Decoupling

- We think of 1D $^{13}$C NMR spectra as being composed of simple single resonances (lock solvent resonance is an exception?).

- Simple singlet $^{13}$C resonances are the result of "$^1H$ decoupling".

- The goal of decoupling — say between $^1H$ and $^{13}$C nuclei — is to disable fine-structure influences on resonance structure.

- An equally important goal is to improve the sensitivity of X-nuclei via the nuclear Overhauser enhancement.

- Both influences enhance X-nucleus detection sensitivity.
• Decoupling operation can be controlled in several ways - the most common way is to define the "decoupler mode", dm.

• In the example above, dm = 'yyy', meaning that decoupling is active during status regions A, B, C.
• For a simple $^{13}$C ID detection experiment, $\rho_1 = 0$ and $d_z = 0$, so that nothing actually is defined during status-B - nevertheless, we must formally acknowledge that status-B is defined.

• The influence of $^1H$ decoupling on $^{13}$C spectra during status-A and status-C are very different.

• During status-A, only sensitivity-enhancement occurs.

• During status-C, only $^1H$ decoupling occurs.

• Thus, it is possible to obtain $^{13}$C spectra:
  1) No enhancement, no decoupling
     \[ \Delta m = 'nnn' \]
2) No enhancement, with decoupling
   \[ d_m = \text{'nnn'} \]

3) Sensitivity enhancement, no decoupling
   \[ d_m = \text{'yyn'} \]

4) Sensitivity enhancement & decoupling
   \[ d_m = \text{'gyy' (or 'yny')} \]