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Title:
Order-disorder transitions in finite-size clusters of objects

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Abstract:

Essential contributions have been made in the field of finite-size systems of ingredients interacting with potentials of different ranges. Theoretical simulations have revealed peculiar size effects on stability, the ground state structure, phases, and phase transformation of systems confined in space and time, [1,2].

The models, developed in the field of atomic and molecular clusters, have been extended and successfully transferred to finite-size systems that are, at a first sight, very much different - small-scale financial markets [3], self-organization of society due to advertisements [4]. Models show that a small-scale market diverges unexpectedly fast as a result of small fluctuations; a social group possesses a critical behavior (social percolation) under the influence of an external field (advertisement), and autoimmune reaction is a sequence of two discontinuous phase transitions [5]. Some of the predicted size-dependent properties have been experimentally observed later on.

These findings imply a hypothesis that confinement of objects in interest determines the overall behavior of a system. This has been shown in the case of graphene with a special distribution of vacancies (objects of interest). While the pristine graphene is non-magnetic, vacancy-vacancy interaction causes appearance of magnetic states (ferro- or antiferromagnetic depending on the vacancy distribution), [6].

Since phases are emergent phenomena produced by self-organization of a macroscoping number of particles, the occurrence of a phase in a system containing a small number of ingredients is a remarkable result.

References:
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