Symposium
“La Física en redes y sistemas dinámicos

PROGRAMME and NOTES

La Física en redes y sistemas dinámicos

Wednesday May 24

***9:30 Ceremonia Inaugural*, Profa. Cecilias noguez, Directora del IFUNAM**

10:00 Keynote speaker Kimmo K. Kaski, "Social Physics: Data-Driven Studies of Human Social Connectome"

11:00 Coffee

11:30 Alberto García Rodríguez , "On social Physics".

12:30 Lunch

15:00 Jan Snellman, "Modeling socio-economics during epidemics:: a simple approach"

16:00 Gerardo García Naumis, "Pattern formation in cloud fields and its importance for global warming"

17:00-18:00 Discussion

Thursday May 25

9:00 Keynote speaker Aurora Hernández Machado*, "Cells,hydrogels and vesicles in micro channels "

10:00 J. Roberto Romero Arias, "Topological transitions in interfaces"

10:30 Alberto Sánchez Luviano, "Highly viscoelastic films in the air-cyclodextrins-surfactant interface "

11:00 Coffee

11:30 Limei Zhang*, "Neuropeptides: how small protein molecules could influence our decision making?"

12:30 Lunch

15:00 Humberto Carrillo, "Mathematical models and physical analogs of nerve cells"

16:30 Matías Nuñez "Unlocking New Insights and Discoveries in Physics and Biology with Machine Learning"

17:00 Julia Tagüeña, "Sustainability as a complex system: research on ecotechnologies"

18:00-19:00 Discussion

20:00 Dinn

Friday May 26

9:00 Tzipe Govezensky, "Geographical propagation of epidemics"

10:00 Miguel Robles "Using networks in the study of wind dynamics at a regional scale"

10:30 Ricardo Arencibia "A multidimensional approach to dynamics of scientific organizations"

11:00 Coffee

11:30 Keynote speaker Cecilia Ventura "Non-conventional superconductors: describing the electronic properties of Fe- and Bi-based ones"

12:30 Lunch

15:00 José Luis Jiménez Andrade "Neural Networks methods to visualize multidimensional data evolution" .

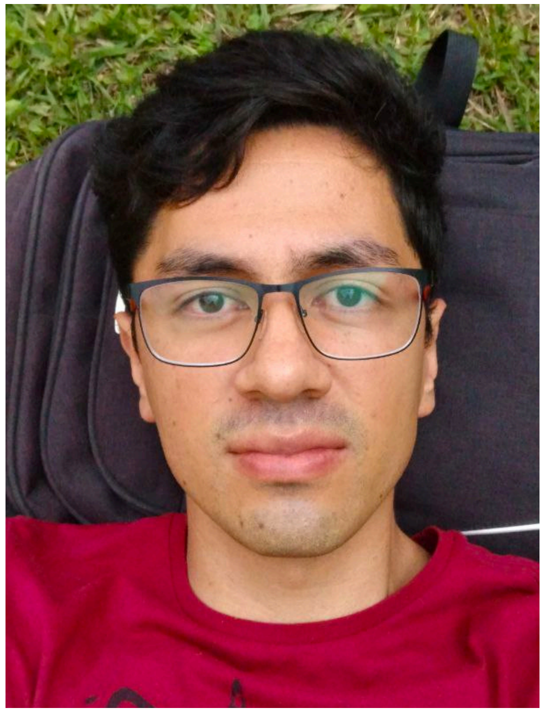
15:30 Nadia Barreiro, "Modeling the Covid 19 Pandemics".

16:00 Rafael Barrio*, "Closing Remarks"

Kimmo Kaski, DPhil (Oxford), is Professor of Computational Science at Helsinki University of Technology, now Aalto University School of Science and been Academy Professor and Director of the Centre of Excellence in Computational Complex Systems Research. He is Supernumerary Fellow of Wolfson College, Oxford University, External Faculty of Complexity Science Hub Vienna, Visiting Fellow of The Alan Turing Institute, UK and Fellows of APS, IOP, and members of Finnish Academy of Sciences and Letters (now President), Academia Europeae, and Academia Mexicana de Ciencas. His research interests are in Computational Science, Statistical Physics, Complexity Science, Complex Systems and Network, Social Physics, AI, and Medical Image Analytics with Deep Learning.

Social Physics: Data-Driven Studies of Human Social Connectome

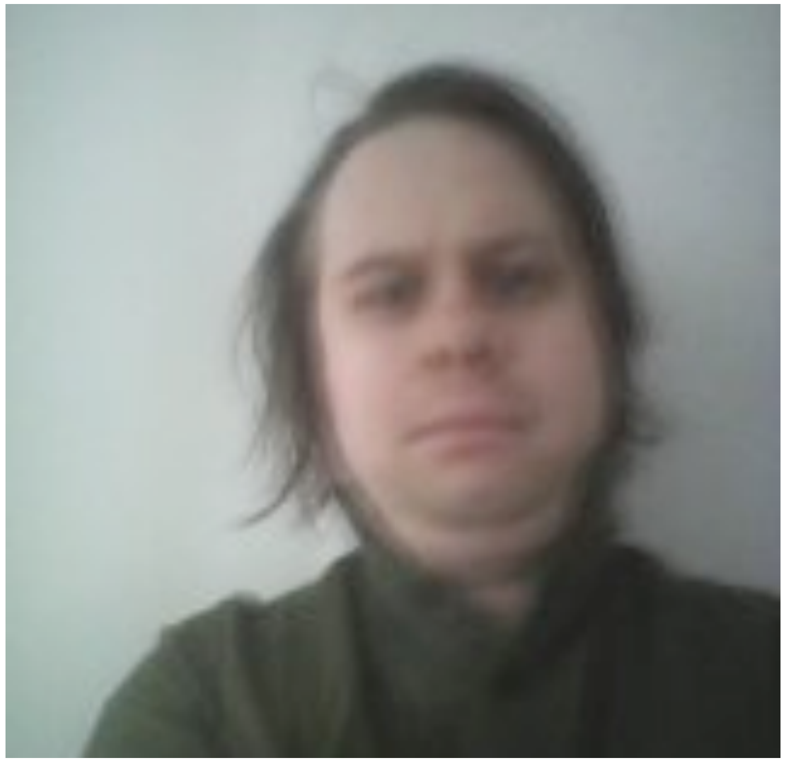
In recent years the modern Social Physics has focused on studying large-scale socially relevant datasets using data analysis and computational modelling and yielded unprecedented insight into human social network structures and processes therein. This is well-demonstrated by our analysis of a large mobile phone dataset finding the social networks having modular structure of communities with strong internal ties and weaker external ties. As this data includes the phone users’ demographics, i.e. gender and age, we have investigated the nature of human social interactions from the egocentric viewpoint and got a deeper insight into the gender and age-related social behaviour patterns and dynamics of human relationships, across their lifespan.



Alberto García Rodríguez, is an engineer in communications and electronics from ESIME Zacatenco, Instituto Politécnico Nacional (2017), he worked as a Network Operation Center Engineer, Versaria (2017,2019). He obtained his Masters degree in Computer Science IIMAS, Universidad Nacional Autónoma de México (2022), under the supervision of Rafael Barrio, Gerardo García Naumis and Carlos Gersherson, obtaining the diploma Juan Manuel Lozano del IFUNAM, and he is currently continuing his doctoratein computer sciences at UNAM.

On social Physics

Twitter is a popular social medium for sharing opinions and engaging in topical debates, yet presents a wide spread of misinformation, especially in political debates, from bots and adversarial attacks. Here, a language-agnostic method to detect real users and their interactions by leveraging network topology from co-events is presented.



Jan Snellman. Dr. Jan Snellman did his Master's (main field of study theoretical physics) and Ph. D at the University of Helsinki, and defended his thesis on second-order closure models in astrophysical hydrodynamics in February 2015. His postdoctoral research at Aalto University concerns the modelling of human societal behaviour using agent based methods.

Modeling socio-economics during epidemics:: a simple approach

The COVID-19 pandemic caused severe disruptions to the everyday life of many, if not most, people in some way or other. Not only were people initially wary of the new disease, the government authorities took tough measures to mitigate its spread, often locking down entire economies. As a result world economy was hit hard, which affected the public discourse: "is it worth shutting down the economy in order to protect public health?" emerged as one of key topics in the initial phase of the pandemic. It is natural to assume that the behavior of the population suffering from an epidemic would have a feedback effect on the spread of the epidemic itself, and that the attitudes of the population on public health, economy and authority would influence their actions. Intrigued by these interconnections, we set out to create a very simple model that could depict a population trying to mitigate a spreading epidemic according to their social values.

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Gerardo García Naumis Degree In Physics, Master in Science, and Phd. in Physics from the Universidad Nacional Autónoma de México.
Posdoctoralstay at the Laboratoire de Gravitation et Cosmologie Quantiques,Univ. de Paris VI, with Prof. Richard Kerner. I'm a physicist working at the Institute of Physics of the National University (UNAM) in Mexico city. The research made in my lab covers different fields: Electronic/Optical properties of 2D materials,topological insulators,glasses,quasicrystals, alloys, time-driven quantum systems, spin-crossover, etc. We also work in Statistical Physics and Complex Systems topics as: soft matter, fluids, proteins, granular media, econo and sociophysics, cloud pattern formation, global warming, hurricanes,

Pattern formation in cloud fields and its importance for global warming Cloud covering
has a dramatic impact on the scenario predictions due to global warming. In spite of this, cloud covering is usually not included in the global warming simulations and cloud patterns formation are not well understood. Here we present an approach based on finding phase diagrams of pattern formation. In particular, the time-dependent Ginzburg-Landau (or Allen-Cahn) equation and the Swift-Hohenberg equation, both added with a stochastic term, are proposed to describe cloud pattern formation and cloud regime phase transitions of shallow convective clouds organized in mesoscale systems. The starting point is the Hottovy-Stechmann linear spatiotemporal stochastic model for tropical precipitation, used to describe the dynamics of water vapor and tropical convection. By taking into account that shallow stratiform clouds are close to a self-organized criticality and that water vapor content is the order parameter, it is observed that sources must have nonlinear terms in the equation to include the dynamical feedback due to precipitation and evaporation. The nonlinear terms are derived by using the known mean field of the Ising model, as the Hottovy-Stechmann linear model presents the same probability distribution. The inclusion of this nonlinearity leads to a kind of time-dependent Ginzburg-Landau stochastic equation, originally used to describe superconductivity phases. By performing numerical simulations, pattern formation is observed. These patterns are better compared with real satellite observations than the pure linear model. This is done by comparing the spatial Fourier transform of real and numerical cloud fields. However, for highly ordered cellular convective phases, considered as a form of Rayleigh-Bénard convection in moist atmospheric air, the Ginzburg-Landau model does not allow us to reproduce such patterns. Therefore, a change in the form of the small-scale flux convergence term in the equation for moist atmospheric air is proposed. This allows us to derive a Swift-Hohenberg equation. In the case of closed cellular and roll convection, the resulting patterns are much more organized than the ones obtained from the Ginzburg-Landau equation and better reproduce satellite observations as, for example, horizontal convective fields.

Profesora Aurora Hernández-Machado

Full Professor (Catedrática) of Condensed Matter Physics in the Department Estructura i Constituents de la Matèria, Facultat de Física, Universitat de Barcelona, Spain. She obtained her first degree in Physics in 1982 and her Ph.D. at the University of Barcelona in 1985. She has written more than 100 research papers. She is head of the group Dynamics of interfaces in nanotechnology, fluidics and biophysics Her student Fèlix Campelo received the 2009 Award for Outstanding Doctoral Thesis Research in Biological Physics by the American Physical Soeciety (APS Physics), for the thesis Shapes in cells. Dynamic Instabilities, Morphology, and Curvature in Biological Membranes. Aurora Hernández-Machado says about one of her articles in Nature Materials: «The miniaturisation in liquids is important to improve the efficiency and optimise the use of substances, as pharmaceutics, cosmetics or ink, which would allow to lower the costs of production and control of these products. Furthermore, the physical model, which could be defined as a microfluidics dispenser of the different substances, allows, on one hand, to overcome the limitations associated to the present processes of formation of drops and, on the other hand, to reach nanometric scales».

Cells, hydrogels and vesicles in micro channels

Migration is a fundamental cellular behaviour that plays an essential role in vascular development and angiogenesis. Due to its relevance to many aspects of human health, the ability to accurately reproduce cell migration is of broad and multidisciplinary interest. We will present a model to reproduce microfluidic experiments in which endothelial cells chemotactically migrate into a fibrin-based porous hydrogel which mimics the extracellular matrix. Experimental results of malaria infected red blood cells in microchannels with endothelial slits and hydrogels with organ-on-a-chip will be discussed. We will also explore the process of vesicle formation and fission in endocytosis promoted by temperature. We will propose a mesoscopic model which includes Gaussian curvature to describe accurately the pinching process. A phase transition between fluctuating and vesiculation phases will be discussed.

J. Roberto Romero Arias

Prof. Romero-Arias studied Physics in the Faculty of Sciences at UNAM and obtained his PhD. at UNAM. He completed a postdoctoral research in the Institute of Mathematics in the UNAM and was commissioner in the CONACyT Chairs in the Institute of Physics and Mathematics of the Universidad Michoacana. Now, Prof. Romero-Arias is a researcher in the Department of Mathematics and Mechanics at the Institute for Research in Applied Mathematics and Systems at UNAM.

Prof. Romero-Arias is interested in developing common tools and languages between various scientific disciplines, such as physics, mathematics and biology, in order to create inter– and multidisciplinary bridges in these disciplines and strengthen common ideas to improve the interpretation of many complex systems. For this reason, Prof. Romero's research focuses on the study of elastic properties that occur at interfaces, the evolution of chronic degenerative diseases, cell differentiation processes, as well as the interaction of physical processes in the morphogenesis.

Topological transitions in interfaces

The origin of the shape and its conformational changes are crucial in many physical and biological processes. Therefore, studying the effects of the shape in different interfaces represents a growing interest in science and industry. In some systems, the description of the interface with surface tension and the bending modulus of a surface using curvature has been sufficient to understand many properties. However, there are interface effects that require the use of Gaussian curvature to understand structural changes. In this talk we will show a phase field model that uses curvature terms to describe membrane fission dynamics using Gaussian curvature and temperature.

Dr. Alberto Sánchez Luviano,

Estudié el doctorado en física en la Universidad Michoacana de San Nicolás de Hidalgo, en el estudios reológicos y termodinámicos bidimensionales de monocapas lipídicas, hice un posdoctorado en la universidad de Guanajuato campus León en el estudio de las interacciones entre micelas tubulares y ciclodextrinas por medio de reología y dinámicamolecular, actualmente estoy haciendo un posdoc en la Fac de Química, UNAM, dondeestudio las interacciones entre ciclodextrinas y tensoactivos en la intercara aire aguasoy SNI candidato.

Highly viscoelastic films at the air/water interface, cyclodextrins-surfactants and their interactions.

The mixture of surfactants of different polar nature with cyclodextrins (cyclic oligosaccharides) give rise to what are known as inclusion complexes, in which, thanks to the hollow truncated cone geometry of the cyclodextrin, hydrophobic molecules can be housed in its interior, modifying physicochemical properties of surfactants such as surface tension. The interaction of these inclusion complexes generate interfaces with high values of viscoelasticity under oscillatory stress, which in some cases can be observed in large molecules, such as proteins, that change their conformational shape to expose hydrophobic groups at the air/water interface. The formation of these complexes and their interaction at the air/water interface has been studied with various experimental techniques and a mathematical model involving dipole-dipole interactions has been developed, the latter capable of reproducing with high efficiency the viscoelastic and surface tension values.

Dr. Limei Zhang is a systems biologist, leading a multidisciplinary research team with medical physiologists, mathematical biologists and physicists. Her research is driven by hypotheses concerning how peptides within sensorimotor circuits affect performance of those circuits, that are tested via (1) modulation of local synthesis of presynaptic and postsynaptic proteins, (2) observation of modification of synapse structure and assembly during physiological events, and (3) circuit regulation through the application of agonists/antagonists in normal and peptide-deficient animals. To determine the spatial relationship between sites of action of peptides and non-peptide neurotransmitters, Dr. Zhang's team is examining the ultrastructure of presynaptic terminals of defined limbic peptidergic subpopulations in healthy rodents using cutting-edge expansion super-resolution microscopy and focused ion beam scanning electron microscopy (FIBSEM). Furthermore, using in vivo electrophysiology methods and mathematical modelling, Dr Zhang's group attempts to predict how alterations in peptide circuit performance affects brain regional oscillation coherence, phase-locking and behavioral switching.

Neuropeptides: how small protein molecules could influence our decision making?

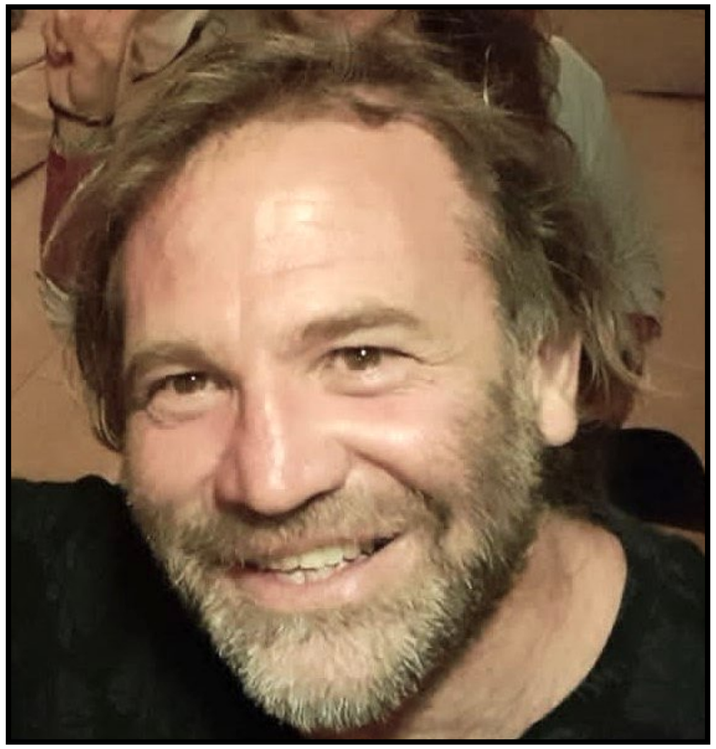
Hypothalamic vasopressin system is critical for regulation of water and salt balance by hormonal release of vasopressin from the pituitary (this is classically known). In this lecture, we´ll re- visit briefly the century-long saga of the establishment of vasopressin neurosecretory canonical concept that nervous tissue secreted something to the body that affected the water homeostasis of the organism. However, could the reciprocal paths also be true? That is, the homeostatic need sharps the brain's decision making machine and switch the animal from some stochastic movement to efficient, goal-direct behavior?

During the last decade, out group, based in the National Autonomous University of Mexico (UNAM), has made some seminal contributions on the pathways specifying the mode of the terminations of hypothalamic vasopressinergic neurons and their innervations of a key mnemonic center, the hippocampus. When we started this novel area of research, very little was known about where vasopressin immunopositive fibers were originated in the brain. We clarified the main origin of these vasopressin fibers as the hypothalamic paraventricular and supraoptic nuclei (Zhang and Hernandez, 2013). The success of clarifying the origin and specification of the above novel pathway prepared our group for further exploration of many brain areas within a clear conceptual framework. We discovered GABAergic neurons in the lateral habenula, their roles and connections to the brain's reward and value evaluation system (Zhang et al., 2016), which is now widely recognized. We discovered a close link between vasopressin and/or glutamate releasing terminals from the paraventricular nucleus and the novel GABAergic cells and a projection from the lateral habenula that gives rise innervation of the ventral tegmental area (Zhang et al., 2018). A fascinating additional observation is that the neuroarchitecture of vasopressinergic neurons is dramatically altered by stress as well as the sexual and sex-hormone status of rodents, in a way that can be rapidly reversed by hormone replacement therapy, and is controlled by a specialized group of cells that we coined the name 'GERN' or GABAergic estrogen-responsive neurons' that help coordinate homeostatic regulation, social and aversive behavior, and sexual hormone status in mammals. From these original observations we have formulated the fundamental concept reflecting subcortical AVP containing circuits' influence on brain limbic function for behavioral adaption coping with stress.

Humberto Carrillo Calvet Founder and Director of the Nonlinear Dynamics Laboratory of the Faculty of Sciences, and associated researcher at the Center of Complexity Sciences of the National Autonomous University of Mexico, in which he is member of the Coordination Committee. Has had visitor positions at the Mathematics Department of the University of Utah, the Lefschetz Center for Dynamical Systems of Brown university, the National Institutes of Health (receiving a Fogarty Award) and the Finlay Institute of Cuba (receiving two national awards). He has relevant contributions to the Qualitative Theory of Dynamical Systems, modeling in Mathematical Biology, Bioinformatics, Scientometrics, and to the application of artificial neural networks to Data Science.

Mathematical models and physical analogs of nerve cells

Throughout history diverse systems, both physical and abstract (mathematical), have been used as models in order to understand the processes underlying the physiology of nerve cells. The usefulness of the different modeling alternatives will be discussed and the models used to develop the spiking neuron networks that today constitute an important research front in Artificial Intelligence will be described. Finally, using the elegant rotation theory developed by Poincaré and Denjoy, it will be shown how a simple mechanical neuron model provides a useful insight into the synchronization phenomena related to neuronal interaction.



Dr. Matias Nuñez is a researcher at the Consejo Nacional de Investigaciones Cientificas y Tecnologicas (CONICET) in Argentina, currently holding positions at Centro Atomico Bariloche and Institute of Biodiversity and Environment Research (INIBIOMA). Dr. Nuñez received his Ph.D. in Physics from North Carolina State University, USA, and a M.S. in Physics from Instituto Balseiro, Argentina. Over the past several years, he has been engaged in applied science at the Department of Nuclear Materials, Centro Atomico Bariloche. Dr. Nuñez's research interests include electronic structure calculations, material science, complex systems, biology, and machine learning and its applications.

Unlocking New Insights and Discoveries in Physics and Biology with Machine Learning

The exponential growth of data in the last two years amounts to a staggering 90% of all data generated since the dawn of civilization. This has resulted in a renewed interest in Machine Learning (ML), a subfield of Artificial Intelligence (AI) that has been in existence for over seventy years but has recently gained unprecedented popularity This presentation will provide insights into the applications of Machine Learning (ML) in the fields of Physics and Biology. The audience will be presented with a showcase of several works that have been conducted utilizing supervised and unsupervised ML approaches. Examples to be discussed include the application of dimensional reduction approaches (Ref. 1) to the evolutionary arms race between bats and nocturnal moths, resulting in the discovery of the existence of Darwinian mimicry in the realm of ultrasound (Ref. 5). Another example will demonstrate how the same approach was used to identify materials with specific properties by visualizing patterns in a vast database of crystal material properties obtained through electronic structure calculations (Ref. 2, 3,4). Lastly, the presentation will explore the use of differential equations and ML to understand the spread of COVID-19. This work involves the analysis of data extracted from social networks and was developed during the quarantine period. This section of the presentation will delve into the potential for these approaches to provide valuable insights into the spread of the virus and the development of effective interventions.(Ref.6)

References:

1-McInnes Leland., et al, UMAP: Uniform Manifold Approximation and Projection, The Journal of Open Source Software 3(29):861 (2018)

2- Nuñez Matias, Weht Ruben, Nunez-Regueiro Manuel, Searching for electronically two dimensional metals in high-throughput ab initio databases , Computational Materials Science (2020),

3- Nuñez, Matias, Exploring materials band structure space with unsupervised machine learning, Computational Materials Science 158, 117–123 (2019).

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5- Barber Jesse, Kawahara Akiro, Nuñez Matias, et. al, Wide Spread anti-bat ultrasound production in moths , PNAS (2022)

6- Matías Núñez, Nadia L. Barreiro, Rafael A. Barrio, Christopher Rackauckas ,"Forecasting virus outbreaks with social media data via neural ordinary differential equations", https://www.medrxiv.org/content/10.1101/2021.01.27.21250642v1.full

Julia Tagüeña studied Physics at the Universidad Nacional Autónoma de México (UNAM) and the Ph.D. at Oxford University, UK. She is a senior researcher at the Instituto de Energías Renovables (UNAM) and the Communication Coordinator of the Centro de Ciencias de la Complejidad (C3-UNAM). She directed the Centro de Investigación en Energía and the Dirección General de Divulgación de la Ciencia, both at UNAM. She has the National Prize on Science Communication 2020 and recently she was awarded *The Public Understanding and Popularization of Science Award 2021*, TWAS-LACREP.

Sustainability as a complex system: research on ecotechnologies

The Sustainable Development Goals (SDG) were defined in 2015 by the United Nations as the way to achieve a sustainable development future. Our final aim is to study a sustainable development model as a complex system, where societal, economic, environmental, and institutional aspects are considered. As a first step, in this work, we apply a machine learning based bibliometric approach to the analysis of ecotechnology networks within the 17 SDG, which are interconnected and multidisciplinary in nature.

Tzipe Govezensky, I studied BA on Food Engineering and Biotechnology in the Technion - Israel Institute of Technology. Got a master degree in Statistics in México in the Instituto de Investigaciones en Matemáticas Aplicadas y Sistemas in UNAM. My first academic work was as experimentalist in immunology at the Instituto de Investigaciones Biomédicas, UNAM. According to my interests, I have been working in statistical analyses and interpretation of experimental data, collaborating in many different projects among others: cysticercosis, Alzheimer disease, thrombocytopenia, applying enzyme kinetics models. Since 2009 I have collaborated with Dr. Rafael Barrio in complex networks models.

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Geographical propagation of epidemics

In a globalized world, where people travel constantly short and long distances, epidemics can easily turn into pandemics. COVID-19 pandemics showed us how quick the spared of an air transmitted disease can be. Also, in big countries like Mexico and Argentina, where population is distributed heterogeneously, including geographical spread of the epidemics along the country becomes an important ingredient of a model. We developed a model based on a traditional compartmental model which includes geographical propagation of the disease, has enabled us to include social behavior, in countries with heterogeneous population, and separates the parameters related to the virus, from the ones related to geography, population density and people's behavior. Results obtained modeling COVID-19 pandemic.

Dr. Miguel Robles Pérez is a physicist, graduated at the Science Faculty of the NationalAutonomous University of Mexico (UNAM); master's Degree in Solar Energy and PhD in physics from the Autonomous University of the State of Morelos (UAEM). Was a researcher at the Laboratory of Computational Engineering at Helsinki University of Technology, in Finland from 1999 to 2001. Actual Senior Researcher at the Institute of Renewable Energies (IER) of theUNAM.

His main research interests rely on Statistical Mechanics and Materials Science. He has worked in the area of liquid theory, where he has made contributions to the study of the thermodynamics of simple liquids and their phase transitions. He is currently participating in multiscale modeling projects of materials for energy conversion and storage devices, as well as the application of stochastic models to wind dynamics, the study of the dynamics of electrical networks with distributed generation and data science applied to multidisciplinary problems related with renewable energy sources.

Using networks in the study of wind dynamics at a regional scale

The assessment of wind power resources is based on data obtained from local weather stations that collect the wind speed and direction. In geographical regions where several stations are installed, the regional dynamics of wind could be rebuilt from this information, however it is not a simple task without a complete orographic model. In this work we present some advances in what could be called a bottom-up data based model to understand regional wind dynamics where several data stations provide only punctual spatial information but for long periods of time. Using the concept of local wind-state and introducing a network model to establish relations between the dynamics of sites we give some clues on how to define and construct a regional wind-state. We used a case of study in a region in the Mexican state of Zacatecas where four weather stations data are available.

Ricardo Arencibia Jorge, With a solid career as researcher in Information Sciences, Dr. Arencibia has focused his work on the study of productivity and scientific collaboration, the mapping of knowledge domains, the analysis of multidisciplinary contexts, and the development of scientometric methods. He has published five monographs and a hundred of research articles, managing innovation and scientific activities in Cuban biopharmaceutical institutions, and collaborating with the Scimago Research Group (Spain), and the International Network for the Availability of Scientific Information (United Kingdom). He is member of the International Society for Scientometrics and Informetrics (ISSI), participating as editor and reviewer of multiple scientific journals. He is currently member the National System of Researchers (SNI) and Invited Researcher at the Complexity Sciences Center of UNAM (Mexico), where he leads the project "Scientometrics, Complexity and Science of Science."

A multidimensional approach to dynamics of scientific organizations

Scope: Science of science is a transdisciplinary approach that uses large digital datasets to analyze and understand the relational structure between scientists, institutions, and ideas for the development of new scientific knowledge. The triggers and mechanisms behind the research processes, the disciplinary convergence in the growth of a knowledge domain, and the nature of collaborative networks, have been some aspects addressed by this novel approach. We present in this talk the experiences achieved in this area by the Complexity Sciences Center at UNAM. Particularly, a case study is presented, combining bibliometrics and artificial intelligence to multidimensionally analyze the structural and leadership changes in a Mexican scientific institution, and the effects of these changes on the institutional scientific performance.

Cecilia I. Ventura is a researcher of the Argentinian National Research Council (CONICET), based at Centro Atómico Bariloche, in the Condensed Matter Theory Division, as well as a Full Professor at UNRN (National University of Río Negro) since 2009. She represents Bariloche physicists at the Argentinian Physics Association (as member of the Comisión Directiva of AFA), and the UNRN-professors at the local Research Council of the university.
She obtained her PhD in Physics at Instituto Balseiro (Universidad Nacional de Cuyo), Bariloche, Argentina, in 1993, studying cuprate superconductors, being Thesis Advisor Prof. Blas Alascio (having taken a graduate course in Green's Functions in Condensed Matter Physics ...with Visiting Professor Rafael Barrio). She obtained her Licenciatura in Physics degree at the University of Buenos Aires in 1987, with a thesis in ...Nuclear Structure Theory. She has been a Regular Associate Researcher of ICTP (Trieste, Italy) , where she previously had been a postdoc, as well as a postdoc at the Institute of Theoretical Physics at the University of Cologne, Germany, with Prof. Erwin Müller-Hartmann. She has directed Master´s and PhD Thesis in Physics at Instituto Balseiro, organized SLAFES XXIII in Bariloche in April 2018 - as Chair of the Organizing Committee, and last year organized the 107 National Meeting of AFA in Bariloche in September, as Vicechair. C.Ventura enjoys various research collaborations , mostly in condensed matter physics (strongly correlated electron systems, disordered systems, magnetism, semiconductor alloys, etc), including her long-term collaboration with Prof. Rafael Barrio of UNAM at the Institute of Physics (now also using physics of complex systems, to study epidemiological models together)

Non-conventional superconductors: describing the electronic properties of Fe- and Bi-based ones”

Superconductivity in layered Fe-based compounds was discovered in 2008, while in layered BiS2-based compounds in 2012. Common to the studied compounds is the fact that they exhibit phase diagrams involving complex coupled charge, orbital and spin orderings, which difficult their experimental study due to the correlations present between the different relevant degrees of freedom.Though the crystal structure of the layers is similar to that of CuO2 planes in cup rate superconductors, other properties are different.
They are also characterized as multi-band superconductors, due to the coexistence near the Fermi level of electron bands from different orbitals, involved in the superconductivity. There are experimental indications that electron-phonon coupling is weak, pointing to a non-conventional pairing mechanism, but the origin of superconductivity is not yet clear. Electron correlations are believed to be intermediate in Fe- and Bi-based compounds.

We proposed simplified microscopic models to describe these two families of compounds, and employed suitable techniques to investigate their properties.We focused on the normal state Fermi surface topology, spectral properties, transport, and magneto-transport, and their dependence on temperature and doping. We could make some predictions and describe the main experimental facts by including intermediate electronic correlations.

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José Luis Jiménez Andrade, Master in Artificial Intelligence. Academic Technician at the Non-Linear Dynamics Laboratory of the Mathematics Department of the Faculty of Sciences and associated researcher at the Center of Complexity Sciences, UNAM, where he develops software systems, collaborates in the mathematical modeling of nonlinear phenomena, and the design of techniques and methods for data analysis

Neural Networks methods to visualize multidimensional data evolution

The use of several indicators to characterize multidimensional profiles of diverse entities of analysis (countries, institutions, individuals, etc.) is very convenient, but the comparison analysis and visualization of multidimensional data represents a non-trivial challenge in Data Science. In this talk, two methods are presented to analyze and visualize the evolution of multidimensional data. These methods are based on self organized neural networks. The effectiveness of the methods will be exemplified by applying them to the analysis of multidimensional performance profiles evolution in the Scientometric´s domain.