

Nanosystems Modeling and Nanoelectronic Computers

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MITRE Sponsored Research

The logo for the MITRE Technology Program, featuring a stylized graphic of stacked blocks in yellow, orange, and blue to the left of the text.

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The MITRE logo, consisting of the word "MITRE" in a bold, black, sans-serif font.

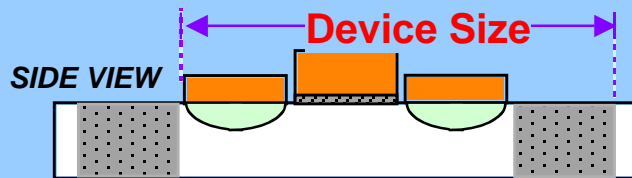
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Problem

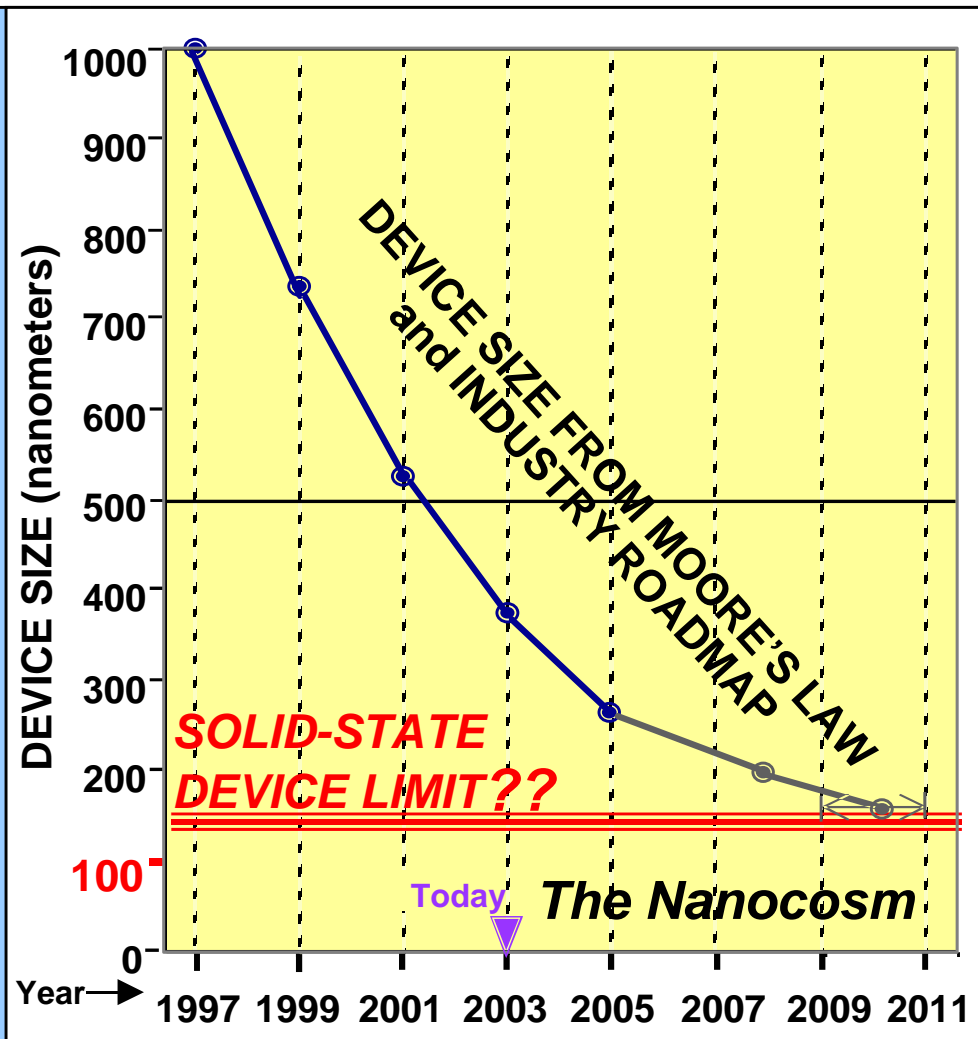
**What should a future, nanometer-scale
electronic computer “look” like?**

Background

- Exponential shrinkage of silicon-based transistors may end soon.



- Problems:
 - ◆ Fabrication & costs: Light is too big.
 - ◆ Operating principles: Quantum mechanics dominates in the nanocosm.

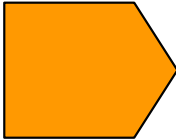


Objectives

- **Assume technical leadership, worldwide, in developing, applying, and disseminating new design concepts for next-generation electronic computers integrated on the nanometer scale**
- **Develop techniques for more rapidly and accurately modeling such “nanosystems”**

Activities

- **Developing and verifying new architectures for nanometer-scale electronic computers – esp. molecular electronic computers**
- **Exploring fabrication concepts for such nanocomputers – e.g., directed self-assembly and new carbon nanotube technologies**



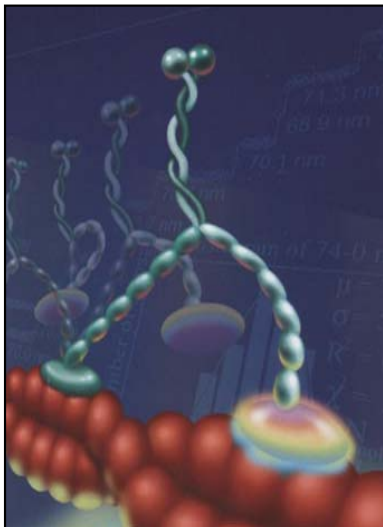
Also investigating biosystems and biotechnology as sources of new mechanisms for computation, power, and fabrication

- **Exploring application concepts as well – esp. designing and building a micro-robot that will be controlled by nanocomputers**

Highlight

Student investigator Divya Nettimi (Sr., TJ High School) won several awards for her research on the structure and mechanisms for the motive power produced by molecular biomotors.

Myosin Molecular Biomotor

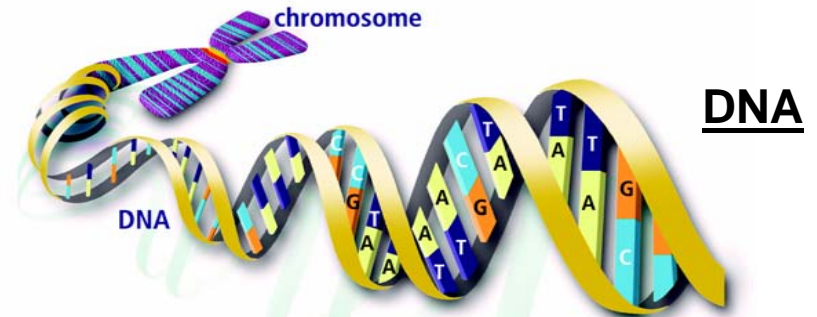


Source: Science, 27 June 2003.

Divya Nettimi



Marin
Halper



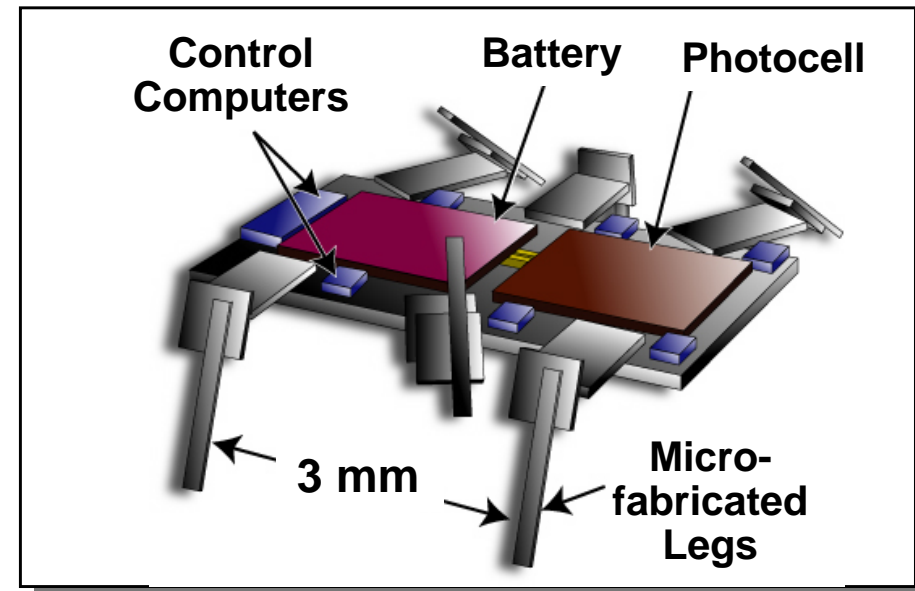
Student investigator Marin Halper (Junior, Yale U.) made significant progress in his exploration of DNA as a new model for ultra-dense memory.

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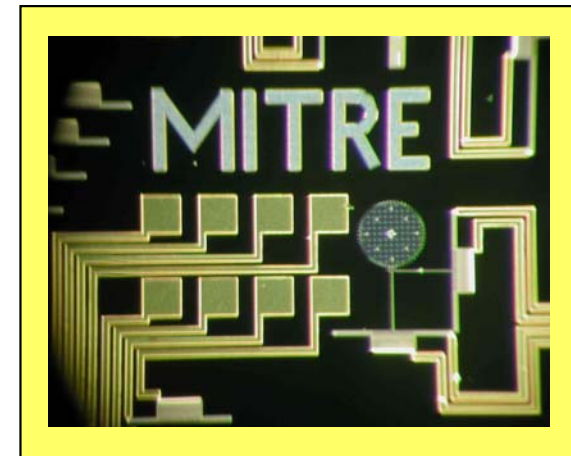
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Highlight

- Microfabrication and testing are proceeding for an insect-like millimeter-scale prototype walking robot
- Will have seven nanocomputers on board to demonstrate the tight integration of nanocomputers applied to the control of micromachines



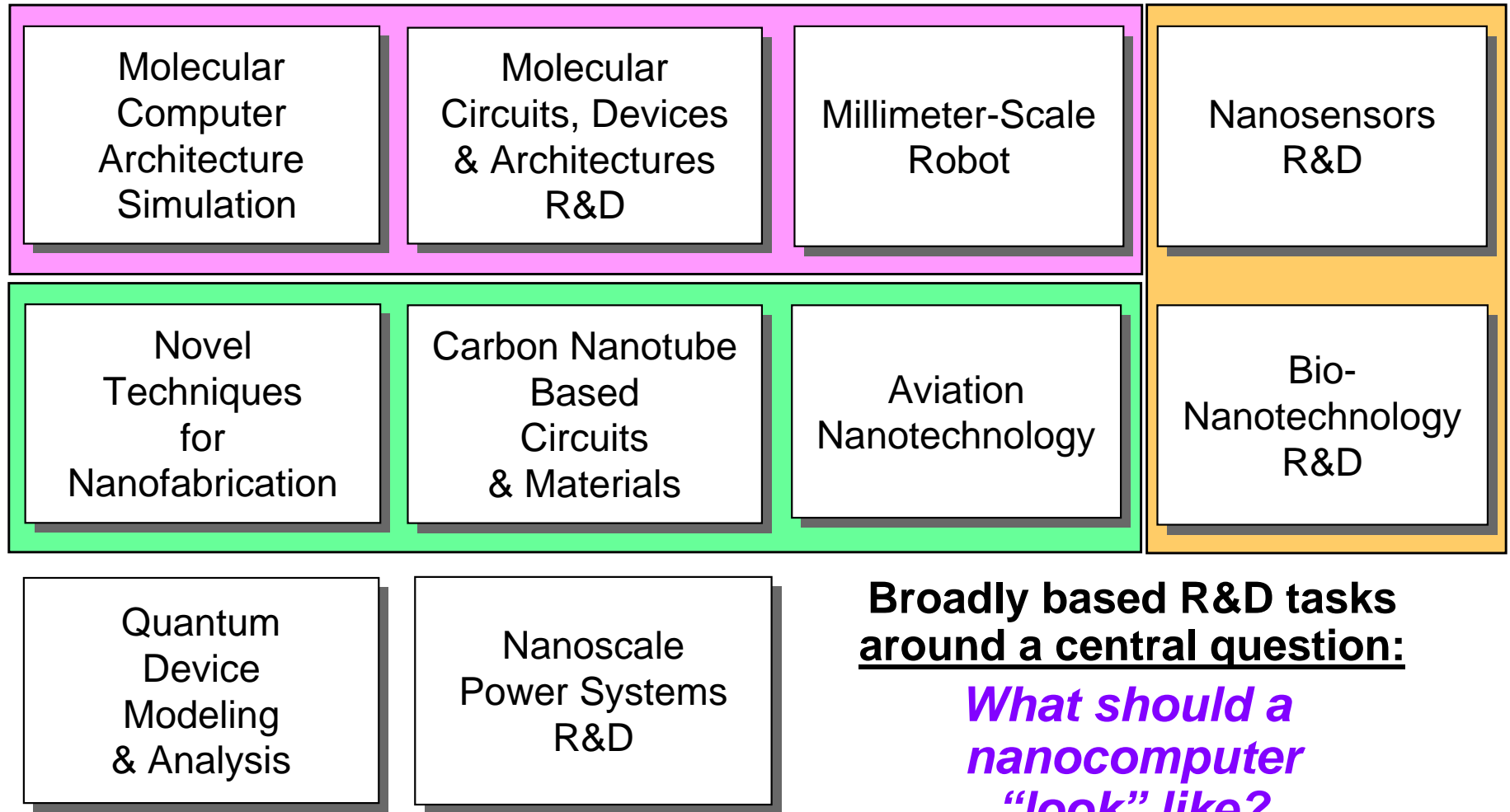
Micrograph of devices on prototype robot chip



Impacts

- **MITRE has invented new approaches for design, fabrication, and application of next-generation nanocomputers.**
 - **5 nanotech patents in last 3 years**
- **MITRE concepts and innovations have assisted DARPA in planning and conducting world-leading R&D program in molecular-scale electronics.**
- **MITRE nanotech publications and presentations assisted in**
 - **Starting other govt. nanotech R&D programs**
 - **Starting U.S. nanotechnology companies**
 - **Educating the next generation of U.S. scientists and engineers**
- **MITRE recognized worldwide as being among the leaders in nanotechnology R&D.**

Future Plans



More than 20 staff will perform nanotech R&D at MITRE during 2004, including at least 10 outstanding undergrads & high school students.