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Preface

Special issue on "Physics Applied to Biological Systems"

There is a great cultural gap between physics, which seeks to understand extremely simple systems, and biology, which studies the behavior of extremely complex systems. Withstanding this gap, a number of physicists have been facing the challenge of explaining biological systems either by employing simple statistical models or by using the concepts of complexity.

One area where simplicity and life intersect is the study of biopolymers and biomembranes. Due to recently developed techniques it is possible to study these systems in isolation and as active elements. It is then possible to observe in this biological structures universal behavior making them suitable to the use of statistical mechanics. In particular, the field of soft matter research provides a bridge between the conventional physics and the biologically oriented sciences. The term soft condensed matter encompasses systems which are highly flexible and extremely sensible to external perturbations. Examples include colloidal suspensions, emulsions, surfactant assemblies, liquid crystals and polymer solutions. Most biological materials are also naturally included in this list, and much of the recent interest in the field has arisen from attempts to understand their physical properties.

In this special issue, there are a few examples where simple physics is able to grasp complicated biological phenomena. This is the case of the contributions of Cieplak, Levin, Naji and Netz, Zhang and Shklovskii and is the basis of the experiments of Safran et al.

Physics also has changed in the last 50 years. A new field of complexity had emerged. Complexity consists in studying how parts of a system give rise to the collective behaviors, and how the system interacts with its environment. This again is found in soft materials. They exhibit numerous forms of self-organization and have significant structure and dynamics. Similar behavior is also found in living organisms and in social science.

In this volume, it is shown how the use of the ideas of complexity helps in understanding protein–protein interaction, the mechanism behind motion, the multicellular aggregation and the evolutionary ecology. This is the case of the works of Vespignani et al., Lipowsky and Klumpp, Glazier et al., and Stauffer et al.

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Of course, this special issue does not cover all areas of physics applied to biological systems, but our hope is that it will serve as an introduction to people who are interested in this field.

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