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### **CCNY PHYSICIST HERNÁN MAKSE RECEIVES \$680,000 NSF GRANT TO STUDY 'DYNAMICS OF SOCIAL NETWORKS'**

NEW YORK, April 12, 2007 – A physicist at The City College of New York (CCNY) contends that the principals used to explain the organization of complex networks in matter can also be used to study the organization of social networks. CCNY Associate Professor Hernán Makse was recently awarded a three-year \$680,000 grant from the National Science Foundation for just that purpose.

Professor Makse was drawn to the problem because of his interest in complexity, a subset of statistical physics. Patterns of organization can be observed and understood, he explains, only when many units or modules of matter are seen interacting within a system.

"People are not molecules, but there are many similarities in how they organize," he continues. "Social networks have complex properties that cannot be explained just by looking at interaction between units."

Professor Makse and his colleagues intend to introduce a statistical method known as self-similarity that is based on partitioning a complex network with successively larger levels in order to unravel its modular structure. This will enable them to study how the scale of observation affects the modules. By doing so, they can observe whether the dynamic evolution of modules, and then modules of modules, behave in a similar way.

"If we see emerging patterns, we can gain understanding of how social networks work," he says. "It is like studying trees. Looking at part of the tree can give you the properties of the entire tree."

Complexity theory maintains that "more is different," he explains; paraphrasing 1972 Nobelist Philip Anderson, founder of the field. "Physicists are diversifying. What we have learned from string theorists is that the reductionist approach to understanding nature has a limit and it has been reached. When scientists are coming up with theories that nobody can solve or even measure, it is time to think about a change.

"The emergency of complexity points to the opposite direction. It assumes that at every level there is new knowledge that cannot be inferred from the previous level."

Professor Makse's preliminary data indicate that while some types of social networks organize around self-similarity, others do not. The researchers will classify available social networks by their degree of self-similarity and then study how modules emerge in a population.

The study of similar properties, such as the nature of a network's modularity, leads to a number of important applications, for example protecting a network from attack, he notes. In an Internet-type network, hubs are points of vulnerability that need to be identified and protected.

"Similar ideas can influence our strategies for immunization of large populations through vaccination, with obvious implications for the public health," adds Professor Makse, who in 2005 received the New York City Mayor's Award for Excellence in Science and Technology in part for his studies of the topology of the Internet. By focusing on the practical question of what determines the probability of spreading on social networks, he and his colleagues hope to devise algorithms for improving immunization strategies that take into account the modular structure of the society.

Professor Makse's study will make extensive use of available databases. "There's been an explosion of available data," he says. "We can get a lot of information from Internet online communities and use it to help understand the structure of networks."

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