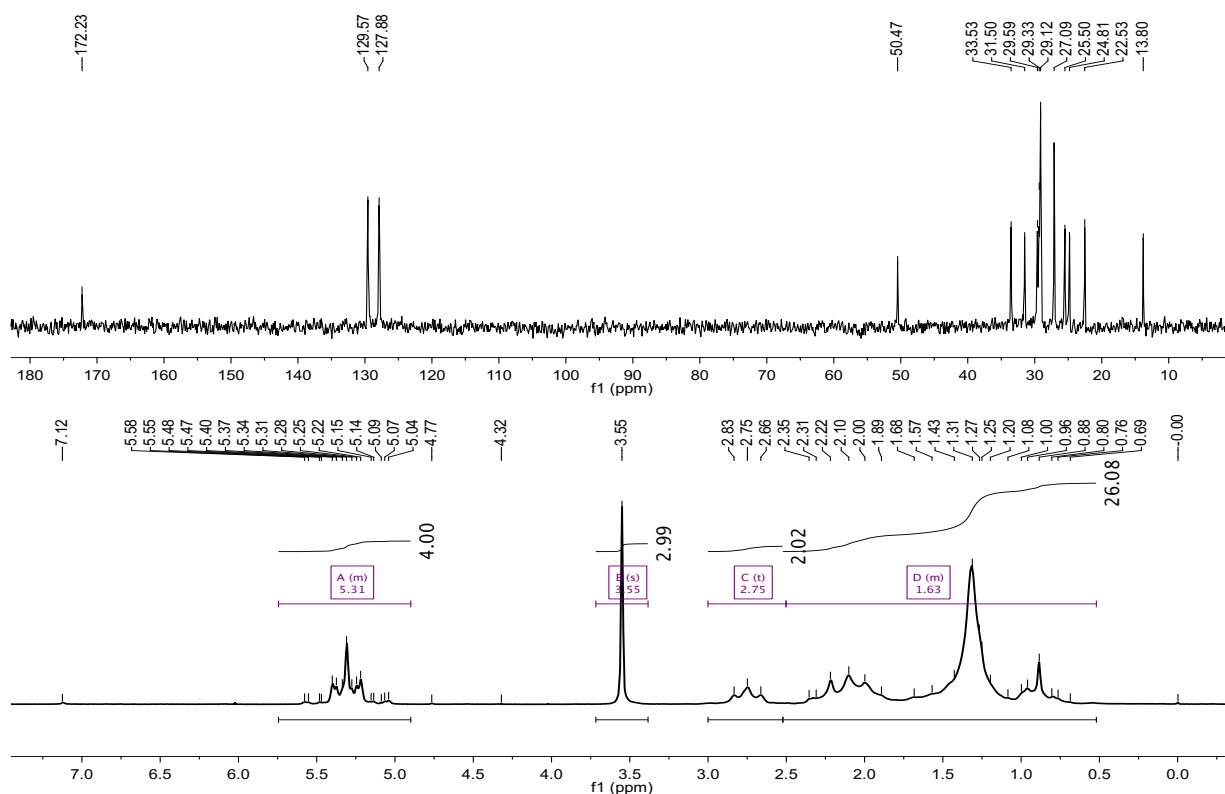


Eft NMR Spectrometer Advantages for Teaching

The Speed Advantage

The ^1H and ^{13}C NMR spectra show in the figure are a 50 wt% solution of methyl linoleate in CDCl_3 . Both spectra were acquired and processed in less than 2 minutes, so the first advantage of the Eft instrument is speed. Users can rapidly acquire and process both ^1H and ^{13}C NMR spectra. Large numbers of students can quickly acquire 1D and 2D spectra for their projects.



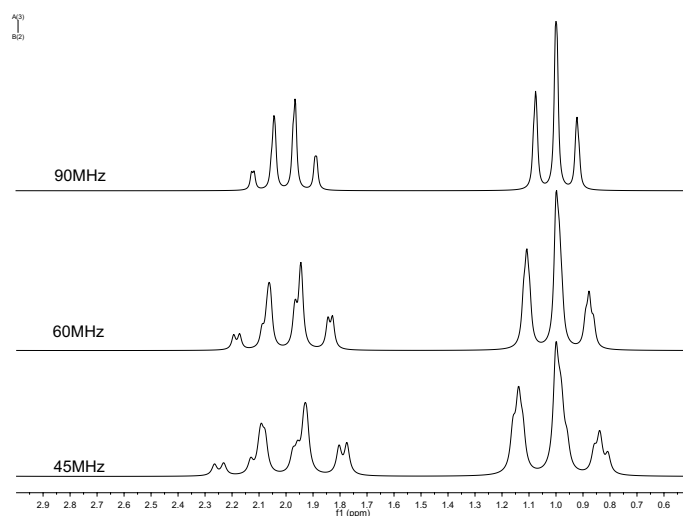
High Quality Spectra

Two features of the Eft spectrometer make it ideal for the teaching laboratory. First, the 60MHz field strength gives excellent resolution for relatively large molecules. Second, the industry standard 5mm tube sample size gives a large sample volume and excellent signal

to noise. The physical laws of magnetic resonance dictate that reducing the sample volume will result in lower levels of signal in a linear fashion. For example, the volume of our 60MHz instrument is about 0.2mL. In a capillary NMR, the volume is 0.0001mL, therefore, for equal

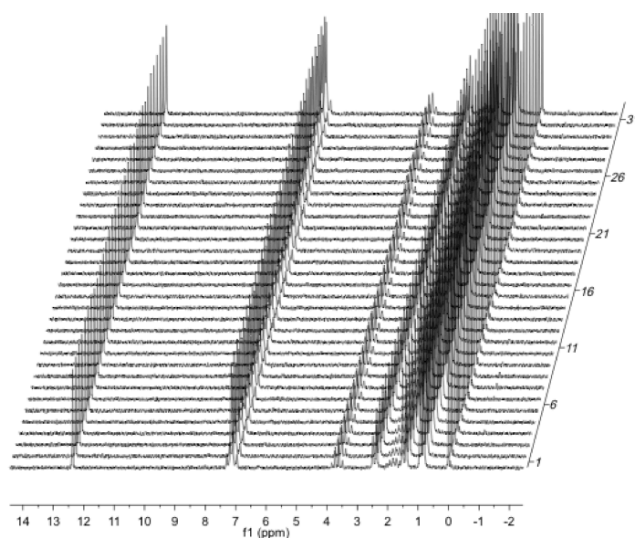
magnetic field strengths, the larger sample volume will provide 2,000 times the signal to noise. Additionally, reducing the field strength results in lower levels of signal, more spectra crowding and more 2nd order effects, which complicate interpretation of spectra. The graphic to

the right shows that the ideal triplet-quartet pattern deteriorates below 60MHz.



Instrument Stability

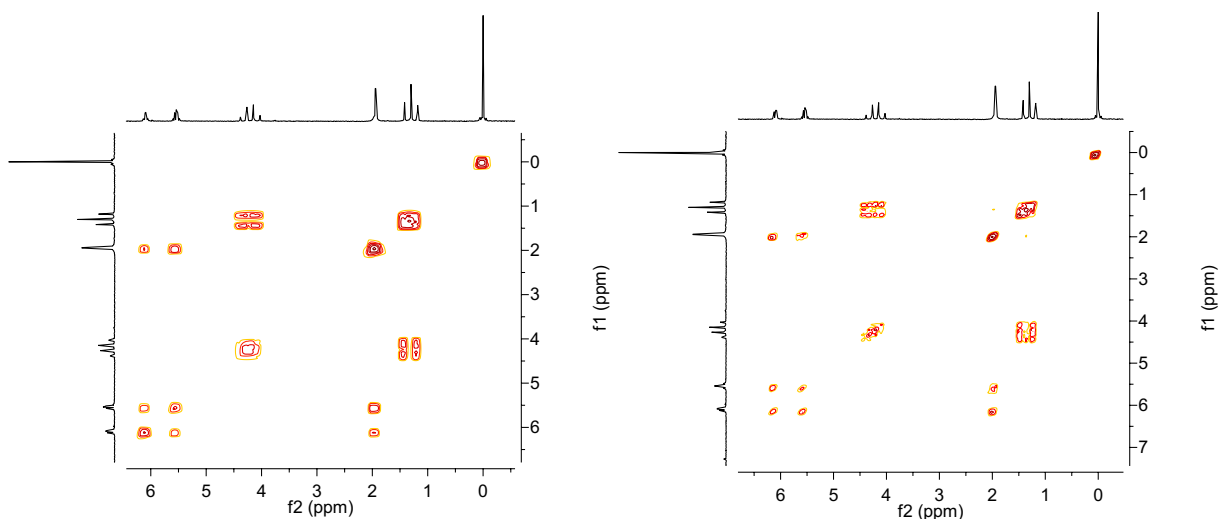
The Eft is a very rugged and well-built NMR instrument. Its design is proven effective by over 15 years of experience in teaching labs all over the world. Critical to the success of any high-resolution NMR experiment is the stability of the magnet field. If a permanent magnet is either poorly shielded or poorly thermally stabilized, the magnetic field will fluctuate during the measurement and deteriorate the quality of the results. Small tabletop NMR instruments are very sensitive as well. The critical test is to measure chemical shift as a function of time. The graph below illustrates the stability of the Eft-60 over a 2.5 hour period, which is long, when considering that typical ^1H spectra require seconds to acquire and ^{13}C spectra require several minutes.



Two Dimensional (2-D) Spectroscopy

Because the Eft spectrometer is a full-featured FT-NMR instrument, it is easily capable of more complex experiments such as DEPT, T_1 and T_2 relaxation, and 2-D spectroscopy. The primary 2-D experiments include $\{^1\text{H}\}$ - ^1H correlation spectroscopy COSY and $\{^1\text{H}\}$ - ^{13}C

correlation spectroscopy HETCOR. COSY spectra can be acquired using gradient enhanced techniques, so it is possible to acquire a low resolution COSY in as little as 3 minutes. The figure below compares a 512 x 128 COSY spectrum (left, <3minutes) for a 5% ethyl methacrylate in CDCl₃ solvent with a COSY-45 1024 x 256 data set (right, < 7 minutes).



Finally, the DEPT and HETCOR measurement is quite valuable in helping students determine the identity of an unknown. The spectrum on the lower left is a DEPT spectrum of menthol and the spectrum on the lower right is a spectrum of ibuprofen. Both of these spectra were recorded in about 5 minutes.

