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More is alive: emergent multi-scale order & collective flows in tissues

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Stellingen

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More Is Alive: Emergent Multi-Scale Order & Collective Flows In Tissues

1. Interestingly, in passive p -atics, nematic defects of strength $+1/2$ are the only thermodynamically stable defects whose self-generated hydrodynamic flows (backflows) contribute positively to their directed motion.

Chapter 2

2. Although separation of scales allows for a clear-cut distinction between various physical models and theories, biology is not so kind. Extremely complex, coupled processes, occur synchronously, and at the same length scales. The reductionist logic we (physicists) are so comfortable with, needs to be supplemented with new intuitions.

Chapter 4

3. Plant cells, are structurally, biologically, and chemically distinct from animal cells. They, however, also organize themselves in compact, continuous structures that are called tissues. After a comprehensive study of order in plant tissues, it would be interesting to see how order affects the way plant cells move in tissues.

Chapter 5

4. Often, the functionality and survival of living systems, hinges on their ability to transition seamlessly between different phases. It would be interesting to perform a careful study that would reveal in how many of these systems, if any, this ability is associated with near-criticality.

Chapter 6

5. Harnessing the potential of soft active matter systems promises an explosion of technological/industrial applications, at the very least comparable to their passive counterpart (liquid crystals, colloidal systems, foams, etc).

S. Shankar et al., Proc. Natl. Acad. Sci. 121, (21)e2400933121 (2024)

6. The dynamical interplay between curvature, topology, and structure of the boundary, will be central in understanding the process of morphogenesis.

L. A. Hoffmann et al., *Sci. Adv.* 8, eabk2712 (2022)

7. Charles Darwin's *survival of the fittest* is one of most powerful natural philosophy principles ever conceived. It is so strong, because it is so general, and fundamentally true. The single, defining goal that all living systems have in common, is *survival*.

C. Darwin, *On The Origin of Species* (1869)

8. The field of active matter is experiencing a surge in the number of theoretical models. In general, models are very accurate, but too fine tuned to be predictive. Conversely, theories have strong predictive power, but less precise. In physics, and specifically in biophysics, we need *both*.

M. R. Shaebani et al., *Nature Reviews Physics* 2, 181-199 (2020)

S. Ramaswamy, *Annu. Rev. Condens. Matter Phys.* 1, 323-345 (2010)

9. Humans are part of Nature. All of our creations and behaviors are natural processes. Often devastating to our environment, and often self-destructive, we are a force of nature, but not above it.

10. Degeneracy is the root of many (if not most) arguments. If we agree on univocal definitions of words and concepts, it will be very hard to find something to disagree about.

Dimitrios Krommydas
Leiden, 06 September 2024