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Liquid Crystal Theory and Modelling Discussion Meeting

by

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Liquid Crystal Theory and Modelling: Discussion Meeting

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The field of liquid crystal research has grown substantially in the last two decades because of diverse liquid crystal applications, the booming display industry, new material technologies and novel liquid crystalline systems. Liquid crystal research today is truly interdisciplinary, spanning across the fields of mathematics, physics, chemistry, engineering and computer science. Moreover, liquid crystals have now found a firm footing in modern colloid science, the polymer industry and biological applications. It is now high time to organize collaborative workshops in liquid crystal science that can bring together the different research strands and we recently organized one such meeting on the 29th - 30th October 2009 in Oxford, U.K. This two-day **Liquid Crystal Theory and Modelling: Discussion Meeting** took place in St. Annes' College, Oxford and was funded by OCCAM (Oxford Centre for Collaborative Applied Mathematics) and a LMS (London Mathematical Society) Conference Grant along with sponsorship from Taylor and Francis and Cambridge University Press. OCCAM is a new centre for applied mathematics in the University of Oxford, funded by the KAUST (King Abdullah University of Science and Technology) initiative in Saudi Arabia and is particularly supportive of applications-based interdisciplinary research. There were over 50 participants in this meeting, from all over the U.K, Europe and North America, 17 of whom were keynote and invited speakers. The meeting comprised six themed sessions: three sessions on the mathematical modelling and theoretical foundations of liquid crystal science, one session on the numerical simulation of liquid crystalline systems, one session on related areas and one session on industry-based liquid crystal applications. The sessions reflect the interdisciplinary nature of liquid crystal research and were aimed at identifying application-based problems where cognate mathematical modelling will play a key role.

There were five keynote speakers: Professor Epifanio Virga, who is an internationally reputed mathematician; Professor Iain Stewart, who is well-known for his theories on smectic liquid crystals; Professor Liu who is a leading expert on the mathematics of complex fluids; Professor Rey who is an expert in computational material science and Professor Zumer who is internationally well-known for numerical simulations of homogeneous and heterogeneous liquid crystalline systems along with colloidal systems. Further, there was an impressive collection of invited speakers, many of whom are eminent theorists, physicists, experimentalists, numerical modellers and mathematical analysts. Two of the keynote speakers and six out of the twelve invited speakers were from outside mathematics, again reflecting the interdisciplinary nature of liquid crystal science and the need for transferable research methodologies. Industrial participation was actively welcomed and indeed, many of the invited speakers in the applications and numerical simulation sessions had industrial affiliations. The talks covered an exhaustive range of contemporary topics in liquid crystal science such as (a) phenomenological theories for nematics, smectics and complex fluids (Liu, Majumdar,

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Sonnet, Stewart, Virga) (b) hydrodynamical theories for liquid crystals and liquid crystal-like systems (Biscari, Yeomans) (c) mean-field liquid crystal theories (Bisi, Robbins) (d) application-based areas such as colloidal systems and functional materials (Rey, Sluckin, Zumer), bistable liquid crystal devices (Brown, Newton) and (d) molecular simulations of homogeneous and heterogeneous liquid crystalline systems (Cleaver, Wilson and Zannoni). This meeting was open to all applied mathematicians or generally to all scientists interested in materials science modelling. Indeed the six themed sessions were chaired by Professor Jon Chapman, Dr Paul Dellar, Professor Sam Howison, Professor Nigel Mottram, Professor John Ockendon and Dr Hilary Ockendon, all of whom are eminent applied mathematicians working in different areas but only one, Professor Nigel Mottram, is a liquid crystal expert.

Further, there were two general discussion sessions, the first of which was chaired by Professor Steve Elston and the second was chaired by Professor Tim Sluckin. These sessions were open to everybody and were aimed to consolidate the different talks, pinpoint some of the main challenges in liquid crystal research and where possible, discuss strategies for dealing with them. For example, hybrid models that can successfully couple microscopic and macroscopic liquid crystal theories are of growing interest in the modern scientific community, particularly in the context of device modelling. There are however a number of different molecular-based, mean-field and continuum theories in the literature and a systematic understanding of the mathematical and physical inter-relationships is still missing i.e. how does molecular-based information manifest itself in macroscopic equations and how do molecular properties influence macroscopic observables. There are, of course, many other fundamental questions in liquid crystal modelling and even the choice of the correct order parameter is not completely agreed on.

The participation of graduate students and early-stage researchers was particularly encouraged at this meeting. The registration fees were waived for all Oxford-based participants and seven graduate bursaries were awarded on the basis of merit and recommendation. These bursaries were intended to cover the registration fees, travel, subsistence and accommodation. Further, a poster session was also organized and seven participants presented posters on their research, most of whom were graduate students.

Finally, this meeting served as an extremely interesting platform for liquid crystal experts to get together, exchange ideas and form new collaborations. We hope that there can be a follow-up meeting in the near future. The proceedings of this meeting will be published as a special issue of the European Journal of Applied Mathematics. The full meeting programme, list of speakers, abstracts and list of participants can be found at the workshop webpage www.maths.ox.ac.uk/events/liquid-crystal-workshop.

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