Los Alamos achieves world-record pulsed magnetic field, moves closer to 100-tesla mark

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Yates Coulter, left, and Mike Gordon of Los Alamos National Laboratory make final preparations before successfully achieving a world-record for the strongest magnetic field produced by a nondestructive magnet. Working at the National High Magnetic Field Laboratory's Pulsed Field Facility at Los Alamos, a team of researchers achieved a field of 97.4 tesla, which is nearly 100 times stronger than the magnetic field found in giant electromagnets used in metal scrap yards.

(PhysOrg.com) -- Researchers at the National High Magnetic Field Laboratory's Pulsed Field Facility at Los Alamos National Laboratory have set a new world record for the strongest magnetic field produced by a nondestructive magnet.

The scientists achieved a field of 92.5 tesla on Thursday, August 18, taking back a record that had been held by a team of German scientists

and then, the following day, surpassed their achievement with a whopping 97.4-tesla field. For perspective, Earth's magnetic field is 0.0004 tesla, while a junk-yard magnet is 1 tesla and a medical MRI scan has a magnetic field of 3 tesla.

The ability to create pulses of extremely high magnetic fields nondestructively (high-power magnets routinely rip themselves to pieces due to the large forces involved) provides researchers with an unprecedented tool for studying fundamental properties of materials, from metals and superconductors to semiconductors and insulators. The interaction of high magnetic fields with electrons within these materials provides valuable clues for scientists about the properties of materials. With the recent record-breaking achievement, the Pulsed Field Facility at LANL, a national user facility, will routinely provide scientists with magnetic pulses of 95 tesla, enticing the worldwide user community to Los Alamos for a chance to use this one-of-a-kind capability.

The record puts the Los Alamos team within reach of delivering a magnet capable of achieving 100 tesla, a goal long sought by researchers from around the world, including scientists working at competing magnet labs in Germany, China, France, and Japan.

Such a powerful nondestructive magnet could have a profound impact on a wide range of scientific investigations, from how to design and control material functionality to research into the microscopic behavior of phase transitions. This type of magnet allows researchers to carefully tune material parameters while perfectly reproducing the non-invasive magnetic field. Such high magnetic fields confine electrons to nanometer scale orbits, thereby helping to reveal the fundamental quantum nature of a material.

Thursday's experiment was met with as much excitement as trepidation by the group of condensed matter scientists, high-field magnet

technicians, technologists, and pulsed-magnet engineers who gathered to witness the NHMFL-PFF retake the world record. Crammed into the tight confines of the Magnet Lab's control room, they gathered, lab notebooks or caffeine of choice in hand. Their conversation reflected a giddy sense of anticipation tempered with nervousness.

With Mike Gordon commanding the controls that draw power off of a massive 1.4-gigawatt generator system and directs it to the magnet, all eyes and ears were keyed to video monitors showing the massive 100 tesla Multishot Magnet and the capacitor bank located in the now eerily empty Large Magnet Hall next door. The building had been emptied as a standard safety protocol.

Scientists heard a low warping hum, followed by a spine-tingling metallic screech signaling that the magnet was spiking with a precisely distributed electric current of more than 100 megajoules of energy. As the sound dissipated and the monitors confirmed that the magnet performed perfectly, attention turned to data acquired during the shot through two in-situ measurements—proof positive that the magnet had achieved 92.5 tesla, thus yanking back from a team of German scientists a record that Los Alamos had previously held for five years.

The next day's even higher 97.4-tesla achievement was met with high-fives and congratulatory pats on the back. Later, researchers Charles Mielke, Neil Harrison, Susan Seestrom, and Albert Migliori certified with their signatures the data that would be sent to the Guiness Book of World Records.

Provided by Los Alamos National Laboratory

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