FSU's Lab to Build World's Strongest Magnet for 'Neutron Scattering' Experiments

The Hahn-Meitner Institute in Berlin has contracted with the National High Magnetic Field Laboratory and Florida State University to build an $8.7-million hybrid magnet for "neutron scattering" experiments.

When finished in 2011, the new, high-field magnet, which is based on the magnet lab's Series-Connected Hybrid concept, will be housed at the Berlin Neutron Scattering Center. The magnet will produce a magnetic field between 25 tesla and 30 tesla - more than half a million times stronger than the Earth's magnetic field. It will be the world's strongest magnet for neutron experiments, eclipsing the 15-tesla system presently at the Hahn-Meitner Institute (HMI).

The magnet lab's Magnet Science & Technology division has been working with Hahn-Meitner since the summer of 2005, recently completing a design study. The results of that study were strong enough to convince the review committee of the German Helmholtz Association and the Federal Ministry of Education and Research that the investment in the new technology was worth the cost.

"Part of the challenge in science is figuring out how to maximize resources," said Mark Bird, interim director of the Magnet Science & Technology division. "We can't always afford to bring the tools and techniques to the magnets; sometimes we have to bring the magnets to the tools to advance the science."

The lab's Series-Connected Hybrid combines copper-coil "resistive" magnet technology in the magnet's interior with a superconducting magnet, cooled with liquid helium, on the exterior. The copper-coil insert is powered by an electrical current, while the superconducting outsert conducts electricity without resistance as long as it is kept colder than 450 degrees below zero Fahrenheit. By combining the power supplies of these two technologies, engineers can produce extremely high magnetic fields using just one-third of the power required by traditional magnets.

The version that magnet lab engineers will build for HMI is different in that its bore, or experimental space, will be conical to allow neutrons to be scattered through large angles. It also will be horizontal, as opposed to the traditional vertical bore of most high-field magnets. These modifications make the magnet ideal for neutron scattering experiments, which are among the best methods for probing atoms to better understand the structure of materials.

"With this major piece of equipment, the Hahn-Meitner Institute itself becomes a magnet, pulling in researchers from around the world to Berlin," said Thomas Rachel, parliamentary state secretary of the German Federal Ministry of Education and Research.

With this new magnet, scientists will be able to carry out experiments that aren't currently possible. One of the greatest challenges in condensed matter physics is to develop a comprehensive theory describing high-temperature superconductors. The combination of neutrons and high magnetic fields will allow scientists to study the normal state of high-temperature superconductors in the low-temperature limit. In addition, it will be possible to probe hydrogen structure in both biological and hydrogen-storage materials.

The project is funded primarily through the German Federal Ministry for Education and Research. In addition to the $8.7-million magnet, the Germans are putting $14.4 million into infrastructure, such as cooling and current supplies, needed to run a high-field magnet. The agreement will be administered by the Florida State University Magnet Research and Development Co., a not-for-profit direct support organization of the magnet lab.

The announcement comes just six months after the National Science Foundation awarded the magnet lab an $11.7-million grant to build a 36-tesla Series-Connected Hybrid, expected to come online in 2011, for the Tallahassee facility. Together with John Hopkins University, the lab also is conducting an NSF-funded engineering design of a split-gap Series-Connected Hybrid for the Spallation Neutron Source, a neutron facility in Oak Ridge, Tenn.

Source: Florida State University