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Editorial

This special issue of the European Journal of Applied Mathematics is devoted to the **'Liquid Crystal Theory and Modelling: Discussion Meeting'** that was held in Oxford on the 29th-30th October 2009. This international, interdisciplinary meeting was organised jointly by Dr Apala Majumdar (University of Oxford) and Prof. Nigel Mottram (University of Strathclyde) and was funded by OCCAM (Oxford Centre for Collaborative Applied Mathematics), the London Mathematical Society, Taylor and Francis and Cambridge University Press.

Liquid crystals were first described almost 150 years ago in 1888 by the Austrian botanist Freidrich Reinitzer, whilst he was investigating various physical properties of cholesterol. Liquid crystal research has grown tremendously since then, particularly so in the last three or four decades, since the realisation that they may be used as the basis of information display devices. Their unique opto-electrical properties continue to make liquid crystals the functional material of choice in the multi-billion dollar display industry, as well as in more general photonic devices and sensors. New liquid crystal materials are being constantly discovered whose novel properties open the door for an array of new technologies. Further, liquid crystal science has today found a firm footing in biological applications and one can safely assume that liquid crystals will continue to be an integral part of future emerging technologies.

The mathematical theory of liquid crystals is very rich, spanning diverse fields such as calculus of variations, theory of elliptic partial differential equations, algebraic topology and geometry. Given the interdisciplinary nature of liquid crystal science, there is tremendous scope for mathematical modelling in this field. Mathematical modelling can answer questions of fundamental scientific interest, give crucial insight into the operational mechanisms of liquid crystal devices and the fabrication of new improved devices, and pave the way for knowledge transfer between liquid crystals and related areas.

The **'Liquid Crystal Theory and Modelling: Discussion Meeting'** was structured to reflect the interdisciplinary nature of liquid crystal science and the increasing need of mathematical modelling and cross-disciplinary collaborations. There were six separate themed sessions: three sessions on mathematical modelling and theoretical foundations of liquid crystal science and one session each on numerical simulations, related scientific areas and industry-based liquid crystalline applications. The talks covered an wide range of topics in modern liquid crystal science such as: phenomenological theories for nematics, smectics and complex fluids; hydrodynamical theories for liquid crystals and liquid crystal-like systems; mean-field liquid crystal theories; application-based areas such as colloidal systems, functional materials and bistable liquid crystal devices; and molecular simulations of homogeneous and heterogeneous liquid crystalline systems.

In this issue, we feature peer-reviewed research articles authored by the invited participants at this workshop. There are a total of seven peer-reviewed research articles in this

issue. The first two research articles by Bisi & Rosso and Bisi, Gartland & Virga focus on mean-field liquid crystal theories. In the paper by Bisi & Rosso, the authors explicitly compute the excluded volume potential for a pair of non-convex V-shaped molecules. In the paper by Bisi, Garland & Virga, the authors present a very readable account of the mean-field free energy model for phase transitions based on the Straley pair-potential with special attention to the existence of tricritical points in the phase diagram. These articles are followed by papers on phenomenological continuum liquid crystal theories by Majumdar and Davidson & Mottram. Majumdar carries out an analytic study of the widely observed radial-hedgehog defect in nematic systems whereas Davidson & Mottram illustrate the use of conformal mapping techniques in the mathematical modelling of bistable liquid crystal devices. There are two further research articles on systems related to conventional liquid crystalline systems - a research article on nematic elastomers by Luo & Calderer and a research article on fibre lattices in a liquid crystal matrix by Phillips & Rey. The last research article in this issue, co-authored by Biscari & Sluckin, focuses on novel asymptotic approaches to the motion of topological defects in a liquid crystalline medium.

All in all, the seven research articles in this special issue focus on some of the main themes in contemporary liquid crystal science - mathematical modelling on different length-scales, theory of defects and novel functional materials. We hope that these articles highlight the importance and the tremendous potential of mathematical modelling in liquid crystal science and, more generally, for problems at the physical sciences-engineering interface. Workshops such as the **'Liquid Crystal Theory and Modelling: Discussion Meeting'** bridge the gap between the many disciplines of liquid crystal research and assist the essential two-way feedback between mathematics and applications, and we hope that this workshop will be followed by many such others in the future.