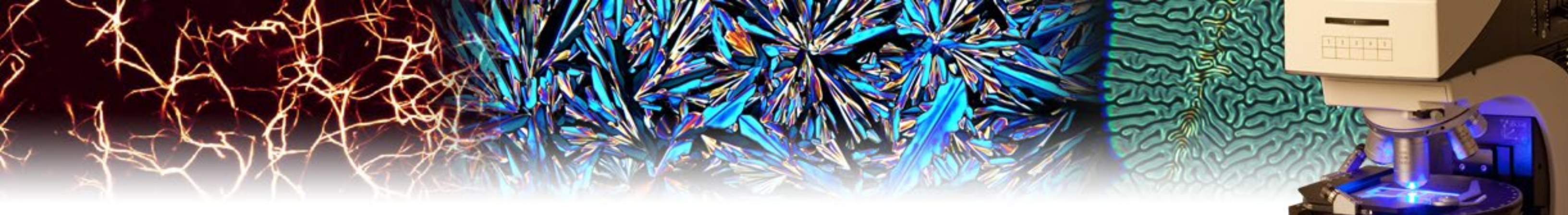


Soft Matter World Newsletter

July | 2012 | Issue 43

Dear Soft Matter Colleagues,

Welcome to our July newsletter. This month, we are featuring Prof. Robin Selinger's group from Kent State University, research describing the physics behind soft wavy structures, shaken granular lasers, and a study on the behavior of smectic liquid crystal under varying spheroidal confinement.

Check the conference bulletin for upcoming conferences and have a great July.

Prof. Robin Selinger's research group at Kent State's Liquid Crystal Institute investigates aspects of soft matter through theory and simulation. A major unifying theme is the study of topological defects and their role in transport, microstructure, and morphology evolution. In particular, the group's research directions include:

see page 2 for captions..

- Liquid crystal elastomers: mechanical actuation, elastic instabilities, shape selection, auto-origami.
- Lipid membranes: interactions between topological defects and membrane curvature.
- Topological defects in curved geometries.
- Liquid crystal phases: active nematics, texture transitions in bistable displays.

In a recent publication in the Journal of Physical Chemistry [1] Robin Selinger and coworkers explored how topological defects known as vortices interact with curvature, to understand how a thin film of a material with orientational order behaves on a curved substrate. Surprisingly, nonuniform curvature induces segregation of positive and negative vortices, producing defect-rich textures under conditions where the same material on a flat substrate would be free of long-lived defects.

In computational materials science, simultaneously modeling the coupled evolution of a sample's microstructure, its shape change and mechanical response represents a major goal. Prof Selinger's group undertook this challenge in modeling nematic elastomer thin films under applied strain. They demonstrated the nucleation of a striped director microstructure at the onset of a plateau in the film's stress-strain response [2]. Instead of relying on commercial software, they developed their own 3-d finite element elastodynamics code from scratch.

Another recent study, "Shape selection of twist-nematic-elastomer ribbons," published in the Proceedings of the National Academy of Sciences [3], combines experimental work by Kenji Urayama's group at Kyoto University and theoretical calculations from the Kent State LCI theory group, exploring the shape evolution of nematic elastomer ribbons with twisted director microstructure. These materials spontaneously flex into a variety of shapes as they are heated and cooled and show a fascinating reversal in chiral symmetry as a function of temperature.

Robin Selinger collaborates often with her husband, Jonathan Selinger, and they jointly manage the LCI Theory Group. She also serves as president of the Hudson STEM Alliance, a local non-profit group that sponsors an annual science fair, LEGO robotics teams, and other extracurricular opportunities for kids interested in science and related fields.

Read these papers and more about the group at Robin Selinger's website.

[1] http://pubs.acs.org/doi/abs/10.1021/jp205128g
[2] http://pre.aps.org/abstract/PRE/v82/i5/e051701
[3] http://pubs.acs.org/doi/abs/10.1021/jp205128g

LEGEND

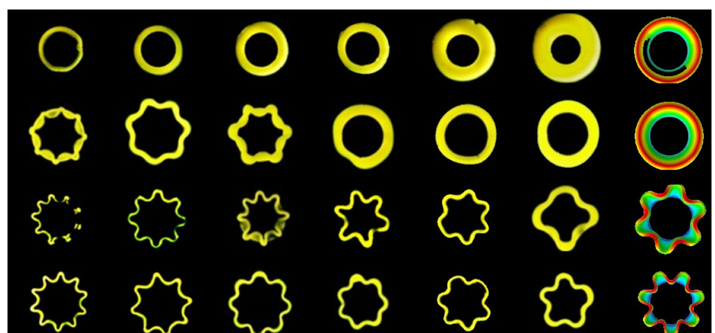
- *Monte Carlo study of the XY model on a torus describing the energy of an array of vector spins. [1]*
- *3D elastodynamics simulation of a radially stretched nematic elastomer disk. [2]*
- *S-geometry sprial twist-nematic-elastomer (TNE) ribbon. [3]*
- *L-geometry spiral twist-nematic-elastomer (TNE) ribbon. [3]*
- *Monte Carlo study of the XY model on a sphere. [1]*
- *Members of the LCI theory group headed by Robin and Jonathan Selinger.*

Prescribed Pattern Transformation in Swelling Gel Tubes by Elastic Instability

Howon Lee, Jiaping Zhang, Hanqing Jiang, and Nicholas X. Fang. Phys. Rev. Lett. Vol. 108. Issue. 21

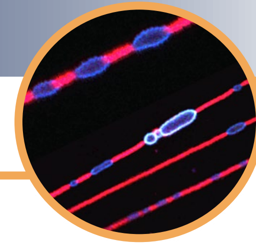
Bell peppers, the brain, wrinkled bronchioles of asthmatics, and ridges on leaves all share wavy patterns produced by soft matter buckling under stress. Researchers from MIT and Arizona State University have proposed a mathematical model based on experimental and simulation results that explains these swelling induced transformations in terms of elastic energy.

Using a novel projection microstereolithography technique, the researchers were able to create a series of hydrogel microtubes of specific, micron- sized thickness, height, and diameter. The microtubes were fixed at one end and immersed in a solution of oil and water. They found that the edges of the tubes in contact with water swell upon wetting. The portion of the gel immersed in oil acts as a fixed boundary, causing the wetted gel portion to develop inhomogeneous stress. Modeling stress distribution in terms of sample radius, height, thickness, and elastic energy revealed the ratio of tube height to tube diameter is the sole parameter that influences wrinkling. They also found that the critical swelling point before mechanical instability occurs is exponentially related to the increase of the tube height and diameter ratio.



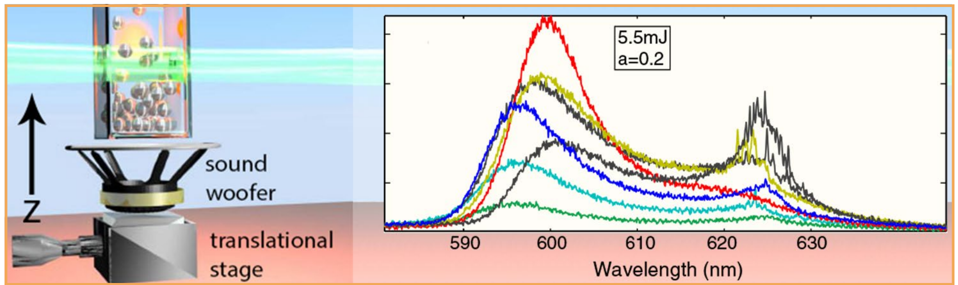
▲ Circumferential buckling of tubular shaped gels. The relationship between tube height and diameter is the sole parameter that influences the critical swelling point for mechanical instability and subsequently the wrinkle number .

You can read this review for a taste of the conversation these findings inspired in the scientific community at the PRL website. To see this play as a movie visit the corresponding youtube video posted by the author.



Shaken Granular Lasers

Viola Folli, Andrea Puglisi, Lucs Leuzzi, Claudio Conti. Phys. Rev. Lett. Vol. 108. Issue. 24



▲ Sketch of the granular sample placed on a vibrating woofer and a vertical translational stage; the light beam is also shown. Single-shot spectra at energy 5.5 mJ.

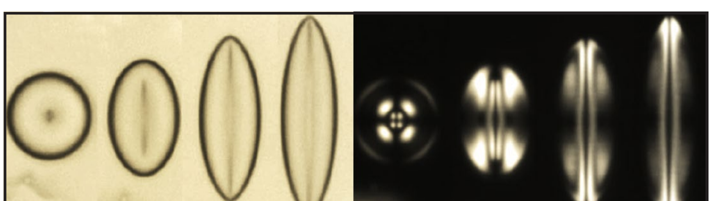
From the perspective of a photon, the components of an agitated granular suspension stand still. However, researchers from University Sapienza in Rome recently investigated laser emission from shaken granular matter and discovered that emission can be controlled through mechanical agitation of the granular material. Metallic grains 1mm in diameter were dispersed in a solution of Rhodamine B and placed on a vibrating plate driven by a sound woofer. The vibrations of the plate were calibrated by an accelerometer and the spectra of continuous and random lasers were recorded with the laser beams passing through different regions of the suspension.

At increased levels of agitation and at higher levels in the sample, the resonance of the laser photons increased due to the agitation of the metallic spheres and an additional emission peak formed at 600nm. The connection between different granular dynamical regimes and random lasers opens the way to a variety of further investigations such as random lasers in compactification, metastable granular states, mixed systems, accelerated flow under gravity, supercontinuum generation, and the interaction of light with granular waves.

You can read the full paper at the PRL website.

Confinement-Induced Defect Transition in Smectic Liquid Crystals: From a Point to a Line and Pearls

Joonwoo Jeong and Mahn Won Kim. Phys. Rev. Lett. Vol. 108. Issue. 20



▲ Confined smectic-A phase. The right hand side shows the bright field images. To the left hand side is the polarized optical microscopy image.

The competing effects of bulk elasticity and surface anchoring on liquid crystal materials have the potential to provide control over the formation of topological defects – an interesting problem in soft condensed matter physics.

In this paper, researchers from The Korea Advanced Institute of Technology report on the behavior of individual, linear defects in smectic liquid crystal droplets held under low symmetry confinement with continuously varying curvature. Films comprised of droplets of the liquid crystal 8CB dispersed in PDMS (a soft elastomer) were stretched on a tensile tester and observed using quasi-monochromatic light microscopy.

The researchers noticed that a linear defect is created when a smectic liquid crystal droplet is stretched to a high aspect ratio. This defect is created because the smectic layers cannot fill the prolate spheroid and instead become misoriented and subsequently dilated. In the paper, the authors define a layer misorientation angle representative of the degree of droplet deformation. When the droplet is stretched above a critical misorientation angle, the line defect is generated. Using a mathematical model for the elastic energy of the system, the authors determine a general value for this critical angle. In addition, it was observed that under certain geometrical conditions, the defect core may break into periodic defects, creating a structure similar to a string of pearls.

Read the review here or the full paper at the PRL website.

Upcoming Events at Julich Research Institute

BioScience 2012 Workshop on "Frontiers in Biomolecular Sciences: From Molecules to Cells" will take place in Forschungszentrum Jülich, Germany from 7th - 9th November, 2012. The workshop intends to educate theorists about the challenges, limitations, and potential of biology-driven experiments as well as encourage experimentalists to explore the potential of molecular or mesoscale simulations. There will be 26 speakers.

Jülich Soft Matter Days 2012 will be held at Seminaris Hotel, Bad Honnef, Germany from 13-16 November, 2012. This year's meeting will focus on active fluids, biosystems, complex fluids, nanofluidics, soft matter and energy, soft matter and medicine, and soft nanotechnology. There will be twenty four speakers.

Final registration begins July 6th and ends on September 14th.

2012/2013 Summer Conference Listing Bulletin posted

The latest Soft Matter World conference listings bulletin is updated and available for download in the Conference Listings section of the website. Over 15 new conferences have been added! If you have a conference, meeting, workshop or seminar you would like to have added to the Bulletin please email:
editor@softmatterworld.org with "*Conference Listing Request*" in the subject title.

We would like to remind our readers that listings are free of charge and will circulate to hundreds of soft matter members around the world. We encourage submissions!

We hope you enjoy browsing softmatterworld.org and come back soon
Linda S. Hirst, Dmitri Medvedko and Adam Ossowski

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