Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Microscopic origins of first-order SmA-SmC phase behavior and electro optics in de Vries smectic liquid crystals[1] Z. KOST-SMITH, M.A. GLASER, P.D. BEALE, N.A. CLARK, Dept. of Physics, University of Colorado — Many de Vries liquid crystals exhibit a first-order SmA-SmC phase transition. The original de Vries hollow cone model, in which molecules in the SmA phase are tilted with respect to the layer normal but are uniformly distributed in azimuthal orientation, ϕ, has been used successfully to model many properties of de Vries materials, but the microscopic origins of first-order behavior remain obscure. We describe a microscopic mechanism for first-order behavior in de Vries smectics based on the hollow cone model, embodied in a generalized planar spin model where effective interactions between tilted molecules in the smectic layer planes are represented by a nearest-neighbor pair potential, $u(\phi_{ij})$, with a minimum of variable width around $\phi_{ij} = \phi_i - \phi_j = 0$. Using mean-field theory and Monte Carlo simulation, we find that the SmA-SmC transition is second order for a relatively broad minimum in the potential, and becomes first-order as the minimum narrows. This reflects the expected behavior due to excluded volume interactions in a tilted smectic, in which increasing cone angle leads to a more steeply varying effective azimuthal potential. This model naturally explains the observed first-order behavior in the framework of a hollow cone model.

[1]This work was supported by NSF MRSEC Grant DMR-0820579 and NSF Grant DMR-1008300

Z. Kost-Smith
Dept. of Physics, University of Colorado

Date submitted: 11 Nov 2011 Electronic form version 1.4