

Boulder International Workshop

Light-Controlled Liquid Crystal Complex Adaptive Materials - LC2CAM

Conference Chairs: **Noel A. Clark & Ivan I. Smalyukh**, University of Colorado at Boulder, USA

Wednesday 6 August: LC2CAM Pre-Workshop Program

8:00-8:30 am: **Registration**, Duane Physics G-1B31

SESSION P-WT1: Materials & Photonics Tutorials

Chair: **Yves Lansac**, Univ. of Colorado at Boulder, USA and Université François Rabelais, France

Room: Duane Physics G-1B30 Wednesday 8:30 to 11:20 am

8:30 am: **Broadband CARS Microscopy - Overview and Applications** (*Invited Tutorial/Research Lecture*),
Marcus Cicerone, National Institute of Standards and Technology, USA

Coffee Break & Informal Discussions - Duane Physics G-1B31 9:30 to 9:40 am

9:40 am: **Adaptive Optics**. (*Invited Tutorial/Research Lecture*), **Sergio Restaino**, Naval Research Laboratory, USA

10:40 am: **Photo-Induced Mass Transport** (*Invited Tutorial/Research Lecture*), **Robert McLeod**, University of Colorado at Boulder, USA

Break & Informal Discussions - Walk to Fiske Planetarium 11:20 to 11:30 am

OUTREACH & EARLY-CAREER PROGRAM

Chair: **Christine Morrow**, University of Colorado at Boulder, USA

Location: Fiske Planetarium & Physics DUANE G-1B30, lunch provided Wednesday 11:30 am to 3:30 pm

11:30 am: **Laser Show**, Fiske Planetarium

12:30 pm: **Farrand Field Photo Session**, Farrand Field, CU Campus

Lunch Break: Farrand Field & Duane Physics Building (lunch provided) 12:50 to 1:20 pm

1:20 pm: **Liquid Crystal Mood Patches: Presentation & Hands-On Experience**, **Stephen Jacobs**, Univ. of Rochester, USA

2:00 pm: **EARLY-CAREER Program Lecture: "Delivering Good Scientific Presentations,"** **Richard Youngworth**, Light Capture, Inc.

2:30 pm: **EARLY-CAREER Panel Discussion: "Milestones of Scientific Careers in Academia, Industry, National Labs & Beyond."** *Discussion Leader:* **Joe Maclennan**, University of Colorado at Boulder, USA
Panel Members: **Daniel Cox**, University of California at Davis, USA and the International Institute for Complex Adaptive Matter; **Tom Furtak**, Colorado School of Mines, USA; **Satyen Kumar**, Kent State University & the National Science Foundation, USA; **Sergio Restaino**, Naval Research Laboratory, USA; **Dave Walba**, University of Colorado at Boulder, USA; **Rachel Pei Chin Won**, Nature Publishing Group, Japan; **Richard Youngworth**, Light Capture, Inc, USA.

Coffee Break & Informal Discussions - Duane Physics G-1B31 3:20 to 3:30 pm

SESSION P-WT2: Materials & Photonics Tutorials

Chair: **Matt Glaser**, University of Colorado at Boulder, USA

Room: Duane Physics G-1B30 Wednesday 3:30 to 5:50 pm

3:30 pm: **Optical Trapping & Manipulation** (*Invited Tutorial/Research Lecture*), **Eric Dufresne**, Yale University

Coffee Break & Informal Discussions - Duane Physics G-1B31 4:30 to 4:40 pm

4:40 pm: **Liquid Crystals: Fundamentals & Recent Advances** (*Invited Tutorial/Research Lecture*), **Oleg Lavrentovich**, Kent State University, USA

Coffee Break & Informal Discussions - Duane Physics G-1B31 5:40 to 5:50 pm

5:50 pm: **International Outreach Forum Poster Session & Reception**

Location: Gamow Tower, 11th floor Wednesday 5:50 to 9:00 pm

Thursday 7 August

8:00-8:30 am: **Registration**, Duane Physics G-1B31

SESSION 1: Adaptive Photonic Crystals & Their Applications

Chair: **Noel Clark**, University of Colorado at Boulder, USA

Room: Duane Physics G-1B30 Thursday 8:30 to 10:55 am

8:30 am: **Opening Remarks**, **Noel Clark & Ivan Smalyukh**, University of Colorado at Boulder, USA

8:45 am: **Liquid Crystals: Optical Properties and Light Driven Effects** (*Invited Overview Lecture*), **Satyendra Kumar**, Kent State University & the National Science Foundation, USA

9:15 am: **Adaptive Photonic Crystals** (*Invited Tutorial/Research Lecture*), **Sajeev John**, University of Toronto, Canada

10:15 am: **Light Induced Structural Color Change and Dynamics of Isotropic Smectic Blue Phase** (*Contributed Talk*), **Jun Yamamoto**, Kyoto University, Japan

10:35 am: **Polychromatic liquid crystal laser arrays** (*Contributed Talk*), **Philip Hands**, University of Cambridge, UK

Coffee Break - Duane Physics G-1B31 10:55 to 11:10 am

SESSION 2: Photonics of Molecular Monolayers and Biological Membranes

Chair: **Ivan Smalyukh**, University of Colorado at Boulder

Room: Duane Physics G-1B30 Thursday 11:10 am to 12:30 pm

11:10 am: **Photo-Induced Structures in Biological Membranes** (*Invited Tutorial/Research Lecture*), **Linda Hirst**, University of California at Merced, USA

11:50 am: **Polymorphism of Liquid Crystal Anchoring Induced by Phase Transitions of a Photoisomerizable Surfactant at the Nematic/Aqueous Interface** (*Contributed Talk*), **Daniel Schwartz**, Univ. of Colorado at Boulder, USA

12:10 pm: **International Institute for Complex Adaptive Matter (I2CAM)** (*Highlight Presentation*), **Daniel Cox**, University of California at Davis, USA

Lunch Break: Restaurants on the Hill or UMC.....12:30 to 2:00 pm

OUTREACH & EARLY-CAREER PROGRAM (*for students & postdoctoral fellows, lunch provided*)

Chair: **Richard Youngworth**, Light Capture, Inc., USA

Room: Duane Physics G-1B30Thursday 12:40 to 1:50 pm

12:40 pm: **EARLY-CAREER Program Lecture: Careers in Academia, Industry, National Labs, & Beyond: Job searching, CV writing, and interviewing.** **Cori Shaff**, Career Services, University of Colorado at Boulder, USA

1:30 pm: **Discussion.**

SESSION 3: Trapping & Manipulation

Chair: **Thomas Perkins**, University of Colorado at Boulder, USA

Room: Duane Physics G-1B30Thursday 2:00 to 3:20 pm

2:00 pm: **Optical Trapping and Manipulation** (*Invited Lecture*), **Kishan Dholakia**, University of St. Andrews, Scotland, UK

2:40 pm: **Manipulation of Disk-Shaped Islands and Direct Measurement of Elastic Interaction Forces Between Islands on Freely Suspended Smectic Films** (*Contributed Talk*), **Cheol Park**, University of Colorado at Boulder, USA

3:00 pm: **Manipulation of Nanowires in Liquid Crystals** (*Contributed Talk*), **Clayton Lapointe**, University of Colorado at Boulder and Johns Hopkins University, USA

Workshop Photo Session & Coffee Break – Physics Lawn & Duane Physics G-1B313:20 to 3:50 pm

SESSION 4: Optical Manipulation and Imaging of Liquid Crystal Colloids

Chair: **Eric Dufresne**, Yale University, USA

Room: Duane Physics G-1B30Thursday 3:50 to 5:30 pm

3:50 pm: **Optical Manipulation of Nematic Colloids: Wires, Superstructures and 2D Crystals** (*Invited Lecture*), **Igor Musevic**, J. Stefan Institute, Ljubljana, Slovenia

4:30 pm: **Imaging Colloidal Particle Induced Topological Defects in a Nematic Liquid Crystal by Using Third-Harmonic Generation Microscopy** (*Contributed Talk*), **Masahito Oh-e**, Liquid Crystal Nano-system Project, Japan Science & Technology Agency, Ibaraki, Japan

4:50 pm: **Confocal Raman Mapping of Colloidal Particles in Smectic A Liquid Crystals** (*Contributed Talk*), **Ebru Buyuktanir**, Kent State University, USA

5:10 pm: **Fluorescence Confocal Polarising Microscopy Imaging of Micro-Spheres in Liquid Crystals** (*Contributed Talk*), **Sharon Jewell**, University of Exeter, UK

5:30 pm: **Workshop Dinner Reception**

Location: Millennium HotelThursday 5:30 to 9:00 pm

Friday 8 August

SESSION 5: Adaptive Optical Nano-Structured Metamaterials

Chair: **Dave Walba**, University of Colorado at Boulder, USA

Room: Duane Physics G-1B30 Friday 8:30 to 10:10 am

8:30 am: **Optics of Metamaterials** (*Invited Tutorial/Research Lecture*), **Y. Ron Shen**, University of California at Berkeley, USA

9:30 am: **Metal Nanocluster Metamaterials.** (*Contributed Talk*), **Qi Wu**, University of Colorado at Boulder, USA

9:50 am: **Nanoimprint Alignment of Liquid Crystals** (*Contributed Talk*), **Youngwoo Yi**, University of Colorado at Boulder, USA

10:10 am: **Nature Photonics** (*Highlight Presentation*), **Rachel Won**, Nature Publishing Group, Tokyo, Japan

Coffee Break - Duane Physics G-1B31 10:30 to 10:45 am

SESSION 6: Lasers and Emissive Materials

Chair: **Daniel Schwartz**, University of Colorado at Boulder, USA

Room: Duane Physics G-1B30 Friday 10:45 am to 12:05 pm

10:45 am: **Red-Green-Blue 2D Tunable Liquid Crystal Laser Devices and Displays** (*Invited Lecture*), **Harry Coles**, University of Cambridge, UK

11:25 am: **Emissive Bent-Core Liquid Crystals** (*Contributed Talk*), **Nandiraju VS Rao**, Assam University, India

11:45 am: **Spatial Self-Organization and Self-Alignment of Fluorescent Nanoparticles by Liquid Crystal Elasticity and Defects** (*Contributed Talk*), **Dennis Gardner**, University of Colorado at Boulder, USA

Lunch Break: Restaurants on the Hill or UMC..... 12:05 to 2:00 pm

SESSION 7: Laser Beam Steering and Control

Chair: **Oleg Lavrentovich**, Kent State University, USA

Room: Duane Physics G-1B30 Friday 2:00 to 3:40 pm

2:00 pm: **Introduction to Liquid Crystal Clad Waveguides: A New EO Architecture That Enables Unprecedented Devices** (*Invited Tutorial/Research Lecture*), **Scott Davis**, Vescent Photonics, USA

3:00 pm: **Using Spatial Light Modulators for generation and control of multiple nondiffracting beams** (*Contributed Talk*), **Tomas Cizmar**, University of St Andrews, Scotland, UK

3:20 pm: **3D Modulated Optical Crystals as Computer-Generated Volume Holograms** (*Contributed Talk*), **Rafael Piestun**, University of Colorado at Boulder, USA

Coffee Break - Duane Physics G-1B31 3:40 to 3:50 pm

SESSION 8: Poster Session

Hallway: Duane Physics Friday 3:50 to 5:30 pm

Pearl Street Tour & Dinner (not provided) in Downtown Boulder: Friday 5:30 to 9:00 pm

Saturday 9 August

SESSION 9: Photo-Responsive Materials

Chair: **Eva Korblova**, University of Colorado at Boulder, USA

Room: Duane Physics G-1B30 Saturday 8:30 to 10:30 am

8:30 am: **Nonlinear Optical Properties of Azo-Dye Doped Liquid Crystals** (*Invited Lecture*), **István Jánossy**, Research Institute for Solid State Physics and Optics, Hungary

9:10 am: **Azo-Bridged Ferroelectric Liquid Crystals Incorporating Chromophores along Their Polar Axes and Measurement of Second-Harmonic Generation.** (*Contributed Talk*), **Yongqiang Zhang**, Displaytech Inc.

9:30 am: **Efficient Photoactive Chiral Nematic Twist Agents** (*Contributed Talk*), **James Rego**, California State Polytechnic University, Pomona

9:50 am: **Rewritable Optical Memory Based on Dye-Doped Liquid Crystals in Binary Grating** (*Invited Lecture*), **Sin-Doo Lee**, Seoul National University, Korea

Coffee Break - Duane Physics G-1B31 10:30 to 10:50 am

SESSION 10: Optical Alignment of Liquid Crystals

Chair: **Tom Furtak**, Colorado School of Mines, USA

Room: Duane Physics G-1B30 Saturday 10:50 am to 12:10 pm

10:50 am: **Liquid Crystal Alignment by Optical Interference and its Application in Making Polarization-Independent Phase Diffraction Gratings** (*Invited Lecture*), **Ophelia Tsui**, Boston University, USA

11:30 am: **Local Photo-Reorientation of a Liquid Crystal Using a Laser Focused on an Azo Dye-Based Monolayer** (*Contributed Talk*), **Yue Shi**, University of Colorado at Boulder, USA

11:50 am: **Optical Studies of Sub-Monolayer Dye Films for Photo-Alignment** (*Contributed Talk*), **Joseph Dahdah**, Colorado School of Mines, USA

Lunch Break: Restaurants on the Hill or UMC..... 12:10 to 1:40 pm

SESSION 11: Liquid Crystal-Polymer Networks

Chair: **Rafael Piestun**, University of Colorado at Boulder

Room: Duane Physics G-1B30 Saturday 1:40 to 3:20 pm

1:40 pm: **Liquid Crystal Networks Controlled by Light: Optics, Mechanics and Complex Patterning** (*Invited Lecture*), **Dick Broer**, Eindhoven University of Technology, Netherlands

2:20 pm: **POLICRYPS Structures & Applications** (*Contributed Talk*), **Luciano De Sio**, University of Calabria, Italy

2:40 pm: **Fast-switching electro-optical films based on polymer encapsulated liquid crystal and carbon nanotubes** (*Contributed Talk*), **Lu Lu**, Kent State University, USA

3:00 pm: **Next Generation Nematic Liquid Crystal Devices Based on Polymer Stabilized Networks** (*Technical Review*), **Robert Ramsey**, Meadowlark Optics, USA

Coffee Break - Duane Physics G-1B313:20 to 3:40 pm

SESSION 12: Poster Session

Hallway: Duane PhysicsSaturday 3:40 to 5:30 pm

Pearl Street Tour & Dinner (not provided) in Downtown Boulder:Saturday 5:30 to 9:00 pm

Sunday 10 August

SESSION 13: Optical Characterization

Chair: Joe MacLennan, University of Colorado at Boulder, USA

Room: Duane Physics G-1B30 Sunday 8:30 to 9:50am

8:30 am: **Microrheology** (*Invited Tutorial/Research Lecture*), **Tom Mason**, University of California at Los Angeles, USA

9:30 am: **The effect of shear on colloidal aggregation and gelation studied using small-angle light scattering** (*Contributed Talk*), **Tahereh Mokhtari**, Kansas State University, USA

Coffee Break - Duane Physics G-1B319:50 to 10:00 am

SESSION 14: Modeling of Colloidal Assembly and Photonic Structures in Liquid Crystals

Chair: Arthi Jayaraman, University of Colorado at Boulder, USA

Room: Duane Physics G-1B30 Sunday 10:00 am to 11:30 am

10:00 am: **Modeling of Nematic Braids: Assembly of Colloidal Superstructures for Optical Materials** (*Invited Lecture*), **Slobodan Zumer**, University of Ljubljana and Jozef Stefan Institute, Slovenia

10:40 am: **Modeling of Cholesteric Photonic Structures** (*Contributed Talk*), **Yves Lansac**, Univ. of Colorado at Boulder, USA and Université François Rabelais, France

11:00 am: **Soft Spheres Make More Mesophases** (*Contributed Talk*), **Matt Glaser**, University of Colorado at Boulder, USA

11:20 am: **Concluding Remarks**, **Noel Clark & Ivan Smalyukh**, University of Colorado at Boulder, USA

Rocky Mountain Tour (*Lunch in Estes Park, Colorado*): Sunday 11:30 am to 7:00 pm

List of Posters

[P-1] **Quantitative phase imaging of biological structures with computational phase-shifted differential interference contrast microscopy**, Sh. King, A. Libertun, R. Piestun, *Univ. of Colorado at Boulder*; Ch. Preza, *Univ. of Memphis*; C. Cogswell, *Univ. of Colorado at Boulder*

[P-2] **Passive three-dimensional imaging with rotating point spread functions**, Sri Rama Prasanna Pavani, A. Greengard, R. Piestun, *Univ. of Colorado at Boulder*

- [P-3] **Optically Tweezing the Colloidal Alphabet**, T. G. Mason, J. N. Wilking, *UCLA*
- [P-4] **Carbon nanotube elastomeric composite - An active material**, S. Ahir, Y. Y. Huang, E. M. Terentjev, *Univ. of Cambridge (UK)*
- [P-5] **Fabrication of Active Micro-lens Array using a Liquid Crystal and a Polymer**, Y. Choi, *Case Western Reserve Univ.*; J.-H. Kim, *Hanyang Univ. (Korea)*; S.-D. Lee, *Seoul National Univ. (Korea)*
- [P-6] **Photonic structures in liquid crystals obtained via depth-resolved sub-micron optical control of self-assembled monolayers**, A. Martinez, Y. Shi, H. C. Mireles, N. A. Clark, I. I. Smalyukh, *Univ. of Colorado at Boulder*
- [P-7] **Properties of Thermotropic Nematic Liquid Crystal C7**, B. Senyuk, O. D. Lavrentovich, *Kent State Univ.*; V. M. Pergamenschik, *Korea University (Korea) and Institute of Physics (Ukraine)*; J. You, J. Y. Jung, K. Rhie, *Korea University (Korea)*; S. T. Shin, *Samsung Electronics Corp. (Korea)*
- [P-8] **Light-Controlled Surface Energy Switching on Zinc Oxide Nanorods**, J. Banks, J. M. Albin, R. T. Collins, T. E. Furtak, *Colorado School of Mines*
- [P-9] **Phase diagram mapping of soft should systems**, R. Blackwell, Z. Smith, N. A. Clark, M. Glaser, *Univ. of Colorado at Boulder*
- [P-10] **Properties of Optically Active Gold Nanoparticles with Cyanobiphenyl Liquid Crystal Ligand**, J. Millette, B. Lennox, L. Reven, *McGill Univ. (Canada)*
- [P-11] **Photoinduced dynamics of amino-azobenzene self-assembled monolayers for high efficient photo control of liquid crystals**, Y. Yi, G. Fang, J. E. Maclennan, *Univ. of Colorado at Boulder*; K. Kim, *Yonsei Univ. (Korea)*; T. E. Furtak, *Colorado School of Mines*; N. A. Clark, *Univ. of Colorado at Boulder*
- [P-12] **Coarsening of two-dimensional islands in freely suspended smectic A films and bubbles**, D. Nguyen, A. Pattanaporkratana, Ch. Park, J. Maclennan, M. Glaser, N. A. Clark, *Univ. of Colorado at Boulder*
- [P-13] **Photocontrolled angle resolved Bragg diffraction in a planar waveguide using a mixed LC and azo-dye co-polymer cladding layer**, Y. Wang, A. Klitnick, N. A. Clark, *Univ. of Colorado at Boulder*; P. Keller, *Institut Curie (France)*
- [P-14] **Entropically Driven Condensed Phase of Lyotropic Chromonic Liquid Crystals**, H.-Sh. Park, L. Tortora, O. D. Lavrentovich, *Kent State Univ.*
- [P-15] **Synthesis and characterization of novel banana liquid crystals of 4-ring system: Influence of linking group direction and OH groups on mesom**, N. VSRao, R. KNath, R. Deb, *Assam Univ. (India)*; T. Francis, *Jackson State Univ.*
- [P-16] **Non-contact optical control of multiple defects and structures in liquid crystals using holographic and time-shared optical trapping**, G. Stockdale, R. P. Trivedi, S. Anand, I. I. Smalyukh, *Univ. of Colorado at Boulder*
- [P-17] **Surface-induced ordering in confined liquid crystals: Influence of alkane**, L. Zhang, G. K. Auernhammer, M. Kappl, B. Ullrich, H.-J. Butt, D. Vollmer, *Max Planck Institute for Polymer Research (Germany)*
- [P-18] **Polar Smectic A Phase from Achiral Bent-core Molecules**, R. Shao, R. Amaranatha Reddy, Ch. Zhu, M. Glaser, J. Maclennan, D. M. Walba, N. A. Clark, *Univ. of Colorado at Boulder*
- [P-19] **Phase behavior of binary mixtures of NOBOW/8CB**, Ch. Zhu, D. Chen, Y. Shen, Ch. Jones, N. A. Clark, *Univ. of Colorado at Boulder*
- [P-20] **Inverse Frederiks Effect in Feronematic Cells**, N. P. Podoliak, V. I. Zadorozhnyi, V. Yu. Reshetnyak, *Kyiv National Taras Shevchenko Univ. (Ukraine)*
- [P-21] **Magnetic field influence on twist-deformation instability of nematic sample with curved surfaces**, N. Podoliak, A. N. Vasilev, *Kyiv National Taras Shevchenko Univ. (Ukraine)*
- [P-22] **Instability of the Nematic Liquid Crystal Filled with Interacting Sphere-Like Impurity Particles against Formation of the Modulated Structures**, A. Kleshchonok, V. Reshetnyak, *Kyiv National Taras Shevchenko Univ.*; V. Tatarenko, *G. V. Kurdyumov Institute of Metal Physics (Ukraine)*

[P-23] **Liquid crystal lens with polymer network**, S. Pavliuchenko, S. Subota, V. Reshetnyak, *Kyiv National Taras Shevchenko Univ. (Ukraine)*

[P-24] **Optically-Induced Multistable Photonic Structures in Confined Chiral Nematic Liquid Crystals**, Ch. Twombly, Univ. of Colorado at Boulder; D. Kaputa, A. Kachynski, A. Kuzmin, P. Prasad, *State Univ. of New York at Buffalo*; Y. Lansac, N. A. Clark, I. I. Smalyukh, *Univ. of Colorado at Boulder*

[P-25] **Realignment-enhanced CARS and labeling-free vibrational CARS-PM imaging of 3D structures in liquid crystals**, R. P. Trivedi, *Univ. of Colorado, Boulder*; A. V. Kachynski, A. N. Kuzmin, P. N. Prasad, *State Univ. of New York at Buffalo*; I. I. Smalyukh, Department of Physics, *Univ. of Colorado at Boulder*

[P-26] **Photoluminescence of urinary calculi in liquid-crystal matrix**, O. Drobchak, O. Bordun, M. Omelchenko, B. Kapustjanyk, *Ivan Franko National Univ. of Lviv (Ukraine)*

[P-27] **Synthesis & Characterization of Silicon Hybrids Nano Composites Containing Non-linear Optical Dyes**, Y. Aghili, M. Mohseni, E. Mohajerani, S. Moradian, A. Khosravi, *Amirkabir Univ. of Technology (Iran)*

[P-28] **Optical properties of ZnO nanoparticles in surfonematic matrix**, M. Omelchenko, V. Kapustianyk, *Ivan Franko National Univ. of Lviv (Ukraine)*; Yu. Nastishin, *Kent State Univ.*

A list of posters accepted for poster presentation after the July 15 deadline will be provided at the registration desk.