SEMPARIS – Séminaires en région parisienne

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Seminaire exceptionnel

Lundi 17 Avril 2023, 11:00

LPENS, E314 (Salle Claude Froidevaux)

Domaines: cond-mat.stat-mech

 ${\bf Titre}: Interdependent\ Networks: Novel\ Physical\ Phase\ Transitions$

Orateur: Shlomo Havlin (Bar-Ilan University)

Résumé: A theoretical framework for studying percolation of interdependent networks will be presented. In interdependent networks, such as

infrastructures, when nodes in one network fail, they cause dependent nodes in other networks to also fail. This may happen recursively

and can lead to a cascade of failures and to a sudden fragmentation of the system. This is in contrast to a single network where the

percolation transition due to failures is continuous. I will present analytical solutions based on percolation theory, for the critical

thresholds, cascading failures, and the giant functional component of a network of n interdependent networks. Our analytical results

show that a single network studied for 80 years is just a limited case, n=1, of the general and a significantly richer case of n
i 1. I will also

show that interdependent networks embedded in space are significantly more vulnerable and have richer behavior compared to non-

embedded networks. In particular, small localized attacks of zero fraction but above a critical size lead to cascading failures that

dynamically propagate like nucleation and yield an abrupt phase transition. I will finally show that the abstract interdependent

percolation theory and its novel behavior in networks of networks can be realized and proved in controlled experiments in real physical

systems. I will discuss the consequences of the recent theory of interdependent networks on phase transitions in real physical

iinterdependent systems and present theory and experiments on interdependent superconducting networks where we recently identified

a novel abrupt transition although each isolated system shows a continuous transition.

References:

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 [6] B. Gross, I Bonamassa and S. Havlin, Fractal fluctuations at mixedorder transitions in interdependent networks, 129 (26), 268301
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