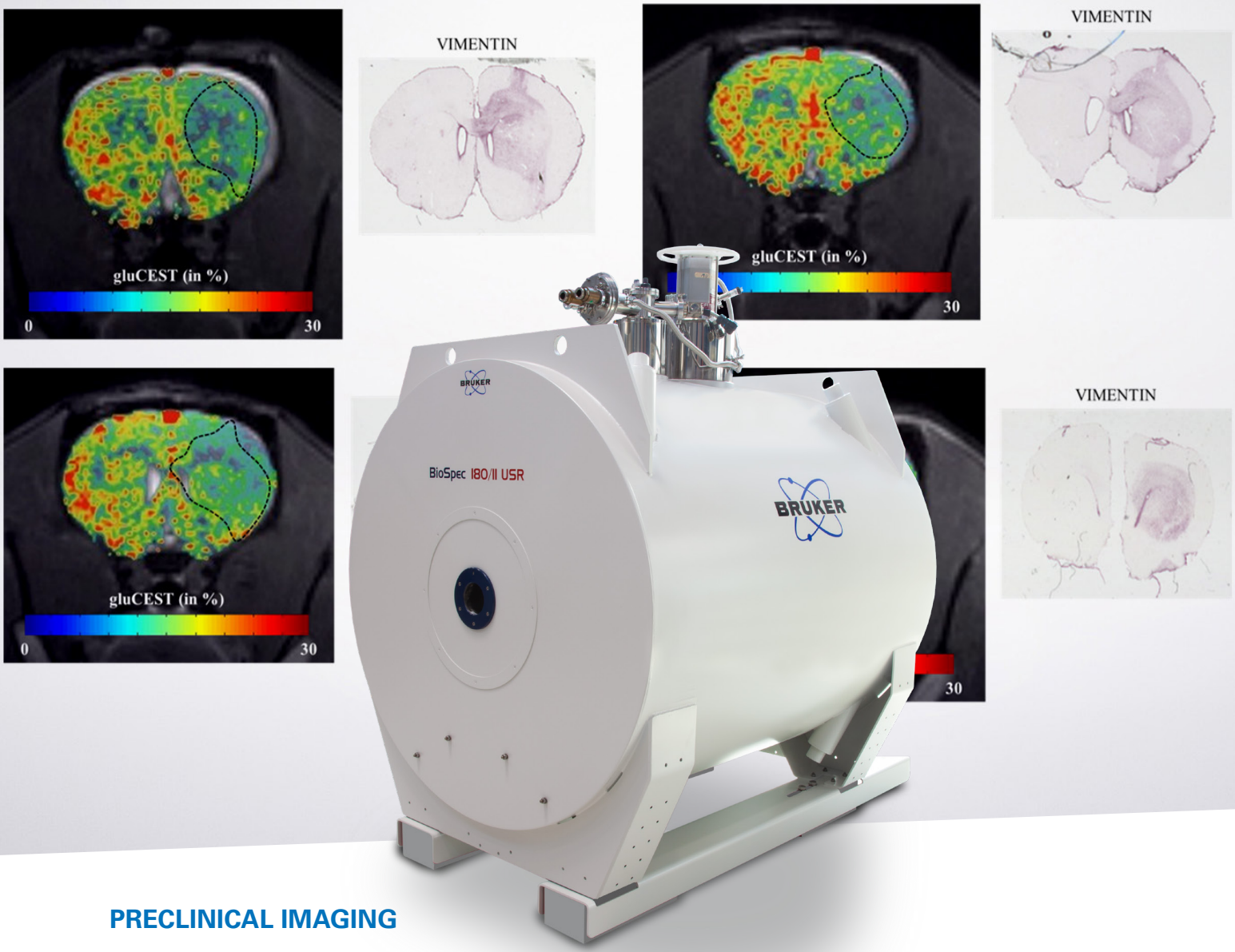


PRECLINICAL IMAGING

BioSpec Ultra-High Field

A Whole New World of MRI - 11.7 Tesla to 18 Tesla

Innovation with Integrity

The Height of MRI Science

MRI research plays a great role in the development of treatments for a multitude of diseases. This is due to the advanced understanding of these diseases and this understanding is constantly deepened as we delve further into the miniscule elements of life.

With the advent of ultra-high field MRIs, scientists are just beginning to shed light on the illusive interplay of the complex structure and function of organs and tissues.

Become a part of this new era of discovery.

Prof. Lucio Frydman

Weizmann Institute of Science, Rehovot, Israel

Among the ten challenges put forth by the US National Science Foundation, none is as appealing as "Understanding the Rules of Life". How do the basic blocks of chemistry and biochemistry come together in the genesis of life? How do they define what is health and what is disease? By allowing us to peer into chemical and physiological processes non-invasively and as they happen within cells, tissues, animals and humans, the advent of ultrahigh field magnetic resonance will play a transformative role in answering these questions.

A Whole New World of Understanding

Make this new world your own and embrace the excitement that your discoveries bring.
Join the elite group of scientists that are pioneering this journey to understand neuronal networks and activity with absolute highest resolution. That are investigating brain architecture and aberrations at a level that has never been seen before. That are gaining a greater understanding of not just the individual components of the brain, but the interactions and interplay between them. That are exploiting the physical effects of ultra-high field in vessel and cancer imaging. That are shedding a new light on metabolic processes. That are going beyond conventional proton MRI to better understand muscular dystrophy and heart failure.

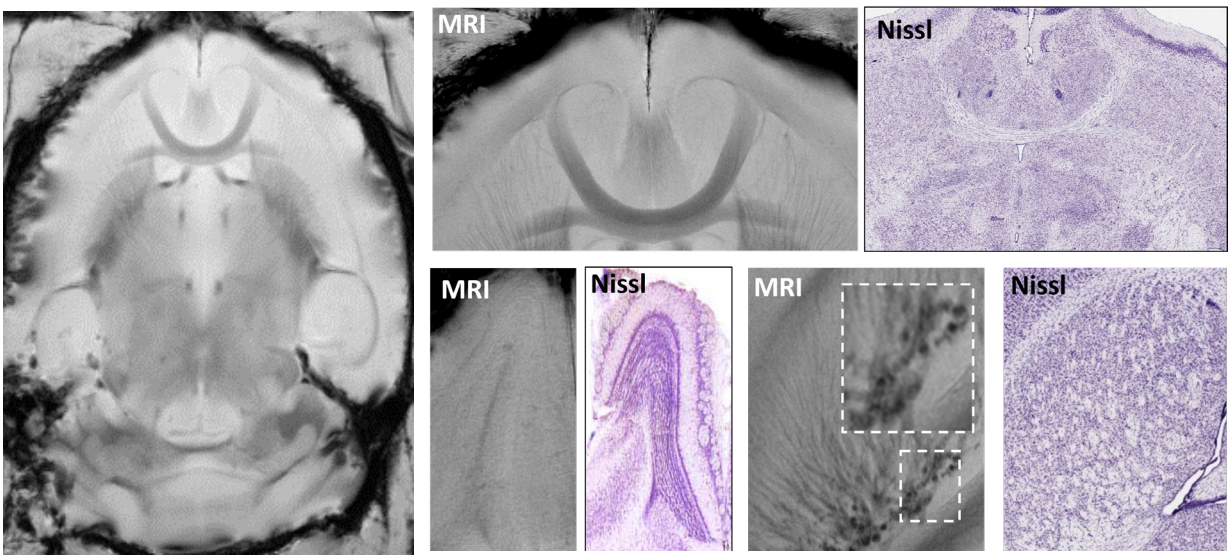
And that are making discoveries that even they did not expect.

Join this quest to go beyond and be the driver of science.

Dr. Noam Shemesh

Champalimaud Center for the Unknown, Lisbon, Portugal

We are very excited to explore the full potential of the 18T MRI system, and to advance our understanding of biological mechanisms underlying healthy and diseased conditions. … to facilitate investigations into microstructure and metabolism dynamics in the brain, as well as in cancer … for answering fundamental questions in biology.



High resolution imaging at 18T

10 µm in plane resolution *ex vivo* mouse brain images acquired with BioSpec 180/11. Top right: anterior commissure; bottom middle: olfactory bulb; bottom right: striatum.

Nissl histology images from http://www.brainmaps.org/

Enhance Your Scanning Capabilities

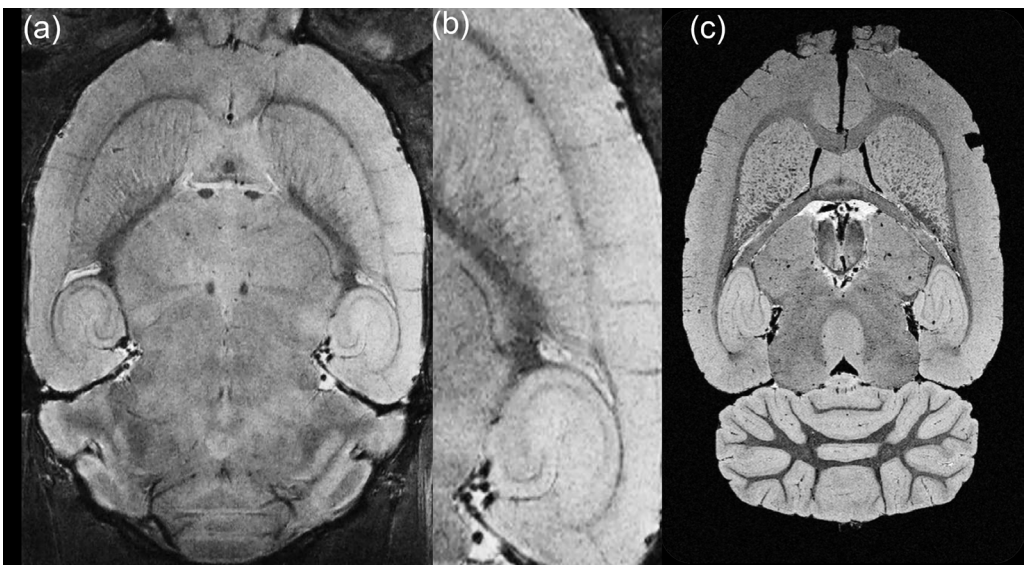
With a signal to noise ratio (SNR) that increases super-linearly with field strength, the extreme sensitivity of ultra-high field MRIs enables a resolution that makes sub-structural preclinical investigations possible. This power is contained in the ultra-high field magnet platform the encompasses the BioSpec 117/22 and reaches its pinnacle with the BioSpec 180/11, the highest commercially available horizontal preclinical MRI. This platform also allows expansion to other instruments, such as a BioSpec 152/17 which is planned for use with mice and rats and will be the choice instrument for these models.

Ultra-high field MRIs are a class of their own. With engineering that is only made possible by reigning the strength of superconducting wire beyond conventional NbTi to use Nb3Sn, this height of technology enables *in vivo* studies to be performed with µm resolutions. It is even further enhanced with optimal RF coils, such as receive array coils, which present temporal acceleration capabilities, or the MRI CryoProbe, which provides an even additional sensitivity boost. Furthermore, gradient strengths up to 1000 mT/m and slew rates of 9000 T/m/s enable you to maximize both spatial resolution and the imaging speed to realize the full potential of your studies.

Prof. Kamil Uğurbil

Center for Magnetic Resonance Research (CMRR) at the University of Minnesota, Minneapolis, MN, USA

Ultrahigh fields enable unprecedented spatial resolutions, permitting for the first time access to mesoscopic scale information. To realize their full potential, ultrahigh magnetic fields must be matched with advanced hardware (RF coils and gradients) and image acquisition and reconstruction methods.



High resolution morphology imaging of mouse and rat brain. (A –B) Mouse brain RARE image with (29 × 29 × 200) µm³ resolution. BioSpec 152/11 with MRI CryoProbe. (C) Fixed rat brain imaged with 3D FLASH with 33 µm³ isotropic resolution. Extreme scanning stability with BioSpec 152/11 for over 6 hours.

(C) courtesy of N. Kelm University of Vanderbilt, Nashville, USA

Widen Your Scope of Applications

This technology instrumentation all combines to facilitate investigations of biological questions via varied methods such glucose metabolism of tumors measured via deuterium metabolic imaging (DMI) or Alzheimer's disease plaque imaging with ^{1}H coupled with studies of altered cellular oxygen metabolism via ^{17}O.

Metabolic defects in neurodegenerative diseases such as Huntington's disease can monitored via Glutamate Chemical Exchange Saturation Transfer (GluCEST), which benefits from an additional attribute of ultra-high field, namely increased spectral dispersion. Metabolic studies via magnetic resonance spectroscopy also profit from this increased chemical shift enabling studies on neurodevelopmental diseases.

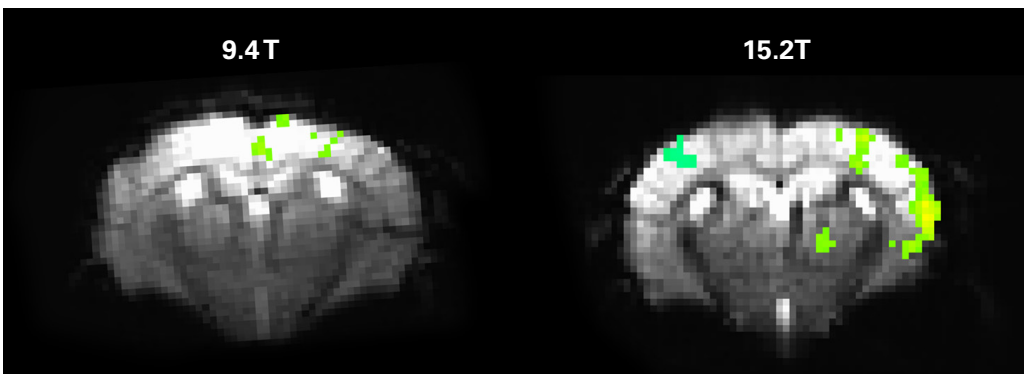
Additionally, the prominent field of functional MRI (fMRI) capitalizes on increased susceptibility effects that translate into greater observable Blood Oxygen Level Dependent (BOLD) signal changes enabling more refined stimulation paradigms. Higher susceptibility effects combined with a high SNR benefit Quantitative Susceptibility Mapping (QSM), which can be used to study microvasculature in animal stroke models.

These improved experimental conditions open unique approaches to answering biological questions and forging forward with new insights.

Prof. Seong-Gi Kim

Sungkyunkwan University (SKKU), Suwon, Korea

The most important role of ultrahigh magnetic field for my lab is to obtain ultrahigh resolution fMRI by enhanced SNR and BOLD contrast.



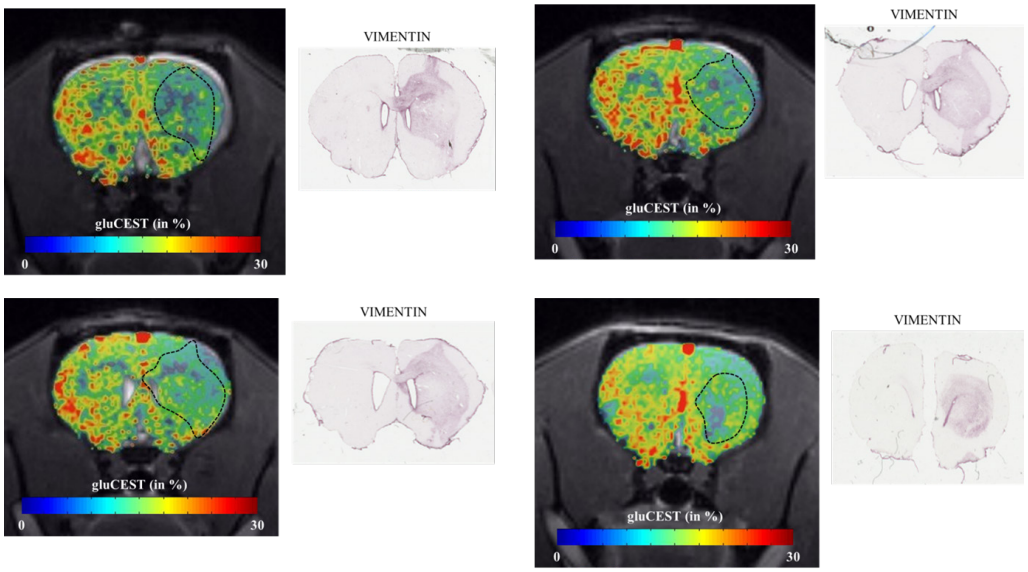
Enhanced functional sensitivity at higher fields. Mouse forepaw stimulation EPI fMRI images demonstrate a 2x higher sensitivity at 15.2 T as comparted to 9.4T. BioSpec 94/30 and BioSpec 152/11

Courtesy of SG. Kim Sungkyunkwan University (SKKU), Suwon, Korea

Expand Your Model Range

To make full use of these techniques to address the most applications, appropriate models are necessary. The Bruker ultra-high field MRIs are designed to accommodate the widest range of preclinical models.

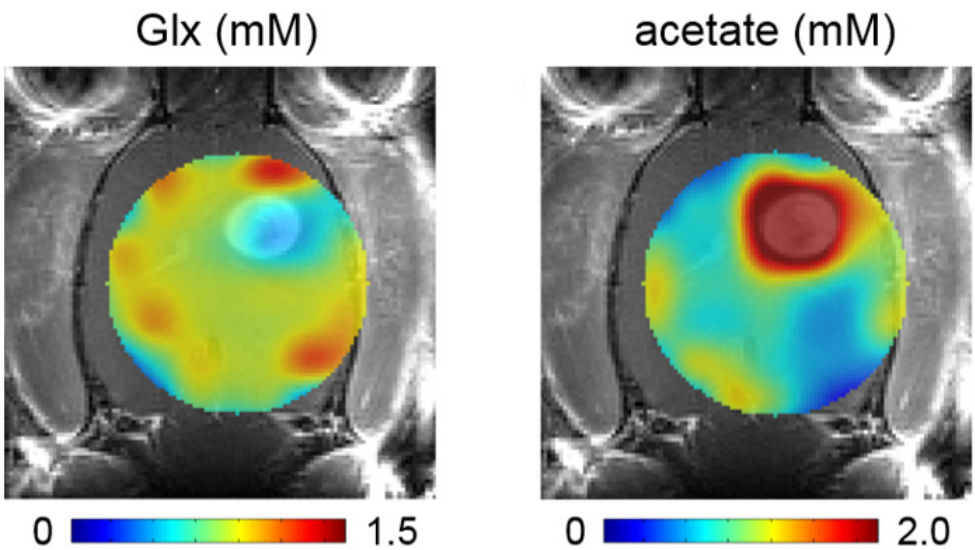
With its full range of murine coils, the BioSpec 180/11 enables all mice studies. In addition to mice, rats, which are more stable, also provide reliable models for a multitude of diseases as well as demonstrating more complex cognitive skills and behaviors, which benefits neuroscience studies. A rat head coil for 18 Tesla as well as a variety of brain, head, body, and cardiac coils for the BioSpec 117/22 enable ultra-high field research on this important model.



Astrocyte activation area indentification in rat model

Lower glutamate levels in striatum displaying activated astrocytes as compared to control striatum detected via GluCEST. BioSpec 117/16

Courtesy: J. Flament, C. Escartin et al., Carillo-de Sauvage MA, JCBFM 2015 , MIRCen, Fonte-nay-aux-Roses, France



Glioma metabolism

Deuterium metabolic imaging (DMI) via 3D ^{2}H MRSI after [$^{2}H_{3}$]-acetate infusion in a rat glioma model reveals high uptake and limited oxidation of acetate. 11.7 Tesla

Courtesy: H. De Feyter and R. de Graaf, Yale University, USA
Science Advances, Vol. 4, no. 8, eaat7314.

In addition to small rodent coils and cradles, the BioSpec 117/22 is available with cradles for small or medium size marmosets. With an anatomical and functional brain structure that that is closer to the human brain than rodent brains are, and the possibility for genetic engineering to model neurodegenerative diseases such as Alzheimer's disease, marmosets play a significant role in neuroscience studies.

Imaging of awake behaving marmosets can be achieved with training and use of the medium marmoset cradle and its corresponding accessories. This cradle can be used in conjunction with a reward system as well as a restrainer for stabilization of the marmoset head and body. The restrainer can be used in combination with ear bars or customer helmets.

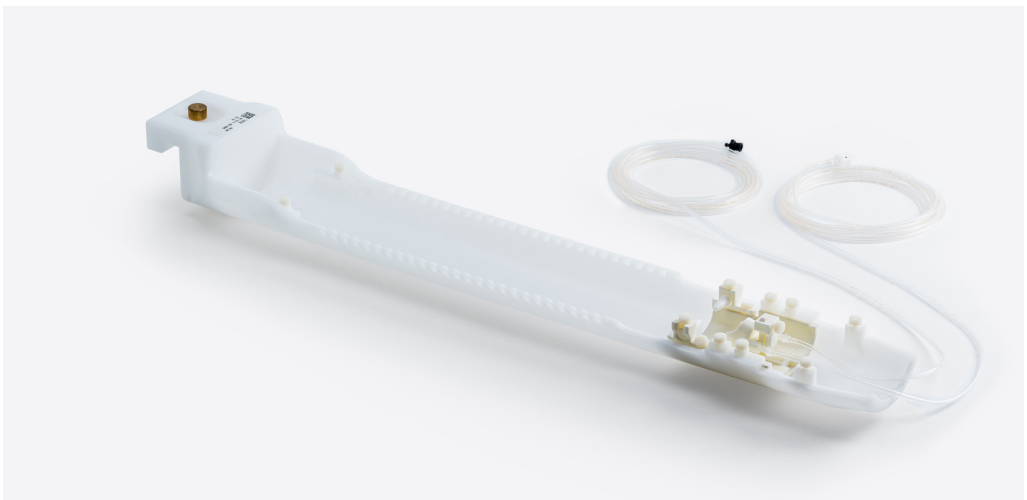
The new imaging fields made possible via the ultra-high field BioSpec instruments can be complimented with the best of your method ingenuity, due to the flexible hardware and software architecture that further open unique research options.

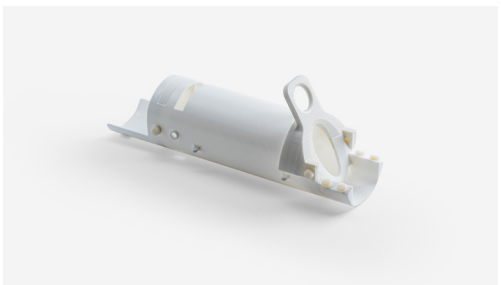
Take the power and flexiblity of the BioSpec ultra-high field instruments to create your own new MR imaging directions.

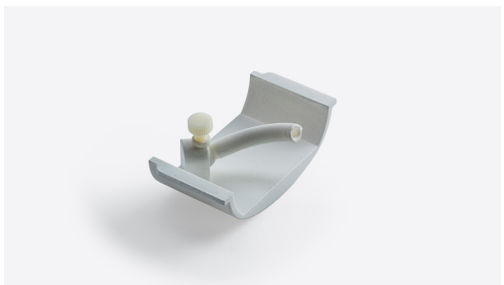
Dr. John Sled

Hospital for Sick Children, Toronto, Canada

The magnet design is excellent. We appreciate having a best-in-class console implementation and sequence library for preclinical imaging







Marmoset imaging cradles and accessories
Open marmoset cradle for medium size marmosets as well as restrainer for stabilization of marmoset head and body, and reward system.

- Revolutionary superconducting wire use enables realization of field strengths of 11.7 T and beyond
- Bore sizes of 22 cm at 11.7 T and 11 cm at 18 T to enable applications on most relevant models
- MRI CryoProbe takes the Ultra High Field sensitivity even further
- Specially designed array coils for accelerated scanning
- Best performance gradients to meet highest demand scanning
- AV Neo electronics for greatest accuracy and fastest scanning
- ParaVision 360 for advanced scanning and analysis
- ParaVision method development platform for individual study design

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