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OHIO UNIVERSITY

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Light-bending helices published in *Nature*

Since its discovery in the mid-20th century, scientists have manipulated the double-helix structure of DNA to engineer crops, build microscopic structures and trace the origins of life. In an article published by Nature in mid-March, NQPI physicist Dr. Alexander Govorov helped prove that the unique molecule could also be used to bend light in ways that do not occur naturally.

The study, conducted by Dr. Govorov and researchers from the Technische Universität München and Ludwig-Maximilians-Universität of Germany, utilized a five-year-old method of DNA nanostructure design called DNA origami to create microscopic helices with special properties. When placed in a particular spatial arrangement, these nanostructures made of gold nanoparticles and DNA origami can result in novel optical properties.

"We predicted this from the beginning," Govorov said. "This structure should rotate light much more efficiently than naturally-occurring chiral biomolecules."

The team began by buying several types of viral DNA from a company in Munich. By manipulating the Guanine-Cytosine (GC) and Adenine-Thymine (AT) links integral to DNA's structure, they engineered highly-specific double helices for the research. DNA origami, true to its name, works by folding one very long strand of DNA and keeping it in place with shorter "staple" DNA molecules. For this project, the team manipulated the long strand of DNA into a cylindrical shape with short arms poking outward in a spiral pattern. On the tips of the helical arms they attached gold nanoparticles, which made the structures chiral and formed a spiral pattern sticking out of the DNA cylinder.

The resulting helical nanostructures created the opportunity for circular dichroism (CD), the differential absorption of left and right circularly polarized light. In the past, researchers discovered that chiral molecules, including DNA molecules and other proteins, exhibit CD in the non-visible ranges of light (such as UV light), but Dr. Govo-

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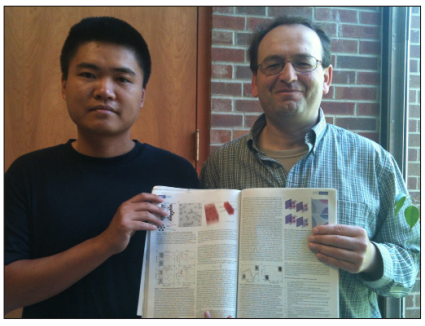
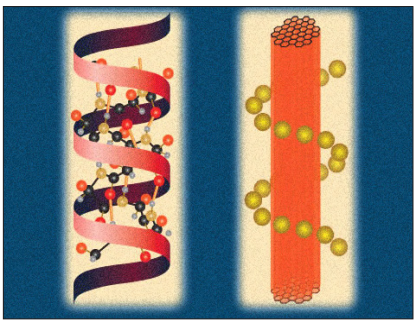


Zihyuan Fan (left) and Dr. Alexander Govorov hold their Nature publication.



An organic DNA molecule (left) provided inspiration for the microscopic helix (right).

Hla in superposition

Dr. Saw-Wai Hla is now splitting his time between Argonne National Laboratory in Chicago and Ohio University. At Argonne, he manages a team of scientists and is setting up a low-temperature STM (scanning tunneling microscope) laboratory for the study of next-generation battery storage and nanotechnology. Observing one of the most fundamental aspects of atomic interaction recently earned the NQPI member even more international attention and a cover story in *Applied Physics Letters* (**99**, 22).

Hla's research, conducted with Drs. Kai Felix Braun and Aparna Deshpande, measured visually for the first time what formulas have predicted for many years: the strength of interactions between very close atoms.

"Before atoms or molecules form bonds, they already see each other, and they have a number of steps," Hla explained, comparing the relationship to that of a young couple taking the necessary steps in a relationship before marriage. "The strength of the prerequisite interaction determines if the atoms bond", Hla said.

Hla's research offered the first visual picture of the phenomenon, shedding light on such atomic interactions.

Because scientists use STM images widely in nanoscale research, Hla said this experimental technique will "add a little more flavor" to existing knowledge. Future researchers could soon use the method to study interactions between molecules, gleaning invaluable information in a variety of cutting-edge fields.

UNIQUE COLLABORATION
NQPI member visits Saudi Arabia to collaborate with former OU students - pg. 3

STUDENT AWARDS
Several NQPI students receive prestigious national and local awards - pg. 4

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Director's Corner

Dear Colleagues,

Welcome to the 7th Edition of the NQPI Newsletter. With spring about to give way to another peaceful green southeast Ohio summer, NQPI faculty are readying themselves for another round of summer travels and more time to focus on research. The academic year is winding down, and commencement plans are being finalized as they have at Ohio University for two centuries. Everything seems to be 'as usual' and yet, change is in the air.

In fact, there are some rather important changes that I'd like to mention. For starters, the university quarter system calendar will be replaced this fall with a semester calendar, a new university business model ('responsibility centered management') is headed our way, and there are many new faces within administration, many of which are those within NQPI.

This spring, we welcome Ms. Alexandria Jeanneret as the new NQPI Outreach Coordinator/Business Manager and Ms. Emma Dean as the new NQPI staff writer.

Change brings with it new opportunities. Indeed, NQPI anticipates various benefits for its educational mission under semesters, including a much longer summer to work with students on research, and longer teaching spans for nanoscience/condensed matter-related curricula during the academic year. New staff members are bringing in their fresh perspectives and ideas, and we have the chance to work with new Deans and other OU officials to advance NQPI's goals and to solidify plans for the next phase of NQPI's development.

After years of cuts to academic programs, it is refreshing to see a year in which cuts appear to be minimal. Now, there is more reason than ever to set higher goals for the future. Plans are currently underway to begin searches for hiring new faculty and to begin investing in major new construction, including new research and teaching facilities. Change is good!

Best Regards,
Arthur R. Smith, NQPI Director

NanoUpdates

Grants

Arthur Smith received $450,000 from the NSF Division of Materials Research to study magnetic bilayers at the atomic scale.

Horacio Castillo received an additional $71,000 from DOE to study fluctuations in the dynamics of glasses.

Publications

Gerardine G. Botte's article "Hydrogen production via urea electrolysis using a gel electrolyte" was published in *Journal of Power Sources* **196**, 5.

Tatiana Savina's article "On non-local reflection for elliptic equations of the second order in R-2 (The Dirichlet Condition)" was published in *Transactions of the American Mathematical Society* **364**, 5.

For a full list of publications and grants, please visit www.ounqpi.org

NanoBytes

NQPI would like to thank Elizabeth Stinaff for her excellent work as NQPI Outreach Coordinator/Business Manager and congratulate the Stinaff family on their new addition.

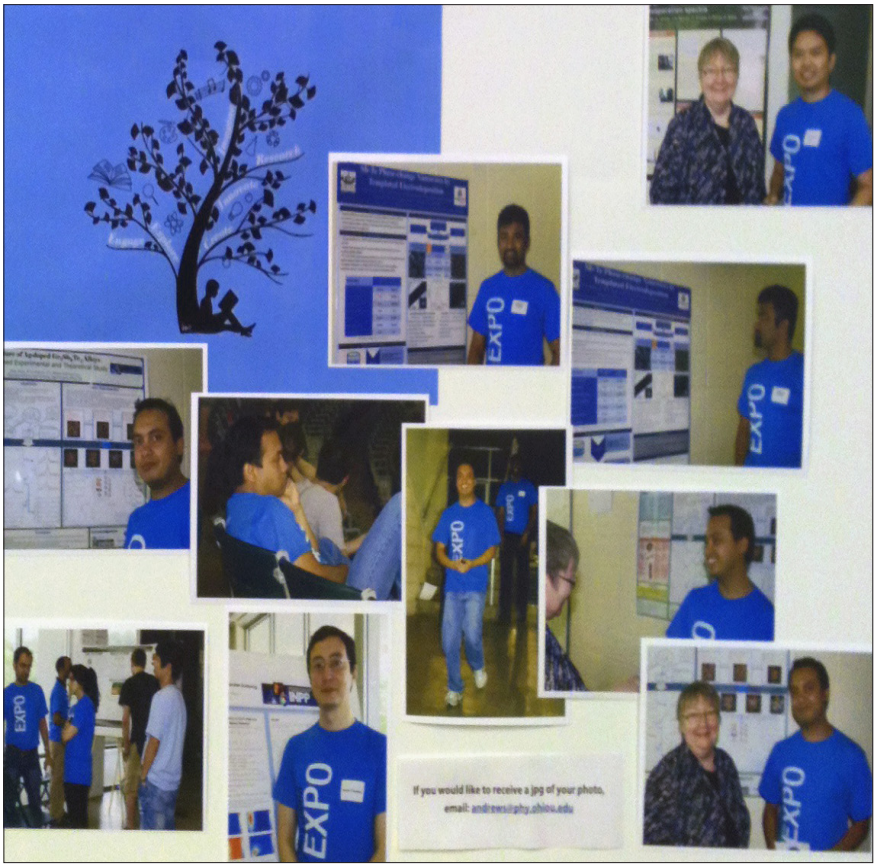
NQPI applauds member Gregory Van Patten on his new position as Depart Chair at Middle Tennessee State University's Chemistry Department.

The helium liquefier is now fully functional. A big thanks goes out to Doug Shafer, Jeremy Dennison, and Todd Koren for helping us accomplish this.

Eric Stinaff was promoted to Associate Professor of Physics and Astronomy.

NQPI thanks Ben White for his two years as staff writer and wishes him well in his future endeavors.

For more news, events, pictures, full articles and interviews, please visit: www.ounqpi.org



More than 600 Ohio University students presented original work at the Student Research and Creative Activity Expo on Thursday, May 3. - photo courtesy of Jean Andrews

Jadwisienczak forms collaborative research efforts in Saudi Arabia

On Dr. Wojciech Jadwisienczak's first trip to Saudi Arabia, even a sandstorm could not mar his efforts to foster interdisciplinary collaboration with scientists at two local universities.

In mid-April, Dr. Jadwisienczak, an NQPI member and associate professor of Electrical Engineering and Computer Science at Ohio University's Russ College of Engineering and Technology, spent a week with former OU students and potential collaborators . He hoped to build upon a past research collaboration and establish a new long-term joint effort between his research group, NQPI and nanoscientists at the University of Tabuk and King Saud University.

"We as a university and NQPI are very serious about international collaboration," Dr. Jadwisienczak said. "That's why I traveled to Riyadh to meet with colleagues and former NQPI members."

His trip coincided with the International Exhibition and Conference on Higher Education (IECHE) organized by the Saudi Ministry for Higher Education in Riyadh. Dr. Jadwisienczak was one of three representatives of OU, but the conference was not the only motive for his trip.

As a representative of NQPI, Dr. Jadwisienczak discussed individual and institutional collaborations between the Departments of Physics at the University of Tabuk and OU. Along with well funded "eye-catching" collaborative international projects focused on nanoscience and nanotechnology, he said, "Saudi Arabia could offer many bright and hard-working students in return for the wealth of experience gained throughout the ten years since NQPI's inception." While discussions of a formal institutional partnership remain in the preliminary stages, Dr. Jadwisienczak hopes to cement the relationship in the coming months.

Dr. Jadwisienczak and Dr. Aurangzeb Khan of University of Tabuk pose with an NQPI brochure during Dr. Jadwisenczak's visit to Saudi Arabia.

In particular, Dr. Jadwisienczak expressed an interest in working with Dr. Aurangzeb Khan, an Associate Professor of physics at the University of Tabuk who heads the university's new nanoscience initiative. Dr. Khan, a native of Pakistan, worked with Dr. Martin Kordesch and earned a doctorate in physics from OU in 2006 as an NQPI student. Dr. Jadwisienczak also visited with Dr. Hamad Al Brithen, a former student of NQPI Director Dr. Arthur Smith.

"Both Dr. Khan and Dr. Al Brithen are familiar with Ohio University, and they know the NQPI faculty and research standards," Dr. Jadwisienczak said. "I foresee them as ambassadors of NQPI in Saudi Arabia."

NSF grant shows creative side of nanoscience

Dr. Sergio Ulloa, an Ohio University professor of physics and astronomy, and Dr. Nancy Sandler, an associate professor of physics and astronomy, have received a grant of $292,599 from the National Science Foundation for their research concerning local environment and time-dependent effects in nanoscale systems.

Ulloa and Sandler work together with professors at Oakland University and the University of Florida as well as Universities in Brazil and Argentina.

Part of a three-year program, Ulloa, Sandler and other collaborators have focused their research on how electrons react in various mediums. The grant, which began last fall, allows NQPI students the opportunity to travel and engage in different cultural research mediums.

"We come to this with different expertise, different perspectives on the same problem and also to provide the opportunity to students—our students—to go and experience this international environment of physics," said Ulloa.

In addition to supporting travel and student research assistants, some of the overall grant funds are funneled toward outreach activities.

"We hired two students in the creative writing program at OU," Ulloa said. These student writers intend to write pieces with a creative spin targeted toward fifth and sixth graders.

"We're interested in the small things, namely nanoscience," noted Ulloa, and providing opportunities for students of varied educational backgrounds.

NQPI members Dr. Sergio Ulloa and Dr. Nancy Sandler with their daughter.

DNA, from page 1

rov's team is the first to show the effect for visible light.

Dr. Govorov, a native Russian who has taught at Ohio University for over a decade, played the part of the team theorist. His predictions, based on classical electrodynamics, meshed almost perfectly with the results. "Strikingly, even the strength of the measured signals closely matches the magnitude predicted by the calculations," the team wrote.

In the future, Govorov and his Ph.D. student, Zhiyuan Fan, hope engineers will apply their discovery in biosensors which could tell researchers if certain molecules exist in a solution. Other applications include optical materials and uses in functional nanodevices.

"We can make more things and build different functional nanostructures," Govorov said. "Although we borrow ideas from Nature, we are often able to construct materials with greatly-enhanced properties - the artificial plasmonic helix rotates light more strongly than the protein helix taken from Nature," he added.

Student accolades

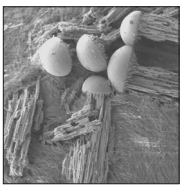
Heath Kersell, a physics doctoral student, received a 2012 Distinguished Master's Thesis Award from the Midwestern Association of Graduate Schools (MAGS) for his research on molecular machines.

"It's been my goal for a long time to pick an interesting career and do something that can somehow benefit society; something useful to people" Kersell said.

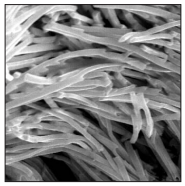
Greg Peterson (left) and Andrew DiLullo were selected-to attend this years Nobel Laureate Meeting in Lindau, Germany. Both students are part of the SPIRE 'spin triangle' program at Ohio University and as such have already traveled during their graduate schooling. Andrew, who works under Dr. Saw-Wai Hla, has studied in Germany and Greg, who works under Dr. Nancy Sandler, has spent time researching in Argentina. SPIRE, coupled with excellent advising, gave them a leg-up in the selection process.

Kangkang Wang, now at Argonne National Laboratory, received the Dorothy M. and Earl S. Hoffman Graduate Research Award at the AVS 58th Symposium in Nashville, TN, effectively naming him as one of the top research graduates within the field of vacuum science and technology. Wang offered, "the guy standing next to me was from Harvard and I felt so lucky to be standing among the nation's top schools and to be recognized among them."

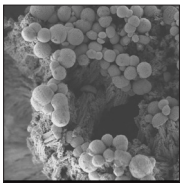
NanoGallery



Aptly named jellyfish, these are overgrown SbTe nanowires. Courtsey of the Chen Group.



SbTe nanowires grown by templated electrodeposition. Courtesy of the Chen group.



Mushroom-like in appearance, here is another depiction of overgrown SbTe nanowires. Courtesy of the Chen group.

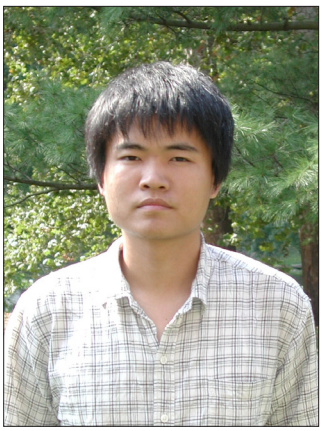
Writing and design by Benjamin White.
Co Writers: Emma Dean and Gabriel Weinstein.
Editing by Dr. Eric Stinaff and Alex Jeanneret.
Please email nqpi@ohio.edu with comments.

Govorov student receives Clippinger Fellowship

Zhiyuan Fan, a doctoral candidate studying under Professor Alexander Govorov, has been awarded the 2012-2013 Donald Clippinger Fellowship. It is one of only five named fellowships awarded by the graduate college annually. Fan will receive a full tuition scholarship for the upcoming academic year and an additional stipend.

Govorov said Zhiyuan's work ethic made him a natural candidate for the award.

"He's performed excellent research and authored 10 papers," Govorov said. "He's had a very strong start to his career at OU."



Fan constructs chiral plasmonic nanostructures and examines how different geometric configurations of plasmonic structures can generate different optical properties.

"Plasmons are collective electron oscillations. They can resonate with visible light, which greatly enhances nearby eletromagnetic fields," Fan said. Based on his findings, he and Govorov were able to publish in the March issue of Nature.

"This project deals with biosensing and metamaterials. For example, they can be used in the development of modern drugs, making a more convenient way to monitor the production of molecules with different handedness."

A native of China, Fan is completing his fourth year at Ohio U. He hopes to graduate at the end of next year and then pursue a post-doctoral program and a career in research.

"Physics is a magical thing. It can explain everything we see in the world" Fan said. "I want to continue broadening my knowledge in math and physics to have more capability to create and contribute to science."