Special Program in Applied Mathematics and Applied Mechanics

Spontaneous optical pattern formations in micro-cavities and nonlinear crystals

2014 - 02 - 19 (Wed.)
15:00 - 18:00
308, Mathematics Research Center Building (ori. New Math. Bldg.)

Thermodynamics gives not only the explanation of heat to work, but also the relation between macroscopic collective motion of particles and their microscopic behavior. Applications of thermodynamics have crucial impacts in chemical engineering, aerospace engineering, phase transitions, transport phenomena, cell biology, and even black holes. The successful calculation in thermodynamical properties relies on the subtle and qdetailed measurements. In this talk, with the help of incoherent beams in non-instantaneous anisotropic photorefractive crystals, we reveal the existence of thermodynamical properties in nonlinear optical systems for the first time, by calculating the configurational entropy from the measured spontaneous optical pattern formations. To the best of our knowledge, we demonstrate experimentally and theoretically the first phase diagram for pattern transitions in the form of stripes, reoriented stripes, hexagons, and spots, with the observations in the boundary of mixed-phase states as the critical temperature in a kinetic system. Moreover, effective optical temperature and optical chemical potential are introduced during different phase transitions, which indicates a variety of possible microscopic states. The results in this work not only provide an important ingredient concerning the link with previous results on pattern formations, but also serve for the discussions on the underlying mechanisms for complex systems.

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