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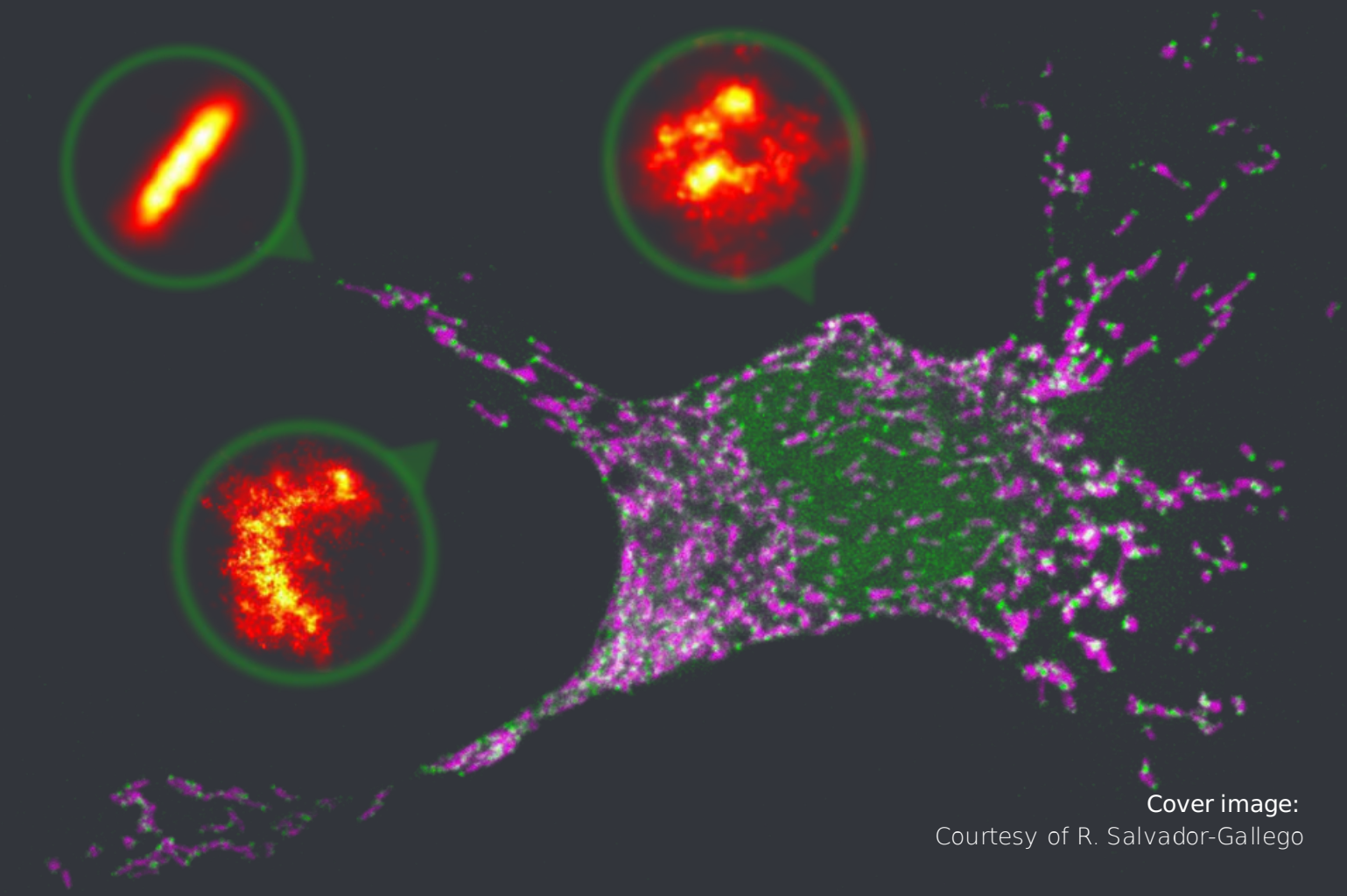

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In this issue

Biofísica Magazine

EDITORIAL

Irreproducibility in Research. What can we do about it?

The team of editors

We all would agree with Karl Popper's statement [1]:

> *Non-reproducible single occurrences are of no significance to science.*

But what if a substantial percentage of published scientific *facts* are of the irreproducible category? Such an alarming scenario may be close to reality, according to a number of recent reports [2,3,4]. Indeed, some shocking statistics suggest that irreproducibility has gone awry in the last years. For instance, pharma and biotech companies can only reproduce between 11 and 25% high-impact research papers in the field of cancer research [5].

Irreproducibility is a growing concern among scientists [6]. Not only does it slow down the advance of science, but it can also undermine the support from society. Although scientists are generally considered as *trustable*, this image can be eroded by the perception that the majority of published scientific facts turn out to be irreproducible. We are already seeing signs of mistrust in the general media (we highly recommend the article *Trouble at the lab* published in 2013 by *The Economist* [7]). As these bad news spread, major journals and professional societies are devoting editorials and discussions to the problem of irreproducibility. Information about the topic is abundant and a vigorous debate is taking place in the scientific community (see section *Discussion forums* below). Biophysics is certainly not immune to this problem [8]. In this article, we discuss the potential sources of irreproducibility and propose some potential fixes.

At first sight, one might be tempted to associate irreproducibility with *fraud*, the latter being defined as dissemination of scientific facts even if the author is aware that they are not backed up by experimental evidence. However, although quantifying the extent of scientific fraud is difficult, the general consensus is that such a type of misconduct is quite rare and cannot be considered a major cause of irreproducibility. Instead, we identify two major sources for this problem:

1. **Inherent difficulty of the scientific enterprise**. Science tackles challenging questions and hence *mistakes* can be made even by the most careful, best trained and honest scientist. This is particularly true in cases of strongly multidisciplinary sciences, like Biophysics. Such mistakes can lead to irreproducibility, but there is little that we can do about it. Even in the absence of mistakes, results can be irreproducible due to variables that are not under the control of the researcher. This is quite common in research that involves live organisms, such as bacteria, cell lines or animals, which are subject to variations due to adaptation to a particular lab, circadian rhythms, age, etc. Again, there is little that can be done to prevent irreproducibility due to uncontrollable variables. In addition, this sort of irreproducibility may indeed be positive, since it may eventually inform about the robustness of a finding (how the finding is independent of specific experimental variables) or pave the way to discover unexpected variables controlling the outcome of the experiment. For instance, the observation that the same strain of mice can have different immunological responses, depending on the geographical location of the laboratory, led to the identification of commensal microbiota as a key modulator of a subset of T-helper cells [9].
   Since we cannot avoid honest mistakes or uncontrollable experimental variables, is there anything that we can do to minimize irreproducibility that arises from the intrinsic difficulty of science? Can we, at least, do something to turn irreproducibility based on intrinsic complexity into positive scientific outcomes?

   In connection to this problem, there is the concern that a major source of irreproducibility is indeed the lack of detail in the experimental methods and conditions described in publications. Thus, it does make sense, if experiments are sophisticated and tricky, that we put a stronger effort into describing them very accurately in the methods section of scientific papers. Many journals are already implementing specific rules so that authors provide all the information that is needed to reproduce their results [10]. Moreover, in a context where digital information is easy to produce, store and disseminate, there is no excuse for all the actors involved (authors, journals...) to provide excruciating details about the materials and methods. Apart from that, there are cases where a detailed reporting of primary experimental results would facilitate reanalysis, using the same or alternative methods. Thus, journals should also implement repositories for all numerical, graphic and image data related to published work, and not only selected, summarized or conclusive data, as usually reported in article tables and graphs. Data repositories are already common for studies of structures of molecules. It may now be the time to universalize this requirement, although this obviously opens questions about standards and formats [8].

   Data repositories are already common for studies of structures of molecules. It may now be the time to universalize this requirement.

2. **Sloppy research**. This reaches *all corners* of scientific research, including the quality of primary experimental data and subsequent analysis, and adequacy of use of methodology [11]. Some examples of sloppy research may even be qualified as misconduct. Actually, the limits between

sloppy research and misconduct are blurry. For instance, cases of malpractice are, reporting results that the authors know that cannot be replicated consistently (without declaring it or without providing reasonable arguments which explain the reasons for the lack of replicability) or presenting results in a manner that masks potential flaws in the experimental design, so that they are unnoticed by reviewers.

Thinking, questioning, discussing, criticizing and re-thinking are essential in science, but seem not to be acknowledged in today's accelerated world of scientific discovery.

Nevertheless, in most instances elements other than misconduct are responsible for sloppy research. Weak supervision by senior scientists, poor training of students, too much emphasis on shiny results, or hyper-competition within a *publish-or-perish* environment that fosters publication in high impact journals are some of the components leading to this severe problem. The common factor for all those cases is the lack of a critical approach to the scientific work: Thinking, questioning, discussing, criticizing and re-thinking (if needed) are essential activities in science. But they all consume time and effort, and seem not to be well acknowledged in today's accelerated world of scientific discovery.

Sloppy research may well be the leading cause of irreproducibility. However, relegating such practices and substituting them by slower and harder, solid and flawless work is not easy.

A possible way to start is by improving the chances to identify sloppy research. This necessarily means improving reviewing of publications and valuing, as it deserves, the important contribution of reviewers. In fact, after accepting that modern multidisciplinary science is a very complex task (see previous point) and that a well done job needs to pay the price of time and effort, we also have to accept that good reviewing cannot be done without recognition, as it is in practice the case. This means that we need to reform the publication and reviewing system (perhaps to rethink it completely), to make possible that the best experts are willing to spend their precious time to evaluate the scientific work in sufficient depth, specially, but not exclusively, for publications in high-rank journals. This revision of the publishing system should be accompanied by other measures, like facilitating open and continuing post-publication review and stimulating criticism and discussion in scientific conferences.

Students should learn that rigor is the correct way (even if not the shortest) to be competitive.

The above measures should also be complemented with others that improve education and training of young scientists, both *technically* and *ethically*, which again seems not to be appropriately valued today. Such training should be included as part of the PhD and MSc programs. Perhaps more importantly, institutes and laboratories should recover critical thinking and discussions at all levels. We should also rescue the *pride for training* next generations of high-quality, rigorous scientists, over that of collecting high-impact publications. Students should be aware of what sloppy research *means* and how to avoid it. They should be instructed to be critical with their own work and with the work of others, and should learn that

> rigor is the correct way (even if not the shortest) to be competitive. This will not only create best scientists, but also finest critics, who will eschew sloppy research manners and take action whenever those are detected.

Finally, we want to make some specific comments about irreproducibility in Biophysics. In this field we develop or employ *cutting-edge* technologies to examine Biology, using approaches which may cover experiments and theory and often make use of living cells or animal models. Such a strong multidisciplinarity poses additional challenges, since it is not uncommon that biophysicists need to use highly specialized techniques on which they are not necessarily experts. Good examples are cases where there is a simultaneous need of hard core theoretical and experimental knowledge or cases where non-trivial statistics or other mathematical / computational methods are mandatory. Hence, the biophysics field is highly susceptible to irreproducibility, and we, biophysicists, should be well aware of that and do all we can to ensure that our research remains sound and solid. This includes consulting and/or collaborating with experts in the techniques we use, being open about our limitations and extra-critical with our results. Minimizing irreproducibility in our field is what we owe to the global scientific enterprise.

This all is certainly not an easy task. It will only work if it is actively promoted with appropriate incentives by funding and regulatory agencies, and with a minimum consensus within the scientific community. In order to stimulate and facilitate your participation in this timely and serious discussion, we leave the page open for your comments.

DISCUSSION FORUMS

Challenges in irreproducible research. Nature special

A large collection of editorials, news, reviews and comments about irreproducible research

AAAS Policy Forum

As concerns about non-reproducible data mount, some solutions take shape

National Institutes of Health

Efforts underway by NIH to enhance rigor and reproducibility in scientific research

Reproducibility and reliability of biomedical research

Academy of Medical Sciences. Symposium Report, October 2015

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Biofísica Magazine

BEYOND BIOPHYSICS

Genetics and Biophysics

Borja Ibarra, *IMDEA Nanoscience (Madrid)*

Genes are us. Our genes tell us about our past and our present. Even more, as the role of genes in the processes of aging, health and disease becomes ever clearer, genes may eventually allow us to predict our future.

Text books, and the Wikipedia, describe Genetics as a field of biology focused on studying the genes, heredity, and genetic variation in living organisms. So, Genetics is a broad research field, which intersects frequently with many of the life sciences. An important intersection is with the field of Biophysics. In the last decades, it has become clear that to fully understand Genetics it is important to acquire quantitative knowledge about the cell behavior, chromosome organization and dynamics, and DNA metabolism (among others). This is where Biophysics, as a bridge between the complexity of life (Biology) and the simplicity of physical laws (Physics), comes into play. Genetics and Biophysics have enjoyed a passionate relationship already for more than 60 years. The passion has not faded away; instead it has grown steadily with time.

The structure of DNA was a great watershed and arguably one of the biggest contributions of Biophysics.

Love at first sight

Experiments in the 1940's showed that genes are made of deoxyribonucleic acid (DNA). How such a simple chemical could be the molecule of inheritance remained a mystery for more than a decade, until the DNA structure was finally described in **1953**. The structure of DNA was a great watershed and arguably one of the biggest contributions of Biophysics. It showed a simple method for replication and how simple variations on a single chemical could generate unique individuals and perpetuate their species. The establishment of the basic patterns of genetic inheritance, together with a focus on new model organisms such as viruses and bacteria, marked the transition to the era of Molecular Genetics.

The iconic landmark of the discovery of DNA structure in the mid-fifties established already the fundamental basics of the biophysical research field: A bunch of scientists from multiple 'classical' disciplines; Chemists, Physicists and Biologists, whom using physical laws and techniques, look for principles that describe patterns in Biology. Since then, Genetics and Biophysics have maintained an ever-increasing, joyful, and committed relationship. Using techniques, initially developed by physicists such as microscopy, spectroscopy, electrophysiology, single-molecule manipulation methods and molecular modelling, biophysicists have shown how DNA serves as the book of life. Inside of cells, genes are opened, closed, copied, edited, read and translated just like phrases and pages from books. The translation leads from DNA to proteins, the molecular machinery of life.

Till death do us part

Much of the current biophysical research in Genetics involves the application of 'classical', and the development of novel, techniques to study DNA, RNA and proteins in crystals, in solution, in cells, and in organisms. Fluorescent imaging techniques, as well as electron microscopy, x-ray crystallography, NMR spectroscopy, atomic force microscopy (AFM) and small-angle scattering (SAS) both with X-rays and neutrons (SAXS/SANS) are used to obtain information about the electronic structure, size, conformational changes, polarity, and modes of interaction of genes and their products.

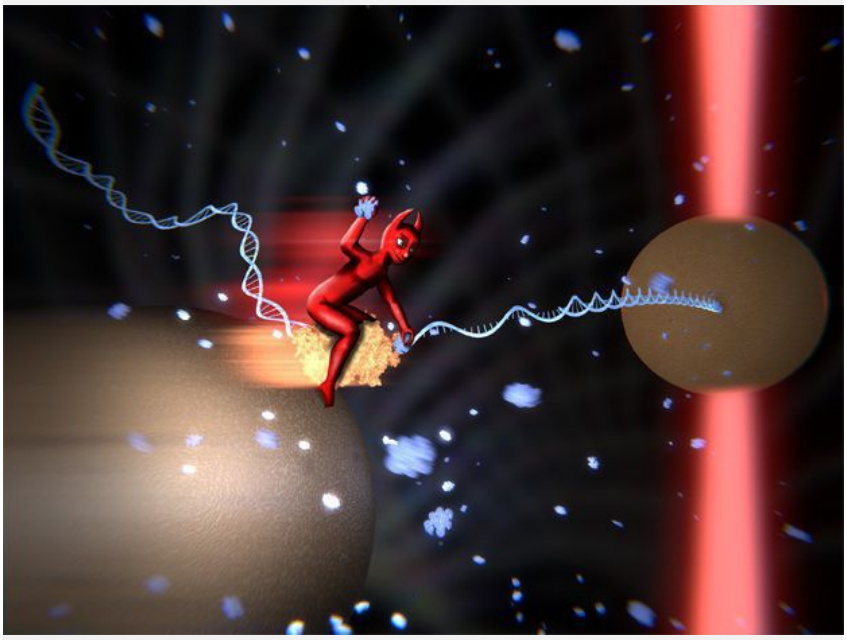

Figure 1. Maxwell's demon controlling the stepping of a DNA polymerase molecule. In real DNA polymerases, binding of the next correct nucleotide plays the role of Maxwell's demon, by pinning the fluctuating polymerase in the post-translocation state -and the second law of thermodynamics is certainly not violated (Morin, et al. *Nucleic Acids Res*. **2015**, 43:3643).

Just as an example, recently, McIntosh, J. R. et al., (Cell, 2008, 135: 322–333), provided a high-resolution look at the ultrastructure of the kinetochore–microtubule linkage. Using electron tomography these authors reported direct evidences about the mechanism coupling tubulin dynamics to chromosome motion during mitosis. In addition, recent advances in single-molecule methodology have made possible to study the dynamics of individual enzymes and the mechanical processes that govern their operation at the molecular level. For example, the laboratories of Steven Block (Stanford University), Vincent Croquette (CNRS-Paris) and

Carlos Bustamante (UC Berkeley), among others (including our lab, see **Figure 1**), have used optical and magnetic tweezers to determine the coupling between the chemical and mechanical processes that govern the operation of the molecular motors involved in the faithful replication (DNA polymerases), transcription (RNA polymerases) and translation (Ribosomes) of the genetic code. All these classical and novel biophysical techniques are currently allowing researchers to access the *ins* and *outs* of genetic processes, which now can be understood quantitatively through statistical mechanics, thermodynamics and chemical kinetics.

In sickness and in health

Future interactions between Genetics and Biophysics, as well as other disciplines, will transform medicine from a matter of serendipity into a rational pursuit grounded in a fundamental and quantitative understanding of the mechanisms of life. Genomics will boost the advance of Molecular Biophysics into the practice of medicine. As the molecular foundations of diseases become clearer, we may be able to prevent them in many cases and in other cases, design accurate, individualized treatments. Genetic tests will routinely predict individual susceptibility to disease. Diagnoses of many conditions will be much more thorough and specific than now. New drugs, derived from a detailed mechanical and dynamical understanding of common illnesses at the molecular level will target molecules logically. Thanks to a fierce interdisciplinary research, decades from now, many potential diseases may be cured at the molecular level before they arise.

With knowledge comes power and with power comes choice, allowing us to dream with a future where genetics is no longer destiny.

All these changes aren't likely to come quickly. It will take a long time to understand the human genome. In this regard, biophysical techniques such as single-molecule imaging and single-channel electrophysiology played a crucial role in the development of next-generation sequencing (NGS) methods. The applications of NGS seem almost endless, allowing for rapid advances in many fields related to the biological sciences. Resequencing of the human genome is being performed to identify genes and regulatory elements involved in pathological processes. NGS has also provided a wealth of knowledge for comparative biology studies through whole-genome sequencing of a wide variety of organisms. Additionally, gene expression studies using RNA-Seq (NGS of RNA) have begun to replace the use of microarray analysis, providing researchers and clinicians with the ability to visualize RNA expression in sequence form. These are simply some of the broad applications that begin to skim the surface of what NGS can offer the researchers and clinicians. As NGS continues to grow in popularity, it is inevitable that it will increasingly shape the practice of health care over the coming decades, as well as shed light on many of the mysteries of biology.

In summary, Biophysics looks for principles that describe patterns. If the principles are powerful, they make detailed predictions that can be tested. Therefore, the interdisciplinary research field of

Biophysics will provide an increasingly amount of knowledge to fully understand the complexity of Genetics. With knowledge comes power and with power comes choice, allowing us to dream with a future where genetics is no longer destiny.

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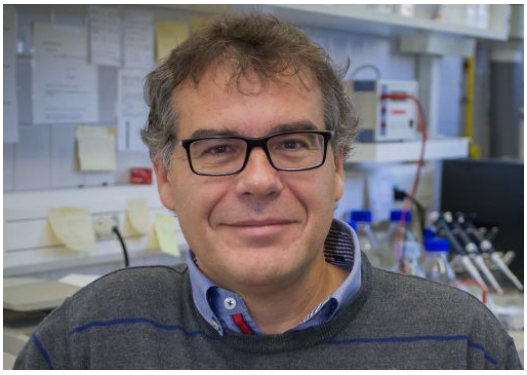
Biofísica Magazine

COOL BIOPHYSICS

Single molecule research: When biology meets physics

Felix Ritort, *Small Biosystems Lab and Ciber-BBN (Barcelona)*



"Take a single DNA molecule and pull from its extremities, while recording the force-extension curve until it gets fully straightened."

This *thought experiment*, which was just a dream a few decades ago, has now become standard in many research institutes worldwide. By labeling the ends of a DNA molecule with specific chemical groups (biotin, avidin, digoxigenin), it is possible to tether a single DNA between two surfaces. By moving one surface relative to the other and using one of them as a force sensor, it is now possible to measure the force-extension curve of single biopolymers, from DNA to RNA and proteins.

The results of this groundbreaking pulling DNA experiment are shown in **Figure 1**, for the case of an optical trap used as force sensor. Initially carried out in **1992** by Bustamante and colleagues using magnetic forces [**1**], the experiment has subsequently been repeated by many groups with different techniques such as optical tweezers, atomic force microscopy, glass needles, centrifugation, and light or acoustic standing waves. Single molecule experiments (*SME*) are either used to exert and measure mechanical forces and torques on single molecules (*force spectroscopy*) or to passively track the motion of individual molecules using fluorescent tags (*single-molecule fluorescence*). Force spectroscopy is used to mechanically stretch, unzip and unwind double-stranded DNA, unfold single RNAs and proteins, control and track the motion of individual motor proteins that translocate along muscle fibers or rotary enzymes synthesizing ATP in the mitochondria, to cite a few [**2**,**3**]. Single molecule fluorescence is used to monitor conformational transitions of individual molecules in real time, the diffusive motion of proteins in crowded environments or to detect small ligands binding nucleic acids, among others [**4**].

A revolutionary tool for biophysics

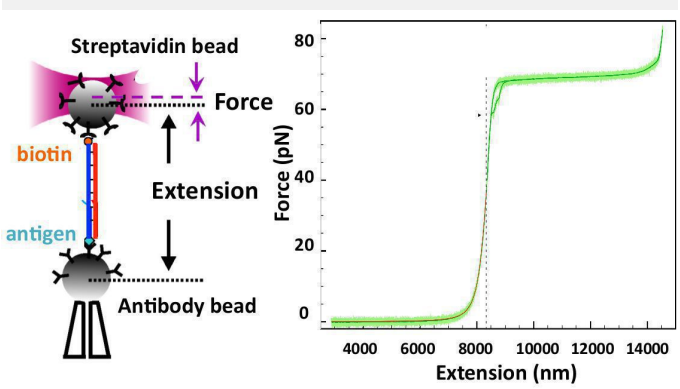


Figure 1. *(**Left**) Illustration of the experimental optical tweezers setup used for pulling a single DNA molecule. A bead is captured in an optical trap and used to measure the force exerted on the molecule while the other is immobilized at the tip of a micropipette by air suction (bottom of the illustration). The DNA molecule is labeled at both extremities to tether it between two plastic beads. (**Right**) Force-extension curve of a half-lambda (24kb) DNA molecule showing different regimes: entropic (enthalpic) response below (above) 10pN and overstretching transition at 65pN, where the DNA overextends by approximately 70% of its natural contour length. Overstretching is known to combine a mixture of distinct DNA structural phases: stretched DNA that forms a ladder, melted DNA that forms bubbles and unpeeled DNA at the extremities of the tether.*

Human history shows that the invention of novel scientific instruments, leading to new observations and phenomena, irreversibly expands our knowledge toward new unexplored venues. Force measuring techniques, such as optical tweezers, have granted scientists access to new phenomena (e.g. the observation of the overstretching transition in DNA, **Figure 1**). Of foremost importance among them is the direct measurement of the progression of a molecular reaction along a well-defined coordinate, such as the molecular extension. This gives also the possibility to measure kinetics by monitoring the evolution of a molecular reaction at the single molecule level in real time (e.g. protein folding), overcoming the limitations of ensemble or bulk methods where molecular events (e.g. conformational transitions) are asynchronous in time. By detecting forces in the piconewton (pN) range and nanometer (nm) extensions, SME can measure extremely tiny energies, on the order of pN*nm=10-21 Joule. Together with their high time resolution (sub-millisecond in force measurements), single molecule techniques allow scientists to perform the most accurate determination to date of thermodynamics and kinetics of complex molecular reactions.

Paradigmatic and illustrative examples of the possibilities offered by SME are unzipping experiments of DNA, where the double helix is mechanically disrupted by pulling the two strands apart (**Figure 2**, upper panel). Such experiments can be carried out with optical tweezers by attaching each of the two strands at one extremity of a DNA hairpin to micron-sized plastic beads via flexible linkers (such as double stranded DNA). One of the beads is then captured in a moving optical trap that acts as force sensor. By moving the optical trap away from the pipette it is possible to exert gradually increasing forces, first to stretch the linkers and then, upon reaching 15pN, to break the intramolecular bonds (base pairing and stacking) that stabilize the double helix. The measured force-extension curves display sawtooth patterns around that force that corresponds to

the "force-induced" melting of the double helix. Specific patterns are characteristic of particular DNA sequences. Upon reversing the movement of the optical trap the double helix can be reversibly reestablished (i.e. without hysteresis) providing a measurement of the thermodynamic force-extension curve. Fitting such curve to polynucleotide models of DNA duplex formation (such as the nearest-neighbour model) allows us to extract improved energy numbers for the hybridization of complementary nearest-neighbour motifs, useful for predicting melting temperatures in DNA duplexes of arbitrary sequence [5]. The unzipping assay can also be used for DNA footprinting or the determination of the accurate location (at one basepair resolution) of small ligands bound to DNA [6] (**Figure 2**, lower panel).

The combination of force spectroscopy and fluorescence is quickly expanding the possibilities of SME [7,8]. Simultaneous measurement of forces and efficiency of fluorescence resonance energy transfer (FRET) between donor-acceptor pairs makes it possible to monitor two reaction coordinates at the same time, enhancing the capability of detecting intermolecular binding events or even correlating translocation modes (e.g. elongation, pausing, backtracking) to conformational and allosteric transitions in motor proteins. As a result of these developments, established paradigms in biophysics such as the uniqueness of the native structure in RNAs and proteins are now under dispute, as evidence shows that a multiplicity of native states in enzymes may be involved in a unique biological function.

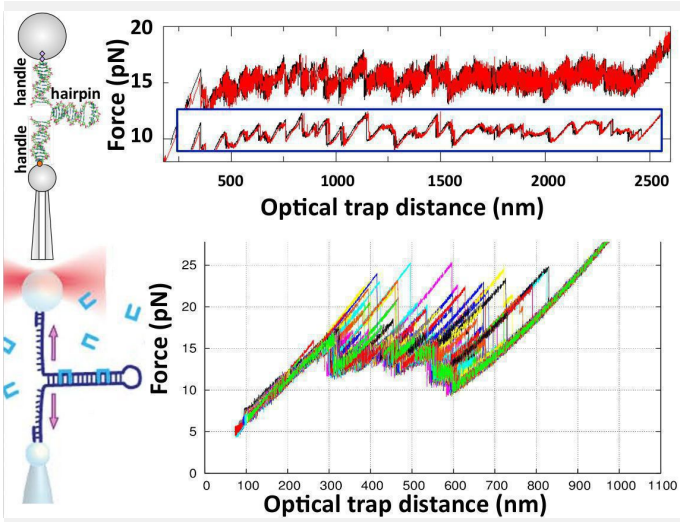


Figure 2. *(**Upper**) Force versus optical-trap position measured in an unzipping (black) and rezipping (red) experiment of a DNA hairpin of 2.2kb at 1kHz acquisition frequency. The force sawtooth pattern at 15pN shows the progressive disruption of the base pairs along the double helix. The last part on the right of the curve corresponds to the elastic response of the single-stranded DNA. Note the strong thermal noise in the curve and the low hysteresis between unzipping and rezipping (black and red curves are practically superimposing). The inset are the same data but filtered to 1Hz bandwith. Data from Ref. [5]. (**Lower**) Repeated unzipping curves of a 480bp DNA hairpin in the presence of the bis-intercalating peptide Thiocoraline (shown as blue staples in the illustration at the left). Note the large force peaks indicative of DNA binding events. Data from Ref. [6].*

When signal and noise are equally important

The wealth of information provided in single molecule assays is changing the way we look at biological processes. Dissipation and fluctuations are two physical concepts sneaking into biology at the hands of SME. Reaction coordinate measurements in single molecules are subject to thermal noise forces, also called Brownian fluctuations. Such fluctuations are intrinsic to SME that, properly

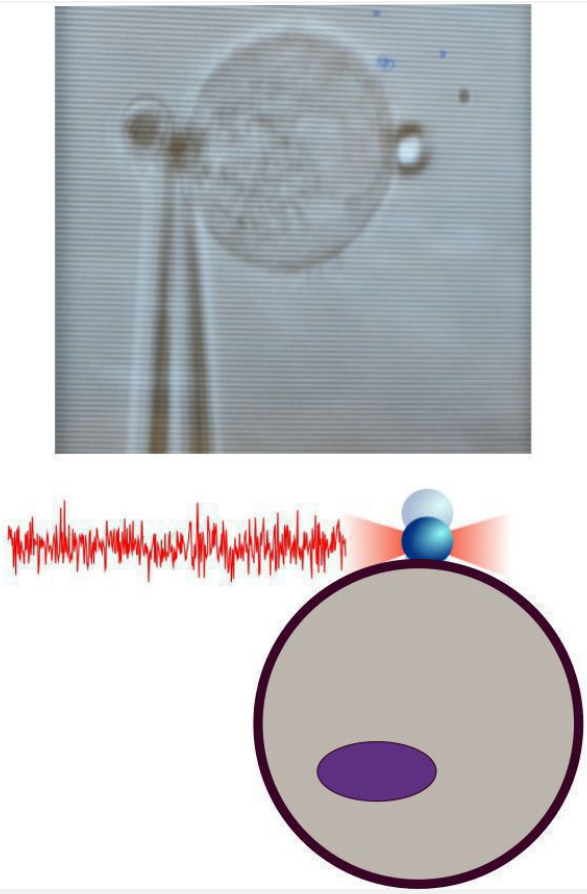


Figure 3. Time-resolved fluctuation spectroscopy. *Noise measurements of the force acting on an optically trapped bead bound to the cell membrane (red trace, bottom) it is possible to characterize the spectrum of membrane rigidities of cell populations known as mechanical phenotyping.*

interpreted, provide useful information about the system. For example, by attaching fibronecting coated beads to the cell membrane, one can use an optical trap to record the power spectrum of the bead movement. This allows measuring the rigidity of the cell membrane, in what has been called time-resolved fluctuation spectroscopy (**Figure 3**). Brownian fluctuations also tell us about a fundamental property of living matter, already apparent in the unzipping experiments previously presented. The reversibility of the unzipping-zipping process, shown in **Figure 2a**, is consequence of a remarkable and generic feature of the interactions governing biological matter: the characteristic energy scale of weak forces (kcal/mol) equals that of thermal forces in aqueous environments (kBT) (1kBT=0.6kcal/mol in physiological conditions). The average free energy required to disrupt a single basepair along DNA (2-3 kBT) falls in the range of the average kinetic energy of individual molecules in the solvent (3/2 kBT according to the equipartition law), demonstrating that the energetics of biological matter is finely tuned to stay at the "edge of chaos". Forces are weak enough to sustain continued remodeling and strong enough to stably store information, providing clear evidence that energy and information are inextricable in biology.

Nonequilibrium systems are characterized by the presence of non-zero currents of physically conserved quantities (such as mass, energy, charge, momentum) that, according to the second law of thermodynamics, result into an overall net positive entropy production. However entropy production is positive only when averaged over many experiments or over very long times, whereas thermal fluctuations make the entropy production to be occasionally negative. Fluctuation theorems establish exact symmetry relations between the probability to produce or absorb a given amount of entropy for a given nonequilibrium setting. Such symmetry relations (and the famous Jarzynski equality as a corollary) allow us to recover equilibrium free energy differences from irreversible and noisy work measurements [9]. Ultimately this shows the useful side of the always so annoying noise for biophysical measurements.

When biology meets physics

The fact that energy and information are strongly linked concepts in biology is not a surprise to anyone. What appears much less evident is how to quantify information, a concept related to statistical entropy in equilibrium thermodynamics but which becomes fuzzy in nonequilibrium systems, among which living systems are the most prominent example. SME provide not only invaluable tools to measure work and energies, but also a suitable playground to better understand the concept and measurement of information. The *Maxwell demon*, a *thought experiment* imagined by J. C. Maxwell at the end of the 19th century that uses information to violate the second law, has been recently implemented in the lab using either single electron devices [**10**] or single molecules (**Figure 4**). Let us consider monitoring the molecular extension of a mechanically stretched two-state folder that hops between the folded and unfolded conformations. It is then possible to feedback the information gained by observing the molecular state at a given time (quantified in bits) into a cyclic pulling protocol that extracts a net amount of work from the bath. The result of this operation constitutes the core of the so-called *Szilard's motor* which is a physical realization of the Maxwell demon. The one-bit single molecule Szilard's motor (**Figure 4**, lower) can reach the maximum efficiency *Landauer limit* of kBTln(2) for the average extracted work per cycle. SME have been also used to study fundamental concepts of nonequilibrium physics, such as fluctuation theorems and effective temperatures [**9**,**11**].

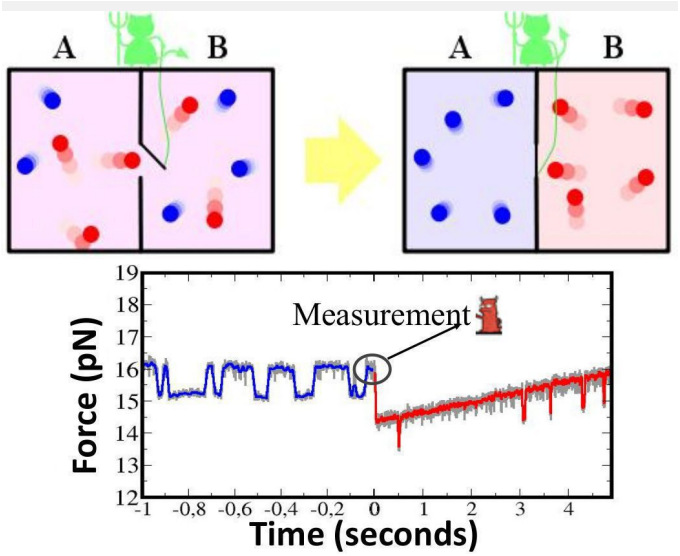


Figure 4. *(**Upper**) The paradox of the Maxwell demon is a thought experiment to violate the second law. A gas vessel contains two compartments separated by a wall with a small gate that can be opened and closed without performing work. A small demon observes the motion of the molecules approaching the gate from each side and closes and opens it to separate fast (red) from slow (blue) molecules. At the end of the process the total entropy has decreased without performing work, against the second law. (**Lower**) Experimental realization of the Maxwell demon in a single DNA hairpin of 20 bp that hops between the folded and unfolded states. At a given time, a measurement is made and, depending on the molecular state, the force is increased or decreased, according to a predetermined protocol (M. Ribezzi-Crivellari and F. Ritort, unpublished).*

Conclusion

SME have emerged as one of the most powerful methodologies to investigate a large variety of biological systems, from single molecules and single cells to the most complex molecular machinery that operates under the concerted action of assembled components. By monitoring the trajectories of individual molecules in space, time and energy, SME gives access to biophysical processes from a new perspective where thermal fluctuations, disorder and information are measurable under generic nonequilibrium conditions. Technological progress going hand by hand with the development of creative biological assays will greatly expand the possibilities of SME in the coming future. Quite probably this will have implications in our understanding of fundamental physical concepts such as energy and information and maybe someday come to understand what is life.

Félix Ritort

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Diagonal 647, 08028 Barcelona (Spain)

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Biofísica Magazine

AWARDS / NEWS / SBE PRIZES

Xavier Gomis-Rüth, 'Manuel Rico' – Bruker – SBE prize 2016

BRUKER prize

For his extensive CV, especially in recent years, and his important contributions in the field of Structural Biology, combining functional and biochemical studies with X-Ray crystallography.

ABOUT THE 2016 AWARDEE

Dr. F. Xavier Gomis-Rüth

Is research professor in the Institut de Biologia Molecular de Barcelona – IBMB (Barcelona, Spain).

Scientific Trajectory

Dr. Gomis-Rüth graduated in chemical engineering (1989) by the Institut Químic de Sarrià, Universitat Ramon Llull of Barcelona. During 1989-1992 he worked in crystallography of proteins, mainly proteolytic enzymes, under the supervision of Wolfram Bode and Robert Huber, Nobel Prize for Chemistry in 1988, at the Max-Planck Institute of Biochemistry in Martinsried (Germany). In 1992 he obtained a PhD in Biochemistry from the Faculty of

chemistry and pharmacy at the Ludwig-Maximilian University of Munich (Germany). At the end of 1992 he returned to Barcelona to continue working in Biochemistry and structural Biophysics of proteases with F. Xavier Aviles at the Institute of Fundamental Biology, Universitat Autònoma de Barcelona. During this time he enjoyed long term fellowships from EMBO and the EU Marie Curie programme. In 1995-1996 he worked again at the Max-Planck Institute of Biochemistry with W. Bode and R. Huber, and from 1997 he joined the Group of Miquel Coll at the Institute of Molecular Biology of Barcelona – IBMB of the CSIC. He became scientific collaborator of CSIC in 1999 and set up his own laboratory, whose first publication appeared in 2003. In 2004 he became research scientist and in 2008 he became research professor, in charge of the Proteolysis Laboratory. He has published 124 scientific articles which have been cited more than 8600 times, giving rise to an index H of 47. His research interests focus on the molecular analysis of proteolytic enzymes, their regulation and inhibition, and the guest-Microbiome interactions.

Dr. Gomis-Ruth is member of eight international scientific societies, acts as a frequent reviewer of research projects, is reviewer for over 25 journals and member of the Panel of editors of the Journal of Biological Chemistry. Throughout his career he has been graced with the Roche Diagnostics Prize of the Spanish society of Biochemistry and Molecular Biology – SEBBM and has been nominated by the SBE for the EBSA 2000 prize of young European Biophysicists. He has been Deputy Director of the IBMB where he is presently Director of the Department of structural biology, which has been recently recognized as a "María de Maeztu" unit of excellence

More information

Please, visit the website of the Proteolysis Laboratory at IBMB.

ABOUT THE *"MANUEL RICO" – BRUKER* PRIZE

> *Awarded in memory of Professor Manuel Rico, who was a leading biophysicist, member of the SBE, and a Research Professor at the Institute of Chemical Physics "Rocasolano", CSIC (Madrid). He was a pioneer using NMR technologies to study protein structure, stability, dynamics and interactions.*

Sponsored by

Bruker Española S.A.

Addressed to

Biophysicist who develope their main activity in Spain. **Preference** is given to members of the SBE working on Structure/Function problems from a Biophisics perspective.

Award

3000 € and a talk delivered by the awardee during a special session of the 5th SPBf / SBE Congress (Porto June 15 – 17, 2016).

Past winners of this prize

In previous editions, this Prize was generously supported by Elsevier.
2015: Juan A. Hermoso (Madrid)
2014: Óscar Llorca (Madrid)
2013: José Manuel Sánchez Ruiz (Granada) and Félix Ritort (Barcelona)
2012: Antonio V. Ferrer Montiel (Elche-Alicante) and Marta Bruix (Madrid)
2011: Ignacio Fita (Barcelona)
2010: Modesto Orozco (Barcelona) and José Luis Rodríguez Arrondo (Bilbao)
2008: José García de la Torre (Murcia)
2006: Jesús Pérez Gil (Madrid)
2004: Javier Sancho (Zaragoza)
2002: José María Valpuesta (Madrid)
2000: Miquel Pons (Barcelona)
1998: Rafael Picorel (Zaragoza)

More information

Please, visit the SBE website.

Biofísica Magazine

AWARDS / NEWS / SBE PRIZES

Raúl Pérez-Jiménez, 'E. Pérez Payá' - SBE40 prize 2016

SBE 40

3CN PEPTIDES

PRIMADERM

For his studies of the mechanical properties of macromolecules.

ABOUT THE 2016 AWARDEE

Dr. Raúl Pérez-Jiménez

Is Ikerbasque Research Professor and Principal Investigator of the Nanobiomechanics group at CIC nanoGUNE, San Sebastian (Spain).

Scientific Trajectory

Dr. Pérez-Jiménez obtained his PhD from the University of Granada in 2005. After spending a research period at the University of Maryland, he moved to Columbia University in New York for his postdoctoral research. At Columbia University he became an expert on single-molecule atomic force spectroscopy techniques. He pioneered single-molecule assays that demonstrated the mechanism of enzyme catalysis at the single-bond level. He combined the

single-molecule techniques with his expertise on molecular evolution to probe the chemistry of ancestral enzymes reconstructed in the laboratory. In 2013 he joined CIC nanoGUNE as an Ikerbasque Research Professor. At nanoGUNE he continued his work on single-molecule protein mechanics and molecular evolution but also initiated a novel research line focused on the effect of mechanical forces on the proteins involved in viral and bacterial infections. His work has been published in high impact journals including Nature Structural and Molecular Biology, PNAS, Science, Nature, ACS Nano or JBC.

More information

Please, visit the website of the Nanobiomechanics group at CIC nanoGUNE.

ABOUT THE *"ENRIQUE PÉREZ-PAYA"* – SBE40 PRIZE

> *Awarded in memory of Dr. Enrique Pérez-Payá, SBE member who contributed to the development, translation and internationalization of Biophysics in Spain. He worked on peptide-membrane interactions and apoptosis and was a pioneer in the use of combinatorial chemistry to expand the chemical space for basic research and to develop peptide-based therapeutics. He was also an entrepreneur and always supportive of young biophysicists.*

Sponsored by

BCN Peptides and Prima – Derm.

Addressed to

Biophysicists under 40 who develope their main activity in Spain. **Preference** is given to members of the SBE and to achievements from the last 10 years.

Award

1500 € and a talk delivered by the awardee during a special session of the 5th SPBf / SBE Congress (Porto June 15 – 17, 2016).

Past winners of this prize

2015: Irene Diaz Moreno (Sevilla)
2014: Fernando Moreno (Madrid)

Sponsored by SBE and Werfen-Izasa-Beckman-Coulter:

2013: Xavier Salvatella (Barcelona)

2012: José Manuel Gómez Vilar (Lejona-Vizcaya)

2011: Teresa Giráldez (La Laguna)

2010: Pau Bernardó (Barcelona)

More information

Please, visit the SBE website.

Biofísica Magazine

AWARDS / NEWS / SBE PRIZES

Lorena Redondo-Morata, AntalGenics SBE33 prize 2016

SBE 33 AntalGenics

For her excellent work on membrane nanomechanics.

ABOUT THE 2016 AWARDEE

Dr. Lorena Redondo-Morata

Is postdoctoral fellow in Dr Simon Scheuring's lab in the Institut national de la santé et de la recherche médicale – INSERM, Aix-Marseille Université, Marseille (France).

Scientific Trajectory

Dr. Redondo-Morata did her PhD with Prof. Fausto Sanz at the Department of Physical Chemistry of the University of Barcelona and with the Institute for Bioengineering of Catalonia – IBEC, where she studied the nanomechanical properties of lipid membranes. As a postdoctoral researcher in Scheuring's lab, her projects address the dynamic imaging of membrane proteins and their assemblies using High-Speed atomic force microscopy. Part of her work is focused on

the Endosomal Sorting Complex Required for Transport (ESCRT) machinery, in collaboration with Dr Aurélien Roux lab (University of Genève, Switzerland). Together, they provided a basis for a mechanistic explanation of how this machinery creates tension for membrane fission. She is also currently working in the regulation of vesicle fusion at the synapse in collaboration with Prof. James E. Rothman's lab (University of Yale, USA).

More information

Please, visit the website of the Bio-AFM Lab at INSERM.

ABOUT THE *ANTALGENICS* – SBE33 PRIZE

> *Recognizes the work of outstanding young Biophysicists under 33, independently of the country where their work has been done.*

Sponsored by

AntalGenics.

Award

1000 € and a talk delivered by the awardee during a special session of the 5th SPBf / SBE Congress (Porto June 15 – 17, 2016).

Past winners of this prize

In previous editions, this Prize was generously supported by Elsevier.
2015: Cecilia Artola (Madrid)
2014: Jorge Alegre Cebollada (Madrid)
2013: Anna Shnyrova (Bilbao)
2012: Sergi García Manyes (London)

More information

Please, visit the SBE website.

Biofísica Magazine

GRANTS / NEWS

Nanotechnology for cancer therapy: EU project leaded by Álvaro Somoza

SBE member and scientist from IMDEA Nanoscience, Álvaro Somoza leads the recently awarded *Industrial Leadership* EU project (Horizon 2020) NoCanTher

> *The efficacy, safety and non-toxicity of this therapy have already been proven through in vitro studies.*

The project, financed with more than € 7 million, aims at translating nanoformulations, previously developed at IMDEA Nanoscience, to early clinical development (phase I) for treatment of pancreatic cancer. The nanodrug consists on multi-functionalized magnetic nanoparticles, which are modified with a therapeutic agent and a targeting peptide. This allows both, intracellular drug delivery and the use of magnetic hyperthermia, as synergistic strategies to kill tumor cells.

NoCanTher will be financed 100% by the EU (program H2020-NMP-2015) and continues the efforts of a previous project (MULTIFUN) also scientifically coordinated at IMDEA Nanoscience. This time, it integrates a consortium of research centres, hospitals and enterprises from Spain, France, Germany, UK and Ireland. Among the rest of participants are the Spanisn National Cancer Research

centre – CNIO and Vall d'Hebron Hospital (Spain), Trinity College Dublin (Ireland), Jena University Hospital (Germany), Paris Diderot University (France) and the enterprises Biopraxis (Spain), Immupharma (UK) and Chemicell (Germany).

More Information

Please visit:

- Dr. Somoza's group web page.
- News in Madrid+D (in Spanish).

Biofísica Magazine

AWARDS / NEWS

Fernando Moreno-Herrero awarded 'Miguel Catalán' prize 2015

Comunidad de Madrid

The Autonomous Community of Madrid has awarded the 2015 *'Julian Marías'* and *'Miguel Catalán'* Research Prizes

Among the awardees is the SBE member Fernando Moreno-Herrero, from the Molecular Biophysics of DNA repair nanomachines Lab, at the *Centro Nacional de Biotecnología* – CNB, CSIC, Madrid (Spain), who wins a *'Miguel Catalán'* prize (*ex aequo*) in the category 'scientists under 40'.

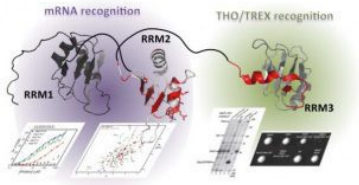
Dr. Moreno-Herrero's performs research at the frontiers between Biology and Physics, with a strong focus on development and application of single-molecule techniques. His excellent work has won financial support from the European Research Council, with an ERC-Starting grant (2007) an ERC-Proof of concept grant (2015) and very recently an ERC-Consolidator grant (2015).

He has also been awarded a SBE-40 *'Pérez-Payá* prize in 2014 and the IZASA-WERFEN prize of SEBBM in 2012.

Fernando Moreno-Herrero graduated in Physics at the University of Oviedo (1998) and got a PhD in Physics at the Autonomous University of Madrid (2003). Before his present position in Madrid, he worked as a postdoc in the Technical University of Delft and as *'Ramón y Cajal'* Researcher at the Catalan Institute of Nanotechnology (Barcelona).

Biofísica Magazine

PAPERS OF THE MONTH BY SBE MEMBERS: JANUARY - APRIL 2016

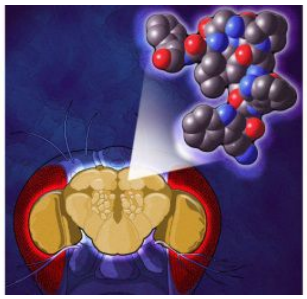


HIGHLIGHTED / JAN. 2016

Gbp2 interacts with THO/TREX through a novel type of RRM domain

Martínez-Lumbreras S, Taverniti V, Zorrilla S, Séraphin B, Pérez-Cañadillas JM.

Nucleic Acids Res 2016 Jan; 44: 437.

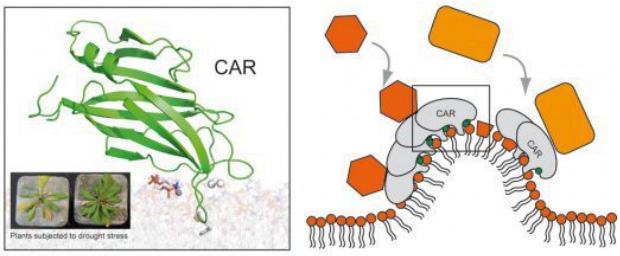


HIGHLIGHTED / JAN. 2016

Molecular Basis of Orb2 Amyloidogenesis and Blockade of Memory Consolidation

Hervás R, Li L, Majumdar A, Fernández-Ramírez Mdel C, Unruh JR, Slaughter BD, Galera-Prat A, Santana E, Suzuki M, Nagai Y, Bruix M, Casas-Tintó S, Menéndez M, Laurents DV, Si K, Carrión-Vázquez M.

PLoS Biol 2016 Jan; 14: e1002361.

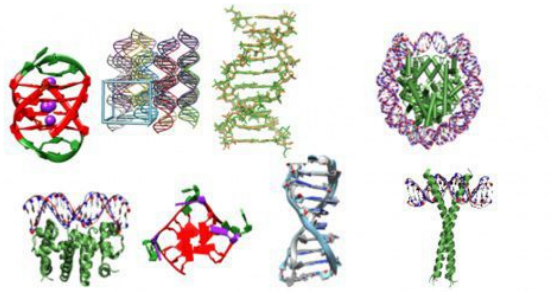


HIGHLIGHTED / JAN. 2016

Calcium-dependent oligomerization of CAR proteins at cell membrane modulates ABA signaling

Diaz M, Sanchez-Barrena MJ, Gonzalez-Rubio JM, Rodriguez L, Fernandez D, Antoni R, Yunta C, Belda-Palazon B, Gonzalez-Guzman M, Peirats-Llobet M, Menendez M, Boskovic J, Marquez JA, Rodriguez PL, Albert A.

Proc Natl Acad Sci USA 2016 Jan; 13: E396.

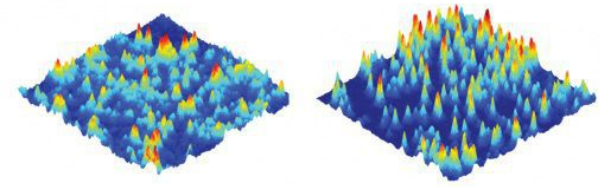


HIGHLIGHTED / JAN. 2016

Parmbsc1: a refined force field for DNA simulations

Ivani I, Dans PD, Noy A, Pérez A, Faustino I, Hospital A, Walther J, Andrio P, Goñi R, Balaceanu A, Portella G, Battistini F,, Gelpí JL, González C, Vendruscolo M, Laughton CA, Harris SA, Case DA, Orozco M.

Nat Methods 2016 Jan; 13: 55.

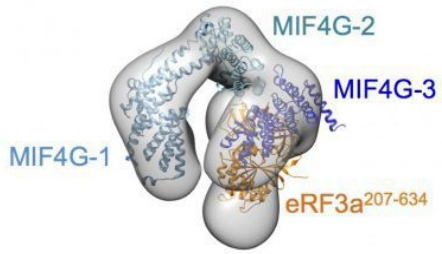


FEB. 2016 / HIGHLIGHTED

The actin cytoskeleton modulates the activation of iNKT cells by segregating CD1d nanoclusters on antigen-presenting cells

Torreno-Pina JA, Manzo C, Salio M, Aichinger MC, Oddone A, Lakadamyali M, Shepherd D, Besra GS, Cerundolo V, Garcia-Parajo MF.

Proc Natl Acad Sci USA 2016 Feb; 113: E772.

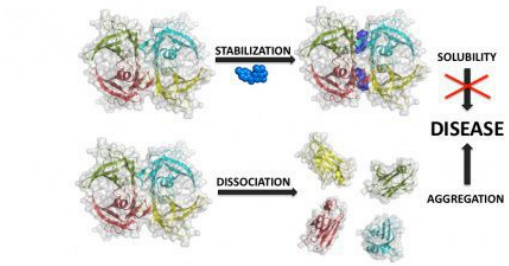


FEB. 2016 / HIGHLIGHTED

Human nonsense-mediated mRNA decay factor UPF2 interacts directly with eRF3 and the SURF complex

López-Perrote A, Castaño R, Melero R, Zamarro T, Kurosawa H, Ohnishi T, Uchiyama A, Aoyagi K, Buchwald G, Kataoka N, Yamashita A, Llorca O.

Nucleic Acids Res 2016 Feb; 44: 1909.

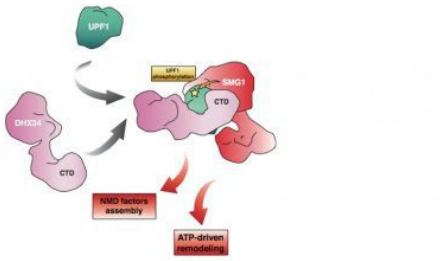


FEB. 2016 / HIGHLIGHTED

Repositioning tolcapone as a potent inhibitor of transthyretin amyloidogenesis and associated cellular toxicity

Sant'Anna R, Gallego P, Robinson LZ, Pereira-Henriques A, Ferreira N, Pinheiro F, Esperante S, Pallares I, Huertas O, Rosário Almeida M, Reixach N, Insa R, Velazquez-Campoy A, Reverter D, Reig N, Ventura S.

Nat Commun 2016 Feb; 7: 10787.

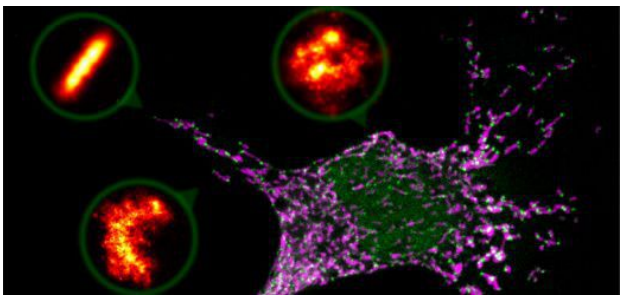


FEB. 2016 / HIGHLIGHTED

The RNA helicase DHX34 functions as a scaffold for SMG1-mediated UPF1 phosphorylation

Melero R, Hug N, López-Perrote A, Yamashita A, Cáceres JF, Llorca O.

Nat Commun 2016 Feb; 7: 10585.

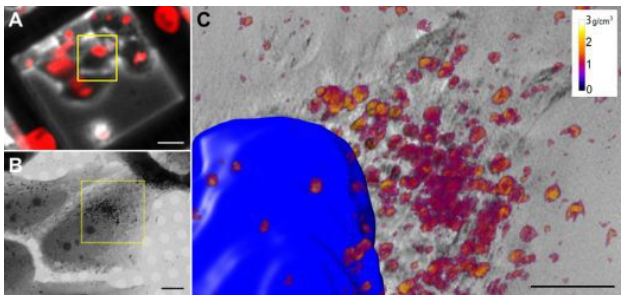


FEB. 2016 / HIGHLIGHTED

Bax assembly into rings and arcs in apoptotic mitochondria is linked to membrane pores

Salvador-Gallego R, Mund M, Cosentino K, Schneider J, Unsay J, Schraermeyer U, Engelhardt J, Ries J, García-Sáez AJ.

EMBO J 2016 Feb; 35: 389.

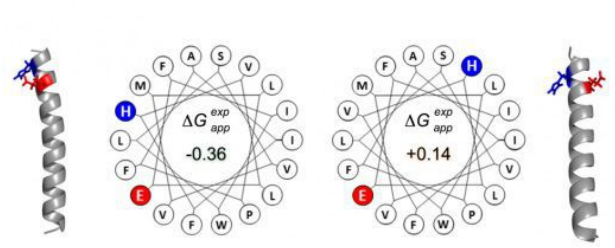


HIGHLIGHTED / MAR. 2016

Intracellular nanoparticles mass quantification by near-edge absorption soft X-ray nanotomography

Conesa JJ, Otón J, Chiappi M, Carazo JM, Pereiro E, Chichón FJ, Carrascosa JL.

Sci Rep 2016 Mar; 6: 22354.

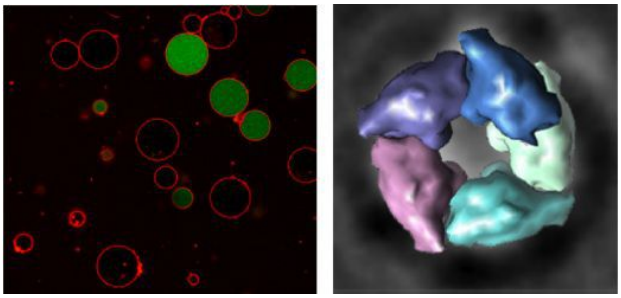


HIGHLIGHTED / MAR. 2016

Biological insertion of computationally designed short transmembrane segments

Baeza-Delgado C, von Heijne G, Marti-Renom MA, Mingarro I.

Sci Rep 2016 Mar; 6: 23397.

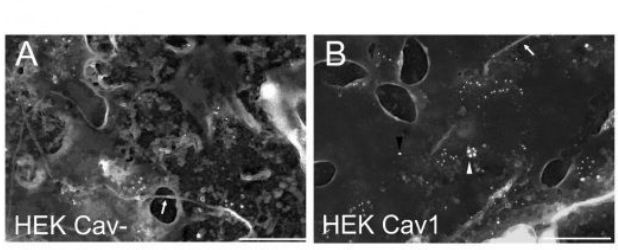


HIGHLIGHTED / MAR. 2016

RepA-WH1, the agent of an amyloid proteinopathy in bacteria, builds oligomeric pores through lipid vesicles

Fernández C, Núñez-Ramírez R, Jiménez M, Rivas G, Giraldo R.

Sci Rep 2016 Mar; 6: 23144.

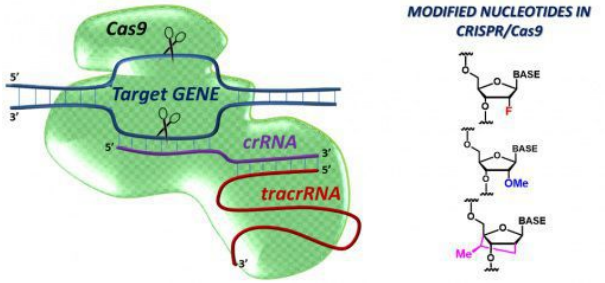


HIGHLIGHTED / MAR. 2016

Caveolin interaction governs Kv1.3 lipid raft targeting

Pérez-Verdaguer M, Capera J, Martínez-Mármol R, Camps M, Comes N, Tamkun MM, Felipe A.

Sci Rep 2016 Mar; 6: 22453.

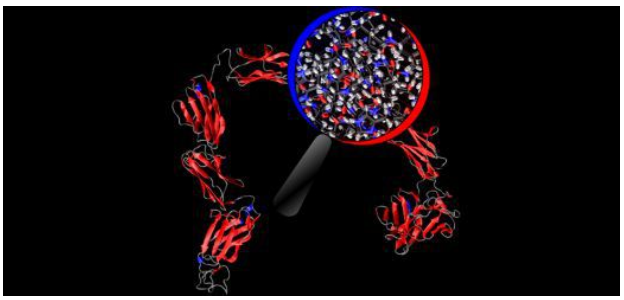


HIGHLIGHTED / MAR. 2016

Modified RNAs in CRISPR/Cas9: An Old Trick Works Again

Latorre A, Latorre A, Somoza Á.

Angew Chem Int Ed Engl 2016 Mar; 55: 3548.

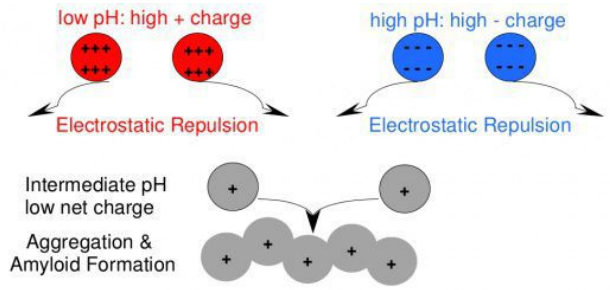


APR. 2016 / HIGHLIGHTED

The Y9P Variant of the Titin I27 Module: Structural Determinants of Its Revisited Nanomechanics

Oroz J, Bruix M, Laurents DV, Galera-Prat A, Schönfelder J, Cañada FJ, Carrión-Vázquez M.

Structure 2016 Apr; 24: 606.

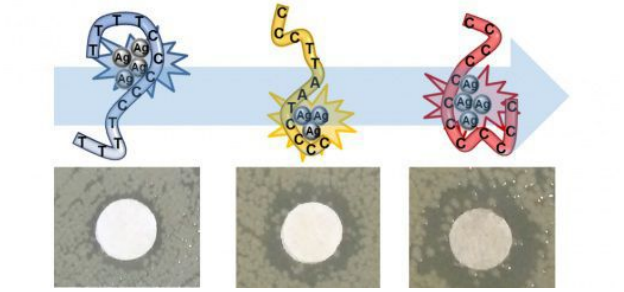


APR. 2016 / HIGHLIGHTED

Electrostatic Repulsion Governs TDP-43 C-terminal Domain Aggregation

Mompeán M, Chakrabartty A, Buratti E, Laurents DV.

PLoS Biol 2016 Apr; 14: e1002447.



APR. 2016 / HIGHLIGHTED

Antibacterial Activity of DNA-Stabilized Silver Nanoclusters Tuned by Oligonucleotide Sequence

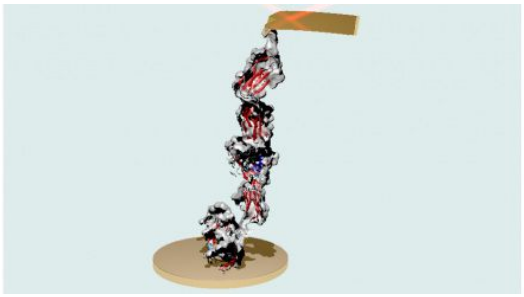
Javani S, Lorca R, Latorre A, Flors C, Cortajarena AL, Somoza Á.

ACS Appl Mater Interfaces 2016 Apr; 8: 10147.

Biofísica Magazine

CATEGORY: JOBS

Positions in Biophysics



JOBS / POSTDOC 14 MAY, 2016

Postdoctoral position in protein nanomechanics at the Cajal Institute – CSIC

The Protein Nanomechanics Lab at Institute Cajal – CSIC, Madrid We are seeking experienced researchers interested in working in nanomechanics to join the research lines...

JOBS / POSTDOC 5 MAY, 2016

Postdoctoral position in protein engineering for functional nanostructures

Biomolecular Nanotechnology Group, CIC biomaGUNE, San Sebastián (Spain). A postdoctoral position is available in the area of computational protein engineering for functional materials and nanostructures,...

JOBS / POSTDOC 1 APR, 2016

Postdoctoral Position at the Small Biosystems Lab

Small Biosystems Lab, University of Barcelona, Barcelona (Spain). The Small Biosystems Lab from the University of Barcelona is offering a postdoctoral position to do research...

CALLS / FELLOWSHIPS / JOBS / POSTDOC / PREDOC

22 MAR, 2016

Postdoctoral and Predoctoral Positions at the Structural Biology Unit of IBMB-CSIC

The Structural Biology Unit (SBU) of the Molecular Biology Institute of Barcelona (IBMB) opens 5 postdoc and 7 predoc positions. The SBU of IBMB is...

CALLS / FELLOWSHIPS / INTERNSHIP / JOBS

14 MAR, 2016

Undergraduate and Masters Training Fellowships at CNIC

Programme description from CNIC website: The Centro Nacional de Investigaciones Cardiovasculares (CNIC) offers Masters students or advanced undergraduate studying toward a university degree in Biomedicine...

CALLS / FELLOWSHIPS / PREDOC 5 FEB, 2016

IC-3i International PhD Program

Call for applications Application deadline: February 11th, 2016 at 17:00 CET. The IC-3i PhD Program provides PhD students with a 3-year fellowship, a high level...

CALLS / JOBS / NEWS / POSTDOC 4 FEB, 2016

Ikerbasque International Research Fellows 2016

15 Contract positions for promising researchers, within any of the Basque Research Institutions 5 years contract in Universities, BERC – Basque Excellence Research Centres, CIC...

JOBS / POSTDOC 16 JAN, 2016

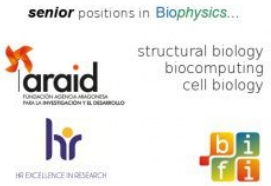
Postdoc in Biomolecular NMR at CBS Montpellier

2 years Postdoctoral position at the "Highly Flexible Proteins" group (Centre de Biochimie Structurale – CBS), lead by Pau Bernadó, Montpellier (France). The project, funded...

CALLS / JOBS 8 JAN, 2016

Computational chemist position – Drug discovery

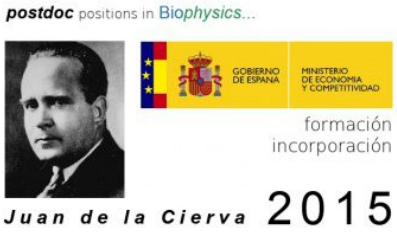
Full time, indefinite position based in Barcelona (Parc Científic) IDP Pharma is a drug discovery company that develops first-in-class medicines directed to a novel type...



CALLS / JOBS 8 JAN, 2016

Senior permanent research positions in Structural Biology, Biocomputation, and Cell Biology

The ARAID Foundation launches an international call for applications to fill up to 8 research positions Deadline: Applications must be submitted electronically before 14.00h (CET)...



CALLS / FELLOWSHIPS / GRANTS / JOBS / POSTDOC

8 JAN, 2016

Grants for contracts 'Juan de la Cierva' – 2015

"Juan de la Cierva" (JdC) training / admission grants Find below a list of Biophysics Positions for this call announced in this site. Deadlines: Closing...

CALLS / FELLOWSHIPS / GRANTS / JOBS / PREDOC

8 JAN, 2016

International PhD "la Caixa" – Severo Ochoa 2016

International PhD program "Severo Ochoa" sponsored by "Obra Social la Caixa" The 'Obra Social "la Caixa"', provides funds for PhD grants to perform research...

Biofísica Magazine

CATEGORY: EVENTS

Upcoming Meetings, Courses and Workshops

EVENTS / MEETINGS / NEWS 14 MAY, 2016

5th International Iberian Biophysics Congress

June 15th – 17th, 2016, Porto (Portugal). Congress Web Site: http://www.iberianbiophysicscongress.pt Deadlines Application for grants: March 24th 2016 Abstract submission and early registration: May...

EVENTS / MEETINGS 5 MAY, 2016

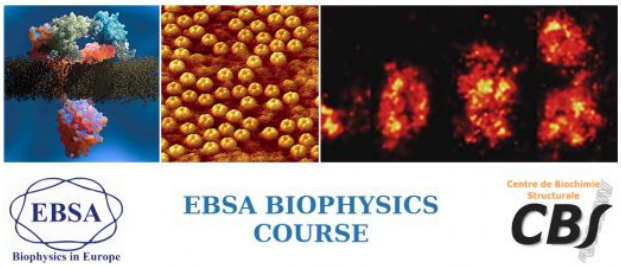
Biomembrane days – 2016

Organized by the Max Planck Institute of Colloids and Interfaces and Collaborative Research Centre 958 'Scaffolding of Membranes'. September 05 – 07, 2016, Berlin (Germany)....

EVENTS / MEETINGS 5 MAY, 2016

41st FEBS Congress

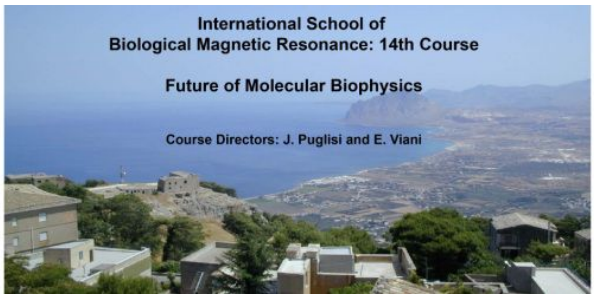
September 03 – 08, 2016, Ephesus (Turkey). The FEBS Congress aims to provide an outstanding international forum in the European area for the face to...



COURSES / EVENTS 5 MAY, 2016

Membrane and lipid-protein interactions

EBSA Biophysics course La Grande Montte, Montpellier (France), September 11th – 16th 2016 . DEADLINE: Early registration closes 15th July 2016. Late registrations (with a...



COURSES / EVENTS 1 APR, 2016

14th International School of Biological Magnetic Resonance

Future of Molecular Biophysics Ettore Majorana Centre, Erice Sicily (Italy), May 7th – 17th 2016 . This course focuses on recent advances in molecular biophysics...

EVENTS / MEETINGS 2 MAR, 2016

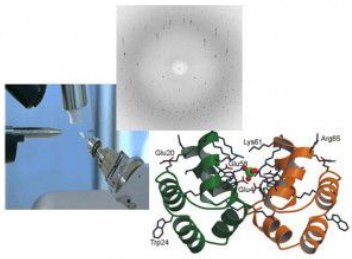
VI CNIC Conference “Mechanical Forces in Physiology and Disease”

CNIC, Madrid (Spain), November 4th – 5th 2016 . DEADLINES: pre-registration September 18th 2016. This CNIC conference will create an exciting forum to exchange...

EVENTS / MEETINGS 9 FEB, 2016

13th Nanospain Conference

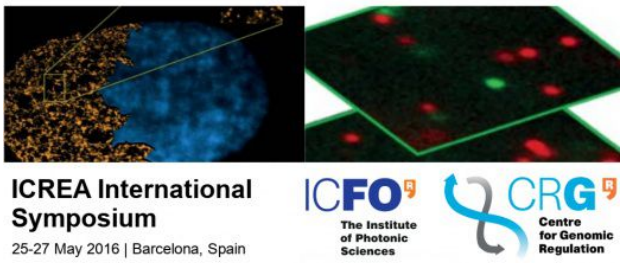
Nanoscience & Nanotechnology in Spain Rioja Forum, Logroño (Spain), March 15th – 18th 2016. DEADLINES: Abstract submission and oral request: February 15th 2016. Since 2004,...



COURSES / EVENTS 4 FEB, 2016

7th Macromolecular Crystallography School – MCS2016

MCS2016 7th Macromolecular Crystallography School. May 25th – 29th 2016, CBE (Department of Crystallography and Structural Biology) of the Institute of Physical-Chemistry "Rocasolano", CSIC, Madrid...



EVENTS / MEETINGS 4 FEB, 2016

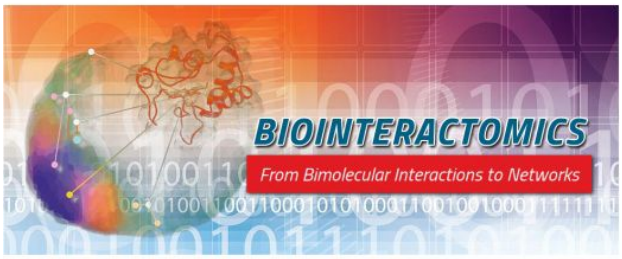
BioNanoVision of cellular architecture: from the nucleus to the cell membrane

25 – 27 May 2016, ICFO – the Institute of Photonic Sciences, Barcelona, Catalonia (Spain). BioNanoVision will bring together a multidisciplinary group of world-leading scientists...

EVENTS / MEETINGS 16 JAN, 2016

60th Biophysical Society Annual Meeting

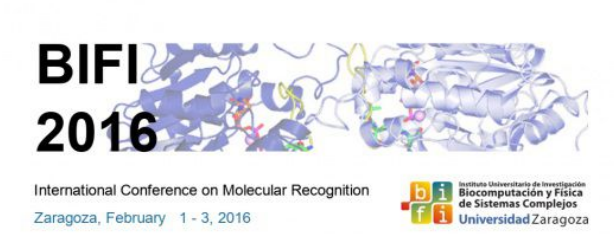
60th Biophysical Society Annual Meeting. February 27 – March 2, 2016, Los Angeles Convention Center (USA). As science becomes increasingly interdisciplinary, the Biophysical Society Annual...



EVENTS / WORKSHOPS 16 JAN, 2016

Biointeractomics: From biomolecular interactions to networks

FEBS / IUBMB | Workshop: Biointeractomics: From biomolecular interactions to networks. May 17 – 20 2016, Seville (Spain). Workshop Web Site: Follow this Link Understanding...



EVENTS / MEETINGS 4 DEC, 2015

VII BIFI International Conference on Molecular Recognition

VII International Conference of the Institute for Biocomputation and Physics of Complex Systems (BIFI) February 1 – 3, 2016, Zaragoza (Spain). Link: Conference Web Site...

EVENTS / MEETINGS 24 NOV, 2015

15th Iberian Peptide Meeting

XV EPI—15° Encontro Peptídico Ibérico/15th Iberian Peptide Meeting February 10th – 12th, 2016, Porto (Portugal). The deadline for abstract sumission is 15th of November, 2015....

EVENTS / MEETINGS 30 OCT, 2015

XII Girona Seminar – Predictive Catalysis

Transition-Metal Reactivity by Design April 17 – 20, 2016, Girona (Spain). Links: Seminar Web Site, or follow in twitter The study of reactions in the...

EVENTS / MEETINGS 15 OCT, 2015

The 3rd International Conference on Physiological Computing Systems – PhyCS 2016

July 27th – 28th, 2016, Lisbon (Portugal). Congress Web Site: Follow this link. Physiological data in its different dimensions, either bioelectrical, biomechanical, biochemical or biophysical,...

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