

## Two Dimensional (2D) NMR

- 2D Spectrum: Horizontal and Vertical Chemical Shift Scales with a Matrix of Intensity Values  
Example:  $^{13}\text{C}$  Scale on Horizontal Axis,  $^1\text{H}$  Scale on Vertical Axis, a “Blob” of Intensity at Intersection of  $^1\text{H}$  and  $^{13}\text{C}$  Chemical Shifts for a C-H Group
- Data Matrix Can be Displayed in Three Ways:
  - Stacked Plot of 1D Spectra
  - Intensity Plot (Pixels)
  - Contour Plot (Topographic Map)
- How It Works: NMR Excitation is Transferred from One Nucleus to Another by:
  - Proximity in Space (H to H, NOE)
  - J Coupling (H to H, H to C, Through-Bond)
  - Multiple J Coupling Jumps (TOCSY)
- A 2D Experiment is Just a Series of Many 1D Experiments (e.g., 750)
- Steps in One of the 1D Experiments:
  - Preparation (Excite Nucleus **I**)
  - Evolution (Wait a Time  $t_1$ ): Record **I** Chem. Shift
  - Mixing (Transfer the Excitation to Nucleus **S**)
  - Detection (Record the FID of Nucleus **S**)
- The  $t_1$  Delay is Incremented (Increased) with Each New 1D Spectrum Recorded