

SHORT AND LONG CHAINS AT INTERFACES

Edited by

J. Daillant
P. Guenoun
C. Marques
P. Muller
J. Trân Thanh Vân



EDITIONS
FRONTIERES

XVth Moriond Workshop on:
**Short and long chains
at interfaces**

was organized by

J. Trân Thanh Vân (Orsay)

with the active collaboration of :

D. Andelman (*Tel-Aviv*)
M. E. Cates (*Cambridge, UK*)
M. Cohen-Stuart (*Wageningen*)
Y. Couder (*Paris*)
J. Daillant (*Saclay*)
P. Guenoun (*Saclay*)
J-F. Joanny (*Strasbourg*)
C. M. Knobler (*Los Angeles*)
C. Marques (*Strasbourg*)
H. Möhwald (*Mainz*)
P. Muller (*Strasbourg*)
G. Porte (*Montpellier*)
H. Ringsdorf (*Mainz*)
C. Safinya (*Santa Barbara*)
R. K. Thomas (*Oxford*)
M. Tirrell (*Minneapolis*)
E. B. Zhulina (*Saint-Petersbourg*)

95' RENCONTRES DE MORIOND

The XXXth Rencontres de Moriond were held in 1995 in Villars-sur-Ollon, Switzerland, and in Les Arcs 1800, Savoie, France.

The first meeting took place at Moriond in the French Alps in 1966. There, experimental as well as theoretical physicists not only shared their scientific preoccupations but also the household chores. The participants in the first meeting were mainly French physicists interested in electromagnetic interactions. In subsequent years, a session on high energy strong interactions was also added.

The main purpose of these meetings is to discuss recent developments in contemporary physics and also to promote effective collaboration between experimentalists and theorists in the field of elementary particle physics. By bringing together a relatively small number of participants, the meeting helps to develop better human relations as well as a more thorough and detailed discussion of the contributions.

This concern of research and experimentation of new channels of communication and dialogue which from the start animated the Moriond meetings, inspired us to organize a simultaneous meeting of biologists on Cell Differentiation (1970) and to create the Moriond Astrophysics Meeting (1981). In the same spirit, we have started a new series on Condensed Matter Physics in January 1994. Common meetings between biologists, astrophysicists, condensed matter physicists and high energy physicists are organized to study the implications of the advances in one field into the others. I hope that these conferences and lively discussions may give birth to new analytical methods or new mathematical languages.

At the XXXth Rencontres de Moriond in 1995, four physics sessions, one astrophysics session and one biology session were held :

- * January 21-28 "Dark matter in cosmology, Clocks and Tests of fundamental laws"
"Short and long chains at interfaces"
- * March 11-18 "Electroweak Interactions and Unified Theories"
"Clustering in the universe"
- * March 19-26 "QCD and High Energy Hadronic Interactions"
" Rencontre de Biologie - Méribel "

I thank the organizers of the XXXth Rencontres de Moriond :

- E. Adelberger, R. Ansari, G. Chardin, T. Damour, O. Fackler, G. Fontaine, G. Gerbier, Y. Giraud-Héraud, G. Greene, B. Guiderdoni, E. Hinds, J. Kaplan, for the session Dark matter in cosmology, Clocks and Tests of fundamental laws,

- J. Daillant, P. Guenoun, C. Marques, P. Muller for the Condensed Matter Physics session,

- P. Binetruy, A. Blondel, R. Cahn, G. Coignet, L. Fayard, P. Fayet, J.-M. Frère, L. Krauss, L. Moscoso, C. Savoy and C. Verzegnassi for the Leptonic session,

- C. Balkowski, A. Blanchard, S. Maurogordato, M. Moniez, C. Tao for the Astrophysics session,

- E. Augé, P. Aurenche, E. Berger, A. Capella, D. Denegri, L. Montanet, B. Pietrzyck, D. Schiff, and C. Voltolini for the Hadronic session,

- M. Fellous, F. Michel, K. Tran Thanh Van, H. Vaucheret, J.-L. Rossignol and H. Denis for the Biology meeting,

and the conference secretaries : G. Ambonati, C. Andrews, N. Bachala, L. Besson, R. Bilhaut, J. Cordier, A. Jacquet, C. Julliard, A. Lecoœur, I. Mac Leod, D. Loncaric, H. Mauger, F. and N. Osswald, H. Pham, J. Plancy, J. Raguideau, C. Renaud, A. M. Renault-Perrin and N. Romain.

I am also grateful to Mrs S. Müller, Ms B. Gautron, Mr. E. Rocca-Serra, Ms. C. Dufourny, Ms. S. Kovalevsky who contributed through their hospitality and cooperation to the well-being of the participants enabling them to work in a relaxed atmosphere.

These Rencontres were sponsored by the Centre National de la Recherche Scientifique (INSU, SPM and FP), the Institut National de Physique Nucléaire et de Physique des Particules (IN2P3), the Commissariat à l'Energie Atomique (DAPNIA, DRECAM), the Ministère de l'Enseignement Supérieur et de la Recherche (programme ACCESS) and the International Science Foundation. The workshop on Dark matter in cosmology, Clocks and Tests of fundamental laws was also sponsored by the National Science Foundation, the meeting on Short and Long Chains at Interfaces by DGA, Elf-Atochem, IFP, Unilever-UK and the Moriond Astrophysics meeting by the Observatoire de Paris-Meudon, the Université de Paris VII and the Centre National d'Études Spatiales. I would like to express my thanks to their encouraging support.

I sincerely wish that a fruitful exchange and an efficient collaboration between the physicists, the astrophysicists and the biologists will arise from these Rencontres as from the previous ones.

J. Trần Thanh Vân

FOREWORD

Both short and long chain amphiphiles create fascinating and yet ill-understood structures at interfaces. However, approaches are often different when dealing with one or the other compounds and it seemed advantageous to organize some kind of meeting such as this, which has tried to bring together the two communities of soft condensed matter physicists dealing with surfactants and polymers. In addition to the presentation of the most recent results in each field, new interesting subjects which involve chains at interfaces, whatever their length, like mixed systems of chains, biological materials or drag reduction in flows by addition of chain molecules were also extensively debated in this meeting.

Polymers present numerous interfacial conformations according to the nature of interfaces and bulk phases. Charged species in solution have recently received lots of interest for grafted configurations as well as adsorbed/depleted ones. This interest comes both from applied problems (charged species are water soluble) and fundamental questions of coupling between the elasticity of the chain and the distributions of monomeric charges and counterions. Such results are directly related to the questions of polymer adsorption, colloidal protection or chemical synthesis in presence of polymers. Melt systems of diblocks or grafted chains, often cast in the form of thin films, can be also strongly distorted by the proximity of an interface. As a result, many experimental situations lead to local ordering or peculiar monomeric distributions which can be described by scaling or field theories (*Interfacial properties of polymer solutions and polymer melts*). The behaviour of chain molecules at interfaces is also essential in wetting and adhesion phenomena. Effects of flow confinement in ultra-thin films and the adhesive properties of polymers were discussed in a series of papers (*Wetting, adhesion and friction*).

A somewhat different situation arises for short chains at the air-solution interface (Langmuir films) where the number of defects in each chain can be very low. The positional or orientational order is now currently assessed by grazing incidence x-ray diffraction, neutron reflection and Brewster angle microscopy. Large instrument facilities are more and more essential to these investigations. The now very precise experimental results can be compared with weak crystallization Landau approaches and simulations. Theory and simulations are indeed more and more precise and therefore increasingly important. More complex systems (several chains per head, coupling between heads and chain ordering, effects of chirality) are now being also investigated. The better understanding of simple species

films allows new original investigations of their mechanical and elastic properties. In particular recent developments enable in-situ manipulation of nano-structures at interfaces (*Two-dimensional assemblies of amphiphilic molecules and macromolecules, Langmuir films, membranes, copolymers...*).

Mixed systems are currently studied as the perturbation of a host phase of short chains by another compound which can be a polymer chain. Another approach of this problem - possibly complementary- is a better understanding of the polydispersity in systems constructed of mixtures of diblock copolymers (*Mixed polymer-surfactant systems*). Of course biological systems always present mixtures of short and long chains which are now studied in this respect. For instance the behaviour of membrane proteins raises many interesting questions. A very different aspect is the understanding of molecular motors where a biological system involving a variety of chain molecules can be understood by using the theoretical tools of statistical physics (*Short and long chains in biology*).

Finally, another aim of the meeting was to direct attention to the problem of chains in hydrodynamic flows (*Hydrodynamics and polymers: turbulence, rheology...*). This question, although rather old, is generally not addressed by people of the polymer and surfactant communities. However examples such as long chains extended in strong flows seem more and more important to people dealing with either friction at interfaces or biological molecules (stretching of DNA molecules for instance).

J. Daillant, P. Guenoun, C. Marques, P. Muller

x

S. Karaborni	Simulating Langmuir monolayers of fatty acids.	113
C. M. Knobler	Imaging studies of monolayers.	125
M. Seul	Phase separation in Langmuir monolayers.	135
E. Scalas	Morphology transitions in the growth of domains in surfactant monolayers.	143
D. Vollhardt	Brewster angle microscopy study of chiral discrimination in Langmuir monolayers.	149
M. Deutsch	Surface crystallization in normal-alkanes and alcohols.	155
E. Scalas	Tilted monolayer phases of chiral diols.	165
F. Bringezu	Structures of branched chain kephaline monolayers at the air/water interface.	171
H. Baltes	Decoupling of chain- and head group ordering in phospholipid monolayers.	177
G. Förster	Lecithins with short and long branched fatty acids : X-Ray diffraction and miscibility or different gel phases.	183
J. Sanchez-Gonzalez	Molecular rearrangements in lipid monolayers : a study on phase transitions.	189
R. Miller	Pendent drop technique for studies of dynamic properties of soluble adsorption layers and insoluble monolayers.	195
J. B. Li	Phase transitions and adsorption characterisation of phospholipid monolayers at air/water, dodecane/water and chloroform/water interfaces.	201
P. Fontaine	Kinetics of polymerization in Langmuir monolayers of n-alkyltrimethoxysilane.	207
J. P. K. Peltonen	Polymerizability of linoleic acid monolayers at the gas/liquid interface.	213
A. Renault	Measurements of the elastic tensor of a crystalline monolayer on water surface by X-ray diffraction.	219
L. Pauchard	Experimental study of the breakage of a two-dimensional crystal.	223
A. Saint-Jalmes	Light scattering from a buckled bidimensional solid.	229
C. Gourier	Phase diagram and collapse of a diacetylenic Langmuir film.	237

III. MIXED POLYMER SURFACTANT SYSTEMS.

A. M. Bellocq	Solubilization of an adsorbing polymer in a lyotropic lamellar phase : effect of polymer molecular weight.	245
E. Z. Radlinska	Polymer in a lyotropic lamellar phase : possible model for proteins in membranes.	251
C. Ligoure	Vesicle formation from neutral amphiphilic bilayers doped by an ionic surfactant.	257
An-Chang Shi	Theoretical studies of diblock copolymer mixtures.	265
P. Sens	Mixed micellisation in a bidisperse diblock copolymer solution.	271
B. S. Valaulikar	Dynamic light scattering studies on the new surfactant cetyl trimethyl ammonium hydroxy naphthalene carboxylate (CTAHNC).	275

IV. WETTING AND ADHESION.

J. De Coninck	Spreading of chain molecules via molecular dynamics.	285
S. Herminghaus	Molecular effects in ultra-thin liquid film spreading dynamics.	295
S. Herminghaus	Observation of enhanced viscosity of wetting layers of small molecules.	301
H. Riegler	Island formation in ultrathin organic multilayers of behenic acid on silicondioxide surfaces.	307
L. Léger, E. Raphaël	Adhesion between an elastomer and a grafted surface.	313
N. Shahidzadeh	Modification of the wettability and adhesive properties of polypropylene by an ammonia plasma treatment. Application to aluminium-PP system.	325
P. Lang	Improvement of adhesion and corrosion protection of metals, from the grafting of conducting polymers via preadsorption of aromatic thiols.	331

V. SHORT AND LONG CHAINS IN BIOLOGY.

H. W. Huang	Interaction of lipid bilayer membranes with amphiphilic helical peptides.	339
-------------	---	-----

E. K. Mann	Exchange kinetics for protein adsorption on solid surfaces.	345
------------	---	-----

VI. HYDRODYNAMICS AND POLYMERS (TURBULENCE, RHEOLOGY).

H. W. Bewersdorff	Turbulent flows of polymer solutions.	353
T. Q. Nguyen	Orientation of polystyrene chains in "strong" flow.	363
P. Sens	Viscoelasticity of compressed polymer layer.	369
E. K. Mann	The hydrodynamics of domain relaxation in a polymer monolayer.	379
G. Gompper	Transport coefficients of microemulsions and sponge phases.	385
List of participants		391