RESEARCH ABSTRACT

RESEARCH IN THE COLLEGE OF SCIENCE & TECHNOLOGY FALL 2009

College of Science and Technology
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Indivisible

Mass is measured in electron-volts. One of the forces holding particles together remains constant regardless of distance. Antimatter is commonly in evidence. Reality is noticeably different, and little understood, at the subatomic level.

Professor Zein-Eddine Meziani, who joined Temple's Physics Department in 1993, spends his workdays in this strange world of subatomic physics. In his Temple University laboratory and at the Thomas Jefferson National Accelerator Facility (JLab) in Newport News, Virginia, where he is chair of the User Group, he explores the behavior and structure of quarks and gluons, the particles that make up the positively charged protons and uncharged neutrons that comprise the nucleus of an atom, the basic building block of matter.

"If there is a Big Bang, you start with particles like neutrinos, electrons, quarks, photons and gluons," Meziani says. "At some point it cools down and you have to make a proton before you make hydrogen."

"How does that proton happen?"

Most of Meziani's research into the constituents and behaviors of subatomic particles, a field known as quantum chromodynamics, uses the particle accelerator at JLab to shoot target particles with specially corralled and oriented electron beams. The patterns and energies at which the electrons scatter onto various detectors tell him what energies were absorbed by the target, which then tells him how the particles in the target interact with each other.

Quantum chromodynamic theory says those particles include six types of quarks, including the most common types, "up" and "down" quarks, antiquarks, and gluons, the particles that carry the force, known as the strong force or color force (hence *chromo*dynamics), that binds protons and neutrons together as individual units as well as in groups in the nucleus of atoms. The other three fundamental forces, electromagnetism, gravitation and the weak force, play smaller roles within protons and neutrons. In practice, the inside of a proton is a very mysterious place, due in large part to a property called confinement.

Dr. Zein-Eddine Meziani

"You can take a protein and you can break it, you can take an atom and remove the electron," says Meziani. "But if you take a proton or a neutron and try to remove the quarks — you can't. There are no 'free quarks.' It gets very complicated. When you try to pull two quarks apart, two new quarks pop up out of the vacuum, so now you have two quark pairs instead of two free quarks."

According to theory, the color force, carried by gluons between quarks, doesn't decrease with distance. So when two bound quarks become too distant from each other, it becomes more energetically economical for a new, color force-bound quark pair to spontaneously appear than for the two separated quarks to snap back into proximity. Matter is energy, after all.

A particle that can't be isolated from its environment is very difficult to study. This difficulty is one of the drivers behind the development of more powerful particle accelerators — the more energy that can be precisely imparted to quarks and gluons within protons and neutrons, the more the resulting scattering of particles tells researchers about these particles.

In a revolutionary 2001 experiment at JLab, which boasts a powerful superconducting particle accelerator, Meziani's group was the first team of physicists to gain experimental insight into the spin structures of protons and neutrons. Physicists had known for years that protons and neutrons possess a magnetization property due to their rotation around their axes, much like the earth, but did not know how the orbital motion of quarks contributed to this spin. By comparing data obtained in experiments with the neutron, which has one down quark and two up quarks, and the proton, which has two down quarks and one up quark, Meziani and his team were able to learn that up and down quarks characteristically rotate in opposition to each other.

Currently, Meziani is analyzing data obtained from recent experiments that could shed light on the nature of the color force, one of the keystones of the theory of quantum chromodynamics.

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ABSTRACT FACT

Meziani's latest experiments could start to address one of the 10 "Physics Problems for the Next Millennium" set out at a 2000 string theory conference: *Can we quantitatively understand quark and gluon confinement in quantum chromodynamics and the existence of a mass gap?*

Active CST Grants

BIOLOGY

Amini, Shohreh; Borguet, Eric; Stull, Deborah; Hillman, Nina, Teachers as Scientists, Scientists as Teachers, *National Science Foundation*

Cordes, Erik, Exploration and Research of Northern Gulf of Mexico Deepwater Natural and Artificial Hard Bottom Habitats with Emphasis on Coral Communities, Reefs, Rigs & Wrecks, *U.S. Minerals Management Service / NOAA Office of Ocean Exploration and Research*

Cromley, Jennifer G. (Education); Tanaka, Jacqueline; Michel, John B.; Horvat, Erin (Education), A Multimethod Approach to Understanding Dropout from STEM Gateway Courses, *National Science Foundation*

Cromley, Jennifer G. (Education); Tanaka, Jacqueline; Newcombe, Nora (Liberal Arts); LaVan, Sarah-Kate (Education), Teaching Effective Use of Diagrammatic Reasoning in Biology, National Science Foundation

Feitelson, Mark A., Early Antibody Markers of HCC, *National Institutes of Health/Department of Health and Human Services*

Feitelson, Mark A., Combination Therapies for Chronic Hepatitis B Virus, Liver Disease, and Cancer, *National Institutes of Health/Department of Health and Human Services*

Feitelson, Mark, Beta-Catenin Signaling in HBxAg Mediated HCC, *National Institutes of Health*

Feitelson, Mark, New Therapeutic Approaches to Hepatitis B, *HEC, Guangzhou, China*

Giordano, Antonio; Macaluso, Marcella, Cancer Biomolecular Markers Research, *Pennsylvania Department of Health*

Giordano, Antonio; Macaluso, Marcella, Cancer Biomolecular Markers Research, *Department of Defense*

Giordano, Antonio; Macaluso, Marcella, Workforce Development Grant, *Pennsylvania Department of Labor and Industry*

Giordano, Antonio, Redevelopment Assistance Capital Project, *Commonwealth of Pennsylvania*

Marcinkiewicz, Cezary; Del Valle, Luis (Medicine); Tuszynski, George, Interaction of Thrombospondin-1 with α9β1 Integrin in Glioma Angiogenesis, *National Institutes of Health*

Otvos, Laszlo Jr., Peptide Agonists to Adiponectin Receptors, *Department of Defense*

Otvos, Laszlo, Universal Vaccine to Influenza A Virus, *Wistar Institute*

Palter, Karen B., EFRI-CBE: An Integrated Computational and Experimental Model for Biochemical and Electrical Interactions in Ion Channels and the Impact of Sialic Acid on Neuronal Function, *National Science Foundation (Johns Hopkins University)*

Sanders, Robert, Collaborative Research: Alternative Nutritional Strategies in Antarctic Plankton, *National Science Foundation*

Smutzer, Gregory S., Cellulose-Based Strips for Human Taste Function, *National Institutes of Health (Osmic Enterprises, Inc.)*

Smutzer, Gregory S., Validation of PROP Taste Strips for the NIH Toolbox Study, *National Institutes of Health (NorthShore University Health System Research Institute)*

Tanaka, Jacqueline; Woodruff-Pak, Diana S. (Liberal Arts), Temple Minority Access to Research (MARC) UPSTAR Program, *National Institutes of Health*

Tanaka, Jacqueline, Canine Achromatopsia: Analysis of Gene Therapy, *National Institutes of Health (University of Pennsylvania)*

CHEMISTRY

Andrade, Rodrigo, Discovery of Novel Macrolide Antibiotics, *National Institutes of Health*

Baran, George (Engineering); Sieburth, Scott M.; Sadeghipour, Keya (Engineering), Bio-inspired Interphases for Tougher Composites, *National Institutes of Health*

Baran, George (Engineering); Sieburth, Scott M.; Delaney, Interphases for Tougher Composites, *National Institutes of Health*

Borguet, Eric, Acid-Base Chemistry at the Aqueous -Mineral Interface, *American Chemical Society*

Borguet, Eric, A Molecular Resolution Investigation of Electron Transfer at Electrochemical Interfaces, *National Science Foundation*

Borguet, Eric, Array Piezoelectric Nanocantilever Sensors to Detect Immune Responses to Theraputic Monoclonal Antibodies and Breast Cancer Markers, *Pennsylvania Nanotechnology Institute*

Borguet, Eric; Dun, Nae (Medicine), Nanoscale Cellular Probes, *Pennsylvania Nanotechnology Institute*

Borguet, Eric; He, Yufan, CRC: Long-Range Electron Transfer in Hybrid Inorganic-Peptide Nucleic Acid Nanoscale Assemblies, *National Science Foundation*

Borguet, Eric, Passive Wireless SAW Humidity Sensors and System, *National Aeronautics and Space Administration*

Dai, Hai-Lung, Structure and Spectroscopy of Buried Interfaces in Organic Thin Film and Colloids, *Air Force Office of Scientific Research*

Dai, Hai-Lung, Nonlinear Optical Probe Absorption and Structure of Molecules on Nanometer and Micron Size Colloidal Particles, *National Science Foundation*

Fleming, Steven; Bio-organic Reaction Animations, *National Science Foundation*

Jansen-Varnum, Susan, Temple University Science Math Assessment Research for Teachers: TU-SMART, *National Science Foundation*

Jansen-Varnum, Susan, TU-CCP Academic Community: Expanding Opportunities, *National Institutes of Health/DHHS*

Jansen-Varnum, Susan, Science in the City, *National Science Foundation*

Jansen-Varnum, Susan, Teacher Professional Development Related to Inquiry in the 11th grade Chemistry SDOP Core Curriculum, *School District of Philadelphia*

Klein, Michael L., Collaborative Research: Cyberinfrastructure and Research Facilities: Chemical Computations on Future High-End Computers, *National Science Foundation*

Klein, Michael L., Computer Simulation of Amphiphilic Aggregates, *National Institutes of Health*

Klein, Michael L., Molecular Modeling of Surfactant Kinetics, *Procter & Gamble Company*

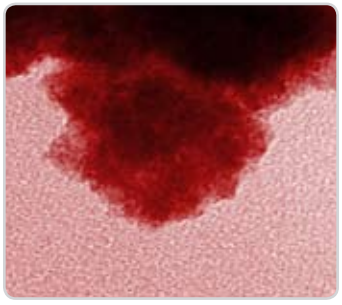
Klein, Michael L., Interaction of Inhalational Anesthetics with Macromolecules, *National Institutes of Health (University of Pennsylvania)*

Chemistry *in terra*

In 1995, geochemist Martin Schoonen sat in on one of Dan Strongin's Stonybrook University classes on surface chemistry. After the class, Schoonen approached Strongin, now a Temple professor of chemistry, and told him that the techniques and concept he'd covered, at the time unused in geochemistry, would be helpful resources in the field.

"So we started working together," Strongin remembers. "And actually, he's still a collaborator. It branched into a lot of different projects, but I would trace the start of my environmental research back to that point."

Today, Strongin has environmental chemistry projects funded by the NSF, NASA and the DOE. He also recently helmed an interdisciplinary grant proposal that obtained NSF funding for Temple's purchase of a transmission electron microscope (TEM); the first successful grant for common instrumentation for the College of Science and Technology. The TEM will be used by Temple physicists, chemists, biologists, materials scientists and engineers.



TEM image of ferrihydrite, an iron oxyhydroxide phase

> "The basic science has really led us to a possible solution to the problem."

Strongin will use the TEM, which can magnify thin samples to nearly a million times their actual size, in all his projects, which include research on acid mine drainage and iron and manganese oxyhydroxide nanoparticles.

Acid mine drainage is a growing problem in regions such as western Pennsylvania, which has many abandoned and active coal mines. The phenomenon usually occurs when the common mineral iron disulfide, also known as pyrite or fool's gold, is exposed to water in abandoned mines. "It gets attacked by water, oxygen and bacteria," Strongin says. "And it decomposes to form sulfuric acid, which can then run off into groundwater, into streams and lakes…it's essentially a half a billion dollar a year problem in the United States for cleanup and remediation."

Strongin's group is ready for field testing with a preventative measure: phospholipids, organic molecules that bind to the active sites on pyrite

Dr. Daniel Strongin

and effectively rubberize the surface, preventing oxidation and decomposition into sulfuric acid. "The basic science has really led us to a possible solution to the problem. If we can show it will work at their mining sites, we think a lot of people will be interested in licensing it," Strongin says.

Purer water is also one of the possible applications of Strongin's work with iron oxyhydroxides, the structure of which was the subject of a 2007 *Science* article coauthored by Strongin's team, and manganese oxyhydroxides. The two classes of materials are relatively stable at the nano-scale and are inexpensive to make. Strongin is interested in them because, since they are highly reactive with heavy metals and arsenic, a toxin prevalent in the groundwater in places like Bangladesh, they have great potential for cheaply removing toxins from the environment.

Yet another Strongin project is helping to evaluate the chemistry associated with potentially storing gigatons of CO_2 far beneath the surface of the earth. The capture and subsurface sequestration of CO_2 is emerging as an attractive technology to limit CO_2 emission into the atmosphere where it can contribute to climate change. "I like to take on problems facing society," Strongin says. "There should be some interesting chemistry, but having a goal in mind is also important."

Training data

It's easy to take the human brain for granted. The brain works so well, so unobtrusively, that the diverse and complex operations it constantly performs are barely noticed by most people. The human mind's incredible faculties become readily apparent, however, when computers are asked to duplicate its functions.

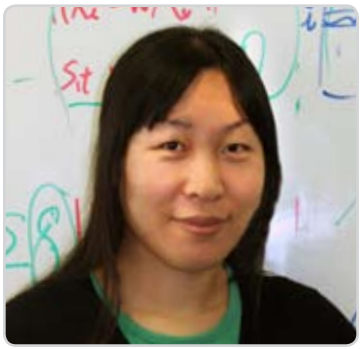
Yuhong Guo, assistant professor of Computer and Information Science, is at the cutting-edge of researchers' attempts to apply the analytical powers of the human brain through the raw processing power of computers, a field known as machine learning. She concentrates on three interconnected subfields of machine learning: active learning, dimensionality reduction, and graphical data networks, often through Bayesian networks.

One of the most telling differences between the human brain and computers, and one of the biggest challenges for machine learning researchers, is the way in which the two systems learn and apply concepts. Humans eventually learn the concept of concepts, and so are able to independently identify the common qualities of categories of things and make decisions about newly encountered things based on both these and new qualities. Computers cannot learn the concept of concepts, and must be taught characteristics and decision-making tools for each category of things.

Guo's work with active learning is aimed at improving the time consuming and often expensive process of teaching categories to computers. "If I have a dataset about credit card fraud detection, I can try to train a predictor for new instances of data," she says. "Suppose you spend $10 to label one instance, and you have $1000. Which subset of 100 instances are you going to label? We're going to train our classifier on the labeled dataset, so your training data will make a huge difference. I try to apply convex optimization techniques to decide which data we're going to label."

Convex optimization is a common thread in Guo's research. A useful but previously cumbersome operation which has been made more practical by recent developments in theory and solution programming, solving problems with convex optimization provides very accurate results. The challenges lie in formulating each problem in the right terms and developing the specific procedures necessary for an accurate solution.

"The inherent drawback with using non-convex techniques, which are commonly used in traditional machine learning research, is that they suffer from local optima," Guo says. "Right now, I am trying to reformulate traditional problems into a convex optimization framework and develop specific procedures to solve these problems. For each problem, we need to develop new approaches."



Dr. Yuhong Guo

Guo also uses convex optimization in her work with dimensionality reduction and graphical networks. With Bayesian networks and other graphical representations of data, which are effective tools for computer learning based on incomplete and irregular data, Guo uses convex optimization to help the system to recognize representations that work well on a network-wide level. With dimensionality reduction, convex optimization helps machines recognize low-dimensional, compact representations of high-dimensional data sets such as photo images and webpages, resulting in much lower computation costs when running predictions.

Guo's paper "Learning Coordination Classifiers" was one of three out of 1323 submitted papers to win a 2005 International Joint Conferences on Artificial Intelligence Distinguished Paper Prize. Her work continues to lead the way in training computers to categorize and process data.

Klein, Michael L., Materials Research Science and Engineering Center, *National Science Foundation (University of Pennsylvania)*

Krow, Grant, New 2-Azabicyclo[2.1.1] hexanes: Methanopyrrolidines, *National Science Foundation*

Levis, Robert, Shaped Intense Laser Detection and Surveillance (SHIELDS), *United States Army Research Office*

Levis, Robert, Multi-Dimensional Detection, *Office of Naval Research*

Matsika, Spiridoula, CAREER: Theoretical Studies of Nonadiabatic Photoinitiated Processes in Complex Systems, *National Science Foundation*

Matsika, Spiridoula, Theoretical Studies of Nonadiabatic Photoinitiated Processes in Complex Systems, *National Science Foundation*

Matsika, Spiridoula, Combining High Level Ab Initio Calculations with Laser Control of Molecular Dynamics, *Department of Energy*

Nicholson, Allen, Reactivity Epitopes of Ribonuclease III Substrates, *National Institutes of Health/Department of Health and Human Services*

Schafmeister, Christian, Molecular Lego Based Catalysis, *Defense Threat Reduction Agency*

Schafmeister, Christian, The Development of Hinged Molecular Containers as Fluorescent Sensors of Small Molecules, *National Science Foundation*

Schafmeister, Christian, Synthesis and Applications of Functional Macromolecules, *National Institutes of Health/Department of Health and Human Services*

Sieburth, Scott, Silanediols as Serine and Threonine Protease Inhibitors, *National Institutes of Health*

Spano, Francis, Optical Excitations in Supramolecular Assemblies of Conjugated Oligomers and Polymers, *National Science Foundation*

Spano, Francis, Using Circularly Polarized Light to Probe Optical Excitations in Organic Supramolecular Systems, *National Science Foundation*

Stanley, Robert, Photoinduced Electron Transfer in DNA Photolyase, *National Science Foundation*

Strongin, Daniel R., Reactivity of Iron-Bearing Minerals and CO_2 Sequestration, *Department of Energy*

Strongin, Daniel R., Collaborative Research: Structure Sorption Relationships for Disordered Iron Oxyhydroxide Minerals, *National Science Foundation*

Strongin, Daniel R.; Borguet, Eric; Wayland, Bradford; Knight, Linda (Medicine); Hutapea, Parsaoran (Engineering), Acquisition of a Transmission Electron Microscope, *National Science Foundation*

Strongin, Daniel, Astrobiology Biogeocatalysis Research Center (ABRC) at Montana State University, *National Aeronautics and Space Administration*

Strongin, Daniel R., Investigating the Surface Structure & Reactivity Bulk Nanometer Nanosized Scale Manganese Oxide, *National Science Foundation*

Wayland, Bradford, Catalytic Hydrogenation of Carbon Monoxide and Hydrocarbon, *Department of Energy*

Wayland, Bradford, Metal-Centered Radicals and Organometallic Complexes in Controlled Radical polymerization of Olefins, *National Science Foundation*

COLLEGE OF SCIENCE AND TECHNOLOGY

Baird, Douglas, Destination Earth, An ExxonMobil Bernard Harris Summer Science Camp at Temple University, *The Harris Foundation*

Conrad, Bruce P., AMP (Alliance for Minority Participation), *National Science Foundation (Drexel University)*

McGuire, Kent (Education); Dai, Hai-Lung, TUteach, *National Math and Science Initiative*

COMPUTER AND INFORMATION SCIENCES

Bai, Li (Engineering); Vucetic, Slobodan, MOSAIC (Multi-agent-based Oil-refinery System Analysis and Intelligent Control), *ExxonMobil*

Du, Xiaojiang, Collaborative Research: Towards Robust and Self-Healing Heterogeneous Wireless Sensor Networks, *National Science Foundation*

Du, Xiaojiang, A Heterogeneous Sensor Network Laboratory for Integrated Research and Education, *National Science Foundation*

Du, Xiaojiang, MRI: Development of a Hybrid Wireless Network Infrastructure for Integrated Research and Education, *National Science Foundation*

Du, Xiaojiang, Designing Secure and Robust Heterogeneous Sensor Networks, *Army Research Office*

Kelsen, Steven G. (Medicine); Merali, Salim (Medicine); Obradovic, Zoran, Ancillary Study: Identification of Plasma Biomarkers in Chronic Obstructive Pulmonary Disease, *National Institutes of Health*

Keshner, Emily A. (Health Professions); Shi, Justin, Posture & Orientation in Older Adults & Post Stroke, *National Institutes of Health*

Latecki, Longin Jan, Collaborative Research: Recovery of 3D Shapes from Single Views, *National Science Foundation*

Latecki, Longin Jan, Robotic Navigation Emulating Human Performance, *Air Force Office of Scientific Research*

Latecki, Longin Jan, RADIUS: Rapid Automated Decomposition of Images for Ubiquitous Sensing, *Department of Energy*

Latecki, Longin Jan, Airborne Dynamic Detection and Discrimination of Dismounts, *Air Force Research Laboratory*

Latecki, Longin Jan, Research Experiences for Undergraduates, *National Science Foundation*

Latecki, Longin Jan, Collaborative Research: Simultaneous Contour Grouping and Medial Axis Estimation, *National Science Foundation*

Megalooikonomou, Vasileios; Ling, Haibin, Collaborative Research: Modeling, Detection, and Analysis of Branching Structures in Medical Imaging, *National Science Foundation*

Megalooikonomou, Vasileios, Collaborative Research: Mining Biomedical and Network Data Using Tensors, *National Science Foundation*

Megalooikonomou, Vasileios; Obradovic, Zoran, Large Scale Data Analysis for Brain Images, *National Institutes of Health*

Obradovic, Zoran; Vucetic, Slobodan, Collaborative Research: Data Mining Support for Retrieval and Analysis of Geophysical Parameters, *National Science Foundation*

Obradovic, Zoran, Bioinformatics Linkage of Protein Disorders and Function, *National Institutes of Health*

Obradovic, Zoran, Improving Biomedical Informatics Support at Temple Health Sciences Center, *Pennsylvania Department of Health*

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ACTIVE CST GRANTS

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Vucetic, Slobodan, CAREER: Memory-constrained Predictive Data Mining, *National Science Foundation*

Wu, Jie, TF-SING: Energy-Efficient Design in Wireless Networks Using Cooperative Communication, *National Science Foundation*

Wu, Jie, EAGER: A New Algorithmic and Graph Model for Networking in Challenged Environments, *National Science Foundation*

Wu, Jie, Efficient & Localized Broadcasting in Ad Hoc Wireless, *National Science Foundation*

Wu, Jie, NeTS-NBD Dynamic Carrier-Assisted Routing in Mobile Networks, *National Science Foundation*

EARTH AND ENVIRONMENTAL SCIENCE

Davatzes, Alexandra, Studies of Buried Impact Craters Using a New Crustal Thickness Model of Mars, *NASA Goddard Space Flight Center*

Davatzes, Nicholas, Use of Multiple Stimulation Methods to Improve Economics of Engineered Geothermal Systems in Shallow High Temperature Intrusives, *Department of Energy*

Davatzes, Nicholas, Evolution of the Hydraulic and Mechanical Properties of Clay-Rich Fault Rocks: Moab Normal Fault System, Utah USA, *Shell Oil Company*

Terry, Dennis Jr., Rare Earth Element Finger Printing of Fossil Bone, *Department of Agriculture*

Toran, Laura; Nyquist, Jonathan, Mapping Spatial and Temporal Heterogeneity of Lake Seepage using Electrical Resistivity and Induced Potential, *National Science Foundation*

Toran, Laura, Shale Hills Critical Zone Observatory, *National Science Foundation (Pennsylvania State University)*

Toran, Laura, T-VSSI Sustaining Our Watersheds Phase II, *William Penn Foundation*

MATHEMATICS

Berhanu, Shiferaw, Linear and nonlinear problems in CR manifolds, *National Science Foundation*

Grabovsky, Yury, Systematic Study of Instabilities in Non-linear Elasticity and Martensitic Phase Transformations, *National Science Foundation*

Gutierrez, Cristian, Nonlinear Equations of Monge-Ampere Type, *National Science Foundation*

Letzter, Edward, Noncommutative Algebra, *National Security Agency*

Lorenz, Martin, Topics in Noncommutative Algebra and Invariant Theory, *National Security Agency*

Mendoza, Gerardo, Collaborative Research: Elliptic Partial Differential Equations on Singular Manifolds and Applications in Complex Geometry, *National Science Foundation*

Pesenson, Isaak, A Framework for Regularizing Hyperspectral Images - Image Processing, Spectral Domain Dimension Reduction, Visualization, and Quality Assessment, *National Geospatial-Intelligence Agency (California Institute of Technology)*

Rivin, Igor, Collaborative Research: Discovery and Design of New Microporous Zeolites, *National Science Foundation*

Seibold, Benjamin, Capturing Subgrid Structures with Level Set Methods, *National Science Foundation (Massachusetts Institute of Technology)*

Szyld, Daniel, Krylov Subspace and Schwartz Methods for PDEs, Control, and other Problems, *Department of Energy*

PHYSICS

Kotochigova, Svetlana, Precision Control of Ultracold Molecules in Optical Lattices, *Air Force Office of Scientific Research*

Lyyra, Marjatta A., Control of Molecular Properties by Coherence Effects in the Laser-Molecule Interaction, *National Science Foundation*

Lyyra, Marjatta A., Molecular Quantum Control within the Frequency Domain, *National Science Foundation*

Mackie, Matthew, Enhancement, Entanglement, and Tunable Three-Body Interactions in Coupled Atom-Molecule Gases, *National Science Foundation*

Martoff, Jeff, MAX- Multi-Ton Argon and Xenon TPC's, *National Science Foundation (Princeton University)*

Metz, Andreas, Hard Scattering Processes in QCD, *National Science Foundation*

Meziani, Zein-Eddine, Nuclear Research Using the Electromagnetic Probe, *Department of Energy*

Meziani, Zein-Eddine, 2009 Nuclear Physics GRC and GRS, *National Science Foundation*

Riseborough, Peter, Heavy Fermion Materials, *Department of Energy*

Tao, Rongjia, Radioactive Materials and the Surrounding Atmosphere, *Defense Threat Reduction Agency*

Tao, Rongjia, Development of Magneto-optic Sensor Materials, *Naval Research Laboratory*

Tao, Rongjia, Device for Fuel Injection and Device for Crude Oil Pipelines, *Save the World's Air*

Xi, Xioaxing, Superconducting Circuits Using Magnesium Diboride Josephson Junctions, *Office of Naval Research*

INDIVISIBLE

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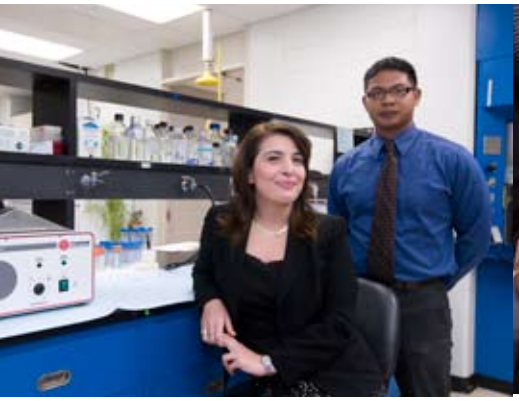
"If you hit a quark with a photon, you never see the quark going off, though it does go off," says Meziani. "And the quarks that remain are pulling on it. What I am measuring is that color force, the gluonic force that is pulling on the quark right at the time I hit it and it wants to go out."

For Meziani, whose interest in the predictions physics can make about reality began in high school in Algiers, Algeria, and led him through a bachelor's degree from the University of Algiers, a doctoral degree from the University de Paris XI in Orsay, France, and an assistant professorship at Stanford University, seeing the hard results of his experiments exploring one of the most important and least understood forces of nature is a thrilling proposition.

"I'm excited about it. It's going to make a big splash, depending on the results we get," he says. "I'm hoping it will help start to unravel how the interactions between gluons and quarks occur. This could show why protons exist and why they don't decay. Matter starts from this."

CST Research Support Facilities



Left: Alla Arzumanyan, PhD, Director of the Solid Phase Peptide Synthesis-Analysis Facility (SPPS; www.temple.edu/cst/spps), and George Mateo, Senior Research Specialist. The SPPS provides peptide synthesis, purification, and identification and characterization of proteins from recombinant or biofluidic sources. Right: Research and Instructional Support Facility (RISF) Supervisor Ed Kaczanowicz (left) and Machinist Matt McCormick (right). The RISF provides fabrication, machining, electronics, glass blowing, technical design and consulting services.

Temple University's College of Science and Technology (CST) *consists of six departments and five major research centers or institutes. CST has grown to more than 3,500 students, including over 200 graduate students, and has hired 26 research active faculty since 2007.*

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