Scientific Report for MAPCOM15

The international workshop, Mathematics and Physics of Multilayer Complex Networks (MAPCOM15, http://www.pks.mpg.de/~mapcom15/), was one of the highlight gatherings for the network-science community in 2015.

The 2.5-day workshop had a dense and exciting scientific program: more than a dozen of the world's leaders in the analysis of multilayer networks presented their latest work (either as invited speakers or as contributed speakers), and numerous rising stars in network science also presented talks. Talks by experts included the latest work by Shlomo Havlin and Peter Grassberger on percolation on multilayer networks (their perspectives differed, and the debate on this was lively), Marc Barthelemy on multilayer networks in transportation networks in cities, and Vittoria Colizza on using multilayer-network representations of temporal networks for the analysis of disease propagations in increasingly realistic networked structures. The talks by the young participants, who were from diverse backgrounds and nationalities, were very vibrant, and the network-science community clearly has much to which to look forward in the coming years. It was by design that so many young scholars were chosen as speakers, and they used the opportunity to discuss their work with scientific leaders and also to interact with them more generally.
The workshop also included a very good gender balance, which tends to be uncommon in hard-science topics. The discussions at MAPCOM15 were plentiful and spirited (sometimes very spirited), and they spilled over into the coffee breaks, poster sessions, and social dinner and excursion.

As suggested by the title, the conference focused on the theory and applications of what has become known as "multilayer networks", which has quickly become arguably the most prominent area in network science during the last couple of years and which encompasses networks with multiple types of ties, multiple networks that are coupled to each other, and many other examples. Some talks focused on structural considerations, but many others focused on dynamical processes (such as percolation, oscillators, and epidemics) on multilayer networks. Still others, such Thilo Gross, focused on their potential use in disciplines --- e.g. ecology --- in which the language of multilayer networks is not yet very common. The participants left with a clear idea of the state of the field, where it is heading, and what are the outstanding open problems.

The workshop also included a vibrant journal session with a panel of editors from Nature Physics, Physical Review X (the editor in chief), and Physical Review E. The panel and the audience discussed both directly scientific issues, such as what types of articles are appropriate for those journals when undertaking interdisciplinary work (e.g. in complex systems) and other issues, such making data and code public (and privacy issues for human data), what work in interdisciplinary topics is also "physics", and so on. Another important issue that was discussed at the workshop was how to use ideas from developing fields, such as the study of multilayer networks, in inherently

very messy scientific problems (e.g. in biological topics like neuroscience).

The short workshop demonstrated clearly that multilayer networks is an exciting field that has had many successes --- especially recently --- and which holds a great deal of additional promise in both theory and applications. There are clearly very big challenges that still need to be overcome, and the role of MPIPKS in bringing together leading scholars and rising young scientists for the MAPCOM15 workshop is an invaluable one. Plans for upcoming sequel workshops are already underway.

MAPCOM15 was a capstone workshop demonstrating research that was funded from a 2012--2015 proactive European Commission call on the Dynamics of Multi-Level Complex Systems. The workshop was coordinated scientifically by Alex Arenas and Mason Porter of the PLEXMATH consortium, and MAPCOM15's participants included many representatives from several of the funded consortia.