



# **DMR Support for National User Facilities and Major Instrumentation Projects**

Solid State Sciences Committee  
The National Academies, Washington, DC  
6 April 2006

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Acting Director, Division of Materials Research



# The National Facilities Program in DMR

- NAF program supports unique experimental capabilities for materials research and a wide range of other disciplines
  - USER FACILITIES for the research and education communities
  - Specialized high-cost, state-of-the-art instruments
  - Resources and research experience for students
  - Student and teacher education, general public awareness, curriculum development materials, educational outreach
- NSF normally supports construction and operation costs
- Facilities are open to researchers at US and international academic institutions, government and industry based on competitive proposals



## DMR National Facilities

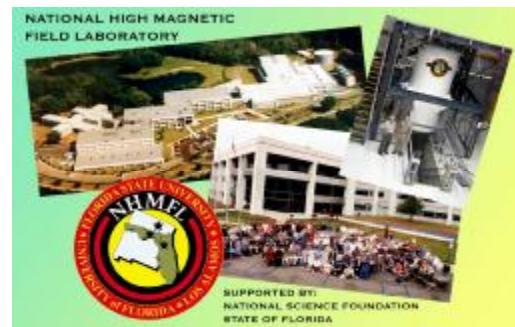
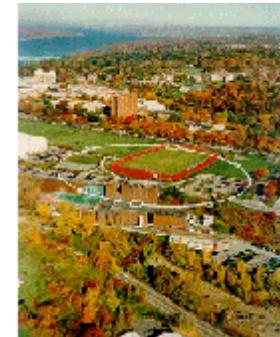
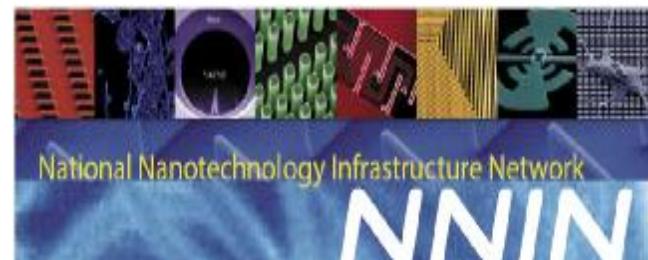
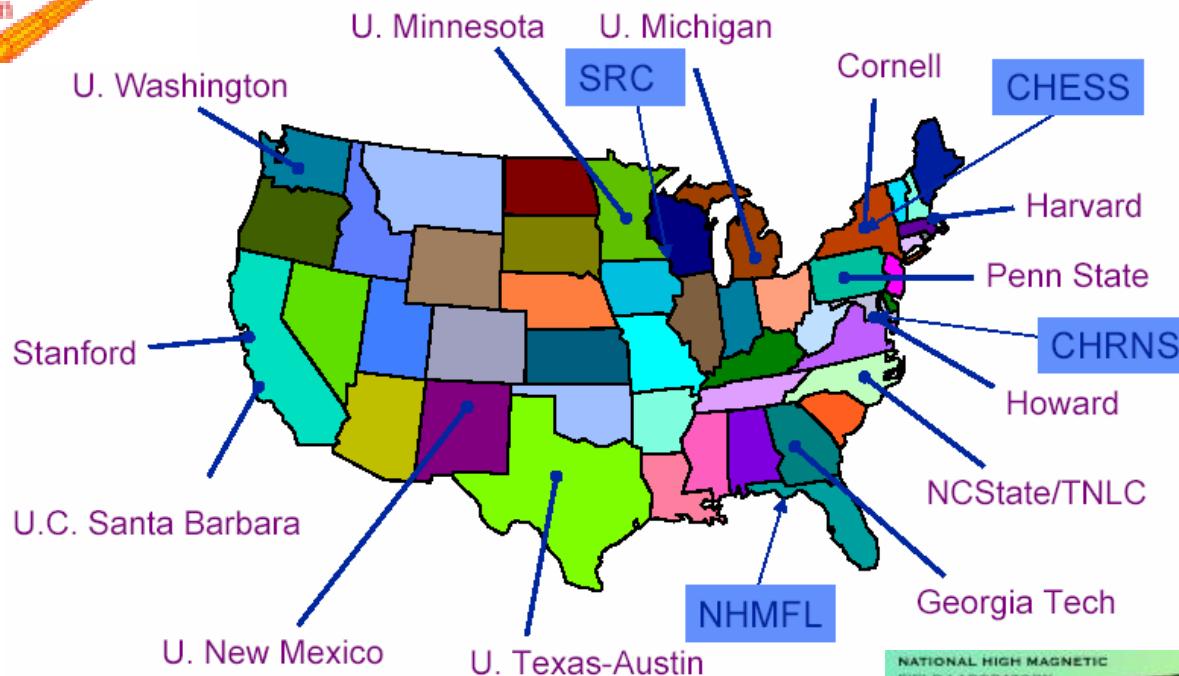
- National High Magnetic Field Laboratory
  - Florida State University, University of Florida, Los Alamos NL
  - Partnership between NSF and the State of Florida
- Neutron Facility
  - CHFRNS at the National Center for Neutron Science, NIST
- Synchrotron Facilities
  - CHESS at Cornell University (NSF-PHY supports CESR)
  - SRC at the University of Wisconsin
  - *CHEM/MAT/CARS beamline at APS (NSF-CHE lead)*
- Nanotechnology Facilities
  - National Nanotechnology Infrastructure Network
    - 13 Universities
    - **NSF-ENG lead**, plus DMR, CHE, BIO co-funding



# DMR NATIONAL FACILITIES

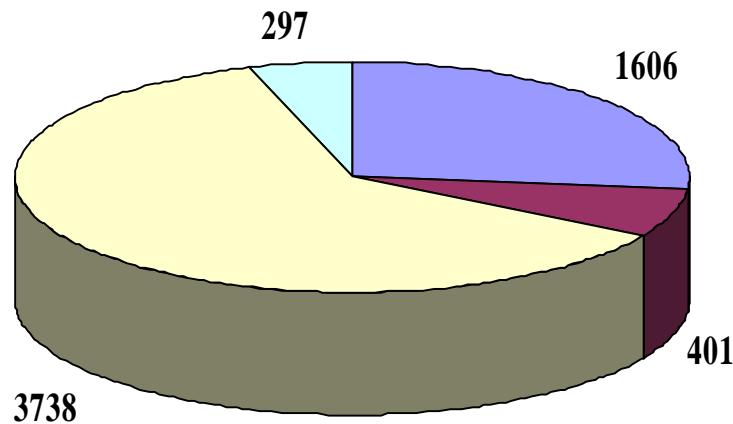


## National Facilities & NNIN Sites

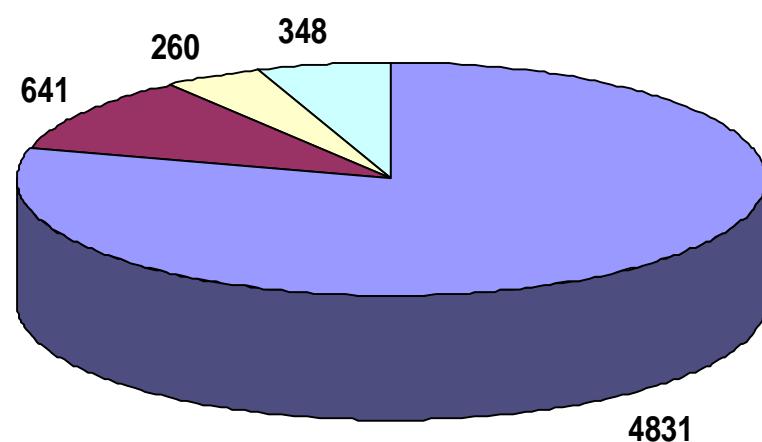




# Researchers Using DMR Facilities



- Faculty and senior researchers
- Postdocs
- Graduate students:  
■ undergraduates



- US colleges and Institutions University
- Industry
- Government Organizations
- Foreign Institutions

**Center for High Resolution Neutron Scattering**  
**Cornell High Energy Synchrotron Source**  
**National High Magnetic Field Laboratory**  
**Synchrotron Research Center**  
**National Nanofabrication Infrastructure Network\***



# National High Magnetic Field Laboratory

<http://www.magnet.fsu.edu/>



- Established 1991, renewed 1996 and 2001, extended 2006
- Continuous-field and pulsed magnets, high B/T, magnetic resonance facilities
- ~900 users annually
- Major magnet development projects include 45T, 900MHz wide-bore NMR, 60T long pulse, 100 T Pulse (with DOE)
- Current Award (\$26M/year) ends December 2007
- **COMMUNITY GUIDANCE and FUTURE PLANS**
  - **NAS COHMAG Report 2005 ‘Opportunities in High Magnetic Field Science’**
  - **NSF Panel on Future Support for High Magnetic Fields 2005**
    - Richardson, Maple, Moore, Sarachik, Greene, Evans-Lutterodt, Tycko
    - Recommended renewal review rather than recompetition
  - **DMR plans renewal review during FY 2007**



# Two University-based Synchrotron Facilities

<http://www.chess.cornell.edu/>    <http://www.src.wisc.edu/>

- **Unique Characteristics**

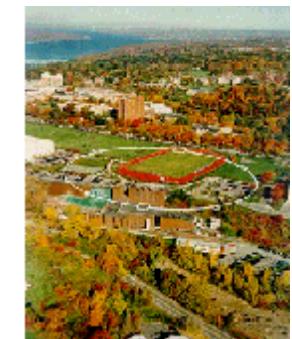
- Education & training of accelerator physicists and synchrotron scientists
- Long beam times allocated for difficult and time-consuming experiments

- **CHESS - based on the Cornell Electron Storage Ring**

- Hard x-rays, 4-100keV. ~500 users annually (~300 from bio)
- Research in CMP, surface science, chemistry, biology, environmental sciences, materials
- MacCHESS, NIH Research Resource for protein crystallography (including hazardous viruses)
- DMR support since 1979, 5 year renewal FY 2003. BIO, NIH co-fund

- **SRC – Stoughton, WI**

- Soft x-rays UV, 5-1000eV. >300 users annually
- Studies of valence electrons, correlated electron systems, superconductors, magnetism, nanostructures, atoms/ions/molecules
- Microanalysis of cells, tissues and minerals
- Nanolithography (EUV and x-ray) and metrology for nanocircuit fabrication
- DMR support since 1977, 3 year renewal FY 2006





# Neutron Scattering Facility



## Center for High Resolution Neutron Scattering

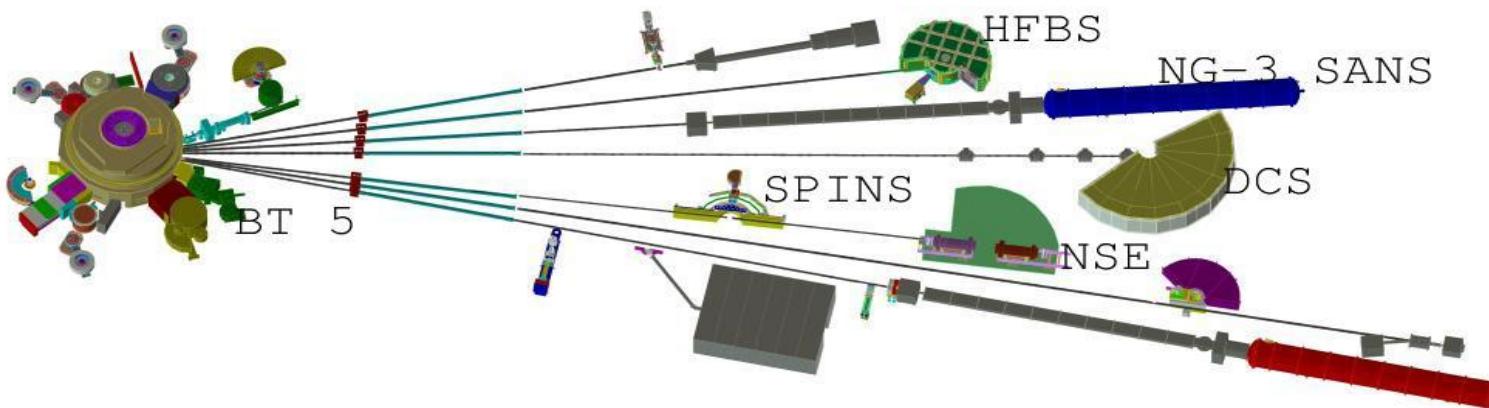
- Supported jointly by DMR and NIST (NCNR)
  - Length scales from 1nm to over 1micron
  - Time scales from 10fs to 100ns
  - Projects in materials science, chemistry, biology, CMP
  - Polymers, metals, ceramics, magnetic materials, porous media, fluids and gels, biological molecules
  - Annual summer school for graduate students, postdocs, other potential users
  - DMR support since 1989, over 450 users annually



# Center for High Resolution Neutron Scattering

<http://www.ncnr.nist.gov/programs/CHRNS/>

## CHRNS INSTRUMENTS



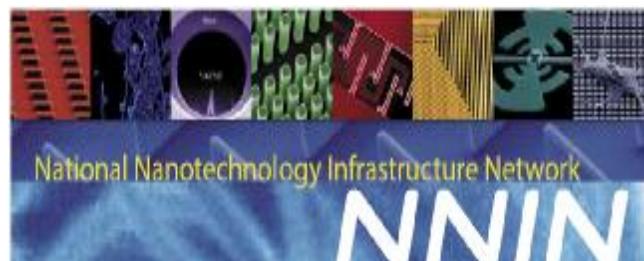
- a 30 meter, high resolution, small-angle neutron scattering instrument (NG3)
- a diffractometer for ultra-high-resolution small angle scattering (USANS)
- cold-neutron, triple-axis, neutron scattering spectrometer (SPINS)
- a very flexible cold-neutron time-of-flight spectrometer (DCS)
- a backscattering spectrometer with 1 microeV resolution (HFBS)
- a neutron spin echo spectrometer (NSE)



# National Nanotechnology Infrastructure Network

established 2004

[www.nnin.org/](http://www.nnin.org/)



An national network partnership of user facilities for nanoscale science, engineering and technology

~3500 users annually from industry, academia, and government labs

Access to tools for fabrication, synthesis, characterization, design, simulation, and integration

Projects reviewed for technical feasibility



# New DMR Program began FY04

## NSF 05-513 (updated)

### Mid-Scale Instrumentation Projects (IMR-MIP)

#### Instrumentation for Materials Research

- **~\$2M - \$20M per instrument**  
e.g. beamline instrumentation, high-field magnets, etc.
- **2 types of proposals**
  - Conceptual & Engineering Design
  - Construction
- **6 CED awards made to date**
- **FY 06 competition currently underway**

DMR contact Dr. G.X. Tessema – [gtessema@nsf.gov](mailto:gtessema@nsf.gov)

***Separate competition for IMR (Instrument Development) also planned for FY 2007***



# DMR MidScale Instrumentation Awards

FY 2004 and 2005

## Magnets, Neutrons, Light Sources

- CNST: Low Energy Neutron Scattering \$3.1M
- CED: Neutron Vibrational Spectrometer at SNS \$1.5M
- CED: Series Connected Hybrid Magnet \$1.8M
- CED: Free Electron Laser Light Source
  - for High Magnetic Field Research \$1.8M
- CED/CNST: Thermal Neutron Imaging System for SNS \$2.0M
- CED: Distributed Data Analysis
  - for Neutron Scattering Experiments (DANSE) \$1.0M
- CED: Phase I Energy Recovery Linac (ERL)
  - *DMR, PHY, CHE, OMA* \$18.0M
- Additional CNST + CED awards are planned for FY 2006



# Reports and Community Guidance

- Cooperative Stewardship (NRC 1999)
- S&E Infrastructure for the 21<sup>st</sup> Century (NSB 2003)
- Advanced Research Instrumentation and Facilities (NAS 2005)
- Midsize Facilities (NRC 2006)
- Opportunities in High Magnetic Field Science (NRC 2005)
- Future Support for High Magnetic Fields (NSF 2005)
  - ('Richardson Panel')
- Interagency WG on Neutron Science (OSTP 2002)
- Interagency WG on Synchrotron Science (OSTP, summer 2006)



# Support for Facilities and Instrumentation

## A Specific Challenge for DMR

- Program balance and budget constraints
- Maintain support for individuals and small groups (COV)
- DMR budget changes 1995-2005 (current dollars)
  - Individuals and Small Groups Programs, ITR +39% (05 \$117M)
  - Centers, PREMs and IMIs +25% (05 \$70M)
  - **Facilities & Instrumentation** +52% (05 \$47M)
  - All Other +59% (05 \$6M)
  - **DMR total** +37% (05 \$240M)
- Support for university-based synchrotron facilities?
- Support for “Mid-Scale Instrumentation” including beamlines at national facilities?
- Role of CHRNS in context of the SNS?
- NSF support for a future ERL?
  - Formal process via the MREFC account (constr. >\$100M)
  - Director’s Office and NSB review/approval
  - (N-3) rule