Hayley R. O. Sohn's Seminar

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"Collective Dynamics of Topological Solitons in Chiral Nematics"

-Date and time : 1st August, 10:00

-Room : E208

Hayley R. O. Sohn 氏は磁性キラル液晶ホップフィオンの発見者として世界的に知られている Prof. Ivan I. Smalyukh (University of Colorado at Boulder, USA) の学生で、最近、ホップフィオンやスキルミオンのダイナミクス で非常に興味深い現象を見出しています。スキルミオンの自己集合組織化や集団行動などが魚の群れや動物の群れの行動と比較しています。興味のある方はお集まりください。

Collective Dynamics of Topological Solitons in Chiral Nematics

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In fields ranging from fluid dynamics to optics, rich dynamic behavior of self-reinforcing solitary wave packets has attracted a great deal of interest among physicists and mathematicians alike. These solitons maintain their spatially-localized shape while propagating and typically emerge from a delicate balance of nonlinear and dispersive effects in the physical host medium. Solitons of a very different type, often called "topological solitons", are topologically-nontrivial, spatially-localized nonsingular field configurations that are rarely associated with out-of-equilibrium dynamics, but rather are studied as static field configurations embedded in a uniform background. Their topologically-nontrivial configurations can be classified using homotopy theory, though their stability in real physical systems usually also requires nonlinearities. We realize reconfigurable motion of various topologically-nontrivial skyrmionic and knotted field configurations in chiral nematic LCs [1]. Topological solitons exhibit directional motion both as individual objects and collectively, often spontaneously selecting and synchronizing their motion directions as this out-of-equilibrium process progresses. This motion is not accompanied with annihilation and generation of defects, can persist for months, and its direction can be controllably reversed. By using a combination of optical microscopy and 3D modeling of both the equilibrium free-energy-minimizing director structures and their temporal evolution, we uncover the physical mechanisms behind the soliton motion. We demonstrate that this motion emerges mainly from spatially-asymmetric changes of director structures that evolve non-reciprocally upon the application and removal of an electric field, so that the periodic modulation of an applied field yields net translational motion of solitons.

References:

[1] H. R. O. Sohn, et. al., Phys. Rev. E **97**, 052701

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