

Physics Creates an Industry

COMPUTERS

- Federally funded research in semiconductors launched one of the largest US industries
- Worldwide sales of semiconductors surpassed \$227 billion in 2005
- Two billion personal computers are projected to be sold by 2008

MORE DATA AT YOUR FINGERTIPS

- Disk-drive costs have plummeted from \$20,000 per gigabyte in 1988 to less than 50 cents today
- Nanotechnology breakthroughs such as “colossal magnetoresistance” promise to increase data storage further
- S&T research in magnetic materials, thin films, and electronics keeps pushing data-storage limits

DARPA, NIST, NSF and NASA are among the agencies that sponsor research in magnetic materials



5 Britannicas in one pocket

FASTER CHIPS, HIGHER PRODUCTIVITY

- Research in plasma physics, lithography, semiconductors, and lasers brought about integrated circuits and microprocessors
- Thanks to research funding, computers have achieved improved speed and performance every year for three decades
- New technologies, such as extreme-ultra-violet lithography and silicon-on-insulator chip designs, promise even faster chips

NSF, DOE, DARPA, ONR and the Air Force funded research on making better chips



Eight processors on one chip

IMPROVING FAMILY LIFE

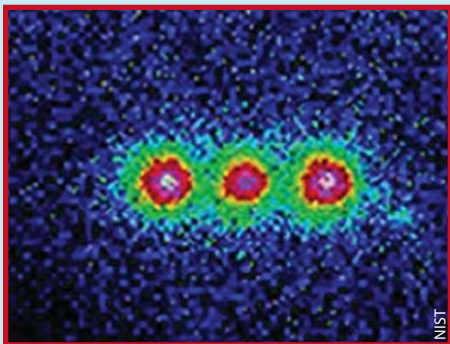
- Mobile phones, microwave ovens, and personal video recorders are just some of the gadgets that now rely on computer chips
- 22 million homes in the US connect their computers in a network, with wireless access rapidly increasing

NIST, NSF, and DARPA are among those that fund innovative uses of computer technology



R&D Pays Off – Support Physics Research

Computers — From Physics R&D to Widespread Use



Quantum, Molecular, and DNA Computing

Taking advantage of the unusual rules of the sub-microscopic world, new computing concepts hold the promise of ultrapowerful computers.

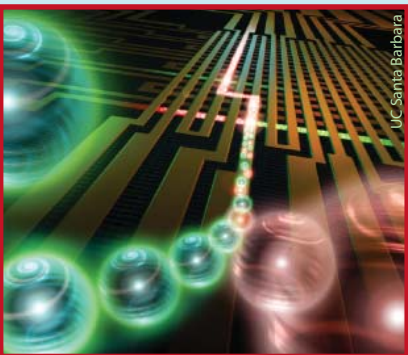
System-on-a-Chip

Incorporating multiple devices on tiny chips promises new brain implants for the vision- and hearing-impaired, as well as tiny nanorobots for medical applications.



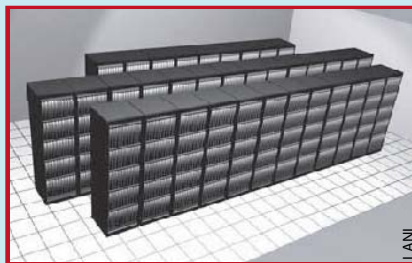
Spintronics

Spintronics exploits a magnetic property in the electron, called spin, to bring the possibility of ultra-high-density data storage and super-fast processors.



Supercomputers

Designed to test the safety and reliability of the nation's nuclear weapons stockpile without underground nuclear detonations, the Lightning computer system at Los Alamos National Laboratory connects, or "clusters," several thousand processors to perform up to 11 trillion operations per second.



Prepared by:

American Institute of Physics, One Physics Ellipse, College Park, MD 20740; Phone: 301-209-3090; Fax: 301-209-0846; email: pss@aip.org.
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Reaping the Rewards: A Century of R&D

COMPUTERS TIMELINE

"I think there is a world market for maybe five computers."
(Thomas Watson, IBM Chairman, 1943)

1940s – Researchers from Iowa State College develop the first electronic digital computer. ENIAC, the first large scale electronic computer, is built under a US Army contract. Bell Lab scientists John Bardeen, Walter Brattain and William Shockley invent the solid-state transistor (Nobel Prize, 1956).

1945 – John von Neumann of the Institute for Advanced Study publishes the design for the modern computer, in which software replaces ENIAC's hard-wired programs.

1950s – There are 10 computers in the US in 1951. UNIVAC, the first commercially available computer, is delivered to the Census Bureau. The first commercial magnetic hard-disk drive and the first microchip are introduced. Transistors are first used in radios.

1960s-70s – Ken Olson, president, chairman and founder of Digital Equipment Corporation, maintains that "there is no reason why anyone would want a computer in their home." The first microprocessor, soft "floppy disks," and personal computers are all introduced. Integrated circuits are used in watches.

1980s – The first Apple Macintosh and IBM PC computers enter the marketplace. High-capacity hard drives get bundled with home computers. SEMATECH, a research consortium of US semiconductor companies and the government, is formed and helps to regain US leadership in the industry. The idea of quantum computers is first developed by Paul Benioff of Argonne National Laboratory and Richard Feynman of Caltech (Nobel Prize, 1965).

1990s – California builds more transistors in a year than the total number of raindrops that fall annually in that state. PDAs and digital cameras are among the new products that use computer chips. Very simple prototype quantum computers are later built at MIT, Berkeley, NIST, IBM, Los Alamos and many other labs.

2002 – First commercial quantum-cryptography products appear.

2006 – As conventional technologies reach their limits, new research areas, such as molecular computing, spintronics, and quantum information science, promise new ways to make computers even faster and more efficient.

From Today's Investment to Tomorrow's Rewards

Funding and Initial Research:
NIH, DOE, NSF, NIST, ONR, NASA
and DARPA, since the 1950s