Today

Practice With One More IR Spectrum

Section 14.1 - 14.9
Introduction to Nuclear Magnetic Resonance,
Shielding, Chemical Shift, and Integration

Next Class

Section 14.1 - 14.9
Introduction to Nuclear Magnetic Resonance,
Shielding, Chemical Shift, and Integration

Second Class from Today

Section 14.10 - 17
Splitting and Multiplicity

Third Class from Today

Section 14.20
^{13}C $\{^{1}H\}$ NMR

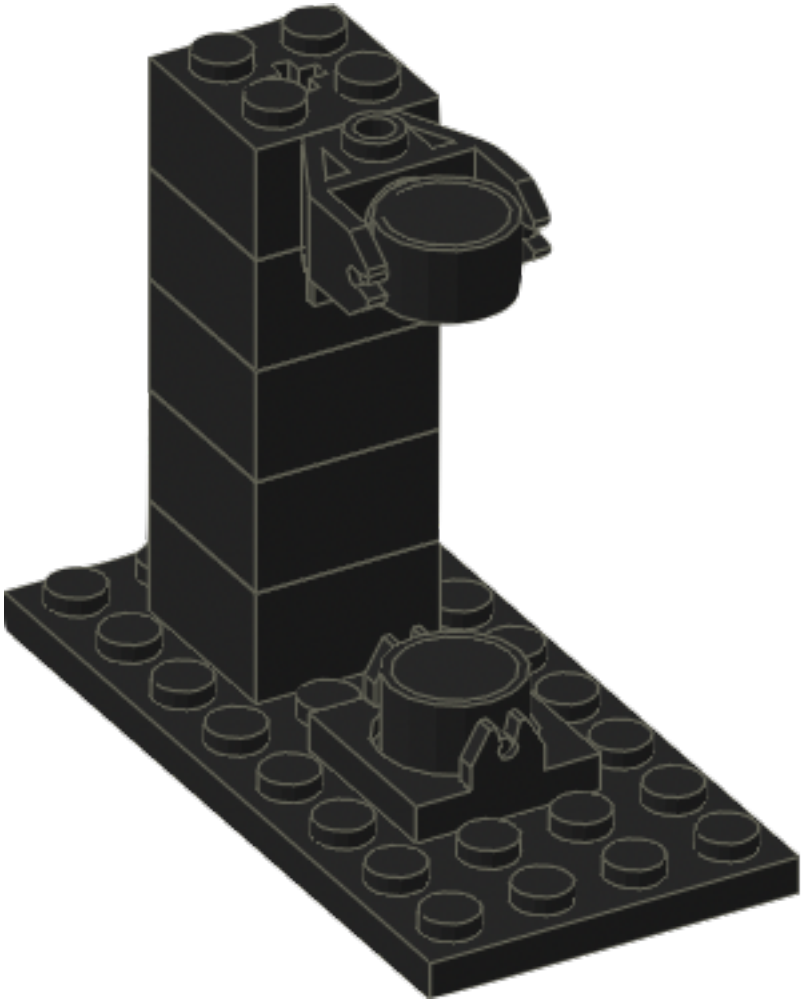
Practice Determining Structure Based on
Spectroscopic Data

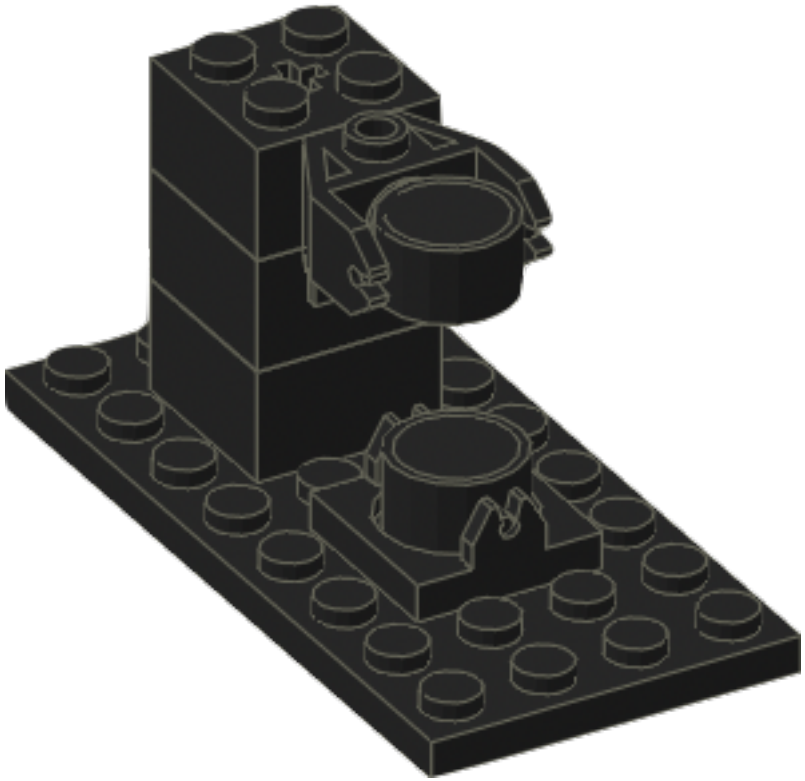
not as in radioactive / ionizing radiation

as in a property of the nucleus

^{1}H atoms are tiny magnets

Interesting things happen when you bring magnets together.





Johns Hopkins University

https://commons.wikimedia.org/wiki/File:Cutaway_of_NMR_magnet.jpg

900 MHz, (21.2 T) NMR Magnet at HWB-NMR, Birmingham, UK

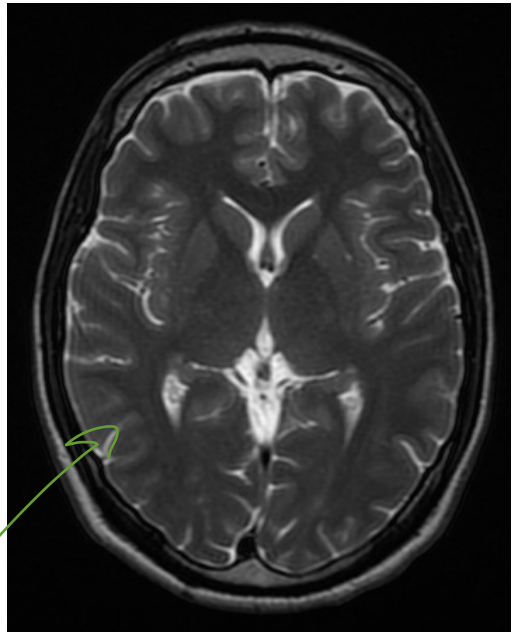
https://en.wikipedia.org/wiki/Nuclear_magnetic_resonance#/media/File:HWB-NMR_-_900MHz_-_21.2_Tesla.jpg

Nanalysis 60Pro (1.4 T)

https://images.squarespace-cdn.com/content/v1/5707ede0d210b8708e037a1e/1599832631533-

Magnetic Resonance Imagining

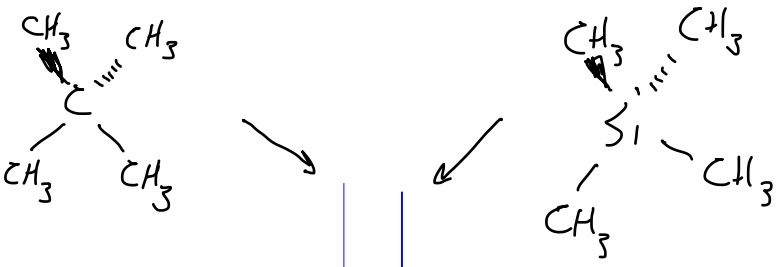
https://en.wikipedia.org/wiki/Magnetic_resonance_imaging#/media/File:Siemens_Magnetom_Aera_MRI_scanner.jpg



https://en.wikipedia.org/wiki/Magnetic_resonance_imaging#/media/File:Normal_axial_T2-weighted_MR_image_of_the_brain.jpg

- some ^1H atoms align with the magnetic field
- perturb them by sending radio waves at them
- as ^1H return to low E the emit radio waves

images soft tissue by recording where ^1H's are

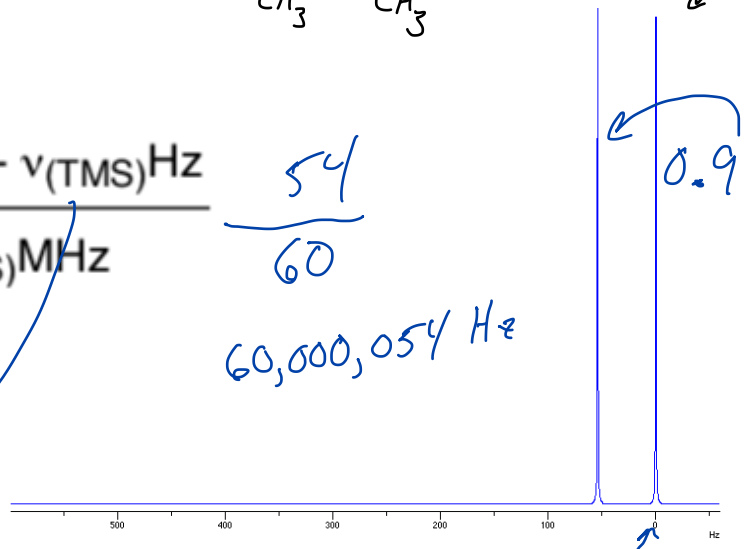


$$\delta \text{ ppm} = \frac{\nu_{(peak)}\text{Hz} - \nu_{(TMS)}\text{Hz}}{\nu_{(TMS)}\text{MHz}}$$

54 / 60

60,000,054 Hz

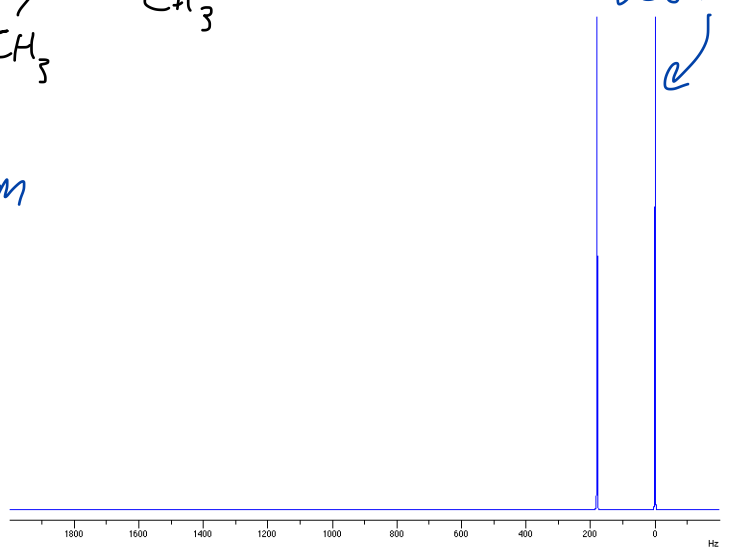
0.9 ppm



+ 60,000,000 Hz (60 MHz)

1.4 T

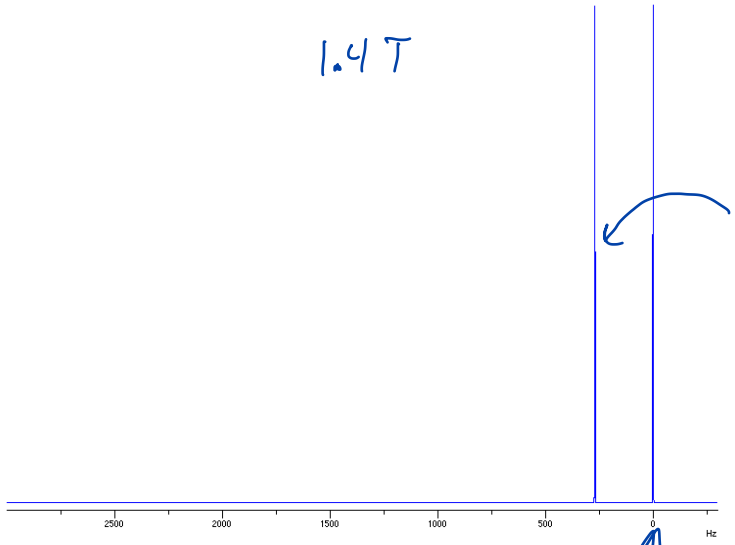
200 MHz



+ 200,000,000 (200 MHz)

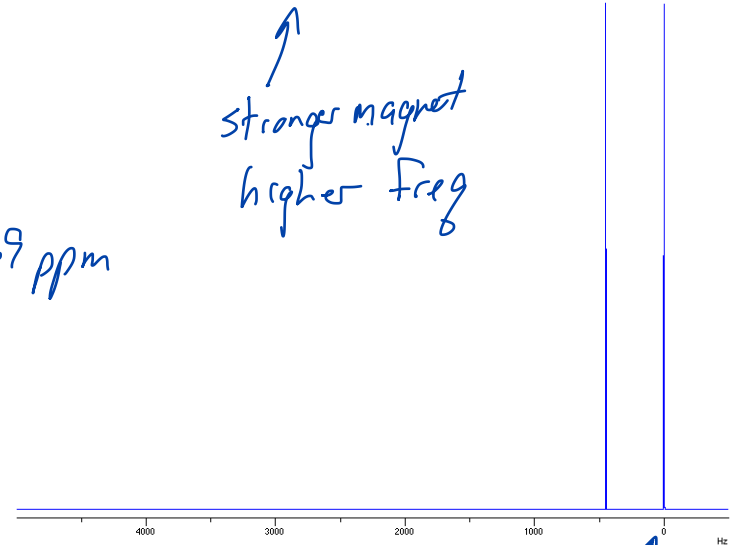
Invent a scale using a standard

stronger magnet higher freq



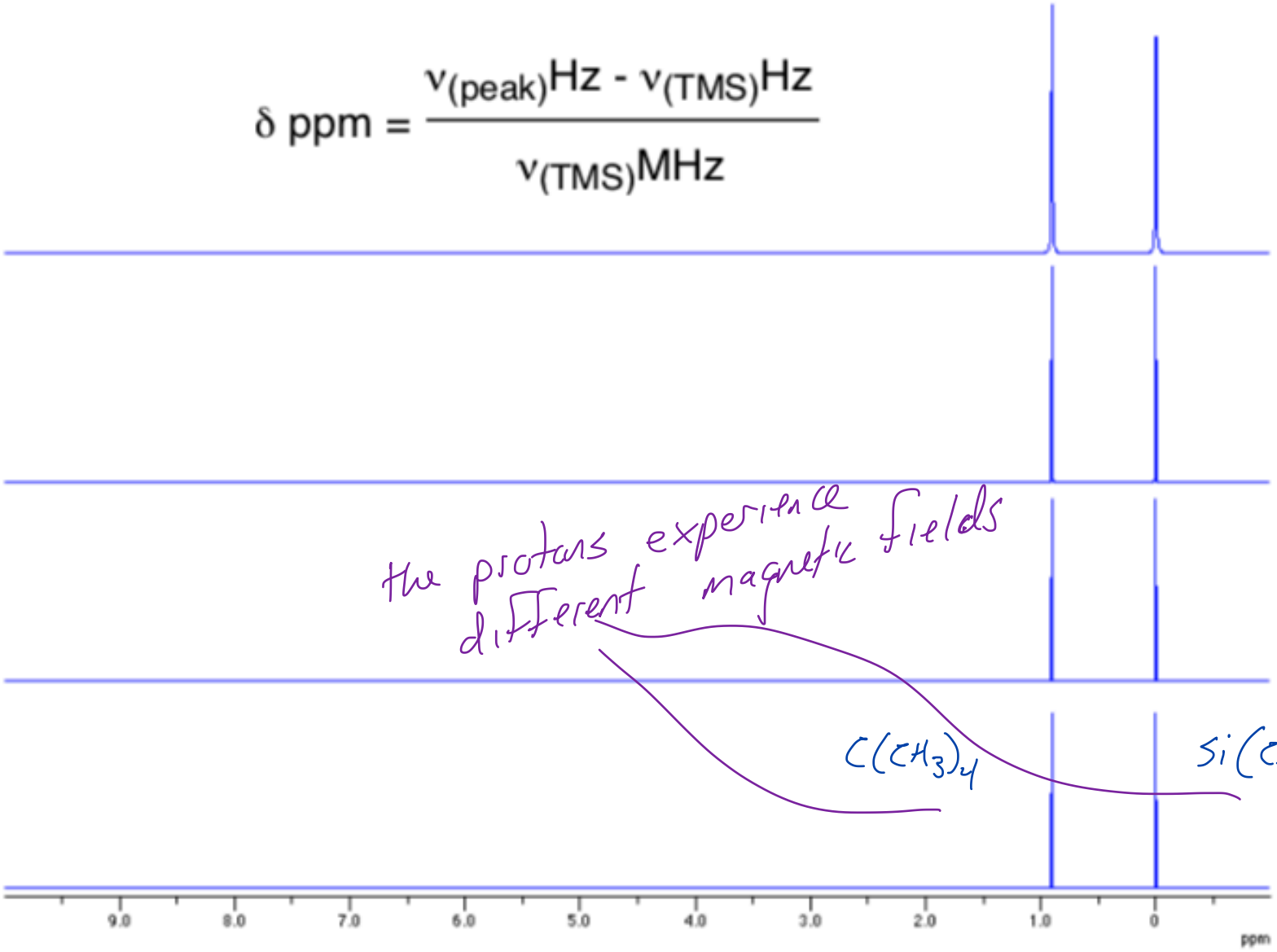
0.9 ppm

+300,000,000 Hz (300 MHz)

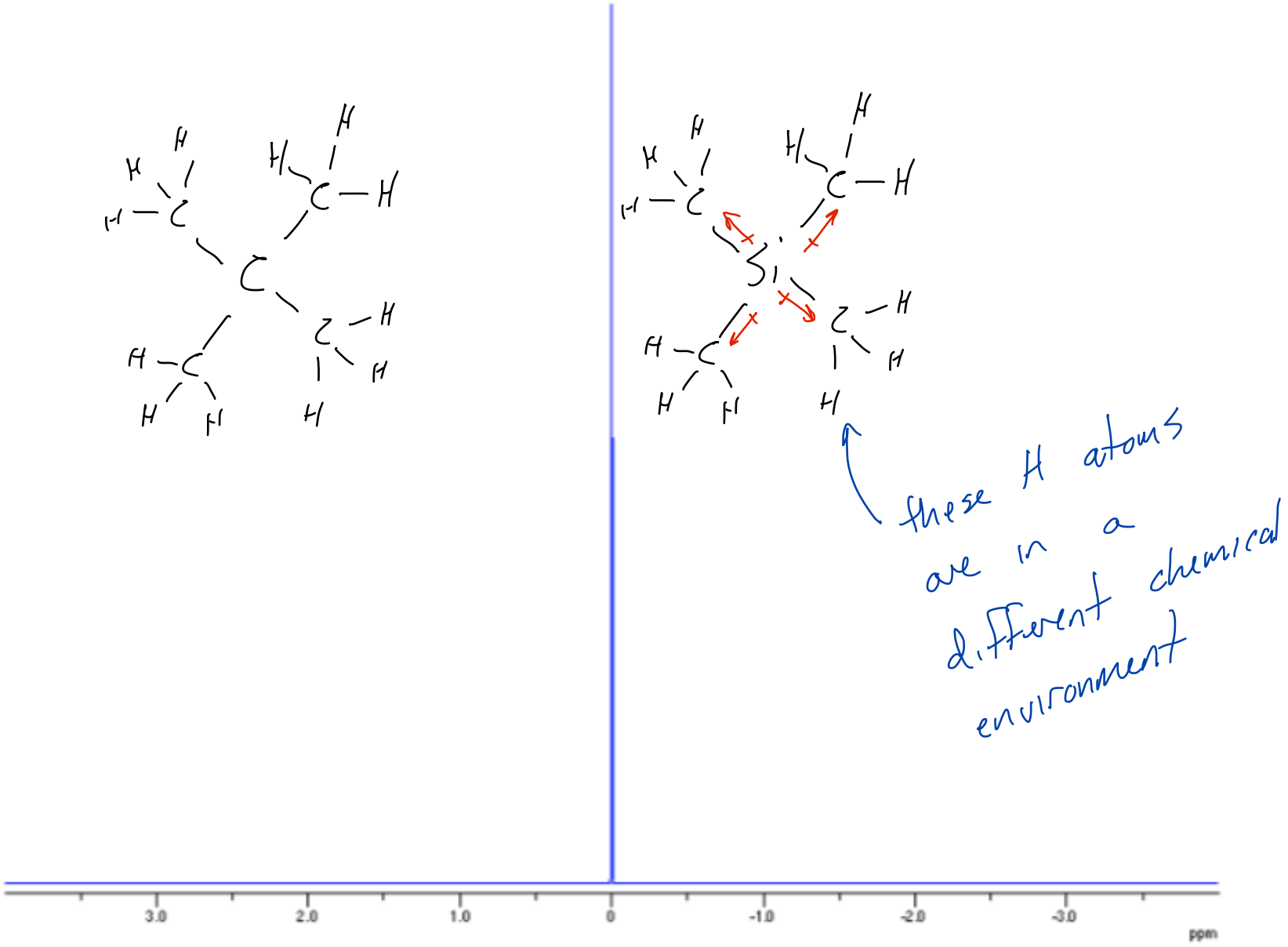


+ 500,000,000 Hz (500 MHz)

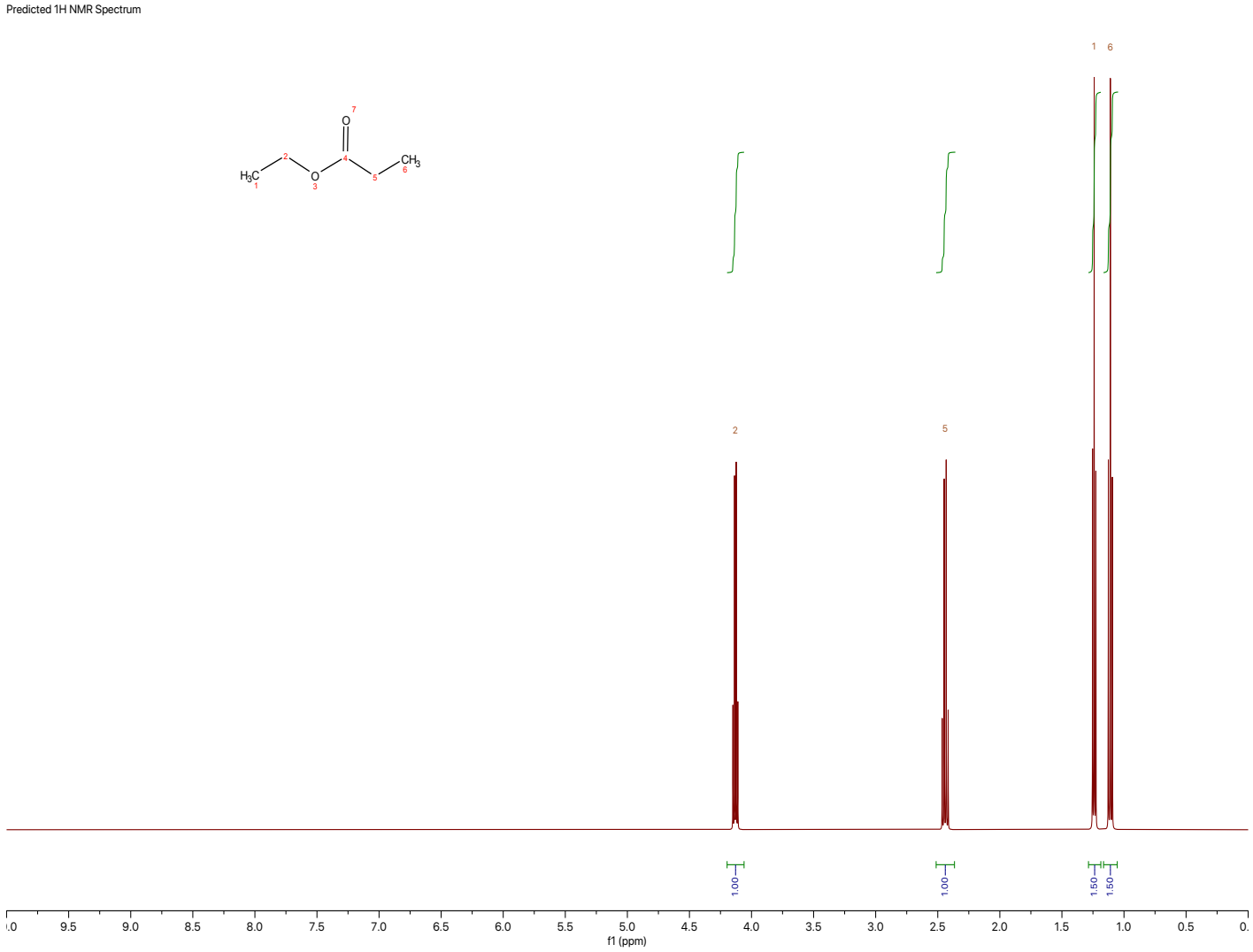
$$\delta \text{ ppm} = \frac{\nu_{(peak)}\text{Hz} - \nu_{(TMS)}\text{Hz}}{\nu_{(TMS)}\text{MHz}}$$



10 ppm 0


these H atoms are in a different chemical environment
3.0
2.0
1.0
0
-1.0
-2.0
-3.0
ppm

The NMR Spectrum



# of different types of H atoms	Chemical environments of the H atoms	How many of each type of H atom	# of H atom neighbors