2020* ANNUAL REPORT

IFISC*

Universitat de les Illes Balears

CSIC

EXCELENCIA MARÍA DE MAEZTU

EXCELENCIA
MARÍA
DE MAEZTU

Institute for Cross-Disciplinary Physics and Complex Systems

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can be downloaded from

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PRESENTATION AND RESEARCH LINES

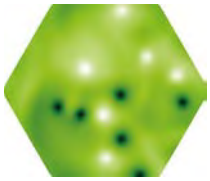
IFISC (Institute for Cross-Disciplinary Physics and Complex Systems) is a joint research institute of the University of the Balearic Islands (**UIB**) and the Spanish National Research Council (**CSIC**) created in 2007 building upon the former Cross-Disciplinary Physics Department of the Mediterranean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

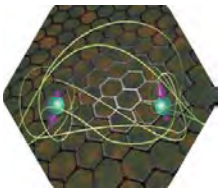
The Computing Services Unit manages the computational resources at IFISC. Capabilities to perform intensive numerical calculations are provided by an IBM iDataPlex cluster with 48 dx360M4 diskless nodes and a total of 576 computational cores and 1.8 TB of RAM configured for High Throughput Computing (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.

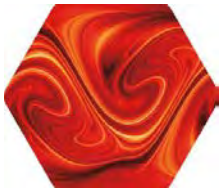
Nonlinear Photonics

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

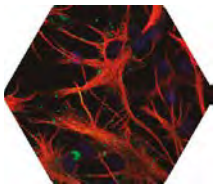
Since 2009 a Photonics Laboratory of highest standards has been established. The lab is equipped with a Faraday cage for electromagnetic shielding and houses several experiments of delay-coupled lasers and laser arrays, optoelectronic systems, as well as photonic information processing systems using 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

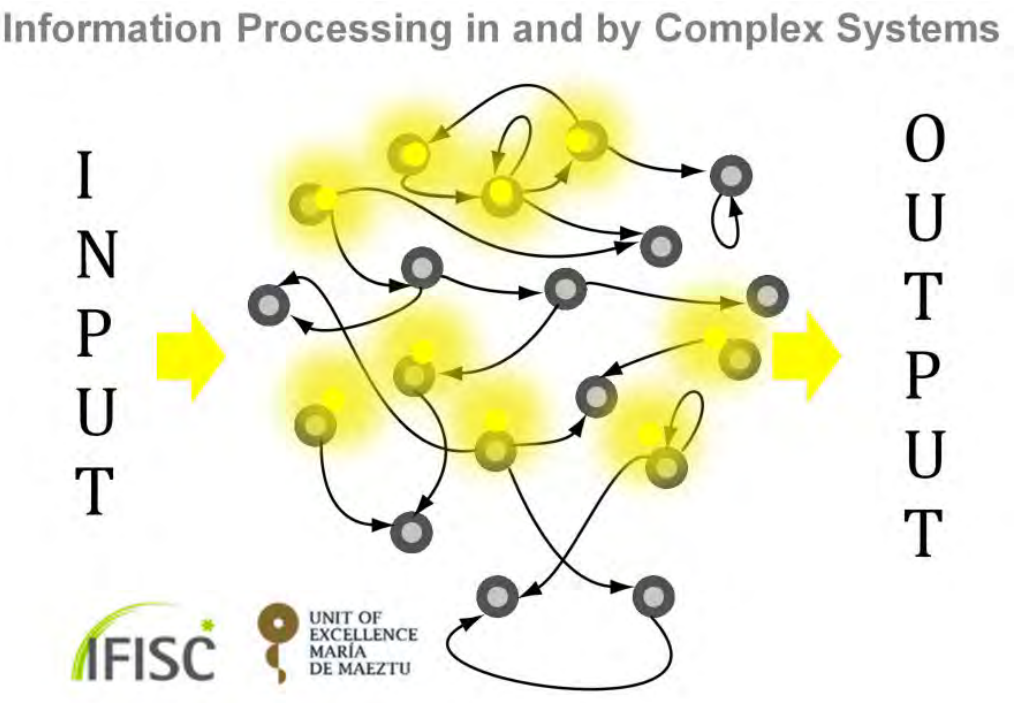
Social systems are prominent examples of Complex Systems, emergent phenomena, and the Micro-Macro paradigm. Today's main societal changes and challenges arise from the feedback loop that entangles society with Information and Communication Technologies (ICT) as a prototypical socio-technical system.

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** was awarded the "**Unidad de Excelencia María de Maeztu**" distinction, for the period 2018-2022, entering the selective **SOMMa Alliance**. These awards are granted by the Agencia Estatal de Investigación (AEI), belonging to the Ministry of Science, and Innovation, 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 center in the research field of complex systems. The research project centers in the study **'Information Processing in and by complex Systems'**. The distinction was granted shortly after IFISC's tenth anniversary, demonstrating its positive trajectory in research excellence.

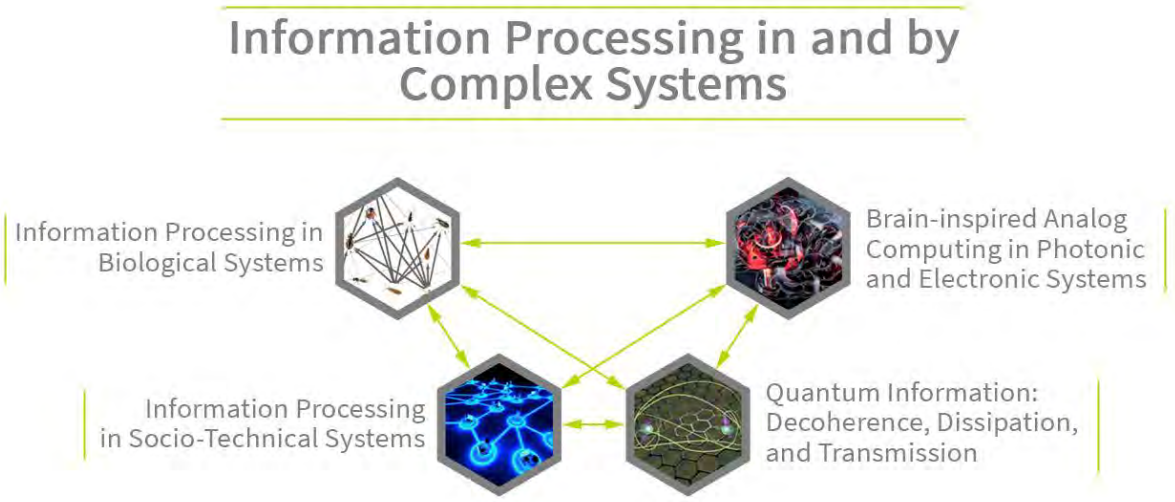
According to the Ministry, being awarded as "Severo Ochoa" or "María de Maeztu" represents "the recognition and accreditation of the best centers and units that stand out for their international impact and the relevance of their results obtained in the last four years". Moreover, it targets "the financing of strategic research programmes with the aim of consolidating their scientific capacities and contributing to their international leadership". Among the 120 research centers of CSIC, 11 have been accredited as Centers of Excellence "Severo Ochoa" and 4 as Units of Excellence "María de Maeztu. IFISC was the first and only awarded center in the Balearic region.



All distinguished centers and units stand out for the international impact of their scientific contributions, their postgraduate training 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, receive a total funding of 2,000,000 Euros during four years, several contracts for pre-doctoral researchers, and access to funding sources restricted to these units of excellence.

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



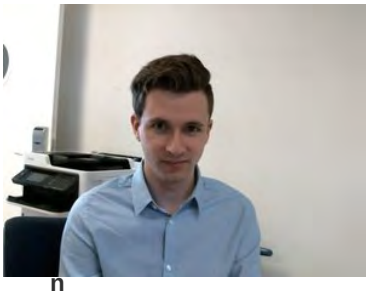
Complex systems can efficiently perform multitude of tasks utilizing very different substrates and a wide variety of network topologies and non-linearities*. Characterizing and understanding information processing in and by complex systems, from both fundamental and practical perspective, is a challenging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

IFISC – MdM PERSONNEL

All **IFISC researchers** contribute to the MdM scientific program, highlighting the institute´s goal of establishing a working environment that seeks coherence and integration from diversity, interactions and scientific dialogue.

Personnel that has been hired during 2020 within the MdM program:

POSTDOCTORAL RESEARCHERS:



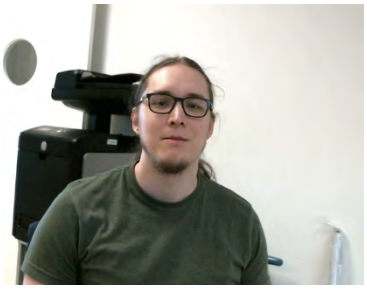
n

André Röhm

Sungguen Ryu

Luíño F. Seoane

Giulia Ruzzene

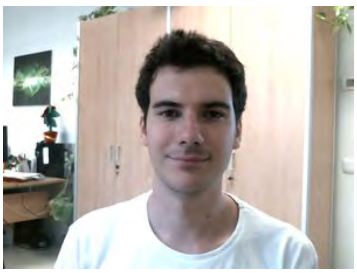


Johannes Nokkala

Christos Charalambous

Andrea Tabi

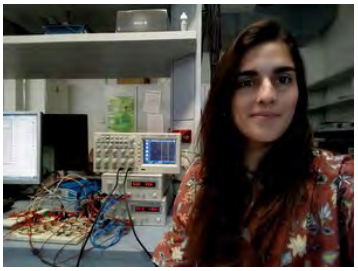
PHD STUDENTS:



Javier Aguilar

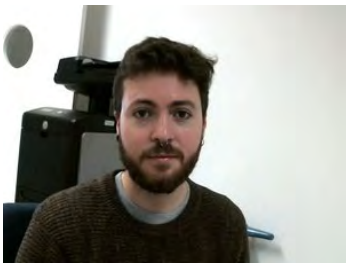
Violeta Calleja

Marco Cattaneo



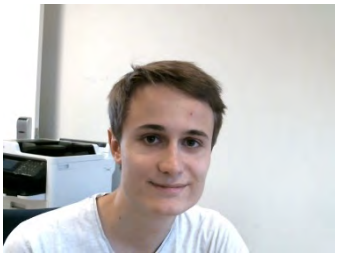
Irene Estébanez

Rodrigo Martínez



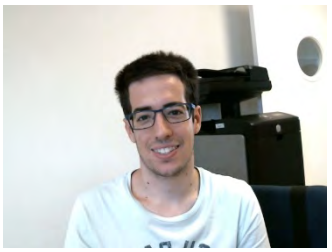
Jaime Sánchez

Giovanni Donati



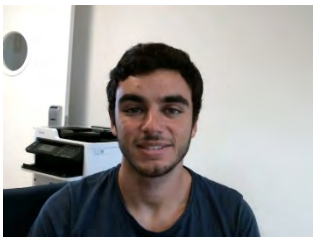
Thomas Louf

Maria Martínez Barbeito



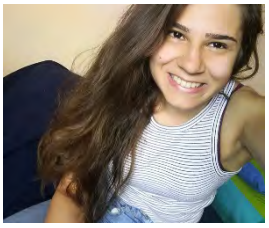
Alejandro Almodóvar

Beatriz Arregui



Javier Galván

Jorge Medina



Annalisa Caligiuri

PROJECT MANAGER: **Simona Obreja**

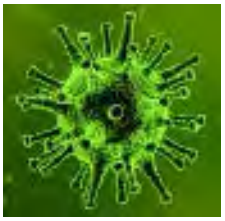
COMMUNICATION: **Adrian García**

COMPUTING LAB TECHNICIAN: **Eduard Solivellas**

IFISC and the SARS-COV-2 PANDEMIC

https://ifisc.uib-csic.es/en/about-ifisc/ifisc-and-sars-cov2/

During this pandemic year IFISC has continued as much as possible with its normal research activities adapted to CSIC and UIB sanitary regulations for on-site and remote work. There has been an intense program of on-line meetings and seminars to continue with a high level of interaction among IFISC researchers. In addition, and as a public research institution, IFISC has paid attention to this very socially relevant situation and devoted a significant part of its resources, know-how and research efforts to the SARS-COV-2 PANDEMIC. These main activities, summarized here, include:



1. Research Projects
2. Reports and Expert Advice
3. Local Health Data and Collaborations
4. Specific Human Resources for COVID studies
5. Scientific Publications
6. Communication and Outreach

1. Research Projects

Project DISTANCIA-COVID funded by CSIC and AENA. General Project Coordinator: Jose J. Ramasco (IFISC)

The project analyzes the effects of mobility restriction and social distancing measures on the spread of the disease using computational techniques and artificial intelligence for massive data analysis. Also participating: CEAB (Center for Advanced Studies of Blanes), IFCA (Institute of Physics of Cantabria), IEGD (Institute of Economy, Geography and Demography), CNB (National Center for Biotechnology), UPF (Pompeu Fabra University), National Center for Epidemiology and the companies Kido Dynamics, Telefónica and ESRI.

https://ifisc.uib-csic.es/en/research/projects/distancia-covid/
https://distancia-covid.csic.es/

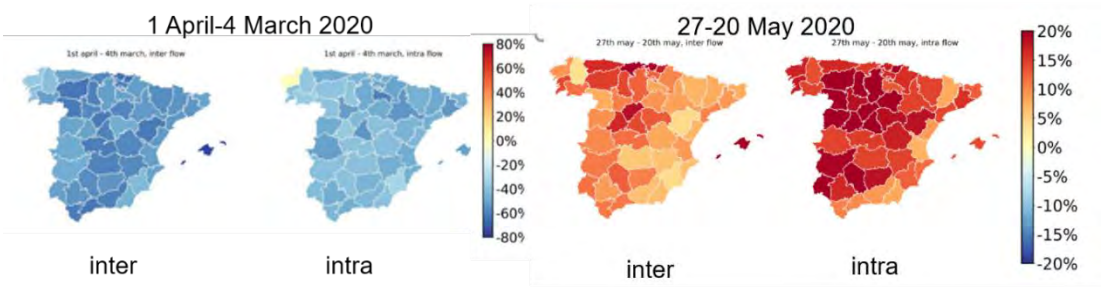
The Project is part of the CSIC Global Health Platform COVID19.
https://pti-saludglobal-covid19.corp.csic.es/

Project COVID-SHINE: Understanding the spatio-temporal social determinants of health.

Project funded by “la Caixa” Banking Foundation Social Research (2021-22) IP: Joan Benach (Pompeu Fabra University). IP at IFISC: V. M. Eguíluz.

2. Reports and Expert Advice

2.1 Weekly reports on inter- and intra-provincial mobility in Spain and at the municipal level in the Balearic Islands in response to confinement measures. These reports are part of the DISTANCIA-COVID project and have been made available to the Government of Spain and the Balearic Islands Government.
http://analytics.ifisc.uib-csic.es/es/respuesta-covid-19/



2.2 J. Ramasco (IFISC) is member of the COVID-19 16 people expert group advicing the Science and Innovation Ministry:

https://www.lamoncloa.gob.es/serviciosdeprensa/notasprensa/ciencia-e-innovacion/Paginas/2020/220420-grupo-covid.aspx

GOBIERNO DE ESPAÑA MINISTERIO DE CIENCIA E INNOVACIÓN

Reports of this multidisciplinary group are available in:

https://www.ciencia.gob.es/portal/site/MICINN/menuitem.26172fcf4eb029fa6ec7da6901432ea0/?vgnextoid=2dcef74a14052710VgnVCM1000001d04140aRCRD

https://digital.csic.es/handle/10261/2867

2.3 Participation in the advisory groups of the Government of the Balearic Islands on digital media against the pandemic and the fight against new outbreaks.

GOVERN ILLES BALEARS

3. Local sanitary data and collaborations.

3.1 Agreement with the Hospital de Son Espases (Dr. Joan Albert Pou) for the use of anonymized health records of COVID patients. IFISC Responsible: Claudio Mirasso.

3.2 Anonymized emergency records of the Son Llatzer Hospital for the completion of Ms. Laura Aviñó's master's thesis (2020) (Directors: Raúl Toral, Claudio Mirasso, Ángel del Río (Son Llatzer))

4. Specific Human Resources for COVID studies

4.1 **Postdoctoral researcher contract** (2021-2022) of Juan Fernández-Gracia funded by the Balearic Government to develop the Project FINE: Forecasting the spread and Inequalities of Epidemics. The project develops a model that includes time scales from days to seasons and includes SARS-COV2 variables of type i) demographic and socioeconomic, ii) environmental and iii) biological, ecological and evolutionary.

4.2 **Predoctoral researcher contract** of Beatriz Arregui, researcher contract under the María de Maeztu Excellence Unit of the IFISC for the development of epidemiological models. Ms. Aguirre comes from the Pierre Louis Institute of Epidemiology and Public Health - INSERM in Paris.

4.3 Master Thesis

Aviñó, Laura
Analysis and simulation of a Palma de Mallorca hospital emergency department
Supervisors: Raúl Toral, Claudio Mirasso, Ángel del Río (2020)

5. Scientific Publications:

A flexible load sharing system optimising ICU demand in the context of COVID-19 pandemic
Lucas Lacasa, Robert Challen, Ellen Brooks-Pollock, Leon Danon
PLoS ONE 15, e0241027

Vector-borne epidemics driven by human mobility
Soriano-Paños,David; Arias-Castro,Judy Heliana; Reyna-Lara,Adriana; Martínez,Hector J.; Meloni,Sandro; Gómez-Gardeñes,Jesús;
Physical Review Research 2, 013312 (1-12)

Risk of secondary infection waves of COVID-19 in an insular region: the case of the Balearic Islands, Spain
Eguíluz,Victor M; Fernández-Gracia,Juan; Rodríguez,Jorge P; Pericàs, Juan M; Melián, Carlos J
Frontiers in Medicine 7, 563455

A minimal model of hospital patients' dynamics in COVID-19
Papo,David;Righetti,Marco;Fadiga,Luciano;Biscarini,Fabio;Zanin,Massimiliano
Chaos, Solitons & Fractals 140, 110157

Assessing functional propagation patterns in COVID-19
Zanin, Massimiliano; Papo, David
Chaos, Solitons & Fractals 138, 109993

Travel restrictions during pandemics: A useful strategy?
Zanin, Massimiliano; Papo, David
Chaos 30, 111103

COVID-19: Predicción de eventos de hospitalización en UCI / muerte usando registros médicos de atención y herramientas de aprendizaje automático
Khajuria, T.; Pou Goyanes, J. A.; Mirasso, C. R.; Vicente, R.
Medicina Balear 35, 25-27

Movilidad durante la pandemia
Mazzoli, Mattia; Ramasco, Jose J.
Medicina Balear, 2020; 35 (4): 30-33

Análisis de Riesgo de Segunda Ola de COVID-19 en las Islas Baleares
Eguíluz, Victor M.; Fernandez-Gracia, Juan; Rodriguez, Jorge P.; Pericàs, Juan M.; Melian, Carlos
Medicina Balear 2020; 35 (4): 27-30

Preprints

A population-based controlled experiment assessing the epidemiological impact of digital contact tracing
Rodríguez, P., Graña, S., Alvarez-León, E.E. et al.
Nature Communications, to appear

Effects of mobility and multi-seeding on the propagation of the COVID-19 in Spain
Mattia Mazzoli; David Mateo; Alberto Hernando; Sandro Meloni; Jose J. Ramasco
MedRxiv: ***http://dx.doi.org/10.1101/2020.05.09.20096339***

Impact of urban structure on COVID-19 spread
Aguilar,Javier; Bassolas,Aleix; Ghoshal,Gourab; Hazarie,Surendra;Kirkley,Alec;Mazzoli,Mattia;Meloni,Sandro;Mimar, Sayat; Nicosia,Vincenzo; Ramasco, Jose Javier; Sadilek, Adam;
https://arxiv.org/abs/2007.15367

A comparative study between the first and second waves of COVID-19 in the Balearic Islands using machine learning on electronic health records
Khajuria, T.; Pou Goyanes, J. A.; Mirasso C.; Vicente. R.

6. Communication and outreach

6.1 **Dissemination Activities**

Efecto de la COVID-19 en Baleares: un estudio interdisciplinar
Mirasso, C. R. Ed.
MEDICINA BALEAR - ESPECIAL COVID 19 35, 24-33

Por qué es difícil controlar brotes epidémicos en un mundo que se mueve tanto
Meloni, Sandro
The Conversation

Jose J. Ramasco participated in the **Webinar** on prevention and de-escalation in the context of Covid-19:

https://ifisc.uib-csic.es/en/news/ifisc-uib-csic-researcher-will-participate-webminar-prevention-and-de-escalation-context-covid-19/

6.2 Press releases:

- https://ifisc.uib-csic.es/en/news/ifisc-uib-csic-participates-csic-strategy-stop-covid-19/
- https://ifisc.uib-csic.es/en/news/ifisc-uib-csic-participates-csic-strategy-stop-covid-19/
- https://ifisc.uib-csic.es/en/news/how-confinement-measures-have-affected-mobility-balearic-islands/
- https://ifisc.uib-csic.es/en/news/mobile-data-study-containment-effectiveness-covid19-dispersion/
- https://ifisc.uib-csic.es/en/news/ifisc-researcher-jose-ramasco-part-group-advising-government-covid-19/
- https://ifisc.uib-csic.es/en/news/ifisc-uib-csic-researcher-will-participate-webminar-prevention-and-de-escalation-context-covid-19/
- https://ifisc.uib-csic.es/en/news/survey-impact-social-distancing-measures-covid-19-epidemic-spain/
- https://ifisc.uib-csic.es/en/news/second-survey-covid19/
- https://ifisc.uib-csic.es/en/news/usefulness-restricting-mobility-during-pandemics/
- https://ifisc.uib-csic.es/en/news/algorithm-help-relieve-pressure-hospital-network-during-pandemic/
- https://ifisc.uib-csic.es/en/news/ifisc-publishes-monograph-covid-19-pandemic-medicina-balear-journal/
- https://ifisc.uib-csic.es/en/news/experimental-evidence-radar-covid-application/

1.4. IFISC SERVICE UNIT: DataAnalytics@IFISC

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.

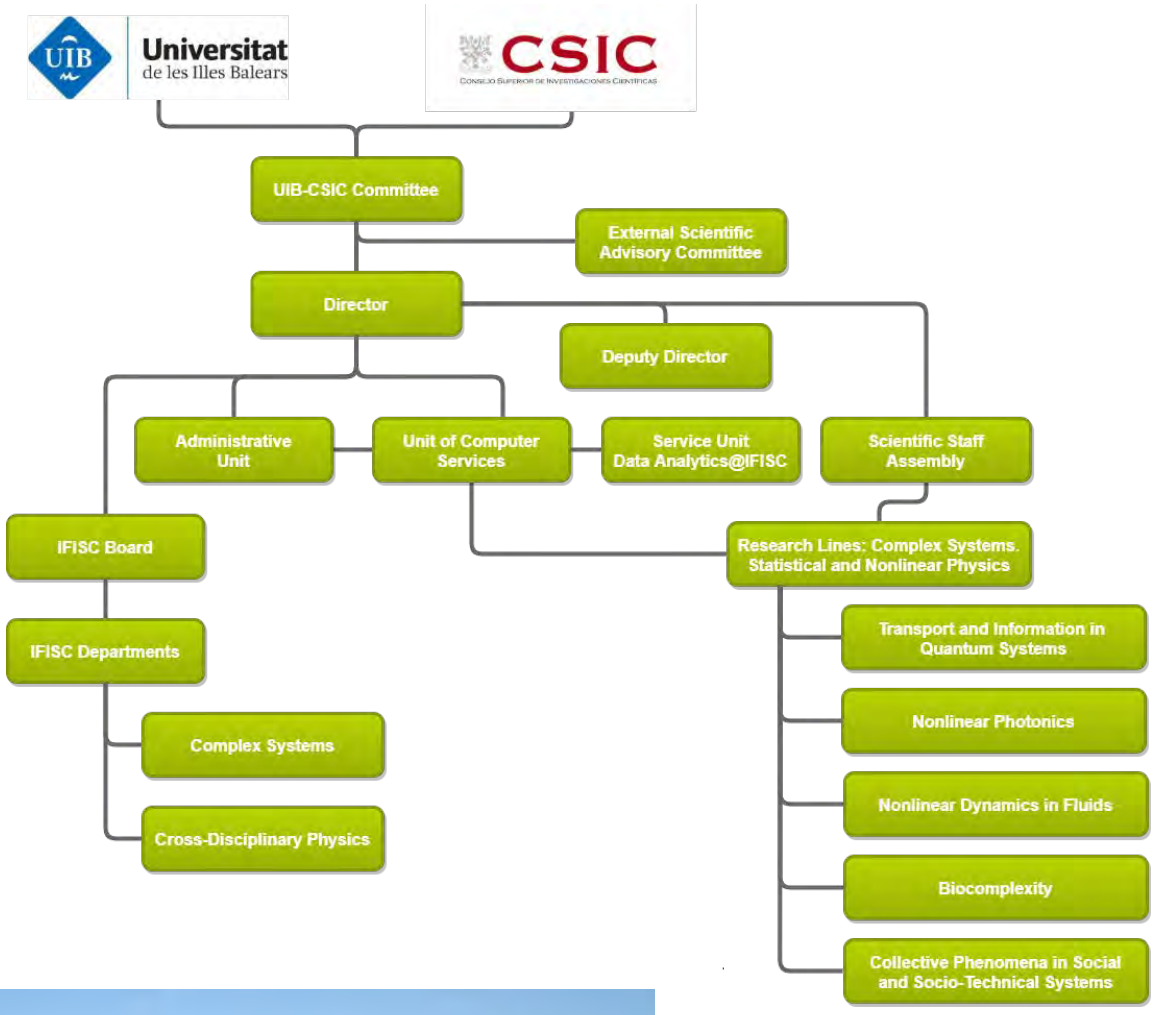
IFISC know-how includes analysis of data from social networks, mobile phone and credit card records, transport networks at the urban scale, air transport, census and surveys, electoral results in the space, electrocardiograms, electro and magneto encephalograms, marine currents and animal populations. 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

1.5 IFISC STRUCTURE CHART



1.6 2020 REPRESENTATIVE RESEARCH RESULTS

Here are some research results published during 2020. They are representative of the different research lines and thus illustrate the range of topics studied at IFISC.

Binary-state dynamics on complex networks: Stochastic pair approximation and beyond

Antonio F. Peralta, Raúl Toral

Physical Review Research **2**, 043370

Theoretical approaches to binary-state models on complex networks are generally restricted to infinite size systems, where a set of non-linear deterministic equations is assumed to characterize its dynamical and stationary properties. Although the deterministic approach gives us relevant information in all situations, it is an accurate description only in the strict infinite system size limit. Depending on the model, the variables chosen, the values of the parameters and the network, the difference between the deterministic approach and the numerical results may be very important on finite networks[1]. Stochastic effects may become relevant even for extremely large system sizes, specially if the system is close to a critical point, or the network has high degree heterogeneity. Besides, there are some models where the deterministic approach does not provide the relevant information sought. The main aim of this work is to give a general theoretical approach to binary-state models on complex networks that takes into account stochastic effects, going beyond incomplete deterministic approaches. In a previous reference [2] this was done but only for the pair approximation, what we called stochastic pair approximation (SPA), and focusing mainly on the noisy voter model. In this work we have considered the stochastic version of all compartmental approaches, in a more general formulation and applied them to several models. In particular, we have developed the stochastic formalism for the approximate master equation (AME), pair approximation (PA) and heterogeneous mean field (HMF), in descending order of accuracy [3]. The stochastic formalism allows us to enlarge the range of validity and applicability of compartmental approaches. This includes: (i) the possibility of studying the role of the size of the system in the different phenomena reproduced by the models together with network structure, (ii) to obtaine the finite-size scaling functions and critical exponents of the macroscopic quantities, and (iii) the extension of the rate description to a more general class of models. In general, see Figure 1, we can highlight that the probabilistic description using the AME gives very accurate results for stationary, but also for time-dependent results.

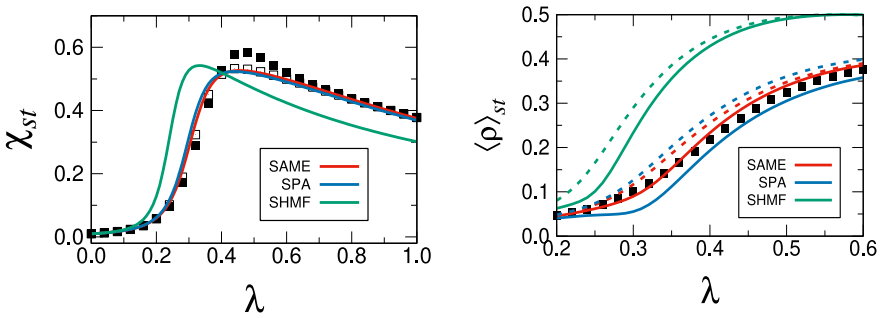


Figure 1: (left) Stationary susceptibility χ and (right) average density of active links ρ as a function of the transmission rate λ for the SIS (Susceptible-Infected-Susceptible) model in a scale-free network with a power-law degree distribution $P_k \div k^{-2.5}$ for $2=k_{min}\leq k\leq k_{max}=10$. Points correspond to numerical simulations of the model with number of agents N=100 (solid squares) and N=400 (empty squares) averaged over an ensemble of 100 networks. Lines of different colors are the theoretical prediction of the different approximations. In the left panel the solid lines are the predcictions of the van Kampen system-size expansion, while in the right panel the dashed lines are the deterministic approaches and the solid lines the corrected average values using stochastic version of the different approximations: Approximate master equation (SAME), Pair approximation (SPA) and Heterogenous Mean-field (SHMF).

References

[1] C. Castellano, R. Pastor-Satorras. Non- mean-field behavior of the contact process on scale-free networks. Phys. Rev. Lett. **96**, 038701 (2006).

[2] A. F. Peralta, A. Carro, M. San Miguel, and R Toral. Stochastic pair approximation treatment of the noisy voter model. New Journal of Physics **20**,103045, (2018).

[3] James P. Gleeson. Binary-state dynamics on complex networks: Pair approximation and beyond. Phys. Rev. X **3**, 021004 (2013).

Andreev-Coulomb drag in Coupled Quantum Dots

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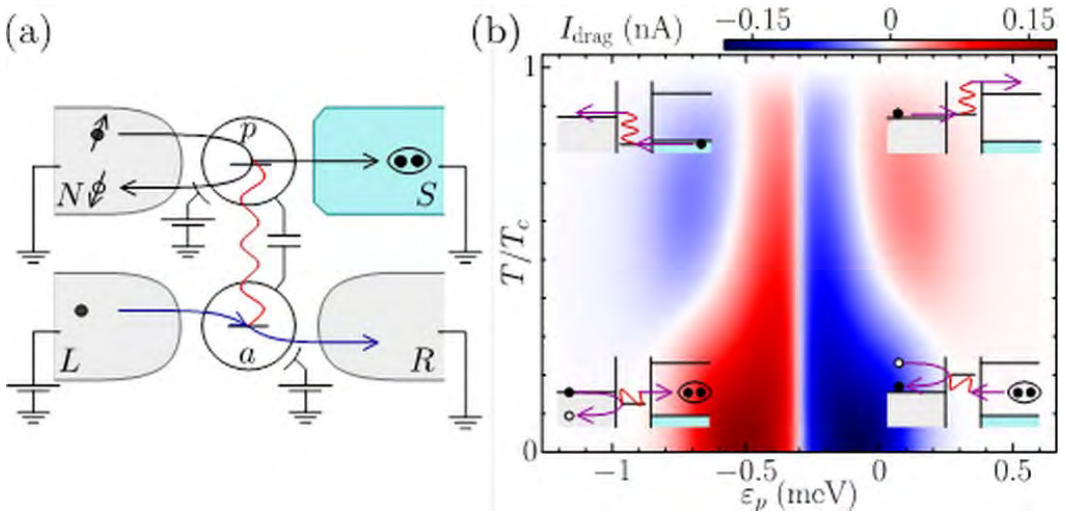
Phys. Rev. Lett. 125, 247701

Coulomb drag is an effect of fundamental interest in nanoscale physics arising from the combined interplay of fluctuations and interactions. It appears as a spectacular consequence of broken symmetries and correlations as a measurable current in an equilibrium conductor [the passive subsystem labeled as *p* in panel (a) below] under the influence of a nearby voltage-biased conductor (the active subsystem labeled as *a*). With very few exceptions, research activity has thus far focused on conductors coupled to metallic (normal) reservoirs. In our work, we consider the case of a hybrid conductor coupled to both a normal and a superconducting reservoir. Our results are to our knowledge the first obtained with normal-superconducting quantum dots in the drag regime. This setup is of utmost interest in studies on Andreev reflection, where an electron is transformed, upon tunneling from a normal lead (labeled as *N* in the figure), into a Cooper pair in the superconductor (labeled as *S* in the figure). This allows for many-body quantum superposition states in the dot, which have a strong impact in the drag physics, as our calculations demonstrate. Whereas drag currents in normal coupled dot systems are determined by rather uncontrolled energy-dependent tunnel asymmetries, we find that the Andreev-Coulomb drag gives rise to more robust signals [see the drag currents in panel (b) below] that can be significantly manipulated with external parameters (gate voltages as in the figure, temperature or pairing coupling). Thus, we believe that our proposal can be easily realized with present experimental techniques.

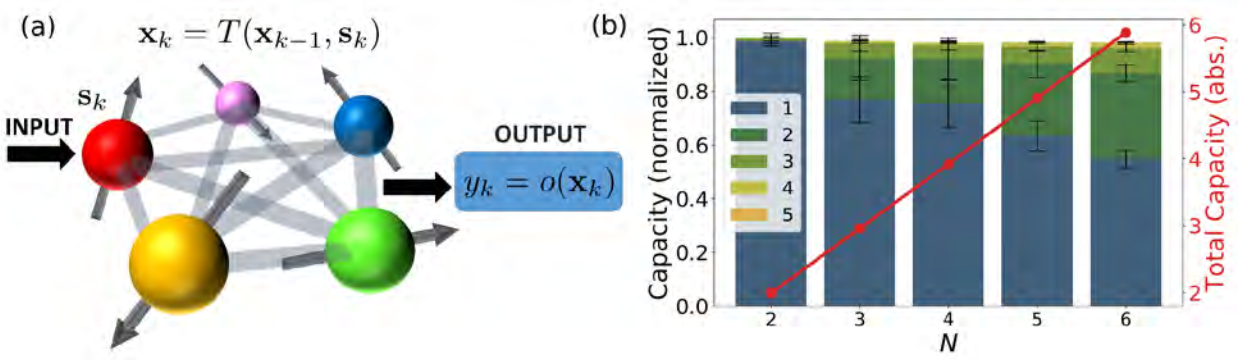
The Coulomb drag effect is nowadays also explored for its application to energy harvesting and heat management in quantum conductors. Since quantum dots can serve as qubit platforms and coupled nanoconductors can work as ultrasensitive charge sensors, our proposal is also of interest for the investigation of quantum backaction effects. Finally, the system we consider has analogies with the ratchet effect, which would raise questions on the role of pair tunneling in quantum thermodynamics theories.



Information processing capacity of spin-based quantum reservoir computing systems

Rodrigo Martínez-Peña, Johannes Nokkala, Gian Luca Giorgi, Roberta Zambrini and Miguel C. Soriano
Cognitive Computation, pages 1–12

Reservoir Computing (RC) is a promising line of research in the machine learning field that exploits dynamical systems to process input information, most adequate for performing temporal tasks. Quantum Reservoir Computing (QRC) was introduced as a possible extension of this computing paradigm to the quantum regime, exploiting the large number of accessible degrees of freedom even with a few physical elements. In our work, we focus on the quantitative characterization of the task-independent capabilities of this QRC model by employing the Information Processing Capacity (IPC). This is a measure of both the linear and nonlinear memory displayed by the system, with the nonlinearity assessed in terms of polynomial degrees. The main goal of this work is to establish the influence on the IPC of different aspects of computational importance such as the input injection frequency, time multiplexing, and additional measured observables encompassing local spin measurements as well as correlations. We find conditions for an optimum input driving and provide different alternatives for the choice of the output variables used for the readout. In particular, we quantify the advantage offered by the quantum approach in an enlarged space of degrees of freedom considering different local and non-local observables.



Schematic representation of a reservoir computing system with a network of 5 quantum spins. (b) IPC versus the number of spins N. The parameters are the strength of the external magnetic field h=1, the strength of the random coupling J_s=1 and the temporal distance between consecutive inputs Δt=10. We normalize the IPC respect to the theoretical maximum capacity (number of output variables, here N), including the behaviour of the total capacity in absolute value (red line) to stress that the capacity of the system increases with the number of observables in the output. The error bars of the plot correspond to the standard deviation over 10 realizations. Different colors in the bar, as shown in the legend, indicate the different degree contributions to the IPC.

More in detail, we focus on the transverse-field Ising model to study a quantum spin network of N randomly coupled spins in the presence of an external magnetic field. We apply the QRC protocol scheme represented in Fig. 1 (a), introducing the classical inputs into the system through one of the spins and rewriting its state every Δt=10. Information is extracted from the quantum system by measuring a set of observables, like the projection of the spins over the z-axis, $\langle\sigma^z_i\rangle$. As an example, we show in Fig. 1 (b) the IPC respect to the number of spins N using the set of observables $\langle\sigma^z_i\rangle$. The IPC quantifier tells us how well a reservoir approximates nonlinear polynomials of a given degree d_i as functions of the input sequence. In addition, the theoretical analysis of the IPC states that the upper bound of this total capacity can only be reached when the dynamical system dissipates the information about the input in time, i.e. when it has fading memory. Figure 1 (b) displays the contributions to the IPC corresponding to different degrees for different system sizes. For the selected parameters, the total memory is always saturated and increases linearly with the system size, corresponding to the number of spins/z-observables. Interestingly, nonlinear contributions show up when we increase the number of spins. This indicates that the system complexity increases with increasing network sizes. Here, we have shown results up to 6 output variables, but an important property of spin-based QRC systems is that they have a large number of available degrees of freedom even if the reservoir is made of only a few spins. Our work highlights the computational capabilities of a quantum network of spins for reservoir computing and the possibility to access the high dimensional space of the spin-based QRC system, paving the way for future practical implementations of quantum reservoir computers.

Accelerating photonic computing by bandwidth enhancement of a time-delay reservoir

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Nanophotonics 9, 13, 4163-4171

Semiconductor lasers (SLs) that are subject to delayed optical feedback and external optical injection have been demonstrated to perform information processing using the photonic reservoir computing paradigm [1]. Optical injection or optical feedback can under some conditions induce bandwidth-enhanced operation, expanding their modulation response up to several tens of GHz [2]. However, these conditions may not always result in the best performance for computational tasks, since the dynamical and nonlinear properties of the reservoir might change as well. In this work we have shown that by using strong optical injection we can obtain an increased frequency response and a significant acceleration in the information processing capability of this nonlinear system, without loss of performance. Specifically, we have demonstrated numerically that the sampling time of the information injection to the photonic reservoir can be as small as 12ps, while preserving the same computational performance when compared to a slower sampling rate (100ps). Bandwidth enhancement is a necessary condition to generate fast transient states with sufficient amplitude; however, it is not a sufficient condition to achieve good reservoir computing performance. Our approach to achieve both attributes is by varying the strength and the frequency detuning of the optical carrier that introduces the information to be processed by the time-delay reservoir.

We have concluded that strong optical injection expands the reservoir's operating conditions for which we obtain improved task performance. This was validated also experimentally for larger sampling times of 100 ps in a signal recovery optical communications task, originating from a 170km fiber transmission system with coherent detection and QPSK modulation. The bandwidth enhanced operation of the time-delay reservoir computer acts in this case as as a nonlinear distortion equalizer. As shown in Figure 1, strong optical injection yields a lower error rate for many operating conditions of the reservoir. However, we find the minimum error rate to be the same for both moderate and strong injection, equal to log(BER) = −2.8.

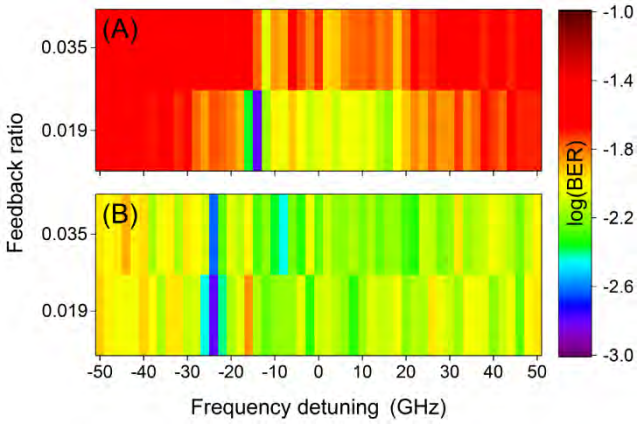

Figure 1. Bit error rate performance of the data recovery after post-processing with an experimental photonic reservoir, for a slow transient reservoir operation with sampling information injection time of 100ps, versus frequency detuning Δf, for two different feedback ratio values of the time-delay reservoir and for (A) moderate (0.125 mW) and (B) strong (0.5 mW) optical injection power.

References

[1] K. Hicke, et al. "Information processing using transient dynamics of semiconductor lasers subject to delayed feedback." IEEE J. Sel. Top. Quantum Electron. **19**, 4, 1501610 (2013).

[2] T. B. Simpson, J. M. Liu, and A. Gavrielides, "Bandwidth enhancement and broadband noise reduction in injection locked semiconductor lasers," IEEE Phot. Technol. Lett. **7**, 7, 709–711 (1995).

Classical analogies for the force acting on an impurity in a Bose-Einstein condensate

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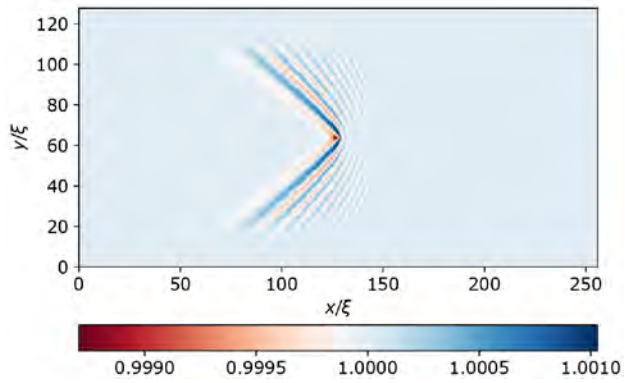
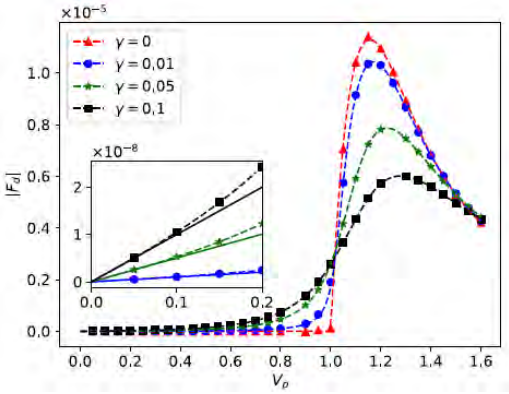
New Journal of Physics 22, 073018

The hydrodynamics of quantum fluids, i.e. gases or liquids composed of particles that exhibit strong quantum coherence, is a topic of major fundamental and applied interest. In particular, much effort is devoted in understanding the nature of quantum turbulence and its relation with its classical counterpart. Fluid velocity fields, accelerations, etc. are usually measured by suspending in the fluid impurities of different types (from atoms and electrons to bubbles and small particles) and analyzing their motion. A proper analysis requires stablishing the equation of motion of the impurity in the presence of the diverse forces exerted by the fluid.

In classical fluid dynamics, determining the forces acting on a small particle immersed in a moving fluid is a long-standing problem, going back to Stokes (1856). It only became relatively well understood, under particular circumstances, after the contributions of Maxey and Riley (1983). These results have been applied to quantum hydrodynamics by considering the fluid as a mixture including a zero-viscosity component. The validity of this approach requires that moving impurities are much larger than typical quantum correlation lengths, as is the case in superfluid liquid helium. But the increasing availability of ultracold gases forming Bose condensates, for which quantum coherence lengths can be larger than test impurities, requires a different approach.

In this work we have modeled a Bose condensate in terms of a finite-temperature version of the Gross-Pitaevskii equation, and derived expressions for the forces acting on submerged particles in several situations, with emphasis on the comparison with the case of classical fluids. For example, quantum-pressure effects appear in a manner similar to finite-particle-size effects in the classical case. A Stokes-like friction is present at non-zero temperature, and the dominant mode of dissipation at large velocities is sound emission.





Left: The density of a Bose condensate perturbed by the wake of a particle moving supersonically.

Right: Force on a small particle moving at constant speed *Vp* (in units of the speed of sound) at different temperatures (proportional to γ).

On the Role of Theta Oscillations in the Hippocampus During Memory-Guided and Novelty Tasks

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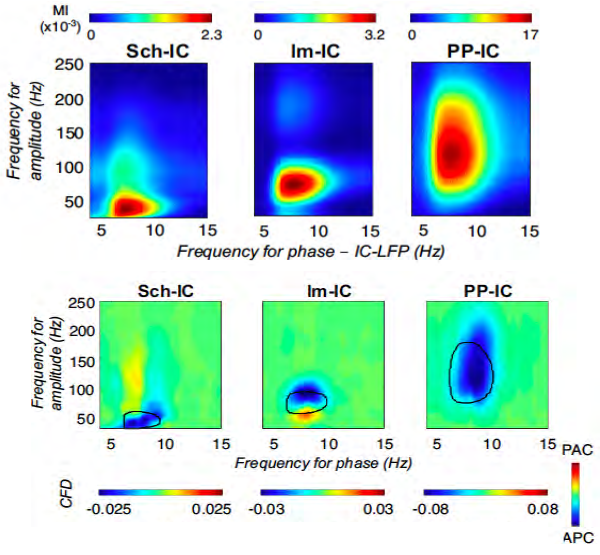
eLife 2020; 9: e57313

Hippocampal firing is organized in theta sequences controlled by internal memory processes and by external sensory cues, but how these computations are coordinated is not fully understood. Although theta activity is commonly studied as a unique coherent oscillation, it is the result of complex interactions between different rhythm generators. Here, by separating hippocampal theta activity in three different current generators, we found epochs with variable theta frequency and phase coupling, suggesting flexible interactions between theta generators. We found that epochs of highly synchronized theta rhythmicity preferentially occurred during behavioral tasks requiring coordination between internal memory representations and incoming sensory information. In addition, we found that gamma oscillations were associated with specific theta generators and the strength of theta-gamma coupling predicted the synchronization between theta generators. We propose a mechanism for segregating or integrating hippocampal computations based on the flexible coordination of different theta frameworks to accommodate the cognitive needs.

Contrary to a generalized view in the field, our results provide functional evidence supporting the existence of independent theta oscillations in the hippocampus whose coordination can be seen as a mechanism to channel information between hippocampal layers. In addition, it provides a mechanism to bidirectionally regulate interactions in a complex network. Synchronized theta states may bind distributed computations (integration), while less synchronized theta states may secure relatively independent processing in local circuits (segregation).

Moreover, since gamma activity is nested to the theta cycle, our result on independent theta oscillations opened the possibility to multiple theta-gamma interactions. Indeed, while a conventional approach to the analysis of theta-gamma phase-amplitude Cross-Frequency Coupling (CFC) identified the typical coupling between CA1 theta and a slow gamma band of CA3 and a medium gamma band of EC3 origin, our analysis further revealed a theta-nested fast gamma band (130 Hz,) in the mid- molecular layer of the Dentate Gyrus overlapping the terminal field of EC2 inputs (see top panel of the figure). We further demonstrated that maximal CFC is quantified when local activities are paired (i.e. theta from the Schaffer generator with low gamma activity of the same generator) further supporting the functional relevance of the discovered theta frameworks. Interestingly, when computing the cross-frequency directionality index we found a predominant gamma-to-theta interaction (see lower panel of the figure). This gamma amplitude to theta phase directionality is given by the consistent anticipation of the gamma activity to the theta phase.

Overall, our results unveil a complex organization of multiple theta activities and layer-specific oscillations that provide a flexible mechanism to route information in the hippocampus.



Theta-gamma coupling reflects pathway-specific interactions. Top panel: Modulation strength (color coded Modulation Index (MI) of gamma amplitude (30–250 Hz) in the Independent Components-LFPs. Lower panel: Cross-Frequency Directionality analysis of the pathway-specific signals demonstrates maximum negative values (APC) for those pairs of theta-gamma oscillations with the highest Cross-Frequency Coupling (encircled area).

Mitochondria interaction networks show altered topological patterns in Parkinson's disease

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NPJ Systems Biology and Applications, 6, 38

Mitochondria, the key organelles regulating cellular metabolism and generating cellular energy, are involved in a plethora of diseases (most of which we probably still don't know of) and their disfunction can cause different types of symptoms in the muscle, in the brain and in other organs. Mitochondrial dysfunction is linked to the pathogenesis of Parkinson's disease (PD); however, individual mitochondria-based analyses have yet to show a uniform feature in PD patients. Since mitochondria interact with each other, in this work we hypothesize that PD-related features might exist in topological patterns found within these mitochondria interaction networks.

We started by collecting a large number of high-resolution 3D mitochondrial immunofluorescence images, which were used by a custom developed software to detect the position of individual mitochondrion within a cell. From this we extracted network adjacency matrices of mitochondria interactions, in which mitochondria branch points were represented as nodes, with an undirected link being present if an interaction is observed between a pair of nodes at the imaging moment. This allowed us to focus the problem from a network science perspective, and to further apply machine learning techniques to evaluate the differences between groups of people. Specifically, we applied this technique to the ganglia from the ascending (left) and descending (right) colon collected from idiopathic PD patients and healthy controls, and to a collection of cells manipulated through the CRISPR/CAS9-based genome editing tool.

The results, synthesised in Fig. 1, show a heterogeneous and complex picture. We found remarkable pattern differences in the networks of enteric ganglia of sporadic PD patients vs. healthy controls. Furthermore, particular network metrics were highly correlated with PD clinical scores, indicating a potential of using particular network features for early diagnosis and basic research purposes of PD. Excitingly, with network topological features alone, we can already accurately distinguish PD patient from healthy controls. This discovery opens a door to a new type of biomarkers leveraging on network science.

Tissue	Comparisons	subnetwork size Power-law distribution	Diameter	Efficiency	ASPL				
Colon ganglia	iPD vs. control	↑	↑	↓	↑	↓	↑	↓	↓
iPSC-based midbrain DANs	SNCA vs. control	↑	↓	↑	↓	↑	↓	↑	↑
	SNCA vs. A30Pgc	—	↓	↑	↓	↑	↓	↑	↑
	SNCA triplication vs. control	↓	↓	↑	↓	↑	↓	↑	↑
	RHOT1 vs. control	↑	↓	↑	↓	↑	↓	↑	↑
	VPS35 vs. control	↓	↓	↑	↓	↑	↓	↑	↑
	VPS35 vs. control (oxidative stress)	—	↓	↑	↓	↓	↑	↓	↓

Fig. 1. Summary table, with the changes observed in different network metrics in different types of PD samples. Red upward arrow indicates an enhanced feature, while the green downward arrow designates a reduction in the given network feature. Horizontal line indicates no clear change between the compared groups. iPD idiopathic PD, ASPL average shortest path length.

Dispersal-induced instability in complex ecosystems.

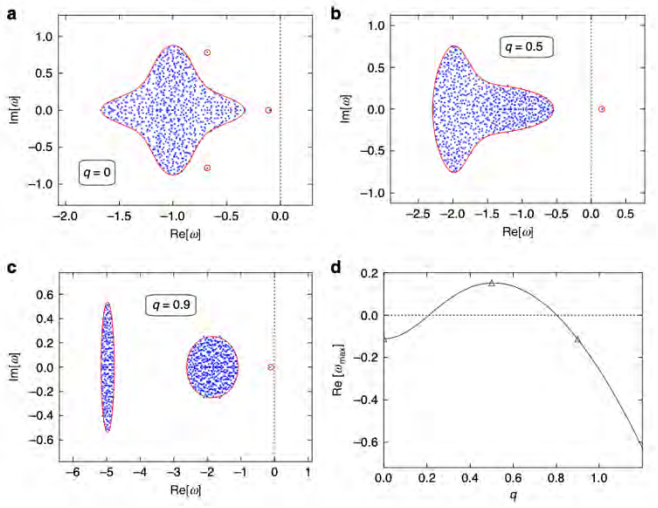
Baron, Joseph W.; Galla, Tobias
Nature Communications 11, 6032

Ecosystems are one of the paradigmatic examples in complex systems science. A large number of species interact with each other, for example by feeding upon each other, competing for the same resources, or by collaborating. The interactions between species are crucial to determine whether there will be a stable equilibrium for the ecological community, or whether possible collapse can occur reducing biodiversity. The interactions between species are however not the only factor deciding this. Other aspects include for example the distribution of species in space, or influences by the environment.

The late Lord Robert May, one of the fathers of chaos theory and a pioneer in theoretical biology, used a statistical model in the 1970s to show that complexity can reduce the stability of ecosystem. May asserted that large communities are more likely to change when disturbed.

In our work we expand on May's model to explore the role of dispersion in space as a destabilizing factor in ecosystems. We combine May's ideas with the seminal work by Alan Turing, who showed how dispersion can destabilize a dynamic system. We start with an ecosystem at a homogeneous equilibrium, and show that dispersal can make such an equilibrium unstable when there is trophic structure in the population, i.e., if there are groups of predator and prey species. These spatial instabilities are detected from the eigenvalue spectra of the relevant community matrices for perturbations of wavenumber q. An example is shown in the figure (panels a-c show eigenvalue spectra at different wavenumbers, panel d is the rightmost eigenvalue as a function of q). Conversely, we also observe that increased complexity can lower the threshold for the diffusion coefficients required for a Turing instability. So complexity not only reduces stability in a non-spatial model as was May's conclusion, but it also destabilises spatial models with dispersal.

May's original findings – complex ecosystems are more likely to be unstable – were controversial at the time, and still are today. His work started the so-called `diversity-stability debate'. Critics argue that adding more realistic features to May's model could remove the bound on complexity required for stability. One results of our study is that adding to May's model opens up new ways in which equilibria can become unstable, and we therefore think that it is unlikely that more realism will remove the limit on complexity that can be sustained in equilibrium.

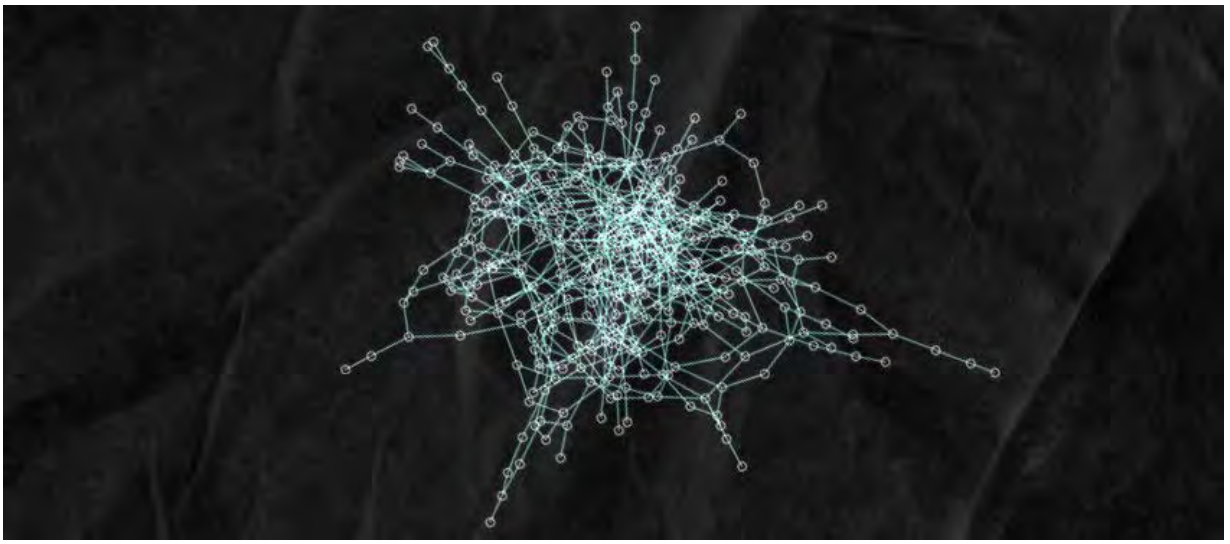


Effects of demand control on the complex dynamics of electric power system blackouts

Benjamin A. Carreras, Eder Batista Tchawou Tchuisseu, José M. Reynolds-Barredo, Damià Gomila, and Pere Colet
Chaos 30, 113121

Power plants generate electricity and send it into power lines that distribute energy to nodes, or sites, where it can be used. But if the electricity load is more than the system's capacity, transmission can fail, leading to a cascade of failures throughout the electric grid. This domino effect was responsible for the largest blackout in U.S. history in 2003, which left 55 million Americans and Canadians without power at an estimated cost of $6 billion. An even larger blackout in 2015 affected 57 million people in Italy. Blackouts cause ripple effects throughout the economies they affect, and they can be dangerous for people depending on electronics in hospitals.

While typically blackouts models are intended for years-long evolution of the power grid with a basic time scale of one day, demand fluctuations require of faster time scales for a proper analysis. The progressive reduction of conventional power plants in benefit of renewable sources introduces generation fluctuations on top of those intrinsic to demand, while overall system's inertia and control capability are reduced. A way to cope with that is the use of demand management techniques. This work addresses the integration of fast fluctuations and demand control in a prototypical model for blackout propagation in power grid. We find that demand control effectively reduces the number of blackouts without increasing the probability of large-scale events.



Article selected by the editor to be Featured in Chaos web page on November.

Scaling in the recovery of urban transportation systems from special events

Bassolas, Aleix; Gallotti, Riccardo; Lamanna, Fabio; Lenormand, Maxime; Ramasco, Jose J.
Scientific Reports 10, 2746.

Public transportation is a fundamental infrastructure for life in cities. Although its capacity is prepared for daily demand, congestion may rise when huge crowds gather in demonstrations, concerts or sport events. In this work, we study the robustness of public transportation networks by means of a stylized model mimicking individual mobility through the system. We find scaling relations in the delay suffered by both event participants and other citizens doing their usual traveling in the background. The delay is a function of the number of participants and the event location. The model is solved analytically in lattices proving the existence of scaling relations and the connection of their exponents to the local dimension. Thereafter, extensive and systematic simulations in eight worldwide cities reveal that a newly proposed measure of local dimension explains the exponents found in the network recovery. Our methodology allows to dynamically probe the local dimensionality of a transportation network and identify the most vulnerable spots in cities for the celebration of massive events. As an example, in the Figure it is shown the scaling of the transportation capacity in Paris as a function of the distance to four centers randomly selected, the distribution of fractal dimensions found in the city, the comparison of the dimension obtained by dynamical modeling and by the capacity growth with the distance and, finally, a map with the values of the exponents measured starting from different positions in the city. The most robust areas to organize special events are those with the smallest gamma exponent.

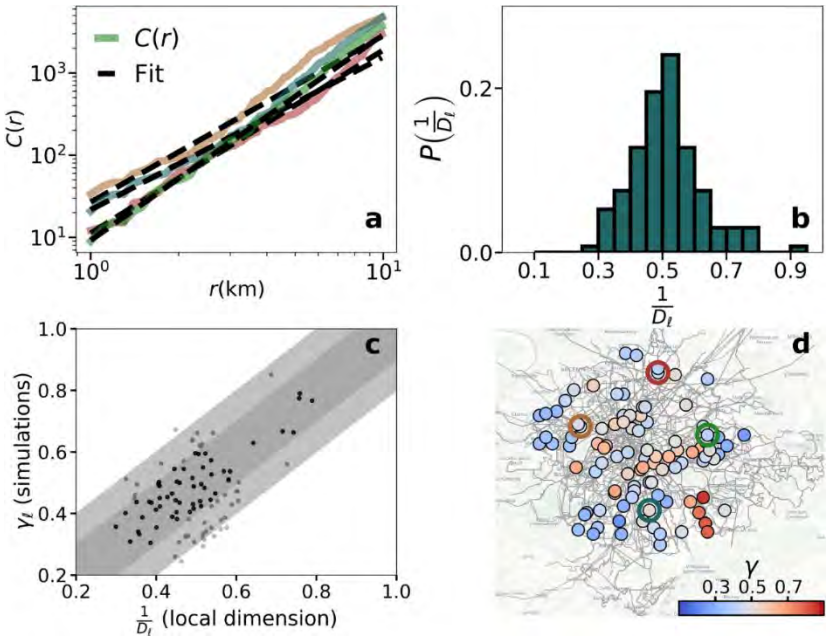


Figure.- Calculation of the local dimension D_ℓ in the multilayer network of Paris and comparison between D_ℓ and $\Delta\tau_{av}$. (**a**) In solid line the scaling of the capacity (r) as a function of the distance to the event in the same four locations and the power law fit in dashed line. The fit corresponds to the growth of capacity in the empirical network of Paris. (**b**) Distribution of the inverse of the local dimension D_ℓ measured from the growth of capacity in the same 100 locations where simulations were performed (Fig. 6). (**c**) Inverse of the local dimension D_ℓ vs the exponent obtained from the scaling of the average delay with $I^(\gamma_\ell)$ in the same location ℓ. The dark and light gray bands correspond to margins of error of 0.1 and 0.2, respectively. (**d**) Map of the scaling exponents of the average delay in the same 100 locations analyzed. The empty circles in the maps mark the four locations highlighted in color in panel (**a**).

Incubation periods impact the spatial predictability of cholera and Ebola outbreaks in Sierra Leone

Kahn, R; Peak, C.R.; Fernández-Gracia, J.; Hill, A.; Jambai, A; Ganda, L; Castro, M.C.; and Buckee, C.O.
Proceedings of the National Academy of Sciences of the USA 117, 5067-5073

The ability to forecast the spread of epidemics, or at least be able to express with certainty what is more probable to occur spatiotemporally, has become a timely question in science, as we have been hard-hit by the present COVID-19 pandemic. Many characteristics shape the spreading patterns of an infectious disease, including the pathogen's underlying transmission parameters and epidemiological dynamics, social networks and population connectivity, and environmental conditions. This work focuses on the effect of incubation periods of different duration and how they impact the spreading patterns of the disease. The incubation period is defined as the time between infection and symptom onset. To observe its effect on spreading patterns in isolation from real data is very difficult, as several conditions have to co-occur: we need two diseases that are epidemiologically mostly equivalent (in terms of spreading mechanisms, outcomes of the disease, …) except for a significant difference in incubation periods; we need that the substrate on which the diseases are spreading is equivalent (in terms of mobility, social networks, percentage of naïve vs inmune population, access to health and sanitation infrastructures, …). These factors did occur together for the Cholera (2012) and subsequent Ebola (2014) outbreaks in Sierra Leone. Cholera has a short incubation period of 2 days as compared to a longer one of around 10 days for Ebola. Both produce inmobilizing symptons such as strong diarrhea. The spreading patterns of both diseases where quite different, with Cholera showing a much more wave-like progression and with a more peaked incidence curve, while Ebola showed a pattern that was more synchronous around the country, with spatial jumps in its spreading and a flatter incidence curve, but longer in time. We show that these characteristics can actually be replicated with a simple SEIR model by changing the duration of the incubation period. These findings have implications for the scale and timing of reactive interventions, such as vaccination campaigns.

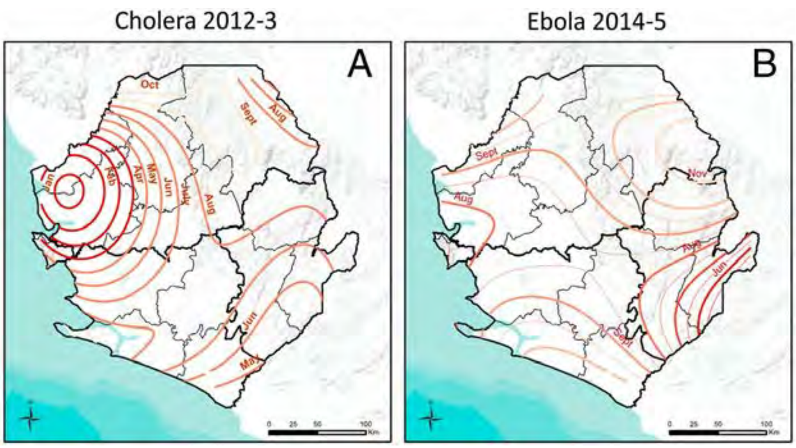
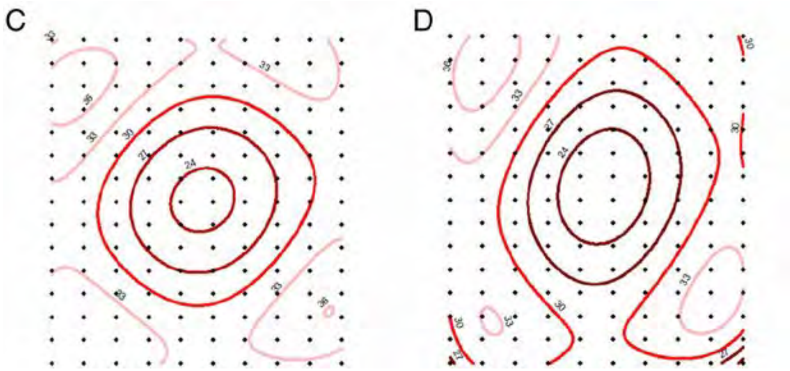


Fig. 1. Spatiotemporal spreading patterns. Spatiotemporal spreading of the outbreaks of Cholera in 2012 (**A**) and Ebola in 2014 (**B**) in Sierra Leone. These are to be compared with simulations of a simplistic model that reproduces qualitatively the patterns for Cholera when using a small incubation period of 2 days (**C**) and for Ebola when using a longer incubation period of 10 days (**D**).



Vector-borne epidemics driven by human mobility

David Soriano-Paños, Juddy Heliana Arias-Castro, Adriana Reyna-Lara, Hector J. Martínez, Sandro Meloni, and Jesús Gómez-Gardeñes
Physical Review Research 2, 013312

Vector-borne epidemics are progressively becoming a global burden, especially those related to flaviviruses, and the effects of different factors such as climate change or the increase of human mobility can sensibly increase the population at risk worldwide. Such outbreaks are the result of the combination of different factors including crossed contagions between humans and vectors, their demographic distribution and human mobility among others. The current availability of information about all those ingredients demands their incorporation into current mathematical models for vector-borne disease transmission. In this work, relying on a Markovian formulation of the metapopulation dynamics, we integrated information from urban daily commutes and the geographic distribution of humans and vectors to estimate the epidemic risk associated with different connected regions. In particular, we provide a formalism to assess the role that the former ingredients play on the propagation of vector-borne diseases. Its Markovian equations enable to reproduce very accurately not only the global incidence of the disease but also the spatiotemporal spreading patterns observed in Monte Carlo simulations. Based on this agreement, we derived an analytical expression of the epidemic threshold that captures the critical conditions which leads to the onset of epidemics. Apart from the detrimental effect that mobility may have on the spread of diseases, the study of the epidemic threshold has revealed interesting phenomena such as the existence of abrupt changes in the way epidemics unfold. In addition, relying on the matrix containing the information about the effective number of human-human contagions, we have derived an epidemic risk indicator that allows us to classify the patches according to their exposure to vector-borne diseases. By computing this epidemic indicator, we have reproduced with great accuracy the geographical distribution of Dengue incidence in the city of Santiago de Cali (Colombia), where Dengue in an endemic disease, thus being able to identify the most vulnerable areas where prevention measures should be promoted. Finally, taken together our results highlight the need of incorporating real human mobility patterns into the design of containment policies targeting specific geographical areas, for efficient policies can turn useless due to a small variation of human mobility habits.

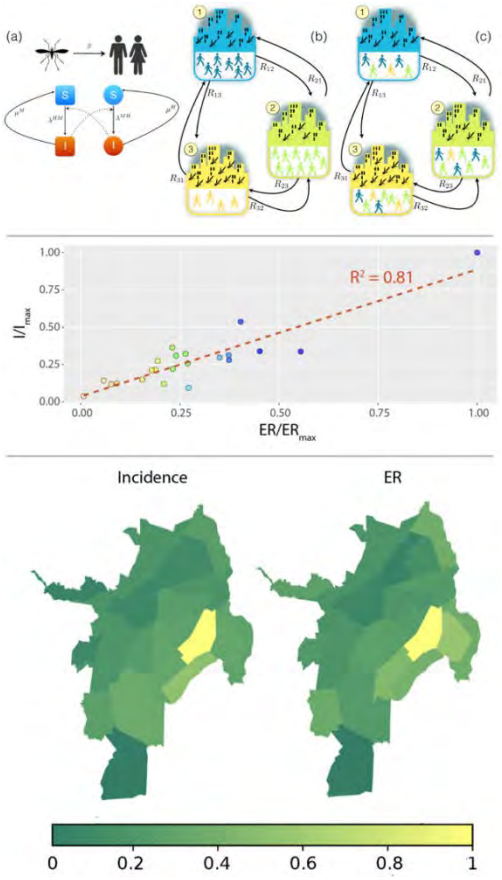


Figure. (upper panels) Epidemiological model and metapopulation approach. (a) Schematic representation of the processes described in the Ross-Macdonald model. (b) and (c), two basic stages of each Monte Carlo step in our metapopulation approach. In (b), individuals are associated with one of the 3 nodes of a network. Once the movement has been done [see (c)] individuals mix and, consequently, the epidemic dynamics then takes place among the individuals and vectors coexisting at that moment in the same population

(central panel) Real Dengue incidence vs estimated epidemic risk in the city of Cali (Colombia). Comparison between the epidemic risk (ER/ER_{max}) obtained from the Markovian model and the incidence (I/I_{max}) of Dengue extracted from epidemiological surveillance data for each of the 22 districts of the city of Cali in Colombia. Color encodes the Epidemic Risk, from the lower (yellow) to the highest (blue).

(bottom panel) Spatial comparison. Distribution of the normalized Dengue incidence in the city of Cali (left) and the normalized epidemic risk (right).

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 2020.

Coherence and Integration / Interaction and Bridges	Pere Colet	Víctor M. Eguíluz	Ingo Fischer	Tobias Galla	Damià Gomila	Emilio Hernández-García	Cristóbal López	Rosa López	Manuel Matías	Sandro Meloni	Claudio Mirasso	David Sánchez	Maxi San Miguel	José Ramasco	Llorenç Serra	Tomàs Sintes	Raúl Toral	Roberta Zambrini
1) Complex Systems: Statistical and Nonlinear Physics	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2) Transport and Information in Quantum Systems								X				X			X			X
3) Nonlinear Photonics	X		X		X						X							
4) Nonlinear Dynamics in Fluids						X	X											
5) Biocomplexity		X	X	X	X	X	X		X	X	X					X	X	
6) Collective Phenomena in Social and Socio-Technical Systems	X	X		X						X		X	X	X			X	

Permanent Staff Meeting in 2020

2.2 SCIENTIFIC ASSOCIATES

NAZARETH CASTELLANOS
ERNESTO ESTRADA
JUAN CARLOS GONZALEZ AVELLA
LUCAS LACASA
STEFANO LONGHI
HORACIO WIO

2.3 POSTDOCTORAL RESEARCH ASSOCIATES

APOSTOLOS ARGYRIS	Balearic Government Program Vicent Mut Contract
JOSEPH BARON	Postdoctoral Contract Project PACCS
ALEIX BASSOLAS	Balearic Government Postdoctoral Contract
CHRISTOS CHARALAMBOUS	Postdoctoral Contract Maria de Maeztu
MIGUEL C. SORIANO	Ramón y Cajal Fellow
GABOR DROTOS	Balearic Government Postdoctoral Contract
JUAN FERNANDEZ GRACIA	UIB Postdoctoral Contract
GIANLUCA GIORGI	Postdoctoral Contract Project QUAREC
LAILA D. KAZIMIERSKI	Postdoctoral Contract Project CAASE
KONSTANTIN KLEMM	Ramón y Cajal Fellow
EVA LLABRÉS	Postdoctoral Contract Project ESPOM
JOHANN MARTINEZ	Postdoctoral Contract Project NouLloguer
PERE MUJAL	Postdoctoral Contract Project QUAREC
JOHANNES NOKKALA	Postdoctoral Contract Maria de Maeztu

TOMASZ RADUCHA	Postdoctoral Contract Project Complexity1
DANIEL RUIZ	FPI Contract Project ESOTECOS
GIULIA RUZZENE	Postdoctoral Contract Maria de Maeztu
SUNGGUEN RYU	Postdoctoral Contract Maria de Maeztu
ANDRE RÖHM	Postdoctoral Contract Maria de Maeztu
LUIS F. SEOANE	Postdoctoral Contract Maria de Maeztu
ANDREA TABI	Postdoctoral Contract Maria de Maeztu
ROELAND VAN DE VIJSEL	Postdoctoral Contract Project SUMAECO
MASSIMILIANO ZANIN	ERC Starting Grant
TONG ZHAO	Taiyuan University of Technology (NSFC) grant

2.4 PHD STUDENTS

JAVIER AGUILAR	Maria de Maeztu Contract
AEJANDRO ALMODOVAR	Maria de Maeztu Contract
BEATRIZ ARREGUI	FPI Contract Maria de Maeztu
NASSIMA BENCHTABER	FPI Contract Project TQM@NANO
ALBERT CABOT	Balearic Government Contract
VIOLETA CALLEJA	FPI Fellow Balearic Government
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 Contract
IRENE ESTÉBANEZ	Maria de Maeztu Contract
ANTONIO FERNANDEZ	FPU Contract UIB
JAVIER GALVAN	FPI Contract Maria de Maeztu
JORGE GARCÍA BENI	Contract associated to Ramon y Cajal
ALEX GIMENEZ	Contract Project SUMAECO
MIRKO GOLDMANN	Marie Curie Postdigital Contract
THOMAS LOUF	Maria de Maeztu Contract
MARIA MARTINEZ BARBEITO	Maria de Maeztu Contract
RODRIGO MARTÍNEZ PEÑA	Maria de Maeztu Contract
MATTIA MAZZOLI	FPI Fellow Balearic Government
JORGE MEDINA	FPI Contract Maria de Maeztu
JESUS A. MORENO	FPI Contract Project PACCS
PABLO MORENO	FPI Contract Project SUMAECO
JAIME SANCHEZ CLAROS	FPI Fellow Balearic Government
SOMAYE SHEYKHALI	Contract Project CAASE

MORITZ PFLÜGER	Volkswagen Contract Project NeuroQNet
LUCAS R. TALANDIER	Marie Curie Contract

2.5 TECHNICAL AND ADMINISTRATIVE SUPPORT

INMA CARBONELL	Accountant
JONATHAN FERRER	Lab Technician
ADRIAN GARCÍA	Communication and Dissemination
JUAN MANUEL GARCIA	Lab Technician
JOSEP MATEU	Administration Unit Head IFISC Manager
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

2 PERSONNEL


IFISC
NONLINEAR OPTICS AND DYNAMICS OF OPTOELECTRONIC DEVICES
IFISC
QUANTUM PHYSICS: PHOTONS, ELECTRONS AND INFORMATION

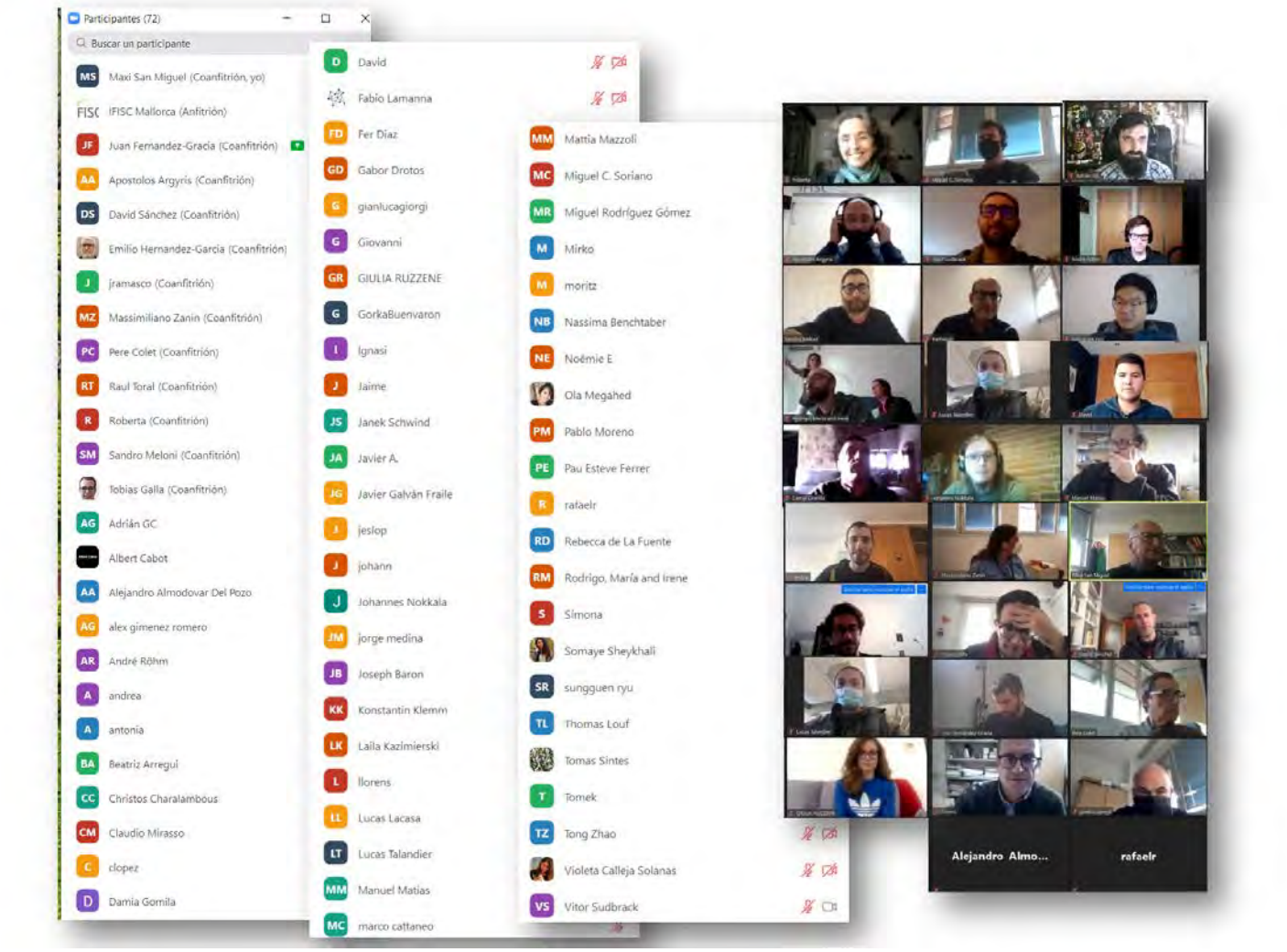
2.6 VISITORS

LONG-TERM VISITORS (more than one month)

BENJAMÍN CARRERAS	Univ. Alaska, USA. (March)
MAXIME LENORMAND	IRSTEA, France. (Oct-Nov)
STEFANO LONGHI	Politecnico, Milan, Italy (January)
CARLOS J. MELIAN	LTH, Switzerland. (January-March)
ALBERTO PEREZ	Higher School of Economics, Moscow, Russia (December)
PIOTR S. TROCHA	Adam Mickiewica Univ., Poland (Feb.-March)
FEDERICO VAZQUEZ	Univ. Buenos Aires, Argentina (Sept-Dec.)

SHORT-TERM VISITORS (Less than one month)

GUILLERMO ROMERO	Univ. of Southampton,UK (January)
EDUARDO MANINO	Univ. of Southampton,UK (January)
MARKUS BREDE	Univ. of Southampton,UK (January)
JONAS RONNING	Oslo Univ. Norwey. (Feb.-March)
FRANCESCO PLASTINA	Univ. della Calabria, Italy. (February)
MARIA MASOLIVER	Univ. Politècnica de Catalunya. (March)
JUAN M. PARRONDO	Univ. Complutense Madrid, Spain. (March)
MALENA SABATINO	LTH Univ. Switzerland. (March)



Winter solstice scientific session. Online participation

2.7 MASTER AND COLLABORATION STUDENTS

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

2019-2020 IFISC Master

DAVID ABELLA BUJALANCE
ALBERT ABIO ROJO
MIGUEL ALVAREZ SANCHEZ
LAURA AVIÑO ESTEBAN
PATRIZIA FERRANTE
JAVIER GALVAN FRAILE
JORGE GARCIA BENI
ALEX GIMENEZ ROMERO
FERRAN LARROYA PAIXA
MARIUS-JASCHA MAGIERA
JAUME S. MARTORELL SERRA
JORGE MEDINA HERNANDEZ
ANA PALACIOS DE LUIS
DIANELA OSORIO BECERRA
LUCIA RODRIGO BORT
MARC SADURNÍ PARERA
RAMON SALETA-PIERSANTI
ROBERT TITZ
BENEDIKT VETTELSCHOSS

2020-2021 IFISC Master

OLA ALI
JOAN ANTICH
GORKA BUENVARON
RUBEN CALVO
MARIA TERESA CORZO
MAR CUEVAS
FERNANDO DIAZ
PAU ESTEVE
ROSA FLAQUER
BENJAMIN M. FRIED
JACOPO GIORGI
TERESA LAZARO
JORGE MAMPEL
CARLES M. MARTORELL
MARTA PEDROSA
BARTOLOME PONS
MIGUEL RODRIGUEZ GOMEZ
ALEXANDRA SERNA

Collaboration students

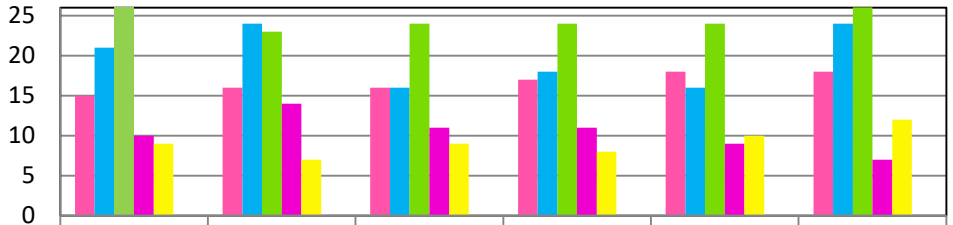
CARLOS M. GUARDIOLA	UIB Training student. (January)
GIOVANNI BAJ	ERASMUS student Univ. degli studi dell'Insubria, Italy (Jan-Feb.)
RAPHAEL J.M. LAFARGUE	ERASMUS student École normale supérieure Paris-Saclay, France. (Jan-Sept.)
JANEK FELIX SCHWIND	ERASMUS student. Univ. Munster, Germany. (Jan. – Dec.)
VITOR SUDBRACK	Brazilian Fellowship FAPESP. (August-Dec.)

2.8 HUMAN RESOURCES OVERVIEW

HUMAN RESOURCES IFISC 2020

	Total	Male	Female
Permanent staff	18	16	2
Postdoctoral fellows	24	20	4
PhD students	28	20	8
Long-term visitors	7	7	0
Support personnel	12	8	4
Total	89	71	18

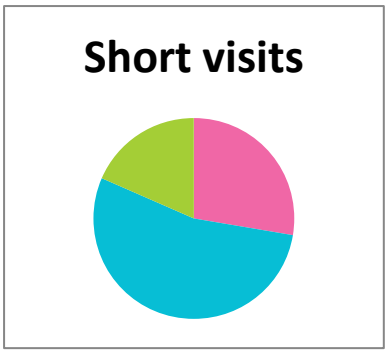
PERSONNEL IFISC 2015-2020

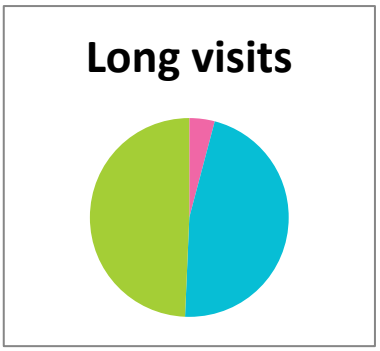


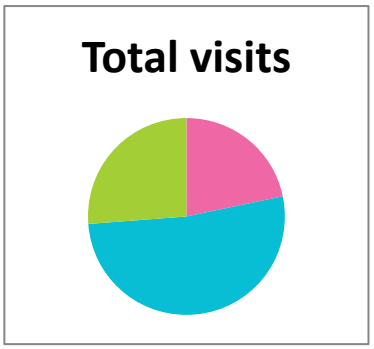
	2015	2016	2017	2018	2019	2020
PERMANENT STAFF	15	16	16	17	18	18
POSTDOCTORAL AND ASSOCIATED	21	24	16	18	16	24
PhD STUDENTS	26	23	24	24	24	28
LONG TERM VISITORS	10	14	11	11	9	7
SUPORT PERSONNEL	9	7	9	8	10	12
TOTAL	81	84	76	78	77	89

VISITING SCIENTISTS AT IFISC 2015-2020

		Short visits	Long visits	**Total visits**
	SPAIN	44	3	47
	EUROPE	90	30	120
	REST OF THE WORLD	36	32	68
	TOTAL	170	65	235







2 PERSONNEL

3

RESEARCH PROJECTS AND FUNDING

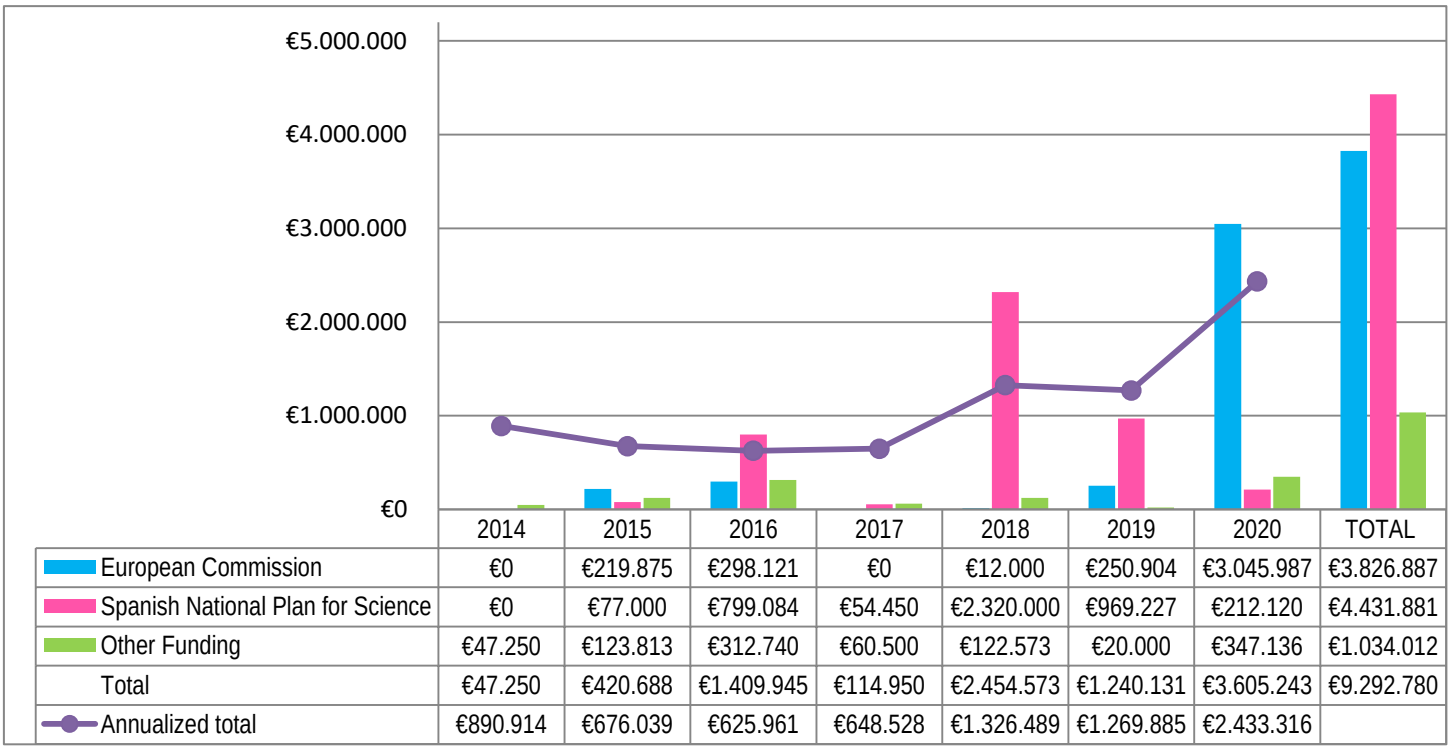
DURING 2020 IFISC HAS RECEIVED FUNDING VIA THE ACTIVE RESEARCH PROJECTS LISTED IN THE FOLLOWING PAGES. IN BRIEF:

- European Commission Framework Program projects: **5**
- Spanish National Plan: **7**
- Collaboration Networks: **5**
- Research Contracts: **2**

Grand total budget of active projects in 2020: **7.210.788 € (including 2,000k € MdM)**
Average yearly project funding in 2014-20: **1.327.540 €**
Average EC funding in 2013-19: **52,48 % of total (excluding MdM)**

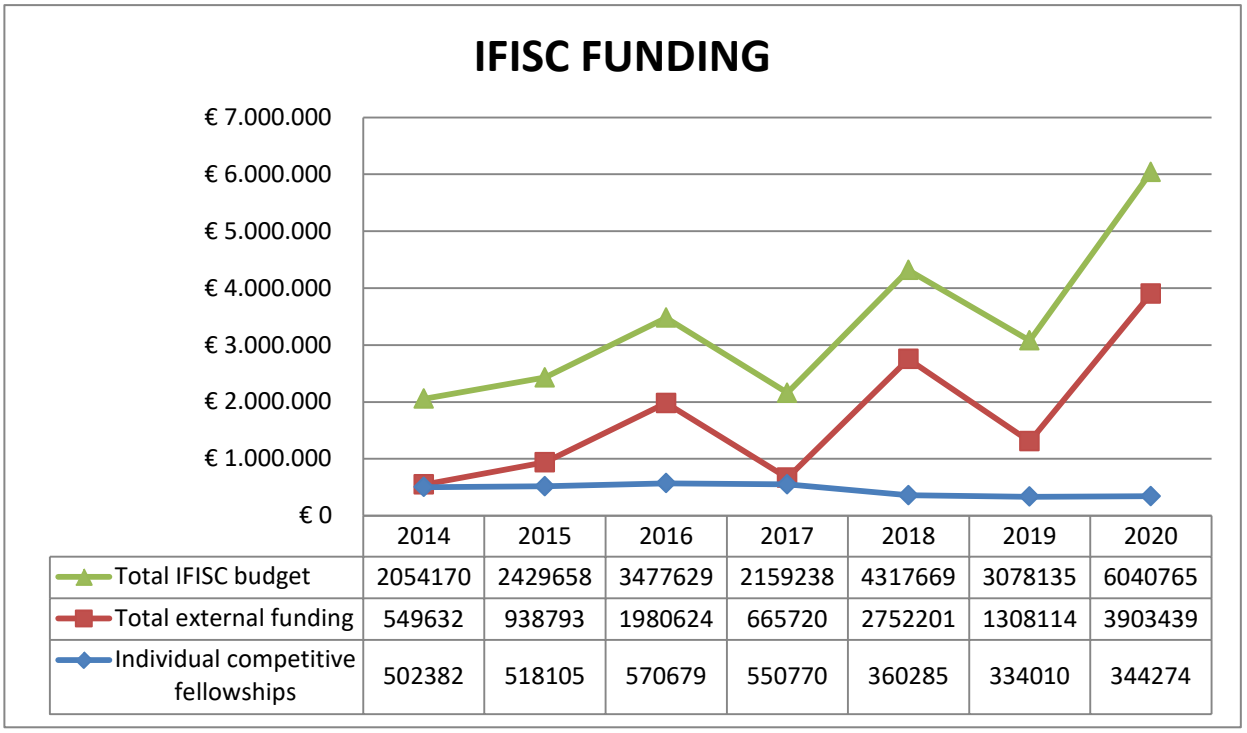
BUDGET FIGURES FOR THE PERIOD 2014-2020 ARE SUMMARIZED IN THE FOLLOWING TABLE
(With budget of a project assigned to the year it is granted. The *Annualized total* is the sum of one-third of the budged granted in that year and in the two previous years):

BUDGET IFISC´S RESEARCH PROJECTS 2014-2020 (IN €)



	2014	2015	2016	2017	2018	2019	2020	TOTAL
European Commission	€0	€219.875	€298.121	€0	€12.000	€250.904	€3.045.987	€3.826.887
Spanish National Plan for Science	€0	€77.000	€799.084	€54.450	€2.320.000	€969.227	€212.120	€4.431.881
Other Funding	€47.250	€123.813	€312.740	€60.500	€122.573	€20.000	€347.136	€1.034.012
Total	€47.250	€420.688	€1.409.945	€114.950	€2.454.573	€1.240.131	€3.605.243	€9.292.780
Annualized total	€890.914	€676.039	€625.961	€648.528	€1.326.489	€1.269.885	€2.433.316	

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.



	2014	2015	2016	2017	2018	2019	2020
Total IFISC budget	2054170	2429658	3477629	2159238	4317669	3078135	6040765
Total external funding	549632	938793	1980624	665720	2752201	1308114	3903439
Individual competitive fellowships	502382	518105	570679	550770	360285	334010	344274

2014-20 yearly-average total budget : **3.365.323 €**
2014-20 yearly-average of total external funding: **1.728.360 €**
2014-20 average ratio of financing from external sources: **51.35 %**
2014-20 individual competitive Pre and Postdoc fellowships **26.28 % of competitive funding**

3.1 RESEARCH FUNDED BY THE EUROPEAN COMMISSION

CAFE

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

ADOPD

Adaptive Optical Dendrites. Program H2020-EU1.2.1. [899265] IFISC Principal Investigators: Claudio Mirasso and Ingo Fischer. (2020-2023) Budget: 955.250 €

VPP4ISLANDS

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

POST-DIGITAL

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

ARCTIC

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

3.2 RESEARCH PROJECTS OF THE SPANISH NATIONAL PLAN FOR SCIENCE

MdM – IFISC

Accreditation of IFISC as "Maria de Maeztu, Unit of Excellence". Principal Investigator: Claudio Mirasso. (2018-2022) Budget: 2.000.000 €

DECAPH

Dendrite-based Computation Applied to Photonics Systems. [PID2019-111537GB-C21 y C22]. IFISC Principal Investigators: Apostolos Argyris, Ingo Fischer and Claudio Mirasso. (2020-2022) Budget: 104.060 €

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 €

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]. Principal Investigators: Damia Gomila and Tomas Sintes. (2019-2021). CSIC Budget: 196.020 €

QUARESC

Quantum Machine Learning using reservoir computing. [PID2019-109094GB-C21] IFISC Principal Investigators: Miguel C. Soriano and Roberta Zambrini (2020-2023) Budget: 108.060 €

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 €

3.3 OTHER PUBLIC FUNDING

ESPOM

Ecosystemic services in posidonia oceanica meadows. Balear Government [PRD2018/18] IFISC Principal Investigator: Tomas Sintes. (2020-2023) Budget: 50.000 €

NouLloguer

Influence of new models of vacation renting on residential housing: ICT Data economic analysis. Balear Government. [PED2018/43] IFISC Principal Investigator: Jose Ramasco. (2020-2023). Budget: 60.671 €

QUAREC

Machine learning with quantum reservoir computing. Balear Government. [PRD2018/47] IFISC Principal Investigator: Roberta Zambrini. (2020-2023) Budget: 99.750 €

Distancia – COVID

Impact of social distancing measures on the spreading of COVID-19 pandemics in Spain. Proyecto Intramural Especial [CSIC-COVID-19] IFISC Principal Investigator: Jose Ramasco (2020-2021) Budget: 96.375 €

iCOOP

Reinforcement of research and training on power grid instability control. Programa CSIC de Cooperación Científica para el Desarrollo (i-COOP+) [COOPB20476] IFISC Principal Investigator: Pere Colet. (2020-2022) Budget: 34.308 €

MOREHOUSE

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

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 €

Xylella

Teledetección multiespectral y machine learning para determinar síntomas y extensión de la Xylella fastidiosa en almendros. Principal Investigator: Jose J. Ramasco. (2020-2021) Budget: 6.031,85 €

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)

IN-TREE

INCT in Interdisciplinary and Transdisciplinary Studies in Ecology and Evolution. CNPq, CAPES, FAPESB Brazil. IFISC Principal Investigator: Emilio Hernández García. (2016-2022)

IBERSINC3

Red sobre dinámica y sincronización en redes complejas. Excellence Network. [FIS2017-90782-REDT]. IFISC Principal Investigator: Miguel C. Soriano (2019-2020). Budget: 17.000 €

MOBILITY2030

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

QTEP

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

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

BBVA DATA & ANALYTICS

HUAWEI

Google

cuebiq

ib-salut servei de salut de les Illes Balears

3 RESEARCH PROJECTS AND FUNDING

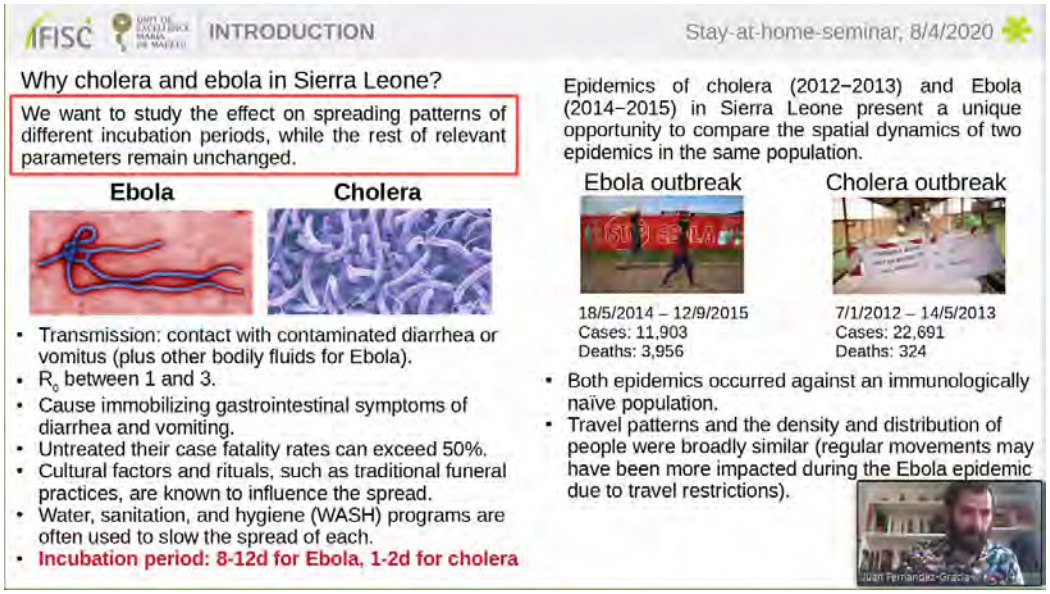
4

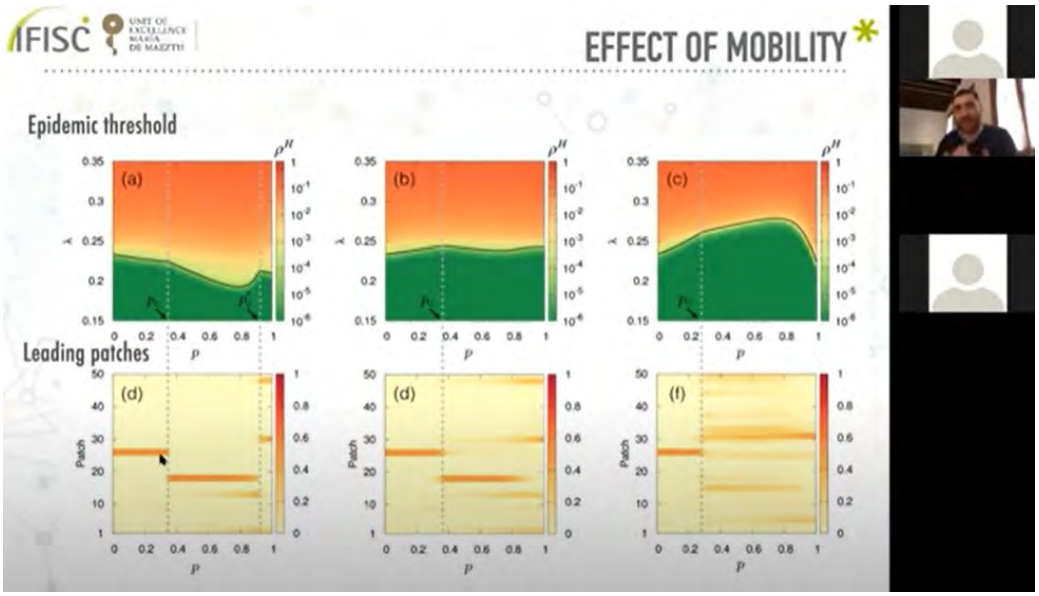
IFISC SEMINARS

Coordinators:
Llorenç Serra
Tobias Galla

The full listing of the 40 seminars given at IFISC during 2020 can be found at **http://ifisc.uib-csic.es/en/events/seminars/** and in the Appendix of this Report.

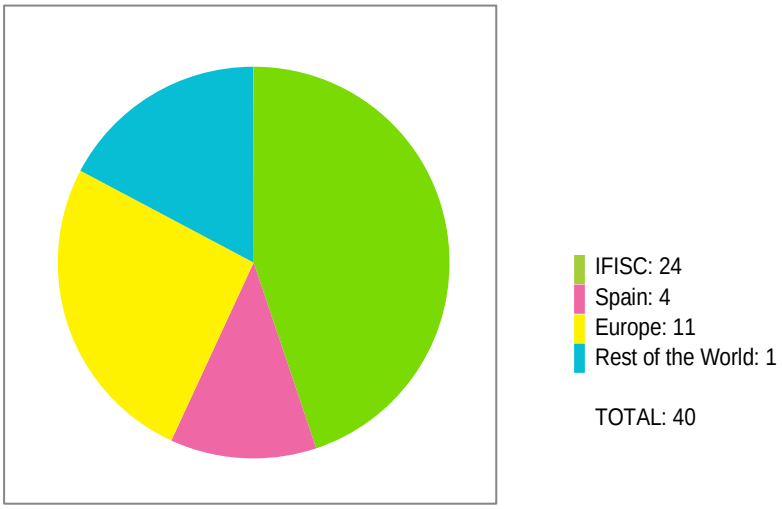
Seminars are broadcasted live and recorded. They are globally available at **http://ifisc.uib-csic.es/en/events/seminars/**, and also on our youtube channel **https://www.youtube.com/user/IFISCseminars/**



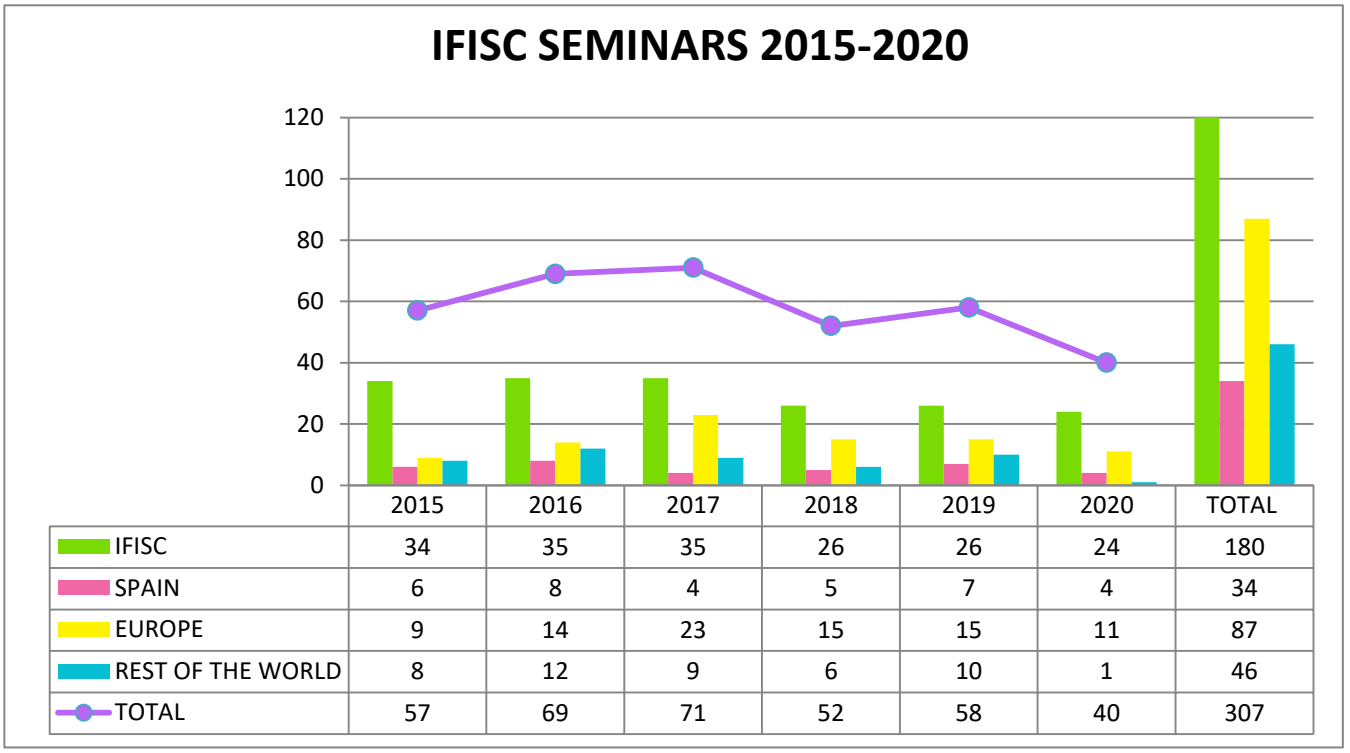


The following graphs show the distribution of seminars by geographical provenance of the speaker for 2020 and for the previous years:

PROVENANCE OF SPEAKERS AT IFISC SEMINARS 2020



IFISC SEMINARS 2015-2020



	2015	2016	2017	2018	2019	2020	TOTAL
IFISC	34	35	35	26	26	24	180
SPAIN	6	8	4	5	7	4	34
EUROPE	9	14	23	15	15	11	87
REST OF THE WORLD	8	12	9	6	10	1	46
TOTAL	57	69	71	52	58	40	307

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.

Wolfgang Mass, **Institute for Theoretical Computer Science, Graz University of Technology**

Recurrent Networks of Spiking Neurons: From Biology to Novel Computing Technology

February 19, 2020 3 p.m.

The rest of talks that were organized had to be cancelled because of the COVID-19 pandemic.

5

PUBLICATIONS

IFISC RESEARCH RESULTS HAVE BEEN REPORTED IN THE FOLLOWING PUBLICATIONS DURING 2020:

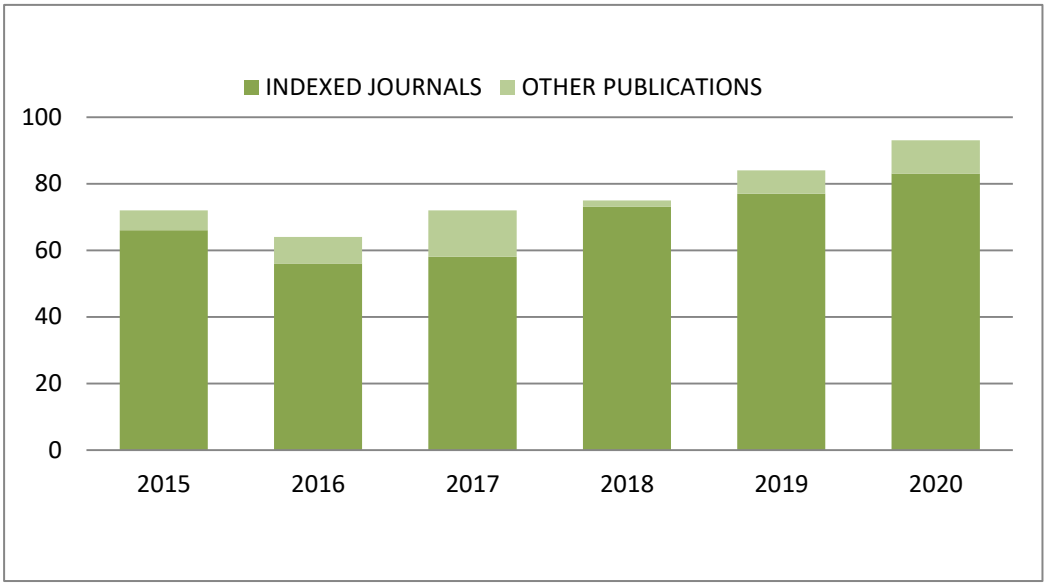
- Papers in indexed journals: **82**
- Other publications: **10**

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 2015-2020 IFISC has published 1 paper in Nature, 1 paper in Science, 3 papers in PNAS, 7 papers in Nature Communications, 2 in Science Advances, 1 paper in Nature Geoscience, 1 in Nature Nanotechnology, 1 in Physics Reports, 1 paper in Physical Review X, and 12 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 2015-2020



	2015	2016	2017	2018	2019	2020	TOTAL
INDEXED JOURNALS	66	56	58	73	77	82	412
OTHER PUBLICATIONS	6	8	14	2	7	10	47
TOTAL	72	64	72	75	84	92	459

JOURNALS WITH THE LARGEST NUMBER OF PUBLICATIONS

IFISC PUBLICATIONS	2015	2016	2017	2018	2019	2020	TOTAL
Physics journals							
Physical Review E	12	9	4	10	8	3	46
Physical Review B	7	5	4	5	2	5	28
Chaos	3	2	5	4	4	8	26
New Journal of Physics	1	5	3	4	3	2	18
Physical Review Letters	4	1	1	3	1	2	12
Physical Review A	2	3	3	0	1	2	11
European Physical Journal B	1	2	3	3	2	0	11
Multidisciplinary journals							
Scientific Reports	3	7	11	3	9	5	38
Plos One	6	2	1	4	0	3	16
Nature Communications	3	0	0	0	2	2	7
IEEE journals	3	2	1	0	2	12	20
Other non-physics journals	8	7	7	13	21	11	67

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, Neural Networks, Interface Focus, eLife, PLoS Computational Biology, PLoS Genetics, Ecological Complexity, Ecography, Biomolecules, Macromolecules, Ecography, NPJ Systems Biology and Applications, Frontiers in Computational Neuroscience, Frontiers in Neuroscience, Frontiers in Neuroinformatics, Frontiers in Medicine, Computer Methods and Programs in Biomedicine, Environmental Microbiology, The ISME Journal,, Global Ecology and Biogeography, and Ecological Applications.

Earth sciences:

Nature Geoscience, Journal of Geophysical Research, Nonlinear Processes in Geophysics, ICES Journal of Marine Science, Earth Science Dynamics, Progress in Oceanography, Frontiers in Marine Science, Journal of Marine Systems, Tellus, and Journal of Climate

Sociotechnical and Social systems:

Palgrave Communications, Journal of Economic Interaction and Coordination, Transportation, Transportation Research, Journal of Air Transport management, International Journal of Electrical Power and Energy Systems, Built Environment, and Journal of Transport Geography.

Data science and Machine learning:

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

5 PUBLICATIONS

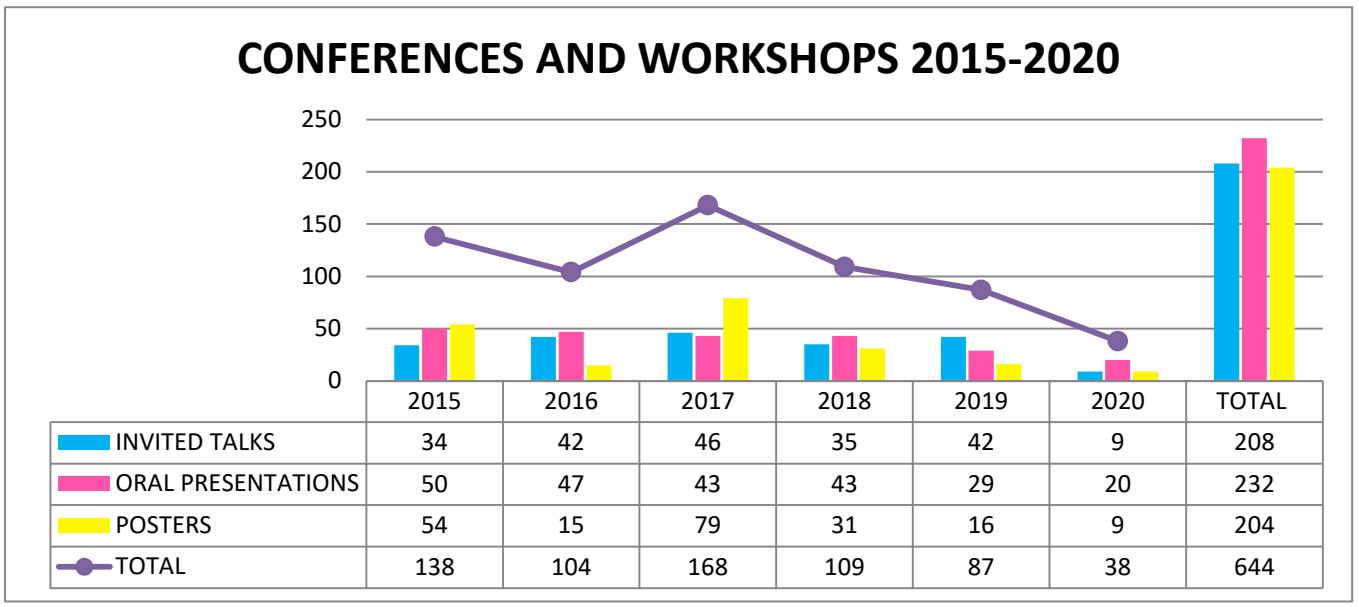
6

CONFERENCES AND WORKSHOPS

6.1 PRESENTATIONS AT SCIENTIFIC CONFERENCES 2020

- Invited talks: **9**
- Oral presentations: **20**
- Posters: **9**
- Total: **38**

Full listing in the Appendix of this Report.



	2015	2016	2017	2018	2019	2020	TOTAL
INVITED TALKS	34	42	46	35	42	9	208
ORAL PRESENTATIONS	50	47	43	43	29	20	232
POSTERS	54	15	79	31	16	9	204
TOTAL	138	104	168	109	87	38	644

Zambrini, Roberta

- **Quantum Technology International Conference, QTech2020.**
  Pompeu Fabra University, Spain..
- **Chair of the** Workshop on Quantum Network Science.
  2020 NetSci Satellite, Rome, Italy, ONLINE

Ramasco, J.J.

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

Meloni, Sandro

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

Raducha, Tomasz

- **Winter Workshop on Complex Systems 2020.**
  Member of the Steering Committee of the Winter Workshop on Complex Systems 2020 held in Charmey, Switzerland.
- **CCS 2020 Warm-up by yrCSS.**
  Member of the Organizing Committee of the Conference on Complex Systems 2020 Warm-Up event by Young Researchers of the Complex Systems Society.

Mirasso, Claudio

- **29th Annual Computational Neuroscience Meeting.**
  Program Committee.

Mattia Mazzoli, Aleix Bassolas, Riccardo Gallotti, Jose Javier Ramasco

- **UrbanNet2020 - NETSCI2020.**
  Urban mobility networks (Satellite of NETSCI2020).

Ramasco, JJ; Mazzoli, M

- **UrbanNet 2020.**
  Co-organizer of the \" UrbanNet 2020" satellite of the conference NetSci 2020 (online).

Soriano, Miguel Cornelles

- **Emerging Topics in Artificial Intelligence (ETAI).**
  Program Committee member .
- **European Semiconductor Laser Workshop.**
  Technical Program Committee member. Virtual conference.

Klemm, Konstantin

- **Complex Networks 2020, Madrid, Spain.**
  Member of the Program Committee.

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 2020, 28 PhD students developed their research project at IFISC, and 2 PhD thesis were completed and successfully defended:

Peralta, Antonio F.
Stochastic binary-state dynamics on complex networks: a theoretical analysis
Supervisor: Raúl Toral
October 6

Artime, Oriol
Temporal activity patterns in social dynamics
Supervisors: Maxi San Miguel and Jose Javier Ramasco
September 17

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 2020, 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, S. Meloni
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, S. Meloni
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, T. Galla
Turbulence and nonlinear phenomena in fluid flows (3 credits)	C. López
Master thesis (12 credits)	Responsible: P. Colet

Other Postgraduate Courses tought in 2020

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 Sintes, Emilio Hernández-García

- **Stochastic simulation methods**
  Pere Colet, Raúl Toral

- **Scientific presentation and visualization**
  José J. Ramasco

- **Spintronics**
  Rosa López, Llorenç Serra, David Sánchez

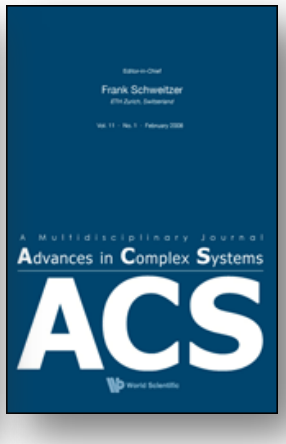
- **Electronic nanostructures**
  David Sanchez, Llorenç Serra

Course at the Master Degree in Physics of Data, University of Padova, Italy:

- **Life Data Epidemiology**

  Sandro Meloni

7.4 MEMBERS OF EDITORIAL BOARD OF SCIENTIFIC JOURNALS



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

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

Associate Editor of Frontiers in Physics (Interdisciplinary Physics).
Eguiluz, V.M.

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

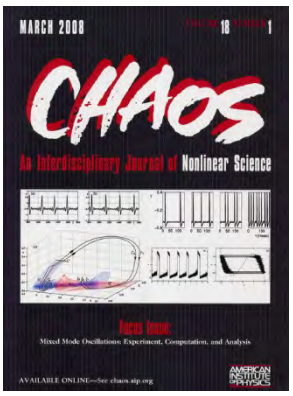
Editorial board of Proceeding of the Royal Society A: Mathematical, Physical and Engineering Sciences.
Zambrini, Roberta

Editorial board of Journal of Physics Communications
Zambrini, Roberta

Editorial Board Members of PLoS ONE.
Meloni, Sandro; Ramasco, Jose J.

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

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



Editorial Board member of Scientific Reports.
Ramasco, J.J.

Members of the Editorial board of Entropy.
López, Cristobal; Sanchez, David; Wio, Horacio

Topic Editor of the Journal Entropy.
Soriano, Miguel C.

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

Member of the Editorial Board of Cognitive Computation as a Guest Editor.
Soriano, Miguel C.

Advisory Editorial Board Physica A.
Wio, Horacio S.

Member of Editotial Board of Journal of Physics Complexity.
San Miguel, Maxi

Member of the Editorial Board of Biology, section Neuroscience.
Mirasso, Claudio

Divisional Associate Editor of Physical Review Letters.
Zambrini, Roberta

7.5 SCIENTIFIC COMMITTEES

Zambrini, Roberta

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

Ramasco, J.J.

- **Elected member of the council of the Complex Systems Society.**
- **President COMSOTEC.**
  Spanish Association for the Study of SocioTechnical Systems.

Colet, Pere

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

Fischer, Ingo

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

Toral, Raul

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

San Miguel, Maxi

- **Vice-chair of IUPAP C3 Commisison on Statistical Physics.**
- **Chair of the International Scientific Advisory Board of the Internet Interdisciplinary Institute (IN3) of the Open University of Catalunya (UOC).**
- **Chair of the Materials Sciences and Energy selection committee of the 2020 EQUIPEX+ program of the French National Research Agency (ANR).**

7.6 RESEARCH STAYS IN OTHER CENTERS

During 2020 IFISC Researchers visited 4 external research centers.

These visits are listed in the Appendix to this Report.

Participation of IFISC in the 11F: International Day of Women and Girls in Science 2020.

The United Nations General Assembly decided to proclaim 11 February 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, 2018 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) participated again for the 2020 edition.

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 complete list of activities that were organized in the framework of the 11F can be found in the web: **11fbalears.org**.

IFISC researchers participated in the following activities:

***Neural Networks, o cómo Facebook etiqueta tu cara**. Feb. 14, 2020, 9 a.m.*
Irene Estébanez at the IES Pius XII in Palma de Mallorca.

***Plásticos, un invasor inteligente en nuestro ecosistema.** Feb. 12, 2020, 9 a.m.*
Rebeca de la Fuente at the IES Ses Estacions in Palma de Mallorca.

***Citas Rápidas con Científicas en el bar.** Feb. 11, 2020, 7 p.m.*
Irene Estébanez at Mariola's Bakery in Palma de Mallorca.

***Citas Rápidas con Científicas**. Feb. 8, 2020, 11 a.m.*
María Martínez Barbeito and Rebeca de la Fuente at CaixaForum in Palma de Mallorca.

***Programming Workshop Django Girls**. Feb. 8, 2020, 8:30 a.m.*
Antonia Tugores at UIB Campus in Palma de Mallorca

Quantum Thermodynamics website.
Responsible and moderator of the website https://qtd.ifisc.uib-csic.es
Zambrini, Roberta

Coordinator of T10 of CSIC white paper.
Zambrini, Roberta

Participation in CSIC 'white books' on Strategic Topics and challenges:

- Theme 5: **Brain, mind and behaviour**.
  Have contributed: C. Mirasso, C. Lopez and E. Hernandez-Garcia

- Theme 10: **Digital and complex information**.
  Coordinated by R. Zambrini. Other contributors: I. Fischer, M.C. Soriano, Ll. Serra, J.J. Ramasco, S. Meloni, D. Sanchez, A. Garcia.

- Theme 11: **Artificial Intelligence, Robotics and Data Science**.
  Have contributed: J.J. Ramasco, A. Argyris, M.C. Soriano, I. Fischer, S. Meloni, C. Mirasso, V.M. Eguiluz, P. Colet, D. Gomila, T. Galla, M. San Miguel, R. Toral

- Theme 13: **Ocean Science Challenges for 2030**.
  Have contributed: E. Hernandez-Garcia and C. Lopez

7 OTHER ACTIVITIES

8

OUTREACH ACTIVITIES

8.1 CONFERENCE SERIES

Conference Series
"Sailing by the Complexity of the 21th Century: Entangled in complexity"

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: Enredados en la complejidad".

PROGRAMME

MARCH 5

Rompiendo la segunda ley de la termodinámica
Breaking the second law of thermodynamics

José Luis Crespo, QuantumFracture

In this house we are governed by the laws of thermodynamics, and the Second Law is no exception. "The entropy of the Universe always increases; the cosmos tends to become disordered"... Or maybe not? Let's talk about what entropy is and how even the almighty Second Law can (although very hardly) be broken in the most surrealistic situation ever seen.

MARCH 12 – CANCELLED FOR COVID PANDEMIC

Epidemics of disinformation: Fake news
Epidemias de desinformación: Noticias falsas

Alex Arenas, Universitat Rovira I Virgili

MARCH 19 – CANCELLED FOR COVID PANDEMIC

Surfing through the complexity of ecological networks
Surfeando por la complejidad de las redes ecológicas

Anna Traveset, Instituto Mediterráneo de Estudios Avanzados (CSIC-UIB)

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 targetting 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 Thurdsay, February 20th at 3:10 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

VOCES CSIC BALEARS – CSIC VOICES IN BALEARIC ISLANDS

At the end of 2020, IFISC (UIB-CSIC) and the Institutional Representation of CSIC in the Balearic Islands joined forces and create "Voces, CSIC Illes Balears", a monthly podcast for the dissemination of science. Through interviews with scientists working at CSIC's centres in the Balearic Islands (IMEDEA CSIC-UIB, IFISC UIB-CSIC and ICTS SOCIB), it aims to increase the visibility of the science carried out in the region. The first episode was launched to coincide with European Researchers' Night 2020 (27 November) at noon through the iVoox platform and consisted of a special feature that gave a voice to researchers involved in European projects. The first researchers to be interviewed were:

- Massimiliano Zanin, postdoctoral researcher at the Institute of Interdisciplinary Physics and Complex Systems (IFISC), joint centre of the CSIC and the University of the Balearic Islands. Massimiliano is coordinator of the ARCTIC Project - Air Transport as Information and Computation, financed through a prestigious ERC Starting Grant awarded by the European Research Council.
- Adèle Révelard, from the High Frequency Coastal Radar Operation and Support Division of ICTS SOCIB. Adèle is participating in the EuroSea Project - Improving and Integrating European Ocean Observing and Forecasting Systems for Sustainable use of the Oceans funded by the European Union's Horizon2020 Research and Innovation Funding programme.
- Anna Traveset, CSIC Research Professor at the Mediterranean Institute of Advanced Studies (IMEDEA), a joint centre of the CSIC and the University of the Balearic Islands, and institutional representative of the CSIC in the Balearic Islands. Anna participates in the LIFE 4 Pollinators - Involving people to protect wild bees and other pollinators in the Mediterranean project, financed by the LIFE Programme, the European Union's financial instrument exclusively dedicated to the environment.

The podcast was hosted by the IFISC communication and dissemination technician Adrián García.

European Researchers' Night

On the afternoon of 27 September, the European Researchers' Night was be celebrated, a European project of scientific dissemination promoted by the European Commission as part of the Marie Sktodowska-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 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.

Ciencia Nocturna – Nocturnal Science

Within the framework of the European Researchers' Night, different researchers from the G-9 universities, including Claudio Mirasso, researcher at IFISC, were interviewed on the radio programme **Ciencia nocturna**, on the Youtube channel of the S-TEAM project.

Los extremos del clima – Weather Extremes

In this online talk for the Researchers' Night at the University of the Republica (Uruguay), four young researchers from the international CAFE Training Network, including PhD student Noemie Ehstand, shared examples of the extreme events they study and how their research can help to detect these phenomena earlier and more accurately, as well as what scientists, politicians, and all of us as a society can do to mitigate their negative effects in the future.

“Investigam per a tu” exhibition – “We investigate for you” exhibition

An exhibition focusing on UIB’s European projects that could be visited from 26th to 30th November at the Palma intermodal station. The exhibition showed the European research projects of UIB funded by the European Commission, among which are the ADOPD and VPP4ISLANDS projects, with the participation of IFISC.

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.

Also in 2020, some outreach articles were published in different media:

- Una nueva ciencia de la movilidad urbana. Aleix Bassolas, Mattia Mazzoli, Jose Javier Ramasco. Investigación y Ciencia, 528, (2020)
- Adiós al padre del caos. Tobias Galla. El País, 4 May (2020)
- Termoelectricidad cuántica: conversión de energía a escala nanométrica. David Sánchez and Rafael Sánchez. Revista Española de Física 34, 11-16 (2020)
- Por qué es difícil controlar brotes epidémicos en un mundo que se mueve tanto. Sandro Meloni. The Conversation, 25 March (2020)

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 2020, IFISC activities produced 329 press releases and appearances in written and digital press (national and international), and 31 clips on radio and TV. See the full lists in the Appendix.


LA RAZÓN

Sociedad

La migración a zonas rurales, más efectiva que los cierres perimetrales

Una investigación muestra que ni el confinamiento ni las prohibiciones de viaje son formas realmente útiles de frenar el avance de una pandemia.


EFE: Agencia EFE

Buscar | Web corporativa

EFE Noticias | EFE Salud | EFE Verde | Efeminista | EFE Escuela | EFE Verifica

Edición España | Ciencia

NEUROCIENCIA MEMORIA

Distintos tipos de onda combinan recuerdos e información nueva en el cerebro

EFE | Madrid | 10 ago. 2020

La investigación ha sido realizada por científicos del Instituto de Neurociencias de Alicante (UMH-CSIC), del Instituto de Física Interdisciplinar y Sistemas Complejos (UIB-CSIC), del Instituto Cajal (CSIC) y de la Universidad de la Laguna. Crédito: UMH-CSIC


DISCOVER VIDEO NEWSLETTERS

BIG THINK

New study argues that migrating from cities, not travel bans, slows spread of disease

Of course, it's all about where you move. The authors argue that it needs to be less populous regions.

DEREK BERES 20 November 2020


laSexta

TecnoXplora

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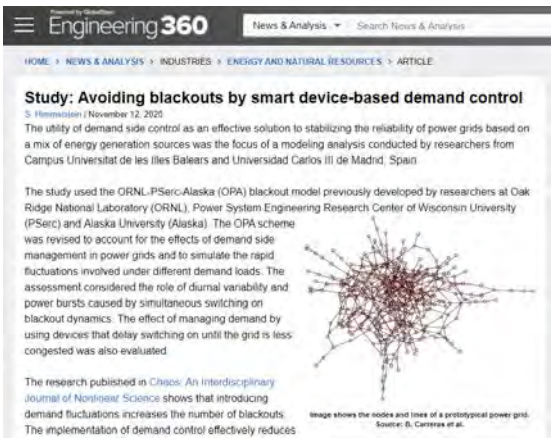
Los periodos de incubación afectan a la dispersión de los brotes infecciosos

Los periodos de incubación afectan a la dispersión de los brotes infecciosos

Los viajes realizados por personas que incuban un patógeno son un factor clave en la extensión geográfica de las epidemias, y la dispersión se predice mejor cuando los periodos de incubación son más cortos. Estas son algunas de las conclusiones obtenidas tras analizar brotes de cólera y ébola en Sierra Leona.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Study: Avoiding blackouts by smart device-based demand control

S. Himmelstein | November 12, 2020

The utility of demand side control as an effective solution to stabilizing the reliability of power grids based on a mix of energy generation sources was the focus of a modeling analysis conducted by researchers from Campus Universitat de les Illes Balears and Universidad Carlos III de Madrid, Spain.

The study used the ORNL-PSerc-Alaska (OPA) blackout model previously developed by researchers at Oak Ridge National Laboratory (ORNL), Power System Engineering Research Center of Wisconsin University (PSerc) and Alaska University (Alaska). The OPA scheme was revised to account for the effects of demand side management in power grids and to simulate the rapid fluctuations involved under different demand loads. The assessment considered the role of diurnal variability and power bursts caused by simultaneous switching on blackout dynamics. The effect of managing demand by using devices that delay switching on until the grid is less congested was also evaluated.

The research published in Chaos: An Interdisciplinary Journal of Nonlinear Science shows that introducing demand fluctuations increases the number of blackouts. The implementation of demand control effectively reduces

Image shows the nodes and lines of a prototypical power grid. Source: B. Carreras et al.


THE CONVERSATION

COVID-19 | Ciencia + Tecnología | Cultura | Economía | Educación | Medicina + Salud | Medioambiente + Energía | Política + Sociedad

Por qué es difícil controlar brotes epidémicos en un mundo que se mueve tanto

SOCIAL MEDIA IMPACT SUMMARY

TWITTER @IFISC_mallorca

Total tweets 4.182

Total Followers 2.103 (14% increase of number of followers in 2020)

FACEBOOK http://www.facebook.com/ifisc

Facebook fans: 1.051 (5% increase of fan number in 2020)

61% men / 37% women

Languages most used: Spanish (73%), English (68%), Portuguese (14%), Catalan (5%).

Mostly located in Spain, Brazil and Mexico

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

Visualizations: 46.401 in 2020 of a total of 188.160 (32% increase of visualizations in 2020)

YouTube subscribers: 1.522 in 2020 (57% increase of subscribers in 2020)

APPENDIX

a.4. IFISC seminars and talks 2020

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

January 15
Influence Maximization in the Voter Model
Markus Brede, School of Electronics and Computer Scince, University of Southampton, UK.

January 21
Reservoir computing with multiple optical nodes
Moritz Pflüger, IFISC (UIB-CSIC)

January 22
Novel elastic and thermoelectric responses in Dirac matter
Vicente Arjona , Instituto de Ciencia de Materiales de Madrid, CSIC

January 28
Information transmission in delay-coupled neural circuits
Jaime Sánchez Claros, IFISC (UIB-CSIC)

February 5
Stochastic dynamics and thermodynamics as inference tools: Examples from the study of living systems
Reinaldo García García, Laboratoire PMMH, Université Grenoble Alpes-CNRS, France

February 12
Reservoir computing with continuous variable quantum systems
Johannes Nokkala, IFISC (UIB-CSIC)

February 25
Phase space structures and escape time in a model for exothermic chemical reactions
Francisco González Montoya, School of Mathematics, University of Bristol, UK

February 26
A Multi-Objective Optimization approach to Statistical Mechanics.
Luiño F Seoane, IFISC (UIB-CSIC)

March 4
Irreversibility and dissipation
Juan M.R. Parrondo, Universidad Complutense de Madrid, Spain

March 6
Aggression-affiliation motifs in bottlenose dolphins social networks
Ana Pérez Manrique, IFISC (UIB-CSIC)

April 8
Incubation periods impact the spatial predictability of cholera and Ebola outbreaks in Sierra Leone
Juan Fernandez-Gracia, IFISC (UIB-CSIC)

April 22
Vector-borne epidemics driven by human mobility
Sandro Meloni, IFISC (UIB-CSIC)

April 27
Emergence of complex structures from nonlinear interactions and noise in coevolving networks
Tomasz Raducha, IFISC (UIB-CSIC)

April 29
Altruism in populations at the extinction transition
Konstantin Klemm, IFISC (UIB-CSIC)

May 6
Is complexity of oscillatory dynamics a resource for neuronal information processing?
Demian Battaglia, Institute for Systems Neuroscience, Aix-Marseille University, France

May 13
Migrant mobility flows characterized with digital data
Pere Colet, IFISC (UIB-CSIC)

May 20
Presentation of new IFISC projects
Researchers, IFISC (UIB-CSIC)

May 27
Artificial topotronics: towards robust quantum circuits for secure communication and decoherence-free computation
Kaveh Delfanazari, University of Glasgow & University of Cambridge, UK

June 3
Transport and vertical distribution of sinking microplastics in the Mediterranean Sea
Rebeca de la Fuente, IFISC (UIB-CSIC)

June 10
Synchronization and coalescence in dissipative quantum systems
Albert Cabot, IFISC (UIB-CSIC)

June 17
Well stirred, but not well mixed: Evolutionary dynamics in flowing environments
Tobias Galla, IFISC (UIB-CSIC)

July 1
Quantum Brownian motion in Bose Einstein condensates
Christos Charalambous, IFISC (UIB-CSIC)

July 8
Geological resources for reaching carbon neutrality
Víctor Vilarrasa, IMEDEA (CSIC-UIB)

July 15
Presentation of new IFISC projects
Researchers, IFISC (UIB-CSIC)

September 9
Biophysical self-organization of coastal wetlands: Unraveling spatial complexity on tidal flats and marshes, from the Precambrian to today.
Roeland Van de Vijsel, IFISC (UIB-CSIC)

September 10
Modelling the Mass Mortality Event of Pinna nobilis
Àlex Giménez Romero, IFISC (UIB-CSIC)

September 18
Dynamic Information Routing in Neuronal Circuits
Jorge Medina, IFISC (UIB-CSIC)

October 14
Collective motion with voter-like interactions: noise-induced flocking
Federico Vázquez, Instituto de Cálculo, Facultad de Ciencias Exactas y Naturales Universidad de Buenos Aires – CONICET, Argentina

October 19
Introduction to Multispectral Satellite Remote Sensing and its Applications
Joan Bauzà, Departament de Geografia, UIB, Spain

October 21
Universality in spin models, automata and neural networks
Gemma De las Cuevas, University of Innsbruck, Austria

October 28
Using physics to understand how antibiotics inhibit bacteria
Rosalind Allen, University of Edinburgh, UK

November 4
Illuminating dendritic function using computational modeling
Panayiota Poirazi, Institute of Molecular Biology and Biotechnology (IMBB), Foundation for Research and Technology-Hellas (Forth), Greece

November 11
Localization and spin-orbit coupling in interacting few-boson systems
Pere Mujal, IFISC (UIB-CSIC)

November 18
Stochastic intermittent perturbations to dynamical systems: rainfall and fires
Mara Baudena, Utrecht University, Germany

November 25
Complexity in neural networks: the good with the bad
Elena Agliari, Sapienza Università di Roma, Italy

December 2
Metastability in open quantum systems
Katarzyna Macieszczak , University of Cambridge, UK

December 14
Competition between Mediterranean clonal seagrasses
Albert Abio Rojo, IFISC (UIB-CSIC)

December 15
Two Lagrangian approaches to atmospheric blocking
Noémie Ehstand, IFISC (UIB-CSIC)

December 16
IFISC Winter Solstice Seminar
IFISC Researchers, IFISC (UIB-CSIC)

December 18
Bilayer graphene nanostructures with potential inversion
Nassima Benchtaber, IFISC (UIB-CSIC)

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

Incubation periods impact the spatial predictability of cholera and Ebola outbreaks in Sierra Leone
Kahn, Rebecca; Peak, Corey M.; Fernández-Gracia, Juan; Hill, Alexandra; Jambai, Amara; Ganda, Louisa; Castro,Marcia C.; Buckee, Caroline O.
Proceedings of the National Academy of Sciencies USA 117, 5067-5073

Tunable topological charge vortex microlaser
Zhang,Zhifeng; Qiao, Xingdu; Midya, Bikashkali ; Liu, Kevin; Sun, Jingbo ; Wu, Tianwei ; Liu, Wenjing ; Agarwal, Ritesh ; Jornet, Josep Miquel; Longhi, Stefano; Litchinitser, Natalia M; Feng, Liang
Science 368, 760-763

Dispersal-induced instability in complex ecosystems
Baron, Joseph William; Galla, Tobias
Nature Communications 11, 6032

Ultrafast relaxation of photoexcited superfluid He nanodroplets
Mudrich, M.;LaForge,A.C.; Ciavardini, A.; O'Keeffe,P.;Callegari, C.;Coreno,M.;Demidovich,A.;Devetta,M.; Di Fraia,M.; Drabbels,M.; Finetti,P.;Gessner,O.;Grazioli,C.;Hernando, A.;Neumark,D.M.;Ovcharenko,Y.; Piseri,P.;Plekan,O.;Prince,K.C.;Richter,R.;Ziemkiewicz,M.P.;Möller,T; Eloran, J.
Nature Communications 11, 112

Andreev-Coulomb drag in coupled quantum dots
Tabatabaei, S. M.; Sanchez, D.; Levy Yeyati, R.; Sanchez, R.
Physical Review Letters 125, 247701 (1-6)

Non-Bloch-Band Collapse and Chiral Zener Tunneling
Longhi, Stefano
Physical Review Letters 124, 066602 (1-7)

Accelerating photonic computing by bandwidth enhancement of a time-delay reservoir
Estébanez, Irene; Schwind, Janek; Fischer, Ingo; Argyris, Apostolos
Nanophotonics 9 (13), 20200184 (1-9) (2020)

Driven progressive evolution of genome sequence complexity in Cyanobacteria
Moya, Andrés ; Oliver, José L.; Verdú, Miguel; Delaye, Luis; Arnau, Vicente; Bernaola-Galván, Pedro; de la Fuente, Rebeca; Díaz, Wladimiro; Gómez-Martín, Cristina; González, Francisco M.; Latorre, Amparo; Lebrón, Ricardo; Román-Roldán, Ramón
Scientific Reports 10, 19073 (1-14)

Emergence of complex structures from nonlinear interactions and noise in coevolving networks
Raducha, Tomasz; San Miguel, Maxi
Scientific Reports 10 , 15660

Robustness to extinction and plasticity derived from mutualistic bipartite ecological networks
Sheykhali,Somaye;Fernández-Gracia,Juan;Traveset,Anna;Ziegler, Maren;Voolstra,Christian R.;Duarte,Carlos M.;Eguíluz,Víctor M.
Scientific Reports 10, 9783

First-passage times and normal tissue complication probabilities in the limit of large populations
Hufton, Peter; Buckingham-Jeffery, Elizabeth; Galla, Tobias
Scientific Reports 10, 8786 (1-12)

Scaling in the recovery of urban transportation systems from special events
Bassolas, Aleix; Gallotti, Riccardo; Lamanna, Fabio; Lenormand, Maxime; Ramasco, Jose J.
Scientific Reports 10, 2746

A flexible method for optimising sharing of healthcare resources and demand in the context of the COVID-19 pandemic
Lucas Lacasa, Robert Challen, Ellen Brooks-Pollock, Leon Danon
PLoS ONE 15, e0241027

Against mass media trends: Minority growth in cultural globalization
Cosenza, M. G.; Gavidia, M. E; González-Avella, J. C.
PLoS ONE 15(4), e0230923

Migrant mobility flows characterized with digital data
Mazzoli,Mattia;Diechtiareff,Boris;Tugores,Antònia;Wives,Willian;Adler, Natalia;Colet,Pere;Ramasco,Jose J
PLoS ONE 15, e0230264

Classical analogies for the force acting on an impurity in a Bose-Einstein condensate
Rønning, Jonas; Skaugen, Audun; Hernández-García, Emilio; López, Cristóbal; Angheluta, Luiza
New Journal of Physics 22, 073018 (1-14)

Absorbing transition in a coevolution model with node and link states in an adaptive network: Network fragmentation transition at criticality
Saeedian, Meghdad; San Miguel, Maxi; Toral, Raul
New Journal of Physics 22, 113001

Binary-state dynamics on complex networks: Stochastic pair approximation and beyond
Peralta, Antonio F.;Toral, Raul
Physical Review Research 2, 043370 (1-25)

Fast and robust quantum state transfer in a topological Su-Schrieffer-Heeger chain with next-to-nearest-neighbor interactions
D'Angelis, Felippo M.; Pinheiro, Felipe A. ; Guéry-Odelin, David; Longhi, Stefano; Impens, François
Physical Review Research 2, 033475 (1-11)

A general model for vegetation patterns including rhizome growth
Ruiz-Reynés, Daniel; Schönsberg, Francesca; Hernández-García, Emilio; Gomila, Damià
Physical Review Research 2, 023402 (1-8)

Synchronization along quantum trajectories
Es'haqi-Sani, Najmeh; Manzano, Gonzalo; Roberta, Zambrini; Fazio, Rosario
Physical Review Research 2, 023101 (1-11)

Altruism in populations at the extinction transition
Klemm, Konstantin; Khalil, Nagi
Physical Review Research 2, 013374 (1-13)

Vector-borne epidemics driven by human mobility
Soriano-Paños,David;Arias-Castro,Judy Heliana;Reyna-Lara,Adriana;Martínez,Hector J.;Meloni,Sandro;Gómez-Gardeñes,Jesús;
Physical Review Research 2, 013312 (1-12)

Symmetry and block structure of the Liouvillian superoperator in partial secular approximation
Cattaneo, Marco; Giorgi, Gian Luca; Maniscalco, Sabrina; Zambrini, Roberta
Physical Review A 101, 042108

Microscopic and phenomenological models of driven systems in structured reservoirs
Giorgi, Gian Luca; Saharyan, Astghik; Guérin, Stéphane; Sugny, Dominique; Bellomo, Bruno
Physical Review A 101, 012122 (1-9)

Unraveling the non-Hermitian skin effect in dissipative system
Longhi, Stefano
Physical Review B 102, 201103(R) (1-6)

Generalized Aubry-André self-duality and mobility edges in non-Hermitian quasiperiodic lattices
Liu, Tong; Guo, Hao; Pu, Yong; Longhi, Stefano
Physical Review B 102, 024205 (1-10)

Subgap spectrum for an interacting hybrid superconducting quantum dot
Lim, Jong Soo; López, Rosa
Physical Review B 101, 245427

Evidence for Majorana phases in the magnetoconductance of topological junctions based on two-dimensional electron gases
Serra, Llorenç; Delfanazari, Kaveh
Physical Review B 101, 115409(1-8)

Discrete diffraction and Bloch oscillations in non-Hermitian frequency lattices induced by complex photonic gauge fields
Qin,Chengzhi; Wang ,Chengzhi; Wong, Zi Jing; Longhi, Stefano; Lu, Peixiang
Physical Review B 111, 064303 (1-14)

Pair approximation for the noisy threshold q-voter model
R. Vieira, Allan; F. Peralta, Antonio; Toral, Raúl; San Miguel, Maxi; Anteneodo, Celia
Physical Review E 101, 052131

Adsorption transition of grafted ferromagnetic filaments controlled by external magnetic fields
Sánchez, Pedro A.; Novak, Ekaterina V.; Pyanzina, Elena S.; Kantorovich, Sofia S.; Cerdà, Joan J.; Sintes, Tomas
Physical Review E 102, 022609 (1-11)

Ecological communities from random generalized Lotka-Volterra dynamics with nonlinear feedback
Sidhom, Laura; Galla, Tobias
Physical Review E 101, 032101 (1-15)

Dynamics in cortical activity revealed by resting-state MEG rhythms
Mendoza-Ruiz, J; Alonso-Malaver, E; Valderrama, M, Rosso, A, Martinez, Johann. H.
Chaos 30, 123138

Travel restrictions during pandemics: A useful strategy?
Zanin, Massimiliano; Papo, David
Chaos 30, 111103

Introduction to the Chaos Focus Issue on the Dynamics of Social Systems
San Miguel, Maxi; Toral, Raul
Chaos 30, 12041

Effects of demand control on the complex dynamics of electric power system blackouts
Carreras, Benjamin A.; Tchawou Tchuisseu, Eder Batista; Reynolds-Barredo, José M.; Gomila, Damià; Colet, Pere
Chaos 30, 113121

Fluctuations and correlations in Kerr optical frequency combs with additive Gaussian noise
Chembo, Yanne K.; Coillet, Aurélien; Lin, Guoping; Colet, Pere; Gomila, Damià
Chaos 30, 083146 (1-6)

Local connectivity effects in learning and coordination dynamics in a two-layer network
Lugo, Haydée; González-Avella, Juan Carlos; San Miguel, Maxi
Chaos 30, 083125(1-10)

Variational Approach to KPZ: Fluctuation Theorems and Large Deviation Function for Entropy Production
H.S. Wio, M.A. Rodriguez & R. Gallego
Chaos 30, 073107 (1-8)

Characterizing signal encoding and transmission in class I and class II neurons via ordinal time-series analysis
Estarellas, C.; Masoliver, M.; Masoller, C.; Mirasso, C.
Chaos 30, 013123 (1-15)

Assessing functional propagation patterns in COVID-19
Zanin, Massimiliano; Papo, David
Chaos, Solitons & Fractals 138, 109993

A minimal model of hospital patients' dynamics in COVID-19
Papo,David;Righetti,Marco;Fadiga, Luciano;Biscarini,Fabio;Zanin,Massimiliano
Chaos, Solitons & Fractals 140, 110157

Risk of secondary infection waves of COVID-19 in an insular region: the case of the Balearic Islands, Spain
Eguíluz,Victor M;Fernández-Gracia,Juan;Rodríguez,Jorge P;Pericàs, Juan M;Melián, Carlos J
Frontiers in Medicine 7, 563455

Community Detection Boosts Network Dismantling on Real-World Networks
Wandelt, Sebastian; Shi, Xing; Sun, Xiaoqian; Zanin, Massimiliano
IEEE Access 8, 111954 - 111965

Assessing airport landing efficiency through large-scale flight data analysis
Zanin, Massimiliano
IEEE Access 8, 170519-170528

Introduction to JSTQE Issue on Photonics for Deep Learning and Neural Computing
Prucnal, P.R.; Shastri, B.J.; Fischer, I.; Brunner, D.
IEEE Journal of Selected Topics in Quantum Electronics 26 (1), 0200103 (1-3)

Comparison of photonic reservoir computing systems for fiber transmission equalization
Argyris, A.; Cantero, J.; Galletero, M.; Pereda, E.; Mirasso, C. R.; Fischer, I.; Soriano, M. C.
IEEE Journal of Selected Topics in Quantum Electronics 26, 5100309

Chiral excitation and effective bandwidth enhancement in tilted waveguide lattices
Longhi, Stefano
Optics Letters 45, 6667-6670

Stochastic non-Hermitian skin effect
Longhi, Stefano
Optics Letters 45, 5250-5253

Topological Anderson phase in quasi-periodic waveguide lattices
Longhi, Stefano
Optics Letters 45, 4036-4039

Superradiance paradox in waveguide lattices
Longhi, Stefano
Optics Letters 45, 3297-3300

Photonic simulation of giant atom decay
Longhi, Stefano
Optics Letters 45, 3017-3020

Quantum statistical signature of PT symmetry breaking
Longhi, Stefano
Optics Letters 45, 1591-1594

Non-Hermitian multimode interference
Longhi, Stefano; Feng, Liang
Optics Letters 45, 1962-1965

Ultrafast control of fractional orbital angular momentum of microlaser emissions
Zhang, Zhifeng; Zhao, Haoqi ; Gomes Pires, Danilo; Qiao, Xingdu; Gao, Zihe; Jornet Josep M.; Longhi, Stefano; Litchinitser, Natalia M.; Feng, Liang
Light: Science & Applications 9, 179 (1-9)

Topological Protection and Control of Quantum Markovianity
Giorgi, Gian Luca; Lorenzo, Salvatore; Longhi, Stefano
Photonics 7, 18 (1-11)

Performance boost of time-delay reservoir computing by non-resonant clock cycle
Stelzer, Florian;Röhm, André;Lüdge, Kathy;Yanchuk, Serhiy
Neural Networks 124, 158-169

Frequency-dependent organization of the brain's functional network through delayed-interactions
Ziaeemehr, A.; Zarei, M.; Valizadeh, A.; Mirasso, C. R.
Neural Networks 132, 155-165

On the importance of trip destination for modelling individual human mobility patterns
Lenormand, Maxime; Arias, Juan Murillo; San Miguel, Maxi; Ramasco, Jose J.
Journal Royal Society Interface 17, 20200673

Ageing, computation and the evolution of neural regeneration processes
Ollé-Vila, Aina; Seoane, Luís F.; Solé, Ricard V.
Journal of the Royal Society Interface 17, 20200181

Mitochondria interaction networks show altered topological patterns in Parkinson's disease
Zanin, Massimiliano; Santos, Bruno FR; Antony, Paul MA; Berenguer-Escuder, Clara; B. Larsen, Simone; Hanss, Zoe; Barbuti, Peter; Baumuratov, Aidos S.; Grossmann, Dajana; Capelle, Christophe M.; Weber, Joseph; Balling, Rudi; Ollert, Markus; Krüger, Rejko; Diederich, Nico J.; He, Feng Q.
NPJ Systems Biology and Applications 6, 38

Spin-Polarized Electron Transmission in DNA-Like Systems
Sierra, M. A.; Sánchez, D.; Gutiérrez, R.; Cuniberti, G.; Domínguez-Adame, F.; Díaz, E.
Biomolecules 10, 49 (1-10)

Sequencing effort dictates gene discovery in marine microbial metagenomes
Duarte, Carlos M; Ngugi, David K; Alam, Intikhab; Pearman, John; Kamau, Allan; Eguiluz, Victor M; Gojobori, Takashi; Acinas, Silvia G; Gasol, Josep M; Bajic, Vladimir; Irigoien, Xabier
Environmental Microbiology 22, 4589-4603

Different theta frameworks coexist in the rat hippocampus and are coordinated during memory-guided and novelty tasks
Lopez-Madrona, V.; Pérez-Montoyo, E.; Álvarez-Salvado, E.; Moratal, D.; Herreras, O.; Pereda, E.; Mirasso, C.; Canals, S.
eLife 9, e57313 (1-35)

Quantum Transport in Mesoscopic Systems
Sánchez, D.; Moskalets, M.
Entropy 22, 977 (1-4)

Fate of Duplicated Neural Structures
Seoane; Luis F.
Entropy 22, 928

Criticality in Pareto Optimal Grammars?
Seoane, Luis F.; Solé, Ricard V.
Entropy **22**, 165

Effective Equilibrium in Out-of-Equilibrium Interacting Coupled Nanoconductors
Maisel, Lucas; Lopez, Rosa
Entropy 22, 8

Ultrafast and anharmonic Rabi oscillations between non-Bloch bands
Lee, Cheng Hua; Longhi, Stefano
Communications Physics 3, 147 (1-9)

Developing a photonic hardware platform for brain-inspired computing based on 5 × 5 VCSEL arrays
Heuser, Tobias; Pflüger, Moritz; Fischer, Ingo; Lott, James A; Brunner, Daniel; Reitzenstein, Stephan
Journal of Physics: Photonics 2, 044002

Tree decompositions of real-world networks from simulated annealing
Klemm, Konstantin
Journal of Physics: Complexity 1, 035003 (1-8)

Fluctuation theorems and large-deviation functions in systems not featuring a steady state
Wio, H.S.; Deza, R.R.; Revelli, J.A.
Journal of Statistical Mechanics: Theory and Experiment 2020, 024009 (1-11)

Reduction from non-Markovian to Markovian dynamics: The case of aging in the noisy-voter model
Peralta, Antonio F.;Khalil, Nagi;Toral, Raul
Journal of Statistical Mechanics 2020, 024004

Accumulated densities of sedimenting particles in turbulent flows
Sozza, Alessandro; Drotos, Gabor; Hernandez-Garcia, Emilio; Lopez, Cristobal
Physics of Fluids 32, 075104 (1-11)

The Forced Response of the El Niño–Southern Oscillation–Indian Monsoon Teleconnection in Ensembles of Earth System Models
Bodai,Tamas;Drotos,Gabor;Herein, Matyas;Lunkeit,Frank;Lucarini,Valerio
Journal of Climate 33, 2163-2182

Global variability in radiative-convective equilibrium with a slab ocean under a wide range of CO2 concentrations
Drotos,Gabor;Becker,Tobias;Mauritsen,Thorsten;Stevens,Bjorn
Tellus 72, 1-19

Partial balance in social networks with stubborn links
Somaye Sheykhalia, Amir Hossein Darooneh, Gholam Reza Jafarid
Physica A 548, 123882

Ordering dynamics in the voter model with aging
Peralta, A. F.; Khalil, N.; Toral, R.
Physica A 552, 122475

Phase transitions in persistent and run-and-tumble walks
Proesmans,Karel; Toral,Raul: Van den Broeck, Christian
Physica A 552, 121934

Patterns, localized structures and fronts in a reduced model of clonal plant growth
Ruiz-Reynés, Daniel; Martín, Luis; Hernández-García, Emilio; Knobloch, Edgar; Gomila, Damià
Physica D 414, 132723

Characterization and Prediction of Air Transport Delays in China
Zanin, Massimiliano; Zhu, Yanbo; Yan, Ran; Dong, Peiji; Sun, Xiaoqian; Sebastian Wandelt
Applied Sciences 10, 6165

a.5.2 Other Publications

Dynamic noise maps for Ljubljana airport
Garnić, Emir; van Oosten, Nico; Meliveo, Luis; Jeram, Sonja; Louf, Thomas; Ramasco, Jose Javier
10th SESAR Innovation Days 2020

Una nueva ciencia de la movilidad urbana
Aleix Bassolas, Mattia Mazzoli, Jose Javier Ramasco
Investigación y Ciencia 528

Termoelectricidad cuántica: conversión de energía a escala nanométrica
Sánchez, D.; Sánchez, R.
Revista Española de Física 34, 11-16

Efecto de la COVID-19 en Baleares: un estudio interdisciplinar
Mirasso, C. R. Ed.
Medicina Balear – Especial Covid 19 35, 24-33

COVID-19: Predicción de eventos de hospitalización en UCI / muerte usando registros médicos de atención y herramientas de aprendizaje automático
Khajuria, T.; Pou Goyanes, J. A.; Mirasso, C. R.; Vicente, R.
Medicina Balear 35, 25-27

Mobility during the pandemic.
Mazzoli, Mattia; Ramasco, Jose J.
Medicina Balear, 2020; 35 (4): 30-33

Risk Analysis of Second Wave of COVID-19 in the Balearic Islands
Eguíluz, Victor M.; Fernandez-Gracia, Juan; Rodriguez, Jorge P.; Pericàs, Juan M.; Melian, Carlos
Medicina Balear 2020; 35 (4): 27-30

From scale-dependent feedbacks to long-range competition alone: a short review on pattern-forming mechanisms in arid ecosystems
Martínez-García, Ricardo; López, Cristóbal
Treballs de la Societat Catalana de Biologia 69, 30-36

Adiós al padre del caos
Galla, Tobias
El Pais , 4 May

Por qué es difícil controlar brotes epidémicos en un mundo que se mueve tanto
Meloni, Sandro
The Conversation, 25 March

a.6. Presentations at conferences and academic centers

a.6.1 Invited talks at conferences and workshops

Aguilar, Javier
Reaction-Diffusion Processes on Hierarchy of Meta-Communities.
VI COMSOTEC, Burgos, Spain.
February 13 -14

Zambrini, Roberta
Synchronization and coalescence in dissipative qubit systems.
Quantum open systems, Quantum thermodynamics, Quantum probability, Universita degli Studi, Milan, Italy.
February 18 - 21

Giorgi, Gian Luca; Cabot, Albert; Zambrini, Roberta
Synchronization and exceptional points in open quantum systems.
Quantum Information Theory and Thermodynamics at the Nanoscale, Al-Hoceima, Morocco.
March 2 – 5

Fischer, Ingo
Computing with Optical Reservoirs.
Neuromorphic Systems (virtual conference organised by Oak Ridge National Laboratory).
July 28 - 30

López, Cristobal
Anticipating climatic tipping points and regime shifts: fundamentals.
1st CAFE (Climate Advanced Forecasting of sub-seasonal Extremes) online workshop.
September 14

Hernandez-Garcia, Emilio
Anticipating climatic tipping points and regime shifts: Classical and Network methods of anticipation.
1st CAFE (Climate Advanced Forecasting of sub-seasonal Extremes) online workshop.
September 15

Nokkala, Johannes
Gaussian states are enough for universal and powerful quantum reservoir computing.
NetSci Satellite Workshop on Quantum Network Science (online).
October 18

Fischer, Ingo
Photonic Reservoir Computing for Optical Communication Systems.
ECOC 2020, Workshop 6: Pathway to Bring Photonics in High-Performance Computing: from Materials to Applications.
December 6 - 10

Colet, Pere
Effects of fluctuations and demand control on the complex dynamics of electric power system blackouts.
Satellite on Complexity in Energy Systems, Conference on Complex Systems CCS2020 .
December 9 – 10

a.6.2 Other talks at conferences and workshops

Ramasco, Jose J
Hierarchical organization of urban mobility and its connection with city livability.
Sixth Meeting of the Spanish Community for the Study of Complex Systems COMSOTEC, Burgos, Spain.
February 13 – 14

Donati, Giovanni
Time delay Reservoir Computing based on silicon microring resonators.
Presentation given in the 'Students talk to Students' event organized by the Nanolab, University of Trento (online).
May 28

Drotos, Gabor; de la Fuente, Rebeca; Hernandez-Garcia, Emilio; Lopez, Cristobal
Vertical dispersion of noninertial particles when sinking in mesoscale oceanic flows.
Dynamics Days Digital 2020.
August 27

Llorenç Serra
Magneto conductance of topological junctions based on 2DEGS reveals Majorana phases.
CMD2020GEFES, Joint meeting of the Condensed Matter Division of the EPS and the 'Grupo Especializado de Física de Estado Sólido' of the 'RSEF' (Madrid online participation).
August 31 – September 4

Sánchez, David
Cooling by Powering the Quantum Hall Effect.
CMD2020GEFES, Joint meeting of the Condensed Matter Division of the EPS and the 'Grupo Especializado de Física de Estado Sólido' of the 'RSEF' . Madrid (online participation)
August 31 – September 4

Ramasco, Jose J.
Hierarchical organization of urban mobility and its connection with city livability.
NetSci conference, (Rome, Italy, online participation).
September 13 - 25

Calleja- Solanas, Violeta; Hernández-García, Emilio; Khalil, Nagi; Meloni, Sandro
Structured interactions in competitive ecological systems.
NetSci conference, (Rome, Italy, online participation).
September 13 - 25

Mattia Mazzoli, Filippo Privitera, Pere Colet, Riccardo Gallotti & José J. Ramasco
Spatial immunization: a temporal network approach to counteract epidemic outbreaks in airports.
NetSci conference, (Rome, Italy, online participation).
September 13 - 25

H.S.Wio, M.A.Rodriguez, R.Gallego, R.R. Deza, J.A. Revelli
Variational Approach to KPZ: Fluctuation Theorems, Large Deviation Function for Entropy Production & Probability Distribution Function.
45th MECO-Conference of the Middle European Cooperation in Statistical Physics, Babes-Bolyai Univ. , Physics Department, Romania.
September 14 - 16

Ehstand, Noémie
Two Lagrangian approaches to atmospheric blocking.
CAFE Mini-workshop, Dresden (Germany).
September 22 – 23

Antònia Tugores
COVID19Gram: seguimiento de la evolución del coronavirus desde telegram.
PyConES 2020 - online.
October 3

Zanin, M.
Caso de éxito StG2019: ARCTIC Air Transport as Information and Computation SH2
Jornada Informativa Nacional – European Research Council, Convocatorias 2021.
October 28

Cabot, Albert
Quantum synchronization in dimer atomic lattices.
Quantum Technology International Conference - QTech2020 (online).
November 3

Nokkala, Johannes
Gaussian states provide universal and versatile quantum reservoir computing.
Quantum Technology International Conference - QTech2020 (online).
November 4

Cattaneo, Marco
Collision models can efficiently simulate any multipartite Markovian quantum dynamics
Quantum Thermodynamics Workshop. National Institute for Theoretical Physics, South Africa.
November 23 - 27

H.S.Wio, M.A.Rodriguez, R.Gallego, R.R. Deza, J.A. Revelli
Variational Approach to KPZ: Fluctuation Theorems, Large Deviation Function & Probability Distribution Function.
33rd M. Smoluchowski Symp. on Statistical Physics, Krakow, Poland.
December 3 - 4

Estébanez, Irene; Schwind, Janek; Fischer, Ingo; Argyris, Apostolos
Bandwidth Enhanced Operation of Photonic Time Delay Reservoir Computer.
European Conference on Optical Communications (ECOC) 2020, CLEO/Europe Focus Meeting.
December 6 - 10

Mattia Mazzoli, Emanuele Pepe, David Mateo, Ciro Cattuto, Laetitia Gauvin, Paolo Bajardi, Michele Tizzoni, Alberto Hernando, Sandro Meloni, Jose Javier Ramasco
Interplay between mobility, multi-seeding and lockdowns shapes COVID-19 local impact.
CCS2020 - Complex-Space2020 (Online).
December 7 - 8

Louf, Thomas; Ramasco, José J.; Sanchez, David
Bilingual societies: from data to agent-based modeling.
Computational Social Science Satellite at the Conference on Complex Systems 2020 (online).
December 9

Martínez-Barbeito, María; Gomila, Damià; Colet, Pere
Frequency fluctuations and stability of power grids with a large renewables penetration ratio.
Satellite Complexity in Energy Systems at the Conference on Complex Systems 2020 (online).
December 10

Nassima Benchtaber , David Sánchez, and Llorenç Serra
Topological states electrically induced in bilayer graphene.
International Conference of Computer Science and Renewable Energies (ICCSRE 2020), Agadir, Morocco.
December 22 - 24

a.6.3 Poster presentations

Almodóvar, Alejandro
Active cluster crystals with repulsive potentials
American Physical Society & International Center for Theoretical Physics – South American Institute for Fundamental Research. Sao Paulo, Brasil.
Young Physicists Forum on Biological Physics.
March 9 – 15

M. Barreiro; A. Corral; C. Deandreis; R. Donner; H. Douville; N. Ehstand; E. Faust; L. Ferranti; S. Gupta; E. Hernandez-Garcia; P. Herrera; X. Hu; A. John; H. Kantz; Meriem Krouma; J. Kurths; L. Magnusson; C. Masoller; N. Mastrantonas; J. Matschullat; M. Minjares; F. Pappenberger; I. Perez; N. Rieger; E. Rouges; R. Silini; A. Turiel; P. Yiou
The Climate Advanced Forecasting of sub-seasonal Extremes (CAFE), ITN Project.
European Geosciences Union General Assembly 2020: Sharing Geoscience Online.
May 4

Drotos, Gabor
On associating significance levels with temporal changes in empirical orthogonal function analysis: a case study for ENSO.
EGU General Assembly 2020: Sharing Geoscience Online.
May 8

Somaye Sheykhali, Juan Fernández-Gracia, Carlos M. Duarte and Víctor M. Eguíluz
Marine prokaryote-eukaryote interactions: Multi-layer network approach.
NetSci 2020.
September 17

Cattaneo, Marco
Collision models can efficiently simulate any multipartite Markovian quantum dynamic
YIQIS 2020 (Young Italian Quantum Information Science

Conference)
September 28 – October 2

Cattaneo, Marco
Collision models can efficiently simulate any multipartite Markovian quantum dynamic
QTD 2020 (Conference on Quantum Thermodynamics)
October 19 – 23

Nokkala, Johannes
Quantum reservoir computing with Gaussian states.
Q-TURN 2020 workshop (online).
November 24

Somaye Sheykhali, Fernandez-Gracia Fernandez-Gracia, Carlos M. Duarte and Victor M. Eguiluz
Inferring Eukaryote-Prokaryote interactions in microbial communities: a multi-layer network approach.
COMPLEX NETWORKS 2020.
December 1

N. Ehstand, R. Donner, C. López, E. Hernández-García
A Lagrangian flow network approach to atmospheric blocking.
Conference on Complex Systems 2020 (online).
December 10

a.6.4 Seminars and talks in other research centers

López, Rosa
Chiral Maxwell Demon.
Universidad de Sevilla, Spain
January 24 - 28

Drotos, Gabor
Climate in radiative-convective equilibrium: dependence on CO_2 concentration.
Institute for Theoretical Physics, Eotvos University, Budapest, Hungary.
January 8

Cabot, Albert.
Synchronization and Coalescence in dissipative two qubit systems.
Institute of Theoretical Physics, Ulm, Gemany.
January 16

Seoane, Luís F; Solé, R.
Information theory strategies to scape parasites.
Santa Fe Institute, Albuquerque, USA
January 17

Donati, Giovanni
Information processing using one silicon microring resonator
Nanolab, University of Trento, Italy (online)
April 9

Hernandez-Garcia, Emilio
Pattern formation in seagrasses: Fairy circles under the sea.
Webinar given in the 'Complexity and Society' series of the Centre for Complex Systems Studies, Utrecht University, The Netherlands.
May 29

Ehstand, Noémie
Numerical continuation of fractional PDEs.
Oberseminar Dynamics, TUM Chair of Multiscale and Stochastic Dynamics. Munich, Germany.
June 15

Donati, Giovanni
Delay-based reservoir computing with silicon microring resonator
Nanolab, University of Trento, Italy (online)
October 19

Zanin, M.
How not to construct functional brain networks: link definition.
Brain & Mind Computational Seminar, Aalto University, Finland
November 17

Cattaneo, Marco
Symmetry and block structure of the Liouvillian superoperator in partial secular approximation
Steklov Mathematical Institute. Moscow, Russia.
November 18

Zambrini, Roberta
From classical to quantum synchronization.
Colloquium at University of Glasgow, UK.
November 20

Drotos, Gabor
Climate change seen through the pullback attractor of an Earth system model: a case study.
Internal seminar of the Centre for Systems, Dynamics and Control at the University of Exeter, UK.
November 26

Drotos, Gabor
Climate change seen through the pullback attractor of an Earth system model: a case study.
Talk at the Nonlinear Dynamics and Time Series Analysis group of the Max Planck Institute for the Physics of Complex Systems. Gemany.
December 1

a.7. Other Activities

a.7.1. Master Thesis

Aviñó, Laura
Analysis and simulation of a Palma de Mallorca hospital emergency department
Supervisors: Raúl Toral, Claudio Mirasso, Ángel del Río
December 17

Ferrante, Patrizia
Hypoxic response in cancer progression: modeling HIF activation
Supervisors: Toral, Raul; Flandoli, Franco
December 17

Titz, Robert
Portfolio Optimization with Random Matrix Theory and Artificial Neural Networks
Supervisor: Colet, Pere
December 17

Pons Rullán, Bartolomé
Behavioral Phenotypes in Evolutionary Games on Networks
Supervisor: Sandro Meloni
December 16

Saleta-Piersanti Besga, Ramon
Effects of third order dispersion on the instabilities of Kerr frequency combs
Supervisor: Damià Gomila
December 16

Fullana Sanchez, Antonia
Collective effects in voltage-gated protein ensembles
Supervisor: Sintes, Tomás
December 16

Larroya Paixa, Ferran
Stochastic and deterministic approaches to generalised random Lotka-Volterra communities
Supervisor: Galla, Tobias
December 15

Abio Rojo, Albert
Competition between Mediterranean clonal seagrasses
Supervisor: Sintes, Tomás
December 14

Magiera, Marius-Jascha
Competition for attention in social networks - An ecological approach
Supervisor: Meloni, Sandro
December 14

Abella, David
Perturbations propagation in self-organized patterns
Supervisor: Gomila, Damià
December 9

Vettelschoss, Benedikt
Fundamentals of Information Processing on an Analog Reservoir Computer
Supervisors: André Röhm and Miguel C. Soriano
November 27

Osorio,Dianela A.
Explosive transitions in site percolation
Supervisors: R. Toral, P. Colet
November 16

Palacios de Luis, Ana
The role of coherence in Quantum Reservoir Computing
Supervisors: R. Zambrini and G.L. Giorgi
October 9

Medina Hernández, Jorge
Dynamic Information Routing in Neuronal Circuits
Supervisors: Mirasso, Claudio R.; Eguíluz, Víctor M.
September 18

Giménez Romero, Alex
Modelling the Mass Mortality Event of Pinna nobilis
Supervisors: Manuel A. Matias and Iris E. Hendriks
September 10

Galván Fraile, Javier
Machine Learning for Remote Sensing of Xylella fastidiosa
Supervisors: Ramasco, Jose J.; Matias, Manuel A.
July 30

Perez Manrique, Ana
Aggression-affiliation Motifs in Bottlenose Dolphins' Social Networks
Supervisors: Fernandez-Gracia, Juan; Ramasco, Jose J.
March 6

a.7. 2. Research stays in other centers

Max Planck Institute for Meteorology (Hamburg), Germany.
Establishing a research plan on variability in radiative-convective equilibrium.
Drotos, Gabor
January 9 - 17

Institute of Theoretical Physics (Ulm), Germany.
Group of Martin Plenio and Susana Huelga, University of Ulm. Funded by CAIB PhD program.
Cabot, Albert.
January 13 - February 21

Institute for Theoretical Physics, Eotvos University (Budapest), Hungary.
Discussions with Stefano Pierini and Tamas Tel on future directions of ensemble studies of climate variability.
Drotos, Gabor
February 10 - 14

Potsdam-Institut für Klimafolgenforschung (PIK), Gemany.
Secondment at PIK, partly online (June-July) and partly on-site (August-September).
Ehstand, Noémie
June 1 – September 30

a.8. Press and Media

The titles are linked to the document or media clip

a.8.1 Press and digital Media

Educación destaca el papel capital del CSIC en la investigación que se lleva a cabo desde las Islas Baleares
Noticias Mallorca
Nou Diari
January 7

«Tanto Palma como Mallorca tienen sus periferias mal comunicadas entre sí»
Última Hora
January 28

El doctor Enrique Playán, director de l'Agència Estatal d'Investigació, visita la UIB
El diari de la UIB
January 29

El català i el castellà coexistiran a Catalunya almenys fins al 2030
Diari de la Llengua
February 3

Nazareth Castellanos: "El corazón percibe, el intestino siente, el cerebro interpreta"
Diario de Mallorca
February 8

Com s'explica la distribució de les praderies de posidònia?
El diari de la UIB
February 18

La UIB i APSL signen un conveni de col·laboració
El diari de la UIB
February 24

La UIB y la empresa tecnológica APSL colaborarán en procesamiento de datos
ABC.es
Europa Press
February 25

Navegando enredados en la complejidad del siglo XXI
Baleópolis, El Mundo
March 1

"La naturaleza te sorprende más que tu imaginación"
Baleópolis, El Mundo
March 9

APSL y la UIB apuestan por la innovación
Última Hora
Menorca.info
Diario de Ibiza y Formentera
March 9

Claudio Mirasso, elegido académico numerario de la Real Academia de Medicina de Baleares
Acta Sanitaria
March 10

La importància del període d'incubació en brots de còlera i de la malaltia de l'Ebola a Sierra Leone
El diari de la UIB
March 10

Un estudio con participación de la UIB profundiza en cómo se propagan las enfermedades en el tiempo y el espacio
Europa Press
Heraldo
20 Minutos
La Vanguardia
Gente en Palma de Mallorca
Infosalus
Salud Ediciones
Gaceta Médica
March 11

Los periodos de incubación afectan a la dispersión de los brotes infecciosos
Agencia SINC
TecnoXplora
Salamanca 24h
Biotech
March 12

El CSIC impulsa investigaciones en biotecnología, nanotecnología y demografía para atajar el coronavirus
CSIC
Madridmasd
Biotech Spain
Innova Spain
Aquí en Vega la Baja
Catalunya Vanguardista
Aquí en Crevillent
Aquí en Elche
La Razón Digital
Alicante Plaza
El Periodico de Aquí
El Diario de Cantabria
Castellón Plaza
Asturias Mundial
Granada Digital
Diario Jaén
Siglo XXI
Redacción Médica
Bolsamanía
Infosalus
March 23

El IFISC participa en la investigación sobre el COVID-19
Europa Press
La Vanguardia
Gente Digital
Diario de Mallorca
March 25

Per què un món tan mòbil complica el control d'epidèmies
El Nacional
March 26

Por qué es difícil controlar brotes epidémicos en un mundo que se mueve tanto
El Portaluco
March 26

Armengol se reúne con científico de Baleares para valorar las medidas frente al Covid-19 en la comunidad
Europa Press
Gente Digital
Salut i Força
Ara Balears
La Vanguardia
20minutos
Noticias Mallorca
March 31

Atos suministrará a la UIB un superordenador
Economía de Mallorca
April 1

El CSIC utiliza datos de móviles para estudiar la eficacia del confinamiento sobre la dispersión de COVID-19
CSIC
La Opinión A Coruña
Faro de Vigo
La Mañana
Ciudad Real Digital
Hora Punta
Més Ebre
Entre Mayores
TecnoXplora
El Periódico de Aquí
Corporació Catalana de Mitjans Audiovisuals
El Periódic
Diari Més
NIUS
Biología y Actualidad
España Buenas Noticias
Solidaridad Digital
La Moncloa
Agencia SINC
VLC Noticias
DiCYT
Servimedia
Asturias Mundial
Ministerio de Ciencia, Innovación y Universidades
Torrevieja Radio
Ibeconomía
AZARPlus
Médicos y Pacientes
NCYT
April 15

Investigadores gallegos afirman que ya empieza a verse "la luz al final del túnel"
Faro de Vigo
Xornal 21
La Opinión A Coruña
April 15

El CSIC ya controla nuestro móviles para vigilar el confinamiento
Menorca al Día
April 15

El CSIC utiliza dades de mòbils per estudiar l'eficàcia del confinament en la propagació del coronavirus
La República
April 15

Baixa la mobilitat entre municipis
Sa Veu
April 15

La movilidad entre municipios de Mallorca cae hasta un 80 por ciento por el estado de alarma UIB
Diario de Mallorca
Europa Press
20minutos
La Vanguardia
Gente Digital
April 15

El CSIC utiliza datos de móviles para estudiar la eficacia del confinamiento
La Razón Digital
La Flecha
Valencia City
Catalunya Vanguardista
Informaria Digital
E-Health Reporter
CiberSur
April 16

Twitter como herramienta para detectar los flujos migratorios en el mundo
Europa Press
CSIC
Catalunya Vanguardista
Bolsamanía
Siglo XXI
La Vanguardia
April 16

Evalúan el confinamiento a partir de datos de móviles
JANO
April 17

Investigan la relación del calor con la propagación del virus
El Telescopio Digital
April 17

Un nuevo método basado en datos geolocalizados de Twitter detecta las corrientes de refugiados a nivel mundial
Madridmasd
NCYT
April 18

Els pobles de l'interior, rècord en desplaçaments durant el confinament
Ara Balears
April 18

La desescalada será asimétrica pero no está claro el orden de las regiones
El Mundo
April 18

Com han afectat les mesures de confinament la mobilitat a les illes Balears?
El Diari de la UIB
April 20

El CSIC idea un método con datos de Twitter para rastrear las corrientes de refugiados
EFE
April 20

Los datos de tu móvil ayudan a estudiar la eficiencia del confinamiento
Actualidad Sanitaria
April 20

De cómo un virus cambió nuestra movilidad
Innovaspain
April 23

Cinco investigadores del CSIC, en el grupo de expertos que asesora al Ministerio de Ciencia sobre Covid-19
CSIC
Ministerio de Ciencia e Innovación
Moncloa
Europa Press
El Economista
EFE
La Vanguardia
Diario de Cádiz
Etleboro
El País
NIUS
COPE
April 27

Cuatro estudios con móviles radiografían la movilidad en la cuarentena
El Periódico
April 28

El investigador del IFISC (CSIC-UIB) José Ramasco forma parte del equipo que asesora el Gobierno de España para hacer frente a la COVID-19
El diari de la UIB
Última Hora
Yahoo!
April 30

El investigador del IFISC (CSIC-UIB) José Ramasco forma parte del equipo que asesora al Gobierno de España para hacer frente al COVID19
Salud Ediciones
May 4

Los expertos del CSIC responden a las preguntas sobre la Covid-19 en un nuevo webinar interactivo
CSIC
May 14

¿La COVID-19? Pregúntale al CSIC
Asturias Mundial
El Periódico de Aquí
May 15

La responsabilidad es nuestra: correlación entre mortalidad del Covid-19 y movilidad
NAUKAS
May 15

Un estudi conclou que el 76% del pic de la pandèmia a l'estat espanyol prové dels trajectes amb origen i destinació a Madrid
Vila Web
May 17

Els viatges des de Madrid van escampar la Covid-19 a tot l'Estat, diu un estudi
El Nacional
El Temps
RAC1.cat
Valencia Diari
Tarragona Digital
Catalunya Diari
El Bloc del Víctor
Corporació Catalana de Mitjans Audiovisuals
El Punt Avui
May 18

El CSIC lanza cuatro encuestas para evaluar el impacto social de la COVID-19
CSIC
Siglo XXI
Bolsamania
Salamanca RTV
La Vanguardia
Moncloa
20minutos
Gente Digital
La Vanguardia
ABC
Benissa Digital
Universidad de Cantabria
Calp Digital
Dénia Digital
Xàbia al Día
Universitat Pompeu Fabra
Con Salud
Catalunya Vanguardista
España Buenas Noticias
Teulada Moraira Digital
BIQFR
May 19

El investigador José Ramasco inaugura el ciclo Movilidad urbana y COVID-19 , de Fundación Ibercaja
La Vanguardia
Gente Digital
May 19

Investigadores del CSIC responden en YouTube a preguntas de ciudadanos sobre prevención y desescalada
Siglo XXI
COPE
Bolsamanía
Crónica Norte
May 20

El investigador del CSIC, José Ramasco ha inaugurado el Ciclo "Movilidad Urbana y Covid", de Fundación Ibercaja
Mobility City
May 22

Madrid, encrucijada del coronavirus: los datos muestran que centrifugó la epidemia en España
NIUS
May 24

Los viajes de Madrid explican el 76 % de las muertes en el pico de la epidemia
La Voz de Galicia
May 25

José Javier Ramasco: "Una vez que los casos se reducen, hay que trazar los contactos"
Heraldo
May 27

Un estudio relaciona el "brutal intercambio" de personas entre Madrid y C-LM como "crucial" en la mortalidad
Europa Press

May 28

El estudio de la movilidad en tiempo casi real a través de los datos permite analizar los diferentes modelos urbanos
CSIC
Aquí en Orihuela
Ambientum
DICYT
Equipamiento y Servicios Municipales
June 5

Movilidad y Covid-19
Catalunya Vanguardista
June 8

Los expertos del CSIC abordan los modelos epidemiológicos de la pandemia de Covid-19
CSIC
June 9

Un estudio basado en las consultas en Internet y el tráfico de Wuhan concluye que el virus empezó a circular el pasado agosto
El País
June 9

Estudo de Harvard indica que o coronavírus começou a circular em Wuhan em agosto, meses antes de surto
El País Brasil
June 9

Qué dice la ciencia sobre la vuelta al cole, en diez preguntas
Agencia SINC
El diario
Público
NIUS
Ibercampus
El Espectador
Entorno Inteligente
Noticias de Gipuzkua
Deia
Noticias de Navarra
Diario Álava
La Flecha
Burgos Noticias
Ethic
iLeón
La Tribuna del País Vasco
Asturias Mundial
El Día de Zamora
June 19

Robustesa a l'extinció i plasticitat en xarxes de pol·linitzadors
El Diari de la UIB
July 8

Mobility City firma un acuerdo marco con el CSIC para desarrollar proyectos de movilidad en las ciudades
La Vanguardia
Europa Press
Gente Digital
20minutos
El Economista
ABC
CSIC
Biotech Spain
July 21

“La crisis de la COVID-19 ha demostrado que las políticas públicas necesitan ciencia”
Delegación CSIC Illes Balears
July 23

Los más jóvenes tuvieron menos contactos fuera de casa que los mayores durante el confinamiento, según encuesta del CSIC
CSIC
Crónica de Cantabria
COPE
Infosalus
Voz Populi
Redacción Médica
65ymás
Noticias CyL
Cantabria Liberal
Aquí en Elche
Aquí en la Vega Baja
Aquí en Crevillent
Astronomía, Física y Misiones Espaciales
Huelva Red
ISanidad
July 24

“Queremos demostrar la dificultad que tiene el virus de propagarse cuando se hacen las cosas bien”
El Boletín
Agencia SINC
ILeon
Biología y Actualidad
El Día de Zamora
Burgos Noticias
Astronomía, Física y Misiones espaciales
Asturias Mundial
Biología y Actualidad
August 6

Distintos tipos de onda combinan recuerdos e información nueva en el cerebro
EFE
CSIC
Redacción Médica
Infosalus
Siglo XXI
Radio Televisión Canaria
El Periódico de Aquí
Yahoo!
El Diario
CSIC
España Buenas Noticias
Asturias Mundial
Aquí en Elche
Salud a Diario
DiCYT
NCYT
Jano
August 10

Una nueva ciencia de la movilidad urbana
Investigación y Ciencia, Nº 528
September 1

Un estudi de la UIB conclou que l’alta mobilitat de Madrid va propagar el virus a l’estat en la primera onada
El Món a RAC1, RAC1
September 18

El IFISC logra un millón para innovar en sistemas de inteligencia artificial
Diario de Mallorca
October 19

Un algoritmo para ayudar a aliviar la presión en la red de hospitales durante la pandemia
El Diari de la UIB
COPE
Última Hora
October 23

Inteligencia artificial para superar la segunda ola de covid-19 en la UCI
El Comercio
El Correo
Ideal.es
El Diario Montanés
La Verdad
Burgos Conecta
El Norte de Castilla
October 26

Sistemas de inteligencia artificial basados en computación fotónica inspiradas en árboles dendríticos
El Diari de la UIB

October 26

Cap a un nou concepte de producció, distribució i monitoratge de l'energia per a les illes
El Diari de la UIB
November 10

In a pandemic, migration away from dense cities more effective than closing borders
Science Daily
November 11

La migración a zonas rurales, más efectiva que los cierres perimetrales
La Razón
November 17

Confinamiento perimetral: ¿La mejor opción?
Diario de Mallorca
Diario de Jaén
Diario Información
La Opinión A Coruña
Levante El Mercantil Valenciano
La Nueva España
Opinión de Málaga
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El Mercurio Digital
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Abandoning Big Cities Beats Closing Borders When Fighting Pandemics, Simulation Shows
Science Alert
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A simulation shows reducing population density in large cities decreases disease spread
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New study argues that migrating from cities, not travel bans, slows spread of disease
Big Think
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Más de 100 actividades CSIC en la Noche Europea de los Investigadores y las Investigadoras
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La Real Academia de Medicina de las Islas Baleares elige al catedrático de Física de la UIB Claudio Mirasso, nuevo académico numerario no-médico y deja fuera a la candidata enfermera, la Dra Gloria Gallego
Salud Ediciones
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Por qué debemos abandonar las grandes ciudades para luchar contra el coronavirus
El Confidencial
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Un estudio de la UIB concluye que las pandemias afectan más a las ciudades con mayor densidad de población
Europa Press
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La Vanguardia
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La Universitat de les Illes Balears i la Fundació Sicomoro signen un conveni de col·laboració
El Diari de la UIB
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La UIB y la Fundación Sicomoro firman un convenio de colaboración
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De la predicción a la detección, la tecnología se adapta a la pandemia
La Verdad
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Tertúlia 11F
Balears Fa Ciència, IB3 Ràdio
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Poster Party: desde Instagram hasta Spiderman
Raíz de 5, Radio 5
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Interview to José Luis Crespo (Quantum Fracture)
Balears Fa Ciència, IB3 Ràdio
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Interview to Maxi San Miguel
Balears Fa Ciència, IB3 Ràdio
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Interview Maxi San Miguel
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Datos móviles para estudiar la eficacia del confinamiento
Noticias, La Sexta
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Big Data contra el coronavirus y ¿nuestra privacidad?
Fallo de Sistema, Radio 3
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La mobilitat entre els municipis de les Illes es reactiva entre un 5 i un 10 %
IB3 Notícies, IB3
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Interview to José Ramasco
La Noche, COPE
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Interview to José Ramasco
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Interview to José Ramasco
Onda Cero
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Hoy por Hoy, SER Baleares
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Interview to José Ramasco
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Balears Fa Ciència, IB3 Ràdio
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Interview to José Ramasco
Multiplex, IB3 Ràdio
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Els Dematins, IB3 TV
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La crisis del coronavirus y el estudio de los datos de movilidad
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Interview to José Ramasco
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Interview to M. Zanin
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Interview to José Ramasco
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Motius per limitar la mobilitat amb Madrid
Telenotícies, TV3
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Interview to Lucas Lacasa
De far a far, Radio Illa Formentera
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VPP4 Islands amb Damià Gomila i Pere Colet
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Movilidad ciudadana en tiempos de la Covid
No es un día cualquiera, RNE
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Presentación podcast Voces CSIC Balears
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