# Brillouin Microscopy as a Tool for Probing Mechanics: Biomedical Applications

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Mechanical properties play a fundamental role in the organization, function, and dysfunction of biological systems. At the cellular and subcellular scale, mechanical cues regulate essential processes such as migration, differentiation, intracellular organization, and signal transduction, while alterations in cellular mechanics are increasingly recognized as hallmarks of disease. Understanding how mechanical properties are regulated across biological length scales is therefore crucial for elucidating both physiological and pathological processes.

This emerging mechanobiological perspective underscores the need for experimental approaches capable of probing mechanical properties in living and heterogeneous biological environments. Despite their importance, the quantitative characterization of mechanics in biological systems remains challenging. Conventional techniques often rely on physical contact, external probes, or applied forces that may perturb the native state of the sample, and can be limited in spatial resolution or compatibility with living systems.

Brillouin microscopy (BM) has emerged as a powerful, non-contact, label-free optical technique for probing the mechanical properties of biological matter. By exploiting the interaction of light with thermally excited acoustic phonons, BM provides access to high-frequency mechanical information with micrometer- to submicrometer-scale spatial resolution. This presentation will highlight recent biomedical applications of BM across multiple length scales, from tissues and living cells to intracellular structures and biomolecular condensates, illustrating its potential to map mechanical heterogeneity and reveal changes associated with biological function and disease. These studies demonstrate how Brillouin microscopy can complement established mechanical and imaging techniques, offering new perspectives on the role of mechanics in health and disease.