ICTS Seminar Series

Title : An introduction to the Ginzburg–Landau theory of phase transitions and nonequilibrium patterns

Speaker : Pierre Hohenberg, New York University, United States

Date : 29, 30 December 2016

Time : 10:00 AM

Venue : Emmy Noether Seminar Room, ICTS Campus, Bangalore

Abstract : In these lectures we present an introduction to phase transitions and critical phenomena on the one hand, and nonequilibrium patterns on the other, using the Ginzburg–Landau theory as a unified language. In the first part Landau's phenomenological mean-field theory is first presented. As is well known, the mean-field approximation breaks down below four spatial dimensions, where it can be replaced by a scaling phenomenology. The Ginzburg–Landau formalism can then be used to justify the scaling theory using the renormalization group, which elucidates the physical and mathematical mechanism for the existence of thermodynamic phases, as well as scaling and universality near critical points. In the second part of the presentation, it is shown how near pattern forming linear instabilities of dynamical systems, a formally similar Ginzburg–Landau theory can be derived for nonequilibrium macroscopic phenomena. The real and complex Ginzburg–Landau equations thus obtained yield nontrivial solutions of the original dynamical system, valid near the linear instability. Examples of such solutions are plane waves, defects such as dislocations or spirals, and states of temporal or spatiotemporal (extensive) chaos.