

Physics meets Biology Webinar

Wednesday, November 18th, 2020 at 4 pm

Talk by Prof. Noel CLARK

University of Colorado, at Boulder
(invited by Prof. Jan Lagerwall)

Liquid Crystals and the Origin of Life: Features of an Ancient Liquid Crystal World

Abstract:

The memory and transfer of genetic information in life is based on the self-assembly of nucleic acid (NA) polymers in solution into duplex columns of selectively paired and stacked aromatic hydrocarbon nanosheet bases. One of the great mysteries of evolution is how such a spectacular scenario first appeared in the universe.

In the proposed prebiotic RNA world, oligomers which enable molecular selection, catalysis, and information transfer are structured by a similar duplex pairing and stacking scheme which is already robust, appearing to have come from some earlier mode of molecular selection and evolution.

I will describe observations made in a longstanding collaboration with Tommaso Bellini of the University of Milan of the LC phase behavior of high concentration aqueous solutions of NA monomers and ultra-short oligomers, including the discovery that polymerization is actually not needed for the stabilization of the duplex base-paired columnar structure of DNA. Motivated by these results we have developed a model of a pre-RNA world era, a “liquid crystal world,” in which the duplex pairing and stacking evolves as the primary “purpose” of autocatalytic molecular selection and oligomerization. Selection is achieved by the molecular gatekeeping of phase separated duplex columnar chromonic NA liquid crystal droplets, which also serve as promoters of their own stability, templating the ligation of selected short oligomers into longer ones.

Biography:

Noel Clark was born in 1940 in Cleveland, Ohio, where he received his B.S. and M.S. degrees in physics from John Carroll University. He received his Ph.D. from MIT in 1970 and joined the Harvard University Division of Applied Sciences as a research fellow and junior faculty. He moved to Boulder in 1977 where he is currently Professor of Physics at the University of Colorado. Clark's research has concerned various aspects of soft condensed matter and complex fluid physics, including liquid crystals, colloids and biophysics. He has been involved in fundamental studies of liquid crystal ordering in a variety of systems, creating novel phases and exploring the role of chirality in soft materials. In recent years his research has focused on the role of liquid crystals in the appearance of DNA in early life. He is a member of the National Academy of Sciences of the USA. In 2003 was awarded the Oliver E. Buckley Condensed Matter Physics Prize of the American Physical Society, and in 2016 the first Pierre Gilles de Gennes Prize of the International Liquid Crystal Society for career achievement in liquid crystal science.