A Hands on Introduction to NMR

22.920

Lab and Problem Set #4

Gradient and Spin Echoes

1. Observe a Hahn echo and see that the echo height is independent of the shimming. Why is this?

2. For water, measure the real spin-spin relaxation time by observing the decay of the echo amplitude as the echo time is increased.

3. Change the phase of the ¼ pulse by 90° and observe that the echo intensity is inverted, explain.

4. Change the ¹ pulse to a ¹/2 pulse and observe that the echo intensity is decreased by a factor of 2, explain.

5. Set up a stimulated echo and observe the five echoes. Make the storage time much longer than the spin-spin relaxation time of water, (say 3 seconds). A stimulated echo is still observed, why? What distinguishes the stimulated echo from the others?

6. Explain how the measurement of a diffusion coefficient that we made last class can be improved by employing spin echo. Suggest a sequence and show the corresponding k-space description.