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Title: National High Magnetic Field Laboratory - Pulsed Field Facility

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NATIONAL HIGH MAGNETIC FIELD LABORATORY - PULSED FIELD FACILITY

Probing and characterizing the thermodynamic properties of new materials to understand their behavior and discover new states of matter

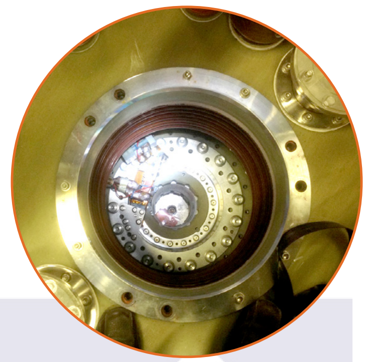
Home of the world's first nondestructive magnet to exceed 100 T, the National High Magnetic Field Laboratory-Pulsed Field Facility (NHMFL-PFF) at Los Alamos National Laboratory specializes in materials science at the highest possible magnetic field intensity.

USER PROGRAM

The Pulsed Field Facility is part of the National High Magnetic Field Laboratory user program, allowing researchers access to a wide variety of experimental capabilities in pulsed magnetic fields and collaboration with some of the world's leading experts in high field condensed matter physics and pulsed magnet science. The NHMFL-PFF is open to all scientists via a competitive proposal process.

HIGH FIELD CAPABILITIES

Non-destructive magnets – Short duration magnetic fields are necessary to overcome runaway heating of the magnet solenoid at high current and to minimize the duration of materials stress due to the magnetic forces.



Short pulse magnets (capacitor driven)

- **Field strength:** 65 T, 10 ms rise time, 100 ms duration (15 mm, 75 K bore; 8 mm, 0.5 K sample space)
- **Field strength:** 72 T, 10 ms rise time, 100 ms duration (7 mm, 75 K bore; 3 mm, 0.5 K sample space)

Long pulse magnet (generator driven) *(adjustable pulse shape)*

- **Field strength:** up to 60 T, 3 sec duration with up to 100 ms full field flat top, (25 mm 75 K bore; 18 mm 0.5 K sample space)

100 T magnet (generator and capacitor driven)

- **Field strength:** up to 100 T, 3 sec duration, 8 ms rise time from 40-100 T, (10 mm, 75 K bore; 5 mm 0.5 K sample space)

Destructive and semi-destructive magnets – Since the intense magnetic field exists only as long as it takes a shockwave to propagate through the magnet, the pulse duration is limited to a few microseconds. The highest magnetic fields are achieved by explosively compressing the magnetic field into the sample.

Single turn magnet system (capacitor driven) *(Samples typically are undamaged during measurements in this system.)*

- **Field strength:** 100-250 T, 2.2 μs rise time 5 μs duration (10 mm room temperature bore; 5 mm 2 K sample space)

Flux compression strip generator (chemical and capacitor driven)

- **Field strength:** 100-250 T, 5-10 μs rise time (available at Los Alamos through collaboration and external funding)

MEASUREMENT TECHNIQUES

Extraction magnetometry • Susceptibility • Torque magnetometry • Magnetotransport (DC-AC-rf) • Contactless conductivity • Dielectric measurements • Microwave frequency, cyclotron, and electron paramagnetic resonance • FIR/THz spectroscopy • Ultrafast optical spectroscopy • UV/visible/NIR optical spectroscopy • Resonant ultrasound and pulse-echo spectroscopy • Capacitive dilatometry • Fiber Bragg dilatometry • Heat capacity • High current and Jc • High pressure

nhmfl.lanl.gov **(505) 667-5032**

MATERIALS PHYSICS AND APPLICATIONS

Cultivating cutting-edge science through national user facilities

CENTER FOR INTEGRATED NANOTECHNOLOGIES

Exploring the continuum from scientific discovery to the integration of nanostructured materials into the micro- and macro world

World-class expertise and unique capabilities (synthesis, fabrication, characterization, and theory) available at the Center for Integrated Nanotechnologies (CINT) focus on creating, characterizing, understanding, and integrating materials at different length scales (from nano- to meso-scale) with controlled functionalities.

USER PROGRAM

CINT operates as a national user facility. As a vibrant partnership between Los Alamos and Sandia national laboratories, CINT leverages the unmatched scientific and engineering expertise of our host DOE laboratories and provides access to state-the-art facilities staffed by scientists, postdoctoral fellows, and technical support personnel who are leaders in the CINT scientific thrust areas. Access is via peer-reviewed technical proposals.

SCIENCE THRUSTS

Nanoscience centers are defined by a scientific field, not specific instrumentation. CINT expertise is organized in four scientific thrust areas.

- Nanoscale electronics and mechanics
- Nanophotonics and optical nanomaterials
- Soft, biological, and composite nanomaterials
- Theory and simulation of nanoscale phenomena

SELECTED CINT CAPABILITIES

Synthesis and fabrication

- Quantum dots, nanoparticles
- Biomolecular composites
- Semiconductor nanowires
- Metamaterials and plasmonic nanomaterials
- Semiconductor molecular beam epitaxy
- Epitaxial nanocomposite films pulsed laser deposition, laser molecular beam epitaxy
- CVD for 2D nanostructured films
- Dip-pen nanolithography
- Atomic precision lithography
- Integration lab: A suite of processing tools for fabrication

Theory

- Molecular dynamics and Monte Carlo simulations
- Classical and quantum density functional theory
- First-principles density-functional theory + dynamical mean-field theory for strongly correlated electronic systems
- Exact-diagonalization approach
- Quantum dynamics and pump-probe spectroscopy in coupled and strongly correlated electronic systems
- Non-adiabatic excited state molecular dynamics in molecules

Characterization

- 3D tracking images
- Ultrafast optical spectroscopies
- In situ transmission electron microscopy
- Optomechanics
- Quantum transport
- Nanomechanics and nanomanipulator
- Discovery platforms
- Holographic optical trapping

U.S. DEPARTMENT OF ENERGY
Office of Science

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National Nuclear Security Administration