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Title: "The Emergence of Cooperation and The Optional Public Good Games"

Understanding the collective behavior in terms of a microscopic description based on the interaction rules among the particles is a well established purpose of the Statistical Physics. Partly inspired by the success in linking micro and macro behavior, collective social phenomena are being currently studied in terms of interacting agents. Social dilemmas and the evolutionary conundrum of cooperation are modeled as games. In this context, two models have attracted most attention: The Prisoner's Dilemma for pairwise interactions and The Public Goods Games for group interactions. In this work, we study under which conditions cooperation can emerge in a type of social dilemma dynamics known as Optional Public Good Game (OPGG). In particular, we analyze the role of topology in the emergence and maintenance of cooperation in this kind of dynamics. We have studied the global properties of the OPGG on a two-dimensional regular network, on small world networks and random networks. Here, the players are placed at the nodes of the network and each can adopt one of three possible states (or strategies): cooperator (C), defector (D) or loner (L). In order to study the effect of network interactions, we have used small-world type networks where the probability p of reconnection defines the disorder degree. This probability p of rewiring determines the disorder degree of the network from a regular lattice to a random network. In combination with the systematic study of the p parameter, we also analyzed the effect of variation of the r parameter, the multiplication factor of OPGG, on the global behavior of the system. Through the systematic study of both parameters p and r, we have found that the system displays two different dynamics: i) convergence to an absorbing state, in which the all agents of the system reach the loner state and ii) evolution to a state of coexistence in which the three strategies are present in the system. In the coexistence state and for some values of the p and r parameters, the dynamics of the system exhibits a cyclic behavior among the three states. Finally, and as main contribution in this work, we have constructed a phase diagram in the parameter space (p,r) in order to characterize the different phases and collective behavior displayed by the system.

Speaker's Bio

M.Sc. Pablo Valverde é um aluno de doutorado do Instituto de Física da Universidade Federal do Rio Grande do Sul (UFRGS), e trabalha no grupo do Prof. Dr. Roberto da Silva. Tem graduação em física pela Escuela Politécnica Nacional, Quito, Equador e mestrado em física pela UFRGS. Suas áreas de pesquisa são dinâmica social e sistemas complexos.