

# Materials Science and Technology Division

## The world's largest pulsed magnets ...

The Pulsed Field Facility of the National High Magnetic Field Laboratory (NHMFL) at Los Alamos advances the frontier of condensed-matter physics at extreme conditions: high magnetic fields, low temperatures, and high pressures. Under these conditions, Los Alamos researchers study novel states of matter. The NHMFL also hosts a large international user program.



**The 60-Tesla Long-Pulse Magnet**  
The largest NHMFL magnet is this 60-tesla long-pulse magnet. It is energized by a 1.4-billion-volt-ampere generator, the country's largest.



### Energizing a Pulsed Magnet

Above 50 teslas, an intensity that exceeds one million times the Earth's magnetic field, energizing a pulsed magnet becomes an exercise in applied metal fatigue. When energized at peak fields, even the smallest magnets at the NHMFL contain one megajoule, roughly the energy equivalent of two sticks of dynamite, whereas the 60-tesla long-pulse magnet contains the energy equivalent of almost 100 sticks of dynamite. With each pulse of the magnet, the magnet wire is stressed nearly to the point of plastic deformation.

## ... and innovative techniques ...

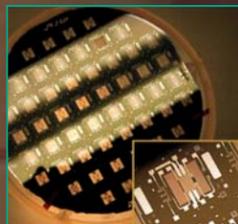
Over the last decade, the NHMFL has pioneered innovative resistivity and magnetization techniques that are now standard in pulsed magnetic-field experiments. The latest techniques, including terahertz spectroscopy, microcalorimetry, and ultrasound spectroscopy are now under development.



Terahertz Antenna



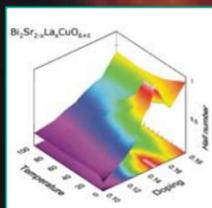
SiN Membrane Calorimeter



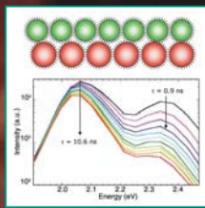
Ultrasound Resonator

## ... are advancing world-class science

The marriage of unique magnets with state-of-the-art techniques yields world-class science. Los Alamos researchers are noted for their work in areas such as quantum phase transitions in actinide compounds (top right) and high-temperature superconductors (middle row, left); harvesting visible light using nanodots of semiconducting materials (middle row, right); and understanding the fundamental properties of plutonium (both images, bottom row).



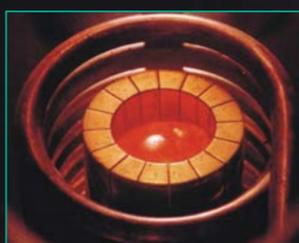
To learn more about this research, see Balakirev, F. F., J. B. Betts, A. Migliori, S. Ono, Y. Ando, and G. S. Boebinger, 2003. Signature of Optimal Doping in Hall-Effect Measurements on a High Temperature Superconductor. *Nature* 424: 912.



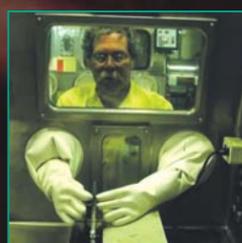
To learn more about this research, see Crooker, S. A., J. A. Hollingsworth, S. Tretiak, and V. I. Klimov, 2002. Spectrally Resolved Dynamics of Energy Transfer in Quantum-Dot Assemblies: Towards Engineered Energy Flows in Artificial Materials. *Phys. Rev. Lett.* 89(18): 186802-4.



To learn more about this research, see Harrison, N., M. Jaime, and J. A. Mydosh, 2003. Reentrant Hidden Order at a Metamagnetic Quantum Critical End Point. *Phys. Rev. Lett.* 90(9): 096402-1.



Plutonium is purified for measurements of thermodynamic properties (left). At right, an NHMFL researcher works in a glove box.



To learn more about this research, see Lashley, J. C., J. Singleton, A. Migliori, J. B. Betts, R. A. Fisher, J. L. Smith, and R. J. McQueeney, 2003. Experimental Electronic Heat Capacities of  $\alpha$ - and  $\delta$ -Plutonium: Heavy-Fermion Physics in an Element. *Phys. Rev. Lett.* 91(20): 205901.

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