DOTY SCIENTIFIC

MRI Catalog

RF Imaging Coils:

Volume Coils – Large or Small

Hundreds of Surface Coils

Curved Surface Coils

Vertical Bore Imaging Probes

Doty MRI

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April 2025

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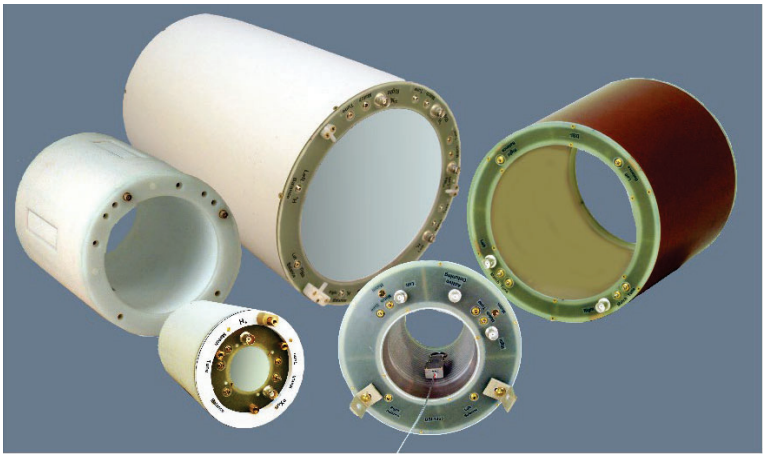
MRI RF Volume Coils
^{1}H or Dual Frequency



RF Research Coils with Easier Tuning and High S/N, Homogeneity, and Isolation.

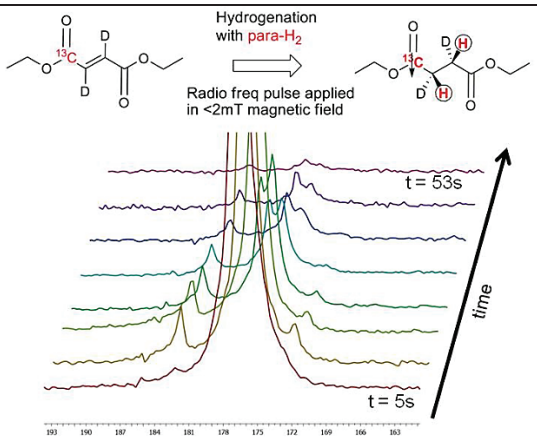
- **Mouse Coils**
- **Rat Coils**
- **Rabbit Coils**
- **Primate Head Coils**
- **Custom Coils**

Dual frequency: Either ^{1}H/ff (fixed Frequency) or ^{1}H/X coils with multinuclear X channel which can include ^{31}P, ^{13}C, ^{129}Xe, ^{2}H, ^{15}N or others.

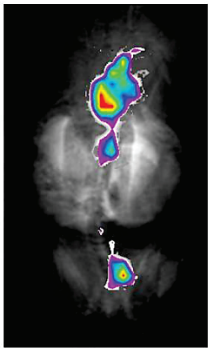
Results Obtained at 4.7 T with a Doty ^{1}H/^{13}C Full Body Mouse RF Volume Coil

^{13}C magnetic resonance spectroscopy (MRS) and magnetic resonance imaging (MRI) of the TCA cycle were achieved seconds after injection of 10 to 20 mmol of hyper-polarized diethyl succinate into normal mice.

Courtesy of N Zacharias, H Chan, N Sailasuta, B Ross, and P Bhattacharya, JACS 2012 Jan 18: 134(2):934-43.



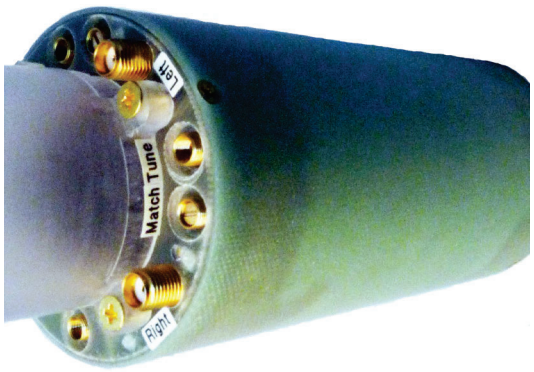
in vivo ^{13}C stackplot



in vivo ^{13}C imaging

Recent Demanding MR Coils from Doty
Quadrature & Dual-frequency Multi-X

Field T	^{1}H MHz	X-channel Nuclides	ID mm	OD mm	^{1}H π/2 μs @100W
15.2	646	-	36	60	38
15.2	646	^{31}P, ^{129}Xe, ^{2}H	34	60	90
9.4	400	^{129}Xe	45	120	53
4.7	200	-	100	255	50
7.06	300	^{13}C	65	120	88
9.4	400	^{31}P, ^{129}Xe, ^{23}Na	40	113	52
9.4	400	^{31}P, ^{13}C	38	120	47
7.06	300	^{129}Xe	45	115	44
14.1	600	^{13}C	25	120	34
3	128	-	170	209	424
7.06	300	^{31}P, ^{13}C	45	112	44
3	128	^{13}C, ^{15}N	65	118	70



Mouse Coil, ^{1}H at 646 MHz for a 15.2 T Horizontal Bore Imager with a 6 cm Bore, 36 mm ID x 50 mm Length (59 mm OD)

(A mounting tube extension is attached on the left.)

See standard coil information on the reverse side.

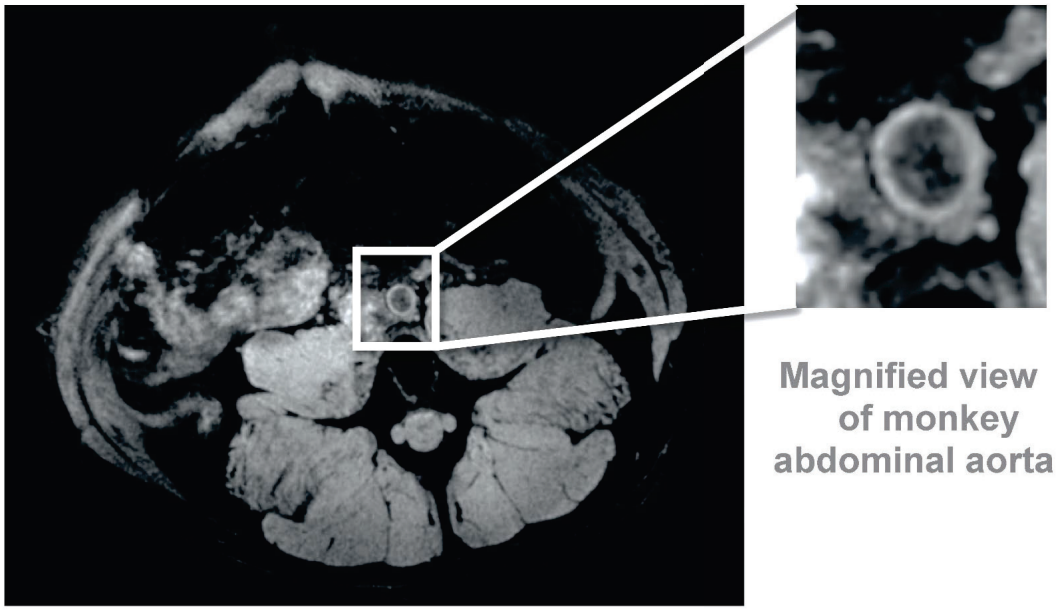
www.dotynmr.com

Standard ^{1}H or H/X RF Volume Coils Each Coil Size can be provided for any Field strength		Recently Supplied RF Volume Coils (25, 37, 40, 45, and 65 mm dia)			
Coil Size OD x Length	Fields	Diameter	Length	Tuning	^{1}H
25 x 22 mm	3 T	25	22	H/C	600
		25	22	H/X	400
37 x 25 mm	4.7 T	37	25	H/C	300
		40	35	H/X	400
40 x 35 mm	7 T	45	45	H/Xe	400
		45	45	H/Xe	300
45 x 36 mm	9.4 T	45	36	H/X	300
65 x 52 mm	11.7 T	65	52	H/X *(X=^{13}C, ^{15}N),*	@ 3 T; 1.5 T; 1 T; 0.5 T; and 0.3 T.

- Longer coils or custom coils can be provided at additional cost.

In vivo 7 T MRI Non-Human Primate Atherosclerosis Imaging with a Doty 150 mm 300 MHz Quadrature Volume Coil

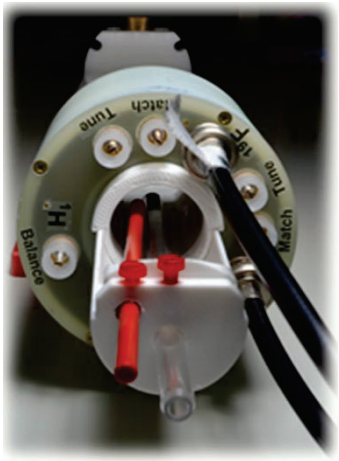
Transverse Anatomical View



Magnified view of monkey abdominal aorta

We thank the Center for Biomolecular Imaging & Department of Pathology Section for Lipid Sciences, Wake Forest University School of Medicine, for sharing their results.

MRI RF Volume Coils
$^{1}H/^{19}F$ Dual Frequency

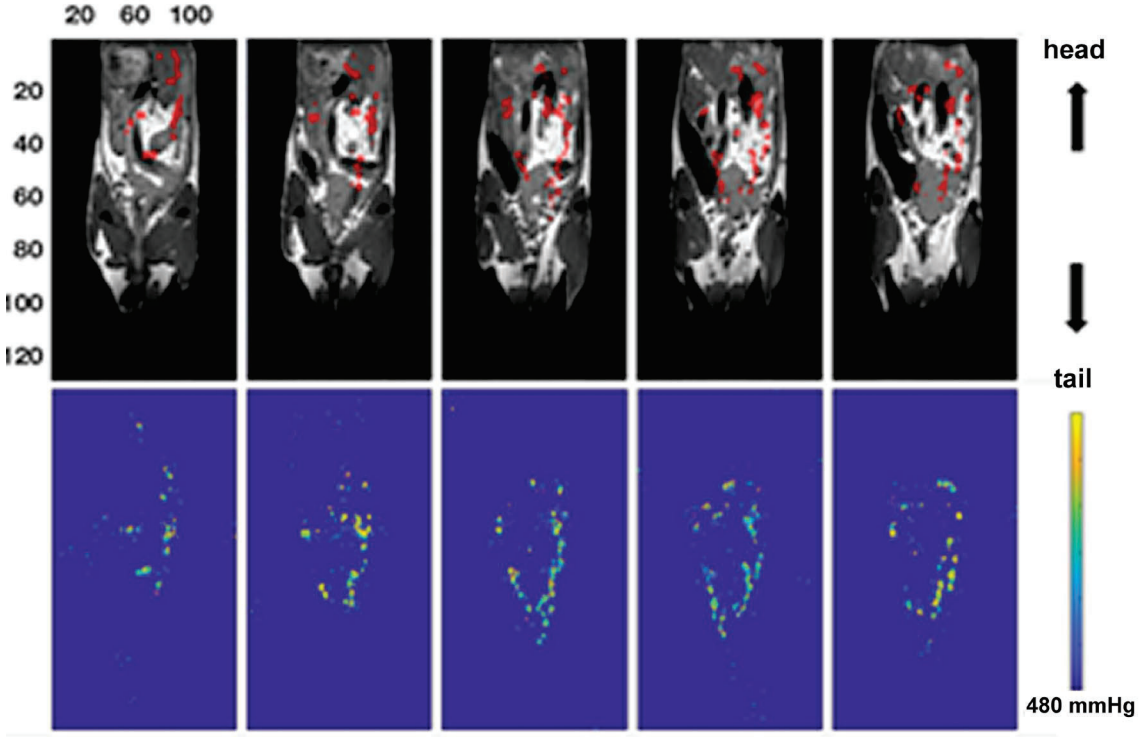


A Doty **9.4 T 32 mm $^{1}H/^{19}F$ Rat Brain Volume Coil. Shown with user incorporated animal bed.**

Coils for Mice, Rats, Rabbits, Primates, & Custom Coils

- High S/N, homogeneity, and isolation.
- Efficient, easy to tune and match over a broad range of sample loading.
- Each channel for TxRx.
- For observe / decouple – with both channels used simultaneously.
- For interleaved acquisitions – with each channel used sequentially.
- Robust stable design

Results Obtained with a *Doty* 7 T 38 mm $^{1}H/^{19}F$ Mouse Body Volume Coil



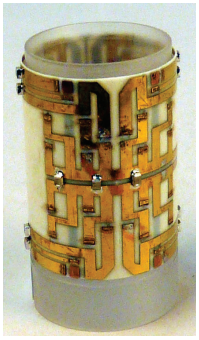
Spatiotemporal in vivo pO_2 tracking and clustering of biomaterial implants in mouse.
Top: in vivo slice-by-slice fused MRI images, collected with 7 T Doty $^{1}H/^{19}F$ module, of fluorocapsule distribution (^{19}F-MRI, red) and soft tissue anatomy (^{1}H-MRI, grayscale) at day 1 post implantation for 1.5 mm fluorocapsules implanted in a healthy mouse.
Bottom: Calculated pO_2 spatial color maps (brighter colors correspond to decreased pO_2).

Spanoudaki V, Doloff JC, Huang W, Norcross SR, Farah S, Langer R, Anderson DG. *Simultaneous spatiotemporal tracking and oxygen sensing of transient implants in vivo using hot-spot MRI and machine learning.* Proc Natl Acad Sci U S A. 2019 Mar 12; 116(11):4861-4870.

Unique MRI Coils

^{1}H and ^{2}H Imaging on a Dual-Frequency ^{1}H-^{19}F/X Mouse Volume Coil – for a 15.2 T scanner with a 6 cm bore. The high frequency (650 MHz ^{1}H) and tight spacing (59 mm OD with two coils and a 36 mm ID) made this coil quite challenging! A 36 mm ID x 35 mm FOV allows surface coil receive, when desired. Tuning included: ^{1}H-^{19}F (tunable from ^{1}H to ^{19}F) and multi-X that includes low gamma nuclei: ^{23}Na,^{13}C, ^{2}H, ^{17}O, ^{15}N, and ^{14}N.

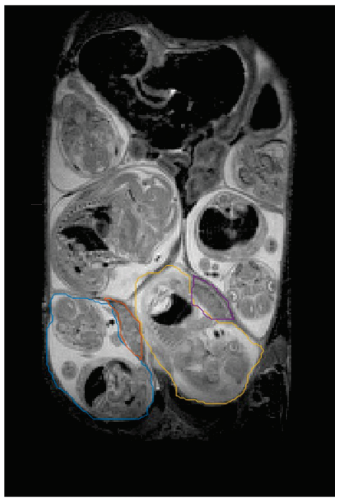
Inner multi-X Coil



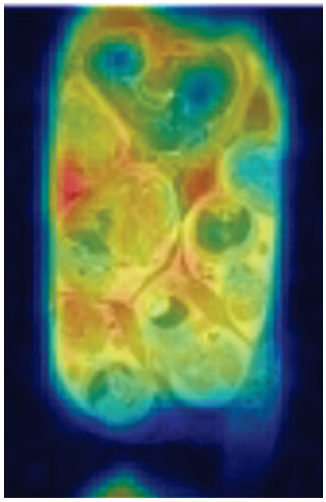
Outer ^{1}H-^{19}F Coil

Finished Coil, 15.2 T, ^{1}H-^{19}F/X

MRI ^{1}H and ^{2}H results on a pregnant mouse (E16.5) were recorded in ~2 minute intervals following injection of saline D_2O, providing water transport information across the placentas and into individual fetal organs at a level never before seen.



^{1}H MRI of the ROI in ^{2}H image (right). RAREacquisition, Matrix: 256x256. Thick: 1 mm. Circled in blue and yellow are two fetuses; orange and purple indicate placentas.



^{2}H MRI showing differential uptakes in a pregnant mouse ~18 minutes after D_2O injection. 3D-bSSFP; TR: 2.206 ms; Matr: 32x32x16.

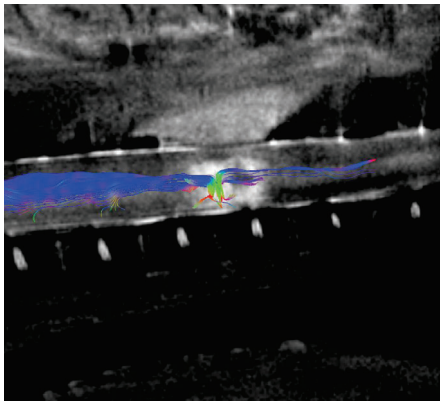
"The probe works very nicely – and it's really a relief to be able to target the full pregnant animal on ^{1}H and ^{2}H without having to search positions fetus-by-fetus with a surface coil." – Lucio

Images courtesy of Clore Institute for High Magnetic Field Imaging and Spectroscopy, Weizmann Institute.

Unique MRI Coils

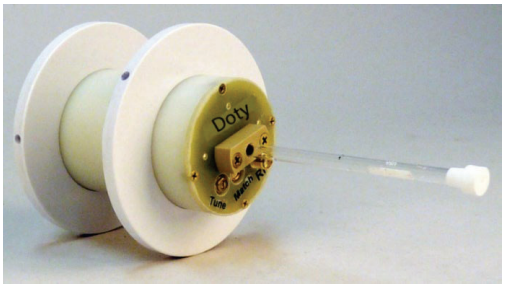
First, the **in-vivo** DTI of rat spinal cord was imaged on a DOTY ^{1}H 7 T quadrature coil with 56 mm ID clearbore, 56 mm homogenous region, O.D. of 87 mm and module length of 129 mm.

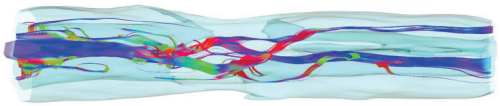
In-vivo 7 T rat spinal cord image (right) with in-plane resolution of 0.44 mm. Showing contused spinal cord injury.



Patented Doty slotted resonator for a 5 mm sample tube

Ex-vivo 7 T microscopy using a ^{1}H slotted resonator (right) in horizontal-bore magnet.





Ex-vivo DTI of rat spinal cord (above), acquired with DOTY 5 mm slotted resonator, 7 T. In-plane resolution of 0.12 mm. Showing spared locomotor descending tracts around the injury after treatment with magnetic stimulation.

Images from the Laboratory of Dr. Prodip Bose; Malcom Randall VA Medical Center, Gainesville, FL.

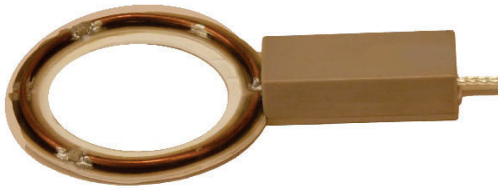
MRI RF Surface Coils
^{1}H or Dual Frequency

Standard coil diameters currently include 8, 12, 16, 20, and 24 mm.

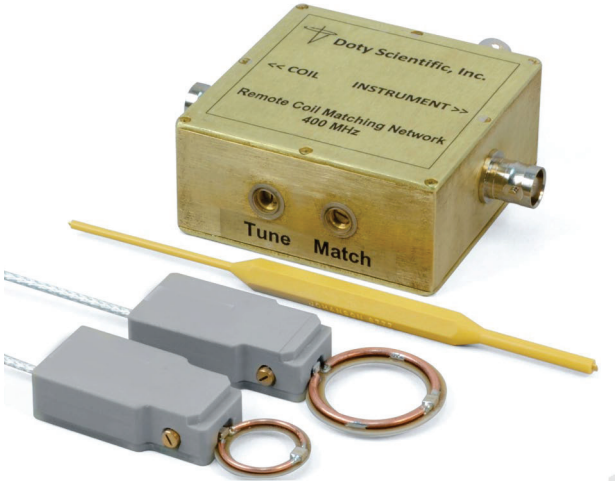
Standard products options:

- 3 T – 11.7 T
- Single or dual frequency
- Frequencies ^{1}H or ^{1}H/ff (fixed frequency) – ^{1}H, ^{19}F, ^{31}P, ^{129}Xe, ^{13}C or ^{2}H
- Transmit-receive (T)
- Passive detuning (P)
- Active detuning (A)
- **Curved surface coils are also available**

Larger coils, Higher frequency coils or custom coils can be provided at additional cost.



Hundreds of Standard Coils
Up to 50% higher S/N



Surface Coils with Remote Coil Matching Network (RCMN), see Reverse side for tuning accessories

Geometries optimized for the best sensitivity and B_1 homogeneity with biological samples.

Balanced and designed for use with 50 Ω systems.

Non-magnetic sealed tuning capacitors mounted adjacent to the coil on a low- loss dielectric substrate – either polyimide or teflon.

Fitted with double-shielded flexible rf line (Teflon or polyethylene) with BNC connector.

Passive or Active Detuning options for homonuclear experiments using a volume transmit coil.

A Remote Coil Matching Network (RCMN) is required. The RCMN (which functions over a range of frequencies) can often be used for several coils.

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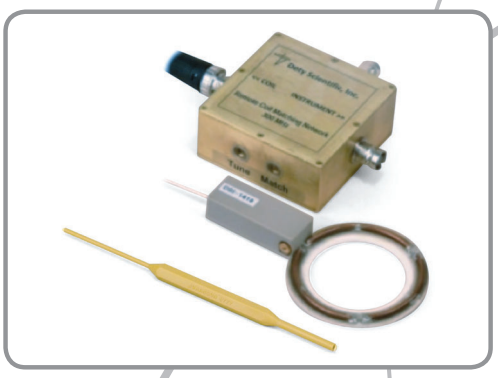
Coil Tuning Accessories



An actively detuned RCMN

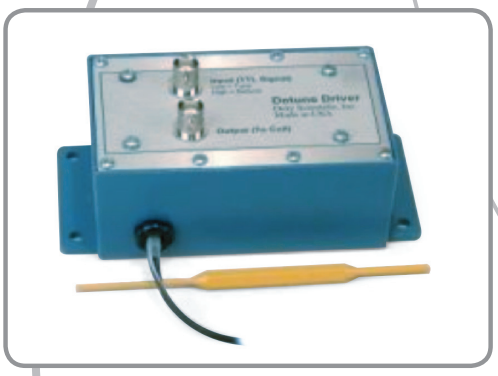
Remote Coil Matching Network (RCMN)

Part# 99648

Allows remote impedance matching and limited (2%) frequency tuning of surface coils. Specify high-range (above 200 MHz), mid-range, or low-range (below 80 MHz).

Remote Coil Matching Network for actively detuned coil.

Part# 99499



Detune Driver

Detune Driver

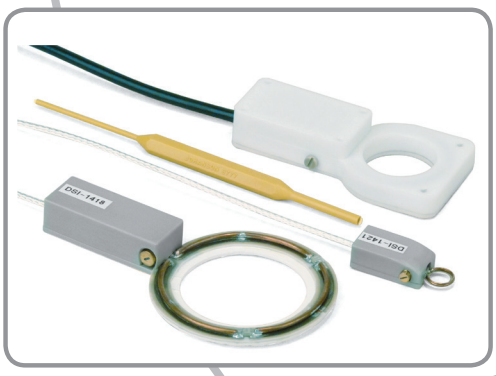
Part# 99477

For actively detuned surface or volume coil.
For driving detune circuit; accepts TTL pulse.
(Output + 15 V)

Dual Channel Detune Driver

Part# 95477

For driving detune circuit of 2 coils (surface and/or volume) simultaneously. Accepts TTL pulse.
(Output + 15 V)



Custom Surface Coils

Custom coils, larger sizes or with unique requirements

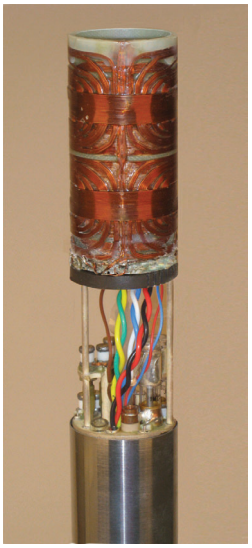
Please contact sales

Vertical Bore Imaging
3-Axes Gradient Probes
for High-Field MRI Microscopy

5 mm to 12 mm Imaging Probes

- Highest S/N
- 350 G/cm at 2.3% duty cycle, water cooled
- Quick, convenient, multi-X tuning
- For magnets up to 900 MHz
- 5, 8, 10, or 12 mm *RF* Coils

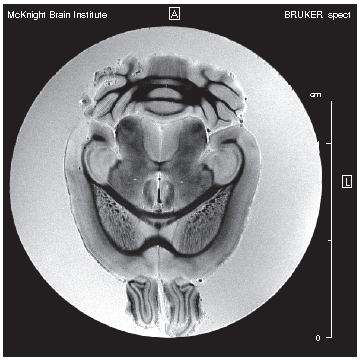
Our MRI probe is designed for high-field magnets with 40 to 72 mm inside the RT shims. The MRI probe includes the 26-40 gradient coil* and ^{1}H or ^{1}H/X, rf *Litz* coils. This probe is normally provided with conventional top "NMR-tube" access. The probe permits highest gradients at highest fields. Effectiveness of the litzcage coil can be seen in the 50 micron resolution of the mouse brain taken at 750 MHz and the mouse rat kidney images at 800 MHz.



NB MRI Probe with
26-40 Gradients and RF

Mouse Brain

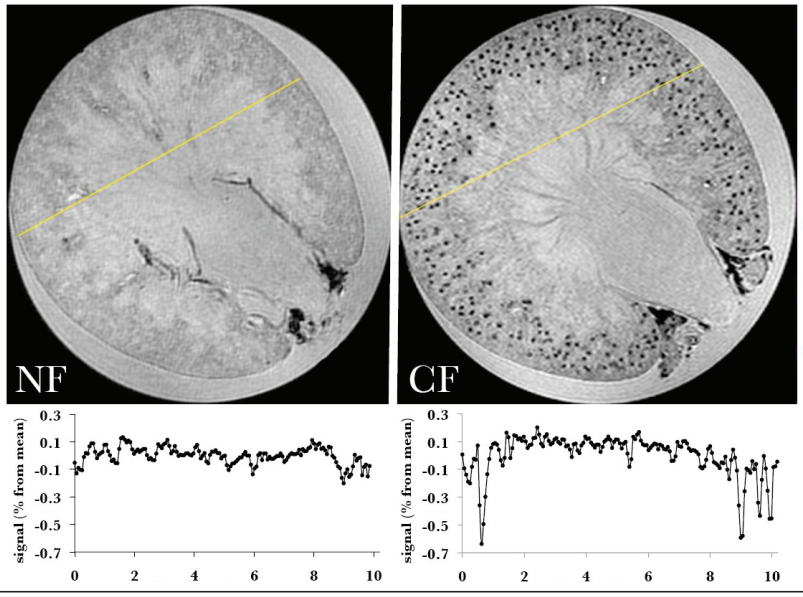
50-micron resolution
Using 21 mm CP *Litzcage* at 750 MHz inside a Doty vertical bore imaging probe. Courtesy of Dan Plant, Univ. of Florida.



Rat Kidney

High resolution images from a healthy rat kidney were acquired at 800 MHz, without contrast (NF), and with contrast (CF). The plot below each image shows the percent change in signal intensity (from mean) versus length, along the yellow line. Each spike on the plot under the contrasted kidney represents a single kidney glomerulus (100-150 µm diameter).

Images courtesy of Scott Beeman, Dr. Brian Cherry, Dr. Jeff Yarger, and Dr. Kevin Bennett, Arizona State University.



RF Litz Volume Coils For NB or WB Vertical Bore Probes

Probe O.D. (mm)	*RF* Coil I.D. (mm)	Shield Diameter (mm)	Tuning	^{1}H MHz	Mod. Load τ_{90}'s (µs)		Heavy Load τ_{90}'s (µs)	
					^{1}H	^{31}P	^{1}H	^{31}P
40-72	10	26	^{1}H/X	500	9	12	10	14
40-72	12	26	^{1}H	500	9	-	12	-
40-72	10	26	^{1}H/X	600	11	13	12	15
40-72	12	26	^{1}H	800	10	-	16	-

For the above coils, the length of homogeneous region is 80% of the coil ID. Coils with a multi-x channel normally tune ^{31}P through ^{13}C simply by changing plug-in capacitors. All coils feature simple tuning, high B_1 homogeneity, external *rf* shield, and susceptibility matching near the sample region. ***(For more Litz or Litzcage coils, see Appendix.)***

Small MRI 3-Axes Gradient Coils

All models feature active shielding and B_0 eddy current compensation.

✓Maximum Sample Volume ✓Low Noise and Vibration ✓High Continuous Gradients

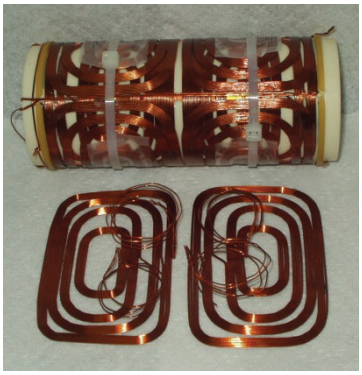
Advances in hardware for magnetic resonance imaging (MRI) are needed to improve image quality, ease of use, and functionality in high-field MRI research using small-animal models. Doty's MRI gradient coils fill this need.

Low-amplitude B_0 eddies are induced in the magnet radiation shields primarily from minute variations in coil diameters along the axis or from axial registration errors between the gradient and shield coils. Our use of alumina ceramic for both the gradient and shield formers allows higher precision to be maintained, and low-amplitude eddy current to be minimal. Ceramic coil forms, together with heavy Golay windings dramatically reduce vibration and noise, even at the highest fields. Any remaining B_0 eddy is compensated by a time-dependent correction applied to a B_0 shim coil. Another advantage of the alumina coil form is its very high thermal conductivity, which helps equilibrate hot spots. The cooling requirements are then satisfied with relatively minor constraints on the winding geometry.

Higher-order eddies are minimized by active shielding. Our coil designs often achieve a factor of 2 better shielding of the transverse gradients than alternative designs.

There is a strong benefit from gradient coil construction with an alumina ceramic coilform and multilayer windings. We significantly reduce acoustic noise, vibration, and recovery time, compared to gradient coils from other microscopy MR vendors.

Doty VB MRI Probes **Parameter**	**Model 26-40**	**Units**
Cooling method	water	
diameter (d_i) for 4% local deviation	14	mm
length (z_i) for 4% local deviation	17	mm
diameter (d_i) for 10% local deviation	18	mm
length (z_i) for 10% local deviation	22	mm
Nearest Gradient Null point	15.4	mm
Outside diameter, d_O	39.6	mm
Coil half-length, h_1	36.1	mm
RF shield diameter, d_S	26	mm
Clear bore, d_i	23.6	mm
Max inductance, L	37	μH
Max DC resistance, R_E	1.4	Ω
Min gradient gain, α	48	mT/Am
Max shielding error at 1.5 d_0	0.4	%
Min slew rate, G_S=αV/L, at 1 V	1,189	T/m/s
Continuous current, I_{RMS}	11	A
Continuous gradient, G_C	**53**	**G/cm**
Peak Voltage	120	V
Approx. EPI Acoustic Noise, 7 T	70	dBa
Rise time to G_C for 100 V	4.6	μs
Total mass	0.4	kg



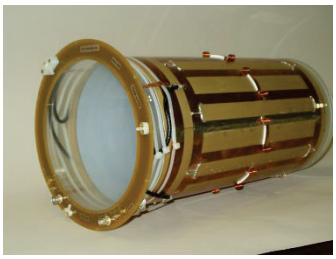
gradients partially assembled

Local deviation (or differential linearity) is defined as the rms deviation from the mean gradient over the specified diameter, d_i, and length, z_i, of the cylindrical sample region. The half-length h_1 is the distance from the center to the closer of the two external end surfaces. Eddy currents from the internal RF shield are negligible. The gradient slew rate G_S is the instantaneous rate of change in gradient when a 1 V step is applied. The continuous current ratings are *true* continuous ratings for a single axis with no time limit and adequate cooling. Derate the current 30% when all three axes are driven simultaneously.

Appendix

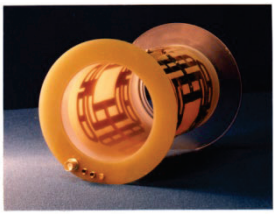
What are Litz and Litzcage RF Coils

What is a Doty RF Litzcage Coil?



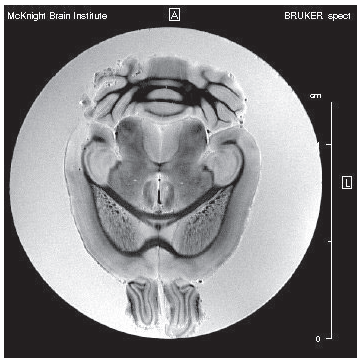
Doty *Litzcage* coils combine the Circular-Polarization (CP) of a *rf* birdcage coil and the insulated crossovers of the Doty *rf Litz* coil to produce a superior quadrature coil with easy tuning.

What is a Doty RF Litz Coil?



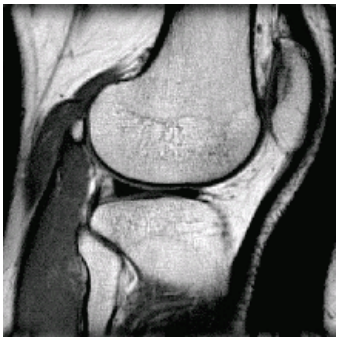
The *Litz* (woven) coil utilizes etched foil patterns with insulated crossovers to obtain *rf* flux transparency and improved S/N. Special symmetries permit an ideal current distribution that is largely independent of tuning, matching, and balancing adjustments. Homogeneity is excellent and tuning is simple.

How do Litz coils or Litzcages compare to Birdcages?

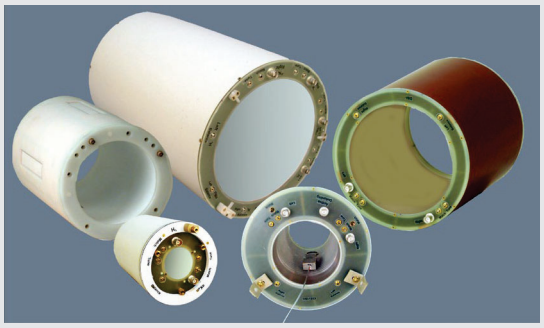


50-micron resolution. Mouse brain image, using 21 mm CP *Litzcage* at 750 MHz (inside a Doty vertical bore imaging probe). Courtesy of Dan Plant, Univ. of Florida.

- **Much Easier Tuning.**
  They easily tune and match to a wide range of samples.
  The *Litz* coil can be single-tuned or double-tuned.
- **B_1 homogeneity is typically 10-40% better.**
- **SNR is at least 10% higher – up to 30% higher.**
- **Substantial cost advantage.**



The T2 knee image was acquired at 3T with a 16 cm Doty *Litz* coil. Courtesy of Qing Yang, Ph.D. Hershey Medical Center. Hershev. PA.



RF Litz or Litzcage Modules

Surface Coils

Curved Surface Coil

Vertical Bore MRI Probe with 3 axis gradients and a *RF Litz* or *Litzcage* coil

Ordering Information

Probes Are Available for All Spectrometer Users

◆ **Bruker** ◆ **JEOL** ◆ **Tecmag** ◆ **Agilent/ Varian/ Chemagnetics**

◆ **Siemans** ◆ **GE** ◆ **Custom**

Pricing

- **<u>There is a $50 minimum per order.</u>**
- For probe prices, please request a quotation. This enables us to confirm prices and specifications.
- Shipping and handling charges will be prepaid and added to the invoice.
- **Pricing is for U.S. domestic sales and subject to change without notice.**
  Add 5% plus customs duties for Canada.
  Add 15% plus customs duties for foreign sales.

Volume Discounts For Rotors, Caps and Other Small Items		
Price Per Item	**Quantity Per Line Item**	**Discount**
under $ 100	4-9	10%
under $ 100	10 or more	20%
$100 - $ 400	4-9	10%
$100 - $ 400	10 or more	15%
$401 - $1000	4-9	5%
$401 - $1000	10 or more	10%

Doty Scientific Warranty Information

DSI warrants that its products will conform to the specifications quoted when used with reasonable care within specifications, and in conjunction with properly performing instruments, for a period of one year from the date shipped. Exceptions: (1) Rotors and turbine caps are not covered under warranty because rotors and caps may be damaged by IMPROPER handling. Please follow the instructions in your manual. (2) Probe VT components may not be covered under warranty unless the probe is used with a DSI VT controller. Products requiring service or modification may be returned with freight, insurance, and handling fees prepaid. DSI will return repaired products freight prepaid. DSI assumes no responsibility for the repair or modification of products not provided by Doty Scientific.

MasterCard and Visa Are Accepted

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