Physics of plants: mechanics, growth, transport

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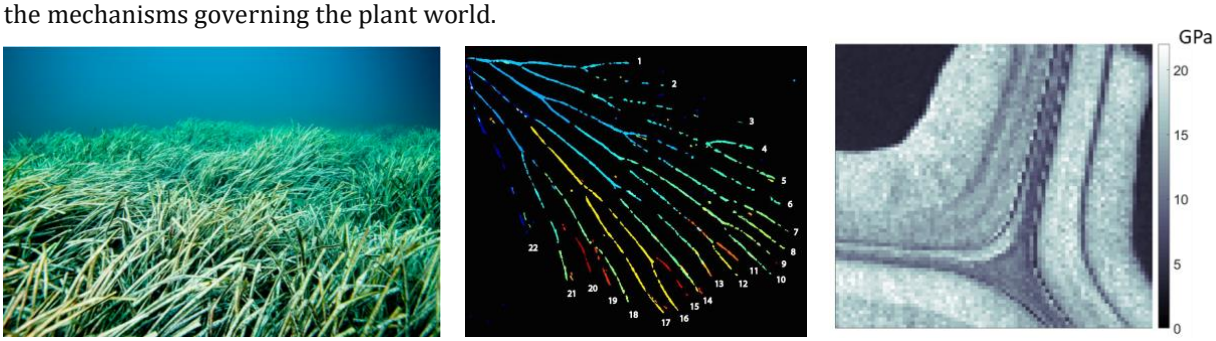
Physics of plants is emerging as an interdisciplinary field exploring the fundamental physical and physicochemical processes that orchestrate various phenomena such as growth, material and signal transport, and biomechanics in the plant world. This discipline has benefited from fruitful collaborations among physicists, chemists, and biologists, marking a significant convergence of knowledge and methodologies.

Cross-disciplinary approaches constitute the common foundation for all research in the field, despite the diversity of explored questions. Among these approaches, the use of advanced imaging and spectroscopic techniques allows for a detailed and precise observation of internal plant processes. The development and implementation of mechanical techniques for plants (using AFM, microfluidics, force measurements at all scales) allows for new advances. The creation and utilization of biomimetic devices (e.g., elastomeric materials, microfluidic techniques...) also prove crucial in faithfully reproducing certain physical phenomena at play in plants while providing a more controlled study environment. Finally, multi-scale physical modeling offers a theoretical framework for predicting and simulating a wide range of processes within plant systems, ranging from the molecular scale to ecosystem-level interactions.

This vast research field is gaining increased importance within the context of climate change, which subjects forest and agricultural ecosystems to growing environmental constraints. This mini-symposium is dedicated to highlighting recent advances in physics of plants, thereby fostering the sharing of discoveries and stimulating exchanges on challenges and opportunities in the field. Its aim is to encourage fruitful exchanges of ideas and methodologies, contributing to the advancement of our collective understanding of the mechanisms governing the plant world.



Left: Posidonia seagrass herbarium subjected to water surface flow. Center: Drying dynamics of a fern leaf. Right: Indentation modulus of poplar cell wall measured by AFM.

Here are some guiding questions:

→ Growth at the ecosystem, organism, and tissue scales: *What roles do environmental constraints (such as water, air or water dynamics, interactions between organisms, confinement, etc.) play in plant growth?*

→ Biomechanics: *Through which molecular mechanisms are mechanical constraints generated at the cellular or tissue level to adapt to environmental variations? What are the mechanisms for transmitting these constraints from the cell to the tissue, and from the tissue to the organism?*

→ Transport phenomena (fluid, signal, molecule): *What are the underlying physical mechanisms of signal transport in plants? How can certain environmental constraints (such as water, temperature, etc.) disrupt the hydraulic system of plants?"*

This mini-symposium aims to bring together physicists, chemists, and biologists to collectively explore the fundamental physical processes that characterize the plant system. By fostering interdisciplinary exchanges, we aim to stimulate collaborations and interactions at the intersection of physics and biology.