Supplementary Information

Local Chiral Symmetry Breaking in Triatic Liquid Crystals

Kun Zhao\textsuperscript{1,2}, Robijn Bruinsma\textsuperscript{1,2}, and Thomas G. Mason\textsuperscript{1,2,3}

\textsuperscript{1}Dept. of Physics and Astronomy, \textsuperscript{2}Dept. of Chemistry and Biochemistry, and \textsuperscript{3}California NanoSystems Institute, University of California, Los Angeles, CA 90095, USA

Supplementary Figures

Supplementary Figure S1. Comparison between Fourier transform intensity patterns. (\textbf{a}) Fourier transform intensity pattern of original microscope image showing triangles at $\phi_t = 0.63$. (\textbf{b}) Fourier transform intensity pattern of center-only image (\textit{i.e.} a reconstructed real-space image which has non-zero positional intensity-- dots-- only at centers of triangles as determined by VPTM). At lower wavevectors $q$ (\textit{i.e.} near the center), the pattern in \textbf{b} has the same modulation and diffuse spots as the pattern in \textbf{a}. However, at higher $q$, interference of the form factors $F(q)$ of the triangles in different orientations becomes important: the pattern in \textbf{a} is weaker than the pattern in \textbf{b} at higher $q$. The similarity in the patterns at lower $q$ for both \textbf{a} and \textbf{b} verifies that the Fourier transforms of the microscope images at low $q$ dominantly reflect the triangles' large-scale positional structure (\textit{i.e.} the structure factor $S(q)$ associated with center locations of triangles, regardless of their orientations). Scale bar in \textbf{a} is 0.2 $\mu$m$^{-1}$. 
Supplementary Figure S2. Positions and orientations of triangles determined by particle tracking. The area fraction shown is $\phi_A = 0.63$. The center (+) and one vertex (*) of each triangle are found by image analysis, yielding its position and orientation. Triangles near the edges of the images are excluded from the analysis. Scale bar is 10µm.
Supplementary Figure S3. 6-fold bond orientational (BO) correlation function $g_{6}^{bo}$ calculated for next-nearest-neighboring (NNN) triangles. Here $r$ is the center-to-center separation between triangles, $D = (2/3^{1/2})L$ is the diameter of the circumscribed circle around a triangle, and $L$ is the average edge length of a triangle. Triangle area fractions are: $\phi_A = 0.56$ (square), 0.58 (diamond), 0.63 (cross), and 0.69 (plus); lines guide the eye. Thus, in addition to order parameters associated with nearest-neighboring triangles, the I-$T_\Delta$ phase transition can also be identified by the appearance of 6-fold MO order of NNN triangles, which is inherently coupled to the 6-fold BO order of NNN triangles that effectively form two interpenetrating lattices that point either predominantly up or down. At the highest $\phi_A$ shown, $g_{6}^{bo}$ for NNN triangles decreases slightly due to the emergence of lateral offsets in the relative positions of nearest neighboring triangles in $T_\Delta\chi$. 