INSTITUTE SEMINAR

Tuesday, 5 May 2015 4:00 p.m. Fermion

Speaker:

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Title:

Phase Transitions in Liquid Crystals:
Ordering kinetics in nematics and properties of ferroic mesogens

Abstract:

In this talk, I shall address some of the questions related with two fascinating problems: (i) Monte-Carlo simulations for the kinetics of phase ordering in nematic liquid crystals and (ii) Description of phase transition properties of ferroic mesogens.

The theory of phase ordering kinetics, that is the growth of order via domain coarsening when a system is quenched from a homogeneous phase to a broken symmetry phase, has been the subject of much active investigation for some time. The problem of ordering dynamics in liquid crystals is almost unexplored and is one of the most challenging fields of soft condensed state and statistical physics. We shall discuss some of the questions related with the morphology of nematic domains and the growth law which they will follow. We have performed comprehensive Monte-Carlo (MC) simulations for the phase ordering kinetics of nematic liquid crystals in d=2 and report the results for three LC Hamiltonians: LL model, LL model with long-ranged interactions ($V(r) \sim r^{-n}$) and GLL model. We have obtained an analytic form for the correlation function of LC order parameter and found that the simulation and analytic results are in excellent agreement. We have examined the time dependence of domains morphology, structure factor, and order parameter correlation function and domain length scale. We find that the domain morphology and its scaling behavior are significantly influenced by the range and form of interaction Hamiltonians and that the growth law is consistent with the Allen-Cahn law with logarithmic correction: $L(t) \sim (t/\ln t)^{1/2}$. For the case of long-ranged interactions, we observe no evidence in the dynamical universality class for n=4, as predicted theoretically on the basis of renormalization- group argument. Our work shows that a large class of systems lies in the same universality class as the system with

nearest-neighbor (LL) interactions. This finding provides a firm basis for the robustness and universality of experimental results for ordering kinetics in liquid crystals.

The understanding about the phase transition behaviour of ferroic liquid crystals is still at the primitive level. We have developed a thermodynamic model for the description of characteristic features of Sm C* and Sm A- Sm C* transition exhibited by several mesogens. We have extended the theory to analyze the influence of external perturbations on the phase transition properties of calamitic as well as bent-core ferroic liquid crystals. In conclusion, we would like to emphasise that the thermodynamic model developed by us is conceptually correct and incorporates the physical reality and are capable of explaining the phase transition properties of ferroelectric and antiferroelectric liquid crystals.
