Connecting Science, Understanding Complexity

IFISC

Institut de Física Interdisciplinària i Sistemes Complexos

Universitat de les Illes Balears

CSIC

IFISC ANNUAL REPORT

2014

Instituto de Física Interdisciplinar y Sistemas Complejos

CSIC
Consejo Superior de Investigaciones Científicas

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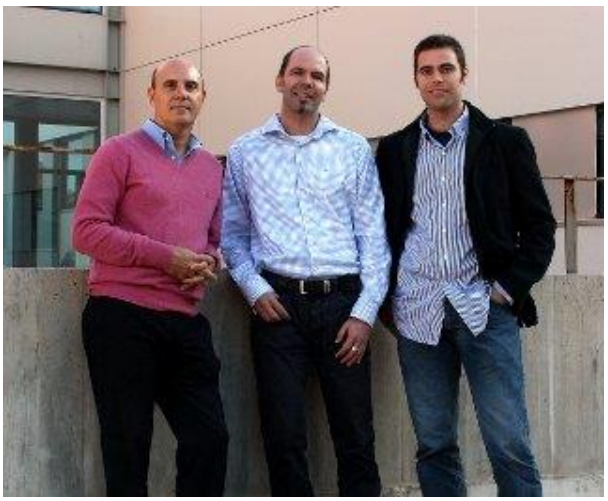
PRESENTATION AND RESEARCH LINES

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 IMEDEA (Mediterranean Institute for Advance Studies) dating from 1995. Its creation foresees that important avenues of scientific development occur at the borders of established fields. As statement of purpose it aims at developing **interdisciplinary** and **strategic** research from the established practices of physicists.

By **interdisciplinary** research we mean the general attitude of willing to transfer knowledge, concepts and methods across the borders between well established disciplines. By **strategic** research we mean focusing in advanced studies in fields with strong future potential, avoiding incremental research as well as the "basic-applied" polarization. We therefore search for windows of opportunity in emerging areas beyond the traditional subjects that defined Physics in the twentieth century.The backbone of IFISC´S research that unifies, percolates, and is the basis of the rest of activities is the study of generic phenomena in **Nonlinear Physics and Complex Systems**, with strong methodological components from Statistical Physics, Dynamical Systems, Computational Methods and Quantum Mechanics. From this source of concepts and ideas, the researchers face the challenge of cooperatively defining and updating specific research lines and projects within a flexible and changing framework.



1.1 IFISC RESEARCH LINES

In the evolving scheme associated with the programmatic orientation of IFISC there is a unifying transverse line of exploratory research on Complex Systems: Statistical and Nonlinear Physics. In addition, for the strategic plan 2010-13 IFISC has identified five lines with a subject defined by the system under study and representing cross-disciplinary interfaces of Physics with other established disciplines.

COMPLEX SYSTEMS:
STATISTICAL AND NONLINEAR PHYSICS


Quantum physics: photons, electrons and information


Nonlinear optics and dynamics of Optoelectronic devices


Fluid dynamics, biofluids, and Geophysical fluids


Biological physics and nonlinear phenomena in ecology and physiology

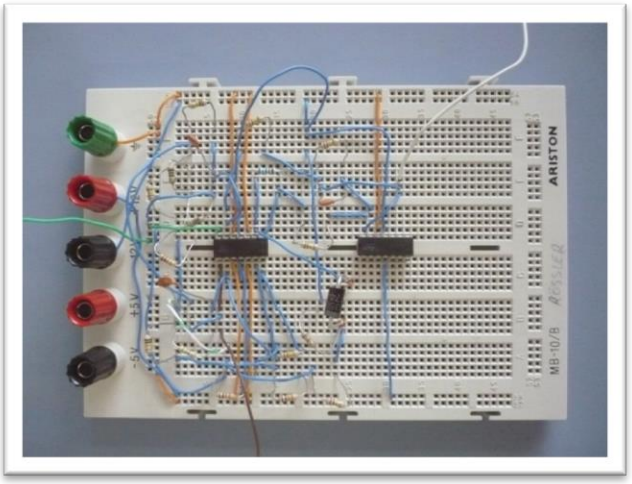

Dynamics and collective phenomena of social systems

Complex systems. Nonlinear and statistical physics

Complex systems, a central paradigm at IFISC, are characterized by emergent and collective phenomena of many interacting units. Fundamental understanding of these systems comes from Statistical Physics together with the Theory of Dynamical Systems, which includes the study of chaos and the effect of fluctuations and random events on systems evolution. Generic phenomena under consideration include synchronization, phase transitions, nonequilibrium instabilities, spatiotemporal pattern formation, or dynamics and evolution of complex networks.

COMPUTING LAB

The Computing Services Unit manages the computational resources. Those include two IBM iDataPlex clusters for intensive calculations and efficient data management. Nuredduna cluster with 48 dx360M4 nodes and a total of 576 computational cores is configured for High Throughput Computing (HTC) used for intensive calculations. Nuredduna-grid with 68 dx360M2 and a total of 544 cores is part of the Grid-CSIC initiative to promote e-science. Big data storage is performed by using a MongoDb a non-relational data base which is distributed over 10 shards and a total of 30 servers. Other computational tools at IFISC include several servers and a fully integrated network consisting on about 50 desktops and a similar number of laptops.



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 for the demonstration of chaos and bifurcation phenomena (including Chua, Mackey-Glass and Rössler oscillators), chaos synchronization, and the study of networks with delay-coupled nonlinear elements for information processing.

Quantum physics: photons, electrons and information

Very small systems (nanoscience) and light-matter interaction (quantum optics) share a common background in Quantum Physics. These are subjects of interest in fundamental research and also in view of new technologies, such as quantum devices and quantum computers. In particular, the possibility to overcome the limitations imposed by classical physics leads to new ways to manage the information (quantum information). The research at IFISC focuses on the theoretical study of specific topics within these timely lines.

Charge and spin transport (nanoelectronics and spintronics) are studied in semiconductor nanostructures, including quantum dots and wires. The possibility to control photonic properties, such as quantum correlations and entanglement in light beams, are studied in nonlinear optical devices, cold atoms and lasers. General properties shared by these systems are studied in the context of quantum information.

Nonlinear Optics and Dynamics of Optoelectronic Devices

The general topic of this line is the study of the light-matter nonlinear interaction and its consequences and potential for applications in emerging photonics technologies. We study the complex dynamics and the generation of non homogeneous spatial light distributions (pattern formation) in photonic sources such as semiconductor lasers and in optical cavities filled with nonlinear media. Experimental studies include the utilization of complex laser dynamics for encrypted communication, key exchange, generation of random bit sequences and information processing.

PHOTONICS LAB

Since 2009 a Photonics Laboratory of high standards has been established. The lab is equipped with a Faraday cage for electromagnetic shielding and houses several experiments of delay-coupled lasers using the latest technology to characterize the laser 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 different spectrometers, and laser modulation can be implemented with arbitrary waveforms up to 9.6 GHz bandwidth.

Fluid dynamics, biofluids, and geophysical fluids

Fluid flow is a natural process occurring in a huge range of scales, from blood capillaries to atmospheric weather systems. It is also widely spread in technological settings, being its understanding crucial to aircraft design or materials production, for example.

We concentrate in two research directions: on the one hand we study basic processes in fluid flows such as stirring, mixing, chemical or biological reactivity, instabilities, pattern formation, motion of non-ideal tracers, etc. The point of view of chaotic advection is a convenient starting point, and Lyapunov methods are thoroughly used. On the other hand, we apply these concepts and methods to geophysical settings, mostly in ocean dynamics: transport modelling, plankton patchiness, Lagrangian coherent structures, etc. Numerical simulation as well as the output from satellite sensors are the main sources of data used here.

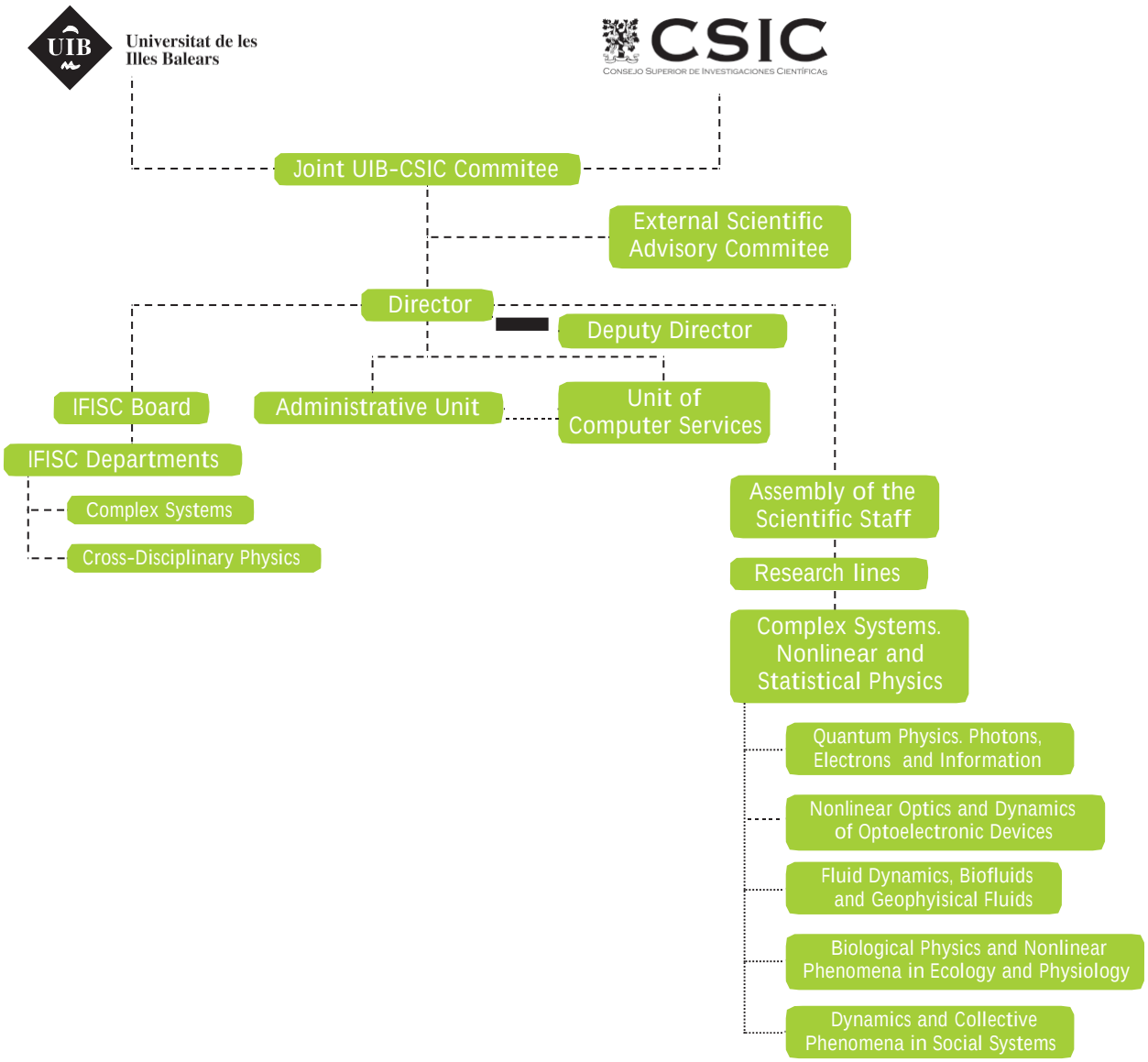
Biological physics and nonlinear phenomena in ecology and physiology

The general topic of this line is the study of some biological systems, mostly under the prism of modern Systems Biology, i.e. from the tenet that most observed behaviors in living systems stem from complex, emergent interactions among its constituents. Present research topics include modeling and simulation of neuronal systems, with special emphasis in stochastic effects and synchronization properties, population dynamics, phylogenetic networks and ecological structure and dynamics, including growth, aggregation processes and spatial effects, with special focus on clonal plants and savannahs. Methods of complex network analysis, stochastic simulations, and the theory of nonlinear dynamical systems, such as delayed coupled systems, are used thoroughly.

Dynamics and collective phenomena of social systems

Social systems are prominent examples of complex systems. Concepts, tools and models aiming at identifying generic mechanisms underlying collective phenomena in these systems are developed with the use of Game Theory, Statistical Physics, Agent Based Models and Complex Networks Theory. Cooperation, cultural conflicts and problems of social consensus are examples of phenomena under study. New emphasis is on data driven research on socio-technical systems, including the impact of ICT, and in particular online social networks.

1.2 STRUCTURE CHART



1.3 SOME REPRESENTATIVE RESEARCH RESULTS OF 2014

In the following we summarize some research results published during 2014. They are representative of the different research lines and thus illustrate the range of topics studied at IFISC

Irreversible work and inner friction in quantum thermodynamic processes

Physical Review Letters 113, 260601

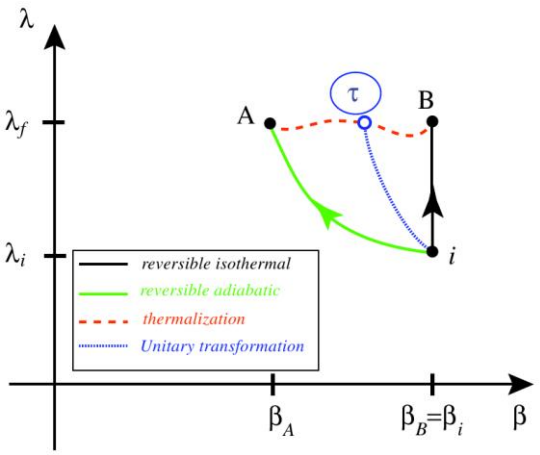
The study of thermodynamics in recent centuries has resulted in great progress in everyday human life, such as combustion engines and refrigerators, without which we would hardly imagine now the world. These processes make use of cycles in which a gas is compressed and expanded, in the engine of a car it is the air mixed with gasoline that pushes the piston, in a refrigerator it is another gas with specific properties for the task. These cycles exchange heat with the environment and ultimately result in a net work that we use to perform useful tasks.

The theoretical discussion of the thermodynamic properties of these cycles goes back almost to the origins of this discipline one and a half centuries ago, however advances in quantum physics and the ability to reduce industrial processes to the microscopic level has risen the interest on thermodynamics in the quantum regime during the last decade.

At the microscopic scale things start to behave statistically: the specific properties of matter fluctuate over time, with these fluctuations due to thermal agitation in the classical case and due to an irreducible, fundamental, origin in the quantum case. Much of the progress of thermodynamics has thus come from both the study of averages (how much heat or work bag averaged a thermodynamic cycle) as from the study of fluctuations around these averages.

Our work, framed in this context focuses on translating a fundamental thermodynamic cycle, the Otto cycle, to quantum language. This cycle is behind the operation of internal combustion engines, consisting of adiabatic expansion/compression and thermalization with the environment (adjustment of the temperature to the outside temperature). Previously, isothermal branches and their fluctuations (protagonist of the Carnot cycle for example) had been translated to quantum language, resulting in fundamental theorems for these processes and the definition of irreversible work. In our paper we do the equivalent for adiabatic processes, giving a fluctuation theorem valid for such fundamental cycles, and defining a new measure of irreversibility which we have called “inner friction”. In the figure we compare these two kind of processes: black is reversible isothermal, green is reversible adiabatic. The degree of deviation of the realistic, fast, (blue) process from the latter is quantified as either irreversible work, in previous studies, and inner friction in our study.

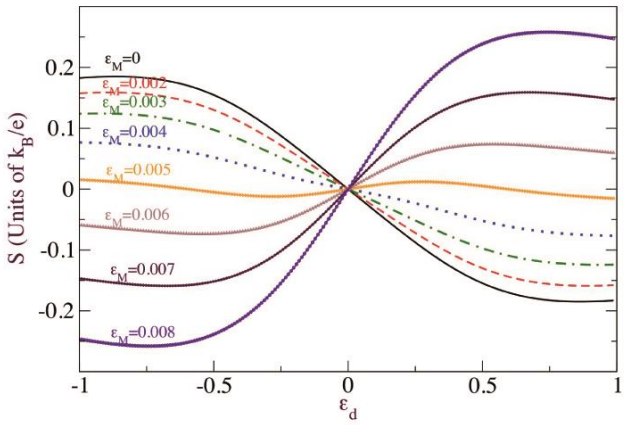
The usefulness of these studies will be increased as industrial processes begin working at nanoscopic scales and quantum effects begin taking an increasingly important role.



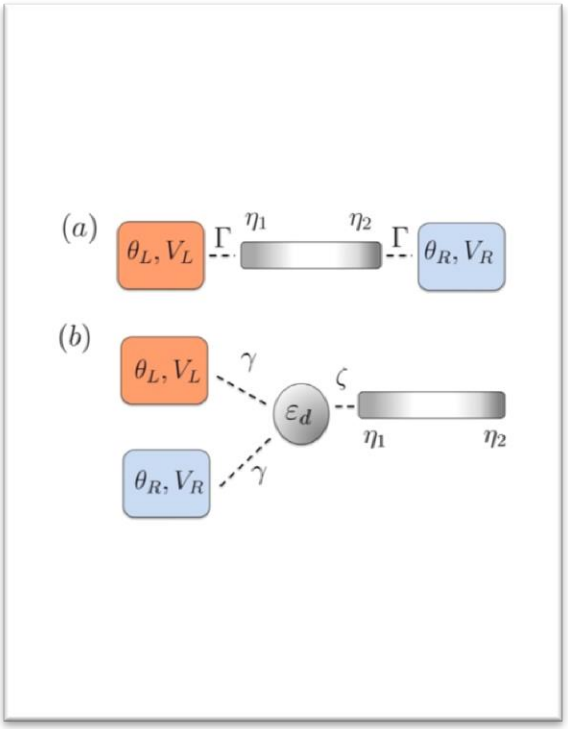
Thermoelectrical detection of Majorana states

Physical Review B 89, 205418

This work resulted from the combination of two of the main research interests of the quantum transport group at IFISC: the thermoelectrical properties at the nanoscale and the physics of Majorana states. The interplay between heat and charge flow in nanostructures, specially the role of quantum behavior, is drawing strong interest. Thermoelectrical nanodevices may lead to novel heat-to-electricity conversion processes. On the other hand, hybrid nanowires have been shown to host zero-energy modes resembling Majorana fermions. These states are localized on the nanowire ends and they leave a signature (a zero-bias peak) on the electrical conductance properties.



In this paper we advocate for thermoelectricity as a probe of Majorana physics. The thermopower of a quantum dot side-coupled to a Majorana nanowire (Fig.1) displays a sign change when varying the energy of the quantum dot level (Fig.2). In absence of the quantum dot the thermopower is zero due to the intrinsic particle-hole symmetry. The predicted behavior may serve as a tool for unambiguous detection of Majoranas.

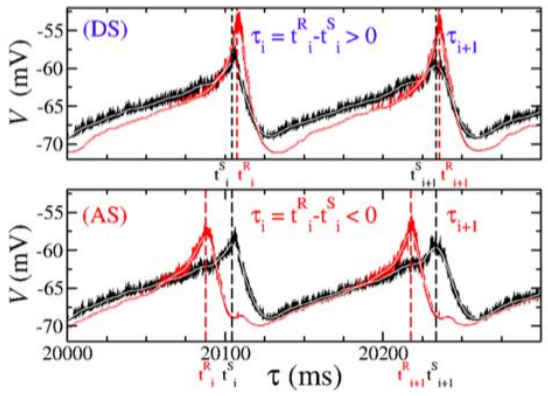


Modeling positive granger causality and negative phase lag between cortical areas

Neuroimage, 99, 411-418

Different measures of directional influence have been employed to infer effective connectivity in the brain. When the connectivity between two regions is such that one of them (the sender) strongly influences the other (the receiver), a positive delay (or phase lag) between their activities is often expected. However, in monkeys engaged in processing a cognitive task, it was observed that either a negative or a positive time delay might accompany a dominant directional influence from one area of sensorimotor cortex to another. In this paper we present a model of two brain regions, coupled with a well-defined directional influence, that displays similar features to those observed in the experimental data.

One approach to detect directional influence in the brain has been to infer it from relative phase measures assuming that the timing difference implicit in the relative phase reflects the transmission time of neural activity. Another attractive measure of directional influence is Granger causality. Brovelli and coworkers [1] found partially contradictory results between these two indicators when studying the cortical activities of monkeys performing a visual discrimination task: Positive Granger Causality was accompanied by either positive or negative time lags even in the presence of a dominant directional influence.



Assessing anticipated and delayed synchronization in a model of sender (S) and receiver (R) populations. Average membrane potential V (equivalent to the Local Field Potential) of S (black) and R (red) populations. In panel the upper panel Delayed Synchronization (DS) is observed while in the bottom panel Anticipated Synchronization (AS) is observed. When changing the inhibitory synaptic conductance in population S, smooth transitions between AS and DS were observed.

To resolve this apparent discrepancy, we developed a model of neuronal population and connected them with a well-defined direction of influence: population S drove population R. The two populations included excitatory and inhibitory neurons (in a 80%-20% proportion). We numerically found that, depending on the inhibitory conductance in population S, the activity of the later can be either delayed (delayed synchronization, DS) or anticipated (anticipated synchronization, AS) with respect to that of population S. Our model provides a concrete (and robust) mechanism by which the apparent contradiction between phase lag and Granger Causality can be resolved and specifically highlights the role that local inhibition could play in the receiver population. Moreover, our results suggest that the primate cortex could operate in a regime of Anticipated Synchronization as part of normal neurocognitive function.

Exploring the tug of war between positive and negative interactions among savanna trees: competition, dispersal and protection from fire

Ecological Complexity 17, 140 - 148

The savanna is an extension of grassland with widely spaced trees. This type of ecosystem covers 10-20% of the global land surface and about half the area of Africa. It provides natural resources (livestock, firewood, ecosystem services) for hundreds of millions of people. From the ecological dynamics point of view, the coexistence of trees and grass for long time without one of the vegetation types completely eliminating the other is a puzzling fact, and has been named “the savanna problem”.

In this work, we proposed a model that combines the ingredients of competitive interactions among trees and between trees and grass, seed dispersal, and a spatially explicit representation of the occurrence of fires and their propagation. The model is used to explore how the pattern of fire-spread affects tree density and spatial pattern, and the coexistence with grass. We find that together with the rest of ecological factors, the occurrence of fires provides a positive interaction between trees, because of the protection factor of ones on the others. Tree density depends strongly on both fire frequency and tree-tree competition although the fire frequency appears to be the crucial factor controlling the tree-extinction transition in which the savanna becomes grassland. We study how adult trees may arrange in different clustering arrangements, more regular or more clumped, also depending on fire frequency.

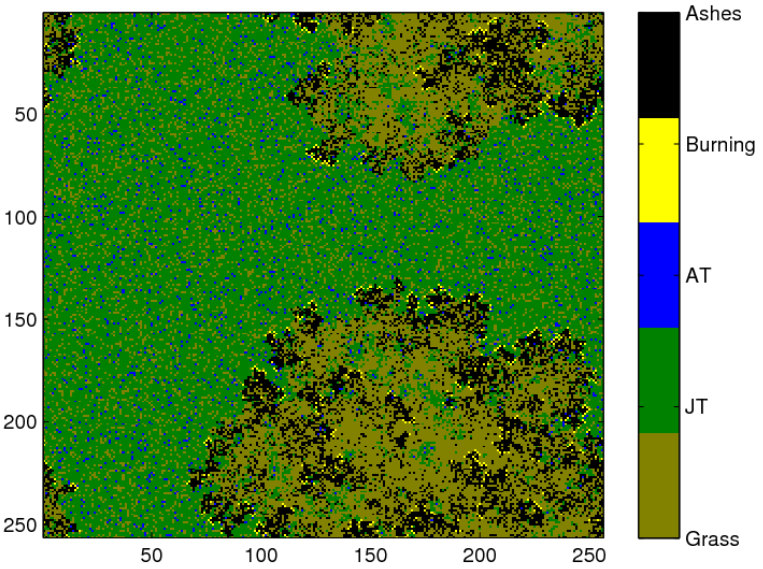


Figure: Left: Fire propagation in the South-African savanna (Photo by J.S. Levine, NASA). Right: Modelling of fire propagation in our savanna model, with different colors indicating grass, juvenile and adult trees (JT and AT, respectively), the burning front, and ashes.

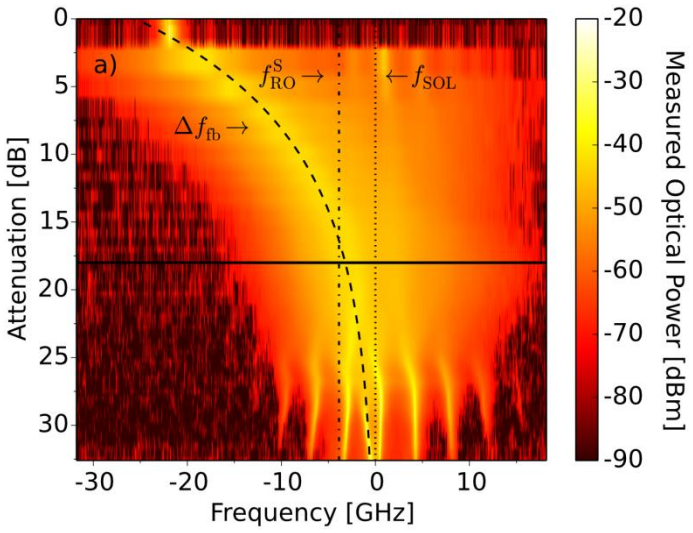
Similarity Properties in Laser Dynamics

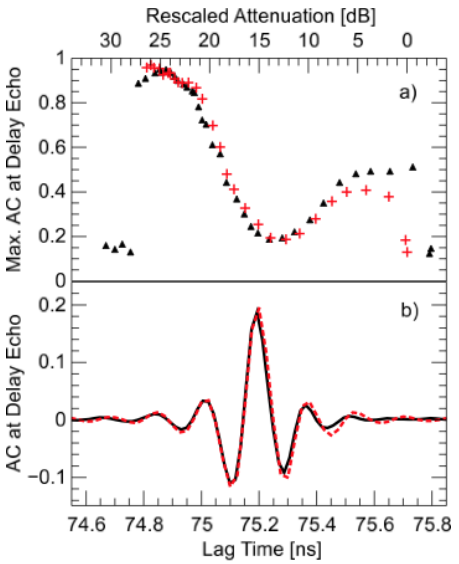
Physical Review A 89, 023822

This paper presents the identification and experimental characterization of the mechanism that leads to the onset of strong chaos in semiconductor lasers subject to delayed optical feedback. Analyzing the optical spectra for different feedback attenuations, as depicted in the left panel, provides insight into the physical mechanism underlying the transition between the weak chaos and strong chaos regimes. These regimes are of decisive importance for the synchronizability of delay-coupled systems in general. Therefore, the relevance of this work extends beyond the field of optics, and relates to several other research areas in which models with delay-coupling are prominent, e.g. biology, chemistry and neuroscience.

Moreover, by experimentally identifying the relevant characteristic frequencies that determine the dynamics, a second fundamental and far-reaching question in the field of delay-coupled systems is addressed: Can dynamical states be reproduced for different experimental parameters? This work demonstrates, that for structurally different real-world semiconductor lasers, by keeping simple ratios of characteristic frequencies constant, similar dynamical states are generated, which are only scaled in amplitude and/or time. This can be illustrated by autocorrelation properties, as depicted in the right panels, which excellently coincide for two different operating conditions for which the frequency ratios are matched. In consequence, a change in pump current of the laser can be compensated for by a change in the feedback parameters, namely feedback strength and delay time, such that the emerging dynamics exhibits similarity properties: we observe the same dynamics at different time-scales.

Beyond its fundamental relevance, this work offers promising perspectives for novel photonics applications such as neuro-inspired information processing. As a consequence of these results, processing speeds can be adjusted at will or due to external demands, without changing the dynamical properties of the system.



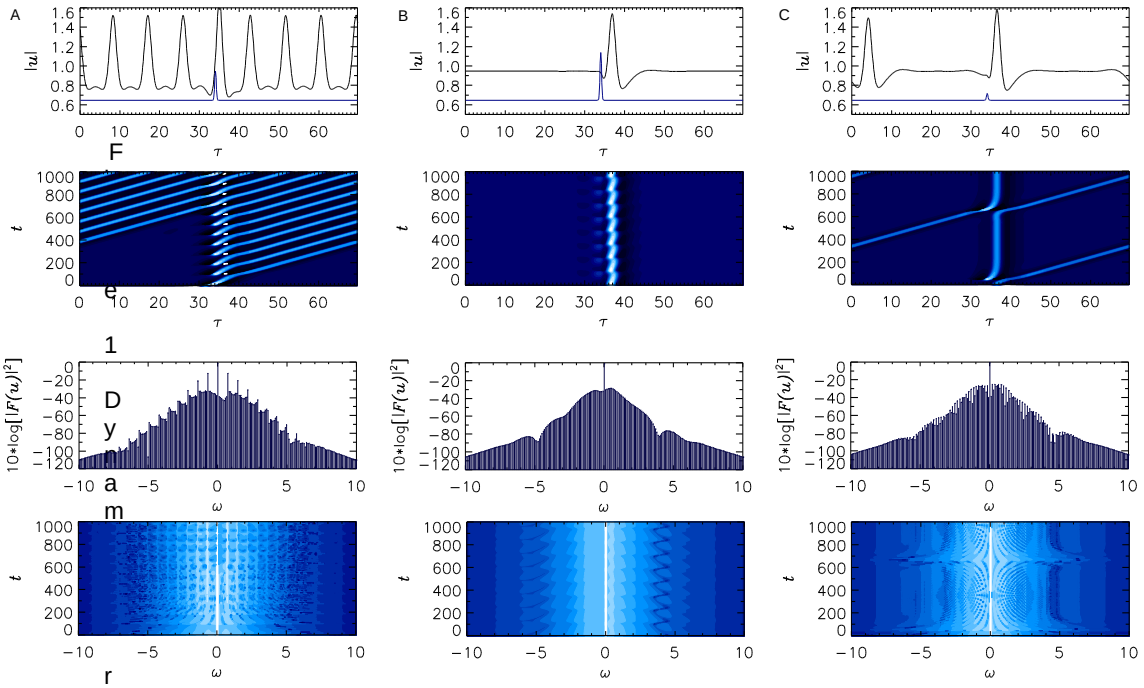


Effects of inhomogeneities and drift on the dynamics of temporal solitons in fiber cavities and microresonators

Optics Express 22, 30943-30954

Dissipative solitons generated in nonlinear optical cavities, also known as cavity solitons (CS), have recently received a renewed interest as they have been shown to play an important role in the generation of Kerr frequency combs (KFC) in microresonators. Stable KFC permit measuring light frequencies and time intervals with extraordinary accuracy, leading to numerous key applications. Various studies demonstrate that temporal CS circulating within an optical microresonator correspond to KFC at the output, and that their dynamical behavior determine the characteristics of the KFC.

In this work we study the dynamics of CS and the corresponding KFC in presence of an inhomogeneity and drift. Inhomogeneities and drift in fiber cavities and microresonators are unavoidable due to imperfections in the fabrication process, material properties, and higher order chromatic light dispersion, therefore, the type of dynamics studied in this work could be of considerable importance for applications of KFC based on CS in nonlinear optical cavities.



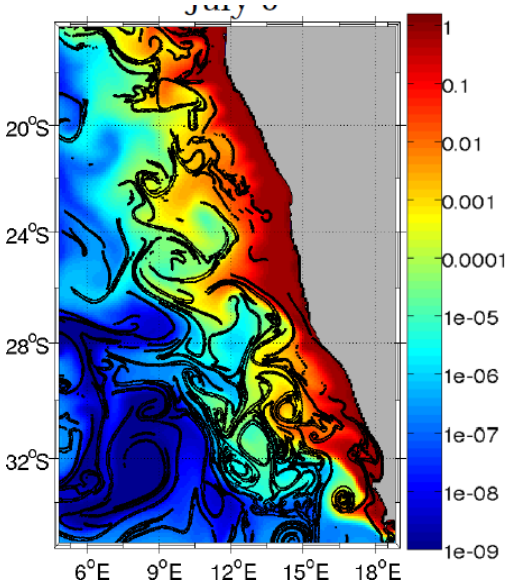
Regimes originated by an inhomogeneity and drift (top) and their corresponding KFC (bottom). A. Train of solitons arising from the inhomogeneity. B. Oscillating CS pinned at the homogeneity. C. Cavity soliton Newton's cradle.

The reduction of plankton biomass induced by mesoscale stirring: a modeling study in the Benguela upwelling

Deep-Sea Research Part I 83, 65-80

In oceanic upwelling areas there is a reduction of biological productivity due to vigorous horizontal stirring. To understand this phenomenon we consider a modelling approach and apply it to the important Benguela marine zone. It consists of an oceanic flow (from satellite altimetry data and numerical models), coupled to a simple biogeochemical model of Nutrient-Phyto-Zooplankton (NPZ) type. On the other side, we compute horizontal particle dispersion in terms of Lyapunov Exponents, and analyzed their correlations with phytoplankton concentrations.

Our results confirms that in the south Benguela there is a reduction of biological activity when stirring is increased. Two-dimensional offshore advection and latitudinal difference in Primary Production, also mediated by the flow, seem to be the dominant processes involved. We estimate that mesoscale processes are responsible for 30 to 50% of the offshore fluxes of biological tracers. In the northern area, other factors not taken into account in our simulation are influencing the ecosystem. We suggest explanations for these results in the context of studies performed in other eastern boundary upwelling areas.



Snapshot of chlorophyll distribution in the surface waters of the Benguela region superimposed with relevant lines of Lyapunov Exponents.

Hydrodynamic provinces and oceanic connectivity from a transport network help designing marine reserves

Geophysical Research Letters 41, 2883-2891

Designing effective conservation measures for ecosystems requires a good understanding of the geographical distribution and dynamics of species. While this is relatively affordable in terrestrial ecosystems, where the landscape evolves slowly and animal movements are directly observable, acquires additional difficulty in the ocean. In fact, most marine organisms have a larval early stage, during which they disperse long distances across the vast and turbulent ocean environment. The entrainment of larvae by ocean currents can connect distant populations affecting the composition and structure of marine populations.

Here we develop a new approach to analyze the dispersion of larvae by ocean currents and, more generally, to describe ocean connectivity. The methodology combines two powerful tools that had been used before separately and applies them to the Mediterranean. First, velocity fields from a surface circulation model are used to build a network of interconnections between different areas of the Mediterranean, among which larvae of different marine species could be interchanged. Second, methods of the modern theory of networks are applied to extract useful information from such networks.

Our main result is to produce maps of 'marine provinces', defined as well-connected regions mixed by currents, but relatively isolated from adjoining regions. The boundaries between these regions are associated both to geographical barriers such as narrow or undersea features as to more dynamic objects such as eddies and fronts. Examining the location and persistence of the we characterize the spatial and temporal scales that control the dispersion of larvae in the sea surface. Finally, we have identified three new indicators of connectivity between areas and have been implemented and tested for all existing marine reserves in the Mediterranean, quantifying their dispersion characteristics and its area of influence. These new findings are relevant to understanding population genetics and biogeography of the ocean, with ecological implications and the design and management of marine protected areas.

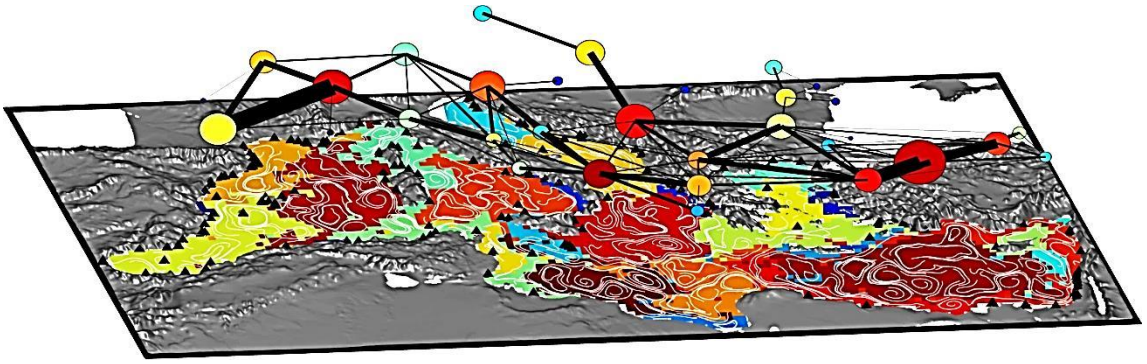
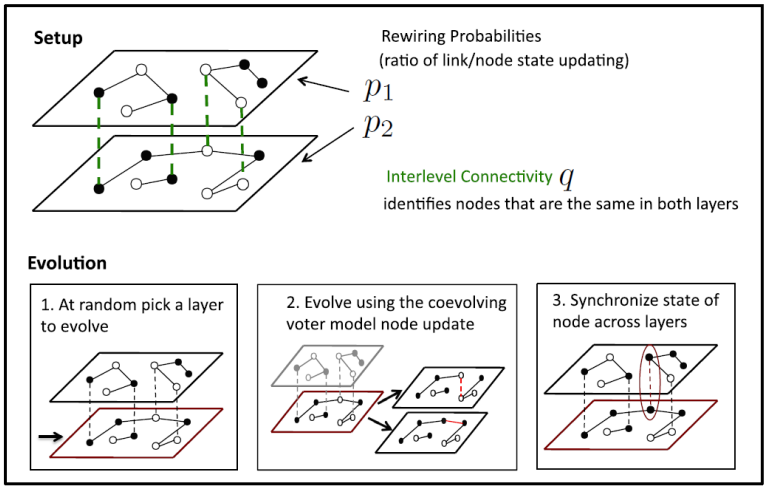


Figure: A view of the 32 hydrodynamic provinces in the Mediterranean sea extracted from our approach simulating 60-day advection of passive larvae during summer 2011. White streamlines represent the modeled surface flow averaged over the period of integration. The resulting transport network, displayed above using a similar color code, organize larval dispersal and control the connectivity of marine reserves (black triangles) in the entire Mediterranean basin.

Fragmentation transitions in complex networks multilayer coevolution

Physical Review E 89, 06218

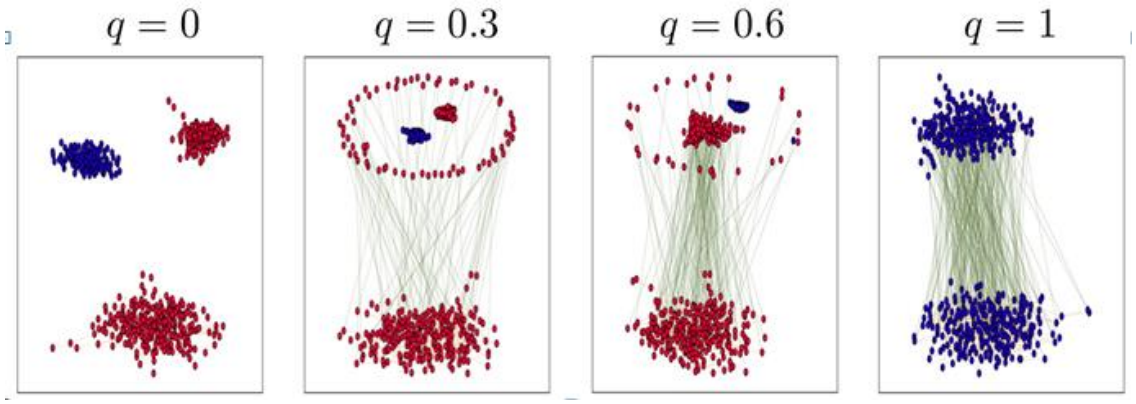
Complex networks are the skeletons of complex systems. An important aspect of current study is the multilayer topology of the networks, the layers representing, for example for social networks, different social contexts in which agents interact. An additional important aspect when studying network dynamics is a coevolution process in which the states of the nodes change by some interaction mechanism coupled to dynamical changes of the network topology. The plasticity of the network is measured by the ratio of time scales in which these tow changes occur. Generically, the network undergoes a fragmentation transition at a critical value of the plasticity parameter. The question addressed in this paper is the existence and nature of this transition in multilayer networks.



The dynamical model considers two coupled layers, each of them evolving through a coevolving voter dynamics.

The system has three parameters: the plasticities p_1 and p_2 of each layer and the multiplexing parameter q identifying the number of nodes common to the two layers

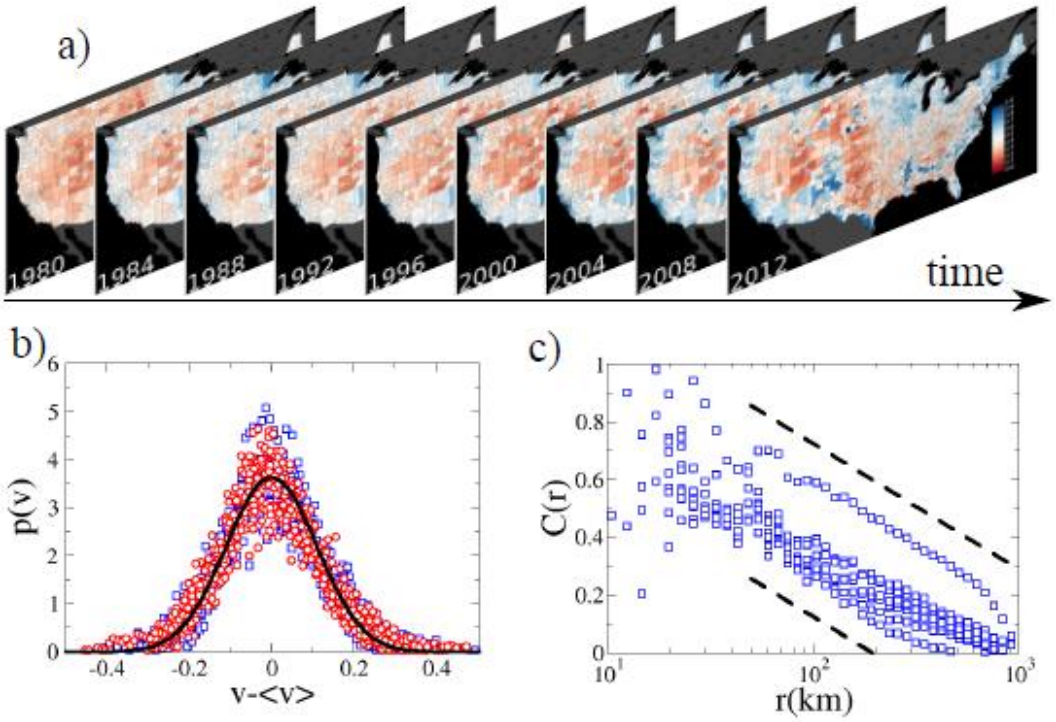
Our main findings are: 1) The multilayer structure can prevent fragmentation because the transition is shifted to larger values of the plasticity. 2) There is a critical degree of multiplexing q^*, such that for $q>q^*$, there is no fragmentation for a layer of large plasticity 3) For $q<q^*$ there is an anomalous *shattered* fragmentation with a multiplicity of solitary nodes. Point 2 and 3 are illustrated in the figure for layer plasticities p_1=0.9 and p_2=0.1.



Social influence and mobility model voting behavior in elections

Physical Review Letters 112, 158701

Social systems represent a paradigmatic example of complex systems. Individuals interact in different communication channels including face-to-face and social media. These interactions combined with other sources of information like mass media shape social behavior from the goods we consume to the opinions we support. It is then natural the effort of the scientific community to model the formation and competition of opinions, cultural traits or language use. This effort has crystalized in a set of models that aim to capture opinion formation in social systems. Despite the plausibility of the mechanisms implemented by these models it is still unclear to what extent they capture social behavior. This contribution represents an attempt to bridge modeling efforts with empirical evidence in voting behavior in elections. The model combines social influence, which dictates how we are influenced by our neighbors, and mobility, which captures our most common social context, commuting between work and home. This simple model is able to capture several statistical features observed in elections: the distribution of vote shares and the logarithmic decay of spatial correlations. This approach allows us now to address other aspects of social dynamics as the influence of large scale communication channels and mobility, the influence of social media and external drives like for example economic cycles.



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ial elections. a) Percentage of Republican vote (blue: 0%; red 100%) per county between 1980 and 2012. b) Distribution of vote per county and year after removal of the annual mean <*v*>. c) Spatial correlation of the vote share per election. The dashed line is a guide to the aye indicating a logarithmic decay.

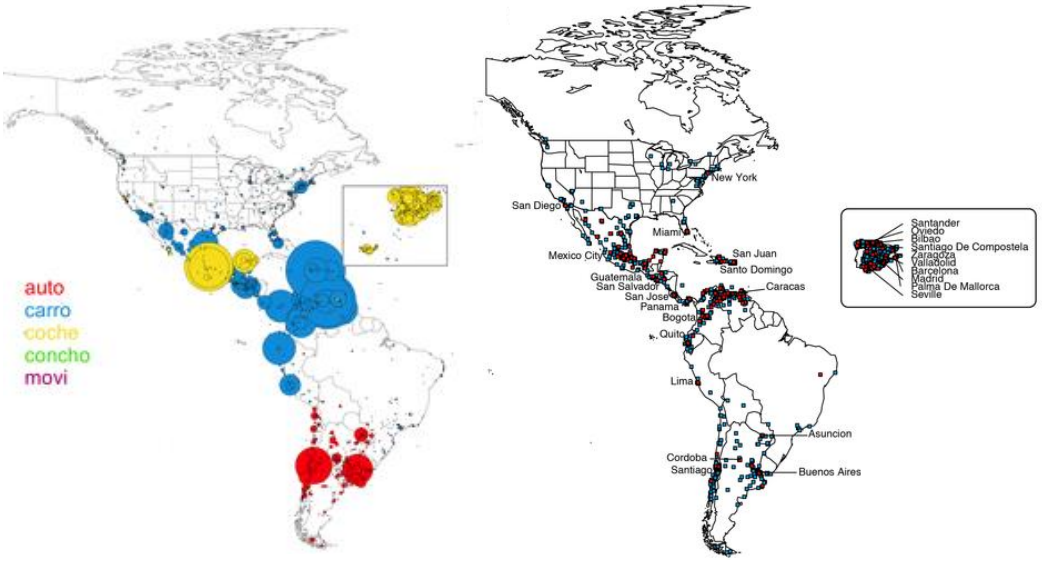
Crowdsourcing Dilalect Characterization through Twitter

PLoS ONE 9, e112074

Typically, a given language is distributed geographically forming regional varieties named dialects. Most of the studies have thus far considered phonological variations and have mapped dialects based on questionnaires and interviews. In this work, we have investigated Spanish varieties performing a lexical analysis from hundreds of thousands of microblogging messages such as those appearing in Twitter. The unprecedented amount of GPS-tagged data allows us to identify two superdialects that differ in the language spoken in cities and rural areas.

In the left panel, we show different variations of the concept *car* ('auto', 'carro', 'coche', 'concho' and 'movi'). The size of the dot is proportional to the number of geolocalized tweets that employ one of the five possible words. We observe that 'auto' is used in the Southern Cone, 'carro' dominates in most of Mexico, Caribbean countries and the Andean region and 'coche' is preferred in European Spanish and central Mexico. The remaining two words are less used. This way, we can plot more than 40 maps encompassing hundreds of words. Our atlas reproduces differences in Spanish dialects across Europe and the Americas.

The right panel shows the main result of a cluster analysis based on the previous data. We find evidence for the existence of two big dialects (red and blue dots, respectively) that are correlated with the population density, thus suggesting a lexical bipartition between an international superdialect centered in large citites and a more heterogeneous dialect situated in rural areas and small towns. Hence, our work demonstrates the usefulness of geotagged microblogging corpora for the linguistic analysis of dialects.



Tweets on the road

PLoS ONE 9, e105407

The pervasiveness of mobile devices, which is increasing daily, is generating a vast amount of geo-located data allowing us to gain further insights into human behaviors. In particular, this new technology enables users to communicate through mobile social media applications, such as Twitter, anytime and anywhere. Thus, geo-located tweets offer the possibility to carry out in-depth studies on human mobility. In this paper, we study the use of Twitter in transportation by identifying tweets posted from roads and rails in Europe between September 2012 and November 2013. The transportation system is divided in segments of 10 kilometers each and then we compute the percentage of highway and railway segments covered by tweets in 39 countries. The coverages are very different from country to country and their variability can be partially explained by differences in Twitter penetration rates. The UK, the Netherlands, Spain and Turkey are the countries in the area with the highest coverage of highways, while the UK, the Netherlands and Ireland are those with highest railway coverage. Some of these differences might be related to cultural factors regarding mobility habits and interacting socially online. Analyzing particular road sectors, our results show a positive correlation between the number of tweets on the road and the Average Annual Daily Traffic on highways in France and in the UK. Transport modality can be studied with these data as well, for which we discover very heterogeneous usage patterns across the continent.

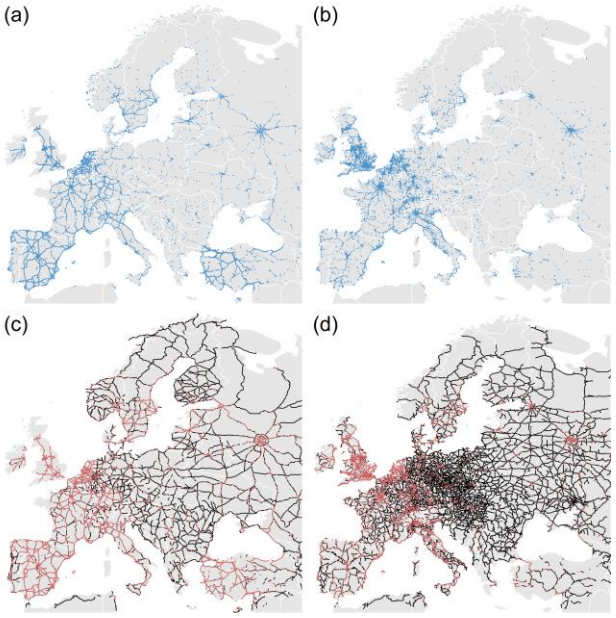


Figure. Highway and railway coverages.

(a)–(b) Locations of the geo-located tweets on the road (a) and rail (b). (c)–(d) Segments of road (c) and rail (d) covered by the tweets. The red segments represent the segments covered by the tweets.

Formation of localized structures in bistable systems through nonlocal spatial coupling. Parts I and II

Physical Review E 89, 012914 – 012915

Classical Partial Differential Equations, like the heat equation, describe the time evolution of systems extended in space. These equations have spatial coupling that depends only on local information, for instance the second derivative at each point. More recently, considerable effort has been devoted to the study of evolution equations in which the spatial influence terms are defined over a domain, typically as an integral term modulated by a spatial kernel. Nonlocal interaction terms can appear in Physics and other fields when long-range interactions are considered, as a result of using approximations in reaction-diffusion descriptions, or due to density-dependent effects in biological and ecological systems.

This work puts a firm theoretical basis to the appearance of oscillatory tails in fronts connecting two equivalent homogeneous states. Our main result is that the inclusion of a nonlocal interaction leads to the appearance of *spatial oscillatory tails, even for scalar fields where fronts are always monotonic.* Interestingly, spatial oscillations imply that the interaction between two fronts also has an oscillatory dependence, and thus, it is zero for some particular distances, leading to the appearance of localized structures.

We illustrate this mechanism with three different kernels: Gaussian, exponential and Mexican-hat. While the first two are monotonic, the third takes both positive and negative values, corresponding to repulsion (competition) and attraction (facilitation) respectively. For the monotonic kernels oscillatory instabilities are found when the coupling is repulsive. A new scenario is, however, reported for the Mexican-hat kernel where attraction and repulsion coexist. In this case oscillatory instabilities are found for both an overall attractive and an overall repulsive interaction, appearing oscillatory instabilities by the known route in which the instability appears for a well-defined value of the parameter, but also through a novel route, in which the transition is not sharp, implying a crossover between monotonic and oscillatory front profiles (Fig. 1).

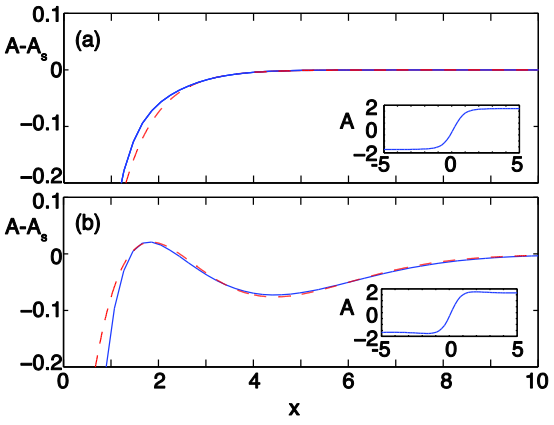


Figure 1 Spatial front profile for the Ginzburg-Landau equation with a Mexican-hat nonlocal kernel.

2

PERSONNEL

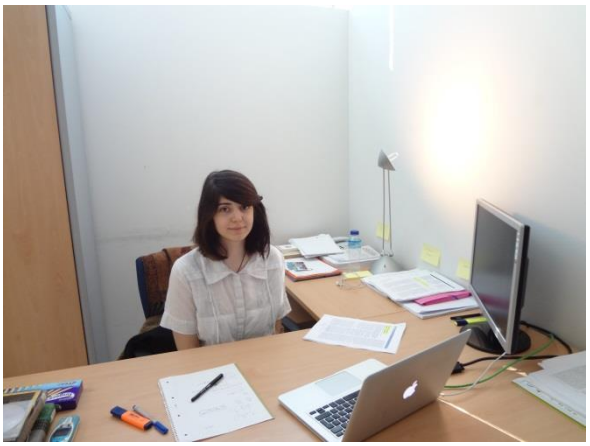
2.1 PERMANENT SCIIENTIFIC STAFF

PERE COLET	CSIC Research Professor
VÍCTOR M. EGUÍLUZ	CSIC Tenured Scientist
INGO FISCHER	CSIC Research Professor
DAMIÀ GOMILA	CSIC Tenured Scientist
EMILIO HERNANDEZ-GARCÍA	CSIC Research Professor, IFISC Deputy Director
CRISTOBAL LÓPEZ	University Professor UIB
ROSA LÓPEZ	University Professor UIB
MANUEL MATÍAS	CSIC Senior Researcher
CLAUDIO MIRASSO	University Full Professor UIB
MAXI SAN MIGUEL	University Full Professor UIB, IFISC Director
DAVID SÁNCHEZ	University Professor UIB
LLORENÇ SERRA	University 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 2014.

	Pere Colet	Damià Gomila	Ingo Fischer	Emilio Hernández-García	Cristóbal López	Rosa López	Víctor M. Eguíluz	Manuel Matías	Claudio Mirasso	David Sánchez	Maxi San Miguel	Llorenç Serra	Tomás Sintes	Raúl Toral	Roberta Zambrini
Complex Systems. Nonlinear and Statistical Physics	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Quantum Physics: Photons, Electrons and Information		x				x				x		x			x
Non Linear Optics and Dynamics of Optoelectronic Devices	x	x	x						x						x
Fluid Dynamics, Biofluids and Geophysical Fluids				x	x								x		
Biological Physics and Nonlinear Phenomena in Ecology and Physiology			x	x	x		x	x	x				x	x	
Dynamics and Collective Phenomena of Social Systems	x			x			x				x			x	



2.2. ASSOCIATED STAFF

DANIEL WALGRAEF	FNRS, Belgium

2.3 POSTDOCTORAL RESEARCH ASSOCIATES

DANIEL BRUNNER	PIE CSIC Postdoctoral Contract
JUAN JOSÉ CERDÀ	UIB lecturer
AGNIESZKA CZAPLICKA	Postdoctoral Contract Project INTENSE@COSYP
JEAN-BAPTISTE A. DELFAU	Postdoctoral Contract Project INTENSE@COSYP
MARINA DIAKONOVA	Postdoctoral Contract Project INTENSE@COSYP
FERNANDO GALVE CONDE	JAE-CSIC Postdoctoral Contract
SUN-YONG HWANG	Postdoctoral Contract Project TIQS
THOMAS JÜNGLING	Postdoctoral Contract Project GABA
FABIO LAMANNA	Postdoctoral Contract Project EUNOIA
MAXIME LENORMAND	Postdoctoral Contract Balear Government
DANIEL A. LÜSEBRINK	Postdoctoral Contract Project EDEN
ANTONIO PÉREZ	Juan de la Cierva Contract UIB
JOSÉ JAVIER RAMASCO	Ramon y Cajal Fellow Tenure Track Contract
VINCENT ROSSI	Postdoctoral Contract Project ESCOLA
MIGUEL C. SORIANO	UIB lecturer
RUGGERO VASILE	Postdoctoral Contract Project TIQS

2.4 PHD STUDENTS

MARIA ISABEL ALOMAR	UIB lecturer
ORIOL ARTIME	Contract Project INTENSE@COSYP
ALEIX BASSOLAS	Contract Project INTENSE@COSYP
JOÃO BETTENCOURT	FCT Fellowship, Portugal
JULIAN BUENO MORAGUES	FPI Fellowship Project TRIPHOP
BRUNO CAMPANELLI	Contract Project TREE
ADRIÁN CARRO PATIÑO	FPU Fellowship
MIGUEL A. ESCALONA-MORÁN	Contract Project PHOCUS
JUAN FERNÁNDEZ GRACIA	Contract Project INTENSE@COSYP
PABLO FLEURQUIN	European Project COMPLEXWORLD
GERARDO GÓMEZ	FPI Fellowship, EVOCOG group
KONSTANTIN HICKE	Balear Government Fellowship
JADE MARTÍNEZ	Balear Government Fellowship
RICARDO MARTÍNEZ	JAE-CSIC Fellowship
FERNANDA MATIAS	CNPQ Brasil Fellowship
PEDRO MONROY	FPI Fellowship Project ESCOLA
NEUS OLIVER	JAE-CSIC Fellowship
JAVIER OSCA COTARELO	UIB Predoctoral Fellowship
PEDRO J. PARRA RIVAS	FWO Fellowship Brussels
MARIE R. POPIEL	Fellowship La Caixa
XAVIER PORTE PARERA	FPI Fellowship Project DECODICA
VÍCTOR M. RODRÍGUEZ	Contract LINC Project
JORGE P. RODRIGUEZ	FPU Fellowship
DANIEL RUIZ REYNÉS	Contract Project INTENSE@COSYP
ENRICO SER-GIACOMI	Contract LINC Project
MIGUEL A. SIERRA	Govern Balear Fellowship
EDER B. TCHAWOU TCHUISSEU	FPI Fellowship Project INTENSE@COSYP

2.5 TECHNICAL AND ADMINISTRATIVE SUPPORT

INMA CARBONELL	Administration Unit Head
DANIEL PALOU VAN ENGELEN	Lab Technician
DAVID DE LA MONTAÑA GUTIÉRREZ	Computing Lab Technician
MARTA OZONAS	Secretary
ROSA CAMPOMAR	Outreach
RUBÉN TOLOSA	Computing Lab Technician
JOSEP C. PORQUER	Computing Lab Technician
MARIA ANTÒNIA TUGORES PONS	Data Mining Engineer

IFISC people - Winter Solstice 2014

2.6 VISITORS

LONG-TERM VISITORS (more than one month)

VERONICA MARTIN GOMEZ	Universidad de la República de Uruguay. January - March
LIUBOV TUPIKINA	Potsdam Institute for Climate Impact Research, Germany. January - March
ANTONIO ALECCE	Padova University, Italy. Feb. – March
SERHIY YANCHUK	Humboldt University, Berlin. March
MICHIEL HERMANS	Ghent University, Belgium. April – May
ANTONIO MANDARINO	Milano University, Italy. April- Sept.
CLAUDIA BENEDETTI	Milano University, Italy. May – August
NICK HAYNES	Duke University, Durham, NC, USA. May - July
JONG-SOO LIM	University of Korea, Seoul. June
DANIEL GARABOA	University of Santiago de Compostela, Spain. June – July
GIANLUCA GIORGI	La Sapienza University, Rome, Italy. July - August
IVAN JUAN ROIJALS	Karolinska Institute, Stockholm Sweden. July
FEDERICO VAZQUEZ	CONICET, La Plata, Argentina. Sept.- Nov.
GANG LI	Huzhou University, China. Sept. – Nov.
BRUNO GONÇALVES	Aix-Marseille University, France. September
PEDRO SANCHEZ	University of Vienna, Austria. Sept. – Oct.
VICTOR LOPEZ MADRONA	Universidad de Alicante, Spain. Oct.- Nov.
MOHAMED EL ARBI BASSALAH	Faculté des Sciences de Tunis, November – December
JOHN GOOLD	International Center for Theoretical Physics, Trieste, Italy. November

SHORT-TERM VISITORS (Less than one month)

YANNE CHEMBO	FEMTO-ST Institute, Besançon, France. January
DANIELE QUERCIA	Yahoo Research, Barcelona. January
AURELIEN COILLET	FEMTO-ST Institute, Besançon, France. January
M. ANGELES SERRANO	Universitat de Barcelona, Spain. February
NIKOS KOUVARIS	Universitat de Barcelona, Spain. February
GUY VAN DER SANDE	Vrije University, Belgium. February
OTTI D´HUYS	Vrije University, Belgium. March
CHRIS VAN DEN BROECK	Hasselt University, Belgium. March
MAHN-SOO CHOI	Korea University, Seoul, Korea. March
SEUNGJU HAN	Korea University, Korea. March
BERND BLASIUS	Oldenburg University, Germany. April
JAN DANCKAERT	Vrije University, Belgium. April
PASCAL SIMON	Université Paris Sud, France. April
PETER KLIMEK	Medical University of Vienna, Austria. April
WOLF SINGER	E. Strüngmann Institute for Neuroscience, Frankfurt, Germany. . April
KARL FRISTON	University College London, UK. April
FRANCESCO PLASTINA	Universita della Calabria, Cosenza, Italy. April
NICOLA LOGULLO	Padua University, Italy. April
JAUME CASADEMUNT	Universitat de Barcelona, Spain. May
FEDERICO BATTISTON	Queen Mary University of London, UK. M May
VICENZO NICOSIA	Queen Mary University of London, UK. May
JUAN CARLOS CUEVAS	Universidad Autónoma de Madrid, Spain. May
JOAQUÍN MARRO	Granada University, Spain. May
HAYDEE LUGO	Univ. Complutense de Madrid, Spain. May
GERMAN PATTERSON	Instituto Tecnológico de Buenos Aires, Argentina. June
GLORIA PLATERO	Instituto de Ciencia de Materiales de Madrid, Spain. June
LENDERT GELENS	Stanford University, USA. June
RAMON AGUADO	Instituto de Ciencia de Materiales, Madrid, Spain. June
ELS HEINSALU	National Institute of Chemical Physics and Biophysics, Tallinn, Estonia. June

ANDREA LANCICHINETTI	Umea University, Sweden. July
MATTEO PARIS	Milano University, Italy. July
PAVEL PAULAU	Oldenburg University, Germany. July
SIFEU TAKOUGANG	Vrije University, Brussels, Belgium. September
ARKADY PIKOVSKKY	Potsdam University, Germany. September
PEDRO TARAZONA	Universidad Autónoma de Madrid, Spain. September
LUTZ SCHIMANSKY-GEIER	Humboldt University, Germany. September
MICHELE THUMS	Institute of Marine Science, Perth, Australia. September
SOFIA KANTOROVICH	University of Vienna, Austria. September
JORDI ORTIN	Universitat de Barcelona, Spain. September
SOPHIE ARNAUD-HAOND	Laboratoire de Ressources Halieutiques de Sète, France. September
MARCO PATRIARCA	National Institute of Chemical Physics and Biophysics, Tallinn, Estonia. October
JYRKI PIILO	Turku University, Finland. October
JOHANNES NOKKALA	Turku University, Finland. October
SAMI MITRA	Physical Review Letters Editor. APS. NY, USA. October
LACHLAN JAMES GUNN	Adelaide University, Australia. October
HORACIO S. WIO	Instituto de Física de Cantabria, Spain. November
KAREL PROESMANS	Hasselt University, Belgium. November
FAKHTEH GHANBARNEJAD	Max Planck Institute, Dreden, Germany. December

2.7 MASTER AND COLLABORATION STUDENTS

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

CHRISTIAN M. DIETRICH	Institut für Angewandte Physik, Münster, Germany. September – December
MELODIE DUBOIS	INRA-Agrocampus ouest, Rennes, France. February – July
JORGE SAUCEDO	Universidad Autónoma de Madrid, Spain. April – May

JASON KHADKA	IFISC MASTER
AOMAR BNIHI	IFISC MASTER
ROK CESTNIK	IFISC MASTER
JUAN LUIS GOMEZ	IFISC MASTER
MIQUEL ALFARAS	IFISC MASTER
ANTONIO FERNANDEZ	IFISC MASTER
SAMUEL BOUMA	IFISC MASTER
GUILLEM ROSSELLÓ	IFISC MASTER

JAVIER MORENO GORDO	SURF@IFISC FELLOWSHIP
JAVIER ARGÜELLO LUENGO	SURF@IFISC FELLOWSHIP
JOSE SANCHEZ PELEGRIN	SURF@IFISC FELLOWSHIP
ANA PAULA MILLAN VIDAL	SURF@IFISC FELLOWSHIP
ADRIA DELHOM LATORRE	SURF@IFISC FELLOWSHIP
PABLO MORALES	SURF@IFISC FELLOWSHIP

2.8 SUMMARY OF IFISC HUMAN RESOURCES

HUMAN RESOURCES IFISC 2014

	Total	Male	Female
Permanent staff	15	13	2
Associated staff	1	1	0
Postdoctoral fellows	16	14	2
PhD students	27	22	5
Long-term visitors	19	17	2
Support personnel	8	4	4
Total	86	71	15

PERSONNEL IFISC 2009-2014

	2009	2010	2011	2012	2013	2014
PERMANENT STAFF	14	17	17	16	16	15
POSTDOCTORAL AND ASSOCIATED	17	14	15	16	19	16
PhD STUDENTS	22	25	23	22	24	27
LONG TERM VISITORS	4	15	8	7	8	19
SUPORT PERSONNEL	7	7	8	9	8	8
TOTAL	64	78	71	70	75	85

VISITING SCIENTISTS AT IFISC 2009-2014

	Shorts visits	Long visits	Total visits
Spain	87	5	92
Europe	141	28	169
Rest of the world	48	28	76
Total	276	61	337

3

RESEARCH PROJECTS AND FUNDING

DURING 2014 IFISC HAS RECEIVED FUNDING VIA THE ACTIVE RESEARCH PROJECTS LISTED BELOW. IN BRIEF:

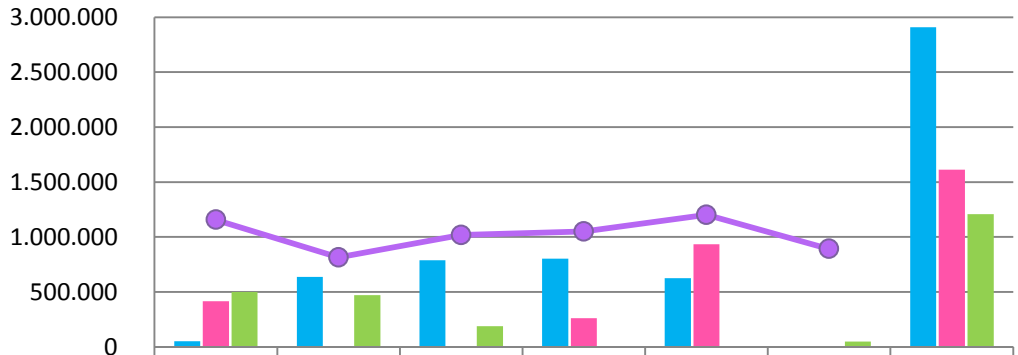
- European Commission Framework Program projects: **6**
- Spanish National Plan: **5**
- Regional Balear Government: **3**
- Research Contract:**1**

SUMMING UP THE BUDGET OF THE ACTIVE PROJECTS IN 2014 WE GET:

- Grand total budget of active projects in 2014: **3.366.903** €
- Grand total budget of European Commission active projects in 2014: **2.051.463** €
- Budget of EC-funded active projects in 2014: **60,93 %** of total

BUDGET FIGURES FOR THE PERIOD 2009-2014 ARE SUMMARIZED IN THIS TABLE
(With budget of a project assigned to the year it is granted. The Annualized total in one year is one third of the budged granted in that year and in the two previous years)

BUDGET IFISC'S RESEARCH PROJECTS 2009-2014 (IN €)



	2009	2010	2011	2012	2013	2014	TOTAL
European Commission	53.000	635.489	789.228	803.952	625.349	0	2.907.018
Spanish National Plan for Science	415.952	0	0	261.360	934.830	0	1.612.142
Other Funding	500.625	470.279	188.700	0	0	47.250	1.206.854
Annualized total	1.155.370	814.172	1.017.758	1.049.669	1.201.140	890.914	

3.1 RESEARCH PROJECTS FUNDED BY THE EUROPEAN COMISSION

TREE

Data-driven modelling of network-wide extension of the Tree of Reactionary delays in ECAC area. European Comission and Eurocontrol. RTD Project. IFISC Principal Investigator: José J. Ramasco. (2013-2016). Budget: 270.000

INSIGHT

Innovative policy modelling and governance tools for sustainable post-crisis urban development. Code: 611307. European Union. STREP Project. IFISC Principal Investigator: José J. Ramasco. (2013-2016). UIB Budget: 274.820 € and CSIC Budget: 80.530 €

LINC

Learning about interacting networks in climate. [FP7-PEOPLE-2011-Marie Curie Initial training Network (ITN), PITN- GA-2011-289447] European Commission. IFISC Principal Investigator: Emilio Hernández-García (2011-2015) Budget: 502.162 €.

PhD ComplexWorld

Analysis of air transportation using complex networks. Subproject of SESAR. European Commission-SESAR Joint Undertaking-Eurocontrol. Contract 10-220210-C4. Principal Investigator: Maxi San Miguel. (2011-2015) Budget: 120.000 €.

EUNOIA

Evolutive user-centric networks for intraurban accessibility. [Number 318367- STREP]. Principal investigator and Euroepan Coordinator: Maxi San Miguel. (2012-2014). UIB Budget: 452.581 €. CSIC Budget: 41.177 €

LASAGNE

Multi-layer spatiotemporal generalized networks. [FP7-ICT-2011-8. Proposal 318132]. IFISC Principal investigator: Maxi San Miguel. (2012-2015). UIB Budget: 205.282 €. CSIC Budget: 104.912 €.

3.2 RESEARCH PROJECTS OF THE SPANISH NATIONAL PLAN FOR SCIENCE

TIQS

Transport and information in quantum systems. [FIS2011-23526].
Principal investigator: Llorenç Serra. (2012-2014). Budget: 183.920 €.

MODASS

Modeling and analysis of social systems. [FIS2011-24785].
Principal investigator: Víctor M. Eguíluz. (2012-2014) Budget: 77.440 €

INTENSE@COSYP

Complex systems physics: Information, technology, society and ecology. [FIS2012-30634].
Principal investigator: Maxi San Miguel. (2013-2015) Budget: 498.420 €.

ESCOLA

Lagrangian coherent structures in the ocean dynamics. [CTM2012-39025-C02-01].
Principal investigator: Cristóbal López. (2013- 2015) Budget: 157.950 €.

TRIPHOP

Towards brain-inspired efficient photonic information processing. [TEC2012-36335]. Principal investigator: Ingo Fischer. (2013-2015) Budget: 278.460 €.

3.3 OTHER IFISC RESEARCH PROJECTS

PIPSeL

Photonic Information Processing Using Semiconductor Lasers. Proyecto Intramural Especial. CSIC. 201350E084. Ingo Fischer. (2013-2014)

CONSISTENCY

Consistency in Semiconductor Lasers and its Applications. Proyecto Intramural Especial. CSIC. 201450E061. Ingo Fischer. (2014-2015). Budget: 99.000 €

3.4 RESEARCH PROJECTS WITH PARTICIPATION OF IFISC MEMBERS

KNOWeSCAPE

Analyzing the dynamics of information and knowledge landscapes. COST ACTION TD1210. European Coordinator: Andreas Schamhorst. IFISC Coordinator: Maxi San Miguel. (2012-2017)

NANOCTM

Nonlinear transport relations in coupled conductors. [234970] Marie Curie Initial Training Network. Principal Investigator: Colin Lambert from Lancaster University, UK. IFISC Participating Scientists: David Sánchez and Rosa López. (2010-2014)

FIS2014-REDT

Red de Física Estadística de no Equilibrio y sus Aplicaciones Multidisciplinares. MINECO. [FIS2014-57117-REDT]. Network of Excellence. IFISC Principal Investigator: David Sánchez. (2014-2016)

3.5 OTHER PUBLIC FUNDING

GrupCompetitiu FESC

Grupo de Física Experimental de sistemas complejos. Govern Balear.. Principal Investigator: Ingo Fischer. (2011-2014) Budget:36.000 €.

GrupCompetitiu GFI

Grupo de Física interdisciplinar. Govern Balear. Principal Investigator: Maxi San Miguel (2011-2014) Budget: 36.000 €.

Govern Balear Institutos

Agreement between Balear Government and UIB for the Universitary Institute´s management of the 2014-2015 academic period. IFISC Principal Investigator: IFISC Director. (2014-2015) UIB Budget: 16.000 €

3.6 RESEARCH CONTRACTS

Xarion Collaboration

XARION Laser Acoustics GmbH (Vienna). Research Cooperation Agreement. IFISC Principal Investigators: Ingo Fischer and Claudio Mirasso. (2014-2015) Budget: 31.250 €

3 RESEARCH PROJECTS AND FUNDING

4

IFISC SEMINARS

Coordinators:
Rosa López and Manuel Matías

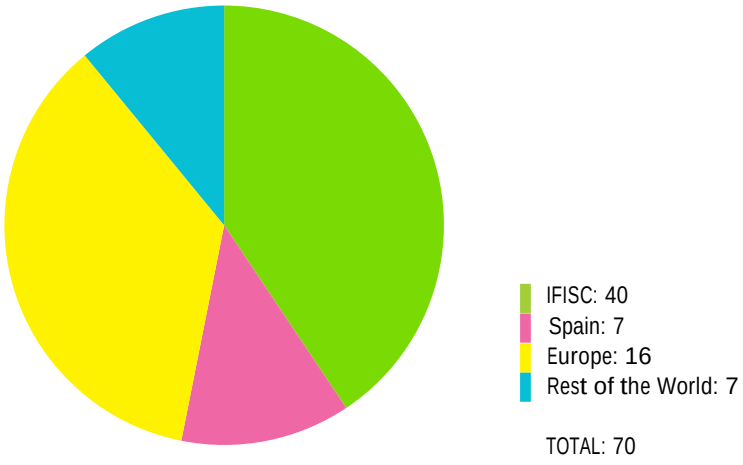
DURING 2014 A TOTAL OF **70** SEMINARS HAVE BEEN GIVEN AT IFISC

This amounts to more than one seminar per week on average. The full listing can be found in **http://ifisc.uib-csic.es/seminars/** and in the Appendix of this Report.

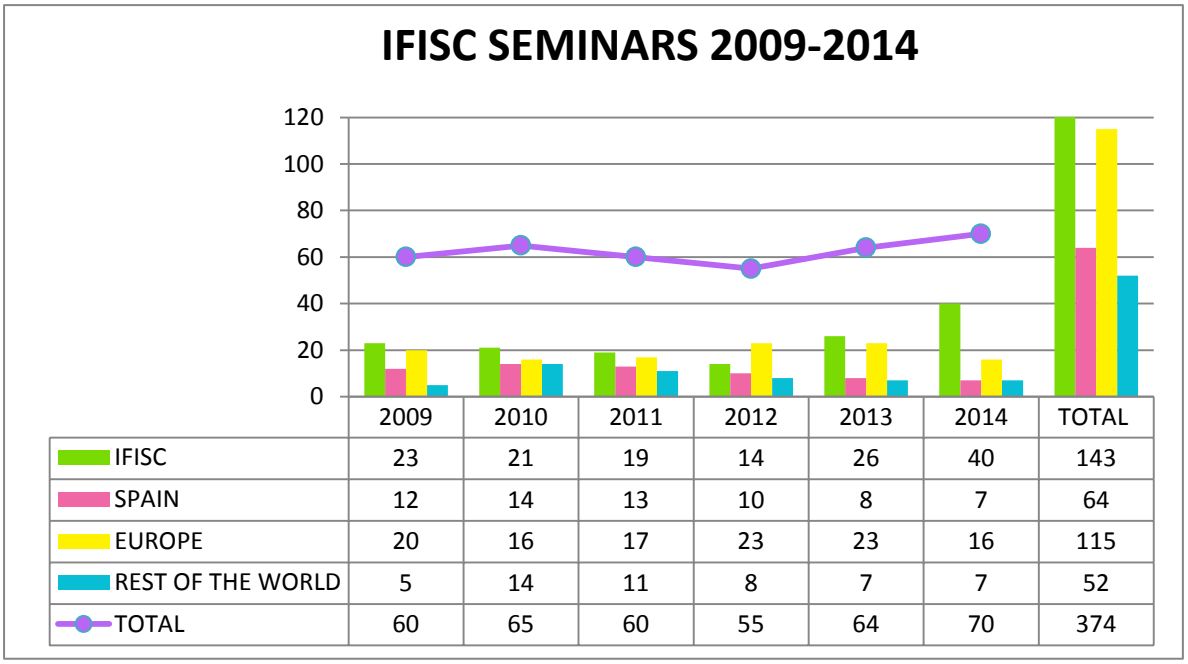
Seminars are broadcasted live and recorded.You can watch and retrieve them at **http://ifisc.uib-csic.es/seminars/**, and also in the youtube channel **https://www.youtube.com/user/IFISCseminars/**

The following graphs show the distribution of seminars by geographic procedence of the speaker for 2014 and for the previous years:

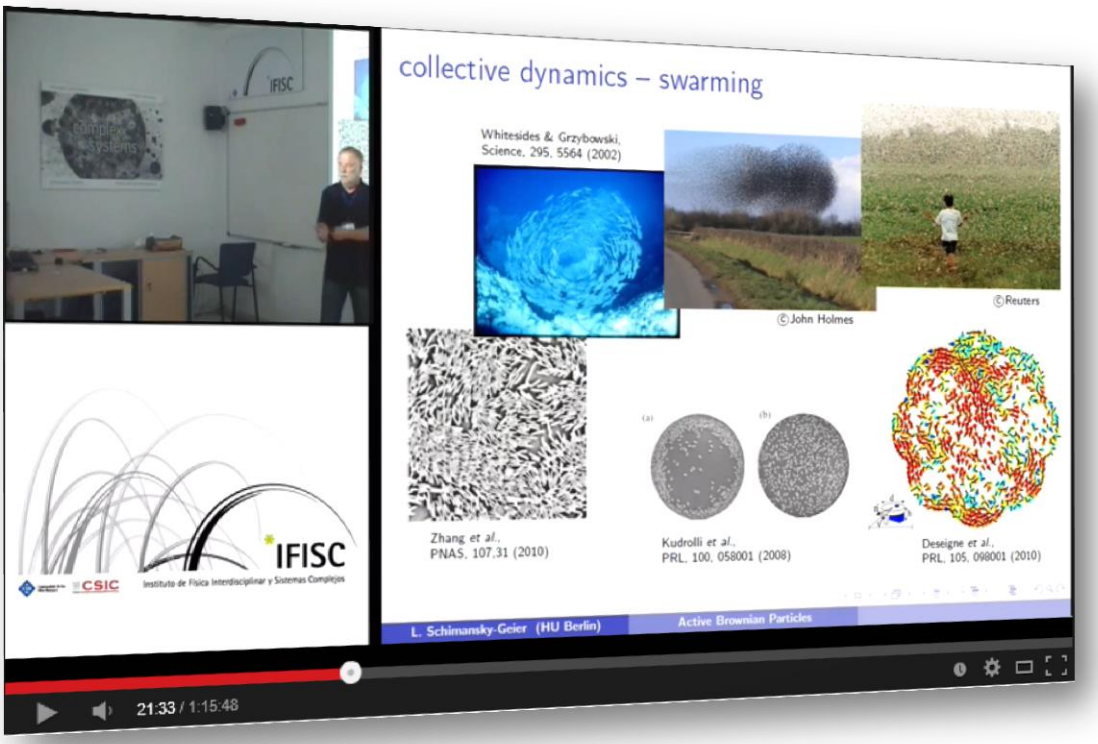
PROCEDENCE OF SPEAKERS AT IFISC SEMINARS 2014

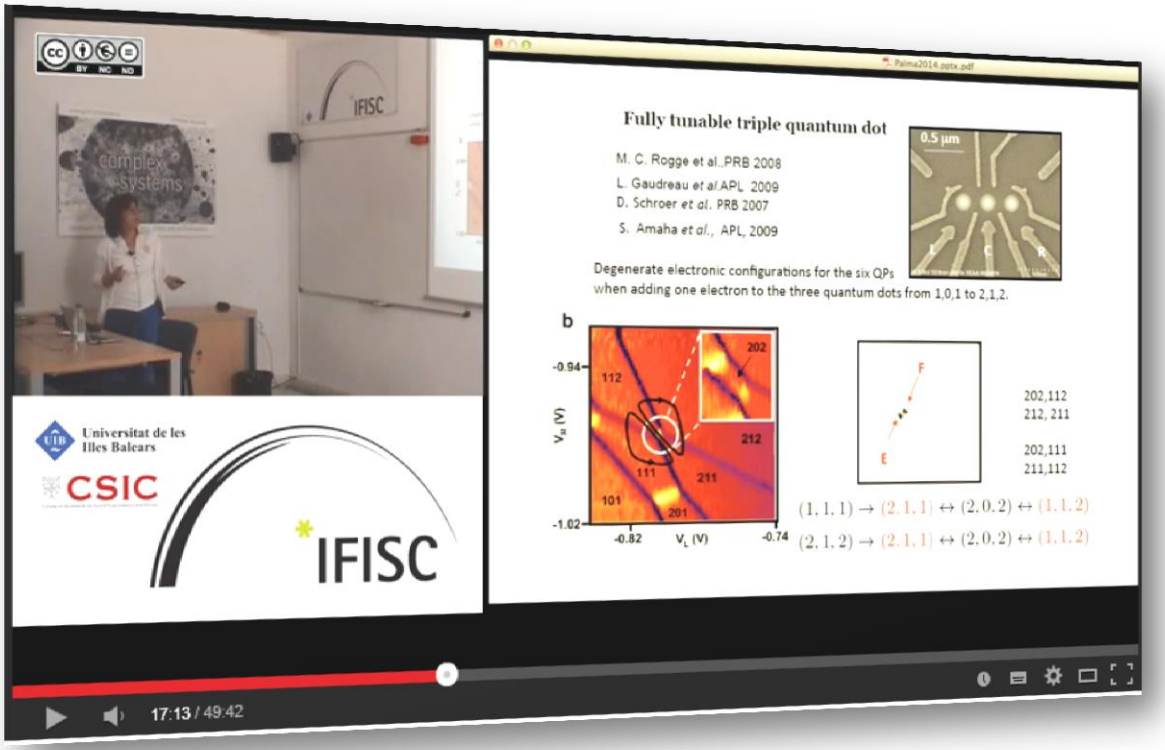


IFISC SEMINARS 2009-2014



	2009	2010	2011	2012	2013	2014	TOTAL
IFISC	23	21	19	14	26	40	143
SPAIN	12	14	13	10	8	7	64
EUROPE	20	16	17	23	23	16	115
REST OF THE WORLD	5	14	11	8	7	7	52
TOTAL	60	65	60	55	64	70	374


collective dynamics – swarming
Whitesides & Grzybowski, Science, 295, 5564 (2002)
© John Holmes
© Reuters
Zhang et al., PNAS, 107,31 (2010)
Kudrolli et al., PRL, 100, 058001 (2008)
Deseigne et al., PRL, 105, 098001 (2010)
L. Schimansky-Geier (HU Berlin)
Active Brownian Particles
IFISC
CSIC
Instituto de Física Interdisciplinar y Sistemas Complejos
21:33 / 1:15:48


Fully tunable triple quantum dot
M. C. Rogge et al.,PRB 2008
L. Gaudreau et al APL 2009
D. Schroer et al. PRB 2007
S. Amaha et al., APL, 2009
0.5 μm
Degenerate electronic configurations for the six QPs when adding one electron to the three quantum dots from 1,0,1 to 2,1,2.
b
-0.94
-1.02
-0.82
-0.74
V_L (V)
V_M (V)
202
112
212
111
211
101
201
F
E
202,112
212, 211
202,111
211,112
$(1,1,1) \rightarrow (2,1,1) \leftrightarrow (2,0,2) \leftrightarrow (1,1,2)$
$(2,1,2) \rightarrow (2,1,1) \leftrightarrow (2,0,2) \leftrightarrow (1,1,2)$
Universitat de les Illes Balears
CSIC
IFISC
17:13 / 49:42

5

PUBLICATIONS

IFISC RESEARCH RESULTS HAVE ORIGINATED THE FOLLOWING PUBLICATIONS DURING 2014:

- Papers in journals indexed in the Journal Citation Reports: **64**
- Other publications: **7**

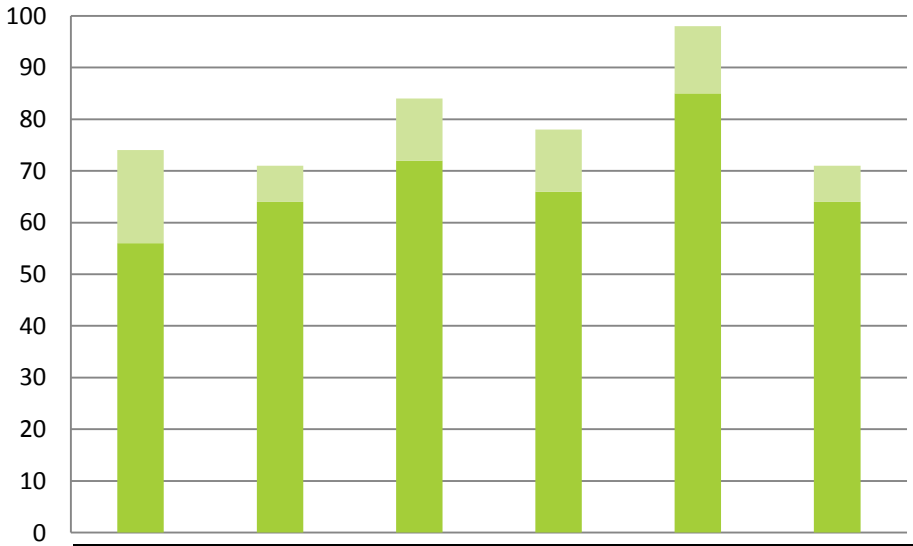
The following tables put these numbers in the context of the publication activity during the past years, and specify which are the main journals in which IFISC papers are published. It is a strategic compromise of IFISC to target cross-disciplinary research areas lying outside the domain of traditional 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 2008-2014 IFISC has published 1 paper in Reviews of Modern Physics, 2 papers in Science, 7 papers in PNAS, and 30 papers in Physical Review Letters

In addition, Profs. Raúl Toral and P. Colet have published the book **Stochastic Numerical Methods: An Introduction for Students and Scientists,** Wiley-VCH.

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

IFISC PUBLICATIONS 2009-2014



	2009	2010	2011	2012	2013	2014	TOTAL
JCR Journals	56	64	72	66	85	64	407
Other Publications	18	7	12	12	13	7	69
TOTAL	74	71	84	78	98	71	476

JOURNALS WITH THE LARGEST NUMBER OF PUBLICATIONS

IFISC PUBLICATIONS	2009	2010	2011	2012	2013	2014	TOTAL
Physical Review E	4	5	11	11	9	14	54
Physical Review B	2	5	5	2	8	7	29
Physical Review A	7	4	4	3	5	5	28
Physical Review Letters	2	4	6	4	8	3	27
European Physical Journal	7	5	2	6	2	2	24
Plos One	0	1	7	4	0	5	17
IEEE	4	4	4	1	4	0	17
Physica A	1	3	3	3	2	2	14
New Journal of Physics	1	2	0	3	2	3	11
Non-Physics Journals (excluding IEEE Journals)	12	12	16	15	19	18	92

5 PUBLICATIONS

6

CONFERENCES AND WORKSHOPS

6.1 IFISC WORKSHOPS

TREE: Data-driven modelling of network-wide extension of the Tree of Reactionary delays in ECAC area

JANUARY 16
IN UIB CAMPUS,, PALMA DE MALLORCA, SPAIN.
SCIENTIFIC ORGANIZERS: José J. Ramasco
Workhop on Airline Disruption Managament Processes

The meeting in Palma of the TREE project was a demonstration session for stakeholders on the potentiality of the model developed in the project. The objective was not only to show the project development, its current state and the future progress, but to engage the community in a discussion regarding the needs and practices in the Air Traffic Management with the aim of implementing their comments in the coming research activities of TREE as well as into the modeling exercise. For this, it was interesting to join a multidisciplinary panel of experts. We counted with the presence of networks managers such as Phillip Bradbury, active controller, and Yves De Wanderler, head of the CODA office for flight performance, of Eurocontrol, personnel of the airlines as Joan Rosello from AirEuropa and Steve Zerkovitz from Brussels, etc. The discussion passed over the different points of the model with interesting suggestions from the panel in terms of modifications to get the model closer to real management practice and possible applications.

6.2 SCHOOLS

Fourth Summer School on Statistical Physics of Complex and Small Systems

SEPTEMBER 08-19

IN IFISC, CAMPUS UNIVERSITY OF THE BALEARIC ISLANDS, PALMA DE MALLORCA, SPAIN. SCIENTIFIC ORGANIZER: P. COLET.

While the traditional basic body of knowledge of Statistical Physics is well described in textbooks and typically at an undergraduate or master level, the applications to Complex and Small Systems are well beyond the scope of those textbooks. The Summer School on these topics aims at bridging the gap between the master level and the necessities of PhD students and young postdocs working on these fields.

Lecturers:

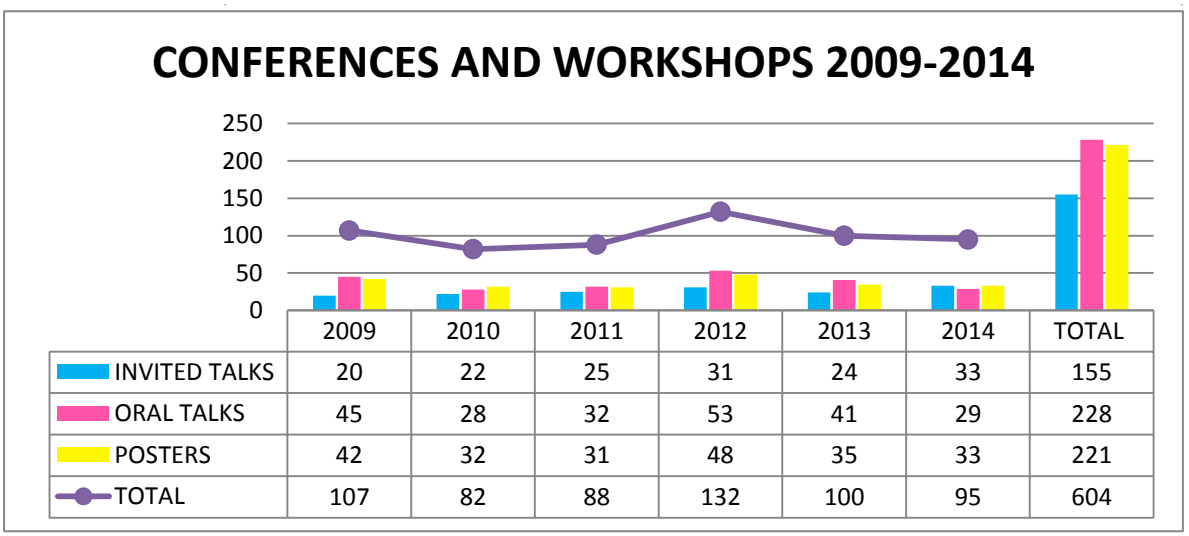
- Pedro Tarazona, Universidad Autónoma de Madrid, Spain.
- Arkady Pikovsky, University of Potsdam, Germany.
- Emilio Hernández-García, IFISC (CSIC-UIB), Spain.
- Daniel Walgraef, FNRS (Belgium) and IFISC (CSIC-UIB), Spain.
- Jordi Ortin, Universitat de Barcelona, Spain.
- Victor M. Eguíluz, IFISC (CSIC-UIB), Spain.

6.3 COMMUNICATIONS TO SCIENTIFIC CONFERENCES 2014

- Invited talks: **33**
- Oral Communications: **29**
- Posters: **33**
- Total: **95**

They are listed in the Appendix of this Report.

PRESENTATIONS AT CONFERENCES AND WORKSHOPS 2009-2014



	2009	2010	2011	2012	2013	2014	TOTAL
INVITED TALKS	20	22	25	31	24	33	155
ORAL TALKS	45	28	32	53	41	29	228
POSTERS	42	32	31	48	35	33	221
TOTAL	107	82	88	132	100	95	604

6.4 SCIENTIFIC COMMITTEES AND ORGANIZATION OF CONFERENCES AND WORKSHOPS

Ramasco, Jose J.
Elected member of the council of the Complex Systems Society.
2013-2016

San Miguel, Maxi
Member of the Steering Committtee of ECCS (European Conference on Complex Systems).
2014

San Miguel, Maxi
Member of IUPAPC3 Commission on Statistical Physics.
2014

Toral, Raúl
Member of the Scientific Committee of FisEs.
2010-2014

Ramasco, Jose J.
Member of the scientific committee of Net-works.
2013-2015

Lopez, Rosa
Quantum Thermodynamics conferences COST.
2014-2015

Ramasco, Jose J.
Organization of TREE workshop on Airline Disruption Management.
January 16

Ramasco, Jose J.
Organizacion del satellite del NetSci'14 “Ecolink: Complex Networks in Ecology".
Satelite del NetSci 2014 en Berkeley, CA, USA.
June 03

Fischer, Ingo
Wireless Intelligent Sensor Networks (WISeNet) Workshop.
Evaluation of WISeNet School and presentation: Building a Reservoir Computer: Concept, Mechanisms, and Performance.
June 9 - 10

Colet, Pere; Toral, Raúl
Organization of the Fourth Gefenol Summer School on Physics of Complex and Small Systems.
Campus UIB.
September 8 -19

Ramasco, Jose J.
Organization of the ECCS'14 “International Workshop on Citizen Networks CitiNet".
September 25

San Miguel, Maxi
Member of Program Committee.
IEEE-Complex Networks 2014, Marrakesh, Marrocco.
November 23 to December 27

6 CONFERENCES AND WORKSHOPS

7

OTHER ACTIVITIES

7.1 MASTER THESIS

Loreti, Simone
Co-evolution of networks
Supervisor: Toral, Raul
April 01

Sierra, Miguel A.
Thermoelectric effects in quantum dots with interaction
Supervisor: Sánchez, David
July 29

Rodríguez, Jorge P.
Synchronization in multilayer networks of mobile oscillators
Supervisor: Eguíluz, Víctor M.
September 02

Ruiz, Daniel
Optical properties of 2D Majorana nanowires
Supervisor: Serra, Llorenç
September 17

Artime, Oriol
Time Series Analysis of Online Social Media
Supervisors: San Miguel, Maxi; Ramasco, Jose J.
September 29

Recuerda, Irene
Lagrangian study of an atmospheric blocking event
Supervisors: Hernández-García, Emilio; López, Cristóbal
October 13

Kiziridis, Danis
Evolution of movement strategies under competitive interactions
Supervisors: Hernández-García, Emilio; López, Cristóbal
October 13

7.2 PHD THESIS

Grabowicz, Przemyslav A.
Complex Networks approach to modeling online social systems: The emergence of computational social science
Supervisors: Eguiluz, V.M. and Ramasco, J.J.
January 10

Fernández Gracia, Juan
From mechanisms to data-inspired modeling of collective social phenomena
Supervisors: San Miguel, Maxi and Eguíluz, Víctor M.
February 19

Matias, Fernanda. S.
Anticipated synchronization in neuronal circuits
Supervisor: Mirasso, Claudio
March 18

Martínez-García, Ricardo
Nonequilibrium Statistical Physics in Ecology: Vegetation Patterns, Animal Mobility and Temporal Fluctuations.
Supervisor: López, Cristóbal
June 27

Hicke, Konstantin
Synchronization and application of delay-coupled semiconductor lasers
Supervisor: Fischer, Ingo
July 10

Bettencourt, Joao P.
Three Dimensional Lagrangian Structures in Turbulent Flows: Application to Oceanic Processes
Supervisors: López, Cristóbal; Hernández-García, Emilio
December 04

7.3 AWARDS

Martínez García Ricardo – PhD student.
UIB Research Award Montserrat Casas in the Science modality.

7.4 MEMBERS OF EDITORIAL BOARD OF SCIENTIFIC JOURNALS

Associate Editor of Advances in Complex Systems.
Eguíluz, Victor M.

Subdirector de la Revista Española de Fisica.
Hernandez-Garcia, E.

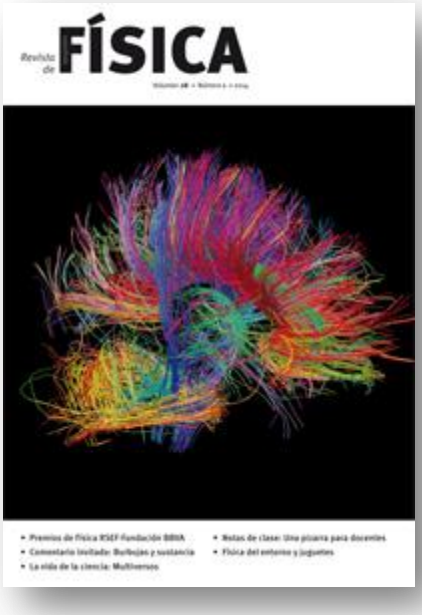
Member of the Editorial Advisory Board of the journal Ecological Complexity.
Hernandez-Garcia, Emilio

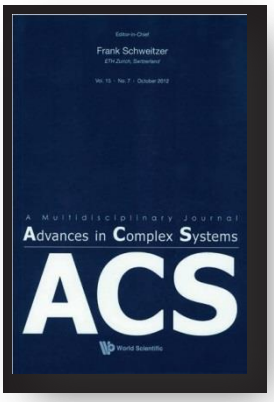
Member of the the Editorial Board of EPJ Data Science.
San Miguel, M.

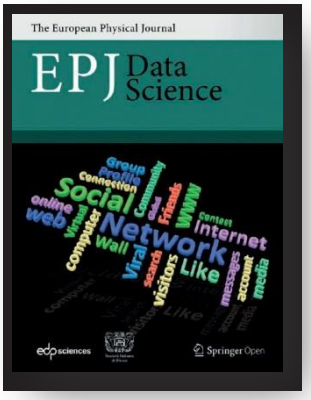
Editor Frontiers in Physics.
Ramasco, Jose J.

Member of the editorial board of PLoS ONE.
Ramasco, Jose J.

Member of the editorial board for Nature Scientific Reports.
Ramasco, Jose J.







7.5 RESEARCH STAYS IN OTHER CENTERS

VORtech. Delft, The Netherlands.
Colaboration with Ir. Johan Dijkzeul and Dr. Hisham Ihshaish.
Rodriguez-Mendez, Victor
January 6 to February 7

Ernst Struengmann Institute for Neuroscience, Frankfurt, Germany.
Visit to Prof. Wolf Singer,
Fischer, Ingo; Mirasso, Claudio
January 22 - 24

Short Term Scholar in Northeastern University, Boston, USA.
Research visit to collaborate with Alessandro Vespignani group.
Fleurquin, Pablo
February 7 to June 20

Aston University, Birmingham, UK.
Visit to Sergei Turitsyn.
Fischer, Ingo; Mirasso, Claudio; Soriano, Miguel C.
February 17 - 19

Institute for the Chemistry and Biology of the Marine Environment, Oldenburg, Germany.
Martínez-García, Ricardo
February 26 - 28

Dipartimento di Fisica, Universita degli Studi di Milano, Italy.
Zambrini, Roberta
March 4 - 5

Visit to Departamento de Fisica, Universidade Federal de Pernambuco, Recife, Brazil.
Hernandez-Garcia, Emilio
March 10 - 11

Deparment of Physics, Universidade Federal de Pernambuco, Recife, Brazil.
Mirasso, Claudio
March 15 – 22

Heriot Watt University, Edinburgh, UK.
Collaboration with S. Maniscalco.
Zambrini, R.; Galve Conde, F.
April 5 - 10

Research visit to the institute of Physics and the Institute of Biology, Universidade Federal da Bahia, Salvador, Brazil.
Hernandez-Garcia, Emilio
April 23 – 25

Instituto de Neurociencias de Alicante, Spain.
Marie R. Popiel
April 30 to January 19

Deparment of Chemistry and Biochemistry of the U. California at San Diego, USA.
Collaboration with Profs. Katja Lindenberg and Christian Van den Broeck.
Toral, Raul
July 14 - 27

Physics Department, Lehigh University, USA.
Collaboration with Prof. James D. Gunton.
Toral, Raul
July 28 to August 10

FEMTO-ST Institute, Besançon, France.
Collaboration with Prof. Laurent Larger.
Oliver, Neus
October 1 to November 30

University of California, Berkeley, USA.
Visit to the group of Prof. Edgar Knobloch
Parra Rivas, Pedro
October 10 to December 17

Queen Mary University, London, UK.
Complex Systems Group, stay with Vito Latora.
Diakonova, Marina
November 3 - 7

Universitat Politècnica de Catalunya. Terrassa, Spain.
Colaboration with Prof. Dr. Cristina Masoller.
Rodriguez-Mendez, Victor
November 24 to December 22

Max Planck Institute for the Physics of Complex Systems, Dresden, Germany.
Visit to the department of Biological Physics headed by Prof. Frank Jülicher with research discussions on the dynamics of biological systems.
Matias, Manuel A.
November 20 - 21

Institute of Physics, Potsdam University, Germany.
Visit to the group of Prof. Arkady Pikovsky and discussions on the dynamics of coupled oscillators.
Matias, Manuel A.
November 28

Universite Pierre et Marie Curie, Paris, France.
LOCEAN, with Francesco d'Ovidio
López, Cristóbal
December 13 – 19

7. 6 IFISC MASTER

IFISC Master in *Physics of Complex Systems*

In October 2012 IFISC started a new 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. They are though by IFISC researchers.

This is the 2014-2015 Master syllabus:

Structural module courses (39 credits):

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

Specific module courses (9 credits minimum)

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

Other Postgraduate Courses Tought in 2014

Master in Advanced Physics and Applied Mathematics, University of the Balearic Islands

- **Cooperative and critical phenomena.**
  Maxi San Miguel, Tomàs Sintes
- **Stochastic simulation methods**
  Pere Colet, Raúl Toral
- **Scientific presentation and visualization**
  José J. Ramasco
- **Spintronics**
  Llorenç Serra Crespí, David Sánchez, Rosa López

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

- **Computational Models of Social Evolution**
  Víctor M. Eguíluz

7.7 OTHER

IFISC provided practical training to two computer technician students from the center IES Emilio Darder (FP intermediate level) and another one from the center IES Sant Josep Obrer (FP superior level) .
From March 24 to June 30.

8

OUTREACH ACTIVITIES

8.1 CONFERENCE SERIES

Conference Series
"Exploring Boundaries Between Disciplines VII"

In 2014 the subject of the Conference Series was Magic and Science: With or Without You.

PROGRAMME

MAY 6

¿Magía, química, o todo a la vez?.
Magic, chemistry, or all together?

Dr. Josep Duran, Profesor del Departamento de Química de la Universidad de Girona. **Pep Anton Vieta**, Doctorando en el Departamento de Quimica de la Universidad de Girona. Miembros de la Cátedra de Cultura Científica y Comunicación Digital de la UdG.

MAY 13

Sorpresa! Las bases neurobiológicas del ilusionismo.
Surprise! The neurobiological basis of illusionism

Luis M. Martínez Otero, Investigador del Laboratorio de Neurociencias Visuales. Instituto de Neurociencias de Alicante CSIC-UMH. **Miguel Angel Gea**, Ilusionista, Madrid.

MAY 20

M3: Magia, Matemáticas y Motivación.
M3: Magic, Mathematics and Motivation

Fernando Blasco, Universidad Politécnica de Madrid. **Jorge Luengo**, Campeón Mundial de Invención de Magia 2009. **Isabel Queralt**, Profesora de Matemáticas.

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

8.2 OPEN DAYS @ IFISC

IFISC organized on February 14th an open day, addressed mostly to undergraduate and master students. The attendees received information on the different IFISC research lines, visited the photonics and nonlinear dynamics laboratories as as the computational facilities. They were also informed about the IFISC Master in Complex Systems and the opportunites to conduct a PhD degree at IFISC.

ACTIVITATS

L'IFISC es presenta als estudiants de la UIB amb una jornada de portes obertes

▶ L'Institut de Física Interdisciplinària i Sistemes Complexos organitzà una jornada per donar a conèixer les seves línies de recerca universitaris ▶ Hi participaren investigadors i estudiants de doctorat que explicaren la seva experiència al centre

Els participants durant una de les conferències. IFISC

Investigadors del centre explicaren la seva experiència. IFISC

J. MATEU
PALMA

■ L'Institut de Física Interdisciplinària i Sistemes Complexos, un centre de recerca mixt entre el CSIC i la UIB, va organitzar dijous passat una jornada de portes obertes per a estudiants universitaris de qualsevol disciplina.

L'objectiu de l'activitat era mostrar l'esperit interdisciplinari d'aquest centre, i anava dirigida especialment a estudiants dels dos darrers cursos acadèmics de la UIB amb inquietud intel·lectual i científica i ment oberta.

Les activitats, que es varen dur a terme durant tot l'horabaixa, varen fer possible que els participants coneguessin les diverses línies d'investigació del centre, així com els itineraris d'accés i desenvolupament d'un doctorat o del màster de l'IFISC.

A més, també es varen programar visites al laboratori de fotònica i les instal·lacions de computació del centre.

Xerrades científiques

Per donar a conèixer les activitats de recerca que du a terme l'IFISC, es varen programar diverses conferències i xerrades a càrrec de científics del centre, que varen compartir les seves experiències en l'àmbit de la recerca i explicaren les característiques principals de les investigacions que dirigeixen.

A més, durant la jornada de portes obertes els participants també varen poder parlar amb els estudiants de doctorat que realitzen la seva tasca d'investigació a l'IFISC i que compartiren amb ells la seva experiència en aquest institut de recerca.

Entre les xerrades i conferències que es varen organitzar a la sala

L'objectiu de les activitats era donar a conèixer les diverses línies d'investigació d'aquest centre mixt UIB-CSIC

A més de les xerrades amb investigadors, els participants varen poder visitar els laboratoris de l'institut

Montse Casas del centre, hi havia la titulada *Fent carrera a l'IFISC: Introducció a la investigació, màster i doctorat* i *Com cercar-se la vida per fer feina en investigació?*

També es varen organitzar diverses activitats desenvolupades sota l'epígraf *Un món complex* en què es varen tractar temes com la *Biocomplexitat, processament de la informació i tractament massiu de dades*, la *Nanociència i informació quàntica*, *El mar i altres fluids complexos* o els *Reptes socials i sistemes sociotècnics* per donar a conèixer als assistents les diverses línies de recerca de l'institut.

Més informació d'aquest institut de recerca:
http://ifisc.uib-csic.es

OPTOMICS

IFISC with the OSA (Optical Society of America) Students Chapter organized a comic contest about Optical Phenomena on February 14th. The comic had to have a maximum of 2 pages.

The awards ceremony was held at IFISC on April 30th.

OUTREACH TALK:

QUANTUM PHYSICS AND QUANTUM MYSTICISM: A STRANGE RELATIONSHIP

David Sánchez, researcher researcher at the Institute for Cross-Disciplinary Physics and Complex Systems, IFISC (CSIC-UIB, discussed pseudoscientific approaches to quantum mechanics that invoke healing techniques, parapsychologic effects and spirituality based on misunderstandings and misuses of the main ideas of quantum physics.

The Diario de Mallorca Club organized this conference on October 16.

Rosa López

Investigadora del Instituto de Física Interdisciplinar

de la UIB, Rosa López explicó ayer las múltiples aplicaciones del grafeno, un material abundante, duro, elástico, con gran conductividad eléctrica y térmica que no dudó en calificar como el material del futuro

"Con el grafeno es posible hacer móviles que se podrán doblar, caer al suelo y mojarse"

Rosa López, física investigadora de la UIB. JUAN CARLOS BALLESTER

"Con diez gramos de carbón puedes hacer tanto grafeno como para cubrir un estadio de fútbol"

CLUB DIARIO DE MALLORCA

CONFERENCIA

El supermaterial del siglo XXI

Conferencia sobre las aplicaciones del grafeno. Jueves, 11 de diciembre, 19 horas. **Club Diario de Mallorca.** C/ Puerto Rico, 15 . **Entrada libre**

L. OLAIZOLA PALMA

—¿Qué es el grafeno?

—Si la mina de un lápiz es el grafito, átomos de carbono en tres dimensiones, el grafeno son estos mismos átomos en dos dimensiones formando una red hexagonal en una superficie de un espesor de un átomo.

—¿Y qué características tiene?

—Es muy resistente y más duro que el diamante. Al mismo tiempo, es muy flexible: No se va a romper pese a que me suba encima de una plancha de este material.

—También tiene una gran conductividad...

—Sí, es una de sus características más valiosas. Conduce mejor la electricidad que cualquier otro conductor eléctrico. Por ejemplo, conduce mil veces mejor que el silicio. También transporta muy bien el calor. Es transparente y flexible, características que lo hacen especialmente idóneo para fabricar pantallas de ordenador, tabletas o móviles así, transparentes y flexibles.

—¿Se ha fabricado ya algún móvil con este material?

—Existen prototipos de Samsung que, por su flexibilidad, se pueden doblar e incluso enrollar para que te lo puedas guardar en el bolsillo, que se podrán caer al suelo porque no se rompen y que incluso se pueden sumegir en el agua...

—¿Un móvil sumergible?

—Sí, basta con combinar el grafeno con otro tipo de átomos para hacerlo más impermeable.

—¿Qué aplicaciones se le está dando a este revolucionario material?

—Todavía está en fase de prototipos, aún no ha llegado a la industria en gran escala.

—¿En qué ámbitos podrá mejorar actuales prestaciones de otros materiales?

—Por ejemplo, en el de almacenamiento de la energía fabricando supercondensadores de este material que permitirán almacenar electricidad obtenida de energías renovables como la eólica. También parece que será el material que solucionará el problema de las baterías de los coches eléctricos.

—¿Por qué?

—Recientemente se ha presentado un trabajo en la universidad de Córdoba de una batería de grafeno que se carga en tan solo unos ocho minutos y que proporciona al vehículo una autonomía de unos mil kilómetros. En el futuro se podrá hacer un coche de grafeno que será el más barato y ecológico del mundo.

—Deme más detalles.

—Se trataría de un vehículo construido íntegramente con grafeno, incluso su parte electrónica. Tendría un techo de placas solares también de este material y se almacenaría esta energía solar en superconductores también de grafeno que, a su vez, cargarían las baterías de carbono. Tendríamos un coche eléctrico que usaría energía solar con una gran autonomía.

—¿Qué otras posibilidades ofrece el grafeno?

—En Medicina son múltiples ya que se trata de un material que es biocompatible con la vida porque está hecho de carbono y, por tanto, el cuerpo no lo rechaza. Se podría crear una microcámara de grafeno y colocarla en el ojo para solucionar problemas de visión. O aparatos para el tímpano. O prótesis traumatológicas de grafeno que serían más resistentes, ligeras y que no se degradarían con el paso del tiempo.

—¿Podría usarse en el sector aeronáutico?

—Por supuesto. Se podrían construir aviones mucho más ligeros que requiriesen menos coste energético para desplazarse. Abarataría este tipo de transporte. Además, su dureza, es doscientas veces más duro que el acero, lo sitúan como el material del futuro en materia de blindajes.

—¿Hay alguna institución que esté apostando por él?

—El programa de investigación 2020 de la Unión Europea ha destinado dos partidas de mil millones de euros para dos estudios muy específicos, el del cerebro y el del grafeno. Es decir, doscientos grupos de investigación de veintitrés países europeos, en los que España tiene mucho peso, se pueden beneficiar de estos fondos desde el año pasado y hasta el año 2020 que acaba el programa, siete años en total.

—¿Quién lo descubrió?

—Lo descubrieron en 2004 dos investigadores de la universidad de Manchester, Andre Geim y Konstantin Novoselov, que en 2010 recibieron el Nobel de Física, algo que no ha pasado nunca tan prematuramente tras un hallazgo científico. Esta da una idea de su importancia.

—Se trata de un material abundante?

—Hay sobreabundancia de grafeno. Además, con diez gramos de carbón o grafito puedes fabricar suficiente grafeno como para cubrir la superficie de un estadio de fútbol. Hay que estirar tanto el material para conseguir el grosor de un átomo que da mucho de sí.

—¿Cuál sería su aplicación práctica más inmediata?

—En las baterías de los móviles, actualmente hechas de litio, un material muy contaminante, escaso y caro. Por contra tendríamos las baterías de grafeno más baratas y biodegradables. Además se cargarían en muy poco tiempo. ¿En cuánto? No lo sé, pero sí las de un coche eléctrico se cargan en ocho minutos...

OUTREACH TALK: "GRAPHENE, THE 21 CENTURY SUPER MATERIAL WITH REVOLUTIONARY APPLICATIONS"

Rosa López, researcher at the Institute for Cross-Disciplinary Physics and Complex Systems, IFISC (CSIC-UIB), talked about graphene, super material, 200 times harder than steel, elastic and flexible, transparent and lightweight, High thermal and electrical conductivity, antibacterial, Clean, store energy, etc...

The Diario de Mallorca Club organized this conference on December 10.

8.4 PRESS & MEDIA

IFISC research has gotten attention from newspapers and other media.

During 2014, IFISC activities produced 83 press releases and appearances in written and digital press, and 12 clips in radio and TV. See the full lists in the Appendix.

INVESTIGACIÓ

Físics de la UIB estudien les eleccions dels EUA

La principal conclusió és la gran influència de l'entorn residencial i laboral a l'hora de decidir el vot

Investigadors de l'Institut de Física Interdisciplinària i Sistemes Complexos de la UIB publiquen un estudi de model microscòpic sobre la influència social i la mobilitat laboral per formar una opinió política als EUA.

GABRIEL MAYOL

PALMA. És possible mesurar matemàticament l'opinió política de les persones? Fins a quin punt viure i treballar en un lloc influeix a l'hora de votar per una opció política o una altra? Com contribueixen els petits trasllats i les interaccions diàries de casa a la feina a l'hora de votar? Amb quina freqüència una persona manté en política el pensament propi enfront dels altres? Físics de la UIB han donat resposta a aquestes preguntes mitjançant un model matemàtic que explica la relació entre vot, mobilitat territorial i entorn residencial als Estats Units d'América (EUA).

En un estudi que es publicarà a la prestigiosa *Physical Review Letters*, investigadors de l'Institut de Física Interdisciplinària i Sistemes Complexos (IFISC-CSIC/UIB) fan una anàlisi de la influència dels veïns, l'entorn residencial i l'entorn laboral en el vot dels ciutadans dels EUA. L'article ha estat elaborat per José J. Ramasco, Maxi San Miguel, Víctor M. Eguíluz, Krzystof Sucheki i Juan Fernández-Gracia, de la tesi doctoral del qual fa part l'estudi.

Entorn i comportament electoral

Per dur a terme l'anàlisi, s'han estudiat els resultats electorals de les presidencials americanes entre 1980 i 2012. El treball recull 3.117 comtats de tots els Estats Units en 9 cites electorals consecutives on s'elegia el president. L'estudi ha detectat les semblances del comportament electoral dels comtats amb una proximitat geogràfica mitjançant una fórmula matemàtica. A partir d'aquí, els investigadors de la UIB han generat un model microscòpic d'opinió basat en la influència social i en la mobilitat diària dels ciutadans. També s'han emprat les dades del cens electoral dels EUA, on es consignen les dades de residència i de lloc de treball. La confrontació del model microscòpic amb les dades del cens ha mostrat la concordança entre el model d'interacció i els resultats electorals dels comtats. Les diferents regions geogràfiques s'interrelacionen a causa del'intercanvi de gent entre unes i altres per viure i treballar.

La principal conclusió és la gran influència de les interaccions diàries que rep una persona a l'hora de decidir el vot. Les relacions d'un ciutadà amb la resta de persones del seu comtat o dels més propers és la principal font per crear opinió i votar en conseqüència. En canvi, són molt poques les ocasions en què una interacció no aconsegueix fer canviar de pensament i l'individu es manté en la seva opinió independent.

El pes de l'entorn en l'opinió dels votants és tan important que només es trenca tres vegades de cada cent. És a dir, un ciutadà dels EUA només canviarà d'opinió de manera lliure i independent en 3 de cada 100 interaccions. En la resta, copiarà el que pensin o opinin els veïns o companys de feina.

EUA
Un 3% dels ciutadans voten al marge de l'opinió de l'entorn

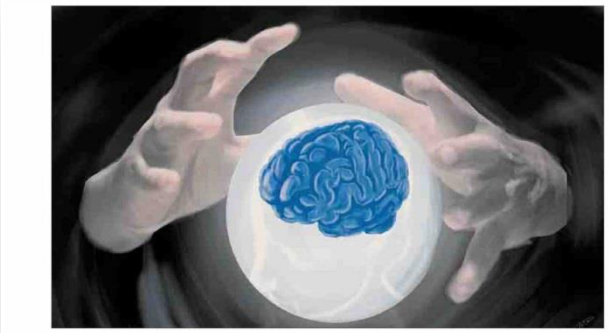
Un estudi pioner

L'article suposa una novetat tant per les dades com pel mètode. El fet de combinar els resultats electorals amb dades del cens (incloent-hi llocs de treball i residència) és pioner, però també ho és que l'estudi sigui un model microscòpic. L'anàlisi de detall permet establir fluxos d'interaccions entre persones que canvien de comtat per qüestions laborals i com aquestes relacions influeixen en el comportament electoral d'uns i altres. Fins ara, la majoria d'aproximacions per explicar el comportament electoral s'havien fet des de models macroscòpics i, en canvi, els científics de la UIB descriuen els individus i la seva interacció de manera minuciosa.

La configuració del sistema electoral dels EUA ha facilitat que un estudi com aquest s'hagi duit a terme. L'acotació a només dues opcions electorals, el Partit Republicà i el Partit Demòcrata, com també la distribució de la població en un nombre relativament redult de comtats, ha estat un factor idoni per a l'estudi. L'anàlisi s'ha pogut fer de manera detallada i a multiescala des del nivell més baix com és l'individu per després pujar, passant pel comtat, la regió i finalment l'estat.

Segons els científics de la UIB, si es volgués fer un treball així a Espanya, seria molt més complicat per la gran oferta electoral de partits polítics i els més de vuit mil municipis de l'Estat, encara que la població sigui molt menor que als EUA. L'estudi en cap cas prova de ser un model per predir els resultats electorals en futures eleccions presidencials, sinó estudiar com funcionen els mecanismes de la dinàmica d'opinió i les fluctuacions de vots entorn del seu valor mitjà.

ANÀLISI MICROSCÒPICA
L'estudi realitzat per un equip de l'IFISC és pioner perquè fins ara el comportament electoral s'havia analitzat amb models macroscòpics. IFISC-CSIC/UIB



El cerebro predice

› **Neurociencia /** Investigadores del IFISC han elaborado un modelo teórico, aportando también datos experimentales, que explica la existencia de la sincronización anticipada entre dos zonas neuronales del cerebro. **Elena Soto**

Es asombroso cómo un órgano, que pesa poco más de un kilogramo, pueda ser una inmensa red formada por aproximadamente unos 100.000 millones de neuronas, con capacidad de conectarse cada una de ellas con al menos otras 1.000, construyendo billones de posibles enlaces gracias a los que percibimos el mundo que nos rodea.

Nuestro cerebro registra una cantidad ingente de información a través de los sentidos y la procesa a una velocidad vertiginosa. Es muy rápido desempeñando muchas tareas, incluso es capaz de realizarlas en periodos de tiempo más cortos que los fisiológicos. Podríamos decir que este órgano predice lo que ocurrirá en el futuro inmediato. En el caso del tenis, por ejemplo, si un jugador de este deporte no tuviera una reacción más rápida que la natural, nunca podría devolver la pelota, porque a la velocidad que viene la bola tardaría menos en llegar que lo que le llevaría al tenista verla y decidir lo que tiene que hacer.

El cerebro se adelanta un instante a lo que percibimos, permitiéndonos reaccionar con mayor rapidez y control. ¿Qué mecanismos utiliza para que esto ocurra?

El estudio de las neuronas como elementos individuales aporta escasa información sobre la relación entre la dinámica de transmisión de impulsos nerviosos y las diferentes funciones cerebrales. Esto se debe principalmente a la aparición de propiedades emergentes que surgen de la interacción entre los elementos que lo forman, y que no se pueden deducir del estudio aislado de estos elementos. ¿Cómo es posible que áreas interconectadas entre sí, pero que se encuentran en muchos casos muy alejadas las unas de las otras, no experimenten retrasos en la señal nerviosa y consigan sincronizarse?

En las redes dinámicas complejas los estados de sincronización entre sus componentes individuales son los que proporcionan el equilibrio entre el procesado en paralelo de diferentes informaciones en diferentes áreas y la coordinación entre ellas. Este enfoque aplicado al estudio de las redes reales biológicas, como el cerebro, abre nuevas vías para descubrir qué mecanismos permiten modelar y predecir hechos, uno de los grandes interrogantes de la neurociencia.

La investigación desarrollada en el Instituto de Física Interdisciplinar y Sistemas Complejos (CSIC-UIB) sobre la Sincronización Anticipada (AS) en el cerebro aborda esta temática. El estudio, que acaba de ser publicado en la revista *Neuroimage*, elabora un modelo teórico y también aporta datos experimentales. En concreto, se han incluido los resultados de pruebas realizadas en cerebros de primates, que pueden constituir la primera verificación de la sincronización anticipada (AS) en el cerebro usando modelos biológicamente plausibles.

«Proponemos un modelo matemático que estudia la interacción entre áreas corticales del cerebro, que muestra que un área que influencia a otra puede reaccionar después de la que es influenciada», explica Claudio Mirasso, investigador del IFISC. «Es como si al mantener una conversación el interlocutor reconociese las palabras sin necesidad de decirlas completas, identificándolas solo con las primeras letras y el contexto».

SIGUE EN PÁGINA 2

RECERCA

Els amics, segons com et moguis

▶ Investigadors de l'IFISC (CSIC-UIB) elaboren un model que parteix de dades geolocalitzades i de l'ús de les xarxes socials per estudiar la mobilitat ▶ S'ha publicat recentment a la 'revista PLoS ONE'

J.M.V.
PALMA

■ La disponibilitat d'informació geolocalitzada ha permès als científics de l'Institut de Física Interdisciplinària i Sistemes Complexos (IFISC, CSIC-UIB) introduir un model que combina la mobilitat humana i la creació de vincles a les xarxes socials en línia.

El model, malgrat la senzillesa, és capaç de reproduir un bon nombre de característiques geosocials observades en les dades reals. El fet de considerar la mobilitat millora notablement els resultats si ho comparam amb models anteriors que només tenien en compte la localització geogràfica de les persones.

L'estudi ha estat realitzat per Víctor Eguíluz i José Ramasco, de l'IFISC, juntament amb els investigadors de l'Institut Max Planck a Alemanya i de la Universitat de Marsella a França, i s'ha publicat recentment a la revista *PLoS ONE*.

La investigació parteix de la idea que, en general, les persones tendeixen a interactuar i mantenir relacions amb companys geogràficament propers, fan amics entre les persones amb les quals passen més temps i trien passar més temps amb els amics. Com a resultat, resulta possible predir no només la ubicació d'algú des de les ubicacions dels seus amics sinó també on farà amics a partir de la concurrència espai-temps.

En concret, per a realitzar l'estudi s'han recollit dades de tres xarxes socials (Twitter, Gowalla i Brightkite) que contenen tant els vincles socials com la informació sobre les posicions físiques dels usuaris. Es varen identificar més de 714.000 usuaris individuals de Twitter, que piularen fent servir un GPS activat al seu dispositiu mòbil durant el mes d'agost de 2011. Si els usuaris varen reportar diversos llocs en diferents piuladas, es va recollir el més recent.

Els altres dos conjunts de dades contenen informació referent a la ubicació dels usuaris de Gowalla i Brightkite, xarxes socials basades en la ubicació, en la qual els usuaris poden registrar-se a les seves ubicacions actuals i rebre informació sobre els serveis disponibles a la zona, així com sobre les posicions dels seus amics. Gowalla i Brightkite han estat desactivats, però les seves dades estan disponibles en línia. En concret es recolliren dades de 196.000 usuaris de Gowalla i 58.000 de Brighkite.

L'estudi s'ha centrat als tres països amb més d'un miler d'usuaris en cadascun dels tres grups de dades: els Estats Units, el Regne Unit i Alemanya.

S'han fet servir dades geolocalitzades de Twitter. B. RAMON

Aplicacions de l'estudi

Entendre i ser capaços de reproduir com la mobilitat i la localització afecten les interaccions socials té infinitat d'aplicacions. Les malalties, els nous comportaments o idees se solen propagar prenent les xarxes socials com a substrat. Aquest model pot ser utilitzat en les simulacions de processos que impliquen xarxes socials i la geografia com una base per generar xarxes semblants a les reals sense necessitar mesurar explícitament les interaccions reals. Això permet predir, per exemple, la propagació d'una epidèmia a l'entorn de la relació social d'un individu infectat, o seguir l'itinerari d'un rumor que pot arribar d'un amic i ser immediatament reproduït a uns altres.

8 OUTREACH ACTIVITIES

APPENDIX

a.4. IFISC seminars and talks 2014

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

Jan 09
Urban*: Crowdsourcing for the good of London
Daniele Quercia, Yahoo Research, Barcelona, Spain

Jan 10
Complex networks approach to modeling online social systems: The emergence of computational social science
Przemyslaw A. Grabowicz, IFISC

Jan 22
Vegetation patterns. The role of nonlocal interactions among plants
Ricardo Martínez-García, IFISC

Jan 29
Electrocardiogram Classification using Reservoir Computing
Miguel Escalona-Moran, IFISC

Feb 05
Scaling Optical Chaos: Similarity properties in the dynamics of delayed-feedback semiconductor lasers
Xavier Porte, IFISC

Feb 11
Programming with Mathematica: Basics
Fernando Galve, IFISC

Feb 12
Excitability of localized structures induced by spatial inhomogeneities and drift
Manuel Matias, IFISC

Feb 17
From mechanisms to data-inspired modeling of collective social phenomena.
Juan Fernández Gracia, IFISC

Feb 26
Formation of localized structures in bistable systems through nonlocal spatial coupling
Pere Colet, IFISC

Feb 27
Programming with Mathematica: Advanced
Fernando Galve, IFISC

March 05
Tuning the period of square-wave oscillations for delay-coupled opto-electronic systems
Jade Martínez Llinàs, IFISC

March 12
Co-evolving link states dynamics
Adrián Carro, IFISC

March 19
Defects and turbulence in systems with two delays
Serhiy Yanchuk, Institute of Mathematics, Humboldt University, Berlin, Germany

March 27
Intrinsic ratchets
Chris Van den Broeck, Universiteit Hasselt, Diepenbeek, Belgium

April 02
Quantum Resistor-Capacitor Circuit with Majorana Fermions
Mahn-Soo Choi, Korea University, Seoul, Korea

April 08
Marine bioinvasion in the network of global shipping connections
Bernd Blasius, Carl von Ossietzky Universität Oldenburg, Germany

April 22
Cortical dynamics revisited
Wolf Singer, Max Planck Institute for Brain Research/Frankfurt Institute for Advanced Studies (FIAS)/Ernst Strüngmann Institute (ESI) for Neuroscience, Frankfurt/Main, Germany

April 24
Life as we know it
Karl Friston FRS, Wellcome Trust Centre for Neuroimaging, Institute of Neurology, University College London, UK

April 30
A voter model with aging
Toni Pérez, IFISC

May 07
Noise focusing: the emergence of coherent activity in neuronal cultures
Jaume Casademunt, Departament d'ECM, Universitat de Barcelona, Spain

May 13
Characterising and modelling correlations in multiplex networks; Biased random walks on multiplex networks
Vincenzo Nicosia and Federico Battiston, School of Mathematical Sciences, Queen Mary University of London, UK

May 14
Heat dissipation in atomic scale junctions
Juan Carlos Cuevas, Depto. de FT de la Materia Condensada, Universidad Autónoma de Madrid, Spain

May 21
Brain complexity and phase transitions
Joaquín Marro, Institute "Carlos I" for Theoretical and Computational Physics, Universidad de Granada, Spain

May 28
Sampling of rare events in equilibrium and non-equilibrium systems
Raúl Toral, IFISC

June 05
Transmission, Storage and Resistive Switching Assisted by Noise
Germán Patterson, Laboratorio de Optoelectrónica, Instituto Tecnológico de Buenos Aires, Argentina

June 05
Qubit transfer between distant sites in a triple quantum dot
Gloria Platero, Instituto de Ciencia de Materiales de Madrid, CSIC, Cantoblanco, Madrid, Spain

June 10
Spatial waves control the mitotic divisions in the early Xenopus frog embryo
Lendert Gelens, James Ferrell's Lab, Department of Chemical and Systems Biology, Stanford University, USA

June 11
Decoherence, non-Markovianity and quantum estimation in qubit systems subject to colored noise
Claudia Benedetti, Università degli Studi di Milano, Italy

June 18
Mesoscale structures as barriers to mixing in the East Tropical Pacific Oxygen Minimum Zone
João Bettencourt, IFISC

June 20
Have Majorana bound states been detected in hybrid superconductor-semiconductor nanowire systems?
Ramon Aguado, Instituto de Ciencia de Materiales de Madrid (ICMM-CSIC), Spain

June 25
Nonequilibrium Statistical Physics in Ecology: Vegetation patterns, Animal mobility and temporal fluctuations
Ricardo Martínez-García, IFISC

July 02
Memory in network flows and its effects on community detection, ranking, and spreading
Andrea Lancichinetti, Umeå University, Sweden

July 03
Synchronization and application of delay-coupled semiconductor lasers
Konstantin Hicke, IFISC

July 08
Analysis of ordered 3-point substructures in food webs
Pavel Paulau, Carl von Ossietzky Universität Oldenburg, Germany

July 09
Modeling Kerr frequency combs using the Lugiato-Lefever equation
Pedro Parra-Rivas, Vrije Universiteit Brussel, Belgium and IFISC

July 21
Presentacion del IFISC a los estudiantes SURF
Emilio Hernandez, IFISC

July 29
Thermoelectric effects in quantum dots with interaction
Miguel A. Sierra, IFISC

July 30
How to write and publish a physics paper
David Sanchez, IFISC

August 26
Synchronization in multilayer networks of mobile oscillators
Jorge Pablo Rodríguez, IFISC

Sept 04
Insights into the movement of marine megafauna
M. Thums, Australian Institute of Marine Science, Australia

Sept 10
Optical properties of 2D Majorana nanowires
Daniel Ruiz, IFISC

Sept 10
Active particles and their stochastic modelization
Lutz Schimansky-Geier, Humboldt Universität, Berlin, Germany

Sept 11
A short introduction to large deviations
Chris van den Broeck, Universiteit Hasselt, Diepenbeek, Belgium

Sept 12
Synchronization, correlations and entanglement in quantum oscillators
Roberta Zambrini, IFISC

Sept 15
Many-body effects @ the nanoscale
Rosa López, IFISC

Sept 15
Tutorial: Quantum transport in nanostructures
David Sánchez, IFISC

Sept 16
Non-equilibrium growth processes applied to Marine Ecology
Tomàs Sintes, IFISC

Sept 17
Transportation networks: structure, organization and propagation phenomena
Jose J. Ramasco, IFISC

Sept 18
Spatiotemporal dynamics of dissipative solitons
Damià Gomila, IFISC

Sept 29
Time series analysis of online social media
Oriol Artime, IFISC

Sept 29
Lagrangian study of an atmospheric blocking event
Irene Recuerda, IFISC

Oct 01
Language use through the lens of Big Data
Bruno Gonçalves, Centre de Physique Théorique, Campus de Luminy, Aix-Marseille Université, France

Oct 03
Evolution of movement strategies under competitive interactions
Diogenis Kiziridis, IFISC

Oct 08
Aspects of Transitions in the Dynamics and Topology of Multilayer Networks
Marina Diakonova, IFISC

Oct 15
Role of bilinguals in language competition
Marco Patriarca, National Institute of Chemical Physics and Biophysics, Tallinn, Estonia

Oct 22
Some fundamental aspects and applications of non-Markovian Quantum Dynamics
Jyrki Piilo, Department of Physics & Astronomy, University of Turku, Finland

Oct 23
PRL today
Samindranath Mitra, Editor, Physical Review Letters

Oct 24
Here is your chance to find out everything you wanted to know about PRL
Samindranath Mitra, Editor, Physical Review Letters

Oct 29
The Kish Key Distribution System: A classical alternative to quantum key distribution
Lachlan J. Gunn, School of Electrical and Electronic Engineering, The University of Adelaide, Australia

Nov 04
Flow networks: characterizing transport and connectivity in the ocean
Enrico Ser-Giacomi, IFISC

Nov 13
Thermoelectric Effects in 2D Electron Systems
Maria Isabel Alomar, IFISC

Nov 18
Reconciling Information Directionality with Negative Time Lag in Neuronal Circuits
Claudio Mirasso, IFISC

Nov 26
Steps towards experimental demonstration of information to energy conversion in a quantum system at the Landauer limit
John Goold, The Abdus Salam International Centre for Theoretical Physics (ICTP), Trieste, Italy

Nov 27
New thought-provoking points of view on KPZ dynamics
Horacio S. Wio, Instituto de Fisica de Cantabria (CSIC-Universidad de Cantabria), Spain

Nov 27
Three Dimensional Lagrangian Structures in Turbulent Flows: Application to Oceanic Processes
João Bettencourt, IFISC

Dec 02
Discontinuous phase transition via cooperation of spreading agents: How two evils are worse than one
Fakhteh Ghanbarnejad, Max Planck Institute for the Physics of Complex Systems, Dresden, Germany

Dec 03
Nonlinear Spin-thermoelectric Transport in Two-dimensional Topological Insulators
Sun-Yong Hwang, IFISC

Dec 10
Emergence scenarios of hierarchical networks
Agnieszka Czaplicka, IFISC

Dec 12
Effects of Dynamically Controlled Users on the Stabilization of The Power Grid frequency
Eder Batista Tchawou, IFISC

Dec 17
Comparing and modeling land use organization in cities
Maxime Lenormand, IFISC

a.5. Publications

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

a.5.1 Book

Stochastic Numerical Methods: An Introduction for Students and Scientists
Toral, Raúl; Colet, Pere
Ed. Wiley-VCH. ISBN: 978-3-527-41149-8

a.5.2 JCR Publications

Is the Voter Model a model for voters?
Fernandez-Gracia, J; Suchecki, K; Ramasco, JJ; San Miguel, M; Eguiluz, VM
Physical Review Letters 112, 158701

High Resolution Coherent Population Trapping on a Single Hole Spin in a Semiconductor Quantum Dot
Houel, Julien; Prechtel, Jonathan H.; Kuhlmann, Andreas V.; Brunner, Daniel; Kuklewicz, Christopher E.; Gerardot, Brian D.; Stoltz, Nick G.; Petroff, Pierre M.; Warburton Richard J.
Physical Review Letters 112, 107401

Irreversible work and inner friction in quantum thermodynamic processes
Plastina, F; Alecce, A; Apollaro, TJG; Falcone, G; Francica, G; Galve, F; Lo Gullo, N; Zambrini, R.
Physical Review Letters 113, 260601 (1-5)

Spin and charge thermopower of resonant tunneling diodes
Nicolau, J. H.; Sánchez, D.
Applied Physics Letters 104, 112402 (1-3)

Orbital caloritronic transport in strongly interacting quantum dots
Lim, J. S.; Lopez, R.; Sanchez, D.
New Journal of Physics 16, 015003 (1-12)

Focus on thermoelectric effects in nanostructures
Sánchez, D.; Linke, H.
New Journal of Physics 16, 110201 (1-3)

Parameter-space topology of models for cell polarity
Khuc Trong, P.; Nicola, E.M.; Goehring, N.W.; Kumar, V.; Grill, S.W.
New Journal of Physics 16, 065009 (1-18)

Constructing optimized binary masks for reservoir computing with delay systems
Appeltant, Lennert; Van der Sande, Guy; Danckaert, Jan; Fischer, Ingo
Scientific Reports 4, 3629

From mobile phone data to the spatial structure of cities
Louail, T; Lenormand, M; Garcia Cantu, O; Picornell, M; Herranz, R; Frias-Martinez, E; Ramasco, JJ; Barthelemy, M
Scientific Reports 4, 5276

Mechanisms of Zero-Lag Synchronization in Cortical Motifs
Gollo, L.; Mirasso, C.; Sporns, O.; Breakspear, M.
PLoS Computational Biology 10, e1003548

Crowdsourcing Dialect Characterization through Twitter
Gonçalves, B.; Sánchez, D.
PLoS ONE 9, e112074 (1-6)

Defining Mediterranean and Black Sea Biogeochemical Subprovinces and Synthetic Ocean Indicators Using Mesoscale Oceanographic Features
Nieblas, A.-E., K. Drushka, G. Reygondeau, V. Rossi, H. Demarcq, L. Dubroca and S. Bonhommeau
PLoS ONE 9(10), e111251

Tweets on the road
Lenormand, Maxime;Tugores, Antonia; Colet, Pere; Ramasco, Jose J
PLoS ONE 9, e105407

Cross-checking different sources of mobility information
Lenormand, Maxime; Picornell, Miguel; Cantu-Ros, Oliva; Tugores, Antonia; Louail, Thomas; Herranz, Ricardo; Barthelemy, Marc; Frias-Martinez, Enrique; Ramasco, Jose J.
PLoS ONE 9, e105184

Entangling mobility and interactions in Social Media
Grabowicz, P.A.; Ramasco, J.J.; Goncalves, B.; Eguiluz V.M.
PLoS ONE 9, e92196

Dynamics of localized and patterned structures in the Lugiato-Lefever equation determine the stability and shape of optical frequency combs
Parra-Rivas, P.; Gomila, D.; Matias, M.A.; Coen, S.; Gelens, L.
Physical Review A 89, 043813 (1-12)

Entangling power of two-qubit gates on mixed states
Zhe Guan, Huan He , Yong-Jian Han , Chuan-Feng Li , Fernando Galve and Guang-Can Guo
Physical Review A 89, 012324 (1-5)

Spectral origin of non-Markovian open-system dynamics: A finite harmonic model without approximations
Vasile, Ruggero; Galve, Fernando; Zambrini, Roberta
Physical Review A 89, 022109 (1-9)

Similarity properties in the dynamics of delayed-feedback semiconductor lasers
Porte, Xavier; Soriano, Miguel C.; and Fischer, Ingo
Physical Review A 89, 023822

Controlling the Likelihood of Rogue Waves in an Optically Injected Semiconductor Laser via Direct Current Modulation
Perrone, Sandro; Vilaseca, Ramon; Zamora-Munt, Jordi; Masoller, Cristina
Physical Review A 89, 033804

Nonlinear spin-thermoelectric transport in two-dimensional topological insulators
Hwang, S.-Y.; López, R.; Lee, M.; Sánchez, D.
Physical Review B 90, 115301 (1-9)

Experimental verification of reciprocity relations in quantum thermoelectric transport
Matthews, J.; Battista, F.; Sánchez, D.; Samuelsson, P.; Linke, H.
Physical Review B 90, 165428 (1-6)

Thermoelectric effects in graphene with local spin-orbit interaction
Alomar, M. I.; Sánchez, D.
Physical Review B 89, 115422 (1-8)

Dynamical energy transfer in ac-driven quantum systems
Ludovico, M. F.; Lim, J. S.; Moskalets M.; Arrachea, L.; Sánchez, D.
Physical Review B 89, 161306 (R)(1-4)

Strongly nonlinear thermovoltage and heat dissipation in interacting quantum dots
Sierra, M. A.; Sánchez, D.
Physical Review B 90, 115313 (1-6)

Thermoelectrical detection of Majorana states
Lopez, Rosa; Lee, Michel; Serra, Llorenç; Lim, Jong Soo
Physical Review B 89, 205418 (1-7)

Effects of tilting the magnetic field in one-dimensional Majorana nanowires
Osca, Javier; Ruiz, Daniel; Serra, Llorenç
Physical Review B 89, 245405

Social imitation vs strategic choice, or consensus vs cooperation in the networked Prisoner's Dilemma
Vilone, Daniele; Ramasco, Jose J.; Sanchez, Angel; San Miguel, Maxi
Physical Review E 90, 022810

Fragmentation transition in a coevolving network with link-state dynamics
Carro, Adrian; Vazquez, Federico; Toral, Raul; San Miguel, Maxi
Physical Review E 89, 062802

Stochastic functionals and fluctuation theorem for multikangaroo processes
Van den Broeck, Christian; Toral, Raul
Physical Review E 89, 062124

Tuning the period of square-wave oscillations for delay-coupled optoelectronic systems
Martínez-Llinàs, Jade; Colet, Pere; Erneux, Thomas
Physical Review E 89, 042908 (1-11)

Self-localized states in species competition
Paulau, Pavel V.; Gomila, Damià; López, Cristóbal; Hernández-García, Emilio
Physical Review E 89, 032724 (1-8)

Suppression of deterministic and stochastic extreme desynchronization events using anticipated synchronization
Zamora-Munt, Jordi; Mirasso, Claudio R. ; Toral, Raul;
Physical Review E 89, 012921

Absorbing and Shattered Fragmentation Transitions in Multilayer Coevolution
Diakonova, Marina; San Miguel, Maxi; Eguiluz, Victor
Physical Review E 89, 06218

Formation of localized structures in bistable systems through nonlocalspatial coupling. I. General framework
Colet, Pere; Matias, Manuel A.; Gelens, Lendert; Gomila, Damia
Physical Review E 89, 012914 (1-14)

Formation of localized structures in bistable systems through nonlocal spatial coupling. II. The nonlocal Ginzburg Landau Equation
Gelens, Lendert ; Matias, Manuel A.; Gomila, Damia; Dorissen, Tom; Colet, Pere
Physical Review E 89, 012915 (1-15)

A Minimal Model Dynamics for Twelvefold Quasipatterns
Gomila, Damià; Walgraef, Daniel
Physical Review E 89, 032923

Simulating non-Markovian stochastic processes
Boguna, Marian; Lafuerza, Luis F.; Toral ,Raul; Serrano, M. Angeles
Physical Review E 90, 042108

Optimal search in interacting populations: Gaussian jumps vs Lévy flights
Martínez-García, Ricardo; Calabrese, Justin M.; López, Cristóbal.
Physical Review E 89, 032718 (1-8)

Autocorrelation properties of chaotic delay dynamical systems: A study on semiconductor lasers
Porte, Xavier; D'Huys, Otti; Jüngling, Thomas; Brunner, Daniel; Soriano, Miguel C.; Fischer, Ingo
Physical Review E 90, 052911 (1-10)

Stochastic switching in delay-coupled oscillators
D'Huys, O.; Jüngling, T.; Kinzel, W.
Physical Review E 90, 032918 (1-9)

Implications of Refined Altimetry on the Estimates of Mesoscale Activity and Eddy-Driven Offshore Transport in the Eastern Boundary Upwelling Systems
Capet, A., E. Mason, V. Rossi, C. Troupin, Y. Faugère, I.Pujol and A. Pascual
Geophysical Research Letters 41 (21), 7602–7610

Hydrodynamic provinces and oceanic connectivity from a transport network help designing marine reserves
Rossi, Vincent; Ser-Giacomi, Enrico; Lopez, Cristobal, Hernandez-Garcia, Emilio
Geophysical Research Letters 41, 2883-2891

The reduction of plankton biomass induced by mesoscale stirring: a modeling study in the Benguela upwelling
Hernández-Carrasco, Ismael; Rossi, Vincent; Hernández-García, Emilio; Garçon, Veronique; López, Cristóbal
Deep-Sea Research Part I 83, 65-80

Corrigendum to Multi-decadal projections of the surface and interior pathways of the Fukushima Cesium-137 radioactive plume
Rossi, V., E. Van Sebille, A. Sen Gupta, V. Garçon and M.H. England
Deep Sea-Research Part I 93, 162–164

Seasonality of sporadic physical processes driving temperature and nutrient high-frequency variability in the coastal ocean off southeast Australia
Rossi, Vincent; Schaeffer, A.; Wood, J.; Galibert, G.; Morris, B.; Sudre, J.; Roughan, M.; Waite, A.
Journal of Geophysical Research-Oceans 119, 445–460

Exploring the tug of war between positive and negative interactions among savanna trees: Competition, dispersal, and protection from fire
Bacelar, F.S.; Calabrese, J.M.; Hernandez-Garcia, E.
Ecological Complexity 17, 140-148

Disentangling the influence of mutation and migration in clonal seagrasses using the Genetic Distance Spectrum for microsatellites
Arnaud-Haond, S.; Moalic, Y.; Hernandez-Garcia, E.; Eguiluz, V.M.; Filipe, A.; Serrao, E.A.; Duarte, C.M.
Journal of Heredity 105, 532-541

Rethinking the logistic approach for population dynamics of mutualistic interactions
Garcia-Algarra, J; Galeano, J; Pastor, JM; Iriondo, JM; Ramasco, JJ
Journal of Theoretical Biology 363, 332-343

Kinetic theory and numerical simulations of two-species coagulation
Escudero,C.;Macià,F.;Toral,R.;Velázquez,J. J. L.
Kinetic and Related Models 7, 253-290

Modelling positive Granger Causality and negative phase lag between cortical areas
Matias F. S.; Gollo, L. L., Carelli, P.; Bressler, S.; Copelli, M.; Mirasso, C. R.
Neuroimage 99, 411-418

Nonlinear dynamics and synchronization of an array of single mode laser diodes in external cavity subject to current modulation
Liu, B.; Braiman, Y.; Nair, N.; Guo, Y.; Colet, P.; Wardlaw M.
Optics Communications 324, 301-310

Effects of inhomogeneities and drift on the dynamics of temporal solitons in fiber cavities and microresonators
Parra-Rivas, P.; Gomila, D.; Matias, M.A.; Colet, P.; Gelens, L.
Optics Express 22, 30943-30954

Third-order chromatic dispersion stabilizes Kerr frequency combs
Parra-Rivas, P.; Gomila, D.; Leo, F.; Coen, S.; Gelens, L.
Optics Letters 39, 2971-2974

Minimal mechanisms for vegetation patterns in semiarid regions
Martinez-Garcia, Ricardo; Calabrese, Justin M.; Hernandez-Garcia, Emilio; Lopez, Cristobal
Philosophical Transactions of the Royal Society A 372, 20140068 (1-11)

Localized coherence in two interacting populations of social agents
Gonzalez-Avella, J.C.; Cosenza, M.G.: San Miguel, M
Physica A 399, 24-30

Deriving partition functions and entropic functionals from thermodynamics
Plastino, A.; Curado, E.M.F.; Nobre, F.D.
Physica A **403**, 13-20

Dynamical Casimir–Polder potentials in non-adiabatic conditions
Messina, Riccardo; Passante, Roberto; Rizzuto, Lucia; Spagnolo, Salvatore; Vasile, Ruggero
Physica Scripta 2014, 014032 (1-4)

Majorana mode stacking, robustness and size effect in cylindrical nanowires
Osca, Javier ; López, Rosa; Serra, Llorenç
The European Physical Journal B 87, 84

Multivariate nonlinear time-series estimation using delay-based reservoir computing
Escalona-Morán, M. A.; Soriano, M. C.; García-Prieto, J.; Fischer, I.; Mirasso, C. R.
The European Physical Journal Special Topics 223, 2903-2912

Metapopulation epidemic models with heterogeneous mixing and travel behaviour
Apolloni, A; Poletto, C; Ramasco, JJ; Jensen, P; Colizza, V
Theoretical Biology and Medical Modelling 11, 3 (1-31)

Characterization of delay propagation in the US air transportation network
Fleurquin, Pablo; Ramasco, José J.; Eguíluz, Victor M.
Transportation Journal 53, 330-344

A discussion on the origin of quantum probabilities
Holik, F.; Saenz, M.; Plastino, A.
Annals of Physics **340**, 293-310

Space–time correlations in urban sprawl
Hernando, A. ; Hernando, R. ; Plastino, A.
Journal of The Royal Society Interface **11**, 20130930 (1-6)

a.5.3 Other publications in journals

A Photonic Brain
Fischer, I.; Mirasso, C.
International Innovation 140 , 64-66 (May)

Theoretical analysis of external noise and bistability in the catalytic CO oxidation on Pd(111)
Pineda, Miguel; Toral, Raul
Journal of Computational Methods in Science and Engineering 14, 17-28

Thermoelectric effects in quantum Hall systems beyond linear response
Lopez, R.: Hwang, S.-Y.; Sanchez, D.
Journal of Physics: Conference Series 568, 052016(1-17)

Time resolved heat exchange in driven quantum systems
Ludovico, M. F.; Lim, J. S.; Moskalets, M.; Arrachea, L.; Sánchez, D.
Journal of Physics: Conference Series 568, 052017(1-3)

Synchronizability of Networks with Strongly Delayed Links: A Universal Classification
Flunkert, V.; Yanchuk, S.; Dahms, T.; Schöll, E.
Journal of Mathematical Sciences 202, 809-824

Dinámica de opiniones y consenso: un problema de física estadística
Toral,Raul
Revista Española de Física 28(3), 42-48

Nuestro cerebro es capaz de anticiparse a lo que va a pasar
Mirasso, Claudio R.
Saberes y Ciencias 34, La Jornada de Oriente, México pag. 10

a.5.4 Book Chapters and Others

Parallel generation of fast random bits based on optoelectronic phase-chaos systems
Nguimdo, Romain Modeste; Colet, Pere; Danckaert, Jan
Nonlinear Optics and Its Applications VIII; and Quantum Optics III (Edited by Benjamin J. Eggleton; Alexander L. Gaeta; Neil G. R. Broderick; Alexander V. Sergienko; Arno Rauschenbeutel; Thomas Durt), SPIE proceedings 9136, 91360V

a.6. Communications to conferences and talks in other centers

a.6.1 Invited talks in conferences and workshops

Hernández-García, Emilio
Network approaches to transport and mixing.
Workshop on "Mixing, transport and coherent structures", at the Mathematisches Forschungsinstitut Oberwolfach, Germany.
January 29

Toral, Raúl
Stochastic Description of Systems with Delay: Applications to Gene Expression models.
Inhomogeneous Random Systems, Institut Henri Poincaré, Paris, France.
January 28 -29

Toral,Raúl
Fluctuation theorem for generalized kangaroo processes.
Stochastic Thermodynamics from its origins to today, Luxembourg University, Luxemburg.
February 28

Fischer, Ingo
Neuro-inspired information processing using complex systems: Concept, mechanisms, and performance.
XIX Congreso de Física Estadística (FisEs' 14), Ourense, Spain.
April 2 - 4

Gelens, Lendert; Parra-Rivas, Pedro Jose; Leo, François; Gomila, Damià; Matias, Manuel A.; Coen, Stephane
Spatio-temporal stability of 1D Kerr cavity solitons.
Photonics Europe 2014 Symposium, SPIE Brussels, Belgium.
April 14 – 17

San Miguel, Maxi
Data for human mobility. Implications for electoral processes.
Ways of Seeing: A Multidisciplinary workshop, Galway, Ireland.
April 22 - 25

Fischer, Ingo; Porte, Xavier; Soriano, Miguel Cornelles
Dynamics of delayed-feedback semiconductor lasers revisited: Similarity properties and applications.
WIAS International Workshop on Nonlinear Dynamics in Semiconductor Lasers, Berlin, Germany.
May 12 - 14

Sánchez, David
Nonlinear thermoelectric transport in quantum conductors.
12th European Conference on Thermoelectrics, Madrid, Spain.
September 15 – 19

Zambrini, Roberta
Spectral origin of non-Markovianity in an exact finite harmonic model.
Quantum 2014, Advances in Foundations of Quantum Mechanics and Quantum Information with atoms and photons. Torino, Italy.
May 25 - 30

Ramasco, Jose J.
Spatial Structure of Cities,.
Satellite " Urban Systems and Networks" of the conference NetSci 2014. Berkeley, USA.
June 2

Hernandez-Garcia, Emilio
Líneas de Lyapunov y redes de flujo: impacto del transporte oceánico en procesos biológicos.
NoLineal 2014. Badajoz, Spain.
June 4

Serra, Llorenç
Majorana modes in semiconductor nanowires.
Encuentro de la red española de sistemas fuera del equilibrio. Barcelona, Spain.
June 12 - 13

Toral, Raul
The interplay between stochasticity an delay.
Heraeus Seminar: The Versatile Action of Noise. Jacobs University Bremen, Germany.
June 22 – 27

Sánchez, David
Nonhomogeneous spin-orbit interaction in nanostructures.
The 10th AIMS Conference on Dynamical Systems, Differential Equations and Applications. Madrid, Spain.
July 7 - 11

Hernandez-Garcia, E.
Stretching fields in the ocean from finite-size Lyapunov exponents: Biological impacts of fluid transport.
Special session on Transport Barriers in Unsteady Fluid Flows. 10th AIMS Conference on Dynamical Systems, Differential Equations and Applications. Madrid, Spain.
July 8

Mirasso, Claudio
Inhibitory Synapses Control Anticipation in Neuronal Circuits.
10th AIMS Conference on Dynamical Systems, Differential Equations and Applications Madrid, Spain.
July 7 - 11

Ramasco, Jose J.
Is the voter model a model for voters.
10th AIMS International Conference on Dynamical Systems, Differential Equations and Applications. Madrid, Spain.
July 7 – 11

Toral, Raúl
Weighted-ensemble Brownian dynamics simulation: sampling of rare events in non-equilibrium systems.
10th AIMS Conference on Dynamical Systems, Differential Equations and Applications, Madrid, Spain.
July 7 - 11

Toral, Raul
Efficient sampling of phase space.
The Many Faces of Computation, University of California at San Diego, USA.
July 14 - 16

Galve Conde, Fernando
Spectral origin of non-Markovianity in an exact finite harmonic model.
LPHYS'14. Sofia, Bulgary.
July 12 – 19

Mirasso, Claudio
Anticipated synchronization in neuronal populations: Reconciling information directionality with negative time lag.
12th International Conference on Cognitive Neuroscience Brisbane, Australia.
July 27 – 31

Lopez, Rosa
Scattering theory of Thermoelectrical nonlinear transport.
27th International Conference on Low Temperature. Buenos Aires, Argentina.
August 7 - 13

Fischer, Ingo
Delay-coupled semiconductor lasers: complex dynamics, its control and application.
International Conference on Control of Self-Organizing Nonlinear Systems, Warnemünde, Germany.
August 25 – 28

Fischer, Ingo; Hicke, Konstantin; Brunner, Daniel; Cornelles Soriano, Miguel; Mirasso, Claudio R.
High-Speed Neuro-Inspired Information Processing Using Semiconductor Lasers.
International Symposium on Nonlinear Theory and its Applications (NOLTA 2014), Luzern, Switzerland.
September 14 - 18

Walgraef, Daniel
Pattern Formation: from Turing to nanoscience.
Five lectures at the IV Summer School on Statistical Physics of Small and Complex Systems. Palma de Mallorca, Spain.
September 15 - 19

Hernandez-Garcia, Emilio
Large-scale transport in oceans: statistical and dynamical systems approaches.
Series of five conferences at the IV Summer School on Statistical Physics of Complex and Small Systems. Palma de Mallorca, Spain
September 8 – 12

Eguíluz, V.M.
Interactions in complex systems: complex, multilayer and temporal networks.
IV Summer School on Statistical Physics of Complex and Small Systems. Palma de Mallorca, Spain
September 15 – 19

Lopez, Cristóbal
Finite-Size Lyapunov Exponents: applications to transport in the oceans.
International conference on"Strolling on Chaos, Turbulence and Statistical Mechanics", Rome, Italy.
September 22 - 24

Hernández-García, Emilio
Networks of geophysical transport.
LINC Satellite at ECCS14, Lucca, Italy.
September 25

Toral, Raúl
Non-Markovian stochasticprocesses: The case of delay.
MEDYFINOL, Maceió, Brasil.
October 13 – 17

Gomila, Damià; Colet, Pere; Walgraef, Daniel
Dynamics of interacting Bloch walls.
III Dynamics Days South America Viña del Mar, Chile.
November 3 - 7

Ser-Giacomi, Enrico; Rossi, Vincent; Vasile, Ruggero; Lopez, Cristobal; Hernandez-Garcia, Emilio
Flow transport network: an application to the Mediterranean Sea.
"Mathematical methods: applications to earth science". Moscow, Russia.
November 15 - 19

Rodriguez-Mendez, Victor
Inferring the underlying connectivity of climate networks.
Mathematical methods: Applications to Earth science. Moscow, Russia
November 15 - 19

a.6.2 Other talks in conferences and workshops

Lenormand, Maxime
Toward a better understanding of cities using geolocalized data.
V Workshop de Econosociofísica, IPHES, Tarragona, Spain.
January 29 -31

San Miguel, Maxi
Collective Social Phenomena.
V Workshop Econosociofísica, IPHES, Tarragona, Spain
January 29 - 31

Rossi, Vincent; Ser-Giacomi, Enrico; López, Cristobal; Hernández-García, Emilio
Hydrodynamic provinces and oceanic connectivity from a transport network help designing marine reserves.
2014 Ocean Sciences Meeting, sponsored by AGU/ASLO/TOS, held in Honolulu. Hawaii, USA.
February 23 - 28

López, Cristóbal
Optimizing the search for resources by sharing information. Mongolian gazelles as a case study.
XIX Congreso de Física estadística, FISES´14, Ourense, Spain.
April 2 - 4

Perez, Toni; Klemm, Konstantin; Eguiluz, Victor
Age-dependent voter model.
DPG-Frühjahrstagung (DPG Spring Meeting) TU Dresden, Germany.
April 2

Lopez, C; Rossi, V.; Ser-Giacomi, E.; Hernandez-Garcia, E.
Oceanic provinces and basin-scale connectivity derived from a hydrodynamical network help designing marine reserves in the Mediterranean Sea.
European Geosciences Union General Meeting. Vienna, Austria
April 30

Campanelli, Bruno; Fleurquin, Pablo; Ramasco, Jose Javier; Eguiluz, Victor
Data-driven Modelling of the Tree of Reactionary Delays.
6th International Conference on Research in Air Transportation, Istanbul, Turkey.
May 26 - 30

Ramasco, Jose J.
Systemic delay propagation in the US airport network.
NetSci 2014. Berkeley, USA.
June 2 - 6

Galve, F.
Discording and entangling power of quantum evolutions.
ICE-1 (Información Cuántica en España) Zaragoza, Spain.
June 24 - 28

Zambrini, Roberta
Spectral origin of non-Markovianity in an exact finite harmonic model.
Segundo Workshop de Informacion Cuantica en España, Zaragoza, Spain.
June 25 - 27

Sánchez, D.
Energy admittance of mesoscopic capacitors.
27th International Conference on Low Temperature Physics, Buenos Aires, Argentina.
August 4 - 8

Toral, Raul
Weighted-ensemble Brownian dynamics simulation: sampling of rare events in non-equilibrium systems.
Conference on Computational Physics, CCP 2014, Boston, USA.
August 11 - 14

Serra, Llorenç
Effects of tilting the magnetic field in 1D Majorana nanowires.
Condensed matter in Paris 2014, JMC14-CMD25, France.
August 24 - 29

Sánchez, D.
Nonlinear heat transport in quantum Hall bar setups.
25th Conference of the Condensed Matter Division of the European Physical Society, Paris, France.
August 25 - 29

Lopez, Rosa
Majorana thermoelectrical detection.
25th Conference of the Condensed Matter Division of the European Physical Society. Paris, France.
August 25 - 30

Jüngling, Thomas; C. Soriano, Miguel; Fischer, Ingo
Determining the sub-Lyapunov exponent from time series of delay systems.
Dynamics Days Europe 2014, Bayreuth, Germany.
September 8 -12

Brunner, D.; Fischer, I.
All-Optical Reservoir Computing in Networks of Lasers.
International Symposium on Nonlinear Theory and its Applications (NOLTA 2014), Luzern, Switzerland.
September 14 - 18

Lenormand, Maxime
Cross-checking different sources of mobility information.
European Conference on Complex Systems (ECCS14), Lucca, Italy.
September 22

Carro, Adrián; Toral, Raúl; San Miguel, Maxi
Coupled dynamics of link and node states: A model for language competition.
ECCS'14 (Multiplex Satellite), Lucca, Italy.
September 22 - 26

Diakonova, Marina; Eguiluz, Victor; San Miguel, Maxi
Absorbing and Shattered Fragmentation Transitions in Multilayer Coevolution.
ECCS 2014, Lucca, Italy.
September 22 - 26

Ramasco, Jose J.
Is the voter model a model for voters?.
European Conference of Complex Systems ECCS' 14, Lucca, Italy.
September 22 - 26

Diakonova, Marina; Ramasco, Jose; Eguiluz, Victor
Role of Heterogeneities in Structural Properties of the Multiplex.
ECCS '14 Lucca 'Multiplex' Satellite.Lucca, Italy.
September 24

Lenormand, Maxime
Functional Network of the City.
CitiNet14, Satellite Workshop of the European Conference on Complex Systems (ECCS14), Lucca, Italy.
September 25

Ghoniem, Nasr M.; Matthes Christopher; Walgraef, Daniel
Theory, Modeling, and Experiments of Nano-structured Surfaces by Plasma Ions.
The Seventh Multiscale Materials Modeling Conference, Berkeley Marina Double Tree Hotel, San Francisco, CA.USA.
October 7

Lenormand, Maxime
Analysis of credit card data: how people move and spend their money.
Big Data, Urban Models and Transport Planning: the EUNOIA project, BBVA innovation center, Madrid, Spain.
November 11

Ramasco, J.J.
New data sources for the study of urban mobility.
Big Data, Urban Models and Transport Planning: the EUNOIA project, BBVA innovation center, Madrid, Spain.
November 11

Fleurquin, Pablo; Campanelli, Bruno; M. Eguiluz, Victor; Ramasco, Jose J.
Trees of Reactionary Delay: Addressing the Dynamical Robustness of the US Air Transportation Network.
The Fourth SESAR Innovation Days, Madrid, Spain.
November 25 - 27

Campanelli, Bruno; Fleurquin, Pablo; M. Eguiluz, Victor; Ramasco, Jose J.; Arranz, A.; Extebarria, Izaro; Ciruelos, Carla
Modelling Reactionary Delays in the European Air Transport Network.
Fourth SESAR Innovation Days, Madrid, Spain.
November 27 - 29

Fleurquin, Pablo; Campanelli, Bruno; M. Eguiluz, Victor; Ramasco, Jose J.
Trees of Reactionary Delay: Addressing the Dynamical Robustness of the US Air Transportation Network.
Fourth SESAR Innovation Days, Madrid, Spain.
November 27 - 29

a.6.3 Poster presentations

Galve Conde, F.
On the spectral origin of non-Markovianity: an exact finite model.
1st Conference on Quantum Thermodynamics. Potsdam, Germany.
January 20 - 24

Zambrini, Roberta
Quantum synchronization.
1st Conference on Quantum Thermodynamics. Potsdam, Germany.
January 20 - 24

Martínez-Llinàs, Jade; Colet, Pere; Erneux, Thomas
Tuning the period of square-wave oscillations for delay-coupled optoelectronic systems.
FISES2014, XIX Reunion de Fisica Estadistica, Ourense, Spain.
April 2 - 4

Ser-Giacomi, E.; Hernandez-Garcia, E.; Lopez, C.; Rossi, V.
Networks of fluid transport in the ocean.
FISES2014, XIX Reunion de Fisica Estadistica, Ourense, Spain.
April 2 - 4

Carro, Adrián; Vazquez, Federico; Toral, Raúl; San Miguel, Maxi
Co-evolving link states dynamics.
FisEs2014, XIX Congreso de Fisica Estadistica, Ourense, Spain.
April 2 - 4

Diakonova, Marina; Eguiluz, Victor M.; San Miguel, Maxi
Fragmentation Transitions in the Multilayer Coevolving Voter Model.
FISES2014, XIX Reunion de Fisica Estadistica, Ourense, Spain.
April 2 – 4

Matías, Manuel A.; Colet, Pere; Gomila, Demià; Gelens,Lendert
Formation of localized structures in bistable systems through nonlocal spatial coupling.
FISES2014, XIX Reunion de Fisica Estadistica, Ourense, Spain.
April 2 – 4

Zamora-Munt, Jordi; Matías, Manuel A.; Colet, Pere
Interplay between internal time scales and network topology in coupled nonlinear oscillators.
FISES2014, XIX Reunion de Fisica Estadistica, Ourense, Spain.
April 2 - 4

Martinez-Garcia, Ricardo; Calabrese, Justin; Hernandez-Garcia, Emilio; Lopez, Cristobal
Vegetation pattern formation in semiarid systems induced by long-range competition in the absence of facilitation mechanisms.
FisEs2014, XIX Congreso de Fisica Estadistica, Ourense, Spain.
April 2 - 4

Parra Rivas, P.; Gomila, D.; Matías, M.; Leo, F.; Coen, S.; Gelens, L.
Modeling Kerr frequency combs using the Lugiato-Lefever equation: a characterization of the multistable landscape.
Photonics Europe 2014 Symposium, SPIE Brussels, Belgium.
April 14 - 17

Martinez-Garcia, Ricardo; Calabrese, Justin; Hernandez-Garcia, Emilio; Lopez, Cristobal
Vegetation pattern formation in semiarid systems induced by long-range competition in the absence of facilitation mechanisms.
European Geosciences Union, Vienna, Austria.
April 29

Bettencourt, Joao H.; López, Cristóbal; Hernández-García, Emilio; Montes, Ivonne; Sudre, Joel; Dewitte, Boris; Paulmier, Aurélien; Garçon, Véronique
Mesoscale structures as barriers to mixing in the East Tropical Pacific Oxygen Minimum Zone.
46th International Liége Colloquium on Ocean Dynamics: Low Oxygen Environments In Marine, Estuarine And Fresh Waters University of Liège - Belgium.
May 5 – 9

Barceló, F.; Cerdà, J.J.; Alemany, R.; Vogler, O.; Gutiérrez, A.; Duran, M.A.; Novo, A.; Jiménez, T.; Ros, T.; Portugal, J.
DSC blood serum proteome chracterization of Monoclonal Gammapathy of Undetermined Significance
XIV Congress of the Spanish Biophysical Society (SBE 2014), Alcalá de Henares, Spain.
June 11

Osca, Javier; Ruiz, Daniel; Serra, Llorenç
Effects of tilting the magnetic field in one-dimensional Majorana nanowires.
The New Generation in Strongly Correlated Electron Systems. Nice, France.
June 16 - 20

Parra Rivas, P.; Gomila, D.; Leo, F.; Coen, S.; Gelens, L.
Third-order chromatic dispersión stabilizes Kerr frequency combs.
2014 Advanced Photonics, OSA Barcelona, Spain.
July 27 - 31

Osca, Javier; Serra, Llorenç
Majorana modes in smooth normal-superconductor nanowire junctions.
2nd School and Conference on Spin-Based Quantum Information Processing. Konstanz, Germany.
August 18 - 22

Alomar, M. I.; Sánchez, David
Thermopower in graphene with spin-orbit interaction.
2nd School and Conference on Spin-Based Quantum Information Processing. Konstanz, Germany.
August 18 - 21

Tchawou Tchuisseu, Eder Batista; Gomila, Damià; Colet, Pere
Stabilization of power grid: demand side management.
International summer school in Nonlinear Dynamics, Peyresq, France.
August 22 – 29

Osca, Javier; Serra, Llorenç
Majorana modes in smooth normal-superconductor nanowire junctions.
Frontiers of Condensed Matter 2014. San Sebastián, Spain.
August 24 to September 4

Alomar, M. I.; Sánchez, David
Thermopower in graphene with spin-orbit interaction.
Frontiers of Condensed Matter 2014, San Sebastián, Spain.
August 25 to September 5

Porte, Xavier; Cornelles Soriano, Miguel; Breuer, Stefan; Drzewietski, Lukas; Elsässer, Wolfgang; Fischer, Ingo
Scaling Properties of the Dynamics of Semiconductor Lasers in External Cavities.
24th International Semiconductor Laser Conference. Palma de Mallorca, Spain.
September 7 – 10

Carro, Adrián; Toral, Raúl; San Miguel, Maxi
Fragmentation transition in a coevolving network with link-state dynamics.
IV Summer School on Statistical Physics of Complex and Small Systems, Palma de Mallorca, Spain.
September 8 - 19

Rodríguez, Jorge P.; Eguíluz, Víctor
Synchronization in multilayer networks of mobile particles.
IV Summer School on Statistical Physics of Complex and Small Systems, Palma de Mallorca, Spain.
September 8 - 19

Ruiz, Daniel; Osca, Javier; Serra, Llorenç
Optical properties of 2D Majorana nanowires.
IV Summer School on Statistical Physics of Complex and Small Systems, Palma de Mallorca, Spain.
September 8 - 19

Osca, Javier; Serra, Llorenç
Majorana modes in smooth normal-superconductor nanowire junctions.
IV Summer School on Statistical Physics of Complex and Small Systems. Palma de Mallorca, Spain.
September 8 – 19

Alomar, M. I.; Sánchez, David
Thermopower in graphene with spin-orbit interaction.
IV Summer School on Statistical Physics of Complex and Small Systems. Palma de Mallorca, Spain.
September 8 - 19

Martínez-Llinàs, Jade; Colet, Pere; Erneux, Thomas
Synchronization of tunable asymmetric square-wave pulses in optoelectronic oscillators.
IV Summer School on Statistical Physics of Complex and Small Systems. Palma de Mallorca, Spain.
September 8 - 19

Tchawou Tchuisseu, Eder Batista; Gomila, Damià; Colet, Pere
Effects of dynamically controlled users on the stabilization of the power grid frequency.
IV Summer School on Statistical Physics of Complex and Small Systems in Palma de Mallorca, Spain.
September 8 - 19

Perez, Toni; Klemm, Konstantin; Eguiluz, Victor
Age-dependent voter model.
ECCS14 Lucca, Italy.
September 25

Luchette, Matt; Escalona-Morán, Miguel; Zhang, Wenhua; Williams, Ziv
Phase-reversal in the oscillatory entrainment of neural interactions is a general principal of learning.
Annual meeting of the American Society for Neuroscience (SfN 2014), Washington, USA.
November 15 - 19

Matias, Manuel A.; Zamora-Munt, Jordi; Colet, Pere
Interplay between internal time scales and network topology in coupled nonlinear oscillators.
"Collective dynamics in coupled oscillator systems", Weierstrass Institute, Berlin, Germany.
November 24 - 26

Galve Conde, Fernando
On the spectral origin of non-Markovianity: an exact finite model.
576 Heraeus Seminar: Designed Quantum States of Matter, Bad Honnef, Germany.
December 1 - 5

Zambrini, Roberta
Quantum synchronization.
576 Heraeus Seminar: Designed Quantum States of Matter, Bad Honnef, Germany.
December 1 - 5

a.6.4 Seminar talks in other research centers

Rodriguez-Mendez Victor
Inferring hidden variables in complex networks.
Vortech ,Delft, Holland.
January 21

Fischer, Ingo
Building a Reservoir Computer: Towards understanding the mechanisms of neuro-inspired information processing.
Ernst Strüngmann Lecture at Ernst Strüngmann Institute (ESI) for Neuroscience, Frankfurt, Germany.
January 23

Martínez-García, Ricardo.
Optimizing the search for resources sharing information: the Mongolian gazelle.
Institute for the Chemistry and Biology of the Marine Environment, Oldenburg, Germany.
February 27

San Miguel, Maxi
Collective Social Phenomena: The voter model at the corssroads of mechanisms, models and electoral data.
Conference Series: "Més enllà de la física: reptes multidisciplinaris" Complexitat. cat, Facultat de Fisica, Barcelona, Spain.
January 28

Hernandez-Garcia, Emilio
Oportunidades de modelagem em Ciências da vida e da terra: Uma panorâmica.
Instituto de Biología, Universidade Federal da Bahia, Salvador, Brasil.
April 23

Hernandez-Garcia, Emilio
Lyapunov lines and flow networks: Impact of ocean transport on biological dynamics.
Instituto de Física, Universidade Federal da Bahia, Salvador, Brasil.
April 24

Zambrini, Roberta
Advances in Quantum Synchronization
Universitat de Barcelona, Barcelona, Spain.
May 9

Rossi, Vincent
On the retention, dispersion and transport of tracers by ocean currents: a Lagrangian perspective.
Seminar presented at IMEDEA, Esporles, Mallorca, Spain.
June 19

Toral,Raul
Weighted-ensemble Brownian dynamics simulation: sampling of rare events in non-equilibrium systems.
Seminar at the Physics Department of Lehigh University, Bethlehem, USA.
August 6

Zambrini, Roberta
Synchronization, quantum correlations and entanglement in oscillator networks
Seminar at Dipartimento di Fisica, Universita degli Studi di Milano, Italy.
March 4

Rossi, Vincent
On the retention, dispersion and transport of tracers by ocean currents: a Lagrangian perspective.
LEGOS, Toulouse, France.
October 6 to October 10

Rossi, Vincent
Linking basin-scale connecitivity, oceanography and population dynamics for the design of marine reserves in the Mediterranean sea.
IOE Palma de Mallorca, Spain.
October 15

Parra Rivas, Pedro
Modeling Kerr Frequency combs using the Lugiato-Lefever equation.
University of California, Berkeley, USA.
October 20

Diakonova, Marina; Nicosia, Vincenzo; Vito, Latora; San Miguel, Maxi
Exploring the two-layer voter model.
Talk in Queen Mary University, London, UK.
November 6

San Miguel, Maxi
The EUNOIA Project.
Big Data, Urban Models and Transport Planning BBVA Innovation Center, Madrid, Spain.
November 11

Matias, Manuel A.; Colet, Pere; Gomila, Damià; Gelens, Lendert
Formation of localized structures in bistable systems through nonlocal spatial coupling.
Institute of Physics, Humboldt University, Berlin, Germany.
November 27

Brunner, Daniel; C. Soriano, Miguel; Mirasso, Claudio; Fischer, Ingo
Photonic reservoir computing: machine learning using laser-networks.
Technical University of Berlin, Germany.
December 9

a.8. Press & Media

Titles are hyperlinked to he corresponding PDF file, or the audio/video clip

a.8.1 Written and Digital Media

Solucions als retard aeris des-de l'IFISC (CSIC-UIB).
Nota de Prensa UIB.
January 16

Expertos en navegación aérea se reunirán este jueves en Palma para participar en un proyecto sobre retrasos.
Europa Press.
January 16

Expertos en navegación aérea buscan soluciones a los retrasos.
Ultima Hora.
January 17

Es imposible acabar con los retrasos aéreos.
El Mundo.
January 17

L'IFISC reuneix experts a la UIB per cercar solucions als retards aeris.
Diario de Mallorca.
January 23

Optòmics, un concurs de còmic sobre la part més divertida de l'òptica.
Nota de Prensa UIB.
February 7

Optòmics, un concurs de còmic sobre l'òptica.
Diario de Mallorca.
February 13

Avui, portes obertes a l´IFISC per als alumnes de la UIB.
Diario de Mallorca.
February 20

L´IFISC organitza @IFISC 2014, una jornada de portes obertes per a alumnes de la UIB.
Nota de Prensa UIB.
February 20

Jornada de puertas abiertas del IFISC para alumnos de la UIB.
Ultima Hora.
February 21

L´IFISC es presenta als estudiants de la UIB amb una jornada de portes obertes.
Diario de Mallorca.
February 27

L´IFISC convoca 7 beques SURF@IFISC 2014 d´introducció a la recerca per aquest estiu.
Nota de Premsa UIB.
March 14

L´IFISC convoca set beques d´introducció a la recerca.
Diario de Mallorca.
March 20

Física estadística al servei de l´estudi de la complexitat social.
Nota de Premsa UIB.
March 20

Només el 3% dels votants que canvien d´opinió ho fan pel seu lliure albir, aliens a la influència social del seu treball o residència.
Nota de Premsa UIB.
March 26

La UIB elabora un modelo para encontrar amigos.
Mallorca Diario.
April 2

Tesi Doctoral. Física Estadística al servei de l´estudi de la complexitat social.
Diario de Mallorca.
April 3

Un modelo de la amistad basado en las conexiones sociales y la movilidad.
Es Materia.
April 5

Un institut de física interdisciplinària.
ARA Balears.
April 7

Físics de la UIB estudien les eleccions dels EUA.
ARA Balears.
April 7

Predir on faràs amics segons com et mous.
Nota de Premsa UIB.
April 8

Un modelo de la amistad basado en las conexiones sociales y la movilidad.
La Razón.
April 9

Els amics, segons com et moguis.
Diario de Mallorca.
April 10

Els amics, segons com et moguis.
ARA Balears.
April 10

Crean un mapa de la amistad basado en las redes sociales y dispositivos móviles.
La Nación.
April 10

Sincronització anticipada al cervell.
Nota de Prensa UIB.
April 14

Un mapa de provincias marinas.
El Mundo.
April 15

Mapes de províncies marines per millorar el disseny de les reserves marines.
Nota de Prensa UIB.
April 16

Voter Model Works for US Elections.
Physics.
April 18

Physics predicts US voting patterns.
Science.
April 23

La UIB concedeix els primers premis d'investigació Montserrat Casas.
ARA Balears.
April 24

La UIB concede los primeros premios de investigación Montserrat Casas.
Diario de Mallorca.
April 24

La UIB concede los primeros premios de investigación Montserrat Casas.
Ultima Hora.
April 24

Un mapa de amistades geolocalizado.
El Mundo Baleares.
April 29

Màgia i ciència, de la mà de l'IFISC (CSIC-UIB).
Nota prensa UIB.
May 5

Ciència i màgia es combinen en un cicle de la Caixa i l'IFISC.
ARA Balears.
May 5

Magia y ciencia, una pareja muy bien avenida.
El Mundo Baleares. Baleopolis.
May 6

Por primera vez se detecta la sincronización anticipada del cerebro en primates en el marco de una investigación de investigadores del IFISC.
Nota prensa UIB.
June 5

Estudian los movimientos de las ciudades a través de los tweets.
Diario de Mallorca.
June 9

El cerebro predice.
El Mundo Baleares (Baleopolis).
June 10

El estudio de patrones de vegetación y los movimientos colectivos de animales centran la tesis de Ricardo Martínez.
Nota prensa UIB.
July 9

La capacitat de processar informació dels làsers de semiconductor.
Nota de premsa UIB.
July 17

Computational Linguistics of Twitter Reveals the Existence of Global Superdialects.
MIT Technology Review.
August 7

Researchers Discover "Superdialects" Through Twitter Study.
Read Write.
August 7

Compútame, compútame, computadora ... ¿o "computador"?.
Manzana Mecánica.
August 8

Twitter revela la existencia de superdialectos digitales globales.
MediaTele.
August 8

'Superdialects' On Twitter Might Be Voicing Your Cultural History.
Popular Science.
August 8

Hablemos de otra forma: Twitter revela el uso de varios superdialectos globales.
Web Genbeta.
August 9

City and rural super-dialects exposed via Twitter.
New Scientist.
August 11

Un membre de l'Institut de Física Interdisciplinària de la UIB revoluciona l'estudi dels dialectes.
ARA Balears.
August 12

Investigadores del IFISC descubren la existencia de dos superdialectos del español en Twitter.
Mallorca Confidencial.
August 12

New Twitter Study Discovers "Global Superdialects".
Mental Floss.
August 12

L'espanyol es divideix en dos superdialectes a Twitter.
Diari de Balears.
August 12

El Ifisc descubre la existencia de dos grandes 'superdialectos' del español en Twitter.
Europa Press.
August 12

Forma lengua española súper dialectos en redes sociales.
Quadratin México.
August 12

¿Coche, auto, carro, concho o movi?.
Materia.
August 13

50 millones de ´tuits´ para estudiar los dialectos.
Diario de Mallorca.
August 13

Descubren la existencia de dos superdialectos del español en Twitter.
Campus Vivo.
August 13

Twitter revela que hay dos superdialectos del español.
Agencia Noticias SINC.
August 13

Twitter revela que hay dos superdialectos del español.
Público.
August 14

En el mundo hay dos dialectos del español, según Twitter.
El Espectador.
August 15

Descubren 2 superdialectos diferentes del español.
Universia.
August 18

Twitter revela que existen dos dialectos del español.
Ideal.
August 20

Descubren la existencia de dos superdialectos del español en Twitter.
Nota prensa UIB.
September 2

España es uno de los países europeos en el que más se tuitea desde carreteras.
El Economista.
September 8

España es uno de los países europeos en el que más se tuitea desde las carreteras y redes ferroviarias.
Europa Press.
September 8

España, entre los países de Europa que más tuitean desde las carreteras y las redes ferroviarias.
Mallorca Confidencial.
September 8

Espanya es troba entre els països d'Europa que més tuitegen des de les carreteres i les xarxes ferroviàries.
Nota UIB.
September 8

España, uno de los países europeos en los que más se tuitea al volante.
Autoocasión.
September 9

Los tuits dibujan la V de la Vía Catalana.
El País.
September 11

La V catalana s'ha dibuixat amb claredat en un mapa a través de tuits geolocalitzats.
ARA Balears.
September 11

La V catalana s'ha dibuixat amb claredat en un mapa a través de tuits geolocalitzats.
ARA Catalunya.
September 11

El IFISC de la UIB dibuja la ´V´ con tuits geolocalizados.
Diario de Mallorca.
September 11

La V catalana en "tuits".
Gaia Ciencia.
September 11

Los tuits dibujan la Vde la Vía Catalana.
Materia.
September 11

La 'V' catalana se dibuja perfectamente a través de Twitter.
Ultima Hora.
September 12

Tweets on the Road: los españoles entre los que más tuitean en ruta.
Cetelem.
September 12

La Via Catalana es fa visible al mapa fent servir dades de Twitter, segons els investigadors de l'IFISC (CSIC-UIB).
Nota prensa UIB.
September 13

Científicos baleares organizan jornada sobre ciudades inteligentes en Italia.
ABC
September 25

L'IFISC presenta els resultats del projecte EUNOIA.
Nota premsa UIB.
November 11

CaixaForum acoge la exposición del 75 aniversario del CSIC.
Brisas.
December 1

Con el grafeno es posible hacer móviles que se podrán doblar, caer al suelo y mojarse.
Diario de Mallorca
December 12

a.8.2 Radio and TV

Interview to José J. Ramasco about TREE project meeting.
Radio Televisión Española.
January 16

Magia y ciencia.
Notícia Informativo RNE.
May 6

Magia y ciencia en CaixaForum.
IB3 TV Notícies vespre.
May 6

Interview to Claudio Mirasso for the Conference "Magia y ciencia".
Ona Mediterrània. Programa "El Crepuscle encén estels".
May 8

Interview to Claudio Mirasso for the Conference "Magia y ciencia".
Cadena SER Baleares: "A vivir que son dos días".
May 11

Interview to Claudio Mirasso " Ciclo Magia y Ciencia".
Cadena SER Radio.
May 11

Magia y ciencia en CaixaForum.
IB3 TV Notícies vespre.
May 20

Interview to Maxi San Miguel for EUNOIA project.
IB3 Ràdio. Programa El Faristol.
June 10

Tweets on the Road.
IB3 TV. Noticia Informativo
September 9

Interview to Jose J.Ramasco, Pere Colet and Antònia Tugores on 'Tweets on the road'.
Això és IB3 (IB3 Ràdio).
September 9

Interview on the analysis of the Catalan Way. Podcast with Tugores, Antònia and Colet, Pere
Mallorca en Xarxa - Ona Mediterrània.
October 1

Movimiento.
Programa Tres14 de TVE.
November 16