A New Era in MRI: Leveraging Earth's Magnetic Field for Diagnostic Imagin

Introduction

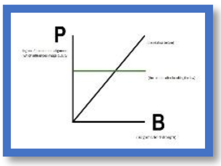
Magnetic Resonance Imaging (MRI) is widely regarded as one of the most effective imaging techniques for visualizing soft tissues. However, MRI faces challenges including prolonged time for MRI scans also, necessity for strict safety precautions. To address these limitations researchers, invest in research into Ultra-Low-Field (ULF) [1] MRI as a solution to precautions.

The law to be broken

$$P \propto {}^{B}/_{KT}$$

Where, B is the magnetic field , K is Boltzmann's constant , T is the temperature and P is is the degree of nuclear spin alignment, which is responsible to the quality of the image[2].

We will assume that P doesn't depend on B which means that the image quality will be the same regardless how strength the magnetic field is, So any magnetic field will make hydrogen atoms aligned Once, the protons are aligned, the MRI machine emits radiofrequency (RF) pulses at a specific frequency, These pulses disturb the alignment of the protons, causing them to absorb energy and move into a higher-energy state, then these protons relaxes producing a signal , by this signal detection we can make an Image for internal body organs, So we can use earth's magnetic field to make a MRI image.

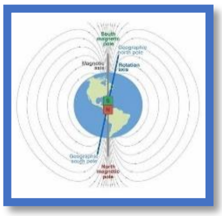


Relation before and after breaking the law

At constant temperature

The benefits of the broken law

This broken law will make us able to take a high-resolution image using earth's magnetic field and that will result in many benefits like: **Affordability**: MRI systems would become significantly cheaper, **Safety**: Patients with metallic implants would no longer face restrictions, **Accessibility**: Claustrophobic patients[3] could undergo MRI scans with ease.



The Earth's Magnetic Field

Challenges And Considerations

1- **Challenge**: The re-engineered MRI system must be lightweight, portable, and energy-efficient while maintaining image quality.

Consideration: Balancing simplicity and performance will be key to scaling the technology for widespread use.

2- **Challenge**: Earth's magnetic field is highly susceptible to electromagnetic interference from electronic devices, power lines, and geomagnetic variations.

Consideration: The system would require effective shielding or real-time noise cancellation technologies to ensure accurate imaging.

Conclusion

By challenging conventional assumptions about the dependence of image quality on magnetic field strength, we open the door to an affordable, safe, and accessible imaging modality. This approach eliminates traditional limitations, such as risks for patients with metallic implants and challenges faced by those with claustrophobia. If successful, this innovation has the potential to democratize MRI technology, making it widely available and reducing healthcare disparities globally

references

[1] M. Espy, A. Matlashov, and P. Volegov, “SQUID-detected ultra-low field MRI,” Journal of Magnetic Resonance, vol. 229, 2013, doi: 10.1016/j.jmr.2013.02.009**.**

[2] J. Scheuer et al., “Optically induced dynamic nuclear spin polarisation in diamond,” New J Phys, vol. 18, no. 1, 2016, doi: 10.1088/1367-2630/18/1/013040.

[3] M. Dewey, T. Schink, and C. F. Dewey, “Claustrophobia during magnetic resonance imaging: Cohort study in over 55,000 patients,” *Journal of Magnetic Resonance Imaging*, vol. 26, no. 5, 2007, doi: 10.1002/jmri.21147.