MAX PLANCK INSTITUTE FOR MATHEMATICS IN THE SCIENCES

P R E S S R E L E A S E

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Perfectly linked – Minerva Fast Track Fellowship for the study of networks

Dr. Raffaella Mulas was awarded a Minerva Fast Track position by the Max Planck Society to establish her first own research group at the Max Planck Institute for Mathematics in the Sciences in Leipzig. The young and promising mathematician is honored for her excellent research on networks, focusing on the spectral theory of graphs and hypergraphs.

We encounter networks in numerous scientific disciplines and areas of life: for instance, in biology, chemistry, economy, sociology, neuroscience, epidemiology. Their underlying structure, which is characterized by the interconnection and interaction of elements, can be described and studied mathematically using graphs and hypergraphs. "My group will carry out research with the motivation to offer valid models and tools for the study of real networks", Raffaella Mulas explains "We will be working on both the mathematical foundations and applications of spectral hypergraph theory."

Despite offering hundreds of challenging problems since the very beginning of graph theory in 1736, graphs and hypergraphs have a very simple description: they are given by points, called vertices, that are connected to each other. In the case of graphs, points can only be connected in pairs and the pairwise connections are called edges. In the more general case of hypergraphs, one can have sets of points, the so-called hyperedges, and not only pairs of points. Therefore, hypergraphs are used to represent communities of elements of any size.

Raffaella Mulas gives a recent example of application: "To model a pandemic, individuals can be represented as vertices in graphs or hypergraphs. And one can then connect these individuals (in pairs or in communities) if they encounter each other. Infected individuals can potentially infect the individuals with whom they are in contact, and therefore the vertices to which they are connected."

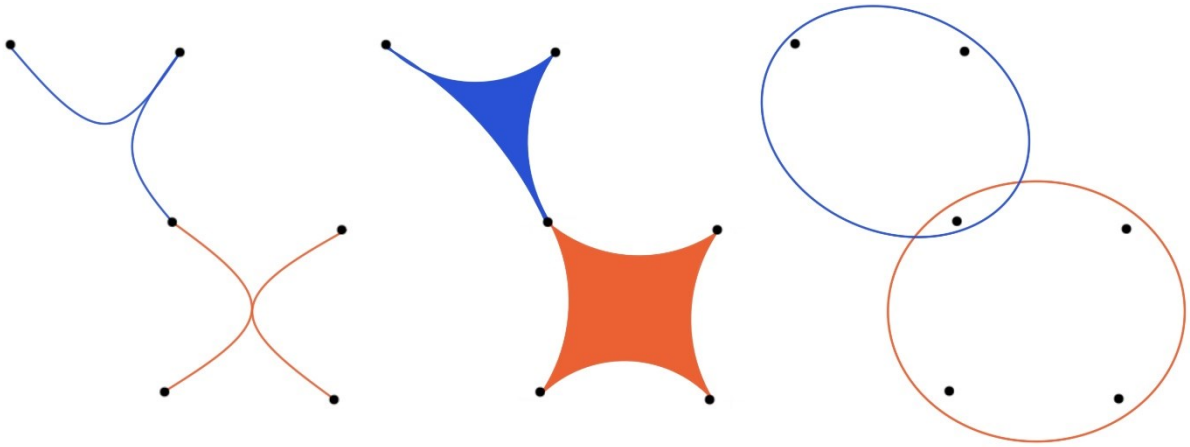
In order to draw more exact conclusions about a given network, especially when dealing with big data, the model is supplemented by the so-called spectral theory. Raffaella Mulas made several contributions in spectral graph theory, and generalized many classical results that were known for graphs to the case of hypergraphs. Together with collaborators from various institutions as for instance the Technical University of Munich, the Alan Turing Institute and

the University of Southampton, she also worked on the application of her mathematical results to dynamical systems, as well as to problems of data analysis arising in biology.

“For my future research, I wish to make the spectral theory of hypergraphs sound and solid. This will be possible thanks to the Minerva Fast Track Position.” Raffaella is pleased about her new position as research group leader. Her team will soon be joined by Christiaan Van de Ven as a postdoctoral researcher and Giulio Zucal, a PhD student.

Raffaella Mulas comes from Cagliari, Italy. She earned her Bachelor's degree at the University of Udine, Italy and her Master's degree at the University of Bonn. From 2017 to 2020 she was a PhD student the group of Jürgen Jost at the Max Planck Institute for Mathematics in the Sciences. Before returning to this institute as a group leader, she was a Postdoctoral Research Fellow between the Alan Turing Institute of London and the University of Southampton. Raffaella is an elected member of the Elisabeth-Schiemann-Kolleg of the Max Planck Society.

The Max Planck Society's Minerva Fast Track Program supports outstanding young female scientists giving them the opportunity of long-term career planning. The maximum three-year funding starts immediately after the dissertation or first postdoc position. In case of a positive evaluation, the scientists can apply then for a Max Planck Research Group / Minerva W2 Research Group.



Three ways to draw the same hypergraph on six vertices and two hyperedges such that the first hyperedge has size three, the second hyperedge has size four, and the two hyperedges share a common vertex.

Information about Dr. Raffaella Mulas:
https://www.mis.mpg.de/hypergraphs
Photo: Dr. Raffaella Mulas

Contact:
Dr. Raffaella Mulas
raffaella.mulas@mis.mpg.de

Jana Gregor / Paul Heine
Science Communication
Phone +49 170 2228049
Mail: presse@mis.mpg.de

Max Planck Institute for Mathematics in the Sciences
Inselstraße 22
04103 Leipzig / Germany
www.mis.mpg.de