

Nanosystems Modeling and Nanoelectronic Computers

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MITRE Sponsored Research

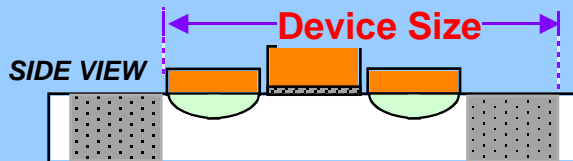


Problem

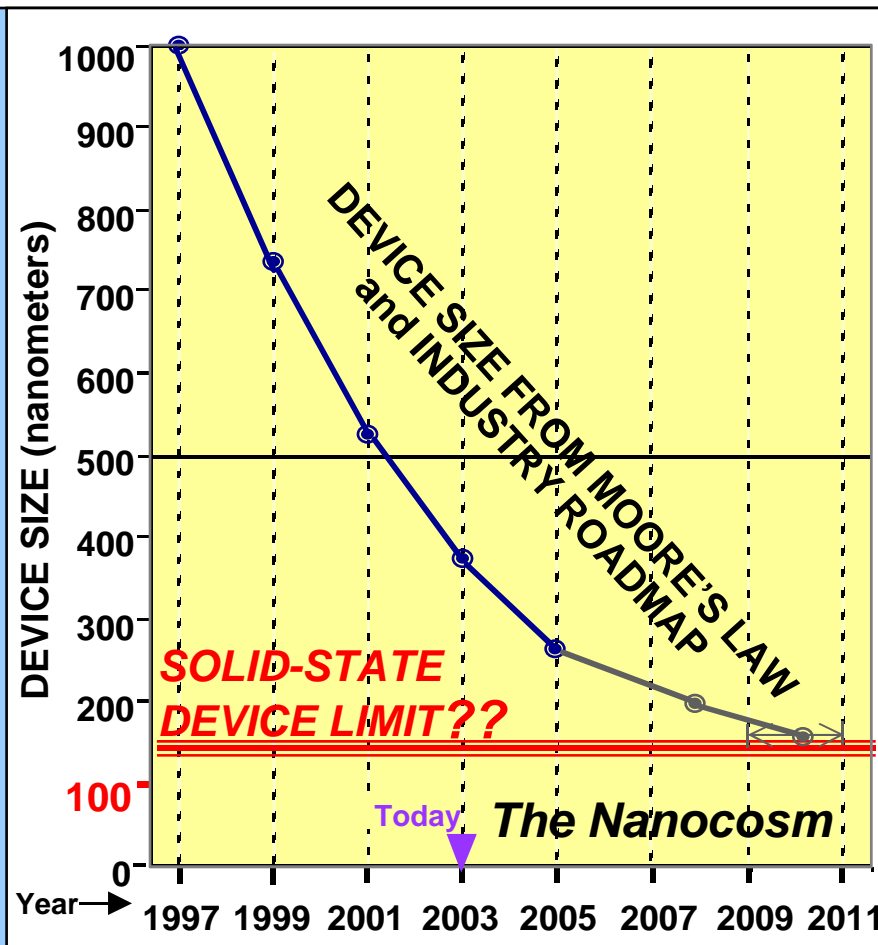
**What should a future, nanometer-scale
electronic computer “look” like?**

Background

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



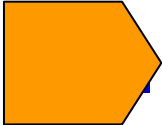
- Problems:
 - ◆ Fabrication & Costs: Light is too big.
 - ◆ Operating principles: Quantum mechanics dominates in the nanocosm.



Objectives

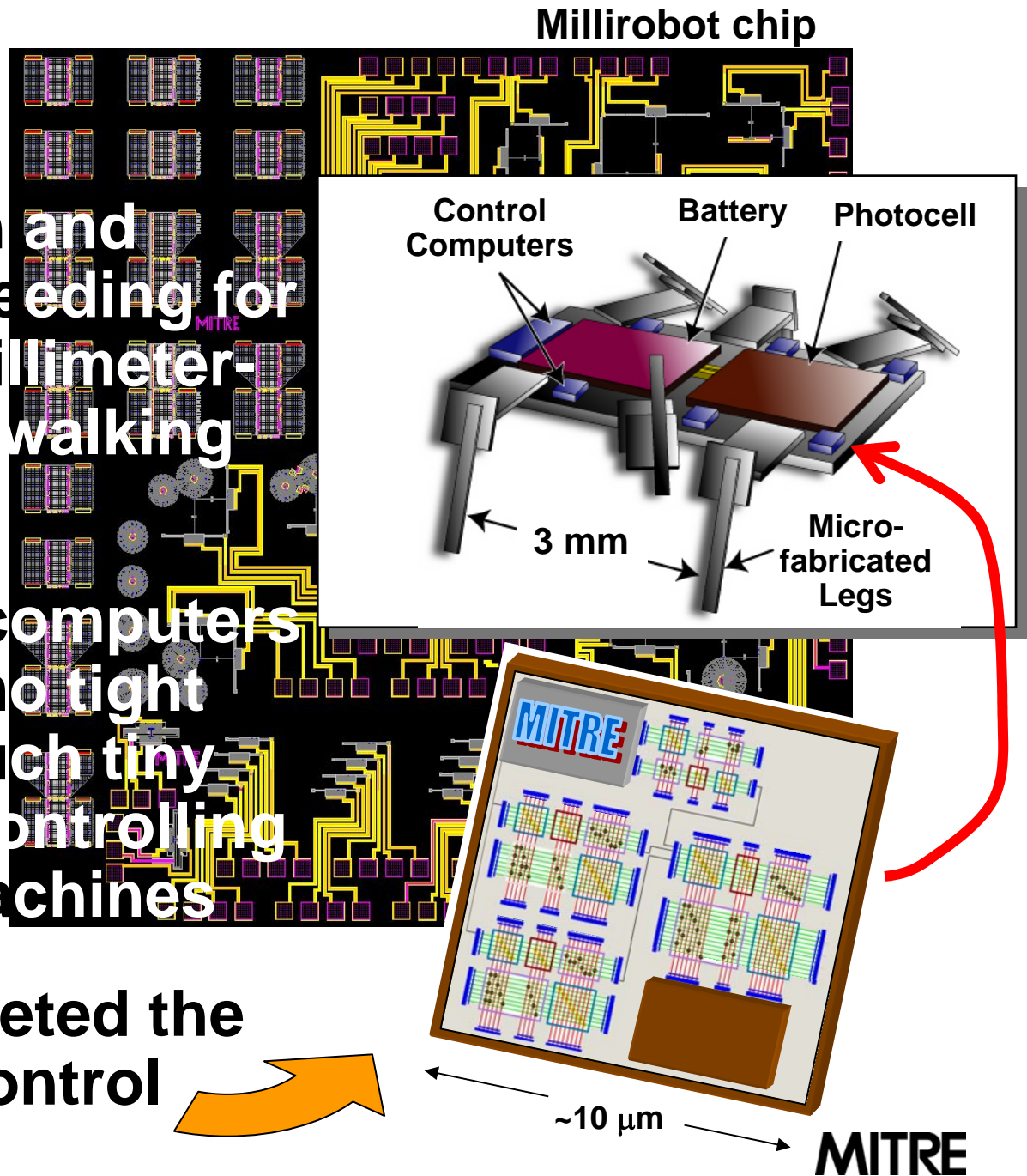
- **Assume technical leadership, worldwide, in developing, applying, and disseminating new design concepts for next-generation electronic computers integrated on the nanometer scale**
- **Develop techniques for more rapidly and accurately modeling such “nanosystems”**

Activities

- **Developing architectures and device designs 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**
-  **Exploring application concepts as well -- esp. designing and building a micro-robot that will be controlled by nanocomputers**
- **Helping to lead nationwide community of investigators in developing very small robots**

Highlight

- Microfabrication and testing are proceeding for an insect-like millimeter-scale prototype walking robot
- To have 7 nanocomputers on board to demonstrate tight integration of such tiny computers for controlling micron-scale machines
- Recently, completed the design for leg control nanocomputer



Highlight



- Staff at MITRE are among the leaders of a nation-wide group of researchers who are developing millimeter to micron-scale autonomous systems.
- MITRE helped organize and hosted a successful technical conference on this topic this past winter.

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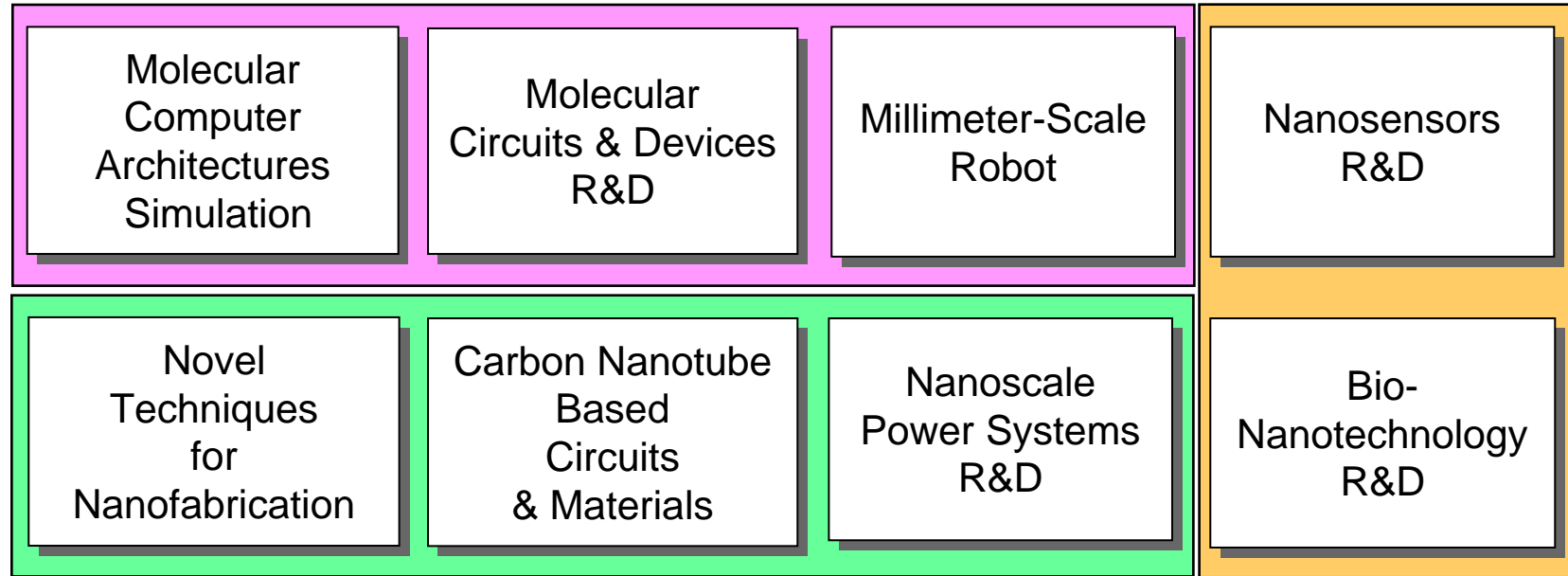
Impacts

- MITRE has invented new approaches for design, fabrication, and application of next-generation nanocomputers: e.g., 7 patents in past 4 years.
- MITRE concepts and innovations have assisted DARPA in planning and conducting a 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, and
 - Educating the next generation of U.S. scientists and engineers.
- MITRE is recognized worldwide as being among the leaders in nanotechnology R&D and its applications.

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Future Plans



Broadly based R&D tasks around a central question:

What should a nanocomputer “look” like?

More than 20 staff will perform nanotech R&D at MITRE during 2005, including at least 10 outstanding undergrads & high school students.