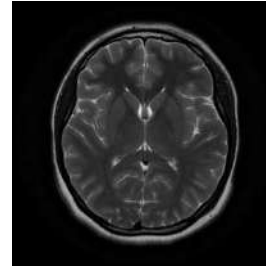


MRI practical course 3

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Today: How do MRI images get their contrast?

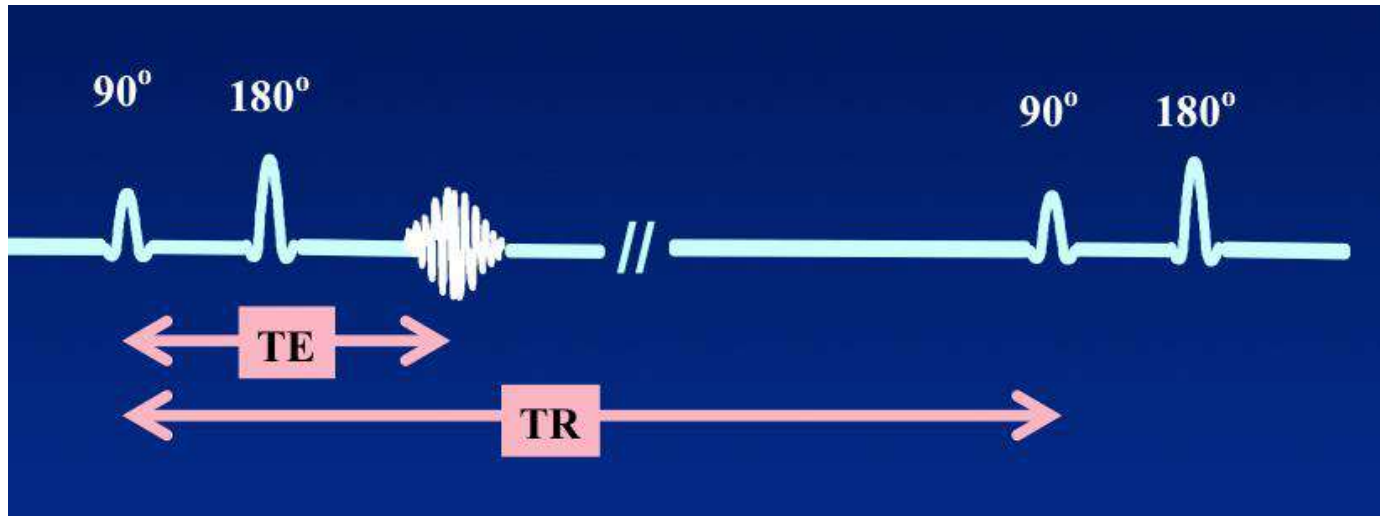
- Acquire a 3D image
- Gradient fields add additional information for spatial encoding (Gradient fields)
- Many RF pulses are needed to scan a complete image

- T1, T2 → tissue depending
- Typically, we do not measure T1 or T2!
 - Very time-consuming sequences
- Sequence parameters are changed to get different weightings (e.g., T1 or T2 weighting)
- Very important sequence parameters are repetition time (TR) and echo time (TE)
 - TR: Time between two RF excitation is called repetition time
 - TE: Time between RF excitation and signal acquisition (spin echo sequence → echo generation) is called echo time

TR and TE

TR: time between two excitation pulses

TE: time between excitation pulse and acquisition

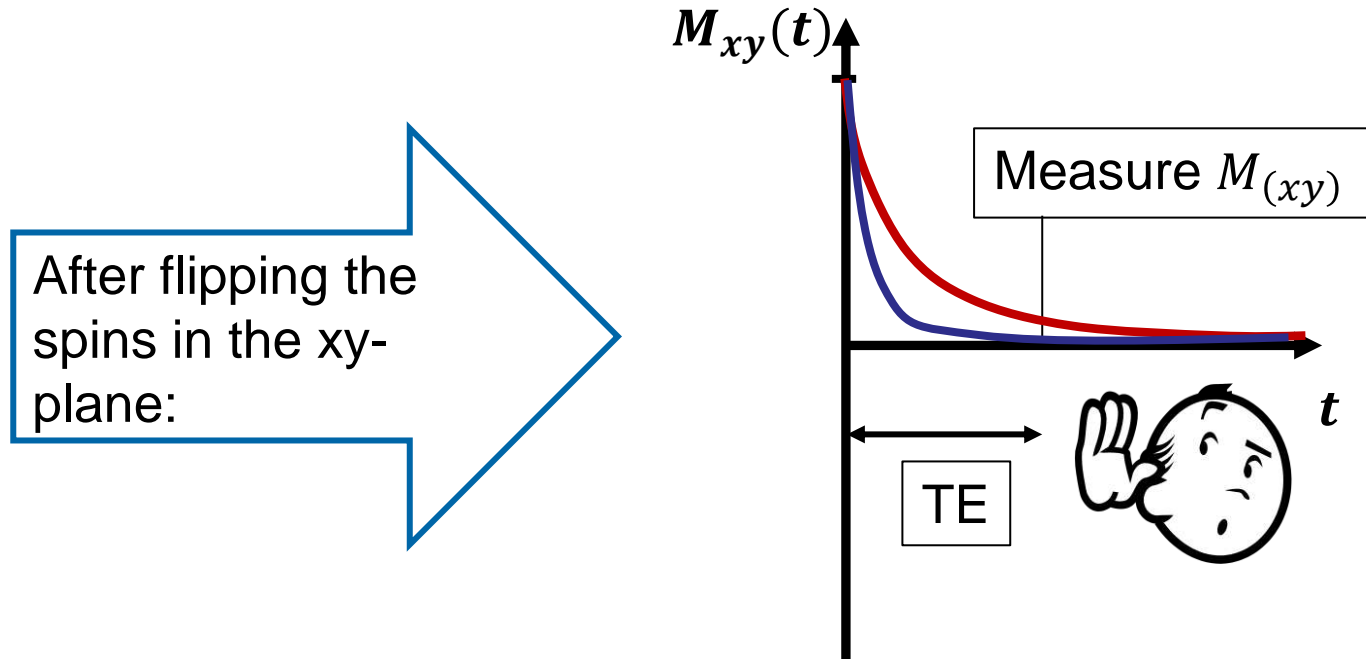


TR can be modified to control T1 contrast

TE can be modified to control T2 contrast

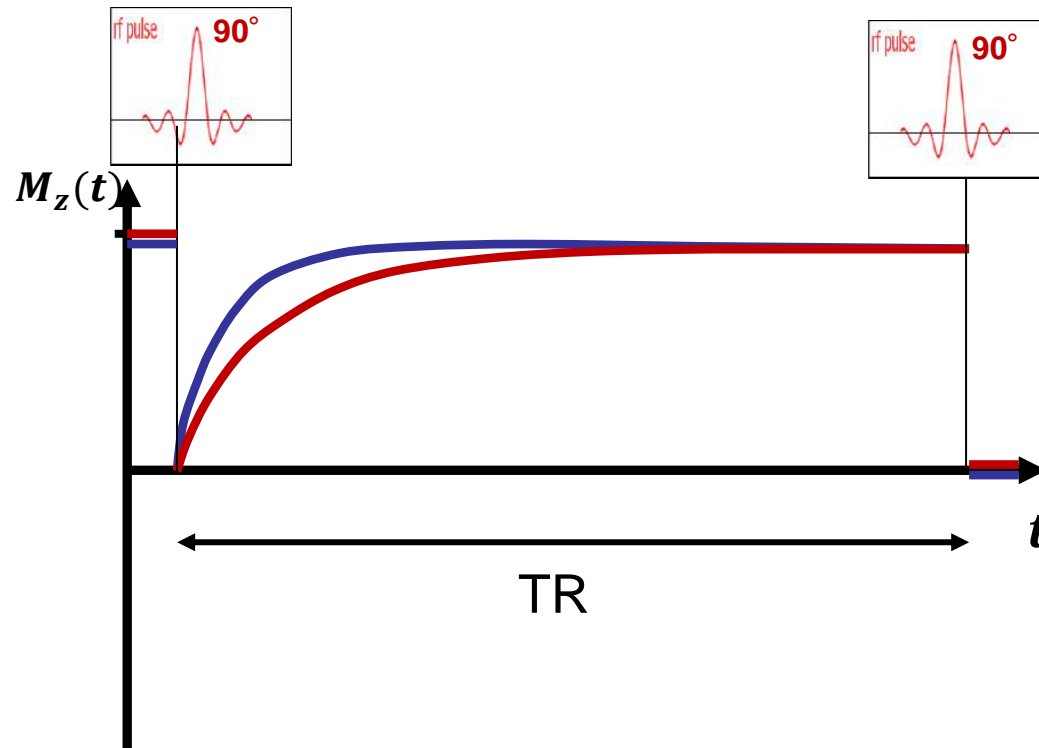
There is no **pure** T1/T2 image → weighted image

Echo time (TE)



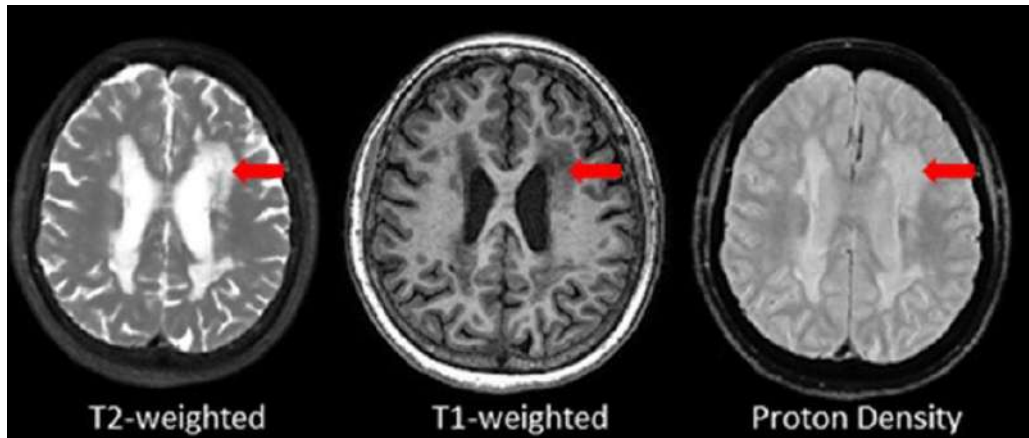
TE can be modified to control **T2** contrast!

Repetition time (TR)

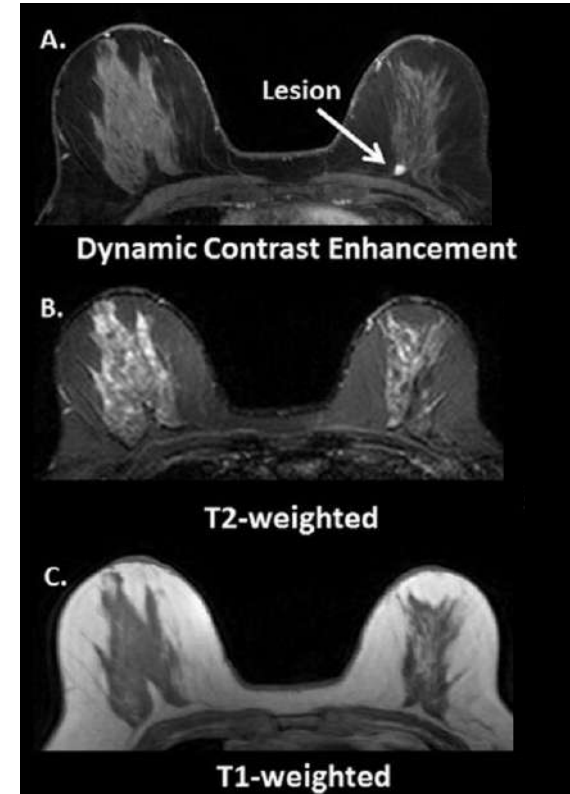


TR can be modified to control T1 contrast

Examples of weighted MR images

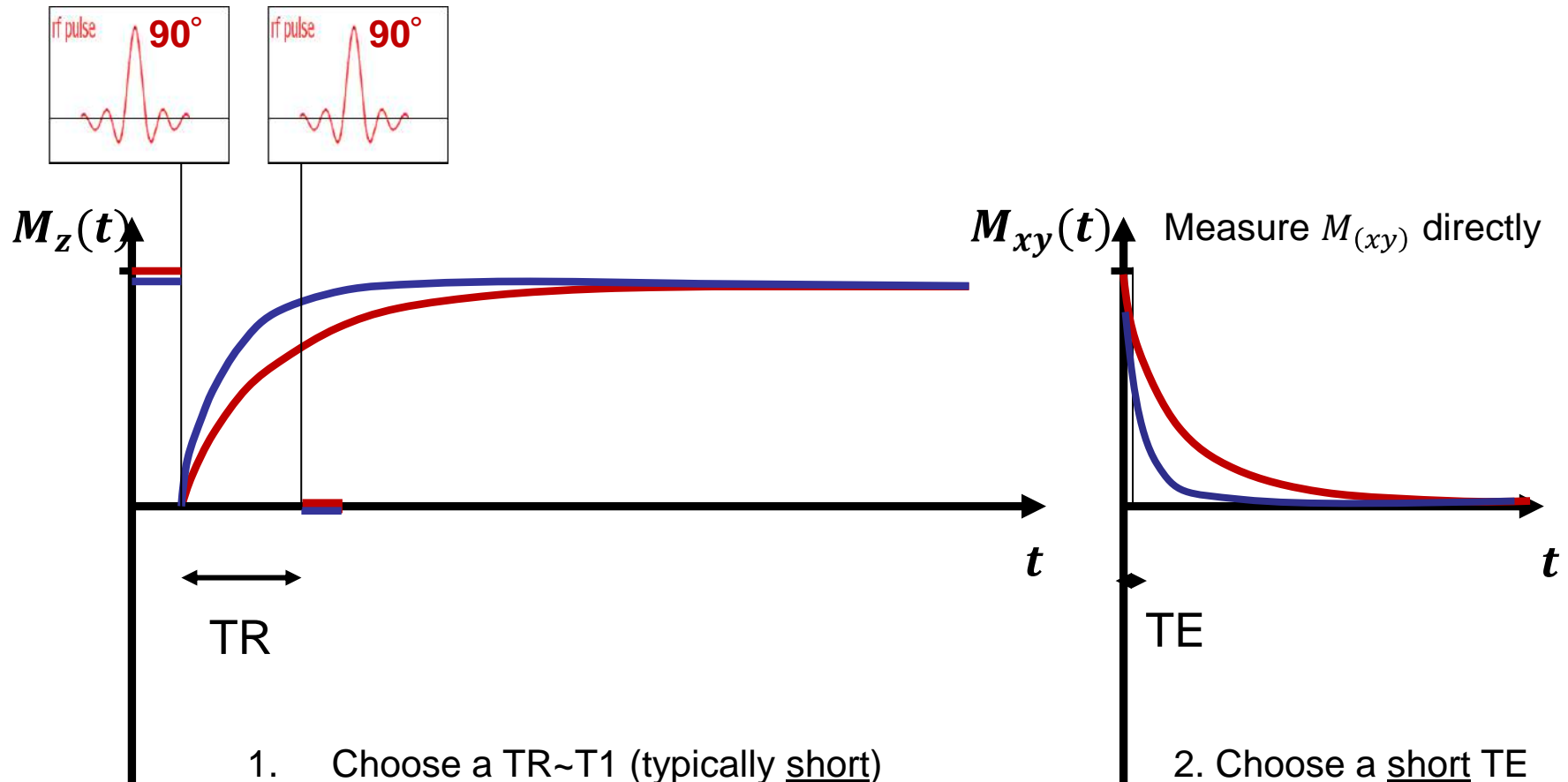


<https://doi.org/10.1101/2019.12.13.875823>



Parekh, Vishwa S., and Michael A. Jacobs. "Integrated radiomic framework for breast cancer and tumor biology using advanced machine learning and multiparametric MRI." *NPJ breast cancer* 3.1 (2017): 1-9.

How to obtain a T1-weighting?

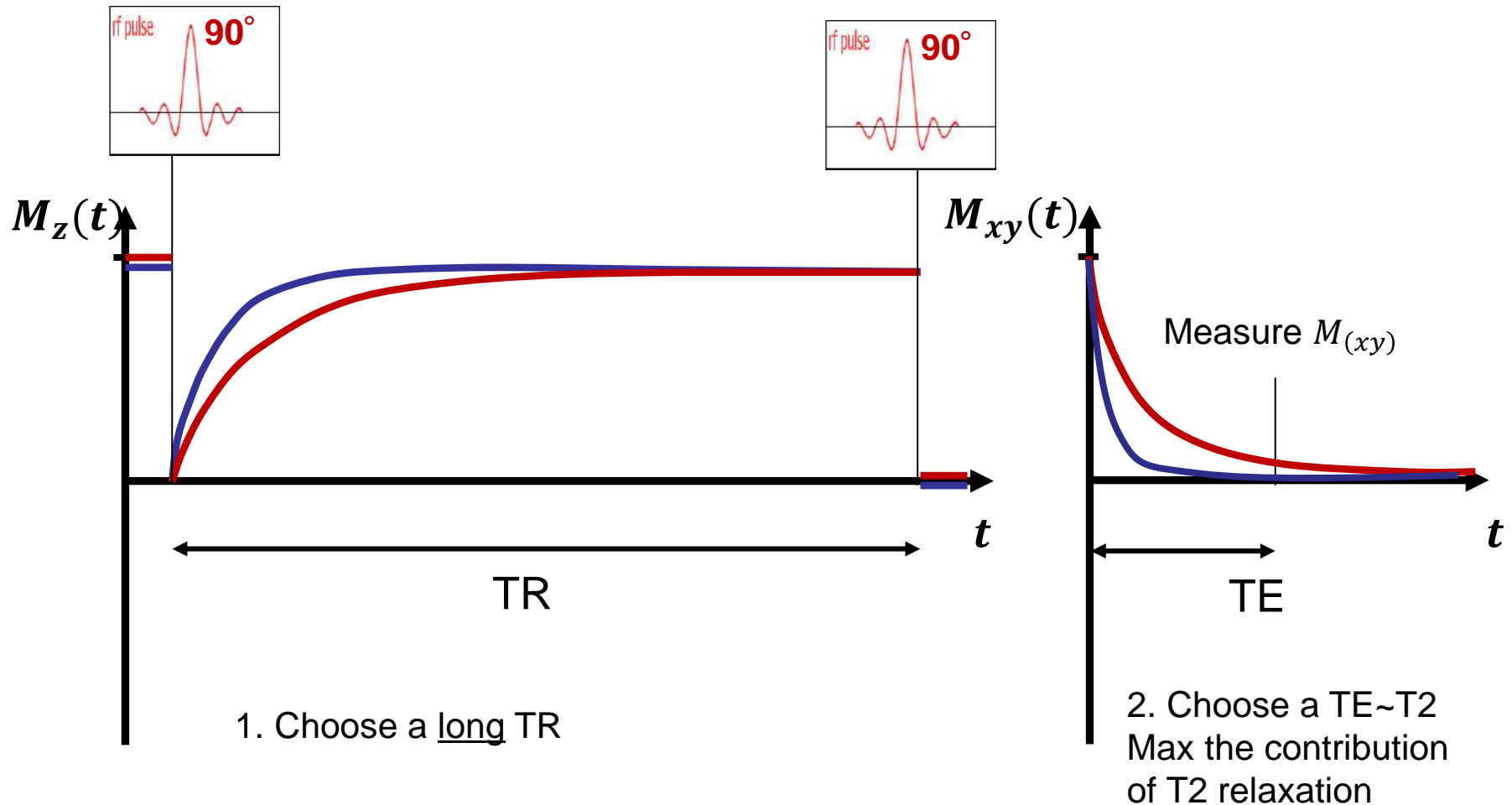


1. Choose a TR~T1 (typically short)
Max the contribution of T1 relaxation

2. Choose a short TE

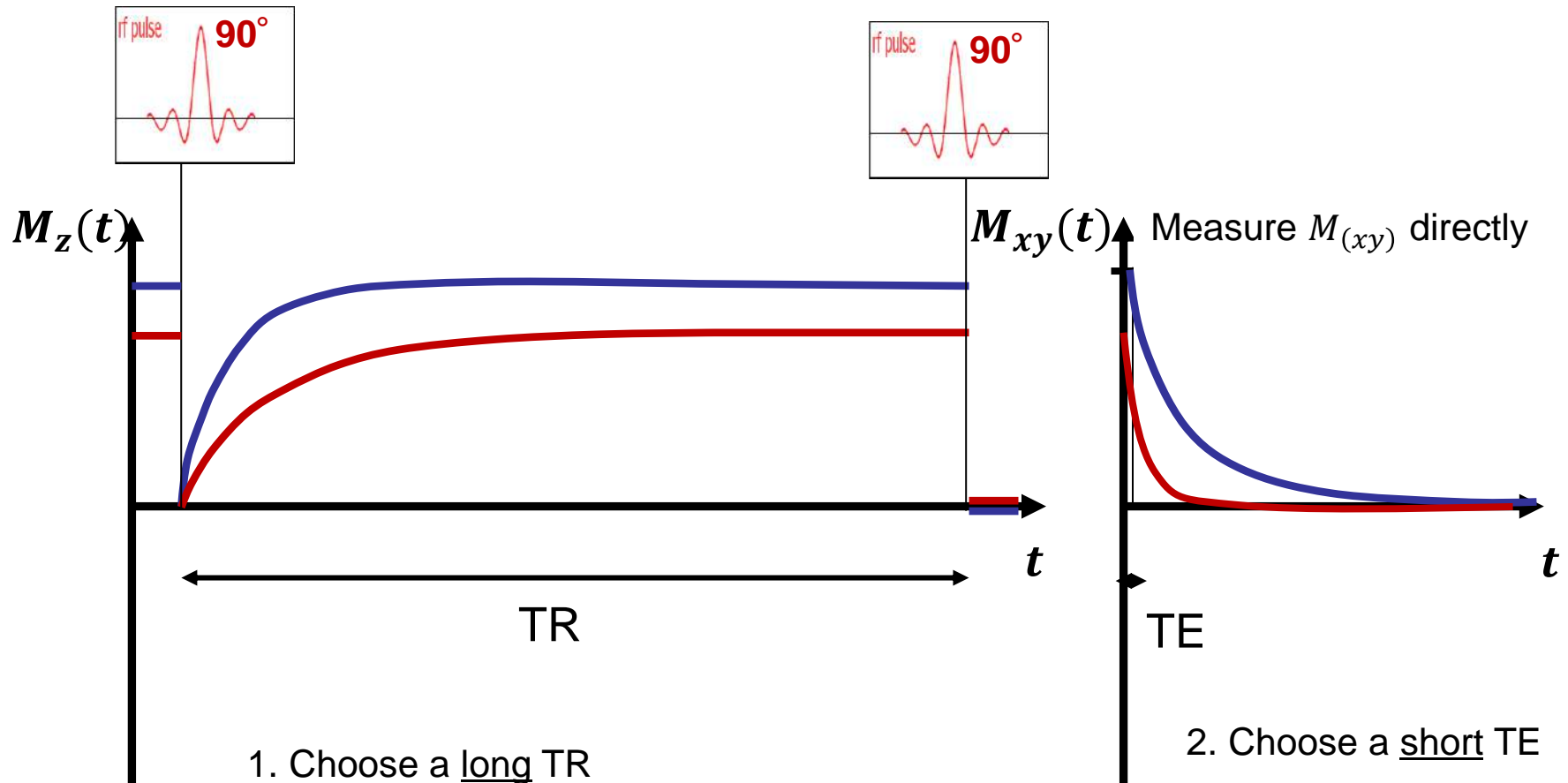
Note: Shorter TR \rightarrow less signal

How to obtain a T2-weighting?



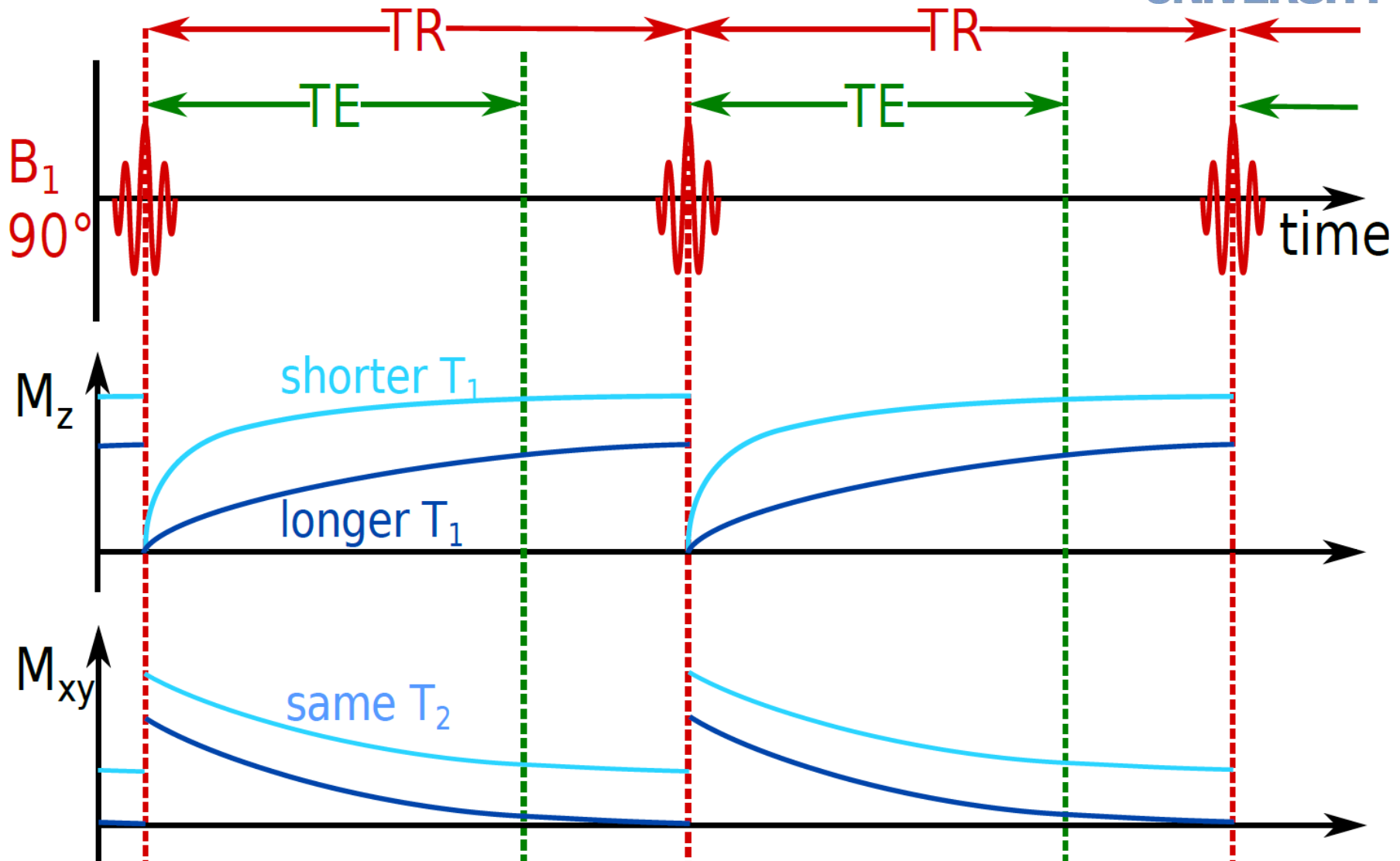
Note: Longer TE → less signal

How about the proton density?

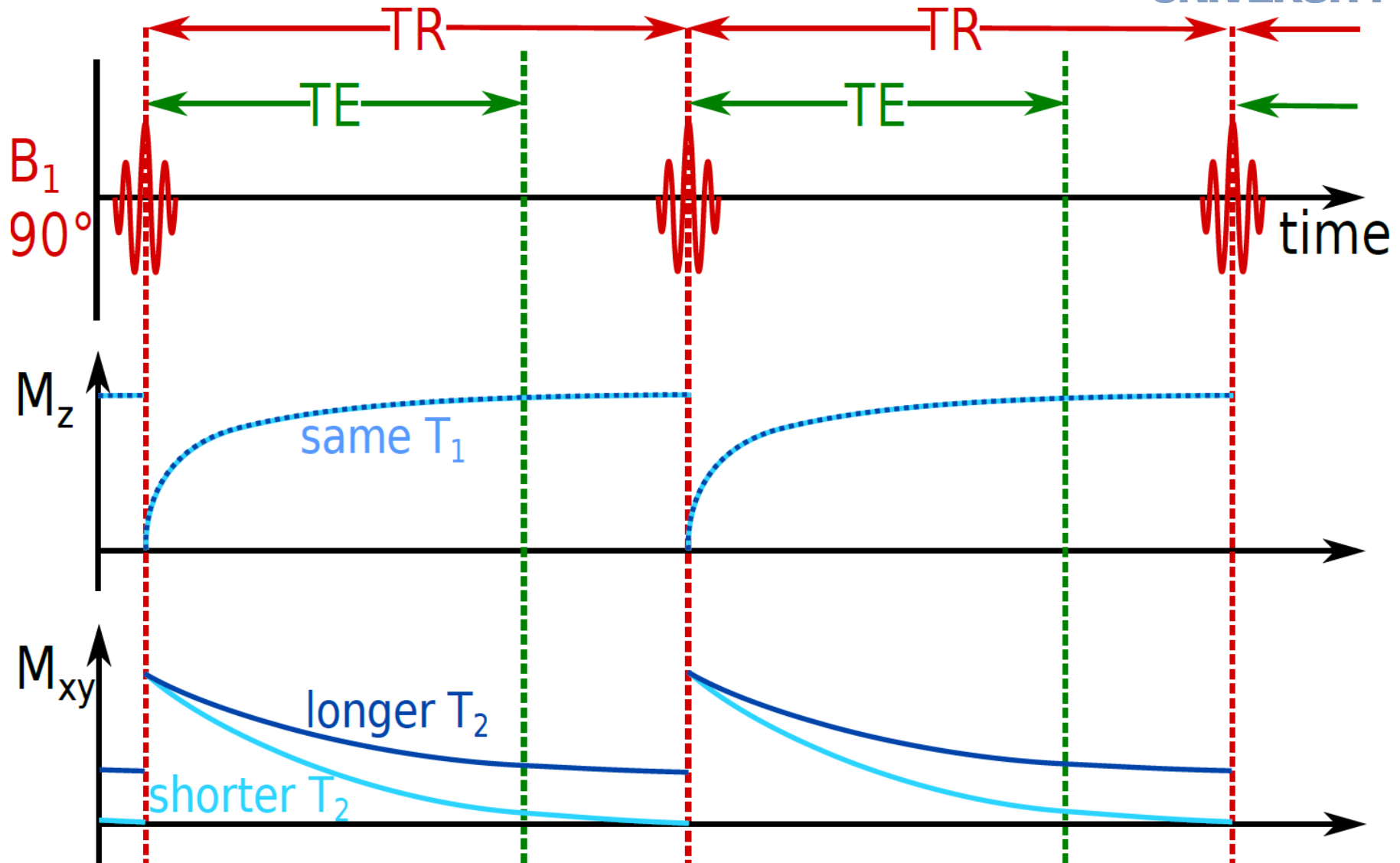


Proton density weighted images maximize the signal \rightarrow highest SNR

T_1 contrast (whole sequence)



T₂ contrast (whole sequence)



Vielen Dank für Ihre Aufmerksamkeit!

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