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Ricardo Martínez-García wins international career award in complex systems' research

Junior physicist from CASUS and SAIFR recognized for his work in statistical physics to better understand the dynamics of complex living systems Physicist Dr. Ricardo Martínez-García is one of the two recipients of the 2023 Junior Scientific Award of the Complex Systems Society (CSS). The CSS grants this prize to young researchers who have achieved outstanding results in their pursuit to understand complex systems. The announcement was made on October 20 during the annual CSS conference, the world's largest and most important international meeting for the complex systems research community.

Martínez-García currently heads a Young Investigator Group at the Center for Advanced Systems Understanding (CASUS) at Helmholtz-Zentrum Dresden-Rossendorf (HZDR, both Germany) and is an associated researcher of the South American Institute for Fundamental Research in São Paulo (ICTP-SAIFR) at the Institute for Theoretical Physics of São Paulo State University (IFT-UNESP, all Brazil).

What have vehicle traffic, the brain, human society and the microbiome in common? All these are examples of complex systems that are formed by many components interacting with each other in very intricate ways. As a result of these interactions, such systems often exhibit new emergent properties that are very different from the combined properties of the individual parts that constitute them. Research on complex systems builds bridges between traditional scientific domains.

This is also a distinct trait of Martínez-García's work as he studies a variety of systems, from microbial communities, such as bacterial biofilms, to arid and semi-arid ecosystems like steppes. Across this variety of systems, his research has focused on understanding how different organisms, whether they are plant species in a steppe or bacteria in a biofilm, interact with each other and how these interactions impact the functioning of the system as a whole. By studying all these many examples using a complex-systems approach, Martínez-García's research aims to understand to which extent different ecological systems are governed by a minimum set of rules, which will improve our ability to manipulate and hopefully conserve them.

Selection Committee highlights Martínez-García's work on organizational dynamics

The Complex Systems Society promotes complex systems research since becoming an international society in 2006. Its Junior Scientific Award is aimed at recognizing excellent scientific record of young researchers within ten years of the PhD defense. It is awarded once a year to a maximum of two young researchers. The decision is made by a Selection Committee appointed by the Executive Committee of the CSS. In its award statement, the Selection Committee referenced Martínez-García's theoretical work on evolutionary, organizational, and ecological collective dynamics.

Martínez-García states his interest in complex ecological systems started because of his love for being outdoors and observing how things happen in nature: "When I learned in high school that it was possible to use physics and

mathematics to understand the rules behind these natural phenomena I was passionate about, it became evident that I wanted to explore this interface more deeply." He also highlights how interactions with fellow scientists aided to shape his research program over the years: "One of the parts that I enjoy the most about my work is talking to people with different scientific backgrounds and learning how they think about questions and problems that I also find interesting."

"A fantastic job"

The researcher adds that the award encourages him to continue working hard, a piece of advice he extends to students interested in choosing science as a profession – one that is as exciting as challenging: "It is very rewarding to see that your peers recognize the relevance of your work and consider it worth this recognition. I believe we very often focus too much on rejections and the downsides of pursuing a scientific career, even though it is, in general, a fantastic job."

Martínez-García obtained his PhD in statistical Physics and Complex Systems at the Institute for Cross-Disciplinary Physics and Complex Systems, a joint research center of the Spanish National Research Council and the University of the Balearic Islands (Spain). His thesis combined approaches from physics and computer sciences to investigate different ecological problems, such as animal movement and the emergence of regular vegetation patterns in drylands. He then received a Life Science Research Foundation fellowship to complete a postdoc in ecology and evolutionary biology at Princeton University (USA), where he investigated the interplay between the ecology, evolution and self-organized multicellularity of microbial communities. Before joining CASUS, Martínez-García worked at the ICTP-SAIFR based at the Institute for Theoretical Physics of São Paulo State University. There he was a São Paulo Research Foundation Young Investigator and an Assistant Professor in the field of biological physics.

A second Junior Scientific Award went this year to Giulia Menichetti (Harvard Medical School & Brigham and Women's Hospital, Boston, USA), who researches the full chemical complexity of the human diet and develops quantitative tools to unveil the impact of these chemicals on our health. Finally, the Selection Committee granted the Senior Award, the most prestigious recognition of the CSS, this year to Melanie Mitchell (Santa Fe Institute, USA) referring, among others, to her contributions to adaptive computation, biologically inspired computing and machine learning.

About the Center for Advanced Systems Understanding

CASUS was founded 2019 in Görlitz/Germany and pursues data-intensive interdisciplinary systems research in such diverse disciplines as earth systems research, systems biology or materials research. The goal of CASUS is to create digital images of complex systems of unprecedented fidelity to reality with innovative methods from mathematics, theoretical systems research, simulations as well as data and computer science to give answers to urgent societal questions. The founding partners of CASUS are the Helmholtz-Zentrum Dresden-Rossendorf (HZDR), the Helmholtz Centre for Environmental Research in Leipzig (UFZ), the Max Planck Institute of Molecular Cell Biology and Genetics in Dresden (MPI-CBG), the Technical University of Dresden (TUD) and the University of Wrocław (UWr). CASUS, managed as an institute of the HZDR, is funded by the German Federal Ministry of Education and Research (BMBF) and the Saxon State Ministry for Science, Culture and Tourism (SMWK).

About ICTP-SAIFR

The South American Institute for Fundamental Research (ICTP-SAIFR) is an international center created in the city of São Paulo (Brazil) through a collaboration between the International Centre for Theoretical Physics (ICTP) in Trieste (Italy), the Institute for Theoretical Physics (IFT) of São Paulo State University (UNESP), and the São Paulo state funding agency FAPESP. Its activities include research in Theoretical Physics and its applications, as well as training for postgraduate students. ICTP-SAIFR also promotes outreach actions with high school teachers and students and the general public.

About IFT-UNESP

The Institute for Theoretical Physics (IFT) is a graduate physics department of São Paulo State University (UNESP) located in the center of São Paulo. IFT-UNESP was founded in 1951 as a private foundation and incorporated into UNESP in 1987. It has approximately 20 professors and 70 graduate students in physics, and has received the top score from the national funding agency since 2011.

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URL zur Pressemitteilung:
https://www.casus.science/news/casus-news/international-career-award-in-complex-systems-research

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