PHYSICS FLASH

News from the Department of Physics ~June 2007

ASU PHYSICS

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THE NEXT STEP:
A LOOK AHEAD WITH ASU PHYSICS GRADS

SUTHARSAN KETHARANATHAN

Q: Talk about your most exciting discovery.
SUTHA: We have confirmed and quantified that we can confine electrons in different sized and shaped Germanium quantum dots grown on Si (100). We have done experimental and theoretical modeling to compare electron charging in both huts and dome structures and obtained very promising results.

Q: Where do you see this research going from here?
SUTHA: This is just the start on this electron charging of Ge quantum dots

Far from the madding crowd? Sabbaticals are often a chance for faculty to SLOW DOWN and focus on research while momentarily removed from the hustle and flow of teaching, office hours, and the day-to-day clamor of academia. Not so for ASU Physics Professor Peter Rez who sent this reflection while on a recent sabbatical in Israel where the study of physics continues under very DIFFERENT circumstances.

"The nightly news shows bombs and rockets and soldiers with guns, but that is in the background. Life goes on, at a frenetic pace most of the time. This is a tiny place and the close proximity of whatever you want to call it - border, green line, pre-67 cease fire line, the other side - concentrates the mind wonderfully. Coming back from Beersheba, I drove on Hwy 25 towards Askelon. Gaza was a 100 meters or so to the left . The town of Sderot, hit by the Al Qassam rockets, was less than one kilometer on the right. A wrong turn and it could get ugly.

Speaking of driving, that is the really dangerous, scary thing. I've had one near death experience driving my cousin's car (which should be called a wreck!) when it suddenly died in the middle lane of the main freeway from Haifa to Tel Aviv. The roads here are a "high threat environment" that demand "total situation awareness" coupled with a "high degree of aggression" Liberal use of the horn is encouraged. I'm now back to taking buses, trains, and shared taxis. The trains are great. The station is at the back gate of the Institute. Tel Aviv is twenty minutes away and Haifa about ninety minutes away. Go much further and you're in Lebanon. The trains are filled with soldiers, often trying to catch up on sleep, their weapons squeezed into any space available. There is also a cacophony of cell phones ringing. Everyone is in touch with someone by cell phone.

The towns are small and close to each well-maintained garden. Weizmann is a graduate-only institute comprised of 300 faculty and about 1000 students. The faculty spend a lot of hands-on time with the students, actually working the microscopes or processing data. They take electron microscopy very seriously here. Weizmann has a state of the art facility, but what makes it really impressive is that it has about ten PhD

A beautiful scene at the Weizmann Gardens.

level staff scientists who initiate projects, help other faculty with microscopy, teach students, etc. It is expected that they are treated with respect as academic equals and they are coauthors of papers where they help get the results. It's all about the research. The Technion at Haifa also has an impressive microscope facility whose star attraction is an aberration corrected Titan.

During the recent conflict, the materials science department took shelter in the Titan room. The thick walls and floor needed for

on Si(100) since it's been rarely investigated before. The potential applications of this investigation and our future work might help the progress of the proposed spin based quantum information processing technology.

Q: What has been your favorite conference?
SUTHA: The American Physical Society (APS) Four Corners meeting held at ASU in 2003.

Q: What is your next step?
SUTHA: I'm going to work as a Postdoctoral Research Associate for a while with my advisor Dr. Jeff Drucker. I'll be investigating more on this simple but rich experimental playground of Ge/Si material system.

other, the main streets filled with little shops. It is not a world of chain outlets in standardized malls. Marilyn and the kids arrive on Sunday. I think the kids will love it. There are no fewer than four well-equipped playgrounds within walking distance of where I'm staying.

There's also the Garden of Science on the Weizmann campus and the recreation center. I must admit I enjoy walking the main street of Rehovot, with the smell of at least twenty falafel stands, passing about ten shoe shops, twenty bakers, book stores, etc, not to mention the market.

At the gates of the Institute all the chaos stops. The campus is beautiful, a vibration isolation and magnetic field shielding made it the ideal bomb shelter! Not that there's a shortage of them. If you look carefully you will see them next to apartment buildings and houses. My office in Structural Biology is the reinforced room with escape ladders both up and down.

Everyone has to do military service here. There are faculty who are on duty with one type of gun for part of the year and work with electron guns for the rest of the year. I just wonder whether they have debates about grain boundary embrittlement in the Titan room as the Katushyas are raining down."

For more information about Peter Rez's research and teaching at ASU, please visit his faculty webpage at: http://physics2.asu.edu/people/atppr.

BOOK REVIEW

A Different Universe: Reinventing Physics from the Bottom Down

By Robert B. Laughlin (New York: Basic Books, 2005)

When I was a young faculty member at Yale, an even younger graduate student called Bob Laughlin, who was working with John Joannopoulos at MIT, would come to visit me in New Haven. He and I shared an interest in developing the theory of the vibrational properties of very wide band gap materials like vitreous silica. He was typical of the very smart and involved physics graduate students that were found in universities like Yale and MIT in those days. I remember having some interesting discussions with him concerning various methodologies, including using Bethe lattices. We published a couple of papers on this as did the MIT group, and then went in separate directions.

I remembered this interaction years later when Bob Laughlin wrote down the wave function that described the newly discovered fractional quantum Hall effect (at low temperatures and with a powerful magnetic field,

FROM THE CHAIR . . .

Just a few weeks ago, I had the opportunity to join a delegation of the Materials Research Society to make the case to congress for the support of science and science education. The Science - Engineering - Technology Congressional Visit Day (SET-CVD) is organized annually by a group of about twenty scientific societies including the American Physics Society. There were over two hundred representatives from the various societies which were split into teams of 3-5 people. Our three person group visited the offices of Senator Kyl and Congressman Pastor along with several other congressional offices. The congressional offices are in about six buildings that are near to the Capital Building. We were welcomed at each office but there was certainly plenty of hustle and bustle since budget issues were of high priority at that time of the year.

One of the main focuses of the visit was to express our support for the American Competitiveness Initiative. This bipartisan initiative develops many of the recommendations of the National Academy of Science study titled 'Rising to the Gathering Storm.' This study describes the crisis in science and technology education at every level of our education system.

We were greeted by Congressman Ed Pastor at the beginning of our visit, and he acknowledged his enthusiasm for the support for science. We then spent nearly an hour with Legislative Assistant Richard Patrick where we

an electron gas can condense to form a new type of *quantum fluid)* for which he later shared the Nobel prize in 1998.

Laughlin has since gone on to consider important questions about the nature of science and particularly of physics. Physics used to be viewed as "reductionist" in that natural phenomena should be described by the fewest and simplest laws and in terms of the most elementary particles, from which one then subsequently built up complex materials. Now there is tendency to focus more on "emergent" phenomena like water waves, the trajectory of a baseball, turbulence, weather patterns, etc., which are quite robust and not so dependent on the microscopic details. For example, water waves are determined by viscosity, density, etc., and are not dependent on the microscopic interactions between water molecules, or even whether it is water! In some ways, as our colleague Professor Tim Newman has pointed out, this is just a re-branding of things we used to refer to as many body theory, cooperative phenomena, and phase transitions. However, the new view of emergence does go a step further in decoupling even further from the underlying microscopic detail, which is regarded as being largely irrelevant. Of course both reductionism and emergence will continue to have their place and co-exist in physics, and both can yield insights in appropriate situations.

Laughlin unashamedly champions the emergent view and writes in a very idiosyncratic and entertaining way in this book . This is good summer read and you will find it refreshing to look at emergence from this perspective. I recommend the book - it is the best book I have come across on emergence for those with a physics background.

Finally, this tale reminds me to always take the extra time to talk and listen to ideas from graduate students. Who knows what they may accomplish in the future. Almost all Nobel prize winners in science started out their scientific research as graduate students.

Reviewed by Mike Thorpe, May 2007

Michael Thorpe is Foundation Professor of Physics, Chemistry & Biochemistry and Director of the Center for Biological Physics. For more information about Professor Thorpe and his research, please visit http://physics2.asu.edu/people/mfthorpe.

explored the issues specific to the Congressman's district which includes the center of Phoenix. Certainly K-12 education and workforce training in technology industries were important concerns.

In Senator Jon Kyl's office we had a long and detailed discussion with Legislative Correspondent John Lee. Correspondent Lee also noted the Senator's support for science and science education. The discussions explored the detailed needs of the scientific community and the interrelationships of the different science funding agencies.

I was very impressed at the substantial issues that were discussed in each office that we visited. From our perspective, we described the successes of our students and the value of supporting research and science education. Each of us had a few specific examples from our university and certainly the growth in science and technology jobs in Arizona served as an example of the critical needs of science education.

It appears that all of the authorizing bills of the American Competitiveness Initiative should pass both houses of Congress. It will be challenging to reconcile the bills from the House and the Senate, but the larger test will be developing support for the appropriations bills which specify the actual funds to support our science research and education programs across the US.

Robert J. Nemanich
Professor and Chair

CONGRATULATIONS!!

Physics student employee - **Rachelle "Shelly" Robinson** who recently made the National Dean's List. The National Dean's list honors high-achieving college students nationwide. Shelly is a junior at ASU currently pursuing a double major in Performance Theatre and Marketing.

Comments, questions, or content suggestions can be directed to Peg Stuart at margaret.stuart@asu.edu