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Banana Phases: Exotic Chiral and Polar Ordering

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Molecular organization in condensed phases is mostly a matter of shape, so a time-honored mode of exploration of "phase space" in liquid crystal science has been to try different molecular shapes (rods, discs, laths, wedges, etc.). A current important theme is molecular bananas, which, as their shape suggests, might be expected to organize in a polar way. Indeed they do, but beyond this, almost everything learned about them in the past few years has been surprising. I will discuss some of the new phases and phenomena, including Pasteur's experiment (spontaneous chiral resolution) in a fluid of achiral molecules, triclinic fluid order, chiral line liquids of achiral molecules, electric field switching of handedness, ferroelectric and antiferroelectric phases with supermolecular-scale polarization modulation, and chiral thermotropic sponge phases. Many of these structures can be understood on the basis of the interplay of strong stratification into 2D fluid layers, and frustration due to molecular "misfitting."

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