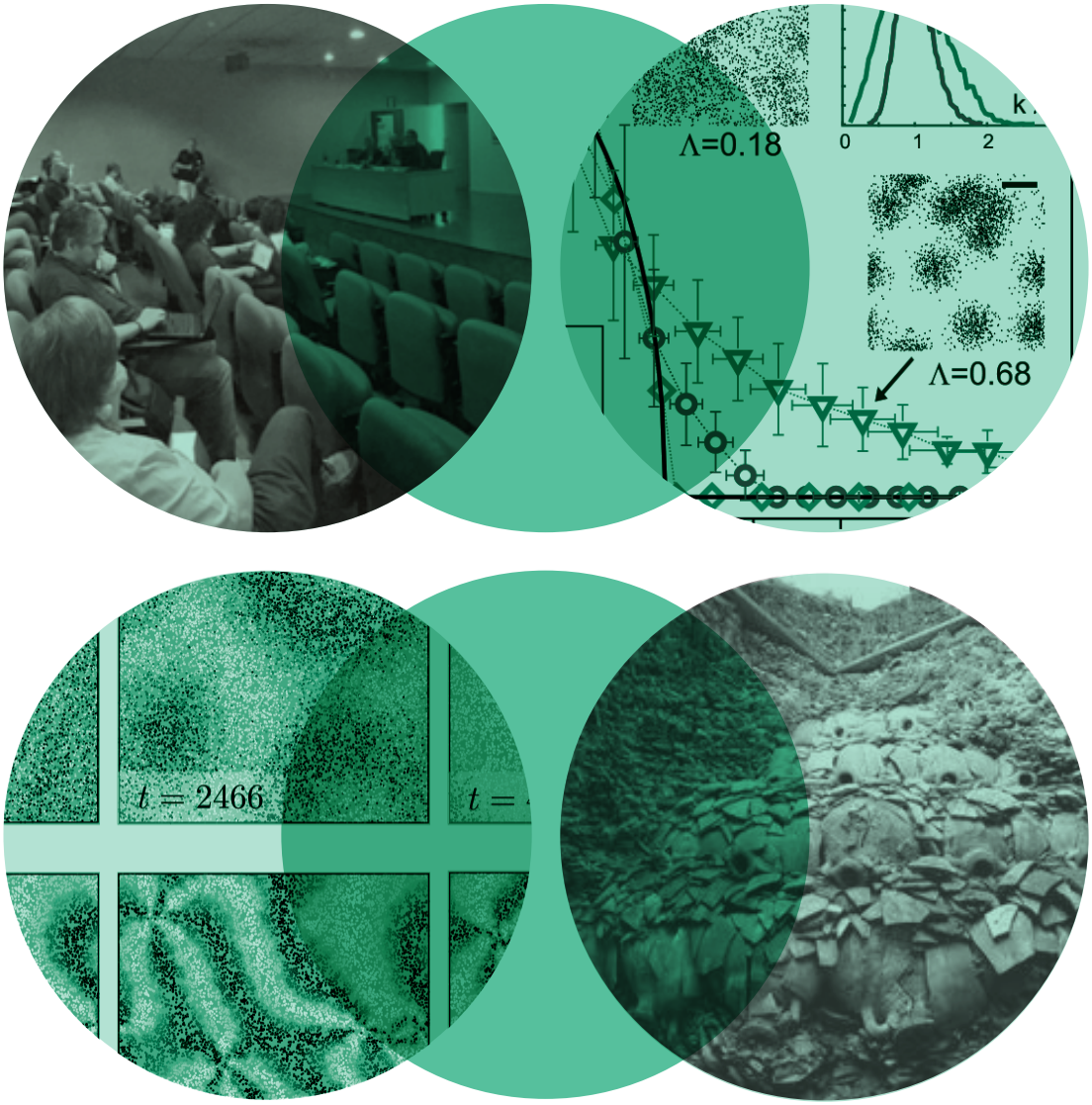
Universitat de Barcelona

UBICS Institute of Complex Systems

Annual Report

2019



UBICS

Institute of Complex Systems

Universitat de Barcelona

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UBICS Institute of Complex Systems
Annual Report
2019

FOREWORD

The Institute of Complex Systems (UBICS), created in 2016, is an interdisciplinary research institute of the Universitat de Barcelona that currently hosts more than 60 senior and young researchers.

At the UBICS, physicists, mathematicians, neurologists, psychologists, historians, linguists and computer scientists work together to advance research in a broad range of disciplines. The UBICS research covers from the most basic aspects of complex systems to applications of new knowledge at the interface between matter, life and social sciences.

The Institute also aims to integrate young researchers with a diversity of profiles with the goal to encourage their training in this multidisciplinary challenging environment.

In this annual report, we present both a global picture of the research conducted at the Institute and the results of the scientific effort in terms of publications, funds, and activities.

Albert Díaz Guilera
Director

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INSTITUTE STRUCTURE

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Organization chart

Executive Board

Díaz Guilera, Albert
→ *Director*
Soriano Fradera, Jordi
→ *Secretary*
Casademunt Viader, Jaume
Miguel López, M. del Carmen
Serrano Moral, Maria Ángeles
Taulé Delor, Maria

Council

Casademunt Viader, Jaume
Díaz Guilera, Albert
Massip Bonet, Maria Àngels
Miguel López, M. del Carmen
Ortín Rull, Jordi
Palassini, Matteo
Pérez Vicente, Conrado Juan
Revilla Calvo, Víctor
Serrano Moral, Maria Ángeles
Soriano Fradera, Jordi
Taulé Delor, Maria
Tierno, Pietro
García Pérez, Guillermo
Navarro Argemí, Eloy
Rosell Tarragó, Gemma
Teller Amado, Sara

Advisory Board

Byrne, David S.
→ *Durham University, UK*

Cugliandolo, Leticia
→ *Université Pierre et Marie Curie - Paris VI*

Joanny, Jean Francois
→ *ESPCI, École Supérieure de Physique et de Chimie Industrielles de la Ville de Paris*

Manrubia, Susanna
→ *Spanish National Centre for Biotechnology (CSIC)*

Vespignani, Alessandro
→ *MOBS Lab - Laboratory for the Modeling of Biological and Socio-technical Systems*

Research Groups

GRUP DE FÍSICA NO-LINEAL (2017SGR-1061)
http://www.ecm.ub.es/nonlinphys/english/index.html

Casademunt Viader, Jaume	Física de la Matèria Condensada
Ibañes Miguez, Marta	Física de la Matèria Condensada
Ortín Rull, Jordi	Física de la Matèria Condensada
Sancho, José Maria	Física de la Matèria Condensada
Soriano Fradera, Jordi	Física de la Matèria Condensada
Tierno, Pietro	Física de la Matèria Condensada

GRUP DE FÍSICA DE BIOMOLÈCULES I SISTEMES PETITS (2017SGR-1614)
http://www.ffn.ub.es/ritort/index.html

Palassini, Matteo	Física de la Matèria Condensada

GRUP DE FÍSICA ESTADÍSTICA (2017SGR-884)
http://www.ffn.ub.edu/statphysgroup

Miguel López, Maria del Carmen	Física de la Matèria Condensada
Pagonabarraga Mora, Ignasi	Física de la Matèria Condensada
Reguera López, David	Física de la Matèria Condensada

COMPLEXITY LAB BARCELONA (CLabB) (2017SGR-1064)
http://www.clabb.eu

Boguñà Espinal, Marian	Física de la Matèria Condensada
Díaz Guilera, Albert	Física de la Matèria Condensada
Masoliver García, Jaume	Física de la Matèria Condensada
Montero Torralbo, Miquel	Física de la Matèria Condensada
Perelló Palou, Josep	Física de la Matèria Condensada
Pérez Vicente, Conrado Juan	Física de la Matèria Condensada
Serrano Moral, Maria Ángeles	Física de la Matèria Condensada

MATERIALS: TRANSICIONS DE FASE I SISTEMES MULTIESCALA (2017SGR-0598)
http://www.ub.edu/web/ub/ca/recerca_innovacio/recerca_a_la_UB/grups/fitxa/M/MATEFASE/index.html?

Vives Santa-Eulalia, Eduard	Física de la Matèria Condensada

GRUP DE COMPLEXITAT, COMUNICACIÓ I SOCIOLINGÜÍSTICA (2017SGR175)
http://www.sociocomplexitat.ub.edu

Bastardas i Boada, Albert	Filologia Catalana i Lingüística General

GRUP D'ESTUDI DE LA VARIACIÓ (2017SGR-94)
http://www.ub.edu/GEV

Massip Bonet, Àngels	Filologia Catalana i Lingüística General

CENTRE PER A L'ESTUDI DE LA INTERDEPENDÈNCIA PROVINCIAL A L'ANTIGUITAT CLÀSSICA (CEIPAC) (2017SGR-512)
http://ceipac.ub.edu

Remesal Rodríguez, José	Història i Arqueologia
Revilla Calvo, Víctor	Història i Arqueologia
Aguilera Martin, Antonio	Història i Arqueologia
Pons Pujol, Luís	Història i Arqueologia

PSICOLOGIA QUANTITATIVA (2017SGR-269)
http://www.ub.edu/gteaap

Guàrdia Olmos, Joan (1/2)	Psicologia Social i Quantitativa
Peró Cebollero, Maribel (1/2)	Psicologia Social i Quantitativa

SISTEMES COMPLEXOS I ESPORT (2017SGR-1637)
http://www.inefc.cat/inefc/AppPHP/main.php?id_pagina=183

Balagué Serré, Natàlia	INEFC- Educació Física
Mateu Serra, Mercè	INEFC- Educació Física

CENTRE DE LLENGUATGE I COMPUTACIÓ (CLIC) (2017SGR-341)
http://clic.ub.edu

Taulé Delor, Maria	Filologia Catalana i Lingüística General
Martí Antonín, Maria Antònia	Filologia Catalana i Lingüística General
Salamó Llorente, Maria	Matemàtiques i Informàtica
Rodríguez Santiago, Inmaculada	Matemàtiques i Informàtica

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UBICS IN FIGURES

2 UBICS IN FIGURES

UBICS

45 Senior Researchers

18 Early Stage Researchers

17 External Members

1 Services and Administration Personnel

ICREA

Catalan Institution For Research And Advanced Studies

3 Research Professors

2 Academia Professors

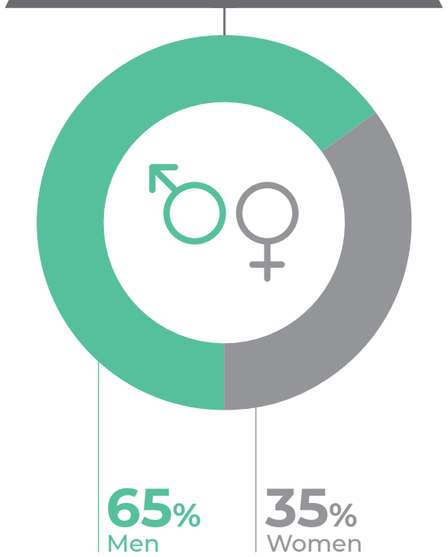
ERC

European Research Council

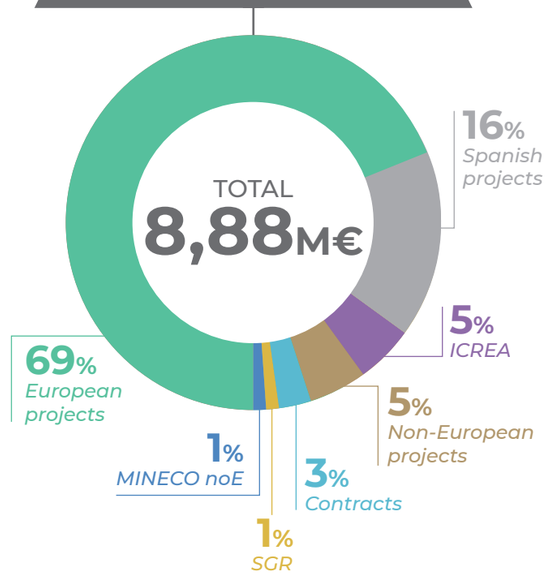
1 Advanced Grant

1 Consolidator Grant

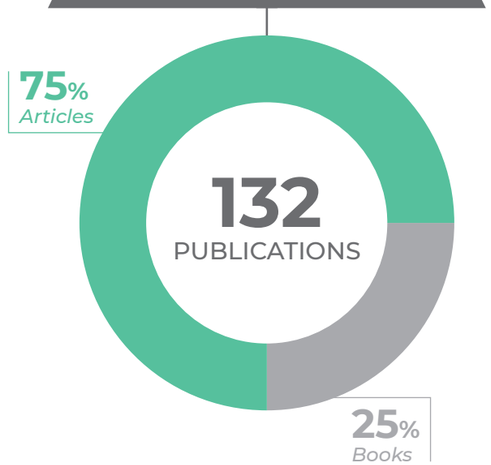
GENDER



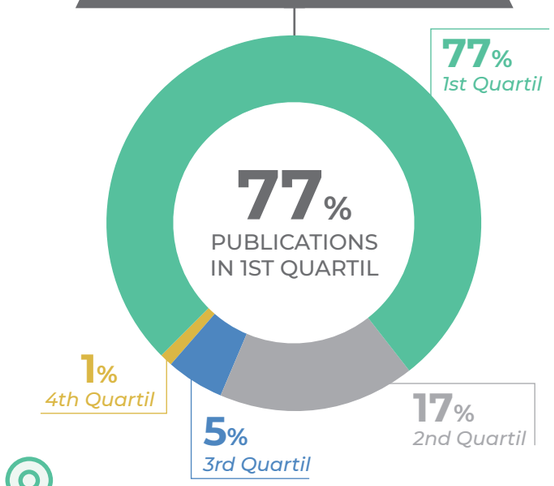
FUNDING



PUBLICATIONS



ARTICLES



Where to find us

Martí i Franquès, 1, 08028 Barcelona | e-mail: ubics@ub.edu | web: ubics.ub.edu | twitter: @UB_ICS

Campuses

Mundet Campus	Barcelona Knowledge Campus	Humanities Campus
Passeig de la Vall d'Hebron, 171 08035 Barcelona	Baldiri Reixac, 2 08028 Barcelona	Gran Via Corts Catalanes, 585 08007 Barcelona

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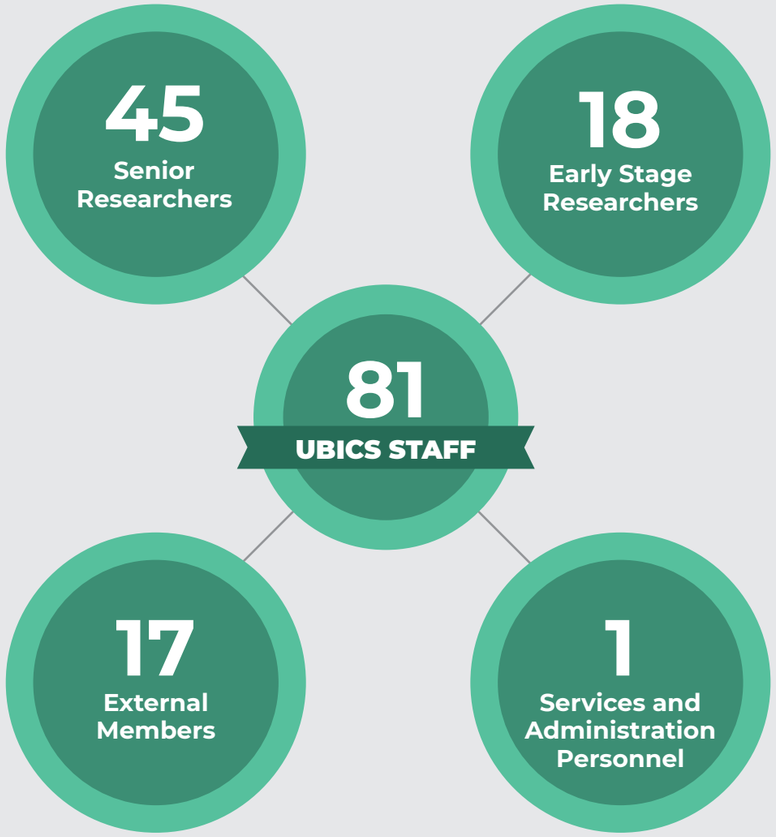
UBICS STAFF

3 UBICS STAFF



45 SENIOR RESEARCHERS

- **Aguilera Martin, Antonio**
  Departament d'Història i Arqueologia
- **Allard, Antoine**
  Departament Física de la Matèria Condensada
- **Almagro Blanco, Pedro**
  Departament Física de la Matèria Condensada
- **Bastardas Boada, Albert**
  Departament Filologia Catalana i Lingüística General
- **Boeckx, Cedric**
  Departament Filologia Catalana i Lingüística General
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  Departament Física de la Matèria Condensada
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  Departament Física de la Matèria Condensada
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- **Cozzo, Emmanuelle**
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  Departament Física de la Matèria Condensada
- **Fernández Nieves, Alberto**
  Departament de la Física de la Matèria Condensada
- **Guardado Alonso, Luis**
  Departament Física de la Matèria Condensada
- **Guàrdia Olmos, Joan**
  Departament Psicologia Social i Psicologia Quantitativa
- **Ibañes Míguez, Marta**
  Departament Física de la Matèria Condensada
- **Levis Sotomayor, Demian Francisco**
  Departament Física de la Matèria Condensada
- **Lozano Pérez, Sergio**
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- **Martí i Antonín, M. Antònia**
  Departament Filologia Catalana i Lingüística General
- **Masoliver García, Jaume**
  Departament Física de la Matèria Condensada
- **Massip Bonet, Maria Àngels**
  Departament Filologia Catalana i Lingüística General
- **Miguel López, M. Del Carmen**
  Departament Física de la Matèria Condensada
- **Montero Torralbo, Miquel**
  Departament Física de la Matèria Condensada
- **Morer Zapata, Ignacio**
  Departament Física de la Matèria Condensada
- **Ortín Rull, Jordi**
  Departament Física de la Matèria Condensada
- **Pagonabarraga Mora, Ignacio**
  Departament Física de la Matèria Condensada
- **Palassini, Matteo**
  Departament Física de la Matèria Condensada
- **Perelló Palou, Josep**
  Departament Física de la Matèria Condensada
- **Pérez Vicente, Conrado Juan**
  Departament Física de la Matèria Condensada
- **Peró Cebollero, Maribel**
  Departament Psicologia Social i Psicologia Quantitativa
- **Planet Latorre, Ramon**
  Departament Física de la Matèria Condensada
- **Pons Pujol, Luis**
  Departament Història i Arqueologia
- **Puertas Prats, Eloi**
  Departament de Matemàtiques i Informàtica
- **Reguera López, David**
  Departament Física de la Matèria Condensada
- **Remesal Rodríguez, José**
  Departament Història i Arqueologia
- **Revilla Calvo, Víctor**
  Departament Història i Arqueologia
- **Rodríguez Santiago, Inmaculada**
  Departament Matemàtiques i Informàtica
- **Salamó Llorente, Maria**
  Departament Matemàtiques i Informàtica

SENIOR RESEARCHERS

- **Sancho Herrero, José María**
  Departament Física de la Matèria Condensada
- **Serrano Moral, Maria Ángeles**
  Departament Física de la Matèria Condensada
- **Soriano Fradera, Jordi**
  Departament Física de la Matèria Condensada
- **Starnini, Michele**
  Departament Física de la Matèria Condensada
- **Tahat, Amani**
  Departament de la Física de la Matèria Condensada
- **Taulé Delor, Maria**
  Departament Filologia Catalana i Lingüística General
- **Tierno, Pietro**
  Departament Física de la Matèria Condensada
- **Vives Santa-Eulalia, Eduard**
  Departament Física de la Matèria Condensada
- **Zheng, Muhua**
  Departament de la Física de la Matèria Condensada

18 EARLY STAGE RESEARCHERS

- **Baldeón Medrano, Johan Paul**
  Departament Matemàtiques i Informàtica
- **Cañete Masse, Cristina**
  Departament Psicologia Social i Psicologia Quantitativa
- **Cigarini, Anna**
  Departament Física de la Matèria Condensada
- **De Frutos Manzanares, Laia**
  Departament d'Història i Arqueologia
- **Gómez Robledo, Maria Aide**
  Departament d'Història i Arqueologia
- **Mancho Fora, Nuria**
  Departament Psicologia Social i Psicologia Quantitativa
- **Mercadal Melia, Josep**
  Departament de Física de la Matèria Condensada
- **Montalà Flaquer, Marc**
  Departament Psicologia Social i Psicologia Quantitativa
- **Moriano Palacios, Juan**
  Departament de Filologia Catalanai Lingüística General
- **Muñoz Andirkó, Alejandro**
  Departament Filologia Catalana i Lingüística General
- **Ortiz Castillo, Elisenda**
  Departament Física de la Matèria Condensada
- **Palacin Copado, Carlos**
  Departament d'Història i Arqueologia
- **Rodriguez Gallo, Carolina**
  Departament Física de la Matèria Condensada
- **Sánchez Cobos, Agustín**
  Departament Física de la Matèria Condensada
- **Sturm, Stefanie**
  Departament de Filologia Catalana i Lingüística General
- **Theofanopoulou, Constantina**
  Departament Filologia Catalana i Lingüística General
- **Tiago Martins, Pedro**
  Departament Filologia Catalana i Lingüística General
- **Venelin Orlinov, Kovatchev**
  Departament Filologia Catalana i Lingüística General

17 EXTERNAL MEMBERS

- **Balaguer, Natàlia**
  INEFC - Institut Nacional d'Educació Física de Catalunya
- **Baldeon, Johan Paul**
  Departament Matemàtiques i Informàtica
- **Bermúdez Lorenzo, Juan Manuel**
  Departament d'Història i Arqueologia
- **Bonhoure, Isabelle**
  FBG - Fundació Bosch i Gimpera
- **Corvera Poiré, Eugenia**
  UNAM - Universidad Nacional Autónoma de México
- **Estévez Priego, Estefania**
  FBG - Fundació Bosch i Gimpera
- **Farràs Permanyer, Laia**
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- **Ferri Condeminas, Irene**
  Departament Física de la Matèria Condensada
- **González Vázquez, Mateo**
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- **Martin Oliveres, Antoni**
  Departament d'Història i Arqueologia
- **Mateu, Mercè**
  INEFC - Institut Nacional d'Educació Física de Catalunya
- **Morer Zapata, Ignacio**
  FBG - Fundació Bosch i Gimpera
- **Pérez González, Jordi**
  FBG - Fundació Bosch i Gimpera
- **Prignano , Luce**
  FBG - Fundació Bosch i Gimpera
- **Vázquez, Pablo**
  FBG - Fundació Bosch i Gimpera
- **Vincens Bennasar, Julián**
  FBG - Fundació Bosc i Gimpera

1 SERVICES AND ADMINISTRATION PERSONNEL

- **Teller Amado, Sara**

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RESEARCH LINES

4 RESEARCH LINES

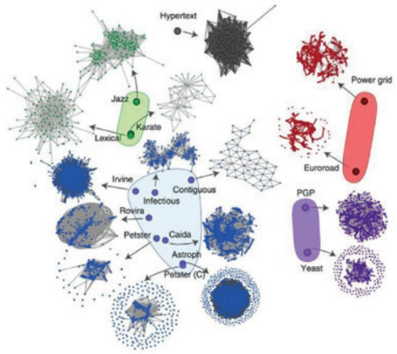
Foundations

An important number of the Institute's researchers are carrying out their own research on the identification and description of the general principles and key mechanisms that govern complex systems. This includes, on the one hand, the study of theoretical aspects within the framework of network science and the modeling of the basic agents that make up a system and the study of emerging behaviors through their interactions. On the other hand, the analysis of many complex systems often involves processing a large amount of information, which requires the continuous development of tools in the context of so-called "Big Data", with clear applications in the context of the Institute. Finally, a large number of complex systems are intrinsically dynamic, that is, they evolve over time. Problems ranging from fluid dynamics and plasticity in neural networks and metabolic networks to the dynamics of social networks, all require the development of common tools. This is a fundamental aspect that focuses the research activities carried out by the members of the Institute. Not to mention the field of Statistical Physics, from which most of the physics researchers at the Institute come, which still has fundamental problems to be solved.

Statistical Physics

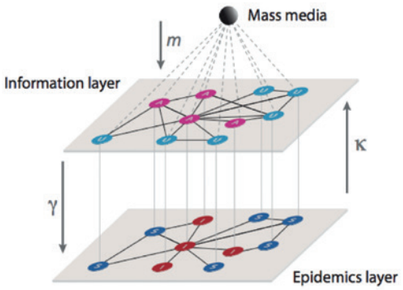
Statistical Physics techniques are at the basis of our approach to the study of complex systems. Statistical Physics uses the methods of probability theory and statistics to bridge the gap between the microscopic properties of individual atoms and molecules and the macroscopic or bulk properties of materials.

At the Institute, statistical physicists generalize the applicability of this discipline by studying other types of microscopic elements that interact to give place to collective macroscopic phenomena. Apart from the philosophical approach, some specific techniques that we have adapted for the study of complex systems are statistical models of anomalous diffusion and transport, models for the study of phase transitions and criticality --such as the Ising model--, and renormalization group theory.



Networks

Network Science focuses on the study of interactions as graph representations of complex systems. Complex networks display patterns of connection that are neither purely regular nor totally random, and are common to many real systems in differents domains. These non-trivial topological features, combined with dynamical processes and evolutionary changes, explain many of the emergent phenomena observed in complex systems.



Researchers at the Institute are working on the development of theoretical and computational tools and methodologies for the study of complex networks, and on their application to the construction of predictive models for physical, biological, and social phenomena. Among the Network Science topics studied at UBICS are network geometry, multilayer networks and dynamical processes, and our research also extends to a wide range of real complex systems, including the molecular networks of interactions in cells, the brain, online and offline social networks, the Internet, and international trade webs.

Dynamical Systems

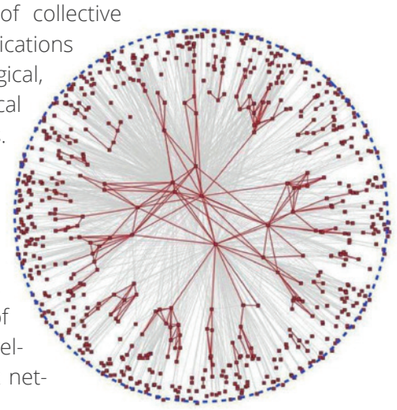
Complex systems are inherently dynamic and both properties and processes change over time. Dynamical systems theory provides a mathematical framework for treating time dependence in complex systems, typically involving continuous time and stochastic or random events. Apart from time dependence in geometrical space, it is common to deal with extended versions for systems with discrete elements. This serves, for instance, to study dynamical processes in networks.

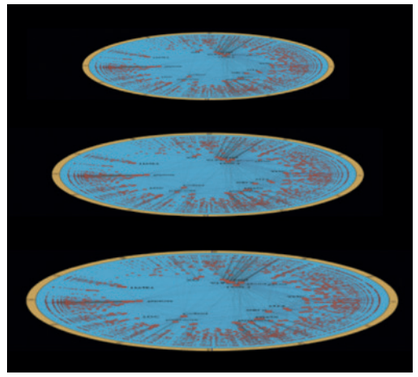
Among the different dynamical processes, the phenomenon of synchronization has received a lot of attention, becoming one of the paradigmatic examples of the emergence of collective properties with applications in physical, biological, chemical, technological and social systems. UBICS researchers have devoted great efforts to understanding synchronization phenomena, taking advantage of the most recent developments in complex network science.

Data Science

The study of real complex systems requires the curation, structuring, filtering, analysis, and visualization of large amounts of empirical and experimental data. The main goal is to extract knowledge from data by combining a data-driven approach, based on different statistical, data mining, and machine learning techniques, with analytic and computational methodologies that allow us to construct and simulate meaningful models with predictive power.

Applications have been developed at the Institute to be applied in fields ranging from language structure to social networks and urban mobility. Concretely, UBICS researchers have proposed a Collaborative Conversational Recommender framework, in which a synchronous and online 3D interface for multiple consumers integrates with a recommender system. Our work has also focused on game-based learning tools for both teachers and students. In the case of teachers, mechanisms for the design of educational games have been proposed. Moreover, related to social awareness (i.e., energy awareness), there are implementations of several gamified solutions that incorporate virtual agents to motivate and educate children in energy issues. These virtual agents communicate with users in natural language.





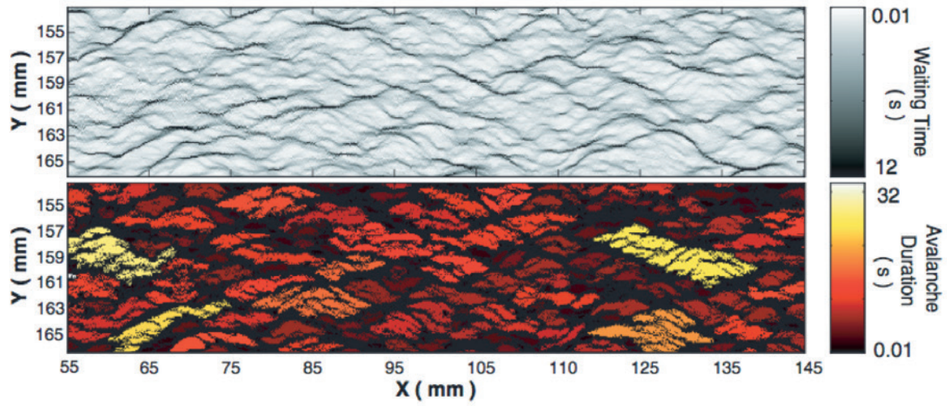
Science Of Matter

Condensed matter systems exhibiting phase transitions and criticality are probably the very first examples of complex systems. In such situations, the system's response to external changes is not a simple superposition of the response of its constituents but rather an emerging collective property. Understanding it through the use of techniques from the fields of statistical and nonlinear physics increases its predictability and allows for the design of new and useful tailored materials. Indeed, a broad variety of physical and chemical systems and processes can be described as complex systems, and their degree of complexity demands the adaptation or the extension of currently existing tools to new situations.

An important field of research within the science of complex matter focuses on soft matter materials, which include colloids, polymers and gels, complex fluids, and biological materials. What these systems have in common is that they are easily deformed by external forces and that their behavior is governed by weak interactions at energy scales comparable to thermal energy. While research on soft matter has traditionally been focused on synthetic materials, rapid developments in molecular biology have provided evidence that soft interactions and fluctuation phenomena also play a vital role in biology. Soft materials display complex spatiotemporal responses and special physical properties, including high deformability and complex rheology, which makes them very attractive for technological applications, in particular, in the food and cosmetics industries. Regarding complex materials, it is also worth emphasizing the interest of the research community in developing intelligent materials, i.e. materials that are able to adapt their properties or structure according to specific needs or to environmental changes (in some cases mimicking natural materials and processes), and thus have a huge technological and industrial impact.

Soft Matter

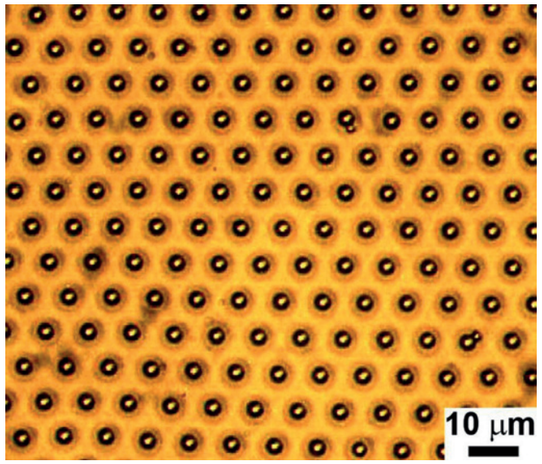
Among the extensive variety of soft matter materials, colloidal systems, i.e. fluid suspensions of micron-sized polymer spheres, are particularly interesting, not only for their ubiquitous nature (colloids are present in creams, foams, smoke, paints, etc..), but also because they provide a rich playground for basic Condensed Matter Physics. Colloidal particles display Brownian motion, size in the visible wavelength and dynamics in experimentally accessible time frames. Yet interactions in colloidal systems can be easily tailored in strength and range via the application of rela-



tively small external fields. These striking features make colloids excellent models for the study of behavior and dynamics in dissipative systems with intrinsic noise, i.e. systems broadly distributed in many physical, chemical and biological disciplines.

UBICS researchers have recently discovered a new scenario for a first-order phase transition that occurs via a complete inversion of the system energy landscape. This phenomenon was termed the "landscape inversion phase transition" (LIPT) and was observed by applying an external magnetic field to an assembly of paramagnetic colloids two dimensionally confined above a stripe patterned magnetic substrate. Another recent breakthrough in the optical manipulation of colloidal microspheres demonstrated the possibility of confining a cluster of particles into a circular assembly, and rotating the outer particle corona via laser tweezing. This colloidal model system was used as a microscopic clutch to investigate the transmission of torque through soft materials at the nanoscale. Another line of UBICS research focuses on understanding how curved colloidal crystalline shells can adapt their shape and resist failure. This is of fundamental importance because these structures are at the forefront of the drive to fabricate new functionalized self-assembled materials. Some biological structures, such as virus capsids, also represent nearly-ideal examples of spherical crystallography. Studies by UBICS researchers highlight the fundamental role played by geometrically necessary crystal defects, such as the pentagons in a soccer ball, in controlling mechanical stability and plastic deformation of these colloidal shells.

Complex flows and complex fluids



Complex fluids are seemingly homogeneous at macroscopic scale, but they are disordered at the microscopic scale and possess structure at intermediate scales. As a result their deformation and flow response to external solicitations is usually very different from that of conventional liquids and solids. Examples of complex fluids include polymeric melts or solutions, glasses, gels and foams. Complex fluids are ubiquitous in industry (e.g. in food and cosmetics) and in living organisms (e.g. blood and mucus).

Researchers at UBICS study hydrodynamic flows in complex scenarios that involve both Newtonian and complex fluids, and either bulk or interfacial instabilities such as vortex ring formation and viscous fingering. Combining experimental work, statistical analysis and theoretical modeling, they also explore the morphological and dynamic properties of two-phase displacements in disordered media, in which scale-invariance, non-Gaussian velocity fluctuations, avalanches, and intermittency can be observed. Current lines of research include the study of (i) the origin of instabilities (vortex ring formation and elastic turbulence) in the oscillatory pipe flow of non-Newtonian fluids, and (ii) the basic mechanism behind hysteresis in drainage/imbibition displacements in laboratory models of single pores.

Active Matter

Condensed matter systems composed of self-propelled units operating far from thermodynamic equilibrium belong to the realm of active matter. Such active "particles" possess internal degrees of freedom that allow them to self-propel by extracting energy from their environment and dissipating it to move in a preferred direction. Interaction between these elements originates patterns of self-organization and characteristic flows similar to those found in natural flocking systems. Flocking is very frequent in nature. Indeed, the phenomenon can be observed at a broad range of length scales, from mammal herds and fish schools to bacteria colonies and cellular migrations. These systems give rise to new fundamental questions and the possibility of synthesizing new types of smart materials, for example, those based on assemblies of filamentous proteins and molecular motors.
Researchers at UBICS are investigating how biological cells sense and respond to mechanical stimuli, which involves the interplay of several cytoskeletal constituents: primarily filaments, such as actin microfilaments or microtubules, crosslinking proteins, and molecular motors. The transport of various types of cargoes in cells is, for example, based on molecular motors moving along the cytoskeleton. Often, these motors work in teams rather than as isolated molecules. Our studies attempt to understand the effects of elastic coupling on (i) the dynamics of motor complexes (small number of motors), and (ii) the mechanical stability of actin assemblies. Another line of research investigates the propulsion of colloidal systems at the micro/nanoscale. It has recently been demonstrated that elongated DNA-linked paramagnetic colloids subjected to external precessing fields are capable to propel in a controlled way in viscous fluids. Future investigations will focus on determining interactions among micro-swimmers and the role played by hydrodynamic interactions, and on implementing optical forces to test swimmers' performance and their constrained motion into microscopic pores or microfluidic networks. As stated before, flocking is a phenomenon by which a general class of self-propelled entities, using limited environmental information and simple rules, organize themselves into an ordered state of motion. In some cases, interactions among moving entities are quite heterogeneous, and this feature has an important impact on collective motion. The presence of heterogeneous social interactions, naturally represented in terms of social networks, has been, for instance, observed in mammals and fish. UBICS researchers are also investigating the effects of such a broad class of interactions among group members, as well as behavioral contagion, on flocking dynamics.

Smart Materials

The design of new useful tailored materials benefits from its fundamental understanding using techniques from statistical and nonlinear physics. In many cases an efficient design implies the control of the amount of disorder as well as the use of multiscale modelling approaches from the nanoscale to large thermodynamic scales.

Our research focuses on the study of functional materials for sensors and actuators, super-elastic materials, shape memory alloys, ferrocaloric materials for efficient refrigeration, as well as the problem of critical failure of materials under compression (up to geophysical scales)

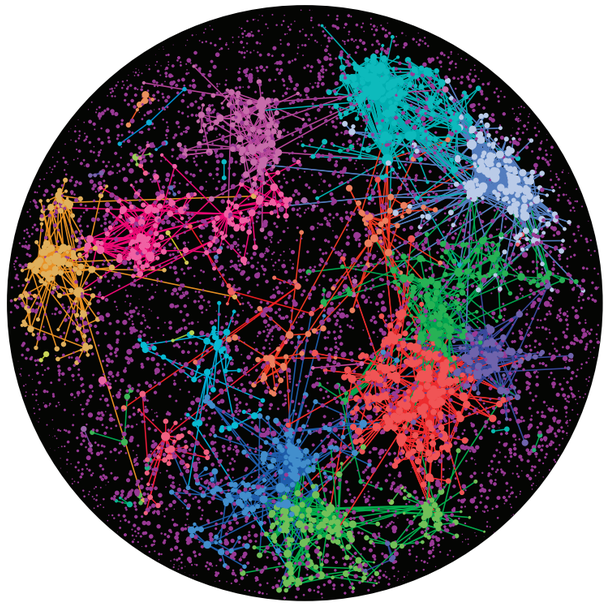
Life Sciences

Biological systems, both for their intrinsic wealth and because of their importance, have received special attention from the complex systems viewpoint. Much of the Institute's research activity is geared towards solving a large variety of problems in the biological context, and at diverse spatial and temporal scales. Investigations cover experimental, computational and theoretical approaches. Research areas include the study of fundamental molecular mechanisms, genomics and proteomics, the generation of forces and the mechanics of cells and tissues, morphogenesis and development, systems biology at the cellular level, and neuroscience. For the latter, the Institute houses its own laboratories. Additionally, the associated studies carried out at the level of microorganisms and tissues exhibit, thanks to their fundamental perspective, a clear connection with the research conducted in active matter, an area that is also central to the Institute.

Molecular Biophysics

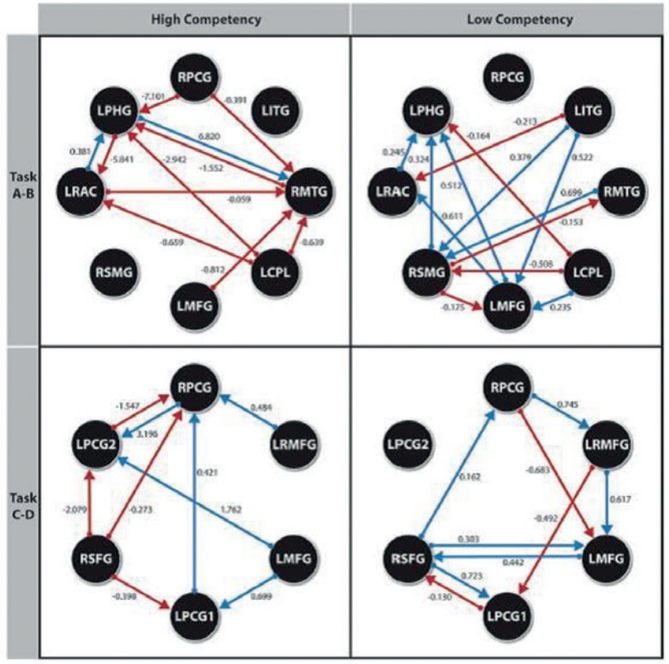
The advent of nanotechnologies in recent decades has made it possible to probe and measure biological systems down to the molecular scale. This has given rise to a more physical approach to traditional molecular biology, and, in particular, to attempts to solve the longstanding puzzles of biological building blocks and their behavior. This includes, for instance, the structure of proteins as a result of their folding dynamics, and the performance of molecular machines such as motor proteins.

In this context, the Institute is developing a first important line of research in single-molecule physics in an effort to understand the structural properties of relevant biomolecules through mechanical measurements of single molecules. A second line of research addresses the collective effects of molecular motors, i.e. cooperation among motor proteins to perform complex tasks, including the development of efficient strategies in intracellular transport and collective force generation. The latter is a problem that is directly relevant to medical applications, such as in neurodegenerative diseases.



Cell and Multicellular Biology

The biological cell is the basic unit of life, and constitutes in itself a remarkably complex system that combines thousands of chemical reactions by thousands of molecular species, all happening at the same time with fascinating harmony within an extremely crowded and noisy environment. The current access to quantitative data enabled by modern technologies has revealed the cell to be a whole new universe for physical inquiry and quantitative modeling, posing a formidable challenge for interdisciplinary science.

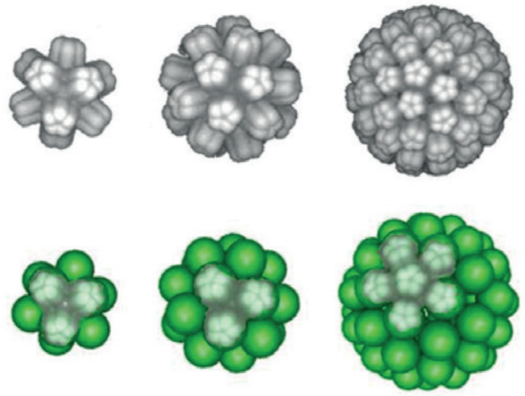


In this context, the research at the Institute aims at understanding the physical mechanisms of self-organization that can integrate such a variety of processes at very different scales. The problem is highly complex given the formidable information processing required to orchestrate cellular mechanisms in response to external stimuli; or to accomplish a variety of tasks required for survival, from metabolism to cell division. Research also focuses on different aspects of the physics within cells, with an emphasis on collective effects and emerging phenomena. Among the aspects that are more amenable to physical modeling under study, we can highlight those referring to force generation and cell mechanics, which are crucial for instance to cell motility and cell division, and to the processes associated with membrane dynamics. At a higher level of organization, the Institute also studies collective phenomena of cells in tissues. Here our emphasis is on mechanical aspects and includes the study of collective cell migration of epithelial cells, an area that is relevant to a variety of problems related to wound healing, cell regeneration, and, ultimately, to the understanding of cancer. Our goal is to extract the generic physical principles that govern the complex network mechanical and biochemical interactions underlying these systems. At the multicellular level, our ultimate goal is to achieve an integration of mechanics and information in development; that is, to understand the organization of physical forces and biological regulation in the context of embryogenesis, organogenesis and beyond.

Systems Biology

Systems Biology is a growing research field that aims at characterizing and understanding living organisms from the interaction among their building blocks, for instance the gene-gene interactions that dictate the animal body plan.

The research performed at UBICS within the field of Systems Biology uses mathematical and computational models of these blocks and interactions, and integrates methodologies from fields like dynamical systems and complex networks. This research includes important collaborations with wet laboratories and uses reported public data. The derived models, tools and approaches are applied to the comprehension of several aspects relating to living systems. A first aspect aims at the understanding of the patterning and growth processes that underlie the development of multicellular organisms. Such studies range from the embryonic animal development of vertebrates to plant growth. A second aspect focuses on the relationship between the large-scale architecture of the biological networks of interactions at different levels and their functionality.



Neuroscience

Living neuronal networks, in particular the human brain, are considered to be among the most complex systems in nature. The quest to understand them has caught the attention of different research groups at the Institute, who are exploring them through a rich repertoire of experimental, computational and theoretical tools.

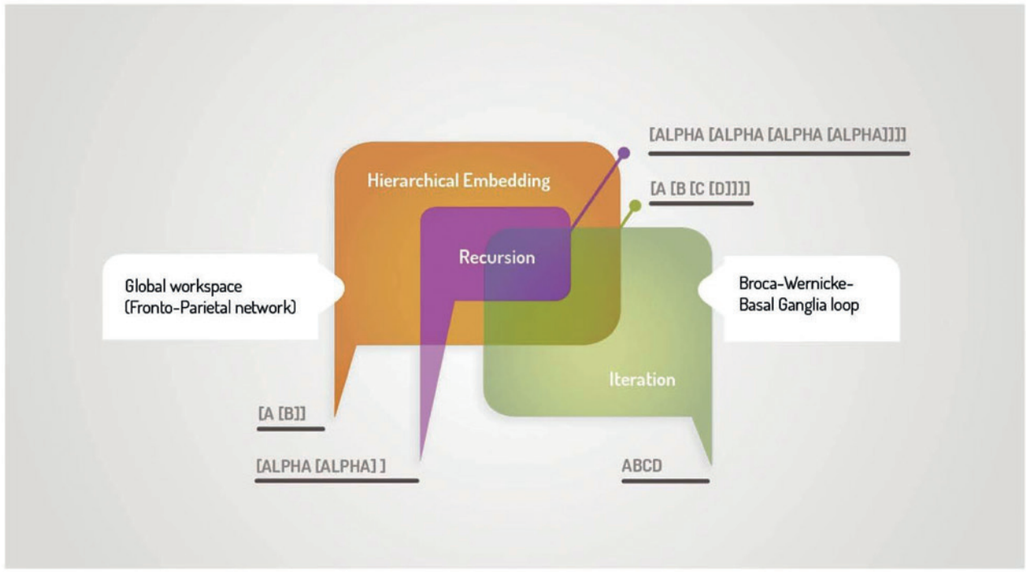
Two major lines of action shape neuroscience research, centered at either the scale of the brain or at the scale of mesoscopic neuronal circuits. At the scale of the brain, researchers study statistical models for the complex representation of the behavior of brain signal recordings in Functional Magnetic Resonance Imaging (fMRI) paradigms. Statistical, computational and mathematical models are generated with the aim of understanding the features of functional and effective connectivity maps between brain regions. These models provide a framework not only for systematic analysis, but also to diagnose and understand brain pathologies such as Mild Cognitive Impairment, Major Depressive Disorder, or simply aging. At the mesoscale, our research focuses on the emergence of collective phenomena in neuronal circuits. Neuronal cultures derived from either rat primary cells or human induced pluripotent stem cells are used as the main experimental platforms, and laboratory data is combined with theoretical modeling and numerical simulations. The investigation of complex phenomena in cultures include the ability of neuronal circuits to exhibit spontaneous activity patterns, synchronization mechanisms, and the capacity of these circuits to manifest an exquisite robustness in combination with broad flexibility. Given the relation between neuronal networks and connectivity, research also covers the modeling of neurological disorders in vitro and in silico, in particular in Huntington's, Parkinson's and Alzheimer's disease.

Social Sciences

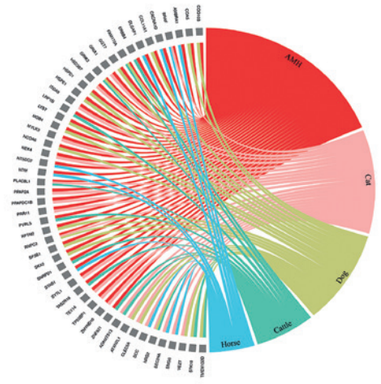
Applications in the social sciences range from aspects at the individual level to the study of large scale sociopolitical and economic structures, including those of the past. One of the applications that we can already consider as traditional in complex system science is economy and finance. But the activities of the institute aim to open up other fields of applicability. For example, concepts such as coordination dynamics and other characteristics of networks are being applied to the study of behaviors related to sports, both individually and at team level. Similarly, we are also working on issues related to the biological nature of human language ability, its development at the individual level, its emergence in species, and its implementation at the brain level. In the same way, the complex perspectives we are adopting illuminate more thoroughly the dynamics of the sociocomunicative and sociopolitical factors influencing language use, evolutionary change and maintenance and replacement phenomena.

Psychology and behaviour

Social dilemmas and game theory provide tools and strategies for measuring and quantifying an individual's social traits based on their actions when these individuals confront their own benefit with another's interest or with the collective interest. These dilemmas therefore make it possible to analyze, for example, the levels of cooperation, trust, reciprocity and sense of collectivity that arise when participants in these types of experiments play together and interact with each other generally through a digital interface capable of gathering the data related to their decisions. The research carried out along these lines combines experimental performance with empirical analysis either through basic statistics or sophisticated clustering algorithms and with the provision of new models to better interpret what is been observed in the experiments.



At UBICS, researchers work together with many actors to build tailored-made research collectives to address concerns and issues grounded mostly in urban contexts by means of citizen science participatory strategies and methodologies. Our methodologies are based on community processes and provides a large set of social dilemmas and dyadic games for the understanding of specific behavioural traits in social interactions. By means of citizen science strategies, our experimental setup was placed in the wild with situated, public and participatory experiments involving citizens at different levels. We have been working in several neighborhoods, applying this methodology to study the mechanisms behind collective climate actions to provide innovative tools for schools to increase student's motivation or to better understand mental health care in community ecosystem.



Economy and finance

Stock markets exhibit several universal statistical stylized facts and patterns that can be studied and modelled thanks to the large data sets available. Relevant issues can therefore be studied to obtain a better understanding of stock price movements and a better description of risk. Physics, complex systems science and their way of looking at natural phenomena have all contributed in a multidisciplinary way to this field, which, since the early 1990s, has been labelled econophysics.

UBICS researchers apply stochastic processes and other tools from the field of statistical physics to model volatility, to understand the statistics of extreme times such as first-passage time, to interpret emerging prices with agent based models and even to identify the relevant information that triggers the actions of individual traders. Other topics that have been studied recently include the economics of climate change and game theory.

Linguistics

Linguistics is a diverse field of research, and several different disciplines within it relate to the notion of complex systems. The study of language can be used to access information about human behaviour, the human brain and its processes, and about social and cultural structures on a larger scale. The field of linguistics further generates some very concrete applications, mostly related to technology and human-machine interactions, as well as clinical applications.

The work done by the linguistics department of our university within the Institute for Complex Systems is focused on three very distinct lines of research. The research group for biolinguistics studies the neurobiological foundations of the human capacity for language, as well as human-specific cognition at a more general level. To do so it employs a combination of theoretical, computational and genetic methods. Some of the main lines of investigation within the group are studying phenomena like the Neandertal genome, vocal learning in songbirds and its relationship to the human capacity for language, and the molecular processes that are involved in memory formation. In the line of Sociolinguistics and Linguistic Variation, the focus is on the application of theories of complexity to the comprehension of social, communicative-cognitive and linguistic phenomena. Finally, concerning Computational Linguistics, we focus on the detection of the linguistic features that allow us to identify communicative attitudes, opinion (polarity), irony, emotions and socio-political stance in oral and written texts, especially those produced on social media. There is also interest in the development of language technology resources, which are the base of natural language processing applications (information extraction, question-answering, recommendation systems, machine translation, etc.).

History

The trade system of the Roman Empire is one of the first recognized networks of interaction and interdependence between the Mediterranean basin and northern Europe and is generally considered to be the first complex European trade network. In the last fifty years, many theories and hypotheses about the organization of the Roman Empire trade system have been proposed but, due to the lack of source material, these theories continue to be speculative.

Among the best archaeological semantic markers available for the Roman Empire are amphorae and their associated epigraphy. Amphorae provide information on geographical origin, transported products, economic transactions and the social positions and relationships between people involved in trade.

At UBICS, researchers model the dynamics of the amphorae trade system during the Roman Empire using geospatial and social network techniques in order to better understand the evolutionary trends of the trading network. The research undertaken is an example of a truly interdisciplinary perspective on trade network studies.

5

FUNDING

5 FUNDING

European Projects

- ***Production and distribution of food during the Roman Empire: Economics and Political Dynamics (EPNet)***
  Period: 01/03/2014 to 28/02/2019
  Investigator: **Remesal Rodríguez, José**

- ***Custom architecturally defined 3D stem cell derived functional human neural networks for transformative progress in neuroscience and medicine (MESO_BRAIN)***
  Period: 01/09/2016 to 28/02/2020
  Investigator: **Soriano Fradera, Jordi**

- ***Transport of soft matter at the nanoscale (NANOTRANS)***
  Period: 01/03/2016 to 29/02/2020
  Investigator: **Pagonabarraga Mora, Ignacio**

- ***An e-infrastructure for software, training and consultancy in simultion and modelling (E-CAM)***
  Period: 01/10/2015 to 39/07/2020
  Investigator: **Pagonabarraga Mora, Ignacio**

- ***Towards novel nano-scale technologies based on phoretic flow effects (nanophlow)***
  Period: 01/02/2018 to 31/01/2021
  investigator: **Pagonabarraga Mora, Ignacio**

- ***Advanced Research Infrastructure for Archaeological Data Networking in Europe - plus (ARIADNEplus)***
  Data: 01/01/2019 to 31/12/2022
  Investigator: **Remesal Rodriguez, Jose**

- ***Charge transport in nanochannels (ELNANO)***
  Data: 01/10/2019 to 30/09/2022
  Investigator: **Pagonabarraga Mora, Ignacio**

- ***Co-designing Citizen Social Science for Collective Action (CoAct)***
  Data: 01/01/2020 to 31/12/2022
  Investigator: **Perello Palou, Josep**

- ***ENgineering FrustratiOn in aRtificial Colloidal icEs: degeneracy, exotic lattices and 3D states (ENFORCE)***
  Data: 01/01/2020 to 31/12/2024
  Investigator: **Tierno, Pietro**

- ***Simulating Roman Economies. Studying the Roman Economy through computational network modelling and archaeological big data (SIMREC)***
  Data: 01/05/2019 to 31/01/2020
  Investigator: **Díaz Guilera, Albert**

- ***Territories as Responsive and Accountable Networks of S3 through new Forms of Open and Responsible decision-Making (TRANSFORM)***
  Data: 01/01/2020 to 31/12/2022
  Investigator: **Perello Palou, Josep**

Other International Projects

- ***Mapping complexity: Embedding networks in hidden metric spaces***
  Agency: James S. McDonnell Foundation
  Period: 01/10/2013 to 30/09/2019
  Investigator: **Serrano Moral, Maria Ángeles**

- ***Mapping big data systems: rembedding large complex network in dimensional hidden metric spaces*** Agency: BBVA Fundation
  Period: 15/06/2018 to 14/06/2020
  Investigator: **Serrano Moral, Maria Ángeles**

- ***Modulation of Tau seeding and pathology in tauopathies by BBB-nanocarriers, epitope selective vaccination and ectoPrP Tau receptor bodies (STOPTauPATHOL)*** Agency: La Caixa Fundation
  Period: 15/09/2019 to 14/09/2022
  Investigador: **Soriano Fradera, Jordi**

Spanish Government Funded Research Projects

- *Materiales con respuesta activa para refrigeración limpia y eficiente*
  Period: 30/12/2016 to 29/12/2020
  Investigator: **Vives Santa-Eulalia, Eduard**

- *Fenómenos de no-equilibrio en Materia Blanda: de fluidos complejos a tejidos celulares*
  Period: 30/12/2016 to 29/12/2019
  Investigator: **Casademunt Viader, Jaume**

- *Adaptabilidad y Cooperación en Sistemas Biosociales en la Multiescala II*
  Period: 30/12/2016 to 29/12/2019
  Investigator: **Serrano Moral, Maria Ángeles**

- *La globularidad y la aparición del cerebro apto para el lenguaje*
  Period: 30/12/2016 to 29/12/2019
  Investigator: **Boeckx , Cedric**

- *Statistical Mechanics for Modeling and Prediction of Human Behaviour*
  Period: 30/12/2016 to 29/12/2019
  Investigator: **Perelló Palou, Josep**

- *Diatopía y cambio lingüístico. Scripta y proyección dialectal*
  Period: 30/12/2016 to 29/12/2020
  Investigator: **Massip Bonet, Maria Àngels**

- *La evolución (inter)generacional de las bilingüizaciones: contextos, mantenimiento y sustitución lingüísticos*
  Period: 01/01/2016 to 31/12/2019
  Investigator: **Bastardas Boada, Albert**

- *Conversión de energía a escalas pequeñas: explotando el carácter de no equilibrio de la materia activa*
  Data: 26/11/2019 to 25/11/2022
  Investigator: Levis Sotomayor, Demian Francisco

- *Desinformación y agresividad en Social Media: Analizando el lenguaje*
  Period: 01/01/2019 to 31/12/2021
  Investigator: Taule Delor, Maria

- *Estructura y dinámica de suspensiones coloidales: El papel de la rigidez de las partículas*
  Period: 01/01/2019 to 31/12/2021
  Investigator: **Fernandez De Las Nieves, Alberto**

- *Estudio de dinámicas no lineales en redes complejas multicapa bajo incertidumbre estructural*
  Period: 01/01/2019 to 31/12/2021
  Investigator: Díaz Guilera, Albert

- *Física no lineal y estocástica de las interacciones reguladoras de procesos biológicos*
  Period: 01/01/2019 to 31/12/2021
  Investigator: Ibañes Miguez, Marta

- *Indicadores estadísticos para el estudio de redes de conectividad cerebral en registros de resonancia magnética funcional (FMRI) y su aplicación para el diagnostico del deterioro cognitivo*
  Period: 01/01/2019 to 31/12/2022
  Investigator: Guàrdia Olmos, Joan

- *Relaciones interprovinciales en el Imperio Romano. Producción y comercio de alimentos hispanos (Provinciae Baetica et Tarraconensis)*
  Period: 01/01/2018 to 31/12/2020
  Investigator: Revilla Calvo, Victor

Spanish Government Funded Networks Of Excelence

- *Ingeniería de la frustración en hielos coloidales artificiales: degeneración y redes exóticas*
  Period: 01/12/2018 to 30/11/2019
  Principal investigator: **Tierno, Pietro**

AGAUR-SGR Consolidated Groups

- *Complexity Lab Barcelona (CLabB)*
  2017SGR1064
  Period: 01/01/2017 to 31/12/2020
  Investigator: **Perello Palou, Josep**

- *Grup de complexitat, comunicació i sociolingüística*
  2017SGR175
  Period: 01/01/2017 to 31/12/2020
  Investigator: **Bastardas Boadas, Albert**

- *Centre per a l'Estudi de la Interdependència provincial a l'Antiguitat Clàssica (CEIPAC)*
  2017SGR512
  Period: 01/01/2017 to 31/12/2020
  Investigator: **Revilla Calvo, Víctor**

- *Física no-lineal*
  2017SGR1061
  Period: 01/01/2017 to 31/12/2020
  Investigator: **Ortín Rull, Jordi**

- *Psicologia Quantitativa*
  2017SGR269
  Period: 01/01/2017 to 31/12/2020
  Investigator: **Guàrdia Olmos, Joan**

- *Centre de Llenguatge i Computació (CLIC)*
  2017SGR341
  Period: 01/01/2017 to 31/12/2020
  Investigator: **Taulé Delor, Maria**

Contracts With Public And Private Entities

15
CONTRACTS

FOR A TOTAL AMOUNT OF

746.928,86 €

6

PUBLICATIONS

6 PUBLICATIONS

Word cloud of all publications of UBICS members

ARTICLES

Research line : **FOUNDATIONS**

- ***Anomalous diffusion under stochastic resettings: a general approach***
  Masoliver, J., & Montero, M.
  Physical Review E, 100(4), 042103.
  https://doi.org/10.1103/PhysRevE.100.042103

- ***Annotating and analyzing the interactions between meaning relations***
  Gold, D., Kovatchev, V., & Zesch, T. (2019)
  Proceedings of the 13th Language Annotation Workshop.
  https://www.aclweb.org/anthology/W19-4004.pdf

- ***Assessing diversity in multiplex networks***
  Carpi, L. C., Schieber, T. A., Pardalos, P. M., Marfany, G., Masoller, C., Díaz-Guilera, A., & Ravetti, M. G.
  Scientific reports, 9(1), 1-12.
  https://doi.org/10.1038/s41598-019-38869-0

- ***Effects of two channels on explosive information spreading***
  Wu, J., Zheng, M., Xu, K., & Gu, C.
  Nonlinear Dynamics, 99(3), 2387-2397.
  https://doi.org/10.1007/s11071-019-05427-2

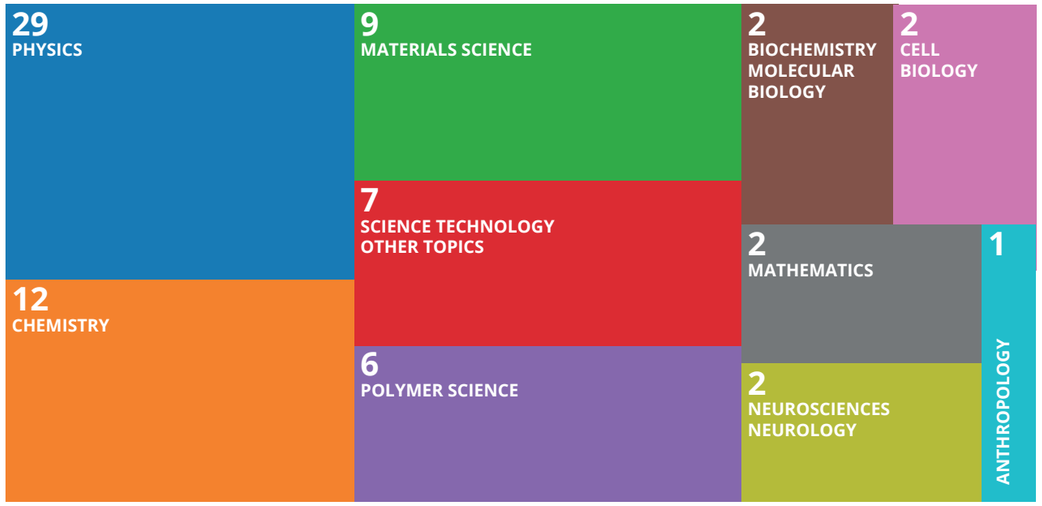
- ***Geometric randomization of real networks with prescribed degree sequence***
  Starnini, M., Ortiz, E., & Serrano, M. Á.
  New Journal of Physics, 21(5), 053039.
  https://doi.org/10.1088/1367-2630/ab1e1c

- ***Lessons learned from supplementing archaeological museum exhibitions with virtual reality***
  Puig, A., Rodríguez, I., Arcos, J. L., Rodríguez-Aguilar, J. A., Cebrián, S., Bogdanovych, A., & Piqué, R.
  Virtual Reality, 1-16.
  https://doi.org/10.1007/s10055-019-00391-z

- ***Memory-induced complex contagion in epidemic spreading***
  Hoffmann, X. R., & Boguñá, M.
  New Journal of Physics, 21(3), 033034.
  https://doi.org/10.1088/1367-2630/ab0aa6

- ***Mercator: uncovering faithful hyperbolic embeddings of complex networks***
  García-Pérez, G., Allard, A., Serrano, M. Á., & Boguñá, M.
  New Journal of Physics, 21(12), 123033.
  https://doi.org/10.1088/1367-2630/ab57d2

- ***Scalar model of flocking dynamics on complex social networks***
  Miguel, M. C., & Pastor-Satorras, R.
  Physical Review E, 100(4), 042305.
  https://doi.org/10.1103/PhysRevE.100.042305



Publications in Web of Science (WoS) according to "Research areas".

- *Telegraphic processes with stochastic resetting*
  Masoliver, J.
  Physical Review E, 99(1), 012121.
  https://doi.org/10.1103/PhysRevE.99.012121

- *The interconnected wealth of nations: Shock propagation on global trade-investment multiplex networks*
  Starnini, M., Boguñá, M., & Serrano, M. Á.
  Scientific reports, 9(1), 1-10.
  https://doi.org/10.1038/s41598-019-49173-2

- *The value of the distant future: The process of discount in random environments*
  Masoliver, J.
  Estudios de economía aplicada, 37(2), 125-149.
  https://dialnet.unirioja.es/servlet/articulo?codigo=6963179

- *Universality of power-law exponents by means of maximum-likelihood estimation*
  Navas-Portella, V., González, Á., Serra, I., Vives, E., & Corral, Á.
  Physical Review E, 100(6), 062106.
  https://doi.org/10.1103/PhysRevE.100.062106

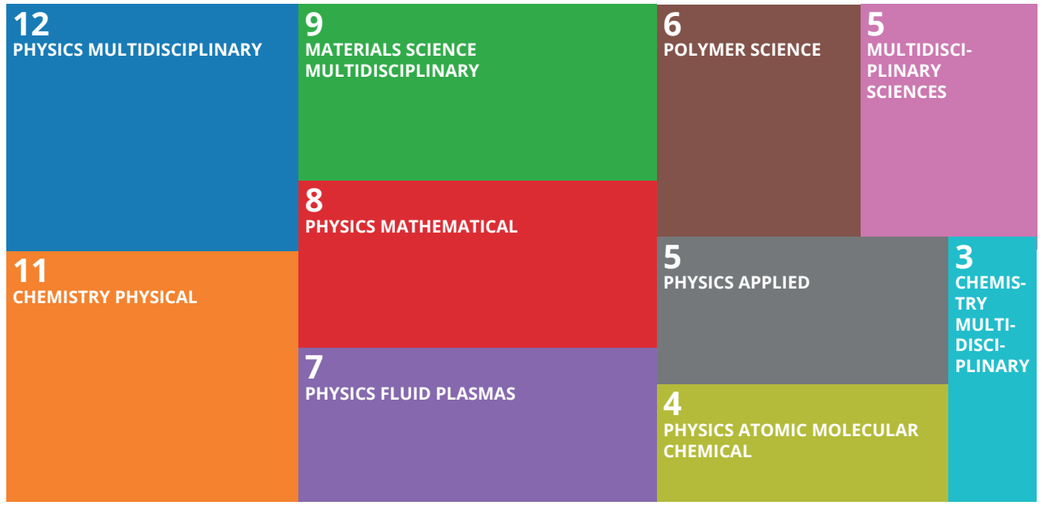
Research line : **SCIENCE OF MATTER**

- *2D melting and motility induced phase separation in active Brownian hard disks and dumbbells*
  Digregorio, P., Levis, D., Suma, A., Cugliandolo, L. F., Gonnella, G., & Pagonabarraga, I.
  Journal of Physics: Conference Series (Vol. 1163, No. 1, p. 012073).
  https://doi.org/10.1088/1742-6596/1163/1/012073

- *A polypropylene carbonate-based adaptive buffer layer for stable interfaces of solid polymer lithium metal batteries*
  Yang, H., Zhang, Y., Tennenbaum, M. J., Althouse, Z., Ma, Y., He, Y., ... & Huang, Y.
  ACS applied materials & interfaces, 11(31), 27906-27912
  https://doi.org/10.1021/acsami.9b08285

- *Active microrheology in corrugated channels*
  Puertas, A. M., Malgaretti, P., & Pagonabarraga, I.
  The Journal of chemical physics, 149(17), 174908.
  https://doi.org/10.1063/1.5048343

- *Activity induced synchronization: Mutual flocking and chiral self-sorting*
  Levis, D., Pagonabarraga, I., & Liebchen, B.
  Physical Review Research, 1(2), 023026.
  https://doi.org/10.1103/PhysRevResearch.1.023026



Publications in WoS according to "Web of Science categories"

- *Asymmetric and long range interactions in shaken granular media*
  Codina, J., & Pagonabarraga, I.
  The Journal of chemical physics, 151(16), 164903.
  https://doi.org/10.1063/1.5123304

- *Avalanche mixing and the simultaneous collapse of two media under uniaxial stress*
  Salje, E. K. H., Liu, H., Xiao, Y., Jin, L., Planes, A., Vives, E., Xie, K. & Jiang, X.
  Physical Review E 99, 023002
  https://doi.org/10.1103/PhysRevE.99.023002

- *Capillary-based microfluidics—coflow, flow-focusing, electro-coflow, drops, jets, and instabilities*
  Guerrero, J., Chang, Y. W., Fragkopoulos, A. A., & Fernandez-Nieves, A.
  Small, 1904344.
  https://doi.org/10.1002/smll.201904344

- *Change of crackling noise in granite by thermal damage: Monitoring nuclear waste deposits*
  Xie, K., Jiang, X., Jiang, D., Xiao, Y., Xen, S., Dahmen, K.A., Vives, E., Planes, A. & Salje, E.K.H.
  American Mineralogist 104, 1578
  https://doi.org/10.2138/am-2019-7058

- *Co-assembly of Janus nanoparticles in block copolymer systems*
  Diaz, J., Pinna, M., Zvelindovsky, A., & Pagonabarraga, I.
  Soft matter, 15(31), 6400-6410.
  https://doi.org/10.1039/C9SM01062A

- *Collective dynamics and conformal ordering in electrophoretically driven nematic colloids*
  Straube, A. V., Pagès, J. M., Tierno, P., Ignés-Mullol, J., & Sagués, F.
  Physical Review Research, 1(2), 022008.
  https://doi.org/10.1103/PhysRevResearch.1.022008

- *Colloquium: Ice rule and emergent frustration in particle ice and beyond*
  Ortiz-Ambriz, A., Nisoli, C., Reichhardt, C., Reichhardt, C. J., & Tierno, P.
  Reviews of Modern Physics, 91(4), 041003.
  https://doi.org/10.1103/RevModPhys.91.041003

- *Competing orders in colloidal kagome ice: Importance of the in-trap motion of the particles*
  Le Cunuder, A., Frérot, I., Ortiz-Ambriz, A., & Tierno, P.
  Physical Review B, 99(14), 140405.
  https://doi.org/10.1103/PhysRevB.99.140405

- *Confinement-controlled rectification in a geometric nanofluidic diode*
  Dal Cengio, S., & Pagonabarraga, I.
  The Journal of Chemical Physics, 151(4), 044707.
  https://doi.org/10.1063/1.5108723

- *Continuously sheared granular matter reproduces in detail seismicity laws*
  S. Lherminier, R. Planet, V. Levy dit Vehel, G. Simon, L. Vanel, K. J. Måløy, & O. Ramos
  Physical Review Letters, 122 (21), 218501
  https://doi.org/10.1103/PhysRevLett.122.218501

- *Criticality in failure under compression: Acoustic emission study of coal and charcoal with different microstructures*
  Xu, Y., Borrego, A. G., Planes, A., Ding, X., & Vives, E.
  Physical Review E, 99(3), 033001.
  https://doi.org/10.1103/PhysRevE.99.033001

- *Curved boundaries and chiral instabilities–two sources of twist in homeotropic nematic tori*
  McInerney, J. P., Ellis, P. W., Rocklin, D. Z., Fernandez-Nieves, A., & Matsumoto, E. A.
  Soft Matter, 15(6), 1210-1214.
  https://doi.org/10.1039/C8SM02055H

- *Direct measurement of lighthill's energetic efficiency of a minimal magnetic microswimmer*
  Calero, C., García-Torres, J., Ortiz-Ambriz, A., Sagués, F., Pagonabarraga, I., & Tierno, P.
  Nanoscale, 11(40), 18723-18729.
  https://doi.org/10.1039/C9NR05825G

- *Driving an electrolyte through a corrugated nanopore*
  Malgaretti, P., Janssen, M., Pagonabarraga, I., & Rubi, J. M.
  The Journal of Chemical Physics, 151(8), 084902.
  https://doi.org/10.1063/1.5110349

- *Emission modes in electro co-flow*
  Guerrero, J., Hijano, A.J., Lobato, M.A., Higuera, F.J., Loscertales, I.G., & Fernandez-Nieves, A.
  Physics of Fluids, 31(8), 082009
  https://doi.org/10.1063/1.5121714

- *Enhancing nanoparticle diffusion on a unidirectional domain wall magnetic ratchet*
  Stoop, R. L., Straube, A. V., & Tierno, P.
  Nano Letters, 19(1), 433-440.
  https://doi.org/10.1021/acs.nanolett.8b04248

- *Geometrical control of active turbulence in curved topographies*
  Pearce, D. J. G., Ellis, P. W., Fernandez-Nieves, A., & Giomi, L.
  Physical Review Letters, 122(16), 168002.
  https://doi.org/10.1103/PhysRevLett.122.168002

- *Guidance of active particles at liquid–liquid interfaces near surfaces*
  Palacios, L. S., Katuri, J., Pagonabarraga, I., & Sánchez, S.
  Soft Matter, 15(32), 6581-6588.
  https://doi.org/10.1039/C9SM01016E

- *Large scale three dimensional simulations of hybrid block copolymer/nanoparticle systems*
  Diaz, J., Pinna, M., Zvelindovsky, A. V., & Pagonabarraga, I.
  Soft Matter, 15(45), 9325-9335.
  https://doi.org/10.1039/C9SM01760G

- *Leap-frog transport of magnetically driven anisotropic colloidal rotors*
  Massana-Cid, H., Navarro-Argemí, E., Levis, D., Pagonabarraga, I., & Tierno, P.
  The Journal of Chemical Physics, 150(16), 164901.
  https://doi.org/10.1063/1.5086280

- *Linear response theory and Green-Kubo relations for active matter*
  Dal Cengio, S., Levis, D., & Pagonabarraga, I.
  Physical Review Letters, 123(23), 238003.
  https://doi.org/10.1103/PhysRevLett.123.238003

- *Microscale magneto-elastic composite swimmers at the air-water and water-solid interfaces under a uniaxial field*
  Bryan, M. T., Garcia-Torres, J., Martin, E. L., Hamilton, J. K., Calero, C., Petrov, P. G., & Ogrin, F. Y.
  Physical Review Applied, 11(4), 044019.
  https://doi.org/10.1103/PhysRevApplied.11.044019

- *Multifractal intermittency in granular flow through bottlenecks*
  Gella, D., Zuriguel, I., & Ortín, J.
  Physical Review Letters, 123(21), 218004.
  https://doi.org/10.1103/PhysRevLett.123.218004

- *Nonspherical nanoparticles in block copolymer composites: nanosquares, nanorods, and diamonds*
  Diaz, J., Pinna, M., Zvelindovsky, A. V., & Pagonabarraga, I.
  Macromolecules, 52(21), 8285-8294.
  https://doi.org/10.1021/acs.macromol.9b01754

- *Orientational order and morphology of clusters of self-assembled Janus swimmers*
  Alarcon, F., Navarro-Argemí, E., Valeriani, C., & Pagonabarraga, I.
  Physical Review E, 99(6), 062602.
  https://doi.org/10.1103/PhysRevE.99.062602

- *Phagocyte-inspired smart microcapsules*
  Nikolov, S., Fernandez-Nieves, A., & Alexeev, A.
  ACS Macro Letters, 8(4), 421-426.
  https://doi.org/10.1021/acsmacrolett.8b00992

- *Relations between stress drops and acoustic emission measured during mechanical loading*
  Zreihan, N., Faran, E., Vives, E., Planes, A. & Shilo, D.
  Physical Review Materials, 3, 043603
  https://doi.org/10.1103/PhysRevMaterials.3.043603

- *Scale-invariant avalanche dynamics in the temperature-driven martensitic transition of a Cu-Al-Be single crystal*
  Romero,F.J., Martín-Olalla, J.M., Gallardo,M.C., Soto-Parra, D., Salje, E.K.H., Vives, E. & Planes, A.
  Physical Review B, 99 (2), 334101
  https: //doi.org/10.1103/PhysRevB.99.224101

- *Selection mechanism at the onset of active turbulence*
  Martínez-Prat, B., Ignés-Mullol, J., Casademunt, J., & Sagués, F.
  Nature Physics, 15(4), 362-366.
  https://doi.org/10.1038/s41567-018-0411-6

- *Simulating optical polarizing microscopy textures using Jones calculus: a review exemplified with nematic liquid crystal tori*
  Ellis, P. W., Pairam, E., & Fernández-Nieves, A.
  Journal of Physics D: Applied Physics, 52(21), 213001.
  https://doi.org/10.1088/1361-6463/ab08a7

- *Simultaneous phase separation and pattern formation in chiral Active mixtures*
  Levis, D, & Liebchen, B
  Physical Review E, 100(1), 012406.
  https://doi.org/10.1103/PhysRevE.100.012406

- *Spontaneous deswelling of microgels controlled by counterion clouds*
  Gasser, U., Scotti, A., & Fernandez-Nieves, A.
  Physical Review E, 99(4), 042602.
  https://doi.org/10.1103/PhysRevE.99.042602

- *Swelling thermodynamics and phase transitions of polymer gels*
  Dimitriyev, M. S., Chang, Y. W., Goldbart, P. M., & Fernández-Nieves, A.
  Nano Futures, 3(4), 042001.
  https://doi.org/10.1088/2399-1984/ab45d5

- *Tunable self-healing of magnetically propelling colloidal carpets*
  Massana-Cid, H., Meng, F., Matsunaga, D., Golestanian, R., & Tierno, P.
  Nature Communications, 10, 2444.
  https://doi.org/10.1038/s41467-019-10255-4

Research line : **LIFE SCIENCES**

- *A brownian ratchet model explains the biased sidestepping of single-headed kinesin-3 KIF1A*
  Mitra, A., Suñé, M., Diez, S., Sancho, J. M., Oriola, D., & Casademunt, J.
  Biophysical Journal, 116(12), 2266-2274.
  https://doi.org/10.1016/j.bpj.2019.05.011

- *Active fingering instability in tissue spreading*
  Alert, R., Blanch-Mercader, C., & Casademunt, J.
  Physical Review Letters, 122(8), 088104.
  https://doi.org/10.1103/PhysRevLett.122.088104

- *Active wetting of epithelial tissues*
  Pérez-González, C. , Alert, R., Blanch-Mercader, C., Gómez-González, M., Kolodziej, T., Bazellieres, E., Casademunt, J. & Trepat, X.
  Nature Physics, 15(1), 79-88.
  https://doi.org/10.1038/s41567-018-0279-5

- *Adaptación transcultural y características de la versión española de la escala COMFORT Behavior Scale en el paciente crítico pediátrico*
  Bosch-Alcaraz, A., Jordan, I., Olmos, J. G., & Falcó-Pegueroles, A.
  Medicina Intensiva.
  https://doi.org/10.1016/j.medin.2019.07.001

- *Adenovirus major core protein condenses DNA in clusters and bundles, modulating genome release and capsid internal pressure*
  Martín-González, N., Hernando-Pérez, M., Condezo, G. N., Pérez-Illana, M., Šiber, A., Reguera, D., & de Pablo, P. J.
  Nucleic Acids Research, 47(17), 9231-9242.
  https://doi.org/10.1093/nar/gkz687

- *Age-related decrease in resting-state functional connectivity in older adults*
  Farras-Permanyer, L., Mancho-Fora, N., Montalà-Flaquer, M., Bartrés-Faz, D., Vaqué-Alcázar, L., Peró-Cebollero, M., & Guàrdia-Olmos, J.
  Neural Regeneration Research, 14(9), 1544.
  https://doi.org/10.4103/1673-5374.255976

- *Brassinosteroid signaling in plant development and adaptation to stress*
  Planas-Riverola, A., Gupta, A., Betegón-Putze, I., Bosch, N., Ibañes, M., & Caño-Delgado, A. I.
  Development, 146(5), dev151894
  https://doi.org/10.1242/dev.151894

- *Collective behavior of red blood cells in confined channels*
  Lázaro, G. R., Hernández-Machado, A., & Pagonabarraga, I.
  The European Physical Journal E, 42(4), 46.
  https://doi.org/10.1140/epje/i2019-11805-0

- *CRISPR/Cas9-mediated generation of a tyrosine hydroxylase reporter iPSC line for live imaging and isolation of dopaminergic neurons*
  Calatayud, C., Carola, G., Fernández-Carasa, I., Valtorta, M., Jiménez-Delgado, S., Díaz, M., ... & Consiglio, A.
  Scientific Reports, 9(1), 1-9.
  https://doi.org/10.1038/s41598-019-43080-2

- *Estimation of brain functional connectivity in patients with mild cognitive impairment*
  Farràs-Permanyer, L., Mancho-Fora, N., Montalà-Flaquer, M., Gudayol-Ferré, E., Gallardo-Moreno, G. B., Zarabozo-Hurtado, D., & Guàrdia-Olmos, J.
  Brain Sciences, 9(12), 350.
  https://doi.org/10.3390/brainsci9120350

- *Impact of targeted attack on the spontaneous activity in spatial and biologically-inspired neuronal networks*
  Faci-Lázaro, S., Soriano, J., & Gómez-Gardeñes, J.
  Chaos: An Interdisciplinary Journal of Nonlinear Science, 29(8), 083126.
  https://doi.org/10.1063/1.5099038@cha.2019.SYOPT2019.issue-1

- *Intermittency of deformation and the elastic limit of an icosahedral virus under compression*
  Hernando-Pérez, M., Zeng, C., Miguel, M. C., & Dragnea, B.
  ACS Nano, 13(7), 7842-7849.
  https://doi.org/10.1021/acsnano.9b02133

- *Kinetics of empty viral capsid assembly in a minimal model*
  Reguera, D., Hernández-Rojas, J., & Llorente, J. G.
  Soft Matter, 15(36), 7166-7172.
  https://doi.org/10.1039/C9SM01593K

- *Patient-specific iPSC-derived astrocytes contribute to non-cell-autonomous neurodegeneration in Parkinson's disease*
  di Domenico, A., Carola, G., Calatayud, C., Pons-Espinal, M., Muñoz, J. P., Richaud-Patin, Y., Fernandez-Carasa, I., Gut, M., Faella, A., Parameswaran, J., Soriano, J., Ferrer, I., Tolosa, E., Zorzano, A., Cuervo, A. M., Raya, A. & Consiglio, A.
  Stem Cell Reports, 12(2), 213-229.
  https://doi.org/10.1016/j.stemcr.2018.12.011

- *Role of substrate stiffness in tissue spreading: Wetting transition and tissue durotaxis*
  Alert, R., & Casademunt, J.
  Langmuir, 35(23), 7571-7577.
  https://doi.org/10.1021/acs.langmuir.8b02037

- *Spontaneous functional recovery after focal damage in neuronal cultures*
  Teller, S., Estévez-Priego, E., Granell, C., Tornero, D., Andilla, J., Olarte, O. E., ... & Soriano, J.
  eNeuro, 0254-19.2019
  https://doi.org/10.1523/ENEURO.0254-19.2019

- *Using an overlapping time interval strategy to study diagnostic instability in mild cognitive impairment subtypes*
  Facal, D., Guàrdia-Olmos, J., Pereiro, A. X., Lojo-Seoane, C., Peró, M., & Juncos-Rabadán, O.
  Brain Sciences, 9(9), 242.
  https://doi.org/10.3390/brainsci9090242

Research line : **SOCIAL SCIENCES**

- *A comparison of probabilistic reasoning in psychology undergraduates in Italy and Spain: Seeking cross-national evidence*
  Agus, M., Peró, M., Guàrdia Olmos, J., Pessa, E., Figus, R., & Penna, M. P.
  Eurasia Journal of Mathematics Science and Technology Education, 2019, vol. 15, num. 10, p. em1752.
  https://doi.org/10.29333/ejmste/106232

- *Arqueologia i col·leccionisme: Gabriel de Molina i els inicis de les excavacions a Empúries*
  Somoza, L. B., & Pujol, L. P.
  Biblio 3w: Revista Bibliográfica de Geografía y Ciencias Sociales, (1).
  http://hdl.handle.net/2445/148565

- *Brokers in a destination's knowledge networks*
  Sanz-Ibáñez, C., Lozano, S., & Clavé, S. A.
  Journal of destination marketing & management, 11, 120-129.
  https://doi.org/10.1016/j.jdmm.2019.01.001

- *Cognitive reserve and working memory in cognitive performance of adults with subjective cognitive complaints: longitudinal structural equation modelling*
  Lojo-Seoane, C., Facal, D., Guàrdia-Olmos, J., Pereiro, A. X., Campos-Magdaleno, M., Mallo, S. C., & Juncos-Rabadán, O.
  International Psychogeriatrics, 1-10.
  https://doi.org/10.1017/S1041610219001248

- *Development and initial validation of a theory of planned behaviour questionnaire to assess critical care nurses' intention to use physical restraints*
  Via-Clavero, G., Guàrdia-Olmos, J., Gallart-Vivé, E., Arias-Rivera, S., Castanera-Duro, A., & Delgado-Hito, P.
  Journal of Advanced Nursing, 75(9), 2036-2049.
  https://doi.org/10.1111/jan.14046

- ***DISCOver: DIStributional approach based on syntactic dependencies for discovering COnstructions***
  Martí, M. A., Taulé, M., Kovatchev, V., & Salamó, M.
  Corpus Linguistics and Linguistic Theory.
  https://doi.org/10.1515/cllt-2018-0028

- ***Dosage analysis of the 7q1123 Williams region identifies BAZ1B as a major human gene patterning the modern human face and underlying self-domestication***
  Zanella, M., Vitriolo, A., Andirko, A., Martins, P. T., Sturm, S., O'Rourke, T., ... & Germain, P. L.
  Science Advances, 5 (12), eaaw7908
  https://doi.org/10.1126/sciadv.aaw7908

- ***El català: llengua minoritària o llengua mitjana?***
  Bastardas-Boada, A.
  Apunts de sociolingüística i política lingüística (CUSC-UB)
  https://www.academia.edu/38916048/_El_catal%C3%A0_llengua_minorit%C3%A0ria_o_llengua_mitjana_El_catal%C3%A1n_lengua_minoritaria_o_lengua_mediana_Catalan_Minority_language_or_medium-sized_language_

- ***El jardí com a font històrica: Mesopotàmia, Egipte, Grècia i Roma***
  Pons Pujol, LL.

- ***Ethical conflicts and their characteristics among critical care nurses***
  Lluch-Canut, T., Sequeira, C., Falcó-Pegueroles, A., Pinho, J. A., Rodrigues-Ferreira, A., Olmos, J. G., & Roldan-Merino, J.
  Nursing Ethics, 27(2), 537-553.
  https://doi.org/10.1177/0969733019857785

- ***Food storage among the iberians of the late iron age northwest mediterranean (ca 225-50 bc)***
  González Vázquez, M.
  Journal of Mediterranean Archaeology, 32 (2)
  https://doi.org/10.1558/jma.40578

- ***Formal modelling approaches to complexity science in Roman Studies: a manifesto***
  Brughmans, T., Hanson, J. W., Mandich, M. J., Romanowska, I., Rubio-Campillo, X., Carrignon, S., & Haas, T. D.
  Theoretical Roman Archaeology Journal 2, 1–19
  https://doi.org/10.16995/traj.367

- ***Gems in ancient Rome: Pliny's vision***
  González, J. P.
  Scripta Classica Israelica, 38, 139-151.
  https://scriptaclassica.org/index.php/sci/article/view/2053/1473

- ***Impact of supports and partnership on family quality of life***
  Balcells-Balcells, A., Giné, C., Guàrdia-Olmos, J., Summers, J. A., & Mas, J. M.
  Research in Developmental Disabilities, 85, 50-60.
  https://doi.org/10.1016/j.ridd.2018.10.006

- ***Impact of the intellectual disability severity in the Spanish Personal Outcomes Scale***
  Carbó-Carreté, M., Guàrdia-Olmos, J., Peró-Cebollero, M., & Giné, C.
  Journal of Intellectual Disability Research, 63(10), 1221-1233.
  https://doi.org/10.1111/jir.12634

- ***Interrater agreement on behavioral executive function measures in adolescents with Attention Deficit Hyperactivity Disorder***
  Krieger, V., Amador-Campos, J. A., & Peró-Cebollero, M.
  International Journal of Clinical and Health Psychology, 19(2), 141-149.
  https://doi.org/10.1016/j.ijchp.2019.02.007

- ***Language evolution and complexity considerations: The no half-Merge fallacy***
  Martins, P. T., & Boeckx, C.
  PLoS Biology, 17(11)
  https://doi.org/10.1371/journal.pbio.3000389

- ***Las causas del absentismo de los estudiantes de Derecho según su propia opinión***
  Rubinat, M. T., Acedo, B. R., Chueca, P. A., i Ivern, X. M. T., Olmos, J. G., Presas, P., & Yarza, I. M.
  Revista de educación y derecho. Education and law review, (19), 8.
  https://dialnet.unirioja.es/servlet/articulo?codigo=6945493#

- ***Lithic refits as a tool to reinforce postdepositional analysis***
  López-Ortega, E., Rodríguez-Álvarez, X. P., Ollé, A., & Lozano, S.
  Archaeological and Anthropological Sciences, 11(9), 4555-4568.
  https://doi.org/10.1007/s12520-019-00808-5

- ***Los negocios de Caius Iuventius Albinus en la Bética***
  Remesal Rodríguez, J., & Díaz, J. M.
  Journal of Roman Archaeology, 32, 224-249.
  https://doi.org/10.1017/S1047759419000138

- ***Mapping individual behavior in financial markets: synchronization and anticipation***
  Gutiérrez-Roig, M., Borge-Holthoefer, J., Arenas, A., & Perelló, J.
  EPJ Data Science, 8(1), 10.
  https://doi.org/10.1140/epjds/s13688-019-0188-6

- ***Modelling terrestrial route networks to understand inter-polity interactions (southern Etruria, 950-500 BC)***
  Prignano, L., Morer, I., Fulminante, F., & Lozano, S.
  Journal of Archaeological Science, 105, 46-58.
  https://doi.org/10.1016/j.jas.2019.02.007

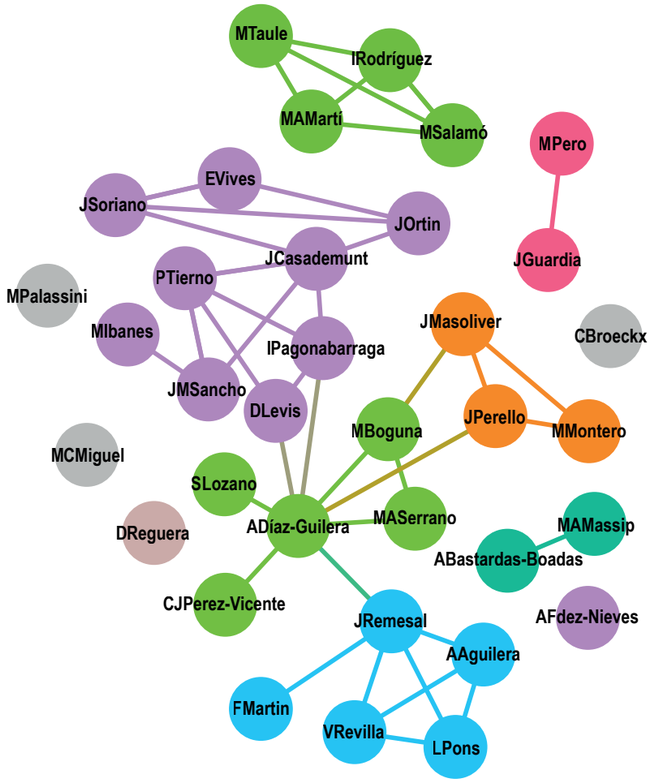
- ***Mujeres, género y estudios clásicos: un diálogo entre España y Brasil / Mulheres, Gênero e Estudos Clássicos: um diálogo entre Espanha e Brasil***
  García-Sánchez, M., & Garraffoni, R.S.
  Instrumenta, 66
  https://dialnet.unirioja.es/servlet/libro?codigo=739777

- ***Neurofunctional activation patterns reflect differences in cognitive control associated with spelling skills in Spanish***
  Martínez-Ramos, A., Gómez-Velázquez, F. R., Peró-Cebollero, M., González-Garrido, A. A., Guàrdia-Olmos, J., Gudayol-Ferré, E., & Gallardo-Moreno, G. B.
  Rev Mex Neuroci, 20(5), 214-221.
  http://www.revmexneurociencia.com/portadas/rmn_19_20_5.pdf#page=8

- ***Nuevas propuestas de datación de la epigrafía anfórica a través de la cronología de los asentamientos militares del limes renano-danubiano***
  Remesal-Rodríguez, J., Pons-Pujol, Ll., Pérez-González, J., & Bermúdez-Lorenzo, J. M.
  Espacio, tiempo y forma. Serie II, Historia antigua, 32, 173-214, (ISSN: 1130-1082)
  https://dialnet.unirioja.es/servlet/articulo?codigo=7136285

- ***Olive oil at the border of the Roman Empire stamps on baetican dressel 20 found on the Tyne-Solway Isthmus***
  Ayllón Martín, A., Pérez González, J., & Remesal Rodríguez, J.
  Marburger Beiträge zur antiken Handels-, Wirtschafts- und Sozialgeschichte, 36, 167-216 (ISSN 1864-1415)
  https://dialnet.unirioja.es/servlet/articulo?codigo=6900469

- ***On the relationship between subjective and objective measures of VR experiences: A case study of a serious game for museums international symposium on gamification and games for learning (GamiLearn 2019)***
  I. Rodríguez, A. Puig, J.A. Rodríguez-Aguilar, JL. Arcos, S. Cebrián, A. Bogdanovych, N. Morera, R. Piqué, & A. Palomo.
  CEUR-WS.org, 2497 (ISSN 1613-0073)
  https://www.semanticscholar.org/paper/On-the-Relationship-between-Subjective-and-measures-Rodr%C3%ADguez-Puig/8118010efab9cf718614b5ed494c6ac0893ce94a



- *Palaeodemographic modelling supports a population bottleneck during the Pleistocene-Holocene transition in Iberia*
  de Pablo, J. F. L., Gutiérrez-Roig, M., Gómez-Puche, M., McLaughlin, R., Silva, F., & Lozano, S.
  Nature Communications, 10(1), 1-13.
  https://doi.org/10.1038/s41467-019-09833-3

- *Politeia: los sistemas políticos griegos en la tradición y en la modernidad*
  Sancho, L., Fornis C., & García Sánchez, M.
  Gerión, 37 (2)
  https://revistas.ucm.es/index.php/GERI/issue/view/3525

- *¿Príncipes o tiranos?: La Ciropedia de Jenofonte, la monarquía aqueménida y los specula principum de la modernidad (siglo XVI)*
  Sánchez, M. G.
  Gerión, 37(2), 399-423.
  https://revistas.ucm.es/index.php/GERI/article/view/65980

- *Qualitative evaluation framework for paraphrase Identification*
  Kovatchev, V., Martí, M. A., Salamó, M. & Beltran, J.
  Proceedings of the 12th Recent Advances in Natural Language Processing conference.
  https://doi.org/10.26615/978-954-452-056-4_067

- *Reseña de MELITTI, Khaled, Carthage Histoire d'une métropole méditerranéenne*
  Pons, L.
  Índice histórico español, 549 (ISSN: 0537-3522, Paris: Perin, 2016)
  http://revistes.ub.edu/index.php/IHE/article/view/29027/29463

- *Sobre un esgrafiado cononomástica ibérica del Tossal de Cal Montblanc (Albesa, Lleida)*
  Revilla Calvo, V., & Velaza Frías, J.
  Palaeohispanica. Revista Sobre Lenguas Y Culturas De La Hispania Antigua, (19), 189-195
  https://doi.org/10.36707/palaeohispanica.v0i19.206

- *Spanish and Catalan polarity detection in student satisfaction surveys*
  Ikauniece, I., Kovatchev, V., & Puertas, E.
  Proceedings of the 21st International Conference of the Catalan Association for Artificial Intelligence, 319 (397). IOS Press.

- *The acquisition of aspect in Spanish by Chinese learners*
  Sun, Y., Gonzalez, P., Parafita Couto, M. D. C., Mauder, E., Child, M. W., Diaz, L., & Taule, M.
  Revista Círculo de Lingüística Aplicada a la Comunicación (CLAC), Ediciones Complutense, 78, 287-315, (ISSN-1576-4737).
  http://dx.doi.org/10.5209/CLAC.64382

- *The Animal Cancer Cachexia Score (ACASCO)*
  Betancourt, A., Busquets, S., Ponce, M., Toledo, M., Guàrdia-Olmos, J., Peró-Cebollero, M., & Argilés, J. M.
  Animal models and experimental medicine, 2(3), 201-209.
  https://doi.org/10.1002/ame2.12082

- *The economy of laetanian wine: A conceptual framework to analyse an intensive/specialized winegrowing production system and trade (first century BC to third century AD)*
  Martín Oliveras, A., & Revilla Calvo, V.
  In Finding the Limits of the Limes , 129-164, Springer, Cham.
  https://doi.org/10.1007/978-3-030-04576-0_8

- *TRAKADAS, Athena in mauretaniae maritimis marine resource exploitation in a Roman north african province Stuttgart: Franz Steiner Verlag*
  Pons, L.
  Indice histórico español, 10 (ISSN 0537-3522)
  https://dialnet.unirioja.es/servlet/articulo?codigo=7124453

- *The development of dynamicity in the acquisition of Spanish by Chinese learners*
  Sun, Y., Díaz, L., & Taulé, M.
  ITL-International Journal of Applied Linguistics, 170(1), 80-111. John Benjamins Publishing (ISSN 0019-0829, E-ISSN 1783-1490, SJR: 0.856)
  https://doi.org/10.1075/itl.18001.sun

BOOKS

- *A comparative study of the acquisition of Spanish aspectual past tenses by Mandarin Chinese learners using guided and semi-guided written productions*
  Sun, Y., Díaz, L., & Taulé, M.
  Language and Communication: Strategies and analyses in multilingual and international contexts. Newcastle: Cambridge Scholars Publishing.
  https://www.cambridgescholars.com/Strategies-and-analyses-of-language-and-communication-in-multilingual-and-international-contexts

- *Bibliographie Analityque de l'Afrique Antique XLVII (2013)*
  Briand-Ponsart, C., Coltelloni-Trannoy, M., Guédon, S., Pons Pujol, L., Rocca, E., & Villey, Th.
  École française de Rome
  ISBN: 978-2-7283-1386-0

- *Complexity applications in language and communication sciences*
  Massip-Bonet, A., Bel-Enguix, G., & Bastardas-Boada, A.
  Springer Nature
  ISBN: 978-3-030-04596-8

- *Clío es nombre de mujer*
  Sánchez, M. G.
  Mujeres, género y estudios clásicos: un diálogo entre España y Brasil, Publicacions i Edicions de la Universitat de Barcelona.
  ISBN: 978-84-9168-318-6 (11-14)

- *El programa musivario de la villa del Romeral (Albesa, Lleida): un proyecto integral de investigación y preservación*
  Marí, Ll., & Revilla, V.
  Neira Jiménez, L. (ed.)
  Mosaicos romanos en el espacio rural: Investigación y puesta en valor, L'Erma di Bretschneider
  ISBN: 9788891318909 (81-100)

- ***Famille, propriété et timbres amphoriques dans le droit grec ancien : le cas des fabricants rhodiens***
  García Sánchez, M.
  N. Badoud-A. Marangou (éds.)
  Analyse et exploitation des timbres amphoriques grecs, Rennes, Presses Universitaires de Rennes
  ISBN: 978-2-7535-7800-5 (211-216)

- ***Family multilingualism in medium-sized language communities***
  Bastardas-Boada, A., Boix-Fuster, E., & Torrens Guerrini, R. M.
  Bern: Peter Lang
  ISBN: 978-3-0343-2534-9

- ***La invención de la alteridad: griegos y persas***
  García Sánchez, M.
  F. Marco Simón; F. Pina Polo; J. Remesal Rodríguez (eds.)
  Xenofobia y racismo en el mundo antiguo, 65 Universitat de Barcelona.
  ISBN: 978-84-9168-207-3 (13-47)

- ***Las estrategias del artesanado rural romano. el repertorio del alfar del Vilarenc (Calafell, Tarragona) y su distribución***
  Revilla-Calvo, V.
  Joan Santacana Mestre. al savi professor, arqueòleg i museòleg, Publicacions i Edicions UB (205-214)

- ***Monte Testaccio. Un archivo único***
  Remesal-Rodríguez, J.
  Remesal, J., Revilla, V., Martín-Arroyo, D.J., Martín i Olievras, A. (eds.)
  Paisajes productivos y redes comerciales en el Imperio Romano / Productive Landscapes and Trade Networks in the Roman Empire. Instrumenta, Publicacions i Edicions UB
  ISBN: 978-84-9168-263-9 (11-28)

- ***Prólogo***
  Remesal-Rodríguez, J.
  Remesal, J., Revilla, V., Martín-Arroyo, D.J., Martín i Olievras, A. (eds.)
  Paisajes productivos y redes comerciales en el Imperio Romano / Productive Landscapes and Trade Networks in the Roman Empire. Instrumenta, Publicacions i Edicions UB
  ISBN: 978-84-9168-263-9 (11-28)

- ***Que viva el que ama: sexualidad y género en la época de Augusto***
  Sánchez, M. G.
  In Mujeres, género y estudios clásicos: un diálogo entre España y Brasil (pp. 215-240). Publicacions i Edicions de la Universitat de Barcelona.
  ISBN: 978-84-9168-318-6 (215-240)

- ***Sabidurías no tan bárbaras: aqueménidas, arsácidas y sasánidas***
  García-Sánchez, M.
  G. Cruz Andreotti (ed.)
  Tras los pasos de Momigliano. Centralidad y alteridad en el mundo greco-romano. Edicions Bellaterra.
  ISBN: 978-84-7290-945-8 (87-108)

- ***Simulando el aprendizaje: modelización basada en agentes para comprender la producción anfórica en el Imperio***
  Coto-Sarmiento, M., Carrignon, S., Rubio-Campillo, X., & Remesal-Rodríguez, J.
  Remesal, J., Revilla, V., Martín-Arroyo, D.J., Martín i Olievras, A. (Eds.) Paisajes productivos y redes comerciales en el Imperio Romano / Productive Landscapes and Trade Networks in the Roman Empire. Instrumenta, Publicacions i Edicions UB
  ISBN: 978-84-9168-263-9, (201-214)

- ***The economy of laetanian wine: A conceptual framework to analyse an intensive/specialized winegrowing production system and trade (first century BC to third century AD)***
  Martín Oliveras, A., & Revilla Calvo, V.
  Philip Verhagen, Jamie Joyce Mark, R. Groenhuijzen (eds.), Finding the Limits of the Limes Modelling Demography, Economy and Transport on the Edge of the Roman Empire, Springer Nature
  ISBN: 978-3-030-04 (129-164)

- ***The economy of roman wine: A proposal for analyse an intensive wine production system and trade. Case study research: Regio Laeetana (Hispania Citerior Tarraconensis) from 1st century BC to 3rd century AD***
  Martín-Oliveras, A., Revilla-Calvo, V., & Remesal-Rodríguez, J.
  J. Remesal Rodríguez, V. Revilla Calvo, D. J. Martín-Arroyo Sánchez, A. Martín Oliveras (eds.), Paisajes productivos y redes comerciales en el imperio romano. Productive landscapes and trade networks in the Roman, Publicacions i Edicions UB
  ISBN: 978-84-9168-263-9 (41-72)

- ***Xenofobia y racismo en el mundo antiguo***
  Marco-Simón, F., Pina-Polo, F., & Remesal-Rodríguez, J.
  Remesal Rodríguez, J. (Ed.) Xenofobia y Racismo en el Mundo Antiguo. Instrumenta 64. Barcelona, vol. 64, Universitat de Barcelona
  ISBN: 978-84-9168-207-3

7

PHD THESES

7 PHD THESES

- *Análisis epigráfico de los sellos olearios en centros de producción: en caso de la zona productora de la Scalensia*
  Author: Juan Moros Díaz
  Director: Remesal Rodríguez, J., & Aguilera Martín, A.

- *Food Storage among the Iberians of the Iron Age North-West Mediterranean*
  Author: Mateo González Vázquez
  Director: Remesal-Rodríguez, J., & Revilla-Calvo, V.

- *Dynamics and Effective Connectivity in Bi- and Three-dimensional Neuronal Cultures: from Self-organization to Engineering*
  Author: Estefanía Estévez Priego
  Director: Soriano, J., & Tornero, D.

- *Out-of-equilibrium dynamics in driven and active magnetic colloids*
  Author: Helena Massana-Cid
  Director: Tierno, P.

- *Mechanics of fire ant aggregations: An experimental study of active matter*
  Author: Tennenbaum, M. J.
  Director: Fernandez-Nieves, A.

8

UBICS ACTIVITIES

8 UBICS ACTIVITIES

UBICS Seminars

- **Long-range interactions in discrete complex systems, d-path Laplace operators and superdiffusion**

Speaker: **Prof. Ernesto Estrada**
Institute of Applied Mathematics, Universidad de Zaragoza
Room 3.20. Departament Física de la Matèria Condensada, Facultat de Física, Universitat de Barcelona | 07.03.2019 | 12:00 h

I will motivate the problem of studying long-range interactions in discrete complex systems, illustrated by some experimental results on the diffusion of adatoms and admolecules on metallic surfaces. I will speculate about other discrete complex systems where such effects can also be observed. Then, I will introduce the d-path Laplacian operators as a natural way to model such systems. I will prove some analytical results about the boundedness and self-adjointness of these operators. Then, I will introduce a generalization of the diffusion equation that takes into account such long-range effects. I will prove that under certain specific transformations of the d-path Laplacians we can reproduce the superdiffusive behaviour observed experimentally. I will clarify the differences between this model and the "random walks with Levy flights" as well as with the use of fractional calculus. I will give some snapshots of extensions to synchronization, epidemic spreading studies and nonlinear diffusion models.
Finally, I will introduce the concept of "metaplexes" in which we combine the internal structure of nodes, modelled as a continuous or discrete space, coupled with the discrete structure of inter-nodal connections. I will show some results about how the internal structure of nodes influences the global dynamics of a metaplex and some potential areas for extension.

- **Machine learning for complex systems**

Speaker: **Prof. G. P. Tsironis**
Department of Physics, University of Crete, Greece
Room Eduard Fonserè, Facultat de Física, Universitat de Barcelona
02.05.2019 | 12:00h

Chimeras and branching are two archetypical complex phenomena that appear in many physical systems; because of their different intrinsic dynamics, they delineate opposite non-trivial limits in the complexity of wave motion and present severe challenges in predicting chaotic and singular behaviour in extended physical systems. We report on the long-term forecasting capability of Long Short-Term Memory (LSTM) and reservoir computing (RC) recurrent neural networks, when they are applied to the spatiotemporal evolution of turbulent chimeras in simulated arrays of coupled superconducting quantum interference devices (SQUIDs) or lasers, and branching in the electronic flow of two-dimensional graphene with random potential. We propose a new method in which we assign one LSTM network to each system node except for "observer" nodes which provide continual "ground truth" measurements as input; we refer to this method as "Observer LSTM" (OLSTM). We demonstrate that even a small number of observers greatly improves the data-driven (model-free) long-term forecasting capability of the LSTM networks and provide the framework for a consistent comparison between the RC and LSTM methods. We find that RC requires smaller training datasets than OLSTMs, but the latter require fewer observers. Both methods are benchmarked against Feed-Forward neural networks (FNNs), also trained to make predictions with observers (OFNNs). Extensions of this method are applied in other dynamical systems.

- **Elastic Properties of Confined Fluids Probed by Ultrasound and by Molecular Simulations**

Speaker: **Prof. Gennady Gor** (New Jersey Institute of Technology)
Room 3.20, Dept. Física de la Matèria Condensada, Facultat de Física, Universitat de Barcelona | 03.05.2019 | 12:00

Almost 25 years ago measurements of ultrasonic wave propagation during adsorption and desorption of n-hexane in nanoporous Vycor glass were reported [1]. Similar experiments were performed recently with liquid argon [2], which stimulated molecular simulation studies of the properties probed in those experiments. Ultrasonic measurements provide information on the elastic moduli (shear and longitudinal) of the porous sample at various filling fractions. When pores are filled with liquid-like condensate, the Gassmann equation should relate the experimentally measured longitudinal modulus of the sample to the moduli of porous solid and compressibility of the fluid [3]. However, the experimental data for Vycor glass filled with both argon and hexane showed mismatch with the Gassmann equation predictions [4]. Our molecular simulations explained this mismatch, showing that liquids in confinement are stiffer than in the bulk phase at the same conditions [5, 6, 7]. Once this effect is taken into account, the Gassmann equation becomes valid [4]. In addition to that, our molecular simulations showed two fundamental regularities: (1) modulus of a confined fluid is a linear function of the solvation pressure in the fluid; (2) modulus of the fluid is a linear function of the reciprocal pore size. Overall, our results suggest that when considering elastic properties of fluids in nanopores, the confinement effects have to be taken into account.

- **Hyperuniformity of quasicrystals and related structures**

Speaker: **Prof. Erdal Oguz** (University of Tel Aviv)
Room Eduard Fontsere, Facultat de Física, Universitat de Barcelona
09.05.2019 | 12:00 h

Density fluctuations in many-body systems are of fundamental importance throughout various scientific disciplines. Hyperuniform systems, which include crystals and quasicrystals, have density fluctuations that are anomalously suppressed at long wavelengths compared to the fluctuations in typical disordered point distributions such as in ideal gases and liquids. Such systems are characterized by a local number variance associated with points within a spherical observation window of radius R that grows more slowly than the window volume in the large-R limit. In this talk, we will provide the first rigorous hyperuniformity analysis of quasicrystals obtained by cut-and-projection method and related points sets derived from substitution tilings. Most importantly, we reveal that one-dimensional quasicrystals produced by projection from a two-dimensional lattice fall into two distinct classes determined by the width of the projection window. The number variance is either uniformly bounded in the one class for large R, or it scales logarithmically in R in the other class. This distinction provides a new classification of one-dimensional quasicrystalline systems and, as we show, the two classes exhibit distinct physical properties. Our analysis further suggests that measures of hyperuniformity may define new classes of quasicrystals in higher dimensions as well.

- **Matter, Life, and Society: An Overview in Complex Systems Perspectives**

  Speaker: **Prof. MooYoung Choi** (Department of Physics and Astronomy, Seoul National University)

  Room 3.20, Dept. Física de la Matèria Condensada, Facultat de Física, Universitat de Barcelona | 25.11.2019 | 12:00h

Every object we experience with our sensory organs is a many-particle system consisting of a large number of elements interacting with each other, and the collective behavior of the whole system emerges via cooperative phenomena due to the interactions. In nature, many-particle systems often exhibit so-called complexity at the boundary between order and disorder, and tend to have self-organized structure under the influence of the environment. From this viewpoint of the complex system, not only traditional matter but also life and society are complex systems composed of many elements; life or social phenomena can be interpreted as the collective properties emerging from the interactions between elements. In this overview, we will briefly examine the physical meaning of complex systems and introduce some studies of matter, life, and society in the complex systems perspectives. Instances include glucose regulation, neural networks, urban morphology and transportation networks.

- **Physics of active matter: A personal overview**

  Speaker: **Prof. Hugues Chaté** (CEA-Saclay & Beijing CSRC, PRL Editoral Board)

  Room Eduard Fontserè, Facultat de Física, Universitat de Barcelona
  03.12.2019 | 12:00

Active matter consists of elementary units producing mechanical work to move themselves or to displace other objects. In other words, active matter is about systems maintained out-of-equilibrium "in the bulk", burning energy to produce directed, persistent motion. This very general definition covers all kinds of situations at all scales: groups of animal or robots, collective of cells and micro-organisms, active colloids and phoretic swimmers, mixtures of biofilaments and motor proteins. Most active matter systems exhibit surprising if not spectacular emerging collective properties that we are only starting to understand. In this talk, I will strive to give a synthetic and organized overview of what is still a fast-growing field. This overview will however be rather personal, drawing mostly from my own work. A large part if the talk will be devoted to presenting experimental results obtained mostly on living active matter, which should be of interest to biologists.

- **DATAPOLITIK2019**

UBICS collaborated in the DataPolitik2019 seminar together with IN3/UOC , UPF and LID. This event was organized by Heurística and Tecnopolítica on November 28 and 29 2019. DataPolitik2019 1st day on politics and communication in the era of big data was an invitation to interdisciplinary dialogue and the sharing of methodological perspectives, socio-political visions, concrete results and lines of research on how digital environments have changed the structure of communication and the grammars of social interaction.
The issues that, among others, were addressed in this event were: the fake news and its political effects; the polarization of media space; the assumptions of viralization, platform designs and their influence on social behavior and social action; post-truth, cultural wars and their impact on the network society; big data and political communication and the rise of data capitalism and datacracy and the crisis of democracy.

More info: https://lid.decidim.barcelona/conferences/DataPolitik?locale

UBICS Activities

- **UBICS Day 2019**

On June 18th 2019, UBICS celebrated its annual meeting at Aula Magna Enric Casassas at the Physics Faculty. The event was composed of four plenary talks given by two members of our Scientific Advisory Board (Alessandro Vespignani and Dave Byrne) and two excellent researchers (Luca Giomi and Patricia Bassereau).

Abstracts of the talks can be downloaded here:
https://drive.google.com/file/d/1Il2kXsV-UvdMOKLnUcCrSU7zvhx-Uli3/view

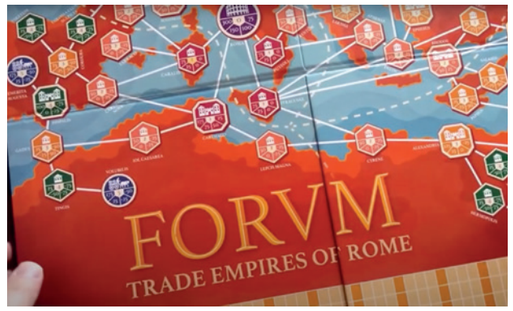
Around 100 people attended the event, which highlights the high interest of the scientific community on Complex Systems and its research frontlines.

- **UBICS boardgame afternoon**

On January 25 2019, the first *UBICS boardgame afternoon* was organized at room 3.20 of the Physics Department at UB. Assistants played 'FORVM: Trade Empires of Rome', a very attractive game that combines network science and Roman history. It was designed by Tom Brughmans (UBICS member), Iza Romanowska and Shawn Graham as an academic outreach activity for their archaeological research that draws heavily on network science.

The creators of the game gave a very short presentation of the academic agenda of the game. After that, some UBICS members played the game in groups of four and the winner received a free copy of the game, courtesy of UBICS!

Find out more information about the game here: www.forvm.ca
Check out our teaser video: www.youtube.com/watch?v=sjcddKhP1UA
And the unboxing video: www.youtube.com/watch?v=x3B1mOIJxDY



- **V Festa de la ciència**

On May 17th 2019, four research groups of UBICS participated in the *"V Festa de la Ciència"* at l'Edifici Històric of UB.
This event takes place every year and its main objective is to present the research that is carried out at UB, and in an innovative and amusing way.

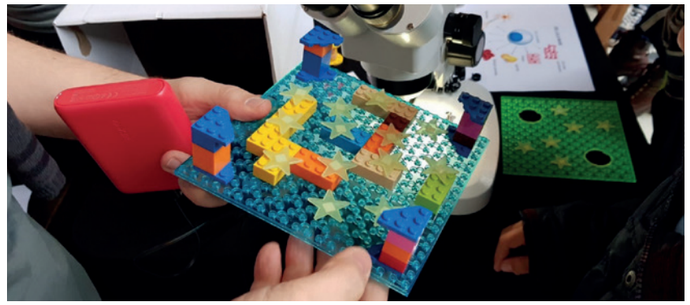
The group of History presented amphora traces. The Institute of Physical Education (INEFC) group created a game for students called SUMA (https://suma.edu.mk). The Neuroscience Group presented neuronal cultures using Lego bricks and fluorescent stars. Finally, Irene Ferri, our UBICS web developer, showed different applets that explain attractive Complex System models.

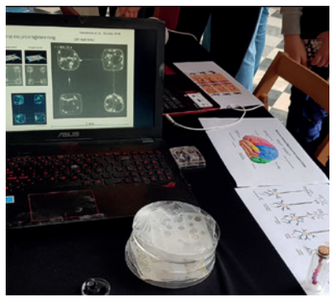
You can see them here:
http://ubics.ub.edu/complexifica/index.html

Our detailed program called **"Descobrint els sistemes complexos"** was the following one:

Europe, amphora land
Here we showed how economics and social classical history can be reconstructed from ancient Roman amphorae. We also presented some results from the EPNet project. In this project historians, mathematicians, physicists and ITs have worked together in order to prove hypothesis, to investigate ancient Roman social relations and to quantifiy food spread networks.

Neuronal Cultures
We explained why neuronal cultures are an interesting tool for physicists and biologists to understand normal and diseased brain functioning. We also described some engineering basic tools used to mimic the brain structure in a micrometric scale.





Transdisciplinary Learning Platform Presentation in order to develop an integrated scientific approach to students
We presented the SUMA website (Synthetic Understanding via Movement Analogies: http://suma.edu.mk/). We also performed different activities using the body for the students to experience general principles that are present in biological, physical and chemical systems. Later, we helped students to link these principles to different physical scales, from atoms to galaxies.

Networks for everybody
Our society is everyday more and more connected, and this connectedness has to be known to understand and to improve the world where we live. Networks are everywhere and everyone can learn their secrets. We introduced to students some related tools that will facilitate their learning and understanding of networks.

More information: http://www.ub.edu/laubdivulga/festacienciaub/

• XIII Fira d'empreses

Barcelona, Facultat de Física 10.04.2019

On April 10th 2019, UBICS participated in the XIV Fira d'Empreses with its own stand. This event was organized by the following faculties: Física, Química, Matemàtiques i Informàtica, Ciències de la Terra i Biologia.

The event took place at Física i Química building. This fair represented a favorable opportunity for the students to get in contact with private business sectors and with research institutes related to their studies. We presented a new poster of UBICS describing its 4 research lines. Many students came to request information, which shows the increasing interest that Complex Systems science has.

More information: www.ub.edu/fisica/firaempreses

• International Day of Women and Girls in Science

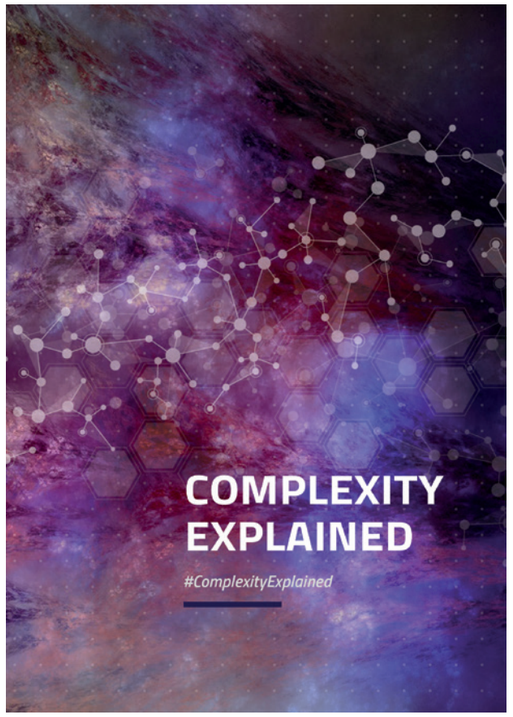
On February 11th 2019, the International Day of Women and Girls in Science, the Institute organized a short open event called "Pursuing a scientific career in Complexity". This event aimed at promoting the scientific career in the field of Complexity in young female degree students by exemplifying the scientific career of women scientists and by discussing gender topics involved in academia. The event was presented by Sònia Estradé (from the Comissió Igualtat de Física) and Albert Díaz-Guilera (UBICS's director) and was divided in two parts. The first part was a presentation given by Marta Ibañes (UBICS member) about the different stages of the scientific career, which were illustrated in the context of Complexity research areas by presenting the trajectory of several women researchers at UBICS: professors M. Angels Massip Bonet, M. Carmen Miguel and M. Angeles Serrano, and students Estefanía Estévez, Elisenda Ortiz, Roser Andreu and Stefanie Sturm. The second part was an open discussion leaded by all these UBICS women researchers, who proposed a list of topics to discuss, and which aimed at hearing and answering to the audience concerns.

UBICS Outreach

• Complexity Explained

#ComplexityExplained is a great initiative coordinated by Manlio De Domenico and Hiroki Sayama where you can find perfectly well explained everything that you should know about Complexity Science.

You can see this enlightening project in this website complexityexplained.github.io where you can play with interactive "explorables" applets made by Dirk Brockman or you also can download a free booklet designed by Serafina Agnello. This contribution has been written as a result of a worldwide collaborative effort from leading experts, practitioners and students in the field. In addition, it has been translated to twelve different languages. In particular, UBICS collaborated with the Catalan translation of the booklet titled "Explicant la complexitat" that you can download in our website here ubics.ub.edu/divulgacio.php



• Complexifica Project

In our website ubics.ub.edu/divulgacio.php you can find other interesting resources to better understand the Complex Systems science. One of our more innovative resources is what we have called "Complexifica" http://ubics.ub.edu/complexifica/index.html. During all this year our web developer Irene Ferri has been creating illustrative videos and interactive applets in order to better understand different representative physical models (as the Ising model) and other complex systems models (as the Shelling model). This initiative has been launched to support the increasing number of students that want to know more about the Complex Systems field. In addition, you can find in every model a final quiz, written by our research manager Sara Teller, to guarantee a better learning for the students.

9

ACTIVITIES OF UBICS MEMBERS

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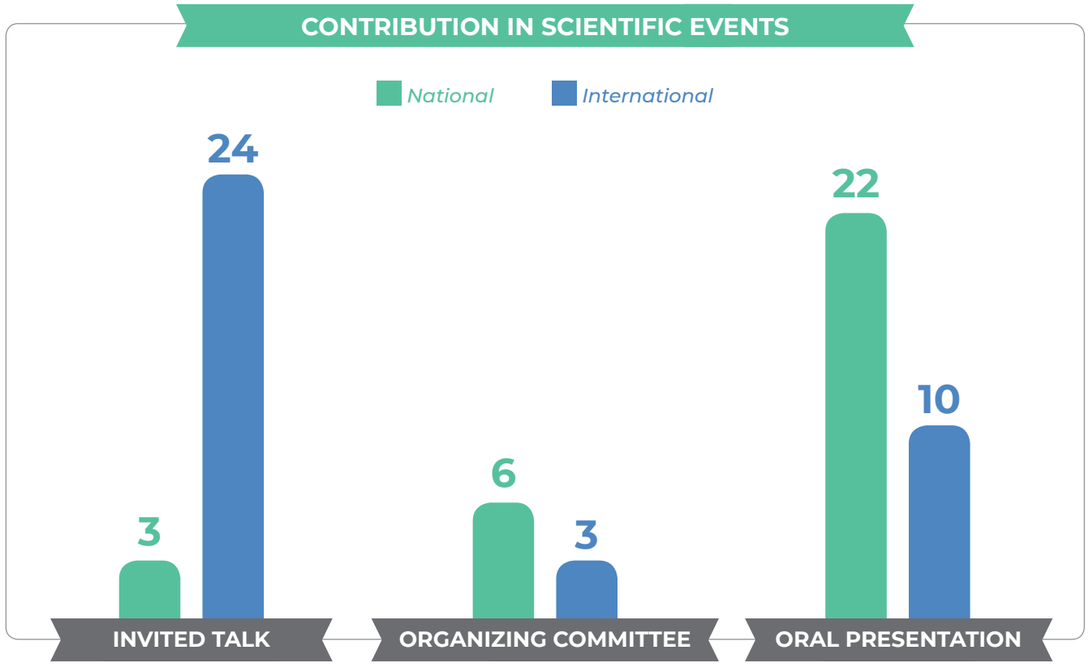

- **Market(s) -Market building -Market square's. Investigating the Economies of Ancient World**
  Kassel (GERMANY)
  Remesal Rodríguez, J.
  Amphoren und der Oelmarkt in Rom

- **Emergent dynamics and self-assembly of out-of-equilibrium colloids**
  Laussane (SWITZERLAND)
  Tierno, P.
  Emergent behaviour in active colloidal systems

- **Transport Phenomena in Complex Environment**
  Erice (ITALY)
  Stoop, R.; Tierno, P.
  Clogging and Jamming of colloidal monolayers driven across disordered landscape

- **XXVI Sitges Conference on Statistical Mechanics**
  Sitges (SPAIN)
  Ortiz-Ambriz, A.; Tierno, P.
  Colloidal spin ice system

- **7th RIEC International Symposium on Brain Functions and Brain Computer**
  Sendai (JAPAN)
  Soriano, J.
  Three-dimensional neuronal cultures: challenges and opportunities

- **4th workshop on Advanced Methods in Theoretical Neuroscience**
  Göttingen (GERMANY)
  Soriano, J.
  Engineering neuronal cultures: shaping brain complexity in a dish

- **LANET2019: Latin American Conference on Complex Networks**
  Cartagena de las Indias (COLOMBIA).
  Soriano, J.; Estévez, E.; Ludl, A.
  Effective Connectivity in Neuronal Cultures: from Physics to Engineering and Medicine

- **XIV Jornada de Recerca, Dept. Física UPC**
  Barcelona (SPAIN)
  Serrano, M. A.
  A geometric approach to the renormalization of complex networks

- **Statistical Physics of Complex Systems**
  Stockholm (SWEDEN)
  Serrano, M. Ángeles
  Geometric renormalization unravels self-similarity of the multiscale human connectome

- **Critical and collective effects in graphs and networks CCEGN-IV**
  Les Houches (FRANCE)
  Serrano, M. A.
  Geometric renormalization unravels self-similarity of the multiscale human connectome

- **Complex networks 2019, The 8th International Conference on Complex Networks and their Applications**
  Lisbon (PORTUGAL)
  Serrano, M. A.
  Tutorial: Mapping networks in latent geometry: models and applications

- **APS March Meeting**
  Boston (USA)
  Serrano, M. A.
  Geometric renormalization of complex networks

- **Mediterranean School of Complex Networks**
  Salina (ITALY)
  Diaz-Guilera, A.
  Synchronization as a link between dynamics and spectral properties

- **Complexity Science and Past Complex Systems**
  Oxford (UNITED KINGDOM)
  Diaz-Guilera, A.
  A Complex Systems Perspective of the Human Past

- **Annual naXys Research Day 2019**
  Namur (BELGIUM)
  Diaz-Guilera, A.
  Universitat de Barcelona Institute of Complex Systems

- **PhysPlex 2019 (satèl·lit dins el congrés Conference on Complex Systems 2019)**
  Singapur (SINGAPUR)
  Diaz-Guilera, A.
  Nonlinear dynamics in multiplex networks

- **Emergent dynamics and self-assembly of out-of-equilibrium colloids**
  Lausane (SWITZERLAND)
  Pagonabarraga, I.
  Active materials: intrinsically out of equilibrium self-assembly

- **50th anniversary of CECAM**
  Orsay (FRANCE)
  Pagonabarraga, I.
  Looking back to the future: The move to Lausanne and the new CECAM structure

- **Emerging behaviour in active matter: computational challenges**
  Lincoln (UNITED KINGDOM)
  Pagonabarraga, I.
  Activity induced phase transitions: from MIPS to chiral self-sorting

- **28th International Conference on Discrete Simulation of Fluid Dynamics**
  Bangalore (INDIA)
  Pagonabarraga, I.
  Transport and instabilities in confined complex fluid flows

- **6th Continental Molecular Simulation Days**
  Hannover (GERMANY)
  Pagonabarraga, I.
  Emerging collective behavior in block-copolymer nanocomposites

- **WaterEurope: Multiscale simulations and coarse-grained models for water and aqueous systems**
  Lausanne (SWITZERLAND)
  Pagonabarraga, I.
  Collective response and emergent morphologies in microswimmer suspensions

- **Applications of Diffusiophoresis in Drying, Freezing and Flowing Colloidal Suspensions**
  Lausanne (SWITZERLAND)
  Pagonabarraga, I.
  Active diffusiophoresis: mechanisms controlling self-propulsion and collective response of chemically sensitive colloids

- **Workshop Complexity 72h,**
  Lucca (ITALY)
  Boguñá, M.
  Network Geometry. A geometric approach to complex networks

- **Workshop on higher-orders connectivity and correlations in complex systems. Complexity Science Hub Vienna**
  Vienna (AUSTRIA)
  Boguñá, M.
  Small worlds and clustering in spatial networks. A maximum entropy approach to geometric random graphs

- **IX GEFENOL Summer School on Statistical Physics of Complex Systems**
  Santader (SPAIN)
  Miguel, M.C.
  Statistical mechanics of topological defects (7 lectures, aprox. 10h)

- **Workshop "Fundamental Aspects of Statistical Mechanics and the Emergence of Thermodynamics in Non-Equilibrium Systems"**
  Bremen (GERMANY)
  Autors: Tierno, P.
  Títol: From integer and fractional plateaus to directional locking in colloidal ratchet currents

Institute of Complex Systems
UNIVERSITAT DE BARCELONA

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Institute of Complex Systems
UNIVERSITAT DE BARCELONA

Martí i Franquès, 1
08028 Barcelona
ubics@ub.edu | ubics.ub.edu | @UB_ICS

CAMPUSES

Mundet Campus
Passeig de la Vall d'Hebron, 171
08035 Barcelona

Barcelona Knowledge Campus
Baldiri Reixac, 2
08028 Barcelona

Humanities Campus
Gran Via de les Corts Catalanes, 585
08007 Barcelona