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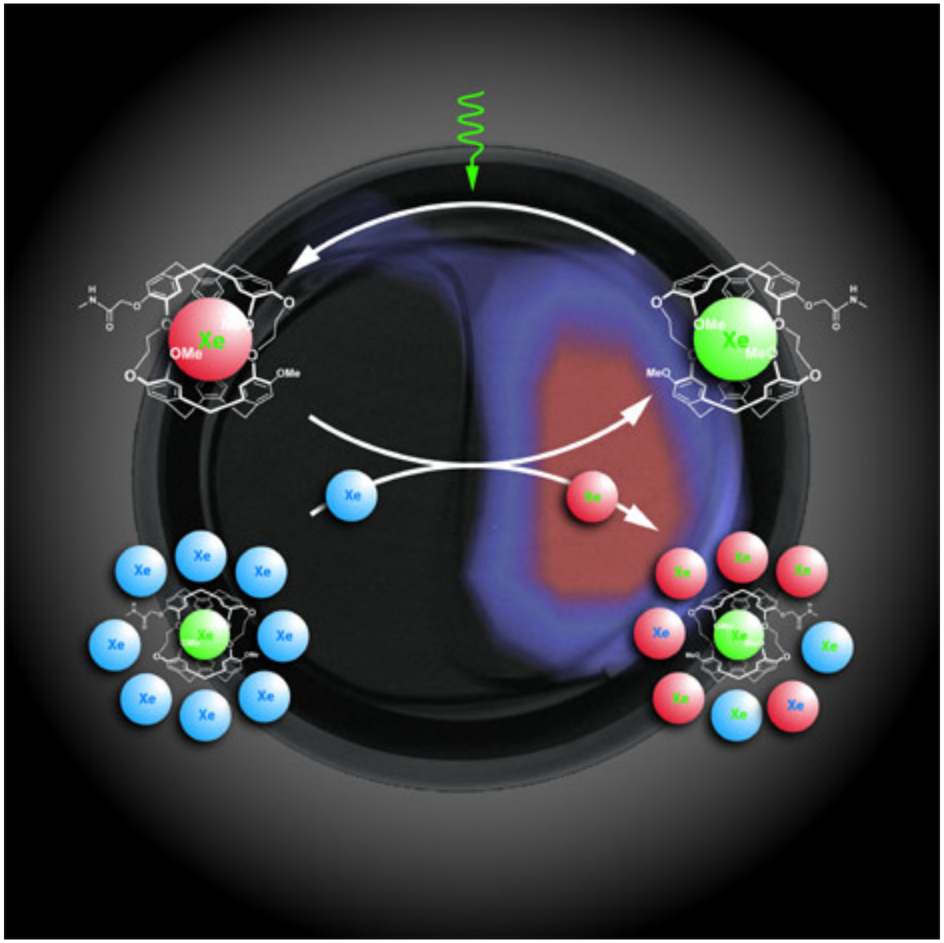
Hyperpolarized Xenon Makes MRI Hypersensitive

Posted By Gene Ostrovsky On October 20, 2006 @ 9:24 am In Genetics,Nuclear Medicine,Radiology | Comments Disabled

A new technique, reported in *Science*, uses xenon atoms attached to specific proteins or other biological molecules, to increase MRI's sensitivity. Investigators at Lawrence Berkeley National Laboratory and UC Berkeley are reporting MRI sensitivity able to detect bio-molecules at concentrations 10,000 less than the present MRI techniques.
This is how MRI with HYPER-CEST (hyperpolarized xenon chemical exchange saturation transfer) works:

> … team of researchers report on a technique in which xenon atoms that have been hyperpolarized with laser light to enhance their MRI signal, incorporated into a biosensor and linked to specific protein or ligand targets. These hyperpolarized xenon biosensors generate highly selective contrast at sites where they are bound, dramatically boosting the strength of the MRI signal and resulting in spatial images of the chosen molecular or cellular target.
> This research was led by Alexander Pines and David Wemmer, who both hold joint appointments with Berkeley Lab and UC Berkeley. Their paper is entitled Molecular Imaging Using a Targeted Magnetic Resonance Hyperpolarized Biosensor. Co-authoring the paper with Pines and Wemmer were Leif Schröder and Thomas Lowery, plus Christian Hilty.
> "Our HYPER-CEST molecular MRI technique makes optimum use of hyperpolarized xenon signals by creating a strong signal in regions where the biosensor is present, allowing for easy non-invasive determination of the target molecule," said Pines, one of the world's leading authorities on NMR/MRI technology, who holds a joint appointment as a chemist with Berkeley Lab's Materials Sciences Division and with UC Berkeley, where he is the Glenn T. Seaborg Professor of Chemistry. "This approach should be broadly applicable, potentially overcoming many shortcomings of currently used strategies for molecular imaging."
> Added Wemmer, a chemist with Berkeley Lab's Physical Biosciences Division and UC Berkeley chemistry professor, "Other molecular MRI contrast agents provide small changes in big MRI signals, making the changes difficult to detect when the amount of contrast agent binding is small. Our HYPER-CEST contrast agent provides a big change in the xenon MRI signal, which means it is much easier to detect even though the xenon MRI signals are rather small."
> In addition to its intrinsically higher contrast, another advantage with the HYPER-CEST technique is that its effects can be "multiplexed," meaning that the polarized xenon biosensors can be targeted to detect different proteins at the same time in a single sample. This capability, which is not shared by most conventional molecular MRI contrast agents, opens up a number of possibilities for future diagnostics.
> Explained co-author Schröder, a member of the Pines' research group who is affiliated with Berkeley Lab's terials Sciences Division, "For example, as a diagnostic tool for the detection of cancer, with HYPER-CEST, we could perform multiple virtual biopsies on a single tissue sample, using different biosensors to screen for each potential form of cancer."



Selective saturation of biosensor-encapsulated xenon (green) and subsequent chemical exchange with the free xenon (blue) allows accumulation of depolarized nuclei (red). This procedure corresponds to continuous depolarization of cage-related magnetization that can be measured indirectly after several cycles by the difference between initial and final bulk magnetization.

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[1] Link: **http://www.lbl.gov/Science-Articles/Archive/MSD-HYPER-CEST.html**