



CONFERENCE ON  
COMPLEX  
SYSTEMS

CCS

2022

PALMA DE MALLORCA  
17 - 21 OCTOBER

PARALLEL SESSIONS

[www.ccs2022.org](http://www.ccs2022.org)

MONDAY 17th , October

**11:00-13:00 SOCIAL MEDIA 1 (Sala Victoria)**

11:00-11:15 **Who talks about what? Comparing the information treatment in traditional media with online discussions**

*Hendrik Schawe, [Laura Hernandez](#), Mariano Gastón Beiró, José Ignacio Alvarez-Hamelin and Dimitris Kotzinos.*

11:15-11:30 **Political polarization: Persistent hatred or issue-dependent sidings?**

*Letizia Iannucci, [Ali Fageeh](#), Ted Hsuan Yun Chen and Mikko Kivelä.*

11:30-11:45 **Self-induced consensus formation among Reddit users on the GameStop short squeeze**

*Anna Mancini, Antonio Desiderio, Riccardo Di Clemente and Giulio Cimini.*

11:45-12:00 **Quantifying the structure of a polarized discussion with unsupervised methods: a look into the Twitter climate change conversation**

*Blas Kolic and Fabián Aguirre-López.*

12:00-12:15 **Measuring the impact of the vaccine campaign on the rewiring of the political landscape using multilayer network link prediction**

*Jeanne Bruneau-Bongard, Victor Chomel, Maziyar Panahi, David Chavalarias and Bruno Gaume.*

12:15-12:30 **Brexit and bots: characterizing the behaviour of automated accounts on Twitter during the UK election**

*Matteo Bruno, Fabio Saracco and Renaud Lambiotte.*

12:30-12:45 **Sentiment and structure in word co-occurrence networks on Twitter**

*Mikaela Irene Fudolig, Thayer Alshaabi, Michael Arnold, Chris Danforth and Peter Dodds.*

12:45-13:00 **Bow-Tie structures in Twitter discursive communities**

*Mattia Mattei, Manuel Pratelli, Guido Caldarelli, Marinella Petrocchi and Fabio Saracco.*



MONDAY 17th , October

**11:00-13:00 URBAN - HUMAN MOBILITY (Sala Falla)**

- 11:00-11:15 **The Distorting Lens of Human Mobility Datasets**  
*Riccardo Gallotti, Davide Maniscalco, Marc Barthelemy and Manlio De Domenico.*
- 11:15-11:30 **A link model approach to identify congestion hotspots**  
*Aleix Bassolas, Sergio Gómez and Alex Arenas.*
- 11:30-11:45 **A generalized vectorial framework for mobility**  
*Erjian Liu, Mattia Mazzoli, Xiao-Yong Yan and Jose J. Ramasco*
- 11:45-12:00 **Contrasting social and non-social sources of predictability in human mobility**  
*Zexun Chen, Sean Kelty, Alexandre Evsukoff, Brooke Foucault Welles, James Bagrow, Ronaldo Menezes and Gourab Ghoshal.*
- 12:00-12:15 **Traveling heterogeneity in public transportation**  
*Hygor Píaget Monteiro Melo and Vittorio Loreto.*
- 12:15-12:30 **LIKE-BCN: estimating pedestrian flows on Barcelona's sidewalk network**  
*Clément Rames, Sergi Lozano, Javier Borge Holthoefer and Albert Solé Ribalta.*
- 12:30-12:45 **Maximum Entropy Approach for the Prediction of Urban Mobility Patterns**  
*Simone Daniotti and Bernardo Monechi.*
- 12:45-13:00 **Comparing Call Detail Records (CDRs) and Location Based Services (LBS) for extracting Individual and Aggregate Mobility**  
*Violet Lingenfelter, Qi Wang, Cris Pais and Marta C Gonzalez.*



MONDAY 17th , October

**11:00-12:45 BRAIN AND NEUROSCIENCE 1 (Sala Granados I)**

- 11:00-11:15 **Informational synergy as a link between biological and artificial brains**  
*Pedro A.M. Mediano, Andrea I Luppi, Alexandra Proca, Fernando E. Rosas, Matthew Crosby and Daniel Bor.*
- 11:15-11:30 Network origins of the brain's synergistic informational architecture  
*Andrea Luppi, Pedro Mediano, Fernando Rosas, Judith Allanson, John Pickard, Guy Williams, Michael Craig, Paola Finioia, Alexander Peattie, Peter Coppola, David Menon, Daniel Bor and Emmanuel Stamatakis.*
- 11:30-11:45 **Criticality and network structure drive emergent oscillations in a stochastic whole-brain model**  
*Giorgio Nicoletti, Giacomo Barzon, Benedetta Mariani, Marco Formentin and Samir Suweis.*
- 11:45-12:00 **Synchronisation Phenomena in Complex Neuronal Networks**  
*Giulio Colombini, Armando Bazzani and Nicola Guglielmi.*
- 12:00-12:15 **Quasi-universal scaling across the mouse brain: a renormalization group perspective**  
*Guillermo Barrios Morales, Serena di Santo and Miguel Ángel Muñoz.*
- 12:15-12:30 **Homological information to refine small-world regime of brain functional connectivity networks**  
*Simone Chiominto, Francesco Pappone, Hanâ Lbath, Lucrezia Carboni and Sophie Achard.*
- 12:30-12:45 **Revealing semantic and emotional structure of suicide notes with cognitive network science (ONLINE)**  
*Andreia Sofia Teixeira, Szymon Talaga, Trevor James Swanson and Massimo Stella.*



MONDAY 17th , October

**11:00-13:00 ECOLOGICAL SYSTEMS 1 (Sala Turina)**

- 11:00-11:15 **Generalizing the concept of network connectivity and applications to marine ecology**  
*Enrico Ser-Giacomi.*
- 11:15-11:30 **A simple model for the formation of coral reefs**  
*Miquel Álvarez-Alegría, Manuel A. Matías and Damià Gomila.*
- 11:30-11:45 **Inferring the interaction structure of the ocean microbiome**  
*Somaye Sheykhali, Juan Fernandez-Gracia, Carlos J. Melian, Jorge P. Rodriguez, Xabier Irigoien, Carlos M. Duarte and Victor M Equiluz.*
- 11:45-12:00 **Diffusion map approach reveals metabolic strategy space and occupancy dynamics in a Baltic Sea bacterial community**  
*Jana Chiara Massing, Ashkaan Fahimipour, Carina Bunse, Jarone Pinhassi and Thilo Gross.*
- 12:00-12:15 **Identification of species traits and quantification of functional diversity by aggregation of monitoring datasets**  
*Pedro Carrasco De La Cruz, Josie Antonucie and Thilo Gross.*
- 12:15-12:30 **Dynamics of seagrass meadows with two species**  
*Pablo Moreno Spiegelberg and Damià Gomila.*
- 12:30-12:45 **Information spread enhanced by criticality in high-responsive groups of fish**  
*Luis Gómez-Nava, Robert T. Lange, Pascal P. Klamser, Juliane Lukas, Lenin Arias Rodriguez, David Bierbach, Jens Krause, Henning Sprekeler and Pawel Romanczuk.*
- 12:45-13:00 **Fountain effect as a collective anti-predator escape in fish schools (ONLINE)**  
*Palina Bartashevich and Pawel Romanczuk.*

MONDAY 17th , October

**11:00-12:45 EPIDEMICS 1 (Sala Albéniz)**

- 11:00-11:15 **Optimal distribution of pre-exposure prophylaxis may not be risk-based**  
*Benjamin Steinegger, Iacopo Iacopini, Andreia Sofia Teixeira, Alberto Bracci, Pau Casanova-Ferrer, Alberto Antonioni and Eugenio Valdano.*
- 11:15-11:30 **JUNE: large-scale agent-based simulations of epidemiological systems.**  
*June Collaboration and Arnau Quera-Bofarull.*
- 11:30-11:45 **The ecological dynamics of influenza subtypes during the Covid-19 pandemic: a study based on compositional analysis**  
*Francesco Bonacina, Pierre-Yves Boëlle, Vittoria Colizza, Olivier Lopez, Maud Thomas and Chiara Poletto.*
- 11:45-12:00 **Spatial clustering in vaccination hesitancy: the role of social influence and social selection**  
*Lucila Alvarez-Zuzek, Casey Zipfel and Shweta Bansal.*
- 12:00-12:15 **Characterizing the complexity of multimorbidity patients using electronic health records, comorbidity networks and machine learning**  
*Paulo Dias, Bernardo Neves, João Colaço, Mário Silva and Andreia Sofia Teixeira.*
- 12:15-12:30 **Detecting contagious spreading of urban innovations on the global city network**  
*Niklas Kitzmann, Pawel Romanczuk, Nico Wunderling and Jonathan F. Donges.*
- 12:30-12:45 **Surveillance-based estimates of the reproductive number may be biased in spatially structured populations**  
*Piero Birello, Boxuan Wang and Eugenio Valdano.*



MONDAY 17th , October

**11:00-13:00 FOUNDATIONS-THEORY (Sala Granados II)**

- 11:00-11:15 **Comparing complex systems: Allotaxonomy with rank- and probability-turbulence divergence**  
*Peter Dodds.*
- 11:15-11:30 **Permutation Compression-Complexity Causality for robust causal inference from irregularly sampled time series**  
*Aditi Kathpalia, Pouya Manshour and Milan Paluš.*
- 11:30-11:45 **Quantifying the Unexpected: a scientific approach to Black Swans**  
*Giordano De Marzo, Andrea Zaccaria, Andrea Gabrielli and Luciano Pietronero.*
- 11:45-12:00 **A method to determine the memory of a discrete sequence based on the calculation of the Shannon entropy**  
*Juan Ignacio De Gregorio, David Sánchez and Raúl Toral.*
- 12:00-12:15 **Maximal Diversity and Zipf's Law**  
*Onofrio Mazzarisi, Amanda de Azevedo-Lopes, Jeferson J. Arenzon and Federico Corberi.*
- 12:15-12:30 **Big whirls talking to smaller whirls: Cross-scale information flow, its detection and implications for predictions**  
*Milan Palus.*
- 12:30-12:45 **Sampling rare trajectories using stochastic bridges**  
*Javier Aguilar, Raúl Toral and Tobias Galla.*
- 12:45-13:00 **Long Wavelength Coherency from Matrix Perturbation Theory**  
*Julian Fritzsche and Philippe Jacquod.*



MONDAY 17th , October

**11:00-13:00 GAME THEORY 1 (Sala Bach)**

- 11:00-11:15 **An Evolutionary Game Theory Analysis of Institutional Incentives for Promoting Commitment Participation and Compliance**  
*The Anh Han.*
- 11:15-11:30 **Aging effects in Complex Contagion**  
*David Abella Bujalance, Maxi San Miguel and Jose J. Ramasco.*
- 11:30-11:45 **The Changing Nature of Social Hierarchies**  
*Laurence Brandenberger, Christoph Gote and Frank Schweitzer.*
- 11:45-12:00 **Successful social norms in indirect reciprocity with ternary reputations**  
*Yohsuke Murase, Minjae Kim and Seung Ki Baek.*
- 12:00-12:15 **Careless Incentives Lead to the Exploitation of Cooperators**  
*Theodor Cimpanu, The Anh Han and Francisco C. Santos.*
- 12:15-12:30 **Inferring the ideological space of multipolar social systems**  
*Samuel Martin-Gutierrez, Juan Carlos Losada and Rosa M. Benito.*
- 12:30-12:45 **Emergencies and Prisoner's Dilemma (ONLINE)**  
*Philippe Mathieu and Jean-Paul Delahaye.*
- 12:45-13:00 **Collective motion and consensus decision-making in social animal groups**  
*M. Carmen Miquel, Julia Múgica, Andreu Puy, Jordi Torrents and Romualdo Pastor-Satorras.*





MONDAY 17th , October

**11:00-13:00 NETWORKS – DYNAMICS (Sala Mozart)**

- 11:00-11:15 **Cumulative Merging Percolation: A long-range percolation process in networks**  
*Claudio Castellano, Lorenzo Cirigliano, Giulio Cimini and Romualdo Pastor-Satorras.*
- 11:15-11:30 **Echo chambers and information transmission biases in social networks**  
*Fernando Diaz-Diaz, Sandro Meloni and Maxi San Miguel.*
- 11:30-11:45 **Nonlinear diffusion in regular networks**  
*Jean-François de Kemmeter, Malbor Asllani and Timoteo Carletti.*
- 11:45-12:00 **Polarization in weighted static graphs**  
*Hugo Pérez-Martínez, Francisco Bauzá, David Soriano-Paños, Jesús Gómez-Gardeñes and Mario Floría.*
- 12:00-12:15 **Analytical studies of binary-state dynamics on complex networks: effect of fluctuations**  
*Raul Toral and Antonio F. Peralta.*
- 12:15-12:30 **Dirac Synchronization on Sparse Uncorrelated Networks**  
*Lucille Calmon and Ginestra Bianconi.*
- 12:30-12:45 **Phase-amplitude reduction of collective oscillating networks**  
*Petar Mircheski, Jinjie Zhu and Hiroya Nakao.*
- 12:45-13:00 **Flocking dynamics mediated by weighted social networks**  
*Jaume Ojer and Romualdo Pastor-Satorras.*

MONDAY 17th , October

**11:00-13:00 NETWORKS – STRUCTURE 1 (Sala Magna)**

- 11:00-11:15 **Bias and limitations in nominal assortativity for assessing homophily in networks**  
*Fariba Karimi and Marcos Oliveira.*
- 11:15-12:30 **Perturbation-based graph theory to the rescue of weighted networks**  
*Gorka Zamora-López and Matthieu Gilson.*
- 11:30-11:45 **Mapping real complex networks in low-dimensional hyperbolic spaces**  
*Robert Jankowski, Marián Boguñá and M. Ángeles Serrano.*
- 11:45-12:00 **Firm growth dynamics and production networks**  
*José Moran and Luca Mungo.*
- 12:00-12:15 **The metric backbone preserves community structure and is a primary transmission subgraph in contact networks**  
*Rion Brattig Correia, Alain Barrat and Luis M. Rocha.*
- 12:15-12:30 **Emergence of complex topologies from flux-weighted optimization of network efficiency**  
*Sebastiano Bontorin, Giulia Cencetti, Riccardo Gallotti, Bruno Lepri and Manlio De Domenico.*
- 12:30-12:45 **Structural measures of similarity and complementarity in complex networks**  
*Szymon Talaga.*
- 12:45-13:00 **How complex is to be a hub? Complexity as a proxy for the network degree distribution.**  
*Inmaculada Leyva and Irene Sendiña-Nadal.*



MONDAY 17th , October

**16:30-18:30 COMPUTATIONAL SOCIAL SCIENCES (Sala Albéniz)**

- 16:30-16:45 **Some scientific knowledge is a dangerous thing: overconfidence grows non-linearly with knowledge**  
*Simone Lackner, Frederico Francisco, Cristina Mendonça, André Mata and Joana Gonçalves-Sá.*
- 16:45-17:00 **Simulation-based feature volatility to determine attitude network's future states**  
*Alejandro Dinkelberg, Pdraig MacCarron and Michael Quayle*
- 17:00-17:15 **The Challenges and Opportunities of Using Big Data to Study Team Productivity**  
*Christoph Gote, Pavlin Mavrodiev, Frank Schweitzer and Ingo Scholtes*
- 17:15-17:30 **Mobile phone communication data to determine chronotypes and turnover in close friendships**  
*Chandreyee Roy, Kunal Bhattacharya, Daniel Monsivais, Robin Dunbar and Kimmo Kaski*
- 17:30-17:45 **The impact of atypical ward-transfers on patient outcomes**  
*Estera Mendelsohn, Paul Expert, Kate Honeyford and Ceire Costelloe.*
- 17:45-18:00 **Structural biases in university rankings: a complex network approach to bridge the gap**  
*Loredana Bellantuono.*
- 18:00-18:15 **Understanding the gender gaps in employment and mobility using large-scale behavioural data**  
*Silvia De Sojo, Sune Lehmann and Laura Alessandretti.*
- 18:15-18:30 **Vulnerabilities of democratic electoral systems**  
*Tomasz Raducha, Mateusz Wilinski, Jaroslaw Klamut, Roger Cremades and Paul Bouman*



MONDAY 17th , October

**16:30-18:30 ECOLOGICAL SYSTEMS 2 (Sala Turina)**

- 16:30-16:45 **Non-Gaussian random matrices determine the stability of Lotka-Volterra communities**  
*Joseph Baron and Tobias Galla*
- 16:45-17:00 **Global predictions for the risk of establishment of Pierce's disease of grapevines**  
*Alex Giménez Romero, Javier Galvan, Marina Montesinos, Joan Bauzà, Martin Godefroid, Alberto Fereres, Jose J. Ramasco, Manuel A. Matías and Eduardo Moralejo.*
- 17:00-17:15 **A general model of avian migratory connectivity**  
*Marius Somveille, Rachael Bay, Thomas Smith, Peter Marra and Kristen Ruegg.*
- 17:15-17:30 **Adaptive cycles of a plant community on the volcanic island of Surtsey**  
*Hannah Zoller, Borgþor Magnússon, Bjarni D. Sigurdsson and Wolfgang Zu Castell.*
- 17:30-17:45 **Characterizing tropical rainforests: Percolation in Ecological Systems**  
*Pablo Villegas, Guido Caldarelli, Andrea Gabrielli and Tommaso Gili.*
- 17:45-18:00 **Recurrent droughts increase risk of cascading tipping events in a complex network of the Amazon rainforest**  
*Nico Wunderling, Arie Staal, Boris Sakschewski, Marina Hirota, Obbe Tuinenburg, Jonathan F. Donges, Henrique Barbosa and Ricarda Winkelmann.*
- 18:00-18:15 **Stochastic Lotka-Volterra model reproduce macroecological patterns**  
*José Manuel Camacho Mateu, Aniello Lampo, Matteo Sireci, Miguel Angel Muñoz Martinez and Jose Antonio Cuesta Ruiz.*
- 18:15-18:30 **Inferring the drivers of species diversification processes**  
*Francisco Richter, Rampal Etienne and Ernst Wit.*



MONDAY 17th , October

**16:30-18:15 EPIDEMICS - COVID-19 (Sala Magna)**

- 16:30-16:45 **Unraveling the interplay of the urban form, mobility and social mixing in the light of the COVID19 pandemic**  
*Marta C. Gonzalez.*
- 16:45-17:00 **Non-trivial interplay between immunity and human mobility shapes the SARS-CoV 2 variants spreading**  
*Beatriz Arrequi García, José J Ramasco and Sandro Meloni.*
- 17:00-17:15 **Meteorological factors and non-pharmaceutical interventions explain local differences in the spread of SARS-CoV-2 in Austria**  
*Katharina Ledebur, Michaela Kaleta, Jiaying Chen, Simon Lindner, Caspar Matzhold, Florian Weidle, Christoph Wittmann, Katharina Habimana, Linda Kerschbaumer, Sophie Stumpfl, Georg Heiler, Martin Bicher, Nikolas Popper, Florian Bachner and Peter Klimek.*
- 17:15-17:30 **Evidence of pandemic fatigue associated with stricter tiered COVID-19 restrictions**  
*Federico Delussu, Michele Tizzoni and Laetitia Gauvin.*
- 17:30-17:45 **Big data and citizen science in the fight against COVID-19 -- The Corona Data Donation project**  
*Marc Wiedermann, Annika Rose, Benjamin Maier, Jakob Kolb, David Hinrichs and Dirk Brockmann.*
- 17:45-18:00 **Assessing the impact of COVID-19 on future TB burden**  
*Mario Tovar Calonge, Alberto Aleta, Joaquín Sanz and Yamir Moreno.*
- 18:00-18:15 **Mobility induces a network interpretation of the Reproductive Number that explains COVID-19 spatial spread and informs surveillance**  
*Mattia Mazzoli, Eugenio Valdano, Shweta Bansal and Vittoria Colizza.*



MONDAY 17th , October

**16:30-18:15 GAME THEORY 2 (Sala Bach)**

- 16:30-16:45 **Group interactions modulate critical mass dynamics in social convention**  
*Iacopo Iacopini, Giovanni Petri, Andrea Baronchelli and Alain Barrat*
- 16:45-17:00 **How economic incentives can fail to increase cooperation: A central authority perspective**  
*Giacomo Vaccario, Luca Verginer and Frank Schweitzer.*
- 17:00-17:15 **Evolutionary-like dynamics of writing**  
*Donald Ruggiero Lo Sardo, Pietro Gravino and Vittorio Loreto.*
- 17:15-17:30 **Ultimatum Game in the evolutionary hunter-gatherer context**  
*Hana Krakovska and Rudolf Hanel.*
- 17:30-17:45 **Network game and Watts threshold model: An application to the spread of competing goods**  
*Teruyoshi Kobayashi, Yoshitaka Ogisu and Tomokatsu Onaga.*
- 17:45-18:00 **Eliciting Fairness in N-Player Network Games through Degree-Based Role Assignment**  
*Andreia Sofia Teixeira, Francisco C. Santos, Alexandre P Francisco and Fernando Santos.*
- 18:00-18:15 **Public good dilemma for a microbial population under the flow**  
*Vivian Dornelas and Ricardo Martinez-Garcia.*



MONDAY 17th , October

**16:30-18:30 INEQUALITIES (Sala Victoria)**

- 16:30-16:45 **Influence of the first-mover advantage on the gender disparities in Physics citations**  
*Hyunsik Kong, Samuel Martin-Gutierrez and Fariba Karimi*
- 16:45-17:00 **Networks of Mutual Support in Mental Health - Results of a Digital Citizen Science Experiment**  
*Franziska Peter, Josep Perelló and Isabelle Cecile Anne Bonhoure*
- 17:00-17:15 **Gender biases in temporal motifs of scientific collaboration**  
*Jan Bachmann, Lisette Espín-Noboa, Gerardo Iñiguez and Fariba Karimi.*
- 17:15-17:30 **High-resolution Poverty Map Inference: A Comparative Study**  
*Lisette Espin Noboa, Janos Kertesz and Márton Karsai.*
- 17:30-17:45 **Gender and the influence of research environment in topic selection on early-career faculty**  
*Lluís Danús, Robert H. Davis, Marta Sales-Pardo and Roger Guimera.*
- 17:45-18:00 **Group mixing drives inequality in face-to-face gatherings**  
*Marcos Oliveira, Fariba Karimi, Maria Zens, Johann Schaible, Mathieu Génois and Markus Strohmaier.*
- 18:00-18:15 **COVID Induces Inequality in Mobility Response Across Socioeconomic Classes**  
*Rafiazka Hilman, Manuel Garcia-Herranz, Vedran Sekara and Márton Karsai.*
- 18:15-18:30 **Use of compartmental models to detect high tuberculosis incidence rates in South Kivu (DRC) (ONLINE)**  
*Mauro Faccin and Emmanuel André.*



MONDAY 17th , October

**16:30-18:30 MACHINE LEARNING - APPLICATIONS (Sala Granados II)**

- 16:30-16:45 **Modelling Multi-Edge Networks: Addressing the challenge with the generalised hypergeometric ensemble**  
*Giona Casiraghi*.
- 16:45-17:00 **Revealing drivers & risks in complex energy systems with explainable AI**  
*Benjamin Schäfer*.
- 17:00-17:15 **Product progression: a machine learning approach to forecasting industrial upgrading**  
*Giambattista Alбора, Luciano Pietronero, Andrea Tacchella and Andrea Zaccaria*.
- 17:15-17:30 **Using a complex network topic model to reveal gender and seniority differences in judicial decisions**  
*Lluc Font, Angelo Piga, Rosa M. Garcia-Teruel, Sergio Nasarre-Aznar, Marta Sales-Pardo and Roger Guimerà*.
- 17:30-17:45 **Blending Machine Learning and mechanistic models to learn ecological time series**  
*Vitor Bousange, Pau Vilimelis Aceituno and Loïc Pellissier*.
- 17:45-18:00 **Spontaneous emergence of Social learning by searching optimal heuristics via deep reinforcement learning**  
*Seungwoong Ha and Hawoong Jeong*.
- 18:00-18:15 **DASentimental: Detecting depression, anxiety, and stress in texts via complexity science and machine learning (ONLINE)**  
*Asra Fatima, Ying Li, Thomas Hills and Massimo Stella*





MONDAY 17th , October

**16:30-18:30 NETWORKS - SIGNED AND TEMPORAL (Sala Mozart)**

- 16:30-16:45 **Topological-temporal properties of evolving networks**  
*Alberto Ceria, Shlomo Havlin, Alan Hanjalic and Huijuan Wang.*
- 16:45-17:00 **Extracting signed relations from interaction data**  
*Georges Andres, Giona Casiraghi, Giacomo Vaccario and Frank Schweitzer.*
- 17:00-17:15 **Neighbourhood matching creates realistic surrogate temporal networks**  
*Antonio Longa, Giulia Cencetti, Sune Lehmann, Andrea Passerini and Bruno Lepri.*
- 17:15-17:30 **Characterization of interactions' persistence in time-varying networks**  
*Francisco Bauza, Mario Floria, Jesus Gomez-Gardenes, Alex Arenas and Alessio Cardillo.*
- 17:30-17:45 **Network Memory**  
*Lucas Lacasa*
- 17:45-18:00 **Evolution of signed relations due to principles of structural balance and status theories**  
*Piotr Górski, Adam Sulik, Giacomo Vaccario, Georges Andres and Janusz Hołyst.*
- 18:00-18:15 **Multiscale walk-based measure of structural balance in signed networks**  
*Szymon Talaga, Massimo Stella, Trevor Swanson and Andreia Sofia Teixeira.*



MONDAY 17th , October

**16:30-18:30 SUSTAINABILITY (Sala Granados I)**

- 16:30-16:45 **Resonating power flows across a highly renewable European electricity network (online)**  
*Mathias Beltoft and Martin Greiner.*
- 16:45-17:00 **Blackout risk reduction by segmenting large power grids with variable impedance lines**  
*Damià Gomila, Benjamín A. Carreras, José Miguel Reynolds-Barredo, Pere Colet and Oriol Gomis-Bellmunt.*
- 17:00-17:15 **Ecosystems are showing symptoms of resilience loss**  
*Juan Rocha.*
- 17:15-17:30 **Frequency fluctuations in the Balearic grid with high penetration of solar PV and HVDC frequency control**  
*María Martínez-Barbeito, Damià Gomila and Pere Colet.*
- 17:30-17:45 **Economic Complexity, Economic Growth, and CO2 Emissions**  
*Henry Laverde-Rojas and Juan C. Correa.*
- 17:45-18:00 **Emergence of scaling in vehicles' emissions and pollution reduction scenarios**  
*Matteo Bohm, Mirco Nanni and Luca Pappalardo.*
- 18:00-18:15 **Assessing the 15-Minute city and its impact on the quality of life**  
*Claudio Chiappetta, Bernardo Monechi, Matteo Bruno, Enrico Ubaldi and Vittorio Loreto.*
- 18:15-18:30 **Uncovering Transportation Emissions using Big Data**  
*Ayse Tugba Ozturk, Helen Fitzmaurice, Olga Kavvada, Philippe Calvez, Ronald C. Kohen and Marta C. Gonzalez.*



MONDAY 17th , October

**16:30-18:30 URBAN - STRUCTURE (Sala Falla)**

- 16:30-16:45 **Inner-city hierarchies: urban self-organization through street percolation**  
*Roberto Murcio, Iacopo Iacopini and Elsa Arcaute.*
- 16:45-17:00 **Efficient, easy-to-read and spatially enriched synthetic population generation, and application to studying spatial inequality resulting from urban (re)development**  
*Hadrien Salat, Dustin Carlino, Fernando Benitez-Paez, Daniel Arribas-Bel and Mark Birkin.*
- 17:00-17:15 **Housing and transport: Analysing multidimensional inequalities from data and infrastructure in Madrid.**  
*Jesús Arturo Moreno López, Jose J. Ramasco, Fernando Martín-Consuegra and Fernando De Frutos.*
- 17:15-17:30 **Quantifying the co-evolution of economic activities locations with geo-historical data: Paris, 19th century**  
*Juste Raimbault and Julien Perret.*
- 17:30-17:45 **Strategic household dwelling investments in Ulaanbaatar, Mongolia**  
*Natalia Fedorova and Richard McElreath.*
- 17:45-18:00 **Central and intermediate cities in Africa**  
*Rafael Prieto Curiel.*
- 18:00-18:15 **Modelling the multi-scalar effect of commuting on exposure to diversity**  
*Valentina Marin, Carlos Molinero and Elsa Arcaute.*
- 18:15-18:30 **Temporal change of the potential field in metropolitan areas based on GPS data by analogy with electric circuits**  
*Yohei Shida, Jun'Ichi Ozaki, Hideki Takayasu and Misako Takayasu.*

TUESDAY 18th , October

**11:00-13:00 BIOLOGICAL SYSTEMS (Sala Bach)**

- 11:00-11:15 **Topology and dynamics of a viral quasispecies under changing environments**  
*Henry Secaira-Morocho, Luís F Seoane, Ester Lázaro and Susanna Manrubia.*
- 11:15-11:30 **Terminal heterocyst differentiation in the *Anabaena patA* mutant as a result of post-transcriptional modifications and molecular leakage**  
*Pau Casanova Ferrer, Saúl Ares and Javier Muñoz-García.*
- 11:30-11:45 **First passage time analysis of spatial mutation patterns reveals sub-clonal evolutionary dynamics in colorectal cancer**  
*Magnus Haughey, Aleix Bassolas, Sandro Sousa, Ann-Marie Baker, Trevor Graham, Vincenzo Nicosia and Weini Huang.*
- 11:45-12:00 **Do compression principle and Brevity law holds in infochemical communication?**  
*Iván G. Torre and Antoni Hernandez.*
- 12:00-12:15 **Analysis of time series of antibiotic-influenced gut microbiome**  
*Rie Maskawa, Lena Takayasu, Wataru Suda, Keiji Watanabe, Hideki Takayasu and Misako Takayasu.*
- 12:15-12:30 **Scaling patterns in enzyme diversity across the tree of life: how do novel biochemical functions arise?**  
*Veronica Mierzejewski, Bradley Karas, Cole Mathis, Hyunju Kim, Christopher Kempes and Sara Walker.*
- 12:30-12:45 **Evolutionary advantages linked to the spatial heterogeneity of plant cells**  
*Silvia Rognone, Liam Walker, George Bassel and Vincenzo Nicosia.*
- 12:45-13:00 **The orthoBackbone: an evolutionarily-conserved multi-layer subgraph of gene regulatory networks**  
*Rion Brattiq Correia, Paulo Navarro Costa and Luis M. Rocha.*



TUESDAY 18th , October

**11:00-13:00 ECONOMICS - NETWORK (Sala Turina)**

- 11:00-11:15 **Economic complexity at a company level**  
*Andrea Zaccaria, Giambattista Albora, Dario Laudati, Manuel Mariani and Luciano Pietronero.*
- 11:15-11:30 **Modelling the growth of supply distribution networks: co-evolution of topology and flows of goods**  
*Ambra Amico, Giacomo Vaccario and Frank Schweitzer.*
- 11:30-11:45 **The Dynamic Resilience of Urban Labour Networks**  
*Xianqnan Feng and Alex Rutherford.*
- 11:45-12:00 **Propagation of disruptions in supply networks of essential goods: A population-centered perspective of systemic risk**  
*William Schueller, Christian Diem, Melanie Hinterplattner, Johannes Stangl, Beate Conrady, Markus Gerschberger and Stefan Thurner.*
- 12:00-12:15 **Identifying optimal strategies for decarbonization with an economic systemic risk measure in firm-level production networks**  
*Johannes Stangl, András Borsos, Tobias Reisch, Christian Diem and Stefan Thurner.*
- 12:15-12:30 **Inequality in economic shock exposures across the global firm-level supply network**  
*Abhijit Chakraborty, Tobias Reisch, Christian Diem and Stefan Thurner.*
- 12:30-12:45 **Understanding European Integration with Bipartite Networks of Comparative Advantage (ONLINE)**  
*Riccardo Di Clemente, Balazs Lengyel, Lars Fredrik Andersson and Rikard Eriksson.*
- 12:45-13:00 **Hysteresis of the diffusion-localization transition of gravity interaction model on the Japanese business network (ONLINE)**  
*Koike Hajime, Hideki Takayasu and Misako Takayasu.*



TUESDAY 18th , October

**11:00-13:00 EPIDEMICS 2 (Sala Magna)**

- 11:00-11:15 **The advantage of self-protecting interventions in mitigating epidemic circulation at the community level**  
*Romualdo Pastor-Satorras and Claudio Castellano.*
- 11:15-11:30 **The impact of complex network structures on the efficacy of digital contact tracing**  
*Angelique Burdinski, Dirk Brockmann and Benjamin Frank Maier.*
- 11:30-11:45 **A Network Dynamical Systems Approach to Mitigate Vaccine Hesitancy**  
*Camilla Ancona, Francesco Lo Iudice, Pietro De Lellis and Franco Garofalo.*
- 11:45-12:00 **Multiscale reactive control policies to control epidemics**  
*David Soriano, Adriana Reyna Lara, Alex Arenas and Jesus Gomez-Gardenes.*
- 12:00-12:15 **Unraveling cradle-to-grave disease trajectories from multilayer comorbidity networks**  
*Elma Dervic, Michael Leutner, Alexander Kautzky, Alexandra Kautzky-Willer and Peter Klimek.*
- 12:15-12:30 **Optimal vaccination strategies countering reinfections and waning immunity in a metapopulation model**  
*Piergiorgio Castioni, Sergio Gómez and Alex Arenas.*
- 12:30-12:45 **Identifying influential subpopulations in metapopulation epidemic models using message-passing theory**  
*Jeehye Choi and Byungjoon Min.*
- 12:45-13:00 **Impact of human contact network on the selective advantage of emerging viral variants**  
*Pourya Toranj Simin, Elisabeta Vergu, Lulla Opatowski and Chiara Poletto.*

TUESDAY 18th , October

**11:00-12:45 GROUP DYNAMICS (Sala Granados I)**

- 11:00-11:15 **Perpetuation of inequality as a result of historical biases**  
*Zahra Ghadiri, Sina Sajjadi, Samuel Martin-Gutierrez and Fariba Karimi.*
- 11:15-11:30 **Quantifying individual uncertainty in decision-making: Unrelated preferences for degree programs reduce students' first-year retention in higher education**  
*Cristian Candia, Joselina Davyt-Colo, Miguel R. Gueva, Javier Pulgar, Tamara Yaikin, Cecilia Monge, Flávio L. Pinheiro and Carlos Rodriguez-Sickert.*
- 11:30-11:45 **Personal network structure predicts migrants' cultural backgrounds**  
*Juan Ozaita Corral, Jose Luis Molina and Anxo Sánchez.*
- 11:45-12:00 **Social nucleation: Group formation as a phase transition**  
*Frank Schweitzer and Georges Andres.*
- 12:00-12:15 **Chimpanzees organize their social relationships like humans**  
*Diego Escribano, Victoria Doldán-Martelli, Katherine A. Cronin, Daniel B. M. Haun, Edwin J. C. van Leeuwen, Jose Antonio Cuesta and Anxo Sánchez.*
- 12:15-12:30 **Socially-enhanced discovery processes**  
*Gabriele Di Bona, Enrico Ubaldi, Iacopo Iacopini, Bernardo Monechi, Vito Latora and Vittorio Loreto.*
- 12:30-12:45 **Friendship Modulates Hierarchical Relations in Public Elementary Schools**  
*Cristian Candia, Melanie Oyarzun and Carlos Rodriguez-Sickert.*
- 12:45-13:00 **Synch.Live: Exploring self-organised collective behaviour in humans using open technology.**  
*Madalina Sas, Pedro Mediano, Fernando Rosas, Daniel Bor and Henrik Jensen.*

TUESDAY 18th , October

**11:00-13:00 NETWORKS - DYNAMICS 2 (Sala Albéniz)**

- 11:00-11:15 **Mapping non-local relations between metadata and network structure with metadata-dependent encoding of random walks**  
*Aleix Bassolas, Anton Eriksson, Antoine Marot, Martin Rosvall and Vincenzo Nicosia.*
- 11:15-11:30 **Linking network theory, dynamical systems and fluid flows: the Lagrangian betweenness**  
*Enrico Ser-Giacomi, Alberto Baudena, Vincent Rossi, Mick Follows, Sophie Clayton, Ruggero Vasile, Cristobal Lopez and Emilio Hernandez-Garcia.*
- 11:30-11:45 **Directed percolation in temporal networks**  
*Arash Badie-Modiri, Abbas K. Rizi, Márton Karsai and Mikko Kivelä.*
- 11:45-12:00 **Long-range interactions and memory on networks: a generalized diffusion equation**  
*Fernando Diaz-Diaz and Ernesto Estrada.*
- 12:00-12:15 **Inferring line failures in complex networks**  
*Alessandra Corso, Lucia Valentina Gambuzza and Mattia Frasca.*
- 12:15-12:30 **Algebraic shortcuts to the onset of network synchrony**  
*Lluís Arola, Giulio Burgio, Benjamin Steinegger and Alex Arenas.*
- 12:30-12:45 **Non-Markovian random walks characterize network robustness to nonlocal cascades**  
*Angelo Valente, Manlio De Domenico and Oriol Artime.*
- 12:45-13:00 **Uncovering the operating system of trees using the approach of Cellular Automaton**  
*Swanand Khanapurkar, Sara Walker and George Bassel.*



TUESDAY 18th , October

**11:00-13:00 NETWORKS - HIGHER-ORDER INTERACTIONS 1 (Sala Mozart)**

- 11:00-11:15 **Graphical expansion of information flows in network motifs**  
*Fumito Mori and Takashi Okada.*
- 11:15-11:30 **Percolation and topological properties of temporal higher-order networks**  
*Leonardo Di Gaetano, Federico Battiston and Michele Starnini.*
- 11:30-11:45 **The effectiveness of sideward contact tracing in simplices**  
*Marco Mancastroppa, Andrea Guizzo, Claudio Castellano, Alessandro Vezzani and Raffaella Burioni.*
- 11:45-12:00 **Social adoption on signed simplicial complexes**  
*Jean-François de Kemmeter, Luca Gallo, Fabrizio Boncoraglio, Vito Latora and Timoteo Carletti.*
- 12:00-12:15 **Diffusion driven instability on Simplicial Complex**  
*Lorenzo Giambagli, Lucille Calmon, Riccardo Muolo, Timoteo Carletti and Ginestra Bianconi.*
- 12:15-12:30 **Do higher-order interactions promote synchronization?**  
*Yuanzhao Zhang, Maxime Lucas and Federico Battiston.*
- 12:30-12:45 **Triadic interactions induce blinking and chaos in the connectivity of higher-order networks**  
*Hanlin Sun, Filippo Radicchi, Juergen Kurths and Ginestra Bianconi.*
- 12:45-13:00 **Sequential Motifs in Observed Walks**  
*Timothy LaRock, Ingo Scholtes and Tina Eliassi-Rad*



TUESDAY 18th , October

**11:00-13:00 QUANTUM COMPLEXITY (Sala Granados II)**

- 11:00-11:15 **Quantum complex networks of light fields**  
*Valentina Parigi.*
- 11:15-11:30 **Robustness of Noisy Quantum Networks**  
*Bruno Coutinho, William J. Munro, Kae Nemoto and Yasser Omar.*
- 11:30-11:45 **Quantum associative memory with a single driven-dissipative non-linear oscillator**  
*Adrià Labay-Mora, Roberta Zambrini and Gian Luca Giorgi.*
- 11:45-12:00 **Open quantum Hopfield-type networks: phase diagram and storage capacity**  
*Eliana Fiorelli, Lukas Bödeker, Igor Lesanovsky and Markus Müller.*
- 12:00-12:15 **Collective effects on the performance and stability of quantum heat engines**  
*Leonardo da Silva Souza, Gonzalo Manzano, Rosario Fazio and Fernando Iemini.*
- 12:15-12:30 **Dimensional Reduction in Quantum Modelling of Complex Processes**  
*Mile Gu, Jayne Thompson, Nora Tischler, Man-Hong Yung, Feiyang Yung, Thomas Elliott, Andrew Garner and Oscar Dahlsten.*
- 12:30-12:45 **Time-Series Quantum Reservoir Computing with Weak and Projective Measurements**  
*Pere Mujal, Rodrigo Martínez-Peña, Gian Luca Giorgi, Miguel C. Soriano and Roberta Zambrini.*
- 12:45-13:00 **Quantum adaptive agents with efficient long-term memories (ONLINE)**  
*Thomas Elliott, Mile Gu, Andrew Garner and Jayne Thompson.*



TUESDAY 18th , October

**11:00-13:00 SCIENCE OF SCIENCE (Sala Victoria)**

- 11:00-11:15 **A multi-layer network approach to modelling authorship influence on citation dynamics in physics journals**  
*Frank Schweitzer, Christian Zingg, Vahan Nanumyan and Christoph Gote.*
- 11:15-11:30 **Team chemistry and its mechanisms in scientific collaboration**  
*Gangmin Son, Jinhyuk Yun and Hawoong Jeong.*
- 11:30-11:45 **The impact of diversity on group performance**  
*Fabian Baumann, Agnieszka Czaplicka and Iyad Rahwan.*
- 11:45-12:00 **Talent or Luck? The role of chance in everyday life and in scientific careers**  
*Alessandro Pluchino, Alessio Emanuele Biondo and Andrea Rapisarda.*
- 12:00-12:15 **Quantifying the Tradeoff Between Team Productivity and Resilience**  
*Christoph Gote, Christian Zingg and Frank Schweitzer.*
- 12:15-12:30 **The global mobility of scientists: Where and Why scientists move**  
*Giacomo Vaccario, Luca Verginer and Frank Schweitzer.*
- 12:30-12:45 **The Sci-Hub Effect**  
*Juan C Correa, Henry Laverde-Rojas, Julian Tejada and Fernando Marmolejo-Ramos.*
- 12:45-13:00 **Interdisciplinarity between acknowledgement and collaboration**  
*Keigo Kusumegi and Yukie Sano.*

TUESDAY 18th , October

**11:00-13:00 URBAN - TRANSPORTATION (Sala Falla)**

- 11:00-11:15 **Uncovering the socioeconomic facets of human mobility**  
*Hugo Barbosa, Surendra Hazarie, Brian Dickinson, Aleix Bassolas, Adam Frank, Henry Kautz, Adam Sadilek, Jose Ramasco and Gourab Ghoshal.*
- 11:15-11:30 **Dynamic stop pooling for flexible and sustainable ride sharing**  
*Charlotte Lotze, Philip Marszal, Malte Schröder and Marc Timme.*
- 11:30-11:45 **Universal Zig-zagging in Public Transport Routes**  
*Kush Mohan Mittal, Marc Timme and Malte Schröder.*
- 11:45-12:00 **Multiscalarity in Socio-Spatial Segregation**  
*Mateo Neira and Elsa Arcaute.*
- 12:00-12:15 **Temporal and spatial variations of road usage patterns**  
*Zhiren Huang, Talayeh Aledavood and Jari Saramäki.*
- 12:15-12:30 **Equilibrium formation in Transportation systems (ONLINE)**  
*Megan Khoshyaran and Jean-Patrick Lebacque.*
- 12:30-12:45 **Measuring the morphological polycentricity of systems of cities: a network-entropy-based approach (ONLINE)**  
*Matteo Mazzamurro and Weisi Guo.*
- 12:45-13:00 **Urban morphologies determining road-travel route choices – from the rush hours to the wee hours (ONLINE)**  
*Hirotaaka Fukushige, Yuto Fukumura, Tomomi Kito and Petter Holme.*



TUESDAY 18th , October

**16:30-18:15 COMPUTATIONAL SOCIAL SCIENCES - COVID-19 (Sala Albéniz)**

- 16:30-16:45 **Living in a pandemic: changes in mobility routines, social activity and adherence to COVID-19 protective measures**  
*Lorenzo Lucchini, Simone Centellegher, Luca Pappalardo, Riccardo Gallotti, Filippo Privitera, Bruno Lepri and Marco De Nadai.*
- 16:45-17:00 **Built Form Exacerbated Experienced Isolation During the Pandemic**  
*Andrew Renninger, Elsa Arcaute and Neave O'Clery.*
- 17:00-17:15 **Effects of the COVID-19 pandemic in higher education: a particular case from the perspective of complex systems**  
*Fátima Velásquez-Rojas, Jesus E. Fajardo, Daniela Zacharías and M. Fabiana Laguna.*
- 17:15-17:30 **Changes in the time-space dimension of mobility during the COVID-19 pandemic**  
*Clodomir Santana, Federico Botta, Hugo Barbosa, Filippo Privitera, Ronaldo Menezes and Riccardo Di Clemente.*
- 17:30-17:45 **Re-organisation of socioeconomic networks due to external shocks**  
*Ludovico Napoli, Vedran Sekara, Manuel Garcia-Herranz and Márton Karsai.*
- 17:45-18:00 **Modeling International Mobility with Roaming Cell Phone Traces during COVID-19 Pandemic**  
*Massimiliano Luca, Bruno Lepri, Enrique Frias-Martinez and Andra Lutu.*
- 18:00-18:15 **Intermunicipal Networks of Mexico during the COVID-19 pandemic (ONLINE)**  
*Oscar Fontanelli, Plinio Guzmán, Amilcar Meneses, Alfredo Hernández, Marisol Flores-Garrido, Maribel Hernandez Rosales, Guillermo de Anda-Jáurequi and Gabriela Olmedo.*



TUESDAY 18th , October

**16:30-18:30 ECONOMICS - FINANCE (Sala Turina)**

- 16:30-16:45 **From Reddit to Wall Street: The role of committed minorities in financial collective action**  
*Lorenzo Lucchini, Luca Maria Aiello, Laura Maria Alessandretti, Gianmarco De Francisci Morales, Michele Starnini and Andrea Baronchelli.*
- 16:45-17:00 **Exploration of phase transitions in an agent-based model of margin calls and fire sales in a scenario of declining growth rates**  
*Anja Janischewski and Torsten Heinrich.*
- 17:00-17:15 **The Evolution Of Centralisation on Cryptocurrency Platforms**  
*Carlo Campajola, Raffaele Cristodaro, Francesco De Collibus, Nicolò Vallarano, Tao Yan and Claudio Juan Tessone.*
- 17:15-17:30 **Circulation of a digital community currency**  
*Carolina Mattsson, Teodoro Criscione and Frank Takes.*
- 17:30-17:45 **Agent-based Modelling of Bitcoin Consensus without Block Rewards**  
*Benjamin Kraner, Shengnan Li, Andreia Sofia Teixeira and Claudio Juan Tessone.*
- 17:45-18:00 **Order-splitting behaviour in the Tokyo stock exchange market**  
*Yuki Sato and Kiyoshi Kanazawa.*
- 18:00-18:15 **Negativity bias and the temporal leverage effect: 2T-POT Hawkes model applied to financial markets and agent-based models**  
*Matthew Tomlinson, David Greenwood and Marcin Mucha-Kruczynski.*
- 18:15-18:30 **Market Structures in Climate (Re)Insurance: a Multi-Layer Model**  
*Roger Cremades, Paul Hudson and Hocine Cherifi.*



TUESDAY 18th , October

**16:30-18:30 FOUNDATIONS – DYNAMICS 1 (Sala Falla)**

- 16:30-16:45 **Information-driven transitions in optimal projections of underdamped dynamics**  
*Giorgio Nicoletti, Amos Maritan and Daniel Maria Busiello.*
- 16:45-17:00 **Liquid-Hexatic-Solid phases in active and passive Brownian particles determined by stochastic birth-death events**  
*Alejandro Almodóvar.*
- 17:00-17:15 **Synchronization of Chaos as Information Pressure System**  
*Christopher Diggans and Erik Bollt.*
- 17:15-17:30 **The entropy of collective motion patterns**  
*Benjamin Sorkin, Avraham Be'Er, Haim Diamant and Gil Ariel.*
- 17:30-17:45 **Synchronization dynamics for SISR oscillators with all-to-all coupling**  
*Jinjie Zhu, Yuzuru Kato and Hiroya Nakao.*
- 17:45-18:00 **Pattern-formation in high-order structures**  
*Riccardo Muolo, Luca Gallo, Vito Latora, Mattia Frasca and Timoteo Carletti.*
- 18:00-18:15 **Hubs, noise, and diversity in a FitzHugh-Nagumo oscillator network**  
*Stefano Scialla, Marco Patriarca and Els Heinsalu.*
- 18:15-18:30 **Low order descriptors of high order interdependencies in complex systems**  
*Tomas Scaqliarini, Davide Nuzzi, Yuri Antonacci, Luca Faes, Fernando E Rosas, Daniele Marinazzo and Sebastiano Stramaglia.*



TUESDAY 18th , October

**16:30-18:15 LANGUAGE AND COMPLEXITY (Sala Granados I)**

- 16:30-15:45 **Ousiometrics and Telegnomics: The distant measurement of essential meaning in language, timelines, characters, and stories**  
*Peter Dodds.*
- 16:45-17:00 **An ordinal pattern analysis of lexical relations in major languages**  
*David Sánchez, Luciano Zunino, Juan De Gregorio, Raúl Toral and Claudio Mirasso.*
- 17:00-17:15 **Inequality and Inequity in Network-based Ranking and Recommendation Algorithms**  
*Lisette Espin Noboa, Claudia Wagner, Markus Strohmaier and Fariba Karimi.*
- 17:15-17:30 **Multilayer representation of semantic and syntactic relations among words as a complex system (ONLINE)**  
*Andrea Simonetti, Michele Tumminello and Tiziana Di Matteo.*
- 17:30-17:45 **Cultural and geographical barriers in language competition**  
*Els Heinsalu and Marco Patriarca.*
- 17:45-18:00 **Collective information processing of long-form text in multi-generational social networks: An experimental investigation using Amazon Mechanical Turk**  
*Javier Garcia-Bernardo, Mathew Hardy, Zohar Neu, Andrea Santoro, P M Krafft, Allison Morgan, Aleksandra Aloric and Thomas Griffiths.*
- 18:00-18:15 **Computational timeline reconstruction of the stories surrounding Trump: Story turbulence, narrative control, and collective chronopathy**  
*Peter Dodds.*



TUESDAY 18th , October

**16:30-18:30 NETWORKS - SPREADING (Sala Magna)**

- 16:30-16:45 **Infection patterns in simple and complex contagion processes**  
*Giulia Cencetti, Diego Contreras and Alain Barrat.*
- 16:45-17:00 **Epidemic spreading and contact tracing on clustered networks**  
*Abbas K. Rizj, Leah Keating, David O'Sullivan, James Gleeson and Mikko Kivela.*
- 17:00-17:15 **Emergence of synergistic and competitive pathogens in a co-evolutionary spreading model**  
*Fakhteh Ghanbarnejad, Kai Seegers, Alessio Cardillo and Philipp Hövel.*
- 17:15-17:30 **Distinguishing simple and complex contagion processes on complex networks**  
*Elsa Andres, Iacopo Iacopini and Márton Karsai.*
- 17:30-17:45 **The predictive potentiality of pair-based models in epidemics**  
*Federico Malizia, Luca Gallo, Mattia Frasca, Vito Latora and Giovanni Russo.*
- 17:45-18:00 **Infection spreading in networks with preferential routing**  
*Giuliano Punzo.*
- 18:00-18:18 **Epidemic processes on self-propelled particles**  
*Jorge P. Rodríguez, Matteo Paoluzzi, Demian Levis and Michele Starnini.*
- 18:15-18:30 **Herd immunity and epidemic size in networks with vaccination homophily**  
*Takayuki Hiraoka, Abbas K. Rizj, Mikko Kivelä and Jari Saramäki.*



TUESDAY 18th , October

**16:30-18:30 NETWORKS – STRUCTURE 2 (Sala Mozart)**

- 16:30-16:45 **Redundancy in the Structure and Dynamics of Complex Systems**  
*Luis Rocha.*
- 16:45-17:00 **Laplacian Renormalization Group for heterogeneous networks: information core and entropic transitions**  
*Andrea Gabrielli, Guido Caldarelli, Tommaso Gili and Pablo Villegas.*
- 17:00-17:15 **Turing Patterns in Geometric Random Graphs**  
*Jasper van der Kolk, Guillermo García Pérez, Nikos Kouvaris, M. Ángeles Serrano and Marián Boguñá.*
- 17:15-17:30 **An evolutionary framework for modelling complex networks**  
*Vito Dichio and Fabrizio De Vico Fallani.*
- 17:30-17:45 **Stochastic resetting in a multiparticle system with correlated transitions: the case of network formation**  
*Oriol Artime.*
- 17:45-18:00 **Variance and covariance of probability distributions on networks**  
*Karel Devriendt, Samuel Martin-Gutierrez and Renaud Lambiotte.*
- 18:00-18:15 **Modularity maximisation for graphons (ONLINE)**  
*Florian Klimm, Nick Jones and Michael Schaub.*
- 18:15-18:30 **Cycle analysis of Directed Acyclic Graphs**  
*Vaiva Vasiliauskaite, Tim S. Evans and Paul Expert.*

TUESDAY 18th , October

**16:30-18:30 OPINION DYNAMICS (Sala Bach)**

- 16:30-16:45 **Explosive Polarization in Opinion Dynamics Models with Multidimensional Topics**  
*Jaume Ojer, Michele Starnini and Romualdo Pastor-Satorras.*
- 16:45-17:00 **Effect of algorithmic bias and network structure on coexistence, consensus, and polarization of opinions**  
*Antonio F. Peralta, Matteo Neri, János Kertész and Gerardo Iñiguez.*
- 17:00-17:15 **Analysis of mean-field approximation for Deffuant opinion dynamics on networks**  
*Alina Dubovskaya, Susan Fennell, Kevin Burke, James Gleeson and Doireann O'Kiely.*
- 17:15-17:30 **Noisy Voter Model with time-varying influencers**  
*Annalisa Caligiuri and Tobias Galla.*
- 17:30-17:45 **Filter Bubble effect in opinion dynamics models**  
*Giordano De Marzo, Giulio Iannelli, Andrea Zaccaria and Claudio Castellano.*
- 17:45-18:00 **Ordering dynamics in the Voter Model with Multiple Opinion States**  
*Lucía Ramirez, Maxi San Miguel and Tobias Galla.*
- 18:00-18:15 **Effects of in-group bias and homophily on opinion dynamics**  
*Peter Steiglechner, Paul E. Smaldino, Deyshawn Moser, Achim Schlüter and Agostino Merico.*
- 18:15-18:30 **Homophily-based social group formation in a spin-glass self-assembly framework**  
*Jan Korbel and Simon David Lindner.*



TUESDAY 18th , October

**16:30-18:15**    **QUANTUM COMPLEXITY AND MACHINE LEARNING (Sala Granados II)**

- 16:30-16:45    **Collective Monte Carlo updates through tensor network renormalization**  
*Miguel Frías-Pérez, Michael Mariën, David Pérez García, Mari Carmen Bañuls, Sofyan Iblidir*
- 16:45-17:00    **Quantum computation applied to complex network problems**  
*João Moutinho, Bruno Coutinho, André Melo, István A. Kovács and Yasser Omar.*
- 17:00-17:15    **Unveiling hidden features of the Kitaev model through a complex-network analysis**  
*Gian Luca Giorqi, Guillem Llodrà and Roberta Zambrini.*
- 17:15-17:30    **Cost and Routing of Continuous Variable Quantum Networks**  
*Federico Centrone, Frederich Grosshans and Valentina Parigi.*
- 17:30-17:45    **MOGen: A Multi-Order Model to Predict Variable-Length Paths in Networks**  
*Christoph Gote, Giona Casiraghi, Frank Schweitzer and Ingo Scholtes.*
- 17:45-18:00    **NodeSim: Node Similarity based Network Embedding for Diverse Link Prediction**  
*Akrati Saxena, George H. L. Fletcher and Mykola Pechenizkiy.*
- 18:00-18:15    **Causal network reconstruction beyond pairwise interactions**  
*Tiago Martinelli, Diogo Soares-Pinto and Francisco Aparecido Rodrigues.*



TUESDAY 18th , October

**16:30-18:15 SOCIAL MEDIA 2 (Sala Victoria)**

- 16:30-16:45 **Issue bundles: Understanding ideological patterns of polarization in political spaces**  
*Eckehard Olbrich and Sven Banisch.*
- 16:45-17:00 **Disagreement and fragmentation, understanding the structures of trust in news**  
*Donald Ruggiero Lo Sardo, Pietro Gravino and Vittorio Loreto.*
- 17:00-17:15 **The pursuit of peer support for opioid use recovery on social media**  
*Duilio Balsamo, Paolo Bajardi, Gianmarco De Francisci Morales, Corrado Monti and Rossano Schifanella.*
- 17:15-17:30 **Spiral of silence in online political deliberation: YouTube during the 2020 US presidential elections**  
*Gabriela Juncosa, Júlia Koltai, Taha Yasseri and Gerardo Iñiguez.*
- 17:30-17:45 **“Doing the Research”: Differential Tracking in Disinformation Websites and its Impact on Search Engine Results and Third-Party Content**  
*José Reis, Íris Damião and Joana Gonçalves-Sá.*
- 17:45-18:00 **Characterizing controversiality of topics utilizing eccentricity of opinions**  
*Srinivas Pandey and Hiroki Sayama.*
- 18:00-18:15 **A Nonparametric Approach to Detect the Endogenous and Exogenous Emotion Bursts from Long-term Social Media Data**  
*Qianyun Wu, Yukie Sano, Hideki Takayasu and Misako Takayasu.*

FRIDAY 21st , October

**11:00-13:00 NETWORKS - HIGHER-ORDER INTERACTIONS 2 (Sala Magna)**

11:00-11:15 **Connecting Hodge and Sakaguchi-Kuramoto: a mathematical framework for coupled oscillators on simplicial complexes**

*Alexis Arnaudon, Robert Peach, Giovanni Petri and Paul Expert.*

11:15-11:30 **Unveiling the higher-order organization of multivariate time series**

*Andrea Santoro, Federico Battiston, Giovanni Petri and Enrico Amico.*

11:30-11:45 **Higher order interactions destroy phase transitions in Deffuant opinion dynamics model**

*Hendrik Schawe and Laura Hernandez*

11:45-12:00 **The impact of directed higher order interactions on synchronization**

*Luca Gallo, Riccardo Muolo, Lucia Valentina Gambuzza, Vito Latora, Mattia Frasca and Timoteo Carletti.*

12:00-12:15 **Community structure in hypergraphs and the emergence of polarization**

*Nicholas Landry and Juan Restrepo*

12:15-12:30 **Simplicially driven simple contagion**

*Maxime Lucas, Iacopo Iacopini, Thomas Robiglio, Alain Barrat and Giovanni Petri.*

12:30-12:45 **Synchronization of phase oscillators in complex hypergraphs**

*Sabina Adhikari, Juan G. Restrepo and Per Sebastian Skardal.*

12:45-13:00 **On the Effectiveness of Simplicial Complex Embeddings for Higher-order Link Prediction and Reconstruction**

*Simone Piaqqesi, André Panisson and Giovanni Petri.*



FRIDAY 21st , October

**11:00-13:00 NETWORKS – MULTILAYER (Sala Mozart)**

- 11:00-11:15 **Meta-validation of bipartite network projections**  
*Giulio Cimini, Alessandro Carra, Luca Didomenico and Andrea Zaccaria.*
- 11:15-11:30 **Dismantling the information flow in complex interconnected systems**  
*Arsham Ghavasieh, Giulia Bertagnolli and Manlio De Domenico.*
- 11:30-11:45 **Node-layer duality in multilayer networks**  
*Charley Presigny and Fabrizio De Vico Fallani.*
- 11:45-12:00 **Excess closure in a multilayer population-scale social network**  
*Eszter Bokanyj, Eelke Heemskerk, Yuliia Kazmina and Frank Takes.*
- 12:00-12:15 **Composing Music with Multiple Biased Random Walks on Multilayer Networks**  
*Lluc Bono Rosselló and Hugues Bersini.*
- 12:15-12:30 **A Marshallian multi-layer model for regional diversification dynamics**  
*Neave O'Clery and Mattie Landman.*
- 12:30-12:45 **Is synchronization stability in multilayer networks a mean-field effect?**  
*Sergio Faci-Lázaro, Jesus Gomez-Gardenes, Charo I. del Genio and Stefano Boccaletti.*
- 12:45-13:00 **Limits of Multilayer Diffusion Network Inference in Social Media Research**  
*Yan Xia, Ted Hsuan Yun Chen and Mikko Kivela.*



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**11:00-13:00 EPIDEMICS 3 (Sala Albéniz)**

- 11:00-11:15 **Inferring country specific import risk of diseases from the World-Aviation-Network**  
*Pascal P. Klamser, Olga Baranov, Adrian Zachariae, Frank Schlosser, Benjamin F. Maier, Clara Jongen and Dirk Brockmann.*
- 11:15-11:30 **Using livestock mobility data to inform surveillance system: application to the Senegal case**  
*Alessandra Giacomini, Mamadou Ciss, Mbarqou Lo and Andrea Apolloni.*
- 11:30-11:45 **Exploring the community structure of hospital wards: A network analysis of unexpected patient movement**  
*Estera Mendelsohn, Paul Expert and Ceire Costelloe.*
- 11:45-12:00 **Assessing the effectiveness of perimeter lockdowns as a response to epidemics at the urban scale: the case of Madrid**  
*Alfonso de Miguel Arribas, Alberto Aleta and Yamir Moreno.*
- 12:00-12:15 **The role of mobility in the initial spread of diseases on random networks**  
*Marta Pardo Araujo, David García García, David Alonso and Frederic Bartumeus.*
- 12:15-12:30 **Contagion-diffusion processes with recurrent mobility patterns of distinguishable agents and control strategies**  
*Pablo Valgañón, David Soriano-Paños, Alex Arenas and Jesús Gómez-Gardeñes.*
- 12:30-12:45 **Spreading dynamics under context-dependent behaviour with an application to face mask adoption**  
*Giulio Burgio and Alex Arenas.*





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**11:00-13:00 SOCIAL SYSTEMS (Sala Bach)**

- 11:00-11:15 **Ranking-based social influence produces path-dependence**  
*Alexandros Gelastopoulos and Pantelis Pipergias Analytis.*
- 11:15-11:30 **An artificial generative model for (more) realistic social dynamics**  
*Didier Le Bail, Mathieu Génois and Alain Barrat.*
- 11:30-11:45 **Linking social network structure and function to social preferences**  
*Josefine Bohr Brask, Andreas Koher, Darren Croft, Lauren Brent and Sune Lehmann.*
- 11:45-12:00 **A general model for how attributes can reduce polarization in social groups**  
*Piotr Górski, Curtis Atkisson and Janusz Hołyst.*
- 12:00-12:15 **Statistical inference of homophily with network ensembles**  
*Sina Sajjadi, Samuel Martin-Gutierrez and Fariba Karimi.*
- 12:15-12:30 **Social explosions: some percolating properties**  
*Mariano Gastón Beiró, Ning Ning Chung, Lock-Yue Chew, Steve Lansing, Stefan Thurner and Yerali Gandica*
- 12:30-12:45 **Representing and Analyzing the Dynamics of an Agent-Based Adaptive Social Network Model with Partial Integro-Differential Equations (ONLINE)**  
*Hiroki Sayama.*
- 12:45-13:00 **Towards a general theory of balance**  
*Carlos Gershenson*

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**11:00-13:00 ECONOMICS - ECONOMIC SYSTEMS (Sala Turina)**

- 11:00-11:15 **Physics of Financial Networks**  
*Guido Caldarelli, Marco Bardoscia, Paolo Barucca, Stefano Battiston, Fabio Caccioli, Giulio Cimini, Diego Garlaschelli, Fabio Saracco and Tiziano Squartini.*
- 11:15-11:30 **Reconstructing firm-level input-output tables**  
*Andrea Bacilieri and Pablo Austudillo-Estevez.*
- 11:30-11:45 **Measuring technological sophistication as synergies in the production networks**  
*Hardik Rajpal and Omar Guerrero.*
- 11:45-12:00 **The indirect costs of corporate tax avoidance exacerbate cross-country inequality: a dynamical model**  
*Javier Garcia-Bernardo, Valeria Secchini, Daniel Haberly, Petr Janský and Miroslav Palansky.*
- 12:00-12:15 **A chain bankruptcy model based on inter-firm transaction volume**  
*Kay Nagayama, Kazuha Mori, Jun'Ich Ozaki, Hideki Takayasu and Misako Takayasu.*
- 12:15-12:30 **Modelling Profile Heterogeneity on Retirement via Deep-RL: Intelligent Agents working towards retirement**  
*Fatih Ozhamaratli and Paolo Barucca.*
- 12:30-12:45 **Revealing the link between corporate structure and tax avoidance using higher order Markov models**  
*Valeria Secchini and Javier Garcia-Bernardo.*
- 12:45-13:00 **Modeling Interconnected Social and Technical Risks in Open Source Software Ecosystems**  
*William Schueller and Johannes Wachs.*

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**11:00-13:00 MACHINE LEARNING - THEORY (Sala Granados I)**

- 11:00-11:15 **Bootstrap statistical testing for causal analysis of time series**  
*Giulio Prevedello and Bernardo Monechi.*
- 11:15-11:30 **Bayesian estimation of information theoretic metrics for sparsely sampled distributions**  
*Angelo Piga, Lluc Font Pomarol, Marta Sales-Pardo and Roger Guimera.*
- 11:30-11:45 **The BIASR Model: Confirmation Bias Emerges from an Approximation to Bayesian Reasoning**  
*Charlie Pilgrim, Adam Sanborn, Eugene Malthouse and Thomas Hills.*
- 11:45-12:00 **On learning agent-based models from data**  
*Corrado Monti, Marco Pangallo, Gianmarco De Francisci Morales and Francesco Bonchi.*
- 12:00-12:15 **The power of coarse-grained measures of information decomposition**  
*Fernando Rosas, Tomas Scagliarini, Pedro Mediano, Andrea Luppi, Sebastiano Stramaglia, Henrik Jensen and Daniele Marinazzo.*
- 12:15-12:30 **Spectral Tools for Neural Networks**  
*Lorenzo Giambagli, Enrico Civitelli, Lorenzo Buffoni, Lorenzo Chicchi and Duccio Fanelli.*
- 12:30-12:45 **Quantifying features of simulation models directly from model code**  
*Marco Pangallo, Andrea Vandin, Damiano di Francesco, Mario Martinoli and Alessio Moneta.*
- 12:45-13:00 **Fundamental limits to learning closed-form mathematical models from data**  
*Oscar Fajardo Fontiveros, Marta Sales-Pardo and Roger Guimera.*



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**11:00-13:00 FOUNDATIONS - DYNAMICS 2 (Sala Granados II)**

- 11:00-11:15 **The Law of Brevity of Words Made Quantitative and its Relation with Zipf's Law**  
*Alvaro Corral and Isabel Serra.*
- 11:15-11:30 **Slower is faster and less is more effects in robot swarms**  
*Till Aust, Mohamed S. Talamali, Marco Dorigo, Heiko Hamann and Andrea Giovanni Reina.*
- 11:30-11:45 **Why is the universe not boring?**  
*Dániel Czégel.*
- 11:45-12:00 **Inversion mutations attenuate complexity catastrophe in NK fitness landscapes**  
*Leonardo Trujillo, Paul Banse and Guillaume Beslon.*
- 12:00-12:15 **Volume exclusion in physical networks**  
*Luka Blagojevic and Márton Pósfai.*
- 12:15-12:30 **Linear physical networks**  
*Márton Pósfai, Iva Bačić, Luka Blagojevic, János Kertész and Albert-László Barabási.*
- 12:30-12:45 **Causality in interactions of solar wind, geomagnetic field and radiation belts: An information theoretic approach**  
*Pouya Manshour, Constantinos Papadimitriou, Georgios Balasis, Milan Palus, Simon Wing, Ioannis A Dagleis, Reik Donner, Adamantia Z Boutsis, Giuseppe Consolini, Jurgen Kurths and Bruce T Tsurutani.*
- 12:45-13:00 **Stochastic thermodynamics with martingales: extreme fluctuations and gambling demons**  
*Gonzalo Manzano.*



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**11:00-12:45 SOCIAL MEDIA 3 (Sala Victoria)**

- 11:00-11:15 **“Born in Rome” or “Sleeping Beauty”: Emergence of hashtag popularity on a microblogging site**  
*Hao Cui and János Kertész.*
- 11:15-11:30 **Empirically grounded opinion models uncover online political polarization in France**  
*Antonio Fernández Peralta, Pedro Ramaciotti Morales, János Kertész and Gerardo Iñiguez.*
- 11:30-11:45 **Monetization in online streaming platforms: an exploration of inequalities in Twitch.tv**  
*Antoine Houssard, Federico Pilati, Maria Tartari, Pierluigi Sacco and Riccardo Gallotti.*
- 11:45-12:00 **Overuse of moral language dampens content engagement on social media**  
*Cristian Candia, Mohammad Atari, Nour Kteily and Brian Uzzi.*
- 12:00-12:15 **Neutral bots probe political bias on social media**  
*Wen Chen, Diogo Pacheco, Kai-Cheng Yang and Filippo Menczer.*
- 12:15-12:30 **Assessing the impact of protests on the COVID-19 spread**  
*Inho Hong, Leonardo Ferreira, Alex Rutherford and Manuel Cebrian.*
- 12:30-12:45 **Empirical studies on user-generated content and behavior of Southeast Asia community in Reddit (online)**  
*Ming Hui Chung and Yukie Sano.*



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**11:00-12:30 BRAIN AND NEUROSCIENCE 2 (Sala Falla )**

- 11:00-11:15 **The role of epidemic spreading on seizure dynamics and epilepsy surgery**  
*Ana Paula Millan.*
- 11:15-11:30 **A delay coupled recurrent oscillator network - lessons from biology**  
*Felix Effenberger.*
- 11:30-11:45 **Cognitive processes in terms of heteroclinic dynamics**  
*Bhumika Thakur and Hildegard Meyer-Ortmanns.*
- 11:45-12:00 **Evolutionary paths to lateralization of complex brain functions**  
*Luís F Seoane.*
- 12:00-12:15 **Small cohort of patients with epilepsy showed increased activity on Facebook before sudden unexpected death**  
*Ian Wood, Rion Brattig Correia, Wendy Miller and Luis M. Rocha*
- 12:15-12:30 **Feature-rich multiplex lexical networks and artificial intelligence quantify cognitive strategies of early language learning (ONLINE)**  
*Salvatore Citraro, Michael Vitevitch, Massimo Stella and Giulio Rossetti.*
- 12:30-12:45 **An information-theoretic approach to hypergraph psychometrics**  
*Daniele Marinazzo, Jan Van Roozendaal, Fernando Rosas, Massimo Stella, Renzo Comolatti, Nigel Colenbier, Sebastiano Stramaglia and Yves Rosseel.*