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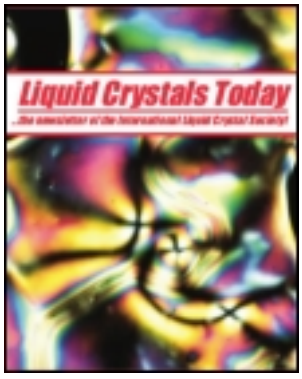

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View from the Ljubljana Workshop 'Confined Liquid Crystals: Landmarks and Perspectives'

Ivan I. Smalyukh [a b]

[a] Department of Physics and Liquid Crystal Materials Research Center, University of Colorado, Boulder, CO, 80309, USA

[b] Renewable and Sustainable Energy Institute, National Renewable Energy Laboratory, University of Colorado, Boulder, CO, 80309, USA

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CONFERENCE REPORT

View from the Ljubljana Workshop 'Confined Liquid Crystals: Landmarks and Perspectives'

Ivan I. Smalyukh*

Department of Physics and Liquid Crystal Materials Research Center, University of Colorado, Boulder, CO 80309, USA and Renewable and Sustainable Energy Institute, National Renewable Energy Laboratory, University of Colorado, Boulder, CO 80309, USA

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Having one of the strongest, most active and largest liquid crystal research centres in the world, in addition to numerous cultural and historical landmarks, Ljubljana is one of the most attractive destinations for a liquid crystal scientist to visit. The workshop 'Confined Liquid Crystals: Landmarks and Perspectives' was a wonderful opportunity to do this. The Workshop took place on 19–20 July 2010 (http://clc.fmf.uni-lj.si/). The timing was tuned in such a way that it allowed many participants from overseas to combine their travel to Ljubljana with that to the International Liquid Crystal Conference ILCC-2010 in Krakow which took place during the week before the workshop.

Ljubljana is the capital city of Slovenia (Figure 1), situated in between the neighbouring countries of Austria, Hungary, Croatia and the Venice region of Italy. The Ljubljanica River runs through the city and many of the activities in the city gather along the river. Ljubljana has a friendly relaxed atmosphere and numerous historic and cultural landmarks that include the Castle Hill, Prešeren Square, Triple Bridge, Dragon Bridge and numerous other bridges across Ljubljanica that all have their unique charming look. The city has some of the world's best dining places with a combination of local Slovenian and international cuisine. The workshop organisation took full advantage of everything that Ljubljana offers, and provided plentiful opportunities for informal discussions during the lunches and dinners that typically took place in restaurants on the banks of Ljubljanica. There was ample time for informal elaboration of ideas exposed during the scientific sessions. Napkins in the restaurants have been extensively used to draw liquid crystal structures, the conversations were full of excitement and technical jargon (such as 'homeotropic', 'order parameter', 'topological defects') that only liquid crystal scientists can fully understand; these were only some of the many indicators that the workshop was a successful event and that the scientific sessions held in the Museum of Modern Art were going well. Most of all, I liked the workshop's friendly atmosphere and the spirit of creativity that was set by its diligent local organisers and all participants.

The scientific theme of the workshop 'Confined Liquid Crystals' matches the research area of the most active involvement and strength of the Ljubljana liquid crystal centre, as well being as one of the most active and promising research directions in the liquid crystal research field. The main goal of the conference was to identify the most exciting prospects and challenges in the study of confined liquid crystals and to explore the future of liquid crystal science and technology. The second goal was to celebrate numerous landmark research contributions of Slobodan Žumer (along with his birthday), one of the most prominent and active researchers in the field of confined liquid crystals and also the president of the International Liquid Crystal Society. Taking place right after the wonderful biennial ILCC-2010 conference (the largest conference in the liquid crystal field) that covered all aspects of liquid crystal research and that practically all workshop participants have attended too, the workshop offered the atmosphere of a small meeting with a community of friends and a focused in-depth (both formal and informal) discussion of a relatively narrow set of liquid crystal research topics related to the effects of confinement. One of its unique important features was that many of the invited lectures have been recorded and are available for viewing along with the presentation files synchronised with the lectures at http://videolectures.net/clc2010_ljubljana/. This is a wonderful resource that will be available for liquid

*Email: ivan.smalyukh@colorado.edu

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Figure 1. The workshop 'Confined Liquid Crystals: Landmarks and Perspectives' took place in the beautiful city of Ljubljana, Slovenia. The pictures in the top three rows were taken in central Ljubljana and the ones in the bottom row were taken in Bled.

crystal researchers many years after the workshop. By following this link, one can not only view these videos along with the presentation files, but also see the number of previous viewers, take a survey, make comments and give various other types of feedback.

Invited speakers included the most prominent researchers in the field, experimentalists and theorists alike (Figure 2). The speakers discussed new and often still unpublished results, touching on both fundamental and applied aspects of this

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Figure 2. The workshop offered a wonderful combination of formal lectures and informal discussions.

research. For example, Philippe Poulin from Centre de Recherche Paul Pascal in France gave a presentation that received by far the largest number of online viewers (http://videolectures.net/clc2010_ljubljana/). Philippe discussed the formation of liquid crystal phases by carbon nanotubes. He focused on the phase behaviour of nanotube suspensions stabilised by surfactants and amphiphilic polymers, as well as their dispersion in a liquid crystalline medium. Poulin showed that, because of their small dimensions and the 'weak anchoring' regime, the carbon nanotubes do not create significant elastic distortions of the liquid crystal host, but still align due to the surface energy anisotropy.

Igor Muševič, a local speaker from the University of Ljubljana with the second largest number of viewers of the videolecture (http://videolectures.net/clc2010_ljubljana/), discussed the use of liquid crystals confined in a droplet geometry for a number of new applications, such as microcavities and three-dimensional (3D) microlasers based on individual nematic or cholesteric droplets suspended in isotropic polymer or fluid hosts. He showed that a small droplet of a nematic liquid crystal is an optical microresonator, provided that the index of refraction of a liquid crystal is higher than that of the surrounding medium. The spectrum of light in the nematic liquid crystal microresonator possesses the Whispering Gallery Mode structure. Light circulating inside the microcavity (due to the subsequent total internal reflections at the liquid crystal-surrounding interface) can have the resonance condition for a particular wavelength at which the light comes back to the point of origin with the same phase. The presentation demonstrated that Whispering Gallery Mode eigenfrequencies in a nematic droplet can be tuned by external fields. This is of interest for application in integrated photonics, where the microresonators are the basic element for many devices. Further, Igor demonstrated lasing in liquid crystal microdroplets and discussed the feasibility and perspectives of realisation of integrated photonics based on liquid crystals.

Several talks focused on confinement effects related to liquid crystal defects. Randal Kamien from the University of Pennsylvania gave a very exciting and insightful presentation on characterisation of nematic point and line defects, disclination loops and defect knots. Noel Clark from the University of Colorado at Boulder discussed the effects of confinement in two dimensions on freely suspended smectic films, including the defects generated by the presence of islands and their interactions. Jun-ichi Fukuda from the National Institute of Advanced Industrial Science and Technology in Japan addressed the effects of strong confinement on defect structures of cholesteric blue phases, showing (by means of computer simulations) that a large number of new defect structures can be observed when a cholesteric sample in the blue phase is subjected to the confinement between flat surfaces with well-defined boundary conditions. Ivan Smalyukh from the University of Colorado at Boulder presented on optically dictated spatially localised structures of defects in confined cholesteric liquid crystals, which, in turn, can be used to control optical phase singularities. Samo Kralj from the University of Maribor in Slovenia discussed liquid crystal defect configurations on thin nematic

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films, focusing predominantly on merging and splitting of topological defects, reshaping of defect cores, positioning of defects and defect-induced global system transformations; all of these phenomena were analysed in the framework of two-dimensional (2D) or 3D Landau–de Gennes theory in terms of the tensorial order parameter.

Daniele Finotello from Kent State University and the US National Science Foundation discussed how phase transitions in liquid crystals are affected by the confinement into porous media, such as silica aerosils, aerogels, porous glass, Nuclepore, Anopore, Millipore filters, etc. He gave a brief introduction to nuclear magnetic resonance (NMR) and dynamic nuclear magnetic resonance (DNMR), their use to study liquid crystalline ordering, and then discussed the detailed properties of phase transitions in nanoconfined liquid crystalline media revealed by these techniques. Boštjan Zalar from the University of Ljubljana discussed the use of the NMR technique too; however, he focused on the phenomena related to demixing and phase separation in liquid crystals. Riccardo Barberi from the University of Calabria in Italy discussed the nematic order reconstruction, by focusing mostly on the so-called 'Pi-cell' and overviewing recent theoretical and experimental advances in this effort (i.e. multiphoton fluorescence studies of field-induced switching dynamics and Q-tensor numerical modelling capable of description of the nematic-order dynamics in full details, as well as comparison of theoretical results with the experiments). Tom Lubensky from the University of Pennsylvania discussed architecture, phonons and elasticity in nearly isostatic periodic media. Michael Allen from the University of Warwick gave a talk on his studies of colloidal suspensions of platelets, including such aspects as phase behaviour, numerical determination of elastic constants, and the effects of confinement. Martin Čopič from the University of Ljubljana gave a lecture on how nematic fluctuations can be utilised as a means of probing the properties of liquid crystal elastomers.

Two talks of the conference focused on numerical studies of colloidal dispersions in nematic liquid crystals. Slobodan Žumer discussed colloidal interactions and self-assembly of particles entangled by disclination lines, revealing a great deal of details and insights about the structure of defects associated with, for example, the formation of colloidal dimmers linked by the defect lines. Workshop participants presented a gift to Žumer, a boogie board (Figure 3) – the popular commercial product that to a large extent was enabled by important contributions of Žumer and his collaborators to the field of confined liquid crystals. Žumer's former PhD student, Miha Ravnik (currently at the University of Oxford, UK) explored structures and defects induced by various kinds of Janus colloidal inclusions and colloidal interactions between particles in liquid crystals subjected to the effects of flow, applied fields, etc.

The other invited speakers (whose lectures do not appear at http://videolectures.net/clc2010_

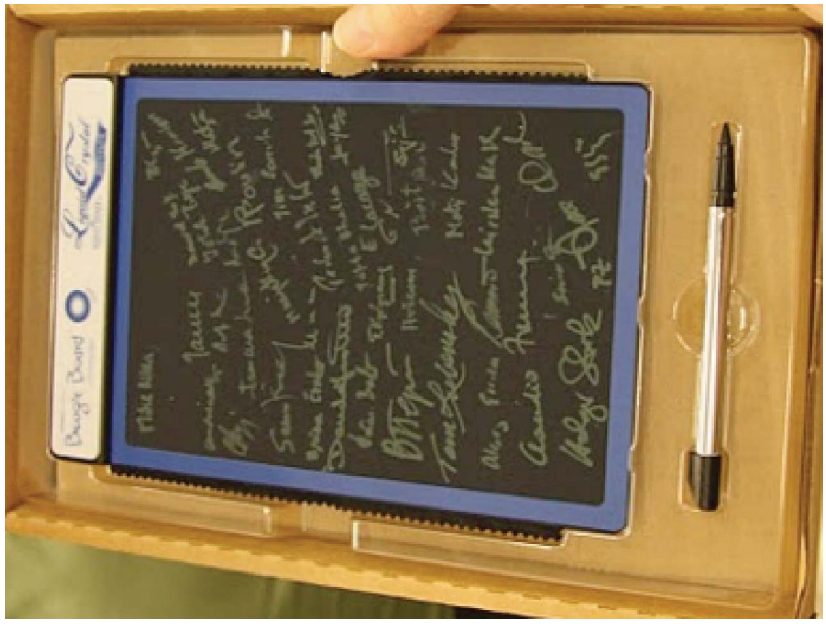

Figure 3. Liquid crystal boogie board presented to Žumer as a gift of appreciation of his numerous important contributions to the field of confined liquid crystals.

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ljubljana/ but whose lectures were equally well received at the workshop) were Vladimir Belyakov (Landau Institute for Theoretical Physics, Russia), Oleg Lavrentovich (Kent State University, USA), Victor Pergamenshchik (Korea University, South Korea), Holger Stark (Technische Universittät Berlin, Germany) and Claudio Zannoni (Università di Bologna, Italy). Oleg Lavrentovich discussed structures and defects related to the confinement of chromonic liquid crystals in phase-separated crowded solutions. Victor Pergamenshchik presented theoretical studies of dipolar colloids in the nematostatics, focusing on tensorial structure, symmetry, and their different types. Vladimir Belyakov gave a lecture on low-threshold lasing in photonic liquid crystals, such as liquid crystals in cholesterics and blue phases. Holger Stark discussed how colloidal particles and nanorods order on quasicrystalline substrates. Claudio Zannoni gave a lecture on the use of computer simulations to obtain important insights into the physics of phenomena related to surface confinement of liquid crystals. In addition to the invited lectures, there were round table panel discussions and presentations on funding opportunities to establish international research collaborations (in particular, Daniele Finotello described various programs of the US National Science Foundation for which he serves as a program officer).

Participation in the meeting was a very valuable experience and it provided perfect opportunities to exchange ideas and establish collaborations. The conference was definitely worth attending. I would like to use this opportunity to sincerely thank all the organisers, especially Primož Ziherl, Miha Ravnik and Igor Muševič, for the titanic work they put into the workshop organisation, making it so successful and enjoyable. I also thank Primož Ziherl and Jennifer Shih for providing some of the photographs used in this article.