Cell Mechanosensing – A Soft Condensed Matter Physics Approach
By
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Host: Prof. Alfred Huan

Abstract
Cellular mechanosensing is a mechanical process. Despite extraordinary advances in biology and a near complete list of molecular players, there is still no fundamental understanding of how cells “feel” mechanical cues and transduced them into biochemical signals. This question cannot be answered without an understanding of the physics of rheology. To unravel the principles of mechanosensing, I developed a platform to probe mammalian cell processes while mechanically and molecularly perturbing them. First, I will discuss how I use concepts of rheology to approach the stress and strain of cellular stiffness sensing. My experiments uncover, for the first time, the timescales and lengthscales at which cells probe their physical environment. Second, I developed an imaging system to probe cell motions at 2nm lengthscale and cell traction forces at 2pN force scales over time scales that span five orders of magnitude. I show that myosin motors in live cells can exhibit cooperative oscillatory behavior and suggest that this may be a way for cells to mechanosense while buffering against external noise. Together, the framework and approaches develop here will help reveal the mechanism of cellular mechanosensing and other mechanical processes in biology.

Biography
Shang-You Tee received his B.S. in Chemical Engineering from Columbia University in 1995 and his Ph.D. in Physics from Harvard University in 2005. He is a postdoctoral associate in the Physics department and the Institute for Medicine and Engineering at the University of Pennsylvania. Together with Prof. David Weitz at Harvard, he ended a thirty year controversy in fundamental fluid mechanics. With Profs. Paul Janmey and Christopher Chen at UPenn, he resolved a debate on how different physical inputs affect cell physiology. His current research interests include soft condensed matter physics, advanced optics and the biophysics of live cells. He has published in Physical Review Letters, Journal of Fluid Mechanics Letters, Biophysical Journal Letters and his work has been highlighted by the Faculty of 1000.