How Nuclear Magnetic Resonance (NMR) Works

Where can NMR be used?

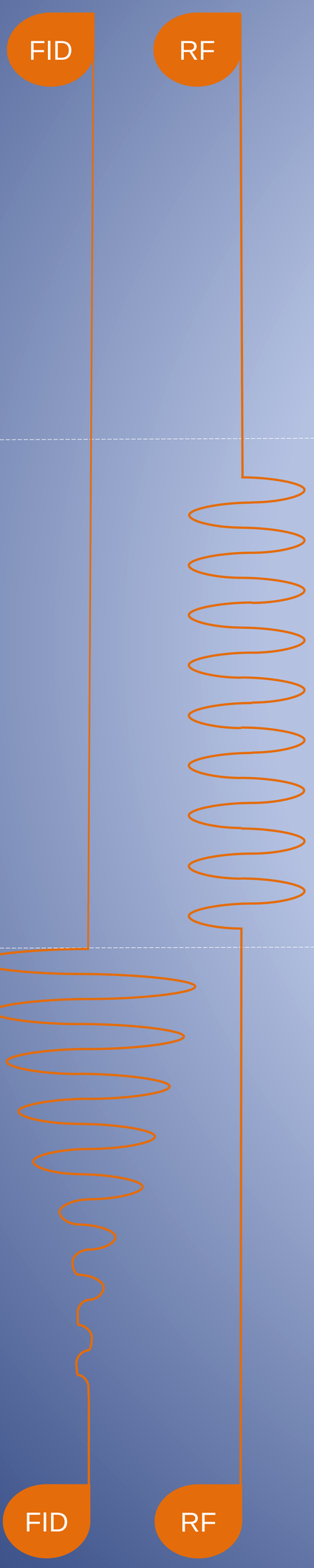
- ❑ Synthetic chemists
- ❑ Drug Discovery and development
- ❑ Life science research
- ❑ Food quality and safety
- ❑ Biochemistry
- ❑ Materials science

What information does it give?

- ❑ Most commonly, number of carbons and hydrogens
- ❑ How the carbons and hydrogens are connected
- ❑ The electronic environment of the atoms

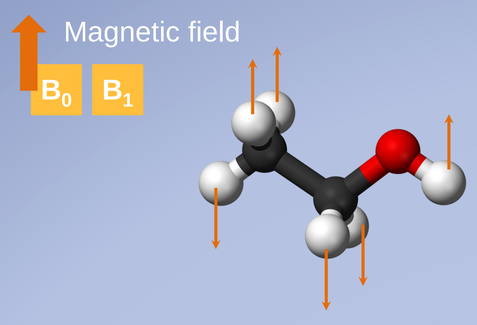
How else can it be used?

- ❑ Determine chemical structures
- ❑ Identify or quantify components in mixtures
- ❑ Quantify molecular compounds
- ❑ Monitor chemical reactions



Free induction decay (FID) is the observable NMR signal generated by non-equilibrium nuclear spin

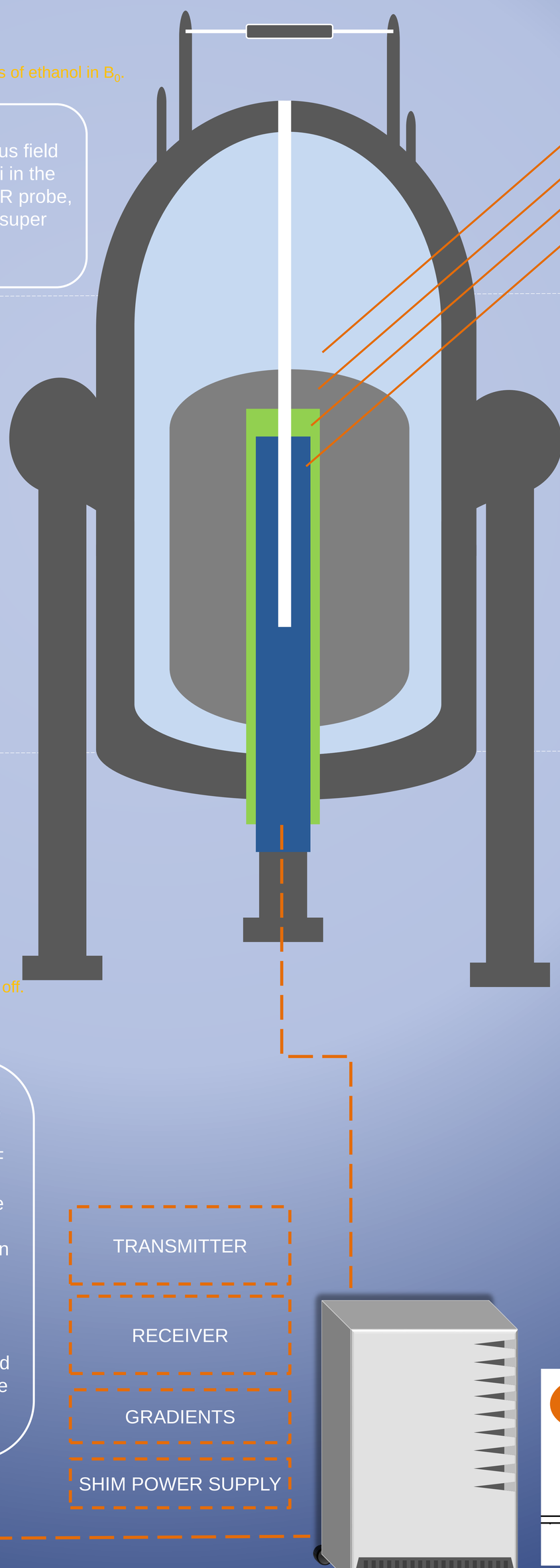
Computer

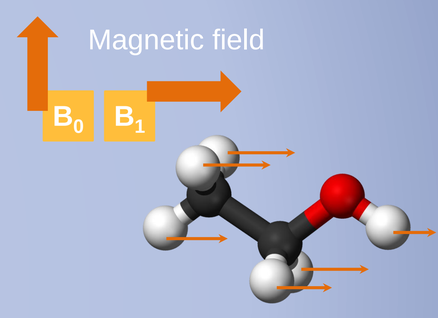


A snapshot of nuclear spins of ethanol in B_0.

Step 1

The sample is placed in a homogenous field (B_0) that aligns the spins of the nuclei in the sample. The sample sits inside an NMR probe, and the probe is surrounded by the super conducting magnet.

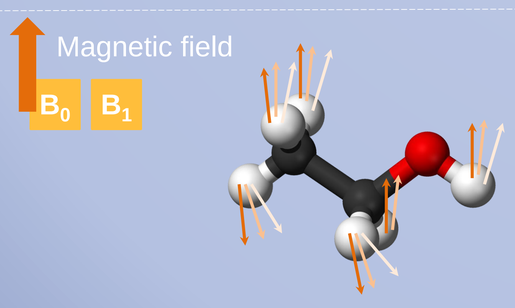




A snapshot of nuclear spins of ethanol after a 90°C RF pulse, which created a temporary B_1 magnetic field.

Step 2

The probe contains the radio frequency (RF) coils that transmit strong RF pulses into the sample. These RF pulses generate an additional magnetic field (B_1). The operator controls the B_1 field through the RF pulses, directing the rotation of the spinning nuclei. The RF coils also detect the much weaker signals produced by the spinning nuclei in the sample.



Snapshot of nuclear spins in ethanol during an intermediate time after B_1 is off.

Step 3

Through a computer program, the user controls the pattern of RF pulses sent to the ample. Each RF pulse has a specific frequency, width, shape, which modulates the B1 field. Different pulse patterns extract different kinds of information from the sample.

The console provides the sophisticated electronics that generate the desired RF pulses and processes the signal emitted by the nuclei.

TRANSMITTER

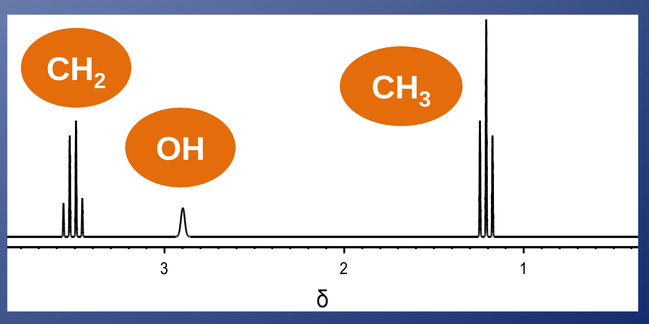
RECEIVER

GRADIENTS

SHIM POWER SUPPLY

Step 4

RF signals detected by the probe are sent to the console and then to the host computer, where the user processes them in NMR spectra. The location, shape, and area of the signals in each spectrum provide spatial and connectivity information about the nuclei in the sample.



1H NMR spectra of ethanol (CH_3CH_2OH)

Source: http://materialsscienceandengineering.tumblr.com/post/129245493969/bucoughman-how-nmr-works