TIME TABLE

TIME	Monday	Tuesday	Wednesday	Thursday	Friday
	July 13	July 14	July 15	July 16	July 17
9.00 - 9.45	Registration	Zerbetto	Nicolis	Nicolis	Biscarini
9.45 - 10.30	Velarde	Zerbetto	Nicolis	Beck	Biscarini
11.00 - 11.45	Zerbetto	Ebeling	Sykes	Beck	Velarde
11.45 - 12.30	Zerbetto	Ebeling	Zerbetto	Biscarini	Discussion
14.30 - 15.15	Nicolis	Beck	Velarde	Biscarini	
15.15 - 16.00	Sykes	Sykes	Ebeling	Biscarini	
16.30 - 17.15	Sykes	Sykes	Ebeling	Velarde	
17.15 - 18.00	Discussion	Discussion	Discussion	Discussion	

ADMISSION AND ACCOMMODATION

Applicants must apply at least one month before the beginning of the course. Application forms should be sent on-line through our web site: http://www.cism.it or by post.

A message of confirmation will be sent to accepted participants. If you need assistance for registration please contact our secretariat.

The registration fee is 600,00 Euro.

A limited number of participants from universitites and research centres who are not supported by their own institutions can be offered board and/or lodging in a reasonably priced hotel. Requests should be sent to CISM Secretariat by **May 13, 2009** 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.

The Deutscher Akademischer Austausch Dienst (DAAD) and the Deutsche Forschungsgemeinschaft (DFG) offer support to German students. Please contact:

DAAD, Kennedyallee 50, 53175 Bonn
tel. +49 (228) 882-0
e-mail: postmaster@daad.de
web site: http://www.daad.de/de/kontakt.html

DFG, Kennedyallee 40, 53175 Bonn
tel. +49 (228) 885 2655
e-mail: ing4@dfg.de
web site: http://www.dfg.de

Information about travel and accommodation is available on our web site, or can be mailed upon request.

For further information please contact:

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ACADEMIC YEAR 2009

The Broglio Session

Centre International des Sciences Mécaniques
International Centre for Mechanical Sciences

MOLECULAR MOTORS AND (NANO) MECHANICAL MACHINES: STOCHASTICS, NONLINEARITY AND COMPLEXITY

Advanced School coordinated by

Manuel G. Velarde
Universidad Complutense de Madrid
Spain

Udine, ***July 13 - 17,*** 2009

MOLECULAR MOTORS AND (NANO) MECHANICAL MACHINES: STOCHASTICS, NONLINEARITY AND COMPLEXITY

The nanometer (10^{-9} m) is the range of forces and extensions typically involved in many bio-molecular reactions where high energy bonds are hydrolyzed and the energy released is subsequently used to perform mechanical work in a rather efficient way. Scientists are building bio-motors with dimensions of less than 100 nm. Work values typically encountered in such reactions (highly irreversible and nonlinear with feed-forward and feed-back agents) are of the order of a few k_BT units (kJ mol^{-1}). Velocities in mechanical displacements and transport vary from very slow motions to the fastest cases occurring in the range 1-10 Angstrom/ps (km/s, the typical value of sound velocity in "molecular" or “lattice” wires).

The processes by which such bio-motors utilize the chemical energy to perform mechanical work are based on either power stroke generation and/or a Brownian ratchet mechanism (rectification of thermal fluctuations from a surrounding heat bath and taking advantage of large and rare fluctuations). Indeed, as a system's dimensions decrease, fluctuations away from equilibrium begin to dominate its behavior. The contribution of fluctuations and the equation of state tend to depend on the type of statistical ensemble, a new recently started line of thought in statistical mechanics.

Bio-molecular motors are finding applications as nano-machines, e.g. used as molecule-sized robots that work in molecular factories where small, but intricate structures are made on tiny assembly lines. Bio-molecular motors could form the basis of bottom-up approaches for constructing, active structuring and maintenance at the nanometer scale. Bottom-up nano-mechanics, nano-chemistry and nano-technology deal with how to control the formation and two- and three-dimensional assembly of molecular scale building blocks into well defined meso- and macroscopic structures.

Capillary action is very prominent in nano-channels, nano-drops, etc, due to the large surface to volume ratio. Mesoscopic surface (DLVO) forces permit to properly describe three-phase contact angle, surfaces with variable wetting characteristics, etc.

PRELIMINARY SUGGESTED READINGS

C. Beck & E.G.D. Cohen, Superstatistics, Physica A, 322 (2003) 267-275.

C. Bustamante, J. Liphardt & F. Ritort: The non-equilibrium thermodynamics of small systems, Physics Today 58 (2005) 43-48.

W. Ebeling & I. Sokolov: Statistical Thermodynamics and Stochastic Systems (World Scientific, Singapore, 2005).

G. Nicolis & I. Prigogine: Self-Organization in Non-equilibrium Systems (Wiley, N.Y., 1977).

E.R. Kay, D.A. Leigh & F. Zerbetto, Synthetic molecular motors and mechanical machines, Angewandte Chemie (International Edition) 46 (2007) 72-191.

Y. Marcy, J. Prost, M.-F. Carlier & C. Sykes, Forces generated during actin-based propulsion: a direct measurement by micromanipulation, P.N.A.S. 101 (2004) 5992-5997.

G. & C. Nicolis, Foundations of Complex Systems (World Scientific, London, 2007).

J. Plastino, S. Olivier & C. Sykes, Actin filaments align into hollow comets for rapid VASP-mediated propulsion, Current Biology 14 (2004) 1766-1771.

J. Plastino & C. Sykes, The actin slingshot, Current Opinion in Cell Biology 17 (2005) 62-66.

M. Cavallini, M. Facchini, M. Massi and F. Biscarini, Bottom-up Nanofabrication of Materials for Organic Electronics Synth. Met., 146, 283-286, (2004).

V. Starov, M.G. Velarde & C.J. Radke: Wetting and Spreading Dynamics (Taylor & Francis, Boca Raton, 2007).

A.H. Zewail (editor): Physical Biology. From Atoms to Medicine (Imperial College Press, London, 2008).

Ph. Leclere, M. Surin, P. Brocorens, M. Cavallini, F. Biscarini, R. Lazzaroni, Supramolecular assembly of conjugated polymers: From molecular engineering to solid-state properties Mat., Sci., and Eng., 55, 1 - 55, (2006).

INVITED LECTURERS

Christian Beck - Queen Mary College, U. London, U.K.
3 lectures on:
"Super-statistical techniques (novel methodologies) for (inhomogeneous) complex systems (pattern forming systems, etc)".

Fabio Biscarini - Istituto Studio Materiali Nanostrutturati (CNR), Bologna, Italy
5 lectures on:
"Unconventional fabrication of multifunctional materials (bottom-up approach): from nanostructures to field effect transistors and label-free sensors and other cases of interest”.

Werner Ebeling - Humboldt Universität, Berlin, Germany
4 lectures on:
"Active Brownian motors (ratchets and molecular motors, rotating and step motors, etc)."

Grégoire Nicolis - U.L.B., Brussels, Belgium
4 lectures on:
"Fluctuations in nonlinear systems out of equilibrium (master equations, role of geometry, meta-stability, information-theoretic approach, fluctuation theorems and dynamical entropies)".

Cécile Sykes - Institut Curie, Paris, France
5 lectures on:
"Building cell movements step by step (cyto-skeletal polymers, cyto-skeletal motor proteins, cell movements, actin-generated forces and their modulation, etc)".

Manuel G. Velarde - IP-UCM, Madrid, Spain
4 lectures on:
"Surface/molecular forces (DLVO theory) role on wetting and spreading" and "Nonlinear mechanical vibrations in model molecular wires and wave-mediated transport”.

Francesco Zerbetto - Università di Bologna, Italy
5 lectures on:
"Can molecules mimic the functions of macroscopic tools?" (numerous cases).

LECTURES

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

MOLECULAR MOTORS AND (NANO) MECHANICAL MACHINES: STOCHASTICS, NONLINEARITY AND COMPLEXITY

Udine, July 13 - 17, 2009
Application Form
(Please print or type)

Surname _____

Name _____

Affiliation _____

Address _____

_____

E-mail _____

Phone _____ *Fax* _____

Method of payment upon receipt of confirmation (Please check the box)

The fee of Euro 600,00 includes IVA/VAT tax and excludes bank charges.

❑ *I shall send a check of Euro* _____

❑ *Payment will be made to CISM - Bank Account N° 094570210900, VENETO BANCA - Udine (CAB 12300 - ABI 05418 - SWIFT AMBPIT2M - IBAN CODE IT83Z 05418 12300 09457 0210900). Copy of the receipt should be sent to the secretariat.*

❑ *I shall pay at the registration counter with check, cash or VISA Credit Card (Mastercard/Eurocard, Visa, CartaSi).*

IMPORTANT: CISM is obliged to present an invoice for the above sum. Please indicate to whom the invoice should be addressed.

Name _____

Address _____

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_____

C.F.* _____

VAT/IVA* No _____

(*) Only for EU residents or foreigners with a permanent business activity in Italy.

Only for Italian Public Companies

❑ *I ask for IVA exemption (ex law n. 537/1993 - art. 14 comma 10).*

Privacy policy: I understand that data received via this form will be used only to provide information about CISM and its activities, within the limits set by the Italian legislative decree no. 196/2003 and subsequent amendments.
Complete information on CISM's privacy policy is available at www.cism.it.

I have read the "Admission and Accommodation" terms and conditions and agree.

Date _____ Signature _____