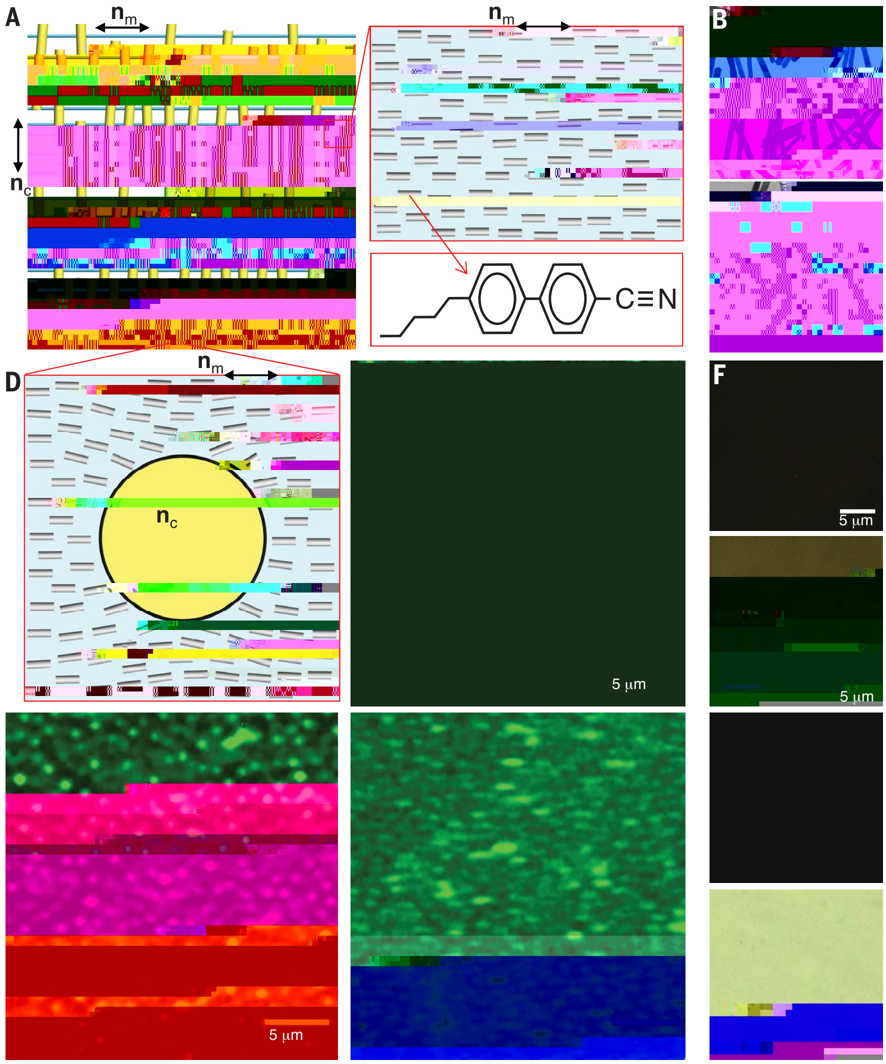
A
nm
nc
nm
C≡N
B
D
nm
nc
5 μm
F
5 μm
5 μm
5 μm

[redacted]

typical biaxial birefringence is ~10^{-3}. Experi-
mental conoscopic images, produced by optical

har84lid 0l 16 [-

reveals their biaxial orientational distributions at different T and ϕ_c (Fig. 4, B to E), as well as facile electric and magnetic switching of $\mathbf{n}_c$ (fig. S5). In the vicinity of ϕ_{cUB}, we detected only small changes of $S_c \approx -0.49$ but find that Δ_c jumps from zero to ≈0.6 at $\phi_c \approx 0.12\%$ (in the beginning of the two-phase coexistence) and then increases with ϕ_c to ≈0.95 at $\phi_c > 0.16\%$ in the biaxial phase (Fig. 4C). Orientational distribution functions are biaxial for both molecular and colloidal rods, though biaxiality of colloidal ordering is much stronger than the weak induced biaxiality in molecular ordering (Fig. 4). The biaxial NLC is not merely a superposition of two uniaxial nematic molecular and colloidal states with orthogonal ordering directions. Anisotropic molecular interactions at interfaces of orientationally ordered nanorods lift the uniaxial symmetry of molecular order and, simultaneously, induce biaxiality in the distribution of colloidal nanorod orientations. Tensorial order parameters describing this behavior of molecules and colloids, $\mathbf{Q}_{m,c} = \mathrm{diag}\{S_{m,c},(\Delta_{m,c} - S_{m,c})/2, -(\Delta_{m,c} + S_{m,c})/2\}$, determine physical properties—such as the optical anisotropies characterized in Figs. 1 and 2—

Hybrid molecular-colloidal liquid crystals

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Science **360** (6390), 768-771.
DOI: 10.1126/science.aap9359

Finding order in twos

In nematic liquid crystals, the local orientation of the molecules hovers around an average direction. The orientational control bestows unusual optical properties. In theory, with the right sort of two-dimensional shape, it should be possible to create nematics with biaxial ordering, but this has proven elusive. Mundoor *et al.* dispersed colloidal rods into a nematic solvent (see the Perspective by Poulin). Within a range of temperature and concentration, the rods ordered orthogonally to the solvent molecules, thus giving the mixture the type of properties that one would expect from a biaxial liquid crystal.

Science, this issue p. 768; see also p. 712

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