Cornell University

Multidisciplinary Science in a Modern Research University

Robert Richardson

January 2005

Cornell University

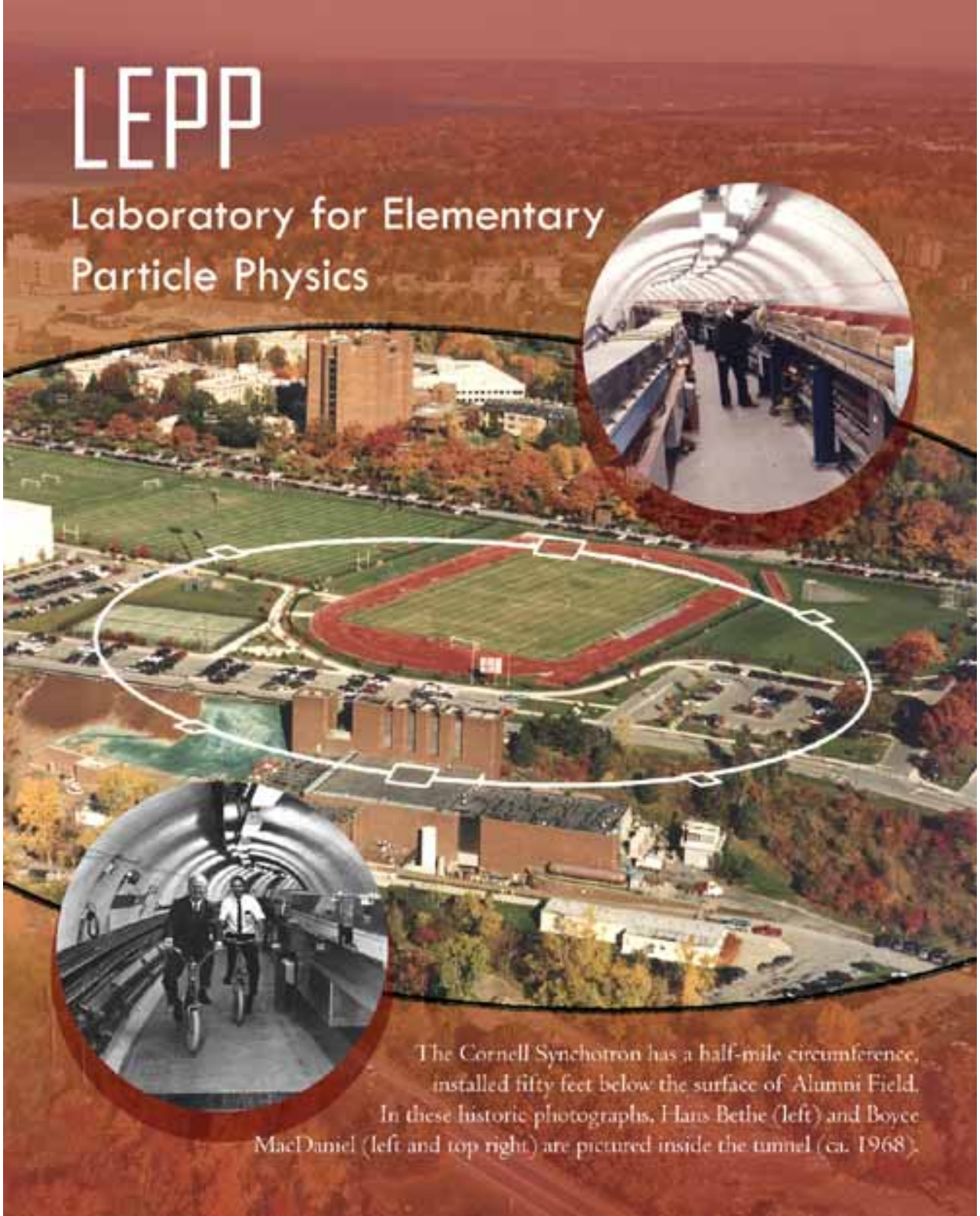
How multidisciplinary research grew at Cornell

- History and examples from the natural sciences.
- Characteristics of effective collaboration.
- Why mixing of disciplines can produce better science.
- Lessons learned.

Cornell University

Laboratory began in 1948. Historical basis for multidisciplinary research at Cornell.

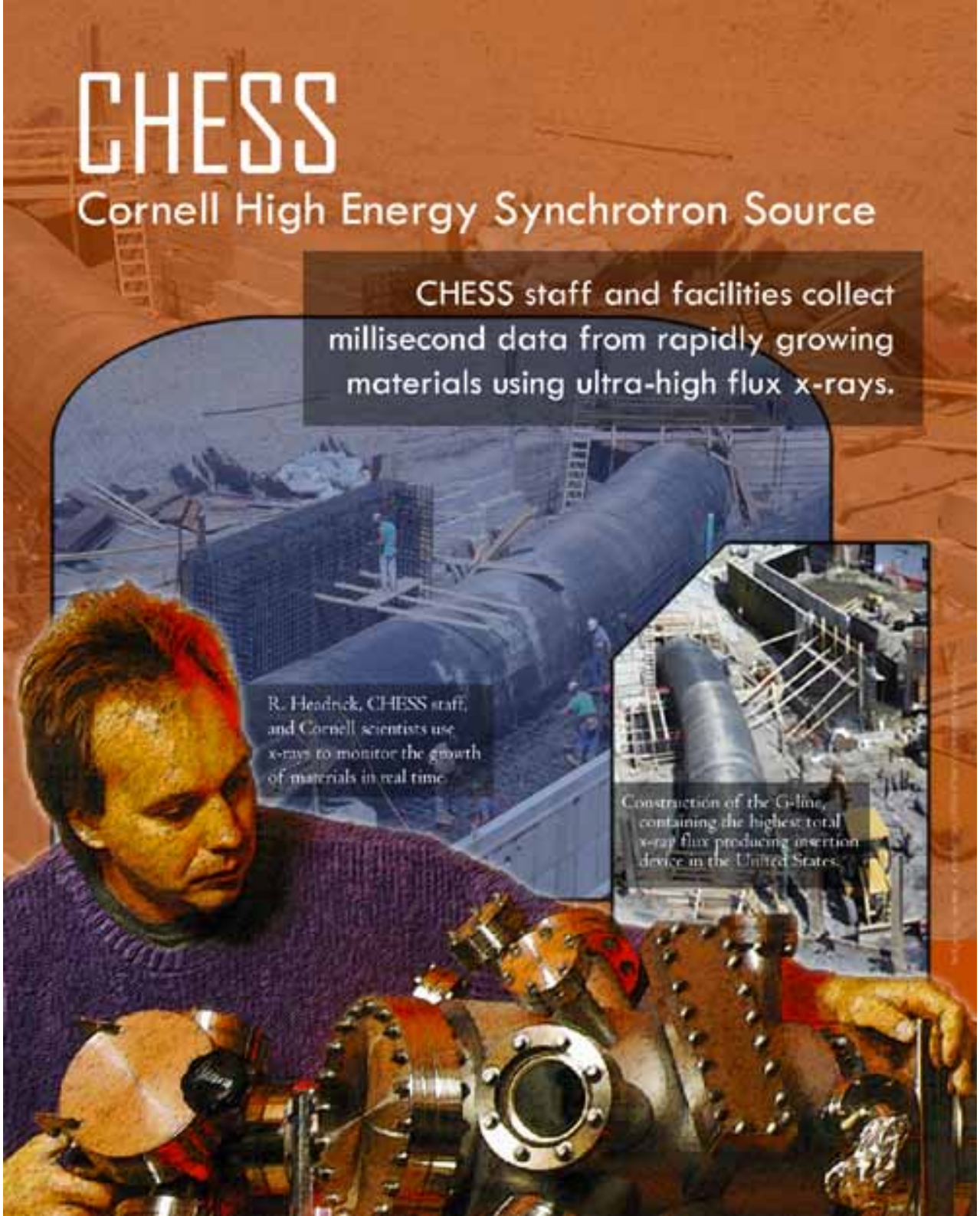
- Accelerator designed for high energy physics.
- Buried under athletic field. Circumference is 1/2 mile (805 m)
- (Note Hans Bethe in lower picture.)



Cornell University

X-rays are generated when the electron path in synchrotron is bent.

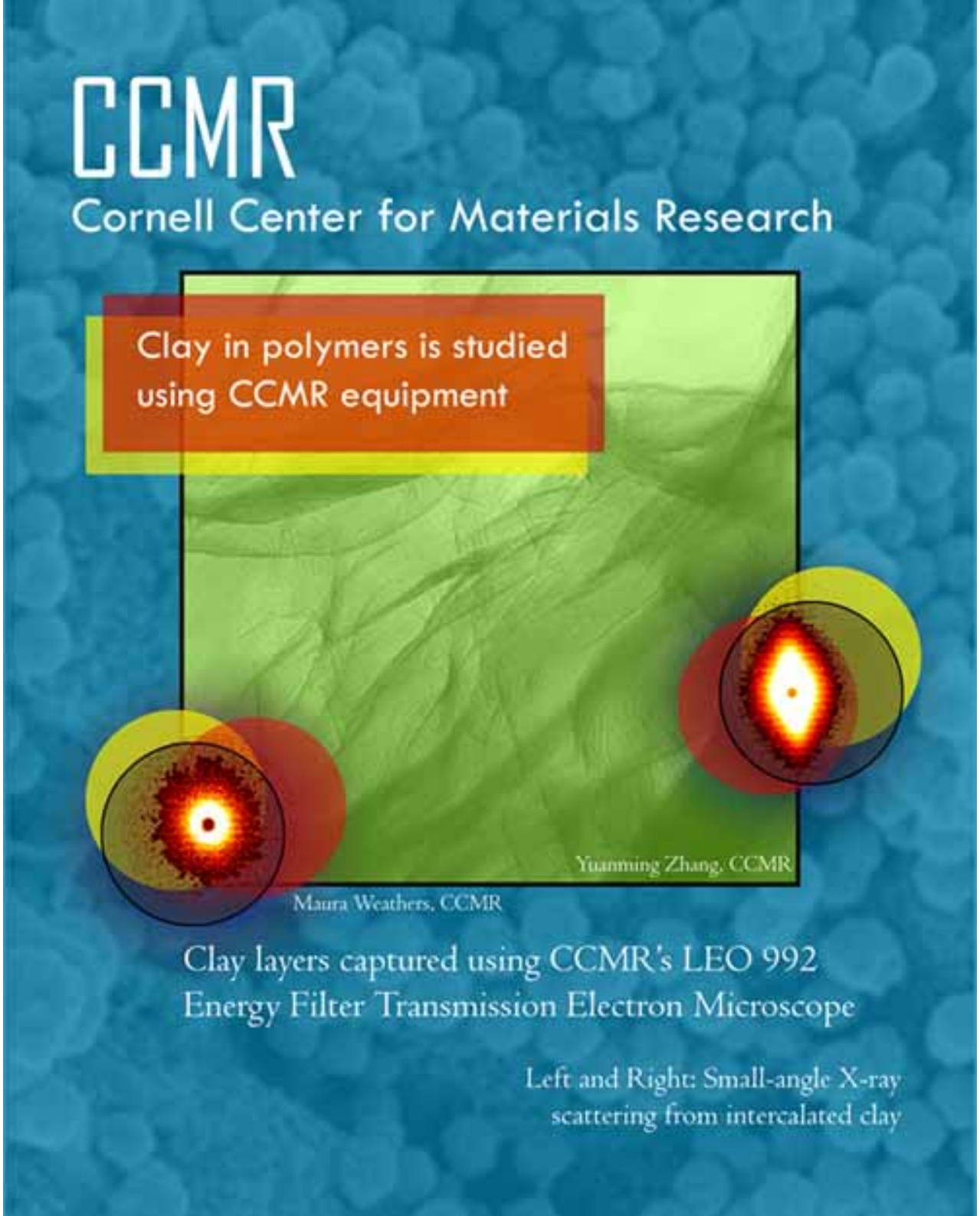
- The first Synchrotron x-rays were observed in 1956 at Cornell.
- The high intensity x-rays are the most effective for studying matter such as living cells. (700 visitors each year)



Cornell University

Materials Research Center (1960):

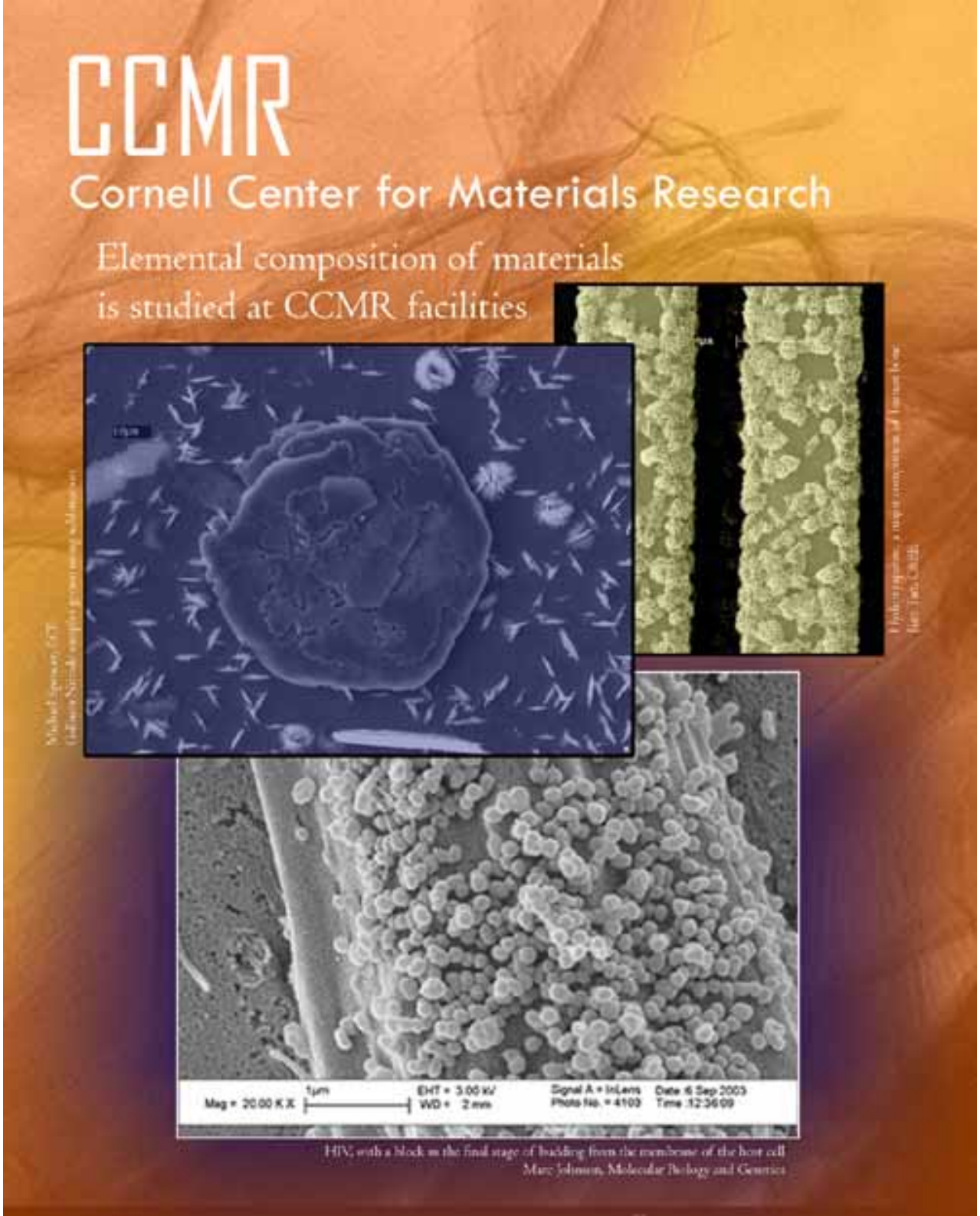
- First US funded multidisciplinary program at Cornell.
- Physics, chemistry, electrical and materials engineering.
- Developed effective collaborative methods between traditionally separate departments and colleges.



Cornell University

Materials (continued)

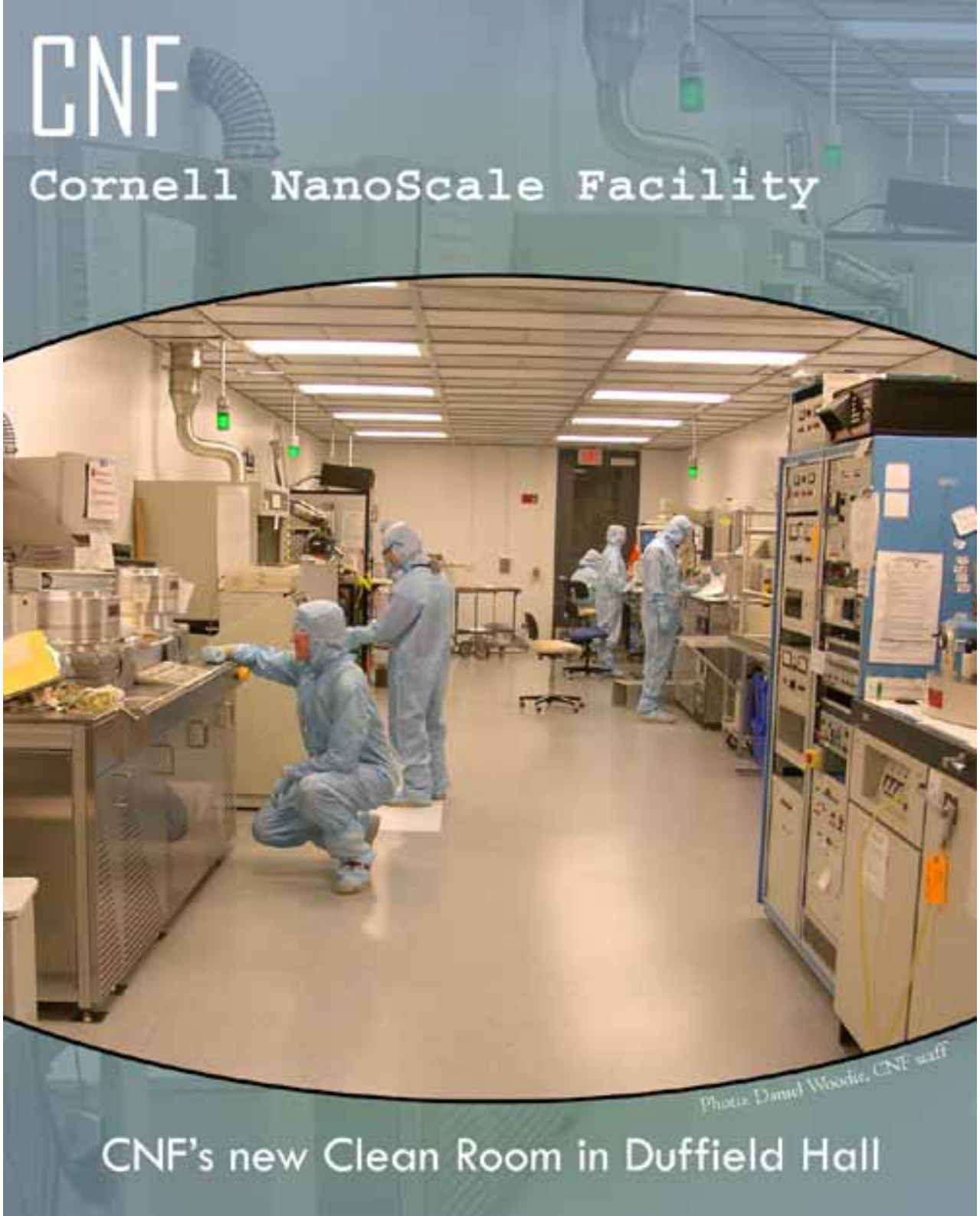
- Shared facilities are a key to collaboration. Electron microscope images here show growth of HIV virus.
- Center has equipment valued at more than $100M acquired over 40 years of joint planning.



Cornell University

Nanoscale Facility founded in 1979 with NSF funding.

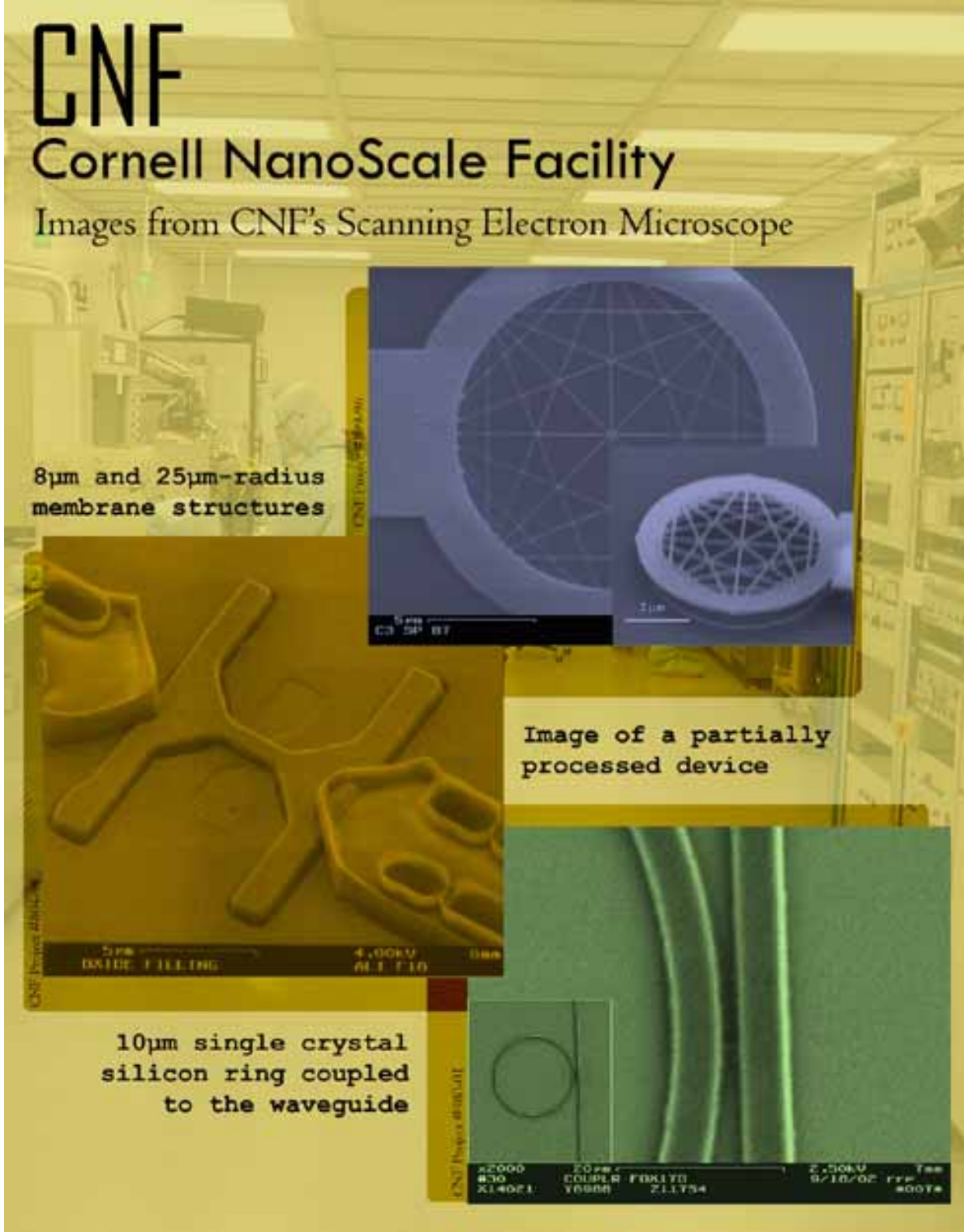
- National multi-discipline fabrication center. (1400 users per year.)
- Disciplines include all of the materials disciplines plus biology, agriculture, and all engineering fields.



Cornell University

NanoScale Facility (continued)

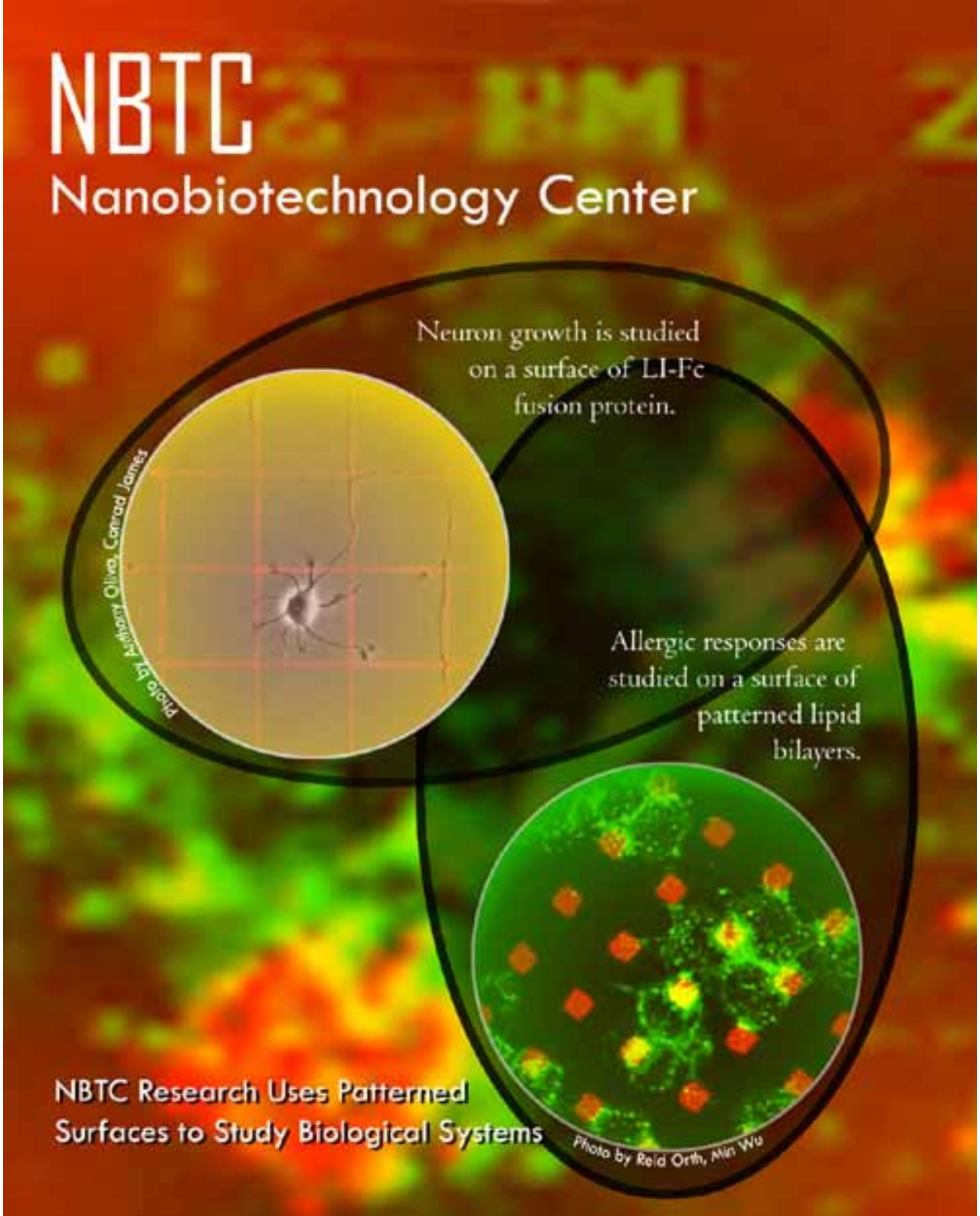
- Multiple lithography and imaging techniques are used to make structures as small as a few atoms.
- Technology transfer is an important mission of the center.



Cornell University

Nanobiotechnology (NSF 1997)

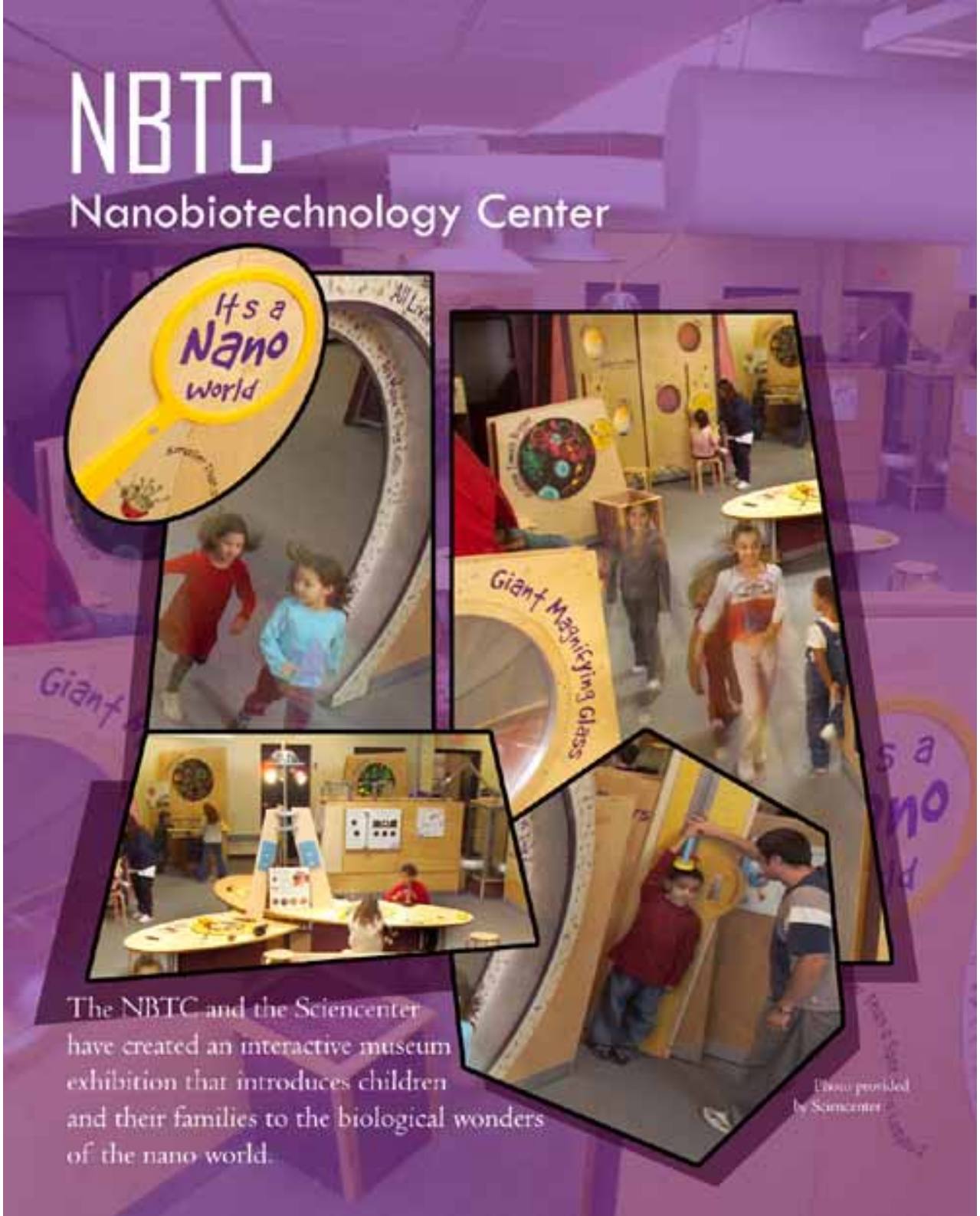
- A fusion of biology with the nanoscale technology.
- Partners with -- 4 universities, 18 corporations, and 3 national laboratories.
- Cornell faculty from 5 colleges and 15 departments.



Cornell University

Nanobiotechnology (continued)

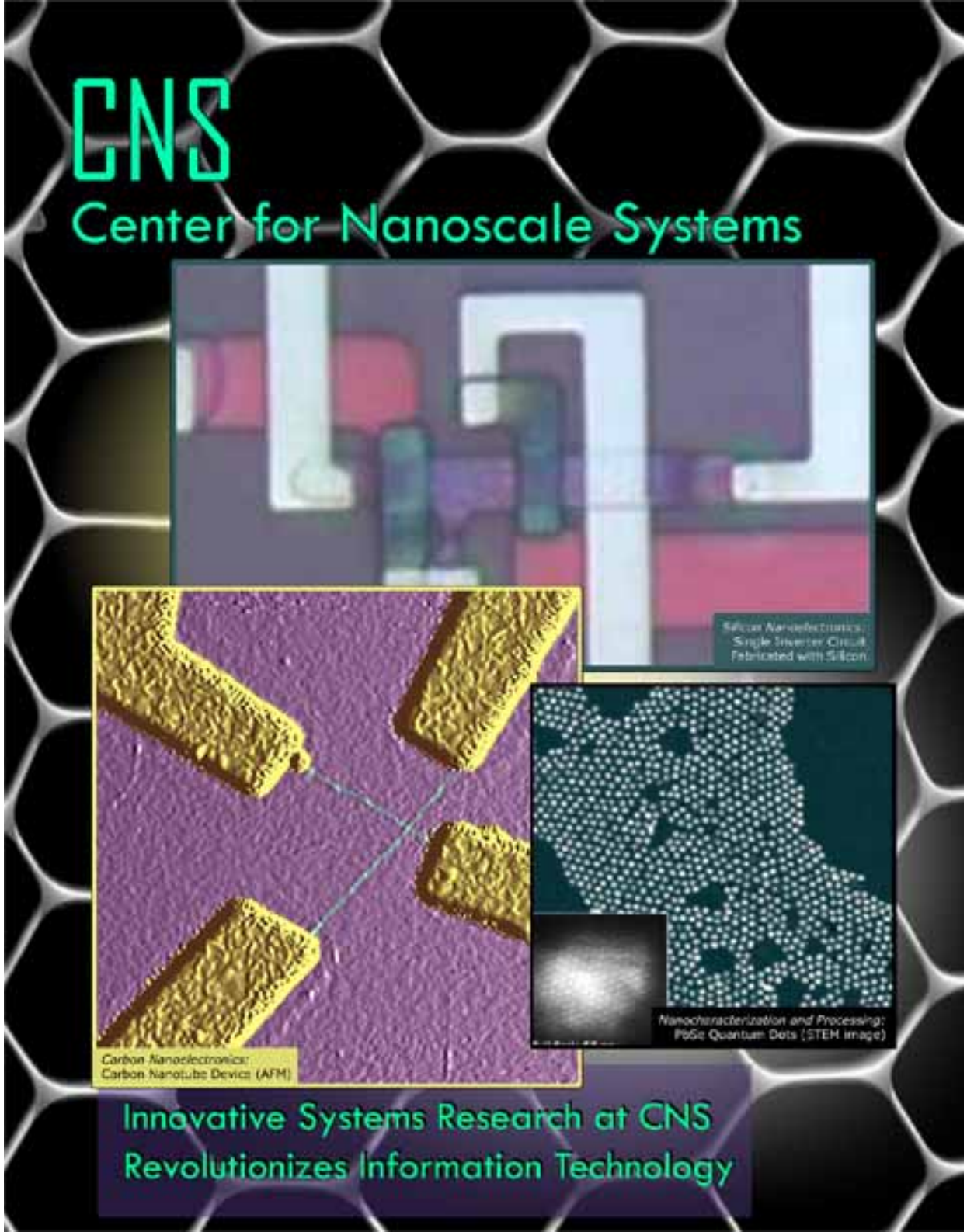
- All Cornell centers have a responsibility for public science education. The image shows a display for young children prepared at Cornell for Science Museums.



Cornell University

Nanoscale System Center (1998)

- Studies electronic, photonic, and magnetic nanoscale systems that can revolutionize information technology.
- Also funded by NSF for multiple disciplines.



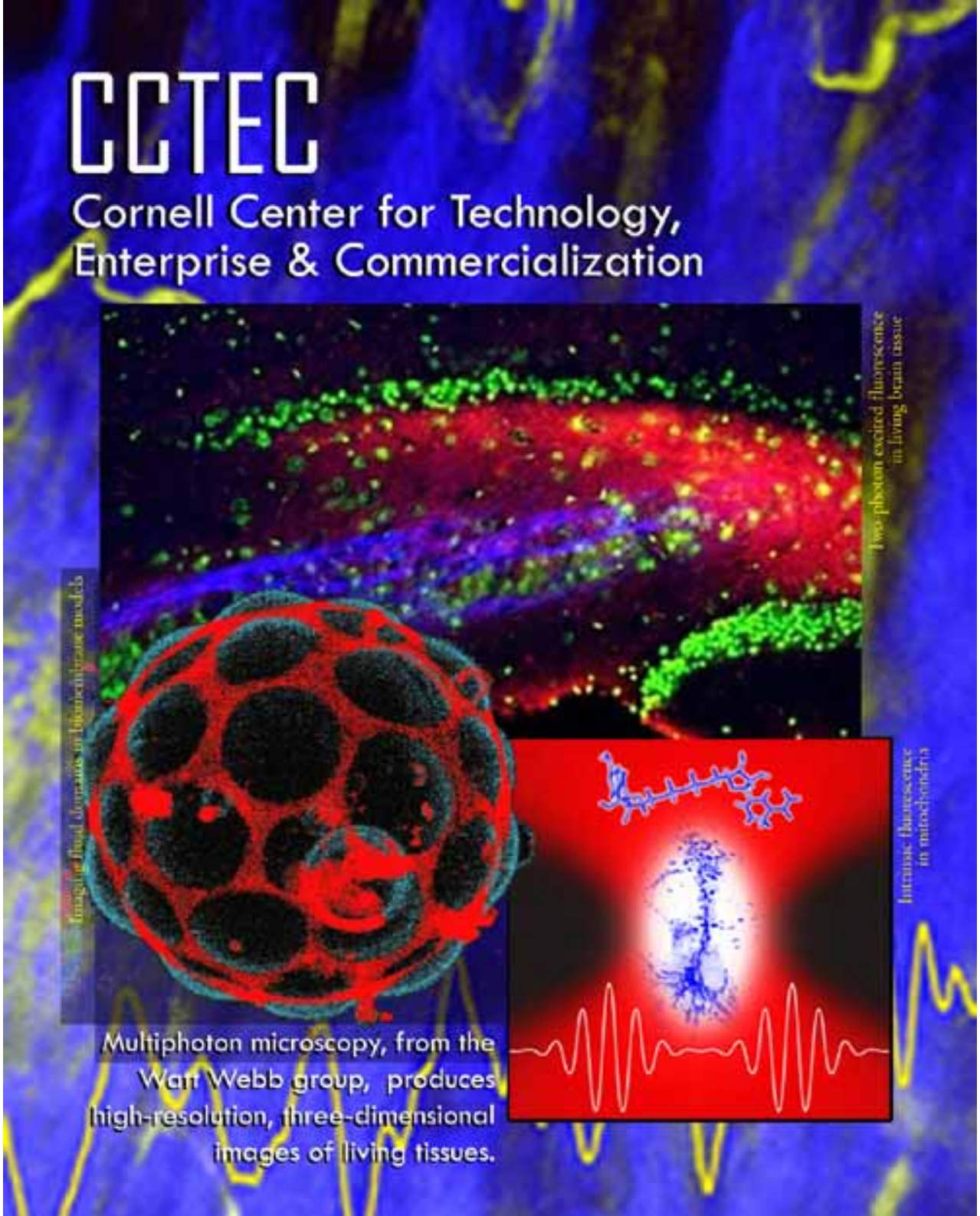
Cornell University

The Kavli Institute at Cornell for Nanoscale Science is a new center (2004).

- KIC is privately endowed. The center sponsors studies of strategies for new science using nanotechnology.
- First conference was a meeting for science writers.
- Second conference was on molecular devices held jointly with Japanese Ministry of Education and Science.

Cornell University

- Transfer of new technology is an important responsibility of a Research University.
- Poster illustrates an invention of W.W.Webb, an engineering physics faculty member of all 5 of the Cornell nanoscience centers.



Cornell University

Effective Collaborations

- Use existing strength in disciplines.
- Grow out of discussions among young scientists as well as recognized leaders.
- Require a willingness to share resources among the disciplines.
- Share in educational and training activities.
- Welcome new scientific associations

Cornell University

Why Mixing Disciplines is Frequently Better

Stronger innovation: -- At Cornell physical scientists and engineers invent important new techniques to attack significant problems in biology of proteins, cells, neurobiology, and medicine. Both groups benefit.

Cornell University

Lessons Learned

- Start with small collaborations.
- Develop excellence in a few areas.
- Use growing reputation to develop other key specialties.
- Expand the breadth of fields in the collaborations.
- Communicate with the public.