Dynamics of helix inversion in phototunable liquid crystals

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Very small amounts of chiral dopant added to achiral nematics are typically sufficient to turn these into chiral cholesteric phases.[1] The sign and magnitude of the helical pitch of the cholesteric is controlled by the chemistry of both dopant and nematogen, the temperature and the concentration of dopant. Some dopants are known to undergo a cis-trans isomerisation if irradiated with light, which expresses itself in a helix inversion of the cholesteric.[2,3] Whilst the kinetics of helix inversion seem to be dominated by the isomerisation of the dopant, it must also be coupled to the chirality transfer from dopant to nematogen and the twisting dynamics of the director field.[2] We propose a simple theory in which chirality amplification is directly connected to the dynamic equilibrium between left- and right-handed twisted conformers of nematogens such as 5CB, and the tendency for these conformers to become correlated (or to synchronise[1]) on account of favourable homochiral interactions acting between them.[4] Our model hinges on the existence of three fundamental timescales, two of which are associated with the isomerisation kinetics of the dopant and the nematogen, and one with response of the director field to the enantiomeric excess of the nematogens induced by the dopant molecules. Recent helix-inversion experiments do indeed point at the existence of multiple timescales,[3] and support our model prediction that the instantaneous chiral field of the nematic couples to the conformational state of the dopant.

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Biography:

Paul van der Schoot is a soft matter theoretician and has worked on a variety of problems in colloidal dispersions, liquid crystals, polymer and liquid crystal networks, supramolecular polymers, viruses and virus-like particles, percolation, thin films and droplets. He studied molecular sciences at Wageningen Agricultural University, and obtained his PhD from Delft University of Technology in 1992. Following postdoctoral research assistantships at the Cavendish Laboratory in Cambridge, the Max Planck Institute for Colloids and Interfaces near Berlin, and the Van 't Hoff Laboratory for Physical and Colloid Chemistry in Utrecht, he joined the department of applied physics at Eindhoven University of Technology in 1999 and has since risen through the ranks. He held visiting scholar and professorship positions at Utrecht University, UCLA, UC Riverside, UPMC in Paris, LPS in Orsay, and CRPP in Bordeaux.