Superconducting magnet attracts molecular research

November 2 2005

One of the newest – and unequivocally the coolest -- pieces of real estate on the Brandeis University campus is a facility containing a state-of-the-art superconducting magnet for use in researching biological macromolecules such as DNA, RNA, enzymes and other proteins.

The installation of the gleaming 800 MHz German-made Bruker magnet was recently completed in a specially built facility on campus. Weighing in at roughly seven and a half tons, the magnetic resonance (MR) spectrometer was funded by a $2 million grant from the National Institutes of Health (NIH) in a stiff competition among research universities. Since 2001, the NIH has funded only three such magnets nationwide, said professor of chemistry Tom Pochapsky, who spearheaded a group effort to bring the magnet to Brandeis.

"It's a testament to Brandeis' strength in this area that the magnet is located on our campus and under our stewardship," noted Pochapsky.

Brought in by crane and located at a site protected from large metal objects and radio frequency interference, the superconducting behemoth was actually energized with about the same amount of power consumed by a big stereo, Pochapsky explained.

First, the superconducting electric coils that create the magnetic field were bathed in liquid helium to drop the temperature to 2 degrees Kelvin or minus 456 degrees Fahrenheit. Once the coils were supercooled, electric current was able to pass through them without resistance, creating the magnetic field. Once at field, the magnet uses no power at all, although the large liquid helium tank surrounding the coil needs to be refilled every six weeks or so.

Once the magnet has been fully tested, Brandeis researchers, as well as other Boston-area universities engaged in NIH-funded biomedical research, will use it around the clock. Experiments usually run in weeklong blocks, though some may run for several weeks at a time, according to Pochapsky.

Magnetic resonance is a physical phenomenon based on the magnetic property of an atom's nucleus. It occurs when the nuclei of certain atoms are immersed in a static magnetic field and then exposed to a second oscillating field, causing them to essentially line up and act in unison, like a battalion of marching soldiers, said Pochapsky.

The electrons, neutrons and protons within the atom have an intrinsic property known as "spin" and within the electromagnetic field created by the magnet, the frequency of the spinning motion of the atoms reveals information about the physical, chemical, structural and electronic characteristics of the molecule in solution.

Magnetic resonance spectroscopy was first described more than a half century ago, and is related to MRI (magnetic resonance imaging) used in hospitals as a soft-tissue diagnostic tool. It is used in chemical and biochemical research because it is the most sophisticated analytical tool available for determining the three-dimensional structure and motion of biological molecules in solution. The average hospital-based MRI has an electromagnetic field of about 7 Tesla, while this superconducting magnet is more than twice as powerful, measuring a magnetic field of 18.8 Tesla, said Pochapsky.

"Brandeis has done pioneering work in structural biology for decades, and this magnet helps keep us at the cutting edge of research," said Pochapsky. "It's an investment in the future."

Source: Brandeis University

Citation: Superconducting magnet attracts molecular research (2005, November 2) retrieved 24 April 2024 from https://phys.org/news/2005-11-superconducting-magnet-molecular.html