Physikalisches Kolloquium

Universität Konstanz

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Di 02.02.21
15:15 Uhr
Zoom-Meeting

Studying Active and Passive Cell Mechanics with Scanning Probe Microscopy

Living cells are highly complex, active mechanical systems and their mechanical properties are involved in various processes in health and disease, such as change of morphology, cell migration, interaction with the substrate and neighboring cells, and the response to external mechanical stimuli or stress. This makes the living cell a unique example for an active soft matter system, but in many current studies it is modeled as a static, homogeneous, purely-elastic, and passive material, which does not reflect the aforementioned complexity.

In this talk, I will present our current advances in the investigation of active and passive mechanical properties of living cells using scanning probe techniques, specifically, atomic force microscopy (AFM) and scanning ion conductance microscopy (SICM). AFM and SICM are powerful tools for investigating cell mechanics on the single-cell and subcellular level, which we developed further to quantitatively measure elastic and viscoelastic properties of living cells. In addition, we combined AFM and SICM with traction force microscopy measuring their contractile forces. We found that living cells can be described as a pre-stressed viscoelastic glassy network and actively change their mechanical properties in numerous physiologically relevant situations by “tuning” the structure and contractility of their cytoskeleton.

In summary, more theoretical work is still necessary to complete the picture, but our studies already contribute to a more realistic description of the living cell as an active soft matter system in terms of its viscoelastic material properties and contractility and thereby shine new light on cell mechanics during physiologically relevant processes.