2024 ANNUAL REPORT

EXCELENCIA MARÍA DE MAEZTU 2023 - 2027

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CSIC

Institute for Cross-Disciplinary Physics and Complex Systems

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PRESENTATION AND RESEARCH AREAS

IFISC (**Institute for Cross-Disciplinary Physics and Complex Systems**) is a joint research institute of the **University of the Balearic Islands** (UIB) and the **Spanish National Research Council** (CSIC) created in 2007 building upon the former Cross-Disciplinary Physics Department of the Mediterranean Institute for Advanced Studies (IMEDEA).

IFISC has been awarded by the Spanish Research Agency (AEI) with the **Maria de Maeztu (MdM) Unit of Excellence** seal since 2018 and it has established itself as a reference center in complex systems and an important actor in the definition of new trends in this field at national and international level.

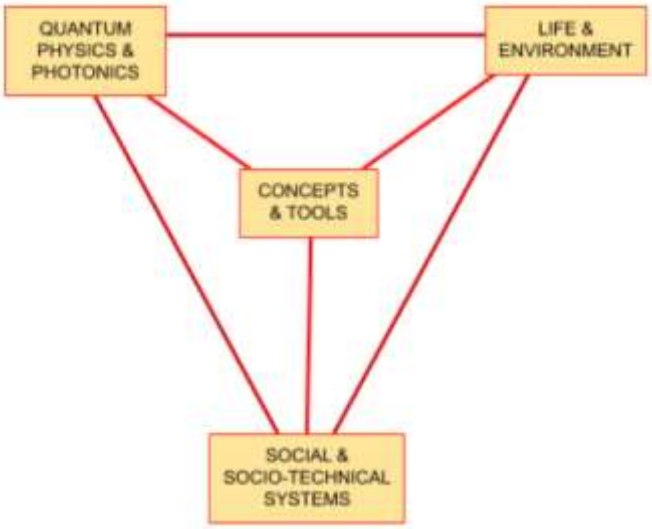
IFISC tackles mainly theoretical but also experimental challenges situated at the dynamic intersection of complex systems and interdisciplinary applications across diverse fields including photonics, quantum physics, biology, ecology, environment, and social systems. Our research is distinguished by its integration of fundamental principles spanning network theory, statistical and nonlinear physics, stochastic processes, mathematical modeling of collective phenomena, and quantum physics. We extend our focus into complex societal contexts, exploring various facets of information technology, while actively participating in unconventional computing and learning endeavors. Moreover, our investigations delve deeply into the dynamic behaviors of life and environmental systems, underscoring the inherently interdisciplinary character of our work.

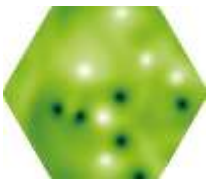
Physics approaches to interdisciplinary research in complex systems are instrumental to solving many of society's challenges. The 2021 Nobel Prize in Physics "*for providing innovative contributions to our understanding of complex physical systems*" highlighted the relevance of this field and the uniqueness of its physics methodology, making clear that complex systems modeling is key to providing understanding and forecast and also to developing practical solutions and advice for governments and policymakers. Complex systems research is key to addressing known challenges such as digitalization, health, or climate change. A healthy research base in complex systems is also necessary to be able to react to future unexpected societal changes and a principal element of a scientific preparedness strategy.

1.1 IFISC RESEARCH AREAS

IFISC's research is structured around four non-disjoint **research areas**: a first one developing methodologies and concepts of broad applicability, and the other three concerning the transfer of these ideas to specific **physical**, **biological** or **social** domains of application, thus giving us a unique opportunity to contribute to future challenges in the areas of digitalization, artificial intelligence, health, mobility or climate and environment, among others.

IFISC researchers participate in several of these research areas, based on **transversality, collaboration and interdisciplinarity**, which are IFISC's distinctive marks. IFISC´s organization and structure encourages joint publications, joint participation in projects, scientific discussions and collaborations, joint supervision of PhD and master students, and cross-cutting seminars.

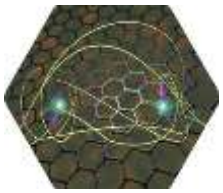




Concepts and Tools

Complex systems are characterized by emergent and collective phenomena of many interacting units. Fundamental understanding of these systems and the Micro-Macro paradigm comes from a variety of disciplines and techniques which we develop and integrate: Statistical Physics, Network theory, Machine Learning and other Artificial Intelligence methods, Big Data and Data Science, Dynamical Systems, Classical and Quantum Information, Quantum thermodynamics, Information Processing methods and, in general, physics thinking for complex systems that allows tackling concepts such as Emergence, Collective Phenomena, Determinism or Stochasticity.

This research area is the backbone of IFISC: we develop new concepts and methods for the study of Complex Systems, and we analyze generic phenomena.



Photonics and Quantum Systems

In this research area, IFISC researchers have been investigating approaches based on complex systems to study processes in physical systems, mostly in quantum physics and in photonic information processing. For example, work has been done in synchronization and information transmission in quantum networks, quantum transport in nanodevices, graphene, thermoelectricity, Josephson junctions and Majorana physics in nanostructures. Quantum machine learning is also a topic of interest, which explores different learning approaches to identify a quantum advantage for data analysis.

Dynamical properties of photonic systems, such as lasers, optical amplifiers and fibers, have been studied in detail and used in data decoding applications for datacom and telecom. They are ideal hardware platforms for brain-inspired and neuromorphic computing, which has led to the development of novel computing concepts such as dendritic computing and folded-in-time deep neural networks and reservoir computers, heading towards more versatile and energy-efficient brain-inspired information processing and artificial intelligence..

Life and Enviroment

Living systems and their environment are perhaps the most archetypical examples of Complex Systems. Their study involves the consideration of a huge range of time and space scales, from small biomolecules to the whole Earth, and has implications in health, conservation, and global change.

At IFISC, researchers have investigated genetic circuits, virus-host interactions, or microbial population dynamics, together with the different effects of noise and the statistical properties of the resulting communities. At a larger scale, different neuroscience topics, such as the role of inhibitory neurons on information processing, coding, and learning, their effects on the computational properties of cortical layers, or the impact of brain-network organization on mental diseases. Epidemics has been the focus of a number of studies, as well the use of ideas from statistical mechanics to the optimal use of medical have been also topics of interest.

Ecological modeling, aerial and satellite observations, and machine learning methods have allowed describing and understanding vegetation distributions on landscapes and seascapes, to detect the occurrence of plagues in plants, and to infer the evolution of seagrass meadows or coral reefs, all under the effects of global change. Animal motion has been tracked and studied. Innovative network-based methodologies have been used to characterize flow structures and transport in oceans, and their influence on the dispersion of abiotic properties and materials (temperature, microplastics), and of organic and living matter (detritus, phytoplankton). Teleconnections in the atmosphere and in the climate system have been investigated and used to anticipate weather and climate patterns associated to extreme events.

Social and Socio-technical systems

We draw on our expertise in the modeling of social and socio-technical complex systems with the aim of expanding our fundamental understanding of collective effects in social systems, and of deploying digital twin technologies for realistic data-driven social simulations and its interplay with critical infrastructures. IFISC researchers have been investigating, among others: models of opinion dynamics, including non-linear interactions and aging; the relation between mobility efficiency and quality of life in cities; migration and integration of migrant communities in cities, using Big Data from ICT and online social network; understanding structure and competition processes between languages and cultural traits; or monitoring and modeling the dynamics of social networks.

When considering the interplay between society and infrastructures, methodologies to increase the stability and resilience of the power grid subject to demand fluctuations and analyzing the robustness of renewable-energy power grids has been a topic of interest. Air transportation has been analyzed focusing on the dynamics of delays from an information processing and macro-scale perspective, identifying correlation and causality relationships.

COMPUTING LAB

The Computing Services Unit manages the computational resources at IFISC. They include:

- Capabilities to perform intensive numerical calculations are provided by a High Performance Computing Cluster (HPC) integrated by 20 Atos Bull Sequana nodes mounting AMD Epyc Rome processors and 7 SIE Ladon nodes mounting AMD Epyc Turin processors for a total of 1724 cores, 16,4TB of RAM and 11 GPU computation units.
- The nodes are interconnected using a low-latency 25Gb/s communications infrastructure which is used for big data analysis and memory intensive simulations.
- Big Data storage and management is handled using a MongoDB non-relational database including a primary node with 512GB of RAM and 42 TB SSD raw storage and two replica nodes with 256GB of RAM and 40TB HD raw storage each.
- Two NFS servers summing up 216 cores and 512GB of RAM manage user's home directories with 96TB of raw storage capacity and a Data repository with 150TB of raw storage capacity.
- Private Cloud virtualization is integrated by one management node and 5 compute nodes with a total of 180 cores, 2.1TB of RAM and 100 TB of SSD raw storage.
- IFISC network is complemented with a backup server, more than 150 linux desktops, mac and windows desktops and laptops and a number of peripherals, and it is integrated to provide a transparent environment.

PHOTONICS LAB

Since 2009 a Photonics Laboratory of highest standards has been established. The lab is equipped with a Faraday cage for electromagnetic shielding and houses several experiments of delay-coupled lasers and laser arrays, optoelectronic systems, as well as photonic information processing systems using the latest technology to characterize the optical emission with multi-Gigahertz bandwidth: in the temporal domain via fast detectors and 40 GHz analog bandwidth real-time oscilloscope, and in the spectral domain via a 44 GHz signal and spectrum analyzer. In addition, high-resolution optical characterization can be performed via heterodyne techniques and different spectrometers. Finally, optical and electrical laser modulation can be implemented with arbitrary waveforms up to 92 GigaSamples/second.

1.2 "MARIA DE MAEZTU" EXCELLENCE AWARD

In 2018, **IFISC** was awarded the "**Unidad de Excelencia María de Maeztu**" distinction, for the period 2018-2022, entering the selective **SOMMa Alliance**. This distinction was renewed for the period 2023-2026 underscoring the outstanding achievements of IFISC during the years 2018-2022. The award is granted by the Agencia Estatal de Investigación (AEI), belonging to the Ministry of Science, Innovation and Universities, after a highly selective process and a thorough evaluation according to the highest standards by an international panel.

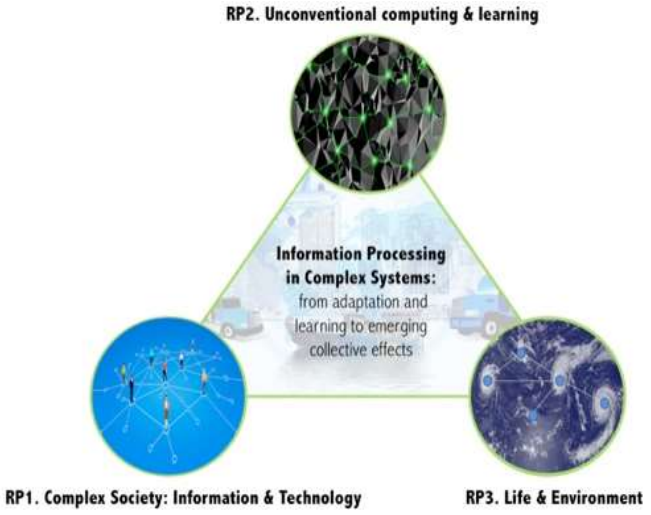
According to the Ministry, being awarded as "Severo Ochoa" or "María de Maeztu" represents "the recognition and accreditation of the best centers and units that stand out for their international impact and the relevance of their results obtained in the last four years". Moreover, it targets "the financing of strategic research programmes with the aim of consolidating their scientific capacities and contributing to their international leadership".

All distinguished centers and units excel due to the global resonance of their scientific contributions, their commitment to postgraduate teaching, their innovation prowess, and their robust engagement with the social and economic spheres. They are categorized as world-class entities with highly competitive frontier research programs that are capable of attracting international talent.

The units that have been selected in the "Maria de Maeztu" (MdM) category, like IFISC, receive a total funding of 2,000,000 Euros during four years plus six pre-doctoral contracts as well as access to funding sources restricted to the units of excellence.

This award consolidated IFISC as a reference institute in the research field of complex systems and allowed a growth of more than 40% in personnel with respect to 2018. **IFISC was the first institute in the Balearic Islands receiving the Maria de Maeztu award.**

The research project associated to the MdM award covers the activities of the entire institute defining a strategic plan and focusing the research effort for the period 2023 – 2026. The following scheme summarizes the research lines on which the Maria de Maeztu award focusses:



Our present MdM project endeavors to conduct strategic research in information processing within complex systems, emphasizing novel dimensions of adaptation, learning, and emergent collective effects. This initiative is structured around three intricately intertwined research pillars (illustrated in the figure above), which are designed to tackle contemporary societal challenges while aligning closely with EU priorities. These pillars encompass:

RP1. Complex society: information & technology

RP2. Unconventional computing & learning

RP3. Life & environmental dynamics

100xCiencia.8

The annual meeting of the Severo Ochoa and Maria de Maeztu alliance (SOMMA) was held in Palma de Mallorca on October 9-11, organized by IFISC and IMEDEA.

IFISC – MdM PERSONNEL

All IFISC researchers actively contribute to the MdM scientific program, underscoring the institute's commitment to fostering a collaborative environment that thrives on diversity, interactions, and scientific dialogue. Personnel who have been recruited since the program's inception on January 1st, 2023, until the end of 2024, include:

Postdoctoral Researchers:

Andrés A. Aguado

Lluis Arola

Sreetama Das

Catharina E. Graafland

PhD Students:

Miguel Álvarez

Beatriz Arregui

Josu Blanco

Gorka Buenvarón

Annalisa Caligiuri

Juan I. de Gregorio

Fernando Diaz

Javier Galván

Juan A. García Castillo

Pedro Jiménez

Jorge Medina

Daniel Montesinos

Carlotta Nunzi

Pablo Rosillo Rodes

Lucas Trigal

Project Manager:

Simona Obreja

Communication and dissemination:

Adrian García Candel

1.3. IFISC SERVICE UNIT: DataAnalytics@IFISC

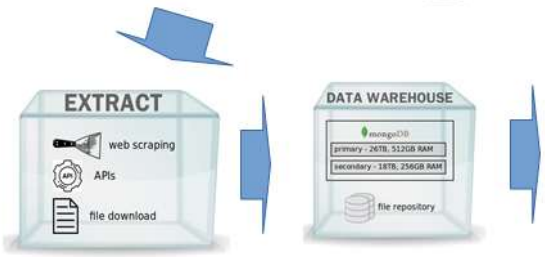
Relying on the experience gained in research projects and contracts with companies, IFISC has created DataAnalytics@IFISC as a **service unit** devoted to data mining and big data analysis.

IFISC know-how includes analysis of data from social networks, mobile phone and credit card records, transport networks at the urban scale, air transport, census and surveys, electoral results in the space, electrocardiograms, electro and magneto encephalograms, marine currents and animal populations. Previous results include works on population levels, mobility, transport and tourism, land use, economic inequalities in urban areas, epidemic spreading, delay propagation in air transportation, heart arrhythmia and encephalogram series analysis using machine learning, hospital emergency demand, and marine megafauna migrations and spatial connectivity studied with satellite data.

Data Analytics@IFISC provides solutions to CSIC, UIB and external entities based on big data for computational social sciences, ecology and biomedicine, including:

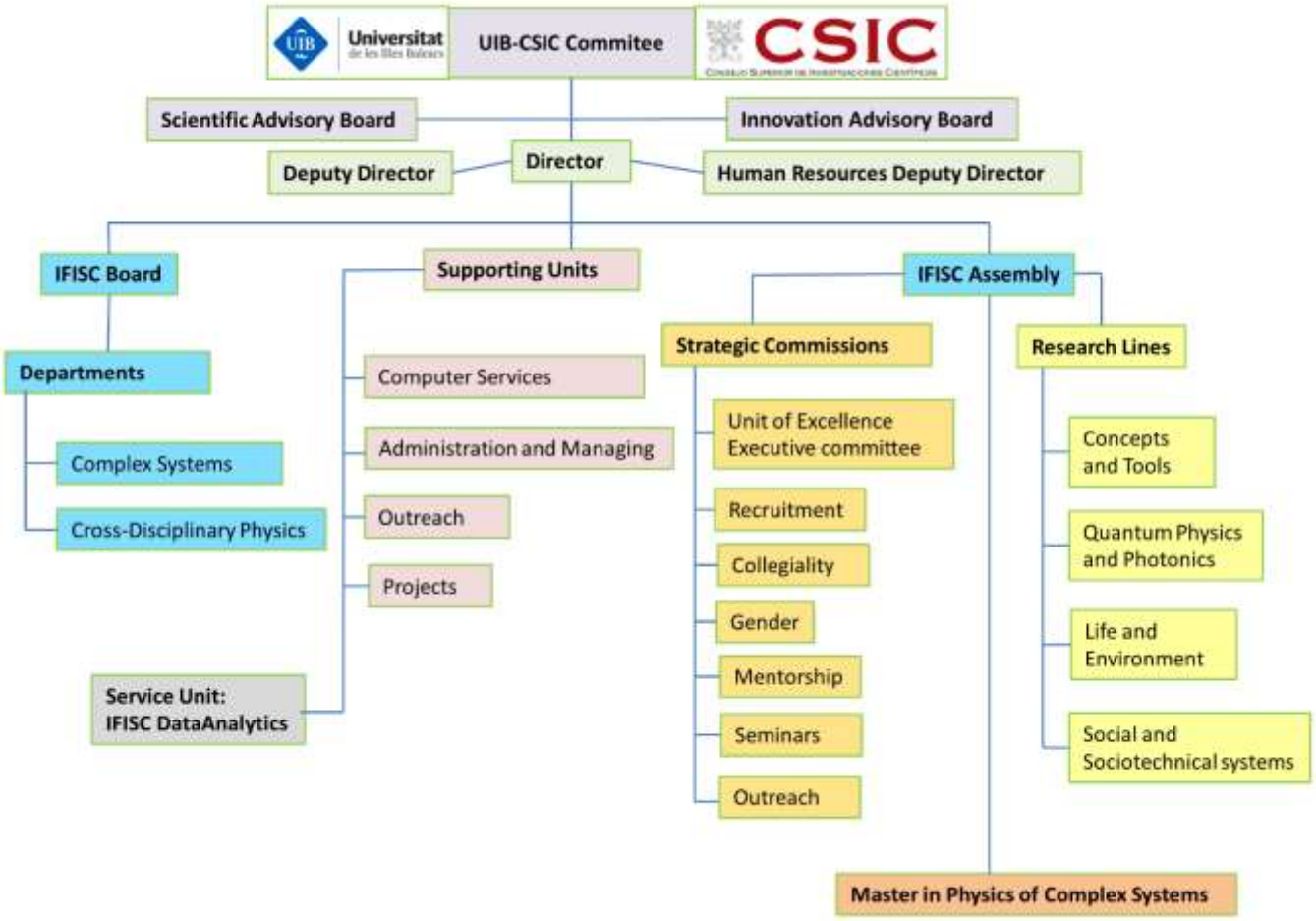
- Sampling from our databases and the preparation of reports based on aggregated data.
- Development of new analysis methods ad hoc including machine learning techniques.
- Consulting on social, economic and technical questions through Big Data analytics.

*IFISC also participates together with other UIB researchers in the UIB Innovation Unit “Data Anaytics@IFISC_UIB”.



- Urban mobility
- Tourism
- Sociodemographics
- Air transportation networks
- Epidemic spread
- Opinion dynamics & elections
- Language use
- Biomedics
- Population mobility in ecology

1.4 IFISC STRUCTURE CHART



1.5 2024 REPRESENTATIVE RESEARCH RESULTS

Here are some research results published during 2024. They are representative of the different research lines and thus illustrate the range of topics studied at IFISC.

Six decades of the FitzHugh–Nagumo model: A guide through its spatio-temporal dynamics and influence across disciplines

D. Cebrián-Lacasa, P. Parra-Rivas, D. Ruiz-Reynés, L. Gelens
Physics Reports **1096**, 1-39.

For over sixty years, the FitzHugh–Nagumo model has served as a cornerstone in the study of excitable systems, originally introduced to describe neuron dynamics but later expanding its influence across disciplines such as cardiac physiology, population dynamics, and electronics. Its ability to capture fundamental behaviors like bistability, oscillations, and wave propagation has made it a valuable tool for understanding spatio-temporal phenomena in diverse fields. Despite its simplicity, the model continues to reveal new insights into complex dynamical systems, making it a timeless framework for studying nonlinear dynamics.

In this work, we provide a comprehensive review of the FitzHugh–Nagumo model, focusing on its diverse spatio-temporal behaviors. Beyond cataloging known dynamical states, we extend previous studies by conducting stability and bifurcation analyses for spatially coupled systems. Our findings shed new light on how traveling waves, localized structures, and extended patterns emerge and evolve in this system. By offering a structured guide for modelers, our work aims to facilitate the application of the FitzHugh–Nagumo model in both theoretical and experimental studies.

The FitzHugh-Nagumo (FHN) model's dynamics are influenced by factors like external driving, internal feedback, noise, and time delays, contributing to its complexity and broad applicability. While these factors have been studied, they require further exploration to fully understand their impact. Combined with the model's ability to capture transient behaviors in non-equilibrium systems and its integration into multiphysics frameworks, they open new avenues for application. This, in turn, provides fresh insights and inspiration for developing mathematical frameworks that are both applicable and essential for understanding complex phenomena.

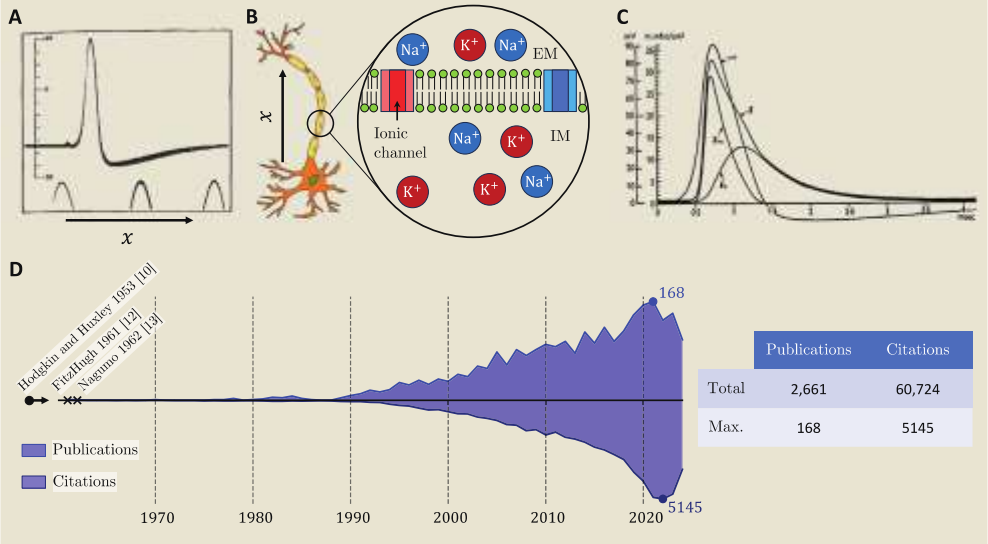


Figure 1: Impact of the Hodgkin–Huxley model on subsequent research via the FitzHugh–Nagumo model. **A.** Depiction of the action potential across an axonal membrane. **B.** Illustration of ion channels within a neuronal axon, detailing the exchange of sodium and potassium ions between the extracellular medium (EM) and the intracellular medium. **C.** Demonstration of excitable behavior as characterized by the HH model. **D.** Publication and citation data gathered from the Web of Science using ''FitzHugh–Nagumo'' as the search term (2024) showing the impact of the subsequent research using the FHN model as a simplified description of the HH model dynamics.

High-order correlations reveal complex memory in temporal hypergraphs

Gallo, Luca; Lacasa, Lucas; Latora, Vito; Battiston, Federico
Nature Communications **15**, 4754

Complex systems are formed by elements, but sometimes also coherent groups of elements, sometimes even groups of groups…

While it is well understood that interactions between elements give rise to collective phenomena, could it be that groups of elements also interact with other groups, leading to new kinds of emergent phenomena?

Yes, this work is indeed inspired by the famous Anderson's hierarchy of emergence [1] at different scales.

To ground this idea, consider a scientific conference. Scientists may interact in pairs, but group discussions also form spontaneously, perhaps in a poster session or in the coffee break. These groups can grow as new participants join the conversation, fragment into smaller subgroups… Sometimes groups nucleate or merge... We see all kind of dynamical behaviors, and, perhaps, also non-random interactions *between* groups?

Mathematically, the standard way to model pairwise interactions is through networks, whereas higher-order interactions—such as conversations in a WhatsApp group—are typically represented using hypergraphs.

In this work, we consider the time-varying version of hypergraphs, and use it to characterize their temporal organization by extending the notion of temporal cross-correlations to higher-order interactions.

The analysis of human proximity data in a real conference indeed revealed not only the existence of a rich group dynamics –capturing aggregation, fragmentation and nucleation processes in social systems–, but the presence of sustained group interactions showing memory (non-Markovianity). One could argue that interactions between these mesoscopic structures represent an instance of Anderson's hierarchy manifesting in a social system.

Looking ahead, we speculate that these emergent mesoscopic interactions could take place –and be characterized by a similar mathematical framework– beyond the traditional remit of network science, e.g. in fields ranging from multifragmentation in nuclear physics to vortex-vortex interaction in fluids.

[1] Anderson, P. W. (1972). More Is Different: Broken symmetry and the nature of the hierarchical structure of science. *Science*, *177*(4047), 393-396.

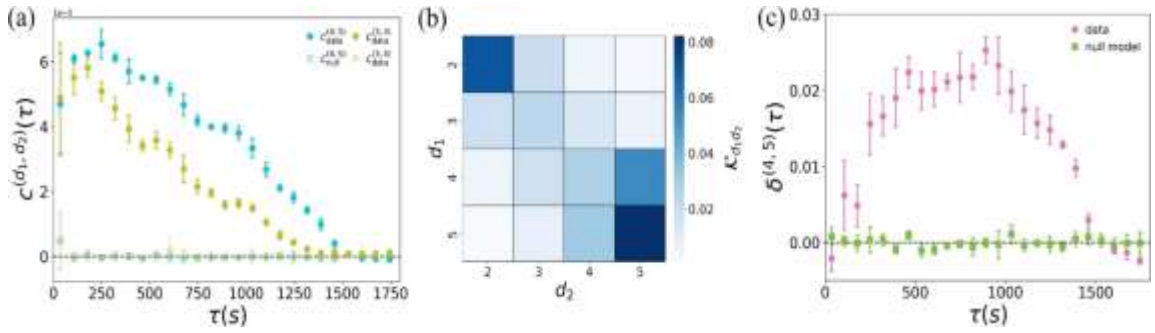


Figure: (a) Cross-order correlation functions describing the temporal dependencies between groups of four people and groups of five people (b) Interaction matrix, showing asymmetric group interactions.

A photonics perspective on computing with physical substrates

Abreu, Boikov, M. Goldmann, Jonuzi, Lupo, Masaad, Nguyen, Picco, Pourcel, Skalli, L. Talandier, Vettelschoss, Vlieg, A. Argyris, Bienstman, Brunner, Dambre, Daudet, Domenech, I. Fischer, Horst, Massar, C. R. Mirasso, Offrein, Rossi, M. C. Soriano, Sygletos, Turitsyn
Reviews in Physics 12, 100093.

This perspective focuses on the field of unconventional computing, which seeks to harness the inherent dynamics of physical systems for computation, contrasting it with traditional digital approaches that engineer substrates to fit discrete logic. We specifically focus on photonic substrates, exploring their fundamental properties and their potential for implementing powerful artificial neural networks to address complex, data-driven machine learning tasks. Our work provides a broad overview of the conceptual frameworks, practical implementations, and key application areas driving this research.

We review various physics-driven and theory-driven photonic implementations. Paradigms such as Reservoir Computing (RC) and Extreme Learning Machines (ELM), which leverage fixed random mappings, are discussed together with their corresponding hardware implementations exploiting space multiplexing (e.g., VCSEL arrays), time multiplexing (e.g., optoelectronic and all-optical delay loops, shown in Fig. 1), and frequency multiplexing (e.g., optical frequency combs). Furthermore, the push toward photonic integration is illustrated by passive silicon nitride chips and coupled micro-resonators. We also present approaches targeting specific computational tasks, such as matrix-vector multiplication and temporal convolution via integrated photonic accelerators, showcasing the potential advantages of photonic implementations in speed and energy efficiency over electronic counterparts, supported by benchmarking comparisons.

Based on these advances, we highlight the significant potential of photonic physical computers, particularly for accelerating machine learning and AI applications with superior speed and energy efficiency. Fulfilling this promise requires overcoming key challenges, including efficient in-situ learning and full programmability beyond the simple readout training common in RC/ELM. We highlight emerging strategies for physical programming, ranging from model-based to model-free optimization techniques. Robust computational abstractions are crucial to achieve cascadability of systems and to develop interconnectivity between diverse physical substrates. This will pave the way for physics-based computing to become a key technology.

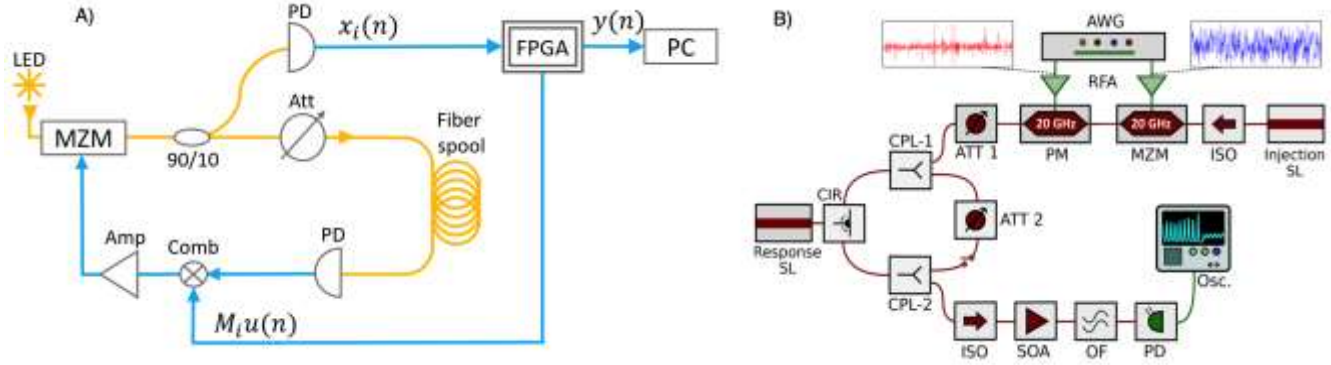


Figure 1: A) Optoelectronic time-multiplexed delay-based reservoir computer using a Mach-Zehnder modulator (MZM) as the main nonlinearity. B) Photonic time-multiplexed delay-based reservoir computer using a semiconductor laser as the main nonlinearity, with amplitude and phase encoding of the input information.

Thermodynamics of computations with absolute irreversibility, unidirectional transitions, and stochastic computation times

Manzano, Gonzalo; Kardeş, Gülce; Roldán, Édgar; Wolpert, David
Physical Review X , 021026.

The exponential growth of computational power and the popularization of modern information technologies has led to a corresponding exponential increase in the associated energy consumption, introducing major challenges for sustainability. However, quantifying the energetic costs of computation even at the most elementary level is a difficult task. In particular, it requires a thermodynamic theory of computation applicable to systems out of equilibrium and affected by fluctuations from their environment. This is in contrast with famous bounds on information processing, such as the famous (generalized) Landauer's principle, obtained in the reversible case where processes are quasi-static. In this work, we make crucial steps for developing such a theory by providing a framework with key ingredients for understanding the fundamental relationship between a given computational task and the energetic resources needed to implement it physically.

By focusing on the resulting dynamics of a computation, we obtain suitable quantifiers for the dissipation incurred by any computer that performs a given task with minimal information about its physical details. To achieve these results, we extend techniques in stochastic thermodynamics to deal with the difficulties of describing computations, such as the breakdown of microscopic reversibility. In this context, we also put forward results that are best known in the mathematics of finance (martingale theory) that allow us to deal with computations that last an uncertain amount of time, as is most often the case in the real world. Our results comprise universal relations and bounds for the minimal energetic costs of generic computations, refining our understanding of the second law of thermodynamics and its relation to information. These developments connect stochastic thermodynamics not only with computational science, but with a much wider range of situations in the physical and biological sciences. For instance our results may be applicable within the fields of biomolecular computation, enzyme kinetic and information processing by living systems where unidirectional transitions and stochastic times are commonplace.

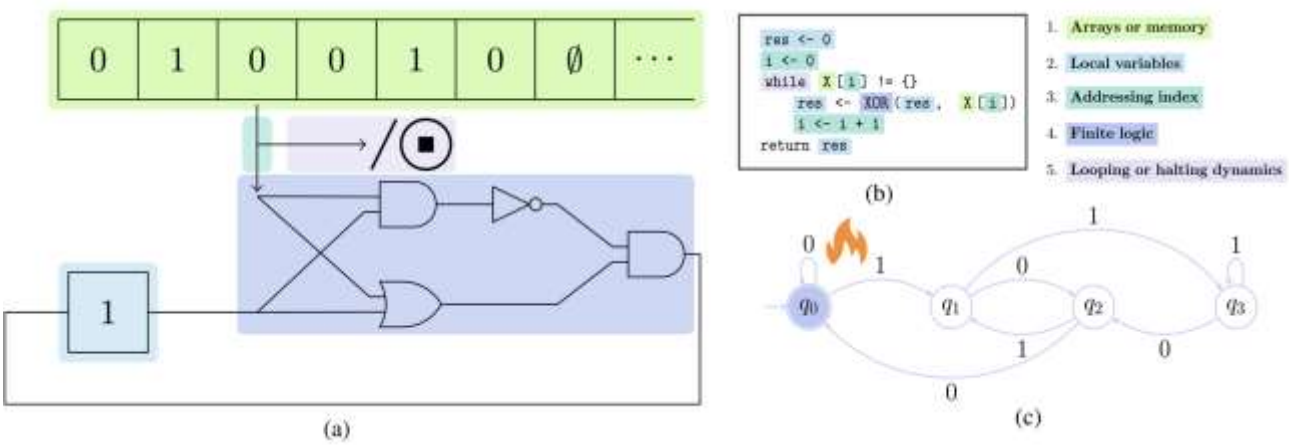


Fig 1. An algorithm is executed by using a set of instructions, a finite control unit or local variables, a working memory to store the input or intermediate execution values, an address index, and mechanisms which specify when to loop and when to halt (the latter is of interest to us in thinking of stopping times). Both in computer science models and physical computers, the finite control unit generally corresponds to a circuit [as in (a), implementing the algorithm in (b)] or a DFA as in (c), here deciding whether input bit strings are divisible by four. In physical implementation of such devices which solve a myriad of computational tasks, energetic costs are inevitab

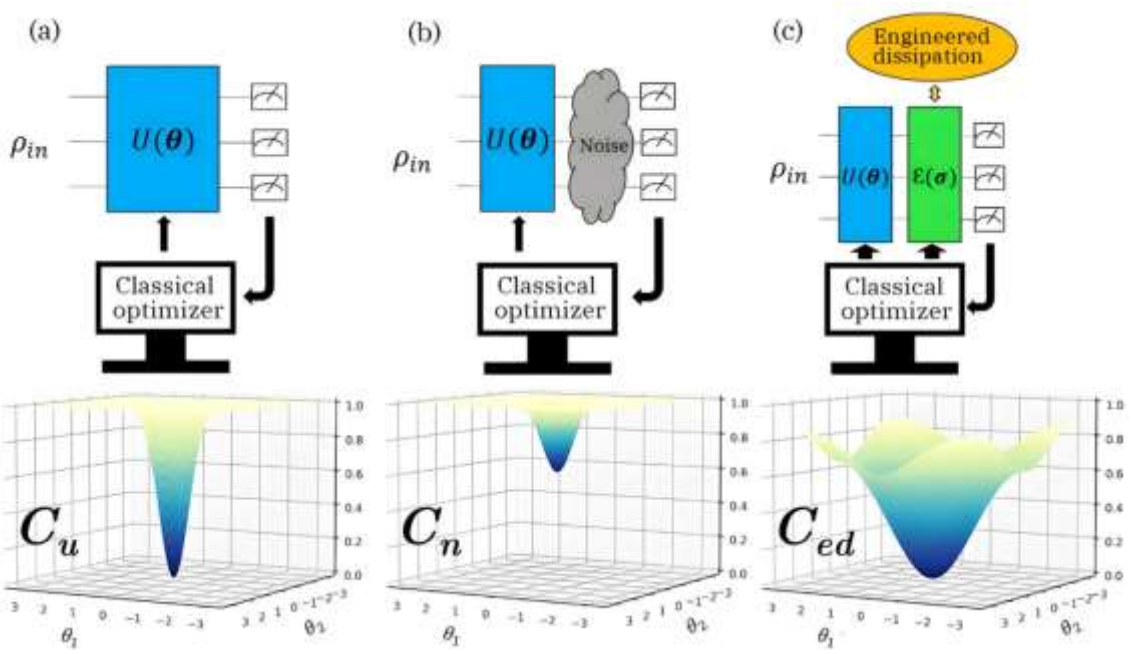
Engineered dissipation to mitigate barren plateaus

Sannia, Antonio; Tacchino, Francesco; Tavernelli, Ivano, Giorgi, Gian Luca; Zambrini, Roberta

npj Quantum Information 10 (1), 81

We introduce a strategy to overcome a critical challenge in quantum computing: the vanishing gradients known as *barren plateaus* that hinder the training of variational quantum algorithms (VQAs). These algorithms, used for optimization tasks in quantum chemistry, machine learning, and more, rely on parameterized quantum circuits to minimize cost functions (Fig. a). However, as quantum systems scale up, the cost function landscape tends to be flat exponentially fast, making the gradient negligible and rendering training impractical.

We propose a novel solution: integrating carefully designed *Markovian dissipation* into quantum circuits. Unlike generic noise, which enforces barren plateaus (Fig. b), engineered dissipation transforms the problem into one that avoids this gradient vanishing issue (Fig. c).



These results, in collaboration with researchers at IBM, open new avenues in optimization with near term quantum devices, where controlled dissipation could be implemented via existing error channels or dedicated hardware modifications.

Characterizing and Mitigating Timing Noise-Induced Decoherence in Single Electron Sources

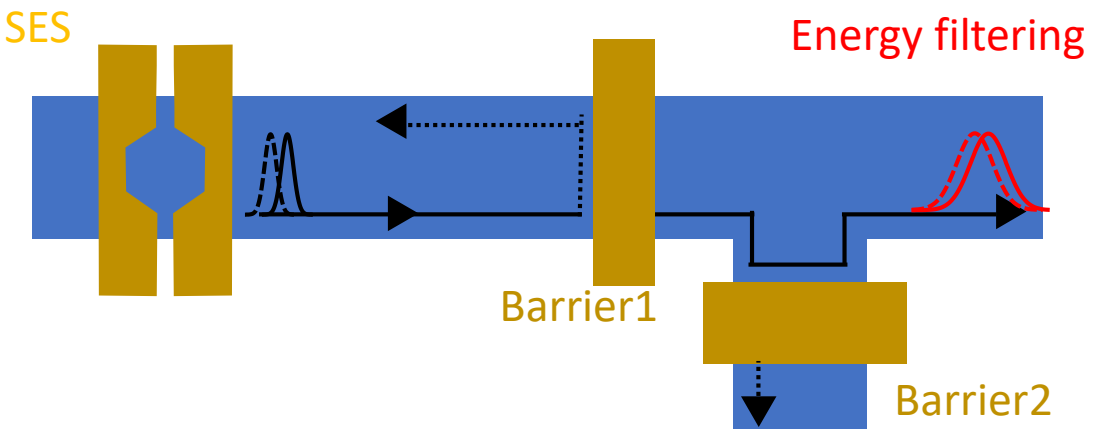
Sungguen Ryu, Rosa López, Llorenç Serra, David Sánchez, Michael Moskalets

Physical Review B **109**, 165306.

Understanding and mitigating decoherence in single-electron sources (SES) is a key step toward advancing solid-state quantum information processing. We investigate a new source of decoherence: fluctuations in the emission timing of SES. These timing noises generate ensembles of temporally shifted electron wave packets, leading to a degradation of quantum coherence in the energy basis—a process known as pure dephasing.

Our work provides a general theoretical protocol for identifying and characterizing this form of decoherence. The protocol reveals that the timing noise is the underlying cause for the severe decoherence observed in the quantum-dot based SESs [Fletcher et al. Nat. Commun. 10, 5298 (2019)]. Beyond offering a diagnostic tool, this work provides a practical route to improve the performance of single-electron sources by presenting an experimentally feasible purification strategy via energy filtering, as sketched in the Figure for a double barrier system. When the filtering elon gate the wave packets by a timescale exceeding the timing noise, the coherence of the electron wave packets can be significantly recovered.

As voltage pulse durations in experiments with SESs continue to shrink, timing noise is expected to play an increasingly critical role in the limitation of coherence. Hence, our theory is useful not only for current quantum-dot SESs, but also for next-generation technologies employing ultrafast voltage pulses.



On the structure of species-function participation in multilayer ecological networks

S. Hervías-Parejo, M. Cuevas-Blanco, L. Lacasa, A. Traveset, I. Donoso, R. Heleno, M. Nogales, S. Rodríguez-Echeverría, C. J. Melián, V. M. Eguíluz.
Nature Communications 15, 8910

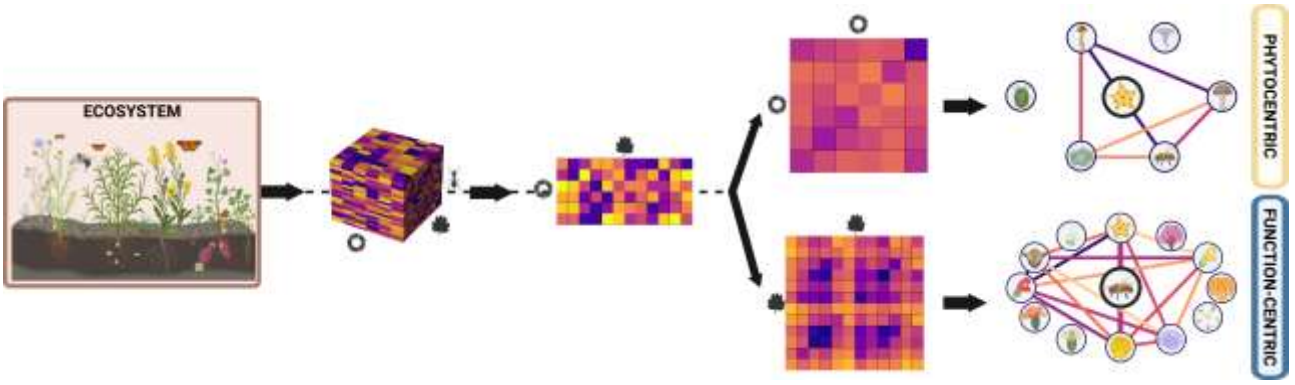
Nowadays, it is a priority in ecology to understand how biotic interactions shape ecosystems and impact their functioning, resilience, and biodiversity—especially now that climate change intensifies environmental challenges. Traditional approaches often represent ecosystems as a web of species interacting via a concrete interaction type (e.g., pollination), overlooking both the synergistic effects of multiple functions as well as the resulting species–function patterns. In fact, ecosystems are inherently multidimensional; for instance, bees not only pollinate but can also facilitate seed dispersal, illustrating how a single species can play multiple and simultaneous ecological roles. Hence, to fully capture ecosystem diversity, it is pivotal to move from considering the solo species role (unifunctionality) to their multiple ecological roles (multifunctionality).

Here we propose a framework for data standardization and its analysis that integrates multiple types of biotic interactions into a single model (Figure 1). Alternatively to the traditional representation of ecosystems, we focus on how entangled species and functions are, that is, how different species participate in different ecological functions, resulting in 'species–function' webs. This perspective allows us to quantify the importance of (i) species and (ii) functions, ultimately identifying key actors whose roles in connecting the ecosystem are disproportionately important for community functioning, among other important ecological questions.

As a case study, we leverage the relative simplicity of a small island community, Na Redona, in the Balearic Islands, to apply our framework. This newly collected data encompasses species interacting across six different ecological functions—reporting 1537 interactions. The framework unveils a non-random, nested structure in the way plant species participate across functions, providing evidence that both species and functions play heterogeneous and dual roles and interact with each other in a non-random way. Woody shrubs and fungal decomposition emerge as key actors whose removal leads to a larger-than-random cascade of secondary extinctions.

The species–function duality that emerges from the framework enables a richer quantification of ecosystem complexity and a better assessment of the impact that multifunctionality has on ecosystems. Key species and functions, a concept we introduce, naturally emerge as two interconnected sides of the same coin, showing that disruptions in either species or functional interactions can disproportionately impact the ecosystem. Such insights are pivotal for understanding and preserving ecosystems in the face of ongoing environmental challenges.

Figure 1: Conceptual framework. From plant species-animal/fungi species- ecological function interactions, to the interconnections between plant species and functions within the ecosystem (species-function perspective), culminating in phytocentric and function-centric perspectives.



Linking intercontinental biogeographic events to decipher how European vineyards escaped Pierce's disease

E. Moralejo, À. Giménez-Romero, and M. A. Matías
Proc. R. Soc. B **291**, 20241130.

Global warming significantly increases the risk of Pierce's disease epidemics in European vineyards

À. Giménez-Romero, M. Iturbide, E. Moralejo, J. M. Gutiérrez, and M. A. Matías
Scientific Reports **14**, 9648.

In 1872, a large amount of American rootstock was brought to Europe to combat phylloxera, putatively contaminated with Xylella fastidiosa, subsp. fastidiosa ST1 that produces Pierce's disease (PD) in vinetrees. Intriguingly, PD did not spread. Using and epidemiological model coupled to climate data from 1850 to 2023, we show that until 1990 most European regions were not climatically suitable for PD spread, specifically regions in France where most of the vegetal material was imported. In addition, we show that climatic conditions were neither conducive for epidemic spreading at the point of origin (Bushberg, USA), while phylogenetic analysis suggests that the export of American grapevines preceded the spread of the Xf grapevine lineage in the USA.

Previously, we have shown that PD risk is growing since 1990. Using the latest regional climate change projections together with our risk model, we study the risk of expansion of PD under different global warming scenarios. We predict a risk increase in several relevant European wine regions, with a critical point at the +3 ºC scenario. Thus, regions in France (Bordeaux and Rhone valley), most of Italy or Northern Portugal are under a growing risk of establishment of the disease, while Spain remains stable, except in coastal Catalonia. The reason is that PD is a vector-borne disease, and global warming, while fostering the growth of the pathogen, is detrimental for the vector *Philaenus spumarius*, that needs a level of humidity that is reduced due to global warming. Continental regions (like Rioja and Ribera del Duero) keep the protection of low minimal temperatures in winter, namely winter curing. Fig. 1 shows the risk projected for different scenarios together with the PD risk velocity, a new metric introduced in this work.

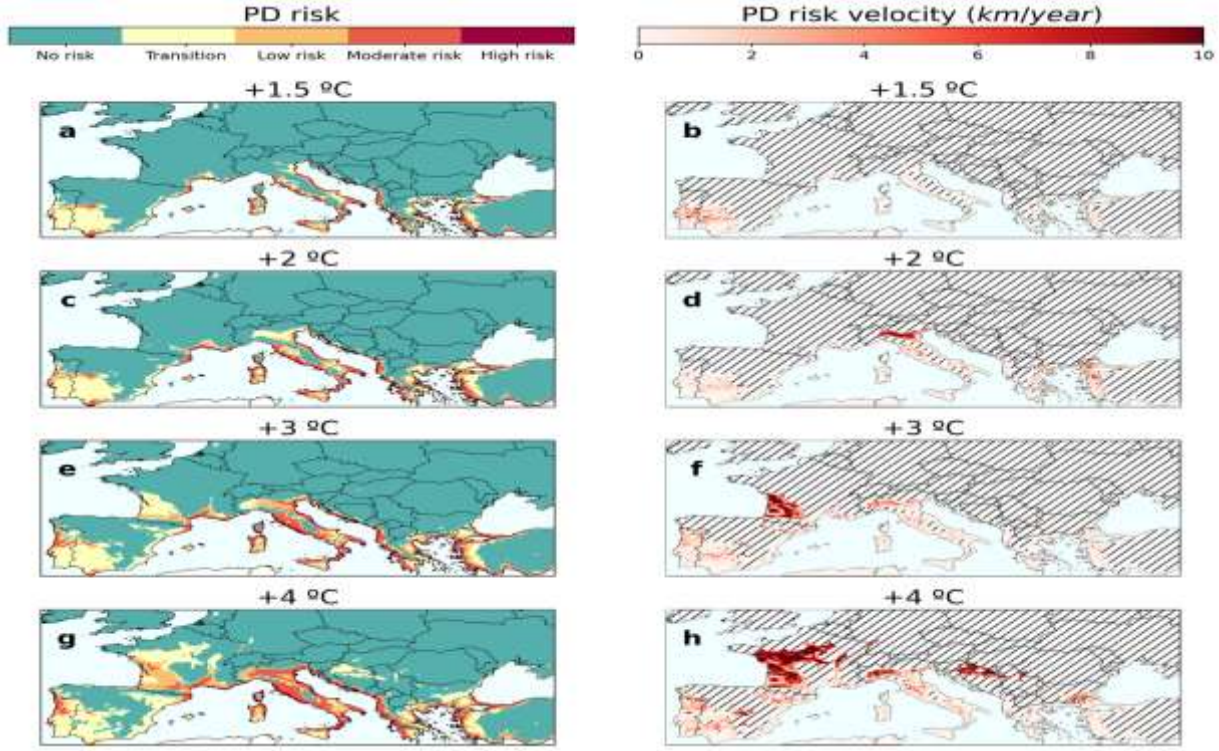


Figure 1: PD risk maps and associated risk velocities under different climate projections.

Circuit dynamincs of cortical responses to visual flow disruptions

Javier Galván Fraile, Franz Scherr, José J. Ramasco, Anton Arkhipov, Wolfgang Maass, Claudio R. Mirasso.
PLoS Computational Biology, 2024; 20(3): e1011921.

Animals' survival depends significantly on their ability to perceive and rapidly respond to changes in their environment. While the primary visual cortex (V1) is critical for mediating this process, the underlying neural mechanisms leading to distinct neuronal responses remain unclear. Using a biologically realistic computational model of mouse V1, we investigated the mechanisms behind opposing responses—depolarizing (dVf) and hyperpolarizing (hVf)—in excitatory layer 2/3 (L2/3) neurons during sudden visual flow perturbations.

Our findings highlight the importance of recurrent inhibition within cortical layers L2/3 and L4, revealing competition between external visual inputs and inhibitory circuits. Depolarizing responses in dVf neurons primarily resulted from strong excitatory input from the lateral geniculate nucleus (LGN) and excitatory L4 neurons. In contrast, hVf neurons displayed hyperpolarization due to enhanced recurrent inhibition from parvalbumin-expressing interneurons, overcoming their weaker excitatory inputs. Additionally, we found functional hubs among these neuron classes, characterized by stronger internal synaptic connections. This segregation was unique to L2/3, as neurons in deeper layers (L5/6) uniformly showed depolarizing or hyperopolarizing responses.

This study enhances our understanding of sensory processing in cortical networks and offers insights into how distinct neuronal response patterns to visual perturbations may facilitate adaptive visual perception and attentional modulation. The identification of inhibitory circuits as key regulators in these responses suggests potential avenues for future research into sensory perception and the neural coding of visual dynamics.

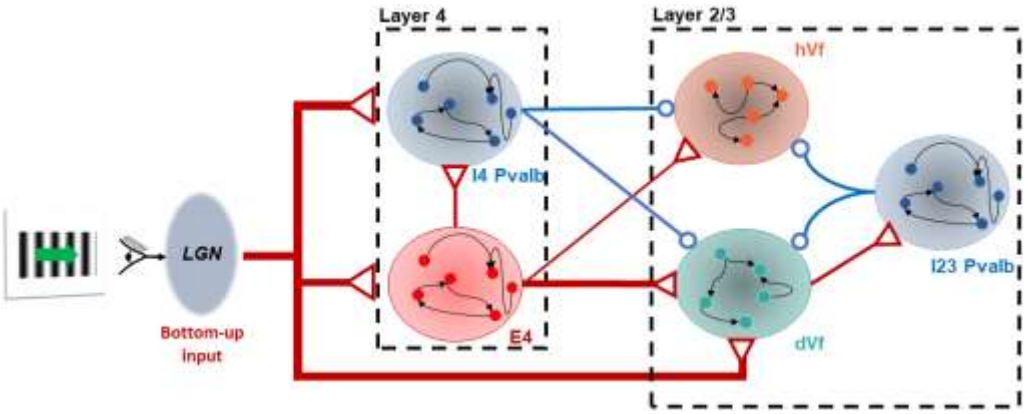


Figure: Schematic representation of the cortical circuit underlying opposing responses to visual flow perturbations. Bottom-up visual inputs from the lateral geniculate nucleus (LGN) drive excitatory layer 4 neurons (E4) and parvalbumin-expressing inhibitory neurons (Pvalb) in layers 2/3 and 4. Excitatory L2/3 neurons segregate into depolarizing (dVf) and hyperpolarizing (hVf) classes, influenced by interactions with inhibitory interneurons. The synaptic weight strength is indicated by the width of the arrows.

Low Cost Carriers Induce Specific and Identifiable Delay Propagation Patterns: An Analysis of the EU and US Systems

Sofia Gil-Rodrigo and Massimiliano Zanin

IEEE Access 12, 75323 - 75336

Delays are one of the major topics of research in air transport, due to their profound implications in the cost-efficiency and safety of the system, and their negative impact on the environment. While some delays are the unavoidable result of external perturbations, more problematic are their propagation, i.e. when a late aircraft induces a delay in other flights. Such propagations are still poorly understood and all mitigation policies are broad in scope, i.e. they tend to penalise all delays, irrespective of their role in the global dynamics.

We here describe the delay propagation patterns in European and US airports, focusing on the meso-scale structures they create, and specifically on their identifiability. In short, given a target airport, we identify the subset of airports to which it strongly connects, for then recovering how delays have propagated between them on a daily basis. The result is then a functional network per day, describing how delays have propagated in the neighbourhood of the target airport. Networks coming from pairs of airports are then classified using Deep Learning models. The accuracy of the classification quantifies how unique, or identifiable, those networks are, and therefore how unique is the structure of the propagation of delays near those airports.

While these delay propagation neighbourhoods are generally not identifiable, some airports stand out for being highly unique, e.g. Málaga-Costa del Sol Airport, Alicante-Elche Miguel Hernández Airport, and London Stansted Airport in Europe; and San José International Airport, Fort Lauderdale-Hollywood International Airport, and Chicago O'Hare International Airport in the US. We demonstrate that such uniqueness is connected to the share of flights operated by Low Cost Carriers, and hence how these induce specific delay propagation patterns. We also show how these results are independent on several methodological choices, like the way functional networks are reconstructed and how the classification is performed. In short, out results yield a novel view to delays and their propagation, especially in relation with the way airlines operate at airports and organise their scheduling.

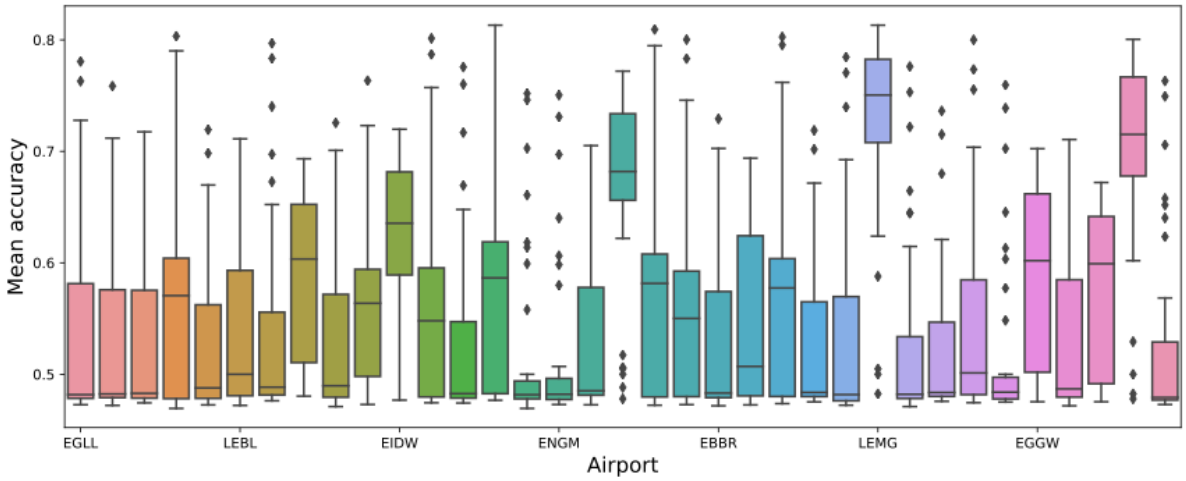


Fig. 1. Overview of the classification of European delay propagation networks. Each box plot represents the distribution of the classification scores obtained between the networks of a given airport (X axis), and each other airport considered in this study. In each plot, the horizontal line represents the median, the box the interquartile range (IQR), and the whiskers the outliers outside the IQR. Airports are ordered in decreasing number of passengers.

Indirect social influence and diffusion of innovations: an experimental approach

Manuel Miranda; Maria Pereda, Angel Sanchez; Ernesto Estrada
PNAS Nexus 3, pgae 409

Humans are continuously adopting ideas, behaviors and technologies, which society perceives as new. This process in which we adopt an innovation can be seen as a diffusive process, like what happen when we put a drop of milk into the coffee. Indeed, the process is known as diffusion of innovations, and it represents the way in which we are influenced by our own social interactions. Obviously, in adopting an innovation we are certainly influenced by the direct ties we have in our social network, what we call our friends. This has been well established in the social sciences for long time. However, as humans we also have a large capacity of imitating those who we perceive as socially close to us in the form of indirect peer's influence.

In this paper we investigated theoretically and experimentally the role of these two types of social interactions — direct and indirect. Based on a mathematical model which include long-distance interactions in a diffusive process, we performed experiments that capture the influence that an individual has from their direct and indirect social ties in their social network. In these experiments with more than 590 participants it is concluded that the rate of adoption of an innovation is significantly influenced not only by our nearest neighbors but also by the second and third levels of influences that an adopter has (see the Figure). In closing, we determine that adopting an innovation turns out to be the result of a complex combination of direct plus indirect social influences, involving differently our second and third circles of influence.

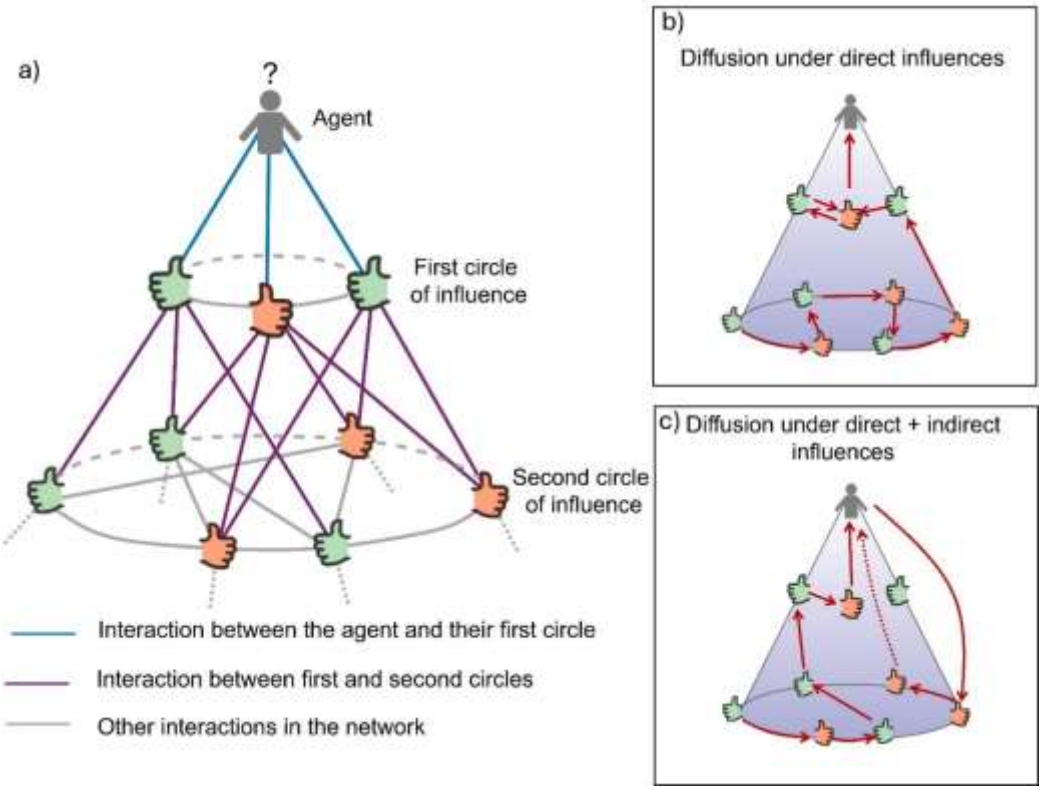


Figure. Illustration of the different circles of influence that an individual has in their social network (a). Two forms in which an innovation can be diffused: (b) with direct peer's pressure only, or (c) with direct and indirect peer's pressure.

Exploring language relations through syntactic distances and geographic proximity

De Gregorio, Juan; Toral, Raúl; Sánchez, David

EPJ Data Science, 13(1), 61

Languages are commonly classified into families based on shared linguistic features. However, accurately quantifying the relationships between languages—particularly at the syntactic level—remains a complex challenge. In this study, we present a novel approach to investigate linguistic similarity by analyzing sequences of parts of speech (POS) for 67 contemporary languages, using data from the Universal Dependencies library.

Using an information-theoretic framework, we find that blocks of three consecutive POS tags (trigrams) offer an optimal resolution for capturing syntactic variation across languages. They provide a good compromise between the information contained in the sequences and the amount of data available across the languages considered. This choice allows us to build a distance matrix by computing the Jensen-Shannon divergence between the distributions of POS trigrams in each language.

The resulting patterns reveal clear clusters that align with established language families, while also shedding light on internal structures and the role of morphological typology. Notably, we observe a strong correlation between linguistic similarity and geographic proximity: with a few exceptions, languages spoken nearby tend to exhibit more similar morphosyntactic traits than those located further apart. As illustrated in Figure 1, this relationship appears to follow a logarithmic trend.

Our findings highlight the value of integrating syntactic data with geographic information when studying language evolution. Moreover, they demonstrate the potential of information-theoretic tools to uncover complex patterns in linguistic structures across a wide range of languages.

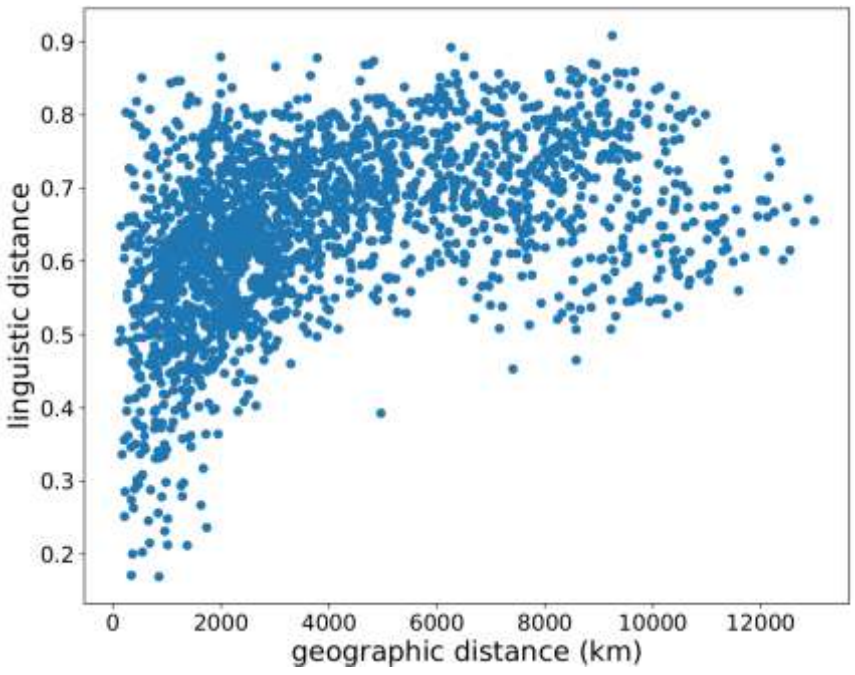


Figure 1: Linguistic versus geographic distances between all language pairs considered.

2

PERSONNEL

2 PERSONNEL

2.1 PERMANENT SCIENTIFIC STAFF

APOSTOLOS ARGYRIS	Associate Professor UIB
PERE COLET	CSIC Research Professor
MIGUEL C. SORIANO	CSIC Tenured Scientist
ERNESTO ESTRADA	CSIC Research Professor
JUAN FERNANDEZ GRACIA	CSIC Tenured Scientist
ANTONIO FERNANDEZ PERALTA	Associate Professor UIB
INGO FISCHER	CSIC Research Professor
TOBIAS GALLA	CSIC Senior Researcher
GIAN LUCA GIORGI	Associate Professor UIB (since December)
DAMIA GOMILA	CSIC Tenured Scientist
EMILIO HERNANDEZ GARCIA	CSIC Research Professor, IFISC Director
LUCAS LACASA	CSIC Senior Researcher
CRISTOBAL LOPEZ	University Full Professor UIB
ROSA LOPEZ	University Full Professor UIB
VICTOR M. EGUÍLUZ	CSIC Senior Researcher (since October)
MANUEL MATÍAS	CSIC Senior Researcher
SANDRO MELONI	CSIC Tenured Scientist (until June)
CLAUDIO MIRASSO	University Full Professor UIB, IFISC Deputy Director
MAXI SAN MIGUEL	University Full Professor UIB, Emeritus
SILVIA ORTIN	Associate Professor UIB (since December)
JOSE J. RAMASCO	CSIC Research Professor
DAVID SANCHEZ	University Full Professor UIB
LLORENÇ SERRA	University Full Professor UIB, IFISC Academic Secretary
TOMAS SINTES	University Full Professor UIB
RAUL TORAL	University Full Professor UIB, HR Deputy Director
ROBERTA ZAMBRINI	CSIC Senior Researcher
MASSIMILIANO ZANIN	CSIC Tenured Scientist (since December)

Contribution of the permanent staff to the IFISC research areas:

Every senior researcher participates in the transversal area on Concepts and Tools. In addition, typically a senior researcher participates in one or two other focused lines. This collaborative organization provides coherence and integration as well as interaction and bridges. It is an alternative to static schemes with disjoint groups of researchers devoted exclusively to one line of research. The following table summarizes the participation of the senior researchers in the different areas during 2024.

	Concepts and Tools	Photonics and Quantum Systems	Life and Enviroment	Social and socio-technical systems
Apostolos Argyris	■	■		
Pere Colet	■			■
Miguel C. Soriano	■	■		
Ernesto Estrada	■		■	■
Ingo Fischer	■	■	■	
Juan Fernández-Gracia	■		■	■
Toni Fernández	■			■
Tobias Galla	■		■	■
Gian Luca Giorgi	■	■		
Damià Gomila	■		■	■
Emilio Hernández-García	■		■	
Lucas Lacasa	■		■	■
Cristóbal López	■		■	
Rosa López	■	■		
Manuel Matías	■		■	
Sandro Meloni	■		■	■
Claudio Mirasso	■	■	■	
Víctor M. Eguíluz	■		■	■
Silvia Ortín	■	■	■	
José Ramasco	■		■	■
David Sánchez	■	■		■
Maxi San Miguel	■			■
Llorenç Serra	■	■		
Tomás Sintes	■		■	
Raúl Toral	■			■
Roberta Zambrini	■			■
Massimiliano Zanin	■		■	■

2.2 TENURE TRACK AND SENIOR RESEARCH FELLOWS

GONZALO MANZANO	Ramón y Cajal
ENRICO SER GIACOMI	Beatriz Galindo
MICHAEL MOSKALETS	CSIC – Ukraine collaboration
LEONARDO LYRA GOLLO	Ramón y Cajal (since September)
FEDERICO VAZQUEZ	APASOS Project (since September)
CARLOS J. MELIAN	Maria Zambrano fellow (until February)

2.3 SCIENTIFIC ASSOCIATES

JUAN CARLOS GONZÁLEZ-AVELLA
STEFANO LONGHI
HORACIO WIO
KONSTANTIN KLEMM
SANDRO MELONI – since July

2.4 POSTDOCTORAL RESEARCH ASSOCIATES

KISHOR ACHARYA	Project ARCTIC
ANDRES A. AGUADO	Maria de Maeztu
JAVIER AGUILAR	Margalida Comas Programme CAIB
LLUIS AROLA	Maria de Maeztu
CHRISTOS CHARALAMBOUS	CAIB contract
SARA CLOUX	Project LAMARCA
SREETAMA DAS	Maria de Maeztu
ELIANA FIORELLI	Marie Curie fellow Project CoQHoNet
CATHARINA E. GRAAFLAND	Maria de Maeztu
ALEX GIMENEZ	SEDIMENT and GRAPHIB Projects
FELIPE E. OLIVARES	ARCTIC Project
JAVIER OSCA	Assistant Professor UIB
MORITZ P. D. PFLUEGER	INFOLANET Project
RICARD RAVELL	COQUSY and Quantum Spain Projects
JORGE P. RODRIGUEZ	Vicent Mut Programme CAIB
DANIEL RUIZ REYNÉS	Margarita Salas Programme
SUNGGUEN RYU	Assistant Professor UIB
MATTEO SCANDI	Associated to the Ramon y Cajal programme
JUAN D. VASQUEZ	MAGMA Project
MIHIR S. UMARANI	LOCAL CORAL SPECIES Project

2.5 PHD STUDENTS

DAVID ABELLA	Next4Mob Project
JOSE ANTONIO ALMANZA	FPI Balearic Government
ALEJANDRO ALMODOVAR	UIB contract
MIGUEL ALVAREZ	FPI Maria de Maeztu
BEATRIZ ARREGUI	FPI Maria de Maeztu
JOSU BLANCO	Maria de Maeztu
GORKA BUENVARON	FPI Maria de Maeztu
CARLSON M. BÜTH	ARCTIC Project
ANNALISA CALIGIURI	FPI Maria de Maeztu
CANIGÓ CALLAU I BOIX	L'euro al Joule Project
STEFANO CAMPAGNOLA	Contract associated to Beatriz Galindo program
PARIDE CRISAFULLI	INPHINIT Project Fundacio La Caixa
MAR CUEVAS	FPI MISLAND Project
JUAN IGNACIO DE GREGORIO	Maria de Maeztu
FERNANDO DIAZ	FPI Maria de Maeztu
NOEMIE EHSTAND	DYMOBIE Project (until February)
PAU ESTEVE	ARCTIC Project
JAVIER GALVAN	FPI Maria de Maeztu
JORGE GARCIA BENI	FPI Balearic Government
JUAN A. GARCIA CASTILLO	FPI Maria de Maeztu
GIOVANNI GUARNIERI	Fellowship Brazilian Government
PEDRO JIMENEZ	FPI Maria de Maeztu
ALFONSO JODAR	FPI COQUSY Project
ADRIA LABAY	Contract associated to Beatriz Galindo program
JAUME LLABRES	UIB contract
GUILLEM LLODRA	Quantum Complex Systems Project
RAUL LOPEZ	FPU Contract
JORGE MAMPEL	European Citizen Project
MARIA MARTINEZ BARBEITO	VPP4ISLANDS Project
JORGE MEDINA	FPI Maria de Maeztu
MANUEL MIRANDA	FPI OLGRA Project
JESUS A. MORENO	FPI PACCS Project
PABLO MORENO SPIEGELBERG	FPI SUMAECO Project
DANIEL MONTESINOS	Maria de Maeztu
ORIOL MORGUÍ	COQUSY Project
CARLOTTA NUNZI	FPI Maria de Maeztu
SARA OLIVER	FPU fellow
DAVID ORTIZ	FPI APASOS Project
JOSE M. RAMOS	Next4Mob Project
JUAN C. RODRIGUEZ	FUEIB contract

PABLO ROSILLO-RODES	FPI Maria de Maeztu
ANTONIO SANNIA	INPHINIT fellow Fundacio La Caixa
LUCAS TRIGAL	Maria de Maeztu
DIMITRIOS CHALKIADAKIS	FPI Alicante Unversity cotutelle
ASIER GARAY	UIB - IKERLAN cotutelle
IRIS M.A. PAPARELLE	UIB - Sorbonne Univ., Paris cotutelle
JUANA M. PAGAN	UIB - REGENERA cotutelle
LOURDES PEREZ	UIB - Univ. San Jorge, Zaragoza cotutelle

2.6 TECHNICAL AND ADMINISTRATIVE SUPPORT

JON GURUTZ ARRANZ	Fundación BBVA – CSIC fellow (Jan-March)
MIGUEL ARTIGUES	Computing Lab Data Engineer CAIB
DHAFER FERCHICHI	Technician Project SEDIMENT
ISABEL F. GALVEZ	FUEIB contract
ADRIAN GARCIA CANDEL	Maria de Maeztu Communication and Dissemination
DAVID JIMENEZ	Maria de Maeztu Systems Technician
NEUS LACOMBA	UIB Proximity Technician
CARMEN M. MARTÍNEZ	Management Technician
SIMONA OBREJA	Project Manager
MARTA OZONAS	IFISC Administration
REBECA PEREZ	Administration Technician
ALBERTO J. SANCHEZ	Accounting Administration
AKSHAY TIWARI	Technician Project RE-TE. ERC - Proof of Concept
RUBEN TOLOSA	Computing Lab Technician
M. ANTONIA TUGORES	Data Engineer
FATIMA Z. VELASQUEZ ROJAS	Management Support Project TRAOC

2.7 VISITORS

LONG-TERM VISITORS (more than one month)

ELOÏSE A. COMTE	INRAE, France (January – July)
FEDERICO BELLISARDI	Univ. Bologna, Italy (Feb. – March)
ANA RUIZ VARONA	Univ. San Jorge, Zaragoza (Feb. – March)
ENRIQUE CANO SUÑÉN	Univ. of Zaragoza (Feb. – March)
AITOR N. AZEMAR	Univ. of Glasgow, UK (March – May)
VERONICA BEDIN	Univ. of Padova, Italy (March – July)
BENJAMIN CARRERAS	Univ. of Alaska, USA (March – April)
JAMES R. WATSON	Oregon State Univ., USA (April – May)
MURIELLE V. TCHAKUI	Univ. Baamenda, Cameroon (Sept. – Oct.)
NANA BONAVENTURE	Univ. Baamenda, Cameroon (Sep. – Oct.)
PAUL WOAFO	Univ. Yaounde, Cameroon (Sep. – Oct.)

SHORT-TERM VISITORS (Less than one month)

PATRICK POTTS	Univ. of Basel, Switzerland (January)
KUN WOO KIM	Univ. Chung-Ang, South Korea (January)
JUNHYEON BAE	Univ. Chung-Ang, South Korea (January)
PEDRO DE CASTRO	Univ. Aalto, Finland (January)
HILBERT KAPPEN	Univ. Neijgmegen Radboud, Netherlands (January)
CELIA ANTENEODO	Pontifical Catholic Univ. Rio de Janeiro, Brazil (Feb.)
LUDMILA VIOTTI	ICTP, Triestre, Italy (February)
VRISHALI SONAR	University of Poland (March)
ALEXANDRE DE OLIVEIRA	Technical University of Denmark (April)
MIGUEL ANGEL MUÑOZ	Univ. de Granada (April)
NIKITA DENISKIN	Scuola Superiore Normale de Pisa, Italy (May)
DALMO BULZATO	Univ. Federal M. G. Belo Horizonte, Brazil (June)
ANDREI MANOLESCU	Reykjavik University, Iceland (June)
JOSHUA ROBERTSON	Univ. Strathclyde, Scotland (June)
FABIO TADDEI	NEST, CNR, Pisa, Italy (June)
PIOTR S. TROCHA	Adam Mickiewica University, Poland (July)
DANIEL FRAIMAN	Univ. San Andres, Argentina (Jan., July, Oct.)
CHRISTOPHER KITCHING	University of Manchester, UK (October)
RUBEN HERZOG	Paris Brain Institute, France (October)
ALESSIA ANNIBALE	King's College London, UK (October)
MARCO CATTANEO	Univ. Helsinki, Finland (October)
SALVATORE MICCICCHÉ	Palermo Univ., Italy (November)
CLAUDIO GALLICCHIO	Pisa University, Italy (November)
SERGIO ALTARES	CAR, Arganda del Rey, Madrid (Nov.)

2.8 MASTER AND COLLABORATION STUDENTS

In addition to the IFISC personnel, master and collaboration students have been also involved in IFISC research:

2023-2024 IFISC Master

DANIEL AGUILAR
AIDA ATAEI
ALBERT CAÑELLAS
ELENA DEL CAMPO
ARNAU DOLS
SOFIA GIL
LUIS IRISARRI
JAVIER MARIN
DANIEL MONTESINOS
ADRIAN NADAL
LAIA PALACÍN
MIGUEL R. SHAW
ADRIAN ROIG
SAULO J. RONQUILLO
SERGIO SICILIA
VICTOR TARASSOV
LUCAS TRIGAL
ARNAU VIVET

2024-2025 IFISC Master

DAVID CARPIO
MATEU COLL
JOAN CUCURULL
MARCO FISCAL
PABLO GALLARDO
ADAM C. MACKOWIAK
DANIEL MARTINEZ
SAKANDER ZIRAI
SERGIO ZUCCHI

Collaboration students

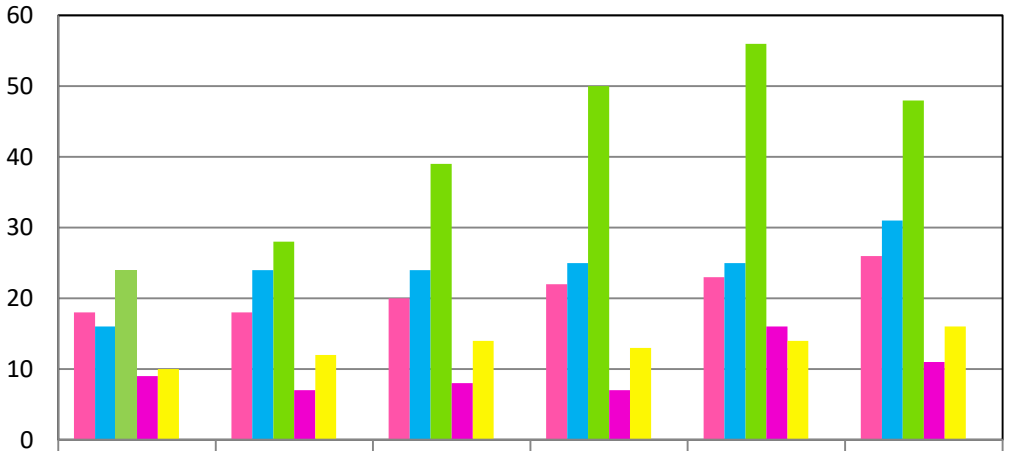
ADRIAN GARCIA LLANES	ERASMUS Univ. Calabria, Italy (Sept. - Nov.)
MARTA GILI	IKERLAN, País Vasco (Dec. – Feb.2025)

2.9 HUMAN RESOURCES OVERVIEW

HUMAN RESOURCES IFISC 2024

	Total	Male	Female
Permanent staff	26	23	3
Tenure track & senior fellows	6	6	0
Postdoctoral fellows	20	16	4
PhD students	48	38	10
Long-term visitors	11	7	4
Support personnel	16	8	8
Total	127	98	29

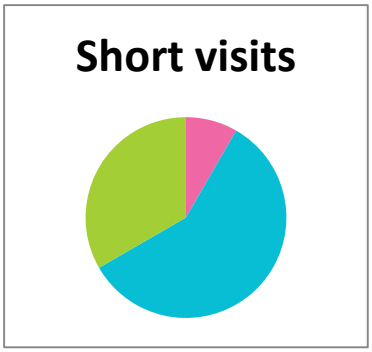
PERSONNEL IFISC 2019-2024

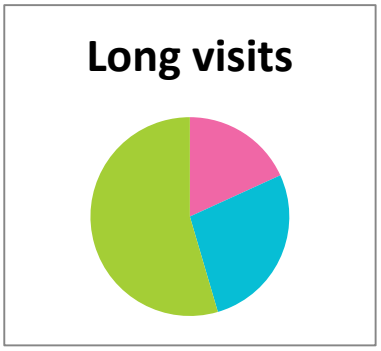


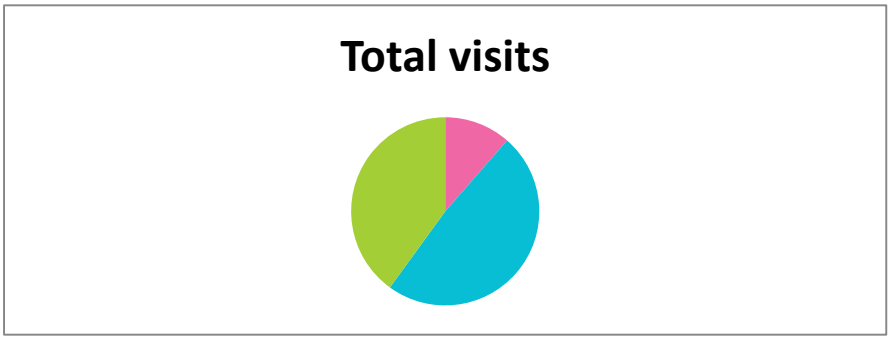
	2019	2020	2021	2022	2023	2024
PERMANENT STAFF	18	18	20	22	23	26
POSTDOCS, SENIORS & ASSOCIATED	16	24	24	25	25	31
PhD STUDENTS	24	28	39	50	56	48
LONG TERM VISITORS	9	7	8	7	16	11
SUPPORT PERSONNEL	10	12	14	13	14	16
TOTAL	77	89	105	117	134	132

VISITING SCIENTISTS AT IFISC 2024

		Short visits	Long visits	**Total visits**
	SPAIN	2	2	4
	EUROPE	14	3	17
	REST OF THE WORLD	8	6	14
	TOTAL	24	11	35







3

RESEARCH PROJECTS AND FUNDING

3 RESEARCH PROJECTS AND FUNDING

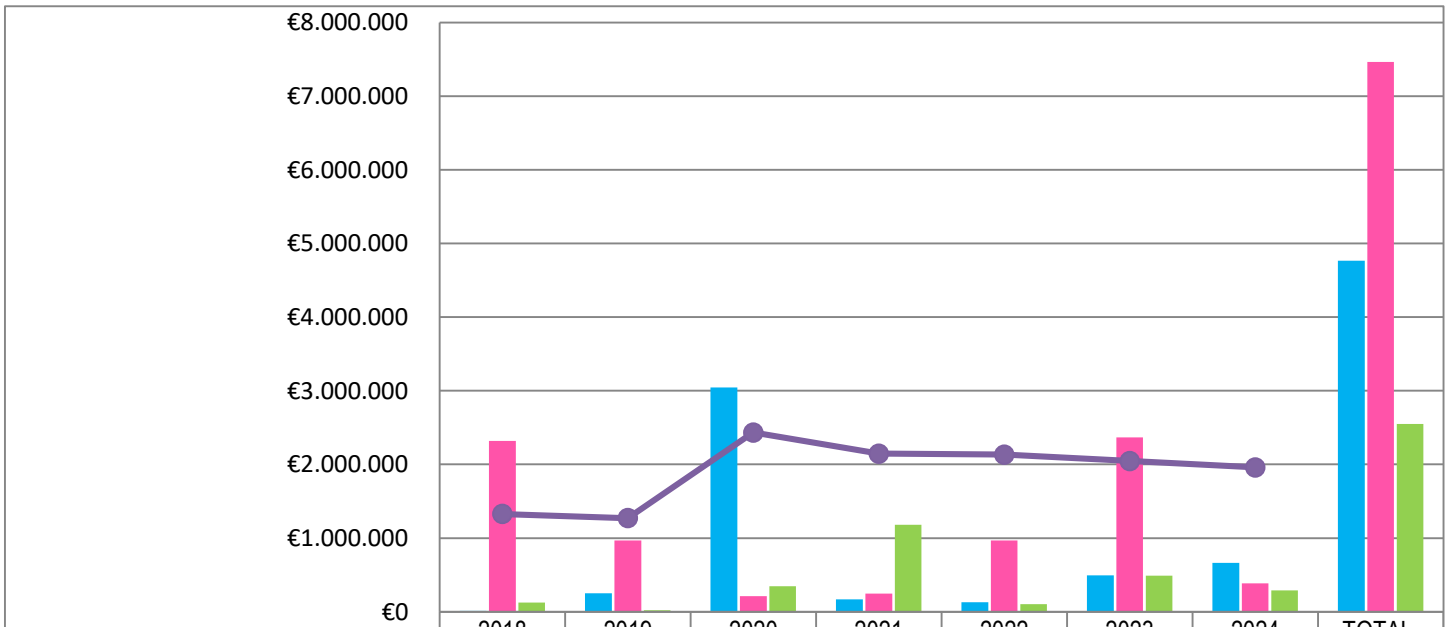
DURING 2024 IFISC HAS RECEIVED FUNDING VIA THE ACTIVE RESEARCH PROJECTS LISTED IN THE FOLLOWING PAGES. IN BRIEF:

- European Commission Framework Program projects: **11**
- Spanish National Plan: **14**
- Collaboration Networks: **4**

Grand total budget of active projects in 2024: **8.411.900 €**
Average yearly project funding in 2018-24: **2.111.235 €**
Average EC funding in 2018-24: **32,24 % of total**

BUDGET FIGURES FOR THE PERIOD 2018-2024 ARE SUMMARIZED IN THE FOLLOWING TABLE
(With budget of a project assigned to the year it is granted. The *Annualized total* is the sum of one-third of the budged granted in that year and in the two previous years):

BUDGET IFISC´S RESEARCH PROJECTS 2018-2024 (IN €)



	2018	2019	2020	2021	2022	2023	2024	TOTAL
European Commission	€12.000	€250.904	€3.045.987	€169.007	€128.799	€493.737	€664.262	€4.764.696
Spanish National Plan for Science	€2.320.000	€969.227	€212.120	€246.865	€966.145	€2.365.150	€383.577	€7.463.084
Other Funding	€122.573	€20.000	€347.136	€1.181.210	€102.344	€488.081	€289.520	€2.550.864
Total	€2.454.573	€1.240.131	€3.605.243	€1.597.082	€1.197.288	€3.346.968	€1.337.359	€14.778.644
Annualized total	€1.326.489	€1.269.885	€2.433.316	€2.147.485	€2.133.204	€2.047.113	€1.960.538	

3.1 RESEARCH FUNDED BY THE EUROPEAN COMMISSION

Hybrid

New hybrid methods to study and forecast flight delay propagation. SESAR Subproject. [101114648] CSIC, Principal Investigators: Jose Ramasco and Massimiliano Zanin (2024-2027) Budget: 60.000€

RE-TE

Regional Economy / Travel Expectations. [101112847] ERC Proof of Concept. Principal Investigator: Massimiliano Zanin (2023-2025) Budget: 150.000€

CoQHoNet

Connecting Quantum Hopfield Networks. [IP-101105267] Marie Curie Intra-European Fellowships for career development. Principal Investigator: Roberta Zambrini (2023-2025) Fellow: Eliana Fiorelli. CSIC Budget: 165.312,96€

Ocean Citizen

Marine forest coastal restoration: an underwater gardening socio-ecological plan. [HORIZON-MISS-2021-OCEAN-02: 101093910] Innovation Action. Principal Investigator: Damià Gomila (2023-2026) CSIC Budget: 178.424,70€

VPP4ISLANDS

Vitual Power Plant for Interoperable and Smart Islands. Innovation Action [957852] IFISC Principal Investigator: Pere Colet. (2020-2024) CSIC Budget: 309.903 €

POST-DIGITAL

Neuromorphic computing in photonic and other nonlinear media. Marie Skolodowska-Curie Initial Training Network [860360] IFISC Principal Investigators: Claudio Mirasso and Ingo Fischer. (2020-2024) Budget: 483.810 €

ARCTIC

Air Transport as Information and Computation. European Research Council Starting Grant [851255] IFISC Principal Investigator: Massimiliano Zanin. (2020-2025) Budget: 1.297.024 €

MAGMA

Magnetic topological insulators for robust majorana bound states. International collaboration Project AEI-PCI-ERA. (2022-2025) Principal Investigator: Llorenç Serra. UIB Budget: 128.799,96 €

CoQuaDis

Collective quantum phenomena in dissipative systems – towards time-crystal applications in sensing and metrology. [PCI2024-153446] AEI-PCI-ERA International Collaboration Project. Principal Investigator: Roberta Zambrini (2024-2027) CSIC Budget: 187.500€

QNet

Transport, metastability, and neuromorphic applications in quantum networks. [PCI2024-153410] AEI-PCI-ERA International Collaboration Project. Principal Investigators: Roberta Zambrini and Gian Luca Giorgi (2024-2027) UIB Budget: 187.500€

SIESTA

Secure Interactive Environments for SensiTive data Analytics. [101131957] Research and Innovation Action (RIA) Principal Investigators: Pere Colet and Jose Ramasco (2024-2026) Total Budget: 4M. CSIC Budget: 229.262€

3.2 RESEARCH PROJECTS OF THE SPANISH NATIONAL PLAN FOR SCIENCE

MdM – IFISC -2

Accreditation of IFISC as "Maria de Maeztu, Unit of Excellence". [CEX2021-001164-M] Principal Investigator: Claudio Mirasso. (2023-2026) Budget: 2.000.000€

Next4Mob

Next Generation Tools for advanced mobility solutions. [PLEC2021-007824] Strategic Line Project. IFISC Coordinator: Jose J. Ramasco (2021-2024) Budget: 62.340 €

INFOLANET

Information processing with coupled laser networks. [PID2022-139409NB-I00] Principal Investigators: Apostolos Argyris and Miguel C. Soriano (2023-2026) Budget: 127.500€

CoQuSy

Complex Quantum Systems: machine learning, thermodynamics and emergent phenomena. [PID2022-140506NB-C21 y C22] Principal Investigators: Gian Luca Giorgi, Roberta Zambrini and Gonzalo Manzano (2023-2026) CSIC Budget: 148.750€. UIB Budget: 112.500€.

SNANDOG

Spatiotemporal Nonlocal and Non-conservative Diffusion on Graphs. [PID2023-149473NB-I00] CSIC. Principal Investigator: Ernesto Estrada (2024-2026) CSIC Budget: 58.625€

SuMQuTT

Surfing Multiterminal Quantum Thermodynamics and Topology. [PID2023-151975NB-I00] UIB. Principal Investigators: Rosa López and Llorenç Serra (2024-2028) UIB Budget: 125.000€

CATSUIT

Climbing at the Source of Irreversibility. [CNS2023-144775] Principal Investigator: Massimiliano Zanin (2024-2026) CSIC Budget: 199.952€

MISLAND

Modelling Island Ecological Complexity in the context of global change. [PID2020-114324GB-C22] IFISC Principal Investigators: Lucas Lacasa and Victor M. Eguiluz (2021-2024) CSIC Budget: 84.095 €

QuTTNAQMa

Transporte cuántico y termodinámica: nuevas avenidas en materiales cuánticos. [PID2020-117347GB-I00] IFISC Principal Investigators: Rosa López and Llorenç Serra. (2021-2024) UIB Budget: 72.600 €

SEDIMENT

Seagrass diversity in the Mediterranean basin in a global change scenario: a machine learning approach from satellite images. [TED2021-131836B-I00] (2022-2024) Ecological Transition project. Principal Investigators: Tomas Sintes, Manuel Matías. Budget: 193.200 €

APASOS

A Physics approach to sociotechnical systems: from theory to data analysis [PID2021-122256NB-C21/C22] (2022-2025) Principal Investigators: Tobias Galla, Sandro Meloni, Maxi San Miguel and Raul Toral. Budget: UIB: 193.600 € and CSIC: 181.500 €

CYCLE

Complex DYnamics of CoastaL Ecosystems: Resilience to Climate Change. Modelling and Simulations. [PID2021-123723OB-C22] (2022-2025) Principal Investigators: Tomas Sintes and Damia Gomila. Budget: 124.630 €

LAMARCA

Lagrangian transport of marlne litter and microplastics in coastal waters: structures of transport and connectivity patterns [PID2021-123352OB-C32] Principal Investigators: Emilio Hernández-García, Cristóbal López (2022-2026) CSIC Budget: 102.850 €

UpMEMO

Updating the brain's memory base: computational perspective [PID2021-128158NB-C22] Principal Investigator: Claudio Mirasso (2022-2025) Budget: 340.365 €

3.3 OTHER PUBLIC AND PRIVATE FUNDING

ADADES

Adquisición De Analizador De ESpectro óptico. [AJUEQCIEN 24/2024] Ajudes especials de recerca, desentvolupament tecnològic i innovació del Gov. Balear. CSIC. Principal Investigator: Apostolos Argyris (2024) UIB Budget: 34.236,7€

SGPU

Servidor de GPUs – IA server. [AJUEQCIEN 28/2024] Ajudes especials de recerca, desentvolupament tecnològic i innovació del Gov. Balear. Principal Investigator: Massimiliano Zanin (2024) CSIC Budget: 49.995€

CAFECONMIEL

Corpus Automático y Fenómenos de Contacto en Mallorca: Inteligencia, Entrenamiento y Lengua. Balearic Government. IFISC Principal Investigator: David Sánchez (2021-2024) UIB Budget: 47.510 €

AISAI

Aerial identification of seagrass meadows at risk using artificial intelligence. Project of the Càtedra de la Mar Iberostar Fundation Principal Investigator: Daniel Ruiz Reynés (2024-2025) UIB Budget: 12.000€

UCRAN20029

Floquet quantum information processing devices. Acción Complementaria. Principal Investigator: David Sánchez. Fellow: Michael Moskalets (2022-2026) CSIC Budget: 217.590,46 €

Quantum Spain

Principal Investigator: Roberta Zambrini (2023-2025) Agreement. Budget: 273.404€

EUR2J

De l'Euro al Joule. Principal Investigator: Raul Toral. La Caixa Foundation (2023-2025) UIB Budget: 107.902€

QTD-InFlexity

Quantum thermodynamics: information, fluctuations and complexity. [20235AT009] PIE - Proyecto Intramural Especial associated to Ramon y Cajal. Principal Investigator: Gonzalo Manzano (2023-2026) CSIC Budget: 50.000€

BOND

Brain Network Organization and Dynamics. [20245MAX011] Proyecto Intramural Especial associated to Ramon y Cajal. Principal Investigator: Leonardo Lyra Gollo (2024-2027) CSIC Budget: 183.333,33€

iCOOP22059

Analysis of stability and resiliance fo Cameroon's power grid on the incorporation of renewable energy sources. Bilateral Project. CSIC. Principal Investigator: Pere Colet (2023-2024). Budget: 23.950,30€

AIAM

Artificial Intelligence & Animal Movement. [DO17] Project with Foundation SOA – Sustainable Ocean Alliance. Principal Investigator: Jorge P. Rodriguez (2023-2024) Budget: 9.225,20€

KCRI-ENCOREDAT

Enhancing coral reef restoration success through data-driven projections of future reef formation. Excellence Network. UIB. Principal Investigators: Manuel Matías and Damià Gomila (2024-2026) UIB Budget: 11.200$

3.4 RESEARCH PROJECTS AND COLLABORATION NETWORKS WITH PARTICIPATION OF IFISC MEMBERS

MOBILITY2030

Sustainable and healthy urban mobility. CSIC Interdisciplinary Thematic Platform (PTI). Principal Investigator at IFISC: J.J. Ramasco

Global Health

Global Health. CSIC Interdisciplinary Thematic Platform (PTI+). Principal Investigator at IFISC: J.J. Ramasco

AIHUB

HUB CSIC for fomenting the research and services on Artificial Intelligence. CSIC Interdisciplinary Thematic Platform (PTI). Principal Investigator at IFISC: J.J. Ramasco

QTEP

Quantum Technologies Platform. CSIC Interdisciplinary Thematic Platform (PTI+). Principal Investigators at IFISC: Roberta Zambrini and Llorenç Serra.

3.5 RESEARCH CONTRACTS

CQD

Activities in the area of electron/hole transport in carbon quantum dot polymer. Services contract with eM-TECH, Inc. FUEIB. Principal Investigator: David Sanchez (2023-2024) UIB Budget: 15.000€

GRAPHIB

Validació d'un model de graus-dia per predir l'aparició de les primeres nimfes de Philaenus spumarius a les Illes Balears. Contrato de servicios FUEIB-CAIB. Principal Investigator: Manuel Matías (2024-2027) Budget: 603.465,72€

3.6 NON-DISCLOSURE AND COLLABORATION AGREEMENTS WITH NON-ACADEMIC INSTITUTIONS

VLC PHOTONICS
A Hitachi Group Company

eTECH

ib-salut
servei de salut de les Illes Balears

Govern de les Illes Balears
Conselleria d'Agricultura, Pesca i Medi Natural

Fundación SICOMORO

cuebiq

AIRBUS

BBVA
DATA & ANALYTICS

DEVELOPMENT PROFESSIONALS, INC.

ikerlan

3 RESEARCH PROJECTS AND FUNDING

4

IFISC SEMINARS

4 IFISC SEMINARS

Coordinators:

Tobias Galla

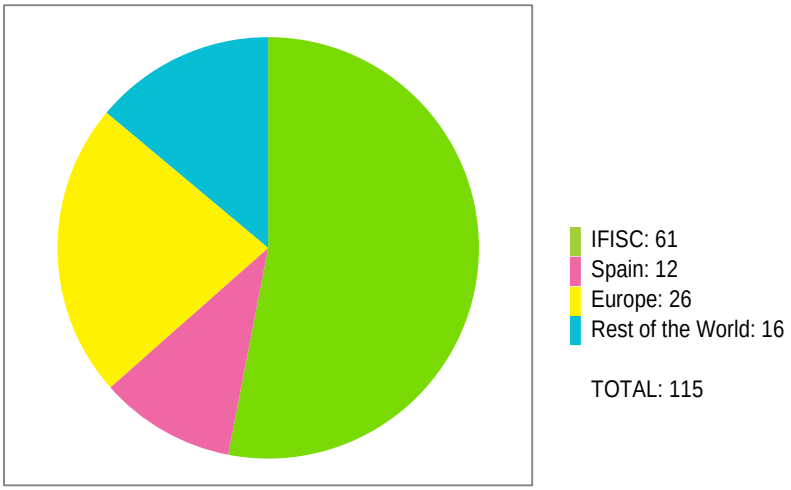
Sandro Meloni

A total of 115 seminars, including weekly regular seminars and talks, were given at IFISC in 2024. The full list of seminars can be found at the website: **http://ifisc.uib-csic.es/en/events/seminars/** as well as in the Appendix of this report.

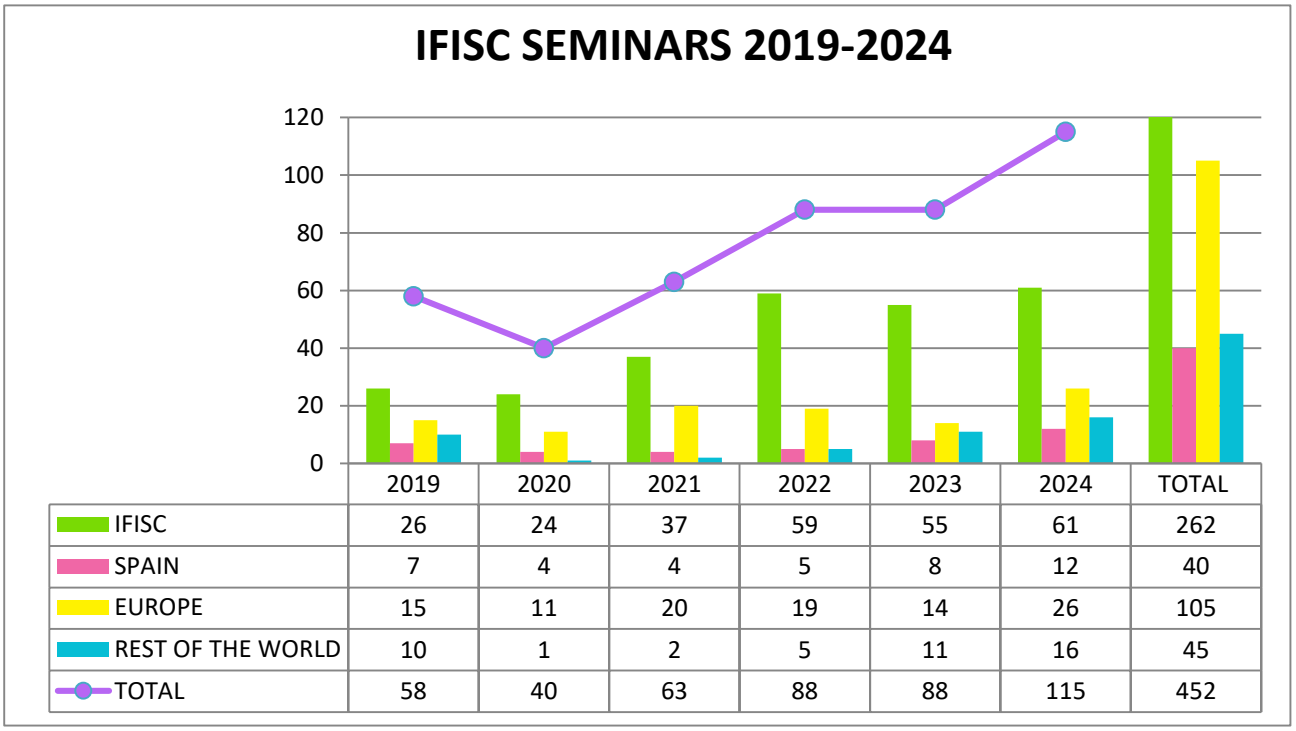
Seminars are broadcasted live and recorded. They are globally available at **http://ifisc.uib-csic.es/en/events/seminars/**, and also on our youtube channel **https://www.youtube.com/user/IFISCseminars/**

The following graphs show the distribution of seminars by geographical provenance of the speaker for 2024 and for the previous years:

PROVENANCE OF SPEAKERS AT IFISC SEMINARS 2024



IFISC SEMINARS 2019-2024



	2019	2020	2021	2022	2023	2024	TOTAL
IFISC	26	24	37	59	55	61	262
SPAIN	7	4	4	5	8	12	40
EUROPE	15	11	20	19	14	26	105
REST OF THE WORLD	10	1	2	5	11	16	45
TOTAL	58	40	63	88	88	115	452

5

PUBLICATIONS

5 PUBLICATIONS

IFISC RESEARCH RESULTS HAVE BEEN REPORTED IN THE FOLLOWING PUBLICATIONS DURING 2024:

- Papers in indexed journals: **109**
- Other publications: **5**

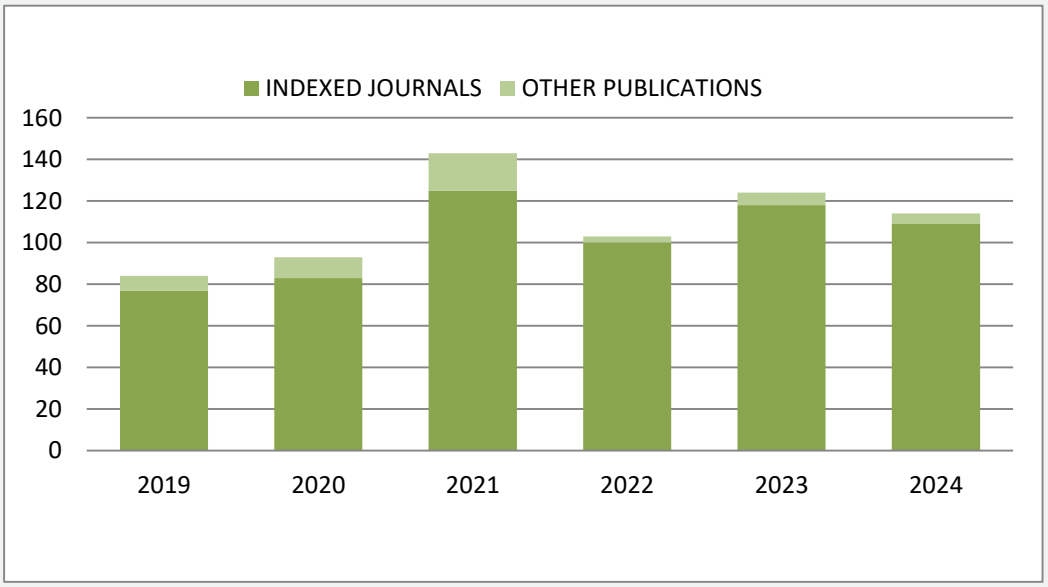
The following tables place these numbers in the context of the publication activity during the past years, specifying the main journals in which IFISC papers are published. It is a strategic commitment of IFISC to target cross-disciplinary research areas lying outside the domain of traditional physics. The success in this objective is highlighted in the tables by indicating the number of publications in *non-physics journals*.

With respect to publications in high impact journals, in 2024 IFISC has published 7 papers in Nature Communications, 1 in Science Advances, 1 in Physics Reports, 1 in npj Quantum Information, 2 in Physical Review X, 2 in Physical Review Letters, 1 in Review in Physics, 1 in Annual Review of Food Science and Technology and 1 in Advanced Photonics.

- Non Physics Journals: **23**
- High Impact Journals: **17**

Full listing of publications and links to the full text are available here: **http://ifisc.uib-csic.es/en/publications/** and in the Appendix of this Report.

IFISC PUBLICATIONS 2019-2024



	2019	2020	2021	2022	2023	2024	TOTAL
INDEXED JOURNALS	77	83	125	100	118	109	612
OTHER PUBLICATIONS	7	10	18	3	6	5	49
TOTAL	84	93	143	103	124	114	661

JOURNALS WITH THE LARGEST NUMBER OF PUBLICATIONS

IFISC PUBLICATIONS	2019	2020	2021	2022	2023	2024	TOTAL
Physics journals							
Physical Review E	8	3	9	10	14	6	50
Chaos	4	8	5	1	10	3	31
Physical Review B	2	5	7	4	7	3	28
Optics Letters	0	7	5	4	5	7	28
Physical Review Letters	1	2	4	4	3	2	16
New Journal of Physics	3	2	5	3	1	1	15
Physical Review A	1	2	2	3	0	2	10
Multidisciplinary journals							
Scientific Reports	9	5	8	8	7	3	40
Nature Communications	2	2	4	5	2	7	22
Plos One	0	3	0	3	0	0	6
IEEE journals	2	4	3	4	2	1	16
Other non-physics journals	21	11	40	20	24	23	139

The journals included in the “other non-physics journals” category are the following:

Biosciences: Helyon Journal, American Naturalist, Plos Computational Biology, Journal of Theoretical Biology, Journal of the Royal Society Interface, eLife, PLoS Computational Biology, PLoS Genetics, Ecological Complexity, Ecological Modelling, Ecography, Biomolecules, NPJ Systems Biology and Applications, Frontiers in Systems Neuroscience, Frontiers in Medicine, Computer Methods and Programs in Biomedicine, Environmental Microbiology, Biological Conservation, Viruses, Methods in Ecology and Evolution, Theoretical Population Biology, Briefings in Bioinformatics, Ecological Applications, Oikos, Communications Biology, BMC Health Services Research, Computational and Structural Biotechnology Journal, Statistics in Medicine, JAMA Network Open, Human Brain Mapping, Brain Topography, Brain Sciences, Phytopathology, and Environmental entomology.

Earth sciences: Journal of Geophysical Research Atmospheres, Marine Pollution Bulletin, Proceedings of the Royal Society, Journal of Geophysical Research, Frontiers in Earth Science, Frontiers in Marine Science, Tellus A, Ocean Science, Journal of Climate, Land, and Journal of the air transport research society.

Sociotechnical and Social systems: Journal of the Air Transport Research Society, Transportation planning and Technology, Zeitschrift für Romanische Philologie, Journal of the Royal Society Interface, Annual Review of Food Science and Technology, Palgrave Communications, Journal of Economic Interaction and Coordination, Transportation Research, International Journal of Electrical Power and Energy Systems, Games and Economic Behaviour, and Cybergeo.

Data science, Neural Computation and Machine learning: Computational and Applied Mathematics, Statistical Methods in Medical Research, Mathematics, Journal of Applied Mathematics and Computing, Network Neuroscience, Machine Learning Science and Technology, AIMS Mathematics, Mathematical models and Methods in the Applied Sciences, Neuroinformatics, Neural Networks, EPJ Data Science, Cognitive Computation, Nature Machine Intelligence, Neurocomputing, IEEE Transactions on Neural Networks and Learning Systems, Research Synthesis Methods, Applied Network Science, and Frontiers in neuroscience.

6

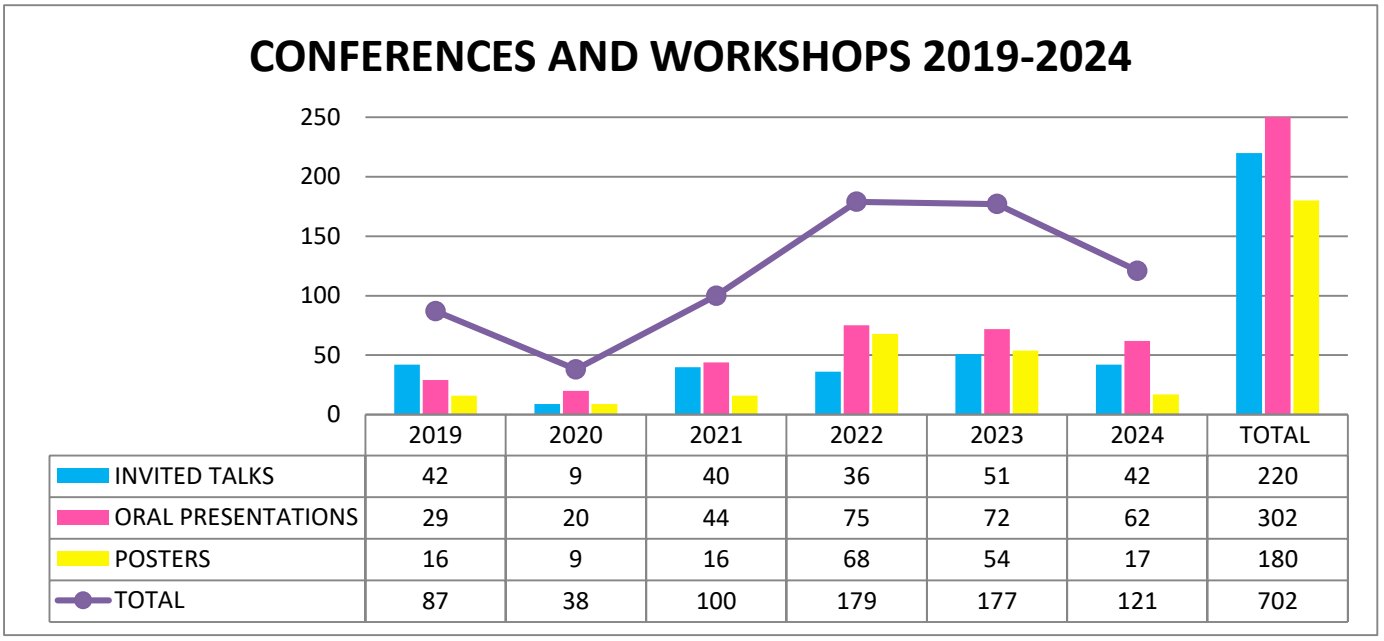
CONFERENCES AND WORKSHOPS

6 CONFERENCES AND WORKSHOPS

6.1 PRESENTATIONS AT SCIENTIFIC CONFERENCES 2024

- Invited talks: **42**
- Oral presentations: **62**
- Posters: **17**
- Total in 2024: **121**

Full listing in the Appendix of this Report.



	2019	2020	2021	2022	2023	2024	TOTAL
INVITED TALKS	42	9	40	36	51	42	220
ORAL PRESENTATIONS	29	20	44	75	72	62	302
POSTERS	16	9	16	68	54	17	180
TOTAL	87	38	100	179	177	121	702

6.2 ORGANIZATION OF CONFERENCES AND WORKSHOPS

- **Colet, Pere**

Member of the Scientific Commitee of XII GEFENOL Summer School on Statistical Physics of Complex Systems. Madrid, Spain

- **Soriano, Miguel C.**

Member of the Porgram Committee of the Emerging Topics in Artificial Intelligence (ETAI) conference, SPIE.

Program Committee Member of SPIE Photonics Europe 2024- Semiconductor Lasers and Laser Dynamics.

Member of the program committee of the International Symposium on Physics and Applications of Laser Dynamics.

- **Ramasco, J.J.**

Chair of the Steering Committee of the Conference on Complex Systems.

- **Rosillo-Rodes, Pablo**

Organization of the Winter Workshop on Complex Systems in Lombardy, Italy.

- **Zambrini, Roberta**

Organization of the satellite event in the CMD31 Conference, MC20 – Neuromorphic computing with complex systems, in Braga, Portugal.

Organization of the event Woman in Quantum II. Calvia, Mallorca.

- **Matias Manuel A.**

Member of the Scientific Committee of FISES.

- **Arregui García, Beatriz**

Organization of the 3rd edition of the FISES Joven (online)

- **Meloni, Sandro**

Member of the programme committee of CompleNet 2024 held in Exeter, UK.

Member of the the programme committee of NetSci 2024 conference held in Quebec City, Canada.

- **Tugores, Antonia**

Organization of “Jornada Jornada Científica: Gestión de datos en Humanidades y Ciencias Sociales”.

- **Sánchez, D.**

Organization of Complexity in Language Variation and Change (COMPILA 2024).

- **Diaz-Diaz, Fernando**

Organizing committee of FISES joven 24.

Satellite of the Conference in Complex Systems (CCS24), Exeter, UK.

Member of the Organizing Committee of the Winter Workshop on Complex Systems, Puigpardines, Catalonia, Spain.

- **Klemm, Konstantin**

Member of the Program Committee of the Complex Networks 2024. Istambul, Turkey.

- **Zanin, Massimiliano**

Scientific Committee member of SESAR Innovation Days 2024.

Organization of workshop: Information Systems for Health Emergencies and Patients Oriented Research in 2024 IEEE International Conference on Bioinformatics and Biomedicine. Lisboa, Portugal.

- **Mirasso, Claudio; Obreja, Simona**

Organizing Committee of 100xCiencia.8 in Palma de Mallorca, Spain

- **Toral, Raul**

Organizing committee of the Symposium on Physics on Complex Systems, at the XXXIX Bienal de la Real Sociedad Española de Física, San Sebastian, Spain.

- **Argyris, Apostolos; Cornelles Soriano, Miguel; Ortín, Silvia; Mirasso, Claudio**

Organizing committee of Facilitating neuromorphic computing: Are dendrites the next step forward? - Fundamentals and Hardware Implementation, in Palma de Mallorca, Spain.

6 CONFERENCES AND WORKSHOPS

7

OTHER ACTIVITIES

7 OTHER ACTIVITIES

7.1 PhD PROGRAM

IFISC participates in the PhD Program in Physics of the University of the Balearic Islands. During 2024, 48 PhD students developed their research project at IFISC, and 7 PhD thesis were completed and successfully defended:

Theoretical and data-driven models in Ecology
Giménez-Romero, Àlex (Supervisor: Matias, Manuel A.)
October 30

Aging and memory effects in social and economic dynamics
Abella, David (Supervisors: Ramasco, Jose J. and San Miguel, Maxi)
October 10

Computing with Dynamical Systems: from implementations towards novel concepts
Goldmann, Mirko (Supervisors: Fischer, Ingo; Mirasso, Claudio R.; Soriano, Miguel C.)
October 4

Power grid dynamics and stability with a high penetration of renewable energies
Martínez-Barbeito, María (Supervisors: Colet, Pere; Gomila, Damià)
September 10

Complex Systems Perspectives on Large-Scale Weather and Climate Variability Patterns
Ehstand, Noémie (Supervisors E. Hernandez-Garcia, C. Lopez and R.V. Donner)
July 10

Neural dynamics and information transmission: from cortical circuits to the hippocampal modelling
Jaime Sánchez Claros (Supervisors Claudio Mirasso and Santiago Canals)
June 4

Information processing with photonic hardware neural networks
Estébanez, Irene (Supervisors: Fischer, Ingo; Argyris, Apostolos)
February 14

7.2 SURF@IFISC

The Summer Undergraduate Research Fellowships (SURF@IFISC) program is part of one of the IFISC compromises: to offer training for the future generations of researchers in the field of complex systems.

Since 2013 we offer fellowships for introduction to academic research under the supervision of an IFISC researcher. These fellowships are aimed at world-wide undergraduate students of physics, mathematics, chemistry, biology and engineering.

SURF fellowships provide support for a 4-weeks summer stay at IFISC, carrying a research program under the supervision of an IFSIC researcher.

For the 2024 program we received 37 applications from 20 universities belonging to 7 different countries and the candidates were citizens of 6 different countries.
The following six were selected:

Irene López Larios, from the University of Alicante, Spain

Adam César Maćkowiak Pellón, from the University of the Balearic Islands, Spain

Sergio Arias Rangel, from University Carlos III of Madrid, Spain

Agostina Iozzi Acosta, from University of Barcelona, Spain

Ernest Staffetti Cruañas, from Complutense University of Madrid, Spain

Andreu Fiol Mateu, from University of Barcelona, Spain

IFISC Master in *Physics of Complex Systems*

https://ifisc.uib-csic.es/master/

In October 2012 IFISC started a Master program in Physics of Complex Systems. It is a one year (60 ECTS) official Master of the University of the Balearic Islands, in collaboration with CSIC. The courses provide an innovative entry point to Complex Systems fundamentals and applications and introduce the students in the research lines developed at IFISC. For the 2024-2025 academic course 12 students of 3 different nationalities and 6 different universities are registered in the master.
In the year 2024, 16 master thesis were defended. They are listed in the Appendix of this Report.

This is the 2023-2024 Master syllabus:

Structural module courses (33 credits):

Simulation methods (6 credits)	P. Colet, R. Toral
Cooperative and critical phenomena (6 credits)	E. Hernández-García, T. Sintes
Dynamical systems, chaos and patterns (6 credits)	D. Gomila, M. Matías
Stochastic Processes (3 credits)	P. Colet, R. Toral
Complex Networks (3 credits)	E. Estrada, J. Fernández-Gracia
Complex Quantum Systems (3 credits)	G. Giorgi, Ll. Serra, R. Zambrini
Introduction to data analysis and machine learning I (3 credits)	L. Lacasa, J. Ramasco
Information Theory (3 credits)	D. Sánchez

Specific module courses (9 credits minimum)

Non equilibrium collective phenomena (3 credits)	C. López
Spatiotemporal dynamics (3 credits)	D. Gomila
Systems Biology (3 credits)	M. Matías, T. Galla
Statistical Biophysics (3 credits)	T. Sintes
Modeling and dynamics of neural systems (3 credits)	C. Mirasso
Complex Photonics (6 credits)	A. Argyris, M. C. Soriano, I. Fischer
Open quantum systems (3 credits)	R. Lopez, G. Manzano
Computational social sciences (6 credits)	P. Colet, J.Ramasco, M.San Miguel, D.Sanchez, M.Zanin, J. Fdez-Gracia
Collective quantum phenomena (3 credits)	G. Giorgi, G. Manzano, L. Serra
Quantum Information (3 credits)	D. Sanchez
Nonlinear phenomena in fluid flows and climate (3 credits)	C. Lopez
Advanced complex networks (3 credits)	S. Meloni
Ecology and population dynamics (3 credits)	T. Galla
Modeling based on complex systems in economics (3 credits)	P. Colet, R. Lopez
Introduction to data analysis and machine learning II (3 credits)	M. C. Soriano, M. Zanin

Master thesis (12 credits)	Responsible: P. Colet

7.4 OTHER POSTGRADUATE COURSES

Other Postgraduate Courses taught in 2024

The following courses were also taught in the **Master of Advanced Physics and Applied Mathematics**, University of the Balearic Islands:

- **Cooperative and critical phenomena (6 credits)**
Tomàs Sintes, Emilio Hernández-García

- **Stochastic simulation methods (6 credits)**
Pere Colet, Raúl Toral

- **Spintronics (3 credits)**
Rosa López, Llorenç Serra, David Sánchez

- **Electronic nanostructures (3 credits)**
David Sánchez, Llorenç Serra

The following courses were also taught in the **Master in Quantum Technologies**, International University Menendez Pelayo, Santander, Spain:

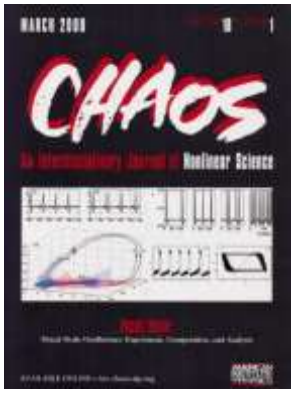
- **Quantum machine learning and computing (3 credits)**
Roberta Zambrini

- **Hybrid and Semiconductor Qubits (6 credits)**
Rosa Lopez

- **Open Quantum systems and Thermodynamics (3 credits)**
Gian Luca Giorgi, Rosa Lopez.

7.5 MEMBERS OF EDITORIAL BOARD OF SCIENTIFIC JOURNALS

Ecological Complexity.
Hernandez-Garcia, Emilio (advisory board)



Chaos: An Interdisciplinary Journal of Nonlinear Science.
Fischer, Ingo (advisory board)

European Physical Journal Special Topics.
Colet, Pere

Entropy.
Lacasa, Lucas
Wio, Horacio

Entropy, Complexity Section.
San Miguel, Maxi

Proceeding of the Royal Society A: Mathematical, Physical and Engineering Sciences.
Giorgi, Gian Luca

Frontiers in Physics.
Argyris, Apostolos
Wio, Horacio
Lacasa, Lucas

Journal of Complex Networks.
Lacasa, Lucas

European Physical Journal B.
Wio, Horacio

Physica A.
Wio, Horacio

Advances in Complex Systems.
Sánchez, David

Physical Review Letters.
Zambrini, Roberta (divisional associate editor)

Nature Communications Physics.
Argyris, Apostolos (guest editor)

7.6 SCIENTIFIC COMMITTEES

- **Toral, Raul**

Member of the board of the division C3: Statistical Physics of the International Union for Pure and Applied Physics (IUPAP).

- **Ramasco, Jose J.**

Coordinator PTI Mobility 2030 of CSIC.

Adjunct coordinator of the CSIC area of MATERIA.

- **Cornelles Soriano, Miguel**

Elected Member of IEEE Task Force on Reservoir Computing.

Elected member of the Quantum Optics and Nonlinear Optics Committee (SEDOPTICA).

- **Fischer, Ingo**

Elected Member of IEEE Task Force on Reservoir Computing.

Member of the advisory board of the Japanese national project "Photonic Computing Highlighting Ultimate Nature of Light\" (MEXT Grant-in-Aid for Transformative Research Areas).

- **Zambrini, Roberta**

Gestora AEI. Area Physics; Subarea Physics and applications.

Responsible and moderator of the Quantum Thermodynamics website.

- **Tugores, Antonia**

Member of Authentication and Authorization Infrastructure Architecture (AAI) Task Force of the European Open Science Cloud, EOSC.

- **Sintes, Tomas**

Member of the IUPAP Working group on the Green Economy.

7.7 RESEARCH STAYS IN OTHER CENTERS

During 2024 IFISC Researchers visited 23 external research centers, 12 in Europe and 7 in the rest of the world.

These visits are listed in the Appendix to this Report.

8

OUTREACH ACTIVITIES

8 OUTREACH ACTIVITIES

8.1 POSTER PARTY

The IFISC Poster Party is an annual event where PhD students and postdoctoral researchers at IFISC present their research in a poster format. In a relaxed atmosphere, attendees can learn first-hand about the work carried out by young researchers at IFISC. It is an excellent opportunity for undergraduate students to discover what a career in research involves, as they can interact directly with IFISC researchers and doctoral students who share their personal experiences and answer questions.

8.2 PINT OF SCIENCE

IFISC actively participates in the Pint of Science festival, which aims to present exciting and relevant talks on the latest scientific research in an accessible format to the public, typically in bars and pubs. The festival provides a platform for people to engage with researchers directly, without requiring any prior knowledge of the subject. Originating in the UK in 2012, it is primarily organized by volunteers.

During one of the three days of the event (May 13, 14, and 15), four scientists from IFISC gave outreach talks at the iconic Café a Tres Bandas (Plaza de Barcelona, Palma):

- *¿En que se parecen los gases y las ciudades?* by David Abella
- *Descifrando el fondo marino desde el espacio* by Álex Giménez
- *Interacciones de alto orden en redes sociales* by Beatriz Arregui
- *Desmitificando el Demonio de Maxwell* by José Antonio Almanza

8.3 LA RESITÈNCIA CIENTÍFICA 2.0

On April 4, 2024, the CSIC Delegation in the Balearic Islands and IFISC presented the second edition of La Resistència Científica 2.0 at CaixaForum Palma. This late-night science show brought together specialists from various research centers in the Balearic Islands to share key aspects of their work with the public in an engaging and entertaining format.

Over four sessions, attendees explored topics such as the functioning of complex systems, the deep sea, marine and aquifer research, and the crucial role of mathematical models in conserving endangered species. The events took place on April 11, 18, and 25, and May 2, at 7 p.m., in a hybrid format that combined live presentations at CaixaForum Palma with online streaming.

Continuing its commitment to sustainability, this edition featured stage decorations made from recycled materials, thanks to the collaboration of the Deixalles Foundation, which provided props to give the show its signature punk aesthetic.

Organized in collaboration with the "la Caixa" Foundation and supported by the Autonomic Secretariat for Innovation and Digital Society of the GOIB, La Resistència Científica 2.0 blended humor and scientific outreach to connect the public with cutting-edge research conducted in the Balearic Islands.

PROGRAM

Thursday, April 11 – A Brain of Airports

In the first session, IFISC researcher Massimiliano Zanin discussed how air transport networks can be studied as complex computational units, drawing inspiration from the way the brain processes information. He explored how airports receive, process, and redistribute data through incoming and outgoing flights, creating a dynamic system that mirrors information processing in biological systems.

Thursday, April 18 – The Future of the Oceans

Carme Alomar and Beatriz Rios, from the Oceanographic Center of the Balearic Islands (COB, CSIC-IEO), led a discussion on oceanographic culture and the multidisciplinary study of marine ecosystems. They addressed the challenges facing marine sciences in a changing climate, the human impact on marine life, and the effects of microplastics on ocean flora and fauna.

Thursday, April 25 – Between Waves and Aquifers

This double session featured Pedro Robledo, director of the Territorial Unit of the Geological and Mining Institute of Spain in the Balearic Islands (IGME, CSIC), who examined the impact of climate change on the Cabrera archipelago and how rising global temperatures affect groundwater in coastal aquifers. Additionally, Àngels Fernández, from ICTS SOCIB, introduced the audience to the dynamics of ocean waves and currents, explaining how these natural phenomena shape the evolution of beaches and how we can adapt to future coastal changes.

Thursday, May 2 – Conservation of Mediterranean Biodiversity

In the final session, researcher Ana Sanz from the Mediterranean Institute for Advanced Studies (IMEDEA, CSIC-UIB) explored how mathematical models are used to study the population dynamics of endangered species, particularly birds and reptiles. She highlighted conservation efforts for species such as the black vulture and the Balearic shearwater (virot in the Balearic Islands), emphasizing the importance of scientific research in protecting Mediterranean biodiversity.

8.4 CIÈNCIA A TOT TREN

A group of about twenty scientists from various public research institutions in the Balearic Islands came together to carry out "Ciència a tot tren", a unique proposal inviting audiences of all ages to experience science through a journey on the iconic Sóller train. The event took place on November 11 and consisted of mini scientific talks and activities in Sóller.

This event aimed to bring to the public the science developed in the laboratories of the Balearic Islands in an environment that combines cultural, ethnological, and natural aspects of great value. Specifically, scientists shared their latest advancements and knowledge with the passengers of the century-old wooden train through a series of thematic micro-talks, on a journey with the Tramuntana mountain range in the background. Upon arriving in Sóller, the public had the opportunity to visit some of the most important cultural and scientific centers in the area, such as the Jardí Botànic de Sóller, the Museu Balear de Ciències Naturals, and the Museu de la Mar in the Port de Sóller. The informative talks continued on the return journey to Palma.

The event was open to people of all ages interested in science, offering an opportunity for participants to learn about the research conducted in their region in an accessible and entertaining way. On the IFISC side, three pre-doctoral researchers participated:

- Juan Antonio García (IFISC): «Todo está conectado: redes, redes y más redes»
- Josu Blanco (IFISC): «El gran secreto de las estrellas: el plasma»

8.5 100xCiencia.8

100xCiencia 8 was a conference in October 9-11, where more than 200 members of the Spanish scientific community that make up the Alliance of Severo Ochoa Centers of Excellence and María de Maeztu Units of Excellence participated to highlight the role of the science of complex systems in contributing and providing solutions to challenges related to a just digital, ecological and social transition, and climate change, among others.

As part of this congress, a session open to the public was organized at the Club Diario de Mallorca, presented and moderated by Luis Quevedo, a prominent Spanish science communicator, journalist and filmmaker, known for making science accessible to the general public through various media. This session featured speakers Ernesto Estrada (IFISC) and Angel Amores (IMEDEA) who discussed the role of science in the face of global challenges.

8.6 NAUKAS PALMA

On Saturday 5th October the third edition of **Naukas 360º** was held in Palma de Mallorca, organised by the UIB with the collaboration of the Govern de les Illes Balears and the Ajuntament de Palma. Naukas is Spain's most famous science outreach event series. The event was held in Palma's famous Palacio de Congresos with high-level local and national speakers. Among them, IFISC researchers participated:

- Pablo Rosillo (IFISC): «¿Puede un ordenador cantar flamenco?»
- Adrián Garcia (IFISC): «Nos vemos en el mosh-pit: la física que aprendí con el heavy metal»

8.7 SCIENCE AND TECHNOLOGY FAIR OF INCA

Members of IFISC participated in the «*Fira de la Ciència i la Tecnologia d'Inca*» (October 19). Both seniors and children were able to visit the IFISC stand in order to learn more about our institute and the importance of complex systems in the study of nature. Among the experiments shown, the attendees highlighted the chaotic pendulum, the synchronization of metronomes, ambiguous cylinders and ferromagnetic fluid.

8.8 NIT DE LA RECERCA

Science Fair located in the Parque del Mar with stands from the Oceanographic Centre of the Balearic Islands - Spanish Institute of Oceanography (COB-IEO), the Balearic Islands Health Research Institute (IdISBa), the Institute of Cross-disciplinary Physics and Complex Systems (IFISC), the Mediterranean Institute of Advanced Studies (IMEDEA), the Balearic Islands Institute of Agri-Food and Fisheries Research and Training (IRFAP), and the University of the Balearic Islands (UIB).

In addition, there was a final show where scientists from our islands explained their work in a fun and entertaining way. On behalf of IFISC, the outreach technician Adrián García participated with his talk «*Cuando el todo es más que la suma de las partes*»

8.9 OTHER OUTREACH EVENTS

STEM Talks Menorca

On January 25 and 26, IFISC participated in the 7th edition of STEM Talks Menorca, held at Centre Bit Menorca. This event, dedicated to the dissemination of scientific and technical knowledge in the fields of Science, Technology, Engineering, and Mathematics (STEM), brought together the community once again for two days of lectures by leading professionals in science and technology.

Representing IFISC, communication officer Adrián García gave a talk on complex systems and interdisciplinarity, illustrating these concepts with examples of research conducted at IFISC. The event, free and open to all, covered topics such as artificial intelligence, quantum computing, virtual reality, and the metaverse, with speakers from various public and private institutions across Spain.

Pràctiques Vocacionals CUC Calvià

IFISC has participated in the presentation of diplomas to the 68 young students of Calvià of 4th ESO and 1st Batxillerat who have participated in the XI Edition of Professional Practices organized by the City Council of Calvià. These internships, in which IFISC has received two students, have allowed them to get to know professions first hand, in a direct contact with a view to the choice of their future academic training.

Outreach talks in high schools

On March 26, IFISC outreach technician Adrián García visited high school students at IES Madina Mayurqa to explain the science being done at IFISC and what Complex Systems research consists of.

On April 23 the same talk was given to high school science students at IES Son Rullán.

Visit of IES Ágora Portals

On April 11, IFISC welcomed a group of students from IES Ágora Portals as part of its commitment to scientific outreach and education. During their visit, students had the opportunity to learn about the research conducted at IFISC and explore key concepts in complex systems.

Night at the Institute

An activity in which the students of 1st ESO of IES Joan Alcover go to the high school in the afternoon to learn in extracurricular workshops. IFISC participated with a workshop on light and lasers, relating it to the photonic and quantum technologies that are carried out at the institute.

Vivimos en un mundo enREDado.

Outreach talk by Ernesto Estrada in Club Diario de Mallorca, in the framework of 100xCiencia.8.

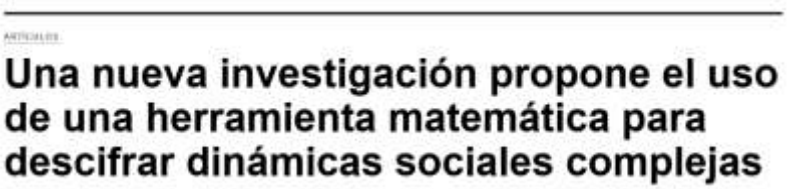
Científic@s en prácticas.

IFISC participated in the program Científic@s en Prácticas, organized by CSIC and AEAC, to promote scientific careers among high school students in their third and fourth years. Students from various public high schools spent a week at IFISC learning about Complex Systems under the supervision of Dr. R. Lopez, a female scientist @IFISC.

8.10 PRESS AND MEDIA

News about IFISC and its research results are regularly posted in the 'News' section of the web site: https://ifisc.uibcsic.es/en/news/.

IFISC research has also received attention from newspapers and other media. During 2024, IFISC activities produced 133 press releases and appearances in written and digital press (national and international), and 11 clips on radio and TV. See the full lists in the Appendix.



SOCIAL MEDIA IMPACT SUMMARY

TWITTER @IFISC_mallorca

Total Followers 3.399 (5% increase of number of followers in 2024)

http://www.facebook.com/ifisc

Facebook fans: 1.138 (1% increase of fan number in 2024)

62% men / 38% women

Mostly located in Spain, Brazil and Mexico

http://www.youtube.com/user/IFISCseminars

Visualizations: 35.309 in 2024 of a total of 330.491

YouTube subscribers: 3.272 (33% increase of subscribers in 2024)

85% men / 15% women

Mostly located in Spain, USA, Mexico, India and Colombia

https://www.linkedin.com/company/ifisc-institute-for-cross-disciplinary-physics-and-complex-systems-csic-uib-

Total Followers: 998 (16% increase of number of followers in 2024)

https://bsky.app/profile/ifisc.uib-csic.es

Total followers: 303 (since December)

8 OUTREACH ACTIVITIES

APPENDIX

a.4. IFISC seminars and talks 2024

In the electronic version of this report, titles are hyperlinked to the recording of the seminar, if available.

December 17
Sociomeeting: Journal Club: Intersectional inequalities in social networks/Emergence of group size disparity in growing networks with adoption
Juan Antonio García Castillo, IFISC

December 16
Fluctuation theorems revisited: the role of imperfect monitoring and feedback
José A. Almanza-Marrero, IFISC

December 13
Packaging and assembly advancements for commercialization of neuromophic PIC
Tigers Jonuzi, VLC Photonics, Valencia, Spain

December 12
Thermodynamics of coupled time crystals with an application to energy storage
Paulo Paulino, Tubingen University, Germany

December 5
2024 Winter Solstice IFISC Project Presentations
IFISC Principal Investigators, IFISC

December 3
Sociomeeting: Analysis and modelling of photovoltaic installations diffusion
Canigó Callau i Boix, IFISC

November 27
A complete theory of quantum mechanics?
Damià Gomila, IFISC

November 25
Combining Ecological Theory with Data to Predict Nonlinear Ecosystem Dynamics
John Buckner & James Watson, Oregon State University | College of Earth, Ocean and Atmospheric Sciences, USA

November 22
Deep Learning for Time Series: Advancements in Recurrent Architectures and Reservoir Computing
Claudio Gallicchio, Department of Computer Science, University of Pisa, Italy

November 22
Linking neuronal connectivity with brain cross-rhythmic interactions
Dimitrios Chalkiadakis, IFISC - Instituto de Neurociencias Alicante, Spain

November 21
Automatic Generation of Optimized Quantum Circuits for Real-world Machine Learning Applications
Sergio Altares-López, Centre for Automation and Robotics (CSIC-UPM), Spain

November 20
Role of data embedding in equivariant quantum convolutional neural networks
Sreetama Das, IFISC

November 19
Discussion meeting "The virtues and limits of reductionism"
Interested participants, IFISC

November 12
Sociomeeting: Interacting social and disease dynamics in multiplex networks
Federico Vázquez, Instituto de Cálculo, Univ. de Buenos Aires, Argentina

November 5
Sociomeeting: Large-scale analysis of trajectory interaction networks in Europe
Raúl López Martín, IFISC

November 4
Community based dismantling strategies in real-world complex networks
Salvatore Micciche , Palermo University, Italy

October 31
Compressed representations in deep learning: From algorithmic information to autoencoders and hypernetworks
Arnau Vivet, IFISC

October 30
Thermalization is typical in large classical and quantum harmonic systems
Marco Cattaneo, QTF Centre of Excellence, Department of Physics, University of Helsinki, Finland

October 30
Theoretical and data-driven models in Ecology
Alex Giménez Romero, IFISC

October 29
Sociomeeting: Data Collection on Traffic Accidents and Flows
Lourdes Pérez López, Universidad San Jorge, Zaragoza, Spain

October 29
MdM Quantum Seminar: Constrictions between topological edge channels
Niccolò Traverso Ziani, Università degli studi di Genova, Italy

October 29
A self-organized criticality participative pricing mechanism for selling zero-marginal cost products
Daniel Fraiman, Departamento de Matemática y Ciencias, Universidad de San Andrés & CONICET, Argentina.

October 24
Communicating science
Adrián García Candel, IFISC

October 24
Gene-regulatory networks viewed through statistical mechanical glasses
Alessia Annibale, Disordered Systems Group, Department of Mathematics, King's College London, UK

October 23
Beyond pairwise interactions: Exploring brain high-order interactions in neurodegeneration and states of consciousness
Rubén Herzog, Institut du Cerveau – Paris Brain Institute, France

October 22
Sociomeeting: Estimating transmission noise on networks from stationary local order
Christopher R. Kitching, University of Manchester, UK

October 18
Improving Location and Prediction Region Accuracy in Marine Animal Movement with Temporal Fusion Transformer.
Jorge Medina, IFISC

October 16
Predictive inference and material world in cognitive processes
Felipe Criado/Luis Martínez, Instituto de Ciencias del Patrimonio del CSIC / Instituto de Neurociencias, Alicante, Spain

October 15
Sociomeeting: Universality of noise-induced transitions in nonlinear voter models
Jaume Llabrés, IFISC

October 9
Network Epidemiology: from analytical insights to data-driven modeling of contagion
Yamir Moreno, Institute for Biocomputation and Physics of Complex Systems (BIFI) , University of Zaragoza, Spain and Centai Institute, Turin, Italy.

October 8
Aging and memory effects in social and economic dynamics
David Abella, IFISC

October 7
Towards understanding of the social hysteresis – insights from statistical physics and surprises
Katarzyna Sznajd-Weron, Department of Humanities and Social Sciences, Faculty of Management, Wroclaw University of Science and Technology, Poland

October 7
Branching processes for cascades on networks
James Gleeson, SFI Centre for Research Training in Foundations of Data Science, University of Limerick, Ireland

October 1
Sociomeeting: The Sore Loser Effect and Affective Polarization in the UK
Andrés Bernstein, UIB, Spain

September 24
Sociomeeting: Monitoring the Economy with Big Data and Alternative Methods
Luca Tiozzo Pezzoli, Department of Applied Economics, UIB, Spain

September 19
Generating functional analysis of a thresholded random generalised Lotka-Volterra model
Adrian Roig Oliver, IFISC

September 18
The functional role of oscillatory dynamics in neocortical circuits: a computational perspective
Felix Effemberg, Ernst Strüngmann Institute, Frankfurt, Germany

September 17
Sociomeeting: A PhD journey in ABMs for social systems
Jesús A. Moreno López, IFISC

September 16
Best Teacher Award for the Master in Physics of Complex Systems
Maxi San Miguel, IFISC

September 11
Resilience of power grids against extreme events
Mehrnaz Anvari , Fraunhofer Institute for Algorithms and Scientific Computing, Sankt Augustin, Germany

July 22
Quantum optical complex networks for information and energy processing
Federico Centrone, ICFO, Barcelona, Spain

July 22
Gaussian and non-Gaussian resources in quantum optics
Francesco Arzani, INRIA Paris, France

July 12
Integrating Biology and AI: Enhancing Recurrent Networks of Spiking Neurons for Visual Information Processing
Javier Galván, IFISC

July 9
Quantum Long Short Term Memory
Asier Garay, Ikerlan and IFISC

July 3
Theta-gamma coupling in the auditory cortex is purely acoustic, but it is a mechanism for speech perception (starting time 14.15)
Víctor López Madrona, Aix-Marseille Université, France

July 2
Sociomeeting: Structure and dynamics of specialised meetings in a research environment
Jupaán Garoillo, Computational Social Science Unit, Thayland Research Center, Thayland

June 25
Sociomeeting: Understanding following patterns among Olympic medallists
Jorge P. Rodríguez, IFISC

June 21
Interplay between Quantum Machine Learning and Open Quantum Systems
Antonio Sannia, IFISC

June 21
Quantum Reservoir Computing in ordered atomic lattices
Guillem Llodrà, IFISC

June 20
Heat-charge separation in hybrid superconducting systems
Fabio Taddei, NEST, NANO-CNR & Scuola Normale Superiore, Pisa, Italy

June 20
The Complexity of Violence
Rafael Prieto-Curiel, Complexity Science Hub Vienna, Austria

June 20
Numerical methods for quasi-stationary distributions
Sara Oliver, IFISC

June 19
Stochastic dynamics on networks: insights into opinion polarization
Toni Fernandez Peralta, IFISC

June 19
How bifurcation theory explains coral reef formation
Miguel Álvarez, IFISC

June 19
Indirect social influence helps shaping the diffusion of innovations.
Manuel Miranda, IFISC

June 18
Sociomeeting: Unveiling emerging moderation dynamics in Mastodon's federated instance network.
Beatriz Arregui, IFISC

June 18
On the structure of species-function participation in multilayer ecological networks
Mar Cuevas Blanco, IFISC

June 17
Integrating Embedding and Network Community Detection to Unveil Terrestrial Virome Domains
Gorka Buenvarón, IFISC

June 14
General framework for quantum associative memory
Adrià Labay-Mora, IFISC

June 12
Thermodynamics of Computations with Absolute Irreversibility, Unidirectional Transitions, and Stochastic Computation Times
Gonzalo Manzano, IFISC

June 11
Sociomeeting: Heterogeneous Dynamics
Fernanda Sánchez, Universidad Nacional Autónoma de México, Mexico

June 6
The Cortex and the Critical Point
John Beggs, Indiana University, Bloomington, USA

June 6
Forecasting emergency department visits at Son Espases hospital: Is tourist and weather data relevant?
Paride Crisafulli, IFISC

June 4
Sociomeeting: Bartoli's areal norms revisited: an agent-based modeling approach
Dalmo Bulzato, Universidade Federal de Minas Gerais Belo Horizonte, Brazil

May 29
Cooper pair splitter in a photonic cavity: Detection of Andreev scatterings
Bogdan Bulka, Institute of Molecular Physics Polish Academy of Sciences, Poznan, Poland

May 28
Sociomeeting: The communicability efficiency
Aitor Azemar, University of Glasgow, UK

May 22
Analysis of marine fishing using vessels trajectories: global structure, suspicious behavior and emergent pathways
Jorge Rodriguez, IFISC

May 21
Demonstration of quantum projective simulation on a single-photon-based quantum computer
Giacomo Franceschetto, Quandela, Massy, France

May 20
Information processing with photonic hardware neural networks
Irene Estébanez, IFISC

May 17
Quantum machine learning enabled by quantum teleportation
Jorge García Beni, IFISC

May 16
IFISC joins the [matrix] network: A new way of communicating
Rubén Tolosa, IFISC

May 16
On the use of probabilistic network models to assess spatially compound (rare) events in a warmer world
Catharina E. Graafland, IFISC

May 15
Probabilistic Networks for Modeling Complex Systems
Catharina E. Graafland , IFISC

May 14
Sociomeeting: Spanish secondary education curriculum as a complex network
Juan Fernández-Gracia, IFISC

May 14
Quantum and classical computing with exciton-polaritons
Michal Matuszewski, Center for Theoretical Physics, Polish Academy of Sciences, Poland

May 8
Inside Nature Communications
Cristiano Matricardi, Senior Editor, Nature Communications, USA

April 30
Sociomeeting: Biased versus unbiased numerical methods for stochastic simulations: application to contagion processes
Javier Aguilar, IFISC

April 30
Mapping the distribution of seagrass meadows from space with deep convolutional neural networks
Àlex Giménez Romero, IFISC

April 24
Society needs a software update: measuring, predicting and managing the complexity of socio-environmental systems
James R. Watson , College of Earth, Ocean and Atmospheric Sciences, Oregon State University, USA

April 23
Mitigating cross-talk errors in gate-based quantum computations
Kyrylo Snizhko, CEA Grenoble, France

April 23
Sistemes Complexos i divulgació a l'IFISC
Adrián García, IFISC

April 18
Data-driven load profiles and the complex dynamics of electricity consumption
Christian Beck, Centre for Complex Systems, School of Mathematical Sciences, Queen Mary University of London, UK

April 17
Stochastic Optical Quantum Circuit Simulator (SOQCS): model and inner workings
Javier Osca, IFISC

April 16
Sociomeeting: Assesing the housing market spatial segmentation
David Abella, IFISC

April 10
Quantum catalysis in cavity QED
Alexssandre de Oliveira Jr., Technical University of Dennmark, Germany

April 9
Shortcuts to adiabaticity from quantum control to quantum computing
Xi Chen, (UPV/EHU and SHU), Pais Vasco, Spain

April 9
Olé tu léxico! A computational investigation into Flamenco lyrics
Pablo Rosillo-Rodes, IFISC

April 8
Exploring the Complexity of the Microbial World
Miguel Angel Muñoz, Universidad de Granada, Spain

March 26
Sistemes Complexos i divulgació a l'IFISC
Adrián García, IFISC

March 22
Driven semiconductor lasers for information processing
Mirko Goldmann, IFISC (CSIC-UIB), Femto-ST (CNRS), France

March 19
Sociomeeting: Social metabolism: quantifying and analysing footprints
Ivan Murray, Departament de Geografia, Universitat de les Illes Balears, Spain

March 2
Recerca sobre la Posidònia Oceànica
Damià Gomila, IFISC

February 27
Sociometing: Similarity and centrality in networks
Ernesto Estrada, IFISC

February 21
Optimal control of lake eutrophication
Éloïse Comte, French National Research Institute for Agriculture, Food and Envi- ronment (INRAE), Complex Systems Lab, France

February 20
Presentation of the Artificial Intelligence and Data Analytics team, IKERLAN
Aizea Lojo, IKERLAN, member of MONDRAGON Corporation and the Basque Research and Technology Alliance (BRTA), Spain

February 15
Communicability geometry reveals antagonistic factions in signed networks
Fernando Diaz, IFISC

February 14
Quasi-equilibrium states in non-confining fields
Celia Anteneodo, Department of Physics, Pontifical Catholic University of Rio de Janeiro, PUC-Rio, Brazil

February 14
New CSIC administrative procedure for travels
Fátima Velasquez and Alberto Sánchez, IFISC

February 13
Sociomeeting: Exploring linguistic relations through memory effects in parts-of-speech sequences
Juan Ignacio de Gregorio, IFISC

February 13
Quantum meeting: Geometric phases along quantum trajectories: ensembles and topological transitions
Ludmila Viotti, ICTP, Trieste, Italy

February 6
Sociomeeting: Language dynamics within adaptive networks: An agent-based approach of nodes and links coevolution
Christos Charalambous, IFSC

February 2
Transmission grid stability with large scale power flows due to renewables
María Martínez-Barbeito, IFISC

February 1
Extinction and coexistence in a binary mixture of proliferating motile disks
Alejandro Almodóvar, IFISC

January 31
An Out-of-Equilibrium 1D Particle System Undergoing Perfectly Plastic Collisions
Daniel Fraiman, Departamento de Matemática y Ciencias, Universidad de San Andrés & CONICET, Argentina.

January 30
Statistical methods for the analysis of samples of (brain) networks
Daniel Fraiman, Universidad de San Andres, Argentina

January 26
Sistemas complejos y otras movidas
Adrián García, IFISC

January 23
Sociomeeting: Using triangles to compute segregation
David Abella, IFISC

January 17
Path integral control theory
Hilbert Kappen, Donder Institute, Radboud University Nijmegen, the Netherlands.

January 16
Sociomeeting: Dynamical Metrics for Temporal Networks: State of art, Extensions and Applications
Annalisa Caliguri, IFISC

January 15
Quantum meeting: Heat Pulses in Electron Quantum Optics
Pedro De Castro Portugal, Doctoral Student at the Centre of Excellence in Quantum Technology, QTF, Aalto, Finland

January 15
The Madden Julian Oscillation skeleton model with time-dependent observation-based forcing
Noémie Ehstand, IFISC

January 9
Sociomeeting: Air transport through the lens of complex networks: airspace structure and aircraft mobility
Pau Esteve, IFISC

January 9
Quantum meeting: Maxwells demon crosses the quantum-to-classical transition
Patrick Potts, University of Basel, Switzerland

a.5. Publications

In the electronic version of this report, titles are hyperlinked to the summary and PDF file of the publications

a.5.1 Indexed Publications

Self acceleration from spectral geometry in dissipative quantum-walk dynamics
Xue, Peng; Lin, Quan; Wang, Kunkun; Xiao, Lei; Longhi, Stefano; Yi, Wei
Nature Communications 15, 4381 (1-11)

High-order correlations reveal complex memory in temporal hypergraphs
Gallo, Luca; Lacasa, Lucas; Latora, Vito; Battiston, Federico
Nature Communications 15, 4754

Observation of discrete-light temporal refraction by moving potentials with broken Galilean invariance
Qin, Chengzhi; Ye, Han ; Wang, Shulin; Zhao, Lange ; Liu, Menglin; Li, Yinglan ; Hu, Xinyuan ; Liu, Chenyu ; Wang, Bing ; Longhi, Stefano; Lu, Peixiang
Nature Communications 15, 5444 (1-11)

Probing coherent quantum thermodynamics using a trapped ion
Onishchenko, O.; Guarnieri, G.; Rosillo-Rodes, P.; Pijn, D.; Hilder, J.; Poschinger, U.G.; Perarnau-Llobet, M.; Eisert, J.; Schmidt-Kaler, F.
Nature Communications 15, 6974

Spatial heterogeneity accelerates phase-to-trigger wave transitions in frog egg extracts
Puls, Owen; Ruiz-Reynés, Daniel; Tavella, Franco; Jin, Minjun; Kim, Yeonghoon; Gelens, Lendert; Yang, Qiong;
Nature Communications 15, 10455

A cross-disciplinary research framework at institution level and beyond
Argyris, Apostolos; Hernández-García, Emilio; San Miguel, Maxi
Nature Communications 15, 10399 (1-3)

On the structure of species-function participation in multilayer ecological networks
Hervías-Parejo, Sandra; Cuevas-Blanco, Mar; Lacasa, Lucas; Traveset, Anna; Donoso, Isabel; Heleno, Rubén; Nogales, Manuel; Rodríguez-Echeverría, Susana; Melián, Carlos; Eguíluz, Victor
Nature Communications 15, 8910

Deviation from neutral species abundance distributions unveils geographical differences in the structure of diatom communities
Pigani, E; Hay Mele, B; Campese, L; Ser-Giacomi, E; Ribera, M; Iudicone, D; Suweis,S
Science Advances 10, 10

Six decades of the FitzHugh–Nagumo model: A guide through its spatio-temporal dynamics and influence across disciplines
Cebrián-Lacasa, Daniel; Parra-Rivas, Pedro; Ruiz-Reynés, Daniel; Gelens, Lendert;
Physics Reports 1096, 1-39

A photonics perspective on computing with physical substrates
Abreu; Boikov; Goldmann, M.; Jonuzi; Lupo; Masaad; Nguyen; Picco; Pourcel; Skalli; Talandier, L.; Vettelschoss; Vlieg; Argyris, A.; Bienstman; Brunner; Dambre; Daudet; Domenech; Fischer, I.; Horst; Massar; Mirasso, C.R.; Offrein; Rossi; Soriano, M. C.; Sygletos; Turitsyn
Reviews in Physics 12, 100093

How Diet and Lifestyle Can Fine-Tune Gut Microbiomes for Healthy Aging
Tamayo, M.; M. Olivares, M.; Ruas-Madiedo, P.; Margolles, A.; Espín, J. C.; Medina, I.; Moreno-Arribas, M. V.; Canals, S.. ; Mirasso, C. R.; Ortín, S.; Beltrán-Sánchez, H.; Palloni, A.; Tomás-Barberán, F.; Sanz, Y.
Annual Review of Food Science and Technology 15, 283–305

Observing the collapse of super-Bloch oscillations in strong-driving photonic temporal lattices
Hu, Xinyuan; Wang, Shulin; Qin, Chengzhi ; Liu, Chenyu; Zhao, Lange; Li, Yinglan ; Ye, Han; Liu, Weiwei; Longhi, Stefano ; Lu, Peixiang ; Wang, Bing
Advanced Photonics 6, 046001 (1-11)

Engineered dissipation to mitigate barren plateaus
Sannia, Antonio; Tacchino, Francesco; Tavernelli, Ivano; Giorgi, Gian Luca; Zambrini, Roberta
NPJ Quantum Information 10, 81, 1 – 10

Nonequilibrium Transition between Dissipative Time Crystals
Cabot, Albert; Giorgi, Gian Luca; Zambrini, Roberta
Physical Review X Quantum 5 , 030325 (1-22)

Thermodynamics of computations with absolute irreversibility, unidirectional transitions, and stochastic computation times
Manzano, Gonzalo; Kardeş, Gülce; Roldán, Édgar; Wolpert, David
Physical Review X , 021026

Temporal Goos-Hänchen Shift in Synthetic Discrete-Time Heterolattices
Qin,Chengzhi; Wang, Shulin ; Wang ,Bing; Hu, Xinyuan; Liu, Chenyu; Li, Yinglan; Zhao, Lange ; Ye,Han; Longhi, Stefano; Lu, Peixiang
Physical Review Letters 133, 083802 (1-6)

Dephasing-Induced Mobility Edges in Quasicrystals
Longhi, Stefano
Physical Review Letters 132, 236301 (1-7)

Quantum fidelity kernel with a trapped-ion simulation platform
Martínez-Peña, Rodrigo; Soriano, Miguel C.; Zambrini, Roberta
Physical Review A 109, 042612

Quantum memories for squeezed and coherent superpositions in a driven-dissipative nonlinear oscillator
Labay-Mora, Adrià; Zambrini, Roberta; Giorgi, Gian Luca
Physical Review A 109, 032407 (1-15)

Resonances, mobility edges and gap-protected Anderson localization in generalized disordered mosaic lattices
Longhi, Stefano
Physical Review B 110, 184201 (1-12)

Topological properties of finite-size heterostructures of magnetic topological insulators and superconductors
Legendre, Julian; Zsurka, Eduárd; Di Miceli, Daniele; Serra, Llorenç; Moors, Kristof; Schmidt, Thomas L.
Physical Review B 110, 075426 (1-14)

Characterizing and Mitigating Timing Noise-Induced Decoherence in Single Electron Sources
Sungguen Ryu, Rosa López, Llorenç Serra, David Sánchez, Michael Moskalets
Physical Review B 109, 165306 (1-11)

Mass media competition and alternative ordering in social dynamics
Alvarez-Llamoza, O.; Cosenza, M.G.; Gonzalez-Avella, J.C.; Suarez, M.A.; Tucci, K.; Valverde, P.
Physical Review E, 110, 2, 024311

Q -deformed evolutionary dynamics in simple matrix games
Kitching, C.R.; Galla, T.
Physical Review E 110, 6, 064319

Extinction and coexistence in a binary mixture of proliferating motile disks
Almodovar, Alejandro; Galla, Tobias; López, Cristóbal
Physical Review E 109, 064140

Noisy kinetic-exchange opinion model with aging
Vieira, Allan R.; Llabrés, Jaume; Toral, Raúl; Anteneodo, Celia
Physical Review E 109, 064119

Eigenvalue spectra of finely structured random matrices
Poley, Lyle; Galla, Tobias; Baron, Joseph
Physical Review E 109, 064301

Ordering dynamics of nonlinear voter models
Ramirez, Lucia; Vazquez, Federico; San Miguel, Maxi ; Galla, Tobias
Physical Review E 109, 034307

Quantized conductance in hybrid split-gate arrays of superconducting quantum point contacts with semiconducting two-dimensional electron systems
Delfanazari, Kaveh; Li, Jiahui; Xiong, Yusheng; Ma, Pengcheng; Puddy, Reuben K.; Yi, Teng; Farrer, Ian; Komori, Sachio; Robinson, Jason W.A.; Serra, Llorenc; Ritchie, David A.; Kelly, Michael J.; Joyce, Hannah J.; Smith, Charles G.
Physical Review Applied 21, 014051 (1-10)

Spin-polarized thermoelectrical currents induced in Aharonov-Bohm rings
Hwang, S.Y.; Sothmann, B.; López, R.
Physical Review Applied, 22, 3, 034070

Low-energy modeling of three-dimensional topological insulator nanostructures
Zsurka,Eduárd; Wang, Cheng; Legendre, Julian; Di Miceli, Daniele; Serra, Llorenç; Grützmacher, Detlev; Schmidt, Thomas L.; Rüßmann, Philipp; Moors, Kristof
Physical Review Materials 8, 084204 (1-11)

Quantum coherence enables hybrid multitask and multisource regimes in autonomous thermal machines
Hammam, Kenza; Manzano, Gonzalo; de Chiara, Gabriele
Physical Review Research 6, 013310

Effective theory of collective deep learning
Arola-Fernández, Lluís; Lacasa, Lucas
Physical Review Research 6, L042040

Multidimensional political polarization in online social networks
F. Peralta, Antonio; Ramaciotti, Pedro; Kertész, János; Iñiguez, Gerardo
Physical Review Research 6, 013170

Phase-controlled heat modulation with Aharonov-Bohm interferometers
Sun-Yong Hwang, Björn Sothmann, Rosa López
Physical Review Research 6, 013215 (1-8)

Complex networks approach to study comorbidities in patients with unruptured intracranial aneurysms
Kivelev, J.; Saarenpää, I.; Karlsson, A.; Crisafulli, P.; Musciotto, F.; Piilo, J.; Mantegna, R.N.
Scientific Reports, 14, 1, 9175

Analyzing bacterial networks and interactions in skin and gills of Sparus aurata with microalgae-based additive feeding
Cerezo, Isabel María; Herrada, Ernesto Alejandro; Fernández-Gracia, Juan; Sáez-Casado, M. I.; Martos-Sitcha, J. A.; Moriñigo, M. A.; Tapia-Paniagua, S. T.
Scientific Reports 14, 31696

Global warming significantly increases the risk of Pierce's disease epidemics in European vineyards
Giménez-Romero, Àlex; Iturbide, Maialen; Moralejo, Eduardo; Gutiérrez, José M.; Matías, Manuel A.
Scientific Reports 14, 9648 (1-12)

Dynamic response of a ferromagnetic nanofilament under rotating fields: effects of flexibility, thermal fluctuations and hydrodynamics
Sánchez, PA; Cerrato, A; Cerdà, JJ; Bona-Casas, C; Sintes, T; Massó, J
Nanoscale 16, 11724-11738

Role of coherence in many-body Quantum Reservoir Computing
Palacios, A; Martínez-Peña, R.; Soriano, M. C.; Giorgi, G. L.; Zambrini, R.
Communications Physics 7, 369

Biased versus unbiased numerical methods for stochastic simulations
Aguilar, Javier; Ramasco, Jose J.; Toral, Raúl
Communications Physics 7, 155

A generalized vector-field framework for mobility
Liu, Erjian; Mazzoli, Mattia; Yan, Xiao-Yong; Ramasco, Jose J.
Communications Physics 7, 190

Subdiffusive dynamics in photonic random walks probed with classical light
Longhi, Stefano
Optics Letters 49, 5989-5992

Photonic random walks with traps
Longhi, Stefano
Optics Letters 49, 2809-2812

Photonic Mpemba effect
Longhi, Stefano
Optics Letters 49, 5188-5191

Non-Hermitian dynamical topological winding in photonic mesh lattices
Longhi, Stefano
Optics Letters 49, 3672-3675

Experimental reservoir computing with diffractively coupled VCSELs
Pflüger, Moritz; Brunner, Daniel; Heuser, Tobias; Lott, James A.; Reitzenstein, Stephan; Fischer, Ingo
Optics Letters 49, 2285-2288

Optical phase encoding in a pulsed approach to reservoir computing
Henaff, Johan; Ansquer, Matthieu; Soriano, Miguel C.; Zambrini, Roberta; Treps, Nicolas; Parigi, Valentina
Optics Letters 49, 2097-2100

Robust Anderson transition in non-Hermitian photonic quasicrystals
Longhi, Stefano
Optics Letters 49, 1373-1376

Squeezing as a resource for time series processing in quantum reservoir computing
García-Beni, Jorge; Giorgi, Gianluca; Soriano, Miguel C.; Zambrini, Roberta
Optics Express 32, 6733-6747

Time delay reservoir computing with a silicon microring resonator and a fiber-based optical feedback loop
Donati, Giovanni; Argyris, Apostolos; Mancinelli, Mattia; Mirasso, Claudio R.; Pavesi, Lorenzo
Optics Express 32 (8), 13419-13437

Non-local transitions and ground state switching in the self-organization of vascular networks
Klemm, Konstantin; Martens, Erik A.
Chaos 34, 123157 (1-10)

Adaptive control of recurrent neural networks using conceptors
Pourcel, Guillaume; Goldmann, Mirko; Fischer, Ingo; Soriano, Miguel C.
Chaos 34, 103127

How representative are air transport functional complex networks? A quantitative validation
Acharya, Kishor; Olivares, Felipe; Zanin, Massimiliano
Chaos 34, 043133

Deep Learning models for the analysis of time series: A practical introduction for the statistical physics practitioner
Crespo-Otero, Alfredo; Esteve, Pau; Zanin, Massimiliano
Chaos Solitons & Fractals 187, 115359

Identifying Ordinal Similarities at Different Temporal Scales
Zunino, Luciano; Porte, Xavier; Soriano, Miguel C.
Entropy 26, 1016

Entropy Estimators for Markovian Sequences: A Comparative Analysis
De Gregorio, J.; Sánchez, D.; Toral, R.
Entropy 26, 79 (1-26)

Patterns in temporal networks with higher-order egocentric structures
Arregui-García, Beatriz; Longa, Antonio; Lotito, Quintino Francesco; Meloni, Sandro; Cencetti, Giulia
Entropy 26(3), 256

Deep Learning Unravels Differences Between Kinematic and Kinetic Gait Cycle Time Series from Two Control Samples of Healthy Children Assessed in Two Different Gait Laboratories
De Gorostegui Álvarez de Miranda, Alfonso; Kiernan, Damien; Martín-Gonzalo, Juan-Andrés; López-López, Javier; Pulido-Valdeolivas, Irene; Rausell, Estrella; Zanin, Massimiliano; Gómez-Andrés, David
Sensors 25, 110

Neural networks with quantum states of light
Labay-Mora, Adrià; García-Beni, Jorge; Giorgi, Gian Luca; Soriano, Miguel C.; Zambrini, Roberta
Philosophical Transactions of the Royal Society A 382, 20230346 (1-24)

Manipulating Time Series Irreversibility Through Continuous Ordinal Patterns
Zanin, Massimiliano
Symmetry 16, 1696

Evaluating Time Irreversibility Tests Using Geometric Brownian Motions with Stochastic Resetting
Zanin, Massimiliano; Trajanovski, Pece; Jolakoski, Petar; Sandev, Trifce; Kocarev, Ljupco
Symmetry 16, 1445

Navigational bottlenecks in nonconservative diffusion dynamics on networks
Soares, Giovanni G.; Estrada, Ernesto
AIMS Mathematics Volume 9, , 24297-24325

What is a mathematician doing…in a chemistry class?
Estrada, Ernesto
Foundations of Chemistry 26, 141–166

Low Cost Carriers Induce Specific and Identifiable Delay Propagation Patterns: An Analysis of the EU and US Systems
Gil-Rodrigo, Sofia; Zanin, Massimiliano
IEEE Access 12, 75323 - 75336

Ordinal language of antipersistent binary walks
Olivares, Felipe
Physics Letters A 527, 130017 (1-6)

Understanding following patterns among high-performance athletes
Rodríguez,Jorge P.; Arola-Fernández,Lluís
Journal of Physics: Complexity 5, 045007

Quantum fluctuation dynamics of open quantum systems with collective operator-valued rates, and applications to Hopfield-like networks
Fiorelli, Eliana
Journal of Physics A: Mathematical and Theoretical 57, 32, 325003.

Editorial: Complexity in language variation and change
Heinsalu, E.; Patriarca, M.; Sánchez, D.
Frontiers in Complex Systems 2, 1497038 (1-2)

Linking intercontinental biogeographic events to decipher how European vineyards escaped Pierce's disease
Moralejo, Eduardo; Giménez-Romero, Àlex; Matías, Manuel A.
Proceedings of the Royal Society B 291, 20241130 (1-12)

A generalized numerical model for clonal growth in scleractinian coral colonies.
Llabrés, E.; Re, E; Pluma, N; Sintes, T; Duarte, CM
Proceedings of the Royal Society B 291, 20241327

Exploring language relations through syntactic distances and geographic proximity
De Gregorio, Juan; Toral, Raúl; Sánchez, David
EPJ Data Science 13, 61 (1-27)

Identification of suspicious behaviour through anomalies in the tracking data of fishing vessels
Rodríguez, Jorge P.; Irigoien, Xabier; Duarte, Carlos M.; Eguíluz, Víctor M.
EPJ Data Science 13, 23

Emergence of cooperation in the one-shot Prisoner's dilemma through Discriminatory and Samaritan AIs
Zimmaro, Filippo; Miranda, Manuel; Ramos Fernández, José María; Moreno López, Jesús Arturo; Reddel, Max; Widler, Valeria; Antonioni, Alberto; Han, The Ahn
Journal of the Royal Society Interface, vol. 21, issue 218, 11 pages.

Commentary: A road map for future data-driven urban planning and environmental health research
Dyer, Georgia M.C. et al.; Ramasco, JJ
Cities 155, 105340

Ordering dynamics and aging in the Symmetrical Threshold model
Abella, David; González-Avella, Juan Carlos; San Miguel, Maxi; Ramasco, José J.
New Journal of Physics 26, 013033

Aproximación estadística al reparto de <b> y <v> en manuscritos latinos de autores hispanos
Miguel Franco, Ruth; Sánchez, David
Zeitschrift für Romanische Philologie 140, 365-384

Shortest path or random walks? A framework for path weights in network meta-analysis
Rücker, Gerta.; Papakonstantinou, Theodoros; Nikolakopoulou, Adriani; Schwarzer, Guido.; Galla, Tobias; Davies, Annabel L
Statistics in Medicine 43, 4287-4304

Retrieving past quantum features with deep hybrid classical-quantum reservoir computing
Nokkala, Johannes; Giorgi, Gian Luca; Zambrini, Roberta
Machine Learning: Science and Technology 5, 035022 (1-14)

Experimental multi-bit header classification at 28.5 Gb/s with step-index few-mode fibers
Pflüger, Moritz; Ortín, Silvia; Leininger, Lars; Mirasso, Claudio R.; Argyris, Apostolos
Journal of Lightwave Technology 42 (22), 7962 - 7968

Algebraic Localization–Delocalization Phase Transition in Moving Potential Wells on a Lattice
Longhi, Stefano
Annalen der Physik 536, 2300488 (1-8)

Shipping traffic through the Arctic Ocean: Spatial distribution, seasonal variation, and its dependence on the sea ice extent
Rodríguez,Jorge P.;Klemm,Konstantin;Duarte,Carlos M.;Eguíluz,Víctor M.
iScience 27, 110236

Indirect social influence and diffusion of innovations: An experimental approach
Miranda, Manuel; Pereda, María; Sánchez, Angel; Estrada, Ernesto
PNAS Nexus 3, 10 (409)

Dynamical stability and chaos in artificial neural network trajectories along training
Danovski, Kaloyan; Soriano, Miguel C.; Lacasa, Lucas
Frontiers in Complex Systems 2, 1367957

Incoherent non-Hermitian skin effect in photonic quantum walks
Longhi, Stefano
Light: Science & Applications 13, 95 (1-9)

System capacity model and algorithm for urban multimodal transport network with transfer
Zhao, Fang ; Si, Bingfeng; Su, Guanghui; Lu, Tianwei; Ramasco, JJ
Transportation Planning and Technology 1, 20

Aging in some opinion formation models: a comparative study
Llabrés, Jaume; Oliver-Bonafoux, Sara; Anteneodo, Celia; Toral, Raúl
Physics 6, 515-528

Status quo and challenges in air transport management research
Wandelt, Sebastian; Antoniou, Constantinos; Birolini, Sebastian; Delahaye, Daniel; Dresner, Martin; Fu, Xiaowen; Gössling, Stefan; Hong, Seock-Jin; Odoni, Amedeo R.; Zanin, Massimiliano; Zhang, Anming; Zhang, Hui; Zhang, Yahua; Sun, Xiaoqian
Journal of the Air Transport Research Society 2, 100014

Heat and charge transport in interacting nanoconductors driven by time-modulated temperatures
López, Rosa; Simon, Pascal; Lee, Minchul
SciPost Physics 16, 094 (1-36)

Reconstructing brain functional networks through identifiability and deep learning
Zanin, Massimiliano; Aktürk, Tuba; Yıldırım, Ebru; Yerlikaya, Deniz; Yener, Görsev; Güntekin, Bahar
Network Neuroscience 8, 241–259

Dissipation as a resource for Quantum Reservoir Computing
Sannia, Antonio; Martínez-Peña, Rodrigo; Soriano, Miguel C.; Giorgi, Gian Luca; Zambrini, Roberta
Quantum 8, 1291

Bosonic Mpemba effect with non-classical states of light
Longhi, Stefano
APL Quantum 1, 046110 (1-7)

Reducing hardware requirements for entanglement distribution via joint hardware-protocol optimization
Labay Mora, A.; Ferreira da Silva, F.; Wehner, S.
Quantum Science and Technology 9, 4, 045001

The role of data embedding in equivariant quantum convolutional neural networks
Das, S.; Martina, S.; Caruso, F.
Quantum Machine Intelligence, 6, 2, 82

Pulsed interactions unify reaction-diffusion and spatial nonlocal models for biological pattern formation
Eduardo H. Colombo, Ricardo Martinez-Garcia, Justin M. Calabrese, Cristobal Lopez, Emilio Hernandez-Garcia
Journal of Statistical Mechanics: Theory and Experiment 2024, 034001

Depletion Interactions at Interfaces Induced by Ferromagnetic Colloidal Polymers.
Cerdà, JJ; Batle, J; Bona-Casas, C; Massó, J; Sintes, T
Polymers 16, 820

Modeling circuit mechanisms of opposing cortical responses to visual flow perturbations
Galván Fraile, J; Scherr, F; Ramasco, J. J.; Arkhipov, A.; Maass, W; Mirasso, C. R.
Plos Computational Biology 20, e1011921

Wave Breaking Events and their link to Rossby Wave Packets and Atmospheric Blockings during Southern Hemisphere Summer
Pérez-Fernández, Iago; Barreiro, Marcelo; Ehstand, Noémie; Hernández-García, Emilio; López, Cristóbal
Journal of Geophysical Research-Atmospheres 129, e2022JD038380

Controlling systemic corruption through group size and salary dispersion of public servants
Valverde, P.; Fernandez, J.; Buenaño, E.; Gonzalez-Avella, J.C.; Cosenza, M.G.
Helyon Journal 10, e25148

Communicability cosine distance: similarity and symmetry in graphs/networks
Estrada, E.
Computational and Applied Mathematics 43, 49.

A model for seagrass species competition: dynamics of the symmetric case
Moreno-Spiegelberg, Pablo; Gomila, Damià
Mathematical Modeling of Natural Phenomena 19, 2 (1-18)

Golden Laplacian Graphs
Akhter, S; Frasca, M.; Estrada, E.
Mathematics 12, 613

Mathematical modeling of local balance in signed networks and its applications to global international analysis
Diaz-Diaz, Fernando; Bartesaghi, Paolo; Estrada, Ernesto
Journal of Applied Mathematics and Computing, 70, 6195 - 6218

What is a complex system, after all?
Estrada, E.
Foundations of Science 29, 1143–1170

A cost opportunity model for human mobility
Wang, Y.; Liu, Erjian.; Zhao, D.; Niu, X.; Wang, X.; Lv, Y.
Physica A: Statistical Mechanics and its Applications, 646, 129847

Anomalous negative magnetoresistance in quantum-dot Josephson junctions with Kondo correlations
M. Deng; C. Yu; G. Huang; R. López; P. Caroff; S. Ghalamestani; K. Thelander; G. Platero; H. Xu
Science China-Physics Mechanics and Astronomy, 67, 8, 280362

A regional Lagrangian model to evaluate the dispersion of floating macroplastics in the North Atlantic Ocean from land and river sources in the western coast of Spain
Sara Cloux; Patricia Pérez; Hilda de Pablo; Vicente Pérez-Muñuzuri
Marine Pollution Bulletin, 209, 117110

A Spatial Signal of Niche Differentiation in Tropical Forests
Umarani, M.S.; Wang, D.; O¿dwyer, J.P.; D'andrea, R.
American Naturalist, 203, p. 445-457

Delayed kernels for longitudinal survival analysis and dynamic prediction
Davies, A.L.; Coolen, A.C.C.; Galla, T.
Statistical Methods in Medical Research, 33, 10, p. 1836-1858

a.5.2. Other Publications

Food Webs as Multilayer Networks
Melián, Carlos J.; Eguíluz, Victor M.
Encyclopedia of Biodiversity (Third Edition), vol. 5. Edited by Samuel M. Scheiner, 84-91

Conservative vs. non-conservative diffusion towards a target in a networked environment
Estrada, E.
Target Search Problems , Eds. D. Grebenkov, R. Metzler, G. Oshanin (pp. 511-540). Cham: Springer Nature Switzerland.

Advanced Methodologies and Technologies for Innovative Information Systems
Cecil, Roy R.; Miranda, João L.; Nagy, Mariana; Da Silveira, Marcos; Zanin, Massimiliano
2024 IEEE International Conference on Bioinformatics and Biomedicine (BIBM) 6745-6752

La enfermedad de Pierce, una nueva amenaza para los viñedos del sur de Europa
Moralejo,Eduardo; Giménez-Romero, Àlex; Matías, Manuel A.
Phytoma España 363, 14-16

Clonal Growth Patterns in Colonial Anthozoan Corals
Re, E; Schmidt-Roach, S; Llabres, E; Sintes, T; Duarte, CM
Oceanography and Marine Biology: An Annual Review (edited by P.A.Todd and B.O.Russell) 62, 248-266

a.6. Presentations at conferences and academic centers

a.6.1 Invited talks at conferences and workshops

Modeling Xf diseases: transmission dynamics, global spatiotemporal risk predictions and design of control strategies.
Minisymposium in Dynamical Systems Applied to Biology and Natural Sciences (DSABNS), Caparica, Portugal.
Giménez Romero, Àlex
Februrary 6-9

Time-series quantum reservoir computing with quantum measurements.
APS March Meeting 2024, Symposium Quantum Stochastic Processes, Minneapolis, USA.
Zambrini, Roberta
March 3-8

Estimating thermodynamic costs under unidirectional transitions, absolute irreversibility and stopping times.
CSH Workshop: Trade-offs between thermodynamic cost, intelligence and fitness in living organisms, Vienna, Austria.
Manzano, Gonzalo
March 11-12

A Lagrangian seascape: ecological communities and network description.
Reimagining ocean ecology: Towards a paradigmatic framework for the seascape. Venice, Italy.
Enrico Ser-Giacomi
March 12-15

Some biological implications of connectivity in flow networks.
Reimagining Ocean Ecology: Towards a paradigmatic framework for the seascape. Venice, Italy.
Hernandez-Garcia, E.
March 13

Marine connectivity and plankton multifractality: exploring new ideas
Reimagining Ocean Ecology: Towards a paradigmatic framework for the seascape. Venice, Italy.
Lopez, Cristobal
March 13

Opportunities and challenges in quantum reservoir computing.
87 Annual DPG Spring Meetings of the German Physical Society, Condensed Matter Section, Berlin, Germany.
Zambrini, Roberta
March 17 - 22

Vision vs. Inhibition: Cortical Competition during Visual Flow Perturbations.
Criticality, Networks and Neuroscience. Cuernavaca, Mexico.
Mirasso, Claudio
April 8 - 12

Retrieving past quantum features with deep hybrid classical-quantum reservoir computing.
Statistica e data Science 2024, Palermo, Italy.
Giorgi, Gian Luca
April 11 - 12

Similarity and centrality in networks.
WINQ Program on complex and Quantum Systems. Week 1. Dynamics and Topology of Complex Network Systems, Stockholm, Sweden.
Estrada, Ernesto
April 29 to May 3

Thermodynamics of Computations with Unidirectional Transitions, Absolute Irreversibility and Stochastic Computation Times.
Workshop on Stochastic Thermodynamics WOST V (online).
Manzano, Gonzalo
May 13 - 17

Non-Gaussian random matrices predict the stability of feasible Lotka-Volterra communities.
Workshop on 'From Ecology to Economics and back', Paris, France.
Galla, Tobias
May 13 - 15

Non-Gaussian matrices predict the stability of feasible Lotka-Volterra communities.
Workshop on Stochastic Models and Experiments in Ecology and Biology, l'Aquila, Italy.
Galla, Tobias
May 28 - 31

Quantum Reservoir Computing in ordered atomic lattices.
XXXIX Reunión Bienal de la Real Sociedad Española de Física, Spain.
Llodrà Bisellach, Guillem Mujal, Pere Zambrini, Roberta Giorgi, Gian Luca
June 15 - 19

Computational sociolinguistics through the lens of social media.
La Rioja Connection. International Network of Computational Linguistics, Natural Language Processing and Artificial Intelligence applied to language. Spain.
Sánchez, D.
June 17 - 18

Quantum reservoir computing in quantum many-body systems.
"International Workshop on Disordered Systems" (IWDS), Salamanca, Spain.
Giorgi, Gian Luca
June 17 - 21

Pattern formation in systems of repulsive particles.
Summer school on Approximation theory and approximation practice, CASUS, Gorlitz, Germany.
Lopez,Cristobal
June 18

The fluid ocean: tracers dynamics and Lagrangian approaches.
Synergy Summer School: Complexity and emergence in marine ecosystems/seascape: theory, mechanisms and data. Naples, Italy.
Ser Giacomi, Enrico
June 24 - 28

Modelling vector-borne plant diseases in a changing climate.
KSMB-SMB, Seul, South Korea
Giménez Romero, Àlex
June 30 to July 5

Air transport as information and computation.
International Conference on Research in Air Transportation, Singapore.
Zanin, Massimiliano
July 1 – 4

Thermodynamic uncertainty relations in superconducting systems.
Non-equilibrium quantum many-body systems: From superconductors to quantum devices. Genova, Italy.
Lopez, Rosa.
July 10 – 12

Field theory for human mobility.
XXXIX Reunión Bienal de la Real Sociedad Española de Física, Simposio en Sistemas Complejos, hold in San Sebastian/Donostia, Spain.
Ramasco, JJ
July 15 - 19

Computational analysis of Flamenco.
Conference of the cultural agenda of Lo Ferro International Flamenco Cante Festival. Lo Ferro, Spain.
Rosillo-Rodes, P
July 25

Quantum-anomalous-Hall current patterns and interference in thin slabs of chiral topological superconductors.
Frontiers of Quantum and Mesoscopic Thermodynamics, Prague, Czech Republic.
Di Miceli, Daniele
July 26

Minimalist Reservoir Computing: Implementation, Dynamics, and Future Directions.
Dynamics Days Europe, Bremen, Germany.
Soriano, Miguel Cornelles
July 29 to August 2

Spatio-temporal dynamics enhances ecosystems resilience.
Dynamics Days Europe 2024 Constructor University Bremen, Germany.
Moreno-Spiegelberg, Pablo; Rietkerk, Max; Gomila, Damià
July 29 to August 2

The Spatiotemporal Dynamics of Coral Reefs.
Dynamics Days Europe 2024 Constructor University Bremen, Germany.
Álvarez, Miguel (speaker); Matías, Manuel A.; Gomila, Damià
July 29 to August 2

Reducing blackout risk by segmenting large power grids with HVDC lines.
Minisymposium on Dynamics in Energy Systems - From Analytics to Machine Learning within XLIV Dynamic Days Europe, Bremen, Germany.
Colet, Pere
July 29 to August 2

Continuous Ordinal Patterns: Between ordinal analysis and Deep Learning.
Bernoulli-ims. 11th World Congress in Probability and Statistics, Germany.
Zanin, Massimiliano
August 12 - 16

Timing-Noise-Induced Decoherence in Single Electron Sources.
CMD31-General Conference of the Condensed Matter Division of the European Physical Society. Braga, Portugal.
Ryu, Sungguen; López, Rosa; Serra, LLorenç; Sánchez, David; Moskalets, Michael
September 1 - 6

Computing with Photonic Substrates.
Machine Learning Photonics III (Lake Como School of Advanced Studies), Como, Italy.
Soriano, Miguel Cornelles
September 2 - 6

Prestige and Volatility in Language Contact Dynamics.
Complexity in Language Variation and Change, Satellite, Conference on Complex Systems, Exeter, UK.
Maxi San Miguel
September 2 - 6

An excursion through complex networks.
XVII International Conference Zaragoza-Pau on Mathematics and its Applications, Spain.
Estrada, Ernesto
September 4 - 6

Quantum Reservoir Computing and continuous monitoring.
Workshop on Physical Reservoir Computing: Classical- and Quantum-based devices, Montpellier (virtual), France.
Zambrini, Roberta
September 11

Opportunities and challenges in quantum reservoir computing.
16th IQIS \– The Italian Quantum Information Science Conference, Pizzo Calabro, Italy.
Zambrini, Roberta
September 16 - 20

Photonic Quantum Reservoir Computing.
Quantum Photonics Spotlight QPS2024, Paderborn, Germany.
Zambrini, Roberta
October 8 - 10

Opportunities and challenges in quantum reservoir computing.
Brainspiration 2024, Groningen, Netherlands.
Zambrini, Roberta
October 16 - 17

Optimisation of laser dynamics for information processing.
International Symposium on Physics and Applications of Laser Dynamics 2024 (IS-PALD 2024), Saitama, Japan.
Goldmann, Mirko; Soriano, Miguel Cornelles
November 5 - 7

How to conciliate criticality with a hierarchy of timescales in the brain.
Brain Criticality Hybrid Meeting. Bethesda, USA.
Lyra Gollo, Leonardo
November 8

Transitions and Criticality in models of Collective Social Phenomena.
Complex Systems Workshop 2024, Sydney, Australia.
San Miguel, Maxi
November 11 - 14

Modelling Mechanisms behind Collective Social Phenomena from a Complex Systems perspective.
Complex Systems Workshop 2024, Sydney, Australia.
San Miguel, Maxi
November 12 - 14

Minimal Neural Motifs Connectivity Explain Cross-Frequency Directionality and Gamma-Theta Interactions in hippocampal circuits.
Dynamics Days Latin America and the Caribbean 2024, Buenos Aires, Argentina.
Mirasso, C.
December 9 - 13

a.6.2 Other talks at conferences and workshops

Experimental multi-bit header recognition with few-mode fibers.
SPIE Photonics West 2024, San Francisco, USA.
Argyris, Apostolos
January 27 to February 1

Data and Model Analysis of Socioeconomic Influence on Linguistic Variation.
Second Meeting of the Spanish Chapter of the Complex Systems Society. Barcelona, Spain.
Sánchez, D.
February 21 - 23

Analysis of language ideologies and social interconnectivity for languages in contact.
2nd meeting of the Spanish Chapter of the Complex Systems Society (CS3), Barcelona, Spain.
Rosillo-Rodes, Pablo; San Miguel, Maxi; Sánchez, David
February 22 – 23

Partisan Voter Model: Stochastic description and noise-induced transitions.
2nd Meeting of the Spanish Chapter of the Complex Systems Society. Barcelona, Spain.
Llabrés, Jaume
February 22 - 23

Impossible pattern formation made possible by pulsed interactions.
2nd meeting of the Spanish Chapter of the Complex Systems Society, Barcelona, Spain.
Hernandez-Garcia, Emilio
February 22 – 23

Network trajectories.
Conference of the Spanish Chapter of the Complex Systems Society, Barcelona, Spain.
Lacasa, Lucas
February 22 – 23

An effective theory of collective deep learning.
2nd Meeting of Spanish Chapter (Conference of Complex Systems). Barcelona, Spain.
Arola-Fernández, Lluís
February 22 – 23

Assesing the housing market spatial segmentation.
2nd meeting of the Spanish Chapter of the Complex Systems Society (CS3), Barcelona, Spain.
Abella, David
February 22 – 23

Engineered dissipation to mitigate barren plateaus.
APS March meeting 2024, Minneapolis, Minnesota, USA.
Sannia, Antonio; Tacchino, Francesco; Tavernelli, Ivano; Giorgi, Gian Luca; Zambrini, Roberta;
March 4 - 8

Bond percolation and tree decompositions of real-world networks.
DPG spring meeting. Berlin, Germany.
Klemm, Konstantin
March 17 - 22

Associative memories in the quantum regime.
Machine Learning and Quantum Physics Workshop, Obergurgl, Austria.
Adrià Labay-Mora, Eliana Fiorelli, Roberta Zambrini and Gian Luca Giorgi
March 25 – 31

Statistical validation of machine learning models.
Workshop on Machine Learning in Industry, Universidad Politécnica de Madrid, Spain.
Lacasa, Lucas
March 25 - 28

Reservoir computing for the prediction of semiconductor laser dynamics.
SPIE Photonics Europe, Strasbourg, France.
Goldmann, Mirko; Cunillera, Alejandro; Mirasso, Claudio R.; Fischer, Ingo; Soriano, Miguel Cornelles
April 7 - 11

Unveiling the airspace structure and aircraft mobility in Europe: a complex network perspective.
CompleNet. Exeter, UK.
Esteve, Pau; Zanin, Massimiliano
April 23 - 26

Local balance reveals major historical events in signed networks of international relations.
International Conference on Complex Networks (Complenet), Exeter, UK.
Diaz-Diaz, Fernando; Bartesaghi, Paolo; Estrada, Ernesto
April 23 - 26

Endemic infectious states below the epidemic threshold and beyond herd immunity.
International Conference on Complex Networks. Complenet, Exeter, Devon, UK.
Ramasco, JJ
April 23 - 26

Mapping the pathways of marine litter: insights from 3D ocean trajectories and vertical dynamics.
Euromech Colloquium 639 on Microplastic Dispersion Pathways. Lerici, Italy.
Sara Cloux; Ismael Hernández-Carrasco; Alejandro Orfila; Enrico Ser-Giacomi; Cristóbal López; Emilio Hernández-García
May 6 - 8

A climate-driven epidemiological model for Xylella fastidiosa diseases.
Climate-Inclusive Ecosystem Modelling: Understanding the Dynamics of Ecosystems in a Changing World. Bellaterra, Spain.
Giménez Romero, Àlex
May 27 – 29

On the formation of coral reefs.
Climate-Inclusive Ecosystem Modelling: Understanding the Dynamics of Ecosystems in a Changing World - CIEM 24 Conference. Barcelona, Spain.
Álvarez, Miguel (speaker); Matías, Manuel A.; Gomila, Damià
May 27 – 29

Higher-order interactions and the stability of competitive ecological communities on networks
SMEEB 2024 Conference, L'Aquila, Italy..
Meloni, Sandro
May 28 - 31

Local balance reveals major historical events in signed networks of international relations.
British Chapter of the Network Science Society, London, UK.
Diaz-Diaz, Fernando; Bartesaghi, Paolo; Estrada, Ernesto
May 30 - 31

Use of batteries for frequency control.
Anciliary Systems for Distribution System Operators. Çanakkale, Turkey.
Gomila, Damia; Martínez-Barbeito, Maria; Colet, Pere
June 26

On the structure of species-function participation in multilayer ecological networks.
XII GEFENOL Summer School on Statistical Physics of Complex Systems. Madrid, Spain.
Cuevas Blanco, Mar; M. Eguíluz, Victor; Lacasa, Lucas
July 1 – 12

Game theory to implement conservation strategies on marine life.
XII GEFENOL Summer School on Statistical Physics of Complex Systems. Madrid, Spain
Buenvarón-Campo, Gorka
July 1 – 12

Forecasting emergency department visits at Son Espases hospital: Are tourist and weather data relevant?.
XII GEFENOL Summer School on Statistical Physics of Complex Systems. Madrid, Spain
Crisafulli, Paride
July 1 - 12

Conductance asymmetry and current distributions in proximitized magnetic topological insulator junctions with Majorana modes.
Condensed Matter and Quantum Materials. St. Andrews, Scotland, UK.
Serra, Llorenç; Di Miceli, Daniele; Zsurka, Eduard; Legendre, Julian; Moors, Kristof; Schmidt, Thomas L.
July 2 - 5

Thermodynamics of monitored quantum systems under imperfect detection.
kTLog2 '24: Information and thermodynamics from quantum to biological systems, Cuenca, Spain.
Manzano, Gonzalo
July 3 - 5

Photonic Quantum Reservoir Computing: Role of Squeezing.
XIV Reunión Nacional de Óptica (RNO), Murcia, Spain.
Garcia-Beni, Jorge; Giorgi, Gian Luca; Soriano, Miguel Cornelles; Zambrini, Roberta
July 3 – 5

Noise induced (phase) transitions.
KTlog2: Information and Thermodynamics from quantum to biological systems. Cuenca, Spain.
Toral, Raul.
July 3 – 5.

Unconventional Computing with Photonic Substrates.
Unconventional Computing Workshop, Erice, Italy.
Soriano, Miguel Cornelles
July 3 - 12

General framework for quantum associative memories.
QTYR Young Researchers Workshop, Madrid, Spain.
Labay Mora, Adrià; Fiorelli, Eliana; Zambrini, Roberta; Giorgi, Gian Luca
July 9 – 12

A single- particle dipole excitation carrying superconducting correlations.
Non-equilibrium quantum many-body systems: From superconductors to quantum devices. Genova, Italy.
Moskalets, Michael.
July 10 – 12

Phase-to-trigger wave transition: The spatial coordination of mitosis.
XLIV Dynamics Days Europe, Bremen, Germany.
Ruiz-Reynés, D.; Puls, O.; Tavella, F.; Jin, M.; Kim, Y.; Gelens, L.; Yang, Q.
July 29 to August 2

Language distances and geographical proximity through the lens of syntactic variation: An information-theoretic approach.
Conference on Complex Systems CCS24. Exeter, UK.
Sánchez, D.
September 2 - 6

Universal spatial properties of coral reefs.
Conference of Complex Systems, CCS24, Exeter, UK.
Giménez Romero, Àlex; Matías, Manuel A.; Duarte, Carlos M.
September 2 - 6

Critical mobility in policy making for epidemic containment.
Conference on Complex Systems (CCS) 2024 Exeter & London, UK.
Moreno López, J.A.; Meloni, S., Ramasco, J.J.
September 2 - 6

On the structure of species-function participation in multilayer ecological networks.
20th Conference on Complex Systems, CCS2024, Exeter, UK.
Cuevas-Blanco, Mar; M. Eguíluz, Victor; Lacasa, Lucas
September 2 - 6

Indirect social influence helps shaping the diffusion of innovations.
Conference on Complex Systems, CCS2024, Exeter, UK.
Miranda, Manuel; Pereda, María; Sánchez, Anxo; Estrada, Ernesto
September 2 - 6

Assesing the housing market spatial segmentation.
Conference of Complex Systems, CCS2024, Exeter, UK.
Abella, David
September 2 - 6

Communicability geometry reveals antagonistic factions in signed networks.
Conference in Complex Systems (CCS24), Exeter, UK.
Diaz-Diaz, Fernando; Estrada, Ernesto
September 2 - 6

Game theory to implement conservation strategies on marine life.
Conference of Complex Systems, CCS2024, Exeter, UK.
Buenvarón-Campo, Gorka; P. Rodríguez, Jorge; Fernández-Gracia, Juan; M. Eguíluz, Víctor
September 2 - 6

Endemic infectious states below the epidemic threshold and beyond herd immunity.
Conference of Complex Systems, CCS2024, Exeter, UK.
Ramasco, JJ
September 2 – 6

On the structure of species-function participation in multilayer ecological networks.
Conference of Complex Systems, CCS2024, Exeter, UK.
Cuevas Blanco, Mar; M. Eguíluz, Victor; Lacasa, Lucas
September 2 - 6

Lexical analysis of a Flamenco lyrics corpus.
Conference of Complex Systems, CCS2024, Exeter, UK.
Rosillo-Rodes, Pablo; San Miguel, Maxi; Sánchez, David
September 3

Ultrafast eletronics meets quantum thermodynamics
31st Condensed Matter Division Conference. Braga, Portugal.
Lopez, Rosa; Moskalets, Michael.
September 4 - 8

Emission spectra of VCSELs with noncircular optical apertures.
VCSEL DAY 2024, Toulouse, France.
Marciniak, M.; Gębski, M.; anczak, M.; Więckowska, M.; Lott, J.A.; Fischer, I.; Czyszanowski, T.
September 12 -13

Thermodynamics with imperfect detection and Time-crystal as a quantum clock.
CoQuaDis kickoff meeting, Tübingen, Germany.
Manzano, Gonzalo
September 16

Biased versus unbiased numerical methods for stochastic simulations of complex systems.
Conference on Complex Systems, Exeter, UK.
Toral, Raul; Ramasco, Jose; Aguilar, Javier
October 2 - 6

Non-Markovianity in Quantum Reservoir Computing.
Quantum Thermodynamics meets Quantum Computing Workshop. Pisa, Italy.
Ricard Ravell Rodríguez
October 7 - 10

Vertical cavity surface emitting lasers (VCSELs) with noncircular optical apertures.
10th Workshop on the Physics and Technology of Semiconductor Lasers, Sopot, Poland.
Marciniak, Magdalena; Gębski, Marcin; Janczak, Mikołaj; Więckowska, Marta; Lott2, James A.; Fischer, Ingo; Czyszanowski, Tomek
October 13 - 18

Leveraging acoustic telemetry data to understand spreading processes on marine animal populations.
European Tracking Network Symposium. Palma de Mallorca, Spain.
Rodríguez, Jorge P.; Fernández-Gracia, Juan
October 17

The Role of Inhibitory Neuronal Heterogeneity in Phase Relations Between Cortical Networks.
IV National Meeting on Statistical Physics, in Curitiba, Brazil.
Katiele V. P. Brito, Joana M. G. L. Silva, Claudio R. Mirasso, and Fernanda S. Matias
November 3 - 7

Skin effect in quantum neural networks.
ICE-9, Quantum information in Spain, Puerto de la Cruz, Tenerife, Spain.
Sannia, Antonio; Giorgi, Gian Luca; Longhi, Stefano; Zambrini, Roberta
November 11

Entropy production and fluctuation theorems for monitored quantum systems under imperfect detection.
ICE-9, Quantum information in Spain, Puerto de la Cruz, Tenerife, Spain.
Almanza-Marrero, José A.
November 11 – 15

Universality of noise-induced transitions in nonlinear voter models.
III Congreso FisEs Joven'24 (online), Spain.
Llabrés, Jaume
November 13 - 14

Large-scale analysis of trajectory interaction networks in Europe.
SESAR Innovation Days 2024, Rome, Italy.
López-Martín, Raúl; Zanin, Massimiliano
November 12 - 15

Exploring Delay Propagation in Air Transport using Temporal Networks.
III Congreso FISES Joven (Online), Spain.
Esteve, Pau; Zanin, Massimiliano
November 13 - 14

Language relations through syntactic distances: An information-theoretic approach.
III Congreso FISES Joven (Online), Spain.
De Gregorio, Juan
November 13 - 14

On the structure of species-function participation in multilayer ecological networks.
III Congreso FISES Joven (Online), Spain.
Cuevas-Blanco, Mar; M. Eguíluz, Victor; Lacasa, Lucas
November 13 – 14

Numerical methods for quasi-stationary distributions.
III Congreso FISES Joven (Online), Spain.
Oliver-Bonafoux, Sara; Aguilar, Javier; Galla, Tobias; Toral, Raúl.
November 13 - 14

Engineered dissipation to mitigate barren plateaus.
Quantum Techniques in Machine Learning (QTML) 2024, University of Mel- bourne, Australia.
Sannia, Antonio; Tacchino, Francesco; Tavernelli, Ivano; Giorgi, Gian Luca; Zambrini, Roberta
November 25 - 29

Beyond Subjects: A Multilayer Network Perspective on Key Competencies in Spanish Secondary Education.
Thirteenth International Conference on Complex Networks \& Their Applications. Istambul, Turkey.
Fernández-Gracia, Juan; Ablanque, Javier; Benito, Rosa María
December 10 - 12

a.6.3 Poster presentations

General framework for quantum associative memories.
Quantum Matter 2024, San Sebastian, Spain.
Adrià Labay-Mora, Eliana Fiorelli, Roberta Zambrini and Gian Luca Giorgi
May 6 - 10

Quantum anomalous Hall current patterns and interference in thin slabs of chiral topological superconductors.
QuantumMatter 2024. San Sebastian - Donostia, Spain.
Serra, Llorenç; Di Miceli, Daniele
May 7 - 10

Unraveling Timing Noise-Induced Decoherence in Single-Electron Sources.
QUANTUMatter2024 Conference. San Sebastian - Donostia, Spain.
Ryu, Sungguen; López, Rosa; Serra, Llorenç; Sánchez, David; Moskalets, Michael
May 7 – 10

A dynamical network mechanism for gamma-leading-theta hippocampal rhythms.
Dendrites 2024 in Chania Crete, Greece.
Chalkiadakis, Dimitrios; Claros, Jaime; Canals, Santiago; Mirasso, Claudio
May 21 - 24

Universal spatial properties of coral reefs.
Climate-Inclusive Ecosystem Modelling: Understanding the Dynamics of Ecosystems in a Changing World. Bellaterra, Spain.
Giménez Romero, Àlex; Matías, Manuel A.; Duarte, Carlos M.
May 27 - 29

Universal spatial properties of coral reefs.
Complexitat Day. Barcelona, Spain.
Giménez Romero, Àlex; Matías, Manuel A.; Duarte, Carlos M.
June 5 - 6

Population dynamics and competition in seagrass meadows.
2024 World Seagrass Conference (2024 WSC) & 15th International Seagrass Biology Workshop (ISBW15). Naples, Italy.
Sintes, Tomas
June 17 – 21

Numerical Methods for stochastic simulations. Application to contagion process.
Simposio en Física de Sistemas complejos de la XXXIX Reunión Bienal de la Real Sociedad Española de Física.San Sebastian, Spain.
Toral, Raul; Ramasco, Jose; Aguilar, Javier
July 15 – 19

Shaping coral reef growth, the role of nutrient diffusion and erosion.
XXXIX Reunión Bienal de la Real Sociedad Española de Física. San Sebastián, Spain.
Sintes, Tomas; Llabrés, Eva
July 15 - 19

A biologically constrained model displaying gamma-to-theta cross-frequency directionality.
*CNS*2024 in Natal, Brazil.*
Chalkiadakis, Dimitrios;Sánchez-Claros, Jaime;Canals, Santiago; Mirasso Claudio
July 20 - 24

Self-organized traveling pulses shape seagrass meadows.
XLIV Dynamics Days Europe, Bremen, Germany.
Ruiz-Reynés, D.; Mayol, E.; Sintes, T.; Hendriks, I.E.; Hernández-García, E.; Duarte, C.M.; Marbà, N.; Gomila, D.;
July 29 to August 2

Patterns in temporal networks with higher-order egocentric structures.
Conference on Complex System (CCS), Exeter, UK.
Arregui-García B., Longa A., Lotito QF., Meloni S. & Cencetti G
September 2

Mapping the distribution of seagrass meadows from space with deep convolutional neural networks.
Conference on Complex Systems. Exeter, UK.
Giménez Romero, Àlex; Ferchichi, Dhafer; Moreno Spiegelberg, Pablo; Síntes, Tomàs; Matías, Manuel A.
September 2 - 6

Emergence of collective learning in coupled deep neural networks.
Mathematical Aspects of Learning Theory- 20 YEARS LATER (CRM-UAB). Barcelona, Spain.
Arola-Fernández, Lluís
September 9 - 13

Dissipative entanglement generation using coherent collisions.
Quantum Thermodynamics meets Quantum Computing Workshop, Pisa, Italy.
Ryu, Sungguen; López, Rosa; Serra, Llorenç; Sánchez, David; Moskalets, Michael
October 7 - 10

The connectivity of minimal neuronal motifs could explain gamma-leading theta interactions in recordings of synchronous neural activity.
Brain Criticality Hybrid Meeting. Bethesda, USA.
Chalkiadakis, Dimitrios;Sánchez-Claros, Jaime;Canals, Santiago; Mirasso Claudio
November 6 - 8

Neuronal heterogeneity and phase relation diversity between unidirectionally coupled networks.
XXXVIII North and Northeast Physics Meeting, in Aracaju, SE, Brazil.
Pereira Brito, Katiele Valeria: Selingardi Matias, Fernanda.
November 25 – 27

a.6.4. Seminars and Talks in other research centers

New questions on epidemic spreading suggested by the COVID-19 pandemic.
Department of Applied Mathematics, National University of Kaohsiung, Taiwan.
Rodríguez, Jorge P.
January 3

Deep Learning y Redes Complejas en Neurociencia.
Jornadas SEDAR, Sociedad Española de Anestesiología, Reanimación y Terapéutica del Dolor, Madrid, Spain (online).
Zanin, Massimiliano
February 7

Onsager Theory with Non-Commuting Charges and applications to Thermosqueezing Effects.
IQOQI Vienna Seminar, Austria.
Manzano, Gonzalo
March 14

Deep Learning in Science: Going Beyond Classification Tasks.
Macedonian Academy of Science and Arts, Skopje, República de Macedonia del Norte.
Zanin, Massimiliano
April 2

Quantitative modeling of linguistic ideologies in multilingual societies.
Seminaris del LICLE. UIB, Palma de Mallorca, Spain.
Rosillo-Rodes, Pablo; Sánchez, David
April 10

Modelització quantitativa de les ideologies lingüístiques en societats multilingües
Dept de Filologia catalana i lingüística general, UIB.
D. Sanchez and P. Rosillo-Rodes, IFISC
April 10

Una excursión a través de las redes complejas.
Real Academia de Ciencias Exactas, Físicas y Naturales de España.
Estrada, Ernesto
April 11

From Light to Thought: Exploring the Functional Parallels between Semiconductor Lasers and Neurons.
Benemérita Universidad Autónoma de Puebla, México.
Mirasso, Claudio
April 17

Challenges and opportunities in quantum reservoir computing.
Princeton Quantum Signals (PQS) Seminar, Princeton (virtual).
Zambrini, Roberta
April 30

Modelling the epidemiology of plant diseases caused by the bacterium Xylella fastidiosa.
CASUS (Center for Advanced Systems Understanding), Görlitz, Germany.
Matias, Manuel A.; Giménez-Romero, A.; Moralejo, Eduardo
June 21

Studying marine connectivity and plankton ecosystems with complex networks.
CASUS Institute Seminar, Gorlitz, Germany.
Lopez, Cristobal
July 7

Neuro-inspired Photonic Information Processing: Understanding the mechanisms of reservoir computing.
Potsdam Institute for Climate Impact Research, Berlin, Germany.
Fischer, Ingo
July 9

Power grid frequency fluctuations in scenarios of large penetration of renewables.
Laboratoire d'Informatique et Systèmes, Aix-Marseille Université. Marseille, France.
Colet, Pere; Martínez-Barbeito, María; Gomila, Damia
July 11

Reservoir Computing with Complex Quantum Systems.
Quantum Spain Seminar, Talent Q, (virtual).
Zambrini, Roberta
October 22

Open Quantum Hopfield Networks: Phase diagram and storage capacity.
Seminar at CESQ, University of Strasbourg, France.
Fiorelli, Eliana
July 6

De los láseres de Semiconductor a las Neuronas y Vuelta.
Coloquio del Departamento de Física, Universidad de Buenos Aires, Argentina.
Mirasso, Claudio
November 14

Link-Node Co-Evolution Dynamics.
University of Auckland, New Zealand.
San Miguel, Maxi
November 22

Visual Flow Disruptions: How Excitation and Inhibition Compete in the Mouse (Primary) Visual Cortex.
Instituto de Investigación en Biomedicina de Buenos Aires, Instituto Asociado a la Sociedad Max Planck, Buenos Aires, Argentina.
Mirasso, Claudio
November 25

Imitation Mechanisms and consensus states in collective social phenomena.
Victoria University, Wellington, New Zealand.
San Miguel, Maxi
November 29

Modelling Social Dynamics: Aging, Co-evolution and Innovation Spreading.
Manaaki Whenua Landcare Research, Lincoln, New Zealand.
San Miguel, Maxi
December 11

Communicability in coplex networks
Honda Research Institute, Frankfurt, Germany.
Estrada, Ernesto.
December 13

a.7. Other Activities

a.7.1. Master Thesis

Asymmetries in mutual intelligibility: An information-theoretic approach
Tarassov Colomar, Víctor (Supervisor: Sánchez, David)
December 20

Compressed representations in deep learning: From algorithmic information to autoencoders and hypernetworks
Vivet, Arnau (Supervisors: Arola-Fernández, Lluís; Lacasa, Lucas)
November 10

Efficiency in the self assembly of viral capsids.
Aguilar Rosero, Daniel (Supervisor: Sintes, Tomas)
October 4

Stochastic thermodynamics of imitation models
Irisarri, Luis (Supervisors: Manzano, Gonzalo; Toral, Raúl)
October 3

Segregation in urban systems and mobility
Dolc, Arnau (Advisors: Lopez Moreno, Jesus; Ramasco, Jose)
October 3

Temporal Network Embedding Using Classical Multidimensional Scaling
Marín Rodríguez, Francisco Javier (Supervisors: Arola-Fernánez, Lluís; Lacasa, Lucas)
October 1

Innovation diffusion models
Miguel Rodríguez Shaw (Supervisors Raúl Toral and Pere Colet)
September 30

Reservoir Computing with Quantum Memristors
Montesinos Capacete, Daniel (Supervisors: Zambrini, Roberta; Giorgi, Gian Luca)
September 27

Information-to-energy conversion in an autonomous thermal machine
Trigal, Lucas (Supervisors: Manzano, Gonzalo; López, Rosa)
September 27

Fluctuations in molecular motors: thermodynamics of F1-ATPase
Nadal Rosa; Adrian (Supervisor: Manzano, Gonzalo)
September 26

Opinion Dynamics in Social Networks under Bias: A Study Based on the DeGroot Model
Ronquillo Guachamin, Saulo Javier (Supervisors: Meloni, Sandro; San Miguel, Maxi)
September 25

Generating functional analysis of a thresholded random generalised Lotka-Volterra model
Roig Oliver, Adrian (Supervisor: Galla, Tobias)
September 20

Information-theoretic metrics of higher-order interactions on graphs
Danovski, Kaloyan (Supervisors: Meloni, Sandro; Sánchez, David)
July 30

Understanding the role of top-down input in visual information processing
Sofía Gil Rodrigo (Supervisors: Javier Galván and Claudio Mirasso)
July12

Heterogeneous volatility in language shift models
Rodríguez Díaz, Juan María (Supervisors: San Miguel, Maxi and Sánchez, David)
March 26

Theoretical and numerical study of the Cahn-Hilliard equation
García Castillo, Juan Antonio (Supervisors: Fernandez, Miguel Ángel and Gomila, Damià Gomila)
February 8

a.7. 2. Research stays in other centers

Australian National University. Canberra, Australia.
Research stay under the supervision of Dr. Ana M. M. Sequeira. Objective: analyze tracking data from marine animals and create forecasting models to predict their future occurrences.
Medina Hernandez, Jorge
December 1, 2023 to February 28, 2024

ISI Foundation. Turin, Italy.
De Gregorio, Juan Ignacio.
March 1 - May 31

University of Oxford, UK.
Diaz-Diaz, Fernando
March 1 – June 1

IQOQI, Vienna, Austria.
Manzano, Gonzalo
March 13 - 15

Universidad de Granada, Spain.
Visit to Dr. Michalis Skotiniotis to work with Quantum Thermodynamics and Computation Group.
Ricard Ravell Rodríguez
April 2 - 5

Queen Mary Univerity of London, UK.
Caligiuri, Annalisa
April 3 – July 3

Institut des Sciences de l'Evolution-Montepllier, France.
Visiting Dr. Guim Aguadé (CNRS), a postdoctoral researcher working in the lab of Dr Sonia Kéfi (CNRS) for a collaboration in a project on theoretical ecology and complex networks about phenological mismatch in large ecosystems.
Arola-Fernández, Lluís; Aguadé-Gorgorió, Guim
April 8 - 11

Universidad Complutense, Madrid, Spain.
Research visit at the Complex Systems group of Rosa Benito.
Fernández-Gracia, Juan
May 6 - 10

Instituto de Ciencias Agrarias, ICA-CSIC, Madrid, Spain.
Visit t the group of Porf. Alberto Fereres and meeting with Prof. Alexander Purcell.
Matias, Manuel A.
May 27 – 28

CASUS, Center for Advanced Systems Understanding), HZDR, Görlitz, Germany.
Invited visit to the Center for Complex Systems Understanding, (Scultetus program).
Lopez, Cristobal
June1 to July 31

EPFL. Lausanne, Switzerland.
Collaboration with Prof. Vincenzo Savona.
Labay Mora, Adrià
June 3 – 7

ICTP, Trieste, Italy.
Collaboration visit.
Manzano, Gonzalo
June 3 - 7

CASUS, Center for Advanced Systems Understanding), HZDR, Görlitz, Germany.
Visit to Justin Calabrese's and Ricardo Martínez-García's groups in CASUS.
Matias, Manuel A.
June 20 – 25

CESQ, Centre Européen de Sciences Quantiques. University of Strasbourg, France.
Fiorelli, Eliana
June 26 to July 21.

Instituto de Ciencias Agrarias, ICA-CSIC, Madrid, Spain.
Visit to the group of Prof. Alberto Fereres and meeting with Prof. Alexander Purcell.
Matias, Manuel A.
June 27 - 28

Laboratoire d'Informatique et Systèmes, Aix-Marseille Université, France.
Colet, Pere; Gomila Damià
July 10 - 11

Instituto de Ciencia de Materiales de Madrid (ICMM-CSIC), Spain.
Visit to Pedro David García and Cefe López labs.
Soriano, Miguel Cornelles
July 14 - 15

Université Aix-Marseille, France.
Short visit to Dr. Giulia Cencetti and Dr. Marco Mancastroppa.
Arregui, Beatriz
July 16 – 18

University of Oxford, United Kingdom
Gimenez, Alex
July 28 to October 26

École Polytechnique Fédérale de Lausanne, Switzerland.
Stay at LTPN group with Prof. Vincenzo Savona.
Labay Mora, Adrià
September 2 to December 13

CESQ, Centre Européen de Sciences Quantiques. University of Strasbourg, France.
Visiting at CESQ (Centre Européenn de Sciences Quantiques) for scientific collaboration.
Fiorelli, Eliana
September 29 to December 21

Centre for Complex Systems, University of Sydney, Australia.
Maxi San Miguel
November 9 - 17

Universidad Complutense, Madrid, Spain.
Research visit to the group of Complex Systems of Rosa Benito.
Fernández-Gracia, Juan
November 20 - 24

University of Canterbury, Christchurch, New Zealand.
Visit to the Department of Mathematics and Statistics,
San Miguel, Maxi
December 12

a.8. Press and Media

The titles are linked to the document or media clip

a.8.1 Press and digital Media

El 'ébola del olivo' podría llevar casi una década en Mallorca
Última Hora
February 6

La UIB posa les matemàtiques al servei de la localització i la prevenció de la Xylella
El diari de la UIB
Fora Vila
February 6

Un modelo matemático caracteriza diferentes enfermedades producidas por la bacteria Xylella fastidiosa
Óleo Revista
February 9

La Cátedra del Mar Iberostar concede 12 premios y ayudas para la investigación y conservación marina a alumnado y jóvenes investigadores
FUEIB
Ok Diario
Última Hora
Mallorca Diario
Economía de Mallorca
La Palmesana Magazine
March 19

Una visión naturalista de la física a bordo de un velero en el Mediterráneo
CSIC
March 22

CaixaForum Palma acoge en abril el ciclo 'La Resistencia Científica 2.0' con cuatro sesiones de humor y divulgación
Europa Press
COPE
Gente Digital
Noticias De
Fibwi Diario
Uep! Mallorca
CSIC
April 3

La teoría de los seis grados de separación: las matemáticas que explican las redes sociales
El País
April 29

Palma, bares y ciencia: vuelve el Pint of Science
La Palmesana
May 6

El físico teórico que se ha hecho a la mar para rastrear microplásticos
BBVA OpenMind
May 14

El cambio climático potencia la bacteria que devora olivos en el Mediterráneo
CSIC
ABC
Siglo XXI
Última Hora
Todo Alicante
InfoBae
RTVE
Asturias Mundial
Interempresas
Servimedia
Agropopular
Mundiario
Agronews
El Observador
Diario de Mallorca
Europa Press
Diario de la Mancha
Mallorca Services
Head Topics
Eco Avant
Noticias de la Ciencia
Guía Verde
Mundiario
Olimerca
El Diario Vasco
Agencia SINC
El diari de la UIB
Nova Ciencia
El Periódico
El Diario
20 minutos
Phytoma
AMP
Portal Frutícola
Valencia Fruits
Ecoticias
El Periódico de España
EurekAlert!
Phys
Tenchnology Networks
Bioengineer
Lokalno
The Microbiologist
Tridge
Atelier
Earth
Ezadar
El Debate
Huffington Post
EUNews
May 23

Si de dos partículas entrelazadas una cae en un agujero negro, ¿qué le pasa a la otra?
El País
May 25

El canvi climàtic afavoreix l'expansió de la Xylella cap al Nord
Fora Vila
May 26

'Xylella fastidiosa' y el cambio climático amenazan la viticultura europea: hemos calculado cuánto
The Conversation
June 10

Una nueva investigación propone el uso de una herramienta matemática para descifrar dinámicas sociales complejas
CSIC
El diari de la UIB
Dicyt
The Smart City Journal .
La Palmesana
June 11

La investigación de la UIB se concentra en un nuevo complejo en el ParcBit
Diario de Mallorca
Diario de Ibiza
El Diari de la UIB
June 13

Aplaudimos la incorporación del Instituto de Física Interdisciplinar y Sistemas Complejos como miembro del Cercle
Cercle d'Economia de Mallorca
June 16

Análisis Global de Residuos: Localización de los Puntos Críticos de Desechos Peligrosos
Mi Revista
August 19

Imedea e IFISC recibirán dos millones del Ministerio de Ciencia
Diario de Mallorca
Diario de Ibiza y Formentera
Última Hora
September 10

Ya tenemos programa (provisional) de Naukas Palma 2024
Naukas
El Diari de la UIB
September 23

El CSIC organiza más de 200 actividades lúdicas para divulgar la ciencia
El Imparcial
September 23

Mallorca reúne a casi 70 centros de excelencia Severo Ochoa y María de Maeztu en la octava edición de 100xCiencia
ICMAT
October 8

El evento 100xCiencia.8 llega a Palma para afrontar los retos digitales y medioambientales
Salud Ediciones
October 8

100xCiencia.8 llega a Palma para afrontar los retos digitales y medioambientales
La Palmesana
October 8

100xCiencia.8 arriba a Palma per afrontar els reptes digitals i mediambientals
El diari de la UIB
October 8

Arranca en Palma el 100xCiencia.8: un evento clave para abordar los retos globales desde la ciencia interdisciplinaria
CSIC Balears
October 9

100xCiencia.8 arriba a Palma per a afrontar els reptes digitals i mediambientals
El Sóller
October 9

El estudio de los sistemas complejos, clave para afrontar los desafíos actuales
Última Hora
October 10

Las consecuencias del aumento del nivel del mar centran la jornada inaugural del 100xCiencia.8
Pasión por el mar
October 10

Debate sobre el cambio climático en Palma: «El 30% de las empresas actuales desaparecerán en un año»
Diario de Mallorca
October 11

Debate sobre el cambio climático en Palma: «Los científicos empiezan a influir en la toma de decisiones políticas»
Diario de Mallorca
October 11

Foro '100xCiencia': diálogos transformadores en el Club Diario de Mallorca
Diario de Mallorca
October 12

Revelan que las conexiones indirectas en una red social "tienen un impacto significativo"
La Vanguardia
UC3M
Universidad Politécnica de Madrid
Innovar o morir
October 21

Researchers analyze how our relationships affect the adoption of innovations
EurekAlert!
October 21

Un nuevo marco matemático revela la arquitectura de las interacciones bióticas
CSIC
Madridmasd
Fora Vila
Buenas noticias
El diari de la UIB
Nova Ciencia
October 23

Com les vinyes europees varen esquivar una devastadora malaltia americana
Va de vi
October 26

Ciència a tot Tren: un recorregut per la ciència de Palma a Sóller
El Diari de la UIB
October 28

Cómo los viñedos europeos escaparon de una devastadora enfermedad… por ahora
The Conversation
December 2

Un estudio revela patrones espaciales universales en corales de todo el mundo
La Vanguardia
El Diari de la UIB
Montevideo Portal
El Cronista
Yahoo!
La Patria
San José Ya
MSN
Última Hora
Fora Vila
El Universal
La Palmesana
Acoiris.fm
December 19

El derretimiento de los glaciares reduce los tiempos de envío, pero conlleva un costo oculto
Hackernoon
December 31

a.8.2 Radio and TV

La intel·ligència artificial, una eina al servei de la posidonia
IB3 TV, Meteo
January 9

Dona i ciència, un binomi amb futur.
Govern de les Illes Balears
February 5

Interview to David Ordinas, La Resistència Científica
IB3 Ràdio
April 7

Interview to Carolina Morán, La Resistència Científica
Onda Cero
April 9

Interview to Carolina Morán and Adrián García, La Resistència Científica
COPE
April 11

La UE podría revisar las áreas protegidas de pesca de fondo
RTVE
May 3

Interview for Pint of Science
IB3 Ràdio, La Gran Vida
May 11

Alumnes de 3r d'ESO es converteixen en "científics en pràctiques" per una semana
IB3 TV, Notícies
June 2

Inauguren el Centre Balear de Recerca al Parc Bit
IB3 TV, Notícies
June 12

Interview to Ernesto Estrada
Canal Extremadura, Principio de Incertidumbre
November 9

Interview to Manuel Matías
IB3 Ràdio, Nautilus
December 21