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Symmetry and Symmetry Breaking: Phase Transitions and Critical Phenomena

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Message from the Guest Editor

Symmetry plays a primordial role in physics and mathematics, the symmetry of the order parameter and the spin group which directly concern the nature of the phase transition when an external parameter such as temperature, pressure or magnetic field breaks the system symmetry.

In various domains not restricted to physics and mathematics. The nature of the phase transition is known if we know which symmetry of the system is broken. In addition, the symmetry transformations that leave some properties of the system unchanged allow us to simplify calculations in the search for solutions. Recent investigations show that well-established methods including Renormalization Group and Monte Carlo simulations encountered many difficulties when dealing with frustrated spin systems. In addition, transitions with complicated nature have been found due to the fact that several symmetries are broken at the same point or at points very close to each other in phase space. This makes the determination of the criticality difficult. Phase transitions in biophysics are also subjects of great challenge in the years to come.

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Message from the Editor-in-Chief

Symmetry is ultimately the most important concept in natural sciences. It is not surprising then that very basic and fundamental research achievements are related to symmetry. For instance, the Nobel Prize in Physics 1979 (Glashow, Salam, Weinberg) was received for a unified symmetry description of electromagnetic and weak interactions, while the Nobel Prize in Physics 2008 (Nambu, Kobayashi, Maskawa) was received for the discovery of the mechanism of spontaneous breaking of symmetry, including CP symmetry. Our journal is named *Symmetry* and it manifests its fundamental role in nature.

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