Viscoelastic stiffness and relaxation of CNS tissue and its impact on neural and glial cells

# Katarzyna Pogoda¹, Paul A Janmey2

1 Institute of Nuclear Physics Polish Academy of Sciences, PL-31342, Krakow, Poland, katarzyna.pogoda@ifj.edu.pl

2 Department of Physiology, Institute for Medicine and Engineering, University of Pennsylvania, Philadelphia, PA, USA, janmey@pennmedicine.upenn.edu;

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The brain is one of the softest tissues in the body that responds in the time-dependent manner when subject to different loading conditions. Under compression, tension or shear it behaves as non-linear, viscoelastic body, and the response to shear deformation is often different from response to uniaxial strain. Despite its natural softness, brain tissue compression-stiffens, and the cells within the brain tissue are exposed to forces and stiffnesses higher than those predicted from measurements in the low strain limit of tissue samples *ex vivo*. In this regard, it is important to understand how brain cells adopt to an increased stiffness of their surrounding and whether this implies changes in their fate and function. In parallel, brain is also highly viscous, and brain cells’ response to viscosity is different from their response to elastic resistance. Recent development of soft viscoelastic materials where the elastic and viscous moduli can be independently tuned has opened up the possibility to characterize the impact of both elasticity and viscous dissipation on brain cells. The potential of mechanical stimuli to directly influence cell function is relevant to brain tumor growth and essential for understanding how cells and tissues develop under normal conditions and how they change when exposed to altered mechanical loads We present measurements of CNS tissue mechanical response over a range of length and time scales, The response of neuronal and glial cells is highly cell type dependent in a manner that might shed light on the changes that occur during malignant transformation. Increased mechanical characterization of the brain and further investigation of the mechanobiology of single brain cells under active mechanical forces have both diagnostic and therapeutic relevance.

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