

## **Advanced MRI Center Facilities**

The advanced MRI Center (AMRIC) is located in Room SA-107L of the UMASS medical school, it facilitates a Philip's Achieva 3.0T X-series Quasar system, and includes a RF coil labs, a nurses' station, two patient holding rooms, two patient changing rooms with lockers. It shares a contiguous research space of 7,520 square feet with the New England Center for Stroke Research (NECStR). One of the primary features of this center is having a state-of-the-art angiography suite immediately adjacent to the 3T scanner room, separated by a radiofrequency insulation door. The key details of this facility are listed below.

### **3T MRI System**

This 3.0T system comes with a higher order shim function which offers advanced shimming capabilities to obtain improved image quality in field-sensitive applications and techniques such as single-voxel spectroscopy, chemical shift imaging, single-shot EPI and balanced FFE.

This 3.0T system features high performance whole body, non-resonant, self-shielded gradient technology with new amplifiers that deliver high peak and slew rates for the demanding requirements of the latest and emerging clinical imaging techniques. The Quasar Dual gradient system provides industry leading performance specifications for peak strength and slew rate with a dual mode capability that optimizes advanced applications requiring very high peak mode capabilities. The maximum gradient amplitudes and slew rates corresponding to the dual mode are 62 mT/m, 100 mT/m/ms and 31 mT/m, 200 mT/m/ms respectively. It has a bore diameter of 60cm and provides a full-size 50cm field-of-view. The system has 16 receiver channels and provides a wide range of dedicated, anatomy-specific SENSE coils making optimal use of the signal-to-noise offered by the 3T MRI magnet.

This 3.0T system is equipped with a Multi-nuclear spectroscopy (MNS) system, which provide the ability to perform  $^{13}\text{C}$ ,  $^{31}\text{P}$ ,  $^7\text{Li}$ ,  $^{23}\text{Na}$  and other nuclei spectroscopy and imaging. The multiple RF amplifiers in this system includes one 25 kW  $^1\text{H}$  channel narrowband amplifier and one 4 kW broadband Multi-nuclear amplifier.

### **Coils**

In addition to the T/R quad body coil available with the scanner, a wide range of dedicated, anatomy-specific T/R and SENSE coils are available:

**1) Philips SENSE Head coil (P/N: 4535 670 61672; S/N: 000191; Invivo; Pewaukee, WI, USA)**

Receive-only volume coil consisting of 8 elements; Closely contours the head for high signal-to-noise ratio and full brain coverage; Optimized for substantial increase of signal-to-noise ratio in lateral and cortex areas and shorter scan times; Open design optimized for BOLD studies and reduced claustrophobic effects.

**2) Philips T/R Quad Head coil (Type: 4522 132 19831; ON: 300034088; Philips; Holland)**

Volume T/R Quad coil covering head down to C3.

- 3) Philips SENSE NeuroVascular coil (P/N: 4522 132 21713; S/N: 000101; Invivo; Pewaukee, WI, USA)**

Receive-only volume coil consisting of 8 elements; For brain imaging including intracranial MRA, spine imaging down to T4 and carotid vessels from aortic arch to Circle of Willis.

- 4) Philips SENSE Spine coil (P/N: 4535 670 14331; S/N: 518; Instruments, Inc; Aurora, OH, USA)**

Receive-only Volume coil consisting of 6 elements; For thoracic and lumbar spine; Screening total spine and total neuro in combination with SENSE.

- 5) Philips SENSE Cardiac coil (P/N: 4535 670 09711; S/N: 447; Instruments, Inc; Aurora, OH, USA)**

Receive-only consisting of 6 elements; Volume coil consisting of a rigid lower part and flexible upper part; Each part contains three phased-array coil elements. For thoracic and lumbar spine; Screening total spine and total neuro in combination with SENSE.

- 6) Philips SENSE Torso coil (P/N: 4535 670 09721; S/N: 469; Instruments, Inc; Aurora, OH, USA)**

Receive-only consisting of 6 elements; Volume coil consisting of a rigid lower part and flexible upper part; Lower part contains two phased-array coil elements, upper part contains four phased-array coil elements; For Abdomen, Thorax, Pelvis, Abdominal Angiography and Peripheral Vascular Angiography.

- 7) Philips SENSE Knee coil (P/N: 4535 670 61681; S/N: 000115; MRI Device Corporation; Waukesha, WI, USA)**

8 elements receive-only rigid volume coil consisting of a coil base (base plate with the posterior coil part attached to it) and an anterior coil part plus accessories; For knee imaging.

- 8) Philips Flex coil (P/N: 4522 132 19264; S/N: 000000; Philips; Holland)**

Receive-only consisting of 2 flexible elements; Imaging small Fields of View from 5 cm to 20 cm.

- 9) 31P T/R head coil from Clinical MR Solutions**

Volume 31P T/R coil covering head.

- 10) 7Li T/R head coil from Clinical MR Solutions**

Volume 7Li T/R coil covering head.

- 11) Other custom-made coils for small animals**

Different size volume <sup>1</sup>H and other nuclei T/R coils were also available for small animal studies.

## **fMRI Stimulus Delivery System**

A fully integrated fMRI stimulus delivery system from MRA (Model: fMRI-0502-STD1; MRA; Washington, PA, USA; <http://www.mra1.com/>) and Presentation (Neurobehavioral Systems, Inc; Albany, CA, USA; <http://www.neurobs.com/>) is available for both clinical and research. The MRA complete system includes the fMRI stimulus delivery console, Windows computer system, patient response hand switches, video projection into the MRI bore, and MRI compatible patient headphones.

Presentation is the world's most popular experimental control software for neuroscience, is a stimulus delivery and experimental control program. It runs on PC, and delivers auditory, visual and multimodal stimuli with sub-millisecond temporal precision. Presentation is powerful enough to handle almost any behavioral, psychological or physiological experiment using fMRI, ERP, MEG, psychophysics, eye movements, single neuron recording, reaction time measures, other performance measures, and more.

### **MRI Compatible Goggle Set**

MediGoggle Adult Research Set (Cambridge Research Systems Ltd, England; <http://www.crsLtd.com/>) has interchangeable prescriptive goggles suitable for use in MRI and fMRI environments. It is fully MRI compatible with no metallic components and an easy 'click' lens system -6 to +6 dioptre lens sets in 0.5 dioptre increments.

### **MRI Compatible Microphone System**

FormRI-III Dual Channel Microphone System (Optoacoustics Ltd, Israel; <http://www.optoacoustics.com/>) is an industry-standard microphone for MRI research and clinical settings. It uses fiber-optic technology and an advanced set of noise-cancelling algorithms to reproduce high-quality speech in real time and from recordings within a magnetic resonance imaging environment.

### **MRI Compatible Eye Tracking System.**

The SR Research Eyelink 1000 is the most powerful eye tracker on the market, customized for compatibility with the MRI environment (SR Research Ltd, Ontario, Canada; <http://www.sr-research.com/>). The system is capable of completely remote eye tracking at 500 Hz with an average accuracy of 0.5°. The Eyelink 100 integrates with the Philips Achieva 3T system in real time through proprietary SR Research Experiment Builder© software.

### **MRI Compatible Insert Earphones for fMRI Research**

The S14 insert earphones (<http://www.sens.com/products/model-s14/>) provide high-quality acoustic stimulus delivery while attenuating scanner noise. They are small enough to fit within any head coil, and can be covered with circumaural muffs for added protection if the coil allows.

### **In Vivo Physiological monitoring system and Injection system**

Medrad Veris 8600 MR Vital Signs Monitor (Model: 8600; S/N: 023426; Medrad, Inc; Warrendale, PA, USA; <http://www.medrad.com/>) is available to monitor patients while they are undergoing an MR exam. It interprets and displays physiologic data as waveforms and numeric information which include ECG, NIBP, SpO2, CO2, respiration, temperature, O2, anesthetic gases, and IBP.

Medrad Spectris Solaris EP MR Injection System (Model: 3010890; System Serial #: 20080; Medrad, Inc; Warrendale, PA, USA; <http://www.medrad.com/>) is available to offer the flexibility to meet the demands of complex contrast enhanced procedures.

### **Small Animal Monitoring and Gating System**

Small animal monitoring and gating system is from SAI (Model: 1025; SA Instruments, Inc; Stony Brook, NY, USA; <http://www.i4sa.com/>). SAI's monitoring and gating systems are compatible with MR imaging systems. Sensors measure ECG, respiration, temperature, pressure including invasive blood pressure, oxygen saturation and end-tidal CO<sub>2</sub> in sedated mice, rats and other small animals undergoing imaging research.

The system provides continuous monitoring of animal physiologic status while generating gate signals to synchronize scanner data acquisition with cardiac and respiratory motion. MR-compatible heater and ventilator options are available to control the temperature and ventilation of mice and rats during MR or other imaging procedures.

### **MR Compatible Anesthesia Delivery System**

MR compatible anesthesia delivery system (VetEquip, Inc; Pleasanton, CA, USA) is available to deliver anesthesia gas while the animal is undergoing an MR exam.

### **Electronic shop**

The AMRIC houses an electronic shop that is used to construct RF coils and animal cradles needed for our MR studies. The shop contains a Philips PM 3355 oscilloscope (S/N: 9444 033 55000; Philips, Holland), Network analyzer (Agilent 8713B), Morris 405NV+ RF Sweeper (Model: 405NV+; Morris Instruments Inc; Ottawa, ON, Canada), Function generator, DC power supply, stores of variable and fixed capacitors, soldering equipment, a drill press, band saw and hand tools, etc. need to construct the requisite RF hardware.

### **Computer facilities**

ViewForum from Philips provides fast 2D, 3D, and 4D post processing applications to help manage the clinical workflow demands. Each laboratory member has an on-line late-model PC. The computers are networked locally via PC client protocol. Xerox WorkCenter 7535 is available for copy, fax, print and scan. The UMMS Help Desk provides computer-aided assistance for software and hardware problems. Additionally, AMRIC maintains license to MatLab (Mathworks, Natick MA).

### **Other resources**

### **Animal Facilities and Services**

The University of Massachusetts has animal facilities consisting of over 93,000 gross sq. ft., in seven different sites, all fully AAALAC-accredited. The main animal housing area is located on the lower level of the University across the corridor from the AMRIC. The new LRB animal facility is a complete barrier

facility and includes a mouse Transgenics Core Facility. A system of suites containing animal research labs and procedure rooms provides the flexibility to house colonies of varying sizes and species. This state-of-the art facility utilizes ventilated animal housing racks and an automated cage processing system to maximize productivity. The main campus animal facility includes a major surgical area consisting of four fully equipped operating rooms and adequate associated storage and prep areas. A diagnostic lab is used for basic blood chemistries, CBCs, and other animal health monitoring procedures. There is 7-day-a-week coverage, veterinarians on call, and a cadre of veterinary technicians that will provide training of researchers in small animal handling and systemic administration of imaging drugs. Animal facilities include quarantine rooms for incoming animals of unknown or questionable health status. There is also a biocontainment suite for the use of certain biohazardous substances in animals and a DNA gun room for in vivo gene transfer. The UMASS animal facility and Radiology Medical Imaging Center has the necessary equipment for the histologic analysis of tissues.

### **Other Research Core Facilities and MR Instruments Available**

The University of Massachusetts Medical School UMMS is a highly productive, highly collaborative research enterprise with outstanding scientific resources and facilities. Different core facilities are available through the university (<http://www.umassmed.edu/research/cores/index.aspx?linkidentifier=id&itemid=80096>). Addition to 3T Philips system, three 1.5T GE scanners, one 4.7T/40cm Bruker MR scanner (Billerica, MA) and one 600 MHz NMR spectrometer are also available for clinic and research.