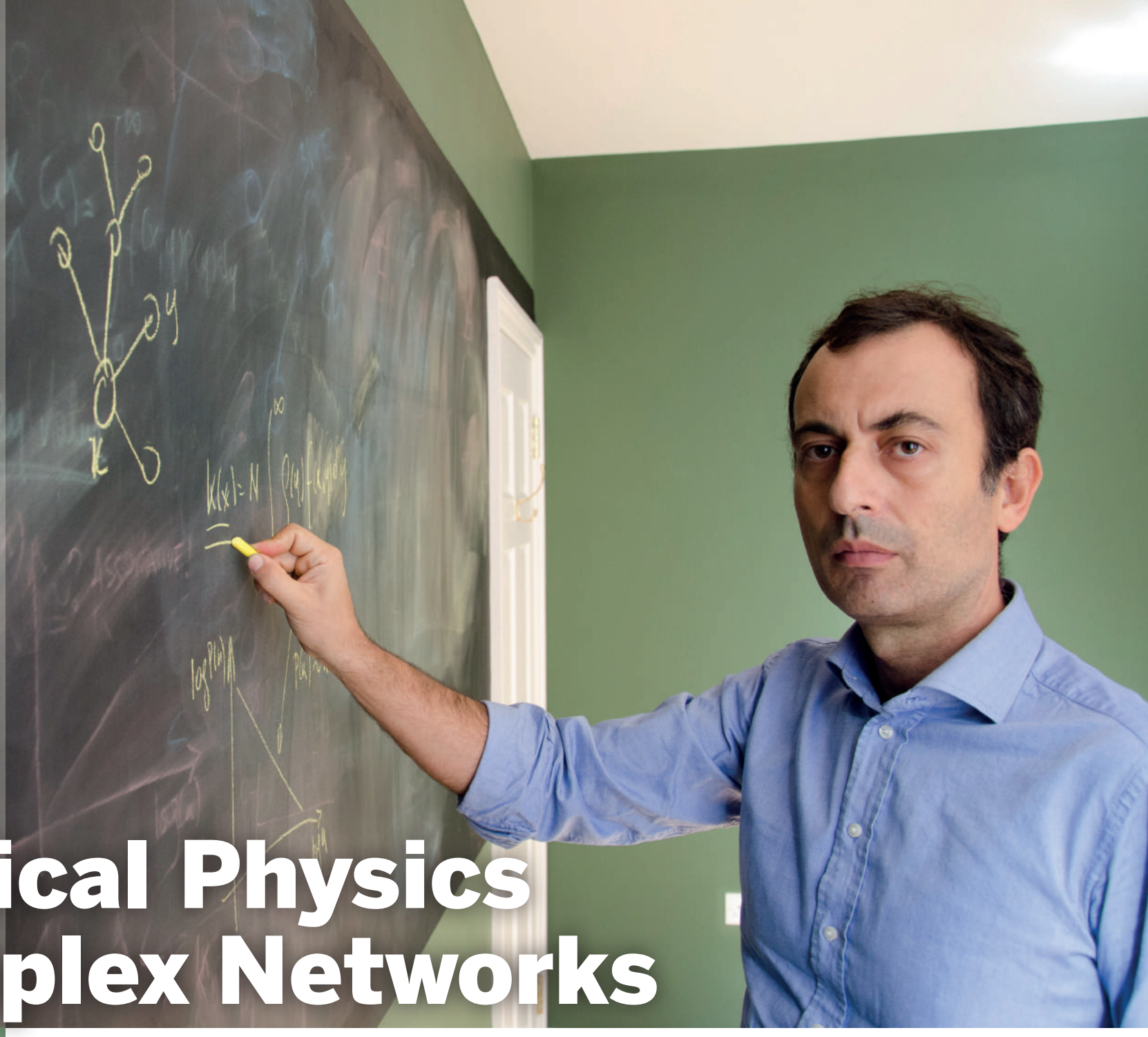
Università Ca'Foscari Venezia

Science of Complexity



Statistical Physics of Complex Networks

Guido Caldarelli,

Full Professor in Theoretical Physics at IMT

Friday **25th May 2018**, 3 pm – 5pm
Sala Conferenze Orio Zanetto, Campus Scientifico
Via Torino 155, 30170 Venezia Mestre

He studied Statistical Physics, and works in the field of Complex Networks.
Full Professor of Physics at IMT Lucca, and a LIMS Fellow.
Vice-President of the Complex Systems Society
Member of the board of the SNP Division of European Physical Society

His interests:

- Complex Networks
  Complex Networks are one of the most fascinating contemporary field of research.
- Scale-Invariance
  With the term Scale-Invariance we indicate various properties. Self-similarity (spatial scale-invariance), avalanche dynamics (temporal scale-invariance) and complex networks (topological scale-invariance)
- Plants
  Plants are able of amazing sensing capabilities, each single root apex being able to simultaneously and continuously monitor at least five chemical and physical parameters.

Abstract.
We review here, the statistical physics of complex network modelling for various physical problems showing the effectiveness of such approach. We also focus on the determination of their correct null case and focusing in particular on analytic models reproducing the local features of the network. The application of these model is valid both to detect statistically significant structural patterns in real networks (by testing them against their correctly-defined null hypothesis), and both in order to reconstruct the network structure in case of incomplete information. As a case of study we present an analysis of brain networks from fMRI, showing how brain regions tend to coordinate by forming a highly hierarchical chain-like structure of homogeneously clustered anatomical areas. A maximum spanning tree approach revealed the centrality of the occipital cortex and the peculiar aggregation of cerebellar regions to form a closed core. We also report the hierarchy of network segregation and the level of clusters integration as a function of the connectivity strength between brain regions. Finally applications to detection of diseases will be briefly outlined.