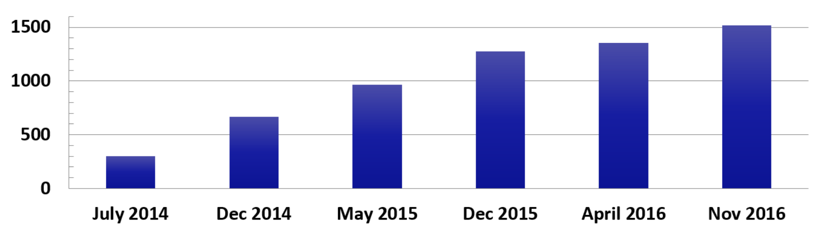
Welcome to GSOFT, APS's topical group on soft matter

Welcome to GSOFT, APS's topical group on soft matter Soft Matter is a highly interdisciplinary field involving scientists, mathematicians and engineers, and is one of the fastest growing areas of research today. Soft matter unites a broad class of physical states ranging from colloids and micelles to biological and granular matter that are easily deformed by external stresses. While these materials span length scales from nm to cm, they share a common feature in that predominant physical behaviors occur at energy scales comparable with thermal energy, and quantum aspects are typically unimportant. Self-assembly, non-equilibrium, driven/active matter, frustration, topology and folding are just a few of the many diverse topics addressed by soft matter researchers.

GSOFT early career award for soft matter research aims to recognize outstanding and sustained contributions by a young researcher in during their initial period of full-time employment. The award provides $5,000 + cost of travel to APS March Meeting. The award is generously sponsored by Solvay. Visit www.aps.org/units/gsoft for details.

Join GSOFT's Growing Membership

www.aps.org/units/gsoft



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Membership Statistics: Group founded in May 2014
1,519 members as of Nov 2016

Front/Back illustration based on image by Qiong Tang, courtesy of Joe Zasadzinski, featured in *Physics Today*, April 2015 showing domains of mixed lipid-cholesterol monolayers at the air water interface. Inner centerfold image shows a diverse range of images representing many areas of research in Soft Matter. Starting at the top and going clockwise:

Colloids - Simulated colloidal gel consisting of 750,000 attractive hard spheres
nsf.gov/discoveries/disc_images.jsp?cntn_id=131092&org=NSF // R. N. Zia, B. J. Landrum, W. B. Russel, J. Rheol. 58, 1121 (2014)

Polymers - Mechanical properties of polymer fibers are measured with minimally invasive tetrapod quantum dots
newscenter.lbl.gov/2013/07/29/tetrapod-quantum-dots-light-the-way-to-stronger-polymers // S. N. Raja et al., Nano Lett. 13, 3915 (2013)

Membranes, Vesicles, & Droplets - High performance computing is used to investigate properties of lipid membranes
www.lobos.nih.gov/mbs // R. W. Pastor, R. M. Venable, S. E. Feller, Acc. Chem. Res. 35, 438 (2002)

Self-Assembly - Low energy electron microscopy image of PB self-assembly on a Pb/Cu surface alloy
sandia.gov/surface_science/glk/leem_images_movies.html

Surfaces & Interfaces - Air-stable water droplet networks on a superhydrophobic surface
ornl.gov/ornl/news/news-releases/2014/novel-ornl-technique-enables-air-stable-water-droplet-networks- // J. B. Boreyko et al. PNAS 111, 7588 (2014)

Packing, Geometry, & Topology - Vortex avalanche in disordered packings
cnls.lanl.gov/~olson/images.html

Fracture & Failure - Simulations of nanoscale mechanisms for stress corrosion and cracking in a wet environment
alcf.anl.gov/projects/sio2-fracture-chemomechanics-machine-learning-hybrid-qmmm-scheme // ANL/James Kermode, King's College London

Active & Driven Matter - Flock of Auklets flying off Kasatochi before 2008 eruption
alaska.usgs.gov/science/kasatochi/photo_gallery.php // Vernon Byrd, U.S. Fish and Wildlife Service

Dynamics of Structured & Complex Fluids - Micrograph of nano-iron emulsion with applications in environmental remediation
www.nasa.gov/offices/oct/home/tech_life_ezvi_prt.htm // NASA

Soft Biological Matter - Mouse fetal heart fibroblast cells used in studies of stem cell-based tissue repair
images.nigms.nih.gov/index.cfm?event=doSearch&searchTerm=&typeID=&page=9 // J. I. Luna, Kara McCloskey lab, University of California, Merced

Designed by *Jesse L. Silverberg*, 2015. *Jesse.Silverberg@wyss.harvard.edu*

GSOFT

Topical Group on Soft Matter

APS physics™

FRONTIERS IN SOFT MATTER...

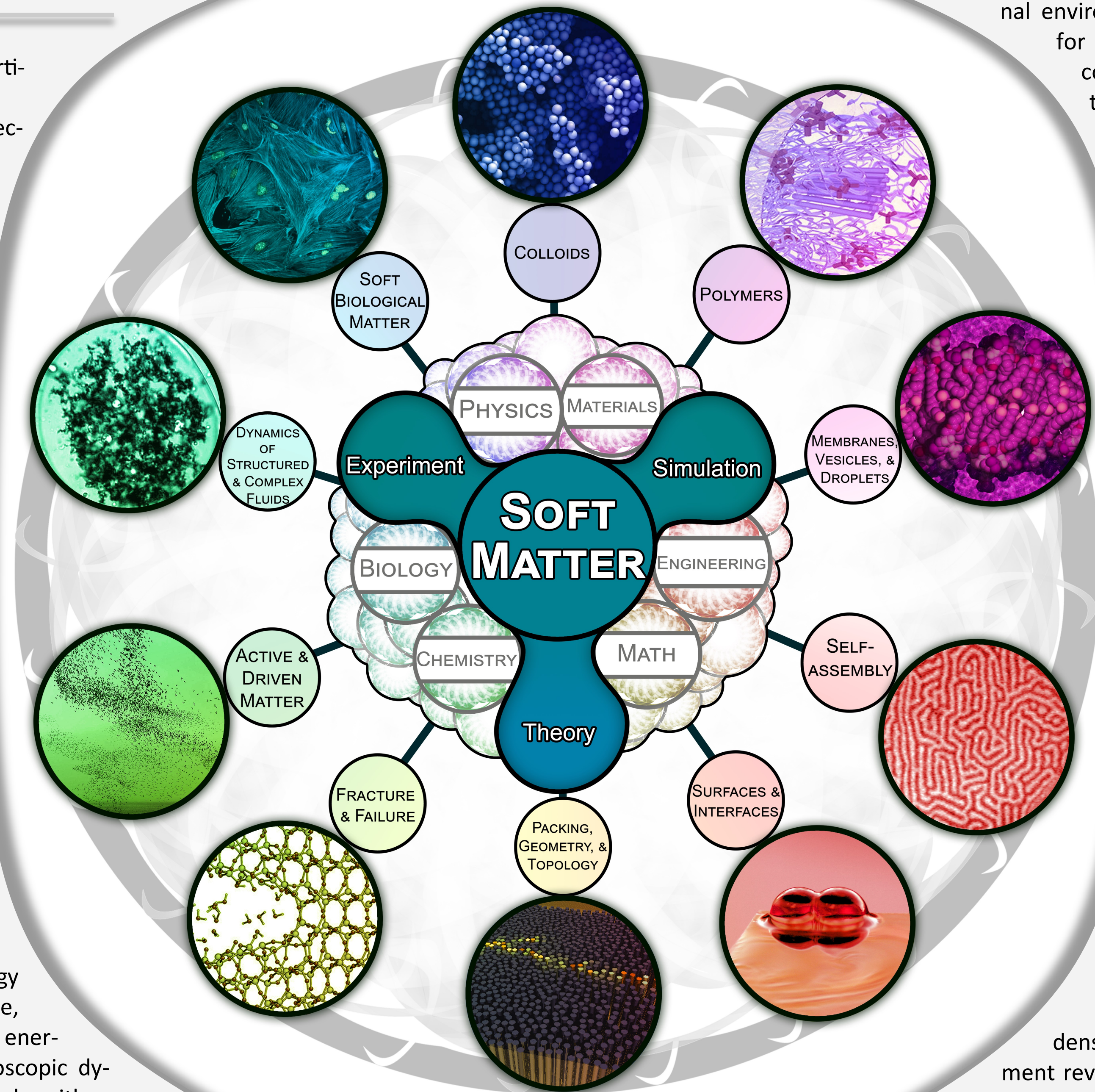
ACTIVE AND DRIVEN MATTER explores systems of particles that interact with each other while consuming energy. This is a valuable test bed for studying collective dynamics in non-equilibrium systems ranging from vibrated grains of sand to motile bacteria and animal flocks.

SOFT BIOLOGICAL MATTER probes the mechanical properties of hierarchically organized biological materials from cytoskeletal networks to entire organs. Coarse graining across length-scales is extremely useful as it offers insights for structured and functional materials.

COLLOIDS are a mainstay of the soft matter community. The ability to image and track these micron-sized particles in experiments enables direct tests of fundamental thermodynamics, phase transitions, self-assembly, and suspension rheology. Moreover, they have numerous real-world applications including flexible electronics and drug delivery.

DYNAMICS OF STRUCTURED COMPLEX FLUIDS is a subject similarly at the roots of the soft matter. These solid-liquid, solid-gas, liquid-gas, and liquid-liquid suspensions, to name just a few, exhibit unusual flow behavior that can be attributed to microscopic internal structure.

FRACTURE AND FAILURE have become topics of broader interest for their role in phenomenology beyond linearized continuum theories. For example, fracture depends critically on the concentration of energy in materials, and hence non-equilibrium microscopic dynamics. Failure, on the other hand, has more to do with mechanical instabilities – buckling, wrinkling, and snapping – that are widely utilized in biological pattern formation.



MEMBRANES, VESICLES, AND DROPLETS are relevant to problems in biophysics where regulated flow of molecules between the external environment and internal cellular machinery are critical for survival. More broadly, understanding both how confined fluids fluctuate, deform, and pinch, as well as the consequences of these structural changes still holds unsolved questions.

PACKING, GEOMETRY, AND TOPOLOGY covers not a specific material system, but a broad set of organizational principles. Jamming in granular systems, arrangement of colloids on spheres, topological defects in liquid crystals, and finite deformations of linkage structures are just some of the problems that benefit from these deeper mathematical ideas.

POLYMERS, like colloids, are at the heart of soft matter. Recognized with a 1991 Nobel Prize in physics awarded to Pierre-Gilles de Gennes, this topic builds on an understanding of statistical mechanics and chemistry to explain mechanical properties. Remarkably, even Feynman diagrams have been introduced to polymer theory to help understand the multitude of interactions governing these systems.

SELF-ASSEMBLY describes the processes by which individual units come together to form organized structures. Whether mediated by individual particle interactions or globally applied external fields, the principles of self-assembly can be found widely across soft matter.

SURFACES AND INTERFACES can be found whenever two phases come into contact. As with hard condensed matter, the physics of systems under confinement reveals dimensionally-dependent scaling laws and non-trivial modifications to existing theories. Self-assembly, colloidal chemistry, diffusion, and biophysical problems all stand to learn from these studies.

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