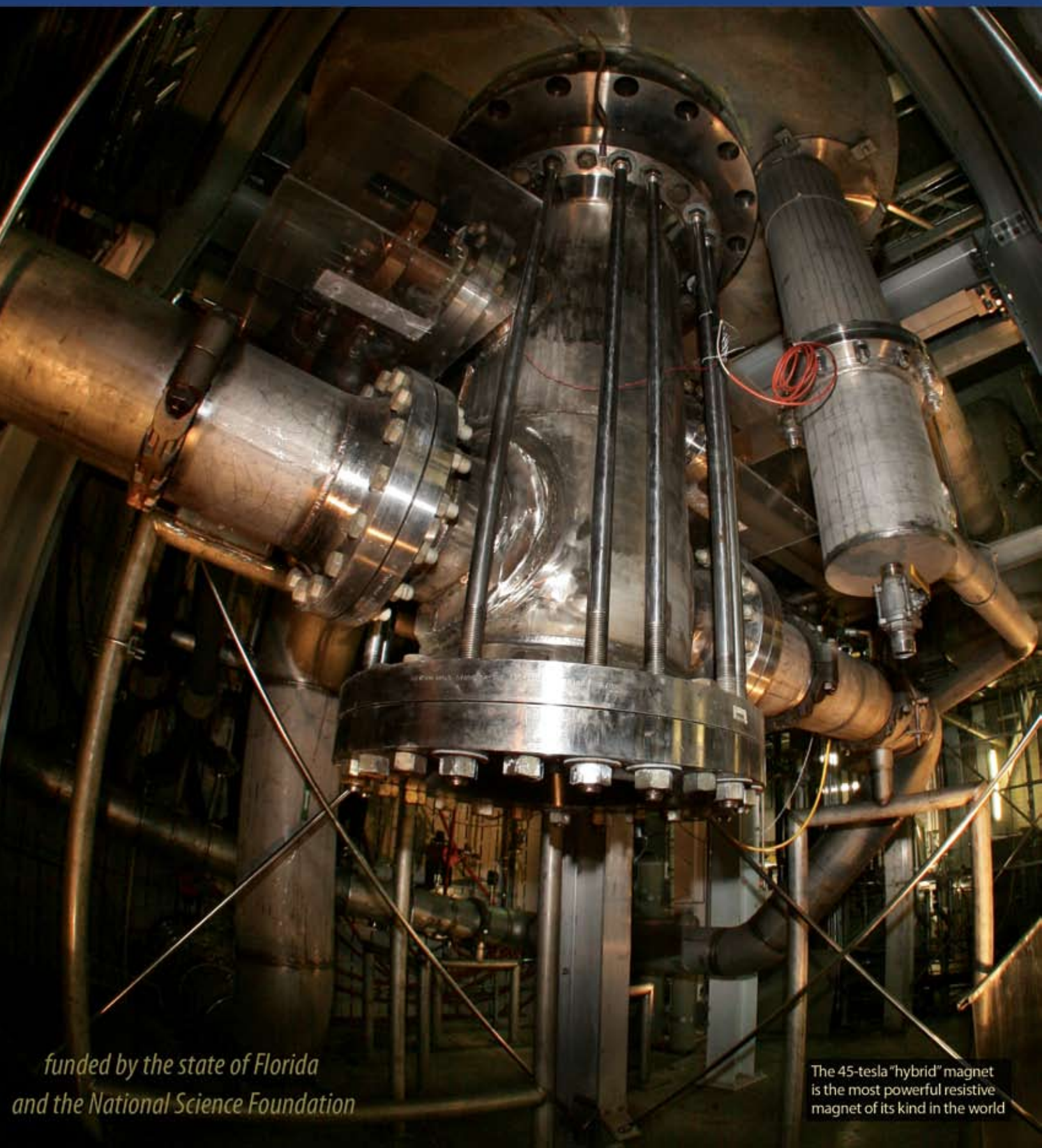
MAGNET LAB

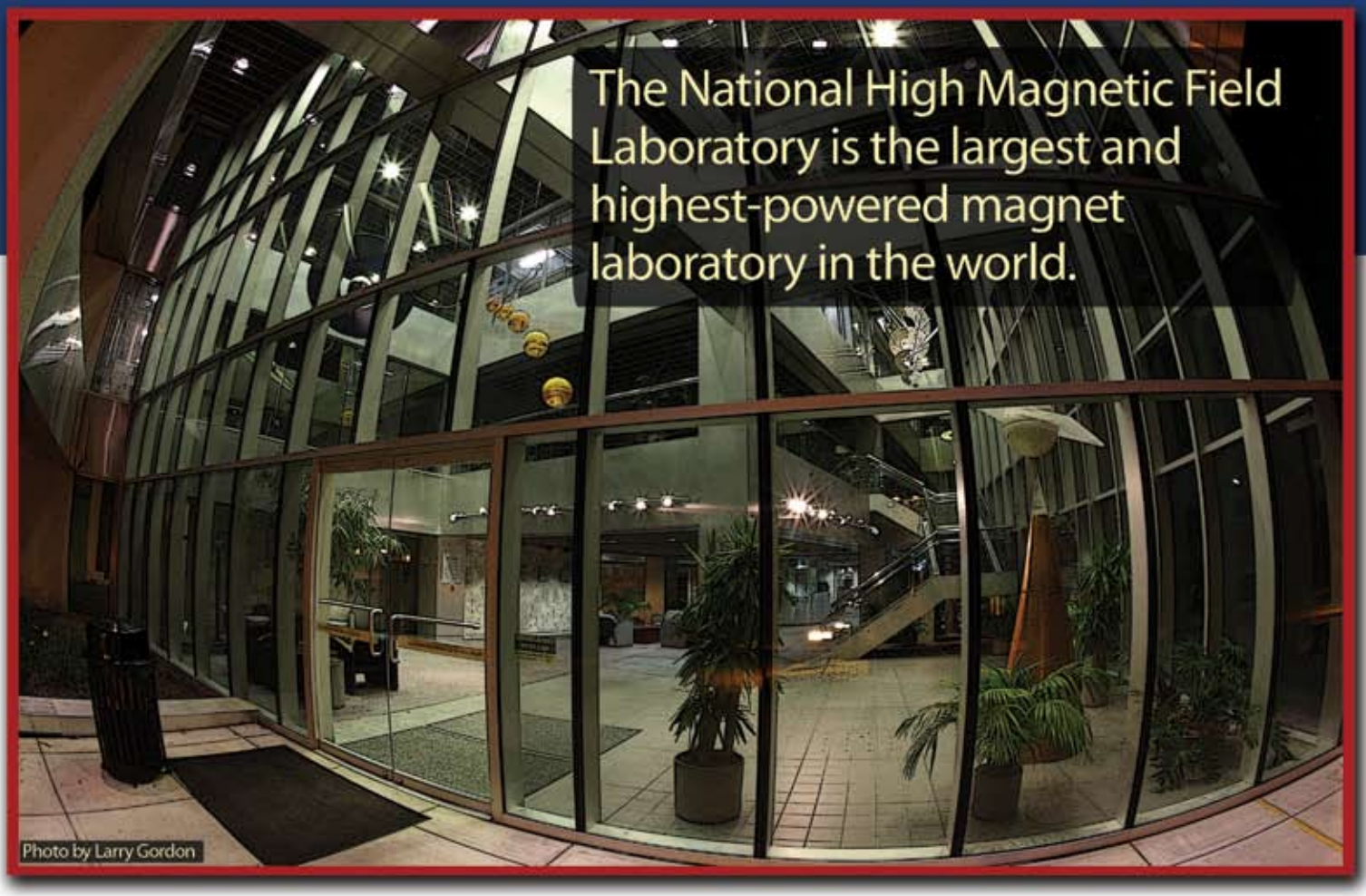
National High Magnetic Field Laboratory

- FLORIDA STATE UNIVERSITY
- LOS ALAMOS NATIONAL LABORATORY
- UNIVERSITY OF FLORIDA



funded by the state of Florida and the National Science Foundation

The 45-tesla "hybrid" magnet is the most powerful resistive magnet of its kind in the world



The only facility of its kind in the United States and one of only a few in the world, the **Magnet Lab** was established by the National Science Foundation (NSF) to provide the highest magnetic fields and necessary services for scientific research conducted by scientists from a wide range of disciplines, including physics, chemistry, materials science, engineering and biology.

The lab is funded by both the NSF and the state of Florida to pursue basic science and to advance high-magnetic-field research. This federal-state partnership is a primary reason the lab was awarded to the Florida State University (FSU) in 1990 and continues to help the lab leverage resources today.

The Magnet Lab is headquartered in a sprawling 370,000-square-foot complex near FSU in Tallahassee. The lab also includes sites at Los Alamos National Laboratory in New Mexico and the University of Florida in Gainesville. Together these three institutions operate the lab, collaborating in a unique, interdisciplinary way to further science, engineering and technology.

Centralizing the country's greatest magnet-related tools, resources and expertise is not only efficient and cost-effective, but it also encourages fruitful, collaborative research at the highest level. Every year, nearly 1,000 visiting scientists and engineers from across the world conduct experiments using the Magnet Lab's state-of-the-art equipment. Its flagship magnets and many of the experimental probes that hold the samples were designed, developed and built by the lab's scientists and engineers.

Magnet Lab Milestones

1989 ***Jack Crow*** *of FSU,* ***Don Parkin*** *of Los Alamos National Lab and* ***Neil Sullivan*** *of the University of Florida collaborate on a proposal for a new national magnet lab.*

1990 *National Science Board awards the National High Magnetic Field Laboratory to the consortium.* ***Crow*** *is named director.*

Magnet Research: Transforming Our World

In a world where information is so readily available, it's easy to forget how much remains unknown about the natural world. Basic science builds knowledge and understanding, which spurs later innovations that enhance and lengthen life, and give us new technologies and experiences.


Photo by LeRoy Sanchez

Basic research is the National High Magnetic Field Laboratory's stock-in-trade.

High-magnetic-field research underpins nearly every modern technology and material, including energy-saving electric lights, high-strength plastics, faster computers, more powerful motors, and the modern medical miracle of magnetic resonance imaging (MRI). In the decades to come, this research will continue to change and shape our world. High-field magnets probe the mysteries of nature, yielding discoveries that often lead to new materials and technologies.

Among other work, researchers at the lab:

- Explore new physical phenomena that will enhance future computers and computer networks, and could one day lead to advanced supercomputers.
- Develop high-definition MRIs to make possible more effective medical diagnostic and research technologies.
- Study human proteins, a research strategy that likely will lead to a new generation of drugs to treat illnesses.
- Analyze chemical compounds in crude oil, research that reduces pollution in refining and saves money in drilling costs.
- Perform basic research that will usher in next-generation batteries and energy storage devices.
- Develop highly sensitive techniques to study chemicals used by plants and animals that might one day be useful as new medicines.
- Study new superconductors – materials with the potential to revolutionize how power is stored and delivered, producing both energy and cost savings.

1992 *First class of undergraduates participates in **Minority Scholars** program, which eventually becomes the **Research Experiences** for **Undergraduates** program.*

1993 *Pulsed Field Facility at **Los Alamos** launches its scientific user program.*
Final construction and renovation of the FSU facility completed.

1994 *FT-ICR-Mass Spectrometry Facility established.*
*High B/T at the **University of Florida** completed for user operation.*
*Official opening of the **Magnet Lab**.*

The 45-tesla hybrid magnet weighs 34 tons and stands 22 feet tall.

There are 95 miles of superconducting cable in the 900 megahertz, 21.1-tesla nuclear magnetic resonance magnet.

Did you know?

- Just as a microscope allows us to view details invisible to the naked eye, so do magnetic fields reveal the nature of things – and the very laws of science that account for them. Magnets are another way – a unique and powerful way – that science can shine a light into the unknown.
- Of the 1,000 visitors who come to the Magnet Lab's three sites each year to do research, 20 percent come from overseas.
- Fifty countries are represented by Magnet Lab staff and students.
- When magnets are running at full field, the Magnet Lab consumes 7 percent of the electricity provided to all Tallahassee residences and businesses.
- The High B/T (magnetic field/temperature) Facility at the University of Florida makes the kind of cold found here on Earth seem tepid. The coldest temperature ever recorded on Earth (in nature), is a mere -89° C (-129° F). The coldest man-made temperature at the High B/T Facility is -272° C (-459° F).
- The lab's most powerful non-destructive magnet, the 100 Tesla Magnet Project, contains the energy of more than 200 sticks of dynamite when turned on.
- Roughly 80 percent of the lab's funding is provided by the National Science Foundation and other federal grants; the remaining 20 percent comes from the state of Florida.

Magnet Lab Milestones

1995 *Lab holds first* ***Open House.***

1996 *Mag Lab engineers complete* ***33 T resistive magnet.***

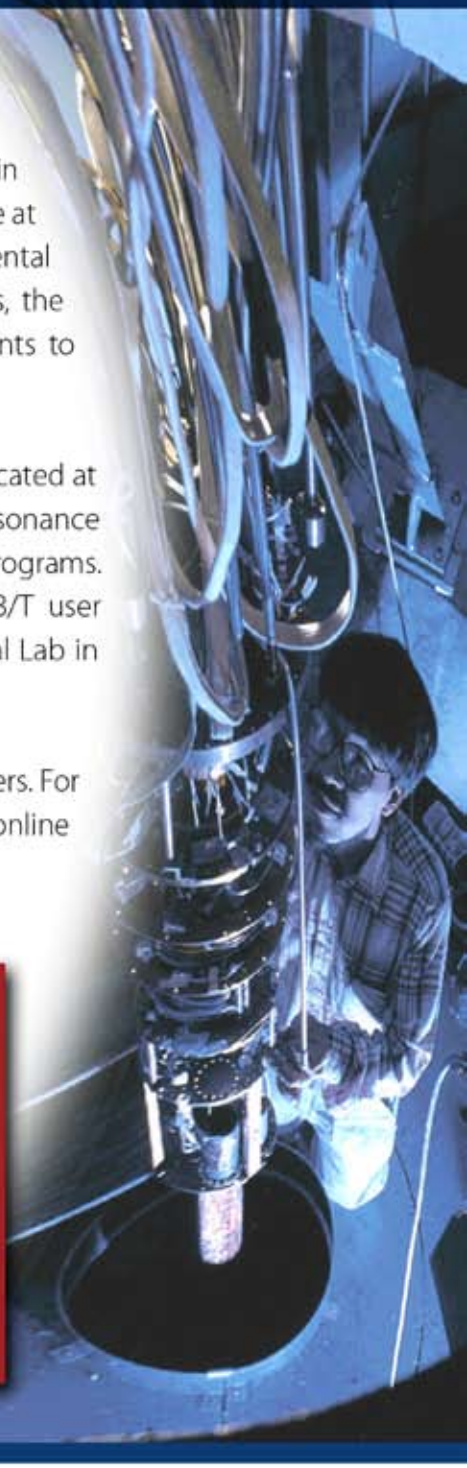
1998 *Advanced Magnetic Resonance Imaging and Spectroscopy (AMRIS) user program debuts at the* ***University of Florida.***

Without its **users**, there would be no **Magnet Lab.**

The Magnet Lab is a national – and international – resource that centralizes the country's greatest magnet-related research tools, resources and expertise. The Magnet Lab's magnets are unrivaled anywhere in the world, and lab engineers are constantly striving to push fields higher still. But it's not only the magnets that pull in upwards of 1,000 researchers each year; it's also the world-class scientific support available at the Magnet Lab. The lab's scientists and technicians develop the experimental instrumentation and techniques. Whether they are active collaborators or consultants, the scientists know how the get the most from the magnets, from setting up experiments to acquiring and interpreting data.

The National High Magnetic Field Laboratory spans three sites, with the main campus located at Florida State University in Tallahassee, which is home to the DC Field, Ion Cyclotron Resonance (ICR), Nuclear Magnetic Resonance (NMR) and Electron Magnetic Resonance (EMR) user programs. The Advanced Magnetic Resonance Imaging and Spectroscopy (AMRIS) and High B/T user programs are located at the University of Florida in Gainesville. The Los Alamos National Lab in New Mexico houses the lab's Pulsed Field user program.

As a national lab, Magnet Lab facilities are generally offered free of charge to qualified users. For more information about conducting research at one of the lab's seven user programs, go online to the Users Hub at **www.magnet.fsu.edu**.



1999 *New Experiment Hall opens at Pulsed Field Facility.* ***World's strongest resistive magnet*** *– the 45-tesla hybrid – is commissioned for user service.*

2004 ***Greg Boebinger*** *becomes the second director of the Magnet Lab.*

2005 *The 900 megahertz ultra-wide-bore magnet, engineered and built at the Magnet Lab, is commissioned for magnetic resonance experiments.* ***Applied Superconductivity Center*** *joins the Magnet Lab at FSU.*

Integrating Research and Learning

The Magnet Lab supports and enables educational outreach to the general public and all academic levels. Through its educational arm, the Center for Integrating Research & Learning, the programs – developed through close collaboration between research scientists and educators – are designed to excite and educate students and teachers about science, technology and the world around them.

The Center's initiatives include:

K-12

- Guided tours and hands-on experiences
- Classroom visits
- Middle-school mentorship program
- High-school mentorship program
- SciGirls summer camp
- Educational resources laboratory and lending library

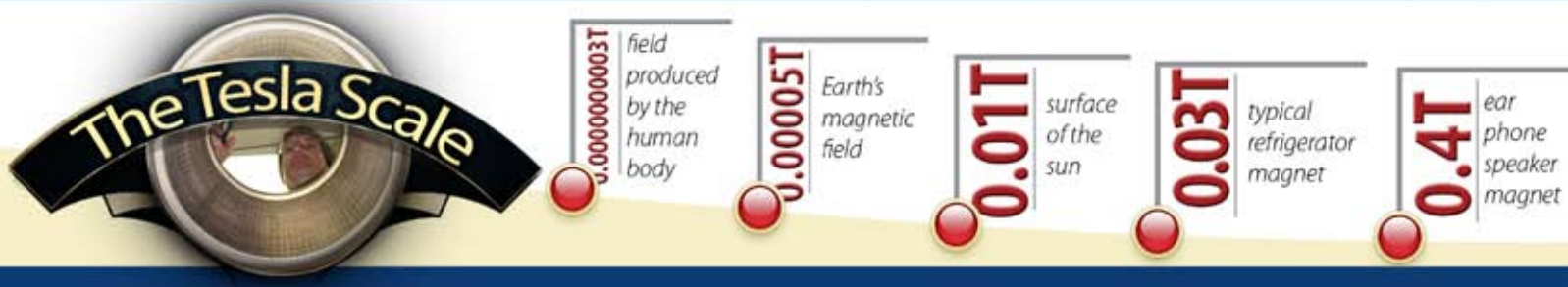
Undergraduate and graduate

- Research Experiences for Undergraduates (paid, eight-week summer program)
- Pre-service teacher training
- Service learning opportunities
- Training for educational outreach

Teacher professional development

- Research Experiences for Teachers (paid, six-week summer program)
- Annual workshops and summer institutes on magnets, magnetism and related concepts
- Ambassador Program (a network of K-12 science educators)
- Science curriculum development

Scientists measure magnetic field strength in units called tesla. The following scale gives you



The National High Magnetic Field Laboratory welcomes visitors.

In fact, on any given day you will likely see a school class, civic group or curious family taking a guided tour of the sprawling building in Tallahassee's Innovation Park. Group tours are available for free to the general public for groups of eight or more. Tours last about an hour and are scheduled at least three weeks in advance. Scientists, educators and administrative staff alike serve as tour guides, each providing a unique perspective. These tours include a general overview of the Magnet Lab and its research as well as explanations of the different types of magnets used.

For more information or to schedule a public tour, call (850) 644-0311 or visit www.magnet.fsu.edu.

Magnet Lab Annual Open House

Every February, the Magnet Lab's FSU campus invites the public to spend the day at the world-class research laboratory. The free event, which draws thousands of visitors every year, features hands-on demonstrations, lectures, tours, games, presentations and the chance to meet and chat with scientists and other Mag Lab staff.

some perspective about the strength of the magnetic fields produced at the Magnet Lab:

- **1-2T** *junkyard magnet*
- **3T** *top-of-the-line MRI magnet*
- **21T** *Mag Lab's 900 MHz magnet*
- **35T** *Mag Lab's highest powered resistive magnet*
- **45T** *Mag Lab's world-record hybrid magnet*
- **65T** *Mag Lab's short-pulse magnet (Los Alamos)*
- **250T** *Mag Lab's single turn magnet (Los Alamos)*

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Photo by Larry Gordon

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