SAND2005-7593P

The DOE Center for Integrated Nanotechnologies

Neal D. Shinn, Ph.D.
User Program Manager

Sandia National Laboratories
Albuquerque, NM 87185-1413
ndshinn@sandia.gov

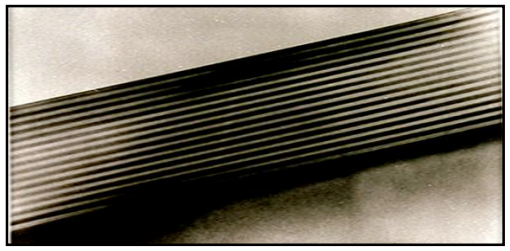
National Center for Manufacturing Sciences
November 22, 2005

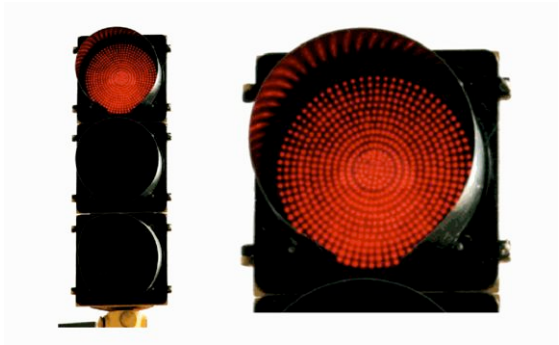
Sandia is a Multiprogram Laboratory Operated by Sandia Corporation,
a Lockheed Martin Company, for the United States Department of Energy
Under Contract DE-ACO4-94AL85000.

Sandia National Laboratories

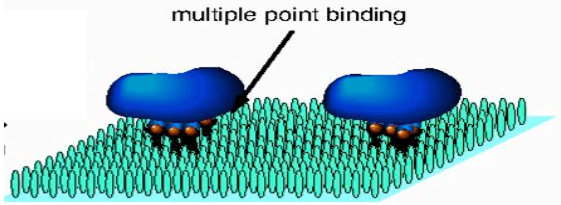
Integrated Nanotechnology will impact our world

Energy

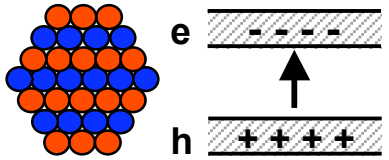




Health Care



Environment



Connecting scientific disciplines and length-scales is key to success

Los Alamos NATIONAL LABORATORY

Sandia National Laboratories

Center for Integrated Nanotechnologies

Sandia National Laboratories • Los Alamos National Laboratory

- Highly collaborative DOE National User Facility
- Focused on nanoscience and its integration across scientific disciplines and multiple length scales.
- Open access to tools and expertise to explore the continuum from scientific discovery to the integration of nanostructures into the micro and macro worlds.

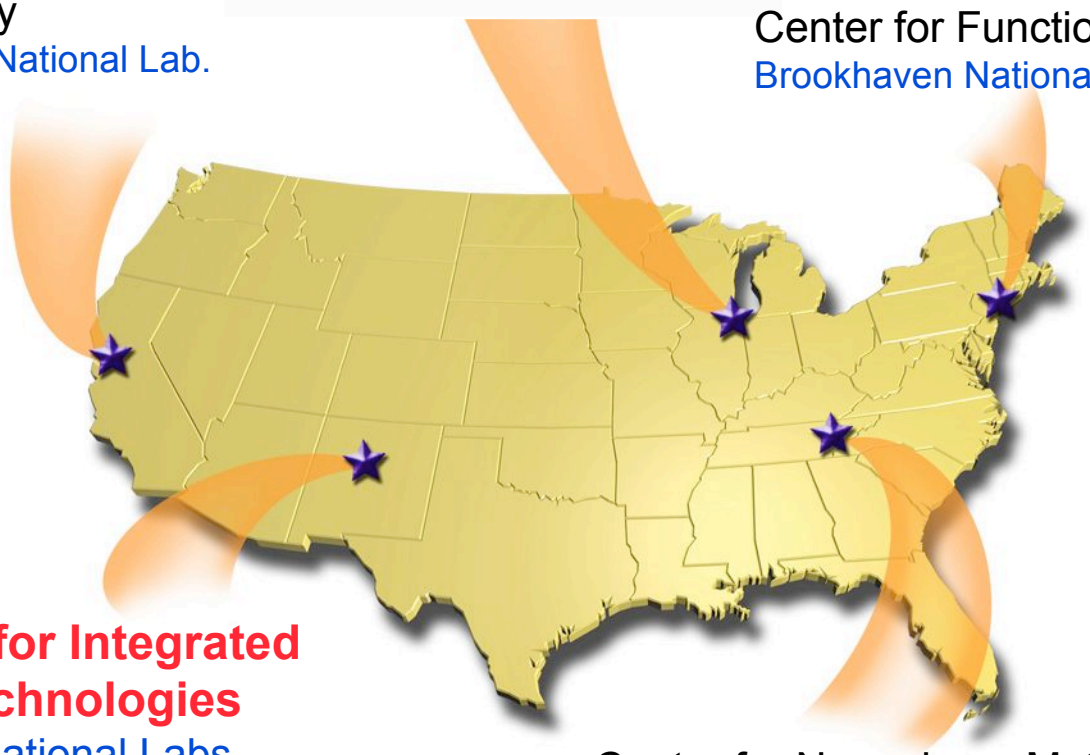
"One scientific community focused on nanoscience integration"

CINT is one of five Department of Energy Nanoscience Centers

Center for Nanoscale Materials
Argonne National Lab.

Molecular Foundry
Lawrence Berkeley National Lab.

Center for Functional Nanomaterials
Brookhaven National Lab.



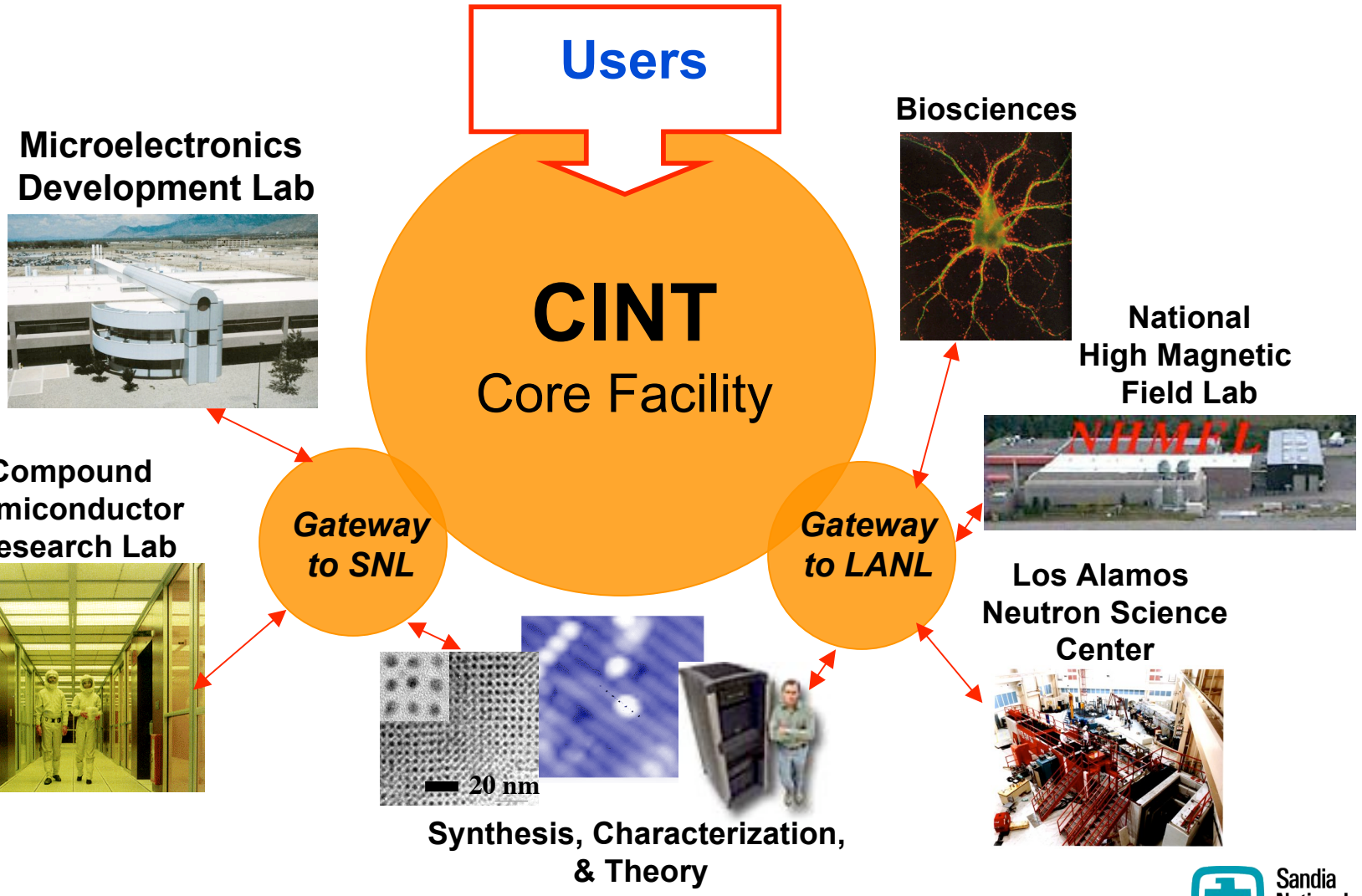
Center for Integrated Nanotechnologies
Sandia National Labs.
Los Alamos National Lab.

Center for Nanophase Materials Sciences
Oak Ridge National Lab.

Los Alamos NATIONAL LABORATORY

Sandia National Laboratories

One community focused on nanoscience integration



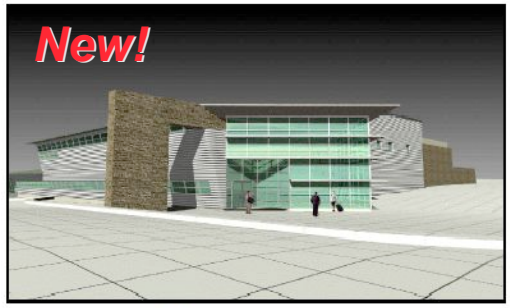
Los Alamos NATIONAL LABORATORY

Sandia National Laboratories

The CINT Core/Gateway model embodied with physical user facilities

Core Facility in Albuquerque

CINT Gateway to Sandia
Nanomaterials/Microfabrication



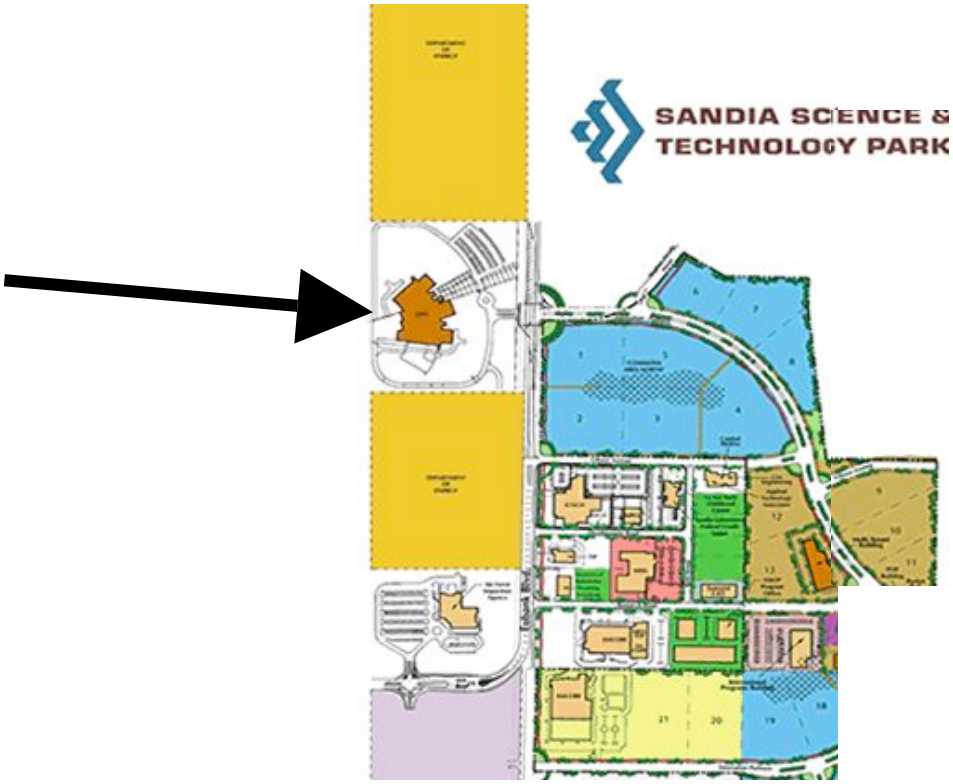
CINT Gateway to Los Alamos
Nanomaterials/Biosciences

Buildings Complete	**November 2005**
Begin Operations	**April 2006**
Fully Operational	**May 2007**

Los Alamos NATIONAL LABORATORY

Sandia National Laboratories

Core Facility is located adjacent to the Sandia Science & Technology Park



- **Low vibration characterization labs**
- **Chemical/biological synthesis labs**
- **Class 1000 clean room**
- **93,000 GSF**

Los Alamos NATIONAL LABORATORY

Sandia National Laboratories

A peek inside the CINT Core Facility!

Los Alamos NATIONAL LABORATORY

Sandia National Laboratories

Key laboratory assets will be available through Gateway Facilities

CINT Gateway to Los Alamos
(Nanomaterials/Biosciences)

Biosciences

Nanomaterials

Theory & Computing

Visitor Space

CINT Gateway to Sandia
(Nanomaterials/Microfabrication)

Microsystems - MESA

Nanomaterials

Theory & Computing

Visitor Space

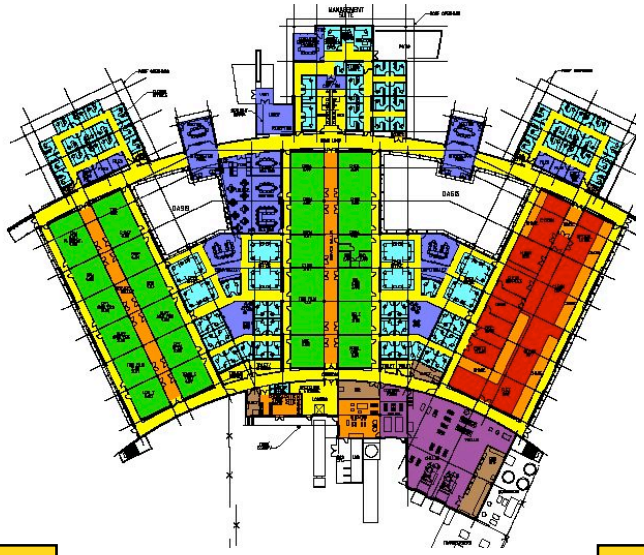
Los Alamos NATIONAL LABORATORY

Sandia National Laboratories

CINT laboratories are supported by state-of-art special equipment

Characterization

- TEM, SEM, FE-SEM
- AFM
- FTIR, UV/VIS, X-ray
- Nano-indenter
- Low Temp Transport
- Ultra-fast Laser Spec.
- Raman Spec.



Integration

- E-beam lithography
- Photolithography
- Thin Film Deposition
- REI, Plasma Etch

Gateway to Sandia

- AT-STM
- IFM
- Chemistry labs
- LB Film
- µ-fluidics

Synthesis

- MBE
- PLD
- P-CVD
- Wet Chem
- Bio

Gateway to Los Alamos

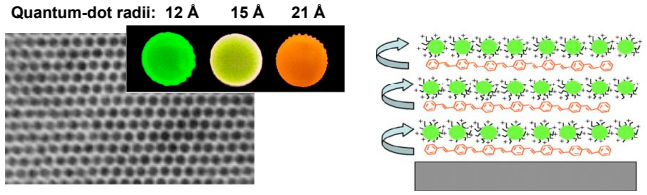
- NSOM, AFM
- Environmental SEM
- Nano-indenter
- Ultra-fast Laser
- Computer Cluster

Los Alamos NATIONAL LABORATORY

Sandia National Laboratories

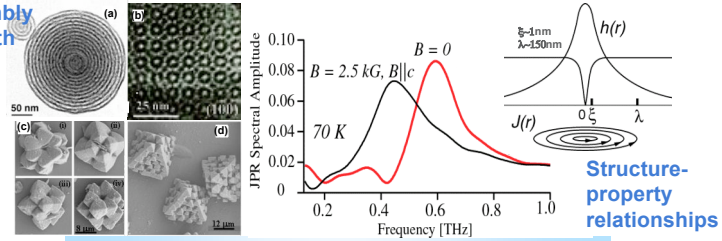
CINT Thrust Areas provide expertise for integration science challenges

Nanoelectronics & Nanophotonics:
Precise control of electronic and photonic wavefunctions



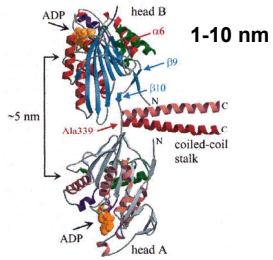
Complex FunctionalNanomaterials:
Relationships between synthesis, structure and complex and emergent properties

Self-assembly on all length scales

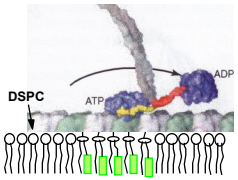


Structure-property relationships

Nano-Bio-Micro Interfaces:
Biological principles & functions imported into artificial bio-mimetic systems



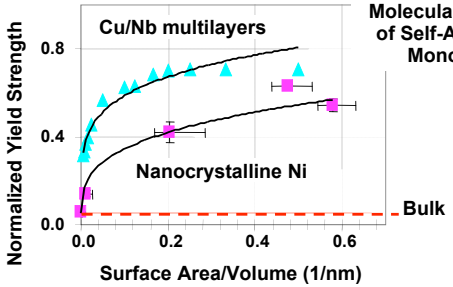
1-10 nm

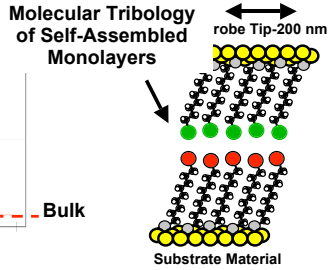


Aggregated receptors

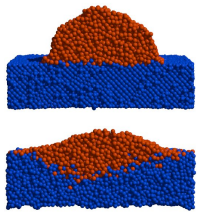
10 -100 nm

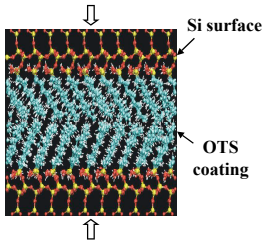
Nanomechanics:
Understanding the mechanical behavior of nanostructured materials

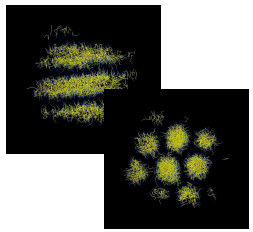




Theory & Simulation:
Theoretical, modeling and simulation techniques for multiple length and time scales and functionality



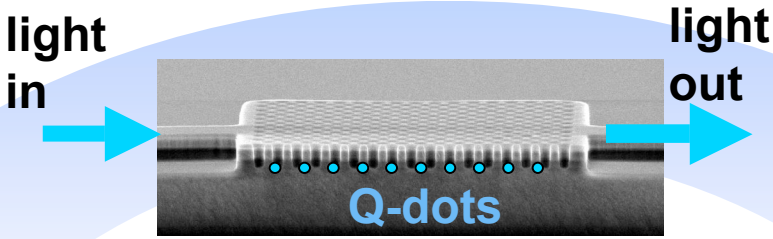




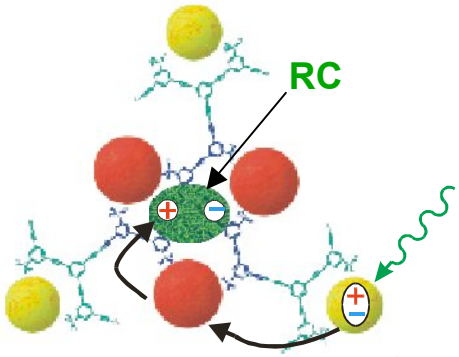
Los Alamos NATIONAL LABORATORY

Sandia National Laboratories

Integration Science Challenge: Energy transfer

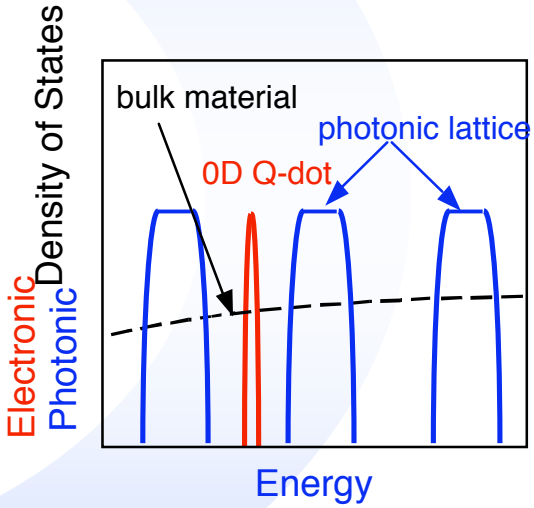


Multi-length scale integration



Nonlinear response: new behaviors for switching, sensing, energy harvesting

Technology Opportunity



Nanoscale physics

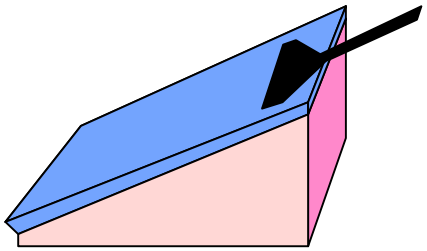
Theory and simulation

Los Alamos NATIONAL LABORATORY

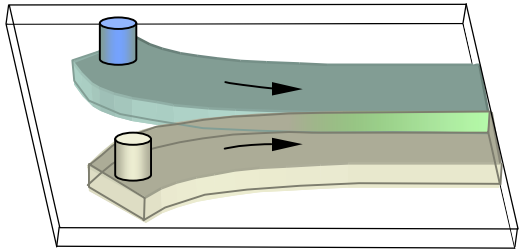
Sandia National Laboratories

New techniques will be developed and made available to user community

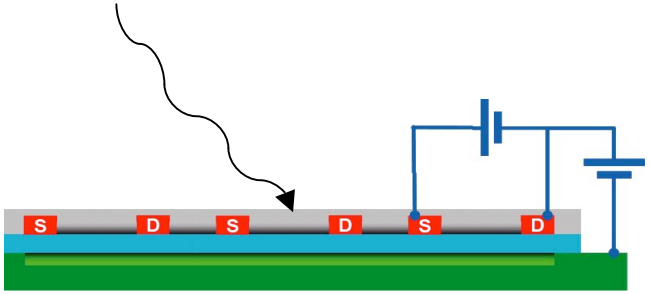
- **Innovative Instrumentation**
  - Atom Tracking STM
  - Magnetic Force Microscope
  - Interfacial Force Microscope
- **Theory and Simulation**
- **Discovery Platforms™**



nanomechanics



microfluidics



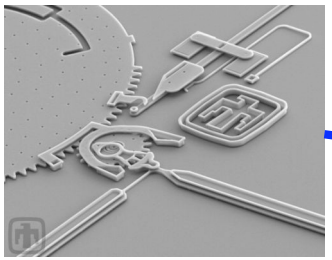
optical, transport

Los Alamos NATIONAL LABORATORY

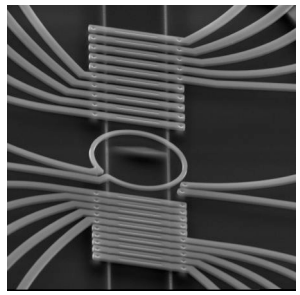
Sandia National Laboratories

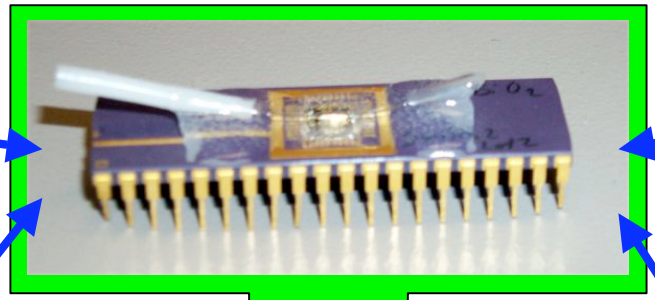
CINT Discovery Platforms™ are micro-labs for nanoscience exploration

Mechanics

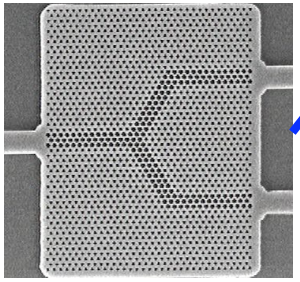


Electronics

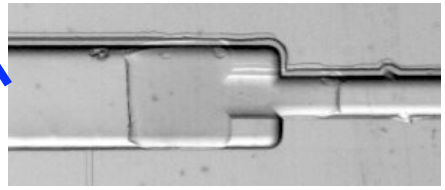


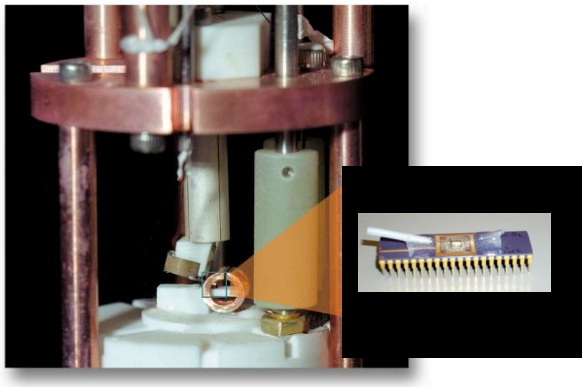


Optics



Fluidics





Discovery Platforms™ will be compatible with characterization instruments

Los Alamos NATIONAL LABORATORY

Sandia National Laboratories

Researchers access CINT via the User Program

- **Universities**
  - Postdocs, students and visiting faculty researchers.
- **Industry**
  - Pre-competitive and propriety research mechanisms.
- **Other Laboratories**
  - Other Federal agencies.
- **International Science Community**
  - Open to the international science community

Key Aspects of User Program

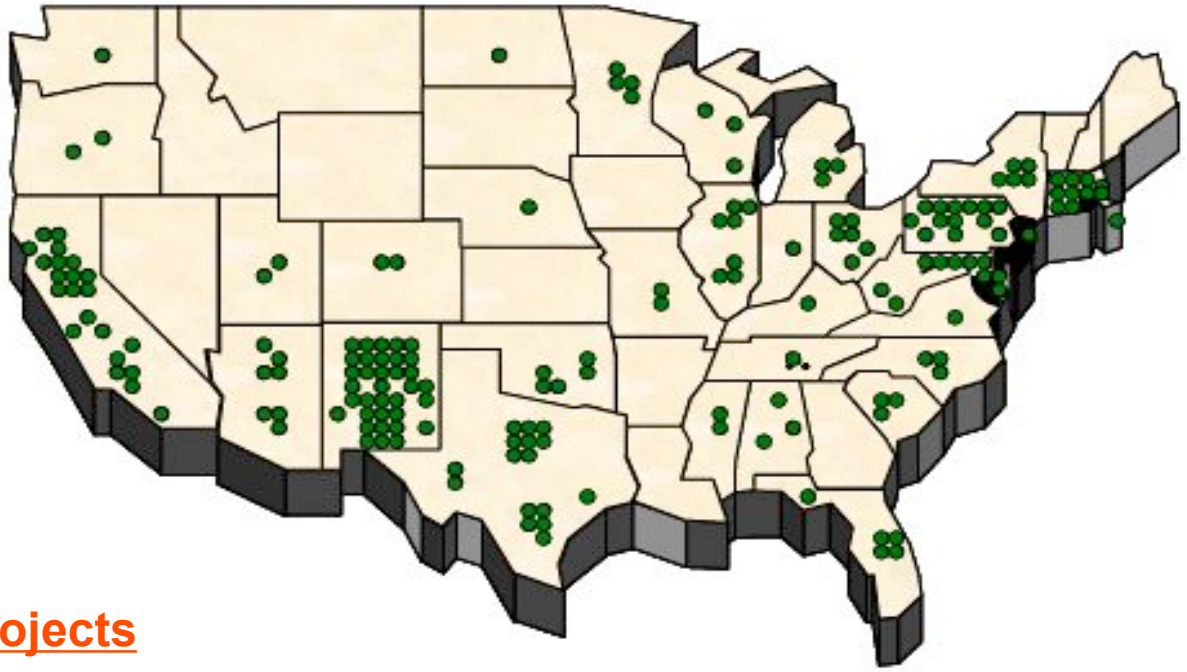
- **Open access to facilities based on user proposal quality**
- **Spectrum of user modes**
  - **Access to equipment**
  - **Collaborative research**
  - **Multi-year projects**
- **External evaluation of proposals**
- **Mechanisms for proprietary work**
- **User program "jump-started" in FY03**
- **Normal operations start April 2006**

http://CINT.sandia.gov* or *http://CINT.lanl.gov

Los Alamos NATIONAL LABORATORY

Sandia National Laboratories

External users are already working at CINT



Jump-start Projects

Two rounds (2003 & 2004)
188 proposals submitted
68 projects approved
40 institutions (37 academic)
23 states, 3 foreign countries

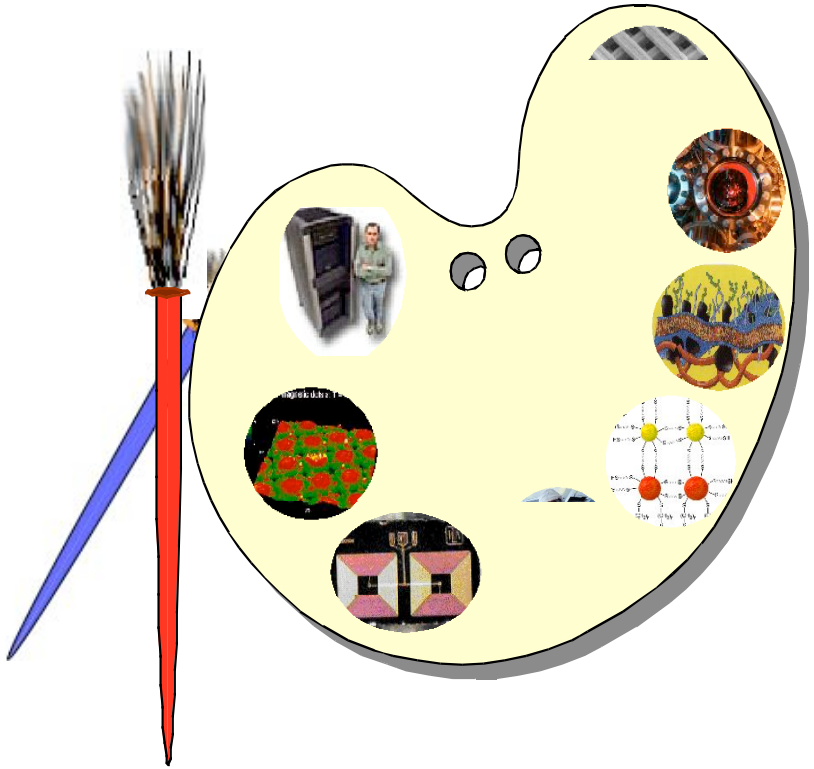
3rd Jump-start Round (2005)

70 proposals received
21 additional projects launched

Los Alamos NATIONAL LABORATORY

Sandia National Laboratories

CINT: A National user facility for nanoscience integration research



Upcoming Events

4th CINT Users Workshop
Albuquerque, NM
January 12-13, 2006

Next Call for User Proposals:
January 2006

http://CINT.sandia.gov *or* http://CINT.lanl.gov

Los Alamos NATIONAL LABORATORY

Sandia National Laboratories