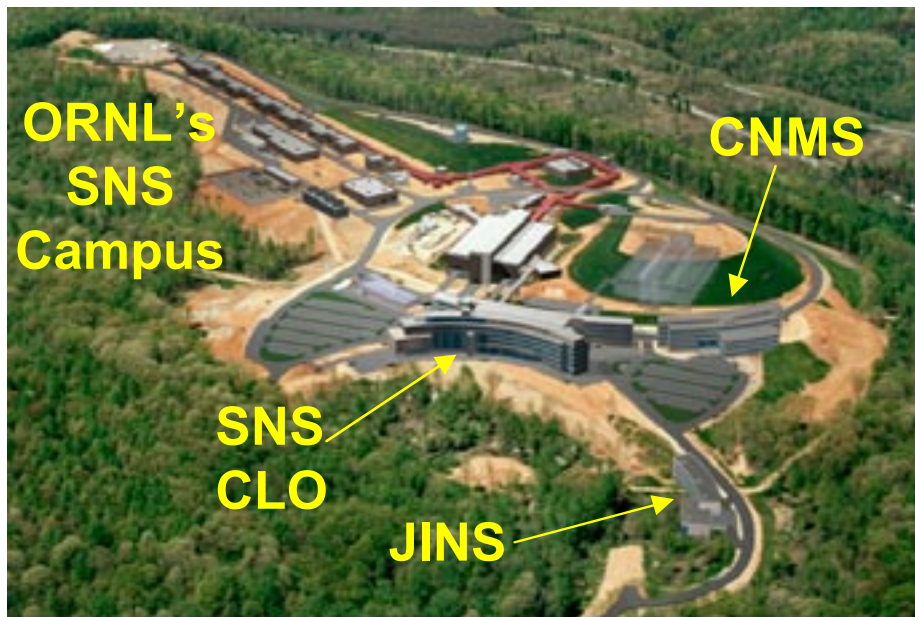


Oak Ridge National Laboratory has been selected to develop, together with the university community, a highly collaborative and multidisciplinary Nanoscale Science Research Center

The Center for Nanophase Materials Sciences

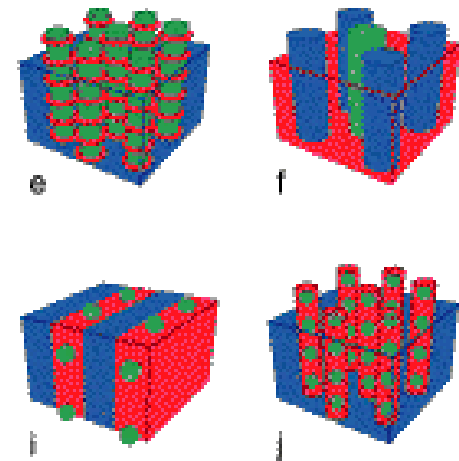


- **CNMS Concept: *Create Scientific Synergies to Advance Understanding***
- **Operations and Outreach: *Enabling Multidisciplinary Collaboration***

A Significant Characteristic of Nanoscale Science

THE GREATEST CHALLENGES AND OPPORTUNITIES REQUIRE WORKING AT A SET OF INTERFACES

- **Understanding:** Boundaries of academic disciplines
 - Physics / chemistry / biology / computational science / engineering
- **New Technology:** Requires Integrating “Soft” & “Hard” Materials Sciences
 - Different tools, different expertise
 - Both needed for new Nanotechnology
- **Nanometer Length Scale:** Midway between
 - Atomic-scale (masters of understanding)
 - Sub-micron scale (masters of miniaturization)



Triblock copolymer morphologies

***Current Scientific Infrastructure Not Well Suited
for Research or Education at the Nanoscale***

The BES Challenge for Nanoscale Science Research Centers

Maximize resources and promote multidisciplinary interactions, to enable research of a scope and depth beyond current national capabilities

Clear Intent

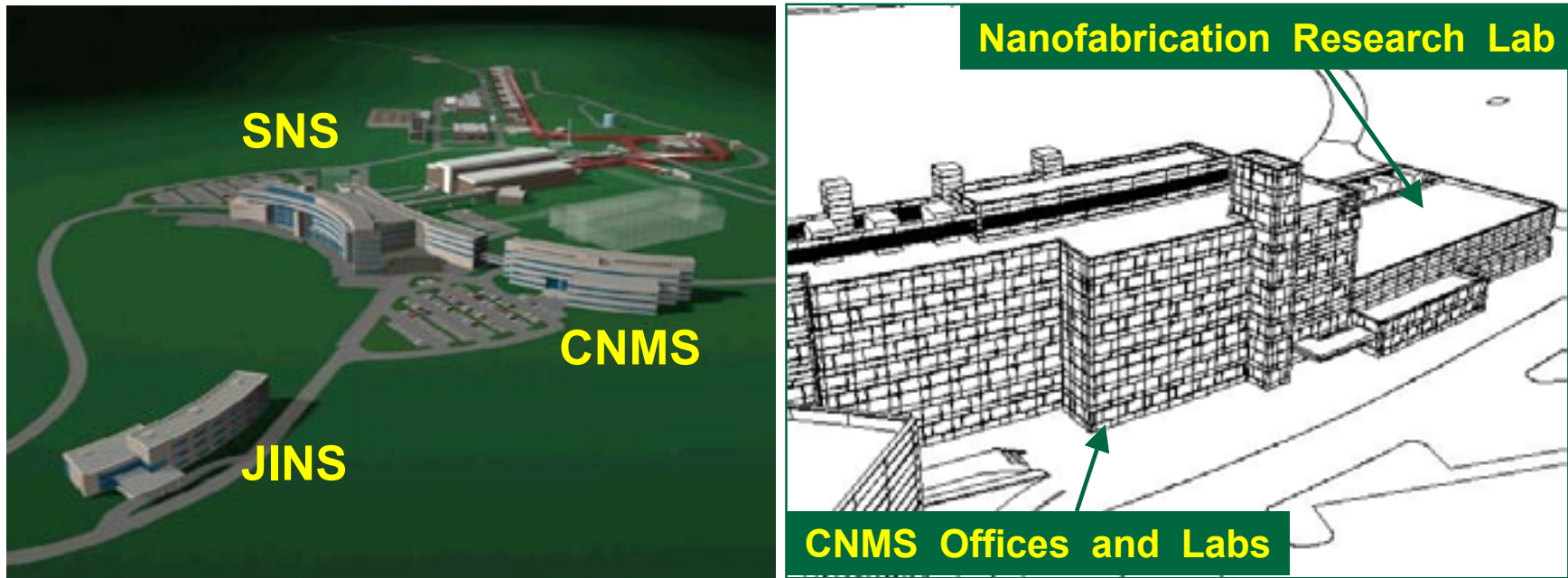
- Focus research on largest, most fundamental challenges to understanding nanoscale materials and phenomena
- Assemble resources--people, facilities, collaborative expertise--and create synergies that will rapidly advance knowledge of nanoscale materials and phenomena
- Identify ways to integrate uniquely nanoscale phenomena and properties with the micro- and macro- scales
- Create an environment for multidisciplinary research education

Key Questions for Responding to the BES Challenge

- **What capabilities does each National Laboratory have to make **unique** contributions to nanoscale understanding, at the **highest** scientific level?**
- **What **synergies** do we need to create to **ensure the fullest use** of these capabilities, both for **new science** and for the **education** of a new generation of scientists?**
- **How can we structure collaborations with Universities to **accelerate the pace of Discovery** in nanoscale science?**
- **What **capabilities** are needed for **integration** of nanoscale materials and phenomena?**

Center for Nanophase Materials Sciences

A *highly collaborative, multidisciplinary* research center



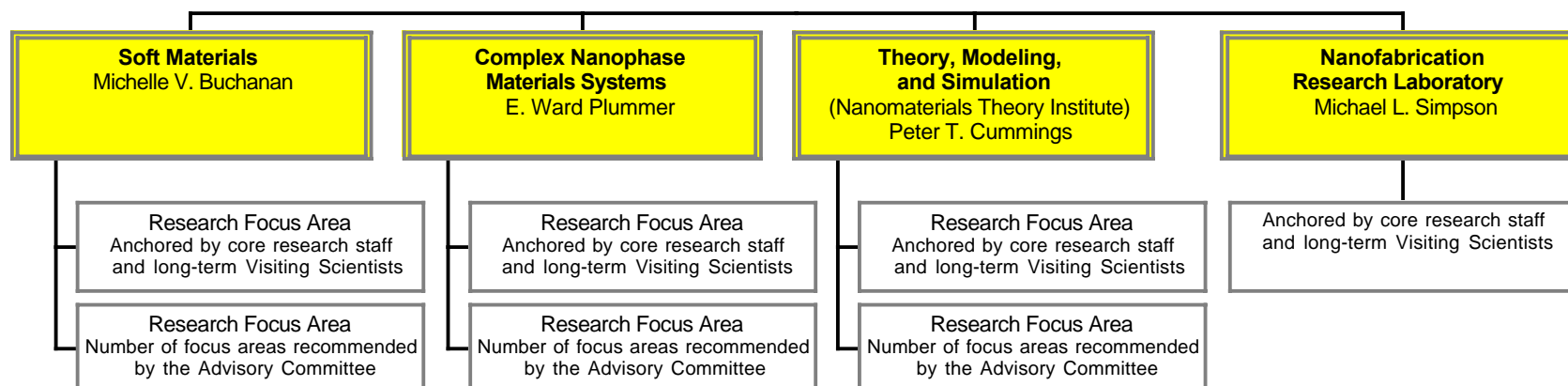
Co-located with the Spallation Neutron Source (SNS)
and the Joint Institute for Neutron Sciences (JINS)
on ORNL's "new campus"

CNMS Integrates Nanoscale Science with Three Synergistic Research Needs

- **Neutron Science [SNS + Upgraded HFIR]**
 - Opportunity to assume world leadership using unique capabilities of neutron scattering to understand nanoscale materials and processes
 - Challenging nanoscience focus helps grow the U.S.-based neutron science community to levels found elsewhere in the world
- **Synthesis Science [Nanofabrication Research Laboratory]**
 - *Science-driven* synthesis: Key role of synthesis as enabler of new generations of advanced materials; evolution of synthesis via TMS
 - More efficient methods: Search & Discovery; new synthesis pathways
- **Theory / Modeling / Simulation (TMS) [Nanomaterials Theory Institute]**
 - Stimulate U.S. leadership in using TMS to design new nanomaterials
 - Investigate new pathways for materials synthesis

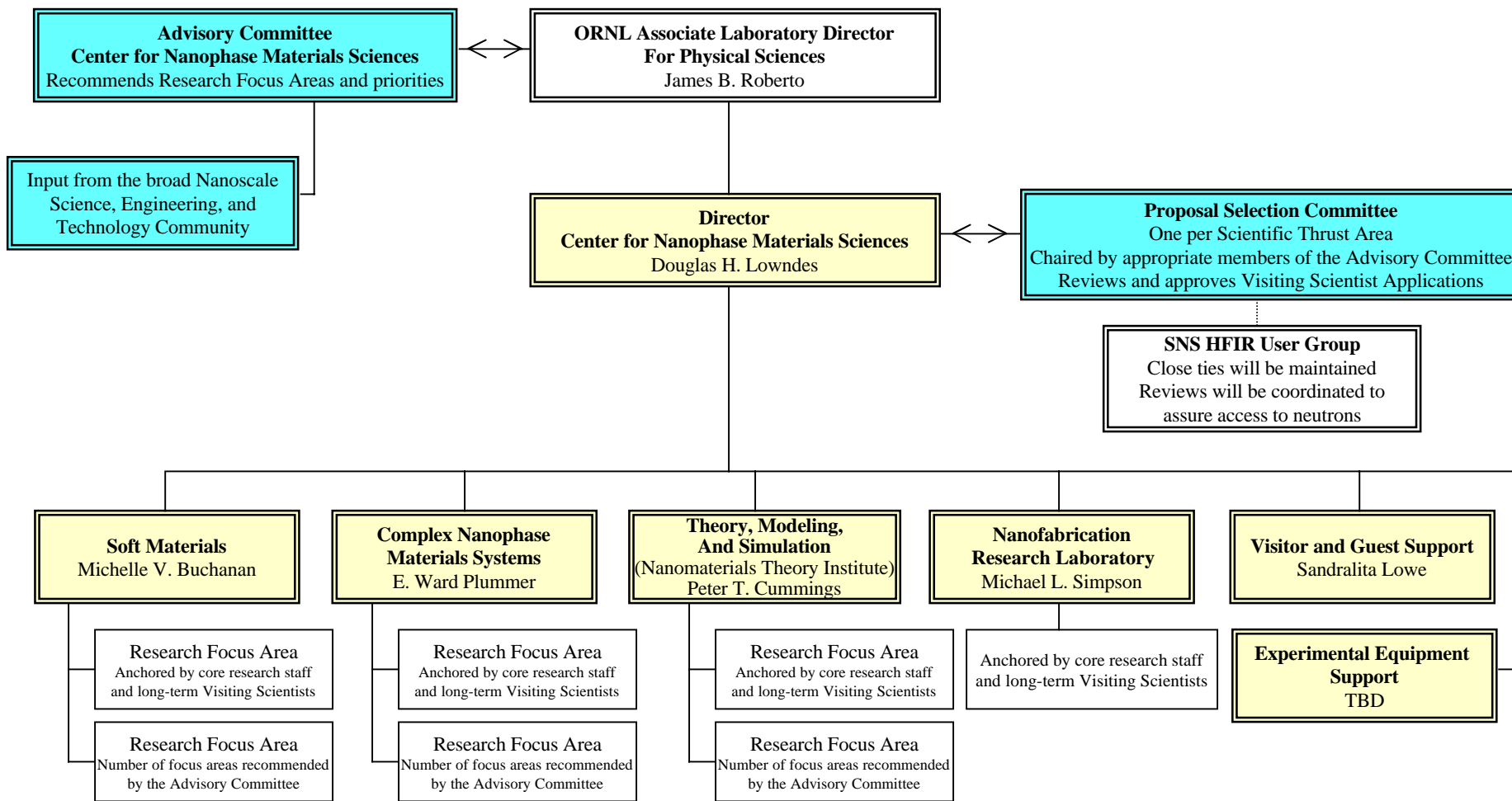
*CNMS will create and exploit synergies among these and with the university community, to **accelerate the pace of Discovery** and produce a **nonlinear return** on investment*

Organization of Research in the CNMS



- **Three “Scientific Thrusts” + Nanofabrication Research Lab**
 - **Soft Materials** -- Michelle Buchanan
 - **Complex Nanophase Materials Systems** -- Ward Plummer
 - **Nanomaterials Theory Institute** (Theory / Modeling / Simulation) -- Peter Cummings
 - **Nanofabrication Research Laboratory** -- Michael Simpson
- **~ 10 Multidisciplinary “Research Focus Areas”**
 - Anchored by permanent staff + long-term visitors (“core” research staff)
 - Dominated numerically by graduate students, postdocs, short-term visitors

Governance of the Center for Nanophase Materials Sciences



Key to Chart colors
 Yellow: CNMS Leadership Team
 Blue: External Advisory Groups and Committees

Advisory Committee

- **Experts in 3 Scientific Thrusts (STs) and Nanofabrication Research**
 - Additional expertise in neutron scattering and other areas determined by the Chair (e.g. synthesis)
 - **Chair to be named in FY2002**
- **Responsibilities**
 - [1] Recommend Research Focus Areas and priorities
Input: Director, ST Leaders, research community (Workshops, reports)
 - [2] Review Committee for ongoing research / educational activities
 - [3] Can recommend discontinuing a Research Focus Area (or Scientific Thrust) for cause (lack of progress; lower priority than emerging science)
- **Nine Advisory Committee Members**
 - 6 external, 3 internal
 - **Initially:** Appointed by ORNL Assoc. Lab Director (ALD), in consultation with CNMS Director, ST Leaders & Advisory Committee Chair
 - **Steady state:**
Nominated by collaborating community and Advisory Committee
Approved by ALD in consultation with CNMS Director + ST Leaders

***The Advisory Committee has teeth in order to
provide the Center with flexibility to evolve***

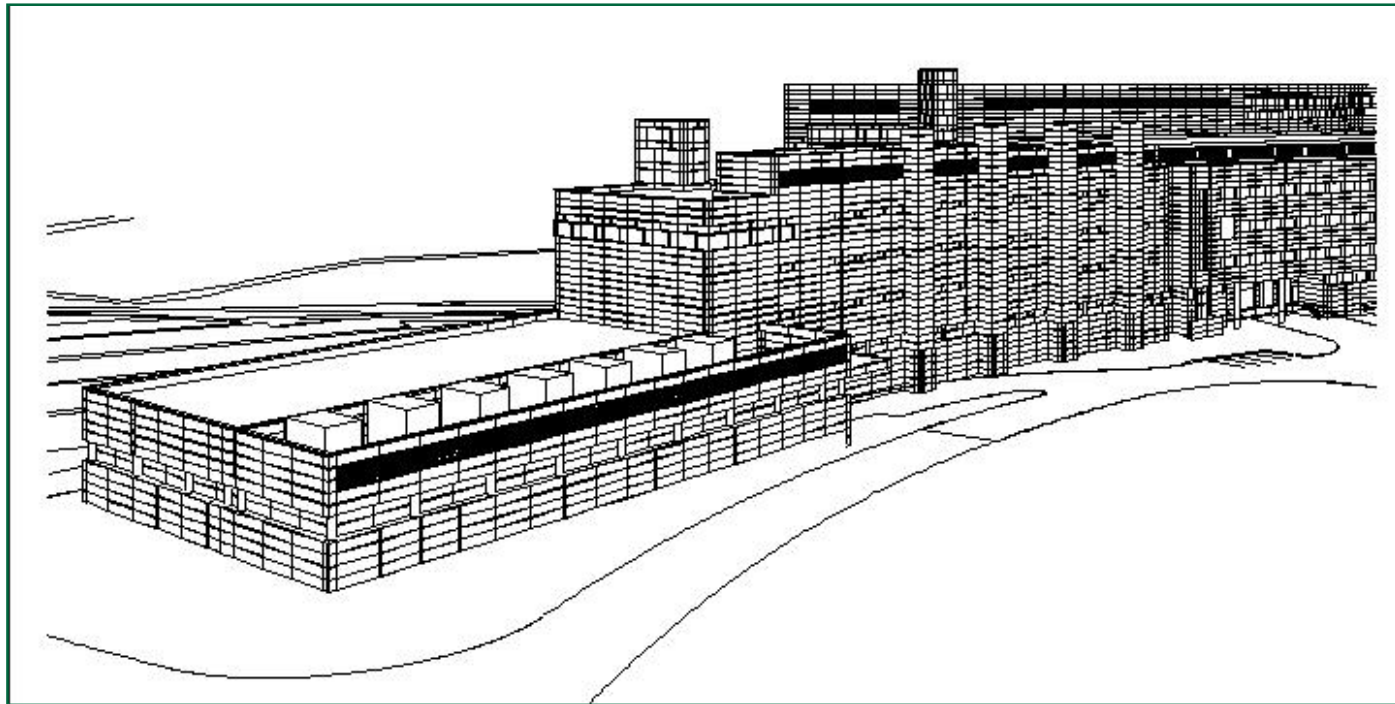
Access by Visiting Scientists

[Similar to CRC Visiting Scientist Selection Process]

- **Through Proposal Selection Committees**
 - One for each Scientific Thrust (three initially)
 - Review and prioritize proposals for short-term access
 - Each Chaired by a member of the Advisory Committee
 - Members include Scientific Thrust Leader & CNMS Director (ex officio)
 - Chair selects other internal and external members from the nanoscience community
- **Input to the Selection Committees: Peer Review** (e-mail or mail)
- **Single Application Process**
 - Internally coordinated with SNS – HFIR User Group (SHUG)
 - Internally coordinated with other ORNL CRCs or User Facilities

TIMELY ACCESS WITH ONLY ONE APPLICATION

CNMS Operations and Outreach: ***Enabling Multidisciplinary Collaborations***



CNMS Mode of Operation

- **Flexible and multidisciplinary**
 - 18 FTE (≥ 27 actual) permanent ORNL-derived research staff
 - ~ 10 Research Focus Areas that evolve and can be changed
- **Highly collaborative (mainly universities; industry, other NLs)**
 - “Core” res. staff includes 18 FTE (≥ 27 actual) long-term visitors
 - Up to 36 postdocs from universities, national labs, industry
 - Hundreds of graduate students and short-term visitors per year

1/2 to 3/4 of FTEs from other institutions
- **Responsive to scientific community**
 - Advisory Committee guides choice of scientific directions
 - *Major university presence* in both staffing and governance
- **Highly leveraged and coordinated:** Infrastructure investments (personnel and equipment) reflect regional and national needs

Maximize resources, promote multidisciplinary interactions, enable research of scope and depth beyond current national capabilities

CNMS Planning Is Highly Leveraged and Driven By Input from University Researchers

- **Initial input from 19 universities** regarding **CNMS mode of operation, research needs,** and complementary nanoscience activities
Clemson, Duke, Florida St., Georgia Tech, Harvard, Kentucky, MIT, Minnesota, NC State, Northwestern, Penn, Princeton, U. Ala.-Birmingham, U. Mass., U. NC, U. Tenn., U. Virginia, Vanderbilt, Virginia Tech
- **Infrastructure investments (organization, equipment, personnel)**
 - **Reflect directly expressed national and regional university needs**
 - Complement or extend existing ORNL and university capabilities
 - Ensure full use of other ORNL facilities for nanoscale materials research
- **“Straw man” equipment list** prepared with **input from 15 universities**
 - Materials synthesis & nanofabrication; chemical & physical characterization
 - Special sample environments for neutron experiments
 - Computational infrastructure

NOW IN PLANNING & DESIGN PHASE

- **GOAL:** *Unique nanoscience research and education experience for new generation of graduate students and postdoctoral scholars*

Overcoming Barriers to Multidisciplinary Research Education

CNMS Scholarships for Graduate Students and Short-Term Postdoctoral Visitors

- **Scholarships cover full-time local living expenses (per diem) for 35 FTE graduate students and 35 FTE short-term research visitors**
 - Hundreds in practice (est. 300 - 750 / year, depending on duration of visit)
- **Criterion: Quality of the Science**
 - Proposal Selection Committee approval required

PURPOSES

- **Overcome a financial barrier**
 - Currently discourages university groups from providing grad students and postdocs with **collaborative, multidisciplinary research experience** using **specialized national facilities**
- ***Increase the pool of young scientists with multidisciplinary nanoscale research experience***

Overcoming Barriers to Multidisciplinary Research Education

CNMS Support for Postdoctoral Scholars

- **CNMS Support for 18 FTE Postdoctoral Scholars**
 - Expect up to 36 people jointly supported with university research groups
 - MODEL: ≤ 6 postdocs hired fully by CNMS, ≥ 24 hired jointly with collaborating groups

CRITERIA FOR POSTDOCTORAL SUPPORT

Center funds will not be the sole support but will leverage other peer-reviewed research funding (e.g. NSF)

- Highly motivated research partners with own research support
- Quality of the Science: *Proposal Selection Committee approval required*
- Advisory Committee recommendations for Research Focus Areas and budget allocations
- Rapidly establish new research direction (Advisory Committee recommendation)

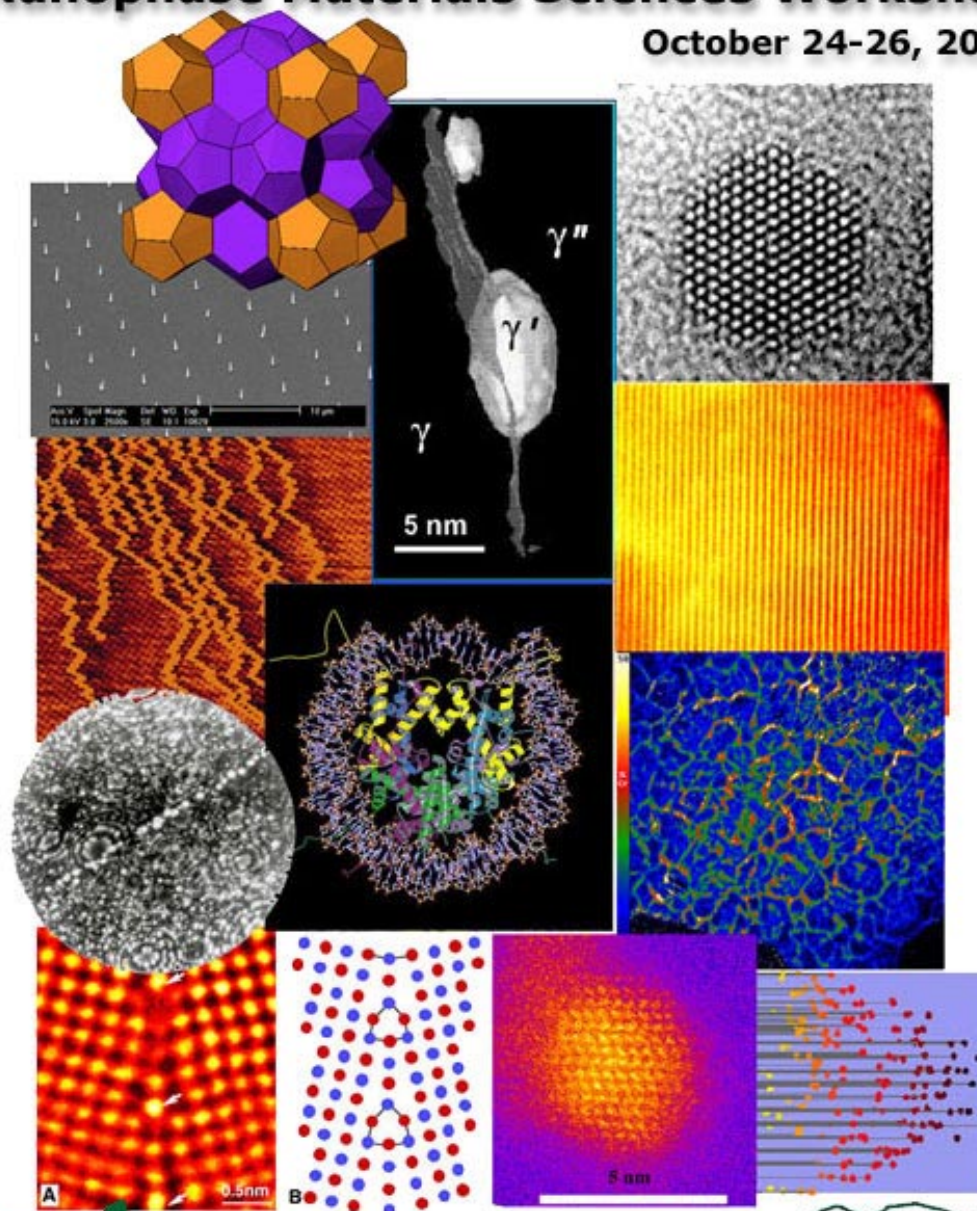
The Nanofabrication Research Laboratory

- Will be operated as a **regional research facility** within the CNMS, in collaboration with the university community
- Will integrate “soft”- and “hard”-materials approaches in the **same structures**, and conduct research on **directed self-assembly** for nanofabrication and linking to the microscale
- Will provide access to clean rooms, electron-beam lithography, high-resolution electron microscopy, various scanning probes, and **specialized materials-handling facilities**
 - Fabrication and characterization tools in the service of nanoscience
- By exploiting the **extensive synthesis capabilities of the CNMS**, the NRL can develop **unique** nanofabrication capabilities

The NRL will satisfy the strongly felt need of universities for a well-equipped nanofabrication facility to enable nanoscale science investigations

Nanophase Materials Sciences Workshop

October 24-26, 2001



ornl

UT-BATTELLE