

TEMÁTICA 10. DIGITALIZACIÓN

PROCESSING DIGITAL AND COMPLEX INFORMATION

BOOK of ABSTRACTS

1st MEETING

Mallorca, January 13th, 2020



DESAFÍO 10A. Electrónica Inteligente y Sostenible

1. How nanoscale semiconductor devices can contribute to the next generation of integrated electronics – IMB-CNM - Francesc Pérez-Murano, francesc.perez@csic.es
2. 2D materials and heterostructures for optoelectronics and spintronics - ICMM - Carlos Prieto, cprieto@icmm.csic.es
3. Efficient electronic devices based on nanoscale conductive, magnetic or superconducting materials - ICMA - David Zueco (on behalf of NANOMIDAS group), dzueco@unizar.es
4. Memristor devices as electronic synapses - IMB-CNM - Gemma Rius (on behalf of ATDF group), gemma.rius@csic.es
5. Sensors and energy sources for the digital interaction with the physical world - IMB-CNM – Gemma Rius (on behalf of MESSI group), gemma.rius@csic.es
6. Advanced Ultrasound Electronics and Sensors - ITEFI - Jorge Camacho, j.camacho@csic.es
7. Materials for electronics and photonics with near-zero power consumption - IEM - Rafael Molina, rafael.molina@csic.es (including presentation materials on behalf of Vincenzo Giannini for 10B, v.giannini@csic.es)

DESAFÍO 10B. Integración de Avances en Fotónica

8. Advanced LIDAR systems based on Optical Frequency Combs, Coherent Technologies and Chaotic Signals - IFCA - Ana Quirce, aquirce@b-phot.org
9. Nonlinear Photonics and its Potential for Future Technologies - IFISC - Ingo Fischer and Miguel C. Soriano, ingo@ifisc.uib-csic.es, miguel@ifisc.uib-csic.es
10. Plasmonics, metamaterials and 2D materials for advanced photonics - ICMA - David Zueco, dzueco@unizar.es

DESAFÍO 10C. Aplicación de las Nuevas Tecnologías Cuánticas

11. Hybrid quantum technologies - ICMA – David Zueco, dzueco@unizar.es
12. Quantum molecular challenges - IFF - Tomás González-Lezana, t.gonzalez.lezana@csic.es
13. Capabilities and versatile hardware solutions for Quantum Technologies IMB-CNM - Gemma Rius, gemma.rius@csic.es
14. Quantum software for NISQ devices and design of quantum simulators - IFF - Diego

Porras, diego.porras@csic.es

15. Quantum Machine learning and quantum networks - IFISC - Roberta Zambrini, roberta@ifisc.uib-csic.es

16. Theory of solid state quantum computing - ICMM - Ramón Aguado, raguado@icmmc.csic.es

17. Qubits in Solid State Platforms - ICMM - Gloria Platero, gplatero@icmm.csic.es

18. Transport in Quantum Materials at the Nanoscale - IFISC - Llorenç Serra, llorens.serra@uib.es

19. Magnonic in DM Helimagnets - ICMA - Victor Laliena, laliena@unizar.es

DESAFÍO 10D. Plataformas Abiertas para Open Science

20. Big data in social systems - IFISC – Jose Javier Ramasco, jramasco@ifisc.uib-csic.es

21. Open Science for supporting scientific reproducibility in the SKA Regional Centres - IAA - Susana Sánchez, sse@iaa.es

22. Open science is not a luxury, it is a must - IATA - Remedios Melero, rmelero@iata.csic.es

DESAFÍO 10E. Desarrollos para Internet of Things

23 Digital Transformation and Cyber-physical systems – Rodolfo Haber, rodolfo.haber@car.upm-csic.es

24. Hardware security for IoT - ITEFI - Agustín Martín (On behalf of IMSE-CNM, Santiago Sánchez / Piedad Brox)

DESAFÍO 10F. Humanidades Digitales

25. Humanidades Digitales. Luces y Sombras - CCHS – Julio Escalona, julio.escalona@cchs.csic.es

26. Language variation in Twitter - IFISC - David Sánchez, dsanchez@ifisc.uib-csic.es

27. The Project 'Hispanic polyphony and music of oral tradition in the age of digital humanities': achievements and challenges - IMF - Emilio Ros-Fábregas, emros@imf.csic.es

DESAFÍO 10H. Participación Ciudadana

28. Neutral innovation? Citizen participation and the future of science - IPBP – Vincenzo Pavone, vincenzo.pavone@csic.es

29. Group decision support methods for e-participation - ICMAT - David Rios Insua,

david.rios@icmat.es

FURTHER PROPOSED CHALLENGES

30. Trust and Security in the Digital Society - ITEFI, Luis Hernández Encinas, luis@iec.csic.es

DESAFÍO 10A. Electrónica Inteligente y Sostenible

1. How nanoscale semiconductor devices can contribute to the next generation of integrated electronics - IMB-CNM – Francesc Pérez-Murano

Decreasing the dimensions of semiconductor devices has been the driving force behind the development of the microelectronics industry. This trend is still alive, as presented by the main players at the last IEDM meeting this December. We work on the development of manufacturing methods for the next generation of integrated electronic circuits, which will contribute, among others aspects, to reduce energy consumption and enable practical quantum computing.

2. 2D materials and heterostructures for optoelectronics and spintronics- ICMM - Carlos Prieto

New generations of materials with enhanced performances in spintronics, optoelectronics and quantum communications based on 2D materials and their heterostructures are expected to emerge. We work on the growth of 2D materials and their controlled doping as a route towards single photon emitters, detectors and magnetic semiconductors. The design of heterostructures which combine different functionalities (ferromagnetic, superconducting and 2D topological materials) will transfigure high density storage and lossless signal transmission paradigms.

3. Efficient electronic devices based on nanoscale conductive, magnetic or superconducting materials ICMA - David Zueco (on behalf of NANOMIDAS group)

The group NANOMIDAS uses state-of-the-art electron and ion microscopes to fabricate, characterize and measure advanced nanoelectronic devices. We develop new fabrication processes to create unique nanostructures. Our characterization tools allow reaching the smallest nanoscale size. We aim to focus our contributions on electronic devices based on nanoscale conductive, magnetic or superconducting materials and to provide new tools useful for the semiconductor industry.

4. Memristor devices as electronic synapses - IMB-CNM - Gemma Rius (on behalf of ATDF group)

Resistive switching structures behaving as memristor devices are promising candidates to emulate the biological synapses in brain-inspired neuromorphic computing, because of their analog control of the device resistance. In addition, these devices should satisfy the synaptic biological learning rules. Currently, the most suitable materials to mimic the biological synapses are being explored, where high-k dielectrics have shown promising synaptic properties.

5. Sensors and energy sources for the digital interaction with the physical world - IMB-CNM– Gemma Rius (on behalf of MESSI group)

Our objective is to use microtechnologies to deliver microdevices built from microstructures with an architecture that confers added functionalities (resonant structures, thermal isolated structures, 3D topography...), as well as the synthesis of sensitive materials (especially nanostructured). We mostly deal with silicon technologies and materials, plus low-cost alternative ones such as polymer/paper. In the energy field, we cover harvesting (thermoelectricity) and generation/storage

(microfuel cells / biodegradable batteries). In the sensing field, we focus on devices that identify gases attending to different physical/chemical parameters.

6. Advanced Ultrasound Electronics and Sensors - ITEFI - Jorge Camacho, j.camacho@csic.es

Ultrasound technology is transversal to many application fields, like medical diagnostic, industrial non-destructive testing, communications and consumer electronics. One of the principal challenges in this field is to obtain a new generation of smart electronic devices and sensors able to implement emerging and disruptive ultrasound applications. In this talk we will present our vision about the main scientific challenges of the field, our previous achievements and future development lines.

7. Materials for electronics and photonics with near-zero power consumption - IEM - Rafael Molina

We are exploring at present new phenomena in novel quantum materials that may lead to topological and chiral flow of electrons, including materials such as graphene, the chalcogenide family and Weyl semimetals like TaAs. We are developing exactly solvable models and advanced numerical methods for the description and understanding of exotic and topologically protected phases of matter in many-body quantum systems.

IEM - Rafael Molina - On behalf of Vincenzo Giannini for Desafío 10B

The aim of this search is the design of devices where transport may take place with no energy dissipation, relying on the topological or the superconducting properties of the material. The new frontier to be reached during the next decades is the development of novel electronic and photonic devices operating at unprecedented high speed and minimum consumption of energy.

DESAFÍO 10B. Integración de Avances en Fotónica

8. Advanced LIDAR systems based on Optical Frequency Combs, Coherent Technologies and Chaotic Signals - IFCA - Ana Quirce

We will develop innovative approaches for lidar systems based on laser diodes for several applications, such as ranging, anemometry, velocimetry, and remote gas sensing. The foreseen approaches will be the use of Optical Frequency Combs (OFCs) and pulsed chaotic signals as lidar sources and coherent and self-mixing techniques. Routes for integration in Photonic Integrated Circuits (PICs) will be explored and a PIC for ranging applications based on OFCs will be designed and fabricated.

9. Nonlinear Photonics and its Potential for Future Technologies - IFISC - Ingo Fischer

Nonlinear photonics and complex phenomena in optical systems promise to achieve significant technological breakthroughs and to contribute solving key societal challenges. At IFISC, we are developing novel concepts to implement complex optical networks and to use their unique dynamical properties to realize fast classical key exchange and neuro-inspired information processing systems. Using photonic reservoir computing we demonstrate ultrafast, versatile and energy-efficient computation.

10. Plasmonics, metamaterials and 2D materials for advanced photonics - ICMA - David Zueco

We discuss the QMAD work and proposals on the use of Plasmonics, metamaterials and 2D materials for advanced photonics. In particular we describe our results in metamaterials for mimicking the plasmonic response of metals in the THz and millimetre regimes, and the use of hybrid metal-dielectric-graphene structures for creating efficient photodetectors.

DESAFÍO 10C. Aplicación de las Nuevas Tecnologías Cuánticas

11. Hybrid quantum technologies - ICMA – David Zueco

We discuss the QMAD results and proposals in the advances of quantum technologies and their applications, both from the theoretical and experimental side. In this talk, we explain the fabrication of single photon detectors for X-rays, quantum-sensing, the construction of a hybrid quantum processor and the theory of light-matter coupling for quantum simulators. We will finish describing our lines of action for the application of these ideas on technological solutions.

12. Quantum molecular challenges - IFF - Tomás González-Lezana

Our research in the MolClu group at IFF involves the theoretical quantum investigation of molecular processes by (a) building up predictive, accurate and transferable models from first-principles approaches for a molecular-level description of relevant molecular processes and (b) the design and development of new computational tools, allowing the full cycle of molecular modelling, employing state-of-the-art programming, software-engineering standards and cutting-edge scientific knowledge.

13. Capabilities and versatile hardware solutions for Quantum Technologies - IMB-CNM - Gemma Rius

We will introduce our previous scientific achievements, current interests and technology capabilities based on specific micro/nanofabrication and quantum/nanomaterials developments, which should be of interest not only in view of future Quantum Technologies but for the broader framework of innovative and emerging Photonics and Electronics and their trends.

14. Quantum software for NISQ devices and design of quantum simulators - IFF - Diego Porras

In QUINFOG (Quantum Information and Foundations Group) at IFF in Madrid, we work on developing quantum software for the solution of optimization problems. We are collaborating with BBVA in the application of those methods in finance, and we would like to work on further applications in digital economy, logistic or quantum chemistry. Also, our group is also focused on design quantum hardware for the quantum simulation of complex problems in condensed matter physics, quantum optics and chemistry.

15. Quantum Machine learning and quantum networks - IFISC - Roberta Zambrini

Quantum complex networks provide descriptions of extended systems where links can range from quantum correlations to physical interactions, particularly relevant in the context of quantum transport or communications. I will present timely applications in quantum machine learning, as in the context of reservoir computing.

16. Theory of solid state quantum computing - ICMM - Ramón Aguado

I will give a brief talk about the state-of-art in solid state quantum computing (superconductor qubits, silicon qubits and Majorana-based topological qubits) and how our group contributes to these topics.

17. Qubits in Solid State Platforms - ICMM - Gloria Platero

I will briefly describe the main research lines in our group, devoted to the theoretical analysis of charge, spin and valley qubits in semiconductor quantum dot arrays. In particular I will discuss ac driven protocols to transfer entangled electron spins directly between the outer dots. Hybrid systems consisting in quantum dots coupled to superconducting cavities are also investigated. Finally, we explore the role of topology and the emergence of edge states in dimerized quantum dot arrays via the dynamics of a pair of particles loaded in the array. Our proposed platforms are within the present experimental state of the art.

18. Transport in Quantum Materials at the Nanoscale - IFISC - Llorenç Serra

In this talk, we will summarize the current research within the Nanophysics group at the IFISC. In particular, we will discuss our recent efforts on (i) time-resolved quantum transport (charge, spin and energy) in nanostructures, (ii) topology and quantum effects in hybrid junctions with superconductivity, and (iii) correlations in interacting quantum conductors.

19. Magnonic in DM Helimagnets - ICMA - Victor Laliena

The study of the magnetic chiral solitons has only been carried out in weak field conditions. It is therefore proposed to study the propagation of magnons in networks of chiral solitons and skyrmions formed in different geometries of thin films and macroscopic materials. Especially interesting is the network of chiral solitons, since their periodicity depends strongly on the applied magnetic field.

DESAFÍO 10D. Plataformas Abiertas para Open Science

20. Big data in social systems - IFISC – Jose Javier Ramasco

The existence for the first time of massive amount of data on social interactions and on the relation between people and their environment has brought the possibility of boarding quantitatively a large number of issues concerning social sciences. Some examples are disease propagation, urbanism, mobility, economic stability, etc. There is, however, important issues on how this data is collected. In this talk, I will briefly review the situation and the level of accessibility of the different sources.

21. Open Science for supporting scientific reproducibility in the SKA Regional Centres - IAA
- Susana Sánchez

Scientific reproducibility is still a challenge, increased by the data deluge generated by current megascience infrastructures. In this talk, we will present how AMIGA group from the IAA is addressing the challenge of handling the SKA (Square Kilometre Array) data to extract scientific knowledge in a reproducible way by means of Open and e-Science developments. SKA will be the greatest data research public project. This ensures transfer to other disciplines of the associated developments.

22. Open science is not a luxury, it is a must - IATA - Remedios Melero

The title of my presentation quotes a sentence Neelie Kroes of the former European Commissioner. Open science must be part of the habits and activities of the Academy. Infrastructure, policies and rewards must change how science is conceived based on FAIR principles (findable, accessible, interoperable and reusable).

DESAFÍO 10E. Desarrollos para Internet of Things

23. Digital Transformation and Cyber-physical Systems – Rodolfo Haber

Computational intelligence will play a key role in modelling and control of cyber-physical systems towards an effective digital transformation. Industry 4.0, and more recently Industry and Society 5.0, are also two technological paradigms well connected with industrial cyber-physical systems in which beyond data analytics, strategic issues related with reconfiguration, condition monitoring, control and optimisation should be addressed and new methods should be delivered accordingly.

24. Hardware security for IoT - ITEFI - Agustín Martín (On behalf of IMSE-CNM Santiago Sánchez / Piedad Brox)

Hardware security plays an essential role in the development of IoT devices. The research line developed by our group cover different aspects related to this topic: hardware implementation of lightweight crypto-biometric systems, analysis of side-channel and fault-injection attack sources, attack-tolerant microelectronic realizations with the inclusion of countermeasures, and extraction of digital identities derived from silicon to provide device authentication.

DESAFÍO 10F. Humanidades Digitales

25. Humanidades Digitales. Luces y Sombras - CCHS – Julio Escalona

Las HHDD son un campo emergente. Han pasado de ser iniciativas de vanguardia a ser condiciones "sine quae non" para los proyectos, con resultados complejos y contradictorios. Si bien ha mejorado la visibilidad de los proyectos, también se ha desplazado fondos relevantes hacia tareas periféricas a la investigación. El "bricolagismo" y la tendencia a "reinventar la rueda" son sólo los problemas más evidentes. La marginalización de las herramientas verdaderamente analíticas es más grave.

26. Language variation in Twitter - IFISC - David Sánchez

In the last years, the use of big data for linguistic purposes has opened up new paths in corpus linguistics, since it offers new opportunities for the investigation of large-scale language variation. Microblogging platforms such as Twitter provide a deluge of textual data that can be employed for the analysis of informal communication between millions of individuals. Because most of these data are geolocalized, the resulting corpus can be used to conduct studies on regional variation

27. The Project 'Hispanic polyphony and music of oral tradition in the age of digital humanities': achievements and challenges - IMF - Emilio Ros-Fábregas

In the field of Musicology, our two linked databases — *Fondo de Música Tradicional IMF-CSIC* (<https://musicatradicional.eu>) and *Books of Hispanic Polyphony IMF-CSIC* (<https://hispanicpolyphony.eu>) — constitute a platform for the development of diverse digital technologies in open access: codification of music notation (MusicXML, MEI), music analysis of big data (Humdrum/Kern), Optical Music Recognition (OMR), use of technology for geolocation, crowdsourcing, and multidisciplinary collaboration with other interested researchers.

DESAFÍO 10H. Participación Ciudadana

28. Neutral innovation? Citizen participation and the future of science - IPBP– Vincenzo Pavone

We are used to think of technological innovation as a neutral tool serving the societal progress, even if they may be used for controversial purposes or have unintended consequences. However, what if all technologies come with an embedded political view? Citizen participation in science, especially in the digital world, represents an opportunity to bring this political background to the fore and to develop alternative vantage points from which science and innovation can be conducted.

29. Group decision support methods for e-participation - ICMAT - David Rios Insua

We shall describe our methodologies for internet based group decision support and their relevance in e-participation. We shall emphasize the problem of participatory budgeting.

FURTHER PROPOSED CHALLENGES

30. Trust and Security in the Digital Society - ITEFI, Luis Hernández Encinas

Digital security is one of the main challenges of our society, which is no longer just the information society, but the data society as it is clear from the massive use of ubiquitously connected devices and the huge number of digital applications. The Research Group on Cryptology and Information Security deals with the R&D of advanced techniques to grant Security of the information transmitted or stored by electronic means and their principal applications as cloud computing, e-governance, etc.