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Richard L. Magin

Biography

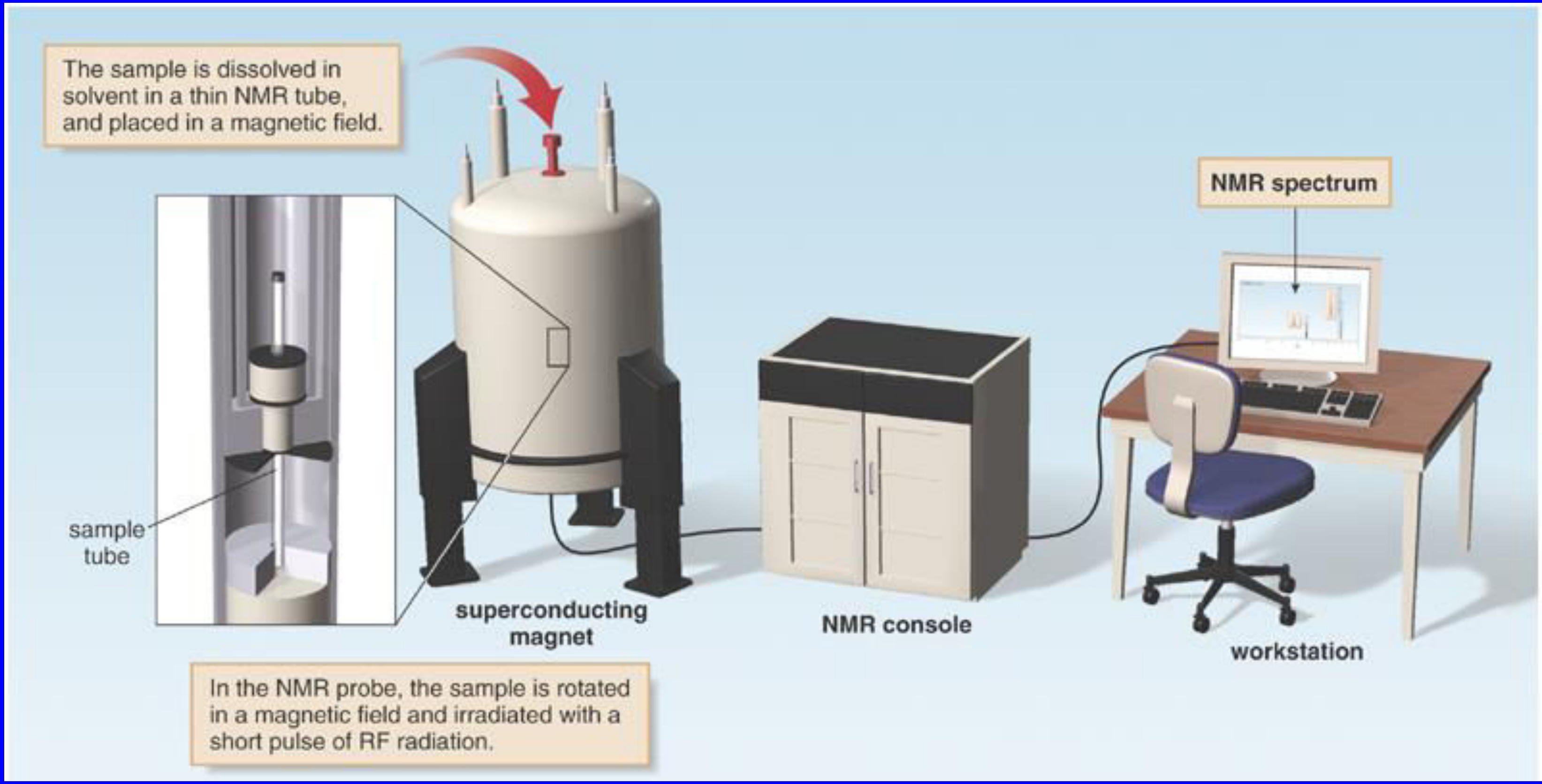
- Professor Richard L. Magin did his undergraduate and graduate studies in physics at Georgia Tech (BS 69, MS 72) followed by additional graduate work in biophysics at the University of Rochester (PhD 76). He worked for three years as a postdoctoral student at the National Cancer Institute, NIH in the Laboratory of Chemical Pharmacology. He joined the faculty of the Department of Electrical and Computer Engineering at the University of Illinois at Urbana-Champaign in 1979. He worked in Urbana for 18 years as an Assistant, Associate, and full Professor before joining the Department of Bioengineering at the University of Illinois at Chicago in 1998. From 1999 to 2002 he was Professor and Head of the Department of Bioengineering at UIC. He is currently a Professor of Bioengineering at UIC and director of the Diagnostic NMR Systems Laboratory. He is a Fellow of the IEEE and AIMBE.

Research Interest

- Diagnostic NMR Systems
  Microscopic Magnetic Resonance
  Elastography
  Fractional calculus in NMR

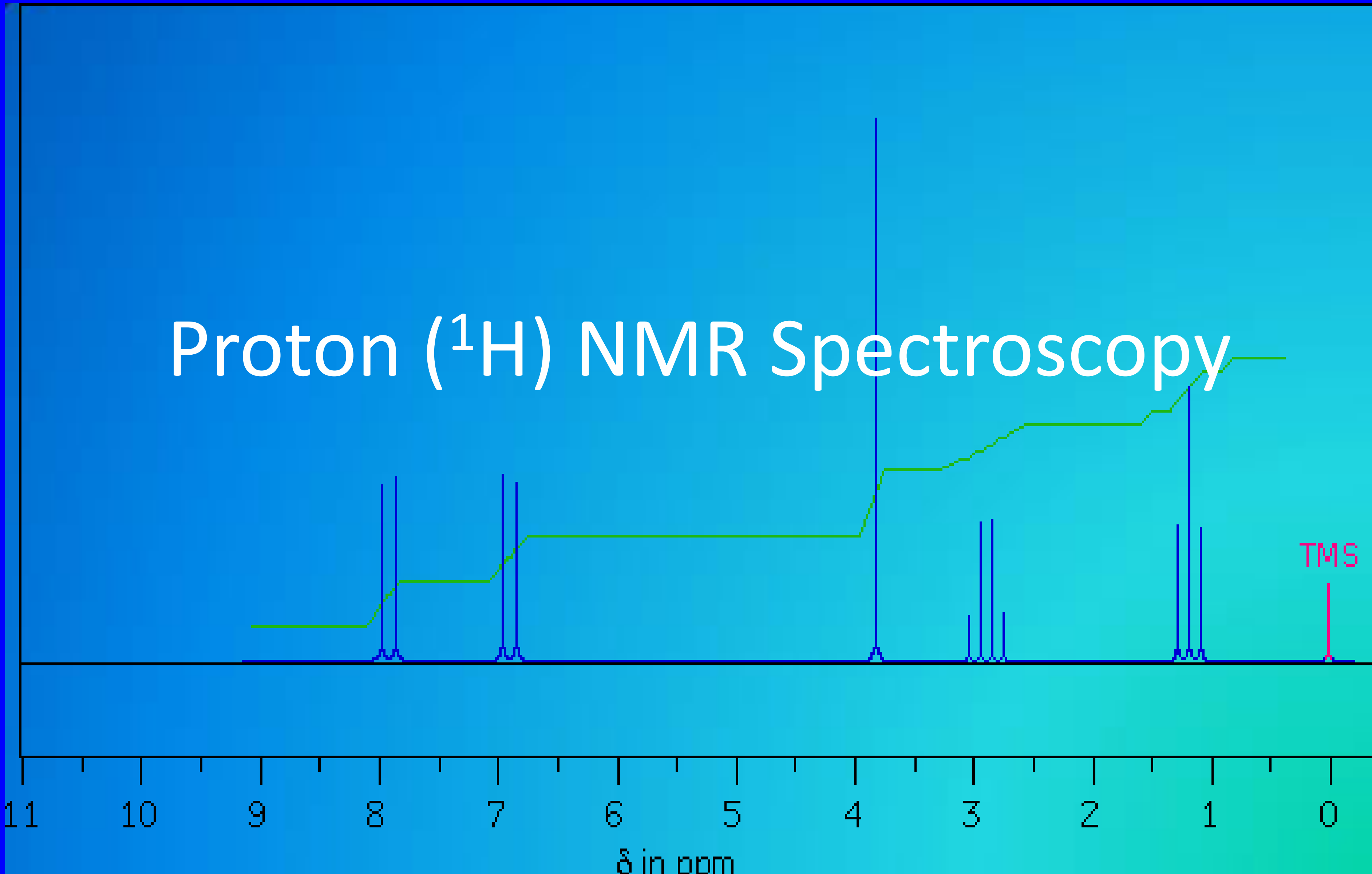
Nuclear Magnetic Resonance Spectroscopy

Introduction to NMR Spectroscopy



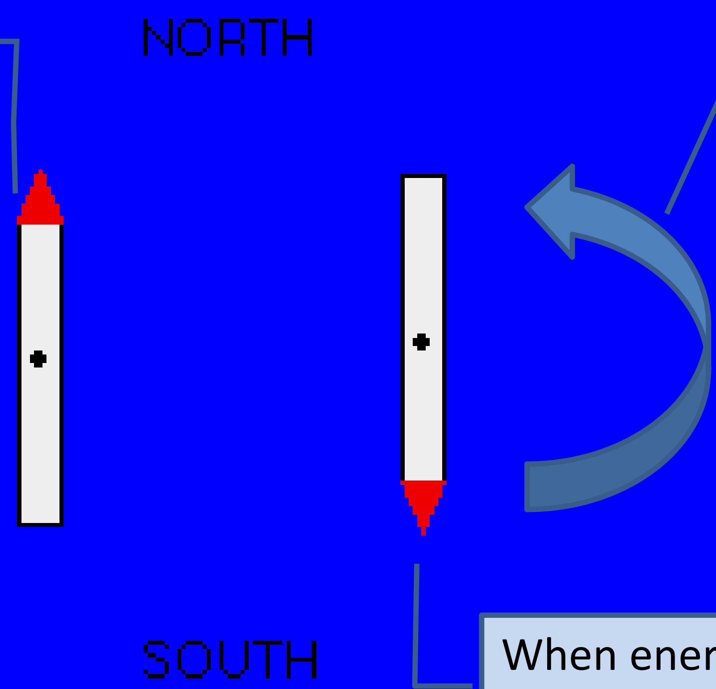
An NMR spectrometer. The sample is dissolved in a solvent, usually $CDCl_3$ (deuterochloroform), and placed in a magnetic field. A radiofrequency generator then irradiates the sample with a short pulse of radiation, causing resonance. When the nuclei fall back to their lower energy state, the detector measures the energy released, and a spectrum is recorded. The superconducting magnets in modern NMR spectrometers have coils that are cooled in liquid helium and conduct electricity with essentially no resistance.

Proton (^1H) NMR Spectroscopy



How are spectra created?

The compass needle aligns with the Earth's magnetic field and points north.

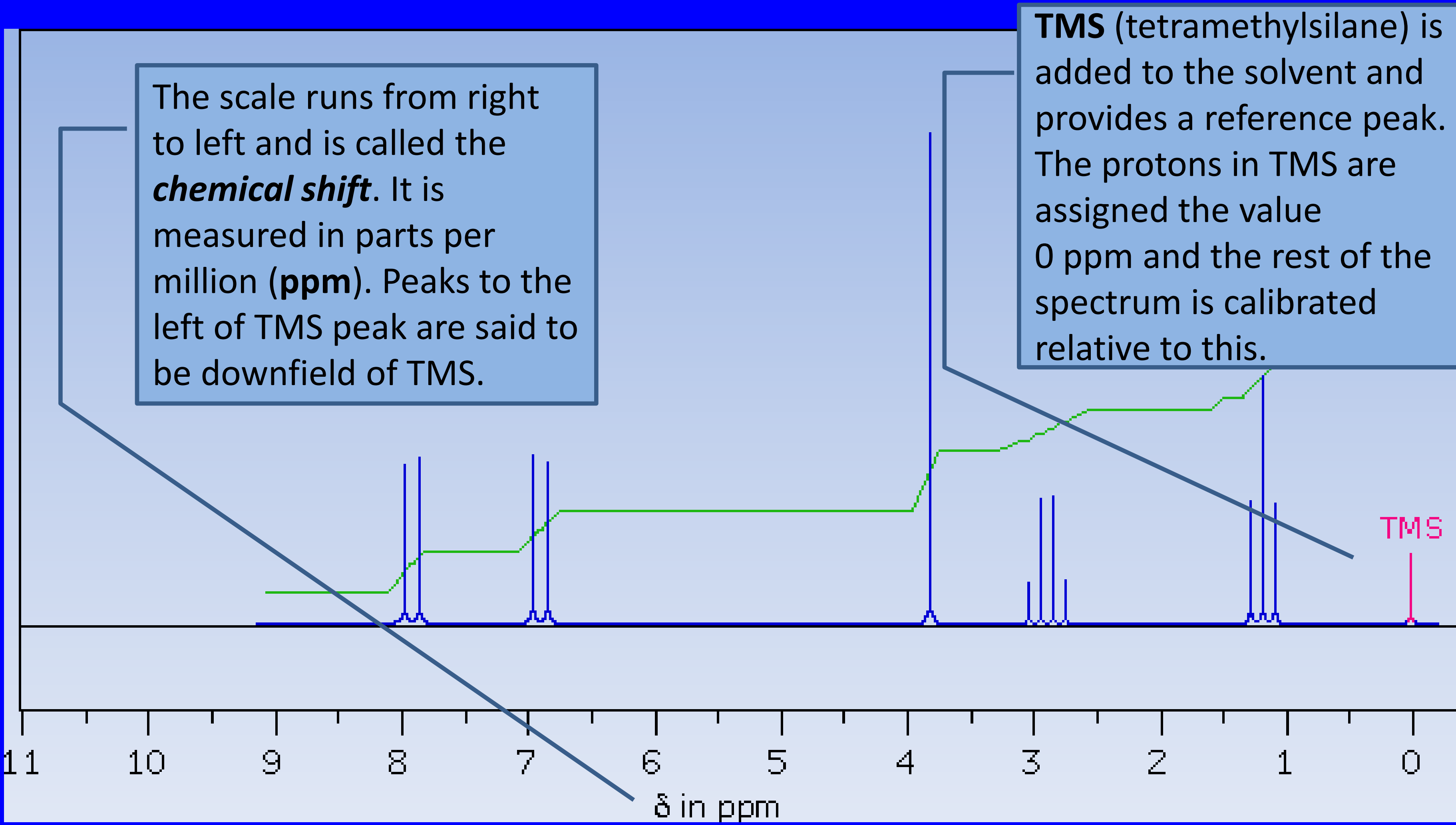


The needle will swing back as soon as the energy is removed.

Nuclei behave like tiny magnets – similar to a compass needle.

When energy is put in, the needle can be made to align in a direction opposite to the Earth's magnetic field.

Explaining spectra



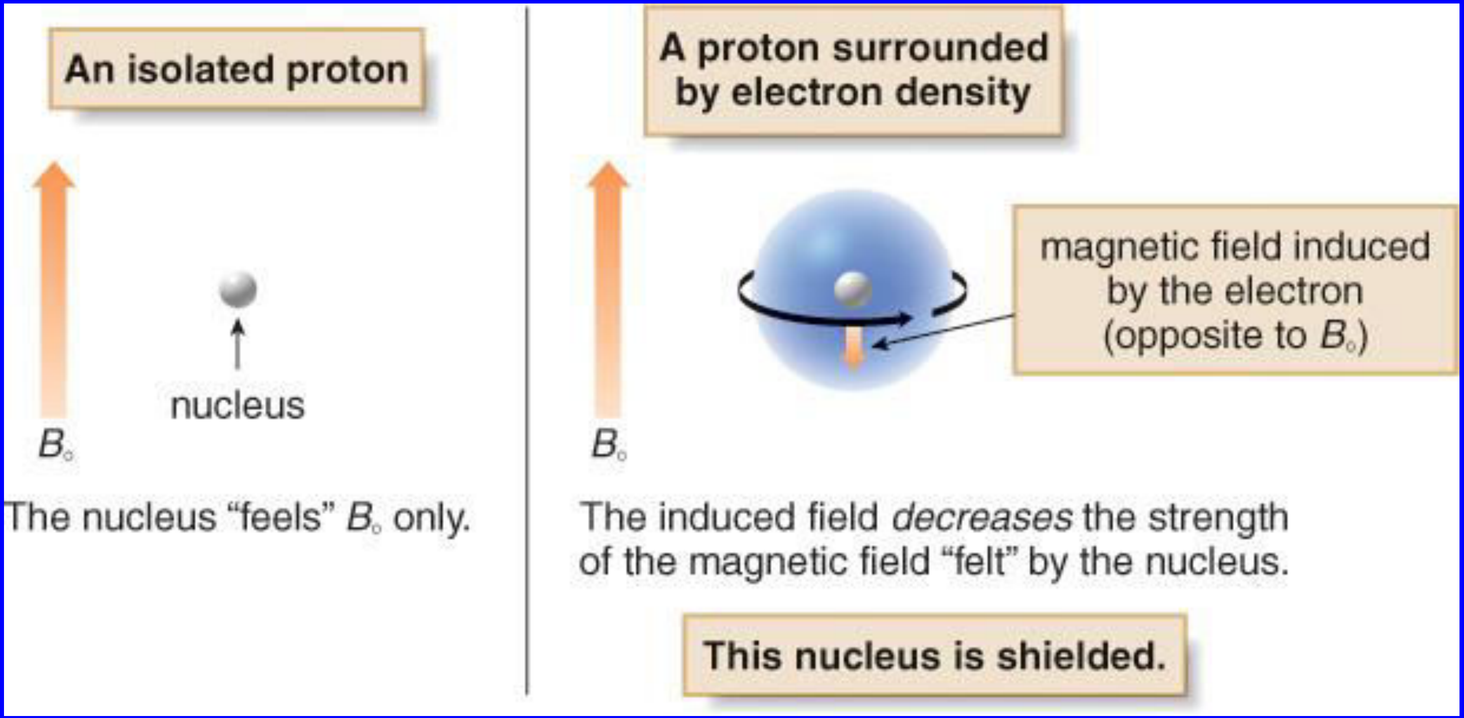
The scale runs from right to left and is called the ***chemical shift***. It is measured in parts per million (**ppm**). Peaks to the left of TMS peak are said to be downfield of TMS.

TMS (tetramethylsilane) is added to the solvent and provides a reference peak. The protons in TMS are assigned the value 0 ppm and the rest of the spectrum is calibrated relative to this.

Nuclear Magnetic Resonance Spectroscopy

^{1}H NMR—Position of Signals

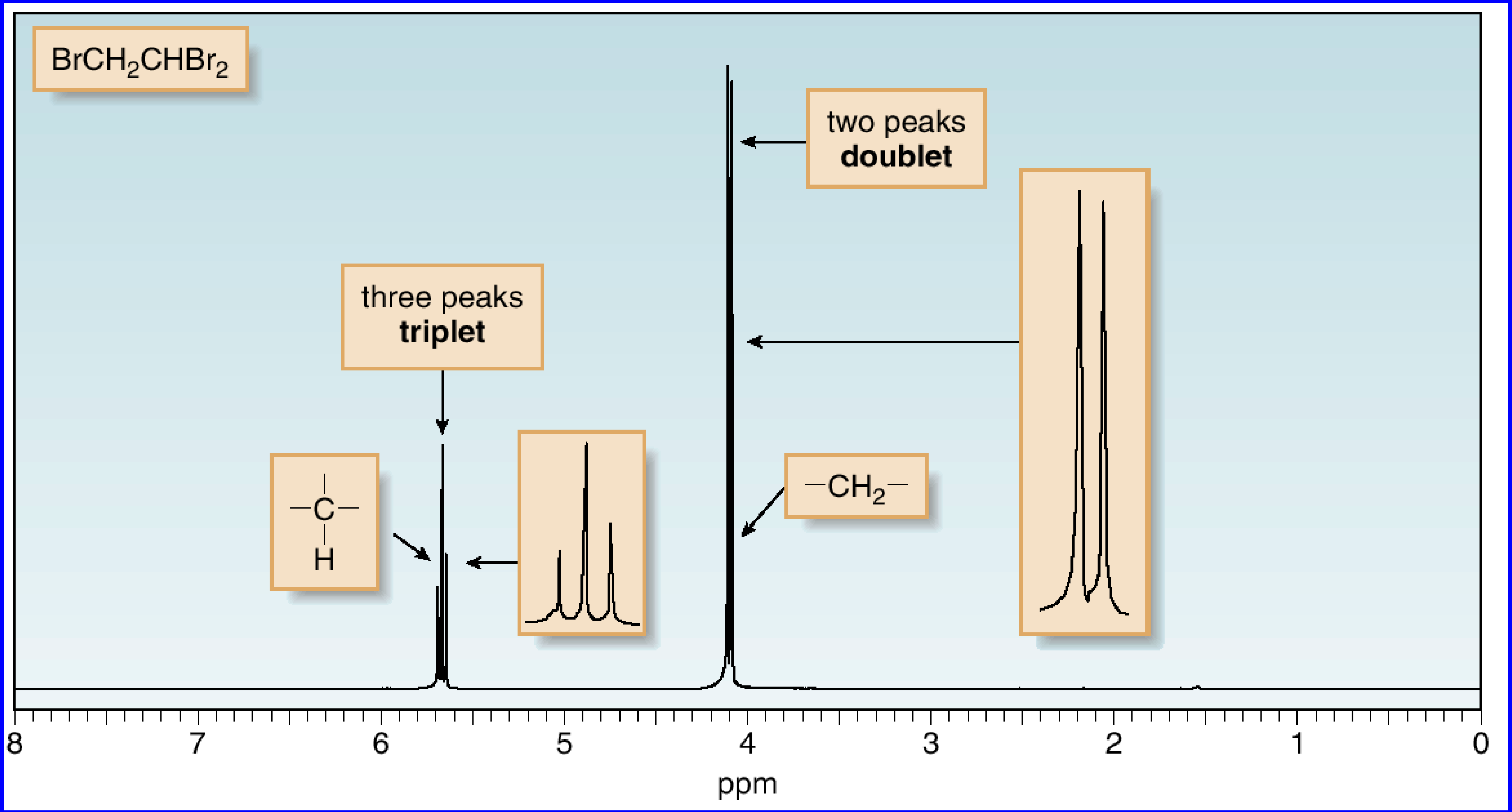
- In the vicinity of the nucleus, the magnetic field generated by the circulating electron decreases the external magnetic field that the proton “feels”.
- Since the electron experiences a lower magnetic field strength, it needs a lower frequency to achieve resonance. Lower frequency is to the right in an NMR spectrum, toward a lower chemical shift, so shielding shifts the absorption upfield.



Nuclear Magnetic Resonance Spectroscopy

^{1}H NMR—Spin-Spin Splitting

- Consider the spectrum below:

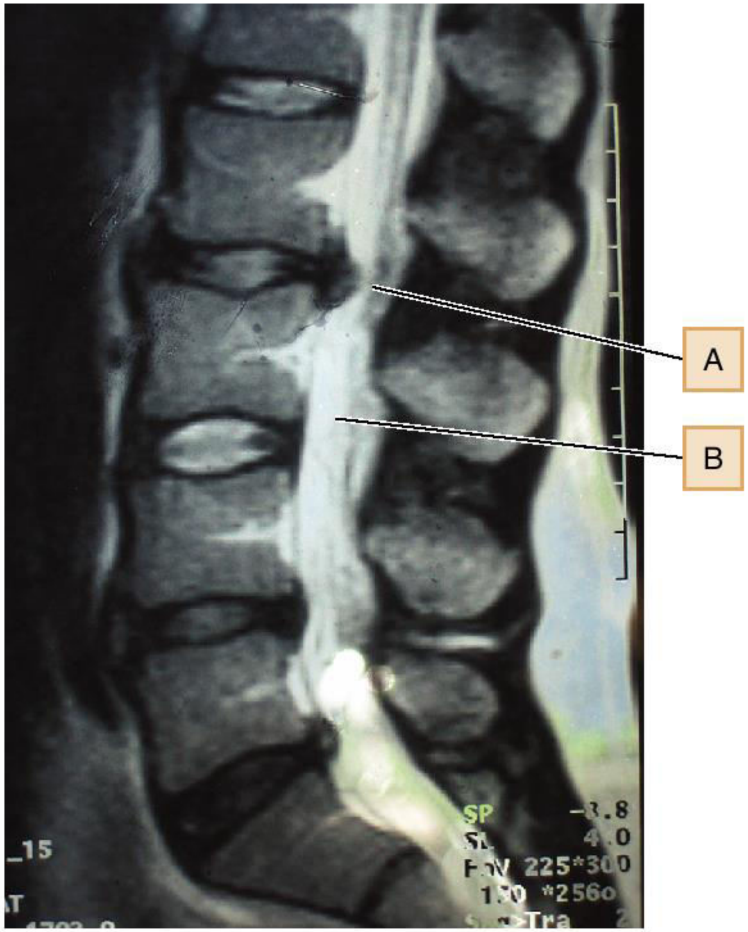


Nuclear Magnetic Resonance Spectroscopy

Figure 14.15
The MRI image of the lower back

An MRI instrument is especially useful for visualizing soft tissue. In 2002, 60 million MRI procedures were performed. The 2003 Nobel Prize in Physiology or Medicine was awarded to chemist Paul C. Lauterbur and physicist Sir Peter Mansfield for their contributions in developing magnetic resonance imaging.

A: Spinal cord compression from a herniated disc
B: Spinal cord (would not be visualized with conventional X-rays)



Signature

Richard L. Magin

Journal of Physical Chemistry & Biophysics Related Journals

- Journal of Electrical & Electronic Systems
- Journal of Lasers, Optics & Photonics

Gynecology & Obstetrics
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- [3rd International Conference and Exhibition on Lasers, Optics & Photonics]

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