Abstract Submitted
for the MAR09 Meeting of
The American Physical Society

Theory and simulation of two-dimensional nematic and tetratic phases[1] JUN GENG, JONATHAN V. SELINGER, Liquid Crystal Institute, Kent State University — Recent experiments and simulations have shown that two-dimensional systems can form tetratic phases with four-fold rotational symmetry, even if they are composed of particles with only two-fold symmetry. To understand this effect, we propose a model for the statistical mechanics of particles with almost four-fold symmetry, which is weakly broken down to two-fold. We introduce a coefficient κ to characterize the symmetry breaking, and find that the tetratic phase can still exist even up to a substantial value of κ. Through a Landau expansion of the free energy, we calculate the mean-field phase diagram, which is similar to the result of a previous hard-particle excluded-volume model. To verify our mean-field calculation, we develop a Monte Carlo simulation of spins on a triangular lattice. The results of the simulation agree very well with the Landau theory.

[1]This work was supported by NSF Grant DMR-0605889.

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Date submitted: 20 Nov 2008 Electronic form version 1.4