Award ID:
R1110

Project Title:
Recruitment of Established Investigators

Award Mechanism:
Recruitment of Established Investigators

Principal Investigator:
Onuchic, Jose

Entity:
Rice University

Lay Summary:

Dr. Jose Onuchic is a Professor of Physics and Astronomy, Chemistry and Biochemistry and Cell Biology at Rice University and is the co-Director of the NSF-sponsored Center for Theoretical Biological Physics. Within the CTBP, Dr. Onuchic and his research group have led the biological physics community as it attempts to devise an integrated picture of a variety of model biochemical and biological systems. This integrated view was achieved by the initiation of a broad range of collaborative efforts that enabled Dr. Onuchic to expand his research across the scales of molecular-level interactions to cellular systems to organized multi-cellular structures. Moving to Houston he plans to expand this view towards medical applications. Looking over the landscape of cancer research, as it currently exists, makes it clear that the cancer research community has a critical need to develop a similarly long-range visionary plan so that it can move toward a comparably integrative view for cancer research. It has been recognized by the cancer community that collaborating with physical scientists is a way to move forward with this goal. The recruitment of Dr. Onuchic and his CTBP colleagues is a clear step toward enabling this to occur.

Dr. Onuchic did his undergraduate work at the University of São Paulo, Brazil, and received his PhD from Caltech at 1987 under the supervision of John J. Hopfield. His thesis work was on new aspects of the theory of electron transfer reactions in biology. He then spent six month at the Institute for Theoretical Physics in Santa Barbara and after that went back to Brazil at the University of São Paulo as an Assistant Professor for two and half years. During this period he continued his work on electron transfer theory as well as on the theory of chemical reactions in condensed matter and molecular electronics. He came to the University of California at San Diego in 1990. In 1989 he was awarded the International Centre for Theoretical Physics Prize in honor of Werner Heisenberg in Trieste, Italy, in 1992 he received the Beckman Young Investigator Award, and he is a fellow of the American Physical Society. In 2006 he was elected a member of the National Academy of Sciences, USA, and in 2009 he was elected a fellow of the American Academy of Arts and Sciences and of the Brazilian Academy of Sciences. In 2011 he was awarded the Einstein Professorship by the Chinese Academy of Sciences (CAS) and recently he has been elected Fellow of the Biophysical Society. His current research interests centers on theoretical and computational methods for molecular biophysics and chemical reactions in condensed matter. In protein folding, his group introduced the concept of protein folding funnels as a mechanism for the folding of proteins. Convergent kinetic pathways, or folding funnels, guide folding to a unique,

stable, native conformation. Energy landscape theory and the funnel concept provide the theoretical framework needed both to pose and to address the questions of protein folding and function mechanisms. Connections between these theoretical advances and experiments are central for the development of this new view for protein folding. A second effort of his group focuses on the theory of chemical reactions in condensed matter with emphasis on biological electron transfer reactions. These reactions are central to the bioenergetic pathways of both animals and plants on Earth, such as the early steps of photosynthesis. Most of the recent work deals with the electronic coupling between the donor and acceptor sites. The concept of tunneling pathways and the methodology for reducing the protein into a combination of relevant tubes of pathways create a new way of designing electron transfer proteins. The connection between this theoretical approach and experiments on electron transfer proteins has substantially improved the understanding of these electron transfer processes.

Currently he is broadening his interests to stochastic effects in genetic networks. His research showed how under life alarming conditions the bacteria in the colony communicate via chemical messages and how each bacterium performs a sophisticated decision process by using a specialized network of genes and proteins. Connections between bacteria decision-making in a colony with cancer are being explored.