and holomictic characteristics, can potentially serve as a valuable sentinel of the environmental/climate change.

The Lake has proven to be an ideal test-bed to track changes in the environment that reflect in the warming, and accumulation of toxic sulphide and ammonium in the bottom layer of the lake. Those changes are congruent with the reports for the Adriatic, and represent a potential trigger for further, even more severe changes, which can ultimately lead to degradation of this lake ecosystem.
On the other side the Lake may be considered as a natural laboratory for the studies of marine redox chemistry since it provides sites with several redox conditions, etc. the redox cline is situated in the sediment and in the water column (euxinic conditions). Comparison between those sites is a unique situation as both sites are situated in the same water body. The small size and physically stable nature of the Lake allows research on small scale spatial and temporal variability as well as longer term processes. In RL's water column a large range of reduced sulfur species (RSS) concentration (nM – mM) can be found, and a variety of organic and inorganic sulfur species, from organosulfur i.e. mercapto compounds to colloidal sulfur and polysulfides, thus RL environment is an ideal site for testing and development of methodology for RSS characterization and speciation. In the same time, the Lake offers a great possibility for studying microbial diversity that control biogeochemical cycling of sulfur. It is apparently that the Lake's extreme environment severely curtails the ecological and metabolic diversity (food-web interactions) relying on dominant taxa, some of which could be easily lost as a result of environmental perturbations.

Examples of collective states driven very far out of equilibrium

D. Dominko,[1] V. Grigorev,[2] J. Demsar[2]
[1]*Institut za Fiziku, Bijenička cesta 46, 10000 Zagreb, Institute of Physics,*
[2]*Johannes Gutenberg-University, 55099 Mainz, Germany*

Using series of two ultrashort laser pulses in pump-probe configuration enables one to track lattice vibrations in solids (phonons) in time domain. By tunug pulse energy density one degree of a state being out of exulibrium can be set, including close to equilibrum, very far from equilibrum or even inducing a phase transition. Going step further and using sets of three pulses, first of high energy and following low-energy pump-probe ones, a sistem being very far from the equilibrium can be fully traced during its path towards the equilibrium. I will show few such cases of Charge Density Waves and pseudo Jahn-Teller, revealing some puzzling behaviors, not expected from classical considerations.

The perspective of the course "Physics of Medical Diagnostics" for students of medicine (2016)

Sanja Dolanski Babić, Kosović M
School of Medicine, University of Zagreb, Croatia

Introduction: School of Medicine (MS) has had a tradition of teaching Physics since its foundation in 1917. The Department of Physics of MS was founded in 1948 and the first Head was Professor Božo Metzger. Nowadays, 300 medical students per generation take the course "Physics and Biophysics" (60 course hours, 6 ECTS) in the first year and the course "Physics of Medical Diagnostics" (a total of 20 hours - 6 hours of lectures, 10 of seminars and 4 hours of lab exercises, 1 ECTS) in the fourth year. Such a program has been implemented by the MS since the academic year of 2006/07. It should be noted that in other medical schools in Croatia (Rijeka, Split and Osijek) students are not obliged to enter a course similar to ours. In this work we present perspective of the course “Physics of Medical Diagnostics” based on results of the exam questions and the students polls through the years.

Strateški plan za uključenje Hrvatske u internacionalnu mrežu za bioinformatičko mapiranje repetitivne DNA i razvoj personalizirane medicine

S. Durajlija Žinić
Ruđer Bošković Institute, Zagreb, Croatia

3D micro- and nano-structuring for opto-bioelectronics

Vedran Đerek
Wallenberg Center for Molecular Medicine, Linkoping University, Norrkoping, Sweden

Great efforts are currently underway to develop methods to record, intercept, and modulate the neural pathways in a living organism, and to exploit them for therapeutic and diagnostic purposes, as well as for brain-machine interfaces. The development of such methods based on bioelectronics begins in a physics laboratory. Bioelectronic methods are based on the effects at the interface of the conductor (metal or semiconductor) and the biological system (water-based electrolyte). To understand these processes and optimize them for the desired effects, a synergy in necessary between the fields of physics, chemistry, and biology. In the state-of-the-art research and applications, the interface between the physical and biological systems has mostly consisted of planar

and flat surfaces. However, it is known that by 3D structuring of the metal or semiconductor by introducing sharp concave or convex shapes, it is possible to control the distribution and strength of the electric fiel!
d on their interfaces. Physical processes responsible for the effects at the biological system interface are highly sensitive to the electric field. In our research, we try to understand and exploit the effects of the modulation of the electric field and the distribution of transient capacitance-related currents in the physiological medium. Our primary goal is the development of optimally three-dimensionally structured bioelectronic devices which are electrically charged by the photovoltaic effect, which are targeted for specific in-vitro and in-vivo usages.

Spontaneous Ergodicity Breaking in Invariant Matrix Models

Fabio Franchini
Ruđer Bošković Institute, Zagreb, Croatia

Many physical systems are ergodic, meaning that, over time, they sample most allowed physical states. Ergodicity is a central tenant for thermodynamics, as it provide meaning to the concept of equilibrium. However, certain systems are not ergodic and thus posses peculiar and important properties. Non-ergodic systems are typically harder to study. Here, we propose a new approach to the study of ergodicity breaking and localization, based on an abstract formulation that can disclose powerful computational techniques.
Such formulation is grounded in the field of random matrix theory, but moves beyond the standard assumption that invariant models describe only extended (ergodic) systems. We show that deviations of the eigenvalue statistics from the Wigner-Dyson universality reflects itself on the eigenvector distribution. In particular, gaps in the eigenvalue density spontaneously break the rotational symmetry of the model to a smaller one, hence rendering the system not ergodic anymore. Models with log-normal weights, recently considered also in string theory models such as ABJM theories, show a critical eigenvalue distribution which indicates a critical breaking of the symmetry.
While the main motivation for this approach is the description of the critical phase of a disordered conductive systems (Anderson Metal/Insulator transition), the underlying picture is very general: the spontaneous breaking of rotational symmetry corresponds to clustering of different physical degrees of freedom, which, not being equivalent anymore, prevent the exploration of the whole configurational space.

Photonic Nanojet of a Microsphere for Raman Scattering Enhancement

Vlatko Gašparić
Ruđer Bošković Institute, Zagreb, Croatia

A new method for enhancing the Raman scattering signal has emerged recently, based on dielectric enhancement. Especially promising is the dielectric method based on microspheres and photonic nanojet. The formation of the photonic nanojet is presented through Generalized Lorenz-Mie theory (GLMT) of light scattering from a microsphere, together with important properties and parameters for formation. Simulation images of the photonic nanojet are shown with the help of homemade GLMT computer program and numerical simulations from other research. Experimental vertical Raman mappings of a 5-µm microsphere on top of a silicon substrate are presented. Enhancement value on maps was the highest (5.7x) for 0.50 NA objective, when the incident beam was focused 9 µm below the top of the sphere. Furthermore, dielectric enhancement can be combined with surface enhanced Raman scattering (SERS), where other research is shown together with future plans.

Prospective fibre-optic based sensors

Hrvoje Gebavi,[1] Vlatko Gašparić,[1] Davor Ristić,[1] Daniil Zhivotkov,[1] Dubravko Risović,[1] Hrvoje Skenderović,[2] Stefano Taccheo,[3] Joanna Borkowska,[4] Paweł Albrycht,[4] Sanja Vidaček,[5] Mile Ivanda[1]
[1]Ruđer Bošković Institute, Zagreb, Croatia, [2]Institute of Physics, Zagreb, Croatia, [3]Swansea University, Swansea, United Kingdom, [4]Polish Academy of Sciences, Warsav, Poland, [5]Faculty of Food Technology and Biotechnology, Zagreb, Croatia

The key for successful and fast health recovery is in early disease detection and adequate treatment. The early and accurate detection method of unwanted processes in a living organism requires low molecules number detection and 'specificity' in order to accurately distinguish similar species. Surface-enhanced Raman spectroscopy (SERS) offers not only ultrasensitive molecular detection, but also a unique 'fingerprint' of the specific molecule, which finds applications from diagnostic to analytical chemistry and environmental monitoring. Fibre-optics based SERS probes are a step towards the solution. They preserve ultra-sensitivity and selectivity of common lab-substrates and offer fast, cost-effective, minimally invasive, real-time, in situ and in vivo monitoring especially suitable for out of lab environment. This work shows preliminary results of the fabrication methodology for fibre-optics based sensors which includes fabrication of silicon and zinc-oxide nanowires on silica fibre. Such sensor has shown Rhodamine 6G concentration detection limit of 10-9 M. Furthermore, we have demonstrated Raman signal enhancement with dielectric microspheres which is a step before the technology transfer to SERS substrates.

Braucht Europa eine mehrsprachige Wissenschaft und Bildung

Siegfried Gehrmanna
University of Münster, Münster, Germany

Die Europäische Union als Gemeinschaft gleichberechtigter Staaten ist in besonderer Weise dem Schutz und der Förderung der Vielfalt der Sprachen und Kulturen ihrer Mitgliedstaaten verpflichtet. Diese Grundlegung der EU als multilinguale und multikulturelle Gemeinschaft ist einer ihrer nicht hintergehbaren Eckpfeiler. Hieraus resultiert 1. eine Identitätskonzeption, die die Herstellung eines gemeinsamen europäischen Bewusstseins über die Anerkennung der sprachlichen und kulturellen Vielfalt der Gemeinschaft herzustellen sucht und 2. eine Sprachenpolitik , die das Erlernen von möglichst vielen Fremdsprachen und die interkulturelle Verständigung zu einer prioritären Aufgaben europäischer Bildungspolitik der EU macht.
Konträr zu diesen Zielen der EU hat sich in zahlreichen Bereichen der Wissenschaft ein Sprachwechsel zugunsten von Englisch als einzige internationale Wissenschaftssprache durchgesetzt. Alle anderen Fremdsprachen spielen dagegen als Wissenschaftssprachen kaum noch eine Rolle. Ähnliche Tendenzen sind auch in der Schulfremdsprachenpolitik der Mitgliedstaaten der EU festzustellen. Auch hier ist eine Entwicklung in Richtung einer anglophonen schulischen Bildung festzustellen.
Der Vortrag untersucht die Diskrepanzen dieser Entwicklung und fragt nach den Mechanismen, die der Ausbreitung der Englischen als Wissenschafts- und Bildungssprache zugrunde liegen. Müssen wir hier von einer unvermeidlichen sprachlichen Entwicklung ausgehen, die der Globalisierung inhärent ist, oder ist im Gegenteil die Anglophonisierung von Wissenschaft und Bildung nur einer unter vielen Wegen, die Herausforderungen der Globalisierung zu bewältigen? Und wie ist in diesem Kontext das Mehrsprachigkeitskonzept der EU einzuschätzen?

Impact of Fe(III) ions on the structural and optical properties of anatase-type solid solutions

Ivan Marić[1], Goran Dražić[2], Mile Ivanda[3], Tanja Jurkin[1], Goran Štefanić[3,4] and Marijan Gotić[3,4]

[1] Radiation Chemistry and Dosimetry Laboratory, Ruđer Bošković Institute, Bijenička c. 54, 1 000 Zagreb, Croatia

[2]National Institute of Chemistry, Hajdrihova 19, SI-1001, Ljubljana, Slovenia

[3]Molecular Physics and New Materials Synthesis Laboratory, Ruđer Bošković Institute, Bijenička c. 54, 10000 Zagreb, Croatia

[4]Center of Excellence for Advanced Materials and Sensing Devices, Research Unit New Functional Materials, Bijenička c. 54, 10000 Zagreb, Croatia

The morphologies of α-Fe2O3 spindles and nanotubes was modified by the addition of divalent metal cations M^{2+} (M = Mn, Cu, Zn, Ni). Divalent metal cations gradually modify the spindle to pseudosphere and the nanotube to nanoring particle morphologies. At a higher concentration of added divalent cations the nanodisc morphology was obtained. The SEM/EDS and TEM/EDX analyses showed that precipitates contained Fe, O and P elements, but none of the precipitates contained divalent metal cations. The XRD patterns of each investigated sample fitted well to pure hematite (α -Fe_2O_3) and there were no other phases
observed. The Mossbauer and XRD lines broadened with the addition of divalent metal cations. The mean crystallite sizes were calculated using the Scherrer equation from XRD line broadening of 104 and 110 lines of hematite. With the addition of a Mn^{2+} cation the mean crystallite size gradually increased in the a-axis direction. The relative high value of the mean crystallite size in the a-axis direction was found for nanorings modified by a Cu^{2+} cation. This high crystal distortion in the a-axis direction upon adding Cu2+ was explained by a strong Jahn–Teller effect of Cu2+ that has a tetragonally distorted coordination sphere in an octahedral coordination. Thus, quite opposite to a pure system, the modification by divalent metal cations induced the preferential growth of α -Fe2O3 crystals in the a-axis direction. It was suggested that divalent metal cations introduced the defects into the planes parallel to the basal plane (001) and thus changed the type of hydroxyl groups on hematite planes, which as a consequence switched the preferential growth of the α -Fe2O3 along the c-axis to the growth along the a-axis.

Centre for advanced research of complex systems (CeNIKS) - University of Zagreb's enhancement of infrastructure for material research

Mihael S. Grbić
Department of Physics, Faculty of Science, University of Zagreb, Croatia

When Croatia joined the EU in 2013. it became possible for it, as a new member state, to increase its research potential through European Regional Development Fund (OP "Competitiveness and Cohesion"). It allowed Croatian researchers to compensate for the lack of government support of science that was a consequence of the recent war and a bad economic situation the country was in.
Faculty of Science in Zagreb seized this unique opportunity and in 2015. the Department of Physics made a first-step application for funding an 8.4 million EUR project CeNIKS [1]. It focuses on enhancing the experimental physics division, since its capacities were sub

sufficient for a truly competitive modern research.k I will present project CeNIKS and its neighbouring projects aimed at enhancing the condensed matter research in Zagreb. Within the project we tend to equip the Department of Physics with: nitrogen liquefier, 16 T cryo-free magnet with dilution refrigerator, SQUID unit and X-ray diffractor, NMR dilution refrigerator, 3He cryostat, ellipsometer and cryogenic optical conductivity setup, and many other supporting systems.

Mechanisms of nutrient-mediated effects of endogenous glucagon-like peptide -1 on cognitive and metabolic alterations in experimental models of neurodegenerative disorders

Jan Homolak,[1,2] Ana Babić Perhoč,[1,2] Ana Knezović,[1,2] Jelena Osmanović Barilar,[1,2] Maja Relja,[3] Peter Riederer,[4,5] Melita Šalković-Petrišić,[1,2,6]
[1]Department of Pharmacology, University of Zagreb School of Medicine, Zagreb, Croatia
[2]Croatian Institute for Brain Research, University of Zagreb School of Medicine, Zagreb, Croatia
[3]Department of Neurology, Clinical Hospital Centre Zagreb, University of Zagreb School of Medicine, Zagreb, Croatia
[4]Center of Mental Health, Department of Psychiatry, Psychosomatics and Psychotherapy, University Hospital Würzburg, Würzburg, Germany
[5]Department of Clinical Research and Psychiatry, University of Southern Denmark, Odense, Denmark
[6]Scientific Centre of Excellence for Basic, Clinical and Translational Neuroscience, University of Zagreb School of Medicine, Zagreb, Croatia

Metabolic dysfunction is currently being investigated as one of the key etiopathogenetic factors in neurodegeneration. Peripheral insulin resistance has been identified as a risk factor for Alzheimer's disease (AD) and Parkinson's disease (PD), and biochemical studies reported desensitized insulin signaling in the brains of AD/PD patients. Based on the molecular similarities of insulin resistance and neurodegeneration, drugs originally developed for treatment of type 2 diabetes mellitus (T2DM) are currently being investigated in the context of neurodegeneration. Incretin mimetics are particulary interesting as incretins are synthetized in the brain where they act as neuropeptides with neuroprotective, anti-inflammatory, and neurotrophic properties. Although exogenous glucagon-like peptide-1 (GLP-1) mimetics are currently being tested in AD/PD clinical trials, neuroprotective effects of endogenous incretins and their therapeutic potential in neurodegeneration is yet to be elucidated. Our previous research in the streptozotocin-induced rat model of sporadic Alzheimer's disease has shown that oral galactose induces GLP-1 secretion and prevents and ameliorates previously developed cognitive impairment in the early stage of sAD pathology.
Aim of this project is further characterization of galactose (nutrient)-induced secretion of endogenous incretins and better understanding of their neuroprotective effects in two rat models of neurodegenerative disease – rat model of sporadic Alzheimer's disease induced by intracerebroventricular administration of streptozotocin (STZ-icv) and rat

model of Parkinson's disease induced by intrastriatal administration of 6-hydroxydopamine (6-OHDA). We first aim to explore whether acute neuroprotective and/or metabolic effects of a single oral dose of galactose in the sAD model are mediated by promotion of solely endogenous GLP-1 or/and by another incretin, glucose-dependent insulinotropic peptide (GIP). Additionally, we will explore whether the therapeutic potential of chronic oral galactose treatment on cognitive deficits, and possible metabolic dysfunction and neuropathology in sAD and PD models results primarily from the complex galactose-induced effects (direct + incretin-mediated ones) or is it solely the incretin-mediated effect.
This work was funded by the Croatian Science Foundation (IP-2018-01-8938). Research was co-financed by the Scientific Centre of Excellence for Basic, Clinical and Translational Neuroscience (project "Experimental and clinical research of hypoxic-ischemic damage in perinatal and adult brain"; GA KK01.1.1.01.0007 funded by the European Union through the European Regional Development Fund).

Bošković's determination of Sun rotation elements in 18th Century using his own observations of Sunspot's positions

Mirko Husak,[1] Roman Brajša,[2] Dragan Špoljarić,[2] Aleksandar Mona Macko Puhek[3]
[1]Državna geodetska uprava, Stanka Vraza 4, 42000 Varaždin
[2]Geodetski fakultet Sveučilišta u Zagrebu, Kačićeva 26, 10000 Zagreb
[3]Treća osnovna škola Varaždin, Trg Ivana Perkovca 35, 42000 Varaždin

Ruđer Bošković (1711-1787) observed himself Sunspots on the disk of the Sun during 12th to 29th September 1777 in France. His method is based on: 1 his first dissertation about Sunspots De Maculis solaribus (1736) in Latin, describing his geometrical and planar trigonometrical methods in 7 pages with 6 pictures, and 2 Detailed calculations elaborated in Opera pertinentia astronomiam ad opticam, Tomus V, Opuscule II (1785) in old Franch, recently translated in Croatian, in 104 pages and 9 pictures. Bošković's method description, formulas and drawings are described in detail in Opuscule II with an example numerically elaborated in detail containing his own observation data. In the appendix are laid down all his observations. In the 8th and 14th chapter Bošković describes Bošković reflexions of science in the view of that time of related scientists. The milestone of the research is old French translation in Croatian that reveals Bošković's way of thinking in this matter.

NMR and NQR study of magnetic field induced quantum criticality in strongly correlated systems Ce3Pd20Si6 and m-NO2PhBNO

Ivan Jakovac1, M. S. Grbić1, T. Cvitanić1, S. Paschen2, A. Prokofiev2, H. Mitamura3, T. Sakakibara3, M. Horvatić4, Y. Hosokoshi5, M. Požek1;
1Faculty of Science, University of Zagreb, Croatia, 2Institute of Solid State Physics, Vienna University of Technology, Austria, 3Institute for Solid State Physics, University of Tokyo, Japan, 4LNCMI-CNRS Grenoble, France, 5Department of Physical Science, Osaka Prefecture University, Osaka

Uncharted area of phase space surrounding quantum critical points (QCPs) makes for an interesting research topic in the field of strongly correlated systems. How novel phases form as a result of strong quantum fluctuations in the vicinity of QCPs is yet to be fully understood. Heavy fermion and quantum magnetic systems provide promising candidates for elucidating the mysteries surrounding QCPs.
Ce3Pd20Si6 (CPS) is a cubic heavy fermion system, with two distinct cerium atoms in (4a) and (8c) crystallographic positions and an enormous conduction electron effective mass at low temperature. In the absence of an external magnetic field, competing interactions induce antiferroquadrupolar (AFQ) and antiferromagnetic (AF) orders below TQ = 470 mK and TN = 300 mK, respectively [2,3]. The magnetic field of 1 T suppresses AF order and reveals QCP with abrupt Fermi surface change. The organic compound m-NO2PhBNO (BoNO) is a good example of a Haldane chain as its spin Hamiltonian contains no anisotropic contributions, because the integer spin is delocalized within a molecular orbital, unlike the compounds with d-orbitals of transition metals. Also, with an intra-chain magnetic coupling of J = 11 K, relatively high ordering temperature of Tc = 2.9 K and critical fields that can be easily reached at user facilities (Bc1 = 0.5 T, Bc2 = 33.65 T) the system is ideal for studying 1D integer chain and the BEC phase diagram in general. We have studied this system by specific heat capacity and NMR, found a field induced BEC phase that is isotropic. Our NMR results confirm the attractive nature of the particle interactions in the TLL regim
Study of the CPS metal is conducted by means of nuclear quadrupole and magnetic resonance (NQR and NMR) of 105Pd and 29Si nuclei. Low-temperature spin relaxation measurements of Pd(32f) hint onset of Kondo screening at Ce(8c) positions, however, magnetic ordering is not observed.

Micro and nanostructuring using glass poling and electric field assisted dissolution

Vesna Janicki
Ruđer Bošković Institute, Zagreb, Croatia

Processes of glass poling and electric field assisted dissolution of metal island and thin compact films enable interesting changes within glass and metal containing layers using a simple experimental setup. Both processes are based on the drift of glass contained alkali ions, naturally present in glasses, under the influence of applied voltage and moderately elevated temperature. Selectively modified glass surface obtained by poling

can be used for fabrication of micro and nano structures in compact thin metal films deposited onto such surface.

Zur Rezption der deutschen Jugendliteratur in Nordkroaten des 18. Jahrhunderts

Alojz Jembrih
Hrvatski studiji, Zagreb

Zwei Autoren gebührt der Verdienst, die duetshe Kinderliteratur für die kroatische Literatur des 18. Jahrhunderts rezipiert zu haben. Es sind dies Juraj Dijanić (1753 – 1799) und Antun Vranić (1764 – 1820). Die Schriften von Dijanić sind in Handschriften erhalten. In Jahr 1796 wurden sie für den Druck verbereitet, jedoch erst im 1994 Jahr vom A. Jembrih veröffentlicht. Es handelt sich um die Ubersetzung von Der Kinderfreund des deutschen Schriftstellers Christian Felix Weiße (1726 – 1804). Der Vergleich mit dem deutschen Text zeigt dass Übertragung von Dijanić an mehreren Stellen eine gelungene, dem kroatischen Leser angepasste Bearbeitung des Ausgangstextes darstellt.
Antun Vranić übersetzte den Roman Robinson der Jüngere, zur angenehmen und nützlichen Unterhaltung für Kinder (1779., 1780) von Joachim Heinrich Campe (1746 – 1818), aus der Zeit der Aufklärung. Kroatische Übersetzung von Vranić erschien 1796 in Zagreb unter dem Titel: Mlajši Robinzon, iliti jedna kruto povoljna i hasnovita pripovest za decu od J. H. Kampe, iz nemškoga na hrovatski jezik prenešena. Es war damals die achte Übersetzung von Campes Roman in Europa.

Role of nuclear spectral diffusion as the measure of disorder in materials

J. Jurec, J. You, B. Rakvin, M. Jokić, D. Carić, M. Kveder
Ruđer Bošković Institute, Bijenička 54, Zagreb, Croatia

Using specific pulse sequences in ESR experiments, we have studied the differences between glassy and crystalline realization of the same material with the aim of finding a suitable experimental parameter for describing the disorder in glassy systems. The aim of our work is to contribute to the understanding of the influence of the disorder on the dynamic effects observed in glass at low temperatures for which a theoretical description has not been agreed upon yet. Focusing on a constant-time version of the Carr-Purcell-Meiboom-Gill (CPMG) pulse sequences, we studied two model systems: ethanol doped with nitroxyl radical TEMPO and γ-irradiated trehalose. Both materials were studied in glassy and polycrystalline state. We studied the hyperfine interaction of the electron spin with the spins of the matrix protons as a function of disorder; i.e. molecular packing. In the case of ethanol, nuclear spectral diffusion (NSD) proved to be a dominant mechanism of the phase decoherence of electron spins [1], while in the case of trehalose, along with NSD, we have detected additional relaxation mechanisms that are supposed to derive

from the electron-electron spin dipolar interaction between different radicals in the sample. The obtained experimental data are the basis for further theoretical studies of the molecular dynamics models in a disordered material since dynamic properties of nuclear spins (NSD), which are detected through the hyperfine interaction, directly reflect properties of the observed material.
This work is supported by Croatian Science Foundation (HRZZ) under the projects IP-2013-11-1108, IP-2018-01-3168.
[1] J. Jurec, B. Rakvin, M. Jokić, M. Kveder, J. Non-Cryst. Solids, 471 (2017), 435

A unifying approach to EM dualization through graded geometry

Georgios Karagiannis
Ruđer Bošković Institute, Zagreb, Croatia

Gauge theories can often be formulated in different but physically equivalent ways,a concept referred to as duality. Using a formalism based on graded geometry, a unified treatment of all parent theories for different types of standard and exotic dualizations. Our approach is based on treating tensor fields as functions of a certain degree on graded supermanifolds equipped with a suitable number of odd coordinates. We present a universal two-parameter first order action for standard and exotic electric/magnetic dualizations and prove in full generality that it yields two dual second order theories with the desired field content and dynamics. Upon choice of parameters, the parent theory reproduces (i) the standard and exotic duals for p-forms and (ii) the standard and double duals for (p,1) bipartite tensor fields,such as the linearized graviton and the Curtright field. Moreover, we discuss how deformations related to codimension-1 branes are included in the parent theory.

BIOcenter: First Five Years

Dubravko Kicić
Biocenter, Zagreb

How can electron paramagnetic resonance spectroscopy contribute to Science and education challenges facing Europe in the next decade

Marina Kveder
Ruđer Bošković Institute, Zagreb, Croatia

Since the discovery of electron paramagnetic resonance spectroscopy, 75 years ago in Kazan, the method has spread to various scientific areas due to its extreme sensistivity and applicability to the systems in any physical state of matter such as liquid, crystal, liquid crystal, amorphous, gas, etc. In this respect activities in the Laboratory for magnetic resonances at Rudjer Boskovic Institute will be presented showing how basic research and education are merged together. Some on-going scientific projects within the group will be discussed. In addition, the link between the basic science and applied investigation will be emphasized showing how together they can affect and improve our everyday life.

Slavic Studies Today: Local and Global Perspectives

Ivana Latković,
The Faculty of Humanities and Social Sciences, University of Zagreb

Unfavorable circumstances in which Slavic Studies worldwide find themselves after the fall of the Iron Curtain represent the starting point of this research, precisely, this review of their situation and perspectives in the near future. Starting with a rich tradition of comparative research of South Slavic cultures, the aim of this research is to question the possibilities of a new understanding of the South Slavic Studies emphasising the context of transnational cross-linked society and modern redefinitions of world and national literature enhanced by it, as well as expanding traditional disciplinary boundaries of comparative studies.
This research implies challenging the traditional category of the national in favour of a more permeable local and regional, but it shall also attempt at defining the research primacy of regional comparative studies within the context of general propulsion of cultural studies, as well as inter- and trans-disciplinary approaches. In line with that, the implementation of inclusion, non-centeredness and variability are considered as assumptions of regional comparative studies inscribed by tradition, their contact zones and interspaces, at the expense of pursuing methodologically only imitating models of "the centre".
Keywords: Slavic Studies, tradition of comparative research of South Slavic cultures, inter- and trans-disciplinary approaches

Epigenetic flexibility of plants

Mateja Jagić, Lucija Markulin, Andreja Škiljaica , Karlo Miškec, Nataša Bauer, Dunja Leljak Levanić
University of Zagreb Faculty of Science, Department of Biology, Division of Molecular Biology, Horvatovac 102a, 10000 Zagreb, Croatia

Methylation of a DNA molecule is one of several epigenetic mechanisms for controlling gene expression in cells, and acts as a signal to "turn" on and off the genes. In addition to regulating developmental processes in plants, the diversity of epigenetic mechanisms plays an important role in the phenotypic and physiological adaptability as well as the ability of plants to survive and reproduce in unpredictably changing environments. One of the basic epigenetic specificities of plants is the mechanism of RNA-directed DNA methylation (RdDM) de novo DNA methylation. RdDM requires a specialized transcription mechanism consisting of two plant-specific RNA polymerases - Pol IV and Pol V - and a large number of accessory proteins, but the mechanism is not fully elucidated. One hypothesis that will be discussed is the potential of RdDM in balancing the active and inactive status of target genes.

Advanced Computational Modelling of Complex Materials

Tomislav Lesičar, Jurica Sorić, Zdenko Tonković
Faculty of Mechanical Engineering and Naval Architecture

University of Zagreb, Ivana Lučića 5, 10000 Zagreb, Croatia

Modern structures and machine components are characterized by high demands in the aspects of safety, reliability, durability and efficiency. However, every structure is tackled by deterioration mechanisms, such as material aging and corrosion, as well as various loading conditions which cause material fatigue and structural damage. Therefore, employment of materials with enhanced properties or development of new materials is crucial for achievement efficient and environmental-friendly structures.
All materials can be treated as heterogeneous at some scale of observation. The mechanical behaviour of heterogeneous materials is usually complex for experimental calibration due to evolving interactions between microconstituents. Hence, numerical simulations complement experimental investigations, where it is essential for numerical models to encompass governing underlying mechanisms occurring in the material. To improve the accuracy of numerical simulations, the multiscale approaches have been developed, where the response of a coarse scale problem incorporates physical understanding of material behaviour at the lower scales. In the framework of multiscale methods, computational homogenization has been proven as highly versatile.
As known, due to heterogeneities appearing at the microscale and constant interaction between microconstituents, various damaging mechanisms occur in material. However, conventional numerical approaches are unable to adequately solve underlying problem

dealing with material softening, due to ill-posedness of governing differential equations. From physical and numerical standpoint, nonlocal models have shown very good regularization abilities for problems of the materials softening.
This lecture presents the research activities conducted in the Laboratory of Numerical Mechanics at the Faculty of Mechanical Engineering and Naval Architecture related to the development of advanced numerical procedures for modelling of mechanical behaviour of materials with complex microstructure. The basics of nonlocal continuum theory, as implementation into finite element framework will be explained. Also, the concept of computational homogenization will be derived and discussed. Numerical modelling of the material softening in heterogeneous materials will be shown, with particular attention appointed to the objectivity of numerical results.

Eckhaus Instability for Surface-Tension Driven Hydrorhermal Waves in the Confined Laser-Matter Interaction

Stjepan Lugomer, B. Farkas and T. Szorenyi
Ruđer Bošković Institute, Zagreb, Croatia, Department of Optics and Quantum Electronics, University of Szeged, P.O. Box 406, H-6701 Szeged,Hungary

We report on the formation of surface-tension-driven instability generated by a KrF nanosecond laser pulse in a confined configuration on a 500 nm thick Cr film encapsulated between a glass substrate and a quartz cover plate. The lateral thermal gradient ∇Ty generates surface tension gradient, which causes instability on a liquid Cr film with a very high aspect ratio, Γ =13 000, and a low Prandtl number of Pr ~ 0.01. Two types of patterns were observed; the low and high wave-number wavy-like structures inclined to the left- and to the right-side ones with respect to the direction of ∇Ty, respectively. Increasing the laser energy from ~ 38 to 100 mJ, the inclination angle of the waves alternates causing the transition between the right and left inclined structures. The formation of inclined waves occurs because the ratio W of the Rayleigh number Ra and the Marangoni number Ma (W = Ra⁄Ma) takes values W >1. The oscillation of inclined waves is governed by the Biot number, which decreases from Bi ~ 49 to the low values of Bi ~ 3–4, as the energy of the laser pulse is increased.

Nano-porosity and Mo surface formed by solitary plasma waves in laser-matter interaction

Stjepan Lugomer Aleksandar Maksimović G. Peto, A. Toth and E. Horvath
Ruđer Bošković Institute, Zagreb, Croatia, Research Institute for Technical Physics and Material Sciences, Hungarian Academy of Sciences,P.O.B 49, H-1525 Budapest, Hungary

Laser-matter interaction (LMI) in the semiconfined configuration has been used to generate one-dimensional (1D) and two-dimensional (2D) irregular and regular arrays of nanoholes of ~ 25–50 nm in diameter on the surface of high-temperature refractory metals. The LMI has generated dispersive and dissipative system of nonlinear solitary plasma waves (humps) that leave temperature/pressure "fingerprints" on metal surface. The 1D irregular array of nanoholes can be interpreted as a result of the irregular string of solitary humps (numerically simulated by the Benney equation with the Gaussian perturbation) while 2D random array of nanoholes results from random solitary humps (numerically simulated by the Benney equation with periodic perturbation). The regular string of nanoholes appears as a result of breather modes - bound state of solitons (numerically simulated by the Boussinesq equation). The regular 2D array of nanoholes are "fingerprints" of breather modes (numerically simulated by the Kadomtsev-Petviashvili equation).

The Frustration of being Odd

Vanja Marić
Ruđer Bošković Institute, Zagreb, Croatia

A central tenant in the classification of phases is that boundary conditions cannot affect the bulk properties of a system. Here, we will show striking, yet puzzling, evidence of a clear violations of this assumption. We use the prototypical example of a spin chain with no external field in a ring geometry with an odd number of sites and calculate directly the magnetizations that are traditionally used as order parameters, to characterize the phases of the system. When ferromagnetic interactions dominate, we recover magnetizations that in the thermodynamic limit lose any knowledge about the boundary conditions and are in complete agreement with the standard expectations. On the contrary, when the system is governed by anti-ferromagnetic couplings, the magnetizations show new behaviors that are qualitatively and quantitatively different from those found with other boundary conditions, hence signaling a strong contrast with the predictions of the general theory for a local, one-point, correlation function.

European Structural and Investment Projects to Promote Excellence in Infectious Disease Research in Croatia: Centers of Excellence and Centers of Competence

Alemka Markotić
Clinic for Infectious Disease, "Dr. Fran Mihaljevic" , Zagreb, Croatia

Political novel in South Slavic context

Ethem Mandić
Faculty of Montenegrin Language and Literature, Cetinje, Montenegro

The theme of this doctoral thesis is the problem of the genre of the political novel, in fact the presence of the "political" in the novels of South Slavic literature, above all in the transcultural context with a focus on Montenegrin and Serbian writers in the Yugoslav social context, as well as in the context of the contemporary history of Southeast and Central Europe in the 1950s to the late 1970s. In short, the thesis of this doctoral research is that the selected works form a genre system which shapes political literature. This genre system in the South Slavic, especially Montenegrin-Serbian inter-literary context, has not yet been systematically studied and presented, although there are critical and scientific representations that indicate its presence in literary production.
Keywords: political novel, political literature, South Slavic literature, interliteracy, genre system.

CERN Membership as an Opportunity for Croatian Physics

Blažeka Melić
Ruđer Bošković Institute, Zagreb, Croatia

On February 28, 2019 Croatia has signed an Agreement admitting Croatia as an Associate Member of CERN, the European Organization for Nuclear Research, one of the world's leading laboratories for particle physics. We will show activities in the past leading to that Agreement and will discuss new opportunities which open up in scientific collaborations, as well as technical development and education.

The Variety of Substrates for Surface-enhanced Raman Spectroscopy

Lara Mikac, Marijan Gotić, Hrvoje Gebavi and Mile Ivanda
Ruđer Bošković Institute, Zagreb, Croatia

Surface-enhanced Raman spectroscopy (SERS) is a widespread and powerful technique for analytic detection in various fields (pharmaceuticals, forensics, agronomy,

biomedicine...). Therefore, today there is an increased demand for the development of stable, sensitive, reproducible and portable SERS-active substrates. Some of the most broadly used SERS substrates are noble metal colloids. During the preparation of colloidal suspensions, the size and shape of the particles can be well controlled. However, the use of colloids for SERS has some disadvantages, like problems with reproducibility and stability. Other popular types of substrates are rough or nanoporous surfaces, such as the substrates obtained by coating the porous silicon with noble metals. Porous silicon (PSi) is a semiconducting material fabricated by electrochemical etching in hydrofluoric acid (HF). Porous materials have high surface-to-volume ratios and are therefore interesting materials for photonic and sensing devices, drug delivery systems and for use in SERS. The third type of substrates to discuss in this article are noble metal films evaporated on the monolayer of polystyrene spheres (PS). The polystyrene spheres are drop-coated on hydrophilic glass substrates in order to form a self-assembled 2D monolayer. In this paper, we present the SERS substrates produced by different synthesis methods. It was possible to detect low concentration of SERS probe molecules on thus prepared substrates. Keywords—Surface-enhanced spectroscopy (SERS), silver, silicon, polystyrene pheres, substrate

Evolution of C-S-H phase in ordinary Portland cement with w/c ratio equal to ½ studied by Raman spectroscopy

Vlasta Mohaček Grošev,[1] M. Đuroković,[2] and M. Škrabić[3]
[1]*Division of Materials Physics, R. Bošković Institute, Zagreb;*
[2]*Institute IGH d.d. Laboratory for binders and ecology, Zagreb,*
[3]*Department of Physics and Biophysics, School of Medicine, University of Zagreb, Zagreb*

After examining dry clinker with optical and atomic force microscopy and Raman spectroscopy, a wet cement paste was prepared from Portland cement powder and water with the water/cement mass ratio of ½. In a series of chemical reactions which followed, new chemical species were produced and the cement paste's composition monitored every day during the first week and after four weeks (28th day) using both 532 nm and 1064 nm lasers as an excitation sources. The observed bands were interpreted using an ab initio phonon calculation for starting alite C3S and belite C2S crystal phases [1-3].

[1] W. G. Mumme, Neues Yahrb. Mineral. H 4 (1995) 145.
[2] C. K. H. Jost, B. Ziemer, R. Seydel Acta Crystal. B33 (1977) 1696.
[3] R. Dovesi,R. Orlando, B. Civalleri, C. Roetti,V. R. Saunders, C. M. Zicovich-Wilson, CRYSTAL: a Computational Tool for the AbInitio Study of the Electronic Properties of Crystals. Z. Kristallogr. Cryst. Mater. 220 (2005) 571.

NMR study of 89Y and 139La in perovskite Ti oxides

A. Najev,[1] S. Hameed,[2] D. Pelc,[1,2] M. Greven,[2] M. Požek,[1]
Department of Physics, Faculty of Science, University of Zagreb
School of Physics and Astronomy, University of Minnesota, Minneapolis

Although the titanates share a similar perovskite structure with the more studied cuprate and manganite families, because of the strong coupling of orbital and spin degrees of freedom they show quite different properties. The trivalent rare-earth R ion in RTiO3 controls the ratio of electron bandwidth to the Coulomb interaction which defines the underlying antiferromagnetic or ferromagnetic order of the system [1]. Solid-solution systems like Y1-xLaxTiO3 allow for almost continuous control of the interplay between the orbitals, spin and the lattice [2]. This generates a rich magnetic phase diagram containing orbital-spin phases and an elusive quantum critical point.
We have conducted nuclear magnetic resonance (NMR) measurements on 89Y and 139La nuclei of the Y1-xLaxTiO3 single crystal samples. We present the obtained spectra and the longitudinal and transvers relaxation times. Our results imply there exists unknown local order well above the ferromagnetic ordering temperatures of measured samples. This work was financed by the Croatian Science Foundation (Project IP-01-2018-2970) and the Department of Energy under DE-SC0016371. Samples were synthesized by M. Greven group, University of Minnesota, USA.

New Approach in Designing Raman Spectrometer with Variable Spectral Resolution

Ivan Pavić1, M. Bonković2, J. Šoda1, M. Ivanda3
1Faculty of Maritime Studies, University of Split, 2Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture, University of Split, 3Ruđer Bošković Institute, Center of Excellence for Advanced Materials and Sensing Devices, Zagreb, Croatia

This work presents novel idea in constructing and manufacturing Raman Spectrometers with variable spectral resolution using zoom optics in the second collimating part of the spectrometer. By using such additional component gives a Raman spectrometer with a spectral resolution comparable to that of a much more expensive Raman spectrometer while preserving low initial costs making Raman spectrometers more affordable. The system is comprised of a 532nm lasers combined with first collimator, diffraction grating, NOTCH filter and a CCD “Starlight Express” detector atop which we implemented zoom objective (up to 6x) that serve as the second collimator that collect the scattered light on the detector. Using the zoom objective alongside computer program designed to take the zoom and pixel density into account we are able to obtain variable spectral resolutions: from the low spectral resolution useful for the detection of photoluminescence spectra

and up to 6 times higher resolution that is appropriate for the detection of Raman spectra. Taking into account the possibility of adaptively changing both the zoom, and the angle of diffraction grating we are capable of gaining complete spectral Raman data of a test sample at high spectral resolution and photoluminescence spectra by using low spectral resolution option. The recorded Raman and photoluminescence spectra of different samples were compared with those recorded with expensive Dilor T64000 Raman spectrometer.

Multidisciplinary research of vulnerable Dinaric karst with the aim of its protection and sustainable use

Dalibor Paar, Stanislav Franciškovi ć, Nenad Buzjak, Diana Mance
Department of Physics, Faculty of Science, University of Zagreb, Ruđer Bošković Institute, Zagreb, Department of Geography, Faculty of Science, University of Zagreb, Department of Physics, University of Rijeka

Some of the fundamental goals of the 21st century Europe are the conservation of biodiversity and geodiversity, preserving water quality, for drinking as well as habitat and the raising of the quality of formal and non-formal education through problem-oriented and field teaching related to those goals. With this project, we are addressing the karst areas of Croatia, which represent almost half of the territory of the state and contribute to the total natural values of the world-renowned Dinaric karst, which is the locus typicus of classical karst. Caves with water streams, especially ponors (swallow holes), represent locations with direct insight into karst vulnerability, current processes and paleoenvironmental reconstruction. There is the question of choice of demanding research locations and the selection of the best scientific methods of investigation of various sources such as rocks, sediments, speleothems, water and perennial ice in correlation with geomorphological, geological, hydrological and other features.

STEM education from kindergarten to lifelong learning

Dalibor Paar
Department of Physics, Faculty of Science, University of Zagreb

Modern education systems are not based on highly developed curricula but on educators, kindergarten and schoolteachers - experts that are holders of the educational process. The experiences of the best education systems have a very clear recipe for success - investing in the top education of these professionals to be as motivated and creative as possible, and ultimately introducing modern methods and ideas with appropriate

support. Education in the world is currently undergoing rapid and major changes and is increasingly moving away from 20th-century education systems. Many professions are disappearing, and there are numerous new 21th-century jobs that require urgent changes in education. The focus of education from an early age (based on new insights into brain development) to science education (STEM or STEAM) is becoming crucial to the development of modern society. In line with the European Commission's strategies, since 2017 we have started a series of activities aimed at introducing modern scientific education from an early age with a focus on educating participants in the educational process. Here we will present a cross-section of experimental programs we have implemented such as Quantum Physics and Quantum Informatics for Kindergartens, 21st Century Field Teaching and Summer School of Science and Technology for Schoolchildren and announce new ones - PMF-Lumen and STEAM Lika.

Challenges and obstacles to study nano-bio interface

Barbara Pem, Rinea Barbir, Krunoslav Ilić, Ivan Pavičić, and Ivana Vinković Vrček
Institute for Medical Research and Occupational Health, Zagreb

The use of nanotechnology for biomedical purposes promises great advancements in diagnostics and treatment of various diseases. However, prior to the application of nanomaterials to the human body, their safety and toxicity need to be thoroughly assessed. The physicochemical properties of nanomaterials are significantly altered upon contact with complex matrices, making their behaviour in a biological system difficult to predict. So far, most methods applied to the study of nano-bio interactions suffer from the inability to accurately model the real-world conditions, as well as the huge variety of nanomaterials, the complexity of their characterization and their tendency to interfere with testing systems. The development of standardised, reproducible assays and the elimination of uncertainty regarding nanomaterial interactions is the next big step towards the safe and effective nanomedical treatment systems.

Electric field assisted dissolution of aluminum and silver compact layers

Petar Pervan, V. Blažek Bregović, I. Fabijanić and V. Janicki
Institut za Fiziku, Bijenička cesta 46, 10000 Zagreb, Ruđer Bošković Institute, Zagreb, Croatia

Electric field assisted dissolution (EFAD) is a process in which metal nanoparticles on the surface of the substrate dissolve and drift away from the anode into the bulk of the substrate under the influence of the applied electric field and moderately elevated temperature. There is a significant interest in EFAD due to its possibility to imprint the

image of anodic electrode structure in glass-metal nanocomposites. EFAD can also be utilized for developing novel bio-, chemical and environmental sensors. Recently, microstructuring of conductive thin silver layers have been obtained using EFAD. Aluminium is a material interesting for microstructuring because of its good conductivity, it is abundant and consequently, relatively cheap. It would be useful to find the maximum conductive microstructure thickness that can be achieved by reasonable EFAD conditions using this material. For this purpose aluminium and silver thin layers were deposited onto soda-lime glass substrate using electron beam evaporation. Different magnitudes of electric field, temperature and duration of EFAD were applied to these layers. Measurements of the obtained samples electrical and optical properties is done by impedance spectroscopy and elipsometry followed by optical characterization. The limitations of EFAD process applied for microstructuring of conductive metal layers, same as guidelines for further research were obtained.

Experimental generation of quantum entanglement and testing fundamentals of quantum physics

Matej Peranić, Martin Lončarić, Anton Radman and Mario Stipčević
Center of Excellence for Advanced Materials and Sensing Devices (CEMS) Photonics and quantum optics research unit Ruđer Bošković Institute, Zagreb, Croatia

Quantum entanglement of photons is of a great importance in the quantum optics and it is used in teoretical and experimental testing of fundamentals of quantum physics, especially in the fields of quantum cryptography, quantum teleportation and the development of quantum computers. Photons are perfect for a quick, efficient and secure way to transfer information considering the speed of data transfer and almost non existing interaction with its environment.
Because of that they have a huge role in the development of quantum communication networks. On this poster description of an experimental setup for realization of polarization entangled photon pairs of the wavelength of 810 nm is shown together with the results of the experimental measurements of correlation of polarized states. Also, the experiment confirmed the violation of Bell's inequality in CHSH form of 114 standard deviations from the classical limit. The experiments have been done at Center of Excellence for Advanced Materials and Sensing Devices (CEMS), Photonics and quantum optics research unit at the Ruđer Bošković Institute in Zagreb.

Slowenische Literaturwissenschaft zwischen Tradition und Digitalisierung

Urška Perenič and Miran Hladnik
Phylosopical Faculty Ljubljana, Slovenia

Die (traditionelle) slowenische Literaturwissenschaft begann sich als eigenständige akademische Disziplin mit der Gründung der Universität in Ljubljana 1919 zu etablieren. Ihre traditionellen Forschungsmethoden sind Positivismus, historische und biogaphische Methode, wie Ivan Prijatelj, einer der Begründer der slowenischen universitären Literaturwissenschaft, in seiner Antrittsvorlesung erläutert hat. In seinem Konzept der Entwicklung sind aus der heutigen Sicht einige Richtlinien enthalten. Das sind die Digitalisierung der literaturwissenschaftlichen Infrastruktur (von Büchern, Zeitungen, Manuskripten und gesamten Nachlässen von Autoren) und die Internationalisierung der Literaturwissenschaft (ihre internationale Vergleichbarkeit) unter sich ändernden Lebensbedingungen. Die Neuheiten, die er nicht vorhersehen konnte, sind: die Forderung nach dem freien Zugang zu literaturwissenschaftlichen Informationen und Wissen und die Beteiligung der Öffentlichkeit an deren Nutzung, Produktion und Austausch. Die digital orientierte Literaturwissenschaft fordert unter anderem Computerkenntnisse, zu denen Organisieren und Analysieren von Daten und visuelle Erstellung von Resultaten gehören. Schusswärter: die traditionelle Literaturwissenschaft, die Digitalisierung der literatur-wissenschaftlichen Infrastruktur, die Internationalisierung der Literaturwissenschaft, die Forderung nach dem freien Zugang zu literaturwissenschaftlichen Informationen

The newborn screening: Unpredictable reaches and challenging limits

Danijela Petković Ramadža,1,2 Tamara Žigman,1 Ana Škaričić,3 Iva Bilandžija,3 Ivana Križić,3 Ksenija Fumić,3 Ivo Barić1,2

1 Department of Pediatrics, University Hospital Centre Zagreb, Croatia

2 School of Medicine, University of Zagreb, Croatia

3 Department of Laboratory Diagnostics, University Hospital Centre Zagreb, Croatia

Newborn screening (NBS) is a vital part of a health care and the most successful program for the secondary prevention of inherited diseases aiming to detect diseases in the first days of life before they become clinically apparent and jeopardize the child. Classical NBS is based on a substance measurement in dried blood spot collected on filter paper from each newborn born in a country/region where NBS program is conducted. Although analytical procedure is essential, pre- and post-analytical processes are crucial for rational and applicable NBS. Along with “biochemical NBS” there are also screening programmes for hearing loss, critical congenital heart disease, developmental dysplasia of the hip, etc. Screening program, i.e. spectrum of diseases included in each country depends on ethnic and genetic background, medical and technical settings, social characteristics and economic status.

Since 1960s, when NBS process started thanks to the brilliant findings of Robert Guthrie, NBS was introduced in many developed countries and it slowly evolved and expanded through the following decades becoming an essential part of the health care. NBS has a

central role for metabolic medicine, as it has really changed the face of some inherited metabolic disorders from severely debilitating to treatable conditions. In fact, early diagnosis stimulated development of dietary treatment for many conditions, but also hastened development of other therapeutic options. Vice versa, new therapies for inherited diseases are pushing expansion and evolvement of NBS. At the turn of the century availability of tandem MS, a new high-throughput multiple-analytes method, and more recently new molecular-genetic techniques have changed the perspective of NBS. Experience and knowledge gained through NBS teach us that some conditions previously considered to be diseases are in effect benign conditions, and that for some disorders majority of patients have mild or asymptomatic type of the disease. This brings many ethical concerns due to unnecessary disease burden to the families, but it also helps us to tailor post-analytical procedures and optimize patient management. Due to the evolvement and availability of gene therapy, NBS is being expanded to other rare inherited disorders today. With the sequencing of entire human genome and availability of modern genetic techniques, genetic screening is being proposed as a major tool in translation of advances in human genetics to public health. This opens Pandora's box of various ethical, organizational and economic controversies.
In conclusion, NBS is both an essential part of health care and very dynamic process influenced by technological development and improvements, medical settings, therapeutic advances, patient needs and ethical issues.

Biophotonics - a Key Technology for Precision Medicine

Jürgen Popp
Friedrich-Schiller-University, Institute of Physical Chemistry and Abbe School of Photonics,

Helmholtzweg 4, 07743 Jena, Germany

Leibniz-Institute of Photonic Technology Jena, a member of the Leibniz Research Alliance Leibniz

Health Technology, Albert-Einstein-Str. 9, 07745 Jena, Germany

InfectoGnostics Research Campus Jena, Philosophenweg 7, 07743, Jena, Germany

Center for Sepsis Control and Care, Erlanger Allee 101, 07747 Jena Germany

Understanding the causes of diseases, recognizing them earlier and treating them more specifically - hopes that are associated with modern biomedicine - requires the determination of diagnostic, prognostic and predictive factors including their comprehensive evaluation in just a few steps or ideally in a single step. In this context, the sharp rise in cancer due to an ageing society and the rapid spread of life-threatening infectious diseases (due in part to unknown pathogens) and antibiotic-resistant germs, which is partly due to increasing worldwide mobility but also to the ill-considered administration of broadspectrum antibiotics, should be mentioned in particular. An

effective and early diagnosis and personalized therapy of cancer and infections requires new methods of differential diagnosis and represents an outstanding task of medicine. In principle, the following applies to all diseases: the earlier treatment begins, the better the chances of cure. There is therefore a great need for new diagnostic methods for targeted early diagnosis of diseases in order to be able to use targeted therapy as early as possible. Light plays a key role in the implementation of these ambitious goals. The use of optical technologies in medical diagnostics and therapy (i.e Biophotonics) has increased rapidly over the last 10 years. In this context spectroscopic approaches like e.g. Raman spectroscopy are especially noteworthy. Here we will introduce a series of innovative Raman spectroscopy approaches for (I) rapid diagnosis of infectious diseases - in terms of rapidly identifying the infection causing pathogen its antibiotic resistance pattern and ideally also its immune response – being decisive parameters for a targeted antibiotic administration, which is crucial for the survival of patients (e.g. in a sespis); (II) precise intraoperative tumor margin control, because reliable tumor margin recognition during an intervention is the key to effective tumor treatment; and (III) early diagnosis of neurodegenerative diseases of the fundus of the eye.

Acknowledgements:
Financial support of the EU, the ”Thüringer Ministerium für Wirtschaft, Wissenschaft und Digitale Gesellschaft”, the ”Thüringer Aufbaubank”, the Federal Ministry of Education and Research, Germany (BMBF), the German Science Foundation, the Fonds der Chemischen Industrie and the Carl-Zeiss Foundation are greatly acknowledged.

PROPERTIES OF DOPED-ZnO THIN FILMS PREPARED BY MAGNETRON SPUTTERING

N. Radić, P. Dubček, K. Salamon, Z. Siketić, M. Marciuš
Rudjer Boskovic Institute, Bijenicka cesta 54, HR-10000 Zagreb, Croatia

Doped-ZnO is is an alternative material to the expensive ITO conductive-transparent oxide layer in planar OLED displays, liquid crystals displays, and solar cells. Further, it can be used as nanosensors, antibacterial coating etc.
Thin films (cca 100 nm) of ZnO material have been prepared/deposited by RF magnetron sputtering onto various substrates (mono-Si, sapphire, fused silica, and glass). Pure argon or argon+oxygen mixture were used as working gas, while substrates were held either at room temperature or at 300̊C. Al- or Ag-doped ZnO layers were prepared by codeposition of RF magnetron sputtered metals under pure argon. Structure of the prepared films was examined by the XRD, XRR, and GISAXS method, respectively, while topography was determined by microscopic (AFM) methods. Chemical composition of the films was determined by nuclear microanalysis technique (TOF-ERDA). Optical characterization was performed by light transmission measurements, while electrical conductivity was determined by Van der Pauw method.
The obtained films thickness was about 100 nm in all cases (100 RFW, 45 mins), except when pure oxygen (10% p.p.) was admixtured into argon, which resulted in reduced

deposition rate and films thickness of about 65 nm. The Zn/O atomic ratio was slightly below 1 in all cases, as expected due to the same ZnO sputtering conditions. Structure of all films is dominated by hexagonal/wurtzite symmetry, with prominent (103) and (002) preferential stacking at RT and 300C, respectively. However, their relative intensity changes oppositely with substrate temperature: (002) is enhanced while (103) is decreased with higher substrate temperature. In addition, otherwise weak (110) diffraction peak strongly increased at 300C in case od oxygen admixture in the working gas. Estimation of grain size from the XRD peaks yields preferential growth along (002) direction during deposition at RT, while grains are more rounded when deposited at 300C. The GISAXS results, however, indicate elongation of the grains perpendicular to the surface with increased substrate temperature in all cases.
Electrical conductivity depends upon type of ZnO-based film and strongly increases with substrate temperature (and subsequent annealing temperature). It turned out that Ag-doped ZnO exhibits el. resisitivity of about 10-2 Ωcm after annealing at 550C. Since both kind of doped-ZnO films exhibit good (> 80%) transmittance in visible light range, they are promising for application as transparent conductive oxide layer.

The Embodied Mind - A Shift Away from Classical Cognitivism.

Z. Radman
Institut za filozofiju, Ulica grada Vukovara 54, 10000 Zagreb

Mind, and especially consciousness, has been considered one of the last big scientific enigmas of our time. Our understanding of the phenomenon is changing as we move away from the 'black-box' model of behaviorism and classical cognitivism toward more embodied notion of the mind. By affirming the body as an important dimension of the mental implies a critique of brain-centrism that dominates contemporary discussions. In the presentation an attempt will be made to outline some consequences of the 'embodiment turn' that has also made us sensitive to the importance of environmental, social, and cultural conditions.

Silicon as anode for lithium-ion batteries

Matea Raić, Lara Mikac, Zoran Mandić, Vedran Petrić and Mile Ivanda
Ruđer Bošković Institute, Zagreb, Croatia

The success of Li-ion batteries in the early 1960s took years of research and contribution of many scientists and engineers. Since then there are several electronic revolutions and still lithium-ion (Li-ion) cells are the most widely used as rechargeable battery system for

portable electronic devices and electrical vehicles. It has many advantages like high energy density, long storage life, small volume, light weight, low self-discharge efficiency and non-memory effect. The most widely used anode is graphite whose lithiated compounds have stable phases up to the LiC6 stoichiometry corresponding to a theoretical specific capacity of 372 mAh / g[1]. In contrast, silicon possesses a very high theoretical capacity of 4200 mAh / g and can intercalate 4.4 Li into Si at high temperature to form Li15Si4[2]. Silicon also features a working potential around 0.4 V vs. Li+/Li which is safer than operating potential of graphite (0.05 V vs. Li+/Li). Although silicon possesses all of these advantages, silicon based anodes suffer from huge volume expansion upon cycling (≈400%) causing electrode fracture and electrical isolation during repeated cycling [3]. Continuous volume changes cause the breaking-reformation of the solid electrolyte interphase (SEI) film which leads to consumption of lithium-ions and electrolyte. Exhaustion of the electrolyte causes the degradation of conductivity and induces fast capacity loss [4]. The porous structure can provide a large space to accommodate volume expansion and provide a large surface area for lithium-ion transport from electrolyte to silicon [5]. In this work we present silicon microparticles as anode material for lithium-ion battery. Anode was based on powder silicon mixed with polyvinylidene fluoride (PVDF) and conductive carbon black (CB) in N-Methyl-2-pyrrolidone (NMP). The structural properties of the anode was characterized by scanning electron microscope (SEM). Silicon particles were also characterized with gas adsorption measurements to obtain pore size distributions and size of particles. Capacitive properties and stability were determined by using cyclic voltammetry (CV), electrochemical impedance spectroscopy (EIS) and galvanostatic measurements. Our work provides promising results so we will continue our research

Laser resonators for different laser Profiles and optical logic gates

M.Rakić, Austin W. Steinforth2, Andrey Mironov2, J. Gary Eden2
Institute of Physics, Bijenicka cesta 46, 10000 Zagreb, 2University of Illinois at Urbana-Champaign, USA

Generation of new laser profiles which are fully defined inside the resonator and require no additional optical shaping presents a challenging task but promises great practical use. Here I will show how linear and cylindrical laser profiles have been realized with an emphasis on their application. We used a laser resonator consisting of two mirrors, gain medium CdSe nanoparticle in solution, and an additional optical component placed within the resonator that is ultimately responsible for the shape of the output laser profile. Additionally, we used similar setup to achieve a NOT logical gate which, besides relatively trivial realization of AND and OR logic gates, allows for creation of XOR gates, resulting in complete optical logical algebra

SiO2-HfO2 coated spherical microresonators

Davor Ristić1, Maurizio Mazzola2, Andrea Chiappini2, Cristina Armellini2, Alphonse Rasoloniaina3, Patrice Féron3, Roberta Ramponi4, Gualtiero Nunzi Conti5, Stefano Pelli5, Giancarlo C. Righini5,6, Gilles Cibiel7, Mile Ivanda1, Maurizio Ferrari2

1Institut Ruđer Bošković, Bijenička cesta 54, 10000 Zagreb, Croatia.

2IFN – CNR CSMFO Lab., Via alla Cascata 56/C Povo, 38123 Trento, Italy.

3FOTON-Systèmes Photoniques (CNRS-UMR 6082), ENSSAT, 6 rue de Kerampont, CS 80518, 22305 Lannion cedex, France.

4IFN-CNR and Department of Physics, Politecnico di Milano, p.zza Leonardo da Vinci 32, 20133 Milano, Italy.

5IFAC - CNR, MiPLab., 50019 Sesto Fiorentino, Italy.

6Museo Storico della Fisica e Centro di Studi e Ricerche "Enrico Fermi", Piazza del Viminale 1, 00184 Roma, Italy.

7Centre National d'Etudes Spatiales (CNES), 31401 Toulouse Cedex 9, France.

We present some results regarding the coating of spherical microresonators and their different applications in photonics. A thin film coating on the surface of the resonator can be used to modify significantly the optical properties of the resonator. We have coated the microresonators with a sol-gel derived 70SiO2-30HfO2 coating and have studied its effect on optical and spectroscopic properties of the microresonator. By coating the sphere with an optically active layer we managed to achieve lasing action in the sphere. We also studied the phase matching influence on the coupling between a tapered fiber and a microsphere. Furthermore we studied the effect of the modal dispersion in the sphere on the coating thickness and have managed to produce spheres with giant normal dispersion

State specific analysis of excited electronic states in the nuclear ensemble approach

Marin Sapunar1 , Wolfgang Domcke2 , Nađa Došlić1
1 Department of Physical Chemistry, Ruđer Bošković Institute,

10 000 Zagreb, Croatia, 2 Department of Chemistry, Technical University of Munich,

85747 Garching, Germany

This work concerns the computation of UV spectra of DNA bases. We propose a procedure based on the computation of electronic wave function overlaps for automatically

determining the character of electronic transitions. Spectra are generated using the nuclear nsemble method in the gas phase and in solution and the electronic states at all nuclear geometries are assigned based on overlaps with a set of reference states defined at the ground state minimum geometry. This allows a state specific analysis of solvation effects. These effects are dominated by solvent-solute electrostatic interactions which are state specific and strongly destabilize nRyd states, and to lesser extent nπ* and πRyd states while ππ* states are slightly stabilized.

Holography and bio-inspired structures for surveillance

H. Skenderović, N. Demoli, D. Abramović, B. Jelenković, D. Pantelić
Institut za Fiziku, Bijenička cesta 46, 10000 Zagreb, Institut za fiziku, Prigrevica 118, Zemun

Through this project we will develop a proof-of-the-concept multispectral surveillance system, inspired by, evolutionary optimized, nano- and micro-structures of insect wings. Compared to existing systems, which are restricted to narrow spectral bands, the proposed system will coverultraviolet (UV), visible and infrared (IR) radiation..Micron-sized particles with internal nanostructures, similar to butterfly wing scales, will be used as sensing elements. Radiation-induced perturbations will beamplified by the interaction with the surrounding gas and detected by sensitive holographic techniques. Multispectral approach will enable efficient detection, recognition and identification, with increase robustness to various noise sources in complex tasks (such as unexploded mine detection or trafficking control).

Experimental generation of quantum entanglement and testing fundamentals of quantum physics

Mario Stipčević
Center of Excellence for Advanced Materials and Sensing Devices, Ruđer Bošković Institute, Zagreb, Croatia

Croatian and US elementary school systems and curricula can be seen as two extremes. In Croatia accent is given to learning and repeating static information of a very wide range of human knowledge, resulting in a large number of disjoint subjects, and with an inflexible approach to pupils and their individual abilities. In US, accent is given to skills and in-depth knowledge of an extremely reduced set of topics, resulting in an overly reduced number of subjects, however with a good approach to individual development of each child. We describe further differences in the two systems in a search for clues.

Differences between Croatian and US elementary schooling systems

Mario Stipčević
Center of Excellence for Advanced Materials and Sensing Devices (CEMS) Photonics and quantum optics research unit Ruđer Bošković Institute, Zagreb, Croatia

Croatian and US elementary school systems and curricula can be seen as two extremes. In Croatia accent is given to learning and repeating static information of a very wide range of human knowledge, resulting in a large number of disjoint subjects, and with an inflexible approach to pupils and their individual abilities. In US, accent is given to skills and in-depth knowledge of an extremely reduced set of topics, resulting in an overly reduced number of subjects, however with a good approach to individual development of each child. We describe further differences in the two systems in a search for clues.

Gas Sensors Based on Nano/Microstructured Organic Field-Effect Transistors

Kamran Syed and Mile Ivanda
Ruđer Bošković Institute, Zagreb, Croatia

Organic semiconductors are thin, flexible and environmentally friendly, enabling the opportunity to manufacture electrical components. These organic semiconductors can be formulated into inks and processed using solution based processing methods. The Poly (3-hexlythiophene) (P3HT) is one of the most successfully studied semiconducting polymers, due to anisotropic molecular structure crystallinity and orientation of the molecules in thin films can strongly affect the organic field-effect transistor (OFET) characteristics. We have developed a region-regular poly (3-hexylthiophene) (rr-P3HT) based organic field-effect transistor (OFET) and the device will be used for detection of low concentration gases. The relationship between the structural and transport properties of the P3HT thin films is studied. Both structural anisotropy and transport properties are enhanced upon thermal treatment. Investigation of the performance parameters of the OFET, source-drain, current/mobility, and threshold voltage will be studied while exposing the
conducting channel to various concentrations of gases. This is of growing technical interest as it may offer opportunities for the detection of gases

Ferrocenyl lithium reacts with phthalimide. DFT study of the mechanism

Davor Šakić, Valerije Vrček, and Alexander Hildebrandt

Faculty of Pharmacy and Biochemistry, University of Zagreb, and Technische Universität Chemnitz

In order to investigate the electronic and structural interactions between organometallic functionalities and heterocycles, a reaction between ferrocenyl lithium (FcLi) and N-phenyl phthalimide was performed. During the course of this reaction an unusual reactivity was observed. The conversion of one equivalent of FcLi with N-phenyl phthalimide, resulted in mono-ferrocenyl lactam, which rapidly undergoes ring-chain tautomerism. When two equivalents of FcLi were used, a bis-ferrocenyl lactone, involving a five-membered oxygen bridged heterocycle, was formed. In addition, a tricyclic product, in which one of the ferrocene moieties displays a planar chiral substitution pattern, was isolated. This complex reaction mechanism has been explored by use of modern computational techniques

Modelling of Sporadic Alzheimer's Disease and Testing of Oral Galactose as a possible Therapeutic Strategy

Melita Šalković-Petrišić
Department of Pharmacology and the Croatian Institute for Brain Research, University of Zagreb School of Medicine, Zagreb, Croatia

Alzheimer's disease (AD) is the most common form of dementia for which currently there is no cure. The most prevailing is its sporadic form (sAD) which presents as a metabolic disorder of the brain characterised by insulin-resistant brain state (IRBS) and brain glucose hypometabolism. Unlike the familial form of AD (fAD) caused by a mutation of the known genes, the cause of sAD is unknown but type 2 diabetes mellitus (T2DM) has been recognised as the important risk factor. Our research group has been the first to develop a rat model which generates IRBS following the intracerebroventricular administration of a betacytotoxic compound streptozotocin (STZ-icv model).
For the last 30 years we have been working on development and characterisation of the STZ-icv model which has afterwards been recognised as a possible model for sAD by professor Siegfried Hoyer† (University of Heidelberg, Germany). In 2004 we started to collaborate on this research with Professor Peter Riederer (University of Wuerzburg, Germany) and Professor Hoyer through the Deutscher Akademischer Austauschdienst (DDAD) Program (Germany – Croatia – Bosnia & Herzegovina). This fruitful collaboration which lasted within DAAD Program until 2010, and has been still going on with Professor Riederer through the projects of the Croatian Science Foundation (CSF), has resulted in a number of publications and validation of the STZ-icv model as a representative model for sAD, introducing its use also as a platform for testing the novel AD treatments.
In line with the increased interest in restoring IRBS in AD with therapeutic agents originally developed for the treatment of T2DM, including those stimulating the release of insulin, we started to collaborate with Professor Werner Reutter† (Charité – Universitätsmedizin Berlin, Germany) on a research of oral galactose and its therapeutic potential in

experimental AD models through the projects of the Croatian Ministry for Science, Education and Sports (2007-2012) and the ongoing CSF projects (2015 -), jointly with a team of Professor Riederer (DAAD project 2017-2018).
The rational for our research on oral galactose came from the previous work of Professor Reutter who found that galactose, a simple sugar composed of the same elements as glucose, is taken up by rat brain cells to a similar extent as by liver cells, and thus might serve as an additional source of energy in a condition of the glucose hypometabolism in the brain. It is known that at high levels, induced by dysfunctional metabolism of galactose or by exogenous parenteral galactose load, galactose causes oxidative damage in the body. However, our research has demonstrated that unlike the parenteral, oral galactose might have some beneficial effects in STZ-icv model of sAD related to stimulation of the release of the glucagon-like peptide 1 (GLP-1). GLP-1 is incretin, a hormone released from the gut into the bloodstream in response to food/nutrient ingestion, which then stimulate β-cells in the pancreas to release insulin. Additionally, GLP-1 has also important noninsulinotropic effects in the brain; neuroprotection, neurotrophy and promotion of neurogenesis. GLP-1-based drugs are registered for the treatment of T2DM and have shown promising results in animal models of neurodegeneration, and accomplished first positive results in AD clinical trials.
Thus, oral galactose treatment might offer a novel strategy to the AD therapy by combining several current trends; incretin-based therapy, nutrients as neuroprotective substances, and agent's multi-modality manifested here by stimulation of endogenous GLP-1-mediated central effects and by direct galactose effects in the brain (normalisation of brain glucose metabolism) and possibly along the oro-gastro-intestinal tract. Our current research is focused on elucidation of GLP-1-mediated effects of oral galactose in the brain as well as limitations of its therapeutic potential in animal models of neurodegenerative disorders.
Supported by the Croatian Science Foundation (IP-09-2014-4639, IP-2018-01-8938) and co-financed by the Scientific Centre of Excellence for Basic, Clinical and Translational Neuroscience (project "Experimental and clinical research of hypoxic-ischemic damage in perinatal and adult brain"; GA KK01.1.1.01.0007 funded by the European Union through the European Regional Development Fund).

Entropy and complexity measures of neaonatal heart rate variability

Matej Šapina1,2,3, Karolina Kramarić1,2,3, Krešimir Milas1,2, Ivan Malčić
University hospital Osijek, Osijek, Croatia, 2 - Medical faculty Osijek, Osijek, Croatia, 3 - Faculty of dental medicine and health, Osijek, Croatia, 4 - University hospital Zagreb, Zagreb, Croatia, 5 - Medical faculty Zagreb, Zagreb, Croatia

The heart rate variability (HRV) is the considered as the variability of the duration between successive cardiac cycles.
Over the last 20 years HRV analysis has gained much atention across various disciplines ranging from basic sciences to clinical medicine. It provides a noninvasive insight into the

autonomic nervous system tone, but also is an important parameter for predicting the outcome of various cardiac, and noncardiac conditions. Methods used in the HRV analysis range from simple linear to complex nonlinear methods.
However, most of the research was conducted on adults, while, only lately HRV research was conducted on the newborn population.
Here we present how two HRV methods behave in newborns undergoing different kinds of stimuli: the classical approach (using frequency domain analysis) and several nonlinear entropy and complexity features. Forty healthy term newborns went through a series of phases: two resting baseline, and two stress states, while recording the HRV.
A decrease of the parasympathetic tone was found when newborns were stressed. The directly and indirectly calculated nonlinear features, in general showed reduction of both entropy and complexity in stress. Combining those features resulted in a model which couild with high accuracy differentiate stress states from resting.
Although the research was conducted in a controlled environment, the results of HRV may be easily exteneded into the existing technology of neonatal intensive care units.

Solvothermal synthesis of zinc oxide: A combined experimental and theoretical study

Ankica Šarić, Ines Despotović and Goran Štefanić
Ruđer Bošković Institute, Zagreb, Croatia, Ruđer Bošković Institute, Centre of Excellence for Advanced Materials and Sensing Devices, Bijenička 54, HR-10002 Zagreb, Croatia

Zinc oxide is of interest in many applications as an important material with excellent combination of optical, electrical and microstructural properties. In order to optimize the properties of ZnO material for the highly technical or biomedical applications it is necessary to control its structure and morphology. This research is a follow up to our previous investigations [1, 2]. In a previous paper [2] we studied and compared the impact of a versatile family of ethanolamines (MEA and TEA) on the microstructural properties of the ZnO particles prepared in ethanol. In the present work zinc oxide particles were synthesized from zinc acetylacetonate in the presence of triethanolamine (TEA) and various alcoholic solvent, ethanol or octanol, at 170°C. The structural, optical and morphological characteristics of ZnO particles were monitored using X-ray powder diffraction (XRD), UV-Vis spectroscopy and field emission scanning electron microscopy (FE-SEM). The experimental findings are confirmed by means of DFT calculations. On the basis of both microstructural and theoretical studies, the nucleation and growth mechanism of ZnO nanoparticles is proposed. The nucleation and formation mechanism of ZnO nanoparticles was proposed considering the results obtained from a computational study of Gibbs free energies of ZnO−TEA molecular interactions (DeltaG*INT) in various solvent system. The calculations revealed different binding affinities which initiated the nucleation processes of ZnO into nanoparticles in the

presence of alcohols of different size and polarity. The high chelating efficiency of TEA towards zinc with tetrahedral geometry is observed. References
1. A. Šarić et al., J. Alloys Comp. 652 (2015) 91.
2. A. Šarić et al., ChemistrySelect 2 (2017) 10038.
Acknowledgements: This work has been partially supported by SAFU, project KK.01.1.1.01.0001.

FTIR spektri humane DNA

Nikola Šegedin1,4, Kristina Serec1,4, Valentina Karin-Kujundžić2,5, Petra Kejla3, Ljiljana Šerman2,5, Sanja Dolanski Babić1,4
1Department of Physics and Biophysics, School of Medicine, University of Zagreb

2Department of Medical Biology, School of Medicine, University of Zagreb

3Cinical Hospital Merkur, Zagreb

4Science center of excellence for advanced materials and sensors, Research unit New functional materials

5Science center of excellence for reproductive and regenerative medicine, Research unit Biomedical research of reproduction and development (CERRM)

Investigations of DNA vibrational properties using Fourier transform infrared spectroscopy can be traced back to 1960s. There is a high interest among researchers for this method given the fact that it's nondestructive and suitable for investigation of DNAs vibrational properties which are related to the DNAs structural properties. In most cases, fragments are short sequences of DNA which are extracted from Salomon testes or calves gland timus. In this type of research, there is a little investigation of DNA from biological tissues [1] and even less on human DNA [2]. FTIR spectrum of DNA with the range of wavenumbers from 4000 to 400 cm-1 contains about 40 spectral lines which are the result of the DNAs double-stranded structure. Range from 1800 to 800 cm-1 is of special interest because in this range we can find the most vibrations that can be divided into two groups: vibrations of bases and backbone of DNA [3].
In this research, we have used DNA that is extracted from the human placenta of regular pregnancies (archive samples of CERRM). DNA was isolated from formalin-fixed paraffin-embedded (FFPE) tissue sections. Sections were deparaffinized with Histoclear II, washed with 100% ethanol, resuspended in digestion buffer and digested with proteinase K. Isolated DNA was purified with DNA purification kit and eluted using Tris buffer. Measurements using infrared spectroscopy were performed on thin films that were made from DNA solutions. Normalization and baseline correction was performed using program Kinetics which is part of the MatLab software and in program eFTIR. This processed spectra will enable us to assign the certain characteristic vibrational bands so we can

compare them with relevant information and finally with the pathological human placenta.

[1] P. Zucchiatti, K. Latella, G. Birarda, L. Vaccari, B. Rossi, A. Gessini, C. Masciovecchio, and F. D'Amico, J Raman Spectrosc 49, 1056 (2018).
[2] Y. Nishida, S. Yoshida, H. J. Li, Y. Higuchi, N. Takai, and I. Miyakawa, Biopolymers 62, 22 (2001).
[3] K. Serec, S. D. Babić, R. Podgornik, and S. Tomić, Nucleic Acids Res 44, 8456 (2016).

Assessment of embryo culture media metabolome by infrared and raman spectroscopy

Marko Škrabić, M. Balarin, Ozren Gamulin
School of Medicine, University of Zagreb, Croatia

Metabolomics is a scientific discipline that studies chemical processes involving intermediates and products of metabolism (metabolites). The field of metabolomics most commonly includes the study of global metabolite profiles in a system (cell, tissue or organism), the systematic study of the unique chemical fingerprints that specific cellular processes leave behind, specifically, the study of their small-molecule metabolite profiles and the systematic analysis of the inventory of metabolites (small-molecule biomarkers) that represent the functional phenotype at the cellular level. The metabolome refers to the complete inventory of small-molecule, non-proteinaceous compounds, such as metabolic intermediates, ATP, fatty acids, glucose, cholesterol, hormones and other signaling molecules, as well as secondary metabolites that are found within a biological sample. As such, the metabolome changes continuously, depending upon the activation and interaction of the various metabolic pathways within the cell. In addition, the metabolome is considered to be a reflection of phenotype, which can then be used to infer gene function. Metabolomics arise from genomics, transcriptomics and proteomics, and due to its simplicity and inexpensiveness (relative to aforementioned disciplines) became popular method for research in biology and biomedicine. While genomics and proteomics can provide important information on the expected function, metabolomics provides an immediate snapshot of all current biological functions reflecting up-to-the-minute events. By systematically measuring the population of small-molecule biomarkers (metabolites), scientists can establish profiles or signatures of healthy individuals versus those with specific illnesses. Moreover, metabolomics can provide indications of a metabolic problem or lesion with high accuracy and at lower costs than genomics, transcriptomics or proteomics, and is therefore well suited for widespread investigations in the life sciences. As such, metabolomics is expected to be a relevant tool in the management of various medical conditions and, therefore, an important method for studying basic biological functions in conjunction with other methods.

Studying complex metabolic profiles of biological systems requires specific analytical techniques. There are several different means of detection that can be used to obtain metabolomic data. While mass spectrometry and nuclear magnetic resonance are by far

the two leading technologies used for metabolomics research, Raman and infrared spectroscopy have also been successfully employed to identify and quantify biomarkers. These latter methods have similar levels of analytical sensitivity to the previous methods, but also have several added advantages such as the direct sample measurement in which no preparation is required, the little chemical bias, smaller instrument size and easier maintenance of instruments as well as the rapid, simultaneous analysis of multiple biomarkers.

In this work we analyzed culture media in which rat embryos grew for 14 days, with and without valproate (VPA) which is a chemical compound used in medicine for the prevention of migraine headaches and in the treatment of epilepsy and bipolar disorder. Using FTIR spectroscopy the spectra of media metabolome were recorded in order to determine whether this method could be suitable for assessing teratogenic effect of different substances on embryo growth. The recorded spectra were analyzed by statistical methods of PC analysis and PC regression. It was shown that the method of FTIR spectroscopy can distinguish media metabolome between control group in which rat embryos grew without valproate and the one in which they grew with valproate which proved that valproat toxicity is reflected in the change of the metabolome of the media, which can be monitored by FTIR spectra. We have established that the spectroscopic analysis of the metabolome media contains information about the difference in the growth and development of embryos through the monitored period of time. Using PCA analysis we have shown that from metabolome spectra we can determine for how long the embryos grew in culture. These results suggest that FTIR spectroscopic analysis of the media metabolome can be a new model for the screening of different embryo toxic and teratogenic substances.

We are now in a process of repeating the same experiment using Raman spectroscopy as a complementary technique to the Infrared spectroscopy, in order to determine whether this method can also be used as a model for the screening of different embryo toxic substances. Preliminary results have been obtained in reflectance mode and show similar trend in results.

Structural and microstructural changes in the ZrO2-MgO system over the course of thermal treatment

Goran Štefanić,1 Vinko Nemec,2 Mile Ivanda,1 Helena Kaper3

1Center of Excellence for Advanced Materials and Sensing Devices, Ruđer Bošković Institute, Zagreb, Croatia

2Division of Inorganic Chemistry, Department of Chemistry, Horvatovac 102A, HR-10 000 Zagreb, Faculty of Science, University of Zagreb, Croatia

3Joint Laboratory CNRS, 1 Rue Sainte Anne, 84350 Courthézon, Saint-Gobain, France

Irreversible Inhibition of the MAO B Enzyme. A Computational Insight into the Inactivation Mechanism

Tana Tandarić
Ruđer Bošković Institute, Zagreb, Croatia

Amorphous precursors of the ZrO2-MgO system have been co-precipitated from aqueous solutions of nitrate salts. Dried samples were calcined in air at different temperatures up to 1000 °C and analyzed at room temperature using X-ray powder diffraction, Raman spectroscopy, Fourier transform infrared spectroscopy, field emission scanning electron microscopy and energy dispersive X-ray spectrometry.
The results of phase analysis indicate an extended capability for the incorporation of Mg2+ ions in the metastable ZrO2-type solid solutions obtained after crystallization of amorphous co-gels. Maximum solubility of Mg2+ ions decreases with the increase of temperature treatments from ~25 mol% (600 °C) to ~15 mol% (800 °C) and finally to 8 mol% (1000 °C). The incorporation of Mg2+ ions partially stabilized high temperature polymorphs of zirconia (tetragonal and/or cubic). Precise unit-cell parameters of the ZrO2-type solid solutions were determined by using both Rietveld and Le Bail refinements of the powder diffraction patterns with added silicon as an internal standard. By increasing Mg2+ content the lattice parameter c in tetragonal polymorph of zirconia decreases rapidly and, with the addition of 5 mol% Mg2+, becomes very close to the lattice parameter a (approaching cubic lattice). However, the results of laser Raman spectroscopy indicate presence of tetragonal symmetry even after incorporation of 10 mol% of Mg2+ ions, which was attributed to the displacement of the oxygen sublattice from the ideal fluorite positions. Microstructural analysis shows that the addition of up to 10 mol% Mg2+ ions promotes sintering of samples treated at 1000 °C.
The influence of thermal treatment on the crystallization of the amorphous precursors was examined also by differential thermal analysis and thermogravimetric measurement. The obtained results show that the crystallization temperature of the amorphous precursors increased with an increase in the magnesium content, from 445 °C (0 mol% MgO) to 625 °C (~50 mol% MgO). The obtained results were compared with the results obtained for mixed oxides of zirconium and undersized divalent metals (systems ZrO2-NiO [1], ZrO2-ZnO [2] and ZrO2-CuO [3]).
Activity of ZrO2-type solid solutions with up to 10 mol% of Mg2+ ions in catalytic oxidation of CO, tested by using temperature-programmed reduction and oxidation (TPR and TPO), show to be very high.

Keywords: ZrO2; MgO; Raman spectroscopy; SEM; EDS; lattice parameters; phase analysis; thermal analysis
References
[1] G. Štefanić, M. Didović, S. Musić, J. Mol. Struct. 834-836 (2007) 435-444.

[2] G. Štefanić, S. Musić, M. Ivanda, J. Mol. Struct. 924 (2009) 225-234.
[3] G. Štefanić, S. Musić, M. Ivanda, J. Alloy. Compd. 491 (2010) 536-544.

Organometallic derivatives of DNA bases

Mateja Toma, Davor Šakić, Jasmina Lapić, Senka Djaković, and Valerije Vrček
Faculty of Pharmacy and Biochemistry, University of Zagreb

Organometallic derivatives of nucleobases (OrDeNs) belong to the new generation of conjugates in which metallocenes are linked to the basic structural elements of heredity. Nucleosides in which sugar part is replaced with organometallic moiety, such as ferrocene, combine electro- and bio-active fragments and are of use in (bio)analytical chemistry, and in medicinal chemistry since they are shown to exhibit anticancer and antibacterial activity.
An attractive feature of ferrocene is that the vertical distance between the two Cp rings in ferrocene is 0.35 nm, which is similar to the distance between the stacked base pairs in DNA. These could provide useful building blocks in supramolecular chemistry coupling molecular recognition derived from DNA bases with electrochemistry from the redox active ferrocene, leading to the novel applications for the electrochemical recognition of a DNA/RNA binding substrates.

Interdisciplinary Research of Human Dipeptidyl Peptidase III

S. Tomić
Ruđer Bošković Institute, Zagreb, Croatia

In my talk I will describe our research activities related to human dipeptidyl peptidase III (hDPP III) a member of the M49 enzyme family. HDPP III is a cytosolic, two-domain metallopeptidase, with the zinc cation participating in the peptide bond hydrolysis. It is involved in the intracellular protein catabolism, pain modulation and, by its binding to the Kelch domain of KEAP1, in the defense against oxidative stress1,2 . KEAP1 is a member of the NRF2-KEAP1 signaling pathway, one of the main regulators of oxidative stress response in the cell. It has been shown that ETGE motif (also present in NRF2) is essential for DPP IIIKEAP1 interaction, and that binding of DPP III to KEAP1 induces NRF2 release from the complex with KEAP1 and the overexpression of the cytoprotective genes2 . I will present our ongoing interdisciplinary research on the KEAP1-hDPP III interaction as well as results of our researches related to the enzymatic mechanism of hDPP III, ligand

binding and the zinc ion parameters derivation3-6. [1] B.E. Hast, D. Goldfarb, K.M. Mulvaney, M.A. Hast, P.F. Siesser, F. Yan, D.N. Hayes, M.B. Major, Cancer Res. 73(7) (2013) 2199-2210.
[2] K. Lu, A.L. Alcivar, J. Ma, T.K. Foo, S. Zywea, A. Mahdi, Cancer Res. 77(11) (2017) 2881-2892.
[3] A. Tomić, M. Berynskyy, R.C. Wade, S. Tomić, Mol. Biosyst. 11(11) (2015) 3068–3080.
[4] A. Tomić, B. Kovačević, S. Tomić, Phys. Chem. Chem. Phys. 18(39) (2016) 27245–27256.
[5] A. Tomić, G. Horvat, M. Ramek, D. Agić, H. Brkić, S. Tomić, J. Chem. Inf. Model. (2019), DOI: 10.1021/acs.jcim.9b00235.
[6] M. Dehić, J. Suć Sajko, Z. Karačić, P. Piotrowski, T. Šmidlehner, I. Jerić, C. Schmuck, I. Piantanida, S. Tomić, J. Biomol.
Struct. Dyn. (2019)

Swift heavy ion irradiation of graphene: effects of the ion charge state

K. Tomić1, D. Iveković1, H. Vázquez2, F. Djurabekova2, A. Gajović1, P. Dubček1, Z. Siketić1, M. Jakšić1, M. Karlušić1
1Ruđer Bošković Institute, Zagreb, Croatia, 2Department of Physics, University of Helsinki, Helsinki, Finland

Material modifications using swift heavy ions usually take into account only electronic stopping power of the ion and its velocity. However, as discussed previously [1], for near surface experiments, ion charge state can also play an important role because ions delivered from accelerators can have lower (or even higher) charge state than equilibrium value for a given beam energy. This can influence modification of the materials' surfaces because ion stopping depends on its charge state.
Abovementioned effect should be most easily detected in case of ion irradiation of 2D materials such as graphene. In this contribution we present experimental results based on Raman spectroscopy and atomic force microscopy, showing the damage in graphene depends strongly on the charge state of the swift heavy ion. Observed damage behaviour can be correlated with increase in the energy loss due to the ion charge state increase. Molecular dynamics simulations have complemented these experimental results in order to investigate role of the substrate on damage production in graphene.

Hybrid Security Challenges and Solution Pathways Framework Using Science and Technology Convergence Paradigm

Ashok Vaseashta
Virginia Polytechnic Institute and State University, Manassas, Virginia, USA

Numerical Modelling of Vascular Disease Progression

Lana Virag, Nino Horvat, Igor Karšaj
Faculty of Mechanical Engineering and Naval Architecture

University of Zagreb, Ivana Lučića 5, 10000 Zagreb, Croatia

Vascular disease is a class of diseases involving blood vessels – arteries and veins. Most (cardio)vascular diseases affect older adults. Diagnosis of disease typically occurs seven to ten years earlier in men as compared to women. The most common vascular diseases are peripheral artery disease, aortic aneurysms, and carotid artery disease. They are usually caused by smoking, diabetes mellitus, lack of exercise, obesity, high blood cholesterol, poor diet, and excessive alcohol consumption.

The underlying mechanisms vary depending on the disease; however, most of them are not well understood due to difficulties related to obtaining human samples for histological or mechanical testing, especially for longitudinal studies on same subjects. Furthermore, it can be difficult to diagnose a vascular disease, since most of them are asymptotic, and diagnoses are made coincidentally. The late discovery of diseases limits our apprehension of their initialization and early progress.

Thus, computational biomechanics shows a great potential for expanding our understanding of biochemomechanical processes happening during evolution of vascular diseases. Models that seek to describe fundamental mechanisms by which changes in the mechanical environment govern biological growth and remodelling have been increasingly in use in order to improve our current understanding of biochemical and biomechanical (biochemomechanical) processes and to predict disease progression. They can be used for modelling various tissues and diseases, from tendon healing and myocardial hypertrophy, to the prediction of arterial adaptations in health (e.g., after a change in flow and blood pressure or during aging) and disease (e.g., abdominal aortic aneurysms). In addition, these models can aid prediction of disease progression and outcome, and stride to help clinicians make treatment decisions.

The focus of this talk will be mainly on the evolution and rupture of abdominal aortic aneurysms, both thrombus-laden and those without thrombi. Numerical simulation of effects of hypertension, smoking, and other risk factors on growth of aneurysm will be shown.

Competitive research funding in Croatia

Dario Vretenar
Croatian Academy of Sciences and Arts Zagreb and Faculty of Sciences, University of Zagreb

Public support for research and research-based innovation includes direct institutional allocations and competitive project funding. In many developing countries the proportion of institutional to project funding is relatively high, but there is a marked trend towards more competitive funding instruments. While a certain level of direct institutional funding is necessary for capacity building and basic research, competitive (performance-based) funding focuses on scientific priorities, promotes collaborations, improves research performance, and stimulates more efficient use of resources. The role and current trend of competitive research funding in Croatia will be illustrated with the example of the Croatian Science Foundation, the national organisation that allocates funds to individual researchers and research groups on a competitive basis, through open calls, and with international peer-review based evaluation of proposals.

Clinical Testing of the New Drug "Osteogrow"

Slobodan Vukičević
Medical faculty, University of Zagreb

Whispering Gallery Mode Microresonator for Ammonia Vapors Concentration Detection

Daniil Zhivotkov1, Elena Romanova2, Davor Ristic1, Mile Ivanda1
1Ruđer Bošković Institute, Center of Excellence for Advanced Materials and Sensing Devices, Laboratory for Molecular Physics and Synthesis of New Materials, Croatia

2Saratov State University, Russian Federation

The microspheres made of silica (SiO2) based on whispering gallery modes (WGM) can be used as a gas and liquid sensor. The evanescent field penetrates in outer medium so that it can carry information about vapors and gasses that change the resonators properties. One of the possible ways is to track the change of the resonance peak position due to the increase of the refractive index of the outer medium. In this work the setup for measuring of ammonia vapors is shown. Also, a small concentration of ammonia vapors were measured with estimated sensitivity of 4.7 pm/ppm corresponding to a detection limit of 0.13 ppm. In order to increase the sensitivity the spheres were coated by sol-gel method

with a porous silica layer with different acid concentration and studied the influence of them on the sensing sensitivity.

Missions and Horizon Europe: the Inter/Multi/Transdisciplinary Context

Milena Žic Fuchs
Faculty of Humanities and Social Sciences, University of Zagreb

Croatian Academy of Sciences and Arts

Academia Europaea

This paper will give insights into the present state and articulations of what 'missions' will be in Horizon Europe, and within this much discussed topic special focus will be directed to the inter/multi/transdisciplinary context. Namely, from the Lamy Report onwards (LAB – FAB – APP: Investing in the European future we want. Report of the independent High Level Group on maximising the impact of EU Research & Innovation Programmes) stress has been put on the 'multidisciplinary' nature of research questions, those which are considered to be of the utmost importance, with special emphasis on the role that the Humanities and Social Sciences can and should play in these contexts.

Challenges of application of modern genetic methods on life and health quality

Tamara Žigman1, Danijela Petković Ramadža,1,2 Sanda Huljev Frković,1,2 Ivo Barić,1,2
1 Department of Pediatrics, University Hospital Centre Zagreb, Zagreb, Croatia

2 School of Medicine, University of Zagreb, Zagreb, Croatia

The discovery of DNA structure more than 60 years ago was the milestone in understanding the diversity and complexity of genomes in health and disease. Great progress was continued in 1990 by launching the Human Genome Project that was completed in 2003. It was the world's largest collaborative research project with the goal of determining the sequence of nucleotide base pairs that build up human DNA, identifying and locating all the genes in the human genome and understanding their function. It also revealed the need for developing new and advanced technologies to answer complex biological questions. Next generation sequencing (NGS) technique enabled reading through entire genome in short time, with great precision and acceptable costs, all prerequisites for starting using sequencing as clinical tool a decade ago. After application to individual patients, it led to many examples of genome-driven medical decision making, which is how we understand today the precision or personalized

medicine. Personalized medicine includes also some degree of personalization that would incorporate pharmacogenomics-based tailoring of therapy. Precision medicine is increasingly recognized as technology-driven and participant-centred approach, especially in the field of rare diseases. A final progress includes the concept of precision health- using similar approaches for disease prevention and health promotion. These exciting advancements have had enormous positive impact on global life and health quality, but not without limitations. As new technologies emerge, existing problems are exacerbated or new problems arise. Further efforts are needed to enable optimisation of sequencing quality and data interpretation. Global sharing of this more accurate genotypic and phenotypic data will accelerate the determination of causality for novel genes or variants.

Besides better understanding of monogenic and complex diseases and individualisation of patients' therapies in some extent, next generation sequencing technologies also enabled further progress in the field of prenatal and preimplantation diagnostics and genetic counselling which further opened new ethical questions and dilemmas. New technologies also enabled discovery of CRISPR–Cas genome editing systems that have transformed our ability to manipulate, detect, image and annotate specific DNA and RNA sequences in living cells of diverse species towards clinical use in gene and cell therapies. The impact of NGS technology allows both small and large research groups to provide answers and solutions to many different problems and questions in the fields of genetics and biology, including those in agriculture, forensic science, virology, microbiology, and marine and plant biology. Future advancements will rely on new technologies and large-scale collaborative efforts from multidisciplinary and international teams to continue generating comprehensive, high-throughput data production and analysis.