



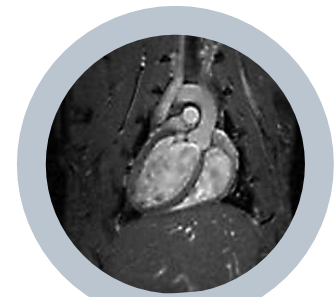
# BioSpec

- Innovative Animal MRI Solutions for Molecular and Preclinical Imaging

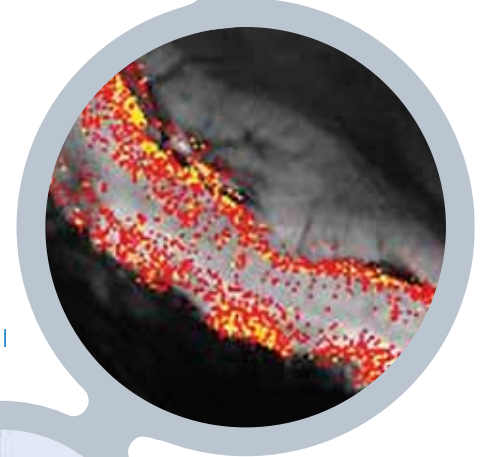
# Molecular and Preclinical Imaging

The BioSpec® series is designed for the emerging market of preclinical and molecular MRI. State-of-the-art MRI CryoProbe™ technology together with ultra high field USR magnets deliver high spatial resolution *in vivo* enabling customers to come closer to the molecular and cellular level research they desire. Thanks to its innovative modular concept, virtually any small animal MR imaging application in life science, biomedical and preclinical research can be conducted. Whatever your application is, the BioSpec series will deliver the optimum solution, will perfectly equipping you for the most demanding tasks and challenges.

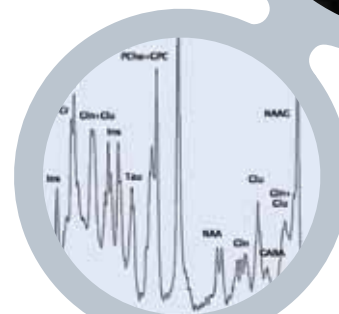
BioSpec benefits from the excellence of Bruker BioSpin, the global market and technology leader in analytical magnetic resonance instruments including NMR, preclinical MRI and EPR. The company delivers the world's most comprehensive range of magnetic resonance research tools enabling life science, materials science, analytical chemistry, process control and preclinical research. With an install base of over 500 MRI systems worldwide and more than 40 local Bruker offices on all continents, you can rely on our long term expertise and dedicated after sales support.



Cardiac MRI



fMRI



MRS

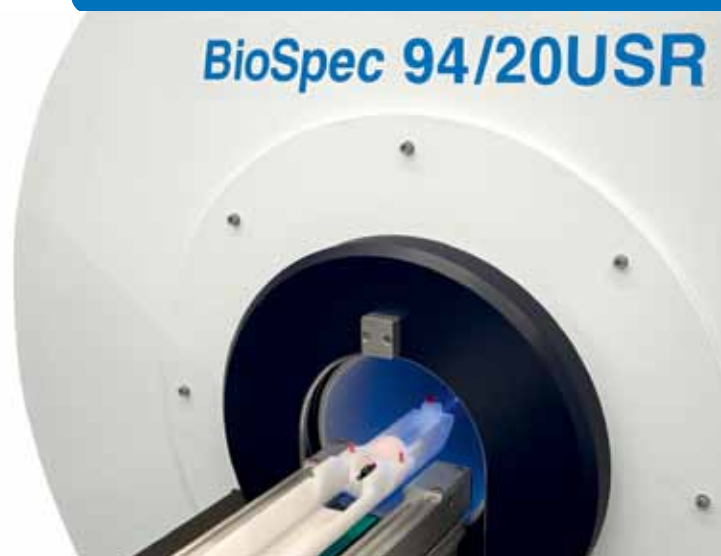
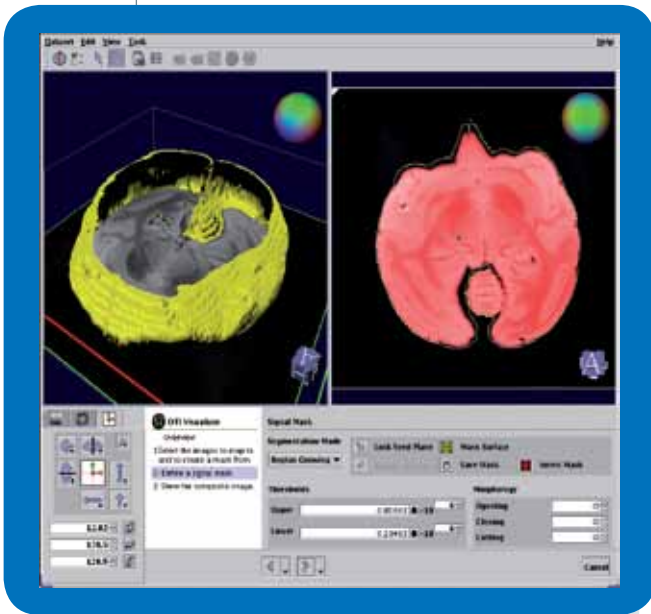
Anatomy



DTI

## Standard Product Features

- High end UltraShield™ Refrigerated (USR) magnet technology at field strengths from 4.7 up to 11.7 Tesla for unsurpassed sensitivity in small animal MRI
- A wide range of bore sizes between 16 and 40 cm for investigations on all animals of relevance in preclinical imaging
- Helium zero-boil-off and Nitrogen free magnet technology for reduced maintenance costs and longer service intervals
- Scalable AVANCE III RF architecture incorporates up to 16 receiver and 6 transmitter channels
- Parallel imaging (GRAPPA) for almost all applications including EPI
- Multiple transmit imaging applications
- High performance BGA-S gradients with highest amplitudes and slew rates, shim strengths, and duty cycles optimized for high field MRI
- AutoPac: Motorized and software controlled animal positioning system for routine handling and increased throughput
- IntraGate™ - Self gated steady-state cardiac imaging (no external sensor hardware and triggering devices)
- Phased-array RF coil technology for maximum sensitivity and minimum scan times
- MRI CryoProbe™ delivers an exceptional increase in sensitivity by 150 %
- ParaVision® - Intuitive user interface, for multi-dimensional MRI/MRS data acquisition, reconstruction, analysis and visualization



# Advanced Technologies

## Magnets

BioSpec benefits from Bruker's expertise in designing and manufacturing ultra-high field superconducting magnets. Field strengths are available at 4.7, 7, 9.4 and 11.7 T. The bore sizes range from 16 to 40 cm. Easy and cost efficient siting is guaranteed by minimum stray fields and compact magnet design. Active helium refrigeration and nitrogen-free cooling provides zero boil-off for reduced maintenance costs and increased service intervals.

## Gradients

The high performance BGA-S™ gradient series delivers unsurpassed slew rates up to 15000 T/m/s and gradient strengths up to 1000 mT/m. Integrated shim coils enable optimal field homogeneity even at the highest magnetic fields. Their dedicated cooling design results in unique duty cycle specifications for high end fMRI applications. Gradients can be used as inserts and due to automatic hardware recognition they are easily exchangeable.

## Spectrometer

The fully broad banded platform AVANCE™ III enables MRI applications on protons as well as all other kinds of X-nuclei. Its scalable architecture provides up to 16 parallel receiver and up to 6 parallel transmitter channels. AVANCE III includes real time spectrometer control for the optimization of acquisition parameters during scanning. The digital preemphasis and digital RF generation ensure a highly precise realization of the experiment.



## RF Coils

Volume resonators at a wide range of diameters ensure maximum signal-to-noise and RF homogeneity. Active RF decoupling allows the flexible combination of up to 4 independent transmit and receive coils. Multi-channel array coils enable parallel imaging applications. Integrated preamplifiers guarantee optimal sensitivity over a large dynamic range.

## MRI CryoProbes

This unique innovation delivers an increase in sensitivity by 150 % compared to standard room temperature RF coils. This results in even higher spatial or temporal resolution and shorter scan times. Cold surface contact with the animal is eliminated by a special patented provision.

## MRI/MRS Acquisition and Processing Software

ParaVision® software offers all state-of-the-art MR imaging and spectroscopy techniques and a rich palette of image evaluation and visualization tools. Application oriented ready-to-use protocols and automatic adjustments enable routine workflow. Automatic hardware recognition increases efficiency and animal throughput. Parallel imaging in combination with Half-Fourier encoding is available for almost all acquisition techniques. Rapid prototyping of user-defined experiments is supported by a powerful developer toolbox.

## Animal Handling and Monitoring

AutoPac, the automatic positioning system simplifies animal handling. A variety of animal beds tailored for different animal species, applications and RF coils are available. They feature anesthesia and fixation devices including body temperature stabilization. Corresponding monitoring units detect the main physiological signals (ECG, respiration, temperature, and IBP) which can also be used for triggering.



# Morphology

## High Resolution Neuroanatomy

The combination of ultra-high magnetic fields with latest RF array coil and spectrometer technology delivers morphological imaging at outstanding quality. High spatial resolution enables the screening of microscopic structures. Optimized imaging techniques deliver excellent contrast even at very high magnetic fields.



## Rat Brain at 11.7 T

Rat brain imaging on a BioSpec 117/16 USR system. The field strength of 11.7 T delivers high resolution images at 50  $\mu\text{m}$  in plane resolution with excellent contrast.



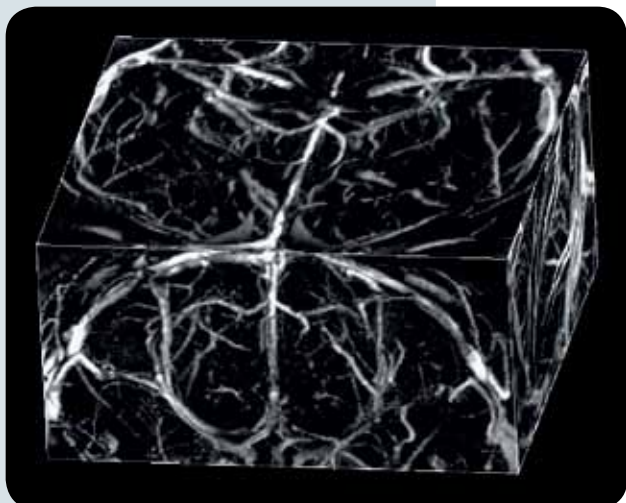
## Mouse Brain using MRI CryoProbe™

The 150 % SNR increase obtained with the MRI CryoProbe at 9.4 T enables the identification of fine anatomical structures down to the cellular level in the mouse brain (e.g. granular layer, Purkinje cell layer).

## Mouse Abdomen

T2 RARE whole body mouse imaging with excellent contrast in an animal model of autosomal dominant kidney disease.

Courtesy: D. Elverfeldt, B. Kreher, J. Hennig et al., University Hospital Freiburg, Germany.

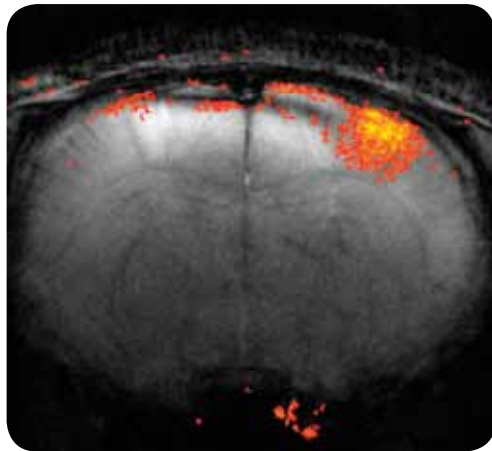


## Angiography

Time-Of-Flight angiography with no contrast agent at high spatial resolution showing excellent contrast enabling the identification of fine vascular structures.

# Functional MRI

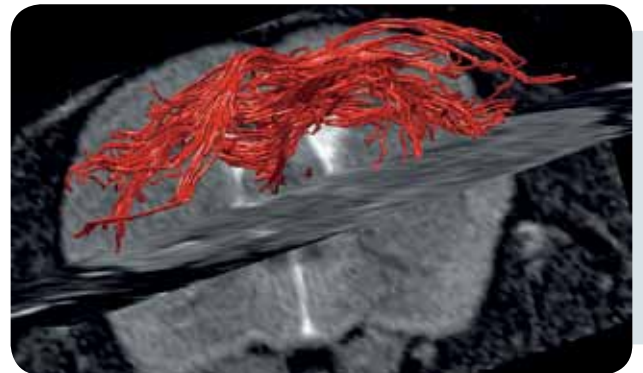
Functional MR Imaging requires highest magnet and gradient performance in combination with maximum system stability. Our gradient systems allow to collect whole brain image data sets in a single shot. Excellent shim performance delivers minimum geometrical



## High Resolution fMRI

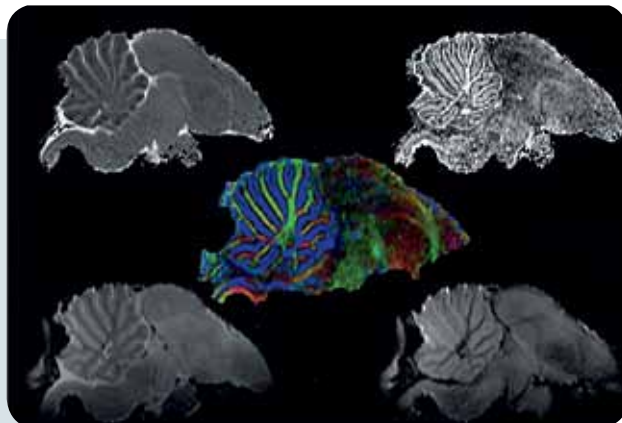
High resolution fMRI at ultra high fields of 11.7 T provides detailed insight into brain function. Exceptional gradient performance based on high gradient strength and ultra short switching times ensure maximum temporal and spatial resolution. Courtesy: A. Silva, NIH, USA.

distortions even when using echo planar imaging techniques. Unique frequency and phase stability enables even segmented diffusion tensor imaging with EPI.



## Fiber Tracking

Fiber tracking in the mouse brain enabled by diffusion tensor multi shot EPI. The images were acquired at 9.4 T at a spatial resolution of  $200 \times 200 \times 400 \mu\text{m}^3$  using 17 encoding directions. Courtesy: D. Elverfeldt, B. Kreher, J. Hennig et al., University Hospital Freiburg, Germany.



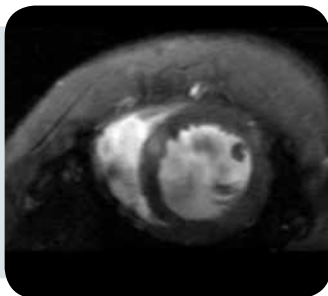
## DTI of the Song Control System (SCS) of Starlings

DTI is used to quantify seasonal changes in the SCS. The density of axonal connections changes under hormonal influences. Courtesy: De Groof, A. Van der Linden, RUCA, Antwerp, Belgium.

# Cardiac MRI

Dedicated phased-array coils allow highest sensitivity for cardiac imaging of rodents. Accelerated acquisition allows high temporal resolution applications such as first pass myocardial perfusion. Self-gating

methods or real time physiological triggering enables free breathing functional cardiac investigations on animals.



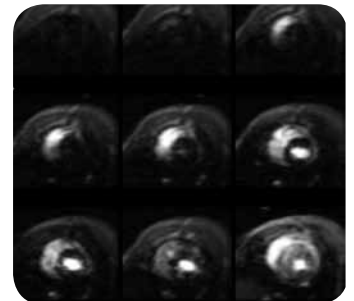
## Bright Blood Imaging

Triggered FISP technique using a 4-channel phased-array cardiac coil provides short axis view of a baby rat heart at high spatial ( $117 \times 195 \mu\text{m}^2$ ) and temporal resolution in 3 min total scan time. Endoventricular structures are visible in the left ventricle.



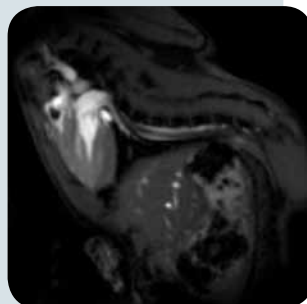
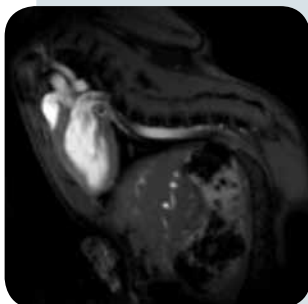
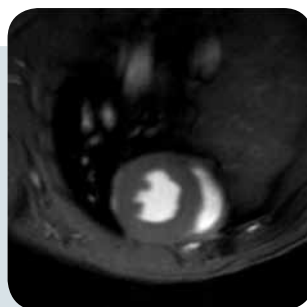
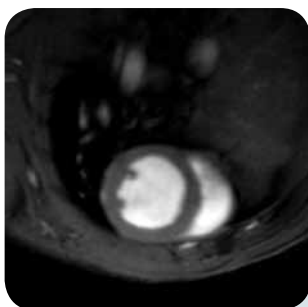
## Black Blood Tagging

FLASH imaging with combined tagging and black blood contrast preparation delivers four chamber views (left) and short axis views (right) of a rat heart.



## First Pass myocardial Perfusion

Nine selected images out of an image sequence of 150 dynamic images of a short axis view of a rat heart. A perfusion dynamics analysis can be done based on the injection of a contrast bolus.



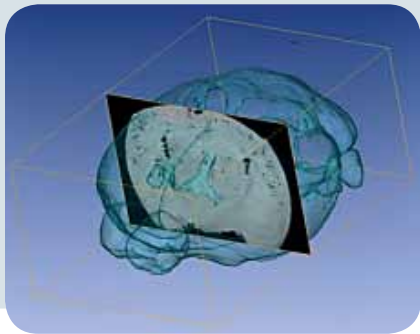
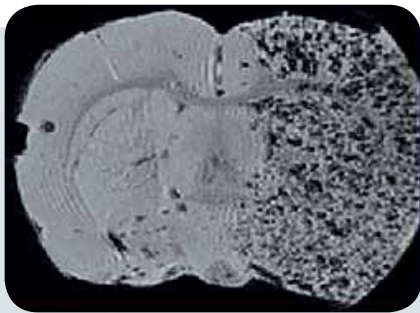
## IntraGate - Self-Gating: Cardiac Imaging

With IntraGate, self-gated cardiac and respiration cine data can be routinely acquired in a steady state condition. Cardiac and respiratory cycles are detected by a navigator signal that requires no ECG triggering or respiratory gating devices. Cardiac movies at a high temporal and spatial resolution are reconstructed with full coverage of R-R-interval even in arrhythmia.



# Molecular MRI

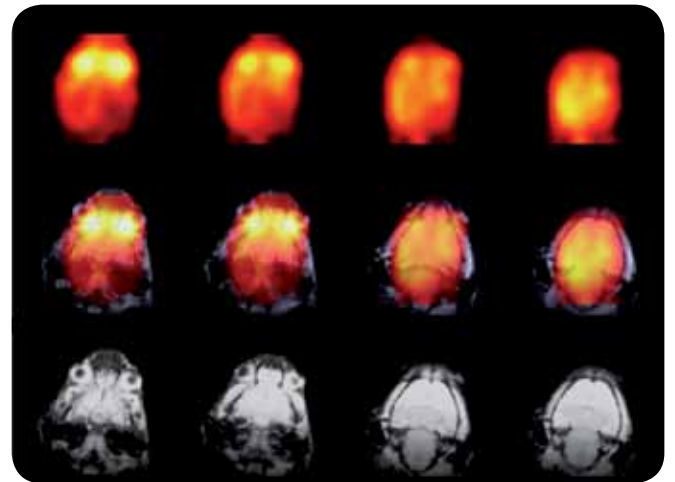
Molecular MR imaging is a highly promising and emerging field of application. New dimensions in spatial image resolution have been reached with the introduction of our well-proven CryoProbe™ technology into the field of MR imaging. The corresponding improvement in sensitivity in combination with ultra high magnetic fields enables imaging down to the cellular level.



## Cellular Imaging

Mesenchymal stem cells, were labeled and used as markers for stroke regions. They are readily visible in T2 and T2\*-weighted images both *in vivo* and *ex vivo*. Full 3D brain coverage allows quantification and volume rendering.

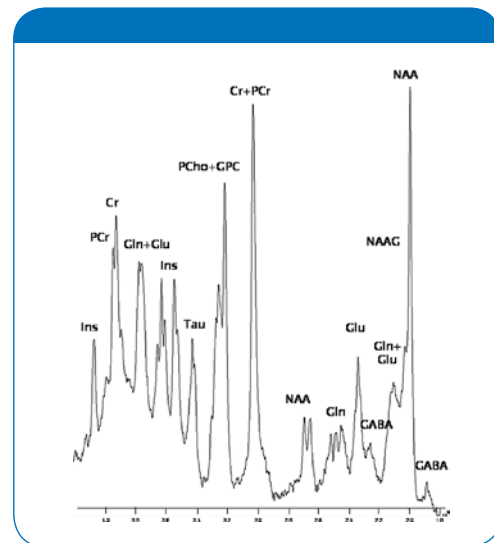
Courtesy: P. Walczak, J. W. Bulte et al., Johns Hopkins University School of Medicine, Baltimore, Maryland, USA.



## Multi Modality Imaging - MRI/PET

Simultaneous imaging of a F-18-FDG labeled mouse head in at 7 T. PET and MRI acquisition was done in parallel without interference between the two modalities.

Courtesy: B. Pichler, M. Judenhofer et al., Laboratory for Preclinical Imaging University Tübingen, Germany



## Spectroscopy

Volume selective *in vivo* spectroscopy at short echo times below 10 ms allows quantitative investigation of a wide range of metabolites. Excellent shim performance provides maximum spectral resolution at 9.4 T for minimum peak overlap.

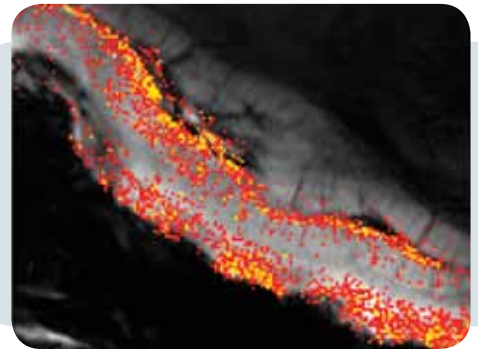
# Customized Solutions

Bruker BioSpin offers customized system solutions for basic research applications. This includes ultra high field horizontal magnet technology up to 17.6 T and vertical MR scanners for neuroscientific research.

## Vertical MRI Systems

The vertical BioSpec® has been engineered for MR research investigations of non-human primates. It enables specifically fMRI studies on monkeys as they are particularly receptive to behavioral conditioning while sitting in upright position.

The vertical systems are offered with two different magnets operating at 4.7 T and 7 T which both have a high magnetic field stability and excellent homogeneity. The actively shielded gradient coil with integrated shims are especially designed for a vertical oriented magnet.



## Ultra-High anatomical and functional Resolution

fMRI-EPI-Image with a resolution of  $(125 \times 125 \times 660) \mu\text{m}^3$  in the monkey visual cortex. Fine details of the visual cortex (Gen=Gennari Line) including small cortical vessels are visualized. Each BOLD-pixel represents as few as 600 neurons.

Courtesy: N. Logothetis, MPI for Biological Cybernetics, Tübingen, Germany



BioSpec 176/25 US for molecular MRI at ultra high magnetic fields of 17.65 T based on Bruker UltraStabilized™ technology.

## Ultra-high Field Systems

Bruker BioSpin is offering up to 17.6 T horizontal MRI systems, enabling high resolution *in vivo* preclinical MRI on small animals at a microscopic scale. The magnet is based on Bruker's UltraStabilized™ sub-cooling technology and operates at a temperature of 2 Kelvin delivering excellent homogeneity and stability. The large magnet bore size of 25 cm permits the integration of a BGA-S™ gradient system with unsurpassed specifications of 1000 mT/m gradient amplitude and 15.000 T/m/s slew rate. Additional cooling provides the very high duty cycle specifications required for high-performance MRI applications. This allows functional MRI (fMRI) applications at ultra high magnetic fields that strongly benefit from their linear increase in sensitivity. These innovations will push the current limits of animal MR imaging towards higher spatial and spectral resolution and resulting in improved sensitivity, enabling new applications for molecular imaging and preclinical research.

# Service & Support

Bruker BioSpin's commitment to providing the highest quality service results in more productivity from your BioSpec system. From the initial site evaluation, through system installation, and throughout the lifetime of your instrument, Bruker BioSpin's service program is dedicated to providing personalized support. By investing heavily in the training of our engineers and support staff, we ensure their up-to-date expertise in the latest MRI technologies. Whether through Bruker BioSpin's support centers, the application, service and software hotlines, or an on-site visit, you can be confident that your Bruker service representative is trained, experienced, and prepared to work diligently to quickly complete your support request.

## Site Planning

Proper site planning for your MRI scanner is the first step in ensuring optimum system performance. Bruker BioSpin engineers have considerable experience in siting large and small high field systems, both in existing and new buildings. Thus, expert advice is available for solving virtually any complex siting problem.

## Contact

Hotline Service: [mri-hardware-support@bruker-biospin.de](mailto:mri-hardware-support@bruker-biospin.de)  
Hotline Application: [mri-application-support@bruker-biospin.de](mailto:mri-application-support@bruker-biospin.de)  
Hotline Software: [mri-software-support@bruker-biospin.de](mailto:mri-software-support@bruker-biospin.de)  
For additional information please visit:  
[www.bruker-biospin.com/mri](http://www.bruker-biospin.com/mri)

## Application Support

Bruker BioSpin provides a worldwide network of senior application scientists to support your research programs. In addition to the training immediately after installation customers can join the Bruker BioSpin Application Continuity Program.

## Responsive Technical Support

Should you ever have questions or require assistance with your BioSpec system, our service & support hotlines are your gateway to a solution. The support center engineers and scientists will quickly and efficiently gather key information and suggest relevant diagnostics.

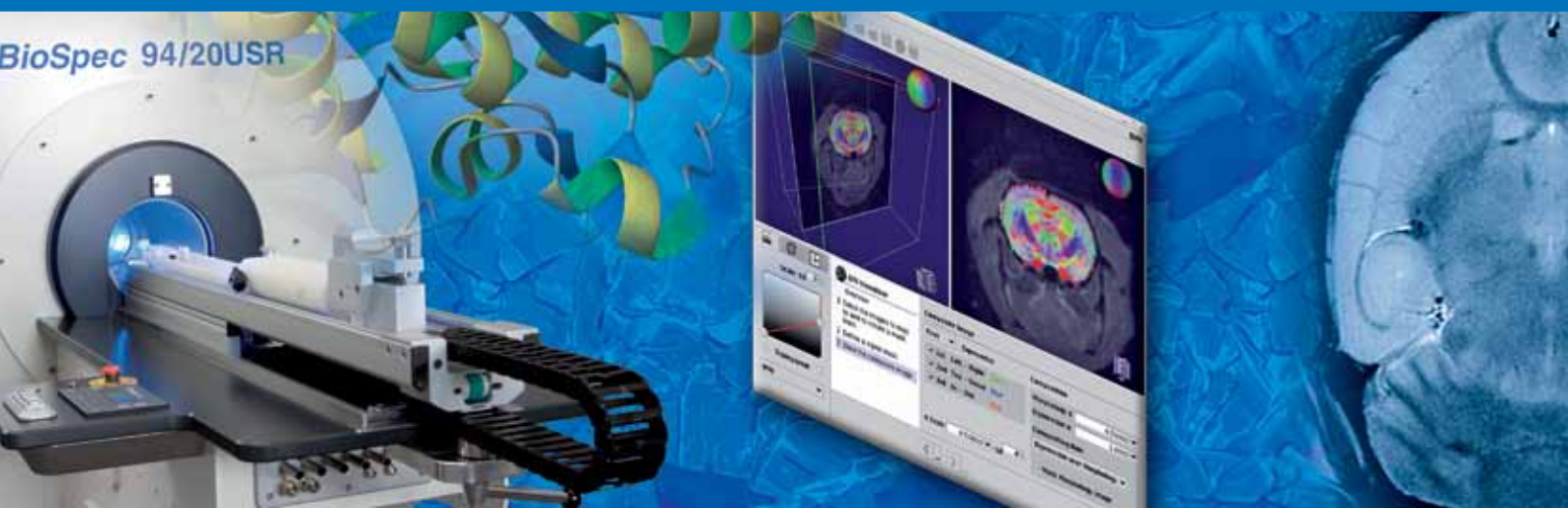
Worldwide support centers arrange for parts to be delivered to your laboratory for troubleshooting and repair.

## Training Courses

Bruker BioSpin offers training courses from introductory classes to advanced operator and programming courses. The courses cover a wide range of applications and include hands-on lab sessions in our dedicated application support centers. For the training schedule and registration, please visit [www.bruker-biospin.com/mri-training](http://www.bruker-biospin.com/mri-training).



Application support center including training and demo facilities in Germany.



● **Bruker BioSpin**

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