2/2

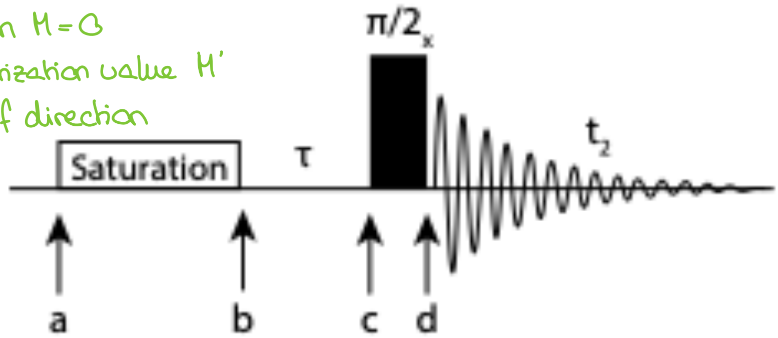
CH-314 Structural Analysis
ruben.rodriguezmadrid@epfl.ch
ray.cowen@epfl.ch

Jigsaw 5B

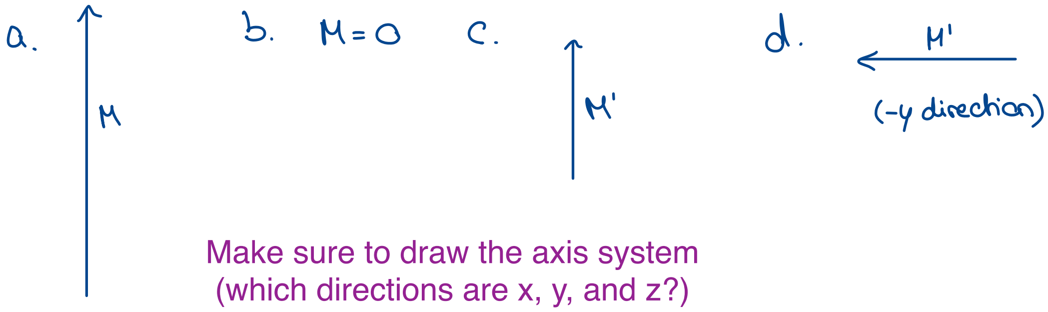
Vector model: Saturation recovery

The saturation recovery sequence is given below. The saturation block applies a series of pulses which randomly orients the spins to “kill” the net magnetization.

a. Magnetization M equals smth
b. Magnetization M = 0
c. New magnetization value M'
d. $\frac{\pi}{2}$ change of direction



1. Use vector diagrams to show what happens during the saturation recovery sequence.



Make sure to draw the axis system
(which directions are x, y, and z?)

2. At each point indicated by arrows, fill in the values of magnetization along the x, y, and z directions in the table below. Use M_{eq} to represent the equilibrium magnetization. *Hint*: Remember the Bloch equations. *Second hint*: There will be a lot of variables.

What is M’? Don’t just make up variables…

	a	b	c	d
M_x	0	0	0	0
M_y	0	0	0	$M_y = -M'$
M_z	M	0	$M_z = M'$	0

M_z_c = -M_y_d = M_eq*(1-exp(-tau/T1))
(From the bloch equations, we can determine what proportion of the equilibirum magnetization will have recovered along z as a function of tau)

3. Draw the expected signal intensity during t_2 as a function of τ.

4. What kind of information can be extracted from a series of experiments with different τ?

We can extract T_1 (longitudinal relaxtion time)

5. What is one advantage of the saturation recovery sequence over the inversion recovery sequence?

Saturation-recovery has a simpler recovery curve (single exponential from zero). So it can be faster and simpler to implement in sequences where repeated rapid measurements are needed.

The biggest advantage is that you don't need to wait a long time between the measurements. For inversion recovery, you want to be (close enough) to equilibrium magnetization before the first pulse. For saturation recovery, the initial state doesn't matter, since you apply the saturation pulses to kill the net magnetization.