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LIQUIDS WITH CUBIC ORIENTATIONAL ORDER - THE CHOLESTERIC BLUE PHASE*

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Many organic chiral liquids form upon cooling a phase, called cholesteric, which is characterized by one-dimensional helical orientational order, but has no positional order. When the pitch is short enough, other phases appear in a narrow temperature range between the disordered liquid and the cholesteric phase. These so-called blue phases have strong optical activity and, in contradistinction to the cholesteric, are optically isotropic. They exhibit Bragg scattering and their growth habit is cubic, suggesting three-dimensional order with a unit cell very large compared to molecular size.

Using Landau theory, we show why such a three-dimensional orientational order emerges. We present models of this orientational order for various blue phases and discuss the implication for the selection rules for Bragg reflection. These turn out to be different from the classical crystallographic ones. The physical reason for this difference will be explained and the role of polarization emphasized. Some properties for the blue phases, including optical activity, light scattering and phase diagrams in the temperature-chirality plane will be discussed and compared with experiment.

A detailed description of the work outlined here is given in "Landau Theory of Cholesteric Blue Phases" by H. Grebel, R.M. Hornreich and S. Shtrikman, in "Theory of Light Scattering in Cholesteric Blue Phases" by R.M. Hornreich and S. Shtrikman and in "Optical Activity of Cholesteric Liquid Crystals in the Pretransitional Regime and in the Blue Phase" by D. Bensimon, E. Domany, and S. Shtrikman, Phys. Rev. A, in press.

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