

Characterization of MR coils: FB_Quad32mm

October 11, 2019

1 Coil

Coil name : FB_Quad32mm
Geometry : volume
Active element number : 1
Manufacturer : Bruker
Operating mode : Tx/Rx
SN : xxxx

2 Phantom

Phantom name : Mouse11.7T
T1 = 190 ms
T2 = 65 ms
Description : 1.25g NiSO₄ x 6H₂O, 5g NaCl /litre d eau.

3 Study

Institution : Neurospin
Station : Biospec117/16
MRI manufacturer : Bruker BioSpin MRI GmbH
Static field $B_0 = 11.8$ T
Date of experiment : 2019-09-18
Nucleus : ¹H
Protocol name : T1_FLASH_3D_iso
Sequence name : Bruker:FLASH 3D

4 Acquisition parameters

BF1 = 500.3079 MHz
BW = 50 kHz
Echo Time : 6 ms
Repetition Time : 15 ms
Number of Average : 1
Flip Angle = 5°
Acquisition Time : 4 min 10 s
FOV (H-F*L-R*A-P) = $128 \times 64 \times 64 \text{ mm}^3$
Voxel Size (H-F*L-R*A-P) = $500 \times 500 \times 500 \text{ }\mu\text{m}^3$
Matrix = $256 \times 128 \times 128 \text{ pixels}$

5 Measurement of the SNRc

• Confidence evaluation of the noise measurement (STD_{air}) :

- C_0 , a data mining class, selects the VOIs where $R_{exp} = R_{th} \pm 1\%$ with $R_{exp} = \frac{MEAN_{air}}{STD_{air}}$ the signal-to-noise ratio in the air and R_{th} is the theoretical ratio for the Rayleigh distribution. The χ^2 test is applied only on these VOIs.
- H_0 , the null hypothesis of the χ^2 goodness of fit test, is defined as: the noise in C_0 follows the Rayleigh distribution. H_0 is accepted (Acc) if $\chi^2 \leq \chi_c^2$ otherwise rejected (Rej) where χ_c^2 is the critical χ^2 for a $p_value = 0.05$.

• SNR measurement :

- $MEAN_{obj}$ is the average of the VOI in the object at 50% of the reference signal.
- $\overline{STD_{air}}$ is the average on 200 values of STD_{air} validated by the χ^2 test.
- $SNR = 0.655 \frac{MEAN_{obj}}{\overline{STD_{air}}}$.

• SNR corrected (SNRc) :

- Sequence parameter correction: $SP_{fac} = \frac{1}{V_{voxel}} \sqrt{\frac{BW}{N_x N_y N_z NA}}$
- Relaxation time correction: $RT_{fac} = \frac{(1 - \cos(\alpha) E_1)}{(1 - E_1) \sin(\alpha) E_2}$ where $E_1 = e^{-\frac{TR}{T_1}}$, $E_2 = e^{-\frac{TE}{T_2}}$
- $SNRc = SNR * SP_{fac} * RT_{fac}$ is the SNR corrected by SP_{fac} and RT_{fac} .

Confidence					SNR measured			SNR corrected		
R_{exp}	R_{th}	C_0	$\chi^2 < \chi_c^2$	H_0	$MEAN_{obj}$	$\overline{STD_{air}}$	SNR	SP_{fac}	RT_{fac}	$SNRc$
1.91	1.91	10029	200	Acc	23646.07	22.08	702 ± 18	0.87	13.17	8068 ± 202

6 Characteristic lengths of uniformity vs capture zone

- Uniform length or volume is a dimension where the signal is inferior or equal to 10% or 50% variation in the reference signal (S_{ref}). In the case of volume coil, S_{ref} is the signal at the center of the phantom. In the case of surface coil, S_{ref} is the maximum value found in the image.
- Capture length or volume is the entire volume captured by the coil. This value is independent of S_{ref} .
- Ratio of lengths or volumes is the uniform-to-capture ratio.

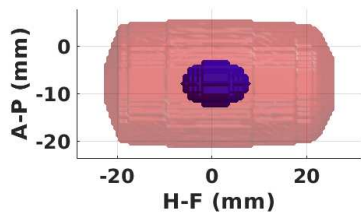
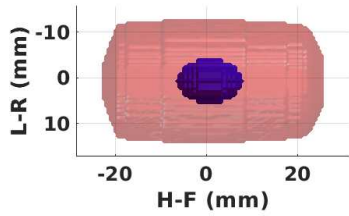
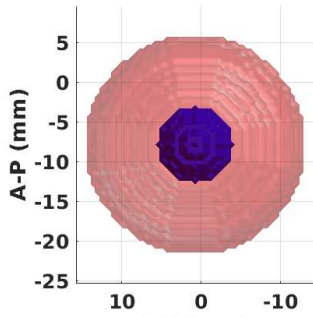
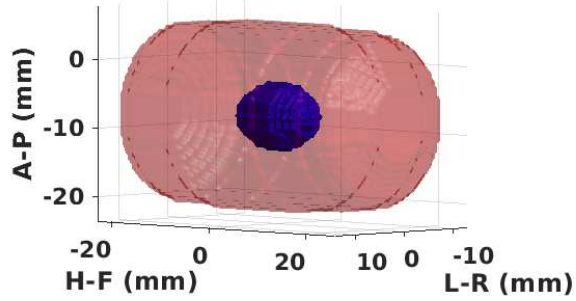
		10% variation in S_{ref}	50% variation in S_{ref}
H-F	Uniform length (mm)	14 ± 1	32 ± 1
	Capture length (mm)	48 ± 1	48 ± 1
	Ratio of lengths (%)	30 ± 3	68 ± 3
L-R	Uniform length (mm)	9.5 ± 1.0	26 ± 1
	Capture length (mm)	26 ± 1	26 ± 1
	Ratio of lengths (%)	36 ± 5	96 ± 7
A-P	Uniform length (mm)	9.5 ± 1.0	26 ± 1
	Capture length (mm)	26 ± 1	26 ± 1
	Ratio of lengths (%)	36 ± 5	96 ± 7
Vol	Uniform volume (cm^3)	0.59 ± 0.20	12 ± 1
	Capture volume (cm^3)	24 ± 2	24 ± 2
	Ratio of volumes (%)	2.5 ± 1.0	50 ± 10

7 Uniform versus capture volumes

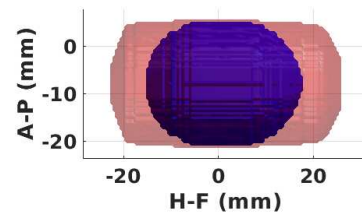
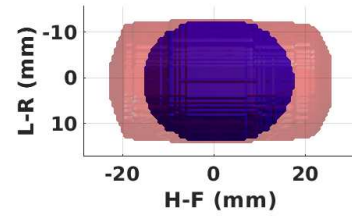
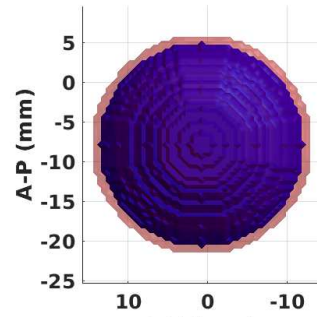
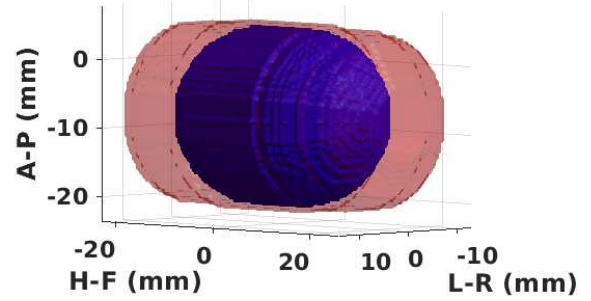
Uniform volume : blue color

Capture volume : red color

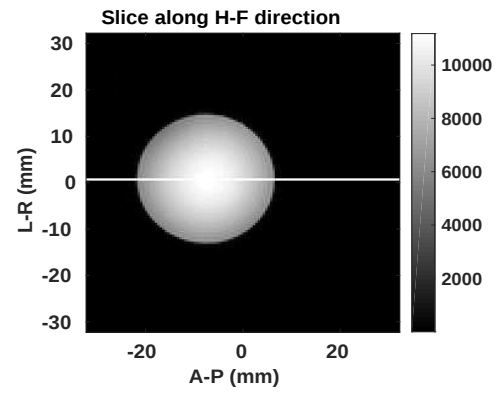
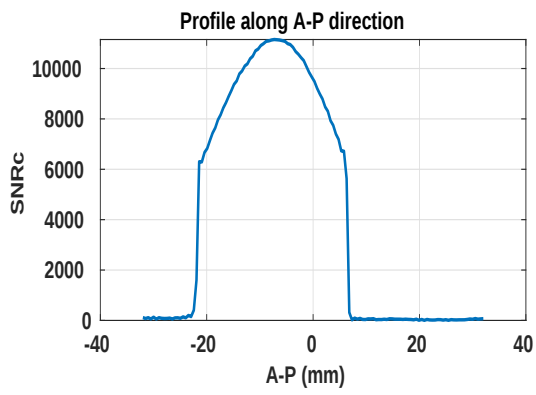
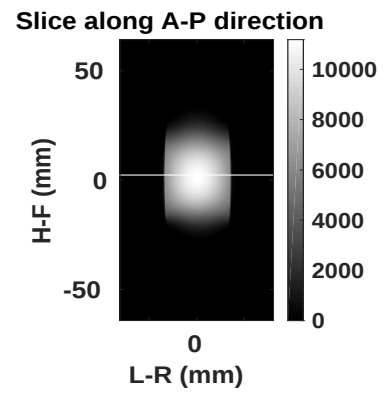
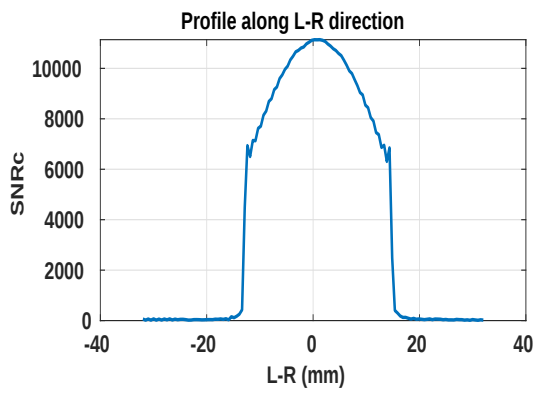
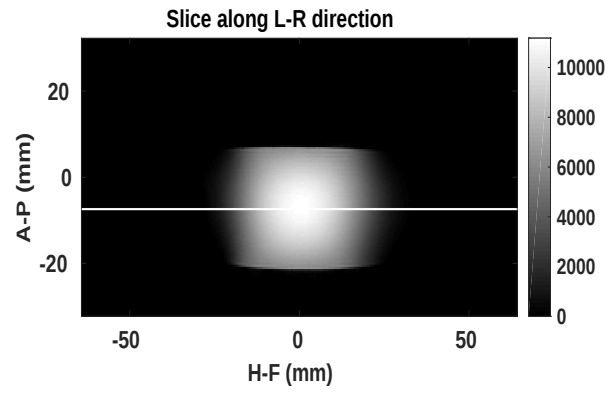
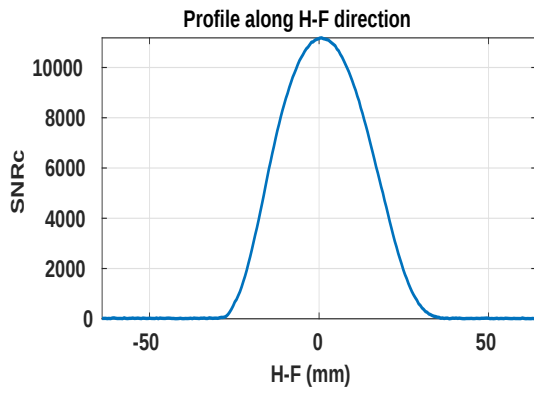
10% variation in S_{ref}



50% variation in S_{ref}



8 Profiles and Slices



9 Comparison with anterior results

Abbreviations:

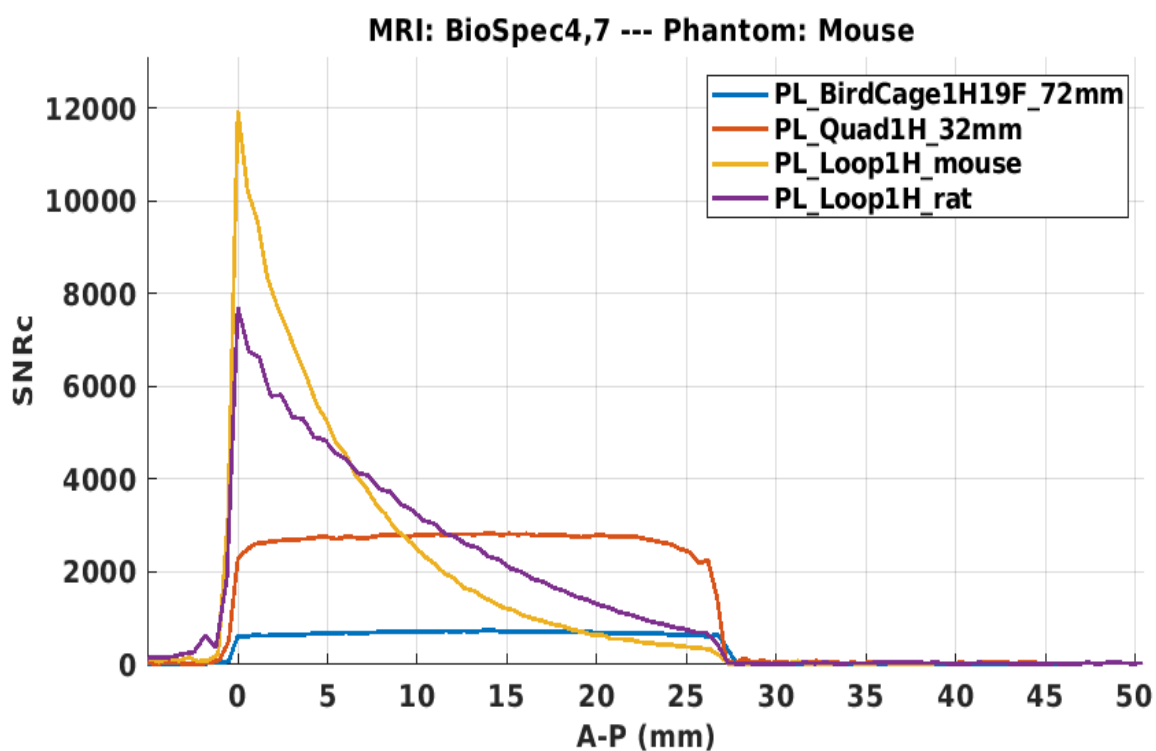
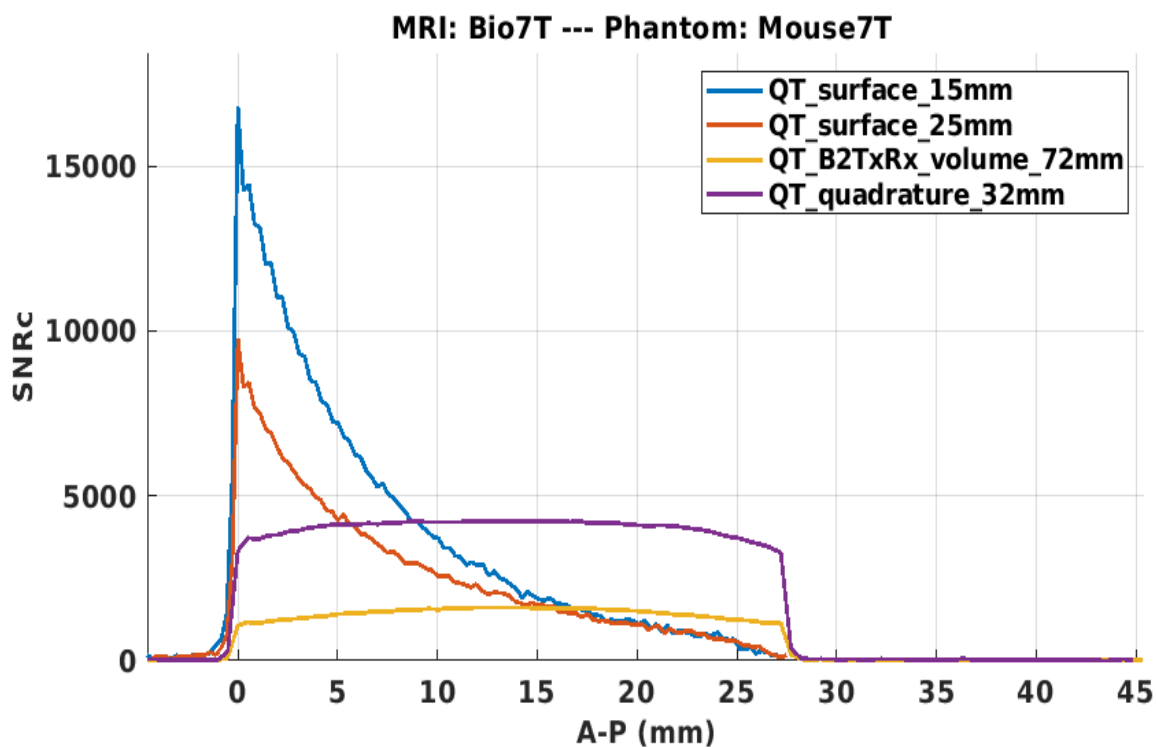
Acc: Rows appear in white when H_0 is accepted which mean that the measurement of SNR is validated.

Rej: Rows appear in gray when H_0 is rejected which mean that the measurement of SNR is biased.

Coil	Mode & Nuc	Date & time	Location & station	B ₀ (T)	Phantom	H ₀	SNR	SNR corrected	Uniform volume @50%(cm ³)
FB_Quad32mm	Tx/Rx 1H	2019-09-18 15h48	Neurospin Biospec117/16	11.8	Mouse11.7T	Acc	702 ± 18	8068 ± 202	12 ± 1
FB_Quad60mm117T	Tx/Rx 1H	2019-09-18 15h23	Neurospin Biospec117/16	11.8	Mouse11.7T	Acc	495 ± 12	5692 ± 142	21 ± 2
FB_Surf_Rat	Tx/Rx 1H	2019-09-18 14h49	CEA 7TPharmascan	7.1	Mouse7T	Acc	567 ± 28	6235 ± 312	1.41 ± 0.44
FB_Quad38mm	Tx/Rx 1H	2019-09-18 14h24	CEA 7TPharmascan	7.1	Mouse7T	Acc	348 ± 9	3824 ± 96	15 ± 2
HEH_-HeadNeck20CH	Tx/Rx 1H	2019-08-30 17h16	Hopital Edouard Herriot Pav B HEHMR2	1.5	Bouteille15T	Acc	166 ± 4	52 ± 1	1355 ± 100
HEH_Knee8CH	Tx/Rx 1H	2019-08-30 16h12	Hopital Edouard Herriot Pav B HEHMR2	1.5	Bouteille	Acc	197 ± 5	62 ± 2	657 ± 75
NC_FS	Tx/Rx 1H	2019-03-29 19h33	CHU NANCY BRABOIS ADULTES AWP166008	3	Bouteille	Acc	195 ± 5	109 ± 3	521 ± 54
NC_HN64	Tx/Rx 1H	2019-03-29 18h09	CHU NANCY BRABOIS ADULTES AWP166008	3	Bouteille	Acc	200 ± 5	112 ± 3	1019 ± 83
NC_HN20	Tx/Rx 1H	2019-03-29 17h12	CHU NANCY BRABOIS ADULTES AWP166008	3	Bouteille	Acc	194 ± 5	109 ± 3	1447 ± 98
NS_HN20CH	Tx/Rx 1H	2018-11-26 09h52	NeuroSpin MRCTRIO	3	Bouteille	Acc	190 ± 5	107 ± 3	1366 ± 95
NS_HN64CH	Tx/Rx 1H	2018-11-26 09h27	NeuroSpin MRCTRIO	3	Bouteille	Acc	197 ± 5	110 ± 3	888 ± 77
Re_FlexSmall	Tx/Rx 1H	2018-11-21 11h05	CTRE AWP166066	3	Bouteille	Acc	177 ± 4	99 ± 2	485 ± 48
Re_20cnx	Tx/Rx 1H	2018-11-21 10h55	CTRE AWP166066	3	Bouteille	Acc	202 ± 5	113 ± 3	1346 ± 94
Re_64cnx	Tx/Rx 1H	2018-11-21 10h46	CTRE AWP166066	3	Bouteille	Acc	210 ± 5	118 ± 3	938 ± 79
IR_HN20	1H 123MH	2018-11-12 20h41	IRMAS NORD AWP66062	3	Bouteille	Acc	189 ± 5	106 ± 3	1326 ± 91
IR_HN64	Tx/Rx 1H	2018-11-12 20h20	IRMAS NORD AWP66062	3	Bouteille	Acc	176 ± 4	114 ± 3	721 ± 61
QC_20CH	Tx/Rx 1H	2018-11-07 14h24	Universite d aix Marseille AWP66072	3	Bouteille	Acc	180 ± 5	101 ± 3	1318 ± 93
PR_knee15	Tx/Rx 1H	2018-09-21 18h55	Cermep AWP66012	3	Bouteille	Acc	223 ± 6	125 ± 3	889 ± 94
QC_FlexSmall	Tx/Rx 1H	2017-09-19 10h29	Universite d aix Marseille AWP66072	3	Bouteille	Acc	184 ± 5	103 ± 3	459 ± 52
QC_64CH	Tx/Rx 1H	2017-05-31 10h23	Universite d aix Marseille AWP66072	3	Bouteille	Acc	185 ± 5	103 ± 3	822 ± 74
LI_FlexSmall	Tx/Rx 1H	2017-03-07 17h21	CERMEP MRC51044	3	Bouteille	Acc	197 ± 5	110 ± 3	594 ± 54
LLL11	Tx/Rx 1H	2017-03-07 15h26	CERMEP MRC51044	3	Bouteille	Acc	258 ± 13	144 ± 7	174 ± 28
LLL7	Tx/Rx 1H	2017-03-07 15h13	CERMEP MRC51044	3	Bouteille	Acc	481 ± 24	269 ± 13	64 ± 14
VS_Loop-Rat4ch	Rx 1H	2017-01-26 16h55	GIN Grenoble BioSpec 94/20 AV3HD	9.4	Mouse9.4T	Rej	1937 ± Inf	21186 ± Inf	2.62 ± 0.84

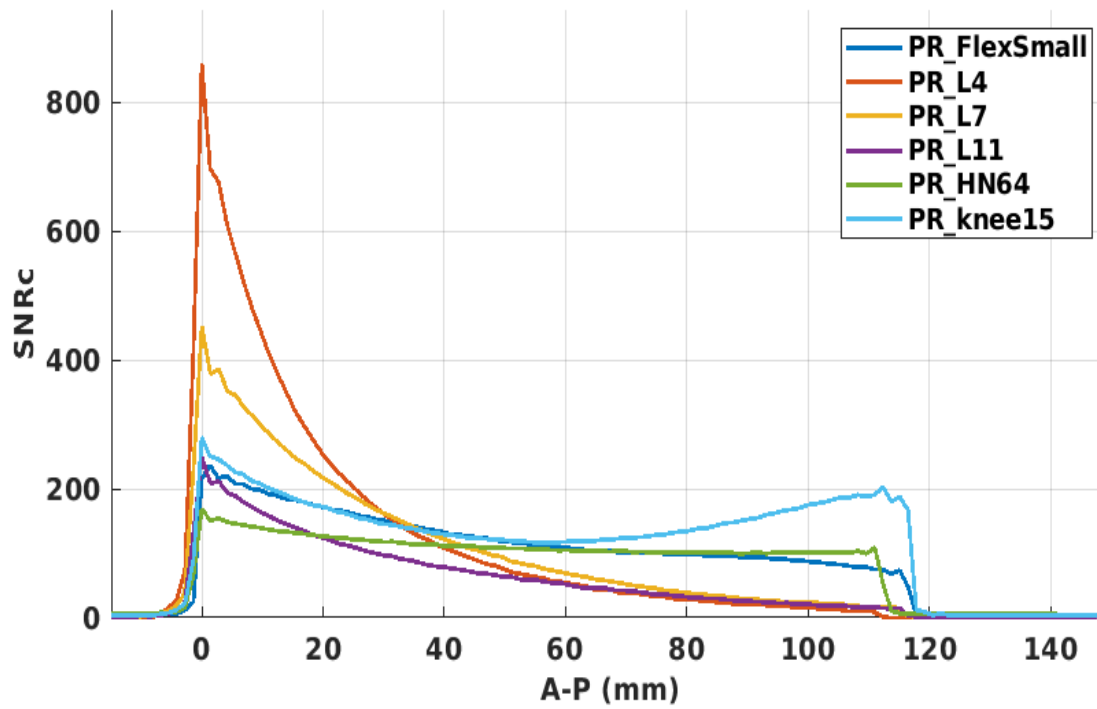
Coil	Mode & Nuc	Date & time	Location & station	B ₀ (T)	Phantom	H ₀	SNR	SNR corrected	Uniform volume @50%(cm ³)
VS_Loop-Rat4ch	Rx 1H	2017-01-26 16h44	GIN Grenoble BioSpec 94/20 AV3HD	9.4	Mouse9.4T	Rej	1929 ± Inf	21103 ± Inf	2.61 ± 0.83
VS_Loop-Mouse4ch	Rx 1H	2017-01-26 16h22	GIN Grenoble BioSpec 94/20 AV3HD	9.4	Mouse9.4T	Acc	1521 ± 76	16637 ± 832	0.91 ± 0.34
VS_Quad72mm	TxRx 1H	2017-01-26 15h50	GIN Grenoble BioSpec 94/20 AV3HD	9.4	Mouse9.4T	Acc	310 ± 8	3395 ± 85	32 ± 3
VS_Loop-RatHole	Rx 1H	2017-01-26 14h33	PIRMG-GIN BioSpec 47/40	4.7	Mouse	Acc	378 ± 19	4181 ± 209	4.11 ± 0.87
VS_Loop-Rat	Rx 1H	2017-01-26 14h17	PIRMG-GIN BioSpec 47/40	4.7	Mouse	Acc	401 ± 20	4438 ± 222	4.24 ± 0.94
VS_Loop-Mouse	Rx 1H	2017-01-26 12h24	PIRMG-GIN BioSpec 47/40	4.7	Mouse	Acc	519 ± 26	5751 ± 288	1.25 ± 0.39
VS_Quad72mm	TxRx 1H	2017-01-26 12h09	PIRMG-GIN BioSpec 47/40	4.7	Mouse	Acc	107 ± 3	1190 ± 30	37 ± 4
VS_BirdCage72mm	TxRx 1H	2017-01-26 11h53	PIRMG-GIN BioSpec 47/40	4.7	Mouse	Acc	80 ± 2	890 ± 22	39 ± 4
VS_Loop-Rat	Rx 1H	2017-01-26 11h02	PIRMG-GIN BioSpec 70/20	7.1	Mouse7T	Acc	641 ± 32	7051 ± 353	5.4 ± 1.0
VS_Loop-Mouse	Rx 1H	2017-01-26 10h48	PIRMG-GIN BioSpec 70/20	7.1	Mouse7T	Acc	1126 ± 56	12382 ± 619	1.07 ± 0.35
VS_Quad72mm	TxRx 1H	2017-01-26 10h30	PIRMG-GIN BioSpec 70/20	7.1	Mouse7T	Acc	220 ± 6	2416 ± 60	36 ± 4
VS_BirdCage72mm	TxRx 1H	2017-01-26 10h12	PIRMG-GIN BioSpec 70/20	7.1	Mouse7T	Acc	146 ± 4	1603 ± 40	38 ± 4
LLL4	Tx/Rx 1H	2017-01-20 15h56	CERMEP MRC51044	3	Bouteille	Acc	825 ± 41	461 ± 23	16 ± 5
IR_FlexSmall	Tx/Rx 1H	2016-12-19 17h21	IRMAS NORD3TR AWP66062	3	Bouteille	Acc	167 ± 4	109 ± 3	393 ± 42
IR_FlexSmall	Tx/Rx 1H	2016-12-19 17h13	IRMAS NORD3TR AWP66062	3	Bouteille	Rej	170 ± Inf	110 ± Inf	392 ± 43
PR_HN64	Tx/Rx 1H	2016-12-14 17h30	Cermep Prisma	3	Bouteille	Acc	194 ± 5	109 ± 3	757 ± 72
PR_L11	Tx/Rx 1H	2016-12-14 16h59	Cermep Prisma	3	Bouteille	Acc	253 ± 13	142 ± 7	173 ± 28
PR_L7	Tx/Rx 1H	2016-12-14 16h29	Cermep Prisma	3	Bouteille	Acc	459 ± 23	257 ± 13	59 ± 13
PR_L4	Tx/Rx 1H	2016-12-14 14h29	Cermep Prisma	3	Bouteille	Acc	816 ± 41	458 ± 23	16 ± 5
RE_quad72	Tx/Rx 1H	2016-12-08 18h08	PRISM-VilleJean spect	4.7	Mouse	Acc	144 ± 4	1597 ± 40	16 ± 2
RE_Surf15mm	Rx 1H	2016-12-08 17h24	PRISM-VilleJean spect	4.7	Mouse	Acc	619 ± 31	6859 ± 343	0.51 ± 0.19
RE_SurfBru	Rx 1H	2016-12-08 16h50	PRISM-VilleJean spect	4.7	Mouse	Acc	34 ± 2	2213 ± 111	0.84 ± 0.18
RE_lin72	Tx/Rx 1H	2016-12-08 15h49	PRISM-VilleJean spect	4.7	Mouse	Acc	15 ± 0.4	953 ± 24	14 ± 1
PR_FlexSmall	Tx/Rx 1H	2016-11-29 18h24	Cermep AWP66012	3	Bouteille	Acc	189 ± 5	106 ± 3	435 ± 49
PL_Loop1H_rat	Rx 1H	2016-10-17 18h01	CREATIS BioSpec4,7	4.7	Mouse	Acc	616 ± 31	4238 ± 212	4.9 ± 1.2
PL_Loop1H_mouse	Rx 1H	2016-10-17 17h42	CREATIS BioSpec4,7	4.7	Mouse	Acc	594 ± 30	6582 ± 329	1.11 ± 0.36
PL_Quad1H_32mm	Tx/Rx 1H	2016-10-17 16h17	CREATIS BioSpec4,7	4.7	Mouse	Acc	231 ± 6	2560 ± 64	16 ± 2
QT_quadrature_32mm	Tx/Rx 1H	2016-09-29 15h56	Animage Bio7T	7.1	Mouse7T	Acc	330 ± 8	3624 ± 91	16 ± 2
QT_B2TxRx_-volume_72mm	Tx/Rx 1H	2016-09-29 15h33	Animage Bio7T	7.1	Mouse7T	Acc	129 ± 3	1416 ± 35	36 ± 4
PL_BirdCage1H19F_-72mm	Tx/Rx 1H	2016-09-01 12h04	CREATIS BioSpec4,7	4.7	Mouse	Acc	53 ± 1	592 ± 15	27 ± 3
QT_surface_25mm	Rx 1H	2015-12-08 16h41	Animage Bio7T	7.1	Mouse7T	Acc	96 ± 5	5645 ± 282	2.11 ± 0.30

Coil	Mode & Nuc	Date & time	Location & station	B ₀ (T)	Phantom	H ₀	SNR	SNR corrected	Uniform volume @50%(cm ³)
QT_surface_15mm	Rx 1H	2015-12-08 14h41	Animage Bio7T	7.1	Mouse7T	Acc	165 ± 8	9705 ± 485	0.70 ± 0.14



Written by CREATIS

MRI: AWP66012 --- Phantom: Bouteille



MRI: spect --- Phantom: Mouse

