How this is maintain?
↳ (small & finite excess of nuclei the lower energy)

Let us explain the NMR phenomenon in the light of electromagnetic radiation. which states that

⟨i⟩ The probability of upward transition by absorption of energy from the magnetic field is exactly equal to the probability of a downward transition by a process stimulated by the field.

⟨ii⟩ Spontaneous transition from a higher energy state to a lower energy state is negligible in the radio frequency (R.F.) region.

Thus, if the two possible spin states in a collection of nuclei were populated exactly equally, the probability of an upward transition would exactly equal to the downward transition. Since there is no net absorption energy there would not be no resonance. But under ordinary condition in a magnetic field, there is a very slight excess of nuclei in the lower spin state, they take up a Boltzmann distribution.

Under ordinary conditions the Boltzmann factor is about 0.001% and very small but finite nuclei in the lower energy state gives rise to net absorption of energy in the R.F. region.

* How do the nuclei in the higher energy state returns to the lower energy state?

The various types of radiationless transitions by which a nucleus in the higher energy state returns to the lower energy state are called RELAXATION —

The two most important relaxation process are -

① Spin-spin or Transverse relaxation

② Spin lattice or Longitudinal relaxation

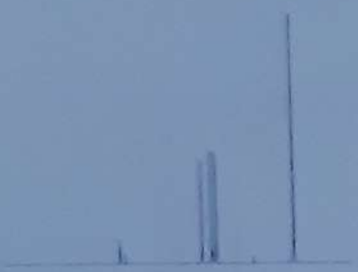
NMR Sensitivity

Increase energy gap → Increase population difference → Increase NMR signal

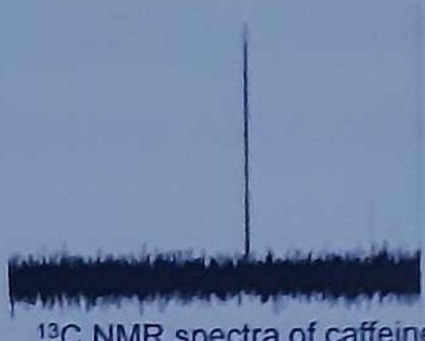
$$\uparrow \Delta E \equiv \uparrow B_o \equiv \uparrow \gamma$$

Relative sensitivity of ^1H, ^{13}C and other nuclei NMR spectra depend on:

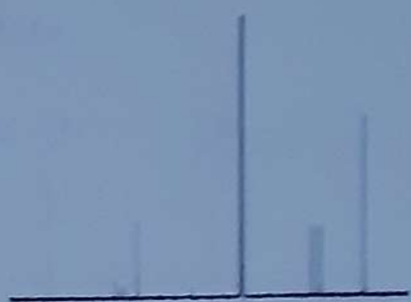
- Gyromagnetic ratio (γ): intrinsic property of nucleus can not be changed
- Natural abundance of the isotope



^1H NMR spectra of caffeine
8 scans ~12 secs



^{13}C NMR spectra of caffeine
8 scans ~12 secs



^{13}C NMR spectra of caffeine
10,000 scans ~4.2 hours

Field Dependence in NMR