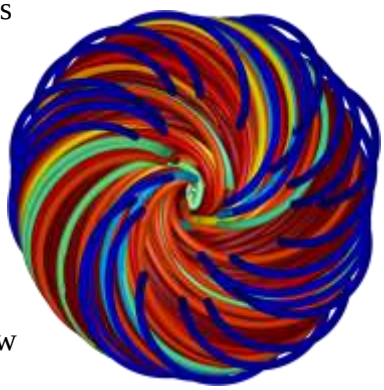
Towards Chiral Liquid Crystal Displays with Knots in Every Pixel

Ivan I. Smalyukh[1,2]
[1]*Departments of Physics, Materials Science & Engineering, & Electrical, Computer & Energy Engineering, University of Colorado, Boulder, USA*
[2]*Renewable and Sustainable Energy Institute, National Renewable Energy Laboratory (NREL) and University of Colorado, Boulder, USA*
Email: ivan.smalyukh@colorado.edu

In every pixel of a liquid crystal display, the ordering direction of rod-like molecules is rotated by a weak electric field, so that the transmitted light can be controlled to convey information at will. This facile electric switching, which is at the heart of $500 billion per year liquid crystal industry, deals with very simple uniform and continuously distorted structures of the molecular alignment field of rod-like molecules. However, chiral liquid crystals were recently shown to be capable of hosting stable three-dimensional topological solitons, continuous but knotted patterns of this molecular alignment field. Recently discovered chiral ferromagnetic liquid crystals, with equally strong responses to both magnetic and electric fields, also can host such three-dimensional knot solitons. In this lecture, I will discuss how electric and magnetic fields can interplay with the topology of structures in these liquid crystal media, knotting or unknotting them and giving origins to different types of fascinating soliton dynamics. Finally, I will conclude with a discussion of how these findings may lead to a new breed of displays.



Biography. Ivan I. Smalyukh is a Professor at the Departments of Physics, MSE & ECEE, University of Colorado, Boulder, USA. He is also a founding fellow of the Renewable and Sustainable Energy Institute (RASEI), a joint institute of the National Renewable Energy Laboratory (NREL) and University of Colorado. At CU, he is heading a soft condensed matter research group with 35 group members (students and postdocs) and with a broad spectrum of research interests, ranging from topology to self-assembly, from naoscience to renewable energy research, and from magnetism to the development of new optical imaging and manipulation techniques. Smalyukh's recent awards and honors include 2017 Paris Sciences Chair and CNRS Chair Awards, 2016 APS Fellow Selection by the American Physical Society, 2015 GSoft Award of the American Physical Society, 2014 Bessel Award, 2013 DOE Career Research Award, 2011 Kavli Frontiers Fellowship, 2010 Presidential Early Career Award for Scientists and Engineers (PECASE) from the Office of Science and Technology Policy of the White House, 2010 Sigma Pi Sigma Favorite Professor recognition, 2009 NSF CAREER Award, 2006 Glenn H. Brown Prize, and many other. Professor Smalyukh published over 150 peer-reviewed research articles in top international journals such as Nature, Science, PNAS, etc. He is on editorial boards of two international journals and organized many conferences, workshops, and summer schools.