TIME TABLE

TIME	Monday	Tuesday	Wednesday	Thursday	Friday
	September 24	September 25	September 26	September 27	September 28
9.00 - 9.45	Registration	Deshpande	Bouten	Recho	Recho
9.45 - 10.30	Discher	Deshpande	Bouten	Recho	Recho
11.00 - 11.45	Discher	Aznar	McMeeking	Aznar	Schwarz
11.45 - 12.30	DeSimone	Aznar	McMeeking	Aznar	Schwarz
14.00 - 14.45	Deshpande	McMeeking	Aznar	Deshpande	
14.45 - 15.30	Deshpande	McMeeking	Aznar	McMeeking	
16.00 - 16.45	Bouten	Recho	DeSimone	Bouten	
16.45 - 17.30	Bouten	Recho	Poster Session	Bouten	
18.00	Welcome Aperitif		Social Event		

ADMISSION AND ACCOMMODATION

The registration fee is 600.00 Euro + VAT*, where applicable (bank charges are not included). The registration fee includes a complimentary bag, four fixed menu buffet lunches (on Friday upon request), hot beverages, downloadable lecture notes and wi-fi internet access.

Applicants must apply at least one month before the beginning of the course. Application forms should be sent on-line through the following web site: http://www.cism.it. A message of confirmation will be sent to accepted participants. Applicants requiring assistance with the registration should contact the secretariat at the following email address cism@cism.it.

Applicants may cancel their course registration and receive a full refund by notifying CISM Secretariat in writing (by email to cism@cism.it) no later than two weeks prior to the start of the course.

Cancellation requests received during the two weeks prior to the start of the course will be charged a 50.00 Euro handling fee. Incorrect payments are also subject to a 50.00 Euro handling fee.

A limited number of participants from universities and research centres who are not supported by their own institutions can be offered lodging and/or board, if available, in a reasonably priced hotel or student guest house.

Requests should be sent to CISM Secretariat by **July 24, 2018** along with the applicant's curriculum and a letter of recommendation by the head of the department or a supervisor confirming that the institute cannot provide funding. Preference will be given to applicants from countries that sponsor CISM.

Information about travel and accommodation is available on the web site www.cism.it, or can be mailed upon request.

* Italian VAT is 22%.

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ACADEMIC YEAR 2018
The Boley Session
Centre International des Sciences Mécaniques
International Centre for Mechanical Sciences

CELL MECHANOBIOLOGY: THEORY AND EXPERIMENTS ON THE MECHANICS OF LIFE

CISM-AIMETA Advanced School
coordinated by

Antonio De Simone
SISSA, Trieste
Italy

Vikram Deshpande
University of Cambridge
UK

ERC AdG MicroMotility

Udine ***September 24 - 28*** **2018**

CELL MECHANOBIOLOGY: THEORY AND EXPERIMENTS ON THE MECHANICS OF LIFE

The role of Mechanics in governing key biological processes at the cell scale is becoming increasingly apparent. At the interface between biology, biophysics, and mechanics, Mechanobiology is emerging as a new, thriving research field, that is attempting to understand Biology from the perspective of Mechanics. And while the key role played by bio-chemical regulation in molecular cell biology is undisputed, the importance of forces and stresses in determining how cells function is becoming more and more widely recognised. Forces control shape and motion of the cells. But also how cells decide when and how much to differentiate, and where cells migrate to (e.g., durotaxis). Unveiling the details of this mechano-transduction opens the way to understanding key biological process at the cell scale first, and then at the tissue and organ scale.

Cell motility provides one concrete example where Mechanics is shaping our understanding of key biological processes. More generally, Mechanics is providing us with a conceptual framework to go beyond the identification of the molecular components and their individual function, by integrating them into a comprehensive understanding of cell motion and migration, of cell and tissue morphogenesis. The course will survey recent advances in the fields of cell motility and Mechanobiology of cells and tissues, emphasising such an integrative approach.

The topics of this Advanced School, which builds upon a previous one organised in 2014 by M. Arroyo and A. DeSimone, will include cell migration on solid substrates, adhesion and control of shape and migration, scaffold design in tissue engineering, mechanics of neural network growth, statistical mechanics and energetics of single cells, and mechanics of the cytoskeleton with an emphasis on its role in detecting and responding to mechanical, topological, and chemical cues. Both theoretical aspects (mathematical and computational modelling) and experimental techniques will be surveyed.

The Course will consist of 7 introductory lectures by the organisers, of 23 lectures on more specialised topics given by four eminent experts in the field, and of 4 “perspectives” lectures that will open and close the Course. In addition, a poster session will be organised, together with a social evening, to allow participants to discuss topics related to their research or professional interests. The financial support from the European Research Council, through the ERC Advanced Grant 340685-MicroMotility, and the endorsement by the Italian Association for Theoretical and Applied Mechanics (AIMETA) are gratefully acknowledged.

PRELIMINARY SUGGESTED READINGS

D. Discher et al.:
Tissue cells feel and respond to the stiffness of their substrate, Science 310 (2005), 1139-1143.

U.S. Schwarz and S.A. Safran:
Physics of adherent cells.
Rev. Mod. Phys., 85 (2013), 1327-1381.

R. Phillips et al.:
Physical Biology of the Cell, Garland Science (2008).

D. Fletcher and J. Theriot:
An introduction to cell motility for the physical scientist, Phys. Biol. 1 (2004), T1-T10.

P. Roca-Cusachs, V. Conte, and X. Trepat:
Quantifying forces in cell biology Nature Cell Biology 19 (2017), 742-751.

M. Arroyo and A. DeSimone:
Shape control of active surfaces inspired by the movement of euglenids. J Mech Phys Solids 62 (2014), 99-112.

J. Eyckmans et al.:
A Hitchhiker’s Guide to Mechanobiology, Developmental Cell 21 (2011), 35-47

V.S. Deshpande, R.M. McMeeking, and A.G. Evans:
A bio-chemo-mechanical model for cell contractility, Proceedings of the National Academy of Sciences, USA 103 (2006), 14015-14020.

P. Recho et al.:
Growth, collapse and stalling in a mechanical model for neurite motility, 7. Phys Rev E 93 (2016), 032410.

J.M. Aznar et al.:
Collective cell durotaxis emerges from long-range intercellular force transmission, Science 353 (2016), 1157-1161.

LECTURES

All lectures will be given in English. Lecture notes can be downloaded from the CISM web site. Instructions will be sent to accepted participants.

INVITED LECTURERS

Dennis Discher - University of Pennsylvania, USA
Opening lecture: “Matrix stiffness, Cytoskeletal tension, and Nuclear viscosity:
Correlations and Mechanisms in Tissues”

Vikram Deshpande - University of Cambridge, UK
5 lectures on: Cytoskeletal and cell mechanics.
Overview of the cytoskeleton; Cell energetics; An introduction to statistical mechanics; Cell entropy and statistical mechanics of single cells; Mechano-sensitive responses of cells: (I) Mechanical cues; (II) Topological and chemical cues.

Antonio De Simone - Sissa, Trieste, Italy
2 lectures on: Shape control in unicellular swimmers.
Motility in euglenids: flagellar propulsion vs motility by shape change (metaboly).
Shape programming in artificial bio-inspired systems.

Carlijn Bouten - TU Eindhoven, The Netherlands
6 lectures on: Introduction to experimental assessment and manipulation of cells.
Mechanical characterisation of adherent and non-adherent cells; The mechanosome and mechanotransduction; Cell-generated forces in 2D and 3D; Manipulating mechano-sensitive responses; Cell-cell and cell-matrix interactions; Cell mechanics in health and disease.

Robert McMeeking - University of California at Santa Barbara, USA
5 lectures on: Cell contractility and adhesion.
Acto-myosin stress fibres and cell adhesion; Biochemomechanical mechanisms of contractility, adhesion and signaling; Model of contractility of the cell and simulating in vitro behavior; Modeling in vivo behavior, smooth muscle cells, controlling the fate of cells.

Josè Manuel Garcia Aznar - University of Zaragoza, Spain
6 lectures on: The role of cell and matrix mechanics in migration.
The mechanics of single and collective cell migration; Cell-matrix adhesion and traction stresses; Microfluidic-based experiments for 3D migration studies; Individual 3D migration: from tumor to healthy cells; Collective cell migration: from cell sheet migration to angiogenesis; Tissue engineering scaffold design: guiding cell movement.

Pierre Recho - LIPhy, Grenoble, France
6 lectures on: Physical models of cell crawling.
Thermodynamic foundations of active gel physics; Protrusion based motility; Contraction based motility; Mechanisms of cell self-polarization; Optimal velocity of cell crawling; Optimal efficiency of cell crawling.

Ulrich Schwarz - University of Heidelberg, Germany
Closing lecture: “Mechanobiology of the actomyosin cytoskeleton: dynamics, regulation, sensing, adaptation, repair and memory”