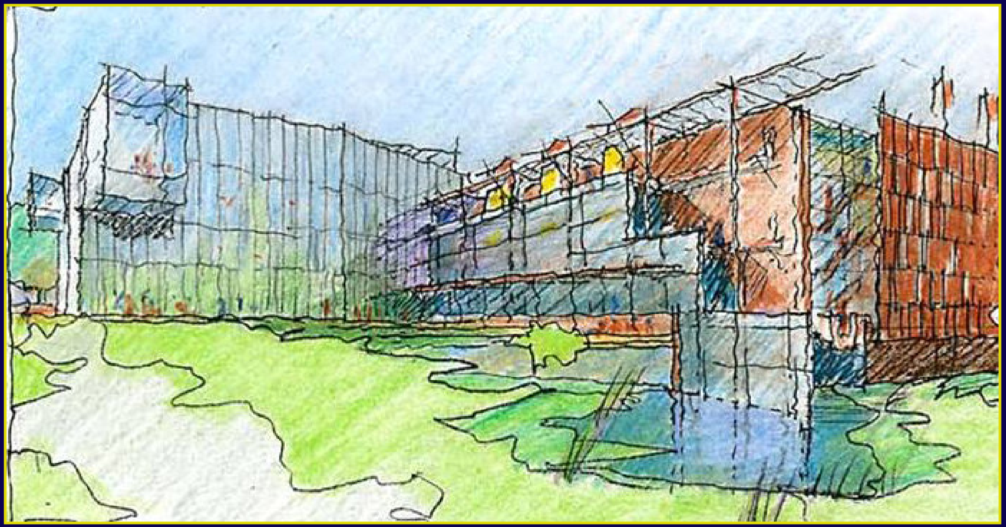
Nanotechnology Research Center Building



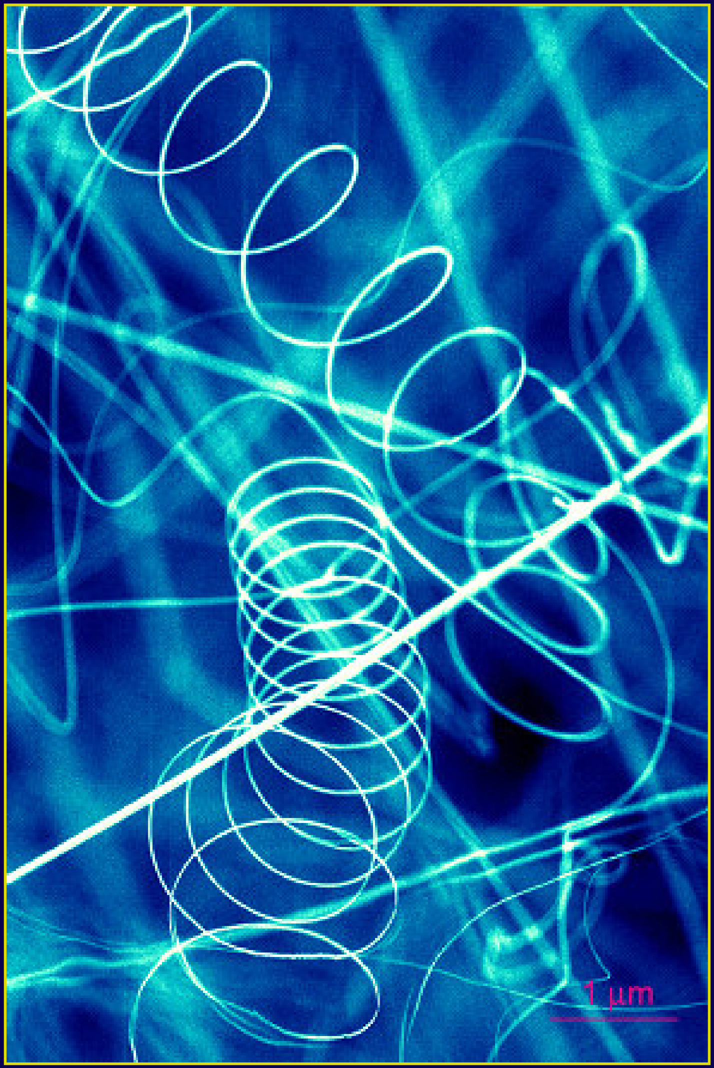
Presentation to the Georgia Tech Foundation

G. Wayne Clough

March 3, 2005

“Nano” is small

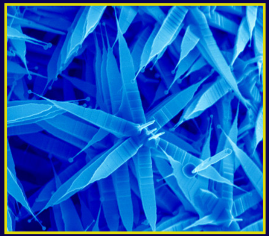
Nanoscience and nano-technology are a revolution in the way we deal with matter. Scientists and engineers study the characteristics and behavior of atoms and molecules, then use that knowledge to create new materials and develop tiny nano-scale machines.

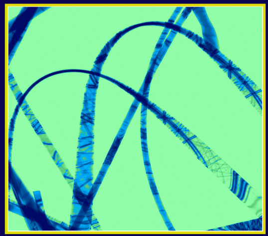


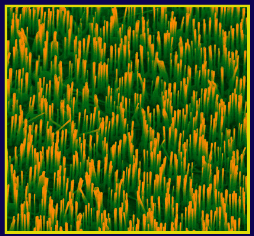
Nanosprings of zinc oxide synthesized at Georgia Tech

A nanometer is one-billionth of a meter.

Small is big



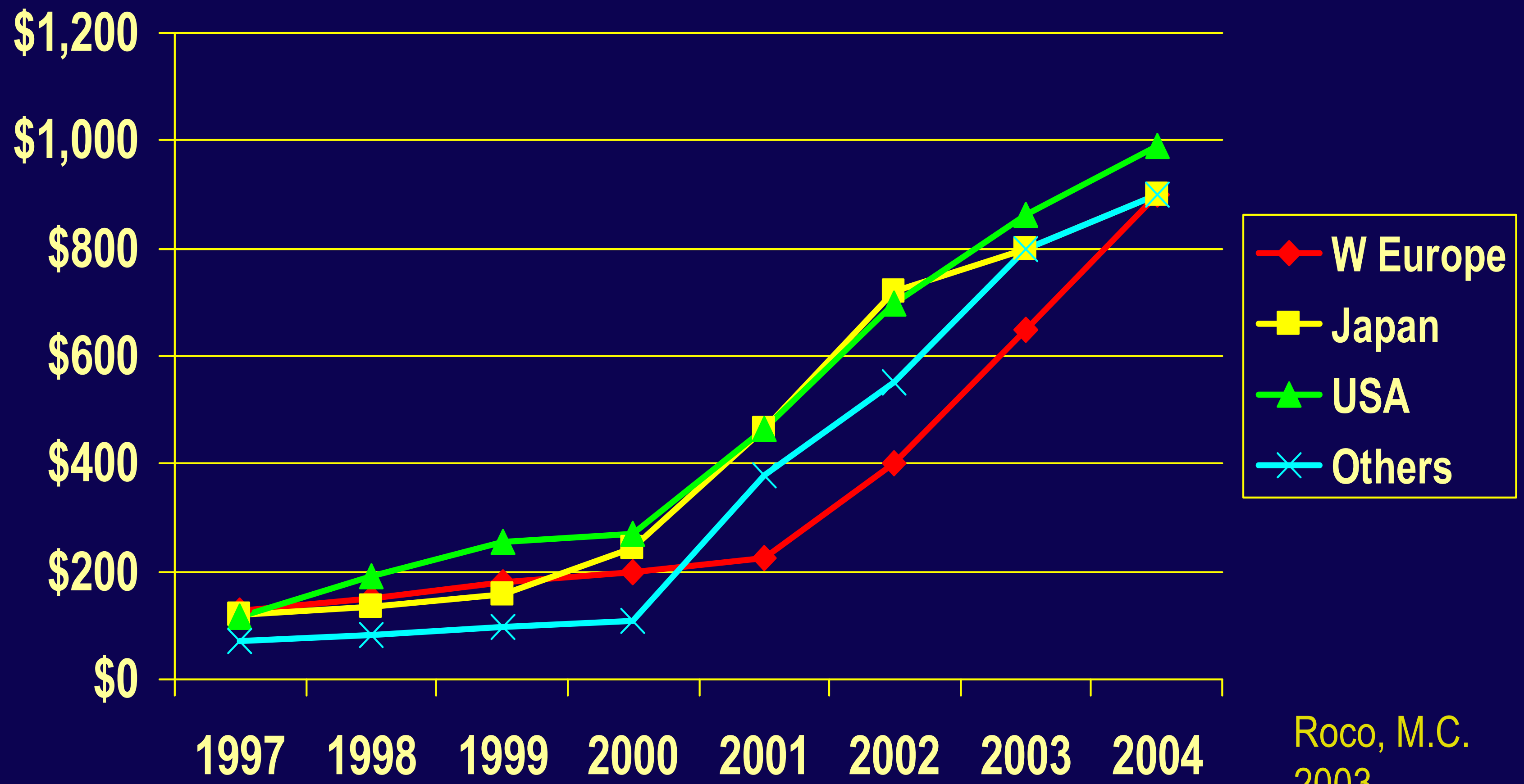




- Coming nanotechnology revolution will touch virtually every aspect of our lives.
- Products incorporating nanotechnology generated sales of $26.5 billion in 2001; predicted to exceed $2.6 trillion within 10 years.
- Federal research investment: $4 billion
- Major companies like IBM and Intel have nano initiatives; more than 400 new nano-related companies have already been created.

The competition is international

Nanotechnology investment in millions



Roco, M.C.
2003

"Everything being made of atoms, the capability to measure, manipulate, simulate, and visualize at the atomic scale potentially touches every material aspect of our interaction with the world around us."

John Marburger III
Science Advisor to the President

"Nanotechnology has a mortal lock on being tomorrow's gold mine. It will produce trillions of dollars in new wealth over the next century. It is sure to reshape every industry it touches."

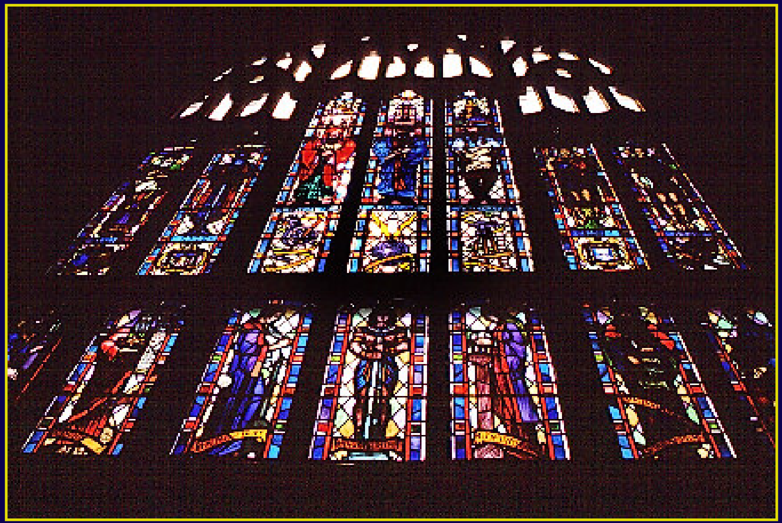
Rick Karlgaard, publisher
Forbes

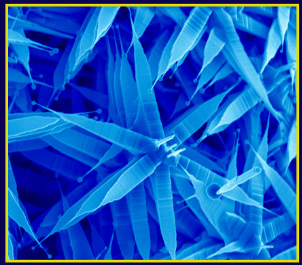
"Nanotechnology is a driving force in the development of energy sources and technology for the future."

John Rice, president & CEO
GE Energy

Nano is not new

- Nature has always done it
  - Plant chloroplasts reconfigure light energy into chemical energy stored within the bonds of sugar.
  - Coal molecules are rearranged make diamonds.
- Early stained glass artisans added nano-particles like gold chloride to liquid glass to produce brilliant jewel-like colors.

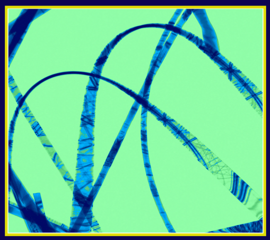


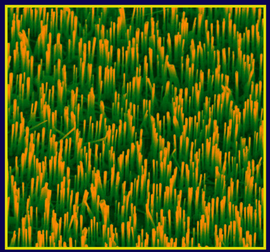


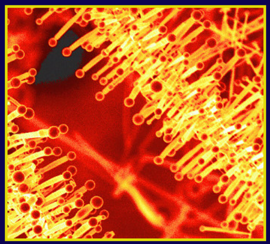
New applications are amazing

- Building materials lighter than steel but ten times stronger.
- Digital storage devices the size of sugar cubes that can hold the entire Library of Congress.
- Flexible digital displays – think TV screens that can roll up like a window shade.
- Fibers for industrial uses that are stronger, last longer, and shrink less.
- Nano-particles injected into the body attach themselves to specific cells to diagnose or treat disease.

Nanoscience, nanotechnology research spans many fields





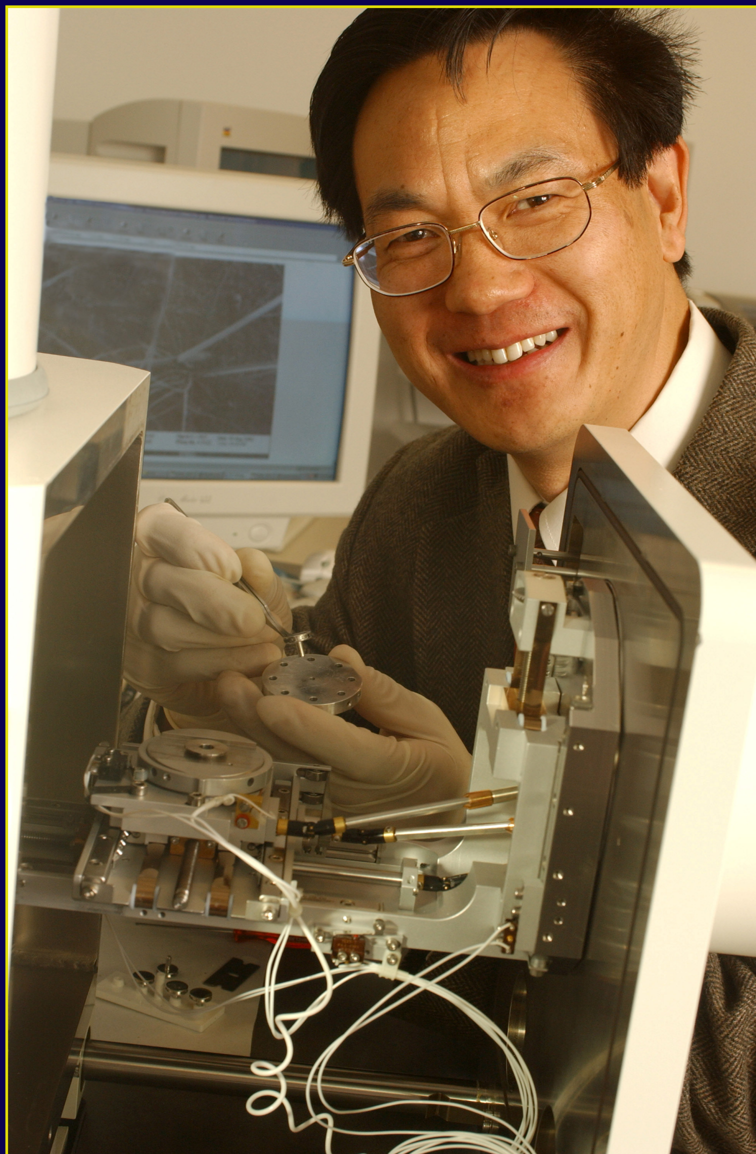


- Chemistry & Biochemistry
- Physics
- Computing
- Biology and Life Sciences
- Electrical & Computer Engineering
- Materials Science & Engineering
- Biomedical Engineering
- Mechanical Engineering

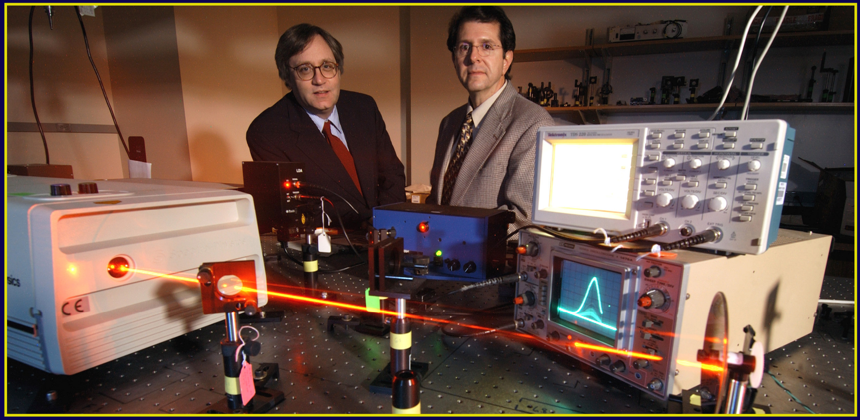
Physics Professor Uzi Landman develops powerful computer simulations that predict the often surprising behavior of fluids and solids at the nano-level. He is shown with a model that accurately predicted how the atoms of different metals would jump to contact each other. His work has won him the Feynman Prize in Nanotechnology and the Rahman Prize for Computational Physics.

Conventional lighting sources waste the majority of their energy in heat rather than light. Electrical and Computer Engineering Professor Russ Dupuis develops new semiconductor materials for light sources that are more efficient, utilizing up to 100% of their energy to produce light.

His work in developed light-emitting diodes (LEDs) won him the 2002 National Medal of Technology, presented at the White House by President Bush.

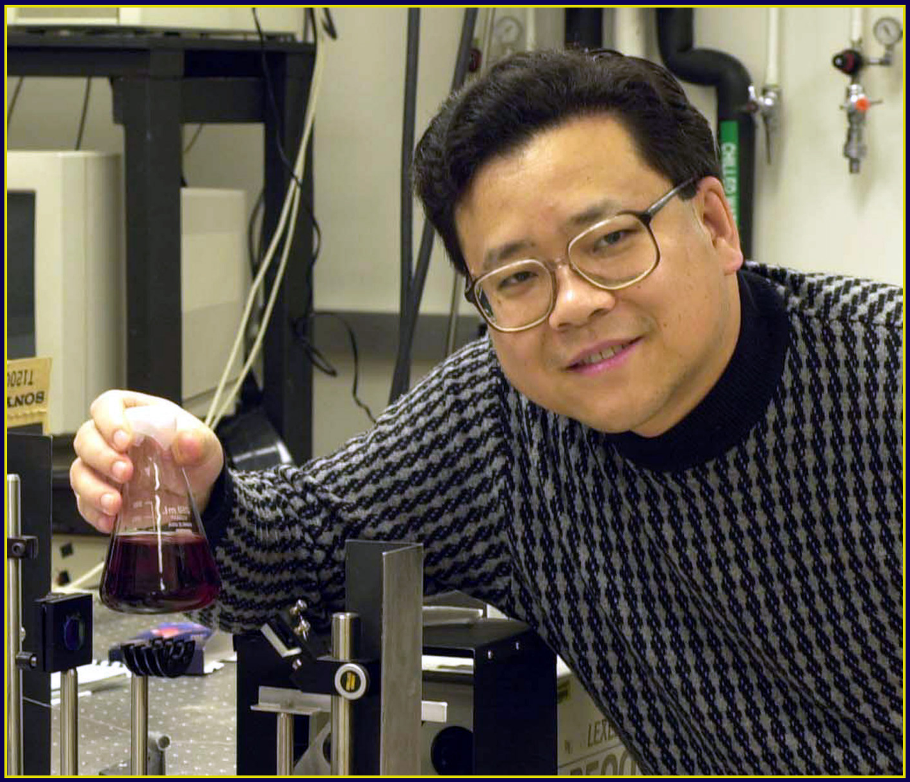


Materials Science and Engineering Professor Z. L. Wang develops and manipulates a variety of nano-structures that will become the building blocks for nano-engineered materials. He is widely regarded as one of the world's leading nano experts, and his published work is among the most frequently cited in the world.



The organic photonics group in the Schools of Chemistry & Biochemistry and Electrical & Computer Engineering works to control the photons in light in ways similar to the electrons in electricity. Applications range from flexible digital displays to medical tools that probe deep within the body without incisions.

Biomedical Engineering Professor Shuming Nie is a pioneer in applying nanotechnology to medicine (i.e. nanomedicine). He recently received $10 million in research grants from the National Institutes of Health for his work in quantum dots.



Injected into the body, these nanoparticles attach themselves to particular molecules or cells, then give off a fluorescent glow that can be detected with imaging technology.

Micro-electronics Research Center Director James Meindl and Electrical & Computer Engineering Professor Gary May coordinate Georgia Tech’s participation as one of a dozen universities in the National Nanotechnology Infrastructure Network. Georgia Tech is the education node and also has a focus on nanotechnology fabrication resources.

Rapid growth in university centers, facilities

2001
- Cornell
- Rice
- Northwestern
- Harvard

2002
- MIT
- Texas A&M
- Princeton
- Purdue

2003
- UC Santa Barbara
- UCLA
- Illinois

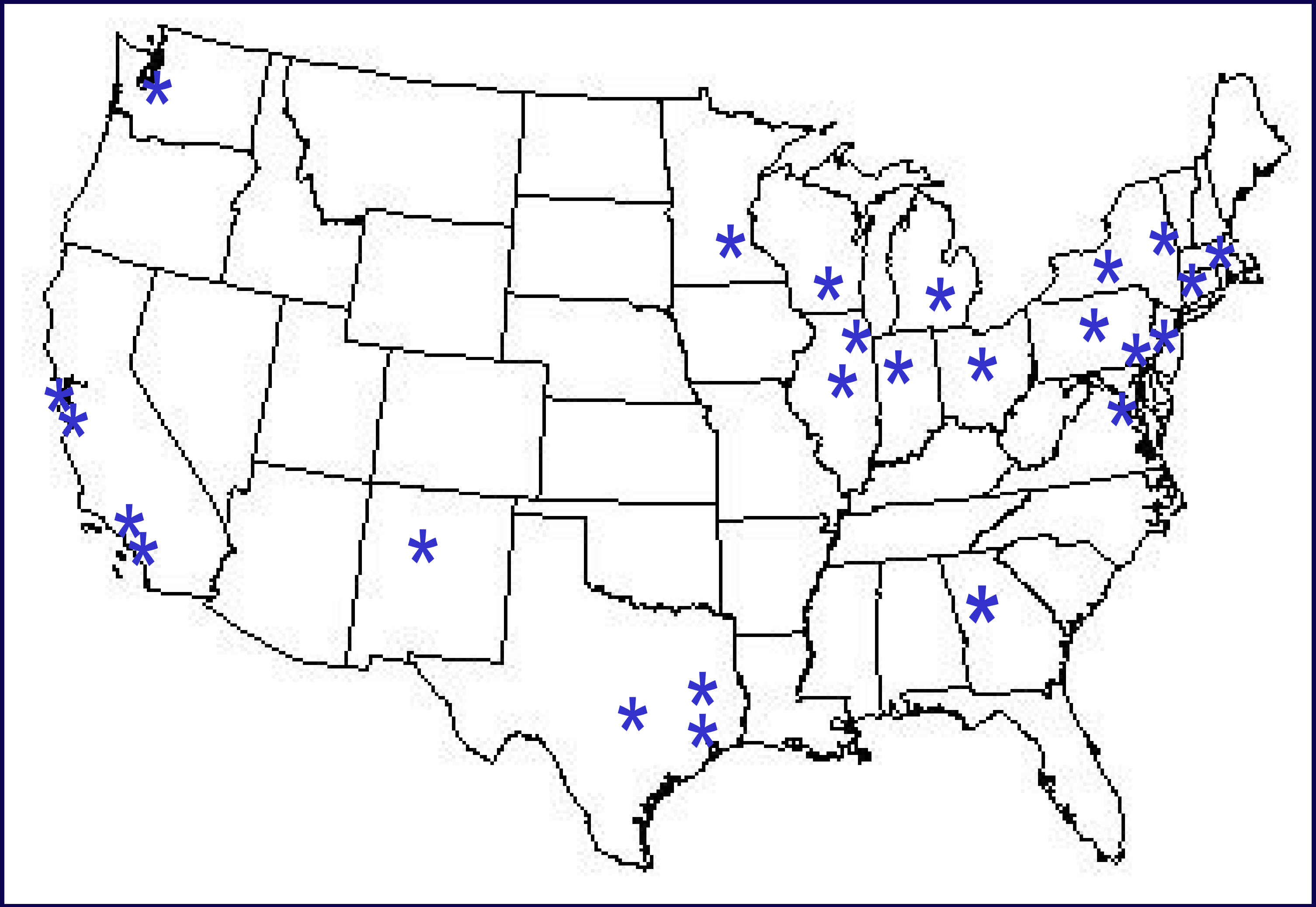
2004
- NNIN*
- Wisconsin
- U Penn
- Ohio State
- UC Berkeley
- Stanford

* National Nanotechnology Infrastructure Network

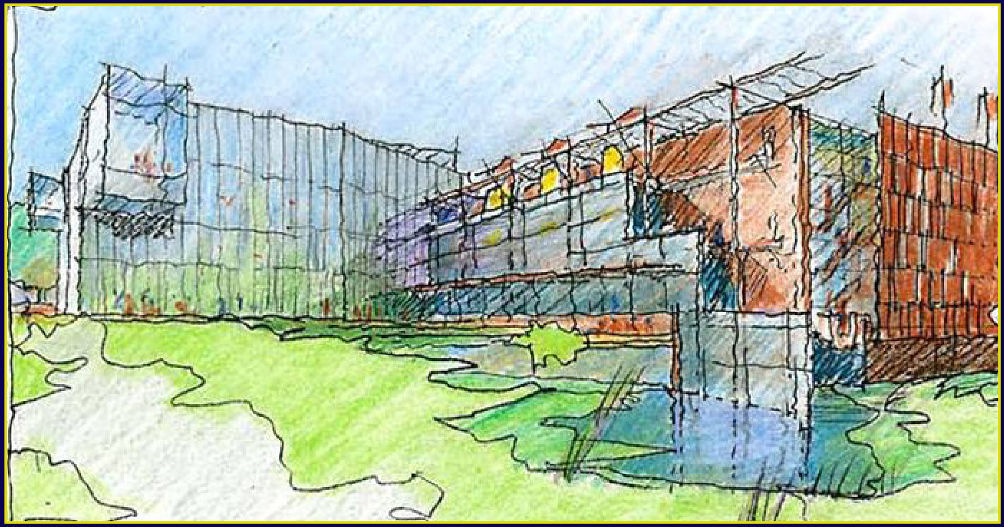
National Nanotechnology Infrastructure Network

- Cornell
- Stanford
- UC Santa Barbara
- Howard University
- U Michigan
- Penn State
- U Minnesota
- U New Mexico
- U Washington
- **Georgia Tech**
- Harvard University
- U Texas - Austin

Centers, facilities & NNIN members



Georgia Tech
Nanotechnology Research Center Building



- 188,000 gross sq ft
- 30,000 sq ft of cleanroom labs
- $80 million total project cost

The Nanotechnology Research Center Building will allow Georgia Tech to become pre-eminent in the Southeast and among the leaders in the nation.

What is a “cleanroom”?

- Vibration “free”
- Particle “free” air
- No chemical or bio-contamination
- Precisely controlled temperature and humidity
- Pure gases and water
- Clean, stable electricity

Classes of cleanrooms

- Air is normally filled with microscopic particles
  - Humans give off 600,000 particles per minute from skin and hair.
  - Fabrics, furniture, carpets, walls, ceilings give off hundreds of thousands more.
- Clean room classes
  - Class 1,000 = 1,000 particles per cubic foot of air
  - Class 100 = 100 particles per cubic foot of air
  - Class 10 = 10 particles per cubic foot of air

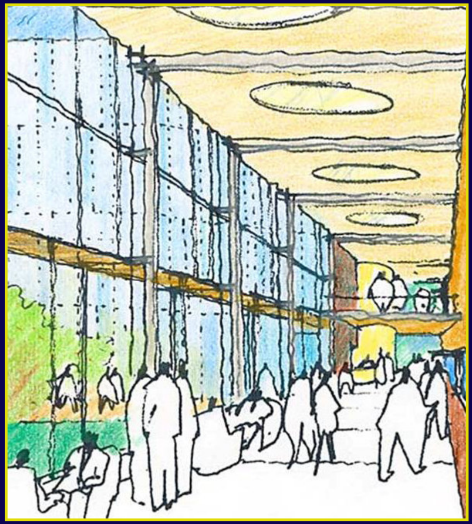
Cleanrooms attract funding

- Sources of revenue
  - Federal research grants
  - Industry-sponsored grants and contracts
  - User fees from industry, other universities
- The 8,500 sq ft cleanroom in the Pettit Microelectronics Building generates about $15 million a year.
- Nanotechnology Research Center projections:
  - 2 years after opening: $20-25 m in research awards
  - 5 years after opening: $40 m + in research awards

Existing Cleanroom for MiRC

- 8,500 square feet of cleanroom
- 75% Class 100; 25% Class 10
- Focused on electronic fabrication
- Revenue of $15 million a year
- Overwhelmed by demand

Unique advantages of GT's NRC



- Large size "hotel type" with multi-users
- Flexible design can be reconfigured:
  - From from organic to inorganic
  - From one class of lab to another (10, 100, 1,000)
  - From materials to devices to biotechnology
- Interdisciplinary preparation labs

Accessible location

Nanotechnology Research Center Building

Biotechnology Complex:

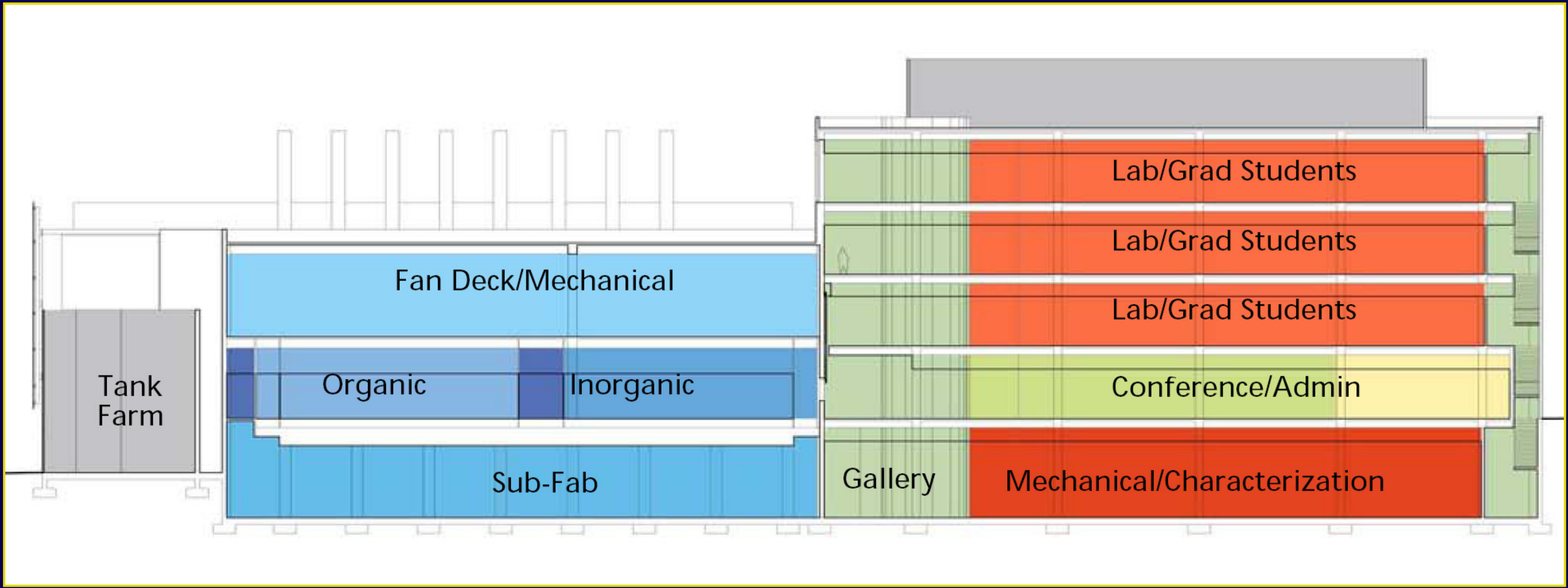
1 - Petit Biotechnology Building
2 - Whitaker Biomedical Engineering Building
3 - Ford Environmental Science and Technology Building
4 - Molecular Science and Engineering Building (under construction)

5 - Neely Research Center
6 - Pettit Microelectronics Research Building
7 - Howey Physics Building
8 - Manufacturing Related Disciplines Complex
9 - Klaus Advanced Computing Building (under construction)
10 - Georgia Tech Research Institute
11 - Centennial Research Building

Footprint

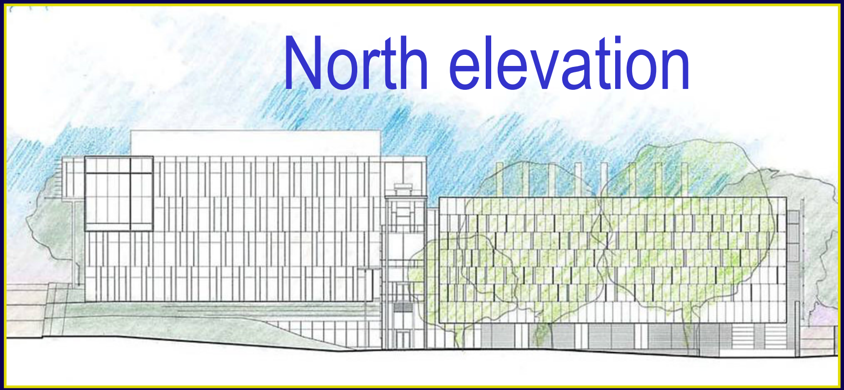
- Offices/prep labs are separated from cleanroom labs
- Landscaping promotes sustainability

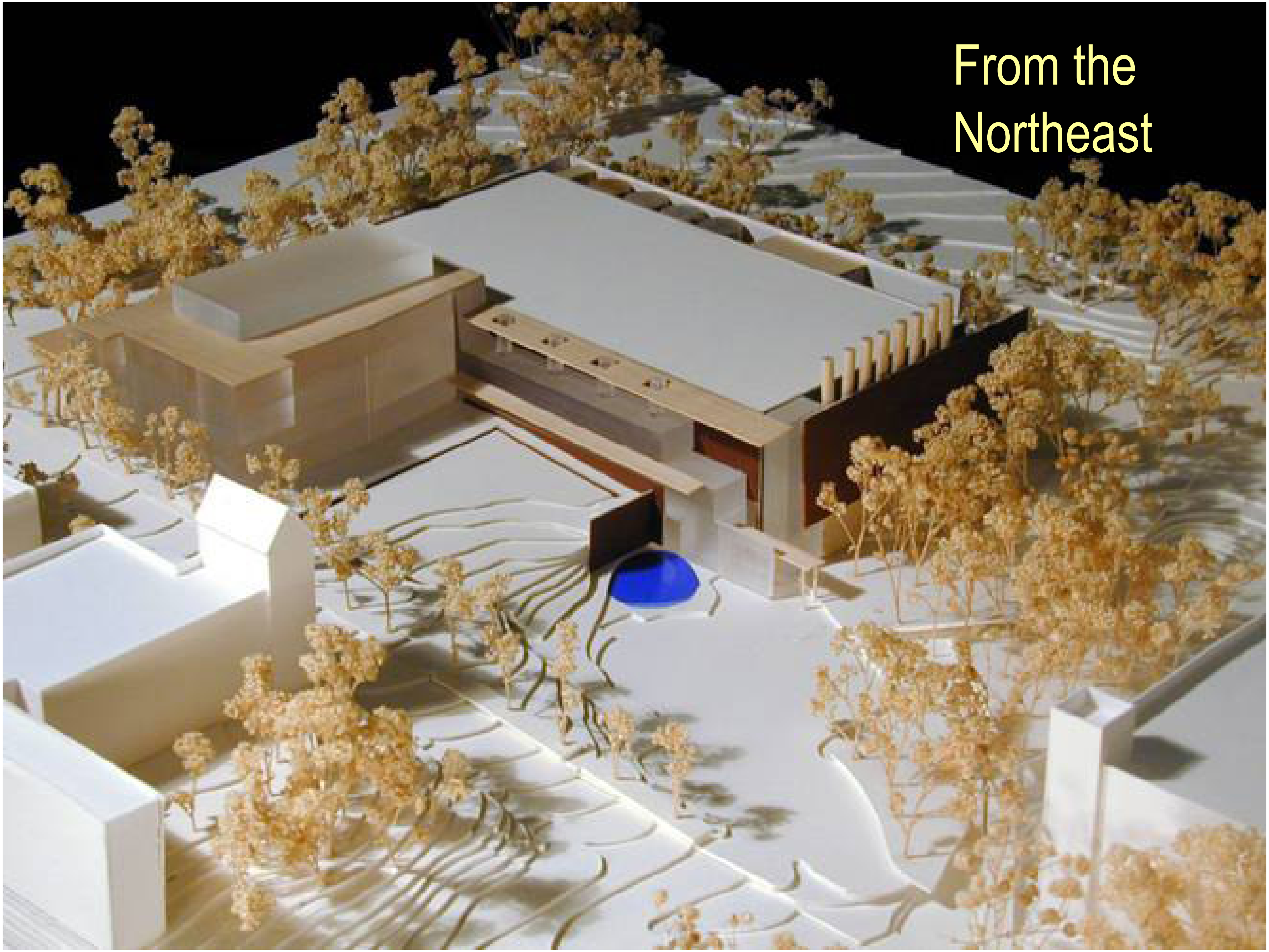
Building section



Mechanical controls in space above and below cleanroom allow flexible use.

The NRC Building




From the
Northeast

Project history

- June 2002: Project presented to BOR, placed on System's capital priority list.
- October 2003: Governor announces project as public-private endeavor.
- March 2004: Initial programming begun
- July 2004: Final pre-design report completed
- Sept 2004: Schematic design begun
- Dec 2004: Schematic design completed
- Jan 2005: Design development begun

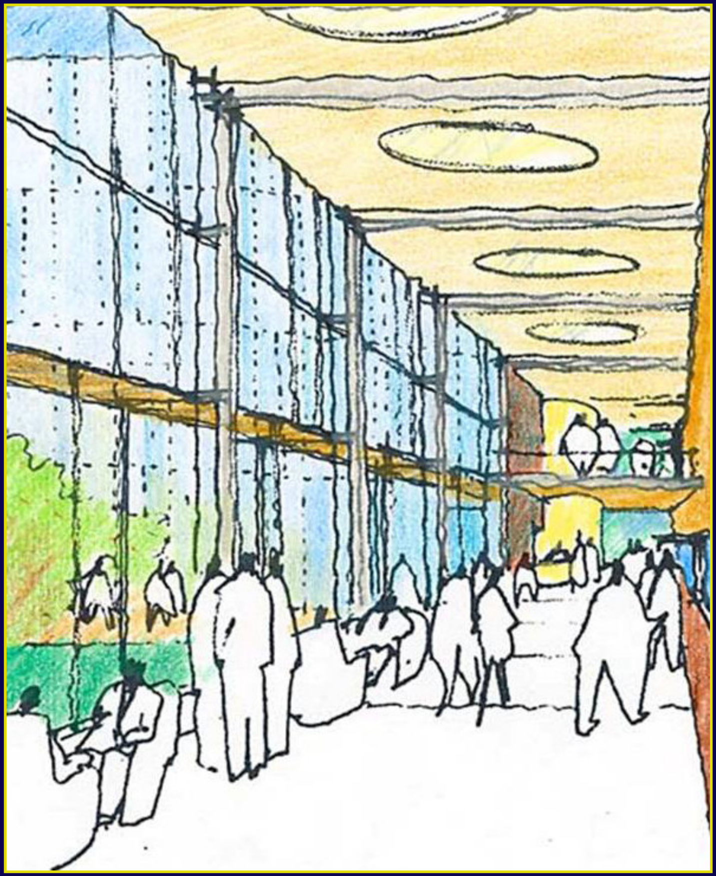
Projected future timetable*

- March 2005: Design development completed
- April 2005: Construction documents begun
- July 2005: Early site/utilities preparation begun
- Late 2007: Construction completed
- Early 2008: Begin occupancy

* Assumes project presses forward without delay.

Funding for NRC Building

- State of Georgia: $45 million
  - $2 million in FY ‘05
  - $5 million in FY ‘06
  - $38 million in FY ’07
- Georgia Tech: $35 million
  - $35 million Line of Credit from GT Foundation
  - Institute reimburses LOC by FY ‘08



Expenditure timetable

- FY2005: $7.32 million
  - State: $2 million
  - GT: $5.32 million
- FY 2006: $10.57 million
  - State: $5 million
  - GT: $5.57 million
- FY 2007: $60.15 million
  - State: $38 million
  - GT: $22.15 million
- FY 2008: $1.98 million
  - State: $0
  - GT: $1.98 million

GT funds: gifts, Institute funds, draw from GTF Line of Credit

Possible revenue scenario: GT sources

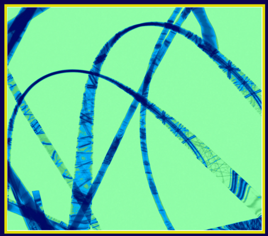
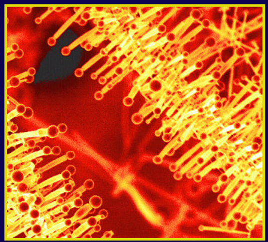
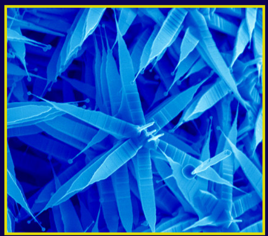
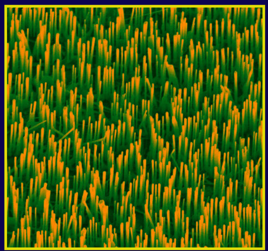
$20 million in gifts; $15 million in Institute funds

Fiscal Year	Gifts	Institute funds
2005	$5 million	$2.5 million
2006	$10 million	$4.1 million
2007	$2.5 million	$4.2 million
2008	$2.5 million	$4.2 million

Development plan

- Donors to be approached
  - Foundations
  - Individuals
  - Corporations

- 3-year timeframe for gifts to be paid
- State matches each donor dollar with $1.3
- Dual emphasis for donors
  - Materials, devices, manufacturing
  - Health and medical applications
- Ties in with coming capital campaign

Conclusion

- Project a priority for GT since 2002
- Project remains #1 priority
- State and Governor have made major commitment
- Establishes GT and Atlanta as key nano resource in the Southeast
- Unique R&D resource for nation, world
- Will allow GT to leverage, build on other extensive investments in nanotechnology