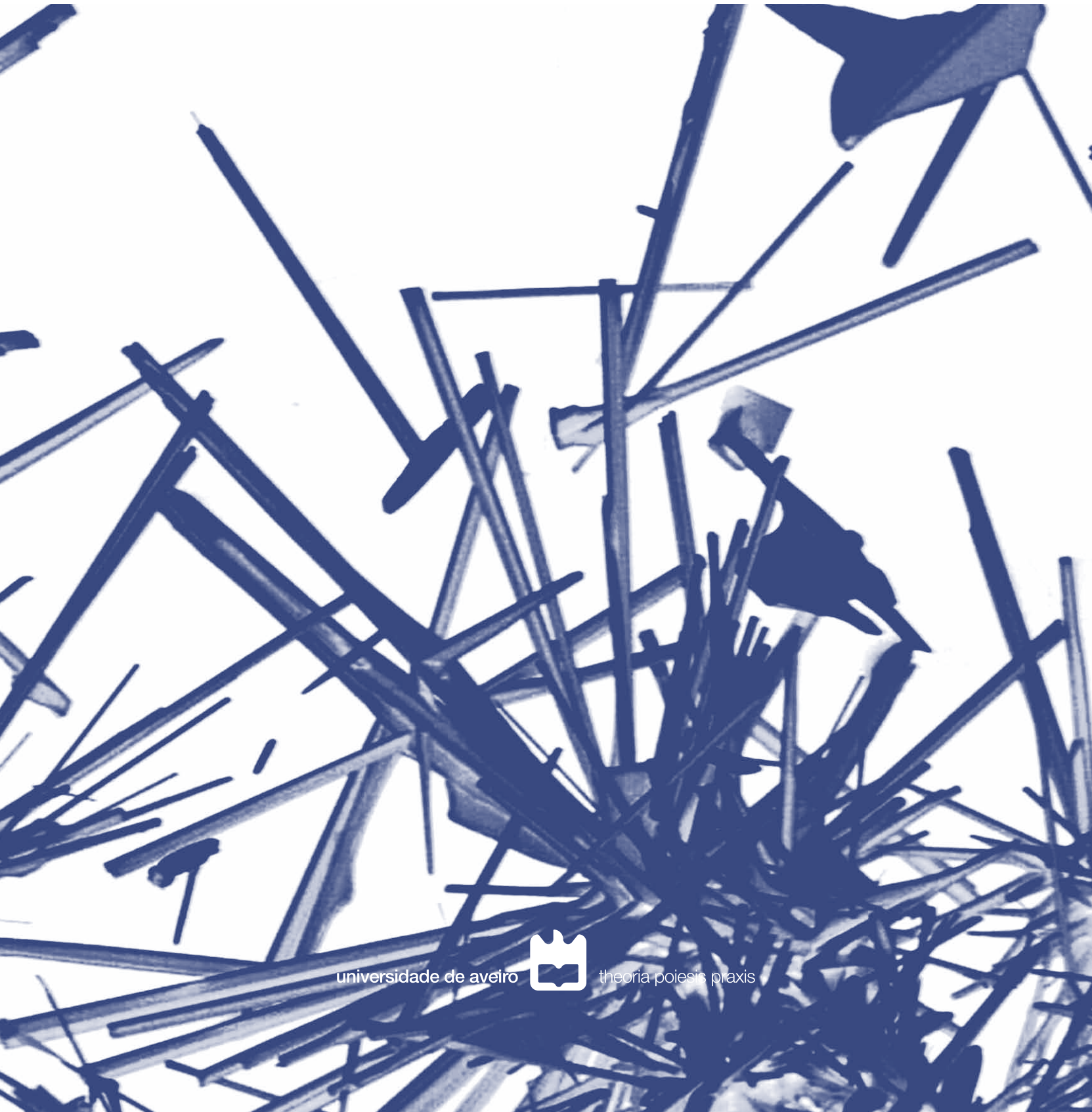
research@ua

2012



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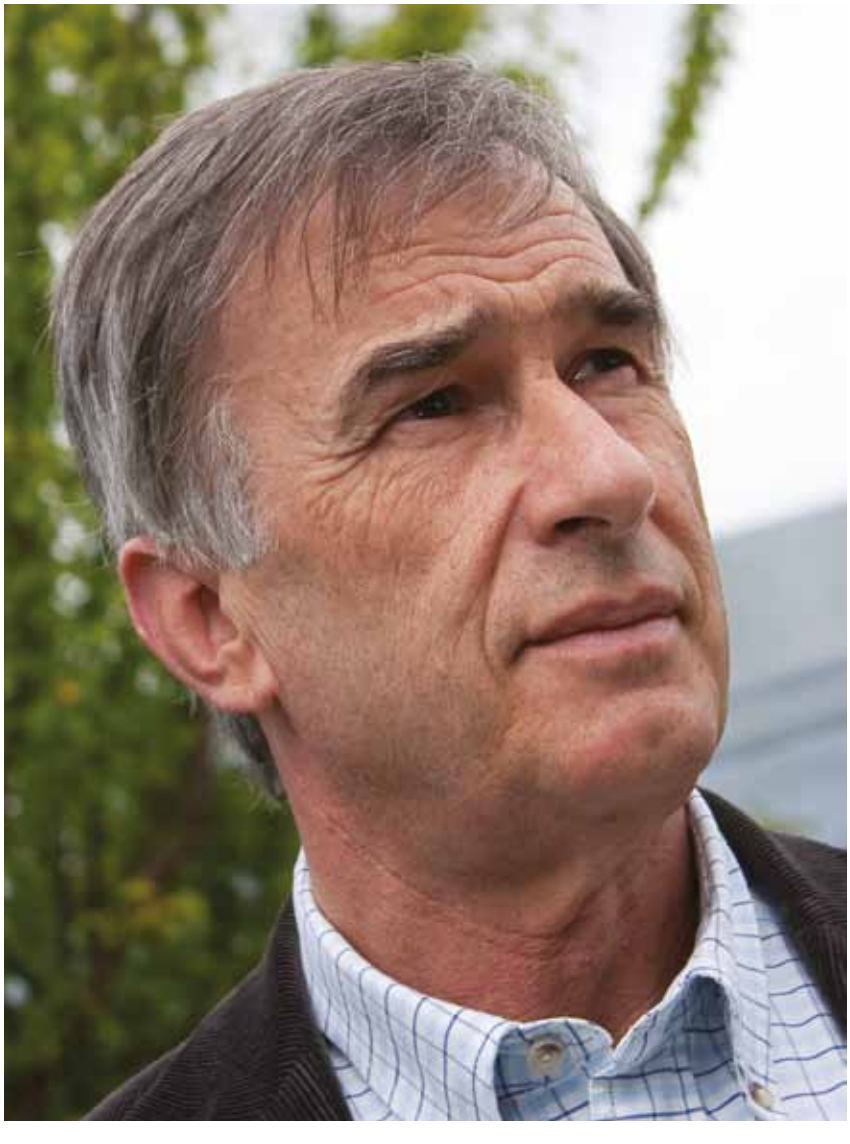
MANUEL ANTÓNIO ASSUNÇÃO
University of Aveiro

A word from the Rector



“A strong research, basic or applied in nature, fosters the projection of the university, which brings, as a consequence, a greater demand from industry collaborations, higher efficiency in raising national and European projects, and a major attraction for high level students, whether nationals or foreigners.”

JOSÉ FERNANDO F. MENDES
University of Aveiro

Message from the Vice-Rector for Research and Doctoral School

Over the last 40 years, the University of Aveiro (UA) has grown steadily not only in terms of number of students and faculty, but also of the quality of research and teaching, being currently considered one of the most dynamic and innovative universities in Portugal. Internationally, the UA has also been acknowledged as a young dynamic and prestigious university, collaborating actively with highly reputed institutions all over the world. Evidencing this position, the results obtained in several world rankings, a proof of its prestige and scientific excellence. In 2012, the UA was considered the sixty-sixth best university of the world, with less than 50 years, by the Times Higher Education ranking.

As Vice-Rector for Research and Doctoral School, it is with great honor that I am introducing the third edition of the research@ua magazine, a picture of the research at UA, with some of the most relevant research outcomes achieved in 2012, reflecting but a small portion of the successful history of our institution, where research has, definitely, been playing a key role in its development and affirmation.

With this restyled edition of research@ua, it is our goal to present some of the most important scientific highlights of 2012, focusing on the achievements of young researchers, especially PhD students and post-docs, from different research fields, and thus reinforcing the idea of multidisciplinary research developed at UA. Considered as essential to an impactful strategy, research dissemination initiatives adopted in 2012 have been also integrated in this issue. *The Researcher of the Month* initiative has proven to be a good dissemination means for researchers' interests and future expectations. The media impact of the research developed at UA is a tool to evaluate its importance and the interaction with society via *Academia de Verão* and *Research Day* are sections dedicated to highlighting the importance of communicating science.

It is my personal conviction that this magazine reflects not only the commitment of the scientific community in the development of high impact and relevant research, but also a successful institutional strategy that enables societal exploitation of research results with the aim of sustainably improving life quality. The UA has to be proud of its contribution to science, in general, and to the country and region, in particular, based on a close collaboration with regional agents.

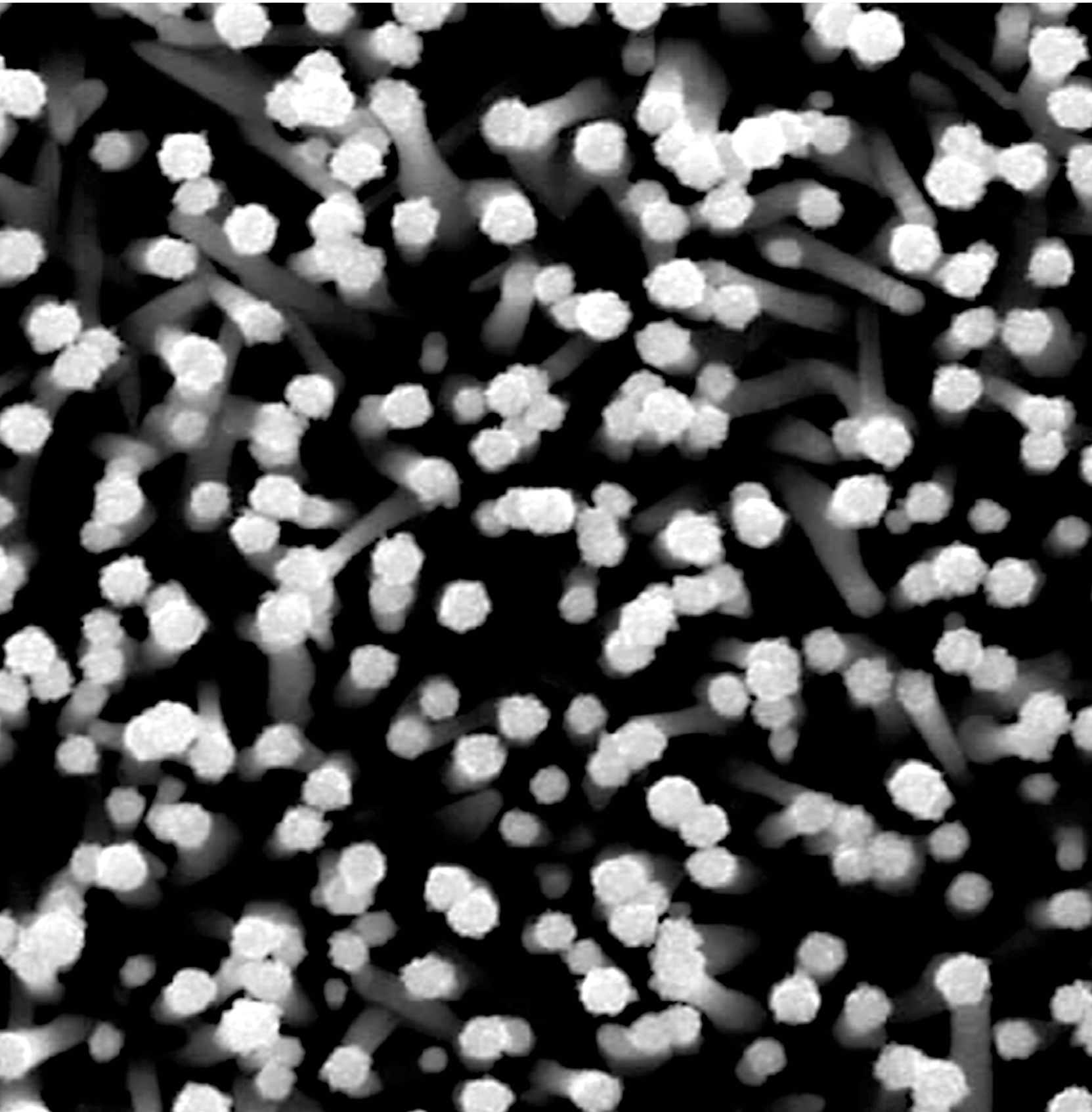
During 2012, efforts have been devoted to the construction of a more coherent and clear strategy for doctoral education, in order to strengthen the relation between teaching and research and, thus, to attract the best students to enroll in PhD at our institution.

Despite the funding constraints for research all across Europe, with special emphasis in Portugal, the UA has been able to successfully move forward. It is important to emphasize, to this respect, the rising participation of UA researchers in EU-funded projects and in international networks, nowadays an important funding source to research, as well as the increasing number of publications in high impact journals, which brings about fruitful collaborations with international institutions.

However, it must be taken into account that challenges are becoming more and more complex and that this may be the moment to rethink approaches and to look for new opportunities. It was, certainly, based on this assumption that the Aveiro Institute of Nanotechnology (AIN) was created in 2012. AIN is a virtual institute that joins the efforts of three excellent research centers at UA working in the field of nanotechnology, with the objective of jointly facing the international competition with better results than they would have with the simple sum of the parts.

In a special year like this, when we are commemorating the 40th anniversary of the UA, this edition of the research@ua celebrates 40 years of great progress and excellent scientific results. I hope you will find this reading exciting and that it may induce future collaborations with UA!

Spotlight on Research Dissemination



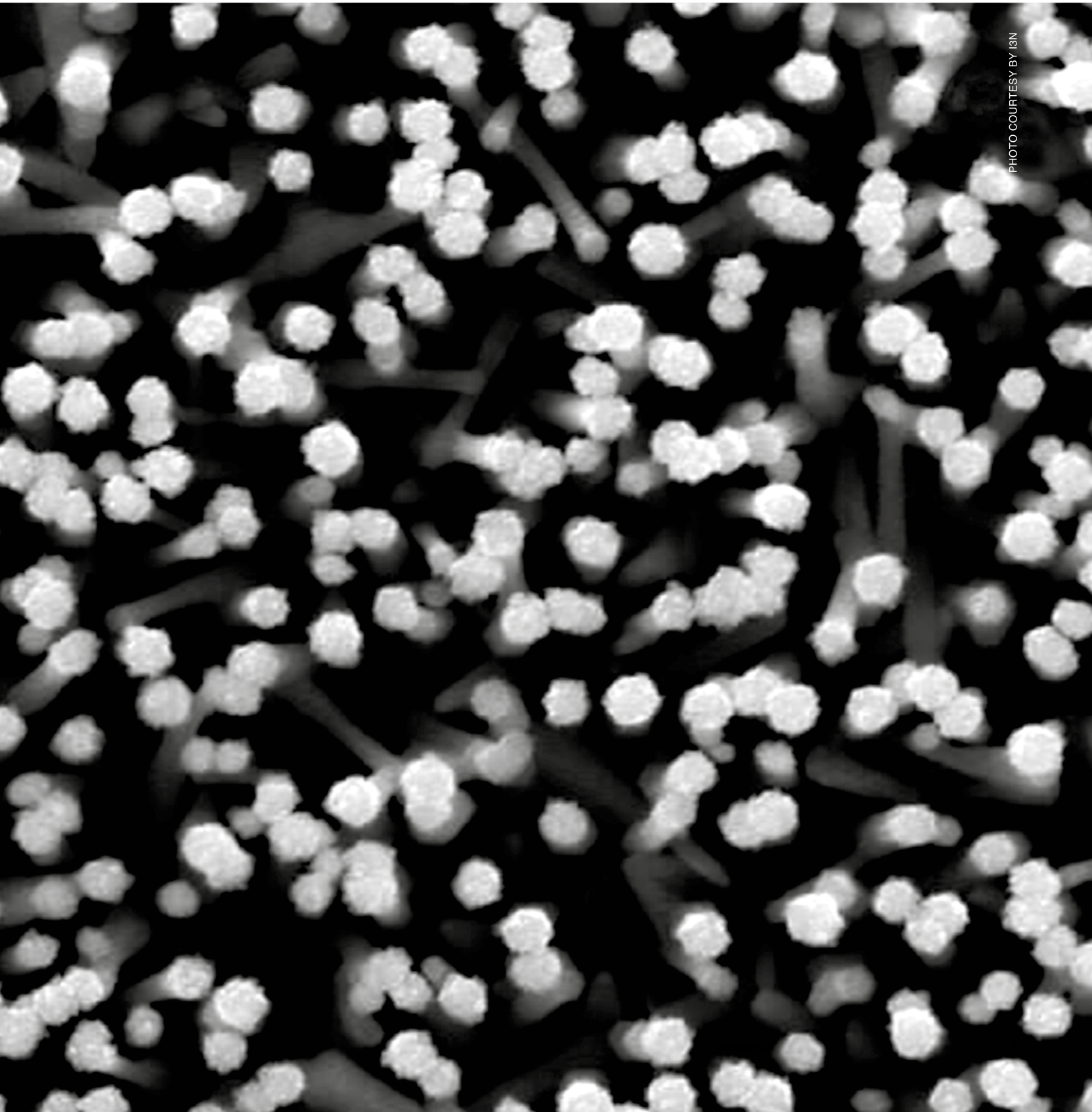


PHOTO COURTESY BY I3N

Research Day 2012

For the 2nd consecutive year, Research Day celebrated the University of Aveiro's research achievements, providing for an opportunity to foster the interdisciplinary sharing of good practice in research and a vehicle for promoting effective collaboration among researchers and departments.

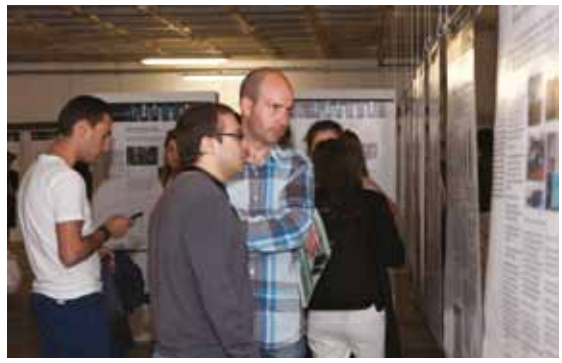
The major goal of the Research Day is to celebrate the quality of research across all departments and research centres of the University. On the Research Day 2012, held last June 13, some of the outstanding research outcomes achieved were presented and shared by postgrad students, researchers and professors.

10 high-quality lectures and 156 posters were presented, so all members of the University community learned 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 3 poster presentations in the fields of Arts & Humanities, Sciences and Engineering, as well as 6 honorable mentions.

Furthermore, Roland Y. Siegwart, Vice President for Research and Corporate Relations, from the Swiss Federal Institute of Technology Zurich (ETH) and Mário Almeida Santos, Quality and Development Engineering Director at OGMA, enriched the program with high-level and interesting keynote talks and attracted over 800 attendees from the University.

The University's researchers are actively engaged in a wide variety of cutting-edge investigation with high impact in society, and the event attracted the Portuguese media. The NAPIS - Navy Positioning and Identification Systems, developed by the University of Aveiro in collaboration with the Portuguese navy was highlighted in the news, as well as other R&D projects at UA.

By promoting this research, knowledge sharing and enhancement event, the University of Aveiro ensures that experience, good practice and know how are capitalized within and across departments and research centres at the campus.



Researchers of the Month 2012

PHOTO COURTESY BY THE HERBARIUM AT UA

The Researcher of the Month is an initiative published on the website of research@ua dedicated to highlighting the people behind the research. Every month a researcher of the University of Aveiro is profiled. The aim is to enhance the knowledge of the research being done and the person developing it, both internally to the academy and to an external audience. When choosing the researcher of the month, the Research Support Office strives to picture the diversity of our research staff, concerning backgrounds, nationality and research subjects as well as research orientation or recommendations for the improvement of the research developed at UA.

Duncan Fagg

The job of a research scientist is delightful for those who possess curiosity.

Duncan Fagg is currently employed as a senior investigator in the nanotechnology research division (NRD) of the Centre for Mechanical Technology and Automation (TEMA), where he is presently the leader of a group studying hydrogen related technologies. His personal perspectives are to continue the research career in the University of Aveiro and the res earch interests include the storage of energy in the form of synthetic fuels that can be transported and reconverted into electricity far from the original source. In his opinion, the key strength of the UA is in granting scientific freedom to researchers to develop their own lines of research while providing them with the infrastructure and support that they need. He believes that the promotion of interdisciplinary research activity, for example by hosting open days at departments with guided tours for UA researchers, would provide researchers with a rare opportunity to see what infrastructure is available in other departments and talk with researchers in completely different scientific areas.

FULL INTERVIEW

José Richard Gomes

Chemistry can be viewed to a large extent as the art of making and breaking bonds.

José Richard Gomes is an assistant researcher of CICECO and his research interests involve the use of computational approaches in Chemistry. José was awarded the prestigious Vicente de Seabra Medal by the Portuguese Chemical Society (SPQ) in 2010, for the autonomous high-quality research he has been carrying out. In the future, he would like to do more applied research, synchronized with the strategic lines for research of CICECO. Usually, computational work can be used to predict electronic and structural configurations quite accurately from which many properties can be calculated and that may be used to plan the work in the experimental laboratory. However, the calculations are usually limited to the nanometer scale) and, therefore, the main challenge is the design of suitable molecular models (aggregates of particles) that can represent the most important states or configurations of the real systems. These limits are imposed by the computational facilities available to perform those calculations, which led to the combination of efforts to start up a central supercomputing infrastructure at UA, the LESCUA (Line of Excellence in Scientific Computing at the University of Aveiro).

FULL INTERVIEW

Mikhail Zheludkevich

Quality is more important than quantity

Mikhail Zheludkevich holds currently a position as researcher at CICECO and his scientific interests include “Smart” corrosion protection based on “self-healing” effect, controllable release systems in the corrosion protection, nanostructured protective coatings, mechanisms of corrosion inhibition, localised techniques in corrosion research. Currently, he is the technical coordinator of the large scale collaborative project MUST and also coordinating an IRSES project (NANEL) and participating as partner in other 6 EU funded projects (Nanobarrier, Saristu, SISET, Nanomar, Actcoras and Duradh).The close international collaborative networking with leading academic research groups in the area as well as with major relevant industries is the key point which allows being always at the hot edge of development of the new functional surfaces for various application. The driving force is a responsibility in front of the society which expects contribution of science to its sustainable development. For him, the main point to improve the research at UA is related to the development of a clear strategy for progression in researcher career in order to motivate and keep the most talented investigators in house.

FULL INTERVIEW

Andrei Kholkin

Teaming is the only way of survival and sometimes leads to the tremendous progress in understanding and creating new areas of research

Andrei Kholkin is a research coordinator and head of the functional imaging and nano-characterization laboratory of CICECO. His group develops multifunctional materials and scanning probe microscopy techniques. He coordinated two European projects on multi-functional materials and serves as an Associate Editor-in-Chief for the IEEE Transactions on Ultrasonics, Ferroelectrics and Frequency Control (TUFFC) and member of editorial boards of several scientific journals. He was a recipient of the "Excellency" award from the FCT. In his view, the goal of a researcher is to advance science or technology to the state-of-art level and beyond even in a very narrow area of activity. In the area of piezoelectrics and ferroelectrics, there is a definitive shift from hard transition metal oxide materials (often containing lead) used in the past in sensors and actuators to the lightweight, flexible and ecologically green polymer or biological materials with almost the same functional properties. This allows researchers to extend the area of applications and finally design new types of the devices, for example, miniature piezogenerators that can be implanted into the human body. According to the researcher, the strength of UA is the flexibility and multidisciplinary research *ad hoc*. Teaming is the only way of survival and sometimes leads to the tremendous progress in understanding and creating new areas of research.

FULL INTERVIEW

João Serôdio

what drives me is mostly the pleasure of pursuing scientific curiosity and (sometimes…) discovery, as well as the training of students

João Serôdio is currently Assistant Professor at the Department of Biology and member of CESAM. Currently he is the PI of two FCT projects and is also coordinating a Marie Curie Action IRSES. In general terms, I aim to make significant contributions to the field of aquatic photobiology, particularly of marine organisms such as biofilm-forming diatoms (a diverse and ecologically important group of microalgae) and photosynthetic symbioses (like corals and seaslugs). More specifically, a big challenge in the study of the photophysiology of marine microalgae will be the integration of large amounts of genomic information, made available for an increasing number of species, with the physiological traits observed at the phenotypic level. In some more specific areas, as in the case of the study of microalgal biofilms, research is further hampered by the difficulty in finding adequate model organisms. The major strength of UA comes from the possibilities offered for multidisciplinary collaboration by the comparatively flexible nature of the university organization. To improve research he considers positive a closer approximation between teaching subjects and scientific expertise. It would help to improve the quality of teaching, and would stimulate the research activity through motivation and attraction of students.

FULL INTERVIEW

Carlos Herdeiro

I am fortunate to live at a very exciting time

Carlos Herdeiro is Assistant Professor at the Department of Physics and leads the relativistic gravity team. Currently he coordinates one European Marie Curie IRSES action, involving five countries. For his research on models of cosmological inflation he was awarded a 2004 Gulbenkian award for stimulating research. He pursues a threefolded goal. Firstly he is committed to continue producing, together with the team at Aveiro (Gr@v group) and outside collaborators, internationally competitive research. His area of research is an overlap between relativistic gravity/cosmology/high energy physics, and in any of these three directions a lot is happening or a lot is about to happen. Secondly, he is working to create opportunities for promising young researchers, both at undergraduate, graduate and post-doctoral level, to work in Portugal and, in particular, in the group at Aveiro. Finally, he is frequently involved in outreach activities that may raise the public awareness of science. Carlos Herdeiro highlights the physical organization in a (very nice) campus, which facilitates the interaction between the various departments and also with the central administrative services, as well as the absence of an intermediate level of Faculties/Schools in between the University and the Departments. Concerning opportunities, he is very pleased with the open-mindedness and support found at the Department/University. Without it, it would have been much harder to setup a group; this is the kind of opportunity not every University makes available.

FULL INTERVIEW

Nancy Lee Harper

Performance is generally viewed as 'entertainment' and not "scientific"

Nancy Lee Harper is Associate Professor with Aggregation in the Department of Communication and Art, where she coordinates the Piano Area. As a concert pianist, she has performed on four continents and has been described as "an extraordinarily multi-talented American musician and scholar who lives and works in Portugal" (Music and Vision). Her personal perspectives as a researcher in music are always generated by a sense of curiosity and love of teaching and are propelled by the fundamental questions of "Why?" and "How?" as well as the adage "Regard Man as a Mine Rich in Gems". As the first university professor in Portugal with Doctor of Musical Arts in Piano Performance and probably still the only one in the career status, she arrived in Portugal in 1992 as an invited Lecturer at a time when practical music was being implemented in the university system. To Nancy Harper, the biggest challenge in the area of artistic research, for a performing artist, is getting their research in Music Interpretation as a Performer to be accepted as valid research by an academic institution and the scientific community. Performance is generally viewed as "entertainment" and not "scientific". This means that the very essence of a performer's art - the many daily hours, months, and years which go into constructing and presenting one's individual interpretation of a work – is not regarded by the scientific community as valid if it is not used in a process of research, be it empirical or other. The strengths of UA regarding research include its openness and innovativeness. It would be hard to imagine some of the research interaction that occurs here as being possible, desirable, or accepted in other countries.

FULL INTERVIEW

Susana Loureiro

Interdisciplinarity is crucial to trigger responses and actions

Susana Loureiro is a researcher at the department of Biology and CESAM. Her research activity focuses on Ecotoxicology, Environmental Contamination and Risks. she is the coordinator of three projects financed by FCT and the WP leader for Ecotoxicology of the FP7 EU project NanoFATE. Under these projects, and as research interest, she is carrying out research on the combined effects of chemicals and natural stressors in soils (CLIMAFUN-FCT), how chemicals flow within a model trophic chain (FUTRICA-FCT), the responses of organisms exposed to chemical pulses and mixtures throughout generations (RePULSE-FCT), or focusing on emergent substances like nanoparticles and evaluate their toxicity and fate in aquatic and terrestrial systems (NanoFATE-EU FP7). In ecotoxicology the "basics" to derive toxicity responses from chemical exposure are well established but there is still a huge amount of work to carry out to understand the main processes that role toxicity. In addition, nano-ecotoxicology is leading us to reconsider all the basics for "regular" ecotoxicology as variables that can hinder and role toxicity are more than the usually ones considered for "regular" chemicals. Nowadays the university has gained strength by the presence of new researchers in its research teams. They brought new vigor, knowhow and energy to build networks, apply to new and innovative projects, and get international funding. For sure that "dressing the UA shirt" is a major strength and several researchers wear it every day! Although contention is one of the most common used words during the last months (or year!), lab and office space are crucial to properly run scientific activities and it is something that must be improved and that would benefit the research activities at the University. In addition it would favor also the visit of external researchers, improving the collaborations abroad and the students' exchange.

FULL INTERVIEW

UA Research in the media

PHOTO COURTESY BY CESAM

Research achievements support the progression of science and their practical applications can promote effective industrial development and social advancement. Research, innovation and new technologies may influence economic, social, political and ethical dimensions of societies.

This potential impact of science on the everyday life of citizens creates a need for effective communication with the public on scientific research activities and results. The media can, thus, play a crucial role as an interface with society, helping to increase public support and general understanding about the need to create a knowledge-based society and contributing to encouraging investments in research and justifying public funding, in an era of budget constraints.

Another important outcome may be the impact on the future science makers. By attracting the attention of the young to science, a solid basis can be created for next generation of scientists which is essential for the lasting competitiveness of the EU.

The University of Aveiro understands the importance of communicating with society. By means of the *Jornal Online*, UA newsletter, press releases, social networks and scientific and non-scientific publications, among other means, a strong communication strategy allows national and international society to get acquainted with our research outputs and achievements, cultivating the image of UA and our researchers.

- CAMBADA ranks 2nd in the RoboCup 2012 Scientific Challenge
- Airbus will use a coating developed at CICECO, University of Aveiro
- Prof. José Fernando Mendes member of Academia Europaea
- Web behaviour could track corn-planting dates
- UA/CESAM research in "Campus do Mar"
- Research developed at ESTGA contributes to the improvement of domestic solar photovoltaic microgeneration
- Study developed at UA prooves that Portuguese have a good working capacity
- First proof of ferroelectricity in simplest amino acid
- Squamatinia algharbica, a land underground insect, was discovered by Ana Sofia Reboleira
- New algorithm for polygraphs developed with the collaboration of UA
- Electronic Tongue developed at CESAM-UA
- Theoretical arguments suggest that an ultra-relativistic particle collision forms a black hole with a strong emission of gravitational radiation
- European Journal of Medicinal Chemistry - Article by UA researchers Cátia Teixeira e José Richard Gomes among the Top 25 hottest articles
- Musikki won the First Prize ISCTE-IUL- MIT Venture Competition
- OutSystems received the EdTech Digest's Cool Tool award for their work with the University of Aveiro
- Alzheimer's disease at the University of aveiro
- Valorization of coffee residues at the University of Aveiro
- Prof. Manuel Coimbra associate editor of Carbohydrate Polymers
- Prof. João Rocha editor of the Royal Society of Chemistry, Nanoscience and Nanotechnology Book Series
- UA Researcher publishes article on domestic cats

Academia de Verão

PHOTO COURTESY BY SCIRP

Promoting Science: 2012 Summer Academy at the University of Aveiro

Between the 8th and 20th of July the University Campus of Santiago received more than 300 young students from all over the country, aged between 10 and 18 years old, to participate in the extraordinary experience of living a true university life, in the scope of the seventh edition of Aveiro Summer Academy.

The 2012 edition focused on the scientific areas of Physics, Biology, Chemistry, Mathematics, Geosciences, Civil Engineering, Telecommunications and Computer Science, Mechanics, Languages, Design, Multimedia and Health studies, but included as well a vast program of cultural and playful activities, specially directed to these potential university students.

Either during one or two weeks, the University gave these young participants the opportunity to explore interesting scientific projects, integrated in a handful of projects totally organized by the fifteen departments that accepted this annual challenge. Some municipalities and companies supported the participation of the best students in the Academy, with a total of 63 scholarships attributed.

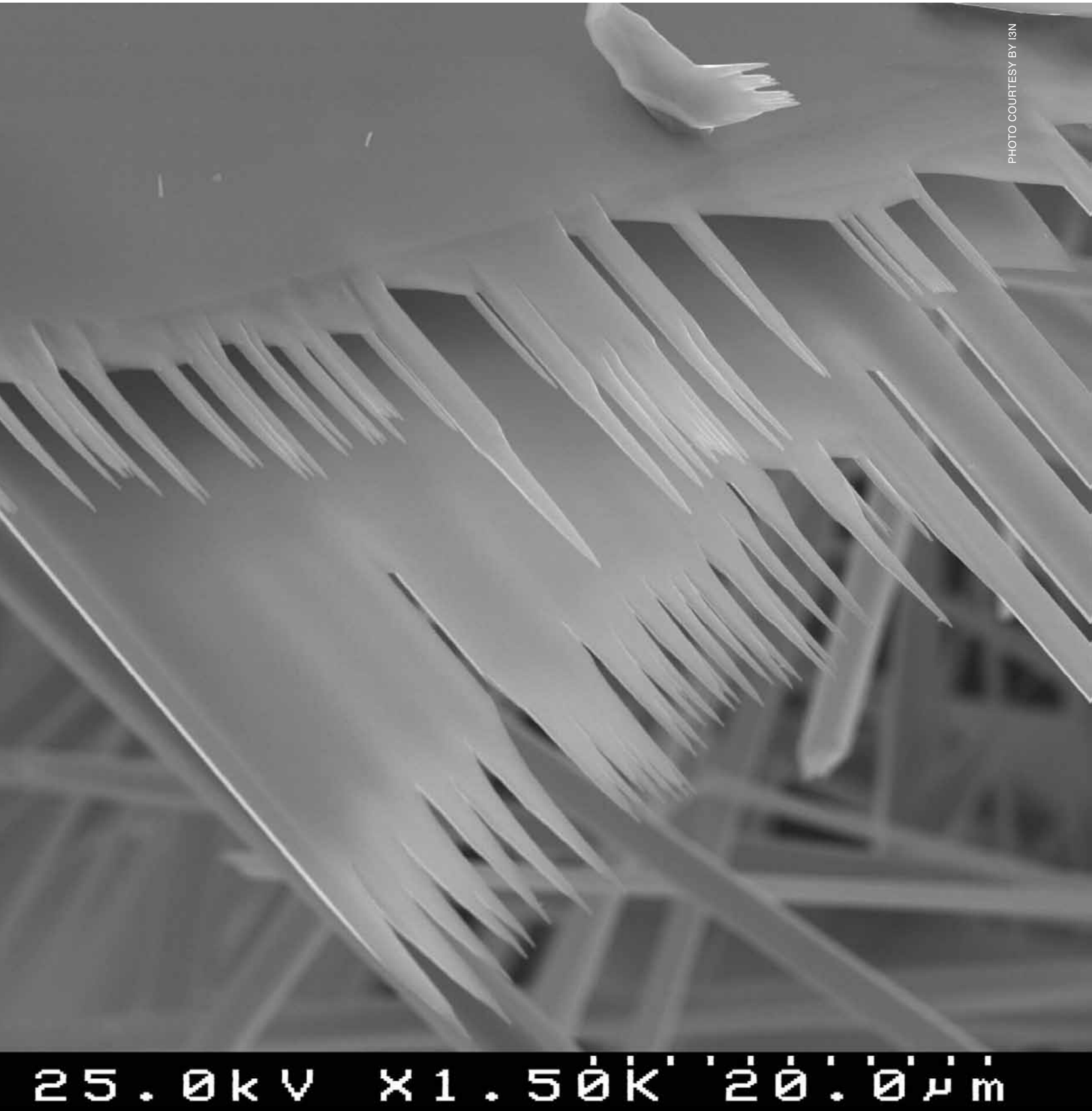
Besides the laboratorial experiments, the exciting field work and the nice field visits outside the Campus, students also had the privilege to be in contact with a real university life - they were accommodated in the students' residences, had meals in the campus canteens and sports activities in the 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.

Before leaving the Academy, participants participated in a «farewell ceremony» at the Auditorium, where they received their Diplomas from the Vice-rector and were applauded by their families and friends.

In the last six editions, more than 2000 students, from 500 Portuguese secondary schools, had the opportunity to experience the university atmosphere and envisage their academic future at UA. The organization of such initiatives to foster public understanding of science plays a central role in the university strategic positioning. Stimulating curiosity and interest for scientific activities, motivating the youngsters for the learning and highlighting the importance of research and science in everyday life is a permanent concern of UA.

A new program with enriching scientific experiments and lots of fun for all participants will certainly be part of next year's Summer Academy.

Aveiro Institute of Nanotechnology



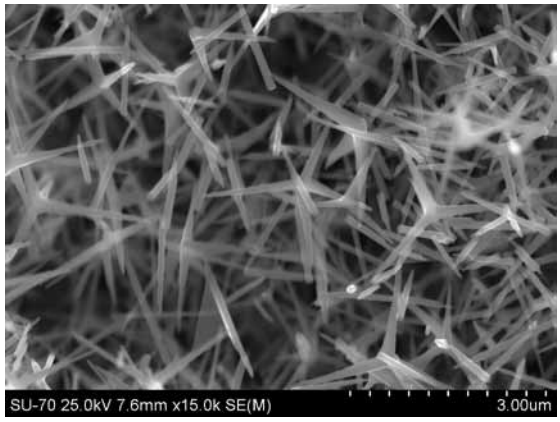
The creation of the Aveiro Institute of Nanotechnology (AIN) in 2012 is an initiative of the University of Aveiro in order to strengthen, coordinate, integrate and foster a wide span of scientific and technological skills and infrastructures of the University, in line with the research activities developed by its researchers, promoting a cohesive and unified image of nanosciences and nanotechnologies at UA.

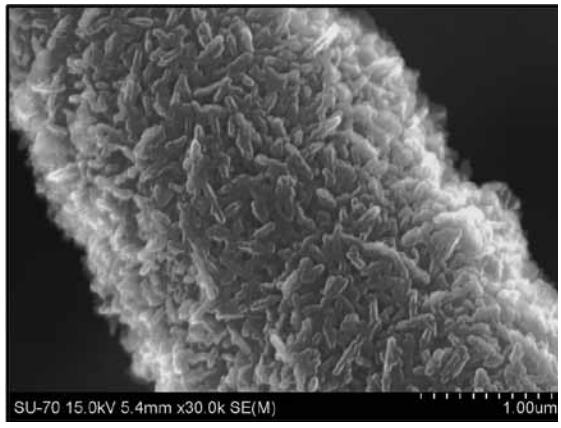
Nanotechnology at UA intertwines several scientific fields organized in different research units crossing seven university departments: Materials Engineering and Ceramics, Physics, Mechanical Engineering, Chemistry, Civil Engineering, Biology and ESTGA. Excellent human resources allied to a unique scientific and instrumental park, allow UA to develop high-level research in the areas of synthesis, characterization and application of nanomaterials.

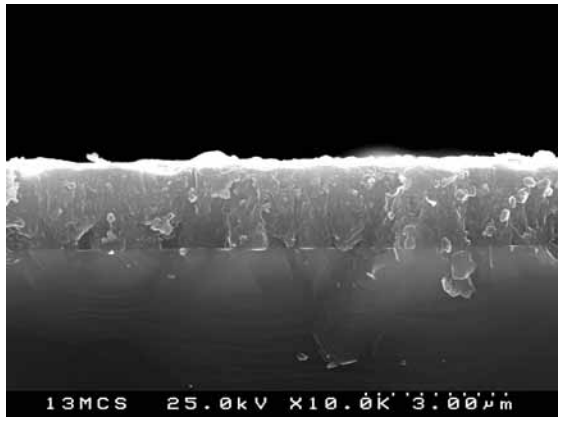
The AIN is a strategic investment arranged by scientific consistency, following the strategic guidelines of the university. AIN is a virtual institute that joins the efforts of three excellent research centers at UA with the objective of jointly facing the international competition with better results than they would have with the simple sum of the parts.

The main objectives of AIN consist, thus, of a larger national and international projection of the high quality research developed at UA, by promoting cooperation between different research units working in the same field, exchange of ideas and resources optimization. It is also important in this framework to train people with skills that can contribute for scientific and technological growth, as they may play the role of facilitators of innovation, wealth creation and the creation of spin-offs.

Hopefully AIN will foster research and advanced education in nanotechnology at the University of Aveiro, benefiting from the obvious complementarity of its research units, enhancing an active participation of AIN in the next Framework Program and promoting intensive collaboration in international networks of excellence in the field of nanotechnology.







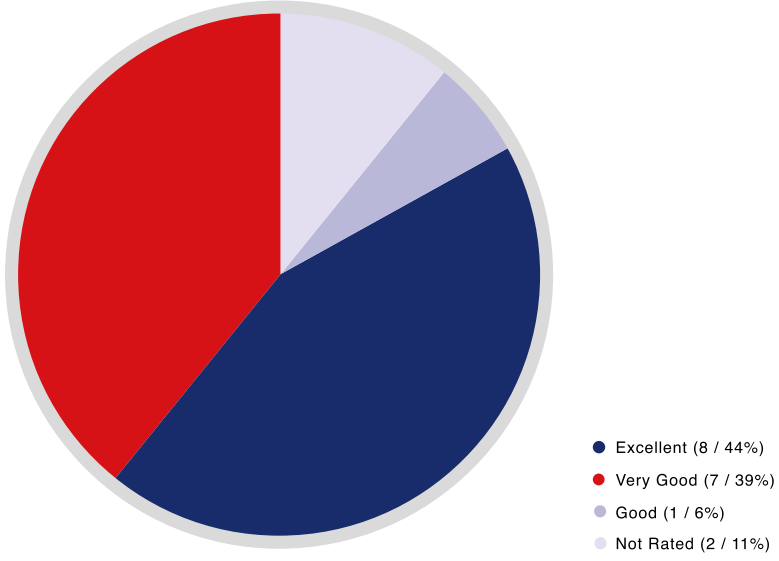
Research Centres at UA

PHOTO COURTESY BY DAO

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.

Research at the UA promotes innovative products and solutions, contributing to the advance of science and technology. It is a privileged partner for companies and other national and international organizations, which place the training and research of UA at the frontiers of science. Excellence in research is one of the hallmarks of the University. It is a multidisciplinary research institution, a relatively small institution, where the pursuit of diverse scientific topics in a led to inter disciplinary collaborations.

Research is driven by its 18 research centres, namely 14 Research Units and 4 Associated Laboratories. 15 of its 18 research units were classified as Very good or Excellent by international panels under the sponsorship of the Portuguese National Science Foundation in its most recent round of assessments. Four of these units carry the label of Associate Laboratory, a distinction attributed by the Portuguese Government to research institutions of sustained and exceptional merit.



ASSOCIATED LABORATORIES

Excellent

CESAM - Centre for Environmental and Marine Studies
marine sciences, environmental sciences, atmospheric quality, biodiversity, and natural hazards
Director: Casimiro Pio
Webpage: http://www.cesam.ua.pt/

Excellent

CICECO - Centre for Research in Ceramics and Composite Materials
materials science and engineering, nanosystems, energy, information technology, sustainability, and biomedical materials
Director: João Rocha
Webpage: http://www.ciceco.ua.pt/

Excellent

I3N-FSCOSD - Institute for Nanostructures, Nanomodelling and Nanofabricattion - Physics of Semiconductors, Optoelectronics and Disordered Systems
materials science and engineering
Director: Armando Neves
Webpage: http://www.i3n.org/

Excellent

IT - Telecommunications Institute
optical communications, wireless communications, telecommunication networks, and multimedia
Director: José Neves
Webpage: http://www.it.pt/

RESEARCH UNITS

CBC - Centre for Cell Biology

Very Good

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

Excellent

CIDTFF - Research Centre for Didactics and Technology in Teacher Education
education, didactics, supervision, evaluation, society, and training
Director: Nilza Costa
Webpage: http://www.ua.pt/cidtff/Default.aspx

Not Rated

CETAC.MEDIA - Research Centre for Communication Technologies and Sciences
social media, mobile media, interactive TV, human computer interaction, and ciberculture
Director: Lídia Silva
Webpage: http://blogs.ua.pt/cetacmedia/

Very Good

CIDMA - Centre of Research and Development in Mathematics and Applications
mathematics
Director: Luís Castro
Webpage: http://cidma.mat.ua.pt

Excellent

CIPES - Centro de Investigação de Políticas de Ensino Superior
higher education research
Director: Rui Santiago
Webpage: http://sigarra.up.pt/cipes/web_page.inicial

Not Rated

CLC - Centre for Languages and Cultures
literature studies
Director: Otília Martins
Webpage: http://www.ua.pt/clc

Very Good

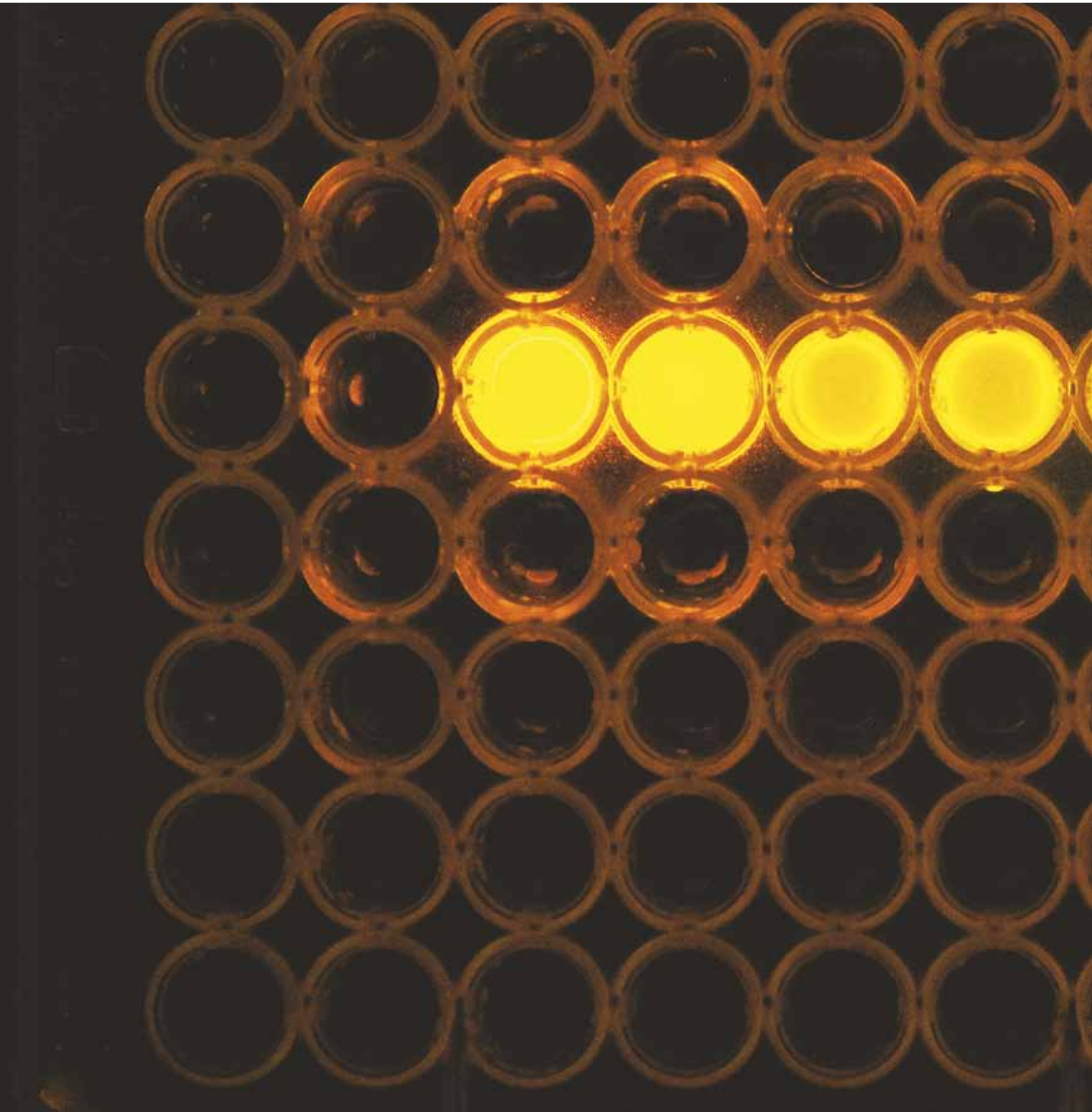
GEOBIOTEC- GeoBioSciences, GeoTechnologies and GeoEngineering
earth sciences, marine sciences, environmental sciences, natural hazards, and materials science
Director: Fernando Rocha
Webpage: http://www.ua.pt/ii/PageText.aspx?id=1356

Very Good

GOVCOPP - Governance, Competitiveness and Public Policies
law and political sciences
Director: Eduardo Castro
Webpage: http://www.cesam.ua.pt/

Very Good	**ID+ - Research Institute for Design, Media and Culture** *art studies* Director: Vasco Branco Webpage: http://www.idmais.org/
Very Good	**INET-MD -The Ethnomusicology Institute – Centre for the Study of Music and Dance** *art studies* Director: Susana Sardo Webpage: http://www2.fcsh.unl.pt/inet/indexeng.html
Very Good	**IEETA - Institute of Telematics and Electronic Engineering of Aveiro** *electrical and computer engineering* Director: Armando Pinho Webpage: http://wiki.ieeta.pt/wiki/index.php/Main_Page
Excellent	**QOPNA - Organic Chemistry, Natural and Agro-food Products** *chemistry and biochemistry* Director: José Cavaleiro Webpage: http://www.ua.pt/qopna/Default.aspx
Excellent	**TEMA - Centre for Mechanical Technology and Automation** *mechanical engineering* Director: José Grácio Webpage: http://www.ua.pt/tema/Default.aspx
Good	**UnIMeM - Research Unit in Music and Musicology** *music and musicology* Director: Isabel Soveral Webpage: http://www.unimem.uevora.pt/en/home.html

Research Highlights



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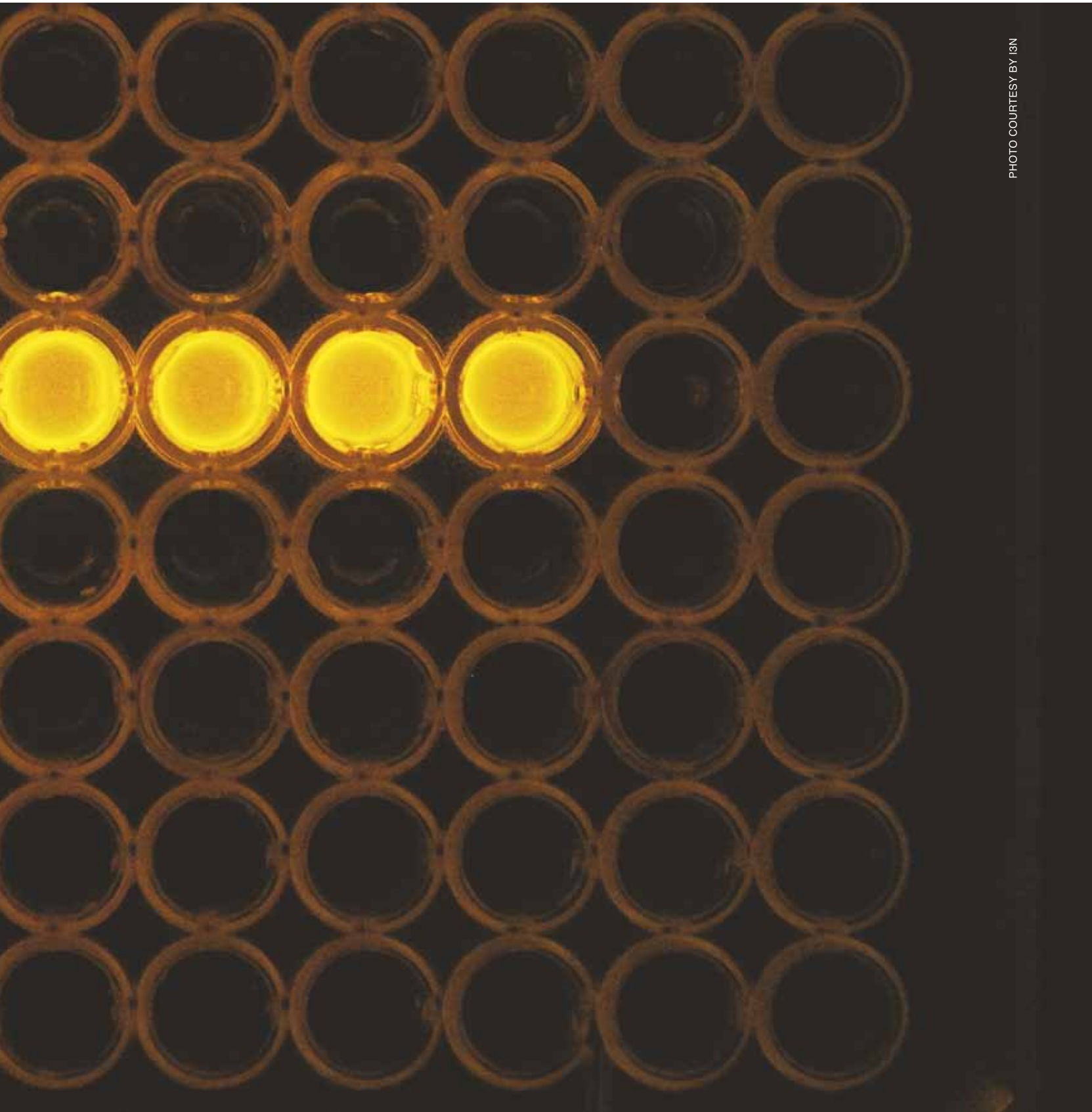

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KNOWING BETTER THE BIODIVERSITY OF THE PORTUGUESE CONTINENTAL SHELF: SOFT BOTTOM BENTHIC MACROFAUNA COMMUNITIES

V. Quintino, A.M. Rodrigues, R. Martins, L. Sampaio, R. Mamede, F. Ricardo, H. Rocha, E. Ribeiro and L. Magalhães

Department of Biology & CESAM, University of Aveiro

Soft bottom benthic macrofauna communities are comprised by small invertebrates that live on sediments. They are formed by long-lived species which hence integrate the surrounding conditions over long periods of time. Amenable to quantitative sampling and responding in relatively predictable manner to a number of anthropogenic stressors, macrofauna communities have long been regarded reliable indicators of the ecosystem health status. They are often prime elements in studies focusing on the biological and ecological effects assessment of disturbance. The identification, characterization and mapping of the benthic macrofauna communities of the Portuguese continental shelf are so key elements to know our seascape, its similarities and uniqueness in relation to other European shelf areas. Such knowledge is vital to an educated management of our marine resources, and to better understand their trajectories of change, either in relation to natural or to anthropogenic pressures.

Our present knowledge of the Portuguese shelf is nevertheless fragmented as very few comprehensive studies have been undertaken. Under the projects ACOSHELF, first and MeshAtlantic, afterwards, the whole of the Portuguese coastal shelf was studied, in greater detail to the North of the Nazaré Canyon, where the shelf is the widest and soft bottoms predominate. This ongoing study allowed so far the identification of more than 700 species, of which four are new to science and nearly 40 are first time records in Portuguese waters. Sediment grain-size, organic matter, depth and hydrodynamic regime were the variables best related to the macrofauna distribution pattern. The study is showing the richness of the Portuguese Coastal shelf macrofauna communities and highlights its transitional characteristics, where cold temperate, warm temperate and subtropical faunas coexist.

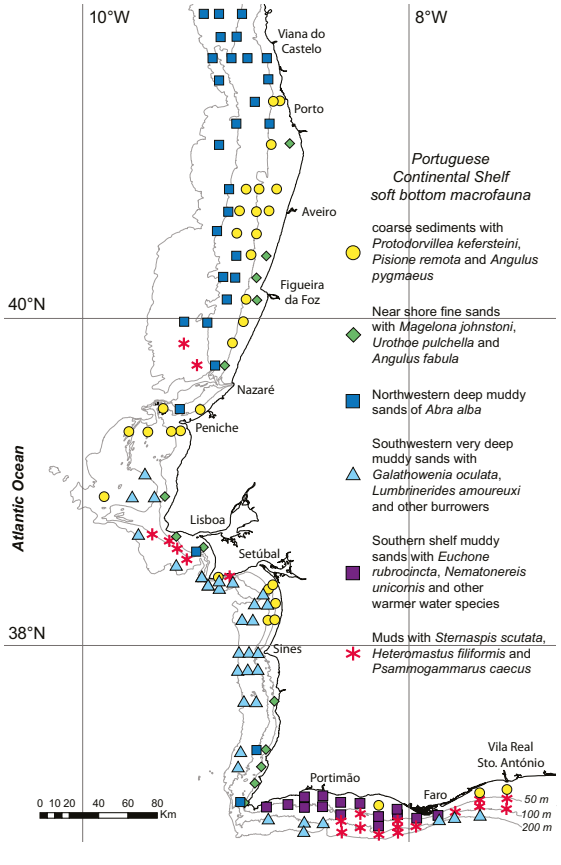
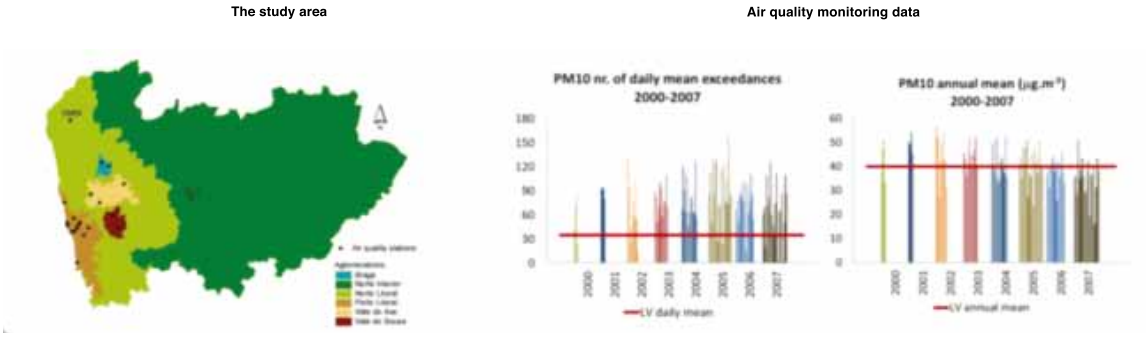


FIGURE 1
Portuguese Continental Shelf soft bottom macrofauna.

TECHNOLOGY, HUMAN BEHAVIOUR AND ECONOMIC CHALLENGES AS DRIVING FORCES TO IMPROVE URBAN AIR QUALITY

C. Borrego, A. I. Miranda, A. Monteiro, E. Sá and A. Carvalho



Air pollution problems are major threats to human well-being compromising environmental, social and economic assets. The Northern Region of Portugal have been often affected by high levels of air pollutants, particularly during the 2000-2007 study period, when a high number of exceedances to human health protection legislated limit values (EU Directive 20008/50/EC) have been measured. These exceedances occurred in traffic, industrial, urban and suburban background stations with an estimated exposed population of around 500,000 inhabitants. Air quality plans/measures to reduce those levels are necessary to design, test and finally implement, related mainly to the traffic sector, but also to the industrial and residential combustion sectors.

Based on an emission inventory, traffic, industrial activity, residential combustion and construction sites were identified as the main anthropogenic sources of PM10. Strategic mitigation measures to reduce PM10 levels were defined according to their environmental performance and economic costs, and they have been discussed with the entities involved in their local/regional implementation. The final list of selected measures was designed and started to be implemented in January 2010.

A numerical modelling tool was used to assess the efficiency of the selected and applied measures and a maximum reduction of about 4.8 $\mu g.m^{-3}$ of PM10 annual mean for 2015 was predicted. Meanwhile, the observed values registered at the air quality network clearly show that the PM10 daily and annual average values are already decreasing since 2008. These outcomes point out two main drivers for the air pollution reduction: the economic crisis (occurring since 2008) and the implementation of the mitigation measures (in practice since 2010). The economic crisis forced a substantial change in consumption patterns and in daily lifestyle contributing to a considerable reduction in the pollutant emissions namely from industry and traffic, and thus leading to a better air quality in the northern region and showing that personal patterns of production and consumption have an essential role in preserving and protecting our environment.

Department of Environment and Planning & CESAM, University of Aveiro

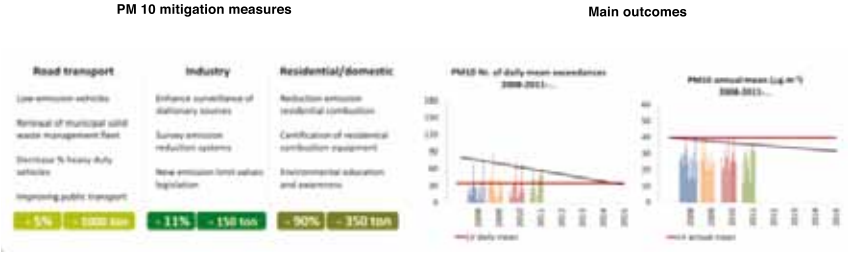


FIGURE 1

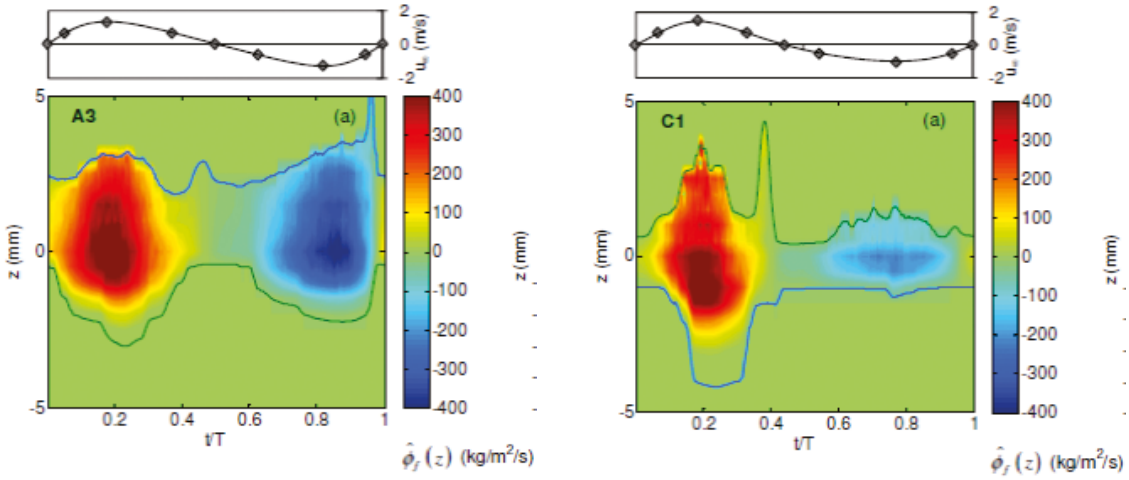
LEFT: The study area and the air quality monitoring stations. RIGHT: The PM10 daily exceedances and annual mean values registered during 2000-2007

FIGURE 2

LEFT: PM10 mitigation measures. RIGHT: Evolution of the PM10 values monitored during and after the mitigation measures

SAND TRANSPORT BY NONLINEAR WAVES

P. A. Silva [1], T. Abreu [2], F. Sancho [3], D. A. van der A [4], H. Michallet [5] and B. G. Ruessink [6]



(1) Department of Physics & CESAM, University of Aveiro
(2) Department of Civil Engineering & CESAM, Polytechnic Institute of Viseu
(3) LNEC-DHA, Portugal
(4) School of Engineering, King's College, University of Aberdeen, UK
(5) Laboratoire des Ecoulements Géophysiques et Industriels, Grenoble, France
(6) Institute for Marine and Atmospheric Research Utrecht, Utrecht University, The Netherlands

The evolution of an offshore sandbar depends, amongst other processes, on the ability to accurately describe the near-shore wave field and the corresponding sediment transport. When surface gravity waves propagate from deep water onto beaches, their sinusoidal appearance transforms to shorter and higher crests and longer and shallower troughs in the shoaling zone towards a sawtooth-shaped profile in the inner surf and swash zone. Both these nonlinear features induce near-bed horizontal oscillatory flow asymmetries that drive sediment transport, but the details of the leading processes remain unclear.

The experimental project TRANSKEW, carried out in the Large Oscillating Water Tunnel at Deltares, The Netherlands, was designed to unravel the influence of near-bed oscillatory flow nonlinearities on sediment transport. The test cases were selected to simulate the near-bed cross-shore sediment motion representative of the upper shoreface, mimicking the degree of velocity and acceleration skewness found before and after wave breaking, including the associated mean flow (due to undertow). Both net sediment transport rates and detailed time-dependent sediment concentrations and flow velocities were measured with state-of-the-art equipment, which allow estimation of the erosion depth and the sediment fluxes in the lower layer near the sand bed.

The results show that acceleration/velocity skewed oscillatory flows produce a net sand transport in the direction of the largest acceleration/velocity, i.e., in onshore direction, opposite the offshore-directed sediment flux observed under near-sinusoidal waves and a mean undertow. Two mechanisms were found to play a key role in the sediment transport: the skewed bed shear stress and unsteady phase lag effects between the sediment concentration and flow velocity observed at flow reversal. The results achieved contribute to a better knowledge of sediment dynamics and to the development of more accurate predictive sediment transport models in the coastal zone.

FIGURE 1
Large Oscillating Water Tunnel (LOWT) at Deltares, the Netherlands.

FIGURE 2
Free-stream velocity (upper panel) and time-space diagram of instantaneous flux ϕ (lower panel) for the experimental conditions A3 and C1.

UNVEILING COPING STRATEGIES WITH MERCURY IN AQUATIC AND SEMI-AQUATIC INHABITANTS

I. Ahmad[1,2], N. A. Anjum[1], J. P. Coelho[1], I. Mohmood[1], M. Pacheco[2], M. A. Santos[2], A. C. Duarte[1] and E. Pereira[1]

Despite the credible information on environmental hazards identification/characterization, risk assessment and coping strategies in aquatic/semi-aquatic inhabitants, lacunae on mechanistic aspects entangling the previous issues are perceptible in literature. Considering the primary consumers (bivalves) and essential marsh ecosystem base components (salt marsh macrophytes), the current work aimed to assess mercury's potential toxicity and to discuss organisms' survival strategies under conditions with well-defined mercury gradient at Laranjo Basin, Ria de Aveiro, Portugal. Inter-age (2^+, 3^+, 4^+ and 5^+ year) approach was applied in bivalve *Scrobicularia plana* and mercury accumulation as well as endpoints combining damage and defence responses were determined (Figure 1). Mercury induced peroxidative damage reflected enzymatic antioxidants insufficiency. The adaptive capacity expressed as antioxidant induction and lesser vulnerability to enzyme inhibition, increased with age. Concerning non-enzymatic antioxidants, *S. plana* adaptive skills evolution over time depends on the contamination extent; under moderate contamination, the different antioxidants intervention took place harmoniously, evidencing an adjustment capacity increasing with age. Contrarily, under higher contamination, *S. plana* failed to cope with mercury threat. We also unveiled mercury's body burdens and its link to increased immunomodulation risk in 4^+ year animals. The antioxidants modulation was substantiated with animal polypeptide pattern revealing its mercury stress adaptation.

Salt marsh macrophyte *Halimione portulacoides* exhibited organ-specific biochemical strategies to cope with environmental mercury-accrued anomalies . *H. portulacoides* relied to a greater extent, on its root-specific adoption of tolerance strategies; though, the exhibition of mercury burden-dependent elevated damages in concurrence with polypeptide patterns in roots is obvious when compared with leaf-specific stress-coping strategies. Conclusively, the current findings unveiled a successful contamination gradient dependent differential coping strategies adoption substantiated by polypeptide patterns in *S. plana* and *H. portulacoides* for their survival in mercury-contaminated coastal lagoon.

(1) Department of Chemistry & CESAM, University of Aveiro

(2) Department of Biology & CESAM, University of Aveiro

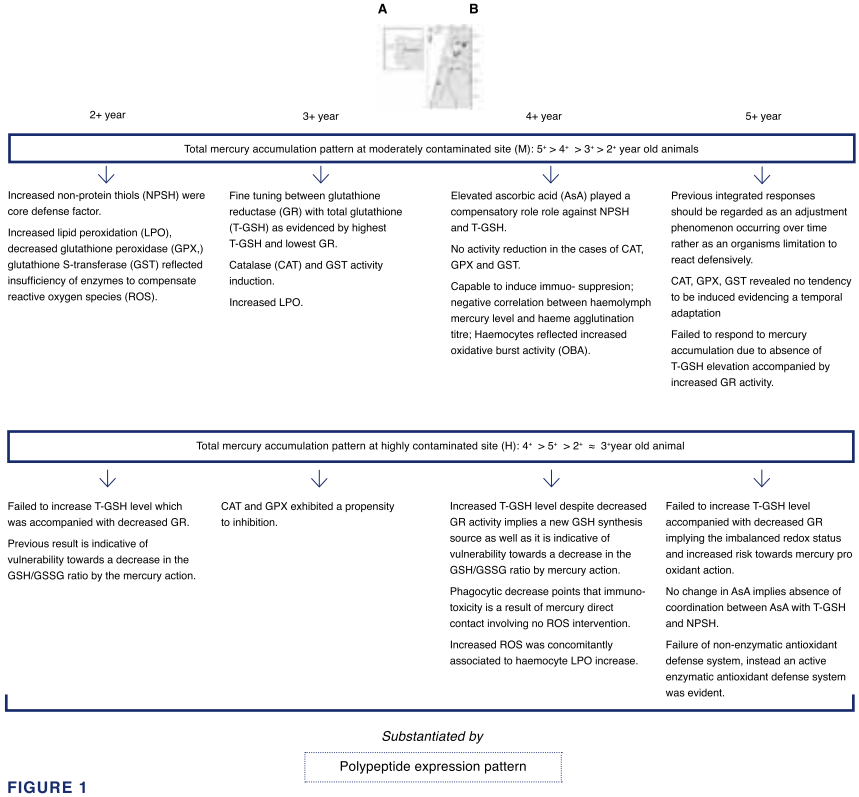


FIGURE 1

(A) Location of Ria de Aveiro (Portugal); (B) Location ( ) of sampling sites moderately (M) and highly (H) mercury contaminated sites at Laranjo basin, and a site at Vagueira assumed as reference R; (C) Coping strategies adopted by bivalve *Scrobicularia plana*.

DVINE – THE DOURO VINEYARDS, WORLD HERITAGE PATRIMONY: ASSESSING THE IMPACT OF AN ANCIENT ACTIVITY IN THE QUALITY OF SEDIMENT AND WATER IN THE DOURO

C. Patinha [1], A.P. Reis [1], A. C. Dias [1], E. Ferreira da Silva [1], A. Cachada [2], P. Martins [2], R. Fonseca [3], F. Barriga [3], A. Janeiro [3], M. Almeida [2], D. Terroso [1], F. Rocha [1], J. Vidinha [1], C. Sequeira [1] and A.J. Sousa [4]

(01) Department of Geosciences & GEOBIOTEC, University of Aveiro
(02) CESAM, University of Aveiro
(03) CREMINER, Lisboa
(04) CERENA, Instituto Superior Técnico, Lisboa

This project aims assessing the effect of vine cultivation in sediments, water and biota of the Varosa River dam. The Varosa is a tributary of the Douro River and the dam is located in the Demarcated Region of Douro Wine (Portugal). The proposed research intends establishing patterns of inorganic and organic pollution arising from the application of pesticides, herbicides, fungicides and insecticides in the vineyards. The most common herbicide used in the region is glyphosate while sulphur and copper sulphate are applied in significant amounts to prevent fungus development. Relationships between pollutants concentrations in vineyard soils, stream and dam sediments, and waters will be investigated to establish the importance of vineyard soils as a pollution source. The temporal geochemical record of vine cultivation will be established through isotopic analysis of sediments cores, namely ^{210}Pb and δ34S.

Soil samples were collected in 3 vineyards of different ages. Water and stream sediments were collected in tributaries and in the dam. Sediments cores were collected at 6 sites within the dam, providing a composite sample representative of the reservoir.

Glyphosate concentrations were below the detection limit (<0.10 µg L-1) in all samples. The stream sediments geochemistry indicates that elements concentrations are similar or lower to that reported for European stream sediments (Salminen et al., 2005), with the exceptions of Cu and Fe that have higher levels. However the study on the metal solid phase distribution shows that both elements are mainly in the form of Fe-oxyhydroxides, indicating a probable geogenic source. Depending on the physical-chemical conditions, Fe- oxyhydroxides can be soluble phase and Cu is a toxic element. Therefore determining Cu concentrations in pore-water samples will be important to assess metal bioavailability. Also the results indicate that soil erosion and metal leaching down slope are not significant and that metals are retained in the soil profile. The project's ultimate objective is to be able of delivering recommendations on future environmental strategies for the catchment and sustainable agriculture practices in the vineyards.

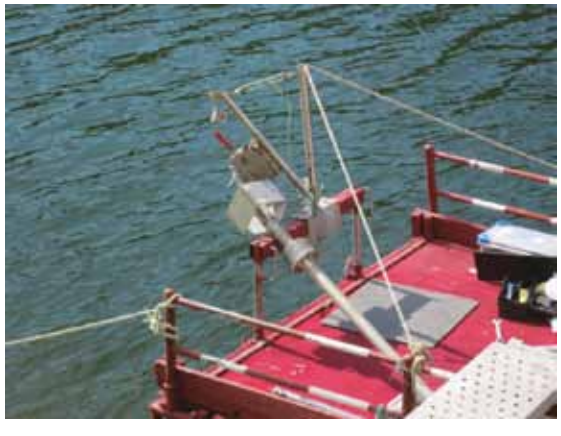


FIGURE 1 and 2
Sediments sampling using a piston and gravity corer device.

DEVELOPMENT OF NOVEL FLUORESCENT MATERIALS BASED ON CORROLE DERIVATIVES FOR MOLECULAR RECOGNITION OF ANIONS

J. A. S. Cavaleiro, M. G. P. M. S. Neves, M. A. F. Faustino, J. F. B. Barata and C. I. M. Santos

Department of Chemistry
& QOPNA, University of Aveiro

The topic of anion recognition has attracted growing interest because of its significant role in the chemical industry, environmental science and biochemistry. For instance, fluoride is an essential anion in humans in moderate levels and cyanide is one of the most active and poisonous anions. In recent years great attention has been given to the development of fluorescent materials to be used as anion chemical sensors. In terms of optical detection, certain macrocycles like the corroles represent attractive candidates for sensor elements. These tetrapyrrolic macrocycles exhibit rich spectroscopic features including: (1) high molar extinction coefficients, (2) high fluorescence quantum yields, and (3) the corrole core can accommodate a broad array of metal ions which in turn can act as active centers. In addition, corroles can be functionalized at the structural periphery to enhance binding specificity.

Recent studies of sensing ability of corroles and metallocorroles towards anions, done in collaboration with Prof. Carlos Lodeiro group from the New University in Lisbon, have demonstrated that corroles are sensitive to fluoride anions (Figure 1) being able to detect and quantify 0.35 and 0.69 ppm of F-.

In addition, this type of macrocycles shows interaction with CN- anions. However, the most promising results come from the application of these chemosensors as solid support polymers, having in mind the determination of contaminants. The non-emissive doped-polyacrylamide gel film, when exposed to water solution containing amounts of CN-, was able to detect a maximum of 1 ppm and a minimal amount of 70.0 ppb of this anion.

The polymethylmetha-crylate (PMMA) films prepared with corrole 1 show a purple colour to naked eye and under an UV lamp a very strong red emission when in the presence of F- or CN-. (Figure 2). These results are really significant for the determination of the highly toxic anion CN- in water samples.

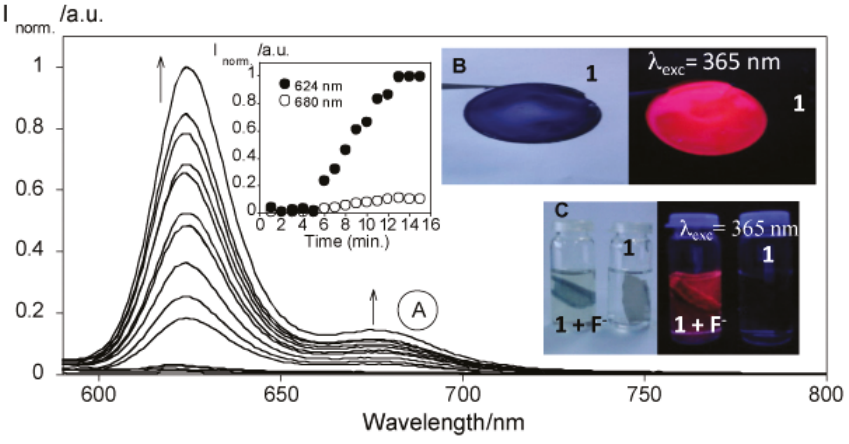


FIGURE 1
Spectrophotometric (A) and spectrofluorimetric (B) titrations of corrole 1 with the addition of F- in toluene

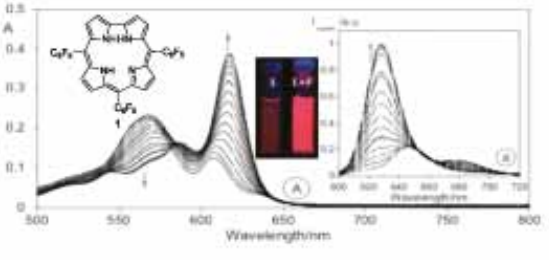
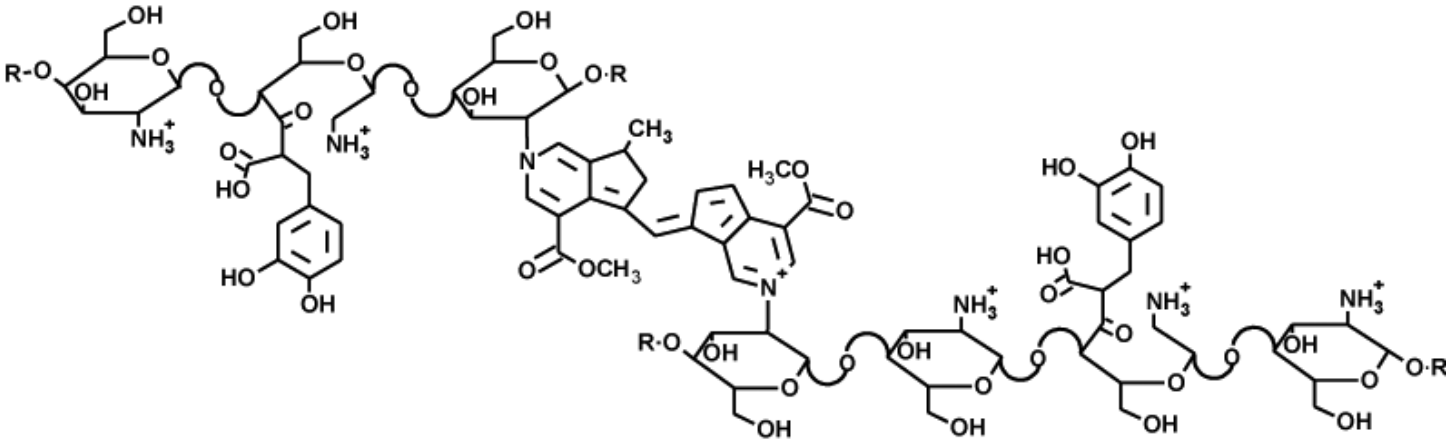


FIGURE 2
(A) Emission spectra with time of acrylamide gel dopped with corrole 1 in the presence of F-. (B) PMMA film with 1 and (C) polyacrilamide gel of 1 in the presence of F-.

CHITOSAN-BASED FILMS WITH ENHANCED PROPERTIES FOR FOOD APPLICATIONS

C. Nunes, É. Maricato, Â. Cunha, J. A. Lopes da Silva and M. A. Coimbra



Department of Chemistry
& QOPNA, University of Aveiro

Chitosan films have an increasing interest in food industry to extend the shelf-life of foodstuffs because of their biocompatibility, non-toxicity, and antimicrobial properties. However, their use has been limited due to their solubility in aqueous acidic media. Cross-linking of chitosan to form a network is a strategy to prepare chitosan films stable in acidic media. Genipin is an iridoid, aglycone of geniposide obtained from Gardenia, which is an effective cross-linker for chitosan.

The chitosan-genipin films are suitable to replace the preservative action of sulfur dioxide during winemaking, which is an advantage due to the intolerance and/or allergic reactions attributed to sulfur dioxide. White wines can be produced according to the traditional method of vinification but, instead of the sulfur dioxide addition, the chitosan films are placed in contact with the wines. After one year of storage, the wines are microbiologically stable. The physico-chemical analyses showed that these wines had slightly lower content of phenolic compounds and lower colour intensity, with a greener tone (lower a*) and less yellow (lower b*). A sensorial trained panel revealed that the wines treated with chitosan films had a good global evaluation with respect to taste, aroma, and colour. These results show the efficiency on white wine preservation of the chitosan-genipin films, maintaining its sensorial characteristics.

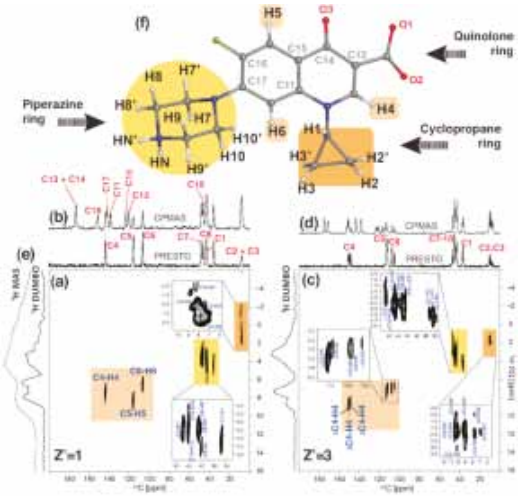
FIGURE 1
Proposed structure of chitosan grafted with caffeic acid and cross-linked with genipin.

One approach to enhance chitosan functionality is to link phenolic compounds into the polysaccharide backbone increasing its antioxidant activity. A process for the preparation of a chitosan-based film was developed by grafting the red wine phenolic compounds to the chitosan glucosamine residues by a radical mechanism and also by cross-liking with genipin. This methodology allowed producing films insoluble aqueous acidic media with 100% higher antioxidant activity than the pristine films. Furthermore, the surface wettability, mechanical properties, and thermal stability of the films were not significantly influenced. These films can be promising materials to be used as active polymers for food preservation and shelf-life extension.

FIGURE 2
Film of chitosan grafted with phenolic compounds and cross-linked with genipin.

QUANTIFYING WEAK PACKING INTERACTIONS IN HYDRATED AND ANHYDROUS FORMS OF THE ANTIBIOTIC CIPROFLOXACIN: A COMBINED SOLID-STATE NMR, X-RAY DIFFRACTION AND COMPUTER SIMULATION STUDY

L. Mafra [1,2], S. M. Santos [1], R. Siegel[1], I. Alves[1], F. A. A. Paz[1], D. Dudenko [2] and H. W. Spiess [2]



Understanding how molecular systems self-assemble in the solid-state continues to be a challenge. In this regard, Hbonding and van der Waals interactions are considered to play major roles as structure-driving entities in the construction of supramolecular arrangements. This is of particular relevance in pharmaceutical sciences, as multiple crystal forms of the same active pharmaceutical ingredient (API) occur frequently, posing diverse problems in the pharmacokinetics, stability, and formulation of drugs.

In an attempt to better understand how drug hydrates self-assemble in the solid-state and reorganizes to produce its anhydrous form, we present a detailed experimental NMR, X-ray diffraction (XRD), and computational study of packing interactions of different types such as weak/strong H-bonds and π···π interactions that constitute the supramolecular assemblies of two crystalline forms of the antibiotic ciprofloxacin (CIP) [Figure 1f]:1 one anhydrate (form I) and one hydrate (form II) forming water wormholes, emphasizing the effect of nonconventional hydrogen bonds and water on NMR chemical shifts. The complete resonance assignment of up to 51 and 54 distinct 13C and 1H resonances for the hydrate is reported, using a toolbox of advanced high-resolution 2D 1H CRAMPS-based NMR experiments and high magnetic fields (Figure 1a-e) combined with GIPAW calculations of 1H/13C chemical shifts. The effect of crystal packing on the 1H and 13C NMR chemical shifts including weak interionic hydrogen bonds and π···π interactions, is quantified through in silico structure dismantlement of I and II (Figure 2). For example, 1H chemical shift changes up to ~ –3.5 ppm for CH···π contacts and ~ +2 ppm (CH···O(–)); ~+4.7 ppm ((+)NH···O(–)) were estimated for hydrogen bonds.1 Water intake induces chemical shift changes up to 2 and 5 ppm for 1H and 13C nuclei, respectively. We show that such chemical shifts are found to be sensitive detectors of hydration/dehydration in the highly insoluble CIP hydrates.

(1) Department of Chemistry & CICECO, University of Aveiro
(2) Max-Planck-Institut für Polymerforschung, Germany

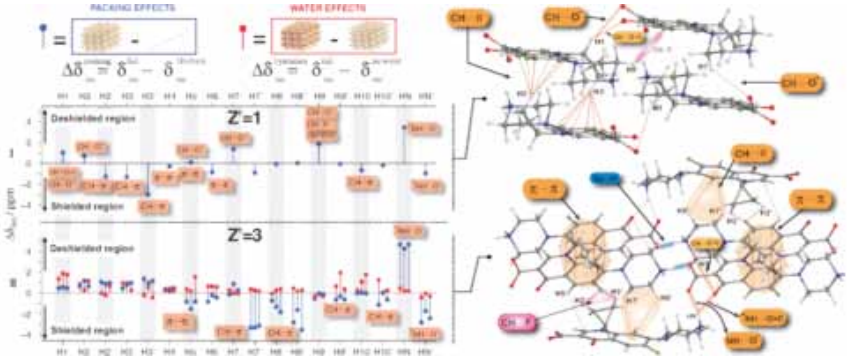


FIGURE 1

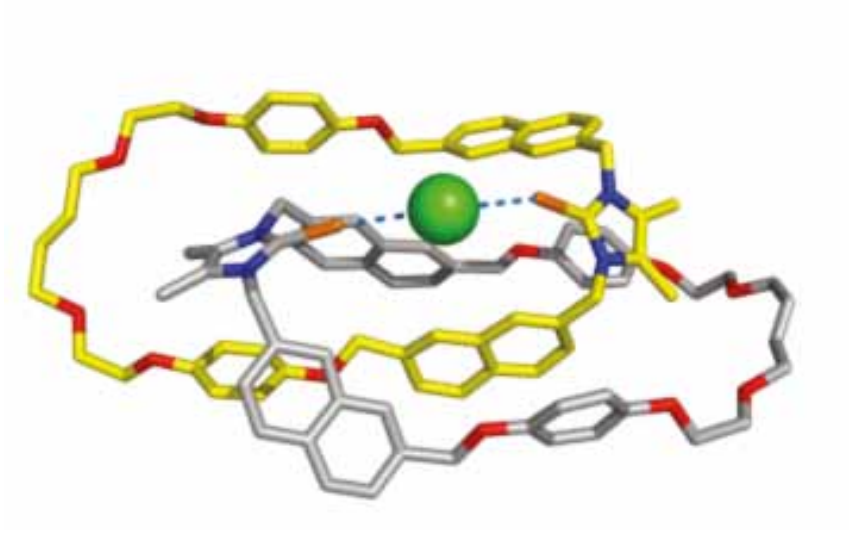
2D 1H–13C PRESTO-HETCOR of CIP forms (a) I and (c) II recorded at 800 MHz. (b, d) 13C CPMAS spectra recorded at 400 MHz. (e) 1H MAS and wDUMBO spectra of I are shown for comparison with the F1 projection of (a). (f) Labeling scheme adopted for CIP. The capability of PRESTO transfer to select only the directly bonded C– H is manifested by comparison with the 13C CPMAS spectra [i.e., (a, c) vs (b, d)].

FIGURE 2

(Left) Stem plots showing the contribution of the crystal packing (blue stems) and water molecules (red stems) to the calculated 1H chemical shifts (positive Δδ values indicate low-field shifts) of the ciprofloxacin forms I and II. In II, each of the three stems per nuclei corresponds to the crystallographically distinct CIP molecules 1, 2, and 3 (from left to right); (right) detailed view of intermolecular interactions in packings of I and II.

HALOGEN-BONDING IN ANION RECOGNITION

P. J. Costa[1], **V. Félix**[1] **and P. D. Beer**[2]



(1) Department of Chemistry & CICECO & Department of Health Sciences, University of Aveiro
(2) University of Oxford

Halogen bonding (XB) is the attractive intermolecular interaction between an electron deficient positively polarized halogen atom and a Lewis base. Usually, anion recognition in solution takes advantage of the ubiquitous hydrogen bonding, but XB is rapidly also becoming an established field in its own right. An extensive collaboration between our group and Prof. Paul Beer (University of Oxford) resulted in the development and application of XBs in the field of anion recognition.

In the first work [1] anion templation was used to prepare the first XB catenane, which bind and sense selectively chloride and bromide in CH3CN solution. Molecular dynamics (MD) simulations were performed in explicit CH3CN using the structure of the XB catenane bound to chloride and, among other analyses, a representative snapshot was extracted (Fig. 1). Two simultaneous halogen bonds are established between the bromine atoms of both macrocycles and the chloride anion. A π–π stacking interaction between one hydroquinone and a naphthalene group was also observed throughout the course of MD simulation, corroborating the experimental data.

In the second work, a new family of fluorescent XB macrocyclic halo-imidazolium receptors was described [2] showing that the bromo- and iodo- receptors bind selectively iodide and bromide, respectively, in the competitive CD3OD/D2O (9:1) aqueous solvent mixture, sensing these anions exclusively via a fluorescence response. The remarkable affinity of both receptors towards bromide was investigated by means of Density Functional Theory (DFT) calculations and MD simulations. The DFT optimized structure of the iodo-imidazolium receptor binding bromide is depicted in Fig. 2 and show that indeed the receptor is able to bind bromide with great affinity and relatively short C-I···Br– distances (3.192 Å). The subsequent MD simulations showed that those two simultaneous XBs were stable in explicit CH3OH/H2O mixtures, helping to complement the experimental characterization.

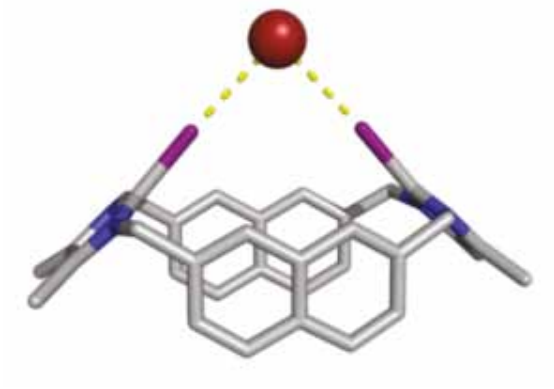
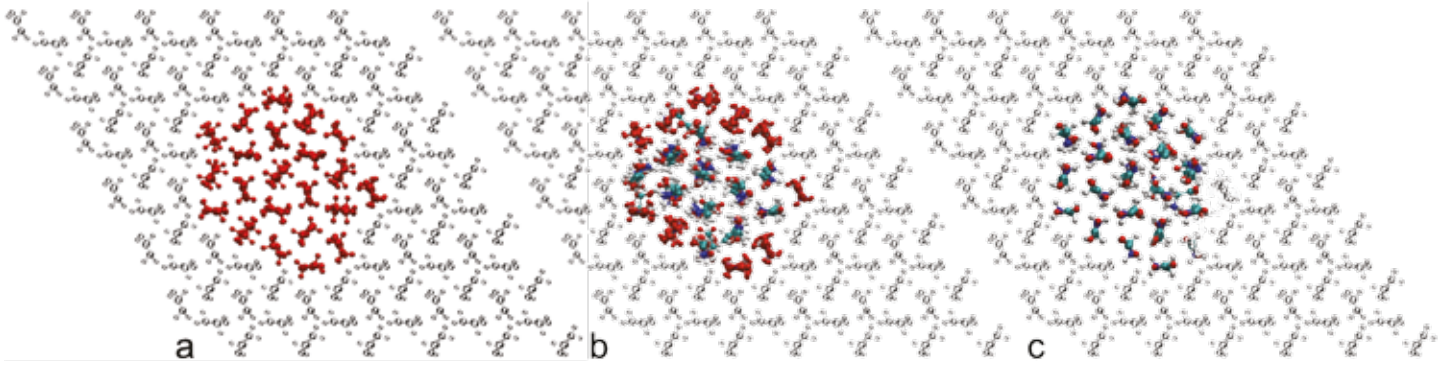


FIGURE 1
Representative co-conformation of the XB catenane bound to chloride in CH3CN solution. The two C-Br···Cl– halogen bonds are drawn as light blue dashed lines.

FIGURE 2
DFT optimized structure of the iodo-imidazolium receptor binding bromide, showing the corresponding halogen bonding interactions as yellow dashed lines

NANOSCALE FERROELECTRICITY IN CRYSTALLINE GLYCINE

A. Heredia [1], A. L. Kholkin [1], I. Bdikin [2], J. Gracio [2], V. Meunier [3], N. Balke [3], A. Tselev [3], P. Agarwal [3], B. G. Sumpter [3] and S. V. Kalinin [3]



Ferroelectrics are multifunctional materials that reversibly change their polarization under an electric field. Recently, the search for new ferroelectrics has focused on organic and bio-organic materials, where polarization switching is used to record/retrieve information in the form of ferroelectric domains. This progress has opened a new avenue for data storage, molecular recognition, and new self-assembly routes. Crystalline glycine is the simplest amino acid and is widely used by living organisms to build proteins. In this work, it has been shown for the first time that γ- glycine, which has been known to be piezoelectricsince 1954, is also a ferroelectric , as evidenced by local electromechanical measurements and by the existence of as-grown and switchable ferroelectric domains in microcrystals grown from the solution (Fig. 1). The experimental results have been rationalized by molecular simulations that establish that the polarization vector in glycine can be easily switched on the nanoscale level under the moderate electric field (Fig. 2). The discovery of ferroelectricity in amino acids offers new pathways to novel classes of bioelectronic logic and memory devices, where polarization switching is used to record and retrieve information in the form of ferroelectric domains. This ferroelectric-based memory can be built, for example, using the synergy with DNA-based conductors and organic transistors. Beyond information storage, these studies open up a set of interesting possibilities regarding the role of glycine piezoelectricity and ferroelectricity in the genesis of life (e.g., protein formation), as well as emerging properties in peptides from the biophysical point of view.

(1) CICECO, University of Aveiro
(2) TEMA, University of Aveiro
(3) Oak Ridge Natl. Laboratory, USA

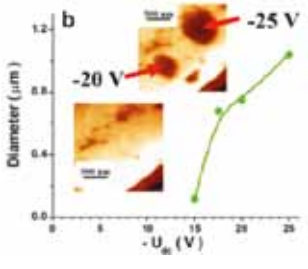


FIGURE 1
(a) As-grown ferroelectric domains in glycine, (b) Polarization switching (shown by arrows) after application of moderate electric field.

FIGURE 2
Molecular switching of glycine molecules under increasing bias field: (a) 0.434, (b) 4.10 and (b) 9.55 V/nm

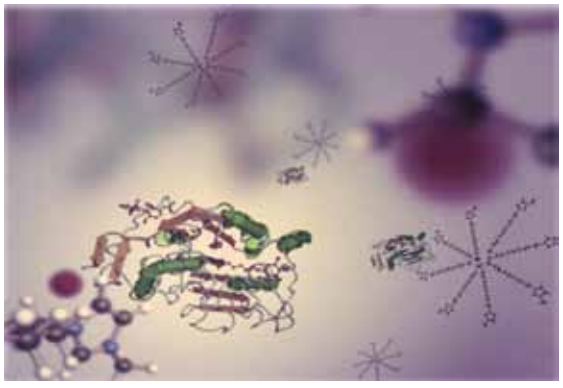
IONIC LIQUIDS MICROEMULSIONS: THE KEY TO *CANDIDA ANTARCTICA* LIPASE B SUPERACTIVITY

S. Ventura [1], L. Santos [1], J. Saraiva [2] and J. Coutinho [1]

(1) Department of Chemistry & CICECO, University of Aveiro
(2) Department of Chemistry & QOPNA, University of Aveiro

An ionic liquid (IL) system, compatible with the lipase *Candida antarctica* lipase B (CaLB) to enhance its activity, was developed. For the first time, the use of a simple method based on 1-decyl-3-methylimidazolium chloride [C_{10}mim]Cl to increase the lipase activity was reported. The effect of different IL molar concentrations, on the relative lipase activity (Act_{IL}/Act_{Bf}) was investigated and is shown in Figure 1 (green dots). The results show that the lipase activity increases with the IL molar concentration, achieving a maximum six-fold increase for 0.090 M of IL. These results suggest that the activity increment does not result from changes in the reaction mechanism or enzyme structure, since the enzyme activation energy is not affected by the IL presence, but instead may be explained by the formation of microemulsions due to the IL alkyl chain self-aggregation as depicted in Figure 2. In fact, the formation of microemulsions in long chain imidazolium ILs, including this IL, was previously demonstrated. To evaluate if the aggregation of [C_{10}mim]Cl was related with the observed activity increase, the critical micelle concentrations (CMC) of [C_{10}mim]Cl in the potassium phosphate buffer with and without the presence of the substrate *p*-nitrophenyl laurate (*p*-NFL) were determined by electric conductivity ($mS.cm^{-1}$) measurements and are reported in Figure 1. Considering the CMC results in the presence (red diamonds) and absence (blue triangles) of the substrate, it is shown that the *p*-NFL significantly contributes to lower the system CMC. A comparison of the relative enzyme activity and conductivity data, presented in Figure 1, shows that the increase of Act_{IL}/Act_{Bf} is observed for molar concentrations of [C_{10}mim]Cl above the CMC for the system with the substrate *p*-NFL.

The behavior here reported is being studied as the basis for novel methodologies of enzyme activation using aqueous solutions of ILs.



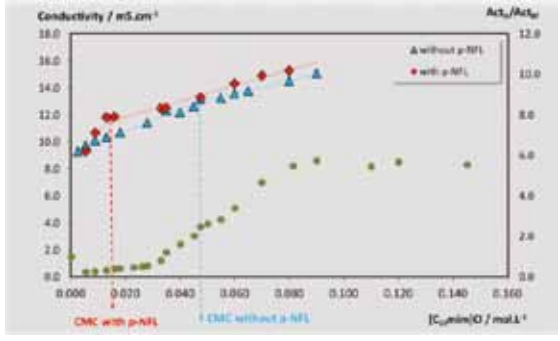
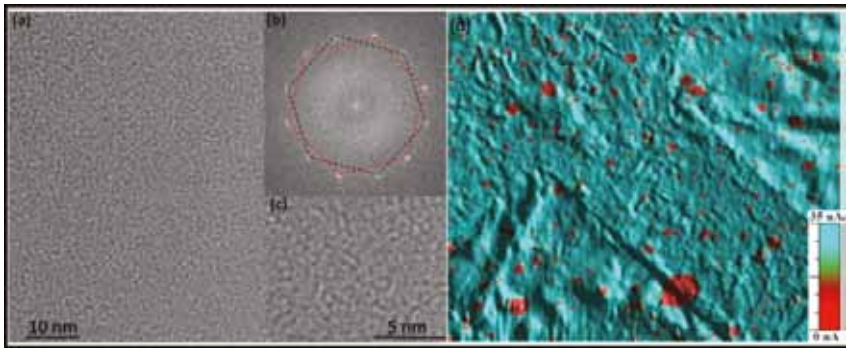


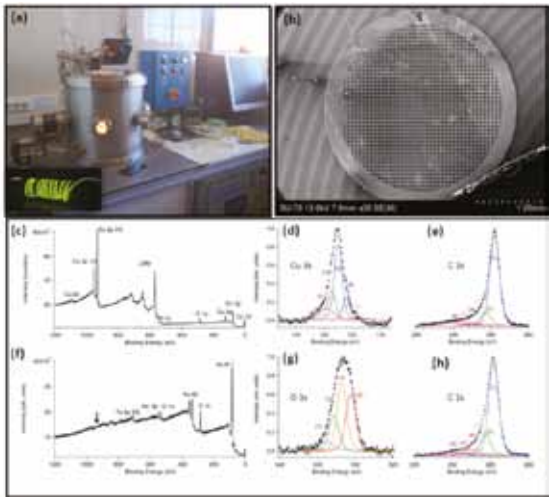
FIGURE 1
Relative enzyme activity of CaLB as function of the IL molar concentration and effect of the substrate (p-NFL) on the conductivity and CMC of [C_{10}mim]Cl aqueous solutions.

FIGURE 2
Illustration of the lipase in a microemulsion environment.

LARGE-AREA HIGH-THROUGHPUT SYNTHESIS OF MONOLAYER GRAPHENE SHEET BY HOT FILAMENT THERMAL CHEMICAL VAPOR DEPOSITION

R. Hawaldar [1], P. Merino [2], M. R. Correia [3], Igor Bdikin [1], Jose Gracio [1], J. Méndez [4], J. A. Martín-Gago [2,4] and M. K. Singh [1]





(1) TEMA, University of Aveiro
(2) Centro de astrobiología INTA-CSIC, Spain
(3) Department of Physics & I3N, University of Aveiro
(4) Instituto Ciencia de Materiales de Madrid-CSIC, Spain

Graphene is considered as a promising electronic material in post silicon electronics. Due to the unusual physical and electronic properties, as well as excellent charge-carrier mobility, graphene quickly grabbed the attention of physicists and engineers; bringing a hope that one day it will compete with silicon to be the material of next generations for certain applications in the electronics industries. It is believed that the graphene based nanodevices can be easily extended to large-scale integration (in contrast to carbon nanotube electronics) and can rank among the most important achievements in nanoelectronics, possibly outweighing other alternatives such as molecular and nanotube electronics. Recently, Research Group at TEMA, University of Aveiro, developed new hybrid of Hot filament Thermal CVD (HFTCVD) as a new hybrid of Hot filament and Thermal CVD and demonstrate its feasibility by producing high quality large area strictly monolayer graphene films on Cu substrates. Gradient in gas composition and flow rate that arises due to smart placement of the substrate inside the Ta filament wound alumina tube accompanied by radical formation on Ta due to precracking coupled with substrate mediated physicochemical processes like diffusion, polymerization etc., led to graphene growth. Figure (1) describes the graphene growth and detailed XPS study. Figure (2) depicts the High-resolution TEM image and local electronic properties of transferred graphene sheets by C-AFM, respectively.

FIGURE 1

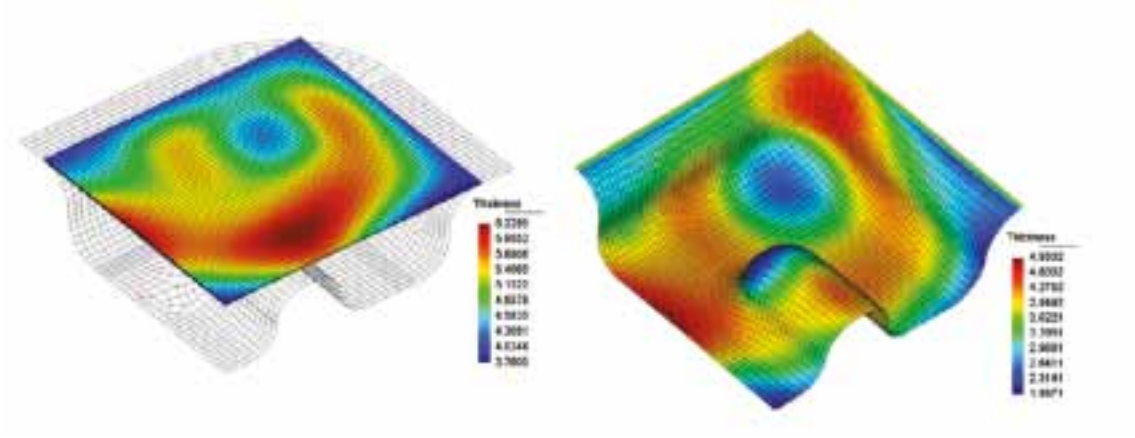
(a) Homemade Hot-filament Thermal CVD set up for the large area graphene growth.
(b) SEM image of Graphene transfer to Cu grid. (c-e) XPS study of as grown graphene on Cu substrate and (f-h) graphene transfer to Au substrate.

FIGURE 2

(a-c) High-resolution TEM image of transferred graphene sheets, and corresponding FFT pattern confirms the bilayer nature of transferred graphene sheet. (d) Shows a combined current and topography image by C-AFM wherein the conducting domain is represented by green color and non-conducting areas are seen as red spots. We further confirmed our mechanistic hypothesis by depositing graphene on Ni and SiO_2/Si substrates. HFTCVD can be further extended to dope graphene with various heteroatoms (H, N, and B, etc.,), combine with functional materials (diamond, carbon nanotubes etc.,) and can be extended to all other materials (Si, SiO_2, SiC etc.,) and processes (initiator polymerization, TFT processing) possible by HFCVD and thermal CVD.
In the continuation of the present work group is extensively involved in further development of Graphene research in the field of Electronics, Biosensor and Energy applications.

BLANK OPTIMIZATION IN A STAMPING PROCESS-INFLUENCE OF THE GEOMETRY DEFINITION

R. de Carvalho, S. Silva, R. A. F. Valente and A. Andrade-Campos



Department of Mechanical Engineering & TEMA, University of Aveiro

Nowadays initial geometry optimization methods are increasingly being adopted in order to solve complex mechanical plastic forming processes. This kind of approach can focus on the estimation of the initial shape of a certain metallic specimen (or blank) in order to achieve a desired geometry after forming. In the present work the superplastic forming of a carter was described and studied in detail. After plastic forming it was possible to verify an undesirable non-homogeneous thickness distribution in the final geometry. In order to obtain a regular final thickness of the sheet, avoiding this non-homogeneous patter, non-uniform thickness distribution of the initial blank can be proposed. To this end, the blank surface was modelled by means of a non-uniform rational B-spline (NURBS) surface, where the coordinates of specific NURBS control net vertices were chosen to be the optimization variables.

The optimization procedure was carried out by combining a Finite Element Analysis (FEA) software and a suitable optimization code. Four different studies were performed, differing in the number of control vertices that formulates the NURBS surface in order to study the influence of the initial geometry definition. In all the studies the location of the control vertices were considered to be uniform in the mesh. The four studies had achieved good values for the objective function, having a minimum decrease of 69.7% for the 25 optimization vertices and a maximum decrease of 81.2% for the 16 optimization vertices. These results were obtained when compared to the initial simulation considering a blank with a uniform 4 mm thickness. A geometry definition leading to better results was then achieved, considering both computational cost and final result precision. The developed methodology can be generalized to other forming cases. Therefore, the implemented numerical tool can be used by the metal forming industry in order to decrease undesirable thickness distribution and avoid premature rupture of the material.

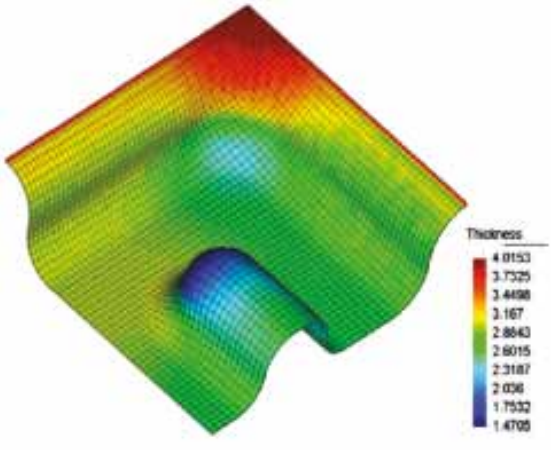
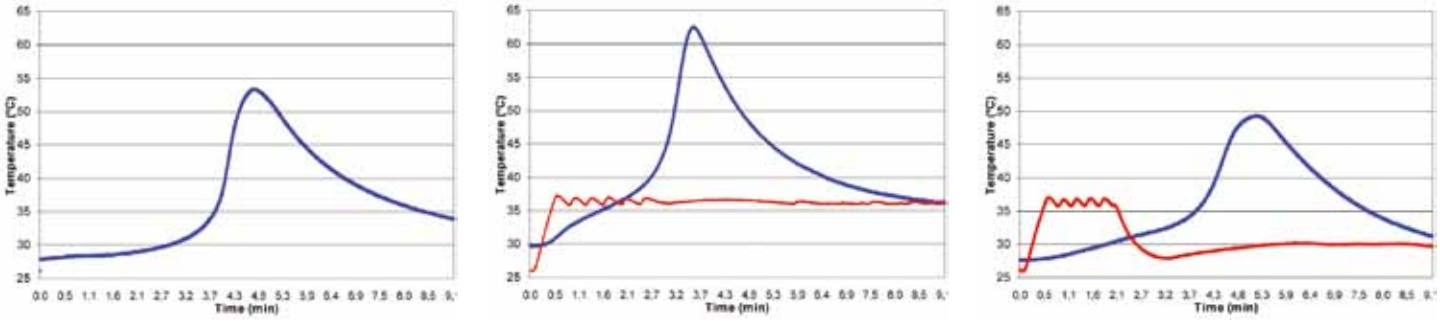


FIGURE 1
Final non-uniform thickness distribution predicted by the FEA.

FIGURE 2
Blank thickness of the best iteration for the: (a) initial and (b) final blank for 25 optimization variables.

A DEVICE TO CONTROL IMPLANT AND BONE-CEMENT TEMPERATURES IN CEMENTED ARTHROPLASTY

A. Completo, M. Coutinho, M. Schiller, A. Ramos, C. Relvas and J. A. Simões



At present, most of the orthopaedic implants used in articular reconstruction are fixed to host bone using acrylic bone-cement. Bone-cement polymerization leads to an exothermic reaction with heat release and consequent temperature rise. The increase of temperature in the bone beyond the tolerated limits can develop osteocyte thermal necrosis and ultimately lead to bone resorption at the cement-bone interface, with subsequent loosening of the implant. Another issue that plays an important role in implant loosening is debonding of the cement from the implant initiated by crack formation at the interfacial voids. Moderate pre-heating of the implant is expected to reverse the direction of polymerization, and has the ability to reduce interfacial void formation and improve interfacial shear strength. To increase the implant temperature at the initial cementing phase in order to reduce interfacial void formation, and subsequently, cool the implant in the latter cement polymerisation phase to prevent the possibility of bone thermal necrosis, a new automated electronic device was designed to be use in cemented joint replacements. The developed device (Figure 1) was specifically designed for the knee arthroplasty. The device controls the heat flux direction between the tibial-tray and the atmosphere through the "Peltier effect", using peltier tablets. The device is placed on the tibial-tray during the cementing phase and starts to heat it in a first phase, promoting the polymerization that initiates at the warmer cement-implant interface. In a second phase, the heat flux in the Peltier tablets is inverted to extract the heat generated during cement polymerization. The device efficiency was evaluated by cementing several tibial-trays in bovine fresh bone and measuring the tray and cement temperatures. The temperature results (Figure 2) showed that the device increases and maintains the implant temperature above room temperature at the initial cementing phase, while in the subsequent phase it cools the tibial-tray and cement. Significant differences were found for peak cement temperatures between the tests performed with and without the device. The device showed its capacity to promote the beginning of cement polymerization at the implant interface contributing towards improving interfacial shear strength, and in reducing the peak cement temperature in the subsequent polymerization process, thus contributing to the prevention of the bone thermal necrosis effect. Currently the device is patented (INPI-Nº 103799) and licensed by UA to the LTelectronic company.

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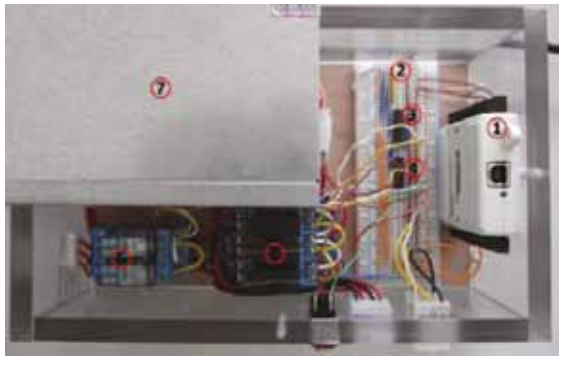


FIGURE 1
Control Unit (left) and heat exchanger (right) in contact with implant during the cementing process.

FIGURE 2
a) Bone-cement temperature without device use (normal cementing process).
b) Bone-cement (blue) and tibial-tray (red) temperatures only with heating phase c) Bone-cement (blue) and tibial-tray (red) temperatures with heating and cooling phases (complete cycle).

ELECTRONIC DOPING OF QUANTUM DOTS

R. N. Pereira [1], A. J. Almeida [1], A. R. Stegner [2], M. S. Brandt [2] and H. Wiggers [3]

(1) Department of Physics & I3N, University of Aveiro
(2) Walter Schottky Institute, Technical University Munich, Germany
(3) Institute for Combustion and Gas Dynamics & CENIDE, University Duisburg-Essen, Germany

In investigations published recently in Physical Review Letters and Applied Physics Letters [1,2], two prestigious physics journals, a team led by Rui N. Pereira, researcher at the Department of Physics of the UA and at the I3N, measured for the first time the interactions that take place between dopant atoms confined in quantum dots of semiconductor materials, using electron paramagnetic resonance. Dopants are atoms added to semiconductor materials that by donating electrons enable the tuning of electronic properties.

The researchers used silicon quantum dots doped with phosphorous atoms to demonstrate that the exchange interaction between dopants inside a quantum dot depends enormously on the relative orientation of the dopants and not only on the inter-dopant distance. Thus, depending on the specific dopants configuration, their interaction energy may take values in a range spanning 3 orders of magnitude, even for quantum dots with a diameter of only 4 nm, where the range of possible inter-dopant distances is small.

Quantum dots are tiny crystals with dimensions of only a few nanometers with uncommon size-dependent physical properties. Doping of quantum dots is expected to enable the control of electronic, optic and magnetic properties key for future application of these materials in for example photovoltaic devices, thin-film transistors, and biomedical tagging. Yet the practical exploitation of quantum dots requires that major scientific advances are achieved in terms of controlling and understanding doping phenomena.
The research team member António José Almeida, PhD student of the UA within the MAP-Fis Doctorate Programme, has been distinguished in 2013 by the Calouste Gulbenkian Foundation with a Research Stimulus Prize for his contribution to this research project.

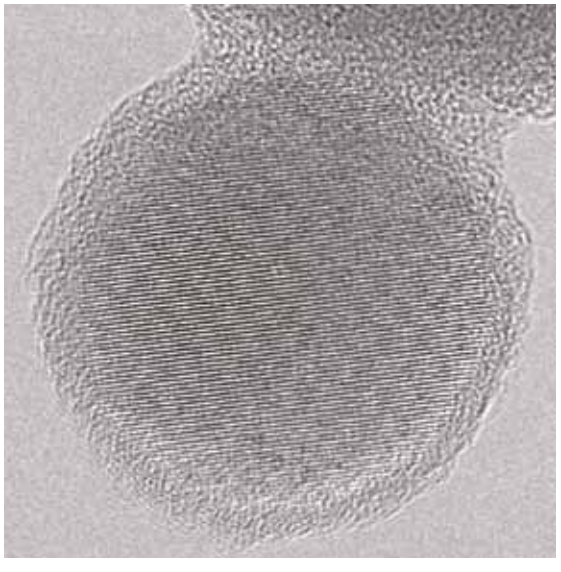


FIGURE 1
Quantum dot.

RADIATED ENERGY IN THE COLLISION OF TWO PARTICLES AT THE VELOCITY OF LIGHT

F. S. Coelho, C. A. R. Herdeiro and M. O. P. Sampaio

Department of Physics & I3N, University of Aveiro

The Nobel laureate Gerard t'Hooft argued in the 1980s that if two particles are collided with velocities extraordinarily close to the speed of light, a black hole should form and part of the energy, E, should be emitted into gravitational radiation. Moreover, the process should be describable by classical (i.e. non quantum) relativistic gravity.

About a decade ago, it was further suggested that if there are D space-time dimensions (with D>4), the necessary velocity for these events could be attained at the Large Hadron Collider, at the European Centre for Nuclear Research (CERN), or in other realistic man-made particle accelerators. It then became a central problem to calculate the total energy emitted into gravitational radiation. Knowing this quantity reveals the size of the black hole formed, since the remaining energy (not radiated) is captured therein. Such microscopic black holes would then decay via Hawking radiation. This decay leaves identifiable signatures in particle physics data, such as a high multiplicity of jets and a large transverse momentum.

The detection of such microscopic black holes would be an astonishing discovery, since it would provide strong evidence towards the existence of extra-dimensions besides the usual three spatial and one temporal. The absence of such detection, on the other hand, provides constraints on the existence and size of such dimensions. Thus, the best possible phenomenology must be performed to either identify detection or set bounds on models.

In a paper published in Physical Review Letters (PRL 108(2012)181102), a team from the University of Aveiro has shown that the energy E follows a remarkably simple pattern with the space-time dimension D. This result provides the best phenomenological value to implement in Monte Carlo event generators being used at the LHC experiments ATLAS and CMS, but raises also a theoretical mystery to explain the simplicity of the obtained pattern.

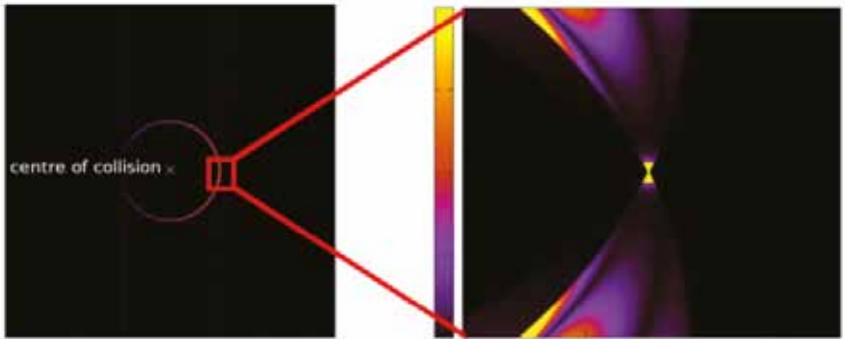
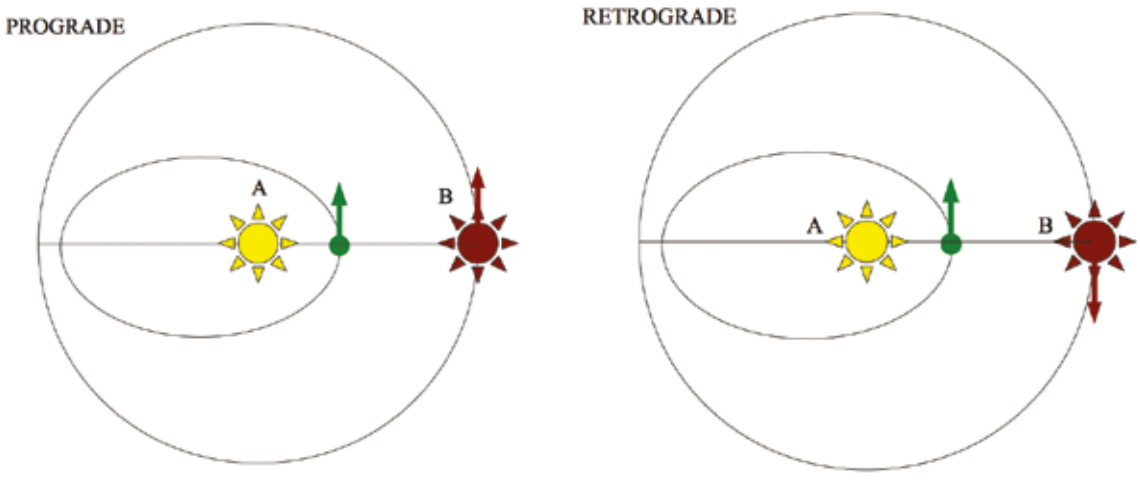


FIGURE 1
Projected representation of the radiation wave front emitted after a collision in D=5 (left panel), and a zoom of the wave amplitude profile seen by an observer near the collision axis (right panel).

RETROGRADE PLANETS ARE MORE STABLE THAN PROGRADE PLANETS

H. Morais and C. Giuppone



Department of Physics & I3N,
University of Aveiro

Currently over 800 exo-planets have been detected mostly by indirect methods. Of these, the most successful are the radial velocity method and the transit method. Recently, transit data allowed to identify planets on retrograde orbits with respect to the star's spin. We now also know several planets which belong to binary systems. These planets can orbit one of the stars or both of them, and could have formed in circumstellar or circumbinary disks, or could have been captured from a passing star. In the latter scenario, the orientation of the planet's orbit is not necessarily aligned with the binary and it could either be prograde or retrograde.

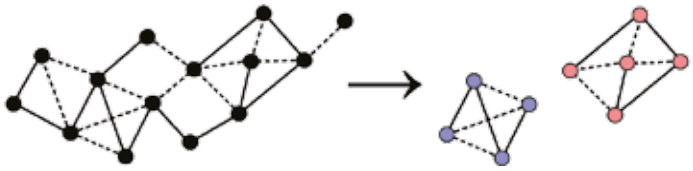
We considered two stars A and B at distance 1AU from each other1. We investigated the stability of planets around A, which included computing a chaos indicator. A planet close to A is always stable and follows approximately a 2-body Keplerian orbit. As we move the planet further away from A it will be subject to increasing gravitational force from B until it is no longer stable. The stability limit depends on the binary's mass ratio and is different for prograde or retrograde planets. When B has 50% of A's mass, prograde planets are stable up to 0.4 AU while retrograde planets are stable up to 0.65 AU. When B has 5% of A's mass, prograde planets are stable up to 0.5 AU while retrograde planets are stable up to 0.9 AU. We showed that instability was due to resonances between the binary's and planet's orbital frequencies, and their eventual overlap which causes Chirikov chaotic diffusion. We used a perturbative analysis to model the effect of B on the planet's orbit around A, and showed that retrograde resonances are weaker than prograde resonances. This explains why retrograde planets are more stable than prograde planets.

FIGURE 1
The results scale with the distance between A and B.

AVALANCHE COLLAPSE OF INTERDEPENDENT NETWORKS

G. J. Baxter, S. N. Dorogovtsev, A. V. Goltsev, and J. F. F. Mendes

Department of Physics & I3N, University of Aveiro



Many complex systems, both natural and man-made can be represented as interdependent networks, in which nodes in each network mutually depend on vertices in other networks, see Fig. 1. The interdependent networks demonstrate a rich set of features and effects unseen in ordinary single networks. Most impressive phenomena are related to avalanche collapse of the interdependent networks, in which an avalanche of damage spreads back and forth between the networks resulting in their complete disintegration. In particular, massive electrical blackouts and power outages, in which vitally interdependent power grids and controlling networks are involved, belong to this kind of phenomena.

In the simplest representative case, which we explore in detail, the interdependent networks can be reduced to the multiplex graphs, which have links of different kinds (coloured connections) and nodes of a single type. We study specific clusters within multiplex networks, in which between each two nodes, there exist paths of all possible colours (all links on a path should be of the same colour). These clusters are called viable clusters or viable components, see Fig. 2. We propose an algorithm enabling us to extract and index viable components in these networks.

We reveal the nature of the avalanche collapse of the giant viable component in multiplex networks under perturbations such as random damage. Specifically, we identify latent critical clusters associated with the avalanches of random damage. Divergence of their mean size signals the approach to the hybrid phase transition from one side, while there are no critical precursors on the other side. We find that this discontinuous transition occurs in scale-free multiplex networks whenever the mean degree of at least one of the interdependent networks does not diverge.

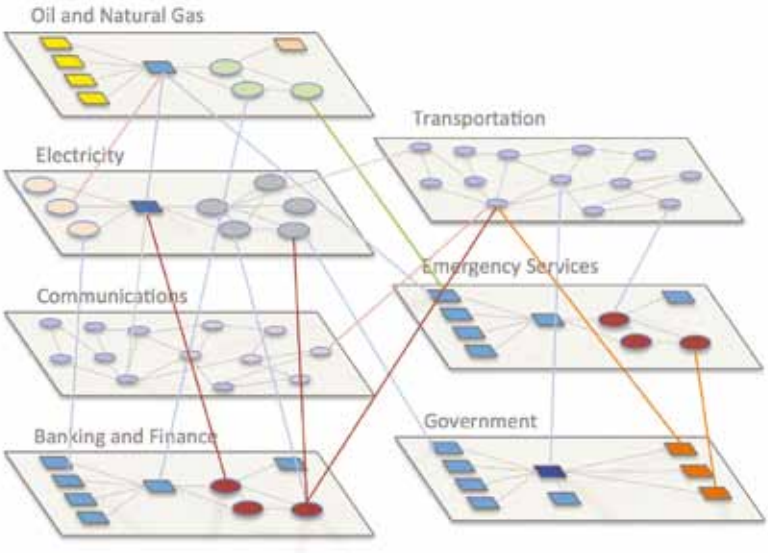


FIGURE 1
Organization of real-world interdependent networks. Various industrial, information, and other networks are actually interdependent. Interlinks between different layers show interdependencies.

FIGURE 2
A small multiplex network with two kinds of links. Applying the proposed algorithm non-viable vertices are removed leaving two viable clusters.

GREEN'S THEOREM FOR GENERALIZED FRACTIONAL DERIVATIVES

T. Odzijewicz[1] , D. F. M. Torres[1] and A. B. Malinowska[2]

(1) Department of Mathematics & CIDMA, University of Aveiro

(2) BTU, Poland

In 1828, the English mathematician George Green (1793-1841), who up to his forties was working as a baker and a miller, published an essay where he introduced a formula connecting the line integral around a simple closed curve with a double integral. Within years, this result turned out to be useful in many fields of mathematics, physics and engineering. Generalizations of Green's theorem have chosen different directions, and are known as the Kelvin-Stokes and the Gauss-Ostrogradsky theorems. In our work we proved Green's theorem for generalized partial fractional (noninteger order) derivatives.

Fractional Calculus (FC) is a generalization of the standard (integer order) differential calculus, in the sense that it deals with derivatives of real or complex order. FC was born on 30th September 1695. On that day, L'Hopital wrote a letter to Leibniz, where he asked about Leibniz's notation of nth order derivatives. L'Hopital wanted to know the result for the derivative of order n = 1/2. Leibniz replied that "one day, useful consequences will be drawn" and, in fact, his vision became a reality. The study of noninteger order derivatives rapidly became a very attractive subject. Many different forms of fractional derivative operators were introduced, e.g., Hadamard, Riemann–Liouville, Caputo, Riesz, Cresson, Katugampola, Klimek, and many results of classical analysis were extended to the noninteger case. Unfortunately, since fractional integrals and derivatives can be defined in many different ways, in each case all results must be considered separately. In our work we introduced more general operators that, by choosing appropriatly special kernels, reduce to the standard fractional integrals and derivatives found in the literature. Using the new operators, we generalized Green's theorem[1].

This work received The Grunvald-Letnikov award for the best student paper – theory, on the Inter-national Conference "Fractional Differentiation and Applications", that took place in Nanjing, China, from 14th to 17th May 2012 (see Fig. 1).

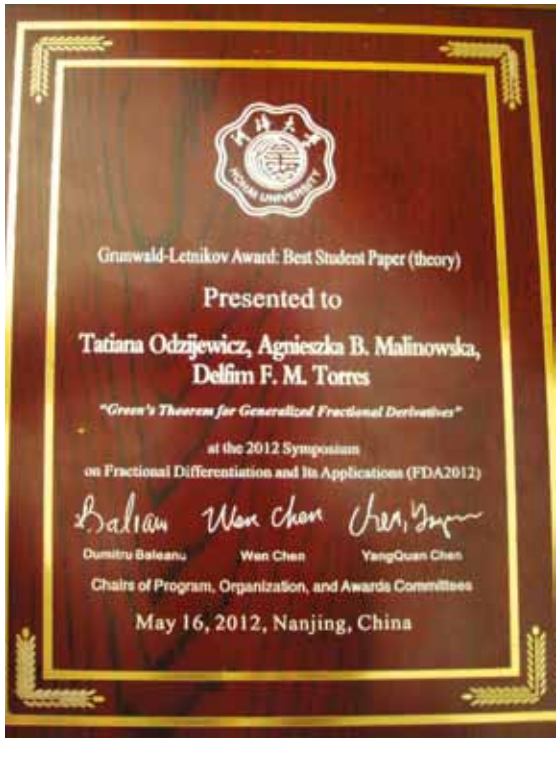
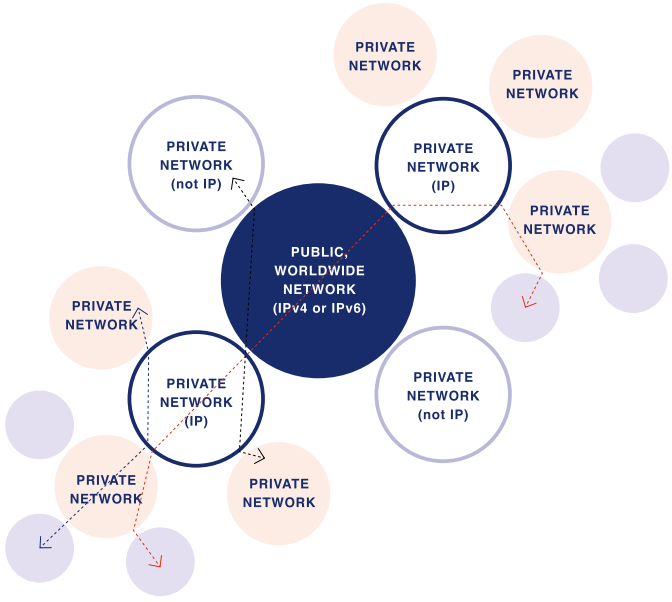


FIGURE 1
Grunvald-Letnikov award, May 2012

A NEW LOCATION LAYER FOR THE TCP/IP PROTOCOL STACK

A. Zúquete [1] and C. Frade [2]

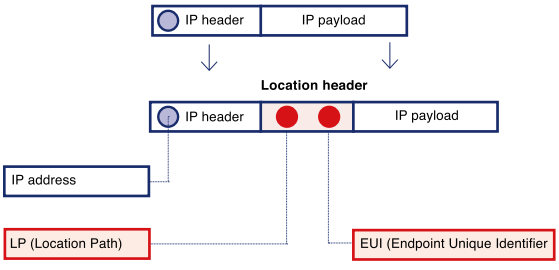


The main goal of the work described in the paper was to develop a mechanism for allowing end-hosts on any IP network, public or private, to address each other without limitations. The key feature that we explored is a novel hierarchical routing mechanism, inspired by the source routing and route recording concepts. With our hierarchical routing mechanism, we imagine the Internet to evolve hierarchically (see Fig. 1), from an IPv4 or IPv6 public backbone to several private leaf networks, each of which with a focused purpose, possibly interconnected by intermediate, private mid-size networks.

For achieving this goal, the paper presents a new location layer for the TCP/IP protocol stack, placed between the network and transport layers. Its purpose is to enable the deployment of addressing bridges over IP. Such bridging enables a seamless routing between heterogeneous addressing domains, such as public/private IPv4 and IPv6 networks.

The location layer adds flexible addressing, location and routing facilities for IP packets. It allows any IP host to become a Locator Node between an IP host and some "addressable entity", which can also be another IP host or an object without IP address, such as a person or a given content. Addresses handled by the Locator Nodes are flexible data structures that use a stacking paradigm to memorize routes or entity identifiers (e.g. a latitude-longitude position, a phone number or a content hash). The paper proposes a simple meta-structure for implementing location layer headers, without imposing specific policies to manage the activities of Locator Nodes.

With the location layer, endpoints are identified within a new, wide and location-free identification space. Such identifiers (Endpoint Unique Identifiers) are handled on the context of the location layer, i.e., by Locator Nodes (see Fig. 2). This enables an effective separation between endpoint identification and location, which is an advantage for addressing mobile or replicated entities.



(1) Department of Electronics, Telecommunications and Informatics & IEETA, University of Aveiro
(2) Institute of Telecommunications, University of Aveiro

FIGURE 1
Hierarchical Internet vision, with a central, IPv4 or IPv6 public backbone and many hierarchies of private networks, using IP or not. The diagram shows three interactions among pairs of endpoints, both located in leaf, private networks, and a hierarchical traffic routing between them passing through a public or private IP network, indirectly accessible to both entities.

FIGURE 2
Diagram showing the placement of the Location Header and the fields used to identify and locate an endpoint: the Endpoint Unique Identifier for endpoint identification, the IP address (of a Location Node) and the Location Path for endpoint location (through the Location Node).

THE LIVING USABILITY LAB PROJECT

Coordination of UA participation: A.J. S. Teixeira[1] and N. Rocha[2]

(1) Department of Electronics, Telecommunications and Informatics & IEETA, University of Aveiro

(2) Health Sciences Autonomous Section, University of Aveiro

Demographic ageing is probably the greatest achievement of mankind. With suitable natural interfaces and the possibilities offered by next generation networks, the introduction of technological solutions can facilitate the daily life of the elderly, fighting isolation and exclusion, increasing their pro-activity, work capacity and autonomy.

The Living Usability Lab for Next Generation Networks (www.livinglab.pt) was a Portuguese industry-academia collaborative R&D project that aimed at creating the conditions to idealize, develop and evaluate innovative services to support healthy, productive and active citizens. The project, which lasted two years and represented an investment in R&D of more than 1.2 million Euros, adopted universal design, natural user interfaces, next generation networks and distributed computing. This Project gathered Microsoft Portugal (project coordinator), two SMEs (Micro-IO and PLUX), two research institutes (IEETA and INESC Porto), two universities (Aveiro and Porto), over 1000 senior citizens or with disabilities, two nursing homes, a social solidarity institution and 25 senior universities.

The project mainly focused on:
— Creating conditions for the existence of a distributed virtual lab to support creating, developing and evaluating new technological solutions for the senior population;
— Developing technologies, such as sensors and speech recognition, for integration into new services and applications;
— Creation and evaluation of demonstrators.

Besides the active leadership regarding the definition of the distributed virtual Living Lab architecture and of the development method, UA contributed to the project with the development of applications and services instantiating the architecture (ex: Home Gateway), the development of a framework to support the use of multimodal interaction in new applications, the conception and development of a new Telerehabilitation service, the development of a home robot and the definition of a complete evaluation methodology.

FIGURE 1
LAB - Living Usability logo.

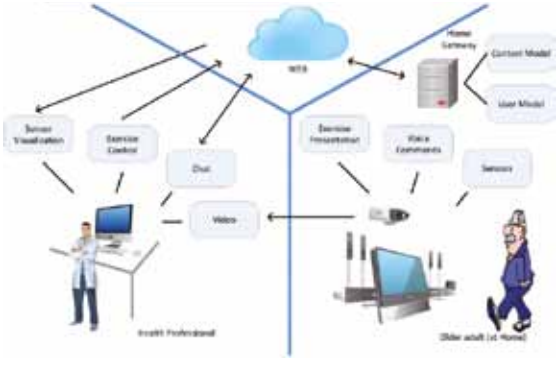


FIGURE 2
The Living Usability Lab New Telerehabilitation Service.

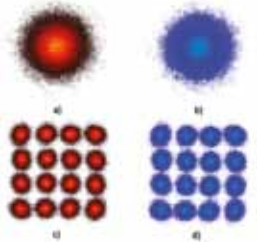
ADVANCED DIGITAL SIGNAL PROCESSING IN HIGH-SPEED OPTICAL COMMUNICATIONS

A. N. Pinto, A. L. Teixeira, F. P. Guiomar, N. J. Muga, S. B. Amado and J. D. Reis

The continuous emergence of new bandwidth consuming services and applications, such as high-definition video and cloud computing, has been causing a steady traffic growth of approximately 30%-50% per year, thus putting a huge pressure into the Internet's enabling engine – optical core networks. In order to meet the bandwidth demands for the next decade, per-channel bit-rates above 100 Gb/s are required, reaching an aggregate multi-channel bandwidth of several Tb/s. These very ambitious requirements have triggered the rise of a new transmission/detection paradigm with the aim to optimize the bandwidth efficiency of long-haul optical fiber communications. Resembling the past evolution of radio-frequency-based communications (but with ~1000x higher bitrates and transmission distances), we are now witnessing the arrival of a digital revolution into fiber optic systems, powered by the adoption of multi-level signal modulation associated with coherent detection and very high-speed digital signal processing (DSP). In this new context, DSP has taken a prominent role, mostly at the receiver-side, simultaneously enabling and being potentiated by coherent detection. Indeed, taking profit of an almost lossless digitalization process, post-detection DSP enables to digitally equalize signal distortions caused by fiber propagation.

Under this topic, we have recently developed an efficient nonlinear compensator based on the Volterra series representation, a fast polarization demultiplexer and a polarization dependent losses compensator using the Stokes space formalism. As an illustrative example of the relevance of DSP post-processing, the constellation diagrams of a received and processed dually-polarized 16-quadrature amplitude modulation (DP-16QAM) signal are shown in Figure 1. Without post-detection DSP, the received signals are clearly meaningless, rendering the communication unfeasible. After DSP equalization and carrier recovery, the obtained constellations enable to successfully decode the transmitted information, guaranteeing an error free communication.

Envisioning real-time signal processing, we are currently working on the hardware implementation of the developed methods and algorithms.



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

FIGURE 1
Constellation diagrams of a DP-16QAM signal before and after DSP. a), b) received signal constellations in the x/y polarization modes; c), d) signal constellations in the x/y polarization modes after DSP, including static linear and nonlinear equalization, dynamic linear equalization and carrier recovery.

BATTERY-LESS REMOTE CONTROLLER

A. Boaventura and N. B. Carvalho

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

Remote Controllers are responsible for more than 20M battery uses each year, only in Portugal. Wireless Power Transmission (WPT) is a technical solution to remove completely the batteries from the remote controller.
This research work describes a novel eco-friendly battery-less remote control system based on a multi-RFID scheme. The proposed remote control device does not require the use of batteries or other installed power source. The controlled device (e.g. a TV, a game console or a garage door) incorporates a reader system that remotely powers up the remote controller device and communicates with it in the UHF band. The concept underneath this idea is based on the Tesla concepts of energy transmission using electromagnetic waves.

The concept of WPT applied to this scenario implies that both energy and information are sent wirelessly, and this will imply that the remote controller is energized and communicates back the ID of the pressed button back to the device to control.

The battery-less remote controller incorporates a plurality of N passive RFID chips/tags, N keys/switches and a multi-port microstrip network specially conceived to interconnect the various RFID chips.

Each remote controller's key is associated with an RFID with an Unique IDentifier (UID), which allows the device to be controlled to identify the key pressed by the user. The microstrip network combined with the switches ensures proper interconnection between the various chips allowing them to share the same antenna in such way that only the chip associated with the pressed key is read by the RFID reader.

The research group related to this experiment is pursuing this work further in order to reduce also the energy being sent to the air, and thus the overall energy efficiency of the system.

More information can be gathered in http://radiosystems.av.it.pt

FIGURE 1
Overall remote control prototype, including the fixed structure near the TV receiver.

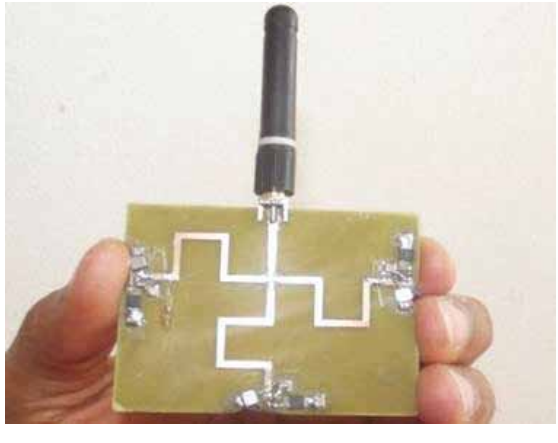


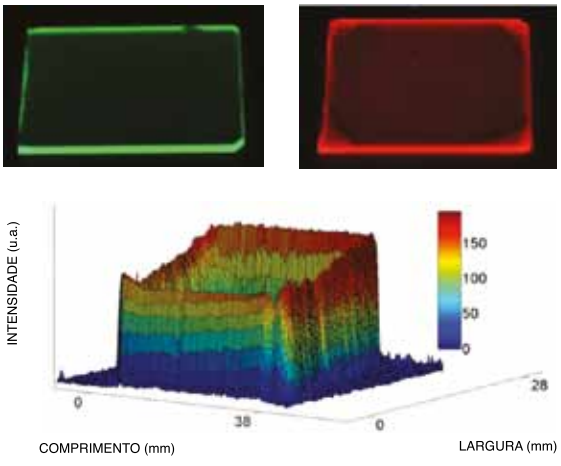
FIGURE 2
Batery-less remote control using Wireless power transmission, 3 button remote prototype.

LUMINESCENT SOLAR CONCENTRATORS BASED ON ORGANIC-INORGANIC HYBRIDS

S. Correia [1], L. D. Carlos [2], R. A. S. Ferreira [2] and P. S. André [3]

Solar energy is the most abundant and reliable source of energy. High conversion efficiency is necessary for cost effectiveness. The efficiency of the Si-based photovoltaic solar cells is limited due to the poor overlap between the Si absorption and the Sun emitting spectrum.

Highly efficient green-, and red-emitting lanthanide-based organic-inorganic hybrids have been used to increase the conversion efficiency of Si-photovoltaic cells, through the implementation of Luminescent Solar Concentrations. The Lanthanide-based organic-inorganic hybrids – processed as thin films on transparent substrates – efficiently convert the ultraviolet sunlight component (not absorbed by the Si-photovoltaic cells) into visible radiation, as illustrated in figure 1. The light emitted at the film surface is trapped within the waveguide substrates and guided to the edges, through total internal reflection, where it emerges in a concentrated form (see figure 2) that can be collected by the photovoltaic cells.



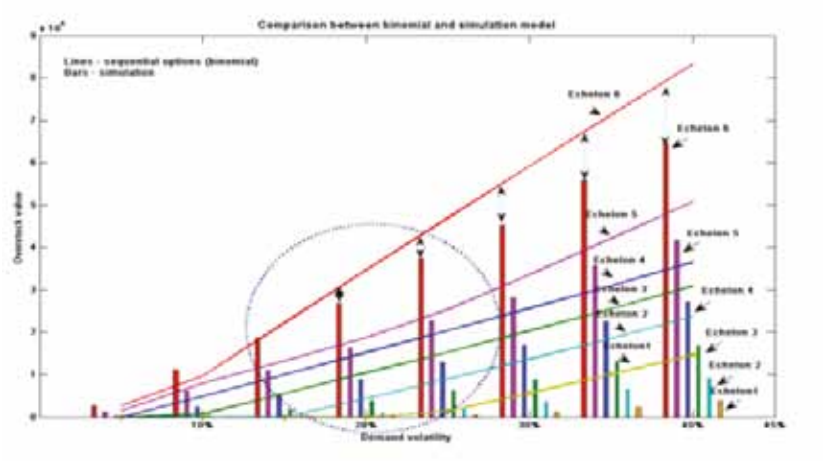
(1) Department of Physics & CICECO & IT, University of Aveiro.
(2) Department of Physics & CICECO, University of Aveiro.
(3) Department of Physics & IT, University of Aveiro.

FIGURE 1
Emission from organic-inorganic hybrids materials doped with (left) Tb3+ and (right) Eu3+ ions excited at [1,2].

FIGURE 2
Intensity map of the red pixel of the Eu3+-based organic-inorganic hybrids excited at 365 nm [2].

INTEGRATED INVENTORY VALUATION IN MULTI-ECHELON PRODUCTION/DISTRIBUTION SYSTEMS

R. Fernandes, J. B. Gouveia and C. Pinho



Department of Economics, Management and Industrial Engineering & GOVCOPP, University of Aveiro

Supply chains are exposed to different uncertainties that can affect expected service levels. The sources of uncertainty can be linked to capacity availability, inbound resources, or changes in demand.

This study is aimed at the determination of overstock in a multi-echelon supply chain considering the impact of demand uncertainty. In particular, the model intends to answer two practical questions: (1) Can we calculate an integrated and balanced overstock level for a multi-echelon supply chain? (2) What is the impact of demand uncertainty on the upstream echelons of inventory level?

We develop the concept of balanced multi-echelon overstock as a flexible inventory planning technique in uncertain environments. The right level of overstock in a network can be viewed as a series of decision points, where that value consists of two components: one is the value of current echelon overstock; the other is the value of downstream overstock.

At each echelon the manager receives information regarding the overstock in the linked stage, and simultaneously, the manager decides whether to plan an overstock.

1-For high demand uncertainty levels, the overstock increases for all the echelons. This effect is stressed in the downstream nodes (close to the market) and less aggressive in the upstream nodes.
2-A decrease in lead time allows for a lower overstock value for all the echelons. The managerial implication is that efficient practises or agile process designs, able to decrease lead times, can contribute to an overstock decrease.
3-Overstock is more sensible to service level changes in the downstream echelons, where changes in the service are more expressive and with higher implications.
4-The communication distortion is higher as the distance from the market is amplified. For higher non-optimal overstock values in different echelons, the global overstock value increases.

The purpose and the practical applications of the present study rely on the definition of adequate levels of inventories to hedge against demand uncertainty. When the supply chain has multiple decision echelons at which different stock levels can be applied, it is very important to balance all the buffers depending on uncertainty of market demand and endogenous penetration.

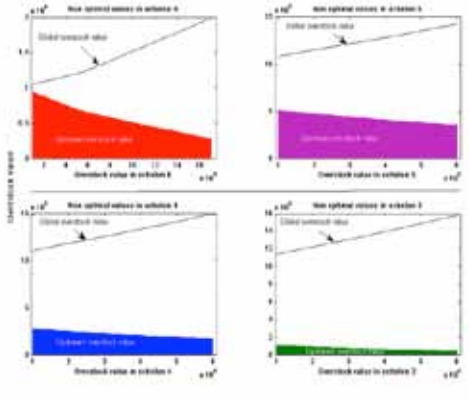


FIGURE 1
Impact on upstream stages of non optimal overstock values

FIGURE 2
Overstock model (binomial and simulation) vs demand volatility.

EXPERIMENTAL SCIENCE TEACHING IN BASIC EDUCATION IN PORTUGAL: EVALUATION OF THE IMPACT OF A NATIONAL TEACHER EDUCATION PROGRAMME

C. Tenreiro-Vieira [2], R. M. Vieira [1], P. Sá [1], A. V. Rodrigues [1], F. Teixeira [2], F. Couceiro [2], M. Luísa Veiga [4], C. Neves [3] and I. P. Martins [2]

The object of this evaluation study is the Teacher Education Programme in Experimental Science Teaching (PFEEC), by requirement of the Ministry of Education of Portugal in 2011 (Martins et al., 2012). The PFEEC was conceived and developed between 2006 and 2010, involving 4 Universities and 14 Polytechnic Institutes, by a Technical Advisory Committee of the Research Centre "Didactics and Technology in Education of Trainers" (CIDTFF), UA, who has elaborated supporting Teaching Guides based on research, addressing several themes considered relevant to the first school years concerning Physics, Chemistry, Biology and Earth Sustainability (Figure 1). In total 140 000 pupils and 7 000 school teachers were involved. The main aim of PFEEC was to prepare primary school teachers to develop experimental science teaching. Figure 2 indicates the numbers of institutions and participants involved in the study in each of the four school years.

This research using stratified sampling design allowed to measure indicators on the valorization, by the teachers, of the proposals of experimental teaching and learning of science. The participation in the PFEEC provided the teachers with more educational activities related to science learning through experimental strategies.
Authors of textbooks (1st to 6th grade) recognize the relevance of the PFEEC. In particular, the supporting Teaching Guides had a great impact on the recently published Science textbooks.

In the schools' dynamics there are indicators on the active role played by teachers who attended the programme, by creating contexts to enhance the importance of science education in the early years.
Concerning the pupils' learning, the study conveys modest average scores in the questionnaire for both groups of pupils whose teachers either attended the PFEEC or not. However, there are significant differences between the two groups if we consider the 25% of pupils with the best marks, with the PFEEC group in the lead position. Moreover, the syllabuses of Science Education Courses in Teachers' Graduation degrees, in the Universities and Polytechnic Institutes, integrated objectives outlined in the PFEEC.

(1) Department of Education & CIDTFF, University of Aveiro
(2) CIDTFF, University of Aveiro
(3) Department of Mathematics & CEAUL & University of Aveiro
(4) Instituto Superior Bissaya Barreto, Lisboa

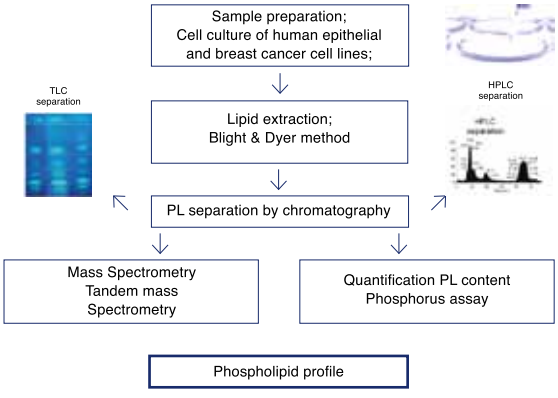
	NUMBER OF			
School year	School-clusters	School	Teachers	Pupils
2006 - 2007	245	581	986	17472
2007 - 2008	498	1495	2961	53986
2008 - 2009	484	1471	2940	53732
2009 - 2010	298	698	1215	24169

FIGURE 1
Teaching Guides conceived and used in the PFEEC

FIGURE 2
School-clusters, schools, teachers and pupils involved in PFEC, 2006-2010

LIPIDOMICS APPLICATIONS IN THE CLINICAL RESEARCH

L. Helguero, L. Dória, D. Santinha, A. Padrão, C. Simões, Z. Cotrim, R. Domingues, P. Domingues, B. Neves, R. Ferreira, R. Vitorino and F. Amado



Department of Chemistry
& QOPNA, University of Aveiro

Lipids are important cellular components and lipid signaling mediators and alteration in lipid metabolism have been found in different diseases. In our lab we used mass spectrometry approaches to identify changes in lipid profile in normal and pathological conditions, such as immunology, depression, diabetes, and cancer with the aim to provide new markers that will be used in clinical evaluation. Our lab is currently focused in the following lines of research:

1) The role of lipids in breast cancer has been largely understudied. Besides their contribution to the cell membrane mass, lipids regulate membrane fluidity, are an energy source and have roles in cellular signalling; all processes altered in malignant progression. We used a lipidomic approach in which phospholipids were separated by thin layer chromatography and analyzed by ESI-MS/MS. Differences in the spectra of sphingomyelins and phosphoinositides - two PLs with roles in regulation of cell survival and motility – were found between non malignant (MCF10A) and breast cancer cells with different degrees of aggressiveness (Fig. 2). Presently, we are extending these studies to breast tumours with the aim to identify prospective biomarkers of disease progression.

2) Prevalence of skin inflammatory disorders has increased in recent years being estimated that 15-20% of the general population suffers from allergic contact dermatitis (ACD). Currently, the sensitizing potential of chemicals is assessed through animal tests; however growing ethical concerns and actual legislative framework impose the development of new alternative tests. A growing body of data suggests that phospholipids (PLs) play important roles in the modulation of immune responses. Presently we were using lipidomic profiling to prospect lipid biomarkers of skin sensitization. We found that phosphatidylcholines and phosphatidylserines molecular species may discriminate immunogenic compounds form irritants. Analysis of such alterations may be therefore valuable in a future in vitro test platform for skin sensitization prediction.

3) Myocardial mitochondria dysfunction seems to represent an important pathogenetic factor underlying cardiomyopathy, a common complication of type 1 diabetes mellitus (T1DM). Despite significant progress in the understanding of the molecular mechanisms of mitochondrial function in the heart, the interplay between phospholipids and membrane proteins in mitochondria still poorly comprehended. Results from our lab showed that mitochondria from T1DM heart presented lower OXPHOS activity and lower transcription ability, related with phospholipid remodeling characterized by higher phosphatidylcholine levels, lower phosphatidylglycerol, phosphatidylinositol and sphingomyelin content, higher amounts of long fatty acyl side chains and increased peroxidation, particularly of cardiolipin (CL). These results suggest that phospholipid remodeling of heart mitochondria is an early event in T1DM pathogenesis and is related with OXPHOS dysfunction.

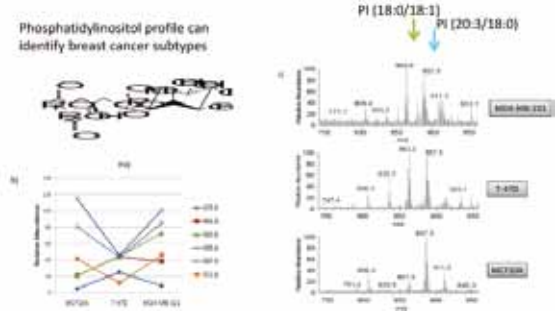


FIGURE 1
Workflow describing lipidomic analysis of cells, tissues and biofluids for disease biomarkers identification.

FIGURE 2
Different phoshatidylinositol (PI) profiling from breast cancer cells.

LEFT VENTRICLE FUNCTIONAL ANALYSIS FROM CORONARY CT ANGIOGRAPHY

S. Silva, B. S. Santos and J. Madeira

Department of Electronics, Telecommunications and Informatics & IEETA, University of Aveiro

The heart is a vital organ in the human body. The analysis of the left-ventricle (LV) is of paramount importance to characterize the cardiac function. Coronary computed tomography (CT) angiography is performed by injecting the patient with a contrast agent that will improve visibility of the coronary arteries and heart chambers (atria and ventricles). Even though coronary CT angiography results in 10-12 image volumes, acquired along the cardiac cycle, only three of these volumes are typically used for diagnosis: one, at around 60% of the cardiac cycle, to assess the coronaries, and other two at end-systole (maximum heart contraction) and end-diastole (heart passively filling with blood). Therefore, due to the lack of tools to do it, a large amount of data, which might improve diagnosis, is left out of the analysis.

The methods proposed by Samuel Silva, researcher at IEETA, during his PhD, allow functional analysis of the left ventricle including all cardiac phases, along the cardiac cycle, by using different regional and local measures to characterize LV function (e.g., endocardium radius, myocardium thickness, and regional blood volumes). Furthermore, to allow analysis and comparison of the different measures and anatomical regions, several features are provided including interactive coordinated views of both functional data and anatomy, complemented by animated sequences to enhance abnormalities detection.

The work carried out received the Fraunhofer Challenge 2012 award for the best practical idea based on a PhD thesis and the José Luís Encarnação award for the best article in the areas of Visualization and Computer Graphics published by a Portuguese student.

FIGURE 1
Interactive analysis screen showing coordinated views of left ventricle functional data as provided by different measures selected by the clinician (e.g. regional blood volumes).

DENGUE: CONTROL MEASURES TO FIGHT THE DISEASE

H. S. Rodrigues [1], D. F. M. Torres [2], M. T. T. Monteiro [3]

(1) CIDMA & Polytechnic Institute of Viana do Castelo
(2) Department of Mathematics & CIDMA, University of Aveiro
(3) Centre Algoritmi, University of Minho

Dengue is a subtropical and tropical disease transmitted by mosquitoes, which affects about 100 million people per year and is considered by the World Health Organization as a major concern for public health. It is a vector-borne disease transmitted from an infected human to a female Aedes mosquito by a bite (see Fig. 1). Then, the mosquito, that needs regular meals of blood to feed their eggs, bites a potential healthy human and transmits the disease making it a cycle.

The mathematical models developed and tested in our work are based on ordinary differential equations that describe the dynamics underlying the disease, including the interaction between humans and mosquitoes. The spreading of Dengue is attenuated through measures to control the transmission vector, such as the use of specific insecticides and educational campaigns. Based on the theory of Optimal Control, we have analyzed the optimal strategies for using these controls and respective impact on the reduction/eradication of the disease during an outbreak. A bioeconomic approach and a compromise between the realism of the epidemiological models and their mathematical tractability were considered.

Strategies to decrease the number of infected individuals were investigated with data from the Cape Verde outbreak. The article “Dengue in Cape Verde: vector control and vaccination” is accepted in the journal “Mathematical Population Studies” and had a considerable impact in the Portuguese media, with an interview at Antena 1 (http://www.rtp.pt/programa/radio/p3053/c89403), and two publications in local periodicals (Diário de Aveiro and Diário do Minho).

FIGURE 1

Fonte: CDC, Center for Disease Control and Prevention.

2012 in review

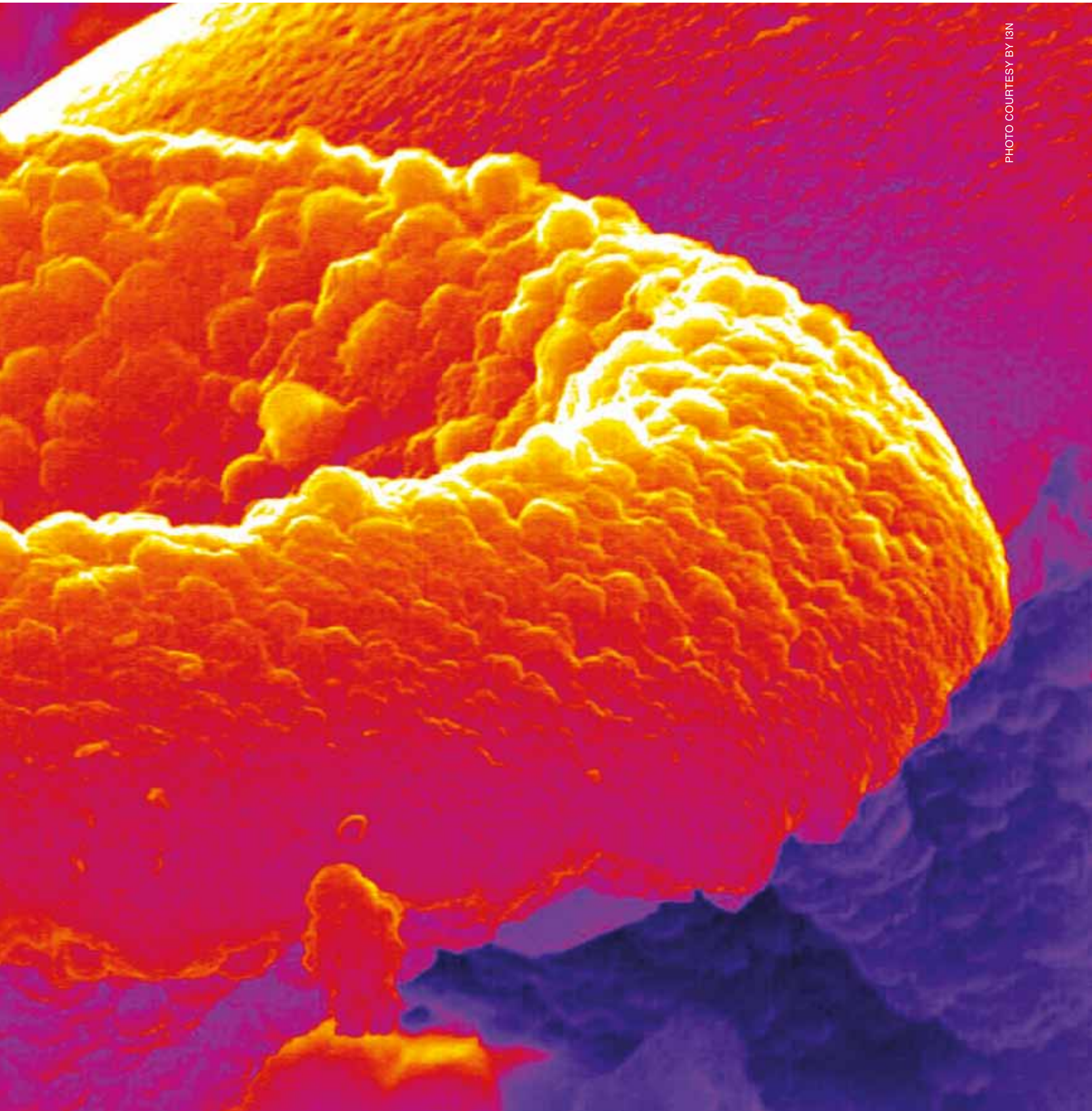


PHOTO COURTESY BY I3N

People

FACULTY BY DEPARTMENT

	TOTAL (FTE)	TOTAL FTE	PERCENTAGE OF WOMEN	PERCENTAGE OF FOREIGNERS
UNIVERSITY	**2011**		**2012**	
Department of Environment and Planning	18	19	58%	
Department of Biology	35,3	32,9	43%	
Department of Social Sciences, Policy and Planning	27	27,3	22%	
Department of Communication and the Arts	81,4	77,6	34%	6%
Department of Economics, Management and Industrial Engineering	57,3	55,1	57%	4%
Department of Education	40	37,3	70%	
Department of Electronics, Telecommunications and Informatics	82,8	81,3	7%	1%
Department of Civil Engineering	19,40	18,6	22%	
Department of Materials Engineering and Ceramics	17	17	47%	
Department of Mechanical Engineering	28,9	27,9	9%	2%
Department of Physics	48,6	47,6	20%	6%
Department of Geosciences	14,5	13,5	37%	
Department of Languages and Cultures	47,5	43,2	58%	21%
Department of Mathematics	66	63,7	47%	9%
Department of Chemistry	49,2	47,3	49%	2%
Department of Health Sciences	17,2	20,3	53%	15%
POLITECHNICAL SCHOOLS				
School of Design, Management and Production Technologies of Aveiro North	19,2	14,4	41%	
School of Health of the University of Aveiro	43,9	39,7	62 %	
Àgueda School of Technology and Management	48,8	46,3	44 %	
School of Accounting and Administration of Aveiro	71,6	70,1	48%	
TOTAL	**829,3**	**800,1**	40%	

RESEARCHERS BY DEPARTMENT

	TOTAL (FTE)	TOTAL (FTE)	PERCENTAGE OF WOMEN	PERCENTAGE OF FOREIGNERS
	2011		**2012**	
Department of Environment and Planning	19	19	63%	37%
Department of Biology	75	69	65%	17%
Department of Social Sciences, Policy and Planning	2	3	67%	67%
Department of Communication and the Arts	12	1	100%	100%
Department of Economics, Management and Industrial Engineering	5	3	67%	33%
Department of Education	19	17	94%	18%
Department of Electronics, Telecommunications and Informatics	23	15	40%	27%
Department of Materials Engineering and Ceramics	39	46	37%	65%
Department of Civil Engineering	2			
Department of Mechanical Engineering	17,4	15,4	45%	68%
Department of Physics	45	37	32%	49%
Department of Geosciences	11	12	58%	17%
Department of Languages and Cultures	4			
Department of Mathematics	16	16	44%	69%
Department of Chemistry	98	101	57%	28%
Department of Health Sciences	1			
TOTAL	388,409	354,40	54%	37%

STAFF BY CATEGORY

	TOTAL (FTE)	TOTAL (FTE)	PERCENTAGE OF WOMAN	PERCENTAGE OF FOREIGNERS
UNIVERSITY	**2011**	**2012**		
Full professors	55,8	55,8	9%	3%
Assotiated professors	118,3	118,3	36%	3%
Assistant professors	371,9	375,90	43%	4%
Lecturer	113,2	92,70	38%	4%
Other teaching staff	17	13,20	62%	47%
Researchers	102,4	93,40	47%	34%
Post-doctoral students	286	261	57%	38%
POLITECHNICAL SCHOOLS				
Coordinator professors	11,6	10,6	28%	
Adjunt professors	89,7	91,30	49%	
Lecturer equivalent	51,8	42,30	56%	
TOTAL	**1217,7**	**1154,5**	**45%**	**14%**

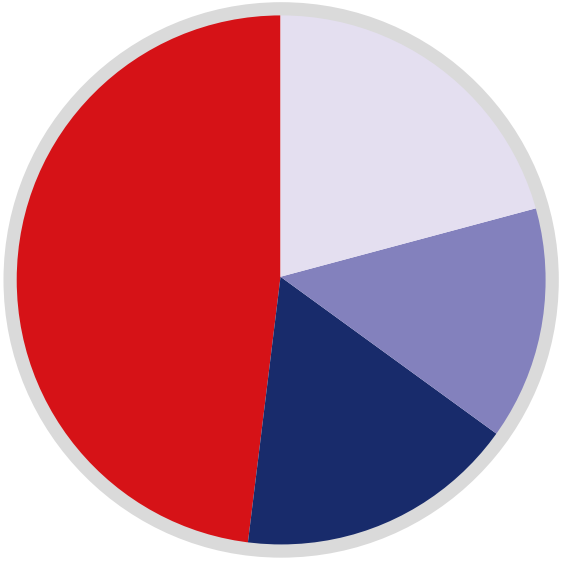
PhD STUDENTS BY DEPARTMENT

	TOTAL	TOTAL	PERCENTAGE OF WOMAN	PERCENTAGE OF FOREIGNERS	PERCENTAGE OF NEW STUDENTS
	2011 / 2012	**2012 / 2013 ***			
Department of Environment and Planning	82	76	67%	29%	32%
Department of Biology	158	130	77%	23%	12%
Department of Social Sciences, Policy and Planning	29	13	54%	8%	
Department of Communication and the Arts	231	192	54%	27%	32%
Department of Economics, Management and Industrial Engineering	216	125	53%	25%	26%
Department of Education	246	179	82%	15%	25%
Department of Electronics, Telecommunications and Informatics	153	102	14%	37%	31%
Department of Civil Engineering	44	33	27%	15%	18%
Department of Materials Engineering and Ceramics	80	71	39%	35%	23%
Department of Mechanical Engineering	79	59	39%	19%	15%
Department of Physics	90	54	39%	19%	24%
Department of Geosciences	18	10	80%	10%	
Department of Languages and Cultures	65	57	68%	28%	46%
Department of Mathematics	38	24	83%	38%	13%
Department of Chemistry	121	102	67%	12%	15%
Department of Health Sciences	58	61	72%	3%	61%
TOTAL	**1522**	**1154**	**59%**	**24%**	**26%**

* Provisional data.

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 CONTINENT, 2012-2013



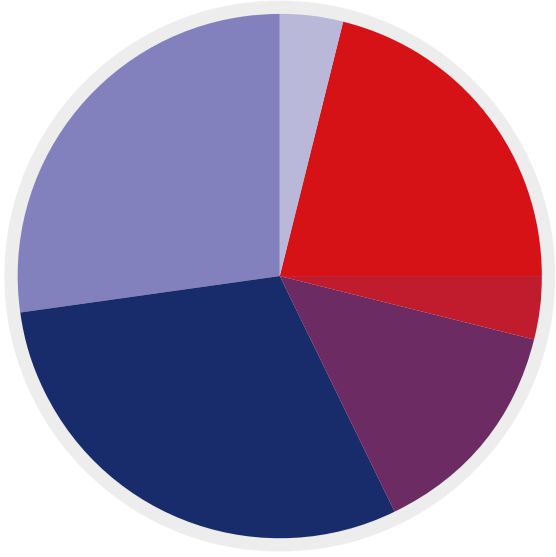
- America
- Asia
- Europe
- Africa

FOREIGN PhD STUDENTS BY NATIONALITY, 2012-2013

- 2012 / 2013
- 2011 / 2012
- 2010 / 2011

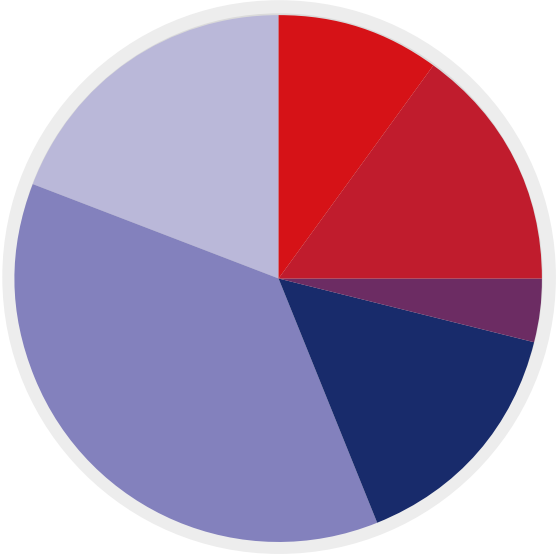
MSc and PhD theses

MSc THESES IN 2012 PER AREA



- Arts and Humanities (21%)
- Exact Sciences (4%)
- Life Sciences (14%)
- Social Sciences (30%)
- Engineering and Technology (27%)
- Health Sciences (4%)

PhD THESES IN 2012 PER AREA



- Arts and Humanities (10%)
- Exact Sciences (15%)
- Health Sciences (4%)
- Life Sciences (15%)
- Social Sciences (37%)
- Engineering and Technology (19%)

Sci Papers

TOP 10 SUBJECT AREAS FOR PAPERS PUBLISHED IN 2012	RECORD COUNT	% OF 1333
Materials Science Multidisciplinary	177	13,28%
Environmental Sciences	128	9,60%
Chemistry Physical	102	7,65%
Chemistry Multidisciplinary	93	6,98%
Physics Applied	93	4,65%
Mathematics Applied	62	4,58%
Physics Condensed Matter	61	4,05%
Biochemistry Molecular Biology	54	4,05%
Nanoscience Nanotechnology	51	3,83%
Marine Freshwater Biology	49	3,68%

Data retrieved from ISI Web of KnowledgeSM (Thomson Reuters) in 7 Jan 2013

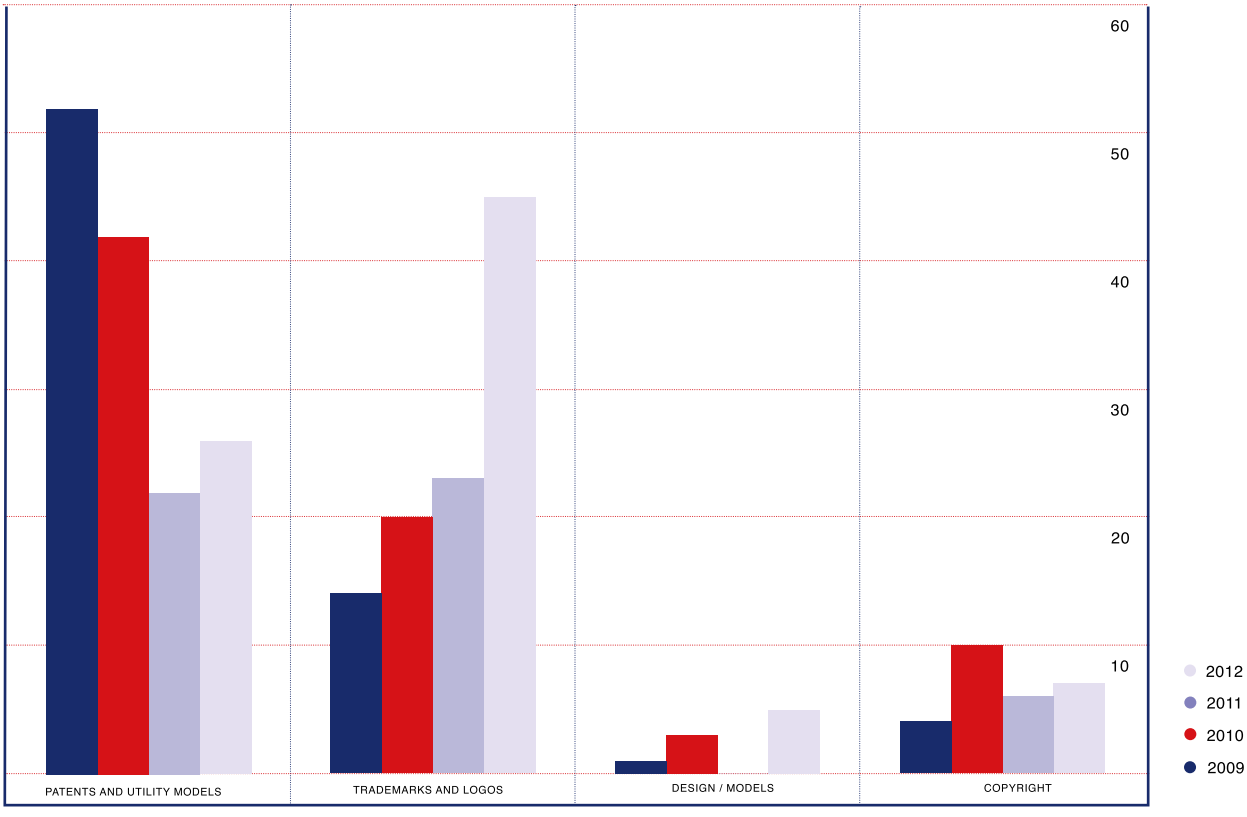
TOP 10 CITED PAPERS	TOTAL Nº CITATIONS (2008 - 2011)
Dorogovtsev, S.N.; Goltsev, A.V.; Mendes, J.F.F. (2008). Critical phenomena in complex networks. REVIEWS OF MODERN PHYSICS, 80: 1275-1335	356
Carlos, L.D., Ferreira, R.A.S., Bermudez, V.Z., Ribeiro, S.J.L. (2009). Lanthanide-Containing Light-Emitting Organic-Inorganic Hybrids: A Bet on the Future. ADVANCED MATERIALS, 21: 509-534	250
Gandini, A. (2008). Polymers from Renewable Resources: A Challenge for the Future of Macromolecular Materials. MACROMOLECULES, 41: 9491-9504	179
Butler, G., Rasmussen, M.D., Lin, M.F., Santos, M.A.S., Sakthikumar, S., Munro, C.A., Rheinbay, E., Grabherr, M., Forche, A., Reedy, J.L., Agrafioti, I., Arnaud, M.B., Bates, S., Brown, A.J.P., Brunke, S., Costanzo, M.C., Fitzpatrick, D.A., de Groot, P.W.J., Harris, D., Hoyer, L.L., Hube, B., Klis, F.M., Kodira, C., Lennard, N., Logue, M.E., Martin, R., Neiman, A.M., Nikolaou, E., Quail, M.A., Quinn, J., Santos, M.C., Schmitzberger, F.F., Sherlock, G., Shah, P., Silverstein, K.A.T., Skrzypek, M.S., Soll, D., Staggs, R., Stansfield, I., Stumpf, M.P.H., Sudbery, P.E., Srikantha, T., Zeng, Q., Berman, J., Berriman, M., Heitman, J., Gow, N.A.R., Lorenz, M.C., Birren, B.W., Kellis, M., & Cuomo, C.A. (2009). Evolution of pathogenicity and sexual reproduction in eight Candida genomes. NATURE, 459: 657-662	178
Harbuzaru, B.V., Corma, A., Rey, F., Atienzar, P.; Jorda, J.L., Garcia, H., Ananias, D., Carlos, L.D., Rocha, J. (2008). Metal-organic nanoporous structures with anisotropic photoluminescence and magnetic properties and their use as sensors. ANGEWANDTE CHEMIE-INTERNATIONAL EDITION, 47: 1080-1083	155
Pinna, N., Niederberger, M. (2008) Surfactant-free nonaqueous synthesis of metal oxide nanostructures. ANGEWANDTE CHEMIE-INTERNATIONAL EDITION, 47: 5292-5304	148
Goncalves, Gil, Marques, Paula A. A. P., Granadeiro, Carlos M., Nogueira, Helena I. S., Singh, M. K., Gracio, J. (2009). Surface Modification of Graphene Nanosheets with Gold Nanoparticles: The Role of Oxygen Moieties at Graphene Surface on Gold Nucleation and Growth. CHEMISTRY OF MATERIALS, 21: 4796-4802	138
Pohl, R., Antognini, A., Nez, F., Amaro, F.D., Biraben, F., Cardoso, J.M.R., Covita, D.S., Dax, A., Dhawan, S., Fernandes, L.M.P., Giesen, A., Graf, T., Haensch, T.W., Indelicato, P., Julien, L., Kao, C.-Y., Knowles, P., Le Bigot, E.-O., Liu, Y.-W., Lopes, J.A.M., Ludhova, L., Monteiro, C.M.B., Mulhauser, F., Nebel, T., Rabinowitz, P., dos Santos, J.M.F., Schaller, L.A., Schuhmann, K., Schwob, C., Taqqu, D., Veloso, J.F.C.A., Kottmann, F. (2010). The size of the proton. NATURE, 466: 213-216	129
Ceppi, M., Pereira, P.M., Dunand-Sauthier, I., Barras, E., Reith, W., Santos, M.A., Pierre, P. (2009). MicroRNA-155 modulates the interleukin-1 signaling pathway in activated human monocyte-derived dendritic cells. PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA,106: 2735-2740	128
Rocha, J., Carlos, L.D., Almeida Paz, F.A., Ananias, D. (2011). Luminescent multifunctional lanthanides-based metal-organic frameworks. CHEMICAL SOCIETY REVIEWS, 40: 926-940	119

Data retrieved from ISI Web of Knowledge SM (Thomson Reuters) in 7 Jan 2013

Intellectual Property

INTELLECTUAL PROPERTY RIGHTS REGISTRATION

	2009	2010	2011	2012
Patents and Utility Models	52	42	22	26
Trademarks and Logos	14	20	23	45
Design/Models	1	3	0	5
Copyright	4	10	6	7



International Projects

EU - FUNDED PROJECTS STARTED IN 2012

SEVENTH FRAMEWORK PROGRAMME: PROJECTS COORDINATED BY UA	ACRONYM	PROJECT COORDINATOR
Synergies through merging biological and biogeochemical expertise in coral research	SymbioCoRe	João Serôdio
Funcional ordered nanomaterials via electrochemical routes in non-aqueous electrolyte	NANEL	Mikhail Zheludkevich
Numerical relativity and high energy physics	NRHEP	Carlos Herdeiro
Nanocontainer-based active coatings for maritime applications	NANOMAR	Mário Ferreira

SEVENTH FRAMEWORK PROGRAMME	ACRONYM	LOCAL COORDINATOR
Extended shelf-life biopolymers for sustainable and multifunctional food packaging solutions	NanoBarrier	Mikhail Zheludkevich
Catastrophic shifts in drylands: how can we prevent ecosystem degradation?	CASCADE	Celeste Coelho
Mitigation of risk and control of exposure in nanotechnology based inks and pigments	NANOMICEX	Nicola Pinna
Air pollution policies for assesement of integrated strategies at regional and local scales	APPRAISAL	Ana Isabel Miranda
An integrated platform connecting registries, biobanks and clinical bioinformatics for rare diseaswe research	RD-CONNECT	José Luís Oliveira
Physiological and behavioural photoprotective processes against oxidative stress in marine photosynthetic symbioses	PhotoSymbiOxiS	Sónia Cruz
Foundational research on multilevel complex network and systems	MULTIPLEX	José Fernando Mendes
European network on luminescent materials	LUMINET	Luís Carlos

INTERREG IV	ACRONYM	LOCAL COORDINATOR
Deploying the added value of water in local and regional development	Aqua-Add	Peter Roebeling
Oil spill prevention and response at local scales	SPRES	João Dias
Observatoire de recherche sur la qualité de lénvironement du Grand Sud-Ouest Européen	Orque Sudoe	Armando Duarte

LIFE+	ACRONYM	LOCAL COORDINATOR
Testing and development of air quality mitigation measures in Souther Europe	AIRUSE	Célia Alves

LIFELONG LEARNING PROJECTS COORDINATED BY UA	ACRONYM	LOCAL COORDINATOR
Higher education institutions online	HEI-ON	Rui Raposo

LIFELONG LEARNING	ACRONYM	LOCAL COORDINATOR
Research_Game: the European scientific research game	Research_Game	Ana Rodrigues
Together old and young: young children and senior citizens learning and developing in intergenerational community spaces	TOY	Liliana Sousa
Mutualisation et innovation pour un réseau de l'Intercompréhension a distance	MIRIADI	Helena Araújo e Sá

OTHERS	ACRONYM	LOCAL COORDINATOR
Transboundary planning in the European Atlantic	TPEA	Fátima Lopes
Erasmus for young entrepreneurs - 4th round	OPEN EYE 4	José Paulo Rainho

NETWORK OF EUROPEAN UNIVERSITIES WORKING WITH THE UA IN EU PROJECTS STARTED IN 2012

Austria (MULTIPLEX; RD-CONNECT); **Belgium** (MIRIADI; NANEL APPRAISAL, HEI-ON); **Bulgaria** (NANEL); **Cyprus** (CASCADE); **Czech Republic** (RD-CONNECT; HEI-ON; BIOMARKAPD); **Denmark** (BIOMARKAPD); **Estonia** (LUMINET); **Finland** (BIOMARKAPD); **France** (ORQUE SUDOE ; RD-CONNECT ; MIRIADI ; OPEN EYE 4); **Germany** (LUMINET ; BIOMARKAPD ; OPEN EYE 4; BIOMARKAPD; RD - CONNECT); **Greece** (APRRAISAL; BIOMARKAPD; RD-CONNECT); **Hungary** (AQUA-ADD); **Italy** (AQUA - ADD; APPRAISAL; LUMINET; MIRIADI; MULTIPLEX; MIRIADI; HEI-ON; NRHEP; BIOMARKAPD; CASCADE; RESEARCH GAME; RD-CONNECT); **Norway** (BIOMARKAPD); **Poland** (LUMINET; BIOMARKAPD; HEI-ON; MULTIPLEX); **Portugal** (coordinated by UA : HEI-ON, NANEL, SymbioCoRe, NRHEP); **Romania** (MIRIADI); **Russia** (NANEL); **Slovenia** (BIOMARKAPD; NANOBARRIER); **Spain** (TPEA, MIRIADI, SPRES, ORQUE SUDOE, MIRIADI, MULTIPLEX, TOY, LUMINET, CASCADE); **Sweeden** (BIOMARKAPD; RD-CONNECT); **Switzerland** (CASCADE; LUMINET; MULTIPLEX; RD-CONNECT); **The Netherlands** (RD-CONNECT; HEI-ON; CASCADE; BIOMARKAPD; MIRIADI; LUMINET); **Turkey** (NANOMICEX; BIOMARKAPD; HEI-ON)

Budget

RESEARCH PROJECTS STARTED IN 2012
TOTAL BUDGET BY RESEARCH CENTRE AND FUNDING AGENCY*

RESEARCH CENTRE	EUROPEAN UNION	FOUNDATION FOR SCIENCE AND TECHNOLOGY	OTHER NATIONAL	2011	2012
CBC		276.779		135.610	276.779
CESAM	1.920.221	1.425.693	221.806	7.144.529	3.567.720
CETAC-MEDIA	32.997			184.037	32.997
CICECO	1.785.334	885.358	770.377	3.192.476	3.441.069
CIDMA				93.888	
CIDTFF	67.997	67.000		230.219	134.997
CLC			8.200		8.200
GEOBIOTEC		18.878		336.448	18.878
GOVCOPP		211.012	120.750	129.698	331.762
I3N	413.173	214.473		768.248	627.646
IEETA	645.000	85.240	227.351	1.820.021	957.591
INET-MD		166.901		0	166.901
IT	1.130.885	990.880	147.569	2.641.654	2.269.444
Not integrated	46.021	170.000	95.137	1.652.487	311.157
QOPNA		363.265	267.598	651.385	630.863
TEMA		620.888	330.260	923.478	951.148
Total	**6.041.737**	**5.496.367**	**2.189.048**	**19.904.177**	**13.727.153**

Contracts with industry not included

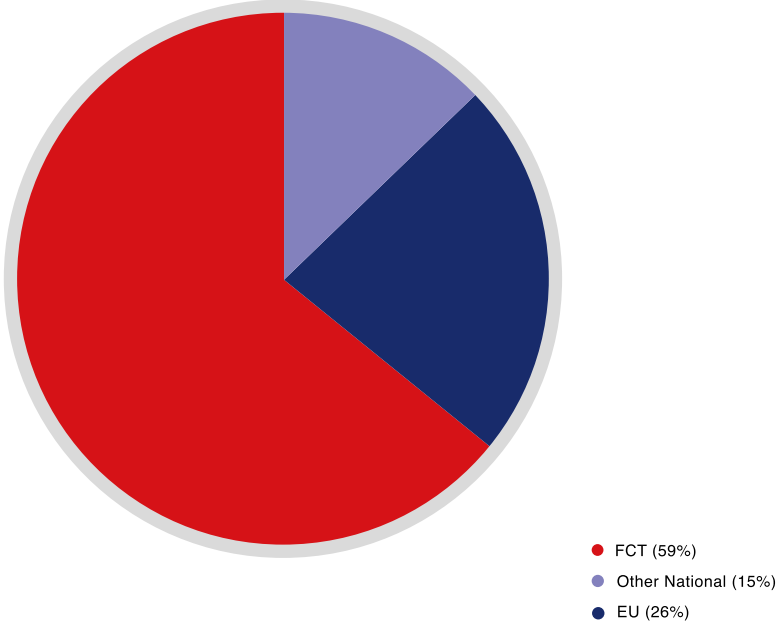
APPROVED BUDGET UNDER EU-FUNDED PROJECTS

EUROPEAN PROGRAMMES	2011	2012
Alfa	40.000	
Erasmus for Young Entrepreneurs		10.001
EU MARE		115.186
FP7 - Cooperation	2.401.476	3.881.251
FP7 - People	1.351.320	869.131
Interreg - ATLANTIC AREA		236.545
Interreg - SUDOE	303.686	100.000
Interreg IVC		227.496
Life+	1.674.116	416.615
Lifelong Learning	153.190	185.513
POCTEP	343.187	
RFCS	898.265	
Total	**7.165.240**	**6.041.737**

APPROVED BUDGET UNDER FCT PROJECTS

RESEARCH CENTRE	ARTS, HUMANITIES AND SOCIAL SCIENCES	ENGINEERING	SCIENCES	2011	2012
CBC			276.779	165.610	276.779
CESAM			1.425.693	3.661.400	1.425.693
CETAC-MEDIA				184.037	
CICECO		21.681	863.677	1.623.301	885.358
CIDMA				93.888	
CIDTFF	67.000			225.219	67.000
CLC					
GEOBIOTEC		2.130	16.748	102.648	18.878
GOVCOPP	211.012				211.012
I3N		2.640	211.833	570.806	214.473
IEETA		85.240		52.038	85.240
INET-MD	166.901				166.901
IT		990.880		1.434.355	990.880
Not integrated	170.000			126.312	170.000
QOPNA			363.265	284.260	363.265
TEMA		413.608	207.280	721.560	620.888
Total	614.913	1.516.179	3.365.275	9.245.434	5.496.367

DISTRIBUTION OF RECEIVED FUNDS, BY FUNDING AGENCY*



* Contracts with industry not included

Research Support Office

PHOTO COURTESY BY DECA

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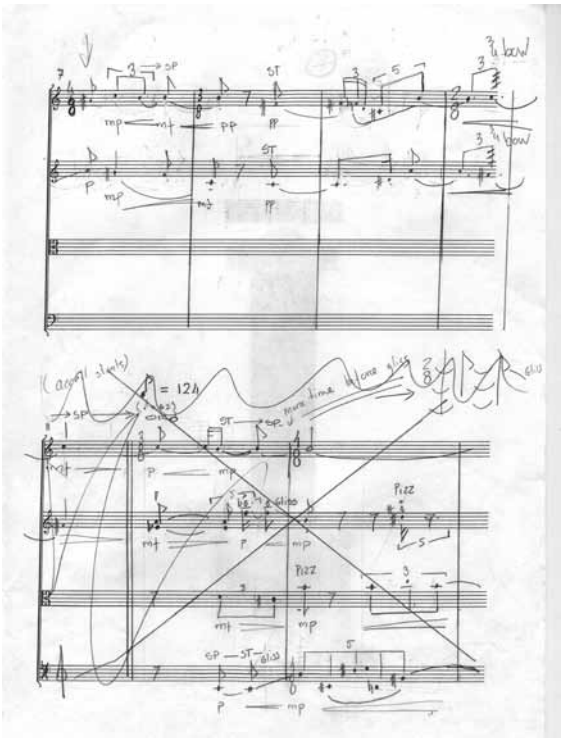
The University of Aveiro aspires to become one of the foremost research organizations in Europe and a major player in the construction of the European Research Area. The action developed at the Research Support Office aims at increasing its visibility, attractiveness, quality of its research and will definitely confirm its competitiveness. UA strongly encourages its researchers to create ties with their colleagues in European countries, by responding jointly to calls for proposals for Eu-funded programs.

The Research Support Office provides UA researchers with help in the development and international research projects, as in the preparatory phase, during the submission and with the management of European research activities. The Research Support Office provides you via email, research@ua webpage and Facebook publications with up-to-date information on research programs and fellowship programs; screening and scanning of specific calls and events; one-to-one coaching and support of proposal submission and project management and organization of information events, among others.

Regarding dissemination of UA research activity, the initiative *Researcher of the Month* is promoted by the Research Support Office, aiming at enhancing high-level research developed at UA and the responsible researcher, both internally to the academy and to an external audience via website and social network. The edition of the present brochure is also coordinated by the Research Support Office.

The creation of the Aveiro Institute of Nanotechnology (AIN) in 2012 and the Aveiro Institute of Marine Science and Technology (AIMare) are also strategies being developed with the cooperation of the Research Support Office. These unifying platforms aim at coordinating, integrating and fostering a wide span of scientific and technological skills and infrastructures of the University, strongly embedded in the experience of scientists and professionals. These umbrella institutes will 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 such science and technology fields.



universidade de aveiro theoria poiesis praxis

www.ua.pt/research

Universidade de Aveiro
Campus Universitário de Santiago
3810 - 193 Aveiro
Portugal

(tel) (+351) 234 370 200
(fax) (+351) 234 370 985
(email) research@ua.pt