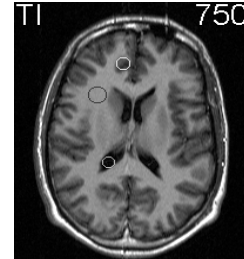




Measurement of Brain Relaxation Times T1 and T2

1. Evaluate from an Inversion Recovery measurement the T1-relaxation of White Matter (WM), Grey Matter (GM), and Cerebrospinal Fluid (CF).

Experiment #1: 6 images were measured (IR_01.ima ... IR_06.ima, data at: <http://www.ma.uni-heidelberg.de/inst/cbtlm/ckm/lehre/> "Medical Physics: Lab Rotation MR-Radiology") with TI = 50, 400, 550, 750, 1200, 2000 ms. Plot signal intensity (= pixel mean value of ROI) as a function of TI and calculate T1 of WM, GM and CF.



2. Evaluate from a spin-echo measurement the T2-relaxation of WM, GM and CF.

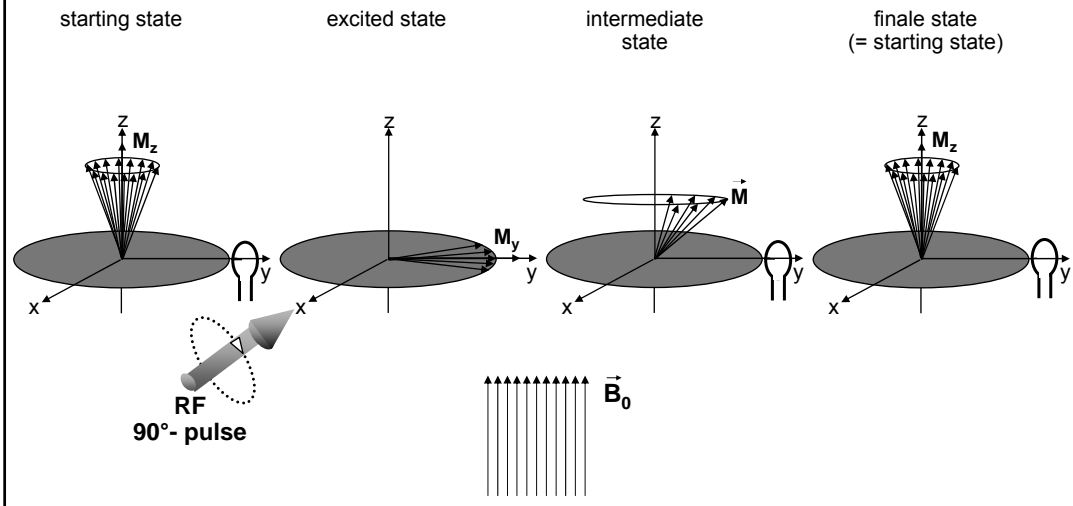
Experiment #2: 11 images were measured (SE_01.ima ... SE_11.ima) with TE = 25, 50 ... 275.0 ms. Plot signal intensity (= pixel mean value of ROI) semi-logarithm as a function of TE and calculate T2 of WM, GM and CF.

- group 1: WM
- group 2: GM
- group 3: CF

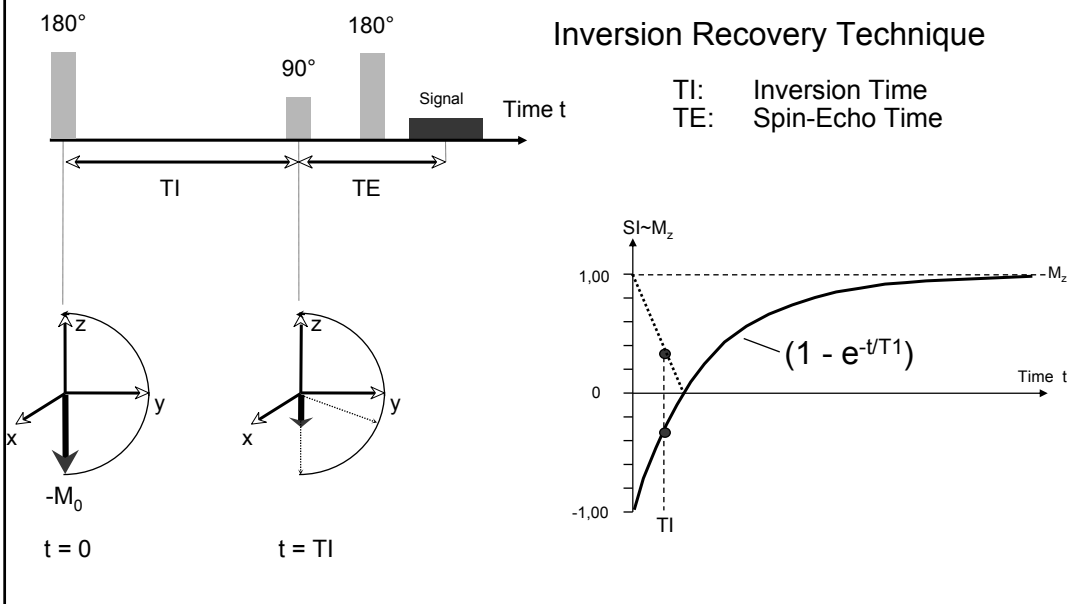


T1 Relaxation

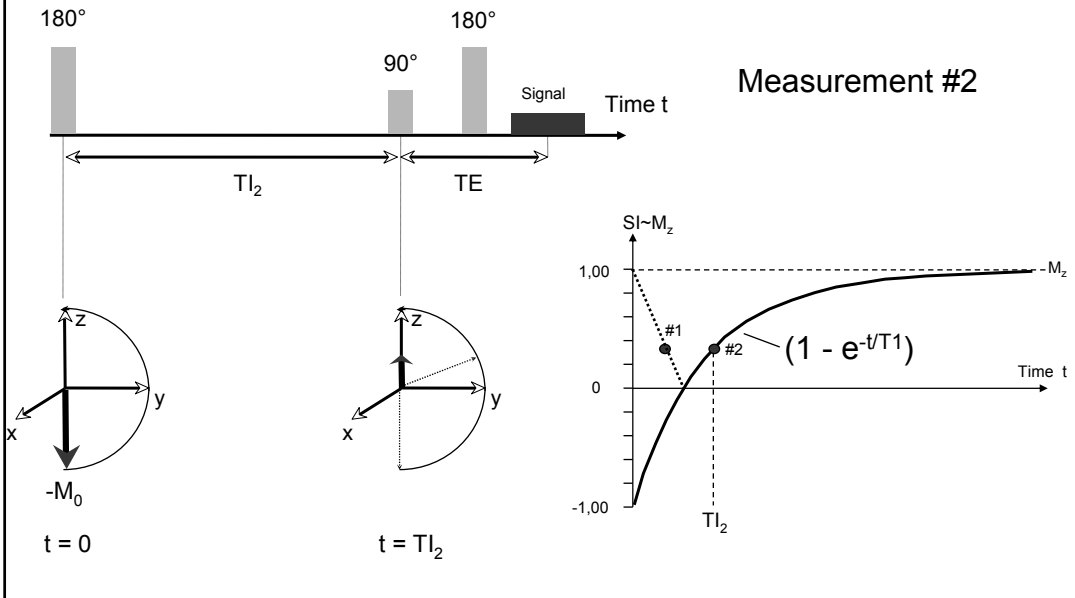
Spin-Lattice-Relaxation T1



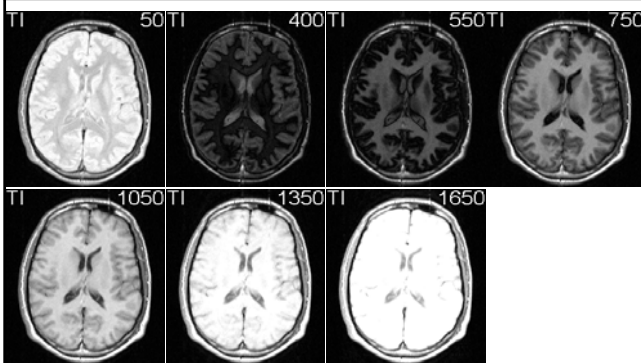
Experiment: T1-Measurement #1



Experiment: T1-Measurement #2



T1 Measurement: Inversion Recovery



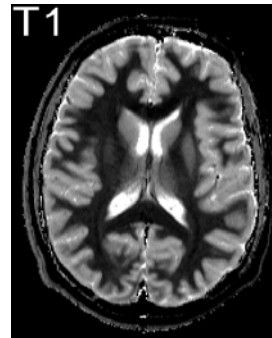
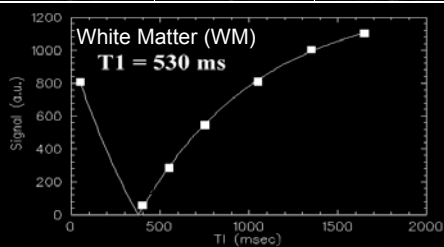
inversion recovery ($M_z(0) = -M_0$):

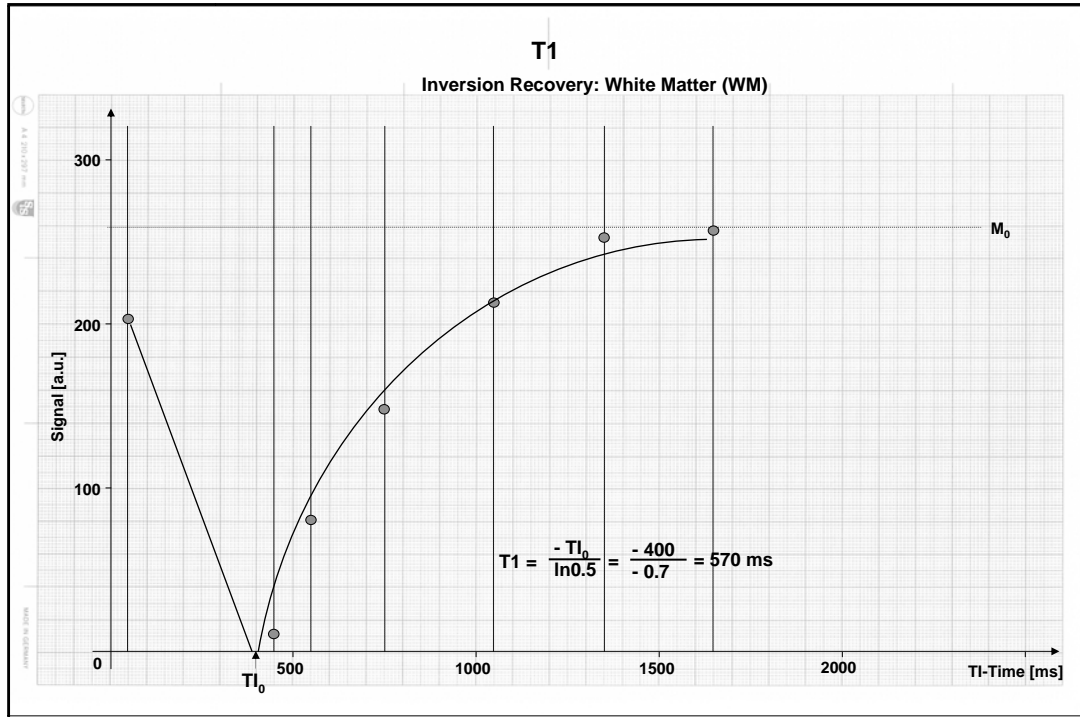
$$M_z(t) = M_0 (1 - 2 \exp(-t/T1))$$

with $M_z = 0$ at $TI = TI_0$:
 $0.5 = \exp(-TI_0/T1)$

$$\rightarrow T1 = -TI_0 / \ln(0.5) = TI_0 / 0.7$$


$$T1_{WM} = -400 \text{ ms} / -0.7 = 570 \text{ ms}$$





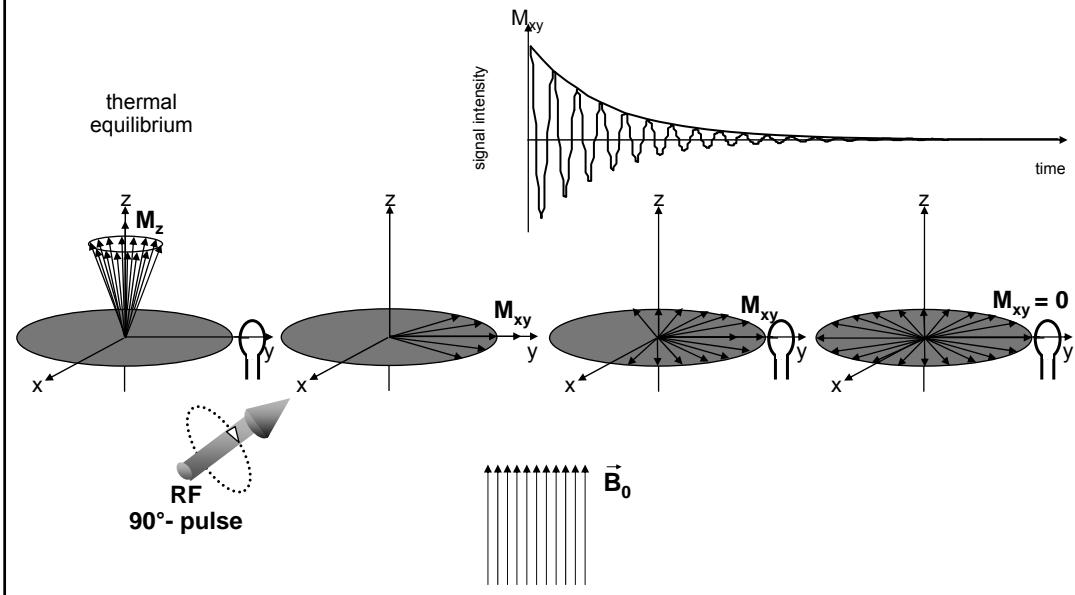
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T2 Relaxation

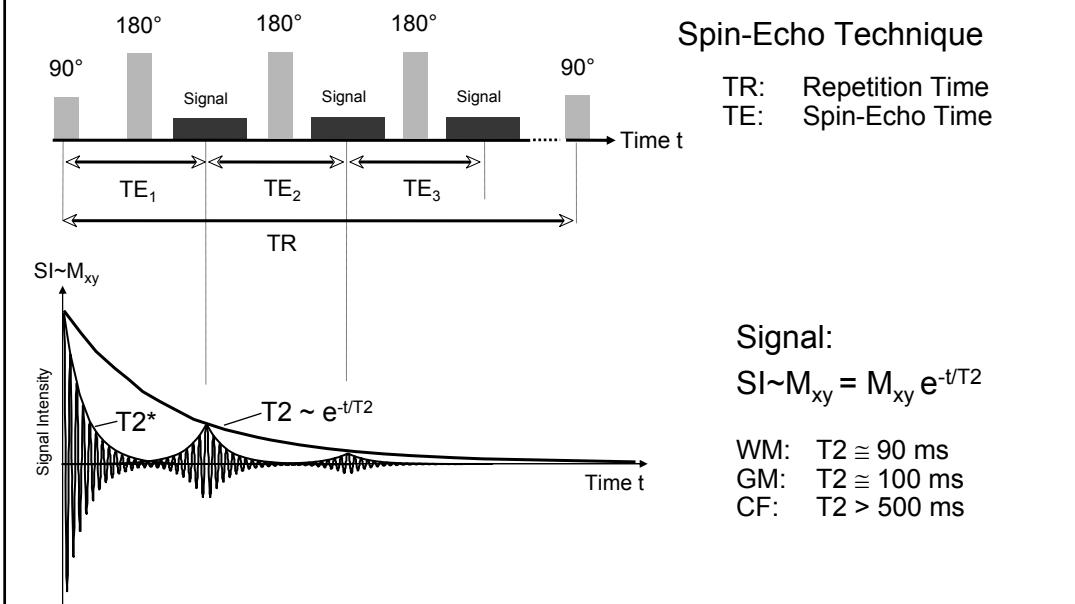


T2 Relaxation

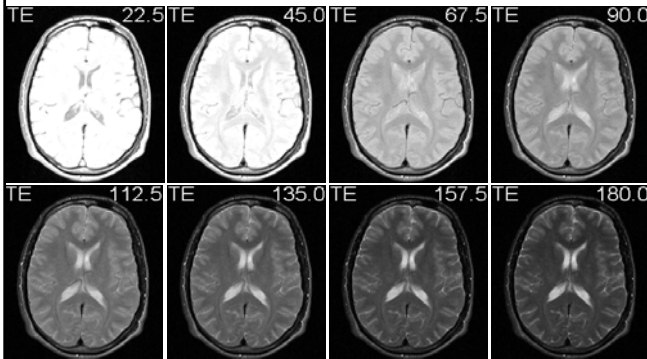
Spin-Spin-Relaxation T2



Experiment: T2-Measurement



T2 Measurement: Spin-Echo

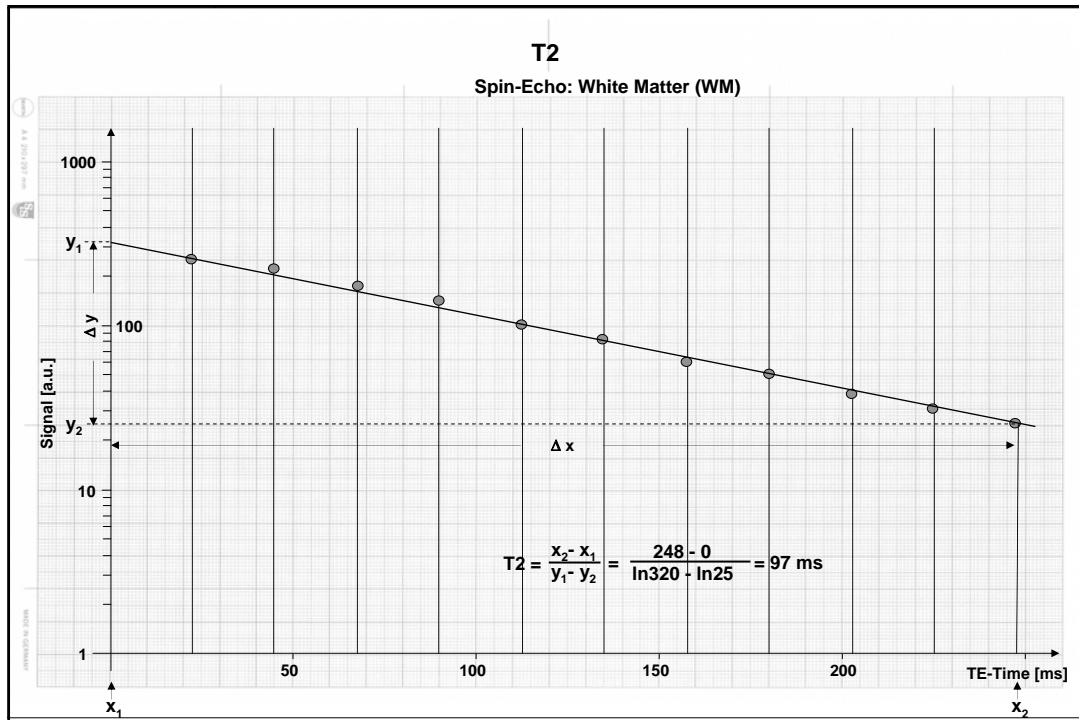
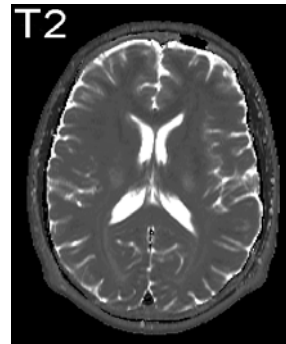
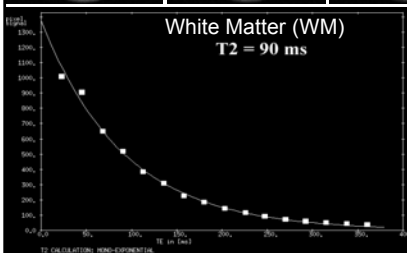


spin-echo ($M_{xy}(0) = M_0$):

$$M_{xy}(t) = M_0 \exp(-t/T2)$$

→ slope of straight-line in semi-logarithm scale

$$T2_{WM} = 90 \text{ ms}$$

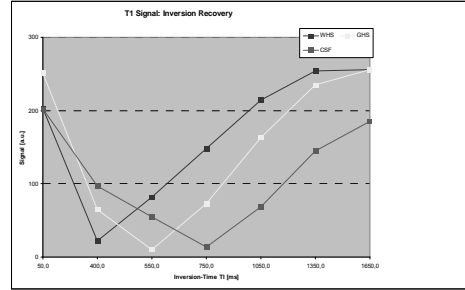


Exercise: T1, T2



TI [ms]	WM Signal [a.u.]	GM Signal [a.u.]	CF Signal [a.u.]
50,0	203	251	202
400,0	22	65	97
550,0	82	10	55
750,0	148	73	14
1050,0	214	163	69
1350,0	254	235	145
1650,0	256	256	185

T1



TE [ms]	WM Signal [a.u.]	GM Signal [a.u.]	CF Signal [a.u.]
22,5	256	256	191
45,0	237	256	218
67,5	169	206	202
90,0	139	177	204
112,5	101	138	195
135,0	83	120	196
157,5	61	92	188
180,0	51	80	188
202,5	39	65	184
225,0	32	56	180
247,5	25	46	176
270,0	21	40	176
292,5	16	31	172
315,0	14	29	169
337,5	12	24	168
360,0	10	22	166

T2

