

The course organised by Prof. Julio Fernandez will consist of ten days of lectures and experimental work.

The course will be focused on the study of protein mechanics using atomic force microscopy (AFM). Recognized world experts will be teaching the latest research on single-molecule biophysics with proteins. The students will use a custom-made atomic force microscope directly imported from Prof. Fernandez laboratory at Columbia University (New York). The students will set up, perform and analyse experiments in the same manner that researchers do in their innovative research in the Fernandez Laboratory. Several model proteins such as ubiquitin, titin and thioredoxin will be employed. The folding and unfolding force-dependent kinetics of single proteins as well as enzymatic catalysis monitoring the rupture of single bonds will be studied in detail using the newly developed force-clamp technique. The experiments will be complemented with practical sessions of molecular dynamics simulations. The students will learn how to perform steered molecular dynamics (SMD) as well as the application of molecular modeling to understand protein dynamics and function.

The course represents a perfect opportunity for young students to introduce themselves in the world of single-molecule with proteins. They will also have the opportunity to interact and discuss top-notch scientific topics with the instructors in a friendly environment.

Organisers:

Sergi Garcia-Mañes (Columbia University, USA)

Raul Perez-Jimenez (Columbia University, USA)

Julio Fernandez (Columbia University, USA)

Invited Speakers:

Jasna Brujic (New York University, USA)

Mariano Carrion-Vazquez (Instituto Cajal, CSIC, Spain)

Hongbin Li (University of British Columbia, Canada)

Wolfgang Linke (Ruhr-Universität, Germany)

Hui Lu (University of Illinois at Chicago, USA)

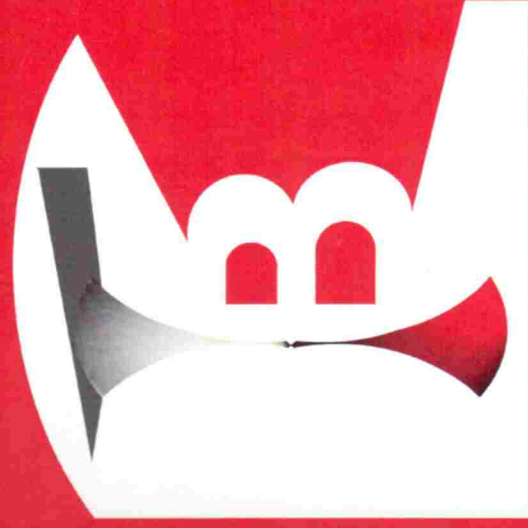
Date: September 20 - 30, Bilbao, Spain

Application deadline: 15 July 2010

Registration: Free registration, a number of travel and accommodation grants will be offered

Contact: bilbaobiophysics@ehu.es

Advanced courses coordinator: Jose Requejo-Isidro



Bilbao Advanced Courses on Biophysics 2010

at Unidad de Biofísica
CSIC- UPV/EHU

www.fundacionbiofisicabizkaia.org/bilbaobiophysics

SINGLE PROTEIN MECHANICS

Speakers

Prof. Julio Fernandez, Columbia University (USA)

Professor Fernández is the world leader in AFM studies with single proteins. He is the inventor of the so-called Force-clamp technique. In this course, he will be teaching the capabilities of the force-clamp technique to study both protein folding and chemical reactions under force.

Dr. Raul Perez Jimenez, Columbia University (USA)

Dr. Perez Jimenez will conduct an experimental approach to study enzyme catalysis at the single-molecule level using force-clamp techniques. The chemistry of oxidoreductase enzymes will be studied in detail. The latest research on enzymatic evolution will also be discussed.

Dr. Sergi Garcia-Mañes, Columbia University (USA)

Dr. Garcia-Mañes will conduct a hands-on experimental approach to demonstrate how protein unfolding is accelerated upon the application of a constant stretching force. He will also show how the reduction of a single disulfide bond with simple nucleophiles can be modulated by force. The experimental demonstration will be complemented by a discussion on the molecular determinants that govern protein folding and chemical reactions at the single molecule level.

Prof. Jasna Brujic, New York University (USA)

Dr. Brujic will introduce the use of statistical physics tools to unravel the signatures of complexity from the individual unfolding trajectories obtained by single molecule force-clamp spectroscopy. In particular, she will comment on the roughness and dynamics of the native state of the small protein ubiquitin.

Dr. Mariano Carrion-Vazquez, Instituto Cajal, CSIC (Spain)

Dr. Carrion-Vazquez will focus on the molecular biology of single molecule experiments. He will explain the importance to construct polyproteins in order to obtain a reliable, unmistakable fingerprint in single molecule experiments.

Prof. Hongbin Li, University of British Columbia (Canada)

Dr. Li will discuss how protein-ligand interactions, including protein-protein interaction and protein-metal ion interaction affect the mechanical stability of proteins, and how such effects can be used to quantitatively determine the binding affinity of protein-ligand interactions.

Prof. Wolfgang Linke, Ruhr University Bochum (Germany)

Dr. Linke will discuss on the contribution of single molecule AFM to the understanding of the molecular mechanisms determining the elasticity of the giant protein titin. He will address the latest research regarding how for instance the presence of disulfide bonds in the N2B sequence of titin control the stiffness of cardiomyocytes.

Prof. Hui Lu, University of Chicago at Illinois (USA)

Dr. Lu will focus on the use of computational methods and theoretical modelling to study protein mechanics. He will teach steered molecular dynamics (SMD), which will be used in combination with single-molecule experiments to better understand protein structure, dynamics and function.

September 20th

5 pm - 7 pm: Introductory Lecture.

September 21st

10 am - 12 pm: Force-clamp technique to study single proteins.

5 pm - 8 pm: AFM Experimental Session.

September 22nd

10 am - 12 pm: Computational methodologies in protein mechanics.

4 pm - 8 pm: AFM Experimental Session. SMD Experimental Session.

September 23rd

10 am - 12 pm: Latest research on single molecule force-clamp spectroscopy.

4 pm - 8 pm: AFM Experimental Session. SMD Experimental Session.

September 24th

10 am - 12 pm: Mariano Carrion-Vazquez.

4 pm - 8 pm: AFM Experimental Session. SMD Experimental Session.

September 27th

10 am - 12 pm: The dynamics of the native state of ubiquitin.

5 pm - 8 pm: AFM Experimental Session.

September 28th

10 am - 12 pm: The elasticity of the giant protein titin.

5 pm - 8 pm: AFM Experimental Session

September 29th

10 am - 12 pm: The mechanics of protein-ligand interactions.

5 pm - 8 pm: AFM Experimental Session.

September 30th

10 am - 12 pm: Single-molecule biophysics: future perspectives.