

## GE 3T MR750 Scanner:

The BIRC has a state-of-the-art GE Signa MR750 3.0T magnet. Current software id SIGNA\_LX1.MR30.1\_R04\_2421.a. When comparing your protocols from a 1.5T magnet to the 3.0T magnet you must remember in general the following.

- The SNR is about twice as much as the 1.5T—increased SNR causes increase in motion (can correct by increasing your matrix)
- T1 Relaxation rate is longer: 800-1000—which will decrease your SAR
- T2 and T2\* rates are shorter: lower TE from 100 to 80
- Chemical Shift has twice the susceptibility: the fat and water chemical shift is 447 hertz
- Magnetic susceptibility is four times greater on 3T—fMRI 5-10% vs. 1.5T 1-2%
- RF Power deposition is about four times greater
- Increases the magnet hydrodynamic effect (T swell)

NOTE: These are only just a few mentioned differences and are not to be taken as absolute.

### I. BIRC 3T Magnet Usage Guidelines: RATES and HOURS

#### A. Magnet usage priorities:

All scheduled use is classified with a starting letter, project # and funding source (for P hours).

**P** = (Paid) Hours funded through accounts that can be transferred to the BIRC. These include administrative hours.

**M** = (Matching) Hours promised to an investigator by the BIRC as part of a previously agreed upon startup package. These are generally few and for only a specific time.

**D** = (Donated) Hours granted to the investigator for a specific project (typically pilot data for a grant application) See criteria below. Also signifies teaching and development hours. –

#### B. Scheduling policy

While we will try to accommodate, scheduled time CANNOT be guaranteed with a

**D** (Donated) designation. Paid studies wishing to schedule during hours already booked with donated hours must contact the BIRC director. Note, this will generally NOT be granted if requested LESS THAN 48 hours before scan time. Also, **P** hours that bump **D** hours will be charged for the time regardless

of circumstance, unless cancelled MORE THAN 24 hours ahead of the scheduled testing time.

### C. Cancellations

Generally, cancellations must be submitted AT LEAST 24 hours in advance. Cancellations LESS THAN 24 hrs. ahead will be charged for one half of the regular scan time (for example: a 1 hour scan would be billed for 30 minutes while a 2 hour scan would be billed for 1 hour).

### D. Obtaining a designation of donated hours

The BIRC SAC will review and decide on possible donated hours (if any) for each project on a case by case basis. These hours can be given to perform pilot experiments or to complete a promising study with a few more hours. The awarding of these hours needs to be linked to a strong likelihood of submitting and obtaining future external funding. Donated hours are not routinely provided for student projects. Obtaining prior donated hours may reduce the likelihood of obtaining future donated hours.

Donating most or all the hours for a study (i.e., no paid hours) can occur for NEW investigators, but typically will not occur more than once. In most cases it is expected that donated hours will minimally be matched with paid hours. The rationale for awarding donated hours is to demonstrate a method so that future funding can be obtained, rather than to support the completion of a large study for publication.

Studies may sometimes have a mixture of paid and donated hours. The paid hours should be used first, with donated hours given afterwards.

Investigators may petition to receive extra donated hours if the study is considered very promising and more hours are needed to complete the study. Again, the demonstration of promise of external funding on completion of the study is considered important when evaluating this request.

### E. Teaching hours

Are given to select classes to demonstrate MR or similar methods as part of the teaching mission of the University. These hours are expected to be limited to 1-2 classes per semester and 1-3 hours per class. Those interested in setting up teaching hours must complete the same application as research investigators.

## F. Criteria for Donated hours

1. Priority of **Donated** hours is for New Investigator status.
2. All available means of payment (from ALL investigators on the project) must be exhausted before **Donated** hours are granted.
3. Unused **Donated** hours for one project CANNOT be rolled over to other projects.
4. Six months after **Donated** hours are granted and used, the investigator must submit a progress report to the BIRC. This progress report should include any publications and especially any grant submissions/funding that has occurred because of BIRC acquired data. This will be a prerequisite for any additional projects requesting **Donated** hours from the same investigator(s).
5. Feasibility of the study to obtain its objectives with the number of provided hours will be considered and must be a part of the application.
6. Likelihood of obtaining external funds will be considered. This includes evaluating the title and aims of the proposed grant and where the grant proposal will be sent.
7. Number of **Donated** hours the investigator(s) has/have received in the past. Having been given donated hours will normally decrease the likelihood of being given additional hours. Evidence of having submitted a grant as a direct consequence of previously donated hours is a requirement for receiving additional donated hours.
8. While not necessary for new investigators, the number of paid hours in the past will be considered. The greater the number of paid hours in the past, the greater the likelihood of being granted donated hours for appropriate requests.
9. Investigators are responsible for not exceeding their allotted number of donated hours. Exceeding these hours without prior approval will result in the investigator being charged for paid hours.
10. Multiple investigators. Determination of donated hours will consider the scanning history of all investigators on the proposal.

## G. Reporting

Regardless of hour type used, all BIRC investigators are asked to submit copies of accepted/published papers and submitted/funded grants associated with BIRC acquired research requests to the BIRC for our record keeping and development purposes. Please acknowledge BIRC in all publications, e.g., "Data acquired for this study was supported in part by the University of Georgia Bioimaging Research Center.", or similar.

## H. Off-hours MR :

Beginning August 28, 2018, the 3T magnet is available to research groups who have BIRC-approved console operators from 7-8am Mon-Fri, after 5pm Mon-Fri, and Sat-Sun. Note: Off hours data acquisition does NOT include BIRC provided technician/console operator. Thus, only experienced laboratories with cleared console operators can scan off-hours..

The cost of the MRI is \$525 per hour. This includes the cost of a Registered MRI Technologist (currently TJ Hardy). Unless cleared prior to your scan time, our MRI technologist (currently TJ Hardy) is the only person authorized to run the MRI unit. The technologist will record start and stop times for billing purposes.

For your first scanning session we request you only schedule a maximum of three hours with one subject for setting and running your protocols. This time is free of charge, up to three hours, and meant to provide initial time to test, manipulate and set your protocols. If this service is not needed than charges will take effective immediately. Please send a copy of your requested protocol at least a day in advance of first test subject. **See protocol guidance sheet Appendix A**

Cancellations are requested 24 hours in advance. Failing to remove your scheduled appointment within 24 hours will cause a late cancellation fee to be applied equal to one half of the study's usual magnet time.

Please check the Faces scheduling before coming to the Center – the Faces manager will post on the schedule and email, to all scheduled researchers for that day any delays or problems with the magnet, as soon as possible.

If you experience any problems with the magnet during your scheduled scan time please let someone know ASAP, and document what problems you had. This information is vital for the BIRC and service engineers.

**Also, please be respectful of other researchers and investigators that are using the magnet. Do not invite yourself in while others are scanning.**

## II. Equipment--The following coils are currently available for use at the BIRC:

### A. Split Head Coil

This coil is a transmit/receive coil used to produce images of the head, including but not limited to the brain, orbits, and blood vessels. The head coil is designed to create an evenly distributed magnetic field within its volume. This field is homogeneous inside the coil and rotates in the transverse plane at the system frequency.

### B. 32 Channel GE Head Coil

*Made by MR Instruments*-phased array design for high signal-to-noise ratio. Z-FOV for imaging the entire head. Parallel imaging with acceleration in all three planes. Sliding coil design for ease of patient positioning. Open face design. Inner Diameter is 24 cm

### C. 8 Channel High Resolution Brain Array Coil

This is a receive only coil –designed for headfirst exams only-the high res brain coil is 24cm in diameter

### D. 8 Channel Neurovascular Array Coil

A receive-only coil designed to give optimum signal-to-noise ratio and uniform coverage of the head and neck. This rigid coil incorporates soft, flexible components that conform to the patient anatomy to accommodate various body contours, while minimizing patient discomfort. The HD Neurovascular Array enables the clinical user to collect high resolution images of the head and neck.

### E. 16 Channel Head Neck Spine Coil

Receive-only 16-channel, 29-element coils designed GE 3.0T MRI Systems. The coil incorporates soft, flexible components that conform to patients' anatomy, accommodating various body contours while minimizing patient discomfort individually as the HNS Coil or collectively as the HNS Coils. HNS Coils are comprised of 4 units: The Head/ Neck Unit (HNU), which includes the Anterior (face) unit, the

Thoracic/ Lumbar unit (TLU), the Neck Chest Unit (NCU) and Adapter Block (Horseshoe

#### F. 8 Channel CTL Spine Coil

This is a receive –only coil designed to give optimum signal to noise ratio and uniform coverage of the spine anatomy, including the cervical, thoracic, and lumbar regions.

#### G. 8 Channel Shoulder Coil

Is a receive-only coil designed to give optimum signal-to-noise ratio and uniform coverage of the shoulder area. The coil uses a single mode of operation with all eight channels active. The coil description in the scanner interface is HD 8-Channel Shoulder Array by NeoCoil. It has one mode of operation: HD Shoulder. Proper patient positioning and a FOV not exceeding 20 cm will produce the best results. Improper use of the coil is the major cause of image artifacts

#### H. 8 Channel High Resolution Wrist Array Coil

This is a receive only coil- this coil is equipped with a baseplate to support the coil. The baseplate is designed to rest directly on the patient table for stability. This baseplate allows for over the head scanning of a subject's wrist or by the patient's side

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#### I. HD T/R Quad Extremity Coil by Invivo

This is a single channel transmit/receive coil—can only choose “QUADKNEE” for coil operation on 3T magnet. Quadrature design offers high quality, homogeneous images of the foot, ankle, and knee. One coil provides all your lower extremity imaging applications.

#### J. 8 Channel Knee Coil

The uniquely sculpted, eight channel design closely conforms to the anatomy while accommodating large knees. The split top, single handle locking design provides quick set-up. Designed for parallel imaging, this coil provides fast enhanced images of the knee.

#### K. 8 Channel Foot and Ankle Coil

Quick easy set-up, fast image acquisition, and minimal coil motion all combine to provide high quality MR exams. Eight imaging channels produce exquisite images of the structures of the entire foot and ankle.

#### L. 32 Channel Body Array Coil

Is a receive-only coil designed to provide optimum signal-to noise ratio and uniform coverage of the chest, cardiac, abdomen, torso, pelvis, prostate, hips, and long bone. The coils are padded with a soft material designed to maximize patient comfort. There are 2 components to the Discovery 3.0T 32 CH Body Array Coil: the anterior component and the posterior component. The posterior component is attached to the nest pad and should remain attached during scanning. The anterior component should always be positioned on top of the patient. It is not designed to bear weight. Four straps immobilize the anterior component on the patient. The Discovery 3.0T 32 CH Body Array Coil comes with P- connectors that are compatible with 3.0T GE scanners with P-connector style ports.

#### M. Flex Suite System

*Small, Medium, and Large-* is a versatile set of high density 16-channel receive coils designed to give high quality images in a wide range of applications. The high degree of flexibility is advantageous when imaging subjects that do not fit the constraints of rigid coils.

#### N. Two small surface coils by Clinical MR Solutions-

Used with the MR750 plug these coils can give extremely high resolution of anatomy towards surface of the skin.

#### O. Sensmetrics S14 Earphones:

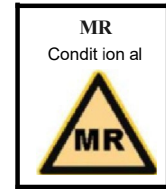
Safety Guidelines must be followed with the S14 Earphones. A S14 Earphones Safety Guidelines and Authorization Sheet must be completed by each person using earphones and will be kept on file.

**S14 Earphones Safety Guidelines and Authorization**

Non-clinical testing has demonstrated that the Sensimetrics S14 earphones are MR Conditional. They can be used safely while scanning under the following conditions:

- Static magnetic field of 1.5 or 3 Tesla
- Normal operating mode (with the exception noted below, in next bullet point)
- Maximum whole body averaged specific absorption rate (SAR) of 0.4W/kg for 10 minutes of scanning

In non-clinical testing, the S14 earphones produced a temperature rise of less than 0.57°C at a maximum whole-body-averaged specific absorption rate (SAR) of 0.4 W/kg, as assessed by calorimetry for 10 minutes of MR scanning in a 3T Siemens Tim Trio (software version VB 15A) MR scanner.



Parameter	Conditions for safest use	Notes
MRI field strength	1.5T and 3T only	Field strengths above 3T use a higher transmit frequency, which may increase the coupling of RF currents on the ear phone cables.
RF transmit coil	Body volume transmit coil Head-only volume transmit coil	
RF receive coil	Any receive coil can be used.	
Cable positioning	<ul style="list-style-type: none"> <li>• Cabling must be routed as close to the center axis of the scanner bore as is possible.</li> <li>• Cables must not be crossed and should be kept at least 10cm apart.</li> <li>• Avoid loops of any kind.</li> <li>• Cables must not be held by the subject.</li> <li>• Under no circumstances should the earphone cable be disconnected from the cable assembly.</li> </ul>	Loops in cables can increase RF coupling.
SAR	Sequence power must be restricted to less than 0.4W/kg (20% of the allowed whole body SAR under the IEC's regulations) and 20W time-averaged power.	Lower sequence powers reduce the risk of heating. Therefore it is recommended that sequences should be adapted to use less power if possible. Additionally high and low power sequences can be interleaved, or pauses in scanning can be introduced, to reduce the time-averaged power.
Sequence type	Any sequence with power less than 20W time-averaged power and 0.4W/kg whole-body SAR may be used.	This limit should facilitate standard GE-EPI fMRI scans, localizer, and T <sub>2</sub> -weighted structural scans (e.g. MDEFT or MP-RAGE). Spin echo scans are not advised as sequence power is much higher; for these scans the earphones must be removed.

By signing this form, I, the undersigned, acknowledge that I have read and understand the S14 safety guidelines and will enforce them at this facility.

Investigator or Graduate Student :

Signature \_\_\_\_\_

Date \_\_\_\_\_

Print Name \_\_\_\_\_

Facility Name and Address:

Bio-Imaging Research Center

University of Georgia

Paul Coverdell Building Athens GA

May 1, 2016



### III. Researchers Equipment:

Researcher Equipment must be labeled MRI Compatible and have documentation that it is MRI SAFE in the 3T environment before it can be brought into the MRI scan room. A hand-held magnet will be available for testing small objects, but large equipment must have proper documentation, or it will not be allowed either in the scan room or pass the 5-gauss line. The BIRC will make the final decision on a piece of equipment compatibility. WHEN IN DOUBT –KEEP IT OUT. For other coils needing configuration files follow Appendix M.

Auxiliary equipment such as gating equipment, vital signs monitoring systems, and RF Coils that have not been specifically tested and approved for use in the 3T MR environment may result in burns or other injuries to the research participant. This equipment may also interfere with the proper operation of the magnet and the coils.

### IV. The MRI Procedure: Subject Clearance and Subject Scanning

To scan a subject at the BIRC we must have a subject cleared utilizing our 3-step clearance process. Without a completed cleared form, it is illegal by federal law to take subject into the MRI room. **Appendix B, Appendix C and Appendix D**

#### Step 1—Telephone Screening:

Telephone Screening: The research lab is to call the subjects and complete the enclosed questionnaire found at the end of the manual. A manual as to questions to ask and information to obtain is also included. Do not sign the questionnaire –this will be signed by subject or guardian while here for scan

#### Step 2—Subject Review:

When subject arrives at the BIRC give the form, filled out over the phone by your lab, to them to review and sign. Make sure date of signature matches the date they are here scanning.

#### Step 3—Technologist Review:

Have the MRI Technologist that is on duty review the form with the subject and they will have final say as to whether the subject scans or not. They will sign and date the form below the subject's signature.

#### After hours subjects:

In the event the scan is scheduled for an afterhours time slot you must deliver the forms to the MRI Technologist a minimum of three days in advance (if possible) along with a contact number. MRI Technologist will call and speak to subject or leave a message to have them call back. Once MRI technologist speaks with subject, if cleared, they will place form in your research projects folder in filing cabinet by magnet. Folders are in cabinet by Main PI last name and project number. When subject arrives pull form from folder and complete Step 2.

#### Completed forms:

Keep form by MRI console during scan. Upon completion of scanning place form in research projects folder. Folders are in cabinet by Main PI last name and project number. When subject arrives for scan complete Step 2.

#### In the event of an emergency:

Need to contact 911. Have someone run and make a copy of the form and give to the emergency response team. See also Emergencies section!

### V. Participant Privacy:

All Researchers and Investigators using the BIRC MRI Unit shall abide by the UGA Research Centers Policy on Responsible Conduct in Research and Scholarship which can be found at <https://research.uga.edu/compliance-training/rcr/>

The UGA Office of Research website is <https://research.uga.edu> for updated information.

It is the responsibility of the research group to assign a participant ID that will be used for their participants. These need to be anonymous for participant privacy. All participant information is considered confidential while at the BIRC.

Researchers and Investigators must follow HIPAA codes while at the BIRC.

### VI. Safety:

MRI SCAN ROOM: Only research participants and necessary researchers will be allowed to enter the MRI scan room after completion of clearance forms and clearance by the MRI technologist.

All safety lines must be adhered to. The door to the MRI scan room is chained off.

Anyone bypassing the chains without permission of the MRI Technologist or Physicist will be **immediately** asked to leave. Inside the magnet room is the 5-gauss line. Absolutely nothing is to pass this line without clearance.

The most important part of the MRI scan is your participants' safety and comfort.

Within the scan room are different materials used to accomplish this, they are:

#### A. Ear plugs

Due to the rapid switching of the gradients, acoustic noise more than 99dBA can be produced within the magnet bore. Therefore, all participants must be given earplugs with at least a 29NRR (noise reduction rating) rating while in the magnet. The BIRC will supply these to your research group.

#### B. Alarm system

What is also called the “panic bulb” is to be given to all participants entering the magnet bore. When squeezed, an alarm will sound at the operator control panel. Be aware that this bulb is latex—so vinyl gloves are provided to cover the bulb in event of latex allergies.

#### C. Padding

Is extremely important and mandatory on the BIRC 3T magnet because contact point heating can occur. To help prevent burns from closed loops formed by the following examples: clasped hands, by hands touching the body, by hands touching the sides of the magnet bore, from thighs contacting etc., insert non- conducting pads at least .25 inches thick between touching parts.

#### D. Specific Absorption Rate (SAR)

The software on the BIRC GE 3T MR750 system allows for SAR monitoring. This is mandatory while scanning your research participants unless otherwise authorized by the Director of the BIRC. Remember the RF power deposition is four times greater on a 3T magnet vs. a 1.5T.

## VII. SAR Limits: NEVER SCAN in Second Level Mode

System	Clinical mode (W/kg)	First Level (W/kg)	Second Level (W/kg)
3.0T MR750	HEAD=3.2	HEAD=3.2	HEAD>3.2
	BODY=2.0	BODY=4.0	BODY>4.0

## VIII. Emergencies:

### A. Medical Emergency:

All medical emergencies must be tended to OUTSIDE the MRI scan room. The patient table can be detached from the magnet system. The table can also be lowered and raised.

1. In the event of a participant needing emergency medical attention during the scanning session, use the undock pedal and the emergency table lever release for quick transportation of participant outside the magnet room.
2. Perform CPR if necessary and/or contact 911
3. Make copy of clearance form to give to emergency response team
4. DO NOT ALLOW anyone responding into the MRI room—NOT SAFE!!!
5. Disinfect and clean room afterwards.

### B. Equipment Emergencies:

1. *Emergency Shutdown Button*—removes all power to the system electrical components—does not quench the magnet—does not stop the magnetic field. If you experience a serious equipment fault (system overheating, smoke, or odor associated with the system) or hazards such as fire/water in the vicinity of the MRI Equipment, you may need to perform a system shutdown with the EMERGENCYSTOP button. The entire MR system is turned OFF with this button, except the static magnetic field.
2. *“Quench” or Emergency Rundown Button*—causes rapid reduction of the magnetic field in about 2 minutes—loud crackling and hissing sounds—boil off cryogen—system will be down for several days and may damage the magnet. Room must be evacuated ASAP—cryogen may cause asphyxiation or frostbite. Magnetic field emergencies can also occur. This is where the presence of the magnetic field may cause injury or harm if someone is pinned between the magnet and a

ferromagnetic object. A magnet rundown results in several days of downtime and may damage the magnet. The only time at the BIRC that the Emergency Magnet Rundown button or “QUENCH” button should be used is in the event of a person being pinned to the magnet and injury to that person is imminent. A controlled magnet rundown should be performed by a Service Engineer in all non-emergency situations.

#### IX. Exam Storage and Archiving:

The BIRC requires all research participants to be assigned a number by the research group for participant anonymizing. It is the researchers' responsibility for keeping track of their participants.

Researchers/Investigators have the option of burning their exams to CD/DVD or having the data emailed using a password protected link.

#### X. Completion of Scan:

Researchers and Investigators are expected to clean and disinfect the equipment and to return the MRI scan room back to the same level of cleanliness as they find it. Do not forget MRI safety rules while cleaning.

Please keep the work area around data analysis and image viewing area clean and uncluttered. Trash cans are provided, please use.

If you notice any problems or experience any problems, please report them to the BIRC ASAP. If you are scanning after hours please leave messages by email to [tj.hardy@uga.edu](mailto:tj.hardy@uga.edu), or by phone at 770-294-6884.

#### XI. Training to Operate Independently:

- A. Must be a graduate student of an active 3T user or Employee of active user lab having a BS/BA degree.
- B. Must have completed MRI Safety Training
- C. Must have passed MRI Safety Training
- D. Be able to dedicate the time to learn system

## XII. Training Materials: Appendix E

- A. Manual 1: 3T MRI Training Schedule Syllabus
- B. Manual 2: MRI Safety Training
- C. Manual 3: Start Up—from Restart
- D. Manual 4: Start Up—from Full Shutdown
- E. Manual 5: System Shutdown—Restart or Full Shutdown
- F. Manual 6: Magnet Warnings and Console Operations
  - 1. Console Operations
  - 2. Things to Know
  - 3. Finding ACPC Line
  - 4. Transferring Data

## XIII. MRI Simulator Room:

A fully functional MRI simulator is housed within the BIRC. The simulator is a life-size “mock-up” of the MR magnet, complete with stimulus presentation and behavioral data acquisition computing equipment. The simulator is used to develop new protocols, train research participants, and acclimate participants to the MR environment.