# Indian Institute of Science
# Centre for BioSystems Science and Engineering

# BSSE Seminar

**15th April 2019, 11:00AM,**
**CES Seminar Hall, 3rd floor, Biological Sciences Building**

## Analyzing Cell Behaviour: From Mitotic Cell Shape to Intracellular Delivery


**Dr Martin Stewart**

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**ABOUT THE SPEAKER:**

Martin P. Stewart received a B.Sc. (Hons) from the University of Technology Sydney in 2007. He then obtained his Ph.D. from TU Dresden, Germany in 2012 working under the supervision of Professors Daniel Müller and Tony Hyman. His Ph.D. research focused on the mechanisms of cell shape in mitosis. After a postdoctoral stint at ETH Zürich, Switzerland with Professor Daniel Müller, he joined the laboratories of Professors Klavs Jensen and Robert Langer at MIT in 2014. Martin's current research interests are in cell manipulation and analysis, specifically in the areas of intracellular delivery and cell biophysics. He has been a recipient of postdoctoral fellowships from the Swiss National Science Foundation and the Life Sciences Research Foundation. He has also been awarded grants from the American Australian Association and the Broad Institute of MIT and Harvard. In 2018 Martin commenced as a research group leader and lecturer in medical technologies at the University of Technology Sydney.

## ABSTRACT


This talk will cover two aspects of cell mechanobiology: 1) recent insights into the mechanics of mitotic cell rounding, and 2) the use of controlled, rapid cell deformations and electric fields for intracellular delivery. 1) Mechanics and Shape of Cells in Mitosis: The forces that control cell shape are fundamental to cell function and growth. We developed an atomic force microscope (AFM)- based approach to analyze the forces generated by cells as they round up during mitosis.

Three major insights arose from this work: First, that intracellular pressure increases throughout mitosis to drive mitotic cell rounding. Second, that cells under mechanical challenge undergo cell cortex herniation and inhibition of mitotic progression when a critical force is reached. And third, the elucidation of previously uncharacterized genes that underpin mitotic cell rounding through an RNAi-based mechanical phenotyping approach. 2) Combined Mechanical and Electrical Treatment for Intracellular Delivery: Biomedical research heavily relies on the introduction of foreign DNA, RNA, proteins, and other bioactive molecules to the intracellular space. Membrane disruption-based methods have emerged as key strategies for rapid, direct and universal delivery of a wide range of cargoes into cells. Here, we have implemented a microfluidic approach for combining mechanical deformation and electric fields for direct delivery of DNA into the nucleus at high throughput. We find that this treatment is able to mediate rapid expression of DNA via means of reversible non-lethal disruptions to the plasma membrane and nuclear envelope.