

## XX International Summer School "Nicolás Cabrera"

### BIOMOLECULES AND SINGLE MOLECULE TECHNIQUES

(21-26 July 2013)

#### School scope and goals:

Most of what we know in chemistry and biology has been determined by bulk studies where billions of individual entities (molecules or molecular aggregates) are considered, providing averaged results. The usual approach is to assume that all the molecules are indistinguishable when performing their task, although this is often not the case. Biochemical processes are likely to be highly asynchronous and intermediate states will be poorly populated. Moreover, some physical magnitudes such as forces or intermolecular distances are hardly accessible using bulk techniques. The development of single-molecule approaches opened the possibility of observing individual molecules and to measure properties that otherwise were impossible to obtain from an undifferentiated ensemble. The main goal of this school is to give an introduction to both theoretical and experimental single-molecule approaches to solve a number of biological problems. There will be dedicated sessions to atomic force microscopy, optical and magnetic tweezers, single-molecule fluorescence techniques as well as a full day dedicated to theoretical approaches to biology. Therefore, this summer school is intended for biologists, experimental and theoretical physicists willing to get a dive in the exciting field of single-molecule biophysics.

#### School Topics:

Atomic force microscopy

Optical and magnetic tweezers

Single-molecule fluorescence techniques

Theory on soft matter.

Single-molecule applications

#### Organizers

<p>Pedro José de Pablo Gómez <a href="mailto:p.j.depablo@uam.es">p.j.depablo@uam.es</a> Departamento de Física de la Materia Condensada, C03 Facultad de Ciencias Universidad Autónoma de Madrid 28043 Madrid Spain</p>	<p>Fernando Moreno-Herrero <a href="mailto:fernando.moreno@cnb.csic.es">fernando.moreno@cnb.csic.es</a> Dept. Macromolecular Structures Lab. B17-B-18 Centro Nacional de Biotecnología (CNB-CSIC) C/ Darwin, 3. 28049, Cantoblanco, Spain <a href="http://www.fernandomorenoherrero.com">www.fernandomorenoherrero.com</a></p>
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**Secretary**

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**KEYNOTE SPEAKERS.**

**Philip Nelson** University of Pennsylvania, USA

**Toshio Ando** Kanazawa University, Japan

**Erwin Peterman** Vrije Universiteit, Amsterdam, The Netherlands

**Félix Ritort** Universtitat de Barcelona, Spain

**Ulrich Keyser** University of Cambridge, UK

**Urs Greber** University of Zurich, Switzerland

**Fred MacKintosh** Vrije Universiteit, Amsterdam, The Netherlands

**Daniel Müller** Eidgenössische Technische Hochschule Zürich, Switzerland

**Ricardo García** Instituto de Ciencia de Materiales de Madrid, CSIC, Spain

**Rudolf Podgornik** Institut "Jožef Stefan", Slovenija

**Melike Lakadamyali** The Institut of Photonic Sciences ICFO, Barcelona, Spain

**Jan Lipfert** Delft University of Technology, The Netherlands

**Iwan Schaap** Georg August Universität, Göttingen, Germany

**INVITED SPEAKERS.**

**Mauricio García-Mateu** Centro de Biología Molecular Severo Ochoa, Madrid, Spain

**Arvind Raman** Purdue University, USA

**Wouter Roos** Vrije Universiteit, Amsterdam, The Netherlands

**Sergi García-Manyes** King's College London, UK

**Carolina Carrasco** Centro Nacional de Biotecnología, CSIC, Madrid, Spain

**Alessandro Podesta** Università degli Studi di Milano, Italy

**Francesco Mantegazza** Università di Milano-Bicocca, Italy

**Borja Ibarra** IMDEA Nanociencia, Madrid, Spain

**Ricardo Arias-González** IMDEA Nanociencia, Madrid, Spain

# Scientific Programme

Sunday 21 July 2013

17:00-20:00	Registration and check-in
20:00-21:00	Dinner

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Monday 22 July 2013

## Morning Session Day 1

Session Topic: ***Optical and Magnetic Tweezers (I)***

Session Chair: *Fernando Moreno-Herrero (Centro Nacional de Biotecnología, CSIC, Spain)*

8:50-9:00	Welcome words. The organizers.
9:00-10:00	<i>Inference in biological physics</i> Philip Nelson (University of Pennsylvania, USA) Keynote speaker
10:00-11:00	<i>Optical tweezers – Force spectroscopy on single molecules (part I)</i> Ulrich Keyser (University of Cambridge, UK) Keynote speaker
11:00-11:30	Coffee break
11:30-12:30	<i>Magnetic tweezers: how do they work, what are they good for, and how can their capabilities be expanded?</i> Jan Lipfert (Delft University of Technology, The Netherlands) Keynote speaker
12:30-13:00	<i>Using optical tweezers to study DNA replication dynamics at single-molecule level</i> Borja Ibarra (IMDEA Nanociencia, Madrid, Spain) Invited speaker
13:00-13:30	<i>Mechano-chemical characterization of the genetic information carriers</i> Ricardo Arias-González (IMDEA Nanociencia, Madrid, Spain) Invited speaker
13:30-15:00	Lunch

## Afternoon Session Day 1

Session Topic: ***Optical and Magnetic Tweezers (II)***

Session Chair: *Pedro J. de Pablo (Universidad Autónoma de Madrid, Spain)*

15:00-16:00	<i>Optical tweezers – Force spectroscopy on single molecules (part II)</i> Ulrich Keyser (University of Cambridge, UK)
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	Keynote speaker
16:00-17:00	<i>Applications of magnetic tweezers: Probing the response of double-stranded RNA to force and torque at the single-molecule level</i> Jan Lipfert (Delft University of Technology, The Netherlands) Keynote speaker
17:00-17:30	Coffee break
17:30-18:00	<i>Magnetic tweezers measurements of the nanomechanical properties of DNA</i> Francesco Mantegazza (Università di Milano-Bicocca, Italy) Invited speaker
18:00-18:30	<i>Modulation of the translocation properties of a model helicase by DNA sequence content within the track</i> Carolina Carrasco (Centro Nacional de Biotecnología, CSIC, Spain) Invited speaker
18:30-18:45	<i>Wringing out a ribonucleoprotein complex</i> Maria Tikhomirova (Westfalen Wilhelms-University Muenster) Selected poster presentation 1
18:45-19:00	<i>Single-molecule folding mechanisms of the apo- and Mg<sup>2+</sup>-bound forms of the human neuronal calcium sensor 1 (NCS1)</i> Mohsin M. Naqvi (University of Modena and Reggio Emilia) Selected poster presentation 2
19:00-20:00	Free time
20:00-21:00	Dinner
21:00-22:00	Posters and beers

## Tuesday 23 July 2013

### Morning Session Day 2

Session Topic: **Atomic Force Microscopy (I)**

Session Chair: *Pedro J. de Pablo (Universidad Autónoma de Madrid, Spain)*

9:00-10:00	<i>What happens inside the eye's photoreceptor cells</i> Philip Nelson (University of Pennsylvania, USA) Keynote speaker
10:00-11:00	<i>Atomic force microscopy in biology</i> Iwan Schaap (Georg August Universität Friedrich Hund, Göttingen, Germany) Keynote speaker

11:00-11:30 Coffee break

11:30-12:30	<i>Development of high-speed atomic force microscopy</i> Toshio Ando (Kanazawa University, Japan) Keynote speaker
12:30-13:00	<i>Manipulation and Biological Implications of the Mechanical Properties of Viruses</i> Mauricio García-Mateu (Centro de Biología Molecular Severo Ochoa, Madrid, Spain) Invited speaker
13:00-13:30	<i>Adsorption of proteins on nanostructured surfaces: investigating the nanoscale interaction mechanisms by atomic force microscopy</i> Alessandro Podesta (Università degli Studi di Milano, Italy) Invited speaker

13:30-15:00 Lunch

#### Afternoon Session Day 2

Session Topic: **Atomic Force Microscopy (II)**

Session Chair: *Fernando Moreno-Herrero (Centro Nacional de Biotecnología, CSIC, Spain)*

15:00-16:00	<i>Applications of high-speed atomic force microscopy</i> Toshio Ando (Kanazawa University, Japan) Keynote speaker
16:00-17:00	<i>Cell mechanics with AFM and optical traps</i> Iwan Schaap (Georg August Universität Friedrich Hund, Göttingen, Germany) Keynote speaker

17:00-17:30 Coffee break

17:30-18:30	<i>High-resolution atomic force microscopy and spectroscopy of native membrane proteins</i> Daniel Müller (Eidgenössische Technische Hochschule Zürich, Switzerland) Keynote speaker
18:30-19:00	<i>Probing viral material properties by Atomic Force Microscopy</i> Wouter Roos (Vrije Universiteit, Amsterdam, The Netherlands) Invited speaker

19:00-20:00 Free time

20:00-21:00 Dinner

21:00-22:00	Posters and beers
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Wednesday 24 July 2013

### Morning Session Day 3

Session Topic: ***Physics of single-molecule approaches and Fluorescence (I)***

Session Chair: *Pedro J. de Pablo (Universidad Autónoma de Madrid, Spain)*

9:00-10:00	<i>Spying on single biomolecules using fluorescence microscopy</i> Erwin Peterman (Vrije Universiteit, Amsterdam, The Netherlands) Keynote speaker
10:00-11:00	<i>Elasticity and dynamics of cytoskeletal and extracellular networks (Part I)</i> Fred MacKintosh (Vrije Universiteit, Amsterdam, The Netherlands) Keynote speaker

11:00-11:30 Coffee break

11:30-12:30	<i>Through the eyes of a virus – imaging adenovirus entry into cells</i> Urs Greber (University of Zurich, Switzerland) Keynote speaker
12:30-13:30	<i>Towards quantitative structure-property relationships of biological samples using dynamic atomic force microscopy</i> Arvind Raman (Purdue University, USA) Invited speaker

13:30-15:00 Lunch

### Afternoon Session Day 3

Session Topic: ***Physics of single-molecule approaches and Fluorescence (II)***

Session Chair: *Fernando Moreno-Herrero (Centro Nacional de Biotecnología, CSIC, Spain)*

15:00-16:00	<i>Intraflagellar transport in the chemosensory cilia of C. elegans tracked and captured with single-molecule fluorescence microscopy</i> Erwin Peterman (Vrije Universiteit, Amsterdam, The Netherlands) Keynote speaker
16:00-17:00	<i>Elasticity and dynamics of cytoskeletal and extracellular networks (Part II)</i> Fred MacKintosh (Vrije Universiteit, Amsterdam, The Netherlands) Keynote speaker

17:00-17:30 Coffee break

17:30-18:30	<i>Imaging and modeling of virus egress from infected cells</i> Urs Greber (University of Zurich, Switzerland) Keynote speaker
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18:30-22:00 Visit to the city of Segovia. Dinner in town.

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Thursday 25 July 2013

#### Morning Session Day 4

Session Topic: ***Physics of single-molecule approaches and Fluorescence (III)***

Session Chair: *Pedro J. de Pablo (Universidad Autónoma de Madrid, Spain)*

9:00-10:00 *Nonequilibrium work relations: basic concepts and derivations*  
Félix Ritort (Universttat de Barcelona, Spain)  
Keynote speaker

10:00-11:00 *Super-resolution fluorescence microscopy: concepts and technical developments*  
Melike Lakadamyali (The Institut of Photonic Sciences ICFO, Barcelona, Spain)  
Keynote speaker

11:00-11:30 Coffee break

11:30-12:30 *Order and energetics of nucleic acids in viral capsids (part I)*  
Rudolf Podgornik (Institut "Jožef Stefan", Slovenija)  
Keynote speaker

12:30-12:45 *Using Highly Inclined, Laminated Optical sheet (HILO) and off-focus imaging for 3D tracking of single molecules in bacteria*  
Matteo Prayer Galletti (University of Florence)  
Selected poster presentation 3

12:45-13:00 *Signal-Driven Tethering System based on DNA-Origami linked to Lipid Bilayers*  
Alexander Ohmann (Technische Universität Dresden)  
Selected poster presentation 4

13:00-13:30 Free time

13:30-15:00 Lunch

#### Afternoon Session Day 4

Session Topic: ***Physics of single-molecule approaches and Fluorescence (IV)***

Session Chair: *Fernando Moreno-Herrero (Centro Nacional de Biotecnología, CSIC, Spain)*

15:00-16:00 *Extended fluctuation relations applied to free energy recovery of kinetic structures*  
Félix Ritort (Universttat de Barcelona, Spain)  
Keynote speaker

16:00-17:00 *Super-resolution fluorescence microscopy: biological applications*  
Melike Lakadamyali (The Institut of Photonic Sciences ICFO, Barcelona, Spain)  
Keynote speaker

17:00-17:30 Coffee break

17:30-18:30 *Order and energetics of nucleic acids in viral capsids (part II)*  
Rudolf Podgornik (Institut "Jožef Stefan", Slovenija)  
Keynote speaker

18:30-18:45	<i>Mechanical Unfolding of the One-State Downhill Folding Protein BBL</i> Jörg Schönfelder (Centro Nacional de Biotecnología, CSIC, and IMDEA nanociencia) Selected poster presentation 5
18:45-19:00	<i>Monitoring dynamics of human adenovirus disassembly induced by mechanical fatigue</i> Alvaro Ortega-Esteban (Universidad Autónoma de Madrid) Selected poster presentation 6
19:00-20:00	Free time
20:00-21:00	Dinner
21:00-22:00	Posters and beers

## Friday 26 July 2013

### Morning Session Day 5

Session Topic: ***Applied single-molecule techniques***

Session Chair: *Pedro J. de Pablo (Universidad Autónoma de Madrid, Spain)*

9:30-10:30	<i>Fundamental aspects of high resolution imaging and quantitative mapping of biomolecules by dynamic force microscopy</i> Ricardo García (Instituto de Ciencia de Materiales de Madrid, CSIC, Spain) Keynote speaker
10:30-11:00	<i>The nanomechanics of individual biomolecules</i> Sergi García-Manyes (King's College London, UK) Invited speaker
11:00-11:30	Coffee break
11:30-11:45	<i>A temperature-controlled Magnetic Tweezers to investigate DNA-translocating proteins</i> Benjamin Gollnick (Centro Nacional de Biotecnología, CSIC, Spain) Selected poster presentation 7
11:45-12:00	<i>Mechanical stability and reversible fracture of vault particles</i> Aida Llauró (Universidad Autónoma de Madrid. Spain) Selected poster presentation 8
12:00-12:15	<i>(Un) Folding of Engrailed Homeodomain by Multiple Spectroscopic Probes: From Equilibrium to Ultrafast Temperature Jump Kinetics</i> Nagalakshmi T Sooriyanarayanan (Centro Nacional de Biotecnología, CSIC, Spain) Selected poster presentation 9
12:15-12:30	<i>Energy transfer studies in binary dye solution mixture of Coumarin 540 and</i>



*Rhodamine B and its lifetime calculations*  
Amitansu Pattanaik (University of Delhi, India)  
Selected poster presentation 10

12:30-13:00 Poster awards. Closing remarks. The organizers.

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14:00 Bus to Barajas Airport