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Ackad studies proteins using x-ray lasers



SIUE photo

Dr. Edward Ackad.

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Segue/Logan Cameron

In this week's segment of Segue, SIUE's College of Arts and Sciences Dean Gregory Budzban, PhD, hosts Edward Ackad, PhD, assistant professor in the Department of Physics.

They discuss Ackad's current research project, computationally modeling the data captured using x-ray lasers to analyze the movement and structure of matter, as well as how his research could contribute to important future developments in the fields of biophysics, biomedicine and more. X-ray lasers have become important tools to study the composition of matter, since the extremely small wavelengths and high energy levels of the x-rays allow researchers to see matter on a much finer scale, even to the point of being able to see the structure and movement of individual molecules.

In this week's show, Ackad explains his excitement in the further development of his research through a grant recently earned by himself and fellow SIUE Department of Physics faculty member Mohammad Yousef, PhD. "In early December, we will have access to the only computer in the world that is able to analyze this complex physics data," he said. "The computer, ANTON, is a super computer which was specially designed to study protein motions and protein models. This will speed up our computations by a factor of 100 to 1,000, meaning one day

becomes the equivalent of three years of regular computations. Using this technology, we'll be able to push those computations further than anyone else has ever done.”

As Ackad discusses the processes and developments of his research, he explains how determining the detailed structure of proteins in the human body is at the forefront of medical and biophysical research. In fact, it is slowly becoming possible to learn to control the movement of these protein molecules, permitting them to be used as “microtools”, perhaps even using them to perform surgery at the cellular level.

Budzban cannot help but be excited by the possibilities for the collaboration between physics and medicine. Budzban states, “The number of proteins that are still unknown to us, and the connections between physics, biology and biomedicine now is so fascinating. Using modern technologies, researchers are now finding details of what is truly occurring in the middle of chemical experiments. The idea that we are coming to a point where matter may eventually be controlled in a way that we can make it do what we want – it’s incredible.”

The research being performed by Ackad is a topic with enormous opportunities for advancement, as the structure of the vast majority of the 250,000 or so proteins known to exist in the human body remain unknown. His research computationally models molecular processes moving at incredibly rapid rates, measured in “femtoseconds” – a speed much less than a trillionth of a second.

Ackad explains the rarity of the x-ray laser facilities, whose data he uses, as well as their impact in the biomedical field. “There are only a handful of free-electron laser facilities in the entire world,” he said. “They have many components, including a particle accelerator and a three kilometer tunnel. “Though expensive, these devices are critical in trying to figure out what the proteins in our bodies look like. If we know their structure, we can start understanding their functions. Right now, we don’t know what most of the proteins in our bodies look like, what can go wrong or how to fix them”.

Dr. Ackad explains how the goal of the technology would be to eventually be able to make a “movie” of molecular movement, with all of the details of how the protein interacts with other matter in our bodies. “These devices were built to image proteins with a single laser-shot. We are dropping in proteins, zapping them with an intense laser, and making an x-ray picture of it. The hope is that this will reveal images of proteins that we have previously not been able to image in any other way. This would be a boon for 21st century biophysics and biomedicine.”

Tune in to WSIE 88.7 FM every Sunday at 9 a.m. as weekly guests discuss issues on SIUE’s campus.

By Logan Cameron, SIUE Marketing & Communications.