

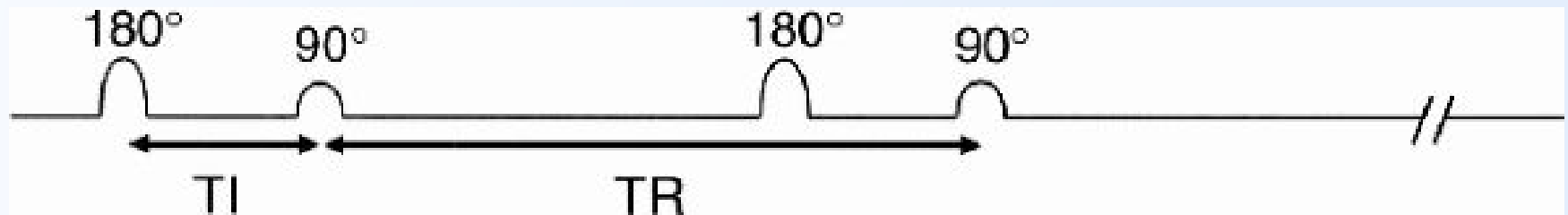
Lesson 8 (B): Pulse sequences (2)

Aims

- Learning the following topics:
- Inversion recovery pulse sequence
- STIR
- FLAIR

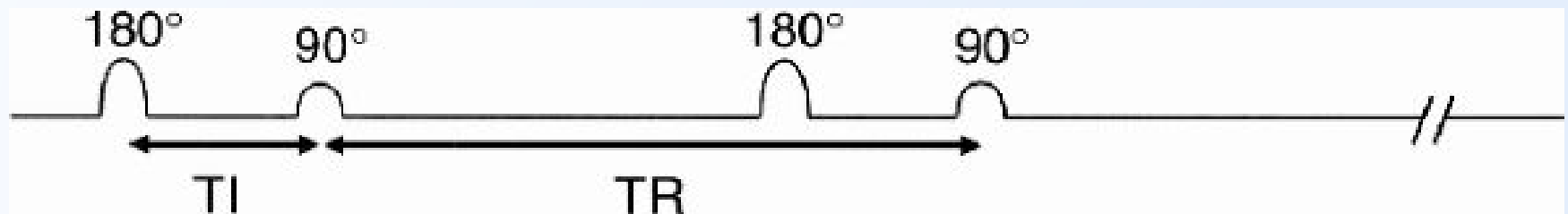
Inversion recovery

- First apply a 180° RF pulse - wait a period of time (the inversion time TI)
- Next apply a 90° RF pulse - wait a period of time TR
- Beginning the sequence all over again.



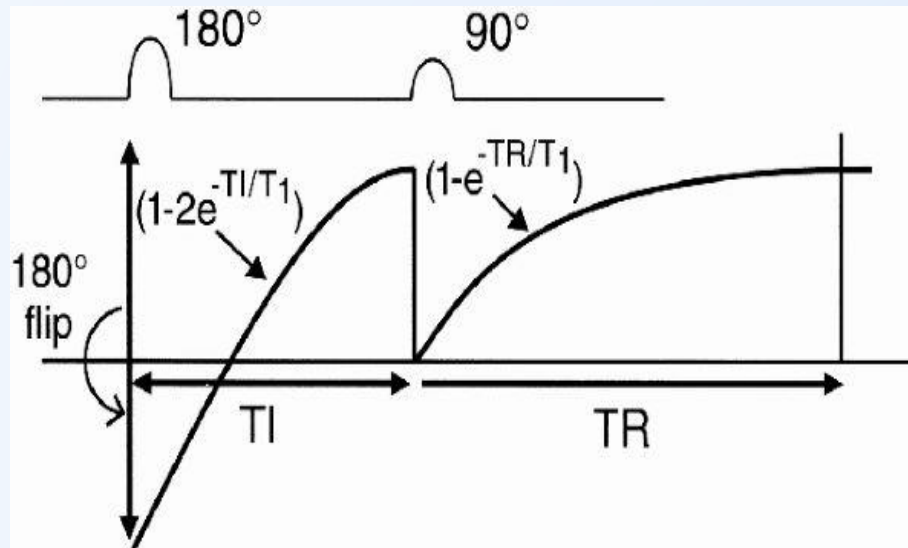
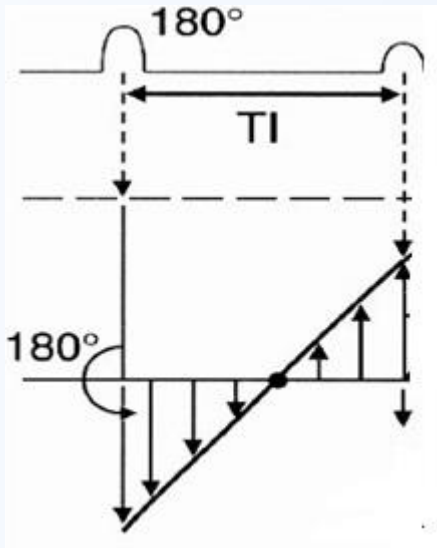
Inversion recovery

- TI:
- The time between the 180° pulse and the 90° pulse
- TR:
- The time between the two 90° pulses or the two 180° pulses



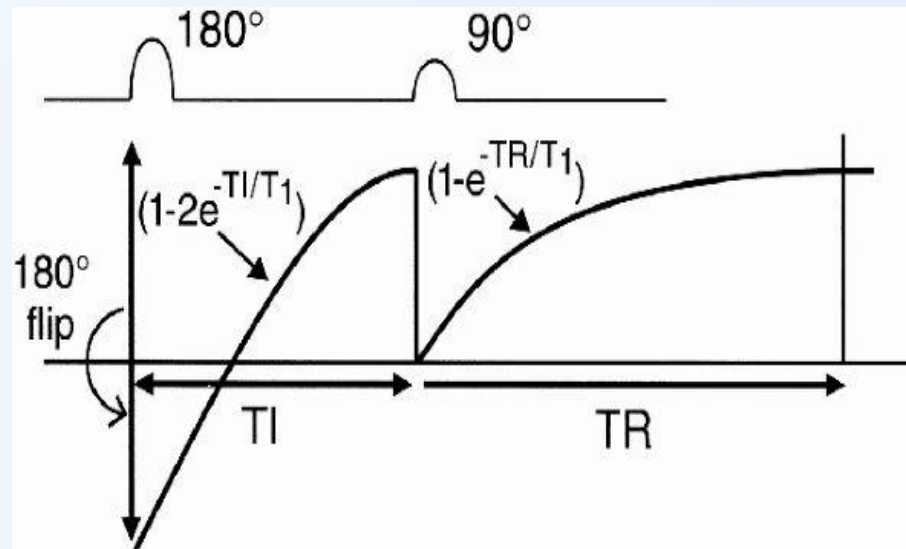
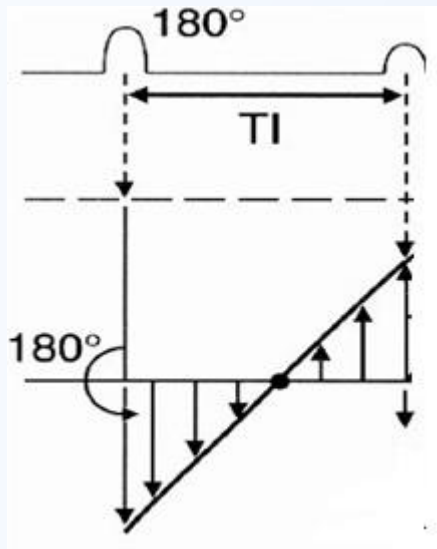
Inversion recovery

- 180° RF pulse:
- $M_0 \rightarrow -M_0$
- The T_1 recovery curve following the 180° pulse starts at $-M_0$ and grows exponentially according to the formula:
 - $M_0 (1 - 2e^{-TI/T_1})$



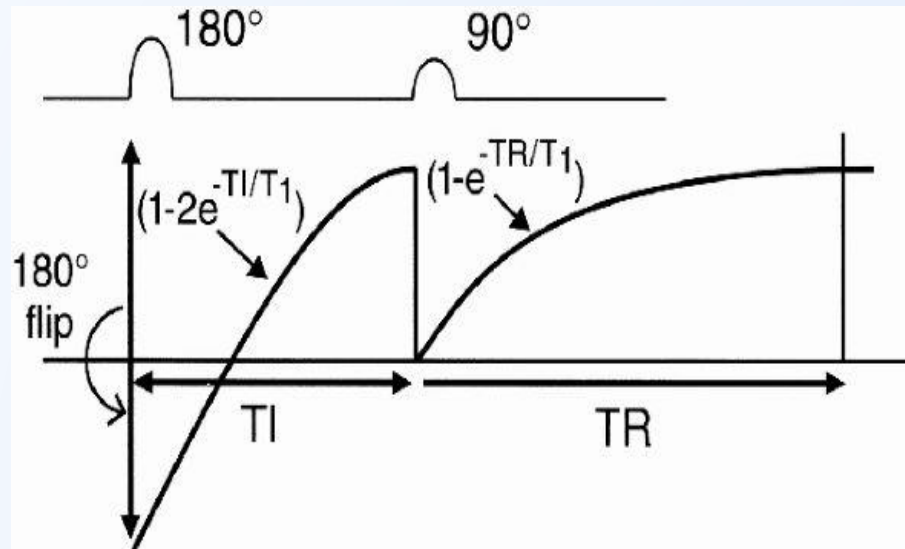
Inversion recovery

- 90° RF pulse:
- The T1 recovery with the formula:
- $M_0 (1 - e^{-TR/T_1})$



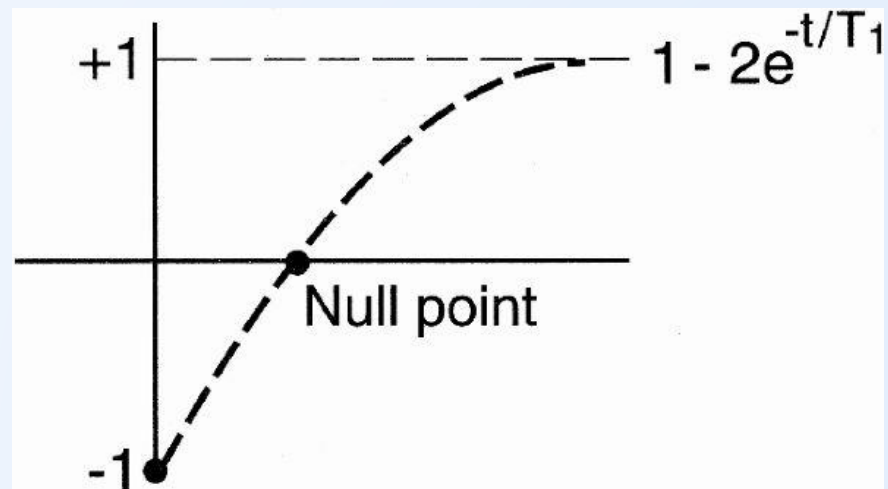
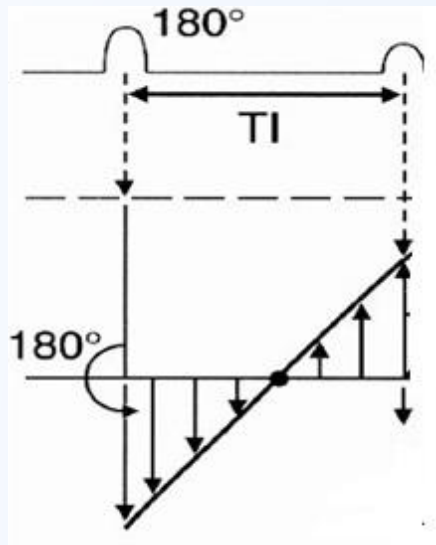
Signal intensity in inversion recovery

- $SI \propto M_0 (1 - 2e^{-TI/T_1})(1 - e^{-TR/T_1})$



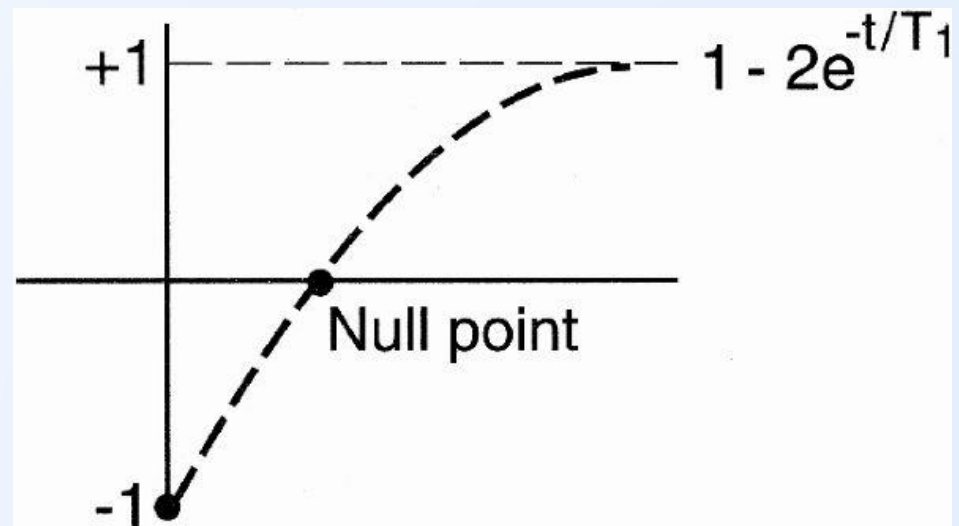
Null point

- The point at which the signal crosses the zero line is called the null point.
- At this point, the signal intensity is
- zero.
- The time at this null point is denoted $T_I(\text{null})$.



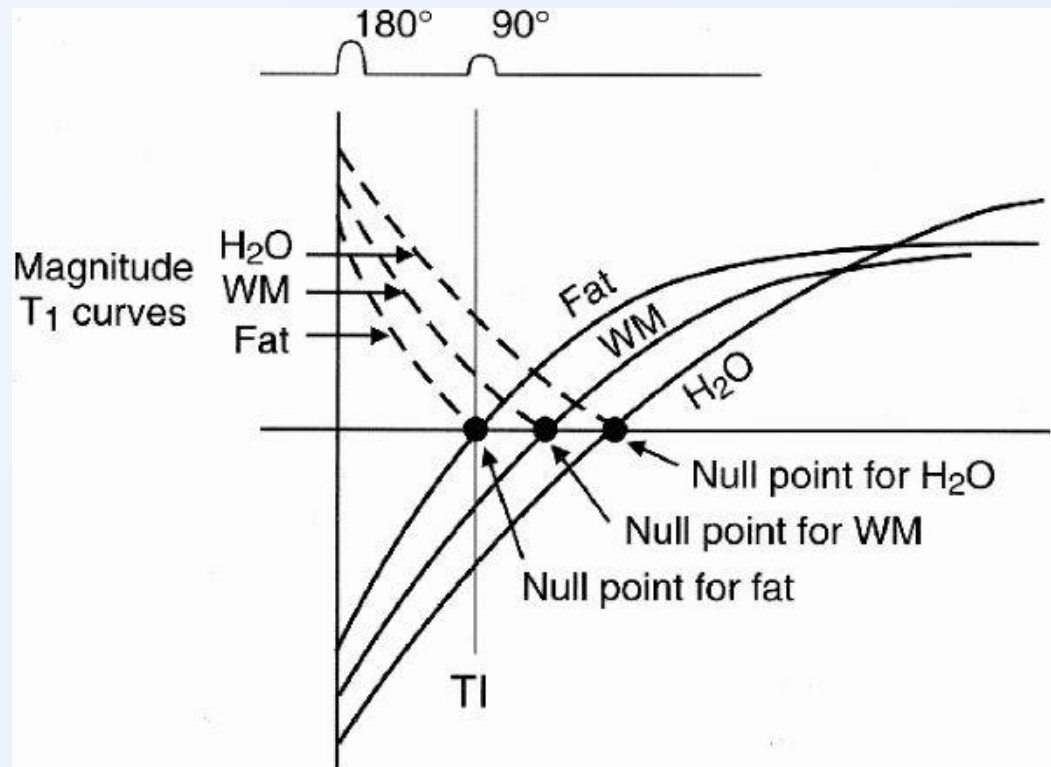
TI(null)

- $TI(\text{null}) = 0.693 T_1$



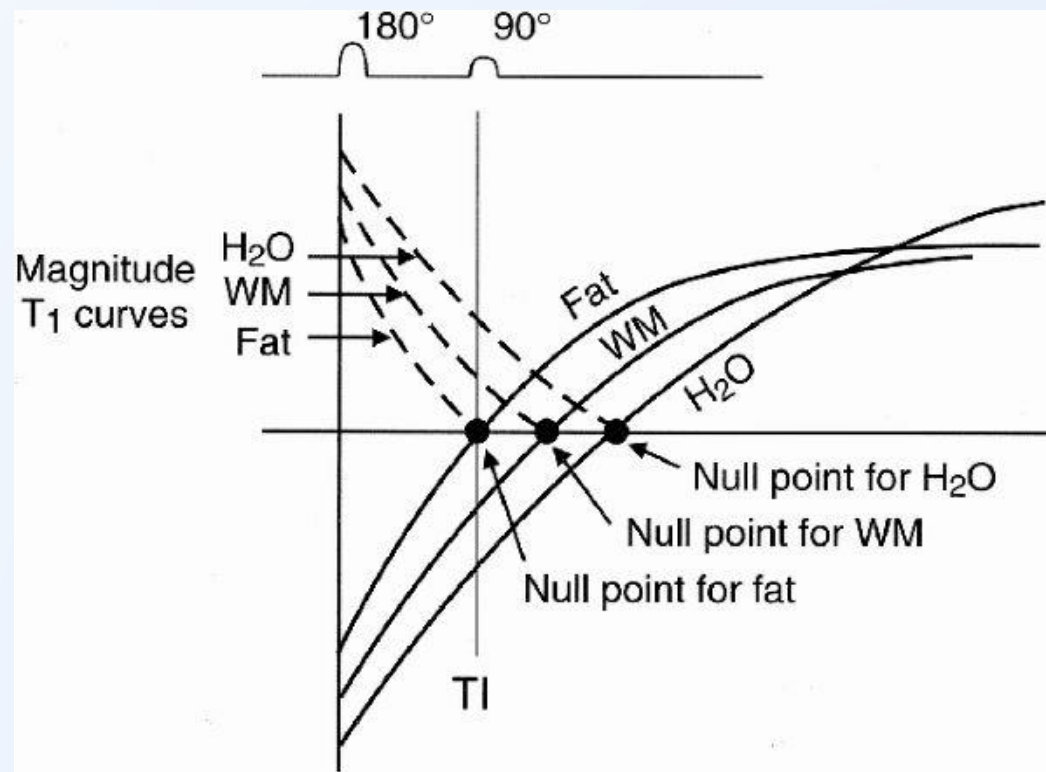
Fat Suppression: STIR Imaging

- STIR: short TI (or Tau) inversion recovery
- In the STIR, TI is chosen so that the T1 recovery curve for fat crosses zero at the time of the 90° pulse.



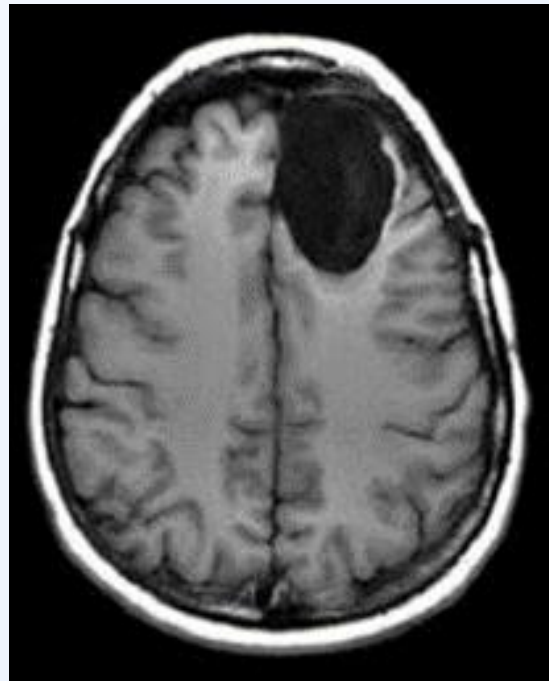
Fat Suppression: STIR Imaging

- Because fat has a very short T_1 ; therefore, a very short TI must be chosen to null it.



FLAIR

- Fluid attenuation inversion recovery



Left frontal lobe cystic tumor on axial brain images

Summary

- Inversion recovery pulse sequence
- Inversion time
- Signal intensity in inversion recovery
- Null point
- $T_1(\text{null})$
- STIR
- FLAIR

Reference

- Hashemi, RH and Brandy, WG. MRI the Basics, Second Edition