



2019/ ANNUAL REPORT



Universitat
de les Illes Balears





EXCELENCIA
MARÍA
DE MAEZTU



Institute for Cross-Disciplinary Physics and Complex Systems

<http://ifisc.uib-csic.es/>



[@IFISC_mallorca](https://twitter.com/IFISC_mallorca)



<http://www.facebook.com/ifisc>



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

An electronic version of this report
can be downloaded from

<http://ifisc.uib-csic.es/en/about-ifisc/annual-reports>

Index

| | | |
|---------------------------------|---|---|
| PRESENTATION AND RESEARCH LINES | 1 | 010 1.1. IFISC RESEARCH LINES 014 1.2. "MARIA DE MAEZTU" EXCELLENCE AWARD 018 1.3. IFISC SERVICE UNIT: DataAnalytics@IFISC 019 1.4. IFISCSTRUCTURE CHART 020 1.5. 2019 REPRESENTATIVE RESEARCH RESULTS |
| PERSONNEL | 2 | 034 2.1. PERMANENT SCIENTIFIC STAFF 035 2.2. SCIENTIFIC ASSOCIATES 035 2.3. POSTDOCTORAL RESEARCH ASSOCIATES 036 2.4. PHD STUDENTS 036 2.5. TECHNICAL AND ADMINISTRATIVE SUPPORT 038 2.6. VISITORS 040 2.7. MASTER AND COLLABORATION STUDENTS 041 2.8. HUMAN RESOURCES OVERVIEW |
| RESEARCH PROJECTS AND FUNDING | 3 | 045 3.1. RESEARCH FUNDED BY THE EUROPEAN COMMISSION 046 3.2. RESEARCH PROJECTS OF THE SPANISH NATIONAL PLAN FOR SCIENCE 047 3.3. OTHER IFISC RESEARCH PROJECTS 046 3.4. RESEARCH CONTRACTS 047 3.5. RESEARCH PROJECTS AND COLLABORATION NETWORKS WITH PARTICIPATION OF IFISC MEMBERS 049 3.6. NON DISCLOSURE AND COLLABORATION AGREEMENTS WITH NON ACADEMIC INSTITUTIONS |
| IFISC SEMINARS | 4 | 052 IFISC SEMINARS 2019 |
| PUBLICATIONS | 5 | 058 PUBLICATIONS 2019 |
| CONFERENCES AND WORKSHOPS | 6 | 062 6.1. PRESENTATIONS AT SCIENTIFIC CONFERENCES 063 6.2. ORGANIZATION OF CONFERENCES AND WORKSHOPS |
| OTHER ACTIVITIES | 7 | 066 7.1. PHD PROGRAM 067 7.2. IFISC MASTER 068 7.3. OTHER POSTGRADUATE COURSES 069 7.4. SURF @ IFISC 070 7.5. MEMBERS OF EDITORIAL BOARD OF SCIENTIFIC JOURNALS 071 7.6. SCIENTIFIC COMMITTEES 071 7.7. RESEARCH STAYS IN OTHER CENTERS 072 7.8. 'WOMEN IN SCIENCE' ACTIVITIES 074 7.9. PATENT |
| OUTREACH ACTIVITIES | 8 | 076 8.1. CONFERENCE SERIES 079 8.2. OPEN DAYS @ IFISC 080 8.3. OTHER EVENTS 085 8.4. OUTREACH MATERIALS 086 8.5. PRESS AND MEDIA |
| APPENDIX | | 091 A.4. IFISC SEMINARS AND TALKS 2018 092 A.5. PUBLICATIONS 097 A.6. PRESENTATIONS AT CONFERENCES AND ACADEMIC CENTERS 102 A.7. OTHER ACTIVITIES 104 A.8. PRESS AND MEDIA |

1

PRESENTATION AND RESEARCH LINES



*CONNECTING SCIENCE
UNDERSTANDING COMPLEXITY

ifisc.uib-csic.es



EXPLORING EMERGENT PHENOMENA
IN THE PHYSICAL, TECHNICAL, BIOLOGICAL
AND SOCIAL WORLD

- 📍 IFISC_mallorca
- 📘 facebook.com/ifisc
- 📺 youtube.com/user/IFISCseminars



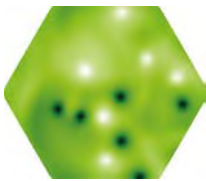
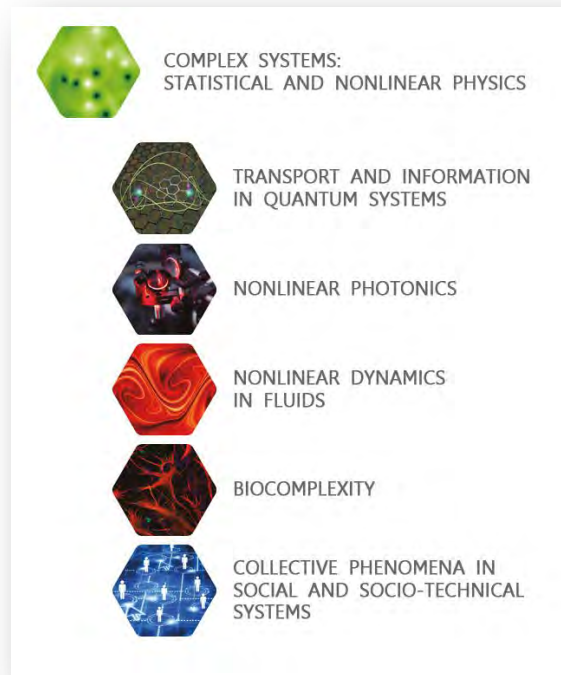
IFISC (Institute for Cross-Disciplinary Physics and Complex Systems) is a joint research institute of the University of the Balearic Islands (**UIB**) and the Spanish National Research Council (**CSIC**) created in 2007 building upon the former Cross-Disciplinary Physics Department of the Mediterranean Institute for Advanced Studies (**IMEDEA**) dating from 1995. Its mission is to develop *Cross-Disciplinary* and *Strategic Research* in Complex Systems following the established scientific approach of physicists.

By *Cross-Disciplinary* Research we mean the transfer of knowledge, concepts and methods to create bridges among traditional disciplines. By *Strategic Research* we mean focusing on advanced studies in emerging strategic fields with a strong potential impact, avoiding the “basic-applied” polarization.

IFISC’s working environment is a complex system in itself seeking coherence and integration from diversity, interaction, scientific dialogue, transversal structures, bridge building and self-organization. Research is therefore organized in terms of research lines, rather than research groups.

1.1 IFISC RESEARCH LINES

Emerging from a back-bone transversal research line of exploratory nature on Complex Systems, Statistical and Nonlinear Physics, there are 5 research lines of transfer of knowledge in the interface with other disciplines (Quantum Technologies, Information and Communication Technologies, Earth Sciences, Life Sciences and Social Sciences):



Complex systems. Nonlinear and statistical physics

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 Statistical Physics together with Computational Methods, Quantum Mechanics, Information Theory, Complex Networks, Big Data analysis and the Theory of Dynamical Systems, which includes the study of nonlinear dynamics, chaos and the effect of fluctuations and random events on system's evolution.

This research line of exploratory nature is the backbone of IFISC: we develop new concepts and methods for the study of Complex Systems, and we analyze generic phenomena such as synchronization, phase transitions, nonequilibrium instabilities, spatiotemporal pattern formation, and the dynamics and evolution of complex networks.

COMPUTING LAB

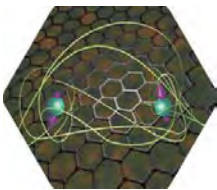
The Computing Services Unit manages the computational resources at IFISC. Capabilities to perform intensive numerical calculations are provided by an IBM iDataPlex cluster with 48 dx360M4 diskless nodes and a total of 576 computational cores and 1.8 TB of RAM configured for High Throughput Computing (HTC). This is complemented by two servers with 256GB of RAM used for memory intensive scientific calculations.

Big Data storage and management is handled using a MongoDB non-relational database on a two servers, one with 16 cores, 512 GB of RAM, 2 2TB SSD for indexes and 20 2TB SSD for data and the other with 20 cores, 256GB of RAM, 2 2TB SSD for indexes and 20 4TB HD for data.

A Data repository is available on a IBM DS4700 disk cabinet with 96 TB of raw storage capacity, connected via fiber channel to four 8-core servers and using GPFS as file system. Private Cloud virtualization is implemented as a opennebula cluster with a 4 compute nodes each with 36 cores, 384GB of memory and 4TB disk and a management node with 16 cores, 96GB of memory and 16TB disk. IFISC network is complemented with an NFS and a backup server, about 100 linux desktops, mac and windows desktops and laptops and a number of peripherals, and it is integrated to provide a transparent environment.

ELECTRONICS LAB

The Nonlinear Electronics Lab focuses on the application of nonlinear dynamics to a variety of topics including synchronization of chaotic systems and information processing based on delay-coupled dynamical systems. The Nonlinear Electronics Lab currently offers a diversity of circuits and systems for the study and demonstration of chaos and bifurcation phenomena (including Autonomous Boolean Networks, Chua, Mackey-Glass and Rössler oscillators), chaos synchronization, and the study of networks with delay-coupled nonlinear elements for information processing.



Transport and Information in Quantum Systems

Understanding of Quantum Complex Phenomena plays a key role in the development of Quantum Technologies identified as one of the most strategic areas for future research and innovation.

In this research line, we are devoted to questions related to quantum transport for charge (nanoelectronics), spin (spintronics), energy (thermoelectrics) and information (quantum correlations), with a particular focus on nanostructures. Moreover, we investigate decoherence effects in complex environments, explore quantum probing, and emergent phenomena such as synchronization, with a focus on quantum correlations and thermodynamics and their impact on information processing.



Nonlinear Photonics

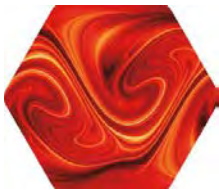
Within this line of research, we explore complex phenomena in photonics, filling the gap between Modern Photonic Sources and Functional Complex Systems. Our Nonlinear Photonics Lab, working alongside a strong theoretical team, aims to gain an in-depth understanding of complex phenomena and to provide novel solutions from communication to information processing, transferring knowledge to the Information and Communication Technologies (ICT) domain.

We study nonlinear and spatio-temporal emission properties of semiconductor lasers, implement optical complex networks based on lasers, advance characterization techniques, and demonstrate the utility of optical complexity for information technologies including encryption and ultra-fast neuro-inspired photonic information processing.

PHOTONICS LAB



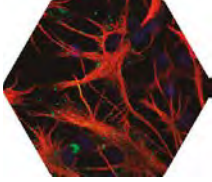
Since 2009 a Photonics Laboratory of highest standards has been established. The lab is equipped with a Faraday cage for electromagnetic shielding and houses several experiments of delay-coupled lasers and laser arrays, optoelectronic systems, as well as photonic information processing systems using the latest technology to characterize the optical emission with multi-Gigahertz bandwidth: in the temporal domain via fast detectors and 16 GHz real-time oscilloscope, and in the spectral domain via a 14 GHz real-time 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 9.6 GHz bandwidth.



Nonlinear dynamics in fluids

Fluid flows occur in a huge range of scales, from blood capillaries to atmospheric weather systems. The way in which substances are transported has large impacts, e.g., on how pollutants arrive to distant locations, plankton meets the nutrients, or into the whole heat balance involved in the Earth climate.

At IFISC we develop techniques useful to characterize transport in fluids, quantify stretching, mixing, and connectivity between parts of a fluid. We apply them to geophysical settings, mostly in the ocean. We develop tools to identify barriers to the transport of oxygen and nutrients, evaluate the ecological implications of larval transport, or track the origins of water vapor masses transported by atmospheric winds.



Biocomplexity

Living systems are the paradigm of complex systems, with nonlinear interactions occurring at all spatial and temporal scales, from molecules and genes to the planetary scales defining the global biosphere. One of the focus of our research is the ecological level where we consider modes of organisms' mobility and their interplay with food search, disease propagation, spatial patterning, and also with the basic ecological interactions such as competition, predation, or mutualism. Another focal issue in our studies is understanding brain function, which requires approaches at scales that range from individual neurons to the whole brain. At the neuronal level, we concentrate on aspects of synchronization between interacting neuronal populations and study how information flows. With the help of statistical measures, we analyze experimental data and compare the results with neuronal models.



Dynamics and collective phenomena of social systems

Social systems are prominent examples of Complex Systems, emergent phenomena, and the Micro-Macro paradigm. Today's main societal changes and challenges arise from the feedback loop that entangles society with Information and Communication Technologies (ICT) as a prototypical socio-technical system.

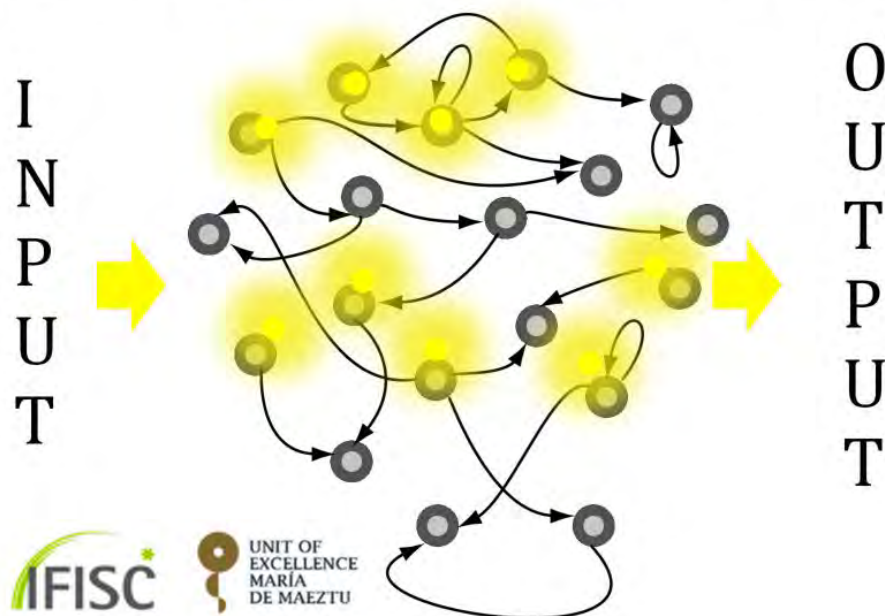
In this line of research we develop new concepts, tools and models aiming at identifying generic mechanisms underlying collective phenomena in these systems. We do this in the framework of Computational Social Sciences with the use of Game Theory, Statistical Physics, Agent Based Models, Complex Networks Theory, and Big Data analysis. We study phenomena such as opinion formation, cooperation, cultural conflicts, language competition and social learning. Moreover, we focus on ICT data-driven research on socio-technical systems, addressing problems of human mobility, transportation, tourism, city science, epidemics, and energy consumption.

1.2 “MARIA DE MAEZTU” EXCELLENCE AWARD

In 2018, **IFISC** (Institute for Cross-Disciplinary Physics and Complex Systems) was awarded the “**Unidad de Excelencia María de Maeztu**” distinction, for the period 2018-2022, entering the selective **SOMMa Alliance**. The award was 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. This award consolidates IFISC as a reference institute in the research field of complex systems. The research title of the proposal was '**Information Processing in and by complex Systems**'. The distinction is granted shortly after IFISC's tenth anniversary, demonstrating its positive trajectory in research excellence.

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". Of the 120 research centers of CSIC, 10 have been accredited as Centers of Excellence "Severo Ochoa" and 6 as Units of Excellence "María de Maeztu". IFISC was the first awarded center in the Balearic region.

Information Processing in and by Complex Systems

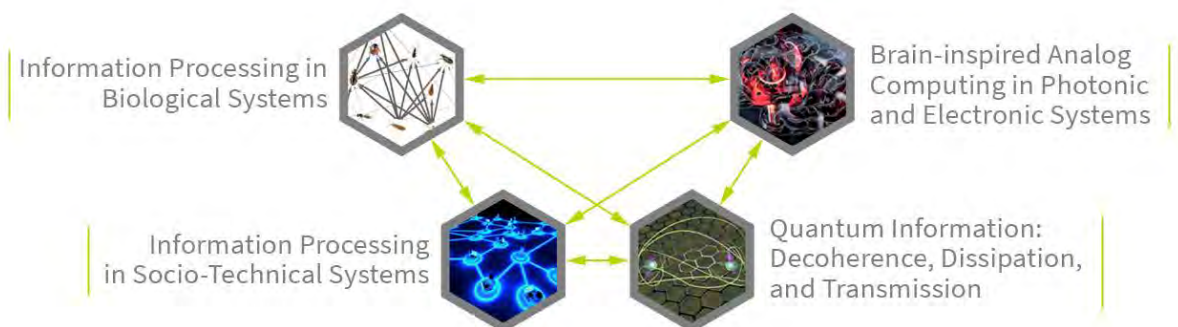


All distinguished centers and units stand out for the international impact of their scientific contributions, their postgraduate teaching activity, their innovative capacity and their intense relationship with the social and economic environment. They are categorized as world-class entities with highly competitive frontier research programs that are capable of attracting international talent.

The units that have been selected in the "Maria de Maeztu" category, like IFISC, will receive a total funding of 2,000,000 Euros during the next four years plus several contracts for pre-doctoral researchers and access to funding sources restricted to the units of excellence.

The following scheme summarizes the research lines on which the Maria de Maeztu award focusses:

Information Processing in and by Complex Systems



Complex systems can efficiently perform multitude of tasks utilizing very different substrates and a wide variety of network topologies and non-linearities. *Characterizing and understanding information processing in and by complex systems, from both fundamental and practical perspective, is a challenging task for the next years.*

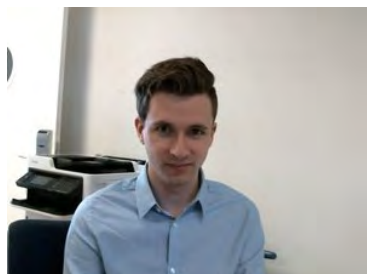
IFISC – MdM PERSONNEL



All **IFISC researchers** contribute to the MdM scientific program. IFISC's working environment seeks coherence and integration from diversity, interactions and scientific dialogue.

Personnel hired within the MdM program during 2019:

POSTDOCTORAL RESEARCHERS:



Andre Röhm



Sungguen Ryu

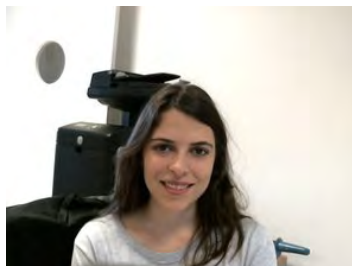


Luíño F. Seoane

PHD STUDENTS:



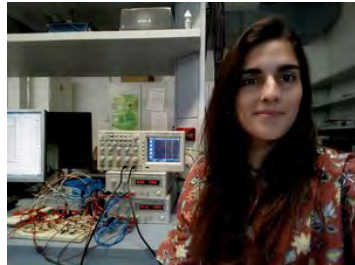
Javier Aguilar



Violeta Calleja



Marco Cattaneo



Irene Estébanez



Rodrigo Martínez

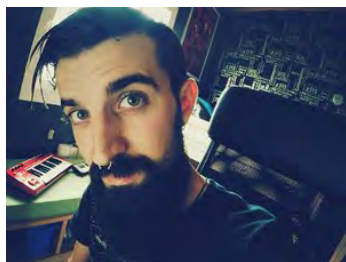


Jaime Sánchez

PROJECT MANAGER: Simona Obreja



COMMUNICATION AND DISSEMINATION: Adrian García



1.3. IFISC SERVICE UNIT: DataAnalytics@IFISC

Solutions based on Big Data for



- * Social Sciences
- * Ecology
- * Biomedicine

Leveraging 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.



- 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 2019 REPRESENTATIVE RESEARCH RESULTS

Here are some research results published during 2019. They are representative of the different research lines and thus illustrate the range of topics studied at IFISC.

Video presentation of some of these results: <https://ifisc.uib-csic.es/en/events/seminars/ifisc-winter-solstice-seminar/>

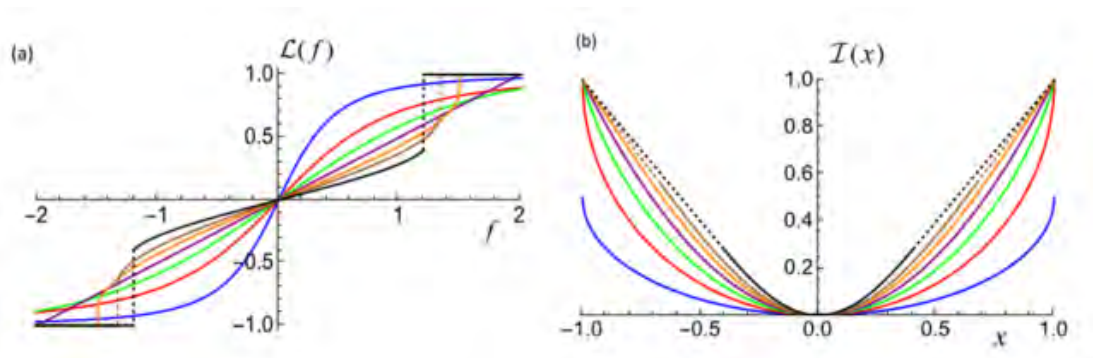
Phase transitions in persistent and run-and-tumble walks

Proesmans, K.; Toral, R.; Van den Broeck, C.

Physica A, published online <https://doi.org/10.1016/j.physa.2019.121934>.

The theory of random walks has played an important role in the development of statistical mechanics and the theory of stochastic processes. Random walks, in their different versions, have modeled an incredibly wide array of phenomena in many fields, ranging from sociology and ecology, over economy and finance, to physics and chemistry. In the basic model, the walker makes a step of a fixed length in a random direction in space. Depending on the problem at hand, additional prescriptions are included. A prominent example is the consideration of persistence, whereby the walker has a preference to make a step in the same direction as its previous one. This takes into account the fact that the motion, while still random, is subject to inertia or memory. A particular limit, called the run-and-tumble walk, in which the trajectory takes consecutively random directions during a time extracted from an exponential distribution, has been studied extensively in the context of bacterial dynamics. A question of considerable interest is the statistics of the end-to-end distance and the related response properties upon applying a stretching force.

In this paper, we report on a surprising first order phase transition in off-lattice random walks with persistence in dimension $d > 5$. In the corresponding force-versus-extension relation, the generalized Langevin function $L(f)$ giving the extension to an external force, becomes independent of the force beyond a critical value. The probability distribution of the maximum extension X after N steps follows a large deviation form $P(L) \sim e^{-N I(x)}$, where we show that the large-deviation function $I(x)$ is the Legendre transform of the generalized Langevin function. The transition is anticipated in dimensions $d=4$ and $d=5$, where full extension is reached at a finite value of an applied stretching force. Full analytic details are revealed in the run-and-tumble limit.

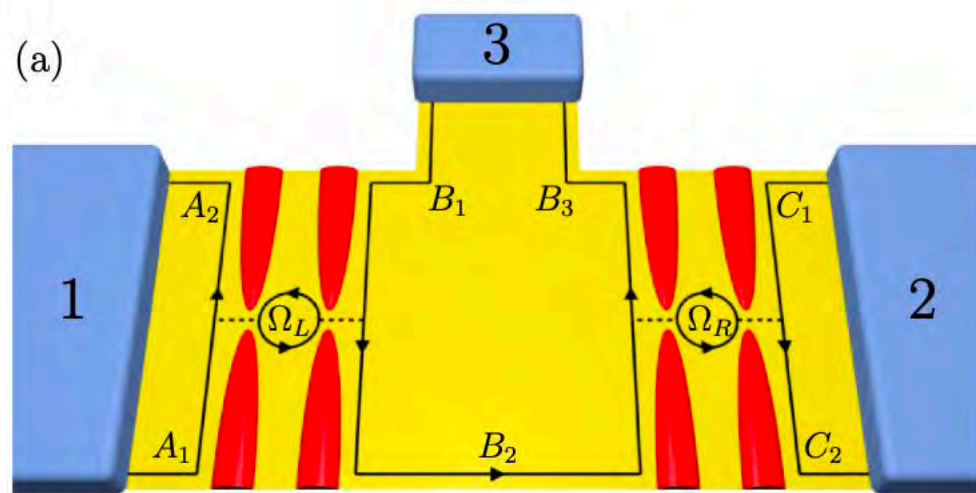


Panel (a): Generalized Langevin function, $L(f)$, for the run-and-tumble walk for spatial dimension $d=1,2,3,4,5,6,8$ (from decreasing slope at the origin). Panel (b) large deviation function $I(x)$ (same color code). Note the existence of a mathematical singularity, indicator of a phase transition, in both functions, for dimension $d=4$ and larger.

Nonlinear chiral refrigerators

Sánchez, D.; Sánchez, R.; López, R.; Sothmann, B.
Physical Review B 99, 245304 (1-9)

One of the main goals of quantum thermodynamics is the creation of energy harvesters and coolers working in nanometer scales. Thermoelectric phenomena could lead to efficient devices operating at very low temperatures, especially when charge and heat currents can be spatially separated. One can use chirality induced by external magnetic fields in quantum Hall conductors to effectively decouple energy and particle fluxes. Here, we propose a multiterminal two-dimensional chiral conductor to work as a refrigerator with good coefficient of performance. Our results suggest that the device would be able to cool by 60 mK when the base temperature is 150 mK, thus paving the way to the employment of chiral coolers in nanochips.

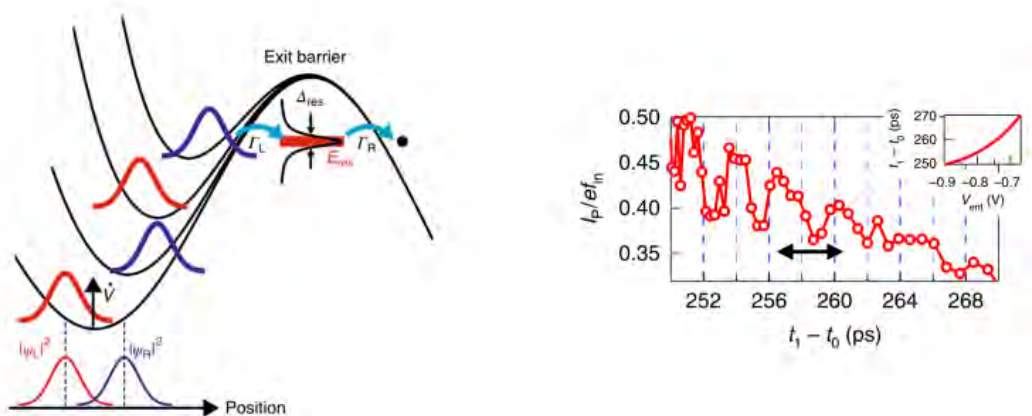


Our proposal is depicted in the figure above. The setup consists of a two-dimensional electron gas (the yellow region) attached to three fermionic baths (blue regions). Baths 1 and 2 are current terminals while bath 3 is a voltage probe whose electrochemical potential adjusts itself to maintain zero net current. Due to the presence of a perpendicular magnetic field (not shown here), electrons move along edge channels with well defined propagation direction (black lines). Key to our proposal is the energy-dependent scattering induced by two quantum dots (left L and right R) generated by the finger gates indicated with the red regions. The dots are energy filters when their energy levels are tuned in an appropriate way. Thus, electrons injected from bath 1 occupy states in bath 3 below the Fermi energy whereas thermally excited electrons in the same bath are extracted into bath 2. As a consequence, the third bath becomes cooled carrying no charge current, which minimizes the Joule dissipation. Our analysis fully takes into account the nonlinear regime of transport within a scattering-matrix formalism. We find the optimal cooling conditions and give a physically intuitive interpretation, namely, the thermopowers of L and R dots should have opposite signs for the device to work. Moreover, our theory predicts that there exists an optimal value of the applied voltage that minimizes the temperature measured at the cooled bath. The optimal value can be also manipulated by varying the coupling between the dots and the edge states, which gives to our device great power and tunability.

Picosecond detection of electron motion

Gento Yamahata, Sungguen Ryu, Nathan Johnson, H.-S. Sim, Akira Fujiwara and Masaya Kataoka
Nature Nanotechnology, 14, 1019-1023

When an electron is captured in a nanoscale trap, its quantum mechanical wave function can exhibit a spatial oscillation of picoseconds. When the potential of the trap changes in time (see the left figure) the wave function can not stay in the ground state, but rather becomes a superposition of the ground state and excited states. The relative phase in the superposition oscillates in time, which results in the spatial oscillation of the wave function moving back and forth between the left and right side of the trap. Such coherent oscillations often serve building blocks of quantum information processing using nanoelectronic devices, such as charge qubits in double quantum dots and flying qubits in circuits. However, the time-resolved detection has been thought to be impossible, since the picosecond time scale is far beyond of the state-of-the-art measurement bandwidth.



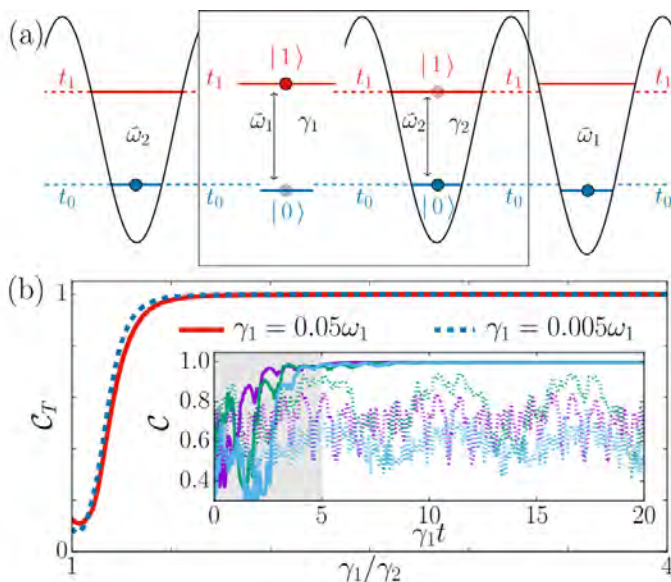
We proposed the detection scheme, which utilizes a quantum-mechanical resonant state formed beside the trap. For the detection, the coupling between the resonant state and the electron is effectively switched on and off in a picosecond scale applying a time-dependent voltage difference to them. Collaborating with experimental teams at NTT and NPL, we applied the detection scheme to electron motions in a nanoscale trap formed in silicon transistors, so-called single-electron pumps, which has been used to realize a high-accuracy current standard. A single electron is captured in the trap in a part of the pumping process, then spatially oscillates due to the nonadiabatic excitation. A resonant state is formed in a potential barrier of the trap due to interface impurities of silicon devices. The switching of the coupling between the electron and the resonant state was achieved by aligning the resonance energy with the electron energy only within a picosecond scale.

Thanks to the sharply defined alignment condition, the spatial oscillations are detected by measuring the current generated by tunneling through the resonant state. (See the right figure) Our result may boost the application of the nanoelectronics in quantum information technologies such as ultrafast quantum-bit operation for quantum computing and high-sensitivity electromagnetic-field sensing.

Quantum synchronization in dimer atomic lattices

Cabot, A.; Galve Conde, F.; Giorgi, Gian Luca; Zambrini, R.
Physical Review Letters 123, 023604

When a large system is synchronized, all its individual components evolve in unison. Spontaneous synchronization is a cooperative effect that emerges when such individuals interact and adjust their own internal pace to evolve according to a common rhythm. In the quantum realm, synchronization can be studied looking at the dynamical behavior of local observables that may have not a classical analog. The time correlation (Pearson coefficient) between such local observables can be taken as a synchronization measure. Synchronization can be induced by the presence of energy dissipation towards an external environment, with respect to which some collective excitations can be more robust than others and survive for long times, bringing the system to a quasi monochromatic regime.



(a) Atomic lattice used to simulate a spin chain: for each lattice site, spin states are realized using the two lowest vibrational atomic levels. The decay from the excited to the ground state is obtained applying local laser fields acting on the internal structure of each trapped atom; the lattice is dimerized, that is, the energy separation between the lowest vibrational levels as well as the induced decay rates assume staggered values along the lattice.

(b) Time correlation (synchronization) between the quantum coherences of spins belonging to different sub-lattices after a transient time as a function of the ratio between the decay rates. Inset: time evolution of correlations for different values of imbalances γ_1/γ_2 . An imbalance between the decay rates of the sublattices is required to attain quantum synchronization.

In this publication, we have proposed a theoretical model to observe spontaneous quantum synchronization in a one-dimensional chain made by an atomic lattice. Quantum systems used to study synchronization are qubits (or spins $1/2$) obtained considering the two lowest vibrational levels of each lattice site. Dissipation is introduced in the system by acting with a series of laser beams that can induce transitions between these pairs of levels in each site, mimicking the presence of an external environment. An essential ingredient for observing synchronization is the dimerization of the lattice, that is, both the energy differences and the decay rates assume staggered values along the chain which can be represented by means of two sublattices. Indeed, the greater the difference in the decay rates, the more dominant is one of the collective excitations, which causes the whole system to achieve a synchronized dynamics following the frequency of the dominant excitation.

Tuning the system parameters, two distinct synchronization regime can be attained: indeed, the most long-lasting collective excitation can be either a single mode or a complete manifold made by almost degenerate modes. This latter regime, never explored before, has the great advantage of being persistent also in the presence of very long chains, as it only relies on the difference between the decay rates between the two sublattices. While our paper focuses on the realization of synchronization in the atomic-lattice platform, the theoretical results are universal, that is, the properties found here can be extended to any two-level quantum system, such as trapped ions, superconducting qubits, etc.

The constructive role of noise in reservoir computing

Estébanez, Irene; Fischer, Ingo; Soriano, Miguel C.
Physical Review Applied 12, 034058

Reservoir Computing (RC) is a neuro-inspired information processing concept that aims at classifying or predicting time dependent data such as the one generated by human speech, communication systems, chaotic systems, weather systems, etc. RC exploits the dynamical evolution of a network, known in this context as reservoir, excited by external inputs for computation. The main characteristic of RC is the presence of recurrently connected nonlinear nodes, whose temporal evolution is able of storing information about the past. Therefore, a reservoir creates responses depending on the context of the previous inputs. In RC, the connections from the input to the reservoir and the connections within the reservoir can be arbitrarily chosen and kept fixed. In contrast, the connections from the reservoir to the output are optimized to fit the reservoir response with the desired output. The fact that only the output connections need to be optimized facilitates hardware implementations of the RC paradigm.

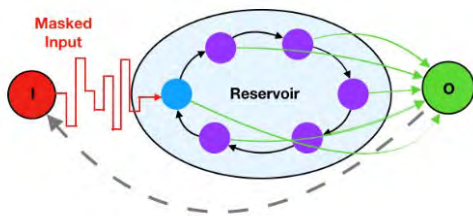


Figure 1. Delay-based RC architecture. The input (red) is time-multiplexed to drive a single nonlinear node (blue). The response of the nonlinear node is measured at different times, creating the so-called virtual nodes (purple). The output of the system (green) is given by a linear weighted combination of the states of the virtual nodes. In autonomous operation, the output of the system is taken as the next input (grey arrow).

Here, we use the delay-based RC concept illustrated in Figure 1 to realize trainable dynamical behaviour. The autonomous operation is achieved by re-injecting the predicted output again into the system, once the reservoir-output connections are optimized. In particular, we train the reservoir-output connections of a hybrid analogue-digital experimental implementation of RC to do one-step-ahead prediction for chaotic time-series of the Rössler system. Inspired by phenomena like stochastic resonance in which noise enhances desired system properties, we investigate the noise-induced performance improvement in autonomous attractor replication of a chaotic dynamical system. Different sets of reservoir-output connection weights were computed for the original time-series and the original one altered with a certain amplitude of Gaussian noise.

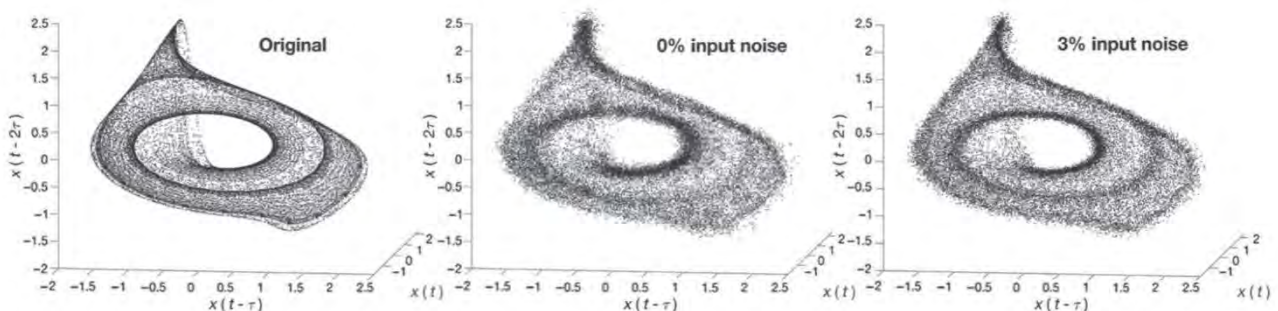


Figure 2. Phase-space reconstructions of the Rössler attractor for the original time-series (left), the one obtained for the RC trained with the original signal (0% input noise, middle) and with the original signal altered with noise (3% input noise, right).

We focus on the experimental replication of the long-term characteristics of chaotic dynamics with high fidelity. We aim to capture the topological properties of the chaotic attractor (climate-like prediction), rather than precise trajectories (weather-like prediction). As shown in Figure 2, we find an overall improvement on the long-term replication of the Rössler dynamics when the reservoir is trained with an addition of 3% of Gaussian noise to the original input signal. Importantly, the system can be trained for the generation of complex dynamics requiring only temporal signals, without the need of having an explicit model.

Spatial inhomogeneities in the sedimentation of biogenic particles in ocean flows

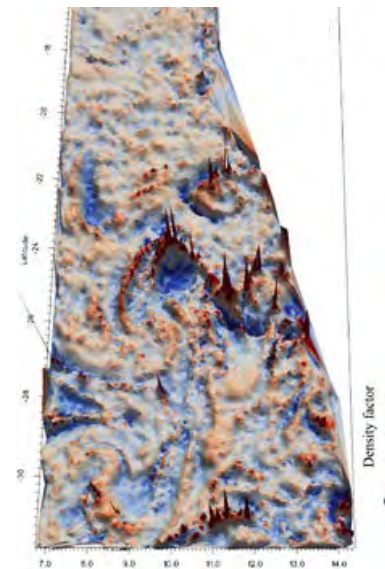
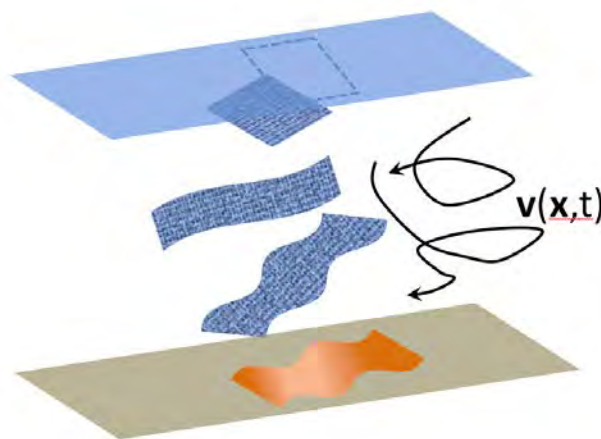
Monroy, Pedro; Drotos, Gabor; Hernández-García, Emilio; Lopez, Cristobal
Journal of Geophysical Research: Oceans 124, 4744–4762

The sinking of biogenic particles (consisting of single phytoplankton cells, aggregates or marine snow, and zooplankton fecal pellets) in the oceans provides the essential food source for the deep-sea organisms and it is also a fundamental ingredient of the biological carbon pump, i.e. the sequestration of carbon from atmospheric CO₂ to sea-bottom sediments by biological activity.

It happens that particle deposition towards the ocean floor, as measured by devices called particle traps, is very inhomogeneous, meaning that sinking-particle fluxes at one location can be very different from those at locations a few kilometers away.

In this work we study simple geometric mechanisms, originated by the action of the ocean turbulent flow, contributing to this inhomogeneity: On the one hand, a homogeneous release of particles from an area in the sea surface can become stretched by the ocean velocity field while sinking, thus reducing its density. On the other hand, the surface release can become tilted or even folded, so that it leaves an irregular footprint when reaching the ocean floor.

We check the presence of these mechanisms for biogenic particles falling at different speeds in the Benguela region (the Atlantic southwestern coast of Africa), a region of important biological activity, and compare analytical predictions for the inhomogeneous bottom deposition to numerical simulations of the process.



Left: Schematics of the sinking process: a homogeneous sheet of particles released from the ocean surface can become stretched, tilted and folded by the ocean turbulent flow $\mathbf{v}(\mathbf{x},t)$, so that it leaves an inhomogeneous footprint on the bottom. **Right:** Actual simulation of the highly inhomogeneous deposited particle density at 1000 m depth on the Benguela region.

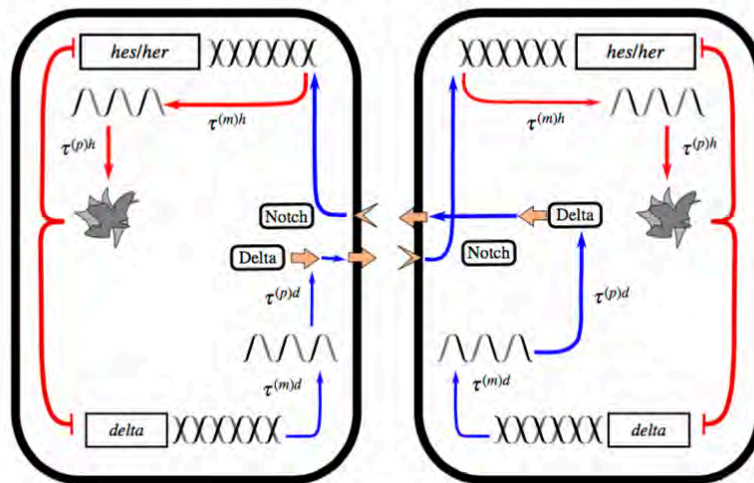
Intrinsic noise, Delta-Notch signaling and delayed reactions promote sustained, coherent, synchronized oscillations in the presomitic mesoderm

Baron, Joseph W.; Galla, Tobias
Journal Royal Society Interface 16: 20190436.

In developing vertebrates as the embryo forms, pairs of blocks of mesodermal progenitor cells assemble. These blocks, termed somites, eventually go on to form vertebrae and ribs. The somites are formed from cells originating in the presomitic mesoderm (PSM).

The prevailing theoretical framework for understanding the process is the so-called 'clock-wavefront' model. This model proposes that the cells in the PSM each possess an internal cyclic 'clock' which is synchronized between the cells. Additionally, a wavefront propagates through the PSM as the embryo grows. The interaction of the wavefront with the cells causes the cells to change their adhesive and migratory properties. The temporal periodicity of the oscillations in the cells is thus converted into the spatial periodicity of the somites.

In this paper we use a stochastic individual-based modelling approach to examine the role that Delta-Notch signalling plays in the regulation of a robust and reliable somite segmentation clock. We find that not only can Delta-Notch signalling synchronize noisy cycles of gene expression in adjacent cells in the presomitic mesoderm, but it can also amplify and increase the coherence of these cycles. We examine some of the shortcomings of deterministic approaches to modelling these cycles and demonstrate how intrinsic noise can play an active role in promoting sustained oscillations, giving rise to noise-induced quasi-cycles. Finally, we explore how translational and transcriptional delays can result in the cycles in neighbouring cells oscillating in anti-phase and we study how this effect relates to the propagation of noise-induced stochastic waves.



Schematic of the reduced two-cell gene regulatory system. Genes (hes/her and delta) are transcribed to produce mRNA. In turn, protein is translated from the mRNA, which goes on to activate/inhibit further mRNA transcription.

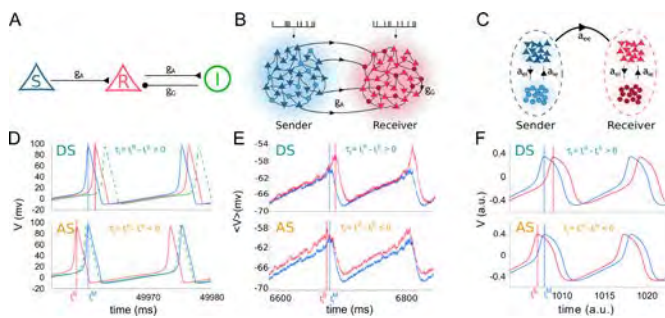
Phase Locking Mechanisms in Neuronal Circuits

Dalla Porta, L.; Matias, F.S.; dos Santos, A.J.; Alonso, A.; Carelli, P.V.; Copelli, M.; Mirasso, C. R. *Frontiers in Systems Neuroscience* 13:41

Synchronization is one of the brain mechanisms allowing the coordination of neuronal activity required in many cognitive tasks. Anticipated Synchronization (AS) is a specific type of out-of-phase synchronization that occurs when two systems are unidirectionally coupled and, consequently, the information is transmitted from the sender to the receiver, but the receiver leads the sender in time. It has been shown that the primate cortex could operate in a regime of AS as part of a normal neurocognitive function, however, it is still unclear what is the mechanism that gives rise to anticipated synchronization in neuronal motifs.

In this manuscript, we investigated the synchronization properties of cortical motifs on multiple scales and show that the internal dynamics of the receiver, which is related to its free running frequency in the uncoupled situation, is the main ingredient for AS to occur. For biologically plausible parameters, including excitation/inhibition balance, we found that the phase difference between the sender and the receiver decreases when the free running frequency of the receiver increases. As a consequence, the system switches from the usual delayed synchronization (DS) regime to an AS regime.

We show that at three different scales, neuronal microcircuits, spiking neuronal populations and neural mass models, both the inhibitory loop and the external current acting on the receiver mediate the DS-AS transition for the sender-receiver configuration by changing the free running frequency of the receiver.

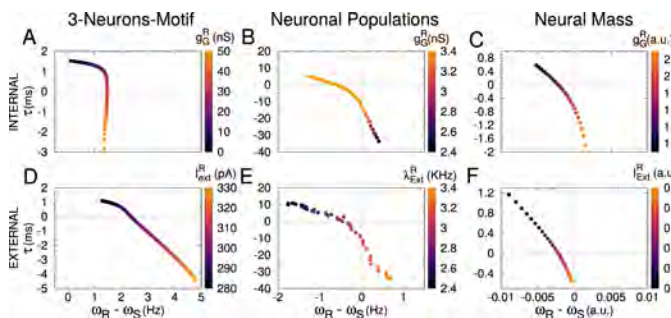


Cortical motif circuits. Schematic representation of the models: (A) 3-neuron motif, (B) two cortical populations, and (C) two neural masses.

(D) Membrane potential of three neurons in a regime of delayed-synchronization (DS, top) and anticipated-synchronization (AS, bottom). (E,F) Average membrane potential in a regime of DS (top) and AS (bottom), for populations and neural masses, respectively. In (D–F) the external current/noise was varied.

external current/noise was varied.

The generality of our results leads us to conclude that a faster internal dynamics of the receiver system is the main mechanism underlying the transition between anticipated and delayed synchronization in brain circuits.



Delayed and anticipated synchronization as a function of the free-running frequency. τ (y-axis) was computed in a coupled system, while the frequency difference (x-axis) was computed for the uncoupled one; parameters used in both cases are specified by the color code. (A–C) Internal parameter vs. frequency differences and (D–F) external parameter vs. frequency differences. Horizontal and vertical dashed lines represent zero-lag synchronization and a perfect match between sender and receiver free-running frequencies, respectively.

and a perfect match between sender and receiver free-running frequencies, respectively.

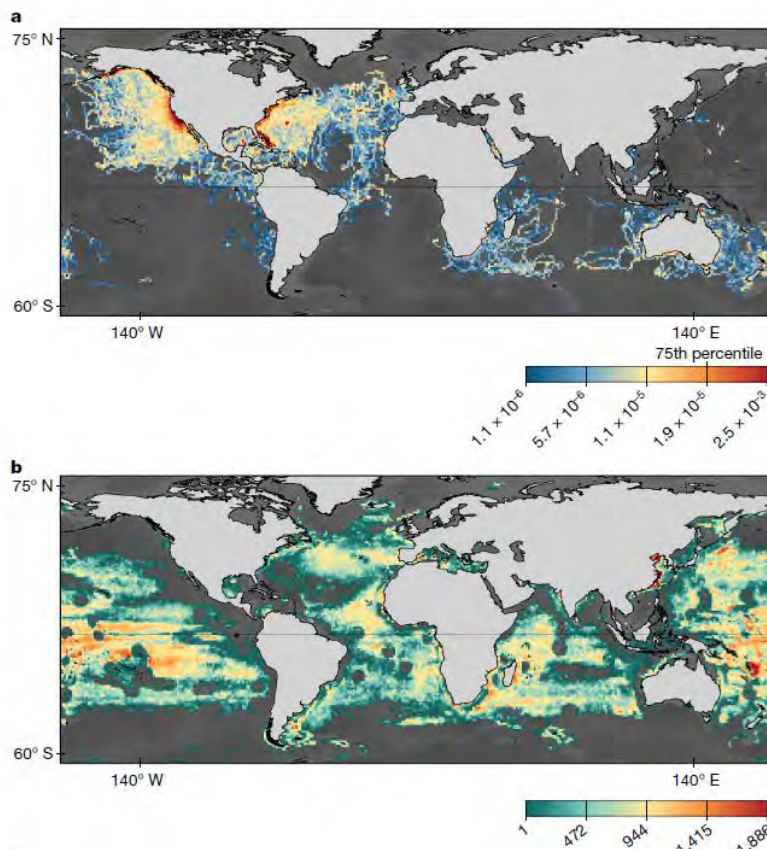
Global spatial risk assessment of sharks under the footprint of fisheries

Queiroz, N.; Eguiluz, Víctor M.; et al.
Nature 572, 461-466

Despite the immensity of the oceans, covering 70% of the area of our planet, the oceans have not escaped the effects of human activity. Overfishing, pollution and climate change are negatively affecting the health of our seas. Sharks are an icon of fierce predator of the oceans. Despite this, sharks do not escape the pressure of fisheries. Sharks, along with their relatives, are one of the most threatened groups of marine species, with a third of them being threatened with extinction. However, the uneven availability of fisheries-dependent data has meant that the full extent of the interaction of sharks with fishing fleets on the high seas, as well as the effects of those fisheries on them, is unknown.

To quantify the impact of human activity on marine life, the Automatic Identification System (AIS) - a tracking system used by many vessels - provides geolocated data that allows for the tracking of vessel movements worldwide. By cross-checking the AIS data with the satellite-tracked movements of 1,681 sharks, it allows us to give a global estimate of the extent to which areas of the ocean frequented by sharks overlap with active industrial fishing areas. The high degree of spatial overlap between sharks and industrial fishing vessels is due to the fact that both target ocean areas that are attractive in terms of productivity and temperature, and allow both fishing vessels and sharks to increase their catch rates. Almost a quarter of the average space occupied by individual sharks overlaps with the footprint of the fishing fleet, leaving these highly diverse animals with little shelter from fishing pressure and underlining the need for shark conservation efforts.

Considering that the work focuses on 11 species of sharks and that it is estimated that only 50-75% of large fishing vessels have AIS emitters installed, the methodology offers significant opportunities for application to other species and shows the capacity to provide information on human impact on the oceans.



Unsupervised extraction of epidemic syndromes from participatory influenza surveillance self-reported symptoms

Kyriaki Kalimeri, Matteo Delfino, Ciro Cattuto, Daniela Perrotta, Vittoria Colizza, Caroline Guerrisi, Clement Turbelin, Jim Duggan, John Edmunds, Chinelo Obi, Richard Pebody, Ana O. Franco, Yamir Moreno, Sandro Meloni, Carl Koppeschaar, Charlotte Kjelsø, Ricardo Mexia, Daniela Paolotti.
 PLoS Comput Biol 15(4): e1006173.

Seasonal influenza surveillance is usually carried out by sentinel general practitioners (GPs) who compile weekly reports based on the number of influenza-like illness (ILI) clinical cases observed among visited patients. This traditional practice for surveillance generally presents several issues, such as a delay of one week or more in releasing reports, population biases in the health-seeking behaviour, and the lack of a common definition of ILI case. On the other hand, the availability of novel data streams has recently led to the emergence of non-traditional approaches for disease surveillance that can alleviate these issues. In Europe, a participatory web-based surveillance system called InfluenzaNet represents a powerful tool for monitoring seasonal influenza epidemics thanks to aid of self-selected volunteers from the general population who monitor and report their health status through Internet-based surveys, thus allowing a real-time estimate of the level of influenza circulating in the population.

In this work we proposed an unsupervised probabilistic framework that combines time series analysis of self-reported symptoms collected by the InfluenzaNet platforms and performs an algorithmic detection of groups of symptoms. The aim of the study has been to show that participatory web-based surveillance systems are capable of detecting the temporal trends of influenza-like illness even without relying on a specific case definition. The methodology was applied to data collected by InfluenzaNet platforms over the course of six influenza seasons, from 2011-2012 to 2016-2017, with an average of 34,000 participants per season. Results show that our framework is capable of selecting temporal trends of syndromes that closely follow the ILI incidence rates reported by the traditional surveillance systems in the various countries. The proposed framework also was able to forecast quite accurately the ILI trend of the forthcoming influenza season (2016-2017) based only on the available information of the previous years (2011-2016). Furthermore, to broaden the scope of our approach, we applied it both in a forecasting fashion to predict the ILI trend of the 2016-2017 influenza and also to detect gastrointestinal syndrome in France. The final result is a near-real-time flexible surveillance framework not constrained by any specific case definition and capable of capturing the heterogeneity in symptoms circulation during influenza epidemics in the various European countries.

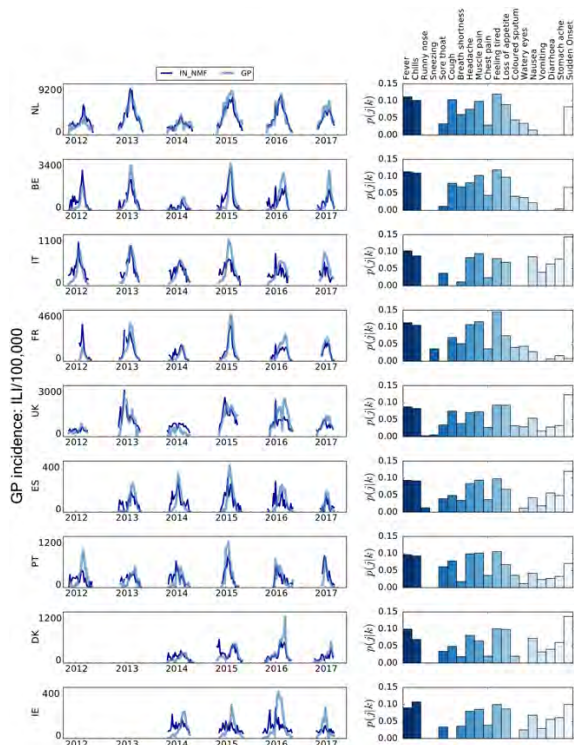


Figure. Qualitative comparison between the InfluenzaNet (IN_NMF) data and the national surveillance ILI incidence (GP) time series.

Left panel: qualitative comparison between the IN_NMF and the national surveillance ILI incidence (GP) time series. To allow for easier visual inspection, the depicted IN_NMF syndromes are rescaled by a fixed factor to the respective GP incidence. On the y-axis, the sample size of the GP incidence is reported. Right panel: contribution of each symptom to the automatically selected IN_NMF component.

Hierarchical organization of urban mobility and its

connection with city livability

Filho,Hugo;Dickinson,Brian;Dotiwalla,Xerxes;Eastham,Paul;Gallotti,Riccardo;Ghoshal,Gourab;Gipson,Bryant;Hazarie,Surendra A.; Kautz,Henry;Kucuktunc,Onur;Lieber,Allison;Sadilek,Adam;Ramasco, José Javier
Nature Communications 10, 4817

The recent trend of rapid urbanization makes it imperative to understand urban characteristics such as infrastructure, population distribution, jobs, and services that play a key role in urban livability and sustainability. A healthy debate exists on what constitutes optimal structure regarding livability in cities, interpolating, for instance, between mono- and polycentric organization. In this work, anonymous and aggregated flows generated from three hundred million users, opted-in to Location History, are used to extract global Intra-urban trips. We develop a metric that allows us to classify cities and to establish a connection between mobility organization and key urban indicators. We demonstrate that cities with strong hierarchical mobility structure display an extensive use of public transport, higher levels of walkability, lower pollutant emissions per capita and better health indicators. Our framework outperforms previous metrics, is highly scalable and can be deployed with little cost, even in areas without resources for traditional data collection.

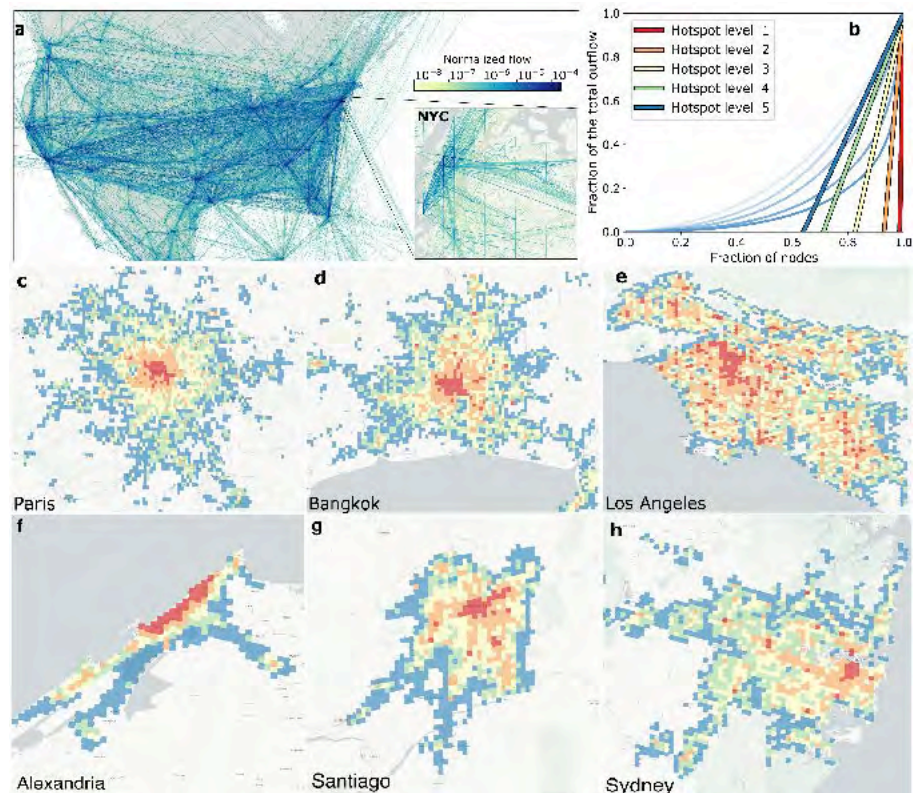


Figure.- Human mobility and hierarchical structure of cities. a Mobility network extracted from North America (New York City shown in inset). Nodes are geographical units and links are weighted by flows between locations with darker colors corresponding to more intense flows. b Hotspot level. c-h Maps of hierarchical hotspots for two groups of three metropolitan areas with similar population: c Paris (France) (12.4 million inhabitants), d Bangkok (Thailand) (14.5 million), e Los Angeles (USA) (13.35 million inhabitants), f Alexandria (Egypt) (5.17 million inhabitants), g Santiago (Chile) (7.11 million), and h Sydney (Australia) (5.13 million inhabitants). The color code is the same as in panel b: level 1 (darkred), level 2 (orange), level 3 (yellow), level 4 (green), and level 5 and below (dark blue).

Reduction of power grid fluctuations by communication between smart devices

Tchawou Tchuisseu, E.B.; Gomila, D.; Colet, P
International Journal of Electrical Power & Energy Systems 108, 145-152

The power grid is one of the most important infrastructures of modern society. It is composed by power plants, both conventional and renewable, transmission and distribution lines and consumers and it is managed in a centralized way by the system operator, which adapts in real time the energy generation to the demand. The progressive penetration of renewable energy sources is however increasing the difficulty in balancing production and demand. Moreover, RES can be distributed over the grid reducing energy transport needs, and therefore losses, but hindering centralized control by the system operator. A control distributed over the grid would then maximize the use of RES at the same time that would increase the efficiency of the system. There are several proposals to achieve such decentralized control, going from virtual power plants that integrate a large number of small RES distributed over a portion of the grid, to the use of smart devices that autonomously adapt their operation to the needs to the system, what is known as dynamic demand control (DDC).

In a previous work we showed that DDC effectively reduces small and medium size frequency fluctuations but, due to the need of recovering pending tasks, the probability of large demand peaks, and hence large frequency fluctuations, may actually increase. Although these events are very rare they can potentially trigger a failure of the system and therefore strategies to avoid them have to be addressed. In this work we introduce a method including communication among DDC devices belonging to a given group, such that they can coordinate opposite actions to keep the group demand more stable. We show that our method, which we call Communication enhanced DDC (CeDDC), reduces the amount of pending tasks by a factor 10 while large frequency fluctuations are significantly reduced or even completely avoided.

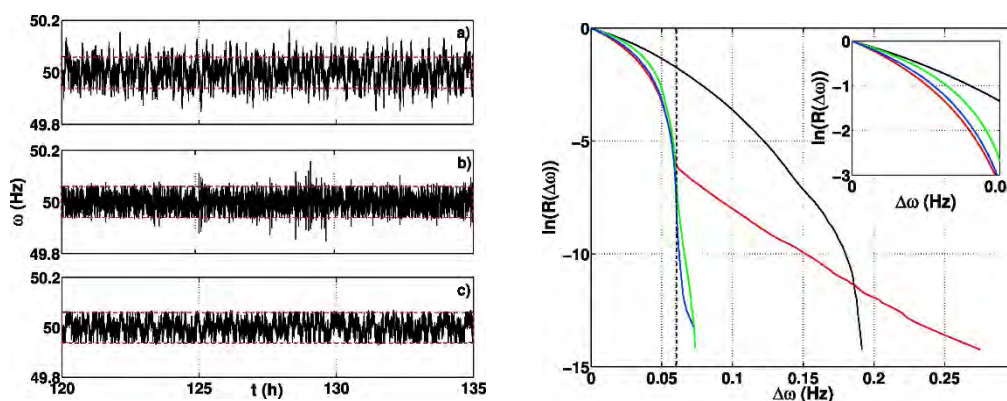


Figure 1: (Left) Time series of the frequency ω for a case a) without DDC, b) with DDC, and c) with CeDDC. Note how DDC diminishes the variance of the frequency fluctuations but introduces large frequency peaks due to the recovery of pending tasks. With CeDDC frequency is kept within the desired range. (Right) Cumulative probability distribution of finding a fluctuation larger than $\Delta\omega = |\omega - \omega_R|$. Black line corresponds to the case without DDC, red line with DDC and green and blue lines with CeDDC for two different group sizes.

1

PRESENTATION AND RESEARCH LINES

2








PERSONNEL

2.1 PERMANENT SCIENTIFIC STAFF

| | |
|-------------------------|--|
| PERE COLET | CSIC Research Professor |
| VÍCTOR M. EGUÍLUZ | CSIC Senior Researcher |
| INGO FISCHER | CSIC Research Professor |
| TOBIAS GALLA | CSIC Tenured Scientist |
| DAMIÀ GOMILA | CSIC Tenured Scientist |
| EMILIO HERNANDEZ-GARCÍA | CSIC Research Professor, IFISC Deputy Director |
| CRISTOBAL LÓPEZ | University Full Professor UIB |
| ROSA LÓPEZ | University Professor UIB |
| MANUEL MATÍAS | CSIC Senior Researcher |
| SANDRO MELONI | CSIC Tenured Scientist |
| CLAUDIO MIRASSO | University Full Professor UIB |
| MAXI SAN MIGUEL | University Full Professor UIB, IFISC Director |
| JOSE J. RAMASCO | CSIC Tenured Scientist |
| DAVID SÁNCHEZ | University Professor UIB, IFISC Academic Secretary |
| LLORENÇ SERRA | University Full Professor UIB |
| TOMÀS SINTES | University Professor UIB |
| RAÚL TORAL | University Full Professor UIB |
| ROBERTA ZAMBRINI | CSIC Tenured Scientist |

Contribution of the permanent staff to the IFISC research lines:

Every senior researcher participates in the transversal line on Complex Systems: Statistical and Nonlinear Physics. 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 lines during 2019.

|  Coherence and Integration Interaction and Bridges | | Pere Colet | Victor M. Eguiluz | Ingo Fischer | Damia Gomila | Emilio Hernández-García | Cristobal López | Rosa López | Manuel Matías | Sandro Meloni | Claudio Mirasso | José J. Ramasco | David Sánchez | Maxi San Miguel | Llorenç Serra | Tomàs Sintes | Raül Toral | Roberta Zambrini |
|--|---|------------|-------------------|--------------|--------------|-------------------------|-----------------|------------|---------------|---------------|-----------------|-----------------|---------------|-----------------|---------------|--------------|------------|------------------|
| 1) <i>Complex Systems: Statistical and Nonlinear Physics.</i> |  | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 2) <i>Transport and Information in Quantum Systems</i> |  | | | | | | | X | | | | | X | | X | | | X |
| 3) <i>Nonlinear Photonics</i> |  | X | | X | X | | | | | | X | | | | | | | |
| 4) <i>Nonlinear Dynamics in Fluids.</i> |  | | | | | X | X | | | | | | | | | | | |
| 5) <i>Biocomplexity</i> |  | | X | X | X | X | X | | X | X | X | | | | | X | X | |
| 6) <i>Collective phenomena in Social and Socio-technical Systems</i> |  | X | X | | | | | | | X | | X | X | X | | | X | |



IFISC people- Winter Solstice 2019

2.2 SCIENTIFIC ASSOCIATES

NAZARETH CASTELLANOS
 JUAN CARLOS GONZALEZ AVELLA
 ALBERTO HERNANDO DE CASTRO
 STEFANO LONGHI
 HORACIO WIO

2.3 POSTDOCTORAL RESEARCH ASSOCIATES

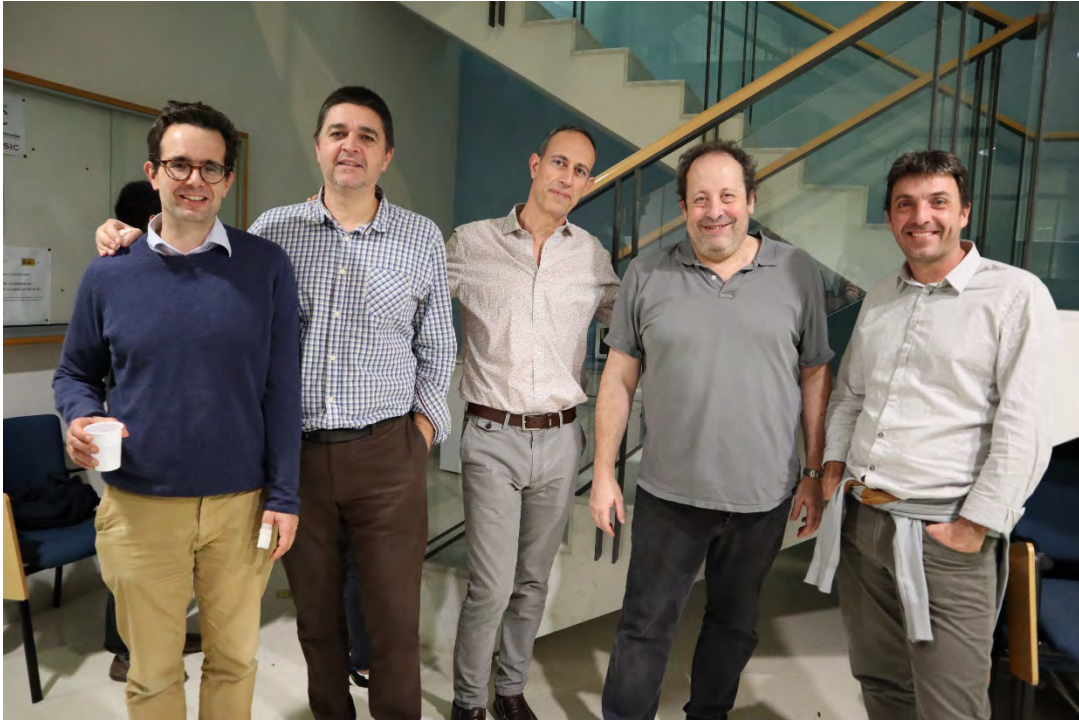
| | |
|-----------------------|---|
| APOSTOLOS ARGYRIS | Balearic Government Program Vicent Mut Contract |
| EDUARDO H. COLOMBO | Postdoctoral Contract Project LINCNETS |
| MIGUEL C. SORIANO | Ramón y Cajal Fellow |
| GABOR DROTOS | Balearic Government Postdoctoral Contract |
| JUAN FERNANDEZ GRACIA | UIB Postdoctoral Contract |
| GIANLUCA GIORGI | Balearic Government Postdoctoral Contract |
| LAILA D. KAZIMIERSKI | Postdoctoral Contract Project CAASE |
| NAGI KHALIL | UIB Lecturer |
| KONSTANTIN KLEMM | Ramón y Cajal Fellow |
| JOHANNES NOKKALA | Postdoctoral Contract Project EPHEQUCS |
| SUNGGUEN RYU | Postdoctoral Contract Maria de Maeztu |
| JORGE P. RODRÍGUEZ | Postdoctoral Contract Project CAASE |
| ANDRE RÖHM | Postdoctoral Contract Maria de Maeztu |
| LUIS F. SEOANE | Postdoctoral Contract Maria de Maeztu |
| TONG ZHAO | Taiyuan University of Technology (NSFC) grant. |
| ALESSANDRO SOZZA | Postdoctoral Contract Project LINCNETS |

2.4 PHD STUDENTS

| | |
|-------------------------|---------------------------------------|
| JAVIER AGUILAR | Maria de Maeztu Contract |
| AEJANDRO ALMODOVAR | Maria de Maeztu Contract |
| ALEIX BASSOLAS | Balearic Government Fellowship |
| NASSIMA BENCHTABER | FPI Contract UIB |
| ALBERT CABOT | Balearic Government Fellowship |
| VIOLETA CALLEJA | Maria de Maeztu Contract |
| MARCO CATTANEO | Maria de Maeztu Contract |
| REBECA DE LA FUENTE | FPI Contract Project LAOP |
| GIOVANNI DONATI | Maria de Maeztu Contract |
| NOEMIE EHSTAND | Contract Project CAFE |
| CRISTIAN ESTARELLAS | Balearic Government Fellowship |
| IRENE ESTÉBANEZ | Maria de Maeztu Contract |
| ANTONIO FERNANDEZ | FPU Contract UIB |
| THOMAS LOUF | Maria de Maeztu Contract |
| MARIA MARTINEZ BARBEITO | Maria de Maeztu Contract |
| RODRIGO MARTÍNEZ PEÑA | Maria de Maeztu Contract |
| MATTIA MAZZOLI | Contract Project ESOTECOS |
| DANIEL RUIZ REYNÉS | FPI Contract Project ESOTECOS |
| SOMAYE SHEYKHALI | Contract Project CAASE |
| MIGUEL A. SIERRA | Contract Project TQM@NANO |
| AREF PARIZ | UIB fellowship InformatProc |
| MORITZ PFLÜGER | Volkswagen Contract Project NeuroQNet |
| TOMASZ RADUCHA | Univ. of Warsaw Fellowship, Poland |
| GUILLEM ROSSELLÓ | Contract Projects Set@QT and TQM@nano |

2.5 TECHNICAL AND ADMINISTRATIVE SUPPORT

| | |
|-------------------|---------------------------------|
| INMA CARBONELL | Administration Unit Head |
| ADRIAN GARCÍA | Communication and Dissemination |
| PAU MASSUTI | Lab Technician |
| SIMONA OBREJA | Project Manager |
| MARTA OZONAS | IFISC Secretary |
| ALBERTO PUEYO | Lab Technician |
| JOAN SEGURA MATEU | Computing Lab Technician |
| EDUARD SOLIVELLAS | Computing Lab Technician |
| RUBEN TOLOSA | Computing Lab Technician |
| ANTONIA TUGORES | Data Engineer |



WINTER SOLSTICE EVENT



2.6 VISITORS

LONG-TERM VISITORS (more than one month)

| | |
|----------------------|--|
| BENJAMÍN CARRERAS | Univ. Alaska, USA. (March) |
| HENDRIK A. DIJKSTRA | Utrecht Univ, Germany. (Jan-February) |
| EDGAR KNOBLOCH | Berkley Univ, California, USA. (May-June) |
| MAXIME LENORMAND | IRSTEA, France. (April-May) |
| SALVATORE LORENZO | Univ. Palermo, Italy. (Sept-October) |
| CARLOS J. MELIAN | LTH, Switzerland. (Sept-Feb2020) |
| PEDRO J. PARRA RIVAS | Univ. ULB Brussels, Belgium (May-June) |
| TOMASZ RADUCHA | Univ. Warsaw, Poland (April-May) |
| FEDERICO VAZQUEZ | Univ. Buenos Aires, Argentina (Sept-October) |

SHORT-TERM VISITORS
 (Less than one month)

| | |
|---------------------|---|
| RICARDO MARTINEZ | Princeton Univ., USA. (January and Sept.) |
| STEFANO LONGHI | Politecnico Milan, Italy (January and October) |
| RONALDO MENEZES | Exeter Univ. UK (January) |
| SUN-YONG HWANG | Duisburg Univ., Germany. (February) |
| CELIA ANTENEODO | Ponfificia Univ. Católica de Rio, Brasil (February) |
| RAFAEL MOLINA | Instituto de Estructura de la Materia, Madrid (March) |
| FRANCESCO PLASTINA | Univ. della Calabria, Italy. (March) |
| ROSARIO MANTEGNA | Palermo Univ. , Italy (March) |
| MARCO DENTZ | (IDAEA-CSIC), Barcelona, Spain (March) |
| VIKTOR JIRSA | CNRS-Aix Marseille University, France (April) |
| RUBEN GOMEZ | Univ. de Extremadura, Spain (May) |
| ENRICO SER GIACOMI | Pierre and Marie Curie Univ. France (May) |
| LENDERT GELENS | Vrije Univ. Brussels, Belgium (May) |
| FEDERICO BILLECI | Palermo Univ. , Italy (June) |
| SALVATORE RAIA | Palermo Univ. , Italy (June) |
| GONZALO MANZANO | ICTP and Scuola Normale Superiore, Italy (June) |
| ELISABETH GIACOBINO | Univ. Pierre et Marie Curie, Paris, France (June) |
| HERNAN MAKSE | Levich Institute of City College of NY, USA (June) |
| HAYDEE LUGO | Univ. Complutense Madrid, Spain (June and Nov) |
| PABLO AMIL | Univ. Politecnica de Cataluña, Spain (July) |
| ALVARO GOMEZ | Inst. Ciencias Materiales Madrid, Spain (July) |
| MARTA ESTARELLAS | National Institute of Informatics, Tokio (July) |
| WOLFRAM M. BARFUSS | Potsdam Inst. Climate Impact Research (July) |
| ALEXANDER IOMIN | Technion, Institute of Technology, Israel (July) |
| NEAL ABRAHAM | Five Colleges, Springfield, MA, USA (September) |
| JOSEPH BARON | Univ. Manchester, UK (October) |
| MASSIMILIANO ZANIN | Univ. Politecnica, Madrid, Spain (October) |
| STEFAN THURNER | Medical Univ. of Vienna, Austria (October) |
| THOMAS LOUAIL | CEA, Saclay, Paris, France (October) |
| JÜRGEN MLYNEK | Helmholtz Association, Germany (November) |
| LORENZO PAVESI | Univ. of Trento, Italy (November) |
| SUSANA HUELGA | Ulm University, Germany (November) |
| FERNANDO PIGAZO | Univ. Cantabria, Spain. (December) |
| TOMASZ CZYSZANOWSKI | Lodz Univ. of Technology, Poland (December) |

2.7 MASTER AND COLLABORATION STUDENTS

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

| | |
|--------------------------|--|
| DAVID ABELLA BUJALANCE | IFISC Master |
| ALBERT ABIO ROJO | IFISC Master |
| MIGUEL ALVAREZ SANCHEZ | IFISC Master |
| LAURA AVIÑO ESTEBAN | IFISC Master |
| GIOVANNI BAJ | IFISC Master |
| VETTELSCHOSS BENEDIKT | IFISC Master |
| PATRIZIA FERRANTE | IFISC Master |
| JAVIER GALVAN FRAILE | IFISC Master |
| JORGE GARCIA BENI | IFISC Master |
| ALEX GIMENEZ ROMERO | IFISC Master |
| FERRAN LARROYA PAIXA | IFISC Master |
| MARIUS-JASCHA MAGIERA | IFISC Master |
| JAUME S. MARTORELL SERRA | IFISC Master |
| JORGE MEDINA HERNANDEZ | IFISC Master |
| DIANELA OSORIO BECERRA | IFISC Master |
| LUCIA RODRIGO BORT | IFISC Master |
| MARC SADURNÍ PARERA | IFISC Master |
| RAMON SALETA-PIERSANTI | IFISC Master |
| ROBERT TITZ | IFISC Master |
| | |
| ANA PALACIOS DE LUIS | IFISC Master and SURF@IFISC Fellowship |
| | |
| RENZO BRUERA | SURF@IFISC Fellowship |
| TEO GIL MORENO DE MORA | SURF@IFISC Fellowship |
| LUCAS MAISEL LICERAN | SURF@IFISC Fellowship |
| NICOLE ORZAN | SURF@IFISC Fellowship |
| PIOTR STOROZENKO | SURF@IFISC Fellowship |
| ANTONIA VERDERA | SURF@IFISC Fellowship |
| | |
| CARLOS M. GUARDIOLA | UIB Training student. Oct-Dec. |
| PERE ROSSELLÓ TRUYOLS | UAB External Training student Agreement. July |
| | |
| GIOVANNI BAJ | ERASMUS student Univ. degli studi dell'Insubria (Varese), Italy Oct-Dec. |
| FEDERICO BILLECI | ERASMUS student Univ. Palermo, Italy. June- August |
| MINSEOK KANG | ERASMUS student Univ. Osnabruck, Germany. Jan – Feb. |
| URSZULA KURDZIEL | ERASMUS student Univ. Warsaw of Technology, Poland. May – July |
| RAPHAEL J.M. LAFARGUE | ERASMUS student Ecole normale superieure Paris-Saclay, France. Sept-Dec. |
| SALVATORE RAIÀ | ERASMUS student Univ. Palermo, Italy. June - August |
| JANEK FELIX SCHWIND | ERASMUS student. Univ. Munster, Germany. Sep. – Dec. |

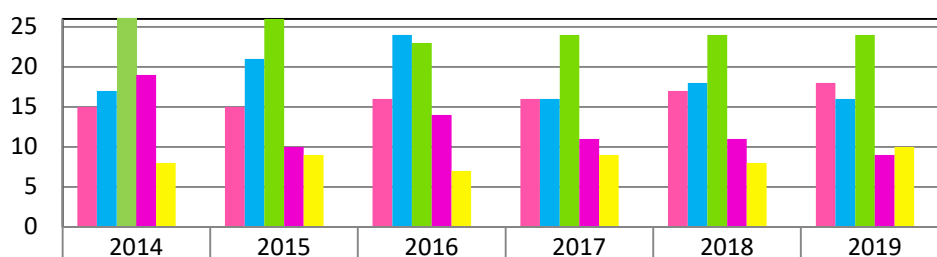
2.8 HUMAN RESOURCES OVERVIEW

HUMAN RESOURCES IFISC 2019

| | Total | Male | Female |
|----------------------|-----------|-----------|-----------|
| Permanent staff | 18 | 16 | 2 |
| Postdoctoral fellows | 16 | 15 | 1 |
| PhD students | 24 | 17 | 7 |
| Long-term visitors | 9 | 9 | 0 |
| Support personnel | 10 | 6 | 4 |
| Total | 77 | 63 | 14 |



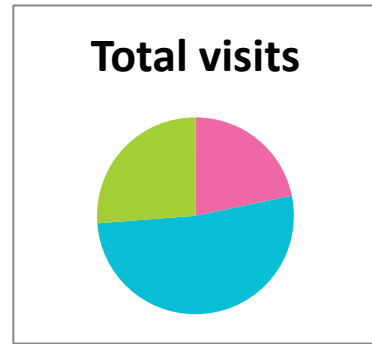
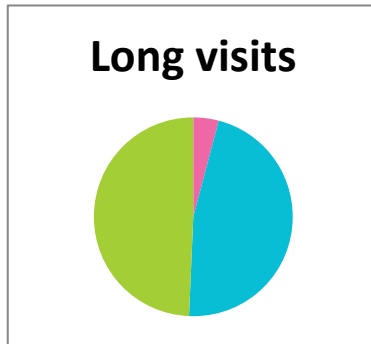
PERSONNEL IFISC 2014-2019



| | | | | | | |
|-----------------------------|-----------|-----------|-----------|-----------|-----------|-----------|
| PERMANENT STAFF | 15 | 15 | 16 | 16 | 17 | 18 |
| POSTDOCTORAL AND ASSOCIATED | 17 | 21 | 24 | 16 | 18 | 16 |
| PHD STUDENTS | 27 | 26 | 23 | 24 | 24 | 24 |
| LONG TERM VISITORS | 19 | 10 | 14 | 11 | 11 | 9 |
| SUPPORT PERSONNEL | 8 | 9 | 7 | 9 | 8 | 10 |
| TOTAL | 86 | 81 | 84 | 76 | 78 | 77 |

VISITING SCIENTISTS AT IFISC 2014-2019

| | Short visits | Long visits | Total visits |
|-------------------|--------------|-------------|--------------|
| SPAIN | 56 | 3 | 59 |
| EUROPE | 119 | 37 | 156 |
| REST OF THE WORLD | 43 | 35 | 78 |
| TOTAL | 218 | 75 | 293 |



3

RESEARCH PROJECTS AND FUNDING

DURING 2019 IFISC HAS RECEIVED FUNDING VIA THE ACTIVE RESEARCH PROJECTS LISTED IN THE FOLLOWING PAGES. IN BRIEF:

- European Commission Framework Program projects: 2
- Spanish National Plan: 9
- Collaboration Networks: 7
- Research Contracts: 1

Grand total budget of active projects in 2019: **4,127k € (including 2,000k €Mdm)**

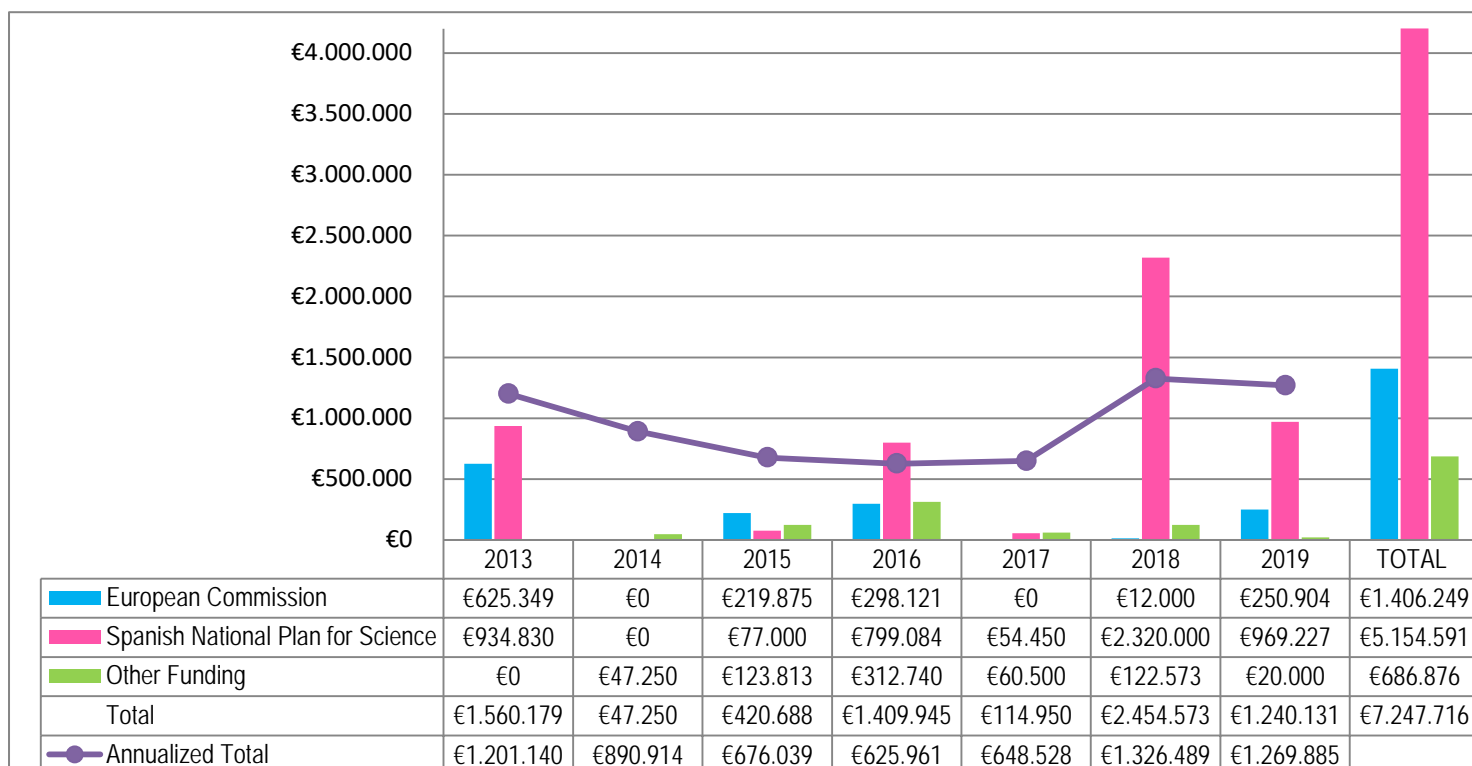
Average yearly funding in 2013-19: **1,035k €**

Average EC funding in 2013-19: **27% of total (excluding Mdm)**

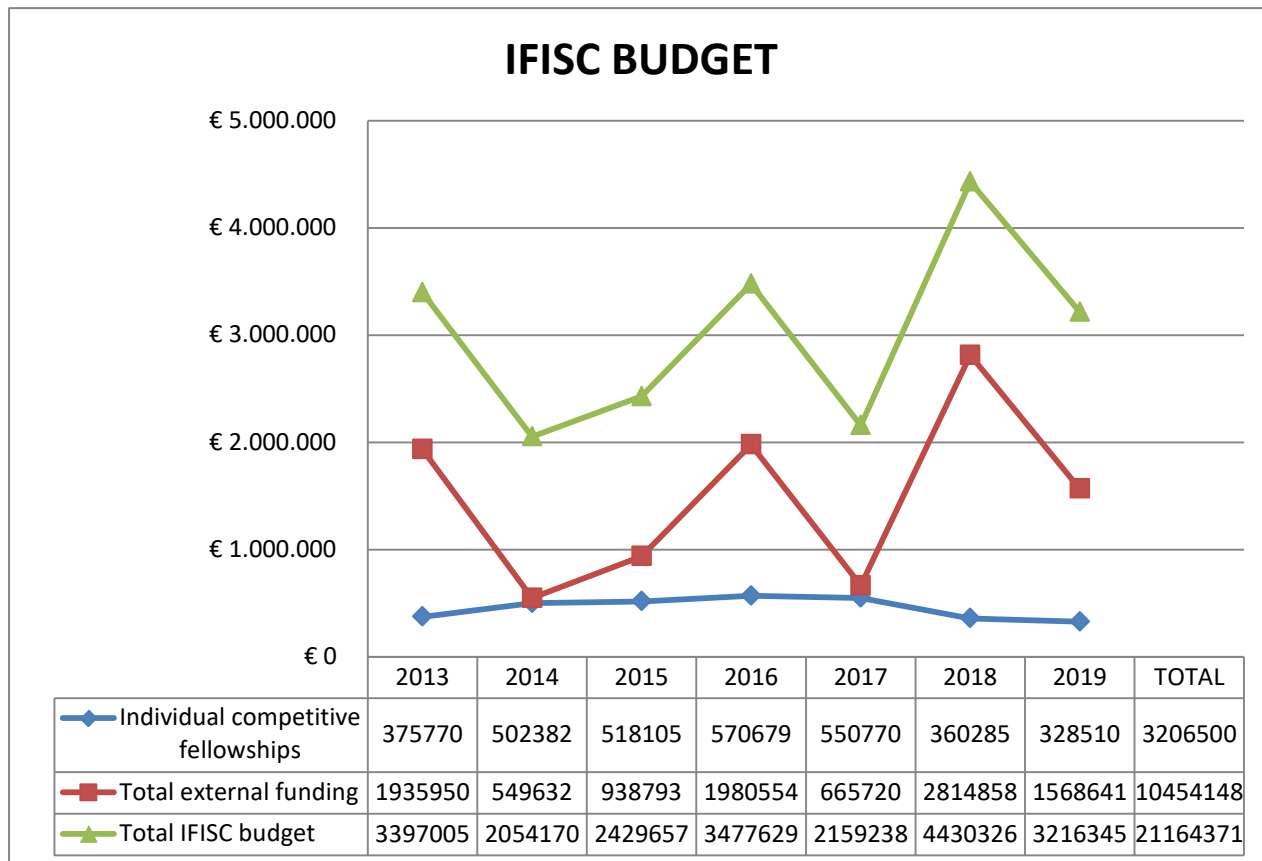
BUDGET FIGURES FOR THE PERIOD 2013-2019 ARE SUMMARIZED IN THE FOLLOWING TABLE

(With budget of a project assigned to the year it is granted. The *Annualized total* is the sum of one-third of the budget granted in that year and in the two previous years):

BUDGET IFISC'S RESEARCH PROJECTS 2013-2019 (IN €)



IFISC also receives external funding in terms of individual competitive predoctoral and postdoctoral fellowships, as specified in the following table and figure. There, 'total external funding' includes these fellowships together with the budget of research projects and contracts. 'Total IFISC budget' includes the total external funding together with costs of permanent staff and regular budget contributions from UIB and CSIC.



2013-19 yearly-average total budget : **3,023,482 €**
 2013-19 yearly-average of total external funding: **1,493,450 €**
 2013-19 average ratio of financing from external sources: **49.4 %**
 2013-19 individual competitive Pre and Postdoc fellowships **31% of competitive funding**

3.1 RESEARCH FUNDED BY THE EUROPEAN COMMISSION

CAFE

Climate Advanced Forecasting of sub-seasonal Extremes. Marie Skłodowska-Curie Innovative Training Network. CSIC. [813844]. IFISC Principal Investigator: Emilio Hernández- García (2019-2023) .
 Budget: 250.904,88 €

ESPON Housing

Espon EGTC “Big data for territorial analysis and housing dynamics”. [2017/S 248-523261] Contract European Commission through the ESPON 2020 program devoted to study territorial uses in the EU. IFISC Principal Investigator: J. Ramasco.(2018-2019) Budget: 12.000 €

3.2 RESEARCH PROJECTS OF THE SPANISH NATIONAL PLAN FOR SCIENCE

MdM – IFISC

Accreditation of IFISC as “Maria de Maeztu, Unit of Excellence”. Programa Estatal de Fomento de la Investigación Científica y Técnica de Excelencia. Principal Investigator: Claudio Mirasso. (2018-2022) Budget: 2.000.000 €

EPheQuCS

Emergent Phenomena and decoherence in quantum complex systems. [FIS2016-78010-P]. Spanish Government. Principal Investigator: Roberta Zambrini. (2017-2019). Budget: 102.850€

IDEA

Improving data Decoding in optical communication networks All-optically using neuro-inspired photonic systems. CSIC [TEC2016-80063-C3-1-R] and UIB [TEC2016-80063-C3-3-R]. Principal Investigators: Ingo Fischer, Claudio Mirasso and Miguel C. Soriano (2016-2019). CSIC Budget: 66.550€ UIB Budget: 46.585€

PACCS

Physics approach to complexity in sociotechnical systems. [RTI2018-093732-B-C2]. Principal Investigators: Maxi San Miguel, Raul Toral, Jose J. Ramasco and Sandro Meloni (2019-2021). CSIC Budget: 133.100 € UIB Budget: 151.250 €

SPASIMM

Spatiotemporality in sociobiological interactions, models and methods. [FIS2016-80067-P]. Principal Investigators: Victor M. Eguiluz and Konstantin Klemm. (2017-2019). Budget: 54.450 €

TQM@Nano

Transport in Quantum Materials at the Nanoscale. [MAT2017-82639]. IFISC Principal Investigators: D. Sanchez and R. Lopez. (2018-2020) Budget: 70.000 €

SuMaECO

Sustainability of marine coastal ecosystems in the context of global change in the Mediterranean sea: Modeling and simulations. [RTI2018-095441-B-C22]. Principala Investigators: Damia Gomila and Tomas Sintes. (2019-2021). CSIC Budget: 196.020 €

NLPLab Infra | **Sistema de generación y detección de señales arbitrarias con gran ancho de banda.** [EQC2019-005691-P] Infraestructura MICINN. Principal Investigator: Ingo Fischer. (2019-2020). Budget: 488.857,46 €

CLUSTER | **Computational Cluster for big data analysis and intensive numerical simulations.** [EQC2018-004787-P] IFISC Principal Investigator: Maxi San Miguel (2018-2019) Budget: 250.630 €

3.3 OTHER IFISC RESEARCH PROJECTS

MOREHOUSE | **Modeling hOusing maRkets dynamics thanks to Emerging and HeterOgeneoUs data SourcEs.** [2018FR0031]. CSIC – CRNS. PICS Project. Principal Investigator: Jose J. Ramasco. (2019-2021). CSIC Budget: 20.000 €

HOINK | **Higher Order Interactions in Complex Networks.** [2018501036] CSIC incorporation project. IFISC Principal Investigator: Sandro Meloni. Budget: 5.000 €

3.4 RESEARCH CONTRACTS

CAASE | **Coupled Animal and Artificial Sensing for Sustainable Ecosystems: The Red Sea as a CAASE Study.** Office of Sponsored Research. KAUST (Saudi Arabia). Principal Investigator: Victor M. Eguíluz. (2016-2020). Budget: 278.413 €

3.5 RESEARCH PROJECTS AND COLLABORATION NETWORKS WITH PARTICIPATION OF IFISC MEMBERS

| | |
|------------------|---|
| COSTNET | European Cooperation for Statistics of Network Data Science. COST Action [CA15109]. IFISC Spanish member of management committee: Maxi San Miguel (2016-2020) |
| RFE2017 | Network of non-equilibrium statistical physics and its multidisciplinary applications. MINEICO [FIS2006-82028-REDT] IFISC Principal Investigator: David Sanchez. (2017-2019) |
| TNT | Thermoelectricity network: new theories. MINEICO [MAT2016-82015-REDT] Excellence Network. IFISC Principal Investigator: Rosa López. (2017-2019) |
| RICTE | Quantum Information and Technologies Network. [FIS2016-81891-REDT]. IFISC Principal Investigator: Roberta Zambrini. (2017-2019) |
| IN-TREE | INCT in Interdisciplinary and Transdisciplinary Studies in Ecology and Evolution. CNPq, CAPES, FAPESB Brazil. IFISC Principal Investigator: Emilio Hernández García. (2016-2022) |
| TEAMS | Towards an Ecological Approach of Information Systems. “Fondazione Cariparo” in Padua, Italy. IFISC Principal Investigator: Sandro Meloni. (2018-2019) |
| IBERSINC3 | Red sobre dinámica y sincronización en redes complejas. [FIS2017-90782-REDT]. Excellence Network. IFISC Principal Investigator: Miguel C. Soriano (2019-2020). Budget: 17.000 € |

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

BBVA

DATA & ANALYTICS



3

RESEARCH PROJECTS AND FUNDING

4

IFISC SEMINARS

Coordinators:
Llorenç Serra
Ingo Fischer

The full listing of the 58 seminars given at IFISC during 2019 can be found at <http://ifisc.uib-csic.es/en/events/seminars/> and 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/>

Quantum fluids of light

Bose Einstein condensation of polaritons

Excitation CW laser 1.755 eV

5 K

• 2D system Berezinski-Kosterlitz-Thousless transition
 • non-resonant optical pump : quasi-thermal polariton distribution :
 polariton creation et recombination (polariton life time ~4 ps)

Kasprzak et al. Nature, 443, 409 (2006)

The video player shows a lecture on Bose-Einstein condensation of polaritons. It includes a diagram of the energy bands for upper and lower polaritons, a plot of the excitation CW laser at 1.755 eV, and experimental data at 5 K showing the condensation of polaritons. The video is from the IFISC channel, University of Barcelona and CSIC.

Spatially Localized Structures in Driven Dissipative Systems: Theory and Applications

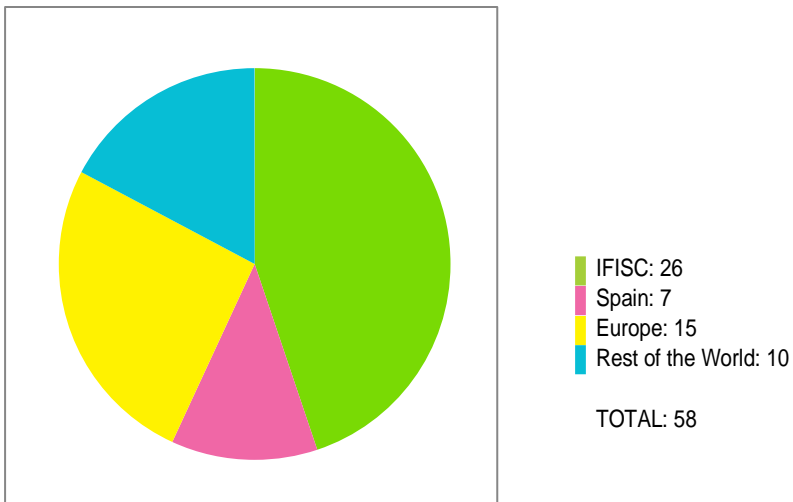
Snaking in two spatial dimensions: SH23

Lloyd et al., SIADS 7, 1049 (2008)

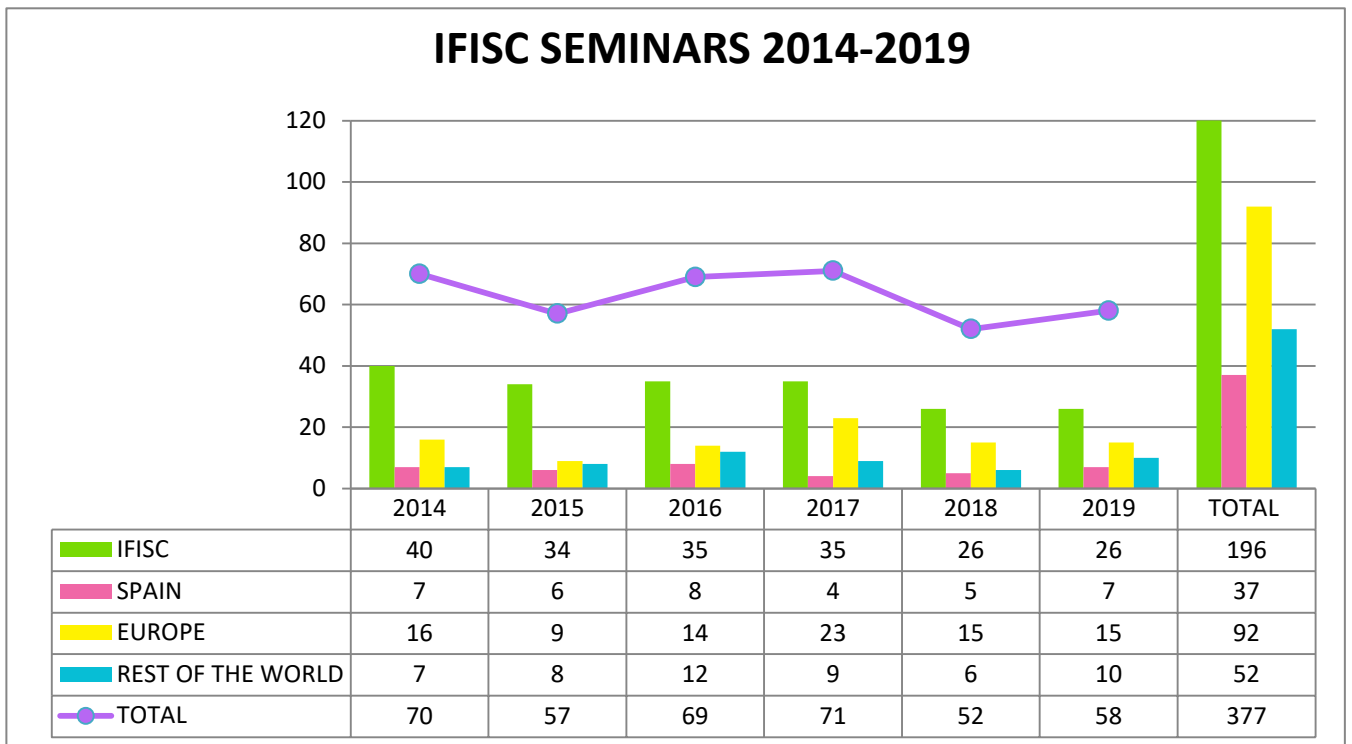
The video player shows a lecture on snaking in two spatial dimensions. It includes a diagram of a circular lattice structure and a plot of the squared magnitude of the wave function $||u||_2^2$ versus the radial coordinate r . The plot shows four distinct snaking branches labeled 1, 2, 3, and 4. The video is from the IFISC channel, University of Barcelona and CSIC.

The following graphs show the distribution of seminars by geographical provenance of the speaker for 2019 and for the previous years:

PROVENANCE OF SPEAKERS AT IFISC SEMINARS 2019



IFISC SEMINARS 2014-2019





A SERIES OF SEMINARS BY LEADING SCIENTISTS IN COMPLEX SYSTEMS

Colloquia on Complex Systems represent a special series of seminars by eminent speakers who are working at the forefront of complex systems and are inspiring the evolution of the field. The series of Colloquia allows students and scientists of IFISC to interact with leaders in Complex Systems science in the intimate environment of our Institute and to discuss the challenges and future directions of this cross-disciplinary research field. Colloquia on Complex Systems are webcast and, as well as past colloquia, available worldwide on IFISC's YouTube channel.



Henk A. Dijkstra, **Centre for Complex Systems Studies, University of Utrecht**

The El - Niño Phenomenon: Complexity and Predictability

Jan 16, 2019 3 p.m.



Rosario N. Mantegna, **Palermo University**

Noise and information in economic and financial systems

Mar 13, 2019 3 p.m.



Viktor Jirsa, **Institute de Neurosciences des Systèmes, CNRS-Aix Marseille University**

Emergence and pattern formation in large-scale brain networks: from bifurcations to epilepsy

Apr 02, 2019 3 p.m.



Hernan Makse, **Complex Networks and Data Science Lab, Levich Institute of City College of New York**

Essential nodes and keystone species in the brain, ecosystems and social systems

Jun 21, 2019 3 p.m.



Stefan Thurner, **Complexity Science Hub Vienna, Medical University of Vienna**

Statistics of driven processes

Oct 18, 2019 noon



Susana Huelga, **Institute of Theoretical Physics and Centre of Quantum BioScience, Ulm University**

Are there non trivial quantum effects in biology? A discussion from an open quantum system perspective

Nov 27, 2019 3 p.m.

4

IFISC SEMINARS

5

PUBLICATIONS

IFISC RESEARCH RESULTS HAVE BEEN REPORTED IN THE FOLLOWING PUBLICATIONS DURING 2019:

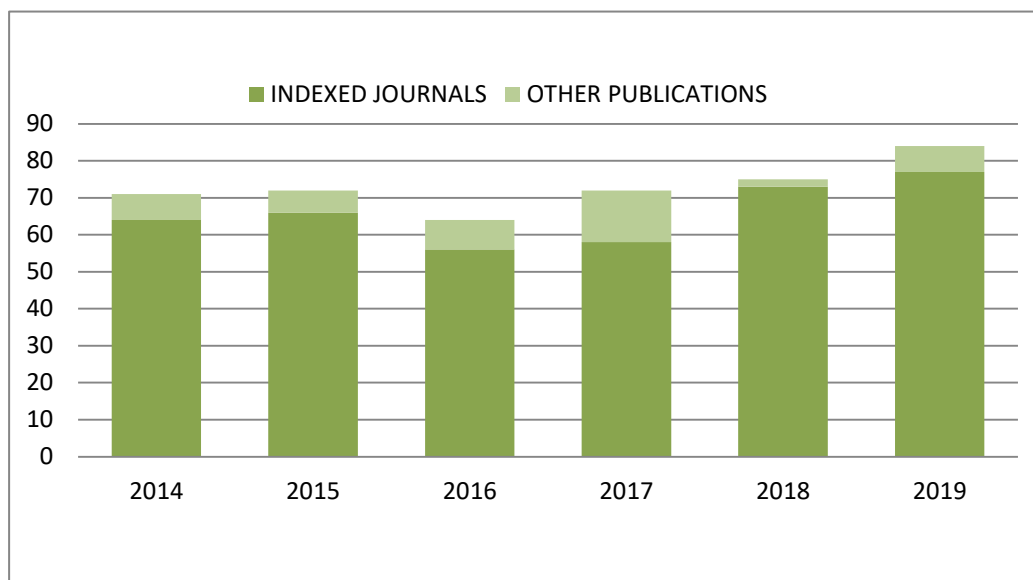
- Papers in indexed journals: **77**
- Other publications: **7 (including 2 books)**

The following tables put these numbers in the context of the publication activity during the past years, and specify which are 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 the period 2014-2019 IFISC has published 1 paper in Nature, 2 papers in PNAS, 5 papers in Nature Communications, 2 in Science Advances, 1 paper in Nature Geophysics, 1 in Nature Nanotechnology, 1 in Physics Reports, 1 paper in Physical Review X, and 13 papers in Physical Review Letters.

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 2014-2019



| | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | TOTAL |
|--------------------|-----------|-----------|-----------|-----------|-----------|-----------|------------|
| INDEXED JOURNALS | 64 | 66 | 56 | 58 | 73 | 77 | 394 |
| OTHER PUBLICATIONS | 7 | 6 | 8 | 14 | 2 | 7 | 44 |
| TOTAL | 71 | 72 | 64 | 72 | 75 | 84 | 438 |

JOURNALS WITH THE LARGEST NUMBER OF PUBLICATIONS

| IFISC PUBLICATIONS | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | TOTAL |
|-----------------------------------|------|------|------|------|------|------|-------|
| Physics journals | | | | | | | |
| Physical Review E | 14 | 12 | 9 | 4 | 10 | 8 | 57 |
| Physical Review B | 7 | 7 | 5 | 4 | 5 | 2 | 30 |
| New Journal of Physics | 3 | 1 | 5 | 3 | 4 | 3 | 19 |
| Chaos | 0 | 3 | 2 | 5 | 4 | 4 | 18 |
| Physical Review A | 5 | 2 | 3 | 3 | 0 | 1 | 14 |
| Physical Review Letters | 3 | 4 | 1 | 1 | 3 | 1 | 13 |
| European Physical Journal B | 1 | 1 | 2 | 3 | 3 | 2 | 12 |
| Multidisciplinary journals | | | | | | | |
| Scientific Reports | 2 | 3 | 7 | 11 | 3 | 9 | 35 |
| Plos One | 5 | 6 | 2 | 1 | 4 | 0 | 18 |
| Nature Communications | 0 | 3 | 0 | 0 | 0 | 2 | 5 |
| IEEE journals | 0 | 3 | 2 | 1 | 0 | 2 | 8 |
| Other non-physics journals | 13 | 8 | 7 | 7 | 13 | 20 | 68 |

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

Biosciences:

Trends in Ecology and Evolution, Journal of Theoretical Biology, Bulletin of Mathematical Ecology, Journal of the Royal Society Interface, Neuroimage, PLoS Computational Biology, PLoS Genetics, Ecological Complexity, Ecography, Macromolecules, Ecography, Frontiers in Computational Neuroscience, Frontiers in Neuroscience, Frontiers in Neuroinformatics, Frontiers in Systems Neuroscience, Journal of Heredity, Theoretical Biology and Medical Modelling, Computer Methods and Programs in Biomedicine, The ISME Journal,, Global Ecology and Biogeography, and Ecological Applications.

Earth sciences:

Nature Geoscience, Journal of Geophysical Research, Geophysical Research Letters, Deep-Sea Research I, Nonlinear Processes in Geophysics, ICES Journal of Marine Science, Earth Science Dynamics, Progress in Oceanography, Frontiers in Marine Science, Journal of Marine Systems, and Journal of Climate

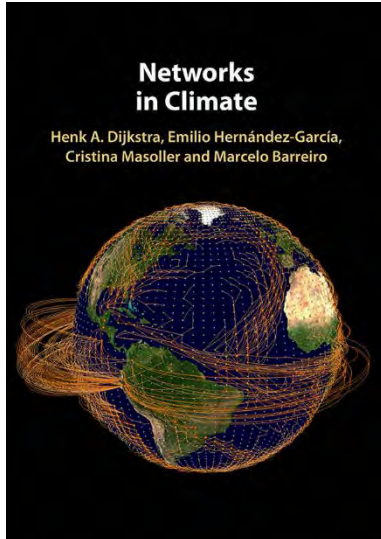
Social and sociotechnical systems:

Palgrave Communications, Journal of Economic Interaction and Coordination, Transportation Journal, Transportation, Transportation Research, Journal of Air Transport management, Built Environment, and Journal of Transport Geography.

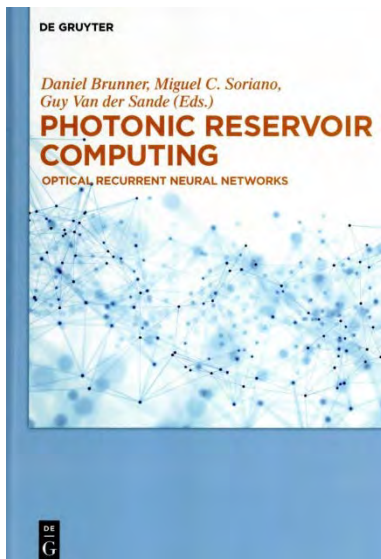
Data science:

EPJ Data Science, Journal of Machine Learning Research, Cognitive Computation, and Applied Network Science.

IFISC researchers have coauthored two books published in 2019:



Networks in Climate
by Henk A. Dijkstra, **Emilio Hernández-García**, Cristina Masoller and
Marcelo Barreiro, Cambridge University Press.



Photonic Reservoir Computing: Optical Recurrent Neural Networks
Edited by Daniel Brunner, **Miguel C. Soriano** and Guy van der Sande,
De Gruyter.

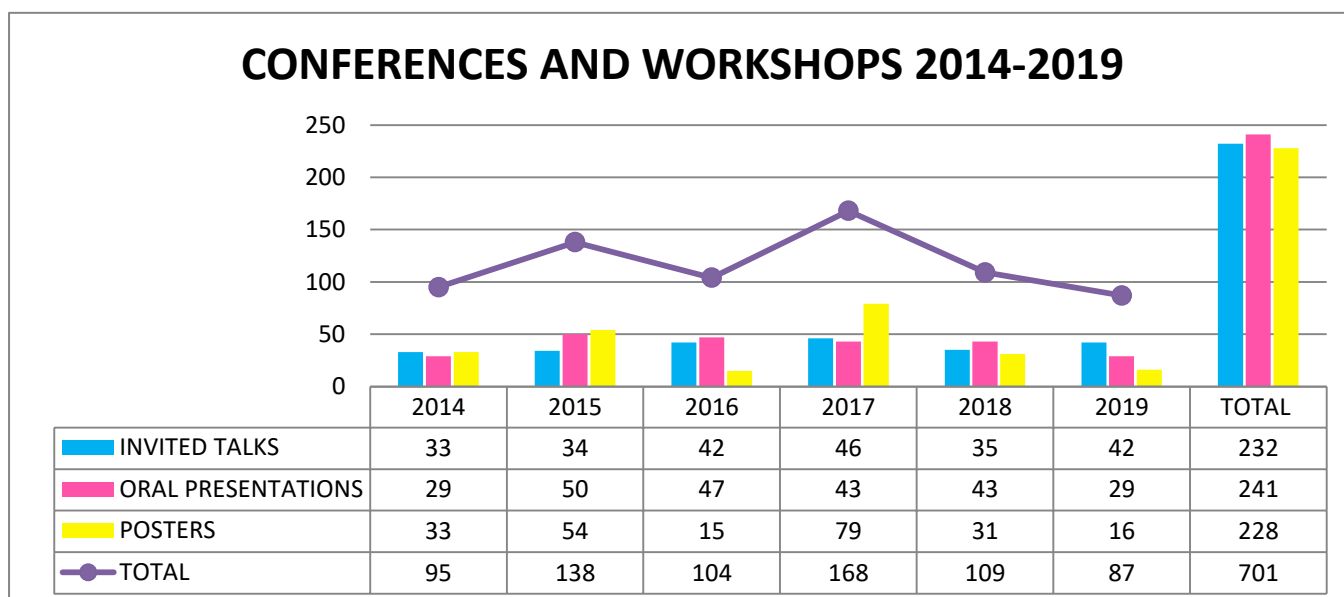
6

CONFERENCES AND WORKSHOPS

6.1 PRESENTATIONS AT SCIENTIFIC CONFERENCES 2019

- Invited talks: **42**
- Oral presentations: **29**
- Posters: **16**
- Total: **87**

Full listing in the Appendix of this Report.



6.2 ORGANIZATION OF CONFERENCES AND WORKSHOPS

Colet, Pere

- Member of the Scientific Committee IX Gefenol Summer School on Statistical Physics of Complex Systems. Santander, Spain.

Soriano, Miguel Cornelles

- Workshop Organizer and Program Chairs of the 1st International Workshop on Reservoir Computing (RC 2019); Munich, Germany.
- Member of the Technical Committee of the European Semiconductor Laser Workshop (ESLW) 2019, University College Cork, Ireland.

Ramasco, Jose J.

- Organization of UrbanSys2019, satellite for the Conference of Complex Systems CCS2019, Singapore.

San Miguel, Maxi

- YrCSS Panel Discussion: How to Talk about Complex Systems to Broader Public?. Conference on Complex Systems CCS2019, Singapore.
- Member of Steering Committee of StatPhys 27, Buenos Aires, Argentina.

Wio, Horacio S.

- Member of International Advisory Committee of the 27th Statistical Physics IUPAP Conference.

Klemm, Konstantin

- Member of the Program Committee of Complex Networks 2019, Lisbon, Portugal.

Sánchez, D.

- Organizer and chairman of the 'Quantum thermodynamics' minisymposium on the XV European Joint Thermodynamics Conference (JETC), Casa Convalescència, Barcelona, Spain.

6

CONFERENCES AND WORKSHOPS

7

OTHER ACTIVITIES

7.1 PhD PROGRAM

IFISC participates in the PhD Program in Physics of the University of the Balearic Islands. During 2019, 24 PhD students developed their research project at IFISC, and 8 PhD thesis were completed and successfully defended:

Ruiz-Reynés, Daniel

Dynamics of Posidonia oceanica meadows

Supervisor: Damià Gomila

December 13

Bassolas, Aleix

A journey across the multiple scales of human mobility

Supervisors: José Javier Ramasco and Maxime Lenormand

November 15

Monroy, Pedro

Lagrangian studies of sedimentation and transport. Impact on marine ecosystems

Supervisors: Cristobal Lopez and Emilio Hernandez-Garcia

September 17

Bueno Moragues, Julian

Photonic Information Processing

Supervisors: Ingo Fischer and Daniel Brunner

June 6

Tchakui, Murielle Vanessa

Complex behaviors, signal propagation and amplification in chains of autonomous electromechanical systems with unidirectional coupling

Supervisors: Pere Colet and Paul Wofo

April 30

Dongmo, Eric Donald

Power grid efficiency and stability: effects of delay and time dependent power sources

Supervisors: Pere Colet and Paul Wofo

April 29

Sierra, Miguel A.

Electrically and thermally driven transport in interacting quantum dot structures

Supervisor: David Sánchez

April 11

Rosselló, Guillem

Heat and charge transport in nanostructures: Interference, AC-driving, environment, and feedback

Supervisor: Rosa López

January 22

7.2 IFISC MASTER

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 2019-2020 academic course 20 students of 6 different nationalities and 11 different universities are registered in the master.

In the year 2019, 17 master thesis were defended. They are listed in the Appendix of this Report.

This is the 2019-2020 Master syllabus:

Structural module courses (39 credits):

| | |
|---|---|
| Complex networks (3 credits) | Victor M. Eguiluz |
| Cooperative and critical phenomena (6 credits) | T. Sintes E. Hernández-García |
| Dynamical systems and chaos (6 credits) | M. Matías, K. Klemm |
| Introduction to complex systems (3 credits) | M. San Miguel, E. Hernández-García, R. Zambrini |
| Pattern formation (3 credits) | D. Gomila |
| Scientific presentation and visualization (3 credits) | J. J. Ramasco |
| Stochastic processes (3 credits) | P. Colet, R. Toral |
| Stochastic simulation methods (6 credits) | R. Toral, P. Colet |
| Quantum physics for complex systems (6 credits) | L. Serra, R. Zambrini |

Specific module courses (9 credits minimum)

| | |
|---|------------------------------|
| Collective phenomena in social dynamics (3 credits) | M. San Miguel, J. J. Ramasco |
| Information theory (3 credits) | D. Sánchez |
| Modelling and dynamics of neural systems (3 credits) | C. Mirasso |
| Non equilibrium collective phenomena (3 credits) | C. López |
| Nonlinear photonics (6 credits) | I. Fischer; M.C. Soriano |
| Quantum and nonlinear optics (3 credits) | R. Zambrini, Gianluca Giorgi |
| Quantum transport and quantum noise (3 credits) | R. López |
| Spatiotemporal dynamics (3 credits) | D. Gomila |
| Statistical physics in biological systems (3 credits) | T. Sintes |
| Systems biology (3 credits) | M. Matías |
| Turbulence and nonlinear phenomena in fluid flows (3 credits) | C. López |
| Master thesis (12 credits) | Responsible: P. Colet |

7.3 OTHER POSTGRADUATE COURSES

Other Postgraduate Courses taught in 2019

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

- **Cooperative and critical phenomena**
Tomàs Sintès, Emilio Hernández-García
- **Stochastic simulation methods**
Pere Colet, Raúl Toral
- **Scientific presentation and visualization**
José J. Ramasco
- **Spintronics**
Rosa López, Llorenç Serra, David Sánchez
- **Electronic nanostructures**
David Sanchez, Llorenç Serra

Master in Human Evolution and Cognition, University of the Balearic Islands:

- **Neural networks**
Claudio Mirasso

7.4 SURF@IFISC



The Summer Undergraduate Research Fellowships (SURF@IFISC) program is part of one of the IFISC commitments: 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 European undergraduate students of physics, mathematics, chemistry, biology and engineering. The researcher in charge of this program is Manuel Matias.

For the 2019 program, we received 52 applications from students of 27 universities and 12 countries. The following seven were selected, developing the SURF activities together with three Erasmus Mundus and one collaboration student:

- Bruera, Renzo (UB, Universitat de Barcelona, Spain)
- Gil Moreno de Mora, Teo (UAB, Universidad Autonoma de Barcelona, Spain)
- Maisel Licerán, Lucas (UB, Universitat de Barcelona, Spain)
- Orzan, Nicole. (Università di Trieste, Italy)
- Palacios de Luis, Ana (UCM, Universidad Complutense de Madrid, Spain)
- Storozenko, Piotr (Warsaw University of Technology, Poland)
- Verdera, Antonia (UIB, Universitat de les Illes Balears, Mallorca, Spain)

7.5 MEMBERS OF EDITORIAL BOARD OF SCIENTIFIC JOURNALS



Member of the Editorial Advisory Board of the journal Ecological Complexity.
Hernandez-Garcia, Emilio

Member of the Editorial board of the journal Advances in Complex Systems.
Klemm, Konstantin

Member of the Editorial Advisory Board of Chaos: An Interdisciplinary Journal of Nonlinear Science.
Fischer, Ingo

Member of the Editorial board of Proceedings of the Royal Society A: Mathematical, Physical and Engineering Sciences.
Zambrini, Roberta



Member of the editorial board of Journal of Physics: Complexity
San Miguel, Maxi

Member of the Editorial board of Journal of Physics Communications (IOP).
Zambrini, Roberta

Member of the Editorial Board of PLoS ONE.
Meloni, Sandro, Ramasco, J.J.



Member of the Board of Editors European Physical Journal, Special Topics.
Colet, Pere

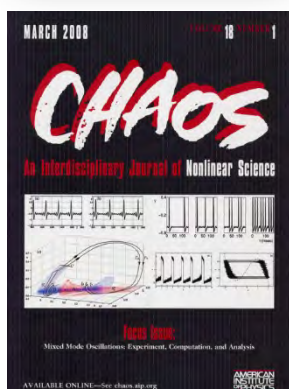
Member of Editorial Board of European Physical Journal B
Wio, Horacio S.



Member of the Editorial Board of Scientific Reports.
Ramasco, J.J.

Members of the Editorial board of Entropy (MDPI)
López, C., Sánchez D., Wio, Horacio S.

Member of the editorial board of Chaos, Solitons and Fractals.
Toral, Raul



Member of Editorial Board of Physica A
Wio, Horacio

Editors of the special Research Topic issue in Frontiers In Physics
Eguiluz, V. Mirasso, C.



7.6 SCIENTIFIC COMMITTEES

Colet, Pere

- **Member of the Board and Treasurer of the Topical Group on Statistical and Nonlinear Physics (GEFENOL) of the Spanish Physical Society.**

Ramasco, Jose J.

- **Elected member of the council of the Complex Systems Society.**

- **President COMSOTEC. Spanish Association for the Study of SocioTechnical Systems.**

Meloni, Sandro

- **Elected Member of the Steering Committee of the Conference on Complex Systems.**

Toral, Raul

- **Member of the board of Statistical and Nonlinear Physics Division of the European Physical Society**

San Miguel, Maxi

- **Vice-chair of IUPAP C3Commission on Statistical Physics.**

- **Chair of the International Scientific Advisory Board of the Internet Interdisciplinary Institute (IN3) of the Open University of Catalunya (UOC).**

Zambrini, Roberta

- **Vice-president of the Non-linear and Quantum optics group (GEOCONL) of the Real Sociedad Española de Física (RSEF).**

Fischer, Ingo

- **Elected Member of IEEE Task Force on Reservoir Computing**

7.7 RESEARCH STAYS IN OTHER CENTERS

During 2019 IFISC Researchers visited 18 external research centers.

These visits are listed in the Appendix to this Report.

7.8 'WOMEN IN SCIENCE' ACTIVITIES

Participation of IFISC in the 11F:International Day of Women and Girls in Science.

The United Nations General Assembly decided to proclaim February 11 as **International Women's and Girls' Day in Science** with the goal of achieving full and equal access to science for girls and women.

February 11, 2019 was a turning point to become aware of the existing situation of inequality and the lack of presence of women in scientific and technological careers in the Balearic Islands. Thus, a group of women linked to these sectors decided to organize themselves into a working group to elaborate a proposal document or roadmap to eliminate the gender gap in the STEM field. As a result of this initiative, the 11F Balearic Islands women's platform was born, in which IFISC (UIB-CSIC) participates. This year 2019, many more women have joined the call made by the 11F Balearic Platform.



In the press conference of last February 1st, given by the representatives of the platform 11F Balears Roberta Zambrini, Julia Mañez and Ana Bonilla, and the vice-rector of Students of the UIB, Rosa Isabel Rodriguez, the activities related to the program and actions carried out by the Platform were announced. The complete list of activities that were organized in the framework of the 11F can be found in the web 11fbalears.org.

The objective of the Platform is to give a face and a voice to women who, from institutions, companies or individually, develop their professional and academic activity especially in the field of the STEM sectors, which include science, technology, engineering and mathematics. These women can be a role model for the new generations of girls, with the idea of motivating interest, promoting scientific and technical vocations among girls and thus contribute to breaking the gender gap that currently also exists in the field of science and technology.

The group presented a document of proposals to the authorities of the Balearic Islands. This document included a roadmap to break the gender gap in the STEM field, setting out the actions that could be carried out in the Balearic Islands, and grouped into three main blocks: management and facilitation of resources; prevention, monitoring and intervention of discrimination; and training, education and dissemination.

IFISC participated in the following activities:

SATURDAY, February 8 from 11:00 to 13:00 (CaixaForum Palma, Plaça de Weyler, 3, Palma). Citas rápidas con científicas

6 minutes to get to know the 24 researchers and technicians who work in the CSIC research institutes (IMEDEA and IFISC) and other scientific institutions of the Balearic Islands (SOCIB, IEO and IDISBA). In a funny and close way, they told us what made them dedicate themselves to science, their experiences in the scientific world, their current projects. The IFISC researchers that participate were:

- **Irene Estebanez** (IFISC): Sincronización
- **Violeta Calleja** (IFISC): Redes complejas
- **Rebeca de la Fuente** (IFISC): Paradojas y fundamentos de la matemática

SATURDAY, February 16 from 08:30 to 18:00 (Ed. Anselm Turmeda, Lab 7 , Campus UIB). PROGRAMMING WORKSHOP Django Girls.

A workshop to learn the fundamentals of Python programming and web application development. Discover the world of information technology with the Django Girls Palma. No previous knowledge was necessary. Participation of Antonia Tugores (IFISC). More information:

<https://djangogirls.org/palma/>



7.9 PATENT

System and methods for classifying arrhythmia-related heartbeats.

US Patent No . : US 10, 383, 539 B2

Applicant : Smart Solutions Technologies , S.L., Madrid (ES)

Inventors : Xavier Ibáñez Català, Silvia Ortín González, Miguel Cornelles Soriano, Claudio Rubén Mirasso Santos.

Date of Patent : August 20, 2019

8

OUTREACH ACTIVITIES

8.1 CONFERENCE SERIES

Conference Series

“Sailing by the Complexity of the 21th Century: Information as an engine”

One of the objectives of IFISC (UIB-CSIC) has always been the organization of activities that promote the dissemination of complex systems and interdisciplinary science among citizens. For this reason, and taking over from "Explorando las Fronteras entre Saberes" (2007-2017), IFISC organizes since 2018 the series of talks "Navegando por la complejidad del siglo XXI".



PROGRAMME

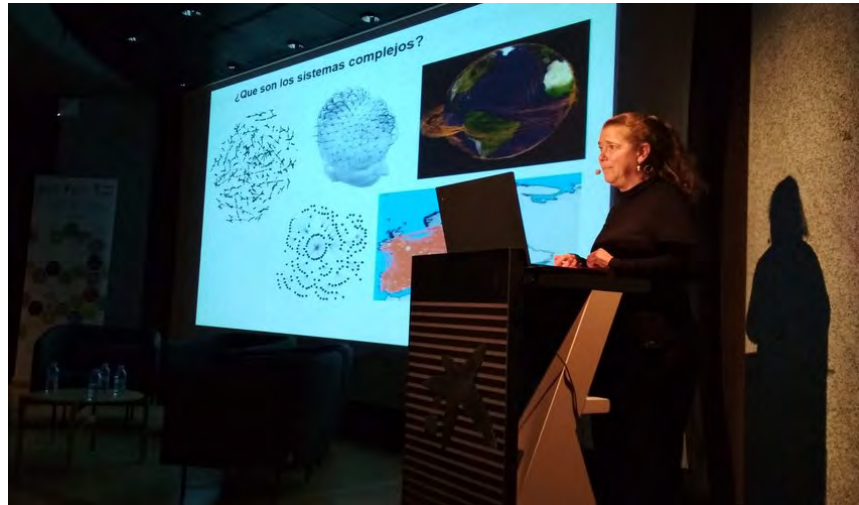
MARCH 20

La computación cognitiva en tiempos de una nueva revolución

Cognitive computing in times of a new revolution

Carlos Santana, dotCSV, Spain

The Fourth Industrial Revolution is proposed as the next great step that humanity will take at the time of introducing disruptive transformations in all spheres of our society, such as economy, medicine, transport, or art. A revolution based on the new emerging technologies we are developing today: blockchain, 5G networks, virtual reality or 3D printing. However, of all these technologies, there is one that redefines everything, and whose results we are already beginning to perceive. A technology that redefines how to process information, how to solve problems and how to understand computing. This technology is Machine Learning, the great revolution within the field of Artificial Intelligence.



MARCH 28

*¿Cómo extraer información de señales complejas?
Estudiando el clima, el cerebro y las olas gigantes
How to extract information from complex signals?
Studying the weather, the brain and giant waves*

Cristina Masoller, Universitat Politècnica de Catalunya, Spain

Complex systems are those made up of several interconnected parts that, when interrelated, generate new information. Among them are examples as disparate as the climate, the brain or the ocean. In this presentation we will discover how all of them can present similar and potentially catastrophic phenomena, hand in hand with the physicist Cristina Masoller, lecturer at the Universitat Politècnica de Catalunya and expert in the analysis of complex climatic phenomena such as El Niño. There are several methods of information theory that are used to "spy" on our complex systems. We will explain which are and analyze some of the phenomena that can trigger in the fate of these systems extreme fluctuations and abrupt transitions. Interlinking the results with the causes we can see how, in the case of climate, the methods used today allow us to detect relevant climate changes that have occurred over the last 30 years.

APRIL 4

No pongas todos los huevos en la misma cesta:
diversificación de riesgos y estrategias mixtas en
evolución

*Don't put all the eggs in one basket: risk
diversification and evolving mixed strategies*

Miguel Ángel Muñoz, Universidad de Granada, Spain

The concept of bet-hedging was first formalized in the context of finance, and is nothing more than the mathematical version of the popular saying "don't put all your eggs in one basket". This concept is very useful in evolutionary biology to understand processes of adaptation of species to the environment and to understand the bizarre variety of forms and strategies they have developed. In this talk we will review some curious examples of bet-hedging in biology, particularly in micro-organisms and plants, and we will see how the science of complex systems can explain them, and thus understand some surprising or apparently paradoxical phenomena of nature.



IFISC organized the Conference Series in collaboration with Fundació La Caixa (Obra Social).

8.2 OPEN DAYS @ IFISC

One more year the Institute of Interdisciplinary Physics and Complex Systems (IFISC-CSIC / UIB) organized its **Open Doors Day** targeting university students of the University of the Balearic Islands with the objective of communicating research work carried out in the center as well as its training offers. It is an open activity to students of any degree (being of special interest for the students of last courses) with intellectual and scientific restlessness. Throughout the activity it is explained what the IFISC is and which are the lines of research of the center, emphasizing the interdisciplinary spirit of the institute.



The event took place on Friday, February 15th at 2:00 p.m., IFISC seminar room Montserrat Casas. The activity began with a presentation of the center, how the IFISC works and the different research lines: transport and information in quantum systems, nonlinear photonics, nonlinear dynamics in fluids, biocomplexity and collective phenomena in social and socio-technical systems. The Master's Degree in Complex Systems Physics imparted by the IFISC was also presented to the students, as well as the itineraries to be followed by those students interested in studying a doctorate. The presentation included visits to the photonics laboratory and computer facilities.

Afterwards an appetizer was offered to the participants, after which the **IFISC Poster Party** began, where the master and doctoral students and the postdoctoral researchers of the center presented their research in poster format. In a relaxed atmosphere, the students were able to see first-hand what the young researchers of the Institute are working on.



It was a great opportunity for undergraduates to know what it means to dedicate themselves to research, as they had the opportunity to chat directly with the IFISC researchers themselves as well as with doctoral students who can tell their personal experience and solve doubts.

8.3 OTHER EVENTS

Participation in “Pint of Science”



IFISC has participated and organized “Pint of Science” which is a festival that aims to deliver interesting and relevant talks on the latest science research in an accessible format to the public – mainly across bars and pubs. The festival provides a platform which allows people to discuss research with the people who carry it out and no prior knowledge of the subject is required. It is run mainly by volunteers and was started by a community of British postgraduate and postdoctoral researchers in 2012

During two of the days of the event (May 20 and 22), four scientists from our Institute were in the iconic bar Palma 80's Café giving a dissemination talk about their work:

- Por qué un gato no puede estar vivo y muerto a la vez: hablemos de la decoherencia, by Rodrigo Martínez Peña
- Neural networks, o cómo Facebook etiqueta tu cara, by Irene Estébanez Santos
- La compleja vida de un flamenco, by Ana Pérez Manrique
- Turbulencia: ¡Vórtices ad Infinitum!, by Javier Aguilar Sánchez



Participation in the “IV Fira de la Ciència i la Tecnologia d’Inca”

Members of IFISC (Rodrigo Martínez and Adrián García) participated in the "IV Fira de la Ciència i la Tecnologia d'Inca" (October 27-28). 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 music-visualization in oscilloscopes.



Week of Science and Technology

On November 9th, on the occasion of the CSIC's Science and Technology Week, a new edition of the activity "¡Ciencia al Bar!" was held, with IFISC members Rodrigo Martínez and Adrián García as hosts. The format, created by them for the European Researchers' Night, aims to explain to the audience physics concepts such as nucleation or the Monte Carlo method using only elements that can be found in a bar. The activity took place at the Ben Trempat bar.



European researchers' night

On the afternoon of 27 September, the European Researchers' Night was celebrated, a European project of scientific dissemination promoted by the European Commission as part of the Marie Skłodowska-Curie actions of the Horizon 2020 programme. Being the first edition in 2005, it is currently being held in more than 250 European cities simultaneously. In the Balearic Islands, it was organised by the Conselleria d'Educació, Universitat i Recerca in cooperation with Universitat de les Illes Balears, el Consell de Menorca, la Fundació Bit, Eiviciència and l'Aquarium Cap Blanc, with the aim of bringing science and research closer to citizens in a fun way and through direct contact with experts in the field.



In the 2019 edition IFISC participated in two activities:

- **CITES RÀPIDES AMB LA RECERCA**

In a relaxed and entertaining way, the different faces of science were made known from the point of view of researchers, from the purest research, through technical work, as well as the relationship between science and society. During the short time of the meeting, the researchers explained their experiences in the scientific world, what their current research is, and answered any doubts. All this in 5 minutes. When the alarm sounds, attendees changed tables to meet the next scientist. IFISC PhD students Rodrigo Martínez and Marco Cattaneo participated in the activity talking about Reservoir Computing and quantum cryptography. The activity took place at Ca'n Oleo.



- **¡CIENCIA AL BAR!**

A new outreach format in which IFISC PhD students explained scientific concepts using elements that can be found in a bar. Approximating the value of pi using the Monte Carlo method using peanuts, explaining colloids with beer foam or learning to calculate probabilities by 'playing' the Monty Hall paradox with shot glasses are some of the examples seen during the activity. The activity took place at the Ben Trempat bar.



Visit of FP students

On February 21, 2019, students of the dual FP (Formación Profesional) in informatics visited IFISC. Guided by Adrián García and Antònia Tugores, the visitors learned what the IFISC is, what research is carried out at the institute and learned about Nuredduna, the centre's computational cluster.

Launch of the Outreach website

One of the main objectives of IFISC (UIB-CSIC) is the dissemination of complex systems and interdisciplinary science across all levels of society. With this objective in mind, IFISC researchers are very active in this field, whether organizing outreach events or generating multimedia content. Now all this material generated by IFISC related to dissemination will be compiled on the new Outreach website. There the visitors can find, divided into categories, videos, leaflets, infographics, presentations, news... as well as links to future and past outreach events.

Also, the blog "Introduction to Complex Systems", written by students of the Master in Physics of Complex Systems, was launched. Explanations, videos of experiments and games on basic concepts of complex systems science can be find there.



<https://ifisc.uib-csic.es/en/about-ifisc/outreach/>

8.4 OUTREACH MATERIALS

The youtube 'IFISC outreach' playlist (<https://bit.ly/3enKSYz>) contains many outreach videos on topics related to IFISC research lines. Five of them were produced during 2019.

Also in 2019, J.J. Ramasco, A. Bassolas, M. Mazzoli and P. Colet published the dissemination article "**¿Cómo gravita usted al trabajo?**" on 'The conversation' site.

8.5 PRESS & MEDIA

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

IFISC research has also received attention from newspapers and other media. During 2019, IFISC activities produced 213 press releases and appearances in written and digital press (national and international), and 20 clips on radio and TV. See the full lists in the Appendix.



SOCIAL MEDIA IMPACT SUMMARY**TWITTER****@IFISC_mallorca****Total tweets 3.052****Total Followers 1.840** (20% increase of number of followers in 2019) 55% men / 45% women

Interested in science news, technology, climate and tech news

Languages most used by IFISC followers: Spanish (72%) and English (69%).

Mostly located in Spain (61%), UK, US, Italy, Germany and Mexico.

**FACEBOOK****<http://www.facebook.com/ifisc>****Facebook fans: 1008** (6% increase of fan number in 2019)

61% men / 37% women

Languages most used: Spanish (72%), English (69%), Portuguese (14%), Catalan (5%).

Mostly located in Spain, Brazil and Mexico

**YOUTUBE****<http://www.youtube.com/user/IFISCseminars>**

Visualizations: 30.109 in 2019 of a total of 141.759 (27% increase of visualizations in 2019)

YouTube subscribers: 967 in 2019 (47% increase of subscribers in 2019)

8

OUTREACH ACTIVITIES

APPENDIX

a.4. IFISC seminars and talks 2019

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

January 11

Linking collective behaviors to diversity in microbial communities: insights from nonaggregated cells in the social amoeba

Ricardo Martínez, Princeton University, USA

January 22

Heat and charge transport in nanostructures: interference, AC-driving, environment, and feedback

Guillem Rosselló, IFISC

January 23

Nanoscale Quantum Calorimetry with Electronic Temperature Fluctuations

Peter Samuelsson, Lund University, Germany

January 25

Phase space reconstruction of semiconductor laser dynamics using reservoir computing

Alejandro Cunillera Pérez, IFISC

January 29

Vegetation front dynamics

Luis Martin, IFISC

January 30

Dynamics of Crime Concentration in Urban Settings

Ronaldo de Menezes, University of Exeter, UK

February 6

Family business: quantifying nepotism in academia

Sandro Meloni, IFISC

February 13

Beyond binary opinion dynamics

Celia Anteneodo, PUC-Rio, Brazil

February 20

Inferring follower-follower relations from presence data: manta ray case study.

Juan Fernández-Gracia, IFISC

February 27

Applications of a simplified model for clonal-growth plants

Daniel Ruiz, IFISC

March 6

Generalized fluctuations relations

Rafael Molina, Instituto de Estructura de la Materia, CSIC, Madrid, Spain

March 20

Mixing and Dispersion in Porous and Fractured Media

Marco Dentz, Instituto de Diagnóstico Ambiental y Estudios del Agua (IDAEA-CSIC), Barcelona, Spain

March 22

Quantum Frequency comb for Quantum Complex Networks

Valentina Parigi, Sorbonne University, France

March 27

Delayed feedback control of cavity solitons in a wide-aperture laser with a saturable absorber

Svetlana Gurevich, Münster University, Germany

March 28

Spatial inhomogeneities in the sedimentation of biogenic particles in ocean flows: analysis in the Benguela region

Pedro Monroy, IFISC

April 10

Information theory, predictability, and the emergence of complex life

Luis Seoane, IFISC

April 11

Electrically and thermally driven transport in interacting quantum dot structures

Miguel A. Sierra, IFISC

April 12

Identifying the hidden multiplex architecture of complex systems (or a new decomposition theory of non-Markovian dynamics)

Lucas Lacasa, Queen Mary University of London, UK

April 30

Exploring dynamical richness in engineered neuronal cultures: challenges and opportunities

Jordi Soriano-Fradera, Universitat de Barcelona and UBICS, Spain

May 6

Sociolinguistics to test the scales of human organization

Luis Seoane, IFISC

May 8

Cognitive health in the second half of life: Use it or lose it!

Matthias Kliegel, Department of Psychology, University of Geneva, Switzerland.

May 15

Spatial eco-evolutionary feedbacks mediate coexistence in prey-predator systems

Eduardo H. Colombo, IFISC

May 16

Presentation of new IFISC projects

Researchers, IFISC

May 22

Probing topological phase transitions by non-Markovianity

Gianluca Giorgi, IFISC

May 29

Coordination of cell division in space and time: lessons from a good frog egg

Lendert Gelens, KU Leuven, Belgium

June 4

Fluctuation theorems for the undriven Duffing oscillator

Roberto Deza, IFIMAR (Universidad Nacional de Mar del Plata y CONICET), Argentina

June 5

Quantum Martingale Theory and Entropy Production

Gonzalo Manzano, ICTP (Trieste) and Scuola Normale Superiore (Pisa), Italy

June 10

Spatially Localized Structures in Driven Dissipative Systems: Theory and Applications

Edgar Knobloch, University of California at Berkeley, USA

June 12

Quantum fluids of light

Elisabeth Giacobino, Laboratoire Kastler Brossel, Univ. Pierre et Marie Curie, Paris, France

June 14

Biodiversity and Stability in Microbial Ecosystems

Samir Suweis, University of Padova, Italy

June 26

Electron quantum optics using single-electron sources in high-frequency nanoelectronics

Sungguen Ryu, IFISC

July 2
Research done by PhD fellows of the MdM program
 PhD fellows, IFISC

July 10
Spin dynamics in the presence of a spin bath
 Álvaro Gómez, Instituto de Ciencia de Materiales de Madrid (CSIC), Spain

July 11
Simulating complex quantum networks with time crystals
 Marta Estarellas, National Institute of Informatics, Tokio

July 11
Computational tools for Complex Systems
 Antônia Tugores, IFISC

July 16
The agent-environment interface for social-ecological system models
 Wolfram Barfuss, Potsdam Institute for Climate Impact Research, Germany

July 17
Richardson diffusion in random media: Comb model with random boundaries and random photonic lattices
 Alexander Iomin, Technion, Israel

September 2
Ordering dynamics in the voter model with aging
 Antonio Fernández Peralta, IFISC

September 13
Topological complexity in the brain: Fragility, volatility, and a hierarchy of timescales
 Leonardo Gollo, QIMR Berghofer Medical Research Institute, Brisbane, Australia

September 24
The boundary between multiple and distributed delays and noisy brain rhythms
 Andre Longtin, University of Ottawa, Canada

September 25
Ordered Defects: A Roadmap towards room temperature Superconductivity
 Pablo Esquinazi, University of Leipzig, Germany

October 2
Opinion dynamics in systems of interacting agents: polarization vs consensus
 Federico Vázquez, Universidad de Buenos Aires – CONICET, Argentina

October 3
Exceptional points in the dynamics of open quantum systems
 Albert Cabot, IFISC

October 15
Noise, delay and synchronisation in developmental pattern formation
 Joseph Baron, The University of Manchester, UK

October 17
Surfing networks: from neuroscience to air transport and back again
 Massimiliano Zanin, Center for Biomedical Technology - Universidad Politécnica de Madrid, Spain

October 22
Quantum Reservoir Computing with Spin Networks
 Rodrigo Martínez-Peña, IFISC

October 23
Field theory for recurrent mobility
 Mattia Mazzoli, IFISC

October 28
Wealth inequalities and the dynamics of housing property markets in European cities
 Renaud Le Goix, Riate - Univ. Paris Diderot, France

November 5
The complex body network: Brain - visceral interaction in cognition
 Nazareth Castellanos, Nirakara Lab – Universidad Complutense de Madrid, Spain

November 8
Spatially structured interactions in competitive ecosystems
 Violeta Calleja Solanas, IFISC

November 13
At the Dawn of the Second Quantum Revolution.
 Jürgen Mlynek, Chair Scientific Advisory Board EU Quantum Flagship, Former President of the Helmholtz Association of German Research Centers, Chairman of the Board of Trustees Falling Walls Foundation, Germany

November 13
Non-equilibrium potentials
 Pedro Garrido, Instituto Carlos I de Física Teórica y Computacional, Universidad de Granada, Spain

November 14
Hardware implementations of trainable nonlinear oscillators via reservoir computing
 Irene Estébanez, IFISC

November 18
Inhibitory Gating in the Dentate Gyrus
 Cristian Estarellas, IFISC

November 28
Symmetry breaking during morphogenesis of a mechanosensory organ
 Adrian Jacobo, Laboratory of Sensory Neuroscience, The Rockefeller University, New York City, USA

December 11
Fluctuation theorems and large-deviation functions in systems not featuring a steady state
 Horacio S. Wio, IFISC

December 17
Symmetry and block structure of the Liouvillian superoperator in partial secular approximation
 Marco Cattaneo, IFISC

December 19
IFISC winter solstice seminar
 IFISC Researchers, IFISC

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

Global spatial risk assessment of sharks under the footprint of fisheries

Queiroz, N; Humphries, NE; Couto, A; Vedor, M; da Costa, I; Sequeira, AMM; Mucientes, G; Santos, AM; Abascal, FJ; Abercrombie, DL; Abrantes, K; Acuña-Marrero, D; Afonso, AS; Afonso, P; Anders, D; Araujo, G; [...]; Irigoien, X; Eguiluz, VM; Duarte, CM; Sousa, LL; Simpson, SJ; Southall, EJ; Sims, DW

Nature **572**, 461–466

Field theory for recurrent mobility

Mazzoli, M; Molas, A; Bassolas, A; Lenormand, M; Colet, P; Ramasco, J J
Nature Communications **10**, 3895

Hierarchical organization of urban mobility and its connection with city livability

Bassolas, Aleix; Barbosa-Filho, Hugo; Dickinson, Brian; Dotiwalla, Xerxes; Eastham, Paul; Gallotti, Ricardo; Ghoshal, Gourab; Gipson, Bryant; Hazarie, Surendra A.; Kautz, Henry; Kucuktunc, Onur; Lieber, Allison; Sadilek, Adam; Ramasco, José Javier
Nature Communications **10**, 4817

Picosecond coherent electron motion in a silicon single-electron source

Yamahata, Gento; Ryu, Sungguen; Johnson, Nathan; Sim, H.-S.; Fujiwara, Akira; Kataoka, Masaya
Nature Nanotechnology **14**, 1019-1023

Quantum synchronization in dimer atomic lattices

Cabot, Albert; Giorgi, Gian Luca; Galve, Fernando; Zambrini, Roberta
Physical Review Letters **123**, 023604 (1-6)

Scaling of species distribution explains the vast potential marine prokaryote diversity

Eguíluz, Victor M; Salazar, Guillem; Fernández-Gracia, Juan; Pearman, John K; Gasol, Josep M; Acinas, Silvia G; Sunagawa, Shinichi; Irigoien, Xabier; Duarte, Carlos M
Scientific Reports **9**, 18710

Spatial eco-evolutionary feedbacks mediate coexistence in prey-predator systems

Colombo, Eduardo H.; Martínez-García, Ricardo; López, Cristóbal; Hernández-García, Emilio
Scientific Reports **9**, 18161 (1-15)

A quantitative description of the transition between intuitive altruism and rational deliberation in iterated Prisoner's Dilemma experiments

Gallotti, Ricardo; Grujic, Jelena
Scientific Reports **9**, 17046

A comparative study between two models of active cluster-crystals

Caprini, Lorenzo; Hernandez-Garcia, Emilio; Lopez, Cristobal; Marconi, Umberto; Marini Bettolo
Scientific Reports **9**, 16687 (1-13)

Inferring correlations associated to causal interactions in brain signals using autoregressive models

López Madrona, V.; Matias, F; Mirasso, C. R.; Canals, S.; Pereda, E.
Scientific Reports **9**, 17041

Flexible model of network embedding

Fernández-Gracia, Juan; Onnela, Jukka-Pekka
Scientific Reports **9**, 11710

Absorbing phase transition in the coupled dynamics of node and link states in random networks

Meghdad Saeedian, Maxi San Miguel, and Raul Toral
Scientific Reports **9**, 9726

Particle velocity controls phase transitions in contagion dynamics

Rodríguez, JP; Ghanbarnejad, F; Eguíluz, VM
Scientific reports **9**, 6463

Impact of origin-destination information in epidemic spreading.

Gómez, Sergio; Fernández, Alberto; Meloni, Sandro; Arenas, Alex
Scientific Reports **9**, 2315

Boosting the performance of small autonomous refrigerators via common environmental effects

Manzano, Gonzalo; Giorgi, Gian Luca; Fazio, Rosario; Zambrini, Roberta
New Journal of Physics **21**, 123026 (1-14)

Local vs global master equation with common and separate baths: superiority of the global approach in partial secular approximation

Cattaneo, Marco; Giorgi, Gian Luca; Maniscalco, Sabrina; Zambrini, Roberta
New Journal of Physics **21**, 113045

Multilayer coevolution dynamics of the nonlinear voter model

Min, Byungjoon; San Miguel, Maxi
New Journal of Physics **21**, 035004

Constructive Role of Noise for High-Quality Replication of Chaotic Attractor Dynamics Using a Hardware-Based Reservoir Computer

Estébanez, Irene; Fischer, Ingo; Soriano, Miguel C.
Physical Review Applied **12**, 034058

Fluctuation-driven Coulomb drag in interacting quantum dot systems

Sierra, M. A.; Sánchez, D.; Jauho, A.-P.; Kaasbjerg, K.
Physical Review B **100**, 081404 (1-5)

Nonlinear chiral refrigerators

Sánchez, D.; Sánchez, R.; López, R.; Sothmann, B.
Physical Review B **99**, 245304 (1-9)

Markovian approach to tackle the interaction of simultaneous diseases

Soriano-Paños, David; Ghanbarnejad, Fakhteh; Meloni, Sandro; Gómez-Gardeñes, Jesús
Physical Review E **100**, 062308

Distribution of growth directions in meadows of clonal plants

Ruiz-Reynés, Daniel; Gomila Damià
Physical Review E **100**, 052208

Unraveling the decay of the number of unobserved ordinal patterns in noisy chaotic dynamics

Olivares, Felipe; Zunino, Luciano; Soriano, Miguel C.; Pérez, Darío G.
Physical Review E **100**, 042215 (1-8)

Stochastic entropies and fluctuation theorems for a discrete one-dimensional Kardar-Parisi-Zhang system

Rodríguez, Miguel A. ; Wio, Horacio S.
Physical Review E **100**, 032111

Consensus and diversity in multistate noisy voter models

Herrerías-Azcué, Francisco; Galla, Tobias
Physical Review E **100**, 022304 (1-13)

Heat flux direction controlled by power-law oscillators under non-Gaussian fluctuations

Colombo, E.H.; Defaveri, L.A.C.A.; Anteneodo, C.
Physical Review E, **100**, 032118

Erratum: Transport coefficients for driven granular mixtures at low density [Phys. Rev. E **88, 052201 (2013)] and Heat flux of driven granular mixtures at low density: Stability analysis of the homogen**

Khalil, Nagi; Garzó, V.
Physical Review E **99** (5), 130004

Single-species fragmentation: the role of density-dependent feedbacks

Dornelas, V.; Colombo, E.H.; Anteneodo, C.
Physical Review E **99**, 062225

Machine learning algorithms for predicting the amplitude of chaotic laser pulses

Amil, Pablo; Soriano, Miguel C.; Masoller, Cristina
Chaos **29**, 113111

Cross-predicting the dynamics of an optically injected single-mode semiconductor laser using reservoir computing

Cunillera, Alejandro; Soriano, Miguel C.; Fischer, Ingo
Chaos **29**, 113113 (1-9)

Anticipation via canards in excitable systems

Köksal Ersöz, Elif; Desroches, Mathieu; Mirasso, Claudio R.; Rodrigues, Serafim
Chaos **29**, 013111

Inhomogeneities and caustics in the sedimentation of noninertial particles in incompressible flows

Drotos, Gabor; Monroy, Pedro; Hernández-García, Emilio; López, Cristóbal
Chaos **29**, 013115 (1-25)

Can Fish and Cell Phones Teach Us about Our Health?

Lee, Michael A; Duarte, Carlos M; Eguíluz, Víctor M; Heller, Daniel A; Langer, Robert; Meekan, Mark G; Sikes, Hadley D; Srivastava, Mani; Strano, Michael S; Wilson, Rory P
ACS sensors **4**, 2566-2570

Magnetic orbital motion and 0.5e²/h conductance of quantum-anomalous-Hall hybrid strips

Osca, Javier; Serra, Llorenç
Applied Physics Letters **114**, 133105 (1-5)

PAM-4 transmission at 1550 nm using photonic reservoir computing post-processing

Argyris, Apostolos; Bueno, Julián; Fischer, Ingo
IEEE Access **7**, 37017-37025

A unifying analysis of chaos synchronization and consistency in delay-coupled semiconductor lasers

Jungling, T.; Porte, X.; Oliver, N.; Soriano, M. C.; Fischer, I.
IEEE Journal of Selected Topics in Quantum Electronics **25**, 1501609

Complexity mapping of a photonic integrated circuit laser using a correlation-dimension-based approach

McMahon, C. Christopher; Toomey, P. Joshua; Argyris, Apostolos; Kane, M. Deb.
Laser Physics **29**, 086202

Host-dependent nitrogen recycling as a mechanism of symbiont control in *Aiptasia*

Cui, Guoxin; Liew, Yi Jin; Li, Yong; Kharbatia, Najeh; Zahran, Noura I; Emwas, Abdul-Hamid; Eguíluz, Víctor M; Aranda, Manuel
PLoS Genetics **15**, e1008189

Motion, fixation probability and the choice of an evolutionary process

Herrerías-Azcué, Francisco; Pérez-Muñuzuri, Vicente; Galla, Tobias
PLoS Computational Biology **15**, e1007238

Unsupervised extraction of epidemic syndromes from participatory influenza surveillance self-reported symptoms

Kalimeri, Kyriaki; Delfino, Matteo; Cattuto, Ciro; Perrotta, Daniela; Colizza, Vittoria; Guerrisi, Caroline; Turbelin, Clement; Duggan, Jim; Edmunds, John; Obi, Chinelo; Pebody, Richard; Franco, Ana O.; Moreno, Yimir; Meloni, Sandro; Koppeschaar, Carl; Kjelsø, Charlotte; Mexia, Ricardo; Paolotti, Daniela
PLoS Computational Biology **15**(4), e1006173

Intrinsic noise, Delta-Notch signalling and delayed reactions promote sustained, coherent, synchronized oscillations in the presomitic mesoderm

Baron, Joseph W.; Galla, Tobias
Journal Royal Society Interface **16**, 20190436 (1-13)

The importance of sample size in marine megafauna tagging studies

Sequeira, A. M. M.; Heupel, M. R.; Lea, M. A.; Eguiluz, V. M.; Duarte, C. M.; Meekan, M. G.; Thums, M.; Calich, H. J.; Carmichael, R. H.; Costa, D. P.; Ferreira, L. C.; Fernández-Gracia, J.; Harcourt, R.; Harrison, A. L.; Jonsen, I.; McMahon, C. R.; Sims, D. W.; Wilson, R. P.; Hays, G. C.
Ecological Applications **29**, e01947

Accounting for ocean connectivity and hydroclimate in fish recruitment fluctuations within transboundary metapopulations

Hidalgo, Manuel; Rossi, Vincent; Monroy, Pedro; Ser-Giacomi, Enrico; Hernández-García, Emilio; Guijarro, Beatriz; Massutí, Enric; Alemany, Francisco; Jadaud, Angélique; Pérez, José Luis; Reglero, Patricia
Ecological Applications **29**, e01913

Connecting metapopulation heterogeneity to aggregated lifetime statistics

Colombo, E.H.
Ecological Complexity **39**, 100777

Spatial inhomogeneities in the sedimentation of biogenic particles in ocean flows: analysis in the Benguela region

Monroy, Pedro; Drotos, Gabor; Hernandez-Garcia, Emilio; Lopez, Cristobal
Journal of Geophysical Research: Oceans **124**, 4744--4762

Crossroads of the mesoscale circulation

Baudena, Alberto; Ser-Giacomi, Enrico; Lopez, Cristobal; Hernandez-Garcia, Emilio; d'Ovidio, Francesco
Journal of Marine Systems **192**, 1-14

Is the coexistence of Catalan and Spanish possible in Catalonia?

Seoane, Luís F; Loredó, Xaquín; Monteagudo, Henrique; Mira, Jorge
Palgrave communications **5**, 139

Coordination in a skeptical two-group population

González-Avella, Juan Carlos; Lugo, Haydée; San Miguel, Maxi
Journal of Economic Interaction and Coordination **14**, 203-214

Election forensics: Quantitative methods for electoral fraud detection

Lacasa, Lucas; Fernández-Gracia, Juan
Forensic Science International **294**, e19-e22

Mobile phone records to feed activity-based travel demand models: MATSim for studying a cordon toll policy in Barcelona

Aleix Bassolas, Jose J. Ramasco, Ricardo Herranz, Oliva G. Cantu-Ros
Transportation Research Part A **121**, 56-74

Assessing the risk of default propagation in interconnected sectoral financial networks

Barja, Adrià; Martínez, Alejandro; Arenas, Alex; Fleurquin, Pablo; Nin, Jordi; Ramasco, Jose J.; Tomás, Elena
European Physical Journal Data Science **8**, 32

Explore with caution: mapping the evolution of scientific interest in Physics

Aleta, Alberto; Meloni, Sandro; Perra, Nicola; Moreno, Yamir
European Physical Journal Data Science **8**, 27

Role of disorder on the signal amplification in an array of unidirectionally coupled MEMS

Tchakui, Murielle Vanessa; Colet, Pere; Wofo, Paul
European Physical Journal B **92**, 34

Complex band-structure analysis and topological physics of Majorana nanowires

Osca, Javier; Serra, Llorenç
European Physical Journal B **92**, 101 (1-19)

Thermoelectric transport through interacting quantum dots in graphene

Isern-Lozano, J. R.; Lim, J. S.; Grosu, I.; López, R.; Sánchez, D.
European Physical Journal Special Topics **227**, 1969–1979

Spatial coupling of quantum-anomalous-Hall and chiral-Majorana modes

Osca, Javier; Serra, Llorenç
European Physical Journal Special Topics **227**, 2025–2035

Exploring the Phase-Locking Mechanisms Yielding Delayed and Anticipated Synchronization in Neuronal Circuits

Dalla Porta, L.; Matias, F. S.; dos Santos, A. J.; Alonso, A.; Carelli, P. V.; Copelli, M.; Mirasso, C. R.
Frontiers in Systems Neuroscience **13**, 41

Chimera and antcoordination states in learning dynamics

Lugo, Haydée; González-Avella, Juan Carlos; San Miguel, Maxi
Frontiers in Applied Mathematics and Statistics **5**, 16 (1-11)

Overhauling ocean spatial planning to improve marine megafauna conservation

Sequeira, A M M; Hays, G C; Sims, D W; Eguiluz, V M; Rodríguez, J P; Heupel, M R; Harcourt, R; Calich, H; Queiroz, N; Costa, D P; Fernández-Gracia, J; Ferreira, L C; Goldsworthy, S D; Hindell, M A; Lea, M-A; Meekan, M G; Pagano, A M; Shaffer, S A; Reisser, J; Thums, M; Weise, M; Duarte, C M
Frontiers in Marine Science **6**, 639

Animal-Borne Telemetry: An Integral Component of the Ocean Observing Toolkit

*Harcourt, R; [...] Eguiluz, VM (31); Fernández-Gracia, J (33); [...] Frontiers in Marine Science **6**, 326*

A nonequilibrium-potential approach to competition in neural populations,

R.R.Deza, J.I.Deza, N.Martínez, J.F.Mejías & H.S.Wio
Frontiers in Physics **6**, 154 (1-9)

Topical Alignment in Online Social Systems

Cardoso, Felipe Maciel; Meloni, Sandro; Santanchè, André; Moreno, Yamil
Frontiers in Physics **7**, 58

A Fast Machine Learning Model for ECG-Based Heartbeat Classification and Arrhythmia Detection

Alfaras, Miquel; Soriano, Miguel C.; Ortín, Silvia
Frontiers in Physics **7**, 103

The application of Machine Learning Techniques to improve El Niño prediction skill

Dijkstra, Henk A.; Petersik, Paul; Hernandez-Garcia, Emilio; Lopez, Cristobal
Frontiers in Physics **7**, 153 (1-13)

Reduction of power grid fluctuations by communication between smart devices

Tchawou Tchuisseu, Eder Batista; Gomila, Damià; Colet, Pere
International Journal of Electrical Power & Energy Systems **108**, 145-152

Mesoscopic description of the adiabatic piston: kinetic equations and H-theorem

Khalil, Nagi
Journal of Statistical Physics **176**, 1138-1160

Magnetic responsive brushes under flow in narrow slits: external field control of brush structure and flowing particle mixture separation

Cerdà, J. J.; Bona-Casas, C.; Pyanzina, E. S.; Sánchez, P. A.; Kantorovich, S.; Sintès, T.
Soft Matter **15**, 8937–9160

Herding and idiosyncratic choices: Nonlinearity and aging-induced transitions in the noisy voter model

Artime, Oriol; Carro, Adrián; F. Peralta, Antonio; Ramasco, José J.; San Miguel, Maxi; Toral, Raúl
Comptes Rendus Physique **20**, 262-274

Exceptional points in 1D arrays of quantum harmonic oscillators

Cabot, Albert; Giorgi, Gian Luca; Longhi, Stefano; Zambrini, Roberta
Europhysics Letters, **127**, 20001 (1-7)

Landau–Zener Topological Quantum State Transfer

Longhi, Stefano; Giorgi, Gian Luca; Zambrini, Roberta
Advanced Quantum Technologies **2**, 1800090 (1-10)

Machine Learning Applied to Quantum Synchronization-Assisted Probing

Garau Estarellas, Gabriel; Giorgi, Gian Luca; Soriano, Miguel C.; Zambrini, Roberta
Advanced Quantum Technologies **2**, 1800085

Quantum probing topological phase transitions by non-Markovianity

Giorgi, Gian Luca; Longhi, Stefano; Cabot, Albert; Zambrini, Roberta
Annalen der Physik **2019**, 1900307 (1-12)

Effects of update rules on networked N-player trust game dynamics

Chica, Manuel; Chiong, Raymond; Ramasco, J.J.; Abbass, Hussein
Communications in Nonlinear Science and Numerical Simulation **79**, 104870

Extinction-induced community reorganization in bipartite networks

Sheykhalil, S; Fernández-Gracia, J; Traveset, A; Eguíluz, VM
Applied Network Science **4**, 23

Automated real-time method for ventricular heartbeat classification

Ortín, Silvia; Soriano, Miguel C.; Alfaras, Miquel; Mirasso, Claudio R.
Computer Methods and Programs in Biomedicine **169**, 1-8

The noisy voter model under the influence of contrarians

Khalil, Nagi; Toral, Raul
Physica A **515**, 81-92

Nanowires: A route to efficient thermoelectric devices

Dominguez-Adame, F.; Martin-Gonzalez, M.; Sanchez, D.; Cantarero, A.
Physica E **113**, 213-225

a.5.2 Other publications

Cyclic structure induced by load fluctuations in adaptive transportation networks

Martens, Erik Andreas; Klemm, Konstantin
Progress in Industrial Mathematics at ECMI 2018 (edited by Faragó, István; Izsák, Ferenc; Simon, Péter L.), Springer International Publishing, pp.147-155

Transient synchronization in open quantum systems

Giorgi, Gian Luca; Cabot, Albert; Zambrini, Roberta
Advances in Open Systems and Fundamental Tests of Quantum Mechanics. Springer Proceedings in Physics (edited by B. Vacchini, H. P. Breuer, A. Bassi), Springer, Cham, pp. 73-89

Transport properties of driven inelastic Maxwell mixtures

Khalil, Nagi; Garzó, V.
31st International Symposium on Rarefield Gas Dynamics (Edited by Yonghao Zhang, David R. Emerson, Duncan Lockerby, and Lei Wu) AIP Publishing, AIP Conference Proceedings **2132**, 130004

Semiconductor lasers as reservoir substrates

Van der Sande, Guy; Soriano, Miguel C.
Photonic Reservoir Computing: Optical Recurrent Neural Networks, De Gruyter, pp. 185-203

Time delay systems for reservoir computing

Ortín, Silvia; Pesquera, Luis; Van der Sande, Guy; Soriano, Miguel C.
Photonic Reservoir Computing: Optical Recurrent Neural Networks, De Gruyter, pp. 117-151

a.5.3 Books

Photonic Reservoir Computing: Optical Recurrent Neural Networks

Brunner, Daniel; Soriano, Miguel C.; Van der Sande, Guy (Editors)
De Gruyter

Networks in Climate

Dijkstra, H.A.; Hernández-García, E.; Masoller, C.; Barreiro, M.
Cambridge University Press

a.6. Presentations at conferences and academic centers

a.6.1 Invited talks at conferences and workshops

Soriano, Miguel C.
Reservoir Computing for the inference of unobserved variables in chaotic systems.
Workshop Ibersinc3 2019, San Cristóbal de La Laguna, Canarias, Spain.
January, 17

Colet, Pere
Synchronization of nonlinear oscillators.
Winter Workshop on Complex Systems, Zakopane, Poland.
February, 05

Gomila, Damià
Pattern formation in optical microresonators for frequency comb generation.
Advances in Pattern Formation: New Questions Motivated by Applications Sede Boquer, Israel.
February, 19

Hernandez-Garcia, Emilio
Underwater pattern formation in marine plants.
Advances in Pattern Formation: New Questions Motivated by Applications, Sede Boquer, Israel.
February, 20

Zambrini, Roberta
Quantum synchronization in dimer atomic lattices.
Ubiquitous Quantum Physics: the New Quantum Revolution, ICTP Trieste, Italy.
February, 26

San Miguel, Maxi
Física de los Sistemas Complejos.
COEFIS XII La Laguna, Tenerife, Spain.
March, 28

Sánchez, D.
Topologically non-trivial valley states in bilayer graphene quantum point contacts.
SP2 workshop 2019, Granada, Spain.
April, 04

Toral, Raul
Aging in the voter model.
Nordita EPS-SNLP conference Statistical Physics of Complex Systems Stockholm, Sweden.
May, 08

Zambrini, Roberta
Quantum complex networks: introduction, synchronization and noise-less subspaces.
Workshop on Quantum Network Science, University of Arizona, Tucson, USA.
May, 13

Giorgi, Gian Luca
Machine learning applied to quantum synchronization-assisted probing.
Quantum 2019, Torino, Italy.
May, 27

Gomila, Damià
Pattern formation in marine clonal plant meadows.
Waves Côte d'Azur Nice, France.
June, 04

San Miguel, Maxi
Round table on "Transdisciplinary working and complex systems- solving global problems together".
Connected Features, University of Brighton, UK.
June, 06

Mirasso, Claudio
Synchronization of Neuronal Circuits: Modeling and Dynamics.
1st Summer School of Interdisciplinary Research on Brain Network Dynamics, Terzolas, Italy.
June, 24

Mirasso, C.
Information Processing with Neuro-Inspired Delay-Based Dynamical Systems.
1st Summer School of Interdisciplinary Research on Brain Network Dynamics, Terzolas, Italy.
June, 24

Klemm, Konstantin
Cooperation in populations at the extinction transition.
Dynamics of Interdependent Decisions, Delmenhorst, Germany.
June, 25

López, Rosa
The Kondo effect in Thermoelectricity.
15th International Workshop on Magnetism & Superconductivity at the Nanoscale. Comarruga, Spain .
June, 30

San Miguel, Maxi
Two lectures on "From Statistical Physics to the Physics of Complex Systems and Collective Social Phenomena".
Preparatory School for Statphys27, ICTP-SAIFR, Sao Paolo, Brazil.
July, 01

Toral, Raul
Reduction to Markovian dynamics: The case of aging in the noisy voter model.
Statphys 27 Conference. Buenos Aires. Argentina.
July, 09

Serra, Llorenç
Conductance oscillations and magnetic orbital effects with chiral Majorana modes.
Frontiers of quantum and mesoscopic thermodynamics, Prague, Czech Republic.
July, 14

Sánchez, D.
How to distinguish between interacting and noninteracting molecules in tunnel junctions.
Frontiers of Quantum and Mesoscopic Thermodynamics FQMT'19, Prague, Czech Republic..
July, 15

Mirasso, Claudio
The role of high-frequency neurons in shaping effective connectivity of brain network.
Latin American Conference 2. 0 on Complex Networks, Cartagena, Colombia.
August, 05

Toral, Raul
A phase transition in persistent random walks.
50 Years of Stochastic Processes at UCSD. La Jolla, California, USA.
 August, 15

Lopez, Rosa
Lectures on Maxwell Demon at the Quantum Scale.
College on Energy Transport and Energy Conversion in the Quantum Regime, Trieste, Italy.
 August, 19

Sánchez, D.
Fluctuation-driven Coulomb drag in double quantum dots.
College on Energy Transport and Energy Conversion in the Quantum Regime, Trieste, Italy.
 August, 26

Colet, Pere
Power grid frequency fluctuations and smart devices with dynamic demand control.
Minisymposium "Structure and dynamics of future power grids" in Dynamic Days Europe 2019, Rostock Germany.
 September, 02

Klemm, Konstantin
Branch decompositions for computing exact percolation properties and Ising partition functions of networks.
Physics Challenges for Machine Learning and Network Science, London, UK.
 September, 03

Zambrini, Roberta
Quantum complex networks.
12th Italian quantum information science conference, IQIS Università degli studi di Milano, Italy.
 September, 09

Tobias Galla
Stability and diversity in random ecologies: the physicists' frustration.
Evolving Populations. Plön, Germany.
 September, 15

Argyris, Apostolos
Post-processing optical communication signals with reservoir computing techniques.
Huawei Workshop on Novel Photonic Technologies, Dublin, Ireland.
 September, 20

Argyris, Apostolos
Mitigation of transmission impairments in short-reach fiber communication systems using time-delayed photonic reservoirs.
45th European Conference of Optical Communication - ECOC 2019, Dublin, Ireland.
 September, 22

Ramasco, Jose J.
Characterizing migration with Twitter data.
Satellite "Computational Social Science: The Ecological Approach to Social Complexity" of the Conference on Complex Systems CCS, Singapore.
 October, 02

Drotos, Gabor
What the snapshot/pullback attractor of an Earth system model can tell about climate change: a case study about the ENSO-Indian monsoon teleconnection.
The Mathematics of Climate and the Environment: Workshop 1: Nonlinear and stochastic methods in climate and geophysical fluid dynamics, Paris, France.
 October, 08

Sánchez, D.
Coulomb blockade and magnetic effects in molecular tunnel junctions.
Molecular Electro-Opto-Spintronics, Mainz, Germany.
 October, 15

Ramasco, Jose J.
Mobile phone records to feed activity-based travel demand models.
ESM' 2019, Palma de Mallorca, Spain.
 October, 28

Hernandez-Garcia, Emilio
Large-scale transport in the oceans.
Lecture in 1st CAFE (Climate Advanced Forecasting of sub-seasonal Extremes) School. Sitges, Barcelona, Spain.
 November, 19

Toral, Raul
Reduction to Markovian dynamics: The case of aging in the noisy voter model.
XVII International Workshop on Instabilities and Nonequilibrium Structures, Valparaiso, Chile.
 December, 02

San Miguel, Maxi
Processes of complex contagion.
XVII International Workshop on Instabilities and Nonequilibrium Structures, Valparaiso, Chile.
 December, 02

Hernandez-Garcia, Emilio
Patterns and fronts in underwater clonal vegetation.
XVII International Workshop on Instabilities and Nonequilibrium Structures, Valparaiso, Chile.
 December, 03

Mirasso, Cluadio
Comparison of Photonic Reservoir Computing Systems for the Recovery of Optical Communication Signals.
NOLTA 2019, International Symposium on Nonlinear Theory and Its Applications, Kuala Lumpur, Malasia.
 December, 02

Mirasso, Claudio
High-frequency neurons influence signal transmission in brain networks.
NOLTA 2019, International Symposium on Nonlinear Theory and Its Applications, Kuala Lumpur, Malasia.
 December, 02

Mirasso, Claudio
Comparison of photonic reservoir computing systems for the recovery of optical communication signals.
NOLTA 2019, International Symposium on Nonlinear Theory and Its Applications, Kuala Lumpur, Malasia.
 December, 02

Soriano, Miguel Cornelles
Delay-based Photonic Reservoir Computing.
ERC International Workshop "Photonic Reservoir Computing and Information Processing in Complex Networks", Trento, Italy.
 December, 04

Cattaneo, Marco
Simmetry and block structure of the Liouvillian superoperator in partial secular approximation.
4th Applied Quantum Mechanics meeting in Milan, Italy.
 December, 20

a.6.2 Other talks at conferences and workshops

Bassolas, Aleix; Gallotti, Riccardo; Lamanna, Fabio; Lenormand, Maxime; Ramasco, José Javier
Scaling in the recovery of cities from special events.
Complenet 2019 Tarragona, Spain.
 March, 18

Mazzoli, Mattia
A network approach to airports mobility and epidemic spreading of airborne viruses.
Complenet 2019 Tarragona, Spain.
 March, 18

Fernández Gracia, Juan ;Rodríguez, Jorge Pablo ;Peel, Lauren ;Meekan, Mark M. ;Eguíluz, Víctor M.
Inferring social relations from presence data. Manta Rays case study.
Complenet 2019 Tarragona, Spain.
 March, 18

Mazzoli, Mattia; Tugores, Antonia; Adler, Natalia; Colet Pere; Ramasco, José J.
Tracking migration flows with geolocalized Twitter data.
V Workshop COMSOTEC 2019, Alcalá de Henares, Madrid, Spain.
 March, 26

F. Peralta, Antonio; Khalil, Nagi; Toral, Raúl.
Reduction of non-Markovian to Markovian dynamics: The case of aging in the noisy voter model.
V Workshop COMSOTEC 2019, Alcalá de Henares, Madrid, Spain.
 March, 26

Drotos, Gabor; Bodai, Tamas; Herein, Matyas; Tel, Tamas
Defining climate by means of an ensemble: why it is possible.
EGU2019 European Geosciences Union General Assembly 2019 Vienna, Austria.
 April, 10

Ramasco, Jose J.
Tackling migration flows with geolocated Twitter data.
IUSSP Research Workshop on Digital Demography in the Era of Big Data, Sevilla, Spain.
 June, 06

San Miguel, Maxi
Contagion processes with heterogeneous adoptability and compatibility.
NetSci, International Conference on Network Science, Paris, France.
 June, 11

Klemm, Konstantin
Structure of adaptive flow networks under load fluctuations.
Oscillations, Transients and Fluctuations in Complex Networks, Copenhagen, Denmark.
 July, 01

Colombo, Eduardo H.;Martínez-García, Ricardo; López, Cristóbal; Hernández-García, Emilio
Spatial eco-evolutionary feedbacks mediate coexistence in prey-predator systems.
Fluctuations, tipping points and emergence in eco-evolutionary dynamics. Leeds, UK.
 July, 02

Mazzoli, Mattia; Molas, Alex; Bassolas, Aleix; Lenormand, Maxime; Colet, Pere and Ramasco, José Javier
Field theory for recurrent mobility.
Traffic and granular flow 2019, Pamplona, Spain.
 July, 02

San Miguel, Maxi; Min, Byungjoon
Complex Contagion: Heterogeneous adoptability, competition, and compatibility.
StatPhys 27, Buenos Aires, Argentina.
 July, 08

Cabot, Albert.
Quantum synchronization in dimer atomic lattices.
XXXVII Reunión Bienal de la Real Sociedad Española de Física. Simposio especializado de tecnologías cuánticas, Spain.
 July, 15

Tugores, Antònia
Tracking migration flows with geolocated Twitter data.
EuroScipy 2019. Bilbao, Spain.
 September, 02

Colombo, Eduardo H.; Martínez-García, Ricardo; López, Cristóbal; Hernández-García, Emilio
Spatial eco-evolutionary feedbacks mediate coexistence in prey-predator systems.
Evolution of interaction populations. Ploen, Germany.
 September, 15

Soriano, Miguel Cornelles; Massuti-Ballester, Pau; Yelo, Jesús; Fischer, Ingo
Optoelectronic reservoir computing using a mixed digital-analog hardware implementation.
28th International Conference on Artificial Neural Networks ; ICANN 2019, Munich, Germany.
 September, 17

Horacio S. Wio Beitelmajer
Fluctuation Theorems for Systems without Stationary PDF: KPZ case.
32nd Marian Smoluchowski Symposium on Statistical Physics, Krakow, Poland.
 September, 18

Calleja-Solanas, Violeta; Meloni, Sandro; Hernández-García, Emilio
Structured vs. Higher-order interactions in competitive ecosystems.
Conference on Complex Systems CCS2019, Singapore.
 September, 30

Toral, Raul
Memory effects in the voter model.
Conference on Complex Systems CCS2019, Singapore.
 September, 30

Min, Byungjoon; San Miguel, M
Coevolutionary dynamics of a nonlinear voter mode.
Conference on Complex Systems CCS2019, Singapore.
 September, 30

Raducha, Tomasz; Min, Byungjoon; San Miguel, Maxi
How does local rewiring change opinion dynamics?
Conference on Complex Systems CCS2019, Singapore.
 September, 30

Ramasco, Jose J.
Scaling in the recovery of urban transportation systems from massive event.
Conference on Complex Systems CCS 2019, Singapore.
 September, 30

Seoane, Luís F; Solé, Ricard.
Information theory strategies to scape parasites.
Conference on Complex Systems CCS 2019, Singapore.
 September, 30

Tugores, Antònia
Taller de Introducció a Python.
PyConES 2019. Málaga, Spain.
 October, 03

González-Avella, Juan Carlos; Tugores, Antònia
Aprendiendo cómo aprenden las máquinas.
PyConES 2019. Málaga, Spain.
 October, 03

Klemm, Konstantin
Structure of adaptive flow networks under load fluctuations.
COSTNET 19 conference, Bilbao, Spain.
 October, 09

Hernandez-Garcia, Emilio
On the sinking of biogenic particles in ocean flows.
Turbulence Effects on Active Species in Atmosphere and Ocean (TEASAO) workshop. St-Ferréol, France.
 October, 28

Mazzoli, Mattia; Molas, Alex; Bassolas, Aleix; Lenormand, Maxime; Colet, Pere and Ramasco, José Javier
Field theory for recurrent mobility.
Complex Networks 2019, Lisbon, Portugal.
 December, 10

Raducha, Tomasz; San Miguel, Maxi
Nonlinear interactions in noisy coevolving networks.
Complex Networks 2019, Lisbon, Portugal.
 December, 10

a.6.3 Poster presentations

Ruiz-Reynés, Daniel; Hernández-García, Emilio; Sintés Tomàs; Marbà, Núria; Gomila, Damià
Sulfide concentration as a mechanism for pattern formation in Posidonia oceanica meadows.
CompleNet 2019, Tarragona, Spain.
 February, 18

Calleja-Solanas, Violeta; Meloni, Sandro
Higher Order vs. Structured Interactions in Competitive Ecosystems.
CompleNet 2019, Tarragona, Spain.
 March, 18

Cabot, Albert.
Unveiling noiseless clusters in complex quantum networks.
Exploring Open Quantum Systems in Quantum Simulators KITP, Santa Barbara, California, USA.
 April, 29-03

Cabot, Albert.
Quantum synchronization in dimer atomic lattices.
Exploring Open Quantum Systems in Quantum Simulators. KITP, Santa Barbara, California, USA.
 April, 29

Martínez-Peña, Rodrigo; Nokkala, Johannes; Giorgi, Gian Luca; Soriano, Miguel Cornelles; Zambrini, Roberta
Quantum approach to Reservoir Computing.
Machine Learning for Quantum Technology Workshop; Erlangen, Germany.
 May, 06

Estébanez, Irene; Fischer, Ingo; Soriano, Miguel C.
School and Workshop on Patterns of Synchrony: Chimera States and Beyond.
ICTP, Trieste, Italy.
 May, 06

Fernández Gracia, Juan;
Rodríguez, Jorge Pablo ;Peel,
Lauren ;Meekan, Mark M. ;Eguíluz,
Víctor M.

**Inferring social relations from
presence data. Manta Rays case
study.**

*Netsci 2019 International school
and conference on network
science, Vermont, USA.*
May, 27

Fernández Gracia, Juan ;Onnela,
Jukka-Pekka

**A flexible model of network
embedding.**

*Netsci 2019 International school
and conference on network
science, Vermont, USA.*
May, 27

Sheykhali, Somaye ;Fernández
Gracia, Juan ;Eguíluz, Víctor M.

**Cooccurrence plasticity
increases modularity and
stability in bipartite networks.**

*Netsci 2019 International school
and conference on network
science, Vermont, USA.*
May, 27

Cattaneo, Marco; Giorgi, Gian
Luca; Maniscalco, Sabrina;
Zambrini, Roberta

**Local vs global master equation
with common and separate
baths.**

*Quantum Thermodynamics
Conference in Espoo, Finland.*
June, 24

Mirasso, C., Pariz, A. Canals, S.,
Valizadeh, A.

**High frequency neurons help
routing information in brain
networks.**

*28th Annual Computational
Neuroscience Meeting CNS2019,
Barcelona, Spain.*
July, 13

Sanchez-Claros, Jaime; Kang, M.;
Pariz, A., Fischer, I., Mirasso, C.

**Information transmission in
delayed-coupled neural circuits.**

*28th Annual Computational
Neuroscience Meeting CNS2019,
Barcelona, Spain.*
July, 13

Cattaneo, Marco; Giorgi, Gian
Luca; Maniscalco, Sabrina;
Zambrini, Roberta

**Local vs global master equation
with common and separate
baths.**

IQIS 2019 in Milan, Italy
September, 09

Chacoma, Andrés; Tugores,
Antònia; Ramasco, Jose J.; Colet,
Pere

**Indicadores turísticos mediante
el uso de redes sociales.**

PyConES 2019. Málaga, Spain.
October, 03

Fernández Gracia, Juan

;Rodríguez, Jorge Pablo ;Peel,
Lauren ;Meekan, Mark M. ;Eguíluz,
Víctor M.

**Inferring social relations from
presence data. Manta Rays case
study.**

Costnet'19, Bilbao, Spain.
October, 09

De la Fuente, Rebeca; López,
Cristobal; Hernández-García,
Emilio; van Sebille, Erik

**Vertical structure of transport
from Network theory and
Dynamical Systems approaches
to Lagrangian Fluid Dynamics.**

*BBOS, Autumn Symposium 2019,
Den Bosch, The Netherlands.*
October, 23

a.6.4 Seminars and talks in other research centers

Drotos, G.

**Coarse-grained finite-time
quantifiers of chaos in open
flows.**

*Seminars in Statistical Physics.
Visit to the Institute for Theoretical
Physics, Eotvos University.
Budapest, Hungary.*
January 6

López, Rosa

Chiral Maxwell Demon.

Universidad de Sevilla, Spain.
January 24 – 28

Meloni, Sandro

Physics of Data

*Two lectures during the course
"Statistical Mechanics of Complex
Systems" of the master in Physics
of Data at the University of Padova
in Italy.*

March 26 - 28

Hernandez-Garcia, Emilio

**Lines on the sea: connectivity,
surface stirring and biological
dynamics.**

*Centro Oceanográfico de Baleares,
Instituto Español de Oceanografía,
Palma de Mallorca, Spain.*
April 1

Hernandez-Garcia, Emilio

**Fairy circles under the sea:
Pattern formation in meadows of
marine plants.**

*Departament de Física i Enginyeria
Nuclear, Universitat Politècnica de
Catalunya, Terrassa, Spain.*
April 3

Rosa López

**Anomalous Joule law in the
adiabatic dynamics of a normal-
superconductor quantum dot.**

University of Lund, Sweden.
April 18 - 19

López, Rosa

**Coulomb drag in coupled
quantum double dot.**

*Luxemburg University Colloquium,
Luxemburg.*
May 31

F. Peralta, Antonio; Toral, Raúl.

**Stochastic binary-state
dynamics on complex networks.**

University of Limerick, Ireland.
June, 03

Cattaneo, Marco

**QMath Masterclass on Quantum
Communication and
Computation with Continuous
Variables.**

*Summer school at the University
of Copenhagen, Denmark.*
June 17 – 21

Nokkala, Johannes; Martínez,

Rodrigo; Giorgi, Gian-Luca;
Soriano, Miguel; Zambrini, Roberta

**Teaching temporal tasks to
quantum networks with
supervised machine learning.**

*Queen Mary University of London,
UK.*
September, 03

Rebeca de la Fuente

**Vertical structure of transport
from Statistical Physics and
Dynamical Systems approaches
in Lagrangian Fluid Dynamics.**

*Institute for Marine and
Atmospheric research. Utrecht, The
Netherlands.*
September 24

Drotos, Gabor
What the snapshot/pullback attractor of an Earth system model can tell about climate change: a case study about the ENSO-Indian monsoon teleconnection.

Institute for Theoretical Physics, Eotvos University, Budapest, Hungary.
 October 12 – 24

Seoane, Luís F.
Information theory strategies to scape parasites.

University of Princeton, USA.
 October 14

Seoane, Luís F.
Information theory strategies to scape parasites.

Santa Fe Institute, New Mexico, USA.
 October 15

San Miguel, Maxi
¿Qué aprendemos con Big Data?.

Ateneu de Maó, Menorca, Illes Balears, Spain.
 November, 8

Drotos, Gabor
Climate in radiative-convective equilibrium: dependence on CO₂ concentration.

Institute for Theoretical Physics, Eotvos University, Budapest, Hungary.
 December, 19

a.7. Other Activities

a.7.1. Master Thesis

Moreno-Spiegelberg, Pablo
Spatiotemporal patterns in the Turing-Takens-Bogdanov scenario
 Supervisor: Damia Gomila
 November 18

Martinez Barbeito, Maria
Propagation of defaults in banking networks
 Supervisor: Pere Colet
 October 24

García Seuma, Ramon Marc
A market model for exploitation and cooperation using the Minority Game
 Supervisor: Pere Colet
 September 30

Ballesteros Ferraz, Lorena
State transfer in Open Quantum Systems
 Supervisors: Roberta Zambrini and Gian Luca Giorgi
 September 30

Llodrà Bisellach, Guillem
Detecting the topological phases of the Kitaev model via complex network analysis
 Supervisors: Roberta Zambrini and Gian Luca Giorgi
 September 30

Lacasta Lopez, Sergio
Stochastic games on complex networks: study on a Prisoner's Dilemma and a Public Good Game
 Supervisor: Sandro Meloni
 September 30

Arcas Cuerda, Alex
Network description of dynamical systems: The clustering coefficient
 Supervisor: Emilio Hernández-García
 September 27

Jaume Suárez, Samuel
Multilayer reservoir computing to overcome the memory-nonlinearity trade-off
 Supervisor: Miguel C. Soriano
 September 24

Barrios, Guillermo
Constructive role of plasticity rules in reservoir computing
 Supervisors: Miguel C. Soriano and Claudio Mirasso
 September 26

Perelló, Joan
Data analysis and modeling of patient flow in emergency services in hospitals
 Supervisors: Raul Toral and Claudio Mirasso
 September 19

Almodóvar del Pozo, Alejandro
Study of cluster crystals with two different stochastic models and two different repulsive potentials
 Supervisor: Cristóbal López
 September 11

Plazas, Adria
Modelling residential segregation for economical reasons
 Supervisor: Jose Javier Ramasco
 September 5

Vilchez, Orestis
Price Dynamics in a Model of Leverage-Based Investment
 Supervisor: Pere Colet
 July 22

Yelo, Jesús
Information processing using optoelectronic delayed systems: Influence of an additional delay
 Supervisor: Miguel C. Soriano
 July 19

Scettri, Giacomo
Studying national and international migration flows with Twitter data
 Supervisors: Jose J. Ramasco and Riccardo Gallotti
 February 8

Martin, Luis
Vegetation front dynamics
 Supervisor: Damià Gomila
 January 29

Cunillera Pérez, Alejandro
Phase space reconstruction of semiconductor laser dynamics using reservoir computing
 Supervisors: Ingo Fischer and Miguel C. Soriano
 January 25

a.7. 2. Research stays in other centers

Nanophysics group, ETH, Zurich, Switzerland.
 Sánchez, D.
 February 1 – April 30

Technical University of Denmark (DTU-Physics), Germany.
 Sierra, Miguel A.
 January 15 – 29

University of Padova, Italy
 Meloni, Sandro
 March 26 - 28

Institute for Theoretical Physics, Eotvos University, Budapest, Hungary.
 Drotos, Gabor
 April 13- 24

KAVLI Institute For Theoretical Physic, Santa Barbara, USA.
 Zambrini, Roberta
 April 24– May 21

Humboldt University. Berlin, Germany.
 Klemm, Konstantin
 April 25

University of Limerick. Limerick, Ireland.
 F. Peralta, Antonio; Toral, Raúl.
 May 1 –July 1

Turku Center of Quantum Physics (Turku) Finland.
 Nokkala, Johannes
 May 17- 31

Harvard T. H. Chan School of Public Health, USA.
 Fernández-Gracia, Juan
 June 3 –7

International Thermonuclear Experimental Reactor (ITER) Cadarache, France.
 Drotos, Gabor
 June 14

Chemistry and Biochemistry Department of UCSD, San Diego, USA.
 Toral, Raul
 August, 8 - 23

Institute for Marine and Atmospheric research, IMAU. Utrecht, The Netherlands.
 De la Fuente, Rebeca
 September 10 – December 10

Institute for Theoretical Physics, Eotvos University, Budapest, Hungary.
 Drotos, Gabor
 October 12 - 24

RIATE LAB - Géographie-cités – CNRS, Paris, France.
 Mazzoli, Mattia
 November 3 – December 3

Department of Informatics, Bioengineering, Robotics and Systems Engineering, University of Genova, Italy.
 Mirasso, C.
 November 6 - 8

The University of Tokyo (Tokyo).
 Röhm, André
 November 16 – 28

Santa Fe Institute, New Mexico, USA.
 Seoane, Luís
 November 19 – December 5

RIATE LAB - Géographie-cités – CNRS, Paris, France.
 Ramaso, José Javier; Colet, Pere
 November 19 – 22

a.8. Press and Media

The titles are linked to the document or media clip

a.8.1 Press and digital Media

Solucions per saber com es mouen els animals
El Mundo
January 9

Facua carga contra Red Eléctrica por la falta de cable y pide que se dé prisa
Menorca.info
January 9

Vuelven los seminarios «Colloquia on Complex Systems 2019» del IFISC
El diari de la UIB
January 10

Henk A. Dijkstra: Se ha avanzado muchísimo en predicción climática, aunque aún es uno de los objetivos
Diario de Mallorca
January 18

Neuro-inspiración para el reconocimiento de patrones
El diari de la UIB
January 25

A fully automatic and real-time arrhythmia classifier
SOMMa
January 28

El IFISC convoca las becas de introducción a la investigación SURF@IFISC 2019
El diari de la UIB
January 31

Un centenar de mujeres reivindican el papel de la mujer en sectores científicotécnicos
Noticias Mallorca
February 1

Enginyeres al servei de la ciència, però en perill d'extinció
Ara Balears
February 2

Dia de la Nina i la Dona en la Ciència
Última Hora
February 2

Charlas, tapas, citas y magia para reivindicar a científicas e ingenieras
Diario de Mallorca
February 2

Un centenar de mujeres en el ParcBit reivindican el papel de la mujer en sectores científicotécnicos
Ibeconomía
February 4

Eliminar la brecha de género en ciencia y tecnología
Baleópolis, El Mundo
February 5

Becas SURF
Baleópolis, El Mundo
February 5

Jornada de portes obertes a l'IFISC (CSIC-UIB)
El diari de la UIB
February 8

11fBalears' reivindica medidas para romper la brecha de género
El Mundo
February 12

La mujer y la ciencia, una brecha por cerrar
Diario de Mallorca
February 12

“El uso de datos que se dio con la elección de Trump o el ‘brexit’ puede repetirse el 26 de mayo”
Diario de Mallorca
February 13

Jornada de puertas abiertas del Institut de Física Interdisciplinària
Última Hora
Periódico de Ibiza y Formentera
February 18

Nuevo sistema de detección de patrones neuroinspirado
Agencia SINC
Madridmasd
Herenciageneticayenfermedad
TECNOXPORA
Universidad Politécnica de Madrid
Todo Diarios
Amazings
Centro de Tecnología Biomédica
CTB – UPM
Psicología al día
La Sexta
Notibol
InfoSalus
Bolsamanía
EcoDiario
February 18

Las mujeres se animan a programar
Diario de Mallorca
February 18

Estudian cómo almacena información el cerebro
Catalunya Vanguardista
February 20
A new neuro-inspired system for pattern detection
Medical Xpress
All My Family Care
News Medical Life Sciences
INPST
February 21

Becas SURF
Baleópolis, El Mundo
March 5

«Navegant per la complexitat del segle XXI: La informació com a motor»
El Diari de la UIB
March 7

La conciliación imposible
Diario de Mallorca
March 8

Què veia Claude Monet mentre pintava el 1873?
Ara Balears
March 9

Conferència: «Noise and information in economic and financial systems», a càrrec de Rosario N. Mantegna
El Diari de la UIB
March 11

Navegando por la complejidad con la información como motor
Baleópolis, El Mundo
March 12

Becas SURF
Baleópolis, El Mundo
March 19

Ciclo Navegando por la Complejidad del Siglo XXI
Baleópolis, El Mundo
March 19

Becas SURF
Baleópolis, El Mundo
March 26

Espionaje de señales complejas
Baleópolis, El Mundo
March 26

| | | |
|--|---|--|
| <p>Ciclo Navegando por la Complejidad del Siglo XXI <i>Baleópolis, El Mundo</i> April 2</p> | <p>Un estudio analiza la movilidad en las ciudades como si fueran un campo gravitatorio <i>CSIC</i> <i>El diari de la UIB</i> <i>COPE</i> <i>La Vanguardia</i> <i>Dicyt</i> <i>La Sexta</i> <i>Público</i> <i>Agencia SINC</i> <i>El Dispensador</i> <i>Ecuador Universitario</i> <i>Unam Global</i> <i>Energy News</i> <i>Coffee Break</i> <i>Nova Ciencia</i> <i>Heraldo</i> August 29</p> | <p>People's potential <i>Nature Physics</i> October 1</p> |
| <p>Los espacios urbanos gallegos preservan mejor que los rurales el equilibrio entre las dos lenguas, según un estudio <i>Europa Press</i> April 11</p> | <p>L'IFISC (CSIC-UIB) recull l'acreditació com a Unitat d'Excel·lència María de Maeztu <i>El diari de la UIB</i> September 9</p> | <p>¿Cómo gravita usted al trabajo? <i>The Conversation</i> October 7</p> |
| <p>El festival de divulgació científica «Pint of Science» 2019 torna a Palma els dies 20, 21 i 22 de maig <i>El diari de la UIB</i> May 13</p> | <p>Duque entrega las acreditaciones 'Severo Ochoa' y 'María de Maeztu' <i>La Moncloa</i> <i>El Confidencial</i> <i>Alicante Plaza</i> <i>El Día de Valladolid</i> <i>El Día de Segovia</i> <i>El Diario de Avila</i> <i>El Día de Soria</i> <i>DeNoticias</i> <i>El Confidencial</i> <i>La Vanguardia</i> <i>COPE</i> <i>Ministerio de Ciencia, Innovación y Universidades</i> <i>Bolsamanía</i> <i>Siglo XXI</i> <i>Innova Spain</i> <i>Estrategia Empresarial</i> <i>Parke</i> <i>El Digital de Asturias</i> September 10</p> | <p>¿Las hormigas más rápidas del planeta? <i>Elciudadano.com</i> October 20</p> |
| <p>Pint of Science: La ciencia llega a los bares <i>Diario de Mallorca</i> May 15</p> | <p>Una tesis doctoral de la UIB investiga el comportamiento termoeléctrico de los puntos cuánticos <i>Europa Press</i> <i>20minutos</i> <i>La Vanguardia</i> <i>Gente Online</i> May 17</p> | <p>Inca promou la investigació amb la quarta Fira de la ciència i la tecnologia <i>Ara Balears</i> October 22</p> |
| <p>Punts quàntics: una passa més envers els ordinadors quàntics <i>El diari de la UIB</i> May 16</p> | <p>Pint of Science, disfrutar de la ciencia desde la barra del bar <i>Baleópolis, El Mundo</i> May 21</p> | <p>Un estudio revela que las ciudades con una movilidad concentrada tienen una mayor calidad de vida <i>CSIC</i> October 23</p> |
| <p>Seminari a l'IFISC (CSIC-UIB), a càrrec del doctor Hernan Makse <i>El diari de la UIB</i> June 17</p> | <p>El IFISC recibe un premio de dos millones de euros <i>Diario de Mallorca</i> September 10</p> | <p>La jerarquia a les ciutats i la seva connexió amb el transport, les emissions i la salut a les ciutats <i>El diari de la UIB</i> October 23</p> |
| <p>Neurociències més enllà de la salut <i>Divulga UIB</i> June 17</p> | <p>La ciencia se marcha de copas con ocasión de la celebración de la Nit de la Recerca <i>Primicia Web</i> <i>Mallorca Actual</i> September 21</p> | <p>Las ciudades compactas son más sostenibles que las dispersas <i>El País</i> October 24</p> |
| <p>La secretaria de Universidad expresa su voluntad de dar más visibilidad al Ifisc como "centro pionero internacional" <i>20 minutos</i> <i>Europa Press</i> <i>La Vanguardia</i> July 31</p> | <p>La 'Nit de la Recerca' acerca la ciencia a la ciudadanía <i>Baleópolis, El Mundo</i> September 23</p> | <p>Las ciudades con una movilidad concentrada tienen una mayor calidad de vida <i>Europa Press</i> <i>COPE</i> <i>Servimedia</i> <i>La Vanguardia</i> <i>Equipamiento y Servicios Municipales</i> <i>República</i> <i>NCYT</i> <i>Nueva Tribuna</i> <i>Tiempo</i> October 24</p> |
| <p>Se exponen en Menorca dos muestras de la actividad científica del CSIC <i>Menorca al dia</i> August 22</p> | | <p>¿Cómo se mueve la gente en las ciudades? <i>Ambientum</i> October 25</p> |
| | | <p>La ciencia de la movilidad urbana o por qué la calidad de vida es mayor en Barcelona que en Madrid <i>El Economista</i> October 28</p> |

Las ciudades con mayores flujos de comunicación entre zonas con diversos niveles de actividad tienen mejores indicadores de salud, según un estudio del IFISC
Salud Ediciones
October 28

Las urbes con movilidad concentrada son más sostenibles
Baleópolis, El Mundo
October 29

Atos mejora la investigación científica del IFISC en la Universitat de les Illes Balears (UIB) con su superordenador BullSequana X
Atos Spain
El Candelerero Tecnológico
Primicia Web
Comptuing España
Finanzen
Cercle Finance
October 30

Atos: BullSequana X aux Baléares
Orange Fr
October 30

Atos enhances scientific research at the University of the Balearic Islands (UIB) with its BullSequana X supercomputer
Planet 3D Now
Inside HPC
HPC Wire
Primeour Magazine
Yahoo Fr
Stockopedia
Press Release Point
Investigate
Finanz Nachrichten
October 30

El Ifisc de la UIB contará un nuevo 'superordenador' para análisis de datos masivos
Última Hora
October 30

La UIB signa un contracte amb Atos per adquirir un superordinador per a l'IFISC (CSIC-UIB)
El diari de la UIB
Economía de Hoy
October 30

Le supercalculateur BullSequana X d'Atos soutient la recherche scientifique à l'université des îles Baléares
Global News Wire
GNT
Zone Bourse
Easy Bourse
MoneyVox
October 30

Atos: signe un contrat avec l'université des baléares
Trading Sat
Fortuneo Banque
ABC Bourse
Boursoraa
October 30

Città, flussi di mobilità, inquinamento e salute
Fundazione Bruno Kessler
October 30

Las urbes con movilidad concentrada son más sostenibles
El Mundo
October 31

La UIB compra un superordenador para análisis masivos de datos
Diario de Mallorca
Data Center Market
October 31

Atos向IFISC提供新型超级计算集群 · 用于跨学科物理与复杂系统研究
· 用于跨学科物理与复杂系统研究
转自中国存储网 · 原文链接
Chinastor
October 31

La supercomputación se instala en la Universitat de les Illes Balears (UIB)
Autelsi
October 31

La UIB incorpora el superordenador BullSequana X de Atos para abordar nuevos retos en el análisis de big data
Ibecnomía
November 1

La UIB compra un superordinador a la empresa Atos
Ara Balears
November 1

Atos Mejora La Investigación Científica Del IFISC En La Universitat De Les Illes Balears (UIB) Con Su Superordenador BullSequana X
Valencia Business
Diario Economía
Diario ABC
Hechos de Hoy
Paper Blog
Castilla la Mancha 24 horas
Cantabria Económica
Notas de Prensa
Estrella Digital
San Sebastián 24 horas
Camaltec Press
Pamplona 24 horas
Cádiz 24 horas
Granada 24 horas
Burgos digital 24 horas
Islas Baleares 24 horas
Extremadura 24 horas
Palencia 24 horas
Bilbao 24 horas
Madrid 24 horas
Valladolid 24 horas
Asturias 24 horas
Sevilla 24 horas
Valencia 24 horas
Zaragoza 24 horas
Galicia 24 horas
Barcelona 24 horas
Vitoria 24 horas
Tarragona Noticias
Lleida Notícies
Stick Noticias
Madrid Noticias
De Noticias
Catalunya Notícies
Girona Notícies
Siglo XXI
Comunicae
Finanzas
Madrid Business
Economía Digital
El Mundo del ADC
Economía de Mallorca
November 5

La Universitat de les Illes Balears mejora su capacidad de investigación con un nuevo superordenador
ITTrends
Noudiari
Argentum News
November 5

New Insights into Human Mobility with Privacy Preserving Aggregation
Google AI Blog
November 12

Googleが都市のモビリティ分析のための新手法！位置情報を匿名化して活用
Techable JP
 November 13

Cities of the future: preserving privacy in ai-powered urban planning
Analytics India Magazine
 November 13

Matemáticos prueban que el bilingüismo en Cataluña es viable y no «devora» al catalán
ABC
 November 14

El idioma español tiene más peso en Cataluña que el catalán
La Voz de Galicia
 November 14

Modelos matemáticos constatan buena salud de la convivencia entre catalán y castellano en Cataluña
Ibercampus
 November 14

Ens movem segons on vivim
El Nacional
 December 7

a.8.2 Radio and TV

Tertúlia 11F (Roberta Zambrini)
Balears Fa Ciència, IB3 Ràdio
 January 2

"Sigue habiendo pasillos rosas para las niñas y no saben lo que se pierden" (Roberta Zambrini)
A vivir que son dos días, Cadena SER
 February 10

Las matemáticas más frikis: desde los Power Rangers a Dónde está Wally (Adrián García)
Raíz de 5, RNE 5
 February 26

Cicle de Conferències: Navegando por la Complejidad del Siglo XXI (Adrián García)
Balears Fa Ciència, IB3 Ràdio
 March 16

Entrevista Carlos Santana (Miguel Soriano y Adrián García)
Balears Fa Ciència, IB3 Ràdio
 March 23

Entrevista Luis Seoane
Balears Fa Ciència, IB3 Ràdio
 April 13

Tertulia Pint of Science (Adrián García)
Balears Fa Ciència, IB3 Ràdio
 May 18

Pint of Science (Adrián García)
Informatiu, RTVE Balears
 May 19

Pint of Science en Palma (Adrián García)
Informatiu, RTVE Balears
 May 20

Entrevista Ana Pérez Manrique
Balears Fa Ciència, IB3 Ràdio
 May 25

Entrevista Antònia Tugores
Al Dia, IB3 Ràdio
 June 17

Campos gravitatorios y movilidad urbana (José Ramasco)
Artesfera, Radio Exterior, RTVE
 September 3

Movilidad urbana como campo gravitatorio (José Ramasco)
A Golpe de Bit, RNE
 September 11

¡Ciencia al bar! (Rodrigo Martínez y Adrián García)
Balears Fa Ciència, IB3 Ràdio
 September 28

La movilidad urbana entendida como un campo gravitatorio (José Ramasco)
Principio de Incertidumbre, Canal Extremadura
 September 28

Anàlisi de dades i modelització del flux de pacients en els serveis d'urgències dels hospitals (Claudio Mirasso y Raúl Toral)
Salut i Força, Canal 4 TV
 October 1

Analitzant el flux de pacients en els serveis d'urgències dels hospitals (Claudio Mirasso y Raúl Toral)
Salut i Força, Canal 4 Ràdio
 October 18

Las ciudades con una movilidad concentrada tienen más calidad de vida (José Ramasco)
La Tarde, COPE
 October 31

Pere Colet (CSIC): "Los datos que contienen geolocalizadores pueden servir para hacer estadísticas"
Canal 4 Diario
 November 4

Analizando los diferentes tipos de ciudades (José Ramasco)
Gente Despierta, RNE
 November 27

