A safer image

Nuclear medicine rolls along

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New York University's Alexej Jerschow, an assistant professor of physical chemistry, and Norbert Müller, a professor of physical organic chemistry at the University of Linz in Austria, have developed a completely non-invasive imaging method.

Their work is said to offer the benefits of magnetic resonance imaging (MRI) while eliminating patients' exposure to irradiation and setting the stage for the creation of light, mobile MRI technology.

MRI allows clinicians to non-invasively visualize soft tissue in the interior of the human body through the application of radiofrequency (rf) irradiation. However, the rf pulses of MRI machines deposit heat in patients and medical staff, though safety regulations that limit energy deposition have long been established. Jerschow and Müller have devised a low-energy, non-invasive nuclear magnetic resonance (NMR) technique that does not require external rf-irradiation. Their technique, instead, relies on the detection of spontaneous, proton spin-noise in a tightly coupled rf-antenna coil.

In order to reconstruct spin-noise images that characterize MRI, the researchers used a commercial, liquid-state NMR spectrometer equipped with a cryogenically cooled probe.

The sample, a phantom of four glass capillaries filled with mixtures of water and heavy water, remained at room temperature while the detection circuit was cooled to -243oC.

The researchers inserted the sample into a standard NMR tube and applied a magnetic field gradient to acquire spatial encoding information. They collected 30 one-dimensional spin-noise images, and after applying a projection reconstruction algorithm, obtained the phantom's two-dimensional image of the phantom's spin density distribution.

Because of its low-energy deposition and particular advantages for small sample sizes, Müller and Jerschow's imaging technique may enable new application areas for magnetic resonance microscopy. Using already-developed methods, the researchers expect expansion to three-dimensional imaging to be straightforward.

The same detection scheme is applicable to NMR spectroscopy. Very delicate samples, such as explosives could be investigated with this method. Preliminary investigations also predict a sensitivity advantage over conventional experiments at length scales of millimetres to micrometers, which may be important in the measurement of NMR spectra within microfluidic devices.

Very strong magnetic fields, as generally required for MRI and NMR, can be avoided with the spin-noise detection scheme, making possible the development of extremely portable and minimally invasive MRI and NMR instruments.