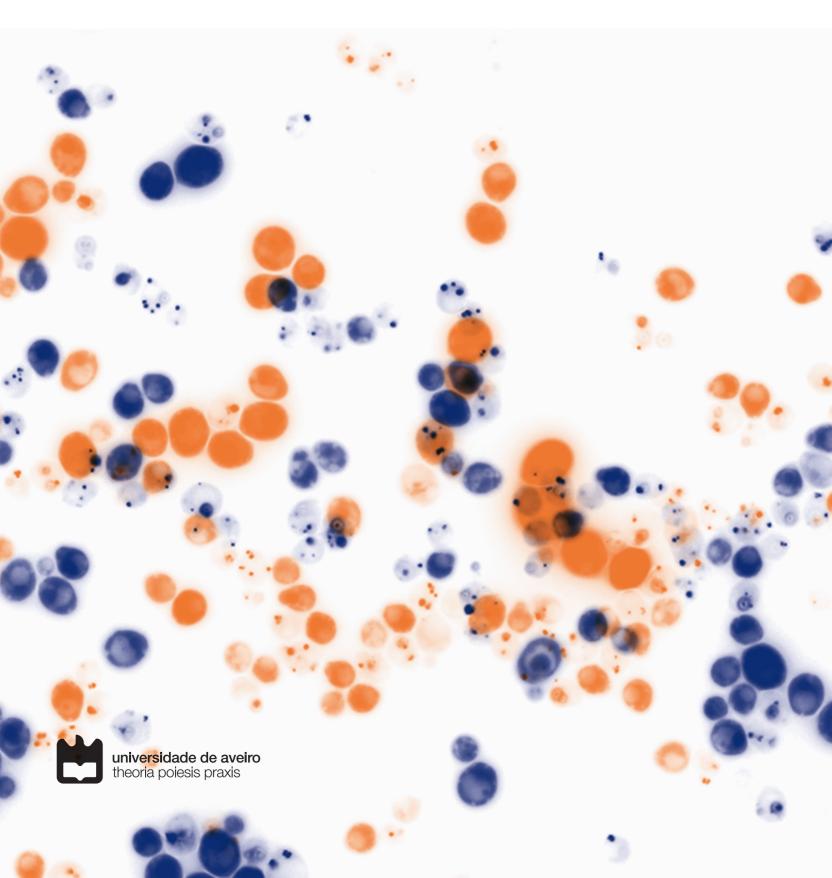
## 2013

# research@ua





**06** A WORD FROM THE RECTOR



- 10 SPOTLIGHT **ON RESEARCH DISSEMINATION**
- 12 Research Day 2013
- 14 Academia de Verão

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**08** MESSAGE FROM THE VICE-RECTOR



**16** Invited Chairs

18 ERC Grant

**20** Researchers

of the month 2013

- 24 RESEARCH INFRASTRUCTURES
- 26 Aveiro Institute for Marine Science and Technology (AlMare)
- 28 Research centres at UA

- **58** 2013 IN REVIEW
- 60 People
- **62** MSc and PhD theses
- 63 SCI papers
- 64 Intellectual property
- 65 International projects
- **66** Budget



30 RESEARCH HIGHLIGHTS

## MANUEL ANTÓNIO ASSUNÇÃO

University of Aveiro

## A WORD FROM THE RECTOR



"We are at the start of a cycle which will bring substantial changes to European funding, and over the next seven years, the European Framework Programme for Research and Innovation - Horizon 2020 will be one of the most important instruments for the development of science and technology in Europe. The creation of the necessary conditions for the ample participation of UA teaching and research staff in research, innovation and demonstration projects and in research networks funded under Horizon 2020 will therefore be crucial to countering the lack of investment at national level. This policy, of promoting the UA's participation in Horizon 2020, should not, however, ignore or dissociate itself from the RIS3 - Research and Innovation Strategy for the Specialisation of the Central Region and from the main areas of interconnection. The international and regional levels should always be viewed as mutually reinforcing."

## **JOSÉ FERNANDO F. MENDES**

University of Aveiro

MESSAGE
FROM
VICE-RECTOR
FOR
RESEARCH
AND
DOCTORAL
SCHOOL



2013 was a special year for the University of Aveiro (UA), not only because it was its 40th anniversary, but also because it was the closure year of the first mandate of the present Rectory. It was the time to reflect and to take important decisions, but, simultaneously, a year to celebrate and to be proud for the great achievements in such a short history.

The interrelation and integration of research, education and cooperation with society have always been present in the history of UA and its reinforcement has marked this last mandate. Training young researchers with high quality education and ensuring that the research developed at the UA research centres has impact at the fundamental and technological levels, contributing to a more sustainable society, continues to be a part of the UA main objectives.

In the prosecution of those objectives, in the last years the UA carried out major efforts to maintain and attract some of the best researchers in strategic research areas and to invest in cutting-edge scientific infrastructures in order to provide to its researchers the best conditions to compete in the national and international levels. Through the programme SAICT - Support System to the Scientific and Technological Infrastructures, the UA has been able to cofinance, in the past few years, several scientific infrastructures of major relevance for its research community. These infrastructures comprise new research facilities, specifically the ECOMARE (research centre for innovation and sustainability of the economy of the sea) and the building for optical communications, radio communications and robotics; the recovery of two buildings which integrate the associated labs CICECO and CESAM and the acquisition of several scientific equipment for the research centres I3N, QOPNA and TEMA and to the Polytechnic School Aveiro North.

During 2013, the scientific projects of two invited Chairs have started in two important scientific fields, with the partnership of the Caixa Geral de Depósitos, the Nokia Siemens Networks Portugal S.A. and the Foundation for Science and Technology - the Chair CGD - Marine Studies and the Chair NSN – Telecommunications, respectively. Furthermore, in the beginning of the year, the projects, co-funded by the program "Mais Centro" in the strategic areas of biomaterials, ICT, energy, neurosciences and marine studies, initiated its work plans, which allowed the recruitment of more than 50 researchers to strengthen the development and impact of those areas.

Additionally to the aforementioned measures, efforts have been made to promote the diversification of funding sources, mainly through the participation in EU-funded projects. The participation in new European projects has been increasing along with the number of exchange programs, joint master and doctoral programs and other internationalization actions. In fact, 2013 was a special year in terms of EU-funded projects, since it was the year in which the UA had its first ERC Grant approved with the project "IgYPurTech", promoted by Mara G. Freire, a young researcher of associated laboratory CICECO.

Taking into account the national constraints and uncertainty in which respects the funds for research, that is, undoubtedly, a strategy to maintain and reinforce with special attention to the new framework programme (Horizon 2020), the most relevant funding instrument for the next seven years. The multidisciplinary nature of the UA research centres will, certainly, be one of our main strengths to potentiate our participation in research projects funded by the Horizon 2020.

In line with the strategy adopted in the previous year with the creation of the Aveiro Institute of Nanotechnology (AIN), and considering the relevance of the research topic at a regional, national and European levels, in 2013, it was launched the Aveiro Institute for Marine Science and Technology (AlMare). This virtual institute integrates researchers from seven research centres and aims at fostering capacity building and know-how transfer, as well as promoting synergies between academia, industry, policy-makers and society, and contribute to the national and international recognition of UA excellence in coastal, marine and maritime sciences and technology. Recent results demonstrate that the UA has been following a path of success. The positions achieved in several international rankings highlight the quality of its research and education. The Leiden ranking has recently acknowledge UA as the best national institution; in the National Taiwan University ranking the UA is among the best world institutions in two fields and in eight subject areas; and the Times Higher Education ranking classified the UA among the best institutions with less than 50 years.

Important prizes attributed to successful students and researchers and prestigious distinctions endorsed to UA faculty members are also important drivers for the university development and its national and international recognition. Currently, UA has members in the prestigious Academia Europaea and in the Sciences Academy of Lisbon in several sections among other relevant distinctions.

Furthermore, in the scientific highlights section of this edition it can be found some of the great achievements of the UA scientific community, resulting from the work developed in the last years in several different research fields, reflecting the important collaborations established with numerous renowned national and international organizations, as well as the multidisciplinary environment that characterizes the UA.

I hope this fourth edition may be considered an exciting and encouraging reading and, who knows, the starting point for new future collaborations!





# **Research Day 2013**



The Research Day, a yearly event promoted since 2011 with the aim of celebrate the University of Aveiro's research achievements and reinforce the interdisciplinary and collaboration among researchers and departments, had its 3rd edition last June 19.

During the day, some of the excellent research results recently achieved were shared by postgrad students, researchers and professors. 12 high-quality lectures, 161 posters and 9 prototypes were presented, so all members of the University community learned more about the research carried out at the University in the most varied fields. A panel of specialists evaluated the studies presented and prizes were awarded to the best 4 poster presentations in the fields of Arts & Humanities, Sciences and Engineering, as well as 4 honorable mentions.

As for the previous editions, two keynote speakers contributed to the quality of the program which attracted over 800 attendees from the University. In 2013, the invited speakers were Bert Verveld, Secretary General of the University of Groningen, Netherlands, and Chairman HUMANE (Heads of University Management and Administration Network in Europe) and Michael Byram, Professor Emeritus of the University of Durham, UK.

The cutting-edge investigation made in UA with high impact in the region and in the society was patent during the event, attracting the Portuguese media for the third consecutive year. Prototypes like a robot developed in the scope of the project CAMBADA@Home to support the independent and active ageing of the elder population and an investigation developed by doctoral students with the objective of creating a walking stick to help guide blind people (Smart Floor) were highlighted in the media, among other research projects.

The Research Day is an event that celebrates the research performed by its community, but also one way of capitalizing the multi and interdisciplinarity existent among the 16 departments and 18 research centres at the campus, which have been contributing to its success and to overcome the complex challenges imposed to research fields in the recent years.









## Academia de Verão



## "ACADEMIA DE VERÃO" IN AN OPEN CAMPUS

The Summer Academy (Academia de Verão) is the most intense outreach activity for young people promoted by the University of Aveiro. In the 2013 edition, 376 young students from all over the country (aged between 10 and 21 years old) participated in this programme. During two weeks of July, the departments and schools organized 22 thematic programmes in different scientific areas, to fulfill the interests and expectations of the young participants.

Either during one or two weeks, the University provided these young participants with the opportunity of exploring interesting scientific projects, integrated in a handful of projects totally organized by the departments that accepted this annual challenge. Some municipalities and companies sponsored the participation of the best students in the Academy, with a total of 74 scholarships attributed.

Besides the laboratorial experiments, the exciting field work and the pleasant field visits outside the Campus, students also had the privilege of being in contact with the real university lifestyle - they were accommodated in the students' residences, had their meals in the campus canteens and performed sports activities in the gymnasium and on the university lanes in the afternoon. Of extreme importance was the close relationship with the university students and researchers that monitored their stay on Campus and coordinated the cultural, sports and lab activities.

Children and young people are welcome to visit the campus and join the scientific and cultural activities, promoted especially for them, throughout the year. In 2013, more than 3000 visitors were in the university campus. In the Science and Technology Open Week, which takes place in November, over 8000 students joined the university students and researchers in 446 activities specially designed for them.

As its motto states, the University of Aveiro is a true "campus with ideas".

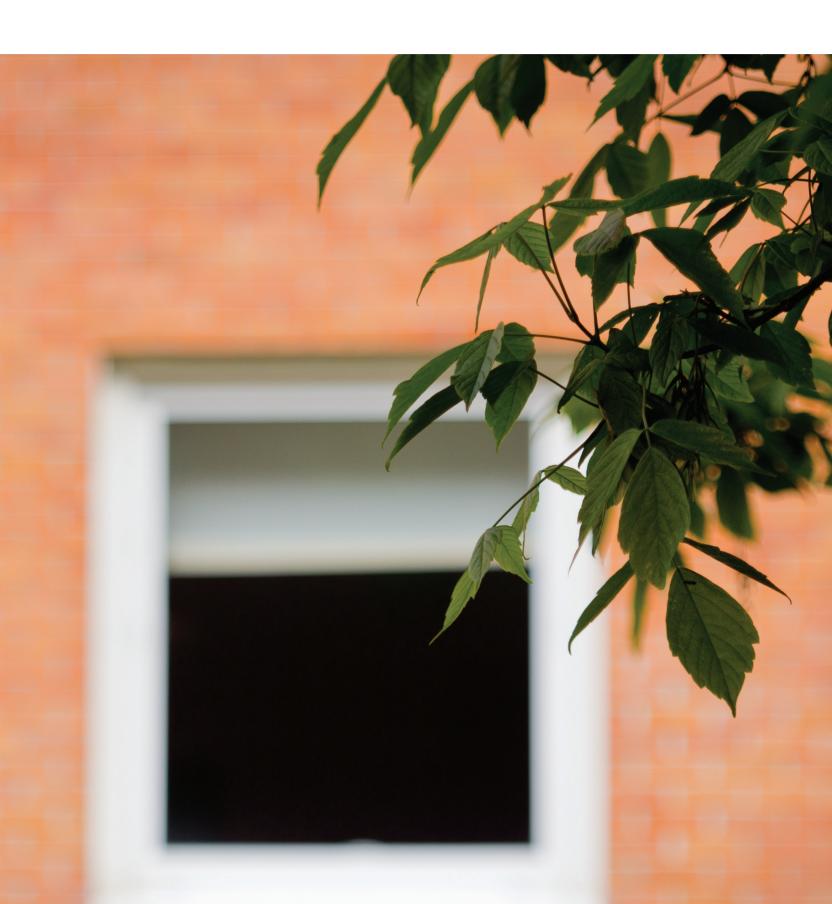








## **Invited Chairs**



### **CHAIR CGD - MARINE STUDIES**

The region of Aveiro has a strong maritime culture and tradition due to its natural conditions, namely, its lagoon, coastline and sea. Being the University of Aveiro (UA) an institution highly committed with the region, its socio and economic development, the coastal, marine and maritime research has become a foremost topic within the UA. In order to reinforce the development and impact of this scientific area, several measures have been implemented by UA in the recent years. In 2010, the Caixa Geral de Depósitos (CGD) and the UA signed the memorandum of understanding that established a Chair dedicated to marine studies - the Chair CGD - Marine Studies.

With the implementation of this Chair, both institutions expect to reinforce the scientific knowledge on marine sciences, by strengthening internal synergies between the existing research areas in UA and by creating opportunities to align the undertaken research with the regional, national and international priorities in this area and, thus, to contribute to the valorization and preservation of marine resources, to support policy makers and to develop the maritime economy.

The official presentation of the Chair CGD-Marine Studies, attributed to Professor Graham John Pierce, occurred last February 22 and counted with the interventions of Professor Manuel António Assunção, the Rector of UA, and Dr. Rui Soares, Representative of the CGD.

Professor Graham John Pierce concluded his PhD in 1985, in the University of Aberdeen, UK, with the thesis "The foraging behaviour of the common shrew Sorex araneus". He is a Full Professor at the School of Biological Sciences of the University of Aberdeen and one of the leading experts in Marine Biology and Fisheries. Professor Graham Pierce develops his research mainly in marine biology and fisheries, particularly on the biology and ecology of marine mammals and cephalopods, but also on biodiversity, coastal zone management, and modelling habitat use in marine animals. The geographical focus of his work includes Scottish waters, the Iberian Peninsula, the Mediterranean and the SW Atlantic.



### **CHAIR NOKIA SIEMENS NETWORK - TELECOMMUNICATIONS**

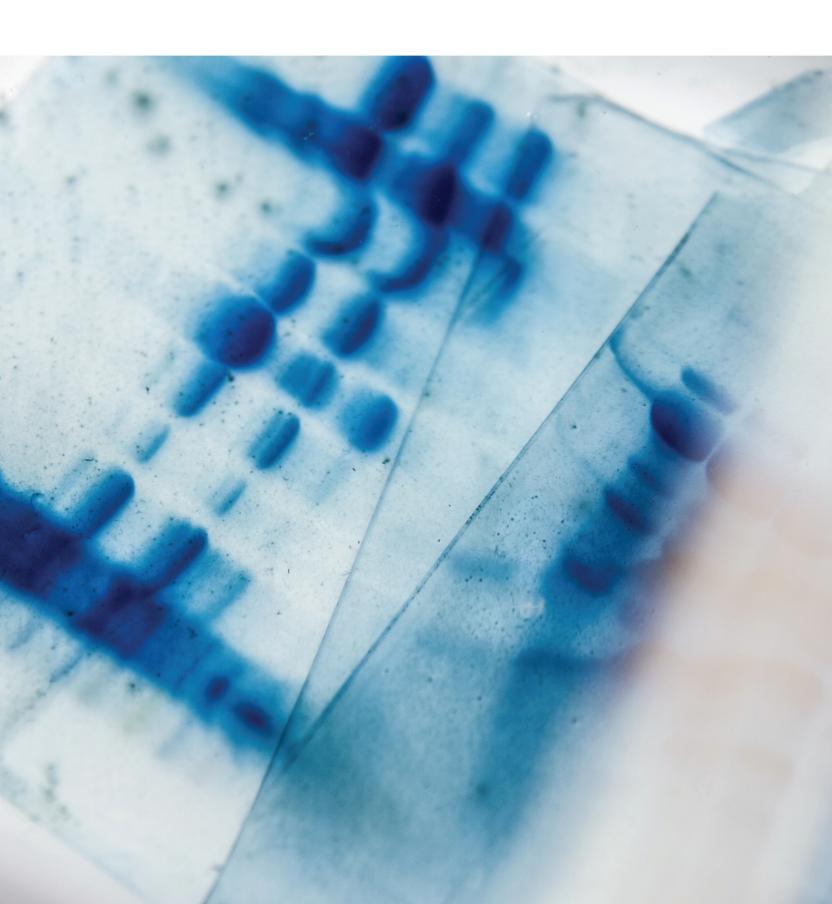
The history of the scientific area of telecommunications in the University of Aveiro (UA) starts with the history of the University itself. The educational and scientific activities of our University began, in 1974, with the course of Telecommunications with its first 46 students. The UA, a new university "stuck" between two great national universities like Porto and Coimbra, needs to make an extra effort to affirm itself in the national and international plans. In this sense, since the very beginning, the focus is to create and develop innovative areas, not explored by the traditional higher education institutions, and that match with the regional and national productive structure. This scientific field has a great importance within UA and is one of the foremost recognized scientific areas in the international plan.

In 2008, the UA, together with the National Foundation for Science and Technology and the Nokia Siemens Networks, Portugal SA, signed a memorandum of understanding that established a Chair dedicated to the telecommunications field with the aim of promoting emerging areas of knowledge and fostering the growth of research and development activities and advanced education in fields of common interest both to the UA and to NSN, as it is the optical networking and the high speed optical communications for access and core networks areas.

The Chair NSN was attributed to Professor Gokhan Sahin, an Associate Professor of the Electrical and Computer Engineering Department of the Miami University, Oxford Ohio, EUA, at the time of the selection. Professor Gokhan Sahin concluded his Ph.D. in 2001, in the University of Washington, Seattle, with the thesis "Service and restoration routing and wavelength assignment, and restoration signaling in optical networks". His research interests are in computer and communication networks, with a focus on optical and quantum communications, sensor and wireless networks, and network security. Professor Sahin's inventions are currently used in DARPA CORONET, a major American initiative aiming to design the next generation Internet, by a consortium consisting of Telcordia, AT&T, Nortel, and USC.



## **ERC Grant**



Pioneering ideas, cutting-edge research and scientific excellence are common attributes of the European Research Council (ERC) Grants. The ERC was established by the European Commission in 2007, and, since then, more than 4.500 projects have been selected for funding across the EU Member States and Associated Countries, of which 34 are from Portugal.

The ERC aims to enhance the dynamic character, creativity and excellence of European research at the frontiers of knowledge providing generous funding for scientists who "persue ground-breaking, high-gain/high-risk research". That was the case of the project "IgYPurTech - IgY Technology: A Purification Platform using Ionic-Liquid-Based Aqueous Biphasic Systems", promoted by Mara G. Freire, a young scientist of CICECO, an Associated Laboratory of the University of Aveiro.

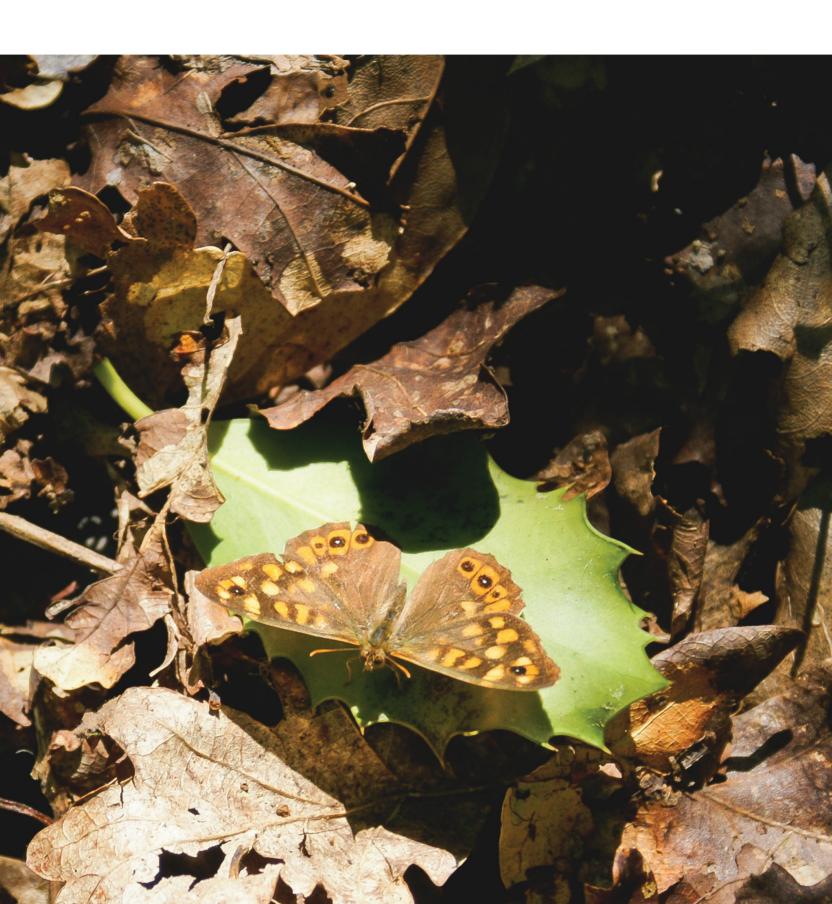
Mara G. Freire graduated in Chemistry - Analytical Chemistry, by the University of Aveiro, in 2003, and concluded her PhD in Chemical Engineering, by the University of Aveiro, in 2007. Over the last years she has built an extraordinary research career, with more than 100 papers in international peer reviewed journals, over 2500 citations and an h-index of 31. Among the published works, 6 are actually "highly cited papers" (Essential Science Indicators by ISI Web of Knowledge).

In 2013, Mara G. Freire was awarded with a 1.4 million euros ERC Starting Grant to develop a new technology, in the scientific area of biopharmaceuticals, which will be applied to the production and purification of antibodies, mainly IgY, an antibody produced in large amount by birds and that exists in egg yolk. The emergence of antibiotic-resistant microorganisms and diseases that do not respond to conventional therapies stresses the need to seek alternatives to conventional drugs, and antibodies may be a hopeful alternative. This project will run over the period of 5 years.

In the new framework programme, Horizon 2020, ERC will have a total budget of 13 095 million euros to support researchers in carrying out frontier research projects in every career stages and all scientific areas: ERC Starting Grant, ERC Consolidator Grants and ERC Advanced Grant, being estimated that around 7,000 grantees will be funded.



# Researchers of the Month 2013





**NUNO BORGES DE CARVALHO** 

Freedom of thought is the best contribution we can give to science

Nuno Borges Carvalho received the Diploma and Doctoral degrees in Electronics and Telecommunications Engineering from the University of Aveiro (UA) in 1995 and 2000, respectively. He is currently Full Professor and a Senior Research Scientist of the Institute of Telecommunications, University of Aveiro, where he coordinates the wireless communication thematic area and the Radio Systems Group (radiosystems.av.it.pt).

His main perspectives as a researcher involve being able to maintain the high level quality UA has achieved in Telecommunications research, which, in his specific case, involve the two emerging areas of Software Defined Radio and Wireless Power Transmission. He strongly believes in interdisciplinary collaboration, in order to be able to maximize some of the main basic components used in RF electronics, and exemplifies with the cross disciplinary group of research labs at the campus.

From his point of view, the independence that universities claim for themselves could be applied to individual departments and research unities as much as possible, allowing the initiative from each individual to promote excellence in the University.



## **JORGE SARAIVA**

One of the important variables of the equation to carry out international top level research is the human resources.

Jorge Saraiva received his Diploma in Biochemistry, in 1989, from the University of Coimbra and his Ph.D. in Biotechnology (specialization in Food Science and Engineering) from the College of Biotechnology (ESB), Portuguese Catholic University (UCP), in 1994. He was Invited Assistant Professor at University of Porto before joining University of Aveiro in 1998 as Assistant Researcher, where he is member of the Food Science and Biochemistry research group of the Research Unit of Organic Chemistry, Natural and Agro-food Products (QOPNA).

His research interests are focused in the area of Novel Food Preservation and Processing Technologies, particularly non-thermal food preservation processes, with emphasis in the use of High Pressure Processing (HPP) for: cold pasteurization of foods, new food sterilization methods, and food quality improvement (functional and sensorial properties). HPP is currently the fastest growing food preservation technology at industrial level (since the early 90's when the first commercial food product reached the market), and this research area was defined as strategic at UA, based on its High Pressure Based Multidisciplinary Technological Platform for Research and Industrial Development, that was recently launched (http://www.ua.pt/ptaltapressao/). This platform will pursue food applications as well as biotechnological new processes and products under pressure.

He strongly believes that UA main strengths involve: a young staff based university; a innovative and research promoting atmosphere; a general strategic approach in key areas; constant trial of anticipating future scenarios and main research opportunities; strong interdepartmental collaboration; all this in a wonderful campus and a very nice city (the Portuguese Venice) with a very pleasant weather.



## **JOÃO VELOSO**

A highly educated scientific community (...) has conditions to contribute more efficiently to the development of Portugal

João Filipe Veloso holds a PhD in Technological Physics from the University of Coimbra (2000), where he lectured as an Invited Assistant Professor from 2004 to 2005, after which he moved to the University of Aveiro (UA) where he has been working as an Assistant Professor at the Physics Department. In 2005, he created the DRIM research group - Radiation Detection and Medical Imaging, which he has been leading since then, in the scope of I<sub>3</sub>N - Associate Laboratory of the UA. He is actively involved in several international collaborations with institutions of excellence, mainly for the development of radiation detectors and physical issues for High Energy, Nuclear and Particle Physics, as well as for Medical Imaging scanners.

His perspectives as a researcher involve the development of new detector concepts for particles and electromagnetic radiation, strengthening, thus, the position of the DRIM Group, already an international reference in the field of the micropatterned gaseous detectors. He considers that one of the main strenghts of UA is the fresh environment which facilitates the interaction between research actors - researchers with researchers and researchers with the leadership, and also the promotion and support to the participation in ambitious

projects for infrastructures, equipment and new research fields, using its research strengths and a good capability for a multidisciplinary research.



### **SÍLVIA ROCHA**

The improvement of the research should be based on a global and sustainable strategy.

Sílvia M. Rocha is Assistant Professor in the Chemistry Department of the University of Aveiro (UA). She studied Pharmaceutical Sciences at the Pharmacy Faculty; University of Coimbra, and got her Ph.D. from UA, in 1997. She has been in the Chemistry Department of UA since mid-1990. She is member of the Bioactive Molecules, Food and Health Laboratory from the QOPNA (Organic Chemistry, Natural Products and Food Chemistry) research unit.

The ultimate goal of her research is to contribute to the responsible and sustainable use of natural resources and to the life quality of citizens. For the last 22 years, she has performed studies on the characterization of plant raw materials, prospection of bioactive compounds, and metabolomics. These studies are focused mainly on the analysis of food composition, evaluation of changes promoted by processing, development of methodologies for quality control and prospection of secondary metabolites that may present human health benefits, especially terpenic compounds.

In her opinion, one of the greatest challenges in these areas of research, that involve multiple skills and the study of complex systems, is the ability to create multidisciplinary teams and put them in communication.



### **PAULA MARQUES**

The positive side of competition: we can better design projects that will be inventive, unique and original

Paula Alexandrina Marques is graduated in Chemistry, master in Physical and Chemistry Teaching and doctor in Materials Science and Engineering. Currently a researcher of the TEMA research unit of the Mechanical Engineering Department, Paula is the scientific coordinator of the Nanotechnology Research Division and the sponsor for the Doctoral Program in Nanosciences and Nanotechnology of the University of Aveiro.

Her research interests are linked to the engineering and development of new nanostructured materials, namely the preparation and study of graphene based nanocomposites with numerous potential applications, specifically for biomedical applications. Paula recognizes the importance of collaboration with researchers from various fields and partnerships with business companies, which may enhance the possibility to move forward the fundamental research domain to applied science.

In her opinion, there are three fundamental aspects to develop good research: researchers, infrastructures and funding. The mobility of researchers, particularly at an early stage

of their career is important to exchange experiences and personal growth but the scientific career requires stability to favour the implementation of outstanding quality contribution and recognition of the research groups in the institution. The infrastructures and funding should be managed in a rational and balanced way to serve researchers and to promote their work.



**JAN JACOB KEIZER** 

Money makes the world go around, so that getting the necessary funding has increasingly become a major challenge

Jan Jacob Keizer has been living in Portugal and working at the UA for about 15 years. As a plant ecologist from origin, he has mainly been working on hydrology and soil erosion, with a special focus on post-fire erosion. He is an Assistant Researcher at CESAM, working for the Integrated Watershed Management Research Line. Since his first FCT-funded project as Principal Investigator, he has gradually created his own research team, comprising 24 people.

He will coordinate one of the workpackages (WP) of RECARE, an EU funded project with 28 partners and a WP that will test and demonstrate measures for the prevention, remediation and restoration of 11 different threats to soils and their ecosystem services across 17 case studies located all over Europe. He believes that the project will be an outstanding opportunity to continue the team's past and ongoing research, as the

case study in Portugal concerns the threat posed by soil erosion by water, in particular following wildfires.

One of the biggest challenges he faces in his field of research is to develop an approach that assesses and predicts the on- and offsite effects of wildfires in an integrated manner, addressing not only the physical, environmental and biological aspects but also the socio-economic dimension. In his opinion, the three important strengths of the UA are its horizontal organization, its tradition towards flexible and solution-oriented management and its increasing culture of collaboration across research units, departments and disciplines.



**ELISABETE FIGUEIREDO** 

I cannot foresee my teaching activities disconnected from my research activities

Elisabete Figueiredo is a Sociologist (ISCTE – IUL, 1989) with a PhD on Environmental Sciences (University of Aveiro, 2003). She is an Assistant Professor at the Department of Social, Political and Territorial Sciences and a researcher at GOVCOPP – Research Unit on Governance, Competitiveness and Public Policies at the University of Aveiro. She is the President of the Portuguese Society for Rural Studies (SPER) and co-coordinator of the Environment and Society Section of the Portuguese Association of Sociology (APS).

Her personal expectations and goals regarding research are to develop high quality

research in the area of Rural Studies (including public policies concerning rural development; rural tourism impacts; social representations of rurality and rural development) and also in the field of Environmental Sociology (particularly in the area of social perceptions of risk and of natural resources). Over the last years as a researcher in GOVCOPP she has been working on the topics of tourism and consumption of rural areas. This work was rewarded by FCT in 2012 through the funding of the project «Rural Matters — meanings of the rural in Portugal: between social representations, consumptions and development strategies».

In her opinion, one of the biggest challenges in this area of research is to contribute, through teaching and research, to foster the role and the importance of Social Sciences as fundamental sciences to the critical understanding of the complexity and multiplicity of phenomena (including 'natural' phenomena) which characterize contemporary societies.





## Aveiro Institute for Marine Science and Technology (AlMare)



Being a coastal region of Portugal in southwestern Europe, the sea has always been part of the history of Aveiro. The socio and economic development of Aveiro has always been linked to the sea. In addition, the strategy and the mission of the University of Aveiro (UA) has, since its beginning, been moulded by the regional background, highly committed with development based on innovation and scientific and technological knowledge, hence it is normal that the coastal, marine and maritime research becomes one of the main strategic topics within the UA.

The UA research distinguishes itself by its multidisciplinary nature, from basic sciences to engineering, framed by sustainability and applied to the economy and governance. Coastal, marine and maritime research is a topic developed in seven of the UA research centres, namely the CESAM - Centre for Environmental and Marine Studies, the CICECO - Centre for Research in Ceramics and Composite Materials, the IT - Telecommunications Institute, the GEOBIOTEC - GeoBioSciences, GeoTechnologies and GeoEngineering, the GOVCOPP - Governance, Competitiveness and Public Policies, the IEETA - Institute of Telematics and Electronic Engineering of Aveiro, the QOPNA - Organic Chemistry, Natural and Agro-food Products and the TEMA - Centre for Mechanical Technology and Automation.

There are numerous activities that were or are being carry out by those research centres in the scope of this topic. UA currently participates in over 20 international and 51 national research projects in the marine sciences area, being the coordinating institution of three major European projects (FP7 Lagoons, FP7 NANOMAR and Life+ Marpro). Additionally, UA contributes to several international R&D networks and initiatives in the marine and environmental sciences area as the Campus do Mar, EurOcean, MarinERA, MARBEF and I-LTER.

UA trains highly competent and motivated professionals in areas related to sea. Through CESAM, the UA participates in two Erasmus Mundus doctoral programmes in marine sciences (MARES and MACOMA), an international doctoral programme, under the scope of Campus do Mar, on science, technology and management of the sea (Do\*Mar) and an interuniversity doctoral programme in marine and environmental sciences (PROMAR), with the participation of the universities of Algarve and Porto, through the Associated Laboratory CIMAR.

Bearing this in mind, UA created, in 2013, the Aveiro Institute for Marine Science and Technology (AIMare), a unifying platform that coordinates,

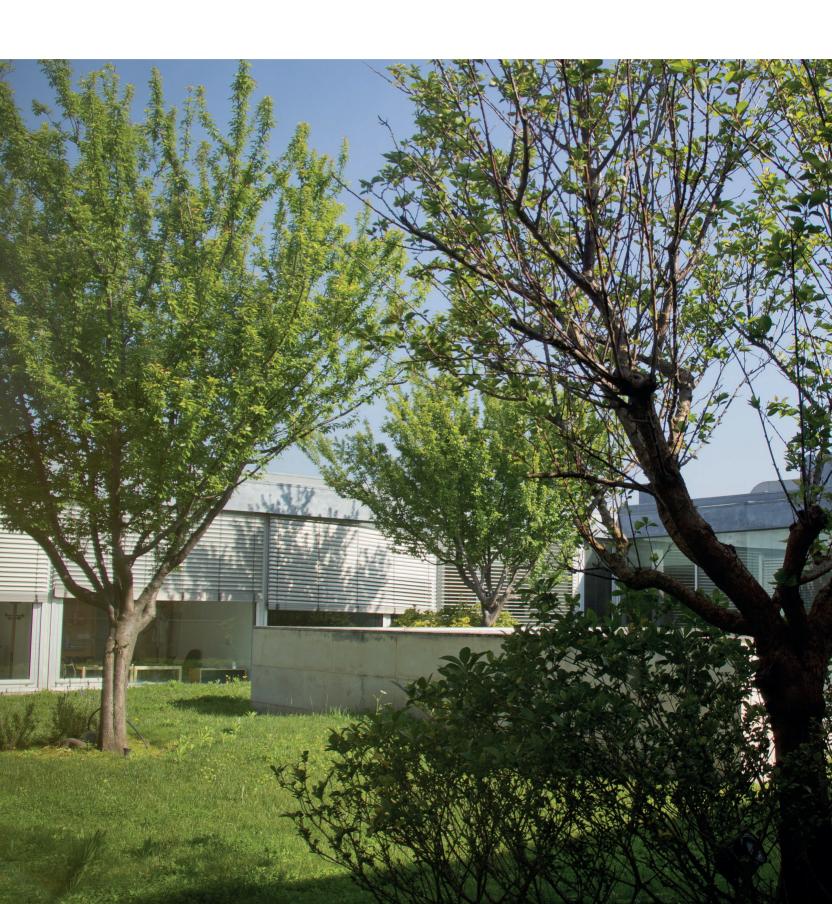
integrates and fosters the wide span of scientific and technological skills and infrastructures of the University, in line with the European Strategy for Coastal, Marine and Maritime Research, strongly embedded in the experience of its scientists and professionals and supported by a sound knowledge in training, research and innovation. This virtual institute aims to foster capacity building and know-how transfer, promote synergies between academia, industry, policy-makers and society, and assert the national and international leadership of UA in coastal, marine and maritime sciences and technology.

The mission of AlMare is the coordination of the scientific competences in the UA in coastal, marine and maritime research, promoting synergies and eco-innovation, and bridging with public and private sectors of society to meet its needs and challenges and to support the socioeconomic development of the region and the country.

To achieve more ambitious goals of R&D&I in the coastal, marine and maritime areas, the synergies and complementarities between the various existing basic sciences at UA must be exploited. Taking into account the skills and capabilities of the various research centres of the UA, the AlMare will develop five strategic areas: Healthy and Sustainable Environment (HSE); Marine Biological Resources (MBR); Marine Mineral and Energy Resources (MER); Marine Technologies and Applications (MTA); and Planning and Governance of Marine and Coastal Zones (PGM).

The challenges facing the Portuguese coastal, marine and maritime zones, including its international projection and visibility, require Institutions with innovative and multidisciplinary scientific and technological skills capable of dealing with the complexity of systems and interactions. A wide integration of knowledge and research is crucial for shaping new governance approaches, promote stakeholder consensus and to establish a continuous dialogue among scientists, political decision-makers and the public and private sectors of society. By facilitating cooperation between UA researchers affiliated to the above-mentioned research centers of excellence, the investment in the new interdisciplinary facility ECOMARE (research centre for innovation and sustainability of the economy of the sea), a collaboration between the UA, the non-governmental organization SPVS, the municipality of Ílhavo and the Port of Aveiro, AlMare will increase the public perception of the importance and magnitude of the research performed in the UA within this area and will strength the position of UA in the national and international scientific arena.

# **Research Centres** at UA



The University of Aveiro is a highly regarded institution of research led education, constituted by university departments, research units, polytechnic schools, interface units, and a vocational education network. Its integrated structure permits the articulation and harmonization of the teaching and research environments, as well as the association with innovative science outreach activities.

Excellence in research is one of the hallmarks of the University. It is a relatively small institution, but a multidisciplinary research institution, where the pursuit of diverse scientific topics promotes interdisciplinary collaborations. Research is driven by 14 Research Units and 4 Associated Laboratories, mostly classified with Excellent or Very Good by international panels under the sponsorship of the Portuguese National Science Foundation. The label of Associate Laboratory is a distinction attributed by the Portuguese Government to research institutions of sustained and exceptional merit.

## **ASSOCIATED LABORATORIES**

## CESAM - Centre for Environmental and Marine Studies

marine sciences, environmental sciences, atmospheric quality, biodiversity, and natural hazards Director: Casimiro Pio www.cesam.ua.pt

## CICECO - Centre for Research in Ceramics and Composite Materials

materials science and engineering, nanosystems, energy, information technology, sustainability, and biomedical materials Director: João Rocha www.ciceco.ua.pt I3N-FSCOSD - Institute for Nanostructures, Nanomodelling and Nanofabricattion - Physics of Semiconductors, Optoelectronics and Disordered Systems

materials science and engineering Director: Armando Neves www.i3n.org

### **IT - Telecommunications Institute**

optical communications, wireless communications, telecommunication networks, and multimedia Director: José Neves www.it.pt

## **RESEARCH UNITS**

## **CBC** - Centre for Cell Biology

neurociences, alzheimer's disease, male infertility, metabolic disorders, and translational research Director: Odete Cruz e Silva www.ua.pt/cbc

## CIDTFF - Research Centre for Didactics and Technology in Teacher Education

education, didactics, supervision, evaluation, society, and training Director: Nilza Costa www.ua.pt/cidtff

## CETAC.MEDIA - Research Centre for Communication Technologies and Sciences

social media, mobile media, interactive TV, human computer interaction, and ciberculture
Director: Lídia Silva
http://blogs.ua.pt/cetacmedia

## CIDMA - Centre of Research and Development in Mathematics and Applications

mathematics
Director: Luís Castro
http://cidma.mat.ua.pt

## CIPES - Centro de Investigação de Políticas de Ensino Superior

higher education research
Director: Rui Santiago
http://sigarra.up.pt/cipes

## CLC - Centre for Languages and Cultures

literature studies
Director: Otília Martins
www.ua.pt/clc

## GEOBIOTEC- GeoBioSciences, GeoTechnologies and GeoEngineering

earth sciences, marine sciences, environmental sciences, natural hazards, and materials science Director: Fernando Rocha

## GOVCOPP - Governance, Competitiveness and Public Policies

law and political sciences Director: Eduardo Castro www.cesam.ua.pt

## ID+ - Research Institute for Design, Media and Culture

art studies Director: Vasco Branco www.idmais.org

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art studies
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## IEETA - Institute of Telematics and Electronic Engineering of Aveiro

electrical and computer engineering Director: Armando Pinho

Director: Armando Pinho http://wiki.ieeta.pt

## QOPNA - Organic Chemistry, Natural and Agro-food Products

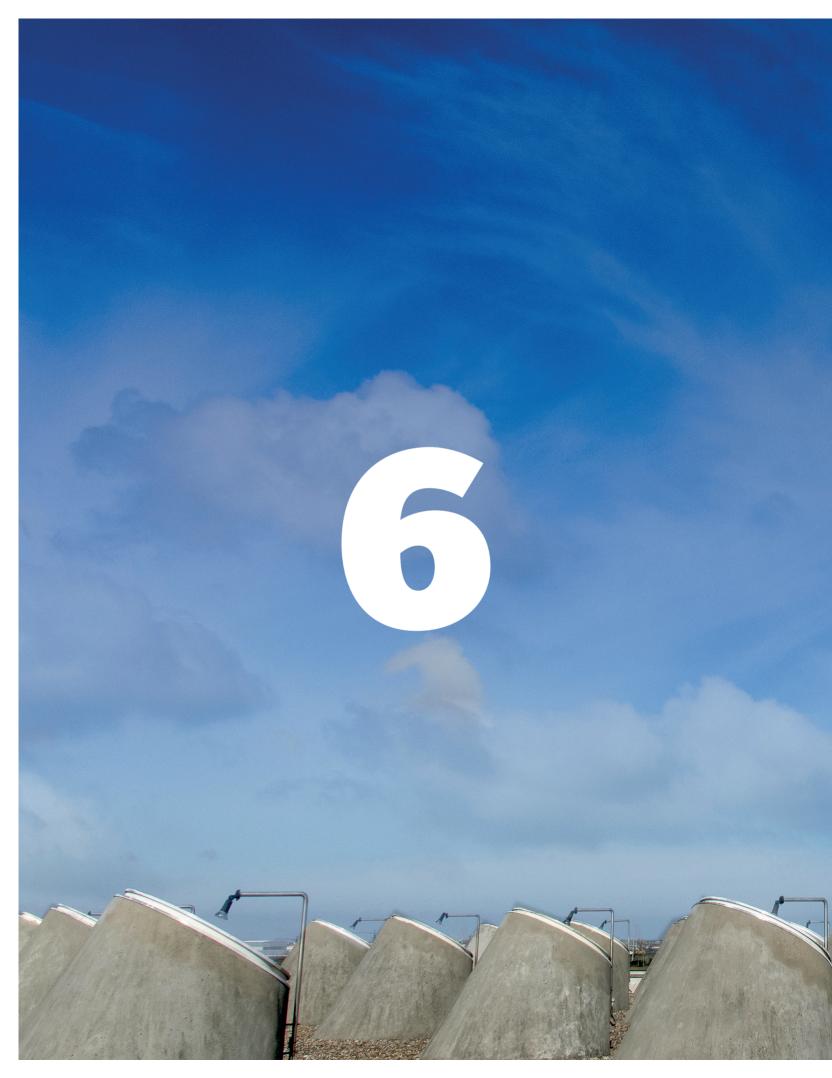
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## TEMA - Centre for Mechanical Technology and Automation

mechanical engineering Director: José Grácio www.ua.pt/tema

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music and musicology
Director: Isabel Soveral
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# The nuclear envelope protein, LAP1B, is a novel Protein Phosphatase 1 substrate

Mariana Santos¹, Sandra Rebelo¹, Paula J. M. Van Kleeff¹, Connie E. Kim², William T. Dauer², Margarida Fardilha¹, Odete A. da Cruz e Silva¹, Edgar F. da Cruz e Silva¹

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### FIGURE 1

Validation of the LAP1B:PP1 interaction. A-Co-immunoprecipitation of the LAP1B:PP1 complex in rat cortex. B- Yeast co-transformation assay in SD/QDO/X-α-gal medium. Full-length LAP1B and its deletion mutants are represented. PP1 binding domains are identified; red boxes - RVxF motifs, green boxes - SILK motif, vellow boxes transmembrane domain. Positive interactions between PP1v isoform and LAP1B are detected by the presence of blue yeast colonies. C- Subcellular distribution of the LAP1B:PP1 complex in HeLa cells. Green - MycLAP1B; Red endogenous PP1a, Blue - Nucleus

## FIGURE 2

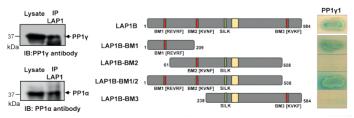
LAP1B dephosphorylation by PP1 in vitro. SH-SY5Y cells were incubated with okadaic acid (OA, protein phosphatase inhibitor) and immunoprecipitated with LAP1 antibody. Immunoprecipitates were incubated with or without 100 ng of PP1y1 protein. IP, immunoprecipitation. IB, immunobloting.

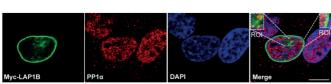
Reversible protein phosphorylation is a major mechanism controlling key intracellular events that are essential for cell health and viability. This process involves the action of both protein kinases and protein phosphatases. Among the protein phosphatases, protein phosphatase 1 (PP1) is a ubiquitous serine/ threonine phosphatase that is estimated to dephosphorylate about one third of all proteins in eukaryotic cells. Therefore, PP1 is involved in many cellular events including glycogen metabolism, transcription, protein synthesis, cellular division and meiosis. The versatility of PP1 is largely determined by the binding of its catalytic subunit to different regulatory subunits, which are responsible for the targeting of PP1 to a particular subcellular compartment and also determine its substrate specificity and activity. To date, more than 200 PP1 regulators have been described and most of them interact with the PP1 catalytic subunit through a conserved PP1 binding motif termed the RVxF motif.

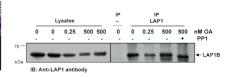
Recently, we described a novel PP1 binding protein, the lamina associated polypeptide 1B (LAP1B), which belongs to a family of integral proteins of the inner nuclear membrane. The function of LAP1B is poorly understood but it is known that it binds to lamins and

chromosomes and is phosphorylated during interphase and mitosis. Moreover, LAP1 was found to interact with torsinA, this is a central protein in the neurological movement disorder known as DYT1 dystonia.

The interaction between LAP1B and PP1 isoforms (PP1a and PP1y) was validated using in vitro and in vivo techniques. The LAP1B:PP1 complex was immunoprecipitated from cultured cells and rat cortex and further validated by yeast co-transformation (Figure 1A and B). PP1, which is enriched in the nucleus, binds to the N-terminal nuclear domain of LAP1B, as shown by immunocolocalization (Figure 1C). The relevant domains for this interaction were also identified. Further, the PP1 binding motif responsible for the interaction was also mapped (REVRF). Functionally this complex determines LAP1B phosphorylation state in vitro (Figure 2). These findings place PP1 at a key pivotal position, participating in the pathogenesis of DYT1 dystonia and related nuclear envelope-based diseases.







# Rivers as reservoirs and disseminators of antibiotic resistance

Marta Tacão¹, António Correia¹, Isabel Henriques¹

Bacterial antibiotic resistance has recently been considered by the World Health Organization as one of the three main threats of this century to human health. This threat is clearly not confined to health-care settings. Rivers, as main receptacles for contaminants, are probably reactors for the spread and evolution of antibiotic resistance.

We recently developed research to uncover the role of rivers as disseminators of antibiotic resistance. We focused on resistance to antibiotics that are critically important for human health.

Higher prevalence of antibiotic resistant bacteria was found in polluted rivers, along with an extensive diversity of antibiotic resistance genes; several of those genes are frequently associated to clinical isolates. Some of the bacterial strains recovered from polluted waters belong to species recognized as important human pathogens. These findings suggest that anthropogenic impacts on water environments promote the dissemination of antibiotic resistance. The presence of bacteria harboring genetic determinants of resistance in water sources that are used for irrigation, recreational activities or fishery, constitutes a relevant risk to human

health. In fact, antibiotic resistance may be transferred to human-associated bacteria through water contact or consumption of contaminated food.

This project is still ongoing and our long term aim is to provide to the authorities tools for effective decision making on antibiotic usage and sustainable management of water resources.

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Detailed information can be found on the following reference: Tacão M, A Correia, I Henriques. 2012. Has antibiotic resistance cracked the (lotic) system? - polluted vs unpolluted environmental resistome. Applied and Environmental Microbiology 78:4134–4140. DOI: 10.1128/AEM.00359-12.

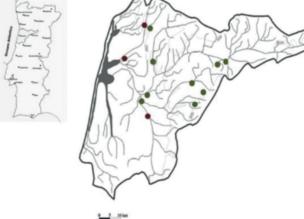
1 — Departament of Biology& CESAM, University of Aveiro

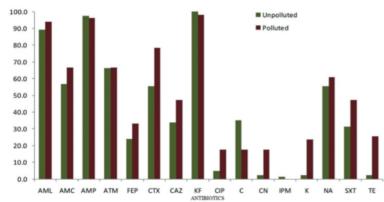
### FIGURE 1

The Vouga River basin with the location of the sampling sites under study.

#### FIGURE 2

Resistance to several antibiotics in unpolluted and polluted sites.





## Photodynamic inactivation of multidrugresistant bacteria in hospital wastewaters: influence of residual antibiotics

Joana Almeida¹, João P. C. Tomé², Maria G. P. M. S. Neves², Augusto C. Tomé², José A. S. Cavaleiro², Ângela Cunha¹, Liliana Costa¹, Maria A. F. Faustino¹ and Adelaide Almeida¹

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#### FIGURE 1

Front page of Photochem.
Photobiol. Sci., 2014, 13, 626

#### FIGURE 2

Representation of the interactions between the photosensitizer, light, oxygen, and the bacteria. Hospital wastewater has the potential to be a threat to public health as it can contain bacteria that may facilitate resistance transfer to other species within sewage treatment plants. Some pathogenic microorganisms are more concentrated in hospital wastewaters and some of these strains are resistant to antibiotics, such as vancomycin-resistant enterococci and methicillin-resistant *Staphylococcus aureus*.

Since these effluents are discharged as conventional urban effluents to the municipal sewage system without prior treatment, there is widespread contamination of natural waters with emerging contaminants.

The traditional methods used to reduce the content of enteric pathogens, including multidrug resistant (MDR) microorganisms, of residual waters are based in disinfection processes that are expensive, unsafe and not always effective. Consequently, new technologies are needed, especially for effluents treatment including hospital residual waters. The antimicrobial photodynamic inactivation (PDI) may represent a potential alternative.

PDI uses a nontoxic photosensitiser, in this case a cationic porphyrin, which absorbs energy from visible light and transfers it to other surrounding molecules, creating highly cytotoxic reactive oxygen species (ROS) that inactivate microbial cells.

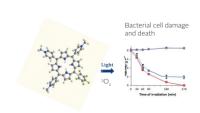


The researchers evaluated the potential of PDI for treating hospital effluent. The efficiency of PDI was assessed in a buffered solution and in hospital residual water for four MDR bacterial strains of vital clinical importance (*Staphylococcus aureus, Pseudomonas aeruginosa, Acinetobacter baumannii and Escherichia coli*). The synergistic effect of PDI and antibiotics (ampicillin and chloramphenicol) was also evaluated.

The results indicate that PDI can effectively inactivate MDR pathogenic bacteria in the buffered solution (reduction of 6–8 log). In wastewater, the inactivation of the four MDR bacteria was again efficient and the decrease in bacterial survival starts even sooner. A faster decrease in bacterial survival occurred when PDI was combined with the addition of antibiotics.

The researchers concluded that PDI has potential to be an effective alternative to the traditional methods for treating hospital effluent. The inactivation of MDR bacteria in hospital wastewaters is effective and the presence of antibiotics may enhance its effectiveness.

Although the study's findings are very positive, the researchers recognise that more experiments are needed to establish an inexpensive and environmentally friendly antimicrobial protocol. 'The next steps are to determine the efficiency of PDI in raw hospital wastewater, the use of sunlight as a low cost light source and the possibility of immobilising the photosensitiser on solid supports.



# Urban Agriculture in Portugal: is it safe to grow our vegetables?

Sónia Rodrigues¹, Nuno Cruz¹, Lina Carvalho², Armando da Costa Duarte¹, Eduarda Pereira¹, Paul Römkens³

Various anthropogenic activities led to a substantial increase in pseudo-total levels of potentially toxic elements (PTEs) such as Pb, Cd, Cu, Zn, Hg and As in urban soils. Considering the expanding trend of urban agricultural practices it becomes necessary to understand both whether these contaminants are available for plant uptake and whether they pose risks to human health. Hence, it is crucial to develop tools to characterize the pathways between soil contamination, plant uptake, dietary transfer of contaminants to animals and finally consumer exposure from dietary intake of plant and animal products. Such tools are essential to determine meaningful threshold concentrations of PTEs in soils in order to deliver safe products.

The information on the impacts of urban soil contamination in Portugal is very scarce. In two of our studies [1,2] we compared the levels of As, Ba, Cd, Cr, Cu, Ni, Pb and Zn in soils and their respective contents in field-grown crops from an urban area in Portugal (Porto: around 1,400,000 inhabitants) with those from a rural area, an industrial area and three mining sites. We applied soil extraction procedures to assess the directly available pool of PTEs for plant uptake as well as a bioaccessibility extraction test that mimics the action of gastric juices in stomach for application in human health risk assessment.

These studies showed that enhanced levels of Cd, Cu, Pb and Zn of anthropogenic origin can be found in soils from the urban area and that there is a potential for dietary transfer of contaminants to grazing animals at unacceptably high concentrations at specific sites. The availability of PTEs for plant uptake decreased in the order: Cd > Zn > Cu $\approx$ Ba > Cr > Ni > As > Pb, with Pb being the least available contaminant. Oral bioaccessibility of Cd, Cu, Pb and Zn in urban soils was higher than in samples from rural, industrial and mining areas which

is most likely related to sources of PTEs in corresponding soils.

Hence, there is an urgent need for a contaminated soil management strategy in Portugal (Figure 1), that focus on the link between soil quality and food safety/human health protection.

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[2] Cruz N., Rodrigues S.M., Coelho C., Carvalho L., Duarte A.C., Pereira E., Römkens P.F.A.M. Urban Agriculture: availability of potentially toxic elements for plant uptake. Applied Geochemistry (in press)

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#### FIGURE 1

Reference to published scientific studies on urban agriculture [1,2] in a national newspaper (Jornal *i*, 23 Julho 2013)



## All-In-One Optical Heater-Thermometer Nanoplatform Operative From 300 to 2000 K Based on Er3+ Emission and Blackbody Radiation

Mengistie L. Debasu<sup>1,2</sup>, Duarte Ananias<sup>1</sup>, Isabel Pastoriza-Santos<sup>3</sup>, Luis M. Liz-Marzan<sup>3,4,5</sup>, J. Rocha<sup>1</sup> and Luís D. Carlos<sup>2</sup>

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FIGURE 1

TEM image of AuNP heaters and Yb/Er thermometers (top left). The up-conversion emission of this nanoplatform is a function of temperature (main plot), and the CIE chromaticity diagram (bottom right) shows that the variation of the emission color coordinates as a function of the laser pump power follows the Planckian locus.

Light-induced thermal heating of noble metal nanostructures has numerous applications in biological detection, remote release of encapsulated material, sensors, photovoltaic and plasmonic devices. In particular, there is a growing interest in developing plasmonic-induced nanoheaters for applications in nanomedicine. In hyperthermia, for example, a controlled local temperature increase avoids the need for macroscopic heating, reducing the collateral effects arising from over heating healthy tissues. Measuring the temperature at the nanoscale with high spatial (10-6 m) and temperature (10-1 degree) resolution is very challenging and an exciting field of research.

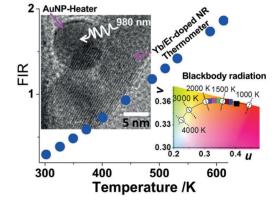
Suitable nanoplatforms integrating heaters and thermometers, however, have not yet been realized, despite their great potential in nanophotonics and biomedicine. Recently, we have reported a step forward towards assessing the local temperature of laser-excited gold nanostructures using an all-in-one nanoplatform comprising (Gd,Yb,Er)<sub>2</sub>O<sub>3</sub> nanorods (thermometers) surface-decorated with gold nanoparticles (heaters), Figure 1.1

The local temperature is calculated using either Boltzmann's distribution (300 – 1050 K) of the Er³+ up-conversion  ${}^2H_{11/2} \rightarrow {}^4I_{15/2}/{}^4S_{3/2} \rightarrow {}^4I_{15/2}$  intensity ratio and the Planck's law (1200 – 2000 K) for a white-light emission ascribed to the blackbody radiation. Increasing the amount of AuNPs increases the surface temperature of the (Gd,Yb,Er) $_2$ O $_3$  nanorods and the operating range of the nanothermometers.

A maximum relative sensitivity up to 1.5 % K (resolution 1K) in the temperature range of physiological interest (301 – 350 K) is demonstrated with NRs-AuNPs-1.25 under low-power (32 – 86 W cm<sup>-2</sup>) near-infrared light (980 nm) excitation in the therapeutic window. This offers much potential for biological applications in laser-induced controlled hyperthermia and in deeptissue optical bioimaging, while avoiding thermal damage of the surrounding healthy tissues and background fluorescence.

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## Second Trimester Maternal Urine for the Diagnosis of Trisomy 21 and Prediction of Poor Pregnancy Outcomes

Sílvia O. Diaz¹, António S. Barros², Brian J.Goodfellow¹, Iola F. Duarte¹, Eulália Galhano⁴, Cristina Pita⁴, Maria do Céu Almeida<sup>4</sup>, Isabel M. Carreira<sup>3</sup>, Ana M. Gil<sup>1,7</sup>

A novel strategy was presented for the detection of deviations in the composition of maternal urine, to define metabolite fingerprints for the recognition of trisomy 21 (T21) and fetal malformations (FM) and prediction of preterm delivery (PTD), intra-uterine growth restriction (IUGR), preeclampsia (PE) and gestational diabetes mellitus (GDM). The challenge is set by the hundreds of metabolites present in urine, which result in complex analytical records from which meaningful variations are to be retrieved/quantified. The tools/strategies used here are applicable not only to biofluids in disease research, such as the present study, but also to other biological samples (tissues, cells) in contexts as varied as exposure to contaminants, pharmaceuticals or (bio)materials.

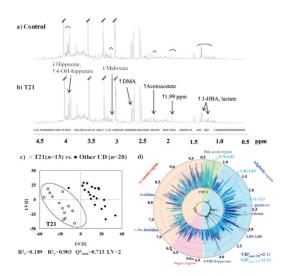
In this work, <sup>1</sup>H Nuclear Magnetic Resonance (NMR) metabolomics was used to find specific metabolic excretory signatures of the conditions specified above. Figure 1a shows an expansion of the NMR spectrum of control urine, with a large number of signals covering a wide range of intensities. Although visual differences are noted between control and disease spectra (Figure 1a,b), comparison of full matrixes was handled by partial least squares discriminant analysis (PLS-DA) and subsequent Monte Carlo cross validation (MCCV)

and permutation tests. Analysis of original datasets resulted in weak models and, hence, several variable importance to the projection (VIP)- and b-coefficientbased variable selection methods were tested (gray dots in Figure 1b represent variables selected for T21 identification). The variable selected subsets led to improved PLS-DA models and specific metabolite signatures (Figure 1c,d), with applicability in T21 and FM diagnosis and identification of PTD, IUGR, PE and GDM pre-clinical markers. This work demonstrated, for the first time, the value of maternal urine profiling as a complementary means of prenatal diagnostics and early prediction of several poor pregnancy outcomes.

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- 3 Cytogenetics and Genomics Laboratory, Faculty of Medicine, University of Coimbra, Portugal and CIMAGO Center for Research in Environment, Genetics and Oncobiology, Portugal,
- 4 Maternidade Bissaya Barreto, Centro Hospitalar e Universitário de Coimbra, Coimbra, Portugal

## FIGURE 1

Expansion (0.5-4.6 ppm) of average 1H NMR spectra of maternal urine for a) control and b) T21 groups, with indication of main visual differences (curved lines), some assignments and variables selected (gray dots); c) PLS-DA scores plot obtained for T21 cases vs. other CDs; d) VIP-wheel representation of the urinary signatures obtained for the general CDs (dark blue) and T21 (light blue) groups. The average <sup>1</sup>H NMR spectrum of controls is represented in the inner circle, with the corresponding ppm scale shown in the outer black circle. Each dot represents a selected variable (spectral data point), positioned in a radial Variable importance for the projection (VIP) scale. Distinguishing features of T21 include changes in bile acids and most other spectral regions.



## A (3 + 3)-Dimensional "Hypercubic" Oxide-Ionic Conductor: Type II Bi2O<sub>3</sub>-Nb<sub>2</sub>O<sub>5</sub>

C.D. Ling<sup>1</sup>, S. Schmid<sup>1</sup>, P.E.R. Blanchard<sup>1</sup>, V. Petříček<sup>2</sup>, G.J. McIntyre<sup>3</sup>, N. Sharma<sup>1</sup>, A. Maljuk<sup>4</sup>, A.A. Yaremchenko<sup>5</sup>, V.V. Kharton<sup>5</sup>, M. Gutmann<sup>6</sup>, Ray L. Withers<sup>7</sup>

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   Australian National University,
   Canberra, Australia

## FIGURE 1

Refined structure of Type II  $(Bi_2O_3)_{o,295}(Nb_2O_5)_{o,205}$ : view along the  $\langle 110000 \rangle$  direction, drawn over  $8\times8\times8$  fluorite-type subcells. Bi atoms are purple, and Nb atoms and polyhedra are green.

## FIGURE 2

Partial oxide-ionic  $(\sigma_{o})$  and electronic  $(\sigma_{e})$  conductivities for the ceramic samples of Type II and Type III  $(Bi_{2}O_{v})_{o,\sigma}(Nb_{2}O_{v})_{o,zd}$ 

The high-temperature cubic form of bismuth oxide, δ-Bi<sub>2</sub>O<sub>2</sub>, is the best intermediate-temperature oxideionic conductor known. The well-established way of stabilizing  $\delta$ -Bi<sub>2</sub>O<sub>3</sub> to room temperature, while preserving a large part of its conductivity, is by doping with higher valent transition metals to create wide solid-solutions fields with exceedingly rare and complex (3+3)-dimensional incommensurately modulated "hypercubic" Type II structures. These materials remain poorly understood because no such structure has ever been quantitatively solved and refined, due to the complexity of the problem and lack of adequate experimental data. In the present work, this was addressed by growing a large (centimeter scale) crystal using a novel refluxing floating-zone method, collecting high-quality single-crystal neutron diffraction data, and treating its structure together with X-ray diffraction data within the superspace symmetry formalism.1 The Type II structure can be understood as an "inflated" pyrochlore, in which the corner-connected NbO<sub>c</sub> octahedral chains move smoothly apart to accommodate the solid solution. While some oxide vacancies are ordered in these chains, others are dis-

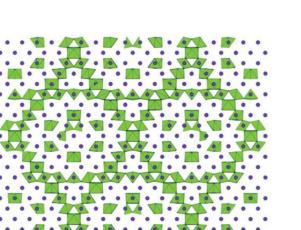
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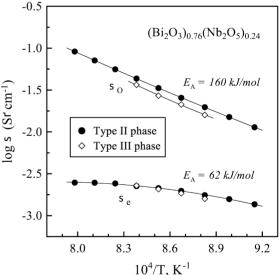
network of wide  $\delta$ -Bi $_2$ O $_3$ -like channels (Figure 1), explaining the superior oxide-ionic conductivity of incommensurate Type II phase compared to commensurately modulated Type III phases in the same pseudobinary system (Figure 2).

tributed throughout a continuous three-dimensional

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# Sensing active coating on the basis of nanoreactors containing pH indicating agent

F. Maia', J. Tedim', A. C. Bastos', M. G. S. Ferreira', M. L. Zheludkevich'

The main idea of this work is to create a novel functionality on active coatings able to sense the initiation of corrosion under the coating or in defects. The goal is to significantly reduce the maintenance costs in many industrial applications. The indication of corrosion activity by such coatings allows optimizing the maintenance operations, avoiding excessive and unnecessary preventive operations.

The present development involves a new sensing active coating on the basis of nanoreactors containing a pH indicating agent (Fig. 1). An important feature of these nanostructures is that the indicating molecules are not released from them, thereby preventing the spontaneous leaching and ensuring long service time.

Mesoporous silica nanocontainers were synthesized and loaded with phenolphthalein (pH indicator) in a one-stage process. The resulting system was mesoporous, which together with the bulkiness of the indicator molecules limits their leaching (Fig. 2). Moreover, the penetration of water molecules and ions inside the mesopores is possible, allowing the hydroxide ions formed on cathodic areas to react with the pH indicator. Colour change is used to detect and

25.0kV ×30.0k' 'i : 0'0' ii m

locate the active corrosion spots in the coated system. The corrosion sensing functionality of the protective coatings with nanocontainers was proven for aluminium and magnesium based metallic substrates. The developed nanocontainers show high potential to be used in the new generation of active high performance multifunctional protective coatings.

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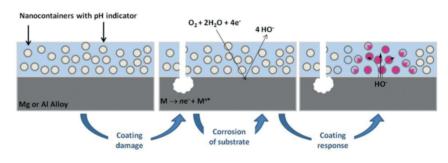
1 — Department of Materials and Ceramic Engineering & CICECO, University of Aveiro

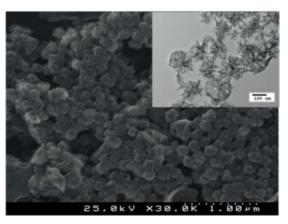
#### FIGURE 1

Scheme of pH sensing response from coating.

### FIGURE 2

SEM images of Si\_NC: (left) empty (inset: TEM picture of Si\_NC with scale bar of 100 nm) and (right) with PhPh (inset: TEM picture of Si\_NC-PhPh with scale bar of 100 nm)





# Portfolios: a powerful tool to promote reflective thinking and human development

Idália Sá-Chaves<sup>1</sup>\*

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 CIDTFF, University of Aveiro
 (Line research coordinator, in collaboration with research teams from master, doctoral and post-doctoral levels)

The importance of cognitive sciences associated with the processes of thinking and feeling in identities' development, both personal and professional, on the variability of their circumstances and matrix cultures has been, throughout the ages and internationally, a constant object of research, lying on the insatiable quest for knowledge and meaning to the human condition itself. It is in this context that *portfolio movement* happens, focusing research on learning and construction of (self) knowledge in its multiple conditions, emergencies, potentialities and limits.

In Portugal, and under the scientific leadership of Idália Sá-Chaves, it is worth mentioning the pioneering role of the University of Aveiro/CIDTFF that, over the past three decades, focused an educational research line on systematic and persistent development of portfolios and reflective thinking used as a privileged strategy of supervision and coaching at all levels and areas of training. It means a strong concentration of experience, evolving itself in time, taking into account the epistemological characteristics of empirical experience fields: education and health. As time goes by, a long term theoretical line production is emerging and perceived through multiple indicators and publications, as being a partner in the international debate about the issues that cross the processes of human development.

The grounded theoretical research developed enables to highlight the importance of the portfolio's strategy as a powerful tool to: improve reflexivity, critical and creative thinking, decision making and dialogic communication on an ecological vision that encompasses universal values and personal/local strategies for action; promote the global perception of personal and professional development growth as a continuum, comprehensive and non-fragmentary perspective

based on a systemic and complex approach; value narratives and life-stories to re-elaborate personal and institutional identities; encourage human awareness and its values, namely democratic relations, collaboration and solidarity, knowledge sharing and experience, that allows portfolios authors to perform, at the same time, as individuals and as partners in a plural, creative and transformative way.

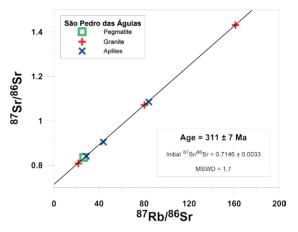
At the end of 2013, the coordination of the "European Network of ePortfolio Experts & Practitioners" by recognizing this research production as a national and pioneer reference, invited the University of Aveiro/CIDTFF to integrate this Network/Project as a national representative on that scientific area.

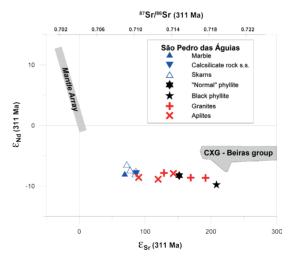


## Geochemical and isotopic studies in the Tabuaço prospect (tungsten mineralizations in northern Portugal)

T. Cerejo<sup>1</sup>, J.F. Santos<sup>1</sup>, J.C.G. Sousa<sup>2</sup>, N. Castanho<sup>2</sup>, G. Sérgio<sup>2</sup>, S. Ribeiro<sup>1</sup>

This work took place in the Tabuaço prospect, which corresponds to an area of 45 km<sup>2</sup> where exploration for W-skarn deposits is being carried out by Colt Resources. The study now presented results from collaboration among that company, the University of Aveiro, the Geobiotec research unit and the team of the Petrochron project (PTDC/CTE-GIX/112561/2009) and it was focussed on the lithologies recognized, both in outcrops and in drill cores, in the area of Quinta de São Pedro das Águias: "normal" phyllites, black phyllites, marbles, calcsilicate (s.s.) rocks and skarns, belonging to the Bateiras Formation, of the Douro Group of the "Complexo Xisto-Grauváguico" (CXG); Paredes da Beira-Tabuaço granite; several aplitic and pegmatitic bodies. Rb-Sr isotope analyses provided a  $311 \pm 7$  Ma age for the granitoids, which dates their emplacement during a late stage of the Variscan orogeny. The isotope geochemical signatures, at 311 Ma. of the granite and of the studied metapelites overlap each other, suggesting that the parental magma was generated by anatexis of Grupo do Douro metasediments. According to their petrographic, geochemical and isotopic features, aplites and pegmatites are viewed as extreme differentiates from the granite. São Pedro das Águias metapelites show REE normalized patterns very similar to those displayed by the most widely accepted upper crustal reference compositions; isotopically, especially due to their lower ENd , the studied metapelites are clearly distinct from the Grupo das Beiras metasediments (the other major division of the CXG), and, instead, they resemble other metasedimentary units of the Iberian Massif. Several lines of evidence suggest that calcsilicate (s.l.) rocks owe their composition not only to metasomatism that accompanied the granite intrusion, but also to an inheritance from their protoliths, which should have resulted from mixed sedimentation, both chemical and terrigenous.





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### FIGURE 1

Whole-rock Rb-Sr isochron for the granitoids from São Pedro das Aguias area. The  $311\pm7$  Ma date is interpreted as the age of granitoids emplacement (and correlative metallogenic processes).

### FIGURE 2

 $\begin{array}{l} {\cal E}_{Nd(311Ma)} \ vs. \ {\cal E}_{Sr(311Ma)} \ vor \ {\cal E}_{Rd(311Ma)} \\ vs. \ ^{87}Sr/^{86}Sr(_{311Ma)} \ plot \ of \ the \\ compositions \ of \ granitoid \ and \\ metasedimentary \ rocks \ sampled \\ at \ São \ Pedro \ das \ Aguias \ area. \end{array}$ 

## The Usefulness of Financial Analysts' Reports: A Content Analysis

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### FIGURE 1

Text information units – Mean and Standard Deviation (SD) – Distribution by category in % Notes: Values are in percentage terms for each category of information units. The components of each category are described in appendix 2 (Codification Tags – Categories and Sub-Categories). SD stands for standard deviation.

### FIGURE 2

Text information unit's distribution for the Analyst Analysis category

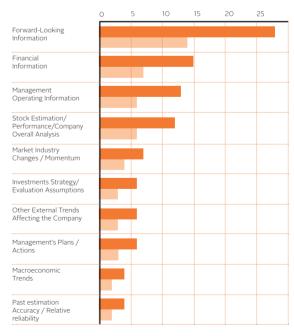
Financial analysts are considered to be an influential class of information intermediaries in capital markets given that stock market investors strongly rely on sell-side analysts' forecasts while forming their investment decisions. Given the influence exerted over investors' beliefs and activities, those reports should contain all the necessary information in order to provide reliable target prices and help investors to form expectations. Whereas other works test the reliability of target prices, this paper investigates whether the method and the parameters of the evaluation report are clearly disclosed and if the procedure undertaken for that is in accordance to the theoretical conventions provided by the Jenkins Report.

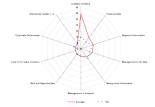
Using content analysis, we explore and encode 73 reports of PSI20 listed companies, presenting empirical results regarding the distribution of categories of information. Subcategories included in Analyst Analysis account for 50% of all available information, while those of Financial Data and Management's Operational Data represent 13% and 10%, respectively, of information units contained in the overall analyzed reports. Empirical results indicate that although there exists an increased importance of intangible and intellectual assets, analysts and the companies for which they work for will always have a tendency to rely on numbers. These, in general, disclose a great amount of financial and high level operational business data, usually delivered as reflections by the analyst itself, whereas only a few is presented using Management words. So, although capable of meeting users most

obvious needs, Portuguese investment firms reports still fail to provide important categories of information like corporate governance, intangible assets data and long term value creators matters. Sell side Portuguese analysts' reports also seem to respond positively when tested against the ability to report separately on each business segment of a company's business. Finally, even though lacking the necessary information to replicate the calculation made, Portuguese reports have in general the potential information to enable their readers with an understanding of the principles beyond the price targets computation as required by "ideal reports" guidelines.

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% Category% All text

### Reinforcement of the proton radius puzzle

João Veloso¹, Daniel Covita¹

A new value of the proton radius was published in *Science*<sup>1</sup> (January 2013), using measurements of different muonic hydrogen transitions, 1.7 times more precise and reinforcing the former proton radius value published in *Nature*<sup>2</sup> (2010) by the same team involving two researchers from the University of Aveiro.

The idea of deducing the proton radius by means of hydrogen laser spectroscopy was born in the early seventies. Muonic hydrogen would be used instead of the atomic hydrogen. About 200 times heavier, the negative muon should orbit about 200 times closer to the proton. Hence, the influence of the proton on the atomic energy levels of the muon should be magnified, leading to an unprecedented accuracy of the proton radius determination method. This is achieved by relating the proton radius to the hydrogen Lamb-shift - the transition energy measured.

This measurement was only possible due to the joint effort of 35 scientists from 3 continents in which each team has brought its own expertise in the fields of accelerator physics, atomic physics, laser technologies and detectors.

One of those technical difficulties was the development of a suitable X-ray detector system (see photo 1). The task was realized through the main contribution from the Portuguese team including the I3N-Aveiro researchers (Prof. João Veloso and Dr. Daniel Covita), which proved crucial to the success of the experiment. The experiment took place at the  $\pi E5$  beam-line of the proton accelerator at Paul Scherrer Institute, Switzerland (see photo 2).

After a long and careful analysis, including values obtain by measuring other muonic hydrogen transi-

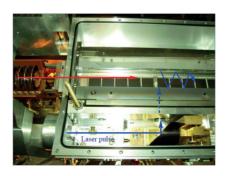
tions, the new deduced value for the proton radius, 0.84087(39) femtometers (1 femtometer = 0.000 000 000 000 001 meter), in agreement with the former one published in *Nature*<sup>2</sup> by the same team, turned out to be ten times more precise, but in strong disagreement with the CODATA accepted value (0.8768 femtometers) and at 7 sigma variance with respect to it. Such unexpected difference of about 4% is huge in the QED framework and discussions on possible reasons to explain it are still ongoing. The origin of the large discrepancy between our proton radius and the CODATA value is not yet known.

There are several aspects which are now under scrutiny: previous high-precision measurements, extended and intricate calculations involved and maybe at some point even small readjustments to the world's most precise and best-tested fundamental theory itself – quantum electrodynamics.

Further developments, experimental and theoretical, from different research teams around the world, are ongoing in attempting to contribute to solving the puzzle.

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# Resonant electronic coupling enabled by small molecules in nanocrystal solids

Rui N. Pereira<sup>1,2</sup>, José Coutinho<sup>1</sup>, Sabrina Niesar<sup>2</sup>, Tiago A. Oliveira<sup>1</sup>, Willi Aigner<sup>2</sup>, Hartmut Wiggers<sup>3</sup>, Mark J. Rayson<sup>4</sup>, Patrick R. Briddon<sup>5</sup>, Martin S. Brandt<sup>2</sup>, and Martin Stutzmann<sup>2</sup>

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- 3 Universität Duisburg-Essen
- 4 University of Surrey
- 5 Newcastle University

### FIGURE 1

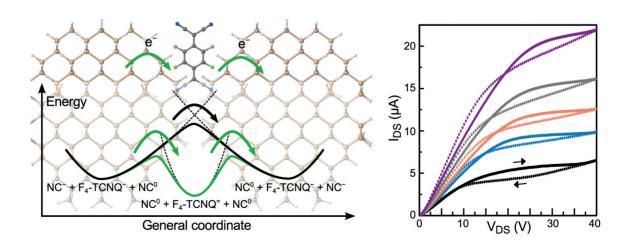
(Left panel) Schematic representation of the resonant electronic coupling enabled by small molecules in nanocrystal solids. The molecules induce new charge transfer paths (in green) responsible for the electrical activation of the films.

(Right panel) Charge transport characteristics of a printed thin film transistor fabricated with a molecule-activated nanocrystal solid

The future exploitation of the exceptional properties of nanocrystal (NC) thin films deposited from liquid dispersions of nanoparticles relies upon our ability to produce films with improved electrical properties by simple and inexpensive means. We show that the electronic conduction of solution-processed NC films can be strongly enhanced, without the need of postdeposition treatments, via specific molecules absorbed at the surfaces of adjacent NCs. This effect is demonstrated for Si NC films doped with a strong molecular oxidizing agent.

Si NC Field Effect Transistors fabricated with solution-processed Si NC layers activated by  $F_4$ -TCNQ exhibit the characteristic linear regime at small drain-source voltages followed by a saturation at higher voltages, minimal hysteresis, and field-effect electron mobilities about an order of magnitude higher than in the best solution-processed Si NC devices reported so far. Density functional calculations were carried out with molecule-doped NCs. We approximated the NC films to a superlattice of packed NCs doped with molecules within its interstitialcies. To the best of our knowledge

this is an original and novel approach to study the electronic structure of NC solids. It is shown that, when populated by electrons, hybrid molecule/NC states edge (and may actually resonate with) the conduction-band states of the NC solid. This provides extra electronic connectivity across the NC network as the molecules effectively flatten the electronic potential barriers for electron transfer across the otherwise vacuum-filled network interstitialcies.



42

# Critical phenomena and noise-induced phase transitions in neuronal networks

K.-E. Lee<sup>1</sup>, M. A. Lopes<sup>1</sup>, J. F. F. Mendes<sup>1</sup>, and A. V. Goltsev<sup>1</sup>

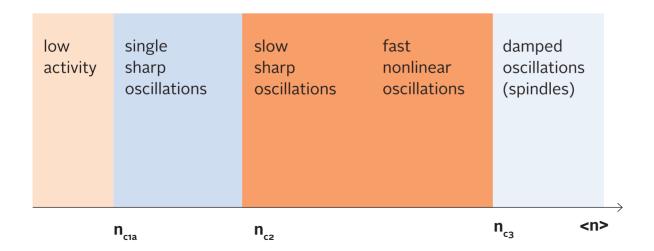
Neuronal networks in the brain are nonlinear dynamical systems in which transitions from one to another state have bifurcation nature. One can mention the appearance of brain rhythms, epileptic seizures, and transitions stimulated by an electric field. In this work, we study numerically and analytically first- and secondorder phase transitions in neuronal networks stimulated by shot noise (a flow of random spikes bombarding neurons). Using an exactly solvable cortical model, we find critical phenomena accompanying the transitions and their dependence on the shot noise intensity. We show that a pattern of spontaneous neuronal activity near the critical point of the transitions is a characteristic property that can be used to identify their bifurcation mechanism. We demonstrate that bursts and avalanches are precursors of a first-order phase transition, paroxysmal-like spikes of activity precede a second-order phase transition caused by a saddlenode bifurcation, while irregular spindle oscillations represent activity near a second-order phase transition caused by a supercritical Hopf bifurcation. Our most interesting result is the observation of the paroxysmal-like spikes. We show that a paroxysmal-like

spike is a single nonlinear event that appears instantly from a low background activity with a rapid onset, reaches large amplitude, and ends up with an abrupt return to lower activity. These sharp oscillations are similar to single paroxysmal spikes and sharp waves observed in electroencephalographic (EEG) measurements. Figure 1 shows sequence of transitions that occur with increasing short noise intensity < n >. Above the saddle-node bifurcation ( $< n > = n_c 2$ ), sustained network oscillations appear with a large amplitude but a small frequency in contrast to oscillations near the Hopf bifurcation ( $< n > = n_c 3$ ) that have a small amplitude but a large frequency.

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K.-E. Lee, M. A. Lopes, J. F. F. Mendes, and A. V. Goltsev, Phys. Rev. E 89, O12701 (2014)

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## Pleasant or Unpleasant? Human Emotion Detection Using EEG

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### FIGURE 1

Acquisition protocol. Emotions are elicited by pleasant and unpleasant pictures of the International Affective Picture System.

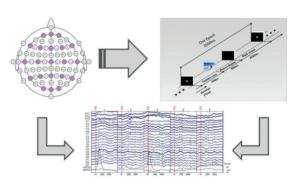
### FIGURE 2

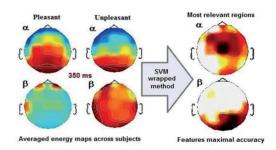
Topographical maps (left) from both conditions in two different ranges of frequencies at 350 ms after stimulus onset. Relevance maps (right) The recognition of emotions, in EEG, induced by the protocol shown in fig. 1, has been addressed with a signal processing and machine learning approach. As it is well-known, neuronal rhythms and the energy on the brain cortex fluctuate in different regions and vary along the time depending on the emotion we feel when we see pleasant or unpleasant images. The topographical maps in fig. 2 show an example of this for two frequencies ( $\alpha$  and  $\beta$ ) at 350 ms after stimulus onset, where it is evident the differences in beta activation. Hence, this is why it is important to search for an optimal method to extract the most relevant features for distinguishing distinct affective reactions.

The system aims to be used either in intra- or intersubject applications. The difference between both procedures is mostly related with the input signals: intra-subject studies deal with single-trial signals for studying the behavior from only one participant, whereas inter-subject studies deal with ensemble averaged signals computed for each stimulus category and every participant.

Inter- and intra-subject methodologies fit well on different scenarios. The former is suitable for off-line applications to complement some information and establish bridges between machine learning approaches and univariate statistical tests widely used in analysis on brain neurophysiology. For instance, a robust classifier, known as support vector machine (SVM) was implemented into a wrapped scheme to identify the scalp spectral dynamics of interest linked to the emotional process, using the available signals from different EEG channels to form the input for the classifier. The wrapper strategy for feature elimination was carried out in order to improve the accuracy and identify the most discriminant features (see fig 2- right).

On the other side, due to the biological variability and the individual differences influence, intra-subject approaches are rather interesting for personalized studies where longitudinal evolution is essential and must be followed over sessions, such as in a rehabilitation therapy, emotional monitoring in psychiatric disorders or for neurofeedback-based applications. However, the system could be applied for recreational purposes as videogames adaptation as well.





## Variobox: Automatic Detection and Annotation of Human Genetic Variants

Paulo Gaspar<sup>1</sup>, Pedro Lopes<sup>1</sup>, Jorge Oliveira<sup>2</sup>, Rosário Santos<sup>2</sup>, Raymond Dalgleish<sup>3</sup>, José Luís Oliveira<sup>1</sup>

Genetic variations not only dictate phenotypic differences between human beings, but are also the underlying cause of many gene-based disorders. Detecting, understanding, categorizing and associating human mutations with phenotypes is becoming the standard process to accomplish personalized medicine. Multiple software and hardware technologies already spanned from miscellaneous projects, leveraging an exponential growth of available genetics data, and it is now fairly easy and cheap to obtain sequence profiles for large cohorts, such as the 1000 Genomes Project, or for unique individuals, such as the ones performed by several genetic analysis companies and labs. Moreover, the overwhelming quantity of genetic patient data emerging from labs, along with available LSDBs, suggests the need for integration solutions that are able to use variations' knowledge for gene research and patient care scenarios.

Variobox is a desktop tool for the annotation, analysis and comparison of human genes. Variobox obtains variant annotation data from WAVe, protein metadata annotations from PDB and UniProt, and sequence metadata is obtained from Locus Reference Genomic (LRG) and RefSeq databases. To explore the retrieved data, Variobox provides an advanced sequence visualization that permits an agile navigation through the various genetic regions, and combines its features in an intuitive interface to analyse genes and mutations. At last, genes can be compared to sequences retrieved from LRG and RefSeq, finding and automatically annotating new potential variations. Variobox is a free cross-platform desktop application, available for download at <a href="http://bioinformatics.ua.pt/variobox">http://bioinformatics.ua.pt/variobox</a>.

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## variobox



# Intonation and Expressivity: A single case study of Classical Western Singing

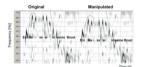
Johan Sundberg<sup>1</sup>, Filipa M. B. Lã<sup>2</sup>, Evangelos Himonides<sup>3</sup>

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University of London, U.K.

### FIGURE 1

Example of the Cor tool of Soundswell workstation showing Fo peaks of both original and manipulated versions of the excerpt Gesellen, song # 3, b 5-11. The high long note of the original version was sung 31 cent sharper as compared to ETT.



The analysis of fundamental frequency (Fo) of recordings of several renowned singers suggests significant deviations from equally tempered tuning ( $\Delta$ ETT) [1-3].  $\Delta$ ETT were of more than  $\pm$ 40 cent in some peak-phrase tones of commercial examples of Ave Maria by Franz Schubert. Although exceeding almost by an order of magnitude the just-noticeable difference for frequency discrimination, these  $\Delta$ ETT were perceived as being in tune [3]. To what extent intonation can be perceived as contributing to expressivity in singing?

Baritone Håkan Hagegård was recorded singing Lieder excerpts: as void of musical expression as he could (*Neutral* version), and (2) as in a public performance (*Concert* version). The emotional contour of these excerpts were assessed: 6 were perceived as *Agitated* and 5 as *Peaceful* (Table 1).

| AGITATED   |  |                                   |                |
|------------|--|-----------------------------------|----------------|
| COMPOSER   | PIECE  | SECTION                           | ACRONYM        |
| G Mahler   | Lieder eines fahrenden<br>Gesellen, song # 3, b 5-11 | Ich hab' ein glühend<br>Messer    | Me(sser)       |
| F Schubert | Erlkönig, b 72-79                                    | Mein Vater, mein Vater            | Vater          |
| R Schumann | Liederkreis XII , b 18-26                            | Und der Mond                      | Sie(ist dein)  |
| R Schumann | Dichterliebe VII, b 12-18                            | Wie Du auch strahlst              | Herz(ensnacht) |
| R Strauss  | Zueignung, b 21-29                                   | Und beschworst darin die<br>Bösen | He(ilig)       |
| G Verdi    | Falstaff, Ford's<br>monologue, b 24-31               | Laudata sempre siab 24-31         | Cor            |
|            |  |                                   |                |

| PEACEFUL     |                                |                                   |          |
|--------------|--------------------------------|-----------------------------------|----------|
| COMPOSER     | PIECE                          | SECTION                           | ACRONYM  |
| F Schubert   | Du bist die Ruh, b 8-15        | Du bist die Ruh                   | Frie(de) |
| F Schubert   | Wanderers Nachtlied,<br>b 3-14 | Über allen Gipfeln ist Ruh        | All(e)   |
| F Schubert   | Nähe des Geliebten, b 3-8      | lch denke dein                    | Mee      |
| R Schumann   | Dichterliebe VI, b 31-42       | Es schweben Blumen und<br>Englein | Lie      |
| F Mendelsohn | Paulus, Aria # 18, b 5-13      | Gott sei mir gnädig               | Syn(der) |

Fo was extracted from these excerpts.  $\triangle$ ETT did not differ clearly between Concert and Neutral versions, neither for Agitated nor for Peaceful excerpts. However, the high long notes were sharper in the Concert than in the Neutral versions of Agitated examples (one sample T-test: t(9) = 2.94; p = 0.017).

The *Agitated* examples were then manipulated using *Melodyne*, bringing the sharp high long notes down to ETT (Fig. 1), and paired with their original versions. A final version of the piloted listening test with 4 presentations of each of

5 examples, 2 with original first and 2 with manipulated first, was presented to 41 expert listeners. They were asked to pay special attention to the peak-phrase tone (the corresponding word in the lyrics was given), and to decide which version was more expressive in the pair. A one sample T-test was applied to assess whether these means differed significantly from 0.5, at a confidence level of  $\alpha$  = 0.05%.

With respect to the average across all excerpts, significant proportion differences were found: the original version was perceived as being more expressive than the manipulated (p <0.01). For individual excerpts, the original versions of the examples "Me(sser)", "Hei(lig)" and "Cor" were rated as significantly more expressive. For "Herz(ensnacht)" and "Sie (ist dein)", the preference for the original versions failed to reach significance (Table 2).

|                |            | one sample T-test |        |  |
|----------------|------------|-------------------|--------|--|
| Example        | Mean (SD)  | t(40)             | р      |  |
| ALL EXAMPLES   | 0.59 (.11) | 4.99              | <0.001 |  |
| Cor            | 0.61 (.23) | 3.04              | <.001* |  |
| Hei(lig)       | 0.63 (.23) | 3.61              | <.001* |  |
| Me(sser)       | 0.67 (.21) | 5.36              | <.001* |  |
| Herz(ensnacht) | 0.52 (.18) | 0.85              | 0.4    |  |
| Sie (ist dein) | 0.48 (.25) | -0.31             | 0.76   |  |
|                |            |                   |        |  |

Two main findings have emerged: (1) the Fo measurements revealed that the singer sharpened phrase-peak tones in agitated but not in peaceful examples, and (2) the listening test demonstrated that expert listeners perceive this sharpening as adding to the expressivity. The results support the frequently made assumption that intonation is used as an expressive mean in music performance [4].

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## Improving Classical Communication Systems Using Quantum Technologies

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Quantum communications apply fundamental laws of quantum physics to encode, transmit, store and process information. The ability to control quantum systems can trigger a completely new generation of communication systems. By using single or few photons we can address two important challenges in nowadays communication networks: security and capacity.

Over the last few years the Instituto de Telecomunicações (IT) has been actively involved in addressing issues related with quantum communications, through several research projects. In the framework of those projects, we succeeded to implement single and entangled photon sources for cryptographic applications. We are using the four-wave mixing process to obtain heralded single photon sources and polarization entangled photon sources. Entanglement is a non-classical phenomenon, in which two photons behave like one single object even though they are physically apart. Entangled states highlight the nonlocality and non-separability of the quantum world.

After encoding single photons in two non-orthogonal polarization states we implemented a long distance optical fiber quantum bit commitment protocol. That protocol has particular interest for applications such as commercial binding, and user authentication, since it allows solving trust issues when people are not closed to each other. Nevertheless, due to random evolution of the polarization states of the photons inside the fiber, a continuous compensation of those polarizations rotations is needed. We develop a real-time non-intrusive method to compensate for those random rotations. With that, we are able to extract the information encoded in the photons polarization, after they travel in the fiber for several kilometers.

Although security is the most obvious application of single or few photon sources, the use of very low-energy optical signals in optical networks can lead to an increase on the fiber capacity. We are engineering few photon transmission systems to pursue that goal, by increasing the number of bits carried per photon. We should note that nowadays we are using 10-5 bit/photon, which is several orders of magnitude below the 1.44 bit/photon pointed out as the fundamental limit.

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#### FIGURE 1

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Laboratory implementation of the quantum bit commitment protocol.





### Green Communications: Energy saving for 5G handsets

Jonathan Rodriguez<sup>1</sup>

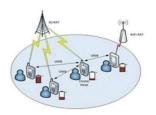
1 — Department of Electronics, Telecommunications and Informatics & IT, University of Aveiro

In this so called "green society", energy consumption has now become an important design metric for wireless systems, which before was confined to the familiar energy ratings seen on electro domestic appliances. The carbon footprint resulting from mobile phone usage has seen an alarming increase in the last decade with the rise in mobile traffic, a trend which is set to continue in the future as we head towards the 5G era. This surge will increase the energy and cost of mobile communications to unprecedented levels, mandating mobile stakeholders to seek urgent solutions to the problem of reducing energy consumption in mobile networks. The ICT C2POWER and Eureka Celtic Green-T projects are prime examples of leading research on this area. Both initiatives are coordinated by the Instituto de Telecomunoações-Aveiro, aim to investigate two complementary techniques to improve energy efficiency at the mobile handset, these include: Cooperative technologies that allow nodes/devices in the near vicinity to form a collaborative group to assist in providing short-range connectivity allowing fast downloading services thereby reducing the connectivity time of the radio interface, the cost of cooperation is seen as a new business model to promote these services; and Cognitive techniques provides the network with in-built intelligence allowing the network/mobile to make intelligent decisions towards network selection and scanning leading towards significant energy savings. Key results include:

- Practical implementation of using short-range collaborative clusters in synergy with long-range devices to provide energy efficient connectivity and high-speed download.
- Game theory protocols for choosing the best available energy efficient cluster for connectivity and for promoting new business modes based on the cost of cooperation

- Going beyond traditional routing strategies by adopting energy efficient metrics.
- Intelligent network and node scanning for reducing the mobile connectivity time and enabling high-speed download.
- Intelligent vertical handovers to enable roaming between different mobile standards, that includes LTE and Femto cells.
- Practical implementation of intelligent energy efficient handovers for multi-standard roaming

These two technology agnostic approaches exploited in tandem have demonstrated energy savings as much as 50% at the mobile handset.



# The MEDIEVAL Project (MultiMEDia transport for mobile Video AppLications)

Daniel Corujo<sup>1,2</sup>, Rui L. Aguiar<sup>1,2</sup>, Sérgio Figueiredo<sup>2</sup>, Carlos Guimarães<sup>2</sup>

The MEDIEVAL project was a FP7 EU research project, which started in July 2010 and finished in July 2013, which focused on the problems faced by mobile operators when confronted with the expected huge traffic increase caused by the explosion of video services. The project aimed at providing novel solutions that can be fed into existing network solutions for mobile operators based on future evolutions of the 3GPP Evolved Packet System (EPS) architecture. To address this problem, the project proposed a set of mechanisms that individually provide enhancements in the efficiency of video transport while cumulatively exploit their cross-layer functionalities to boost performance. The mechanisms targeted in this project include enhanced wireless support (with general abstractions to address heterogeneous wireless technologies), improved mobility (to allow opportunistic handovers across technologies), improved video distribution (with embedded caches in the network), and flexible video service provisioning and control (exploiting the interaction with video applications). These mechanisms can potentially be incorporated separately to future cellular networks, which allows for multiple evolution paths towards the deployment of the MEDIEVAL architecture, which considers an integrated framework that includes all these mechanisms.

The Instituto de Telecomunicações, was a decisive contributor into key areas of the project, composing the framework architecture, mobility management, multicast aspects, L2.5 and contention-based wireless access abstractions. Two important pieces of open-source software were implemented as well, in the form of ODTONE (http://atnog.av.it.pt/odtone), an open source implementation of the IEEE 802.21 Media Independent Handovers standard, and OPMIP (http://atnog.av.it.pt/opmip). Moreover, extensive experimentation activities were conducted in the Advanced

Mobile wireless Network playground (AMazINg - http://amazing.atnog.av.it.pt), a set of 24 interconnected wireless nodes deployed on the rooftop of the Instituto de Telecomunicações premises in Aveiro.

The Instituto de Telecomunicações was also responsible for one of the three project demos, focusing on the Personal Broadcasting Service and showcasing sender side multilink transmission and session management, cross-layer architecture enhanced with intrinsic IP multicast awareness, MIH-boosted multicast session initiation and context transfer and scalable layered multicast.

Video Services Control

Provisioning
(Service, Content and User)

Session Management (E2E
Monitoring, QoE Engine and Video
Control)

Transport Optimization

CDN (App. Monitoring, Node Control, Decision
Module)

Transport Optimization (Traffic Engineering, Core
Monitoring, Cross-Layer Optimization)

Wireless Access
L2.5 Abstraction

Contention-based Wireless Access
Strategies, Interface Configuration, Video Frame Selection,

(WLAN Monitoring, Jumbofra Dynamic Configuration)

Content Source

The same of th

mes, Cognitive Exploit Techs., PDCP Relay) 1 — Department of Electronics, Telecommunications and Informatics, University of Aveiro 2 — IT, University of Aveiro

### FIGURE 1

The MEDIEVAL Architecture.

### FIGURE 2

MEDIEVAL Personal Broadcasting Service Demonstrator

# Ohmic heating: a new tool for organic synthesis

Joana Pinto¹, Vera L. M. Silva¹, Ana M. G. Silva², Artur M. S. Silva¹, José C. S. Costa³, Luís M. N. B. F. Santos³, Roger Enes¹, José A. S. Cavaleiro¹, António A. M. O. S. Vicente⁴ and José A. C. Teixeira⁴

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- 2 REQUIMTE.
- 3 CIQ, DQB, Faculty of Sciences, University of Porto.
- 4 IBB-CBE, University of Minho.

#### FIGURE 1

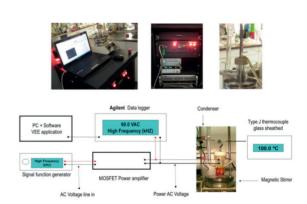
Schematic representation and pictures of the ohmic heating reactor (Portuguese Patent no 105908, 2011-09-27)

Some of the challenging actual topics for chemists, namely reduce energy consumption, replace toxic organic solvents and perform chemical transformations in aqueous media, prompted us to start a project aiming to construct and test an ohmic heating reactor for organic synthesis in aqueous media.

Ohmic heating is an advanced thermal processing method where the reaction mixture or the medium. which serves as an electrical resistor, is heated by passing electricity through it. The heating occurs in the form of internal energy transformation (from electric to thermal) within the reaction mixture. Therefore. ohmic heating can be seen as an internal thermal energy generation technology, and not only as a thermal energy transfer, meaning that it does not depend on the heat transfer to the medium. Thus, electrical energy is dissipated into heat with high efficiency. Some organic reactions were performed using the ohmic heating reactor as a proof of concept and the results, compared with those obtained under conventional (oil bath) and microwave heating, showed that the ohmic reactor allows faster and more uniform heating and induces the increase of dynamics/mobility of charged species, with a virtually unlimited penetration depth, on contrary to microwave heating, leading in several cases to higher reaction yields and shorter reaction times. Besides, its high efficiency, the possibility of fast and uniform heating, as well as the possibility of visual monitoring and addition of reagents during the reaction, which in most microwave closed cavities is not possible, make the use of this process a highly advantageous and versatile option for organic synthesis especially in water.

In addition to organic synthesis, this reactor and heating method can also be applied in inorganic synthesis, mainly in the synthesis of organometallic frameworks and nanoparticles.

Due to the easy scaling up of the reactor and heating process, this technology has real commercial potential in industry, particularly as more chemists start to exploit the high thermal capacity, low cost and nontoxic nature of on-water techniques.



# Application of microwave superheated water extraction of dietary fibres for valuation of food industry by-products

Cláudia P. Passos¹, Elisabete Coelho¹ and Manuel A. Coimbra¹

Microwave irradiation is becoming a feasible tool to extract dietary fibres from food industry by-products using only water or dilute aqueous solutions. Alternatively to the strong alkali treatments that have been applied, the use of microwave irradiation in closed vessels allows to achieve superheated water. Under these conditions, water soluble fibres can be obtained (Fig.1). The superheated water extraction can be applied to a wide range of by-products, allowing a distinct portfolio of soluble fibres. Spent coffee grounds (SCG), brewers' spent grain (BSG), and brewers' spent yeast (BSY) are three examples of available agrofood by-products, which can be used as raw materials for extraction of added-value polysaccharides for incorporation as dietary fibre into novel food industry formulations.

The short time of microwave irradiation (2-5 min) and the modulation of the operating conditions such as temperature and solid to water ratio, allow to obtain different fibres from different matrices: at 180°C, BSG arabinoxylans, BSY mannoproteins, and SCG arabinogalactans are obtained, whereas BSY  $\beta$ -glucans and SCG galactomannans requires 200°C. Furthermore, consecutive extraction cycles of extraction of SCG and BSG and/or different solid to water ratios allows to obtain different types of galactomannan and arabinoxylan structures, respectively.



Beyond the dietary fibre applications, these polysaccharide-based food ingredients present several other health-related properties such as prebiotic and immunostimulatory properties.

The methodology proposed, considering the extraction of fibres from SCG and BSG, was object of publication in three Elsevier Carbohydrate Polymers journal papers. One oral communication award for young scientists was received in a conference in Czech Republic (2011), and three best poster awards were received in conferences in Portugal (2009), Italy (2011), and India (2014).

In collaboration with ESTGA, at the University of Aveiro, the design of a prototype for continuous extraction is under way.

1 — Department of Chemistry & QOPNA, University of Aveiro

### FIGURE 1

Production of fibres from agrofood by-products using the microwave superheated water technology. Extraction of galactomannans and arabinogalactans from spent coffee grounds (SCG); arabinoxylans from brewers' spent grain (BSG); and β-glucans from brewers' spent yeast (BSY).

# Lifelong exercise targets mitochondria phosphoproteome to improve heart function

Rita Ferreira<sup>1</sup>, Rui Vitorino<sup>1</sup>, Ana Isabel Padrão<sup>1</sup>, Guadalupe Espadas<sup>2</sup>, Francesco M. Mancuso<sup>2</sup>, Daniel Moreira-Gonçalves<sup>3,4</sup>, Gonçalo Castro-Sousa<sup>4</sup>, Tiago Henriques-Coelho<sup>3</sup>, Paula A. Oliveira<sup>5</sup>, António S. Barros<sup>1</sup>, José Alberto Duarte<sup>4</sup>, Eduard Sabidó<sup>2</sup>, Francisco Amado<sup>1,6</sup>

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- 3 Faculty of Medicine,University of Porto
- 4 Faculty of Sports, University of Porto
- 5 Department of Veterinary Science, UTAD
- 6 School of Health, University of Aveiro

### FIGURE 1

Effect of lifelong exercise in the regulation of biological processes

### FIGURE 2

Predicted kinases distribution among groups based on specific phosphosites (network constructed using Cytoscape v2.8.3).

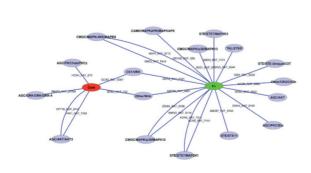
Moderate physical activity has been associated to the improvement of the cardiac function and, consequently, to the extension of the life span. Mitochondria play a key role in the adaptation of heart muscle to exercise-related metabolic demands. In order to disclose the molecular mechanisms underlying the beneficial effect of lifelong physical activity in the cardiac function, we performed label-free quantitative mass spectrometry-based proteomics of heart mitochondrial proteome and phosphoproteome. Data shown that 54-weeks of moderate treadmill exercise modulates the abundance of proteins involved in the generation of precursor metabolites and cellular respiration, suggesting an increase in carbohydrate oxidation-based metabolism.

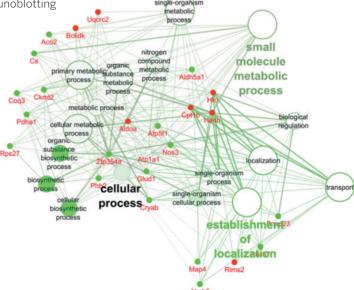
Most of the proteins exhibiting significant alterations in specific phosphorylation sites were involved in metabolism. Motif analysis has aided in the identification of potential kinases responsible for the observed phosphorylation events, such as RAF and p38 MAPK, that have been further validated with immunoblotting techniques.

Taken together, data highlight the plasticity of heart mitochondria by the reprogramming of phosphoproteome, and it provides evidence for the kinases involved in the regulation of metabolic pathways and mitochondrial maintenance in response to long exercise programs.

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# Nano Graphene Oxide: An emerging nanoplatform for cancer therapy

Gil Gonçalves<sup>1\*</sup>, Paula Alexandrina A. P. Marques<sup>1\*</sup>, María-Teresa Portolés<sup>2</sup>, María Vallet-Regi<sup>2</sup>, José Gracio<sup>1</sup> and Mercedes Vila<sup>1\*</sup>

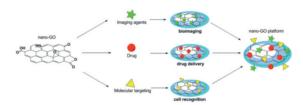
Nano-GO is a graphene derivative with a 2D atomic layer of sp² bonded carbon atoms in hexagonal conformation together with sp3 domains with carbon atoms linked to oxygen functional groups. The supremacy of nano-GO resides essentially in its own intrinsic chemical and physical structure, which confers high aspect ratio, unusual physical properties and an extraordinary chemical versatility arising from the oxygen functional groups on the carbon structure that make possible its relatively easy functionalization.

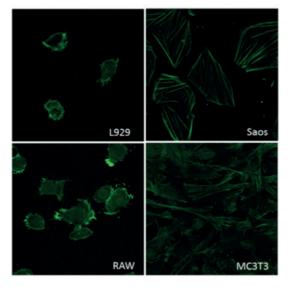
Hence, the synergistic effects resulting from the assembly of well-defined structures at the nano-GO surface, in addition to its intrinsic optical, mechanical and electronic properties, allow the development of new multifunctional hybrid materials with a high potential in the biomedical area (*Adv Healthcare Mater, 2 (2013) 1072*). (Figure 1).

Nano-GO is being investigated on different areas of nanomedicine, especially on the development of cancer treatments by hyperthermia. Due to its strong Near Infrared optical absorption ability and its unique and smaller two-dimensional shape and aspect ratio, it is incomparable to any other particle, especially concerning its low-cost production in contrast with gold or magnetic nanosystems.

Moreover, the functionalization of nano-GO with polyethylene-glycol (PEG) allows the development of new hybrid materials with potential therapeutic effects on applications which imply long lasting circulation on the blood stream and particle cell internalizations. Our recent results showed nano-GO-PEG uptake kinetics differences in the agent's uptake amount and speed as a function of the type of cell involved on the process. Moreover, the PEG nature (poly or single branched) also influences cell viability and particle uptake speed

(Nanotechnology 23 (2012) 465103). Further studies showed that the subcellular distribution of nano-GO-PEG inside the cell (particles are labelled with green fluorescence on Figure 2) is also dependent on the cell type. L929 fibroblasts and RAW macrophages showed particles mainly localized on the cell membrane and in the cytoplasm. However, in SAOS osteoblasts and MC3T3 preosteoblasts, the signal seems located on the microtubules, F-actin filaments, and high doses could induce cell-cycle alterations, apoptosis and oxidative stress. The published results, about PEG nano-GO functionalization, size and dose, were the first discoveries for performing a safe therapy with no secondary effects on surrounding healthy cells (Biomaterials 34 (2013) 1562).





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 2 — Universidad Complutense de Madrid, Spain

### FIGURE 1

Schematic representations of different approaches for the functionalization of nano-GO in order to obtain multifunctional platforms for cancer therapy.

### FIGURE 2

Incorporation of GOs by cultured human SAOS-2 osteoblasts, murine MC3T3-E1 preosteoblasts, murine L929 fibroblasts and murine RAW-264.7 macrophages after 1 day treatment observed by confocal microscopy.

# Investigation of thermal conductivity and viscosity of Fe<sub>3</sub>O<sub>4</sub> nanofluid for heat transfer applications

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1 — Department of Mechanical Engineering & TEMA, University of Aveiro

2 - AIN, University of Aveiro

#### FIGURE 1

(a) XRD pattern of Fe<sub>3</sub>O<sub>4</sub> nanoparticles; (b) TEM results; (c) dispersion of nanoparticles in water; (d) separation of particles from the water with magnet.

### FIGURE 2

(a-b) Experimental thermal conductivity and viscosity of nanofluid with effect of volume concentration and temperature. Nanofluids, colloidal suspensions of nanoparticles in liquid carrier fluids, exhibit unusually large thermal conductivities. Therefore, nanofluids have attracted great interest from many researchers due to their potential benefits for numerous applications such as microelectronics; energy supply; transportation and heating, ventilating and air conditioning (HVAC), and they have been proposed as the next generation heat transfer fluids. Many researchers are now focusing on the measurement of thermal properties of ferrofluids, because of the unique magnetic property of these fluids. Water based magnetic nanofluid thermal conductivity and viscosity data is not available in the literature. So, the present work focuses on the estimation of properties of magnetic nanofluid.

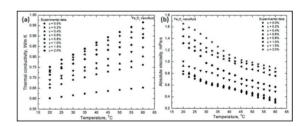
To fully understand the heat transfer capabilities of magnetic nanofluids, it is necessary to understand the thermo-physical properties like thermal conductivity, absolute viscosity, density and specific heat at different volume concentrations and temperatures. All these properties are very important for heat transfer applications of magnetic nanofluids inside a tube. In the present work we develop magnetic  $\text{Fe}_3\text{O}_4/\text{water}$  nanofluid (Fig. 1a-d). Thermal conductivity of different volume concentrations nanofluid is shown in Fig. 2 (a-b) along with the based fluid.

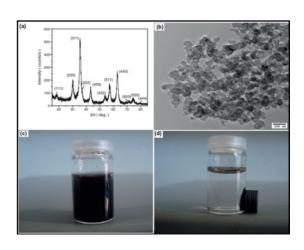
The thermal conductivity of the nanofluids increases with increase of percentage of volume concentration and temperature. In our experiment higher thermal conductivity enhancement of 48% was observed with 2.0% volume concentration at 60OC temperature compared to base fluid. Fe $_3$ O $_4$ /water nanofluid exhibited Newtonian behaviour under the tested volume concentration range. Viscosity of nanofluid increases with increase of particle volume concentration. Higher viscosity enhancement of 2.96 times was observed

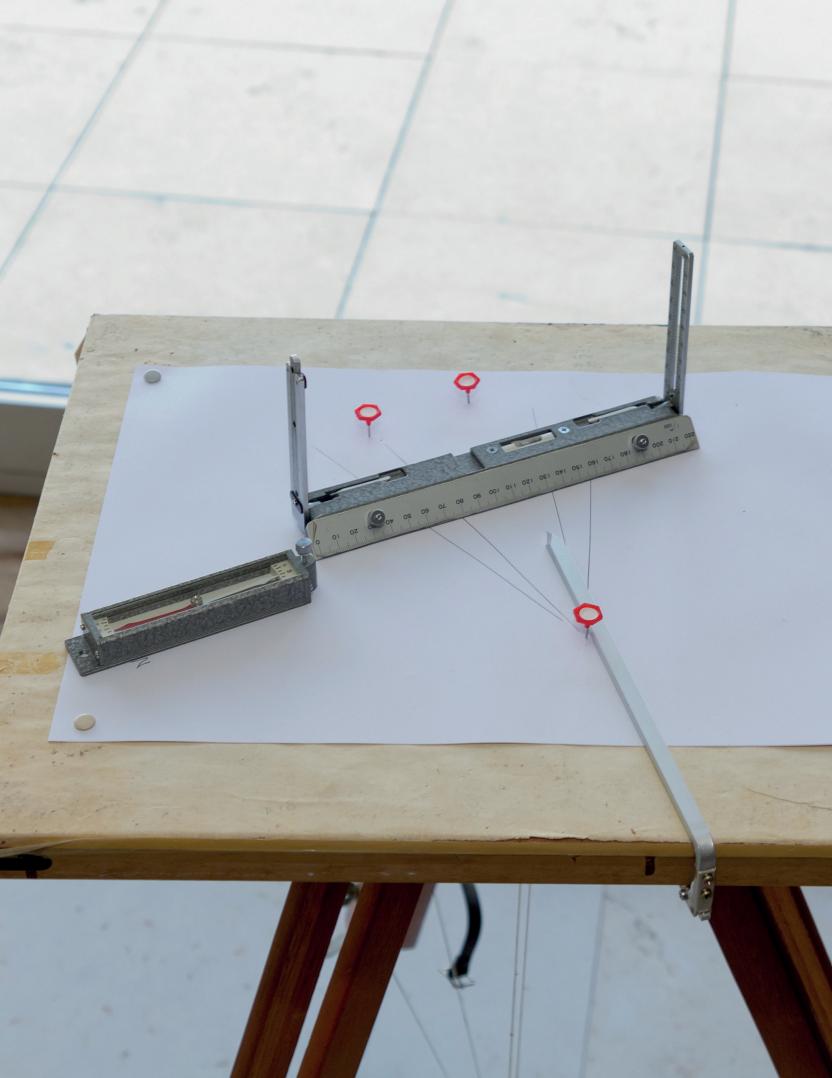
with 2.0% volume concentration at 60OC temperature compared to base fluid. Under the same volume concentration and temperature, viscosity enhancement to more compared to thermal conductivity enhancement. In addition to this, theoretical equations were developed to predict thermal conductivity and viscosity of nanofluids without resorting to the well established Maxwell and Einstein models, respectively. The proposed equations show reasonably good agreement with the experimental results.

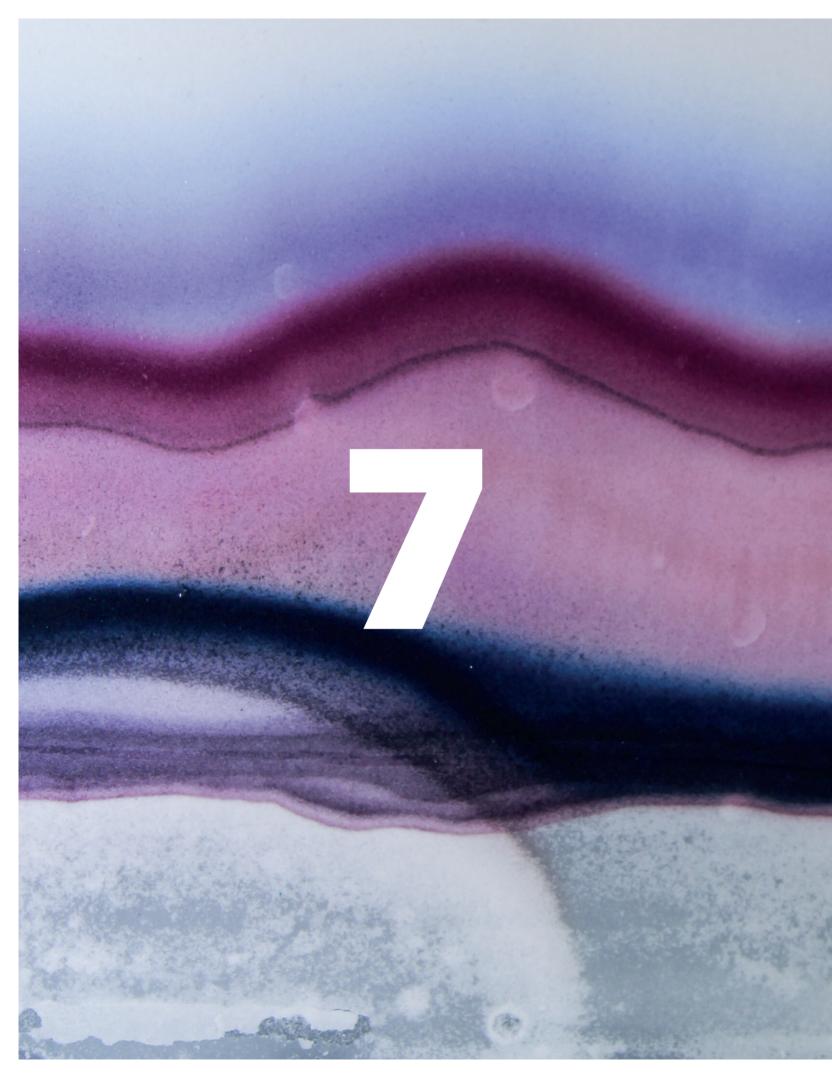
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The details of this work published in reputed Elsevier (*International Communications in Heat and Mass Transfer, Volume 44, May 2013, Pages 7-14*; http://dx.doi.org/10.1016/j.icheatmasstransfer. 2013.02.014; also cited in top 25 hottest articles in July-September).











## **People**

### **FACULTY BY DEPARTMENT**

|  |       | F.A   | ACULTY (FTE)           |                             |
|--|-------|-------|------------------------|-----------------------------|
|  | TOTAL | TOTAL | PERCENTAGE<br>OF WOMEN | PERCENTAGE<br>OF FOREIGNERS |
| UNIVERSITY   | 2012  |       | 2013                   |                             |
| Department of Environment and Planning                                   | 19    | 19    | 58%                    |                             |
| Department of Biology  | 32,9  | 32,7  | 43%                    |                             |
| Department of Social Sciences, Policy and Planning                       | 27,3  | 25,4  | 24%                    |                             |
| Department of Communication and the Arts                                 | 77,6  | 73,2  | 33%                    | 5%                          |
| Department of Economics, Management and Industrial Engineering           | 55,1  | 55,4  | 55%                    | 4%                          |
| Department of Education  | 37,3  | 37,4  | 73%                    |                             |
| Department of Electronics, Telecommunications and Informatics            | 81,3  | 79,3  | 8%                     | 1%                          |
| Department of Civil Engineering  | 18,6  | 17,6  | 17%                    |                             |
| Department of Materials Engineering and Ceramics                         | 17    | 17    | 47%                    |                             |
| Department of Mechanical Engineering                                     | 27,9  | 27    | 10%                    |                             |
| Department of Physics  | 47,6  | 46,3  | 18%                    | 6%                          |
| Department of Geosciences  | 13,5  | 13,5  | 37%                    |                             |
| Department of Languages and Cultures                                     | 43,2  | 44,2  | 59%                    | 23%                         |
| Department of Mathematics  | 63,7  | 58,4  | 45%                    | 10%                         |
| Department of Chemistry  | 47,3  | 46,3  | 50%                    |                             |
| Department of Health Sciences  | 20,3  | 13,9  | 63%                    | 11%                         |
| POLITECHNICAL SCHOOLS  |       |       |                        |                             |
| School of Design, Management and Production Technologies of Aveiro North | 14,4  | 14    | 39%                    |                             |
| School of Health of the University of Aveiro                             | 39,7  | 38,9  | 58%                    |                             |
| Agueda School of Technology and Management                               | 46,3  | 46,9  | 43%                    |                             |
| School of Accounting and Administration of Aveiro                        | 70,1  | 69,3  | 49%                    |                             |
| TOTAL  | 800,1 | 775,7 | 40%                    | 4%                          |

### RESEARCHERS BY DEPARTMENT

|  | RESEARCHERS (FTE) |       |                        |                             |  |  |  |
|--|-------------------|-------|------------------------|-----------------------------|--|--|--|
| DEPARTMENT   | TOTAL             | TOTAL | PERCENTAGE<br>OF WOMEN | PERCENTAGE<br>OF FOREIGNERS |  |  |  |
| UNIVERSITY   | 2012              |       | 2013                   |                             |  |  |  |
| Department of Environment and Planning                         | 19                | 21    | 67%                    | 38%                         |  |  |  |
| Department of Biology  | 69                | 86,8  | 67%                    | 16%                         |  |  |  |
| Department of Social Sciences, Policy and Planning             | 3                 | 4     | 50%                    | 25%                         |  |  |  |
| Department of Communication and the Arts                       | 1                 | 1     | 100%                   | 100%                        |  |  |  |
| Department of Economics, Management and Industrial Engineering | 3                 | 2     | 50%                    | 50%                         |  |  |  |
| Department of Education  | 17                | 19    | 95%                    | 16%                         |  |  |  |
| Department of Electronics, Telecommunications and Informatics  | 15                | 18    | 17%                    | 28%                         |  |  |  |
| Department of Materials Engineering and Ceramics               | 46                | 46,2  | 37%                    | 60%                         |  |  |  |
| Department of Mechanical Engineering                           | 15,4              | 24,4  | 49%                    | 55%                         |  |  |  |
| Department of Physics  | 37                | 48,8  | 29%                    | 43%                         |  |  |  |
| Department of Geosciences                                      | 12                | 11    | 64%                    | 27%                         |  |  |  |
| Department of Mathematics                                      | 16                | 10    | 40%                    | 70%                         |  |  |  |
| Department of Chemistry  | 101               | 116,5 | 58%                    | 27%                         |  |  |  |
| TOTAL  | 354,4             | 408,7 | 54%                    | 33%                         |  |  |  |

### **STAFF BY CATEGORY**

|                        | FACULTY (FTE) |        |                        |                             |  |  |
|------------------------|---------------|--------|------------------------|-----------------------------|--|--|
| CATEGORY               | 2012          | 2013   |                        |                             |  |  |
| UNIVERSITY             | TOTAL         | TOTAL  | PERCENTAGE<br>OF WOMEN | PERCENTAGE<br>OF FOREIGNERS |  |  |
| Full professors        | 52,8          | 54,3   | 9%                     | 2%                          |  |  |
| Assotiated professors  | 118,3         | 116    | 35%                    | 2%                          |  |  |
| Assistant professors   | 375,9         | 368,1  | 43%                    | 4%                          |  |  |
| Lecturer               | 92,7          | 80,2   | 40%                    | 3%                          |  |  |
| Other teaching staff   | 13,2          | 14,2   | 65%                    | 51%                         |  |  |
| Researchers            | 93,4          | 114,7  | 44%                    | 38%                         |  |  |
| Post-doctoral students | 261           | 294    | 57%                    | 32%                         |  |  |
| POLITECHNICAL SCHOOLS  |               |        |                        |                             |  |  |
| Coordinator professors | 10,6          | 11,6   | 34%                    |                             |  |  |
| Adjunt professors      | 91,3          | 94,2   | 46%                    |                             |  |  |
| Lecturer equivalent    | 42,3          | 37,1   | 59%                    |                             |  |  |
| TOTAL                  | 1154,5        | 1184,4 | 45%                    | 14%                         |  |  |

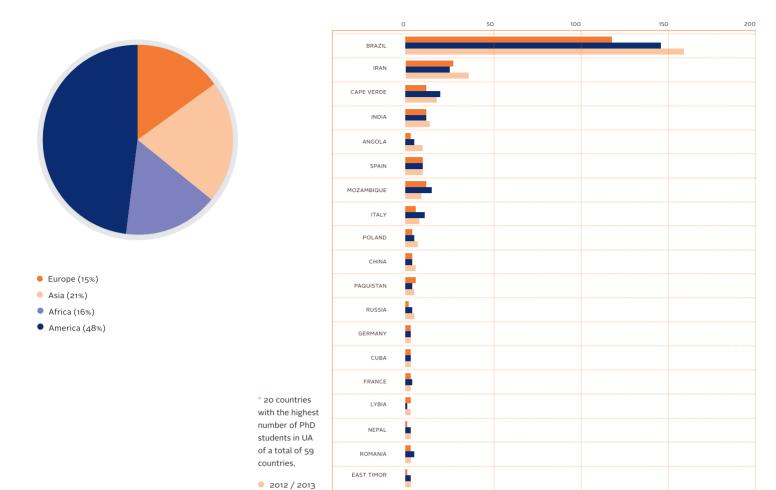
### PHD STUDENTS BY DEPARTMENT

|  | PHD STUDENTS |       |                        |                             |                               |  |
|--|--------------|-------|------------------------|-----------------------------|-------------------------------|--|
| UNIVERSITY   | TOTAL        | TOTAL | PERCENTAGE<br>OF WOMEN | PERCENTAGE<br>OF FOREIGNERS | PERCENTAGE OF<br>NEW STUDENTS |  |
| DEPARTMENT   | 2011 / 2012  |       | 201                    | 2/2013                      |                               |  |
| Department of Environment and Planning                         | 82           | 89    | 66%                    | 29%                         | 28%                           |  |
| Department of Biology  | 158          | 153   | 76%                    | 28%                         | 18%                           |  |
| Department of Social Sciences, Policy and Planning             | 29           | 19    | 63%                    | 11%                         | 11%                           |  |
| Department of Communication and the Arts                       | 231          | 254   | 52%                    | 24%                         | 26%                           |  |
| Department of Economics, Management and Industrial Engineering | 216          | 198   | 55%                    | 19%                         | 26%                           |  |
| Department of Education  | 246          | 233   | 78%                    | 13%                         | 21%                           |  |
| Department of Electronics, Telecommunications and Informatics  | 153          | 162   | 12%                    | 33%                         | 22%                           |  |
| Department of Civil Engineering                                | 44           | 44    | 25%                    | 14%                         | 23%                           |  |
| Department of Materials Engineering and Ceramics               | 80           | 78    | 38%                    | 33%                         | 21%                           |  |
| Department of Mechanical Engineering                           | 79           | 71    | 34%                    | 17%                         | 17%                           |  |
| Department of Physics  | 90           | 87    | 40%                    | 16%                         | 30%                           |  |
| Department of Geosciences                                      | 18           | 15    | 73%                    | 13%                         | 7%                            |  |
| Department of Languages and Cultures                           | 65           | 68    | 68%                    | 25%                         | 37%                           |  |
| Department of Mathematics                                      | 38           | 31    | 71%                    | 35%                         | 16%                           |  |
| Department of Chemistry  | 121          | 114   | 68%                    | 11%                         | 22%                           |  |
| Department of Health Sciences                                  | 58           | 86    | 74%                    | 5%                          | 47%                           |  |
| TOTAL*   | 1522         | 1535  | 57%                    | 22%                         | 25%                           |  |

<sup>\*</sup> The students of joint doctoral studies are considered in each participating department. Therefore, the sum of the students by department is superior to the total.

Note: The students of joint doctoral studies are considered in each participating department. Therefore, the sum of the students by department is superior to the total.

### **FOREIGN PHD STUDENTS BY NATIONALITY\***

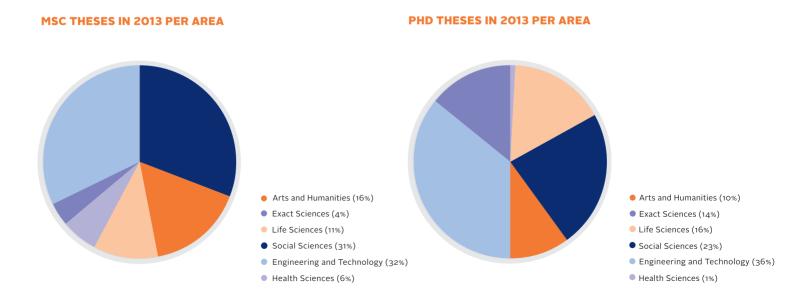


BELARUS

## **MSc and PhD theses**

• 2011 / 2012

0 2010 / 2011



## **Sci Papers**

| TOP 10 SUBJECT AREAS FOR PAPERS PUBLISHED IN 2013 | RECORD COUNT | % OF 1594 |
|---|--------------|-----------|
| Chemistry   | 350          | 21,96%    |
| Materials Science                                 | 248          | 15,56%    |
| Engineering                                       | 234          | 14,68%    |
| Physics   | 189          | 11,86%    |
| Environmental Sciences Ecology                    | 170          | 10,67%    |
| Biochemistry Molecular Biology                    | 94           | 5,90%     |
| Mathematics                                       | 89           | 5,58%     |
| Science Technology Other Topics                   | 80           | 5,02%     |
| Marine Freshwater Biology                         | 69           | 4,33%     |
| Computer Science                                  | 53           | 3,33%     |

Data retrieved from ISI Web of KnowledgeSM (Thomson Reuters) in 2 may 2014

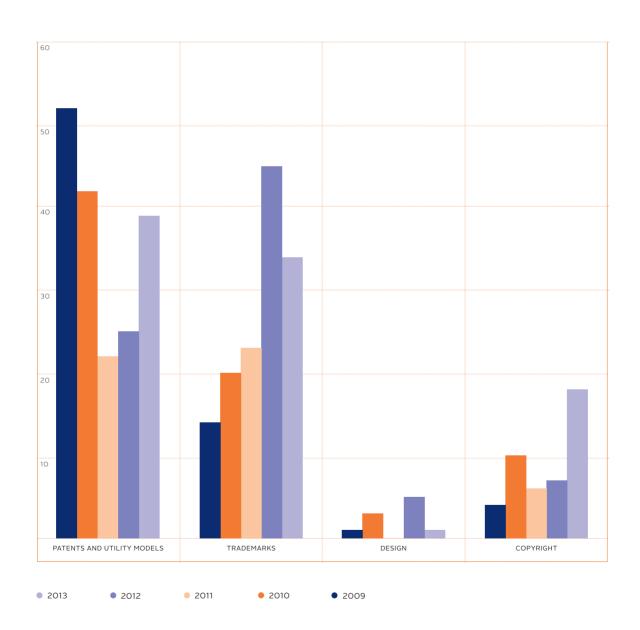
| TOP 10 CITED PAPERS   | TOTAL N° CITATIONS<br>(2009 - 2013) |
|---|-------------------------------------|
| Carlos, LD; Ferreira, RAS; Bermudez, VD ; Ribeiro, SJL (2009). Lanthanide-Containing Light-Emitting Organic-          | 349                                 |
| Inorganic Hybrids: A Bet on the Future. ADVANCED MATERIALS, 21: 509-534   |                                     |
| Rocha, J; Carlos, LD; Paz, FAA; Ananias, D (2011). Luminescent multifunctional lanthanides-based metal-organic        | 295                                 |
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| Butler, G; Rasmussen, MD; Lin, MF; Santos, MAS; Sakthikumar, S; Munro, CA; Rheinbay, E; Grabherr, M; Forche, A;       | 252                                 |
| Reedy, JL; Agrafioti, I; Arnaud, MB; Bates, S; Brown, AJP; Brunke, S; Costanzo, MC; Fitzpatrick, DA; de Groot, PWJ;   |                                     |
| Harris, D; Hoyer, LL; Hube, B; Klis, FM; Kodira, C; Lennard, N; Logue, ME; Martin, R; Neiman, AM; Nikolaou, E; Quail, |                                     |
| MA; Quinn, J; Santos, MC; Schmitzberger, FF; Sherlock, G; Shah, P; Silverstein, KAT; Skrzypek, MS; Soll, D; Staggs,   |                                     |
| R; Stansfield, I; Stumpf, MPH; Sudbery, PE; Srikantha, T; Zeng, QD; Berman, J; Berriman, M; Heitman, J; Gow, NAR;     |                                     |
| Lorenz, MC; Birren, BW; Kellis, M; Cuomo, CA (2009). Evolution of pathogenicity and sexual reproduction in eight      |                                     |
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## **Intellectual Property**

### **INTELLECTUAL PROPERTY RIGHTS REGISTRATION**

|                            | 2009 | 2010 | 2011 | 2012 | 2013 |
|----------------------------|------|------|------|------|------|
| Patents and Utility Models | 52   | 42   | 22   | 25   | 39   |
| Trademarks and Logos       | 14   | 20   | 23   | 45   | 34   |
| Design/Models              | 1    | 3    | 0    | 5    | 1    |
| Copyright                  | 4    | 10   | 6    | 7    | 18   |



## **International Projects**

### **EU-FUNDED PROJECTS STARTED IN 2013**

| SEVENTH FRAMEWORK PROGRAMME   | ACRONYM               | PROJECT COORDINATOR    |
|---|-----------------------|------------------------|
| The singlet oxygen strategy: sustainable oxidation procedures for applications in material science, synthesis, wastewater treatment, diagnostics and therapeutics | SO2S                  | João Tomé              |
| Generalizing truth-functionality  | GeTFun                | Manuel Martins         |
| Eco-innovative, safe and energy efficient wall panels and materials for a healthier indoor environment  | ECO-SEE               | João Labrincha Batista |
| Fabrication and functionalization of biomedical microdevices  | FaBiMed               | Susana Olhero          |
| Stable Interfaces for rechargeable batteries  | SIRBATT               | João de Lemos Pinto    |
| Multifunctional facades of reduced thickness for fast and cost-effective tretrofitting  | MF - Retrofit         | Romeu Vicente          |
| Preventing and remediating degradation of soils in Europe through land care   | RECARE                | Jan Jacob Keizer       |
| Sustainable Nanotechnologies  | SUN                   | Mónica Amorim          |
| INNOVATIVE MEDICINES INITIATIVE JOINT UNDERTAKING (IMI-JU)  | ACRONYM               | PROJECT COORDINATOR    |
| A European Medical Information Framework (EMIF) of patient-level data to support a wide range of medical research   | EMIF                  | José Luís Oliveira     |
| LIFELONG LEARNING PROGRAMME   | ACRONYM               | PROJECT COORDINATOR    |
| COMMITing to the social dimension in universities   | COMMIT                | Lucília Santos         |
| University educators for sustainable development  | UE4SD                 | Rui Vieira             |
| INTERREG IV   | ACRONYM               | PROJECT COORDINATOR    |
| Rede de integração e transferência de produtos de alto valor agregado com<br>base em nanopartículas para indústria do espaço SUDOE                                | CarbonInspired<br>2.0 | Victor Neto            |
| РОСТЕР  | ACRONYM               | PROJECT COORDINATOR    |
| Rede de transferência de conhecimento Universidade - Empresas. Rede Centro<br>de Portugal - Castilha Y León   | INESPO II             | José Paulo Rainho      |

### NETWORK OF EUROPEAN UNIVERSITIES WORKING WITH THE UA IN EU PROJECTS STARTED IN 2013



ALBANIA (UE4SD) AUSTRIA (GetFun, SUN, UE4SD) BELGIUM (SO2S, EMIF, COMMIT, UE4SD) BOSNIA AND HERZEGOVINA (UE4SD) BULGARIA (UE4SD) CYPRUS (UE4SD) CROATIA (UE4SD) CZECH REPUBLIC (UE4SD) DENMARK (EMIF, RECARE, SUN, UE4SD) ESTONIA (EMIF, UE4SD) FINLAND (EMIF, COMMIT) FRANCE (EMIF, INESPO, COMMIT, UE4SD) GERMANY (EMIF, SIRBATT, COMMIT, GREECE (SO2S, MF-Retrofit, RECARE, ADAPT-MED, COMMIT, UE4SD) HUNGARY (COMMIT, UE4SD) IRELAND (SUN, COMMIT) ITALY (GetFun, EMIF, SIRBATT, RECARE, SUN, COMMIT, UE4SD) LATVIA (UE4SD),

LITHUANIA (UE4SD)
MALTA (UE4SD)
NETHERLANDS (EMIF, UE4SD)
NORWAY (UE4SD)
POLAND (SIRBATT, UE4SD)
ROMANIA (COMMIT)
SLOVAKIA (RECARE, UE4SD)
SLOVENIA (UE4SD)
SPAIN (SO2S, EMIF, RECARE, INESPO, COMMIT, UE4SD)
SWEDEN (EMIF, RECARE, UE4SD)
UK (EMIF, ECO-SEE, SIRBATT, RECARE, SUN, UE4SD)
SWITZERLAND (RECARE, UE4SD)

## **Budget**

### RESEARCH PROJECTS STARTED IN 2013 TOTAL BUDGET BY RESEARCH CENTRE AND FUNDING AGENCY\*

| RESEARCH<br>CENTRE | CCDRC     | EUROPEAN<br>UNION | FOUNDATION<br>FOR SCIENCE<br>AND<br>TECHNOLOGY | INNOVATION<br>AGENCY | OTHER<br>NATIONAL | 2012       | 2013       |
|--------------------|-----------|-------------------|--|----------------------|-------------------|------------|------------|
| СВС                |           |                   | 456.340  |                      |                   | 276.779    | 456.340    |
| CESAM              | 1.001.290 | 923.054           | 2.431.183                                      | 136.615              |                   | 3.567.720  | 4.492.142  |
| CETAC-MEDIA        |           |                   |  |                      |                   | 32.997     |            |
| CICECO             | 962.794   | 645.670           | 1.099.784                                      | 883.384              | 11.595            | 3.441.069  | 3.603.227  |
| CIDMA              |           | 8.400             | 61.344   |                      | 3.300             |            | 73.044     |
| CIDTFF             |           | 36.048            | 220.052  | 86.320               |                   | 134.997    | 342.420    |
| CLC                |           |                   |  |                      |                   | 8.200      |            |
| GEOBIOTEC          |           |                   | 5.160  |                      | 3.840             | 18.878     | 9.000      |
| GOVCOPP            |           |                   |  |                      |                   | 331.762    |            |
| I3N                | 962.794   | 246.773           | 806.001  |                      | 43.654            | 627.646    | 2.059.222  |
| ID+                |           |                   | 136.360  |                      |                   |            | 136.360    |
| IEETA              | 962.794   | 779.060           | 254.711  |                      | 46.685            | 957.591    | 2.043.250  |
| INET-MD            |           |                   | 183.811  |                      |                   | 166.901    | 183.811    |
| ΙΤ                 |           | 975.816           | 1.124.771                                      | 868.717              |                   | 2.269.444  | 2.969.304  |
| Not integrated     | 252.229   | 389.040           | 355.148  | 2.289.560            | 283.789           | 311.157    | 3.569.766  |
| QOPNA              | 962.794   | 558.316           | 347.506  | 153.403              | 33.250            | 630.863    | 2.055.269  |
| TEMA               |           | 69.388            | 343.181  | 294.693              |                   | 951.148    | 707.262    |
| TOTAL              | 5.104.696 | 4.631.565         | 7.825.353                                      | 4.712.690            | 426.113           | 13.727.153 | 22.700.416 |

Contracts with industry not included

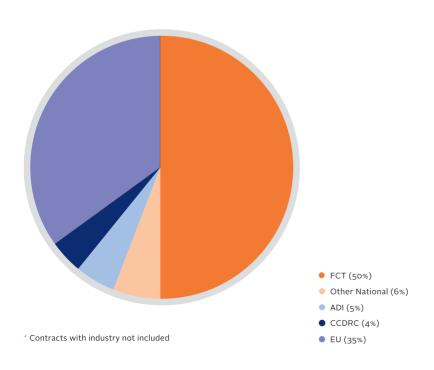
### **APPROVED BUDGET UNDER EU-FUNDED PROJECTS**

| EUROPEAN PROGRAMMES             | 2012      | 2013      |
|---------------------------------|-----------|-----------|
| ERASMUS FOR YOUNG ENTREPRENEURS | 10.001    |           |
| EU MARE                         | 115.186   |           |
| FP7 - COOPERATION               | 3.881.251 | 3.043.713 |
| FP7 - PEOPLE                    | 869.131   | 566.716   |
| IMI-JU                          |           | 779.060   |
| INTERREG - ATLANTIC AREA        | 236.545   |           |
| INTERREG - SUDOE                | 100.000   | 69.388    |
| INTERREG IVC                    | 227.496   |           |
| LIFE+                           | 416.615   |           |
| LIFELONG LEARNING               | 185.513   | 36.048    |
| POCTEP                          |           | 136.640   |
| TOTAL                           | 6.041.737 | 4.631.565 |

### **APPROVED BUDGET UNDER FCT PROJECTS**

| RESEARCH<br>CENTRE | ARTS,<br>HUMANITIES<br>AND SOCIAL<br>SCIENCES | ENGINEERING | SCIENCES  | 2012      | 2013      |
|--------------------|---|-------------|-----------|-----------|-----------|
| CBC                |   |             | 456.340   | 276.779   | 456.340   |
| CESAM              |   |             | 2.431.183 | 1.425.693 | 2.431.183 |
| CICECO             |   | 68.755      | 1.031.029 | 885.358   | 1.099.784 |
| CIDMA              |   | 61.344      |           |           | 61.344    |
| CIDTFF             | 220.052                                       |             |           | 67.000    | 220.052   |
| GEOBIOTEC          |   |             | 5.160     | 18.878    | 5.160     |
| GOVCOPP            |   |             |           | 211.012   |           |
| I3N                |   |             | 806.001   | 214.473   | 806.001   |
| ID+                | 136.360                                       |             |           |           | 136.360   |
| IEETA              |   | 198.517     | 56.194    | 85.240    | 254.711   |
| INET-MD            | 183.811                                       |             |           | 166.901   | 183.811   |
| IT                 |   | 1.124.771   |           | 990.880   | 1.124.771 |
| Not integrated     | 182.388                                       | 172.760     |           | 170.000   | 355.148   |
| QOPNA              |   |             | 347.506   | 363.265   | 347.506   |
| TEMA               |   | 343.181     |           | 620.888   | 343.181   |
| TOTAL              | 722.611                                       | 1.969.328   | 5.133.413 | 5.496.367 | 7.825.353 |

### **DISTRIBUTION OF RECEIVED FUNDS, BY FUNDING AGENCY\***







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