

DEAR COLLEAGUE:

We were pleased to have seen some of you over the last year. We are looking forward to seeing some of you at the ENC and telling you about the exciting advances we have made.

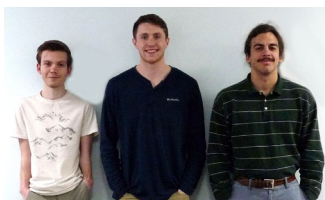
The road to solid state DNP includes **The Ultra Low Temperature (ULT) Probe** and significant advances in THz waveguides and Bidirectional overmoded THz couplers. We're excited about the progress.

We are happy to have added 3 new employees.

Left to right Dylan Harrell, Physicist; Jacob Martin, Engineering Physicist; and Revon Landreneau, Eng. Physicist Technician.

You can meet Jacob (Jake) at the ENC.

David and Judy Doty



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An MRI Customer's Observations

THz Laminate Lined Waveguides (LLWG) and THz Couplers

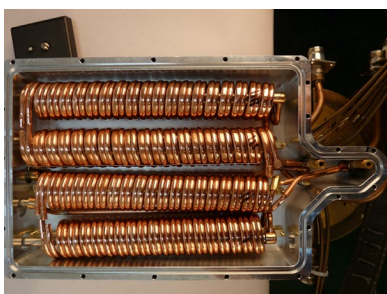
The Doty **ENC Suite** is "**Surf and Sand**".

Come by and learn more about these new products, see what else we do, and enjoy ice cream. Open 7:00 to 11:00 PM, Sunday through Wednesday.

Ultra Low Temperature (ULT) Probes

Doty's ULT Probes

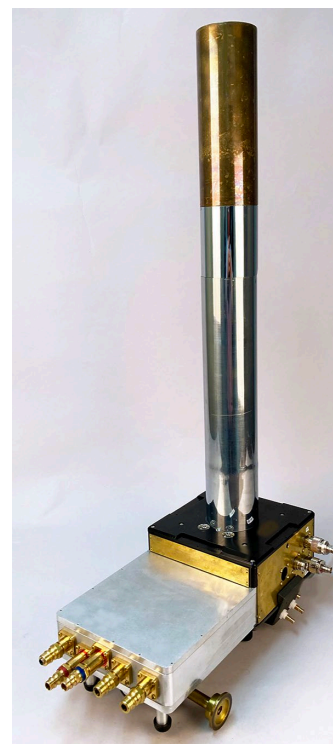
- **ULT probes, with or without DNP**
- **Revolutionary, Affordable, Routine**
- **High-efficiency H/X or H/X/Y RF up to 1100 MHz**
- **High-efficiency Microwave Cavity**
- **No special cryo-cooling system required!**
- **Works with standard liquid helium recycling systems**



Heat Exchanger in the Vacuum Base of the ULT Probe

Patent Pending

**WB ULT H/X/Y 500 MHz
3 mm Wideline Probe**



Rapid cool-down and warm up (~30 minutes)

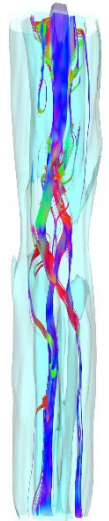
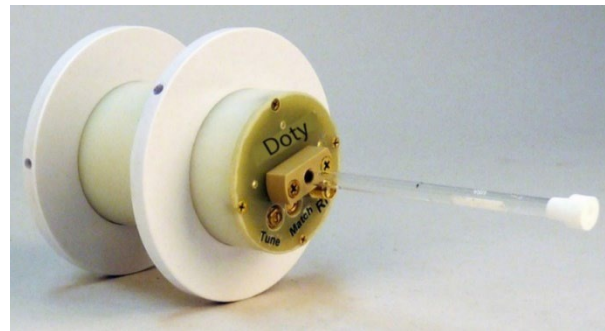
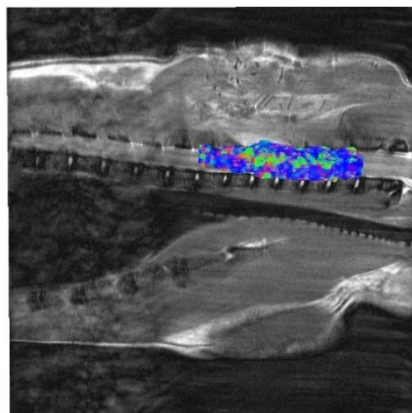
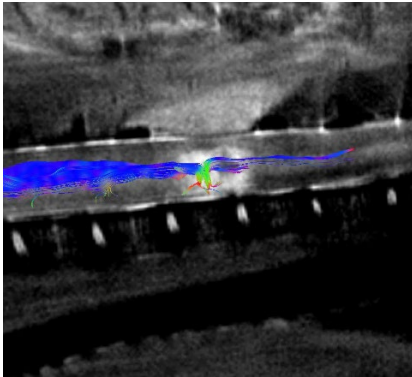
Requires only RT bearing and drive gas inputs, He or N₂

Single low-pressure coolant line – from standard liquid He or N₂ cryostat

Exhaust helium (coolant and spin gas) compatible with standard He recycling systems

MRI 7 T Rat Spinal Cord Studies: In vivo in a Doty 56 x 56 mm ¹H volume coil and ex vivo in a ¹H MRI Doty slotted resonator for a 5 mm sample tube.

A customer contacted us with a request to build custom coils for their studies on rat spinal cord, both in vivo and ex vivo, motivated by performance issues related to RF homogeneity and shielding exhibited in current OEM coils. A quadrature volume coil with 56 mm ID was constructed for the in vivo imaging (on awake or mildly anesthetized rats), and was utilized at the study onset. The volume coil's excellent sensitivity made it possible to generate high resolution DTI images of an injured spinal cord in vivo, with weekly scanning to monitor treatment progress. When treatments ended, it was desired to image an excised cord, with smaller FOV to visualize more specific spinal tracts. High S/N and excellent B1 homogeneity were top priorities. To meet this goal, a Doty slotted resonator (one-turn saddle coil) was used to construct a small coil for the spinal cord contained in a 5 mm NMR tube.



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

Both coils were tuned to ¹H, for use with a 7 T small animal imaging system. Images were processed with DSI Studio software (Fang-Cheng (Frank) Yeh, Dept of Neurological Surgery, University of Pittsburgh).

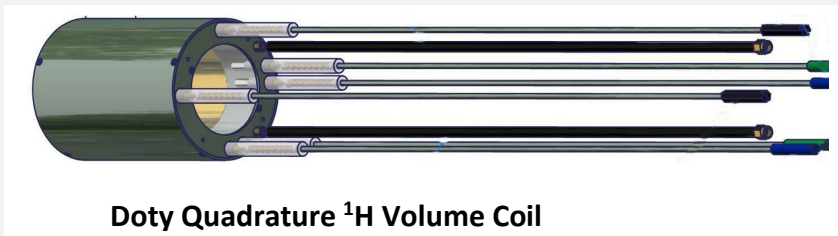
In-vivo DTI of rat spinal cord from a DOTY 56 mm quadrature coil, 7 T. In-plane resolution of 0.44 mm. Showing contused spinal cord injury (top left) and after seeding a specific tract to visualize the status of the injury (bottom left). Treatment progress can now be monitored in vivo.

From Laboratory of Dr. Prodip Bose; Malcom Randall VA Medical Center, Gainesville, FL.

A MRI Customer's Observations:

"The tuning was spot on. It is actually pretty amazing. Normally you only see these high-Qs in high-resolution probes. I have perfect match on both channels to 50 ohm on my network analyzer. The balance is 35dB and is a normal looking peak with only one maximum. If I swap the cables, I get nothing...perfect isolation.

The tuning wands work very well. I had a rat in the magnet on the network analyzer and was able to optimize all capacitors. I do not see any of the stray RF interference I was seeing on my other coil. The B1 as measured by a 50ml falcon tube is pretty nice. Very uniform response."

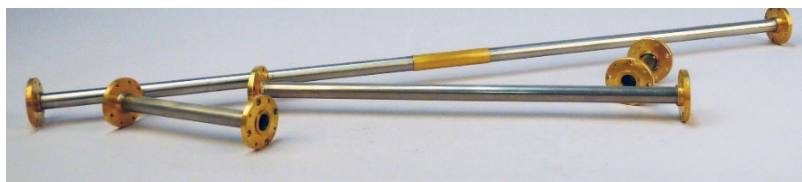


Doty Quadrature ¹H Volume Coil

THz Laminate Lined Waveguides (LLWG), and THz Couplers

Developing Microwaves for DNP Resulted In Some Exciting New Microwave Products

The LLWG: A Low-loss, Low-cost, Small-diameter THz Waveguide for MAS-DNP



- The most significant advance in waveguides for the 70-1500 GHz range in half a century.
- Achieves loss more than two orders of magnitude below that of fundamental-mode waveguides at 400 GHz.
- Loss comparable to that of corrugated waveguides of similar size but much more manufacturable at small diameters.
- The LLWG shows low loss over an even wider bandwidth than the corrugated waveguide.

The novel Laminate-Lined Waveguide (LLWG) is being integrated into a MAS probe for DNP that includes a high-mode THz cavity compatible with MAS and is expected to permit routine low-cost operation below 15 K. For several years we have been working, *and are making major progress*, toward enabling high-field ULT MAS-DNP in NB magnets at low cost using solid-state sources. Come by the Doty suite and we'll tell you more.

Patent pending.

Bidirectional Overmoded THz Couplers

A low-loss bidirectional HE₁₁ coupler is being developed with substantially higher directivity than prior HE₁₁ THz couplers for overmoded waveguides operating in a frequency band centered about f_0 , where f_0 is between 0.03 to 1.5 THz, with mid-band free-space wavelength λ_0 .

Patent Pending

Doty ENC Suite: Surf and Sand *(Ice Cream)*

Open 7:00 to 11:00 PM - Sunday through Wednesday