Theoretical Biological Physics Center at UC San Diego Awarded $11 Million by National Science Foundation

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The National Science Foundation has announced it will provide $11 million over the next five years to continue the operation at UC San Diego of the world's leading center in the emerging field of theoretical biological physics.

The award was made to a group of physicists, chemists and mathematicians in UCSD's Division of Physical Sciences, in collaboration with a theoretical neuroscience group at the nearby Salk Institute for Biological Sciences. Using theoretical machinery from quantum mechanics and statistical mechanics, researchers at the center are demonstrating how physics can help scientists understand the complexity of biological systems, from proteins and DNA to cells and genetic networks to organisms and diseases.

The Center for Theoretical Biological Physics is one of nine NSF Physics Frontier Centers designed to foster aggressive and forward-looking research with the potential to lead to fundamental advances in physics.

"The mission of the Physics Frontiers Centers is to advance the frontier across fields of physics as diverse as quantum optics and the physics of living cells," said Joe Dehmer, director of the National Science Foundation's Division of Physics. "Another significant impact the centers have is to be a talent magnet for students, postdocs and other excited young physicists. Promising young talent and new advances can be expected, and we look forward to both."

The theoretical biological physics center at UCSD brings together theoreticians and experimentalists from around the world to advance research and educate scientists in a discipline that uses the theoretical tools of physics and mathematics to understand the fundamental principles governing complex biological systems. This interdisciplinary approach not only provides biologists with a better understanding of the underlying mechanisms governing complex biological systems, such as networks of neurons or biochemical pathways in the assembly of proteins, but allows physicists to develop new principles and models for complex systems based on biological phenomena.

"What we do in biological physics is to try to understand the fundamental, underlying laws governing biological systems, just as physicists have gained an understanding of the fundamental laws of physical matter," says José N. Onuchic, a professor of physics at UCSD and co-director of the center. "If you understand these underlying principles, you can make predictions. And if you can make predictions and verify them, you gain insight into complex biological processes that now appear unpredictable."

The center was established at UC San Diego in 2002 and has since seen major progress made on a number of key issues in this exciting new discipline. These have included the development of sophisticated models for interpreting experiments on the directed motility of cells, new approaches to the "energy landscapes," which determine the interactions between protein molecules, studies of the complex diffusion-dominated dynamics of neurotransmitters in synapses and major advances in our knowledge of the functioning of genetic networks in the inevitable presence of noise.

According to Onuchic, "NSF's five-year renewal will enlarge the scope of the center's projects, bringing together researchers with complementary expertise to work on the cell as a non-equilibrium active mechanical system, the synapse as a complex information-processing component in neural tissue, and the developing embryo as a system where coupled genetic networks must exhibit robust spatial patterning even when faced with significant environmental uncertainty."

In addition to generating biological insights, the center will also continue to serve be as a national focal point for fostering the idea that biological systems are a critical arena and a natural expansion target for physics efforts.

"Understanding complexity, both biological and otherwise, is turning out to be one of the critical intellectual challenges of 21st century science," said Herbert Levine, a professor of physics at UCSD and the other co-director of the center. "Our approach of using computation to couple data from experimental biology with conceptual frameworks provided by physicists is enabling a whole host of breakthroughs, both for biology and physics."

He added that these ideas, controversial in the past, are now widely accepted and have led to a plethora of new employment opportunities both in academia and in industry for graduates of the center's training programs.

In line with its unique character, the center will be supported by a novel combination of programs from the National Science Foundation. This award is jointly funded by NSF's Directorate for Mathematical and Physical Sciences and Directorate for Biological Sciences as part of a partnership to foster research and education at the mathematical and physical sciences - life sciences interface. Funds are being provided by the Physics Frontiers Centers program and the Condensed Matter and Materials Theory program in the Mathematical and Physical Sciences Directorate and the Biomolecular Systems cluster in the Directorate for Biological Sciences.

Researchers affiliated with the center said its existence has helped both UCSD and the Salk Institute recruit top young scientists to junior faculty positions in La Jolla. Olga Dudko has just arrived from the National Institutes of Health, where she developed a new way to deduce the properties of molecular machines from single molecule experimental data. Similarly, Tatiana Sharpee will bring a new systems neuroscience perspective, and will be investigating the information-theoretic basis for learning in songbirds.

Other researchers involved in the center include; UCSD physics professors Peter Wolynes (also professor in chemistry), Henry Abarbanel and Terrance Hwa; UCSD physicist Wouter-Jan Rappel; UCSD chemistry and biochemistry professors J. Andrew McCammon and Wei Wang; UCSD mathematics professors Michael Holst; and Bo Li; Terrence Sejnowski and Tom Bartol, neurobiologists at Salk, and Charles Brooks, professor of chemistry and biophysics at the University of Michigan.

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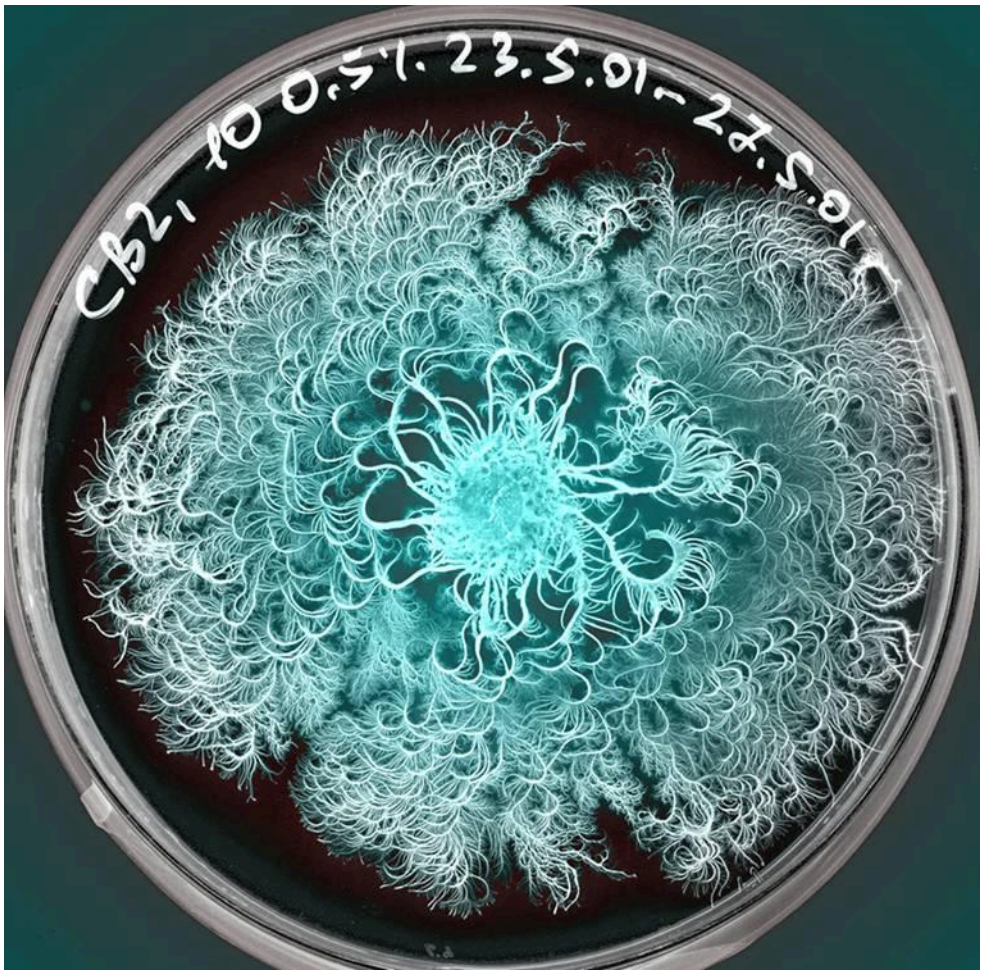
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