BP 49: Posters - Cell Mechanics and Migration & Physics of Cancer

Time: Wednesday 17:00–19:00 Location: Poster C

BP 49.1 Wed 17:00 Poster C

Investigation of Mechanical Properties of the Cytoskeleton Using FEM Simulations — •Ralf Schuster, Tobias Neckernuss, Tobias Paust, Kay Gottschalk, and Othmar Marti — Institute of Experimental Physics, Ulm University, D-89081 Ulm

We show the implementation of structure-bearing parameters in a numerical finite element model of a cell. The point of interest is the interplay between intermediate filament network and mechanical properties. The cytoskeleton is responsible for stiffness and deformability of cells. Changes in structure and shape of cells, caused by external forces, play an important role for cell migration and proliferation. Metastasizing cells can have a softer cytoskeleton through changes in the network. This leads to a reduced resistance against forces.

There are numerical models, concerning cell deformation, but they are either considering the cytoplasm as a continuum, or limit the simulations to microtubules and actin filaments. In contrast we have a closer look at the behavior of intermediate filaments and we implement a 3D-model of the cell, with the intermediate filament network as main component, regarding force transmission and stiffness, to simulate laboratory experiments. Therefore displacements of beads captured in the filament network, caused by an applied force, are simulated and compared to experimental microrheology data. The geometry, material parameters and boundary conditions are varied to find a model reflecting the real behavior of the inside of a cell in an acceptable manner.

BP 49.2 Wed 17:00 Poster C

Force Generation of Blood Platelets — •Jana Hanke and Sarah Köster — Universität Göttingen, Göttingen, Deutschland

Blood platelets play a crucial role in wound closure by attaching to the wounded site and spreading over it to form a temporary seal. During this process, the platelets contract after attachment to the extracellular matrix. Given the heterogeneity of tissues in the body, platelets encounter areas of varying stiffness to which they must adapt. To examine the influence of these environments on the force generated by the platelets, we perform live cell experiments on soft and stiff substrates. We use time-resolved Traction Force Microscopy (TFM) by seeding the cells on polyacrylamide gels of varying physiological stiffness containing fluorescent beads. Given the small size of blood platelets compared to other cells previously studied by TFM, it is important to adjust the experimental set-up as well as the analysis procedures. Here, the evaluation process is performed by a combination of Particle Image Velocimetry (PIV), Lagrangian marker tracking and Fourier Transform Traction Cytometry (FTTC). So far, the manner of contraction leads us to observe three contraction behaviours: One group of platelets show one single contraction towards a maximum force plateau, another group contracts before relaxing again whereas the last group shows oscillations of contraction. A relaxation is mostly observed in gels of lower stiffness while platelets on stiffer gels tend towards a force plateau. Platelets exerting oscillatory forces could so far be observed on various gel stiffness.

BP 49.3 Wed 17:00 Poster C

Phagosomes of different size show qualitatively different transport characteristics — •Steve Keller, Konrad Berghoff, and Holger Kress — Department of Physics, University of Bayreuth, Germany

Phagocytosis is one of the key processes of the mammalian immune system. The uptake of pathogens is typically followed by a transport of the phagosomes towards the perinuclear region as part of their maturation process. This process shows high phagosome-to-phagosome variations that are not fully understood. We hypothesize that the phagosome size has an influence on the maturation process by directly influencing the transport characteristics. We test this hypothesis by tracking the transport of phagosomes with different diameters ranging from 1 μm to 3 μm inside macrophages. We show that larger phagosomes are transported more persistently towards the nucleus and that they exhibit less backwards motion. We furthermore found that the effective transport velocity towards the nucleus increases with the phagosome size despite nearly equal instantaneous velocities for the different sizes. In addition, we investigated the microtubule density distribution in macrophages. We found that density differences between the nucleus-facing side of phagosomes and the opposite side can explain part of the observed transport characteristics. Our findings suggest that a simple size-dependent cellular sorting mechanism might exist that supports inward transport of large phagocytosed bacteria for facilitating their digestion and that simultaneously supports outward transport of small bacterial fragments for example for antigen presentation.

BP 49.4 Wed 17:00 Poster C

Fibroblast mechanics: a story of history — •Mathias Sander and Albrecht Ott — Universität des Saarlandes, Saarbrücken, Germany

Cell mechanics is a key player in development, disease and many other biological processes. Living cells exhibit a complex nonlinear response to mechanical cues, which is not understood yet. A stiffening as well as softening is observed, depending on the stimulus and the experimental technique. Here, we apply large amplitude oscillatory shear (LAOS) to a monolayer of fibroblast cells using the cell monolayer rheology technique. We find that the nonlinear cell response not only depends on the amplitude and the frequency of oscillations. Moreover, it is highly susceptible to a mechanical preconditioning. Cell response can exhibit hallmarks of nonlinear viscoelasticity, elastoplastic kinematic hardening or inelastic fluidization for the same steady state oscillations. Experimental results indicate that a preconditioning changes cytoskeletal network structure in a rate dependent way. Network alterations can be driven by passive filament reorganisations, filament rupture and the binding/unbinding of crosslinking proteins. We speculate that the pronounced strain path dependence of nonlinear cell response might obscure the underlying universality of nonlinear cell mechanics on a molecular/microscopic scale. Our results highlight the interplay between viscoelastic and inelastic contributions to the cell mechanical response.

BP 49.5 Wed 17:00 Poster C

Development of a mechanically stable cell stretcher for measuring the influence of external strain on cell mechanics with the AFM. — •Fabian Port, Patrick Paul, and Kay-E. Gottschalk — Institute of Experimental Physics, Ulm University

The importance of cell mechanics on different physiological or pathophysiological conditions like stem cell differentiation [1] or cancer [2] is increasingly being recognized. Hence the knowledge of the mechanical properties of cells under varying conditions is crucial for understanding the underlying mechano-chemical feedback cycles. Importantly, the effect of strain on cell mechanics is of great relevance for a variety of cell types like endothelial cells in the lung, in arteries or on the bladder, but is not well understood on the cellular and subcellular level. For the detailed analysis of the cellular mechano-response to stretch, we present here a self developed cell stretching device combined with an atomic force microscope.

[1] Engler, A. J., Sen, S., Sweeney, H. L., and Discher, D. E. (2006). Matrix Elasticity Directs Stem Cell Lineage Specification. Cell, 126(4), 677-689.

[2] Suresh, S., Spatz, J., Mills, J. P., Micoulet, A., Dao, M., Lim, C. T., Seufferlein, T. (2005). Connections between single-cell biomechanics and human disease states: gastrointestinal cancer and malaria. Acta Biomaterialia, 1(1), 15-30.

BP 49.6 Wed 17:00 Poster C

Measuring cell clasticity in PXE- and TMEM43-cells using an Optical Stretcher — •Daniel Helling[1], Jialiang Yu[1], Roland Stange[4], Jennifer Petersmeyer[2], Bettina Ibold[3], Doris Hendig[3], Volker Walhorn[1], Hendrik Milting[2], and Dario Anselmetti[1] — [1]Experimental Biophysics & Applied Nanoscience, Faculty of Physics, Bielefeld University, 33615 Bielefeld, Germany — [2]Herz- und Diabeteszentrum Nordrhein-Westfalen (HDZ NRW) - Universitätsklinikum der Ruhr-Universität Bochum, Erich und Hanna Klessmann-Institut für Kardiovaskuläre Forschung und Entwicklung, 32545 Bad Oeynhausen, Germany — [3]Herz- und Diabeteszentrum Nordrhein-Westfalen (HDZ NRW) - Universitätsklinikum der Ruhr-Universität Bochum, Institut für Laboratoriums- und Transfusionsmedizin, 32545 Bad Oeynhausen, Germany — [4]RS Zelltechnik GmbH, 04103 Leipzig, Germany

We compared the cellular elasticity of fibroblasts provided by patients suffering from PXE (Pseudoxanthoma elasticum) and ARVC (Arrhyth-

mogenic right ventricular cardiomyopathy), respectively. We used an optical stretcher setup with edge detection and automated data analysis, which allows for high cell throughput experiments (>1000 cells per measurement, setup provided by RS Zelltechnik GmbH, Leipzig, Germany). The differences in cell elasticity will be discussed in detail and related to the pathological findings.

BP 49.7 Wed 17:00 Poster C

Mechano-sensitivity is cell type specific — •Galina Kudryasheva and Florian Rehfeldt — Georg-August-Universität Göttingen Fakultät für Physik III. Physikalisches Institut

Nowadays it is widely acknowledged that cellular function, morphology and fate are dependent on the mechanical properties of their microenvironment. Human mesenchymal stem cells (hMSCs) are a striking example that stem cell differentiation into various cell types can be guided by tuning the extracellular matrix stiffness. While the entire differentiation process can take several days up to weeks, the structure and dynamics of stress fibers can be used as an early morphological marker and theoretically modeled using classical mechanics with an active spring model. We use this approach to analyze the mechanical cell-matrix interactions of hMSCs and several types of differentiated cells, such as C2C12 myoblasts , SAOS-2 osteoblasts, human primary osteoblasts and 3T3 fibroblasts. We plate hMSCs and differentiated cells on elastic poly-acrylamide hydrogels covering the whole physiological range of stiffness given by Young's moduli E from 1 to 130 kPa. Applying immunofluorescence approach we label stress fibers and analyze cytoskeletal morphology by fluorescence microscopy. We analyze cell shape and extract corresponding material constants that show distinct differences during the differentiation process in different cell types. Our experiments showed that cellular susceptibility to the substrate elasticity is highly cell type specific.

BP 49.8 Wed 17:00 Poster C

Mechanical properties of young and senescence dermal fibroblast cells using passive microrheology. — •Samira Khalaji[1], Fenneke KleinJan[1], Eugenia Makrantonaki[2], Vida Farsam[2], Ulla Nolte[1], Karin Scharffetter-Kochanek[2], and Kay-E Gottschalk[1] — [1]Institut für Experimentelle Physik, Universität Ulm — [2]Klinik für Dermatologie und Allergologie, Universitätsklinikum Ulm

Biological aging is a multi-dimensional process that takes place over a whole range of scales from the nanoscopic alterations within cells, over transformations in tissues and oragans. On the single cell level, aging involves in gene mutations, altered gene expression and post translational modifications of proteins. A variety of proteins are affected, including proteins of the cell cytoskeleton. Previous work quantified the gene and protein expression of cytoskeleton proteins in senescent and young fibroblasts. Their results show that senescent skin fibroblasts have an upregulated expression of the intermediate filament (IF) protein vimentin in contrast to actin and tubulin which are downregulated. IFs play an important role in providing mechanical stability of cells. However the mechanical properties of IFs depending on cellular senescence or age of the donor has not been studied so far. Hence, we employed passive microrheology on young and senescence human dermal fibroblasts from donors with different age and different population doubling level. In contrast to the expectations, our primary results show no significant differences in the viscoelastic properties of fibroblasts depending on age of the donor or cellular replicative senescence.

BP 49.9 Wed 17:00 Poster C

Transport of micro-objects by amoeboid cells — •Manuel Frey, Oliver Nagel, Matthias Gerhardt, and Carsten Beta — Institute of Physics and Astronomy, University of Potsdam, Potsdam, Germany

The transport and positioning of micron-sized objects in complex geometries is often accomplished by fluid flow. However, under geometric constrains, like dead end structures, this is difficult to achieve. An alternative approach would be the use of magnetic or optical tweezers. Yet these techniques require a lot of time to rearrange many objects, since it has to be done one by one. Here, we propose a novel approach to move micron-sized objects in confined geometries, exploiting the chemotactic behavior of single cells. We use cells of the social amoeba Dictyostelium discoideum to transport objects of different sizes and shapes. Both chemotactic movement in artificial gradients as well as the endogenous aggregation of this microorganism can be exploited to achieve different transport tasks. In particular, cells may act individually on small particles but they can also transport larger objects in a collective effort.

BP 49.10 Wed 17:00 Poster C

Mechanical coupling between the cytoskeleton and the nucleus — •Gabriele Straass and Florian Rehfeldt — Third Physical Institute - Biophysics, Georg-August University, Göttingen

It is nowadays widely acknowledged that mechanical cues are as important for cellular behavior as traditional biochemical ones. Strikingly, adult stem cells can be guided to differentiate towards various cell types when cultured on elastic hydrogels with appropriate Young's modulus E. Here, the acto-myosin cytoskeleton organization shows significant differences within the first 24 hours after plating. We investigate the mechanical properties of the nucleus by atomic force microscopy and fluorescence microscopy and demonstrate the impact of substrate elasticity E on nuclear morphology and elasticity via acto-myosin stress fibers and other cytoskeletal filaments. Elucidating the mechanical coupling of the cytoskeleton and the nucleus might reveal a direct mechanical pathway that alters gene transcription and might impact adult stem cell differentiation.

BP 49.11 Wed 17:00 Poster C

Cell adhesion and cell sorting across the EMT — •Steve Pawlizak[1], Anatol Fritsch[1], Steffen Grosser[1], Linda Oswald[1], Dave Ahrens[1], Tobias Thalheim[1], M. Lisa Manning[2], and Josef A. Käs[1] — [1]University of Leipzig, Institute of Experimental Physics I, 04103 Leipzig, Germany — [2]Syracuse University, Department of Physics, Syracuse, NY 13244, USA

The spatial segregation of different cell populations in distinct compartments and the formation of well-defined lineage boundaries inbetween is a fundamental process during the embryonic development. While normal cells will, in general, never cross these boundaries, metastatic cancer cells undergoing an epithelial-mesenchymal transition (EMT) may eventually acquire the ability to do so. To evaluate the role of cell cohesion in cell sorting and compartmentalization across the EMT, we analyze the mechanical properties of three cell lines exhibiting a shift in cadherin levels characteristic of an EMT. We apply a diverse set of methods to measure cell-cell adhesiveness, cell stiffness, and cell shapes, and compare the results to predictions from cell sorting in mixtures of the cell types. Although the final sorted state is extremely robust among all three cell lines, suggesting that cell sorting may play an important role in organization and boundary formation in tumors, we surprisingly find that the differential adhesion hypothesis (DAH) does not correctly predict the final sorted state. This indicates that these tissues do not behave like immiscible fluids, and that dynamical effects such as directional motility, friction, and jamming may play a much more important role than previously expected.

BP 49.12 Wed 17:00 Poster C

Mechanical properties of non-adhering cells — •Samaneh Rezvani[1], Tod M. Squires[2], and Christoph F. Schmidt[1] — [1]Drittes Physikalisches Institut, Georg-August-Universität, Göttingen, Germany — [2]Department of Chemical Engineering, University of California, Santa Barbara, USA

Cells sense their micro-environment through biochemical and mechanical interactions. They can respond to stimuli by undergoing shape- and possibly volume changes. Key components in determining the mechanical response of a cell are the viscoelastic properties of the actomyosin cortex, effective surface tension, and the osmotic pressure. We use custom-designed microfluidic chambers with integrated hydrogel micro windows to be able to rapidly change solution conditions for cells without any hydrodynamic flow. We use biochemical inhibitors and different osmolytes and investigate the immediate response of individual cells. Using a dual optical trap makes it possible to probe suspended rounded-up cells by active and passive microrheology to quantify the response to the various stimuli.

BP 49.13 Wed 17:00 Poster C

Regulation of muscle contraction by Drebrin-like protein 1 probed by atomic force microscopy — •Renata Garces, Eugenia Butkevich, Mitja Platen, and Christoph F. Schmidt — Third Institute of Physics-Biophysics, Georg August University, Göttingen, Germany

Sarcomeres are the fundamental contractile units of striated muscle cells. They are composed of a variety of structural and regulatory proteins functioning in a precisely orchestrated fashion to enable coordinated force generation in striated muscles.

Recently, we have identified a C. elegans drebrin-like protein 1 (DBN-1) as a novel sarcomere component, which stabilizes actin filaments during muscle contraction. To further characterize the function of DBN-1 in muscle cells, we generated a new dbn-1 loss-of-function allele. Absence of DBN-1 resulted in a unique worm movement phenotype, characterized by hyper-bending.

It is not clear yet if DBN-1 acts to enhance or reduce the capacity for contraction. We present here an experimental mechanical study on C. elegans muscle mechanics. We measured the stiffness of the worm by indenting living C. elegans with a micron-sized sphere adhered to the cantilever of an atomic force microscope (AFM). Modeling the worm as a pressurized elastic shell allows us to monitor the axial tension in the muscle through the measured stiffness. We compared responses of wild-type and mutant C. elegans in which DBN-1 is not expressed.

BP 49.14 Wed 17:00 Poster C

Macrophages are sensitive to substrate elasticity during Fcγ receptor-mediated phagocytosis — •Wolfgang Gross, Kathrin Weidner-Hertrampf, and Holger Kress — Department of Physics, University of Bayreuth, Germany

Phagocytosis, the internalization of micrometer-sized objects like bacteria and dead cells by macrophages is a main function of the innate immune system. After the detection of foreign particles by membrane receptors, this process is driven by the reorganization of the actin cytoskeleton, which leads to a protrusion of the membrane around the target. Although many molecular players have been identified in the past, there is still little known about the mechanics of this process and in particular about the role of the mechanical cellular environment.

In this work we investigate the influence of the underlying substrate rigidity on uptake efficiency. We cultured murine J774 macrophages on PDMS-substrates with elastic moduli ranging from 1.5 to 28kPa. The uptake efficiency of IgG-coated microparticles was quantified with secondary antibody staining. We found that the uptake efficiency depends on the rigidity of the substrate. Furthermore, we observed that cells were able to adapt to the various substrate stiffnesses and showed comparable uptake efficiencies after several weeks of adaptation. Our results support the hypothesis that phagocytosis is a mechanosensitive process. In addition, our results might contribute to understand the complex interplay between the immune system and disease states that come along with changes in tissue rigidity such as cancer, atherosklerosis and fibrotic tuberculosis.

BP 49.15 Wed 17:00 Poster C

Non-equilibrium mechanics of suspended cells probed by dual optical traps — •Florian Schlosser, Christoph F. Schmidt, and Florian Rehfeldt — Drittes Physikalisches Institut - Biophysik, Georg-August Universität Göttingen

Cells sense and respond to their mechanical environment. Besides their well characterized biochemical interactions, they also communicate through mechanical interactions. They actively probe the mechanical properties of their surroundings with contractile forces. Key player in the generation of those forces is the actomyosin cytoskeleton.

We use a dual optical trap to suspend cells between two fibronectin-coated polystyrene beads. Analyzing the correlated motion of the beads allows us to dissect the non-equilibrium fluctuations that the cell generates. By applying oscillatory forces, we are able to simultaneously probe the viscoelastic properties of the cell. Using a force-feedback allows us to apply constant forces to a cell and monitor its response. With biochemical perturbation experiments using blebbistatin and nocodazole to interfere with the actomyosin cytoskeleton or microtubules we show that myosin motors are the key element for contractile force generation. We combine our optical trap with a confocal microscope to directly image LifeAct and non-muscle Myosin-II transfected cells to monitor the distribution of the actomyosin cortex during the trapping experiments.

BP 49.16 Wed 17:00 Poster C

Mechanically tunable biomimetic hyaluronic acid based hydrogels — Frederike Derksen, Gevin von Witte, and •Florian Rehfeldt — Third Institute of Physics - Biophysics, Georg-August-University, Göttingen, Germany

Mechanical properties of the microenvironment of cells, e.g. matrix elasticity, influence many aspects of cell behavior including morphology, motility and even more complex processes such as differentiation. Therefore, it is important to design and characterize hydrogels for cell culture that resemble the in vivo environment of cells.

Cross-linked hyaluronic acid (HA) matrices offer an alternative to conventionally used polyacrylamide hydrogels as HA is biocompatible and therefore not toxic for cells. Using different thiol modifications of HA, we prepare hydrogels with a well-defined elasticity in the physiologically relevant range of E = 0.1 kPa to 100 kPa, which is much softer than glass or tissue culture plastic. Coatings with RGD peptide allow cell adhesion leaving hydrogel mechanics independently tunable. Hybrid gels with thiol modified recombinant human gelatin enable the preparation of 3D culture environments by embedding cells during hydrogel polymerization. Gelation kinetics of the hydrogels were investigated by rheology using oscillatory deformation tests. Both the storage modulus G' as well as the loss modulus G" were measured in order to analyze the viscoelastic properties of the cross-linked hydrogels. The morphological and cytoskeletal responses of human mesenchymal stem cells (hMSCs) to different elasticities and hydrogel compositions were investigated both in 2D and 3D cultures.

BP 49.17 Wed 17:00 Poster C

Controlling and multiscale modelling of contractility in adherent cells — •Dimitri Probst[1], Christoph A. Brand[1], Marco Linke[1], Patrick W. Oakes[2], Elizabeth Wagner[3], Michael Glotzer[3], Margaret L. Gardel[2], and Ulrich S. Schwarz[1] — [1]Institute for Theoretical Physics and BioQuant, Heidelberg University, Heidelberg, Germany — [2]Institute for Biophysical Dynamics, James Franck Institute and the Department of Physics, University of Chicago, Chicago, USA — [3]Department of Molecular Genetics and Cell Biology, University of Chicago, Chicago, USA

Cell contractility is coordinated inside the cell mainly by the spatial regulation of RhoA activity, a protein which in its active form is known to promote both growth of actin filaments and their contraction through myosin II molecular motors. For adherent cells, this usually leads to the formation of so-called stress fibers, which are condensed bundles of actin filaments contracted by myosin II minifilaments. In order to attain a theoretical understanding of the cytoskeletal reorganization during phases of RhoA-activity, we have developed a discrete viscoelastic cable network model which can well reproduce the spatiotemporal properties of the actomyosin system. We show how the addition of stress fibers, represented as additional elastic links in the network, changes the overall behaviour of the simulated cytoskeleton from Maxwell-type to Kelvin-Voigt-type. We show that, by means of discrete homogenization, the parameters of the discrete cytoskeleton model can be directly mapped to the macroscopic quantities of a viscoelastic continuum model.

BP 49.18 Wed 17:00 Poster C

Contractility of human induced pluripotent stem cell-derived cardiomyocytes on micropatterned substrates of different stiffnesses — •Til Driehorst[1,2], Malte Tiburcy[2], Wolfram Hubertus Zimmermann[2], and Christoph Friedrich Schmidt[1] — [1]Drittes Physikalisches Institut, Georg-August-Universität Göttingen, Göttingen — [2]Institut für Pharmakologie und Toxikologie, Universitätsmedizin Göttingen, Göttingen

Human induced pluripotent stem cells can be differentiated into cardiomyocytes (hiPSC-CM). This method can be used for high-throughput generation of cardiomyocytes for basic research. hiPSC-CM also hold great promise for in-vitro pharmacologic testing and studies of different illnesses such as arrhythmias. However, these cells remain in a somewhat immature, embryo-like state. This lack of maturity is thought to be partly due to missing biochemical and physical stimuli in currently used culture formats. Here, we have studied the basic sarcomeric contractility of hiPSC-CM in order to gain insight into the behavior of isolated CMs, and to also understand the intercellular mechanical coupling between myocytes. We applied methods of microcontact printing to shape the CMs to physiological aspect ratios (˜7:1) on elastic substrates of various stiffnesses. We then transfected the cells with an ACTN2-Citrine construct to visualize the z-bands in the living mycoytes. Exploiting high-speed confocal microscopy, we recorded the sarcomeric motion of hiPSC-CM at high frame rates and applied statistical algorithms to characterize this motion and investigate the coupling between cells in close proximity.

BP 49.19 Wed 17:00 Poster C

Cell motility generated by actin polymerization waves — •Nicolas Ecker and Karsten Kruse — Theoretical Physics, Saarland University, PO Box 151150, 66041 Saarbruecken, Germany

A cell's ability to move is one of its greatest merits. It enables the cell to efficiently search for nutrients and drives complex processes in tissues. Cell motility is often driven by the actin cytoskeleton. Although many

important factors involved in actin-driven cell crawling have been identified and characterized in amazing detail, it is still poorly understood how the actin filament network is organized in this process. Spontaneous actin waves have been observed in a large number of different cell types. They present an attractive concept to understand actin-network organization during crawling. We introduce a mean-field description for actin assembly by nucleating promoting factors, negative feedback of actin filaments on the nucleators' activity, and active stress generation by molecular motors. The system can spontaneously generate traveling waves. We study confinement of this system to a cellular domain by means of a phase field and calculate the corresponding phase diagram. In particular, we find erratic motion due to the formation of spiral waves.

BP 49.20 Wed 17:00 Poster C

Investigations on Single Squamous Cell Carcinoma Cells — •Susanne Steeger[1], Julia Kristin[2], Marcel Glaas[2], Jörg Schipper[2], and Mathias Getzlaff[1] — [1]Heinrich-Heine-Universität Düsseldorf, Deutschland — [2]Univ.-HNO-Klinik Düsseldorf, Deutschland

In this contribution we report on measurements of the mechanoelastic properties of ENT squamous cell carcinoma cells. The study of these single cancer cells in culture medium is carried out by Atomic Force Microscopy. Our main interest is the determination oft the Youngs Modulus calculated by the Hertzian Model. We identify the elasticity of cancer cells in order to compare it with that of similar benign cells. Because Live Cell Imaging is a challenging task we first focus on testing different cantilevers and various strategies to treat the cells carefully. Just recently we apply our new AFM with QI-Mode (JPK NanoWizard 3) which allows for a more detailed investigation of living cells. In order to determine the individual properties of the cancer cells we additionally analyse their cytoskeleton (actin and tubulin) by using a confocal fluorescence microscope. Cancer cells are known for their modified cytosekelton which is reflected in the different elasticities of both cancer and comparable benign cells.

BP 49.21 Wed 17:00 Poster C

Corellation of Adhesive and Viscoelastic Tumor Markers — •Erik W. Morawetz[1], Lars Christian Horn[2], Michael Höckel[3], and Josef A. Käs[1] — [1]Universität Leipzig, Physik der weichen Materie, Fakultät für Physik und Geowissenschaften, Leipzig, Deutschland — [2]Universitätsklinikum Leipzig, Institut für Pathologie, Leipzig, Deutschland — [3]Universitätsklinikum Leipzig, Klinik für Frauenheilkunde, Leipzig, Deutschland

Compartmentalization is a developmental process, functioning independently from the generation of organ structures. Metastasizing cancer cells are able to pass organ boundaries, but seem to be restricted by compartmental ones, as impressively shown by the success of the Leipzig School of Radical Pelvic Surgery. A transition to different cellular phenotypes is necessary to surpass compartment boundaries, including changes in protein expression, e.g. levels of the Cadherin (Cad) family of adhesion molecules, as well as altered physical properties of the cell body. Cancer cells become softer, providing possibilities for migration and cellular streaming and Cad expression is shifted from E- to P- and N-Cad, what is linked to the epithelial-mesenchymal transition. We conduct clinical studies to directly correlate this two fundamental markers. By the means of optical rheology, coupled with fluorescence microscopy, we are able to link E-Cad levels to viscoelastic properties in the case of tumor samples. Control experiments show no correlations, hinting at the basic change in developmental levels of cancer cells. This interplay of tumor markers in combination with theoretical models may shed new light on mechanisms and development of cancer.