DOTY SCIENTIFIC

The Resonator

NMR - MRI Newsletter Spring 2025

DEAR COLLEAGUE:

It has been a busy year. We may have seen you at last year's ENC at Asilomar or IMS in Washington DC. Maybe in Colorado for the Rocky Mountain conference or in Atlanta for SEMRC.

Along with building NMR probes and MRI coils, exciting advancements continue in our Switched Angle Spinning (SAS) and Ultra Low Temperature (ULT) NMR Probe developments. We are excited about our new No-E two-coil XVT NMR probe – available up to 1300 MHz.

We have impressive images from a unique MRI coil for mouse body or rat brain which was delivered to the Weizmann Institute just before the ENC last year. The high field strength, **15.2 T**, and tight spacing (59 mm OD with two coils and a 36 mm ID) made this dual-frequency coil quite challenging. The coil was used to study pregnant mice.

We look forward to seeing some of you at the ENC/ISMAR and telling you about the exciting advances we have made.

David and Judy Doty

In This Issue

The Doty ENC Suite is "Surf and Sand".

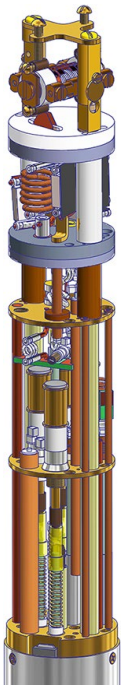
Come by and learn more about these new products, see what else we do, and enjoy ice cream. Open 7:00 to 11:00 PM Sunday through Wednesday. See the map at the end of this newsletter.

A 1200 MHz, No-E two-coil, XVT NMR Probe

The 1200 MHz, 5 mm ^{1}H-^{19}F/X/Y probe shown here is Wideline, but MAS is also available

- **High Performance Triple Resonance Circuit ^{1}H/X/Y or ^{1}H-^{19}F/X/Y with the proton channel tunable from ^{1}H to ^{19}F**
- **Outer No-E ^{1}H Coil for ^{1}H decoupling, and an inner solenoid for the X and Y broadband channels**
- **Extended VT (XVT)**
  -170 to +180°C for Wideline
  -160 to +180°C for MAS
- **1.3 mm to 5 mm for Wideline**
  3 mm or 4 mm for MAS
- **Two broadband channels with appropriate inserts**

Technical details will be presented at the ENC poster session.



MRI ^{1}H and ^{2}H Results from a 15.2 T Mouse Coil with H-F/X tuning. The X channel is multinuclear.

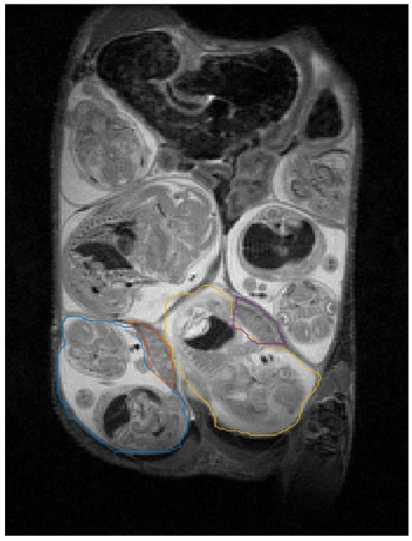
^{1}H and ^{2}H Imaging on a Dual-Frequency ^{1}H-^{19}F/X Mouse Volume Coil - for a 15.2 T scanner with a 6 cm bore**.** The high frequency (650 MHz ^{1}H) and multinuclear X channel enable imaging on low gamma nuclides with good S/N. A 36 mm ID x 35 mm FOV allows surface coil receive, when desired. 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

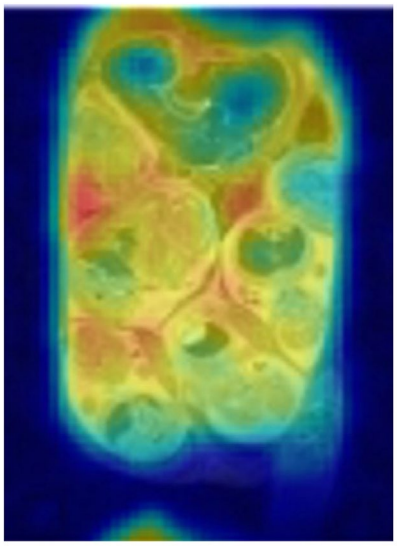
Outer ^{1}H-^{19}F Coil

Finished Coil, 15.2 T, H-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). RARE acquisition, 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 pregrant 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

Technical details will be presented at the ENC poster session.

Switched Angle Spinning (SAS) Probe Updates

Recent Testing of a Doty SAS Probe

The ^{1}H/X/Y probe has a ^{1}H channel and two broadband channels X and Y.

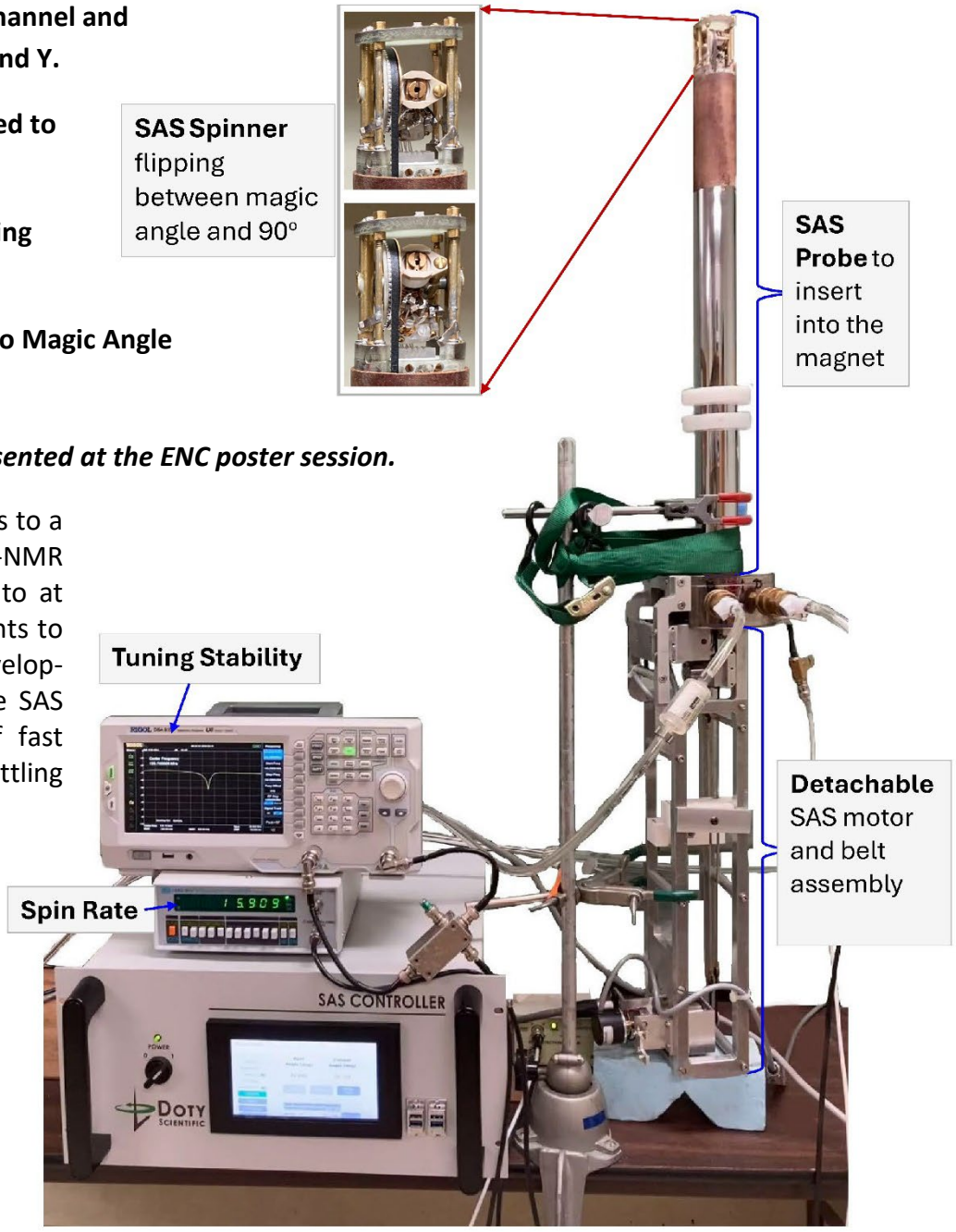
The 500 MHz probe was tuned to ^{1}H/^{13}C/^{15}N.

The 4 mm sample was spinning 15.9 KHz.

Flipping precisely from 90° to Magic Angle in 15 ms.

Technical details will be presented at the ENC poster session.

We'll report on optimizations to a triple-resonance H/X/Y SAS-NMR circuit for higher fields (up to at least 800 MHz); improvements to probe mechanics, and development of a high-performance SAS angle controller capable of fast accurate flipping and settling within 0.1° in 15 ms.



The Ultra Low Temperature Probe (ULT) DNP Cold Probe

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

Patent Pending

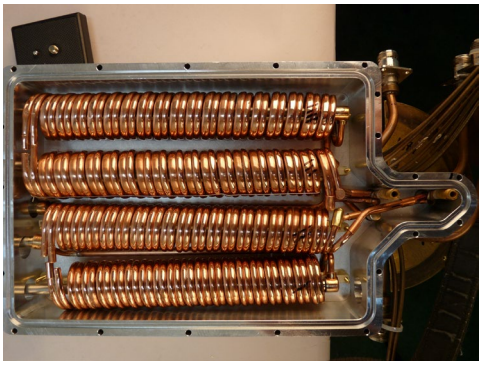
Doty's ULT probes

- **ULT probes, with or without DNP**
- **Revolutionary, Affordable, Routine**
- **High-efficiency ^{1}H/X or ^{1}H/X/Y RF up to 1200 MHz**
- **High-efficiency Microwave Cavity**
- **No special cryo-cooling system required!**
- **Works with standard liquid helium recycling systems**

Requires only RT bearing and drive gas inputs, He or N_2
Single low-pressure coolant line – from standard liquid He or N_2 cryostat
Exhaust helium (coolant and spin gas) compatible with standard He recycling systems

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

Heat Exchanger in the ULT Base



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

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