

MR-BIAS v1.0.1 (released on 16th January 2023)

Source code: <http://github.com/JamesCKorte/mrbias>

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Please cite the following publication:

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TITLE: "Magnetic resonance biomarker assessment software (MR-BIAS): an automated open-source tool for the ISMRM/NIST system phantom"

AUTHORS: James C Korte, Zachary Chin, Madeline Carr, Lois Holloway, Rick Franich

JOURNAL: Manuscript Under Review

YEAR: Manuscript Under Review

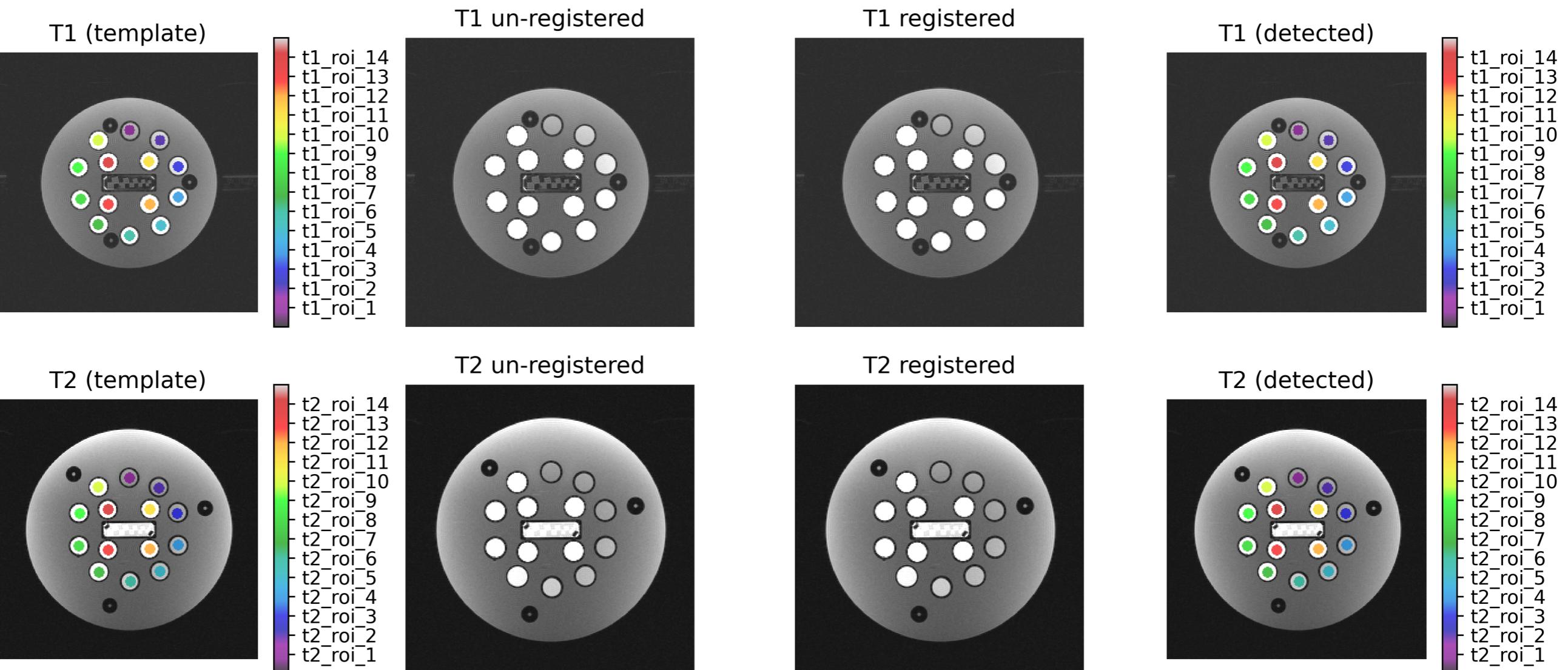
DOI: Manuscript Under Review

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## Image Sorting : Summary

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20190914	153406	T1-VIR-3000ms	t1_vir	t1_vir_000	geom_000	1.2.840.113704.7.32.0.2.19.46069.2019091415340628657102240.0.0.0
20190914	155100	T2	t2_mse	t2_mse_000	geom_000	1.2.840.113704.7.32.05.2.19.46069.201909141551006158202343.0.0.0
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20190914	161731	T1-VFA-30deg	t1_vfa	t1_vfa_000	geom_000	1.2.840.113704.7.32.05.2.19.46069.201909141614291867503185.0.0.0

### ROI Detection: Summary



CurveFit [T1VIRCurveFit4param - AvROI\_NrmVoxMax\_ExclClip-100pct\_no1500ms] <t1\_vir\_000>

ROI_DX	ROI LABEL	M0	M0_var	Finv	Finv_var	n	n_var	T1	T1_var	T1_err	T1_pct.err	T1_ref	T1_init	AVRGD	NORMLD	CLIPD
1	t1_roi_1	0.9	inf	2.3	inf	0.0	inf	1160.7	inf	-723.3	-38.4	1884.0	1442.7	True	True	True
2	t1_roi_2	1.1	inf	2.0	inf	0.0	inf	1367.8	inf	37.6	2.8	1330.2	1442.7	True	True	True
3	t1_roi_3	1.1	inf	2.0	inf	0.0	inf	960.8	inf	-26.5	-2.7	987.3	1442.7	True	True	True
4	t1_roi_4	1.0	inf	2.0	inf	0.0	inf	690.1	inf	0.1	0.0	690.1	360.7	True	True	True
5	t1_roi_5	1.0	inf	2.0	inf	0.0	inf	488.4	inf	3.4	0.7	485.0	360.7	True	True	False
6	t1_roi_6	1.0	inf	2.0	inf	0.0	inf	347.2	inf	5.6	1.6	341.6	360.7	True	True	False
7	t1_roi_7	1.0	inf	2.0	inf	0.0	inf	246.0	inf	5.2	2.2	240.9	216.4	True	True	False
8	t1_roi_8	1.0	inf	2.1	inf	0.0	inf	177.3	inf	2.4	1.4	174.9	180.3	True	True	True
9	t1_roi_9	1.0	inf	2.1	inf	0.0	inf	122.9	inf	1.8	1.5	121.1	144.3	True	True	True
10	t1_roi_10	1.0	inf	2.1	inf	0.0	inf	87.2	inf	1.5	1.7	85.8	108.2	True	True	True
11	t1_roi_11	1.0	inf	2.1	inf	0.0	inf	45.8	inf	-14.4	-24.0	60.2	50.5	True	True	False
12	t1_roi_12	1.0	inf	2.2	inf	0.0	inf	33.0	inf	-9.9	-23.0	42.9	50.5	True	True	False
13	t1_roi_13	1.0	inf	2.1	inf	0.0	inf	24.4	inf	-6.0	-19.7	30.4	50.5	True	True	False
14	t1_roi_14	1.0	inf	2.1	inf	0.0	inf	62.6	inf	41.2	192.1	21.4	50.5	True	True	False

SIGNAL EQUATION:

$$S(TI) = | M0 ( 1 + (1 - Finv) * \exp(-TR/T1) - Finv * \exp(-TI/T1) ) | + n$$

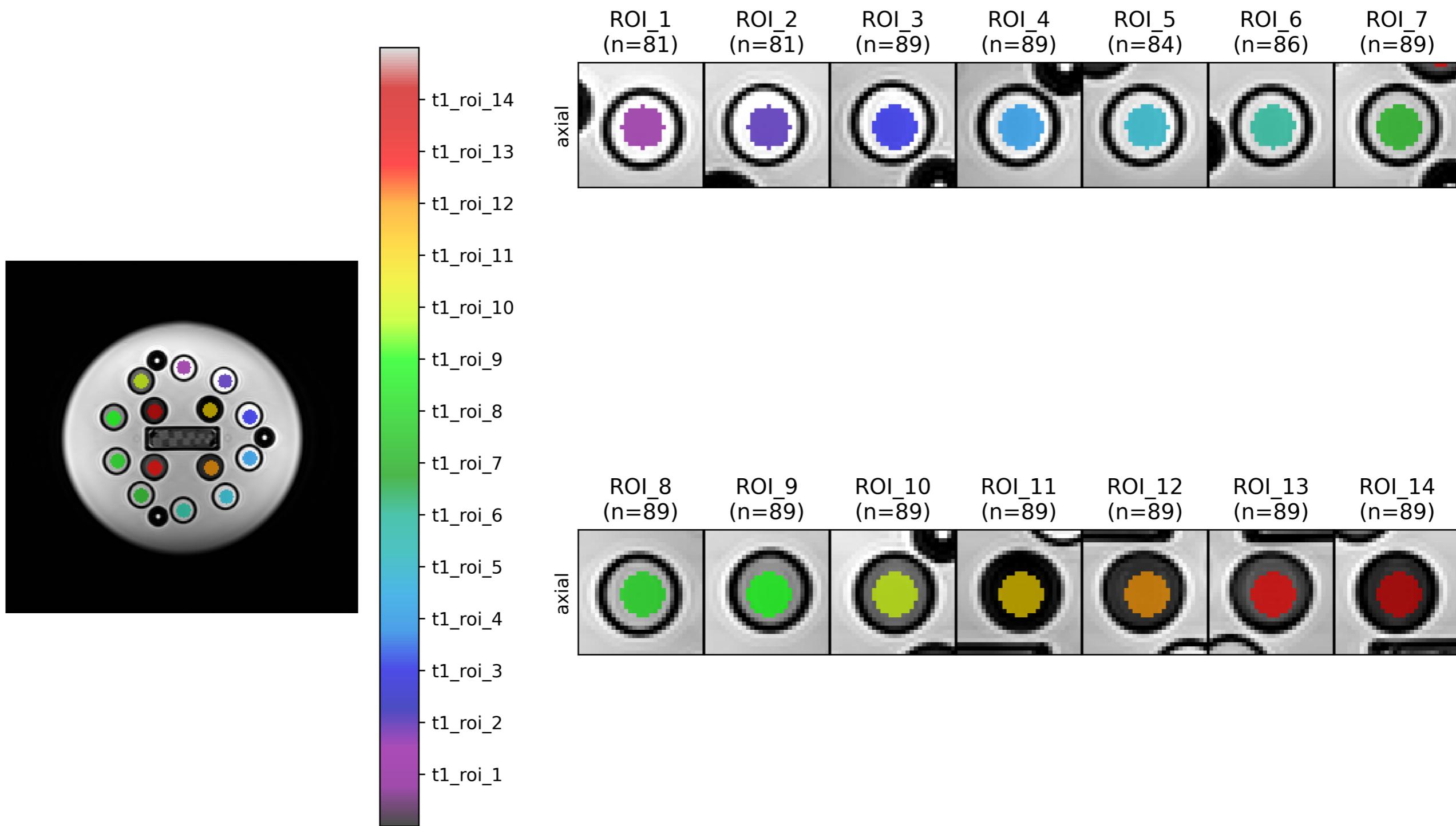
Parameter	Description	Init Val.	Min Val.	Max Val.
M0	Equilibrium magnetisation	max(S(TI))	0.0	inf
Finv	Inversion Factor	2.0	1.0	3.0
n	Noise floor	1e-12	0.0	inf
T1	T1 relaxation time	TI_null/ln(2)	0.0	inf
TR	Repetition time	as measured	-	-
TI	Inversion time	as measured	-	-
TI_null	The inversion time related to the minimum signal intensity	from signal	-	-

GOODNESS OF FIT:

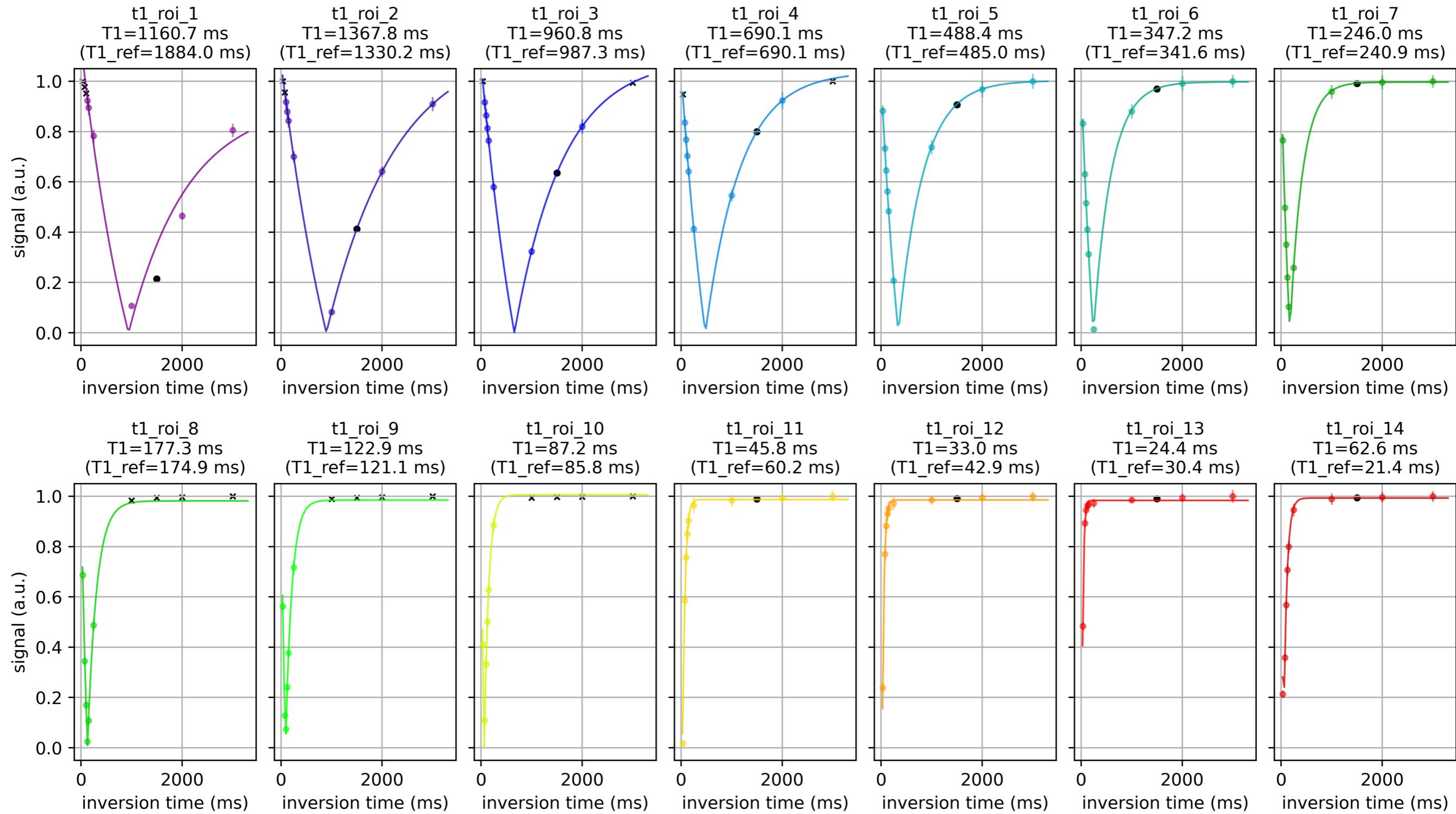
ROI_DX	ROI LABEL	chisqr	redchi	aic	bic
1	t1_roi_1	0.0143288	0.0071644	-28.2234677	-29.0564299
2	t1_roi_2	0.0000026	0.0000009	-95.5906196	-95.8069790
3	t1_roi_3	0.0000053	0.0000018	-90.6467561	-90.8631155
4	t1_roi_4	0.0000099	0.0000033	-86.3164113	-86.5327707
5	t1_roi_5	0.0000285	0.0000057	-105.9788737	-105.1899754
6	t1_roi_6	0.0000340	0.0000068	-104.3734053	-103.5845070
7	t1_roi_7	0.0000754	0.0000151	-97.2091039	-96.4202056
8	t1_roi_8	0.0000390	0.0000195	-63.6633316	-64.4962937
9	t1_roi_9	0.0000143	0.0000071	-69.6912199	-70.5241820
10	t1_roi_10	0.0000027	0.0000014	-79.6470945	-80.4800567
11	t1_roi_11	0.0004682	0.0000936	-80.7751193	-79.9862210
12	t1_roi_12	0.0006509	0.0001302	-77.8095999	-77.0207016
13	t1_roi_13	0.0007649	0.0001530	-76.3567518	-75.5678535
14	t1_roi_14	0.0001528	0.0000306	-90.8505298	-90.0616315

chisqr : Chi-square statistic  
 redchi : Reduced Chi-square statistic  
 aic : Akaike Information Criterion statistic  
 bic : Bayesian Information Criterion statistic

CurveFit [T1VIRCurveFit4param - AvROI\_NrmVoxMax\_ExclClip-100pct\_no1500ms] <t1\_vir\_000>

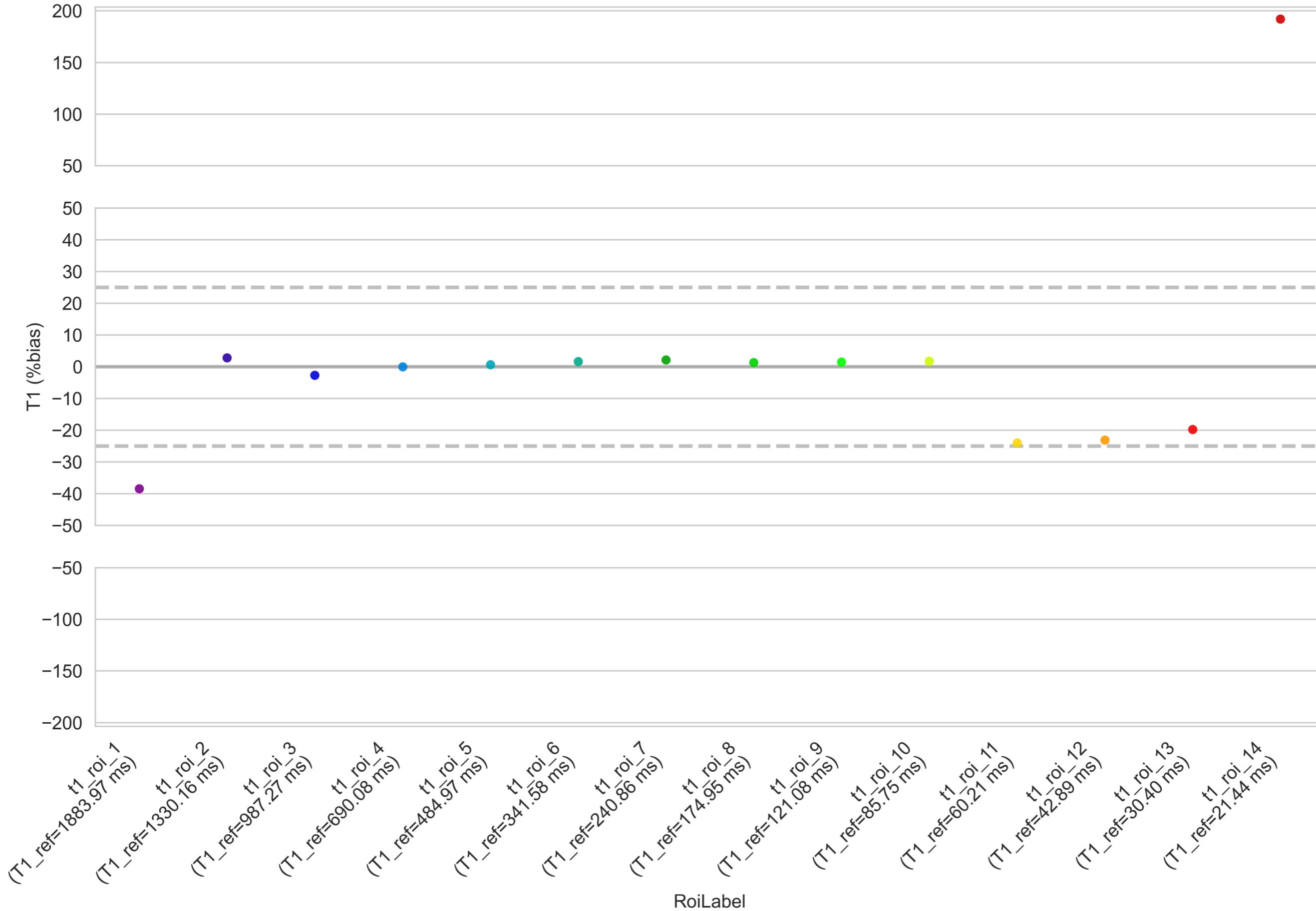


CurveFit [T1VIRCurveFit4param - AvROI\_NrmVoxMax\_ExclClip-100pct\_no1500ms] <t1\_vir\_000>



Included measurements are denoted with colour markers. Excluded measurements are denoted with black markers for (crosses) clipped or (circles) user excluded measurements.

CurveFit [T1VIRCurveFit4param - AvROI\_NrmVoxMax\_ExclClip-100pct\_no1500ms] <t1\_vir\_000>



CurveFit [T1VFACurveFit2param - AvROI\_NrmVoxMax\_ExclClip-100pct\_no15deg] <t1\_vfa\_000>

ROI_DX	ROI LABEL	M0	M0_var	T1	T1_var	T1_err	T1_pct,err	T1_ref	T1_init	AVRGD	NORMLD	CLIPD
1	t1_roi_1	22.2	0.7	1838.3	86.8	-45.6	-2.4	1884.0	800.0	True	True	False
2	t1_roi_2	19.4	0.6	1356.1	65.8	25.9	1.9	1330.2	800.0	True	True	False
3	t1_roi_3	17.2	0.5	993.0	43.1	5.8	0.6	987.3	800.0	True	True	False
4	t1_roi_4	14.1	0.4	731.1	29.2	41.0	5.9	690.1	800.0	True	True	False
5	t1_roi_5	11.5	0.2	498.5	16.5	13.6	2.8	485.0	800.0	True	True	False
6	t1_roi_6	9.8	0.2	345.8	9.0	4.2	1.2	341.6	800.0	True	True	False
7	t1_roi_7	8.3	0.1	257.6	6.4	16.8	7.0	240.9	800.0	True	True	False
8	t1_roi_8	7.3	0.1	199.3	4.5	24.4	13.9	174.9	800.0	True	True	False
9	t1_roi_9	6.0	0.1	131.2	2.4	10.1	8.4	121.1	800.0	True	True	False
10	t1_roi_10	4.7	0.0	82.0	1.3	-3.7	-4.3	85.8	800.0	True	True	False
11	t1_roi_11	3.6	0.0	46.3	0.5	-13.9	-23.0	60.2	800.0	True	True	False
12	t1_roi_12	3.1	0.0	33.6	0.2	-9.3	-21.7	42.9	800.0	True	True	False
13	t1_roi_13	2.8	0.0	24.3	0.0	-6.1	-20.1	30.4	800.0	True	True	False
14	t1_roi_14	4.4	0.0	69.4	1.0	47.9	223.6	21.4	800.0	True	True	False

SIGNAL EQUATION:

$$S(\alpha) = M0 * \sin(\alpha) * \frac{(1.0 - \exp(-TR/T1))}{(1.0 - \cos(\alpha) * \exp(-TR/T1))}$$

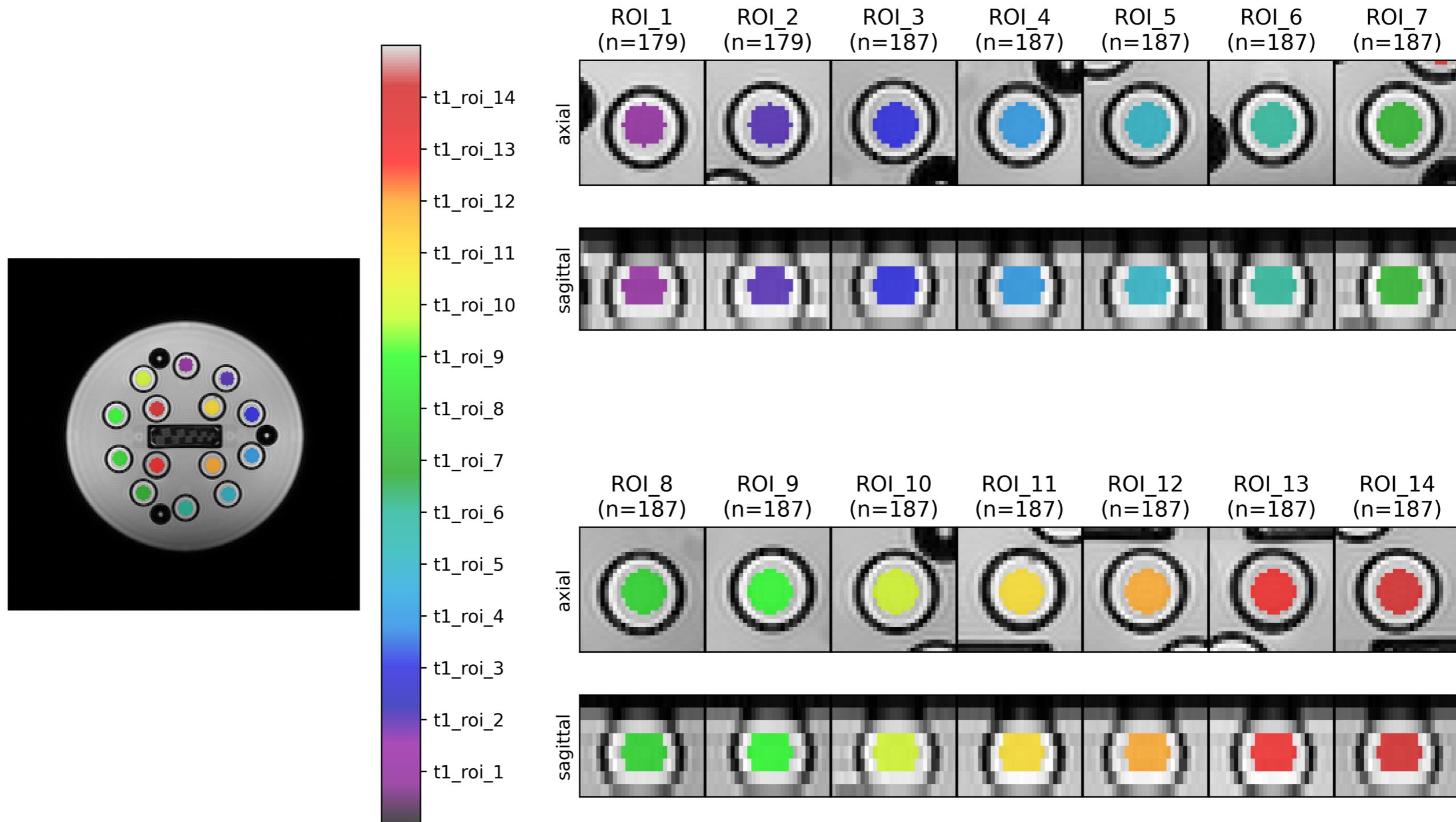
Parameter	Description	Init Val.	Min Val.	Max Val.
M0	Equilibrium magnetisation	max(S(alpha))	0.0	inf
T1	T1 relaxation time	800.0	0.0	inf
alpha	Flip Angle	as measured	-	-
TR	Repetition time	as measured	-	-

GOODNESS OF FIT:

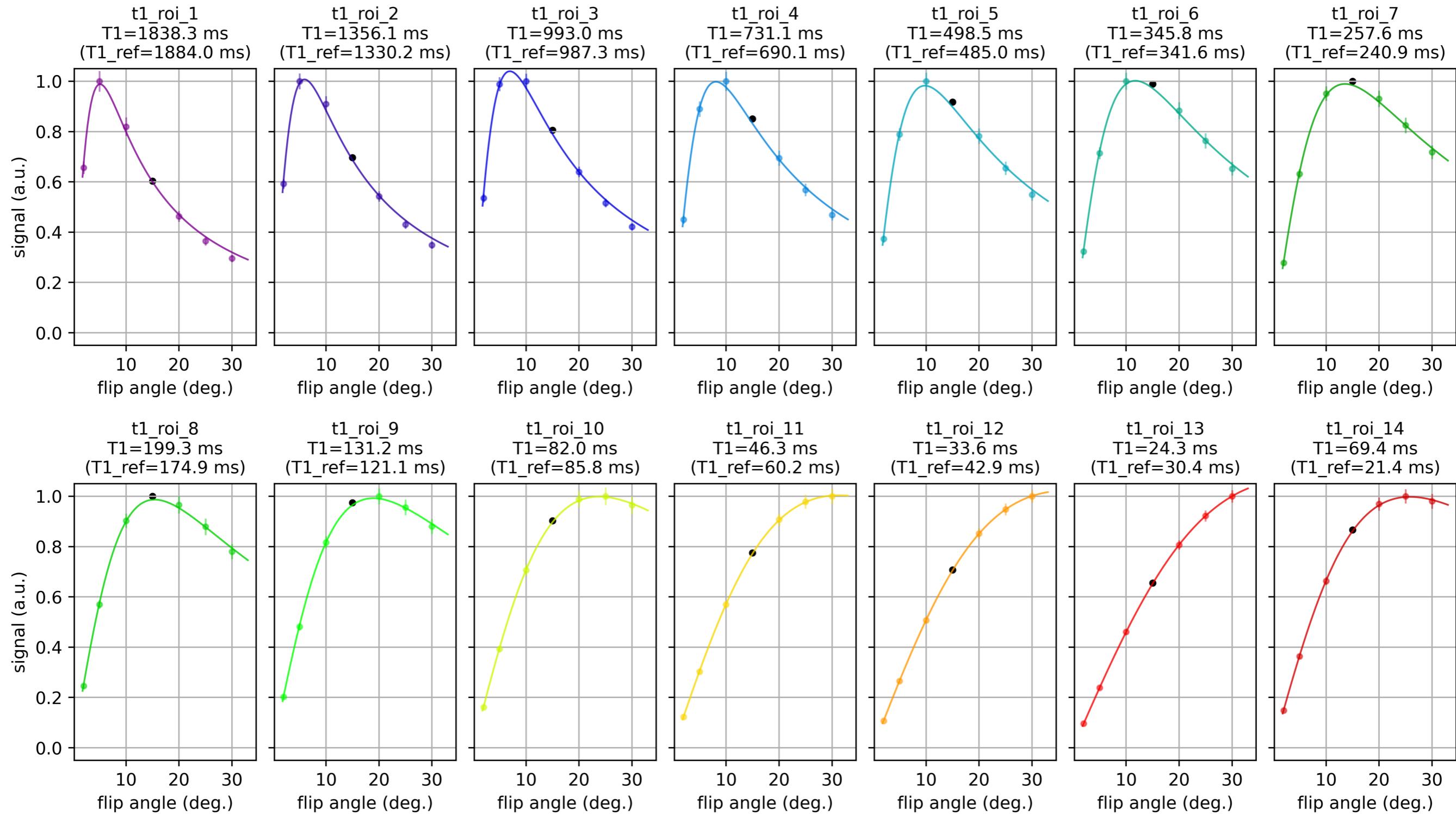
ROI_DX	ROI LABEL	chisqr	redchi	aic	bic
1	t1_roi_1	0.0017161	0.0004290	-44.9568474	-45.3733285
2	t1_roi_2	0.0020132	0.0005033	-43.9987766	-44.4152577
3	t1_roi_3	0.0018365	0.0004591	-44.5499416	-44.9664226
4	t1_roi_4	0.0015084	0.0003771	-45.7309192	-46.1474002
5	t1_roi_5	0.0010437	0.0002609	-47.9404468	-48.3569279
6	t1_roi_6	0.0006756	0.0001689	-50.5503678	-50.9668489
7	t1_roi_7	0.0005604	0.0001401	-51.6717589	-52.0882399
8	t1_roi_8	0.0004270	0.0001067	-53.3033253	-53.7198063
9	t1_roi_9	0.0002294	0.0000574	-57.0297881	-57.4462692
10	t1_roi_10	0.0001050	0.0000263	-61.7191056	-62.1355866
11	t1_roi_11	0.0000255	0.0000064	-70.2055607	-70.6220418
12	t1_roi_12	0.0000033	0.0000008	-82.4665853	-82.8830664
13	t1_roi_13	0.0000003	0.0000001	-96.7114657	-97.1279468
14	t1_roi_14	0.0000778	0.0000194	-63.5195136	-63.9359947

chisqr : Chi-square statistic  
 redchi : Reduced Chi-square statistic  
 aic : Akaike Information Criterion statistic  
 bic : Bayesian Information Criterion statistic

CurveFit [T1VFACurveFit2param - AvROI\_NrmVoxMax\_ExclClip-100pct\_no15deg] <t1\_vfa\_000>

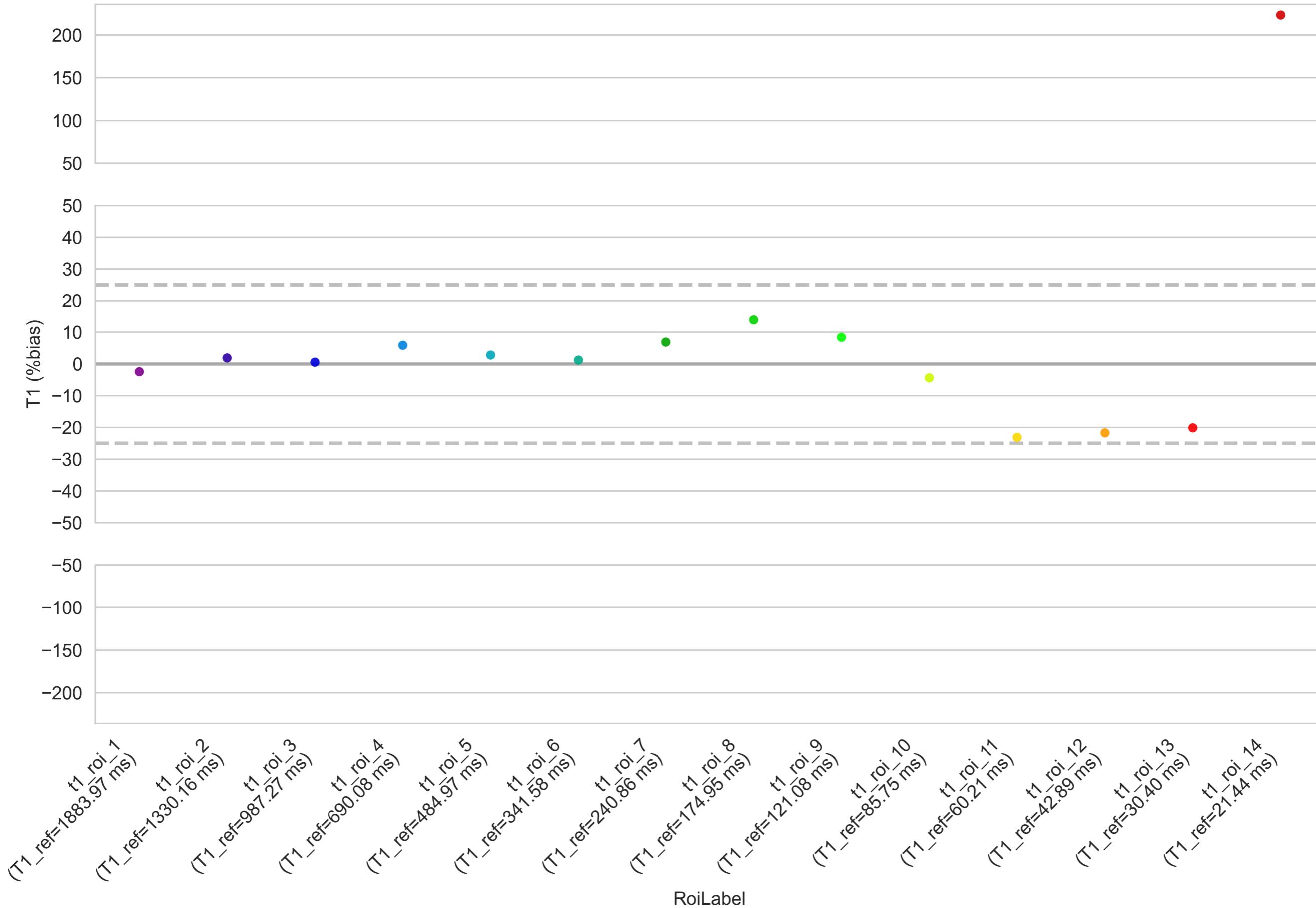


CurveFit [T1VFACurveFit2param - AvROI\_NrmVoxMax\_ExclClip-100pct\_no15deg] <t1\_vfa\_000>



Included measurements are denoted with colour markers. Excluded measurements are denoted with black markers for (crosses) clipped or (circles) user excluded measurements.

CurveFit [T1VFACurveFit2param - AvROI\_NrmVoxMax\_ExclClip-100pct\_no15deg] <t1\_vfa\_000>



CurveFit [T2SECurveFit3param - AvROI\_NrmVoxMax\_ExclClip-100pct\_no10ms] <t2\_mse\_000>

ROI_DX	ROI LABEL	M0	M0_var	n	n_var	T2	T2_var	T2_err	T2_pct.err	T2_ref	T2_init	AVRGD	NORMLD	CLIPD
15	t2_roi_1	nan	nan	nan	nan	nan	nan	nan	nan	1928.3	165.0	True	True	True
16	t2_roi_2	1.6	inf	0.0	inf	432.0	inf	52.5	13.8	379.5	165.0	True	True	True
17	t2_roi_3	1.5	0.0	0.0	0.0	295.2	8.5	28.0	10.5	267.3	165.0	True	True	True
18	t2_roi_4	1.5	0.0	0.0	0.0	196.0	3.4	21.0	12.0	175.1	165.0	True	True	True
19	t2_roi_5	1.4	0.0	0.0	0.0	142.7	1.6	-24.2	-14.5	166.9	165.0	True	True	True
20	t2_roi_6	1.3	0.0	0.0	0.0	99.3	0.9	10.4	11.7	88.9	165.0	True	True	True
21	t2_roi_7	1.4	0.0	0.0	0.0	70.9	0.7	7.5	11.8	63.4	165.0	True	True	True
22	t2_roi_8	1.5	0.0	0.0	0.0	51.0	0.6	6.8	15.4	44.2	165.0	True	True	True
23	t2_roi_9	1.5	0.0	0.0	0.0	36.2	0.6	6.3	21.1	29.9	165.0	True	True	True
24	t2_roi_10	2.0	0.1	0.0	0.0	21.8	0.5	2.4	12.6	19.4	165.0	True	True	False
25	t2_roi_11	3.9	0.3	0.0	0.0	10.9	0.4	-3.9	-26.3	14.7	165.0	True	True	False
26	t2_roi_12	9.2	1.5	0.0	0.0	6.9	0.4	-3.6	-34.6	10.5	165.0	True	True	False
27	t2_roi_13	4.7	0.5	0.0	0.0	9.8	0.5	2.5	34.6	7.3	165.0	True	True	False
28	t2_roi_14	2.5	0.1	0.0	0.0	16.2	0.5	11.1	218.1	5.1	165.0	True	True	False

SIGNAL EQUATION:

$$S(TE) = M0 * \exp(-TE/T2) + n$$

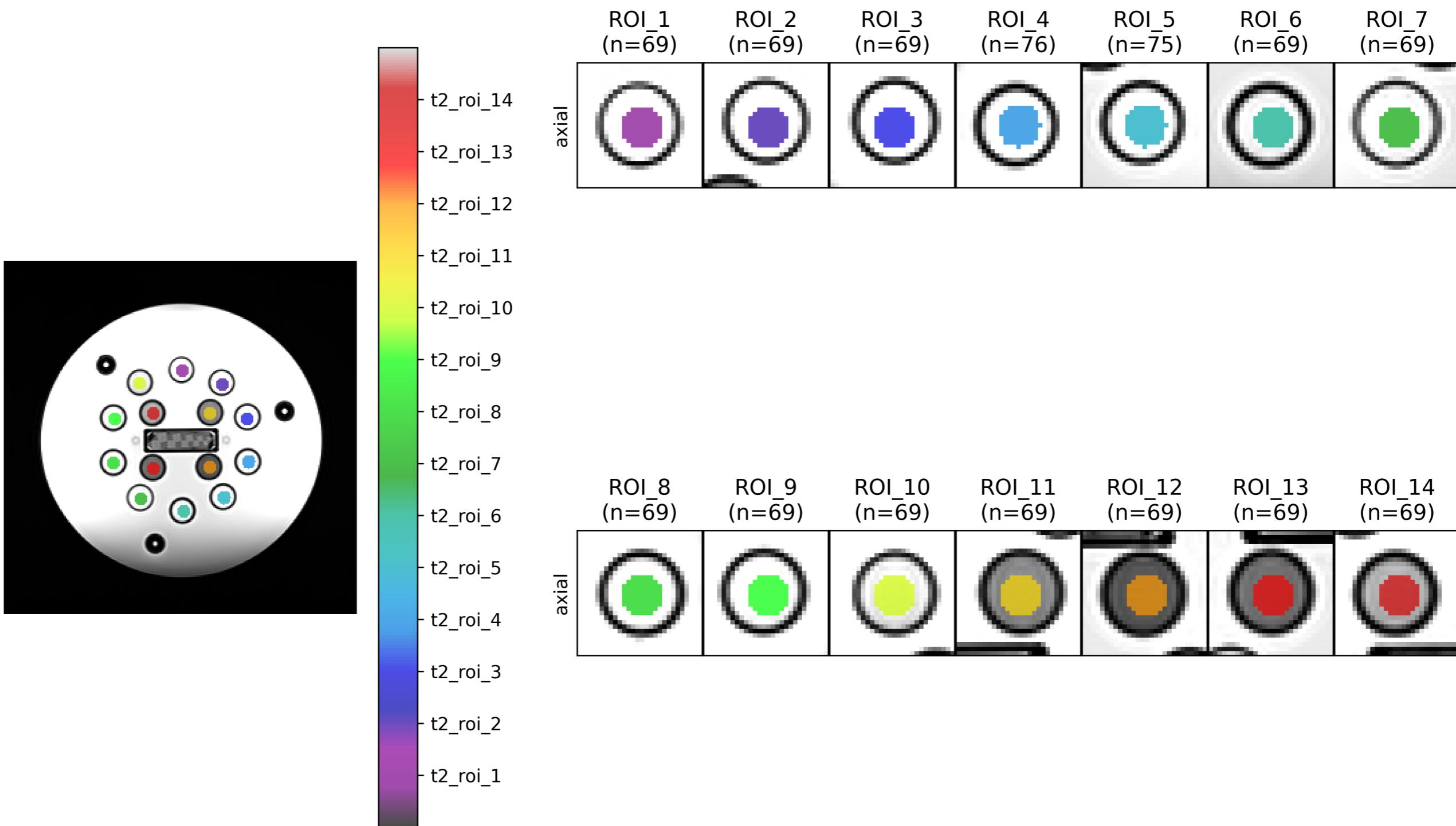
Parameter	Description	Init Val.	Min Val.	Max Val.
M0	Equilibrium magnetisation	max(S(TE))	0.0	inf
T2	T2 relaxation time	TE_median	0.0	inf
n	Noise floor	0.001 * M0	0.0	inf
TE	Echo time	as measured	-	-
TE_median	The median measured echo time	from signal	-	-

GOODNESS OF FIT:

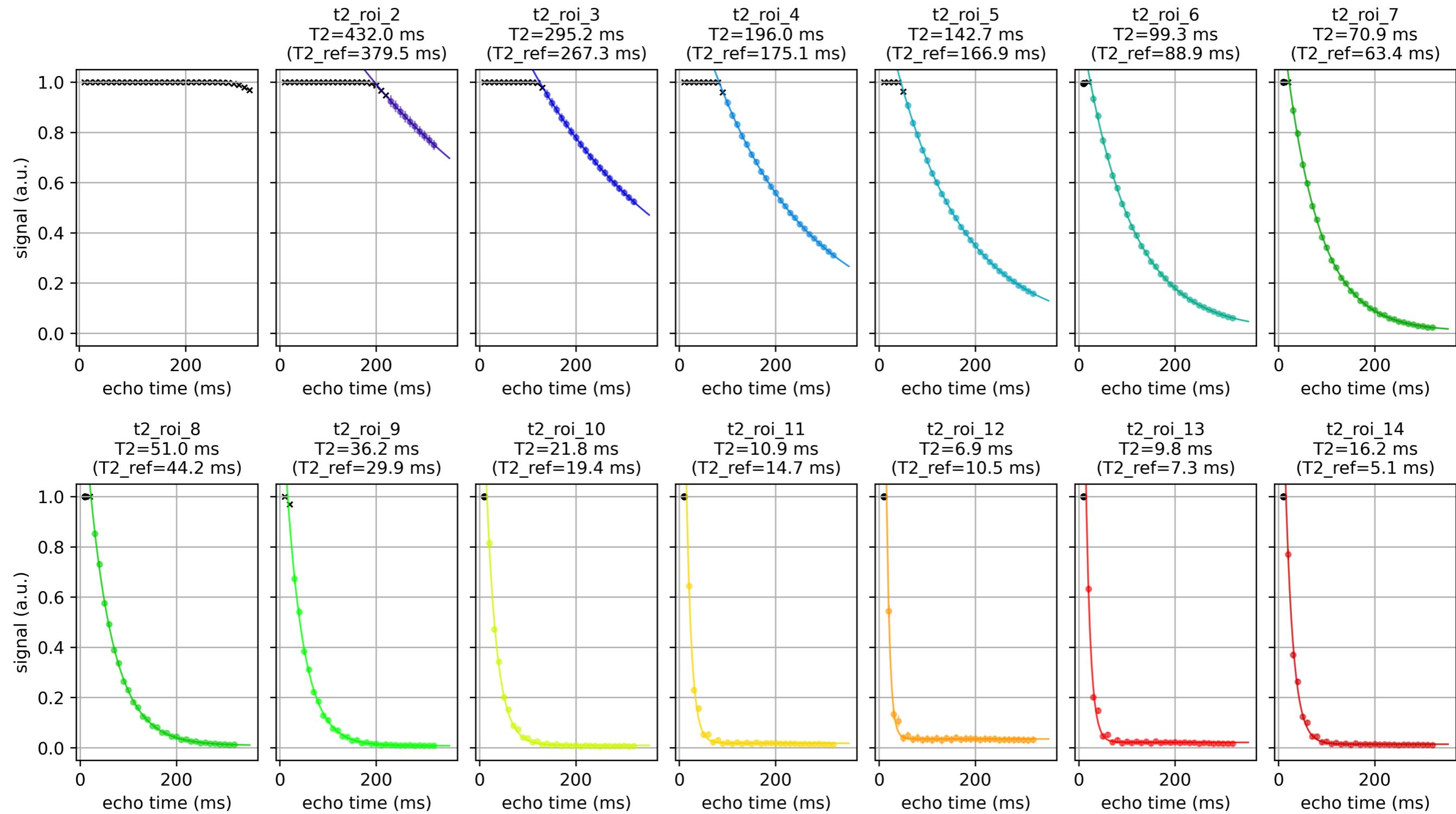
ROI_DX	ROI LABEL	chisqr	redchi	aic	bic
15	t2_roi_1	nan	nan	nan	nan
16	t2_roi_2	0.0000040	0.0000006	-141.3377531	-140.4299978
17	t2_roi_3	0.0000284	0.0000018	-248.8883646	-246.0550477
18	t2_roi_4	0.0000989	0.0000049	-278.2012001	-274.7947175
19	t2_roi_5	0.0001914	0.0000080	-314.1399069	-310.2523963
20	t2_roi_6	0.0004441	0.0000164	-327.6169178	-323.4133256
21	t2_roi_7	0.0006680	0.0000247	-315.3744060	-311.1708139
22	t2_roi_8	0.0011397	0.0000422	-299.3455815	-295.1419893
23	t2_roi_9	0.0011536	0.0000427	-298.9825463	-294.7789542
24	t2_roi_10	0.0027818	0.0000993	-282.8784895	-278.5765278
25	t2_roi_11	0.0036052	0.0001288	-274.8407388	-270.5387772
26	t2_roi_12	0.0026720	0.0000954	-284.1264821	-279.8245205
27	t2_roi_13	0.0045358	0.0001620	-267.7219493	-263.4199877
28	t2_roi_14	0.0041077	0.0001467	-270.7952418	-266.4932802

chisqr : Chi-square statistic  
 redchi : Reduced Chi-square statistic  
 aic : Akaike Information Criterion statistic  
 bic : Bayesian Information Criterion statistic

CurveFit [T2SECurveFit3param - AvROI\_NrmVoxMax\_ExlClip-100pct\_no10ms] <t2\_mse\_000>



CurveFit [T2SECurveFit3param - AvROI\_NrmVoxMax\_ExclClip-100pct\_no10ms] <t2\_mse\_000>



Included measurements are denoted with colour markers. Excluded measurements are denoted with black markers for (crosses) clipped or (circles) user excluded measurements.

CurveFit [T2SECurveFit3param - AvROI\_NrmVoxMax\_ExclClip-100pct\_no10ms] <t2\_mse\_000>

