Information theory and predictability of dynamical and multilevel complex networks
PhD thesis in Applied Mathematics under the supervision of Dr. G. Bianconi

Complex systems are ubiquitous, from brain networks, to technological and social networks. Despite the great advances made in these last ten years of research in network theory and complexity science the existing theory does not capture the intrinsic dynamics of many social and biological networks and their multiple temporal and organization levels.

We propose to hire a PhD student that will approach fundamental open questions related to the information present in multiscale complex networks evolving on different time scale and organization levels.

The aim of this project is to find fundamental principles beyond complex network structure and dynamics by an integrated framework making use of the most advanced techniques of statistical mechanics, information theory and quantum information. At each stage of the proposed research special emphasis will be given to apply and validate the theoretical frameworks to empirical social and brain network data, so that the developed tools will be relevant not only for the future theoretical development of the subject, but also for practical applications. We expect that during the PhD thesis the student will find new results on information theory of dynamical complex networks. This advance in the field of networks will open the way to explore the information encoded in the dynamics of the networks and it will be used on inference problems on dynamical networks evolving on different temporal and spatial scales and on multilevel systems. Moreover we expect the student to develop the relevant theory to build algorithms for evaluating the limit of predictability in dynamical networks.

This research has a clear interdisciplinary focus and it has the potential to attract funds at the national and European level.