J. Phys. Soc. Jpn. **52** (1983) Suppl. p. 45

FRUSTRATED SPIN-GAS MODEL FOR DOUBLY REENTRANT LIQUID CRYSTALS*

A. Nihat Berker and James S. Walker

Department of Physics
Massachusetts Institute of Technology
Cambridge, Massachusetts 02139, USA

A "frustrated spin gas" model is introduced to explain microscopically the doubly reentrant phase diagrams of certain liquid crystals.[1] The important features of the model are a competition between long-range antiferroelectric order and short-range positional order, and a competition between optimal molecular permeation and atomic length scale. A layer normal to the molecule axes in the nematic or smectic phases intersects a positionally disordered array of dipolar molecules. An antiferroelectric long-range order can be maintained within this array, via a subset of the molecules which anti-align with at least two closest neighbors, forming an extended cluster. The extended clusters of successive layers then underpin the density modulation characterizing the smectic phase. As temperature is decreased, frustration is increased due to enhanced short-range positional order. The extended clusters involve fewer and fewer molecules, and disappear at the smectic to reentrant nematic phase transition. Reentrant phase diagrams are calculated, using prefacing transformations. Monolayer or bilayer smectic phases can be discerned, through the dominance of effective ferroelectricity or antiferroelectricity. Thus, doubly reentrant phase diagrams are also obtained, exhibiting nematic, bilayer smectic, reentrant nematic, and monolayer smectic phases as temperature is lowered.

* Supported by NSF Grant No. DMR-79-26405.

1. A. N. Berker and J. S. Walker, Phys. Rev. Lett. 47, 1469 (1981).

INSIDE VIEW OF SHISEN-DŌ TEMPLE
-"SŌZU", A WATER-WORK SCARECRAW-

.....
.....The incessant and monotous murmuring of a little waterfall deepens quiet still more - accompanied with the intermittent, yet punctual sound of clacking which comes from a "sōzu", a sort of water-work scarecraw set up down the garden. The sōzu is made of bamboo, devised so as to make a piece of bamboo stalk strike a rock in a mountain-streamlet automatically by the gravitational power of the very running water that gathers into the stalk, and .....
.....

Upper: Normal equilibrium state.

Lower: Transient non-equilibrium state.