



**Theoretical and Physical Chemistry Institute
National Hellenic Research Foundation**

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LECTURE

**“Mechano-transduction: From a single protein (nm) up to a
single embryo (mm), in vivo”**

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Seminar room, ground floor, NHRF

Mechano-transduction: From a single protein (nm) up to a single embryo (mm), in vivo

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Animals exist in a huge variety of shapes and sizes from ants to elephants. In all cases, tissues and organs in animal's body acquire their shape as the animal develops. Cells in developing tissues squeeze themselves or push and pull on one another, and the resulting forces generate the final shape. During this process called morphogenesis, cells are attached to each other and to their micro-environment by cell adhesions. In fact, the prevailing hypothesis is that the forces produced by the cellular contractility, in particular, motor-like proteins called myosins pull against a mesh-like scaffold within the cell called the actin cytoskeleton, are transmitted to adhesion sites through some proteins, such as Talin, that mechanically link actin with the adhesion sites. The role of biochemical and genetic information in cells in cultures and in the development of a functional three-dimensional tissue morphology is widely studied. In contrast, the importance of mechanical properties, such as stiffness and cortical tension, starts to emerge as a key feature of living systems regulation. How mechanical cues determine cell and tissue behaviour in three distinct experimental biological processes will be explored in today's seminar:

1) The early cell spreading in vitro. Firstly, by developing an experimental setup that switches stiffness of the mechanical environment of a single cell in real time while quantifying cell deformation and force, an unexpected mechanism of rigidity sensing was found, whereby the contractile acto-myosin units themselves can act as sensors.

2) Gastrulation in the developing *Drosophila* embryo in vivo. Secondly, by producing controlled mechanical stimuli at cell scale in combination with spinning disk and FRET-FLIM microscopy in living developing embryo, it has been demonstrated that endogenous mechanical cues also trigger biochemical pathways, generating the active morphogenetic movements shaping animal development through a mechanotransductive cascade of Myo-II medio-apical stabilization. In addition, by developing a tracking algorithm, a spatial-temporal tension map is imminent.

3) Myogenesis in the developing *Drosophila* embryo in vivo. Thirdly, FRET-FLIM microscopy using FRET-based tension sensors revealed that the fraction of Talin protein under forces is greater in Ilk mutant (ILK is a necessary protein for cell adhesion) than in wild type (Wt). Finally, by tracking and fitting every passive muscle cell relaxation to a viscoelastic model, my ongoing research reveals that the viscoelastic properties are altered in Ilk mutant in comparison to Wt.

Overall, a novel mechanotransductive framework on how cells integrate forces and adapt their behaviour in the living organism is provided from a single protein (nm) up to a whole embryo (mm), in vivo.

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