Louisiana EPSCoR
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Louisiana Researchers Discovering the Underlying Physics of Materials

Exotic Interactions Observed

Magnetic materials, also known as ferromagnetic materials, have been around since ancient times. From basic iron to more complex alloys, magnetic materials have been widely used in our daily life for a long time.

The strength of magnets has improved exponentially since the early 20th century, and many important modern technologies depend on magnetic materials, such as MRI devices, sensors, and the data storage devices in our computers. The magnetic phenomena occurring inside these materials can be explained by quantum physics.

Researchers worldwide are performing experiments on ferromagnetic materials, changing different variables such as pressure and impurities to observe the changes in the electron interactions and magnetization. In certain rare scenarios where the competing physical phenomena clash, ferromagnetic materials will exhibit unconventional behaviors. Extreme drops in resistance and superconductor levitation are examples of such remarkable behaviors.

A team of Louisiana State University researchers (pictured above) in the NSF-funded Louisiana Alliance for Simulation-Guided Materials Applications consortium (LA-SiGMA) led by Dr. Shane Stadler observed a rare, exotic interaction, called an "anisotropic Kondo effect," in a ferromagnetic alloy. The lattice effect forms as a result of electrons "screening" the magnetic behavior of the atoms in the material. The electrons move to positions around the magnetic atoms in the material, effectively canceling the magnetic effect of those atoms. "We have found a material that exhibits a rare Kondo-like effect that is not normally observed in ferromagnetic materials," said Stadler.

Louisiana State University students using a magnetometer to test the properties of experimental magnetic materials.

The behavior of these materials cannot be explained by the understanding of the individual atoms alone. Each additional variable, like applied pressure, magnetic field, or the addition of new atoms adds an enormous level of complexity that produces entirely new properties. Observing and measuring exotic phenomena like this at the quantum level gives us a fundamental understanding of the physics at play.

The next step will be to research how to manipulate these properties to produce the desired effects for the development of commercially important applications like nanoscale computer circuits and the next generation of media storage.

UNO Chemistry Student Wins National Competition

University of New Orleans chemistry student, Mr. Edwin Gomez, beat out 39 other competitors from across the country to win first prize in the 2015 American Chemical Society Undergraduate Poster competition held at the American Chemical Society National Meeting in Denver, Colorado. He won in the "Computers in Chemistry" division with his poster titled, "Conforma-

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tional sampling of glucose oxidase for bio-fuel cell applications."

Mr. Gomez is a member of the University of New Orleans chemistry research team led by LA-SiGMA researcher Dr. Dhruva Chakravorty. Their research focuses on understanding protein-ligand, protein-complex and protein-aggregate chemistry using the tools of computational chemistry.

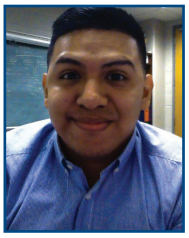
The research being performed by Mr. Gomez focuses on the intersection of biology and materials sciences to understand and develop "green" energy sources and devices for human use.

Unlike most chemists, Mr. Gomez uses high-performance computational methods to address these problems at the atomic level.

"Thanks to the LA-SiGMA project, I have been able to perform this research on High Performance Supercomputers. I have been to multiple conferences to present my work to many researchers across the country and this has helped me build a professional rapport with other researchers," said Gomez.

The effects of this research are important for the design of biofuel cells and diabetes testing kits. In addition, the research has far-reaching implications for understanding the causes of aging-related diseases such as ALS, diabetes and Alzheimer's.

"Edwin hopes that his research will lead to the development of new medical therapies that will benefit millions of people around the world," said Dr. Chakravorty.



Edwin Gomez

Mr. Gomez is a New Orleans native, and is the first member of his family to graduate from high school.

Dr. Dhruva Chakravorty

"As for the future, I plan on attending graduate school to work towards a PhD in chemistry. I enjoy working in the field of computational chemistry and I hope to pursue that in graduate school," added Gomez.

LA-SiGMA Technical Conference: Meeting of the Minds

Over 100 LA-SiGMA researchers and students recently gathered in Baton Rouge for the annual technical meeting. Speakers from each science driver presented research updates, then the participants split up into four groups for a break-out session on sustainability and regrouped for discussion.

During the networking lunch break, 70 students presented posters and received feedback from participants.

Louisiana EPSCoR
P.O. Box 3677
Baton Rouge, LA 70821-3677
#4475