Leopoldina
Nationale Akademie
der Wissenschaften

Curriculum Vitae Professor Dr Peter G. Wolynes

Name: **Peter G. Wolynes**
Born: **21 April 1953**

Research Priorities: Biophysics, energy dynamics, protein folding, cell biology, glass theory

Peter G. Wolynes is an US-American chemist, who applies physical methods to biological problems. He concerned himself with a variety of theoretical questions at the interface of physics, chemistry, and biology, including the glass transition of molecular fluids. A main focus of his research is on protein folding. Peter Wolynes developed methods to simulate the folding of proteins and to more accurately predict them.

Academic and Professional Career

since 2019	Co-Director, Center for Theoretical Biological Physics, Rice University, Houston, USA
since 2011	Bullard-Welch Foundation Professor of Chemistry, Center for Theoretical Biological Physics, Rice University, Houston, USA
2000 - 2011	Francis Crick Professor, University of California (UC) San Diego, San Diego, USA
1980 - 2000	Professor of Chemistry, Physics and Biophysics, Center for Advanced Study, University of Illinois Urbana-Champaign, Champaign, USA
1976	Assistant Professor, Harvard University, Cambridge, USA
1976	PhD in Chemistry, Harvard University, Cambridge, USA
1971	BA in Chemistry, Indiana University, Bloomington, USA

Project Coordination, Membership in Collaborative Research Projects (Selection)

2022	Director, Project „The Role of Charge Density Coupled DNA Bending in Transcription Factor Sequence Binding Specificity: A Generic Mechanism for Indirect Readout“, G. Harold and Leila Y. Mathers Charitable Foundation, Rye Brook, USA
2018	Member, Grant „Anomalous diffusion, spatial coherence, and viscoelasticity from the energy landscape of human chromosomes“, National Science Foundation (NSF), Alexandria, USA
2012	Member, Grant „AWSEM-MD: Protein Structure Prediction Using Coarse-grained Physical Potentials and Bioinformatically Based Local Structure Biasing“, NSF, Alexandria USA
2008	Member, Grant „Origins of barriers and barrierless folding in BBL“, National Institutes of Health (NIH), Bethesda, USA and NSF, Alexandria, USA
2007	Director, Grant „Theory of Structural Glasses and Supercooled Liquids“, NSF, Alexandria, USA
1999	Director, Grant „Fragilities of liquids predicted from the random first order transition theory of glasses“, NSF, Alexandria, USA

Honors and Awarded Memberships

2012	Award in Theoretical Chemistry, American Chemical Society (ACS), USA
2010	Honorary Doctorate, Department of Biochemistry and Biophysics, Stockholm University, Stockholm, Sweden
2009	Joseph O. Hirschfelder Prize, University of Wisconsin-Madison, Madison, USA
since 2007	Member, German National Academy of Sciences Leopoldina, Germany
since 2007	Foreign Member, Royal Society, UK
2004	Max-Delbruck Prize in Biological Physics, American Physical Society, USA
2000	Peter-Debye Award, ACS, USA
since 1991	Member, American Academy of Arts and Science, USA
	Member, National Academy of Sciences, USA
1988	Honorary Doctorate, Indiana University, Bloomington, USA
1986	Award in Pure Chemistry, ACS, USA

Research Priorities

Peter G. Wolynes is an US-American chemist, who applies physical methods onto biological problems. He concerned himself with a variety of theoretical questions at the interface of physics, chemistry, and biology, including the glass-transition of molecular fluids. A main focus of his research is in protein folding. Peter Wolynes developed methods to simulate the folding of proteins and to more accurately predict them.

Proteins are made up of amino acids, whose sequence determines their form. The protein will only adopt their three-dimensional structure during folding. Folding generally happens spontaneously once a protein is synthesized. However, there are certain proteins, called chaperons that aid in folding and that make sure the protein adopts the correct structure. If a protein is folded incorrectly, it cannot fulfil its proper function and may do great harm. Deficiently folded proteins play a part in Alzheimer's disease, Parkinson's disease or Huntington's chorea.

Which choreography the distinct steps follow is not sufficiently known. Furthermore, the correlation between structure and function is determined only for a few proteins. Peter Wolynes pursues the question with considerations from physics, especially on the basis of energy dynamics: the protein passes through stable states on its way to an energetic minimum, so that protein folding forms a complex energy landscape. In the scientific literature, this is called Energy Landscape Theory (ELT). The theory also helps to better understand why some proteins fold quickly and precisely but others fold slowly and are prone to error.

He also developed another metaphor that describes protein folding as a funnel: the "funnel landscape". Amongst the numerous others possible ways of folding, a primary way that leads to an energetic minimum crystallises.

Peter Wolynes is not only concerned with protein folding, but also with the open questions of cellular biology that he views from a novel position. Further areas of his interest reach from the question how loosely arranged strains of DNA are packed into chromosomes to the long-term retention of memories.

He applies the concept of the energetic landscape to glass transition of molecular fluids, which describes the transition of a material from a solid, rigid state into a viscoelastic or rubber-like state. This transition is characterised by a certain temperature at which the material loses its crystalline structures and becomes amorphous.

Glass transition occurs in a variety of materials, including plastics, rubbers, lacquers, and glasses and depends both on the material itself as well as on external factors, such as pressure and moisture. Today, glass transition is part of the more general "Random First Order Transition Theory (RFOT)"

Peter Wolynes' perspective on biological problems and questions of material science not only generated new hypotheses, but also paved the way for new methods in application. With that, he contributed to a deeper understanding of biological processes, as well as to the dynamic behaviour

of various materials. His findings in protein dynamics also bear the potential to develop new ways of treating diseases that that are based on defectively folded proteins.