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New Magnet Design Could Shed Light On Nanoscience

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Magnet coil. Credit: Florida State University

Engineers at Florida State University's National High Magnetic Field Laboratory have successfully tested a groundbreaking new magnet design that could literally shed new light on nanoscience and semiconductor research.

When the magnet -- called the Split Florida Helix -- is operational in 2010, researchers will have the ability to direct and scatter laser light at a sample not only down the bore, or center, of the magnet, but also from four ports on the sides of the magnet, while still reaching fields above 25 tesla. By comparison, the highest-field split magnet in the world attains 18 tesla. "Tesla" is a measurement of the strength of a magnetic field; 1 tesla is equal to 20,000 times the Earth's magnetic field.

Magnetism is a critical component of a surprising number of modern technologies, including MRIs and disk drives, and high-field magnets stand beside lasers and microscopes as essential research tools for probing the mysteries of nature. With this new magnet, scientists will be able to expand the scope of their experimental approach, learning more about the intrinsic properties of materials by shining light on crystals from angles not previously available in such high magnetic fields. In materials research, scientists look at which kinds of light are absorbed or reflected at different crystal angles, giving them insight into the fundamental electronic structure of matter.

The Split Florida Helix design represents a significant accomplishment for the magnet lab's engineering staff. High magnetic fields exert tremendous forces inside the magnet, and those forces are directed at the small space in the middle . . . that's where Mag Lab engineers cut big holes in it.

"You have enough to worry about with traditional magnets, and then you try to cut huge holes from all four sides from which you can access the magnet," said lab engineer Jack Toth, who is spearheading the project. "Basically, near the midplane, more than half of the magnet structure is cut away for the access ports, and it's still supposed to work and make high magnetic fields."

Magnet engineers worldwide have been trying to solve the problem of creating a magnet with side access at the midsection, but they have met with little success in higher fields. Magnets are created by packing together dense, high-performance copper alloys and running a current through them, so carving out empty space at the heart of a magnet presents a huge engineering challenge.

Instead of fashioning a tiny pinhole to create as little disruption as possible, as other labs have tried, Toth and his team created a design with four big elliptical ports crossing right through the midsection of the magnet. The ports open 50 percent of the total space available for experiments, a capability the laboratory's visiting scientists have long desired.

"It's different from any traditional magnet that we've ever built before, and even the fabrication of our new parts was very challenging," Toth said. "In search of a vendor for manufacturing the prototypes, I had phone conversations where people would promise me, 'Jack, we looked at it from every possible angle and this part is impossible to machine.'"

Of course, that wasn't the case, and the model coil, crafted from a mix of copper-beryllium blocks and copper-silver plates, met expectations during its testing in a field higher than 32 tesla with no damage to its parts.

Though the National Science Foundation-funded model has reached an important milestone, years of work will go into the final product. The lab hopes to have a working magnet for its User Program by 2010, and other research facilities have expressed great interest in having split magnets that can generate high magnetic fields.

Source: FSU

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