Prof. José Nelson Onuchic
Professor of Biological Physics, Rice University, Houston, TX

Most important awards, prizes and academies

Honours: 2019 Medal of Honor and Honorary Professor, Instituto de Física de São Carlos, Universidade de São Paulo, Brazil; 2019 American Physical Society's Max Delbruck Prize in Biological Physics; 2018 Grand Cross, National Order of Scientific Merit by the Brazilian National Council in Science and Technology chaired by the Brazilian President; 2017 Fellow of the American Association for the Development of Science (AAAS); 2015 The International Union of Biochemistry and Molecular Biology (IUBMB) Medal; 2014 Diaspora Prize, Ministry of Foreign Affairs and Ministry of Industrial Development and Foreign Trade, Brazil; 2012 Fellow of the Biophysical Society; 2011 Member of The Academy of Medicine, Engineering and Science of Texas (TAMEST); 2011 CPRIT Scholar in Cancer Research - Cancer Prevention and Research Institute of Texas; 2011 Einstein Professorship of the Chinese Academy of Sciences (CAS); 2009 Fellow of the American Academy of Arts and Sciences; 2009 Corresponding Member of the Brazilian Academy of Sciences; 2006 Member of the National Academy of Sciences, USA; 2002 Academic Senate Distinguished Teaching Award, University of California at San Diego; 1995 Fellow of the American Physical Society; 1992 Beckman Young Investigator; 1991 Member of the Academia de Ciências do Estado de São Paulo; 1988 International Centre for Theoretical Physics

Prize in Honor of Professor Werner Heisenberg, Trieste, Italy; 1980 Engineering Institute Prize, São Paulo, Brazil.

Summary of scientific research

Onuchic's main goal is to lead the biological physics community as it attempts to devise an integrated picture of a variety of biochemical and biological systems. His research has expanded across many scales from molecular level interactions to cellular systems to organized multi-cellular structures. At Rice he has moved towards medical applications focusing on cancer. In protein folding, he has 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 to pose and to address the questions of protein folding and function mechanisms. He also works on the theory of chemical reactions in condensed matter with emphasis on biological electron transfer. He is also interested in stochastic effects in genetic networks. His research has shown how each bacterium performs a sophisticated decision process by using a network of genes and proteins. Connections between bacteria decision-making in a colony with cancer are being explored. Further expanding his ideas coming from energy landscapes for protein folding, his group is now exploring chromatin folding and function.

Main publications

Professor Onuchic has published more than 400 scientific papers. According to the Web of Science, he has almost 30,000 citations and a h-index of 85. The following is a list of some of his most important and/or representative publications. Morcos, F. and Onuchic, J.N. "The role of coevolutionary signatures in protein interaction dynamics, complex inference, molecular recognition, and mutational landscapes," *Curr. Opin. Struct. Biol.* 56, 179-186 (2019); Krepel, D., Cheng,, R.R., Di Pierro, M. and Onuchic, J.N. "Deciphering the structure of the condensin protein complex," *Proc. Natl. Acad. Sci. USA* 115, 11911-11916 (2018); Di Pierro, M., Cheng, R.R., Aiden, E.L., Wolynes, P.G. and Onuchic, J.N. "De novo prediction of human chromosome structures: Epigenetic marking patterns encode genome architecture," *Proc. Natl. Acad. Sci. USA* 114, 12126-12131, (2017); Yu, L., Lu, M., Jia, D., Ma, J., Ben-Jacob, E., Levine, H., Kaipparettu, B.A. and Onuchic, J.N. "Modeling the Genetic Regulation of Cancer Metabolism: Interplay Between Glycolysis and Oxidative Phosphorylation," *Cancer Res.* 77, 1564-1574 (2017); Huang, B., Lu, M.Y., Jia, D.Y., Ben-Jacob, E., Levine, H. and Onuchic, J.N. "Interrogating the topological robustness of gene regulatory circuits by randomization," *PLoS Comput. Biol.* 13, e1005456 (2017); Di Pierro, M., Zhang, B., Aiden, E.L., Wolynes,P.G. and Onuchic, J.N. "A Transferable Model for Chromosome Architecture," *Proc. Natl. Acad. Sci. USA* 113, 12168-12173 (2016); Lin, X.C., Eddy, N.R., Noel, J.K., Whitford, P.C., Wang, Q.H., Ma, J. and Onuchic, J.N. "Order and disorder control the functional rearrangement of influenza hemagglutinin," *Proc. Natl. Acad. Sci. USA* 106, 12049-12054 (2014); Jana, B., Hyeon, C. and Onuchic, J.N. "From structure to function: the convergence of structure based models and co-evolutionary information," *Phys. Chem. Chem.*

Phys. 16, 6496-6507 (2014); Morcos, F., Pagnani, A., Lunt, B, Bertolino, A., Marks, D., Sander, C., Zecchina, R., Onuchic, J.N., Hwa,T. and Weigt. M. “Direct-coupling analysis of residue co-evolution captures native contacts across many protein families,” *Proc. Natl. Acad. Sci. USA* 108, E1293-E1301 (2011); Ratje, A.H., Loerke, J., Mikolajka, A., Branunner, M., Hildebrand, P.W., Starosta, A., Doenhoefer, A., Connell, S.R., Fucini, P., Mielke, T., Whitford, P.C., Onuchic, J.N., Yu, Y., Sanbonmatsu, K.Y., Hartmann, R.K., Penczek, P.A., Wilson, D.N. and Spahn, C.M.T. “Head swivel on the ribosome facilitates translocation via intra-subunit tRNA hybrid sites,” *Nature,* 468, 713-716 (2010); Schultz, D., Wolynes, P.G., Ben Jacob, E. and Onuchic, J.N, “Deciding the fate in adverse times: Sporulation and competence in *Bacillus subtilis,*” *Proc. Natl. Acad. Sci. USA*, 106, 21027-21034 (2009); Hyeon, C. and Onuchic, J.N. “Mechanical control of the directional stepping dynamics of the kinesin motor,” *Proc. Natl. Acad. Sci. USA.* 104, 17382-17387 (2007); Balabin, I. and Onuchic, J.N. “Dynamically controlled protein tunneling paths in photosynthetic reaction centers,” *Science* 290, 114-117 (2000); Clementi, C., Nymeyer, H. and Onuchic, J.N. “Topological and energetic factors: What determines the structural details of the transition state ensemble for protein folding? An investigation for small fast folding proteins,” *J. Mol. Biol.,* 298, 937-953 (2000); Onuchic, J.N., Luthey-Schulten, Z. and Wolynes, P.G. “Theory of Protein Folding: The Energy Landscape Perspective,” *Annu. Rev. Phys. Chem.* 48, 545-600 (1997); Bryngelson, J.D., Onuchic, J.N., Socci, D.N. and Wolynes, P.G. “Funnels, Pathways and the Energy Landscape of Protein Folding: A Synthesis,” *Proteins: Struct., Funct., Genet. 21*, 167-195 (1995); Wolynes, P.G., Onuchic, J.N. and Thirumalai, D. “Navigating the Folding Routes,” *Science* 267, 1619 (1995); Beratan, D.N., Onuchic, J.N., Winkler, J.R. and Gray, H.B. “Electron-Tunneling Pathways iProteins,” *Science* 258 1740-1741 (1992); Leopold, P.E., Montal, M. and Onuchic, J.N. “Protein folding funnels: Kinetic pathways through compact conformation space,” *Proc. Natl. Acad. Sci. USA* 89, 8721-8725 (1992); Beratan, D.N., Betts, J.N. and Onuchic, J.N. “Protein electron transfer rates set by the bridging secondary and tertiary structure,” *Science*, 252, 1285-1288 (1991); Hopfield, J.J., Onuchic, J.N. and Beratan, D.N. “A molecular shift register based on electron transfer,” *Science* 241, 817-820 (1988); Garg, A., Onuchic, J.N. and Ambegaokar, V. “Effect of friction on electron transfer in biomolecules,” *J. Chem. Phys.* 83, 4491-4503 (1985).