NYCCT/CUNY

Electrical and Telecommunications Engineering technology

in collaboration with

BMI and **Honors Students Department**

Visit to Brookhaven National Laboratory

April 30th, 2010

The group

- A group of ~25 students from several departments and organizations within NYCCT / CUNY considered that a visit to a place where they could see technicians, engineers and scientists to work would enlarge their vision in their field and also inspire them to pursue a higher degree in engineering, physics and applied sciences. So their professors though about it and concluded that one of the largest and most advanced science center to visit in New York state is the Brookhaven National Laboratories
- So they set out on this venture early morning on April 30^{th}, 2010

Agenda

9:50 a.m.	Arrival – Security Trailer – Main Gate – Photo ID required
10:00 a.m. To 10:30	Berkner Hall – Room B Welcome Brookhaven National Laboratory Overview Elaine Lowenstein
10:40 a.m. To 11:30	Center for Functional Nanomaterials – Bldg 735, Lobby, ext. 7031 Michael Schaeffer (ext. 7941)
11:35 a.m. To 12:15	National Synchrotron Light source – Bldg 725, Lobby, ext. 4791 Emil Zitvogel (ext. 7703)
12:20 p.m. To 1:15	Lunch – Berkner Hall Cafeteria Meet at the upper lobby of Berkner Hall
1:20 p.m. To 2:00	New York Blue Supercomputer – ITD – Bldg 515, second floor conference room Nicholas D'Imperio (ext. 8607), Tom Schlagel (ext. 8765)
2:00 p.m.	Departure

The group


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EXIT

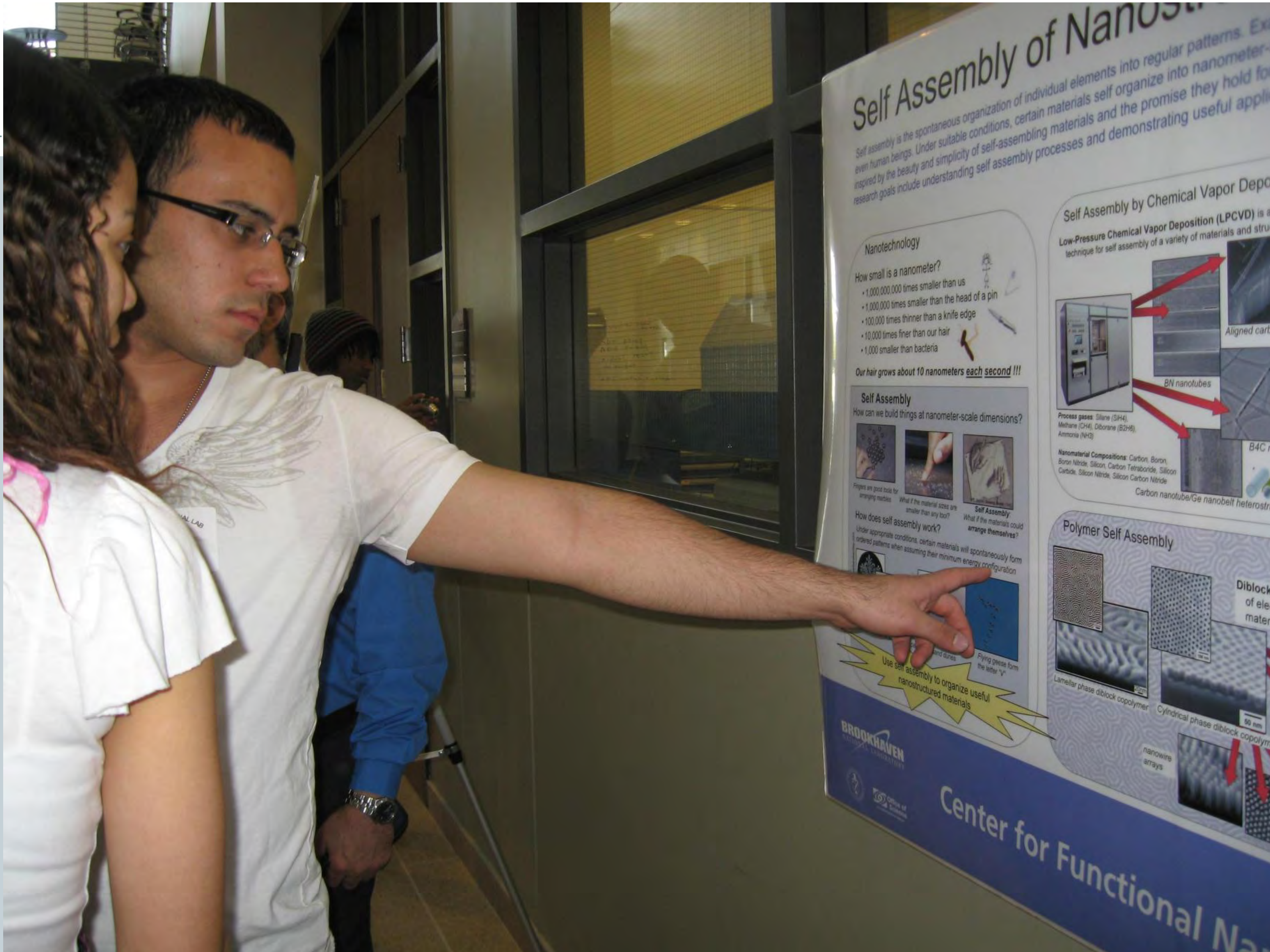
Center for Functional Nanomaterials

- The Center for Functional Nanomaterials (CFN) at Brookhaven National Laboratory provides state-of-the-art capabilities for the fabrication and study of nanoscale materials, with an emphasis on atomic-level tailoring to achieve desired properties and functions.
- The CFN is a science-based user facility, simultaneously developing strong scientific programs while offering broad access to its capabilities and collaboration through an active user program.
- The overarching scientific theme of the CFN is the development and understanding of nanoscale materials that address the Nations' challenges in energy security, consistent with the Department of Energy mission.


CENTER FOR FU


MACHINE DIAGRAMS
NSLS ALL-IN LIST

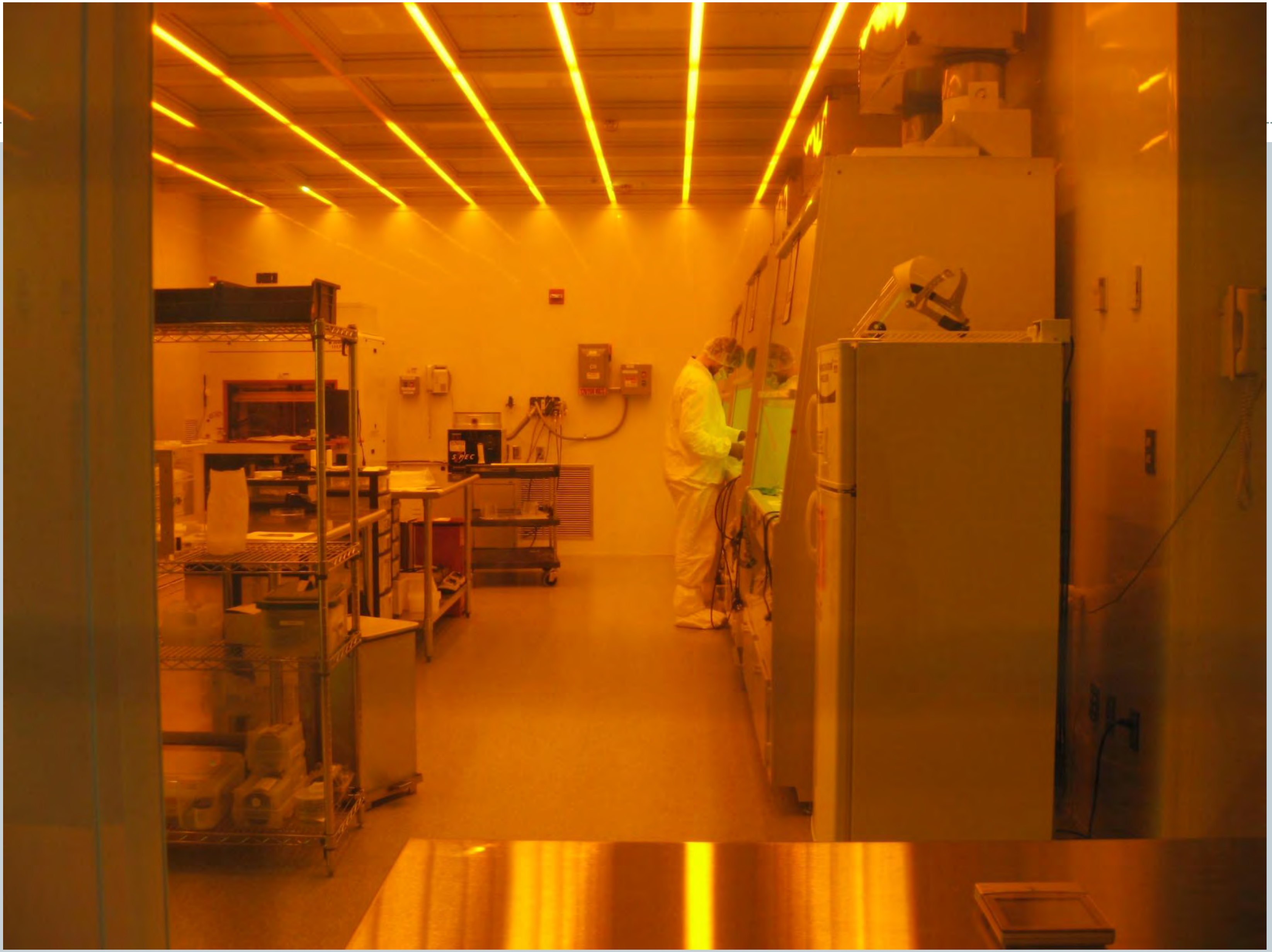

Self Assembly of Nanostructured Mate
Nanotechnology
How small is a nanometer?
Our hair grows about 10 nanometers each second !!!
Self Assembly
How can we build things at nanometer-scale dimensions?
Self Assembly by Chemical Vapor Deposition
Low-Pressure Chemical Vapor Deposition (LPCVD) is a versatile technique for self assembly of a variety of materials and structures
Self Assembly by So
Polymer Self Assembly
Diblock copolymer thin films template fabrication of electronically-active nanostructured inorganic materials
Center for Functional Nanomaterials


Self Assembly of
Nanotechnology
How small is a nanometer?
• 1,000,000,000 times smaller than us
• 1,000,000 times smaller than the head of a pin
• 100,000 times thinner than a knife edge
• 10,000 times finer than our hair
• 1,000 smaller than bacteria
Our hair grows about 10 nanometers each second !!!
Self Assembly
How can we build things at nanometer-scale dimensions?
How does self assembly work?
Use self assembly to organize useful nanostructured materials
Self Assembly by Chemical Vapor
Low-Pressure Chemical Vapor Deposition (LPCVD)
BN nanotubes
Polymer Self Assembly
Lamellar phase diblock copolymer
Cylindrical phase diblock copolymer
nanowire arrays
BROOKHAVEN
Center for Functional


POLO SPORT


Nanopatterning Facility
The Nanopatterning Facility will make it possible for the scientific community to fabricate and analyze, under one roof, a vari
materials with nanoscale dimensions. The Facility will house patterning tools such as electron-beam, ion-beam, and optical
lithography; materials preparation methods to etch fine patterns and deposit thin-film metals and dielectrics; and analytical
instruments for x-ray analysis, scanning electron microscopy, and optical and electrical characterization.
Capabilities
Equipment
Science Example
BROOKHAVEN NATIONAL LABORATORY
Center for Functional Nanomaterials


BROOKHAVEN
Electron beam column with in-lens detector: high resolution imaging
STEM detector imaging in



National Synchrotron Light Source

- In 1945, the *synchrotron* was proposed as the latest accelerator for high-energy physics, designed to push particles, in this case electrons, to higher energies than could a *cyclotron*, the particle accelerator of the day. An accelerator takes stationary charged particles, such as electrons, and drives them to velocities near the speed of light. In being forced by magnets to travel around a circular storage ring, charged particles tangentially emit electromagnetic radiation and, consequently, lose energy. This energy is emitted in the form of light and is known as synchrotron radiation.
- The General Electric (GE) Laboratory in Schenectady built the world's second synchrotron, and it was with this machine in 1947 that synchrotron radiation was first observed. Radiation by orbiting electrons in synchrotrons was predicted by, among others, John Blewett, then a physicist for GE who went on to become one of Brookhaven's most influential accelerator physicists, working on both the Cosmotron and the Alternating Gradient Synchrotron.
- For high-energy physicists performing experiments at an electron accelerator, synchrotron radiation is a nuisance which causes a loss of particle energy. But condensed-matter physicists realized that this was exactly what was needed to investigate electrons surrounding the atomic nucleus and the position of atoms in molecules. So, in the early days, the two branches of physics worked together in so-called "parasitic" operation, where synchrotron light illuminated the condensed-matter physicists' experiments while particle physicists used the electron beam.

NSLS cont'd

Decision to build the NSLS

- When the U.S. Department of Energy's Office of Basic Energy Sciences recognized the need for "second generation" electron synchrotrons dedicated to the production of light, it budgeted construction funding for Brookhaven's National Synchrotron Light Source (NSLS), beginning in fiscal year 1978. Ground was broken for the NSLS on September 28, 1978, and the vacuum ultraviolet (VUV) ring began operations in late 1982, while the x-ray ring was commissioned in 1984.

The Chasman-Green lattice

- Before the light at the NSLS was turned on, however, the two inspired scientists responsible for the ingenious design of the two storage rings had died. The late Renate Chasman and G. Kenneth Green had designed the "double focusing achromat," or what is more commonly known as the Chasman-Green lattice. The lattice is the periodic arrangement of magnets that bend, focus and correct the electron beam, and their simple yet elegant design included straight sections for the insertion of equipment.
- When special magnets are inserted into two straight sections in the VUV ring and five straight sections in the x-ray ring, the electron beam "wiggles" and, therefore, emits even more intense synchrotron radiation. Chasman and Green's inclusion of these devices in their design of the storage rings enables the NSLS to deliver world-class beams of light today.


Canon


SR6
SAFETY KEYS
SPARES


Canon
MACHINE DIAGRAMS

NSLS Control Room

NSLS Control Room

New York Blue Supercomputer

- New York Blue/L is an 18 rack IBM Blue Gene/L massively parallel supercomputer located at Brookhaven National Laboratory (BNL) in Upton, Long Island, New York. It is the centerpiece of the New York Center for Computational Sciences (NYCCS), a cooperative effort between BNL and Stony Brook University that will also involve universities throughout the state of New York. Each of the 18 racks consists of 1024 compute nodes (a total of 18432 nodes) with each node containing two 700 MHz PowerPC 440 core processors and 1 GB of memory (a total of 36864 processors and 18.4 TB of memory). The racks are arranged as six rows of three racks each.
- In addition to New York Blue/L, there is New York Blue/P which consists of two racks of the Blue Gene/P series. Each BG/P rack contains 1024 850 MHz quad-processor nodes with each node having 2GB of memory.

New York Blue

New York Blue is critical for computations in biology, medicine, materials, nanoscience, renewable energy, climate science, finance and technology. It is the centerpiece of the New York Center for Computational Sciences (NYCCS).

Features of New York Blue/L

- IBM Blue Gene
- 100 teraflops
- 18-rack configuration
- 36,864 processors


NYCT TOUR


NYCCS
NYCCS
NYCCS


Canon

Conclusions

- It was motivating and inspiring to see all the technicians working hand in hand with the engineers and scientists.
- There are plenty of learning opportunities for everyone (students and teachers) through the BNL educational programs. For more information regarding the programs and internships please visit http://www.bnl.gov/education/programs.asp

Reflections

- “The Brookhaven National Laboratory (BNL) field trip was an exciting adventure into the world of science. BNL provides its scientists, engineers, technicians and guest researchers with facilities for advanced scientific studies that lead to ground breaking discoveries. Six Nobel prizes have been awarded for discoveries made at BNL. Some main facilities that led to such advancements are the Relativistic Heavy Ion Collider (RHIC) which is the world’s biggest partial accelerator, the Center for Functional Nanomaterials (CFN) which provides state-of-the-art capabilities for the study of nanoscale materials, the National Synchrotron Light source (NSLS) which provides scientists with the ability to analyze new nano materials, and the New York Blue supercomputer which provides computations critical for research in biology, medicine, materials science, nanoscience, renewable energy, finance and technology.

Reflections cont’d

- The main focus of our visit consisted of the National Synchrotron Light source and the New York Blue supercomputer. I was stunned that when one of the physicists was describing the NSLS he mentioned the right-hand rule method to determine the direction of electrons when it comes to velocity, magnetic field and force. When I learned this method in class I thought it was just a dumbed down method to help students. I was also surprised at the fact that no matter how advanced and scientific something is, it can still be covered in aluminum foil like a baked potato to keep the temperature like the NSLS…

  I learned a lot from our field trip and was delighted when Professor Vladutescu asked the troubleshooting engineer technicians their educational background and most had associates in electrical engineering. Working at BNL is definitely something to shoot for and I look forward to applying for their summer internship program. BNL is like a Disney world for the mind.”
- *CC, freshman full time student, Major: Electrical Engineering Technology, ETET*

Reflections cont'd

- "…..Another thing impressed me in this visit was the education background of the technicians. When we were in the control center of the Synchrotron Light source, we learned that four of the five technicians working there have the associate degrees in engineering and another one has the bachelor's degree, but at the same time we also learned that they have much related experience before working in this laboratory. This showed us that both the education and experience contribute the future of our career after we graduate. I hope that on some day I can have a professional job like them."

XC, senior full time student, Major: Telecommunications Engineering Technology, BT, ETET Dept

Special thanks to

- BMI and Citytech Foundation for financial support
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- Sonia Johnson, Elaine Lowenstein and all the BNL supporting crew without which this wonderful experience would not have been possible