
Future Technologies that may Facilitate Science Breakthroughs

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Panelists

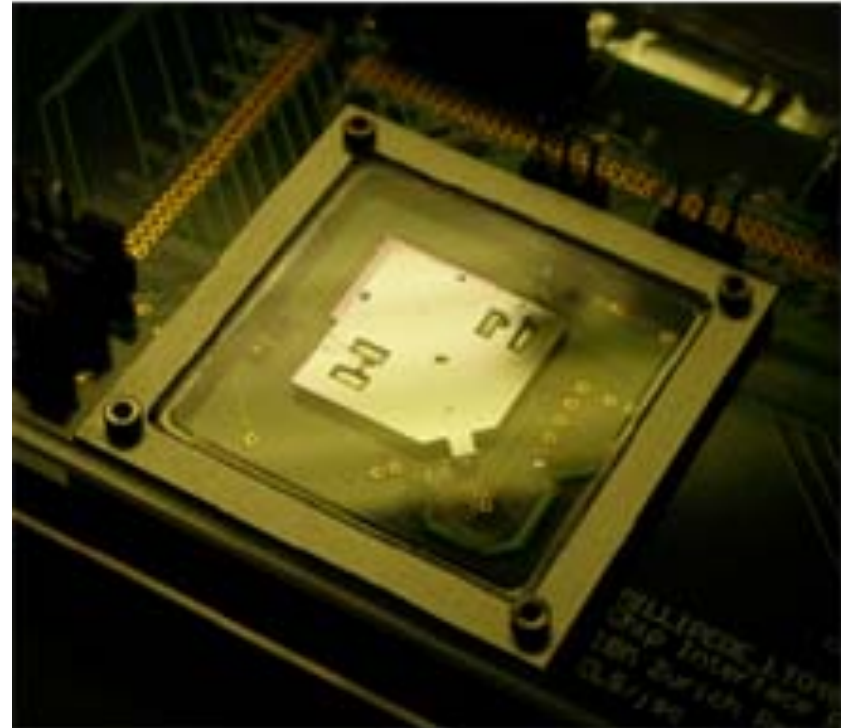
- Bill Gropp, Argonne National Laboratory
- Scott Studham, Oak Ridge National Laboratory
- Dieter Kranzlmuller (Joh. Kepler Univ. Linz and Cern)
- Torsten Schwede (Biozentrum, Univ. of Basel)

The Fun Stuff

- Cool Hardware
 - New Memory Technologies
 - Density
 - Latency
 - Bandwidth
 - Non-volatile
 - New Processors
 - Cell
 - FPGAs
 - New Interconnects
 - Cost effective optical
 - “Proximity Communication”

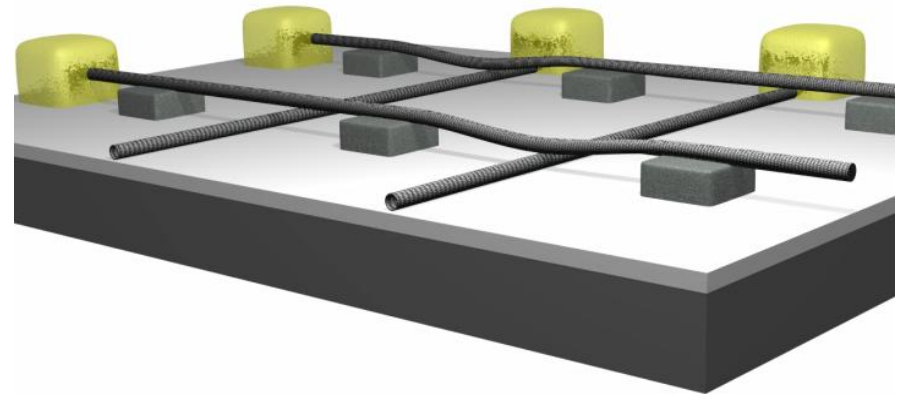
Millipede

- 10nm process
- 1.2 Terabit/in² (25 DVDs)
- Slow (but could compete with Flash memory)



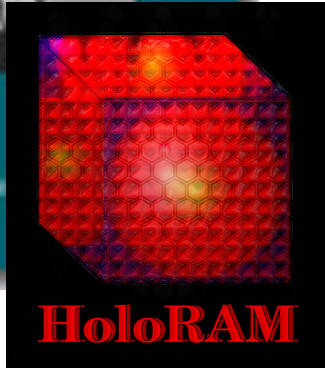
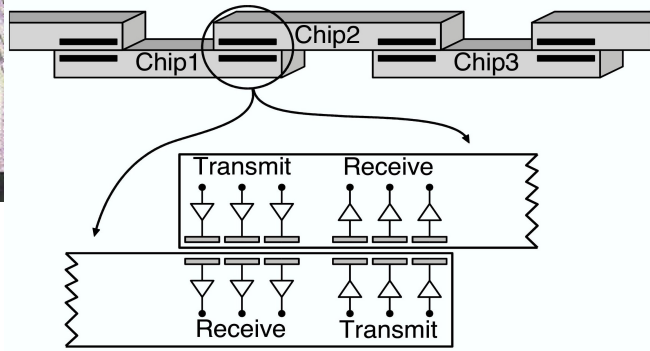
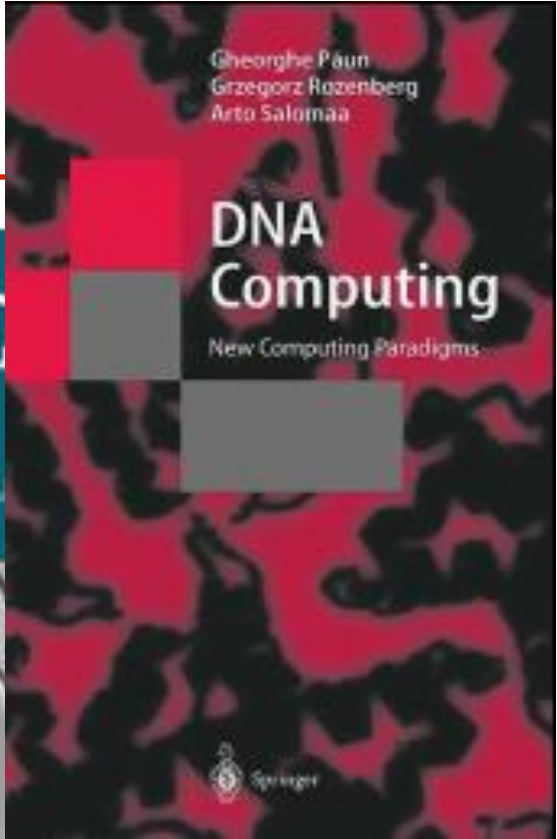
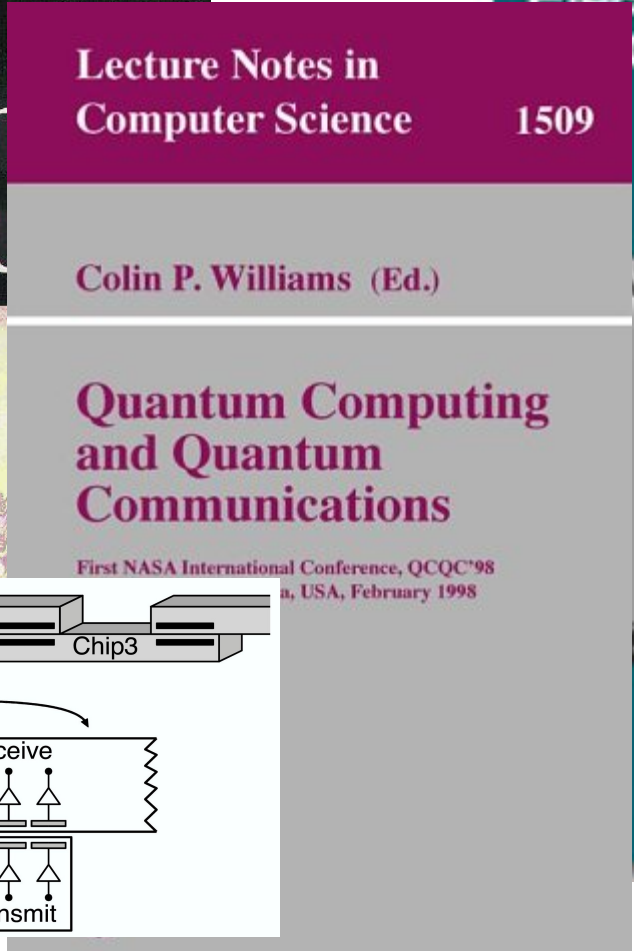
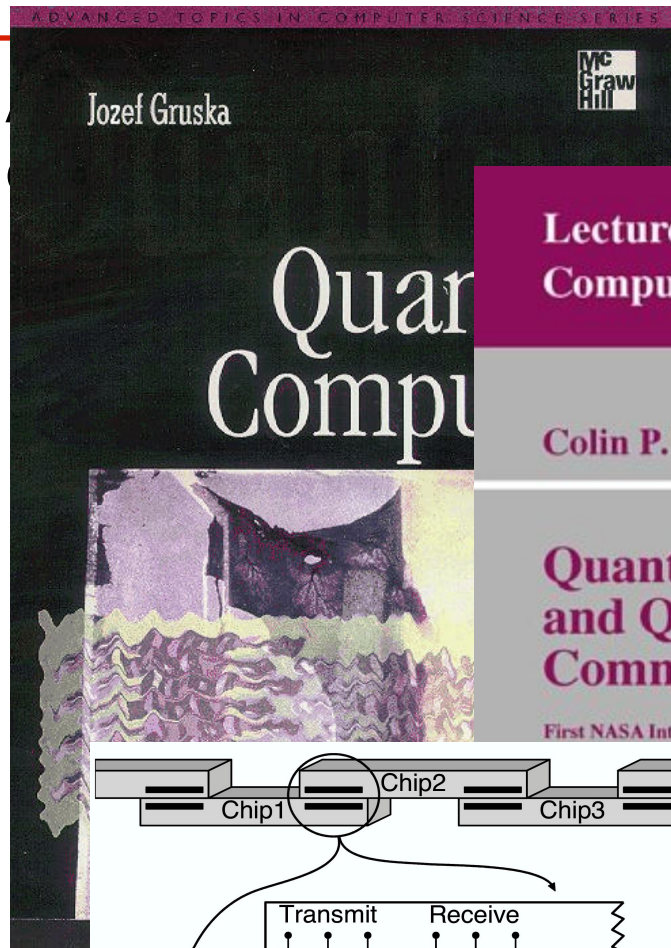
Nanotube Memory

- Electrostatic forces hold nanotubes in place
 - Multiple tubes are used to enhance manufacturability
- Claims 2GHz (0.5 ns) operation
- Nonvolatile



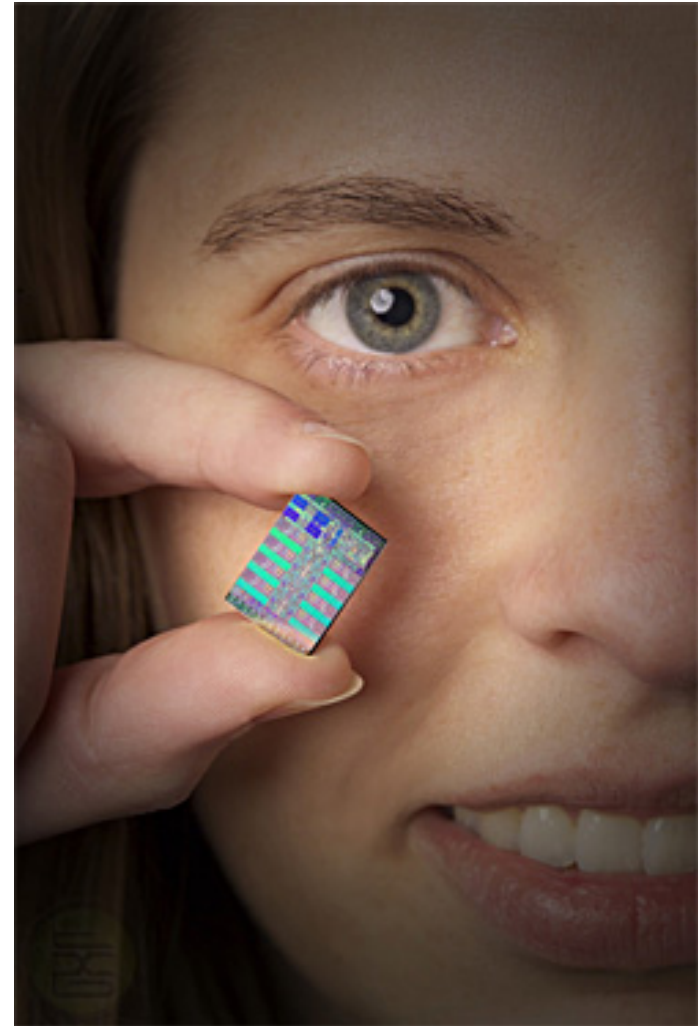
Exotic Technologies

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Cell Processor

- 256 (SP) GFlops/chip
 - +8 for PowerPC processor
- 8 “SPE”s
 - No cache
 - Software managed memory
- Extremely low latency interconnect between adjacent SPEs
- Billions and Billions to be made...
- And put four of these into your laptop and you have a TeraFlop 😊



Personal Supercomputers

- Orion Multisystems
 - Desktop cluster is 10x a single processor
 - Deskside cluster is 100x a single processor
- ... if you have parallel software



Stuff That Matters

- Software
 - Better match of problem concepts to language abstractions
 - Multilevel and/or domain-specific languages
 - “Parallel Matlab”
 - Domain-specific “languages” and problem solving environments
- Algorithms
 - Multiscale and multi-science
 - Error guarantees
- Software that supports *new* algorithms
 - Optimizing for existing applications means optimizing for applications and software developed for machines slower than my laptop

Put the Science First

- Technology Driven
 - What could we do?
 - What can't we do?
 - Can it help applications?
- Application Driven
 - What stands in the way of applications?
 - Managing complexity of modern software
 - Managing the datasets
 - Consequence of data densities is that 40GB is *small*
 - (one thing that does not stand in the way — the ability to write *simple* codes quickly that must run with high parallel performance)



New Question

- In 2025, what technologies *will have been created* to enable scientific breakthroughs?
 - In other words, what problems do we face *now* that we must solve, and what might that solution be?