January 2014 - This list is subject to frequent updates.

UTAH RESOURCES (Utah Center for Advanced Imaging Research)
Utah Center for Advanced Imaging Research (UCAIR) consists of about 7000 sq. ft. of office, class room and laboratory space located in the Imaging and Neurosciences Center (INC) at 729 Arapeen Drive in Research Park.

NON-Clinical Facilities
UCAIR Radio Frequency Coil and Electronics Laboratory
The RF Coil and Electronics Lab is a fully equipped shop (approximately 1200 sq feet) with oscilloscopes, signal generators, and a variety of other essential test and measurement equipment. The lab has a small machine shop, with table, chop, and band saws and a drill press. It also has bench space, and wet-lab space with fume hood in addition to a full stock of electronic parts, manuals, and data books. The heart of the coil lab are the network analyzers including:
- Two Agilent E5061A network analyzers
- One Rohde & Schwarz ZVL network/spectrum analyzer with optional hardware and software that allows for noise figure measurements,
- One Rohde & Schwarz FSH3 portable spectrum/network analyzer.
- One HP 8752A network analyzer
In addition, the lab is equipped with power supplies, and a full size test bore/RF shield to simulate the electrical environment of the MRI patient bore. We have also constructed an MRI patient table simulator, providing necessary bias voltages and connector/plug assemblies, that allows for full 32 channel receiver chain circuitry testing from the coil through the preamp and table connectors. In addition to this full table simulator, we have a similar assembly to test a single coil plug.

Software: The lab has a variety of computer software packages that are used to design and simulate Gradient and RF coils as well as other mechanical design projects. The key pieces are a full version of the SolidWorks CAD software and the Remcom xFDTD 3D electromagnetics simulation software, in addition to countless in-house codes for various types of simulation and image analysis.

Machine shop: UCAIR has a small machine shop for coil parts fabrication that will be used for construction of the inner ear Tx and Rx RF coils for this project. The School of Medicine machine shop is located in the INC building and is fully equipped and available for major machining projects. In addition we have access to the Physics and Mechanical Engineering machine shops which provide a variety of expertise and facilities including 3D printers and water jet cutters.

Subject preparation: There is approximately 200 sq. ft. of preparation area adjacent to the human imaging magnets.

Pre-clinical study equipment: The following is used in anesthetizing and monitoring animals during pre-clinical studies
- MR-compatible anesthesia machine including vaporizer with ventilator
- MR-compatible Medrad telemetry unit for monitoring vital signs of the animal during MR procedures
- SA instruments Model 1025 MR-compatible Small Animal Monitoring & Gating System
- Anesthesia unit (not MR-compatible) used during the preparation and recovery period of pre-clinical procedures.

Computer Resources
A large network of computer resources are available for the collective research in UCAIR. These systems are heavily utilized, but indicate the strength of the network:
- Four 64bit (2.0-2.4Ghz CPUs) workstations with 2GB RAM,
- Three 32bit workstations with 1GB of RAM,
- A dual AMD Opteron 246 (2.0Ghz) compute server with 2GB RAM,
- A Data storage server with 1.7 Tb of available storage, and an administrative PC running windows.
- Group resource servers are also available:
  - One dual Athalon (1.96Ghz, 2GB RAM) with 1.8 TB of RAID disk storage
  - Dual AMD Opteron 244 (1.8 Ghz),
Dual AMD Dual Core Opteron 270 (2.0 Ghz),
AMD Opteron 250 (2.4 Ghz),
Dual AMD 2350 Quad Core with 8 Gbs of RAM

All computers are connected via local-area networks (clinical and research backbone) and to the INTERNET for international electronic communication, and are managed and monitored by a systems administrator for security and data networking.

**Office**
Office space for all faculty, secretarial, and professional staff is provided in areas immediately contiguous to the imaging laboratory. The INC facility represents a substantial increase in available work space which accommodates current and new staff. Additionally, the new space unifies the UCAIR labs, offices, and resources into one location with the exception of some administrative space and shared facilities.

**Major Equipment**
All major equipment is located within the Radiology Department or is located in other parts of the medical center and managed by the Radiology Department:

**MRI**
- CNC (Clinical Neurosciences Center): Siemens TIM Verio 3.0T MRI scanner
- UUMC (University of Utah Medical Center) 4th Floor: Siemens TIM Verio 3.0T MRI scanner.
- INC (Imaging and Neurosciences Center – UCAIR, 729 Arapeen Drive): Two fully equipped Siemens TIM-Trio 3.0T MRI scanners (see below).
- UUMC (University of Utah Medical Center) 1st Floor and HCI: Two 1.5 Tesla Siemens TIM-Avanto MRI scanners equipped with multi-coil capabilities.
- INC (Imaging and Neurosciences Center – UCAIR, 729 Arapeen Drive): One 1.5 Tesla Siemens Espree MRI scanner (wide bore and short design) equipped with multi-coil.
- One 1.5 Tesla Siemens Aera MRI scanner.

**CT**
- One Siemens Definition (dual-tube) multidetector CT scanner.
- Two Siemens Sensation 64 multidetector CT scanners.
- One Siemens Emotion 16 multidetector CT scanner.

**PET/Nuclear Medicine**
- One GE PETtrace cyclotron with Negative ion accelerator (Huntsman Cancer Institute)
- One Siemens Biograph 16 Time-of-Flight PET/CT scanner (Huntsman Cancer Hospital).
- One GE Discovery 710 Time-of-Flight PET/CT scanner with lutetium-based scintillators (Huntsman Cancer Institute)
- One GE Discovery ST PET/CT (dedicated research - Huntsman Cancer Institute)
- Two Siemens ECAM gamma camera with SPECT (one university hospital and one Huntsman Cancer Hospital)
- One IRIX three-detector gamma camera with SPECT (University hospital)
- One Inveon Tri-Modality Dockable PET/SPECT/CT Small Animal Scanner

**Angiography**
- One high resolution digital GE Advantx angiography laboratory,
CLINICAL FACILITIES (includes above-listed equipment)
The Department of Radiology occupies approximately 20,000 sq. ft. in the University of Utah Health Sciences Center (HSC) and about 4,000 sq. ft. in the Imaging and Neurosciences Center (INC). The department also manages resources in the Huntsman Cancer Hospital (HCH), the Clinical Neurosciences Center, and the University Neuropsychiatric Institute (UNI).

All MRI, CT, Nuclear Medicine, and X-ray imagers are directly connected to the lab computer network backbone (ATM); images from all devices can be easily transferred between groups. MRI scanners are equipped with multiple receiver coils and have the maximum memory available from Siemens. The University of Utah Department of Radiology has 12 radiographic rooms for routine radiographic/fluoroscopic procedures. Also available are Special Procedure rooms for conventional, interventional and digital angiography.

3T Human MR scanners for Research
The INC building houses both Siemens TIM-Trio 3T MRI scanners. Both scanners have 32 high-speed RF receiver channels and several coils of variable numbers of elements designed for specific body parts. Custom coils for unique geometries have been designed and fabricated in the coil development lab (above). These systems are also equipped with pulse sequences and appropriate software for spectroscopy, functional MRI, diffusion tensor MRI and other high end imaging capabilities. A user friendly yet highly flexible pulse sequence development platform is also included to allow research and development in novel techniques. The research MRI scanner is also equipped with Siemens transmit TIM capabilities that provides the control lines for an extra RF transmit channel and 3 additional gradient control channels. We are the first Siemens site to install a complete set of additional gradient amplifiers allowing simultaneous, independent operation of two separate gradient systems.

The following MRI scanners are managed by the Department of Radiology:

<table>
<thead>
<tr>
<th>MR Location</th>
<th>Manuftr.</th>
<th>Field Strength</th>
<th>Software Level</th>
<th>Engine</th>
<th>Slew Rate</th>
<th>Amplitude</th>
<th>Bore</th>
<th>TIM</th>
<th>Spacial Gradients</th>
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<tbody>
<tr>
<td>University Hospital MRI Center</td>
<td>Siemens</td>
<td>1.5 Tesla</td>
<td>VB17</td>
<td>SQ-Gradients</td>
<td>200 T/m/s</td>
<td>45 mT/m</td>
<td>60 cm</td>
<td>76 x 32</td>
<td>1100 g/c</td>
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<tr>
<td>University Hospital MRI Center</td>
<td>Siemens</td>
<td>1.5 Tesla</td>
<td>D11</td>
<td>XQ-Gradients</td>
<td>125 T/m/s</td>
<td>33 mT/m</td>
<td>70 cm</td>
<td>204 x 48</td>
<td>1100 g/c</td>
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<tr>
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<td>VB17</td>
<td>Z-Gradients</td>
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<td>32 x 8</td>
<td>1500 g/c</td>
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<td>32</td>
<td>1000 g/c</td>
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<td>VQ-Gradients</td>
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<td>45mT/m</td>
<td>70 cm</td>
<td>32</td>
<td>1000 g/c</td>
</tr>
<tr>
<td>University Neuropsychiatric Institute (UNI)</td>
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<td>VB17</td>
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<td>70 cm</td>
<td>102 x 32</td>
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<td>VB17</td>
<td>TQ-Gradients</td>
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<td>45 mT/m</td>
<td>60 cm</td>
<td>102 x 32</td>
<td>700 g/c</td>
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<td>VB17</td>
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<td>200 T/m/s</td>
<td>45 mT/m</td>
<td>60 cm</td>
<td>102 x 32</td>
<td>700 g/c</td>
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<td>Z-Gradients</td>
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</tr>
<tr>
<td>Orthopaedic Hospital</td>
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<td>Q-Gradients</td>
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<td>33 mT/m</td>
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<td>8</td>
<td>1100 g/c</td>
</tr>
<tr>
<td>South Jordan</td>
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<td>D11</td>
<td>XQ-Gradients</td>
<td>125 T/m/s</td>
<td>33 mT/m</td>
<td>70 cm</td>
<td>204 x 48</td>
<td>1100 g/c</td>
</tr>
</tbody>
</table>
Animal facilities
The Radiobiology Division, within the same building as UCAIR, has a dedicated animal facility that includes 4 individual rodent rooms, cage cleaning room, and procedure suite. The University Department of Comparative Medicine provides oversight of this facility including veterinary services. The facility is certified for the handling of radioactive materials.

The Comparative Medicine Center (CMC) is the main animal facility for the Health Sciences Center (HSC) and the Office of Comparative Medicine. It is a complex of approximately 55,000 gross sq ft and houses a variety of research animals. The original part of the complex is a conventional facility comprised of 25,000 gross sq ft. This facility contains conventional housing rooms, surgical suites, a 3,500 sq ft complex for sheep, and rodent ventilated racks. The 30,000 gross sq ft. rodent facility contains a barrier, isolation suite, biocontainment, cage wash, cubicles, housing suites, pharmacy, procedure rooms, laundry facility, two loading docks, receiving area, employee lunch room, and a central office. All OCM facilities are operated in compliance with the Good Laboratory Practices (GLP). Small Animal Imaging is available at the Small Animal Imaging Core Research Facility. http://www.cores.utah.edu/?page_id=3682

fMRI data acquisition: Each 3T Trio MR scanner is housed in an RF-shielded room especially designed for fMRI. This scanner room was designed with a special 42" plasma technology screen, which replaces the standard RF-screened window, and displays the output of fMRI-compatible video cameras mounted within the room for observation of patients. The cameras are mounted in RF-shielded housings with fiber-optic transmission lines for video output to the plasma screen and with power line filtering. These and other features reduce the RF noise within the scanner room and improve the SNR for fMRI data acquisition significantly. The 3T facility includes a stimulus-presentation computer with E-PRIME and MatLab software, for design and presentation of stimuli to subjects in the 3T scanner. The fMRI Stimulus-Presenting PC controls the presentation of stimuli according to a pre-planned paradigm, records patient responses from button box or eyetracker, and records the temporal relation between stimuli, responses, and acquired raw fMRI brain images. The scanner room contains high-quality audio-visual stimulus-presenting equipment: fMRI visual stimulus projection system with a video projector with high-resolution LCD screen, custom-designed lens with adjustable zoom for easy image focus and alignment; rear-projection screen; VGA coupler for simultaneous video display to subject and operator; magnet-compatible stereophonic audio system with ear-bud headset, noise reduction cups & break-in microphone for presentation of audio signals and communication between subject and operator. An MR-compatible, fast-response button box with 4 switches and fiber-optic interface and an infra-red eye-tracking system are provided for transmitting subject responses from within the scanner room to stimulus-presenting computer, without generating electromagnetic noise that can degrade the weak MRI signals that form the raw brain image data.

fMRI data processing and storage: The fMRI Data System, housed in UCAIR at INC, has a very fast computer for fMRI post-processing tasks and a RAID data storage system which can make the fMRI data of an entire experimental cohort available for on-line statistical analysis. In addition, UCAIR offers services such as the de-identification of fMRI data to comply with HIPAA rules for confidentiality of human subject information.

fMRI magnet simulator: The Magnet Simulator is installed in a separate room at INC, and allows investigators to acquaint the subject with the experimental setup, to acclimate subjects to the magnet environment, including the “feel” and noise of being in the magnet, to verify that subjects can visualize/hear the stimuli, and to train them on the tasks they will be asked to perform. The room has a realistic simulated scanner, with a standard magnet faceplate and headcoil, a “bore” fabricated from a fiberglass tube, and a simple patient table that rolls into the bore. The room is equipped with a stimulus-presentation computer, software, and visual stimulus presentation system consisting of an LCD screen and video splitter (for simultaneous viewing by subject and operator). The stimulus presentation and response systems appear and feel identical to those used in the actual fMRI scans. The stereo system recreates the magnet sounds, and a subwoofer mounted under the “patient table” delivers the vibration that occurs during imaging. This allows investigators to acclimate sensitive subjects - such as children or autistic subjects - to the experimental environment, and to identify those subject who are unable to perform in this environment (because of claustrophobia, excess motion, etc.), without using up expensive scanner time. Since the Simulator stimulus presentation computer is a duplicate of the one at the 3T scanner, it can also be used to set up and troubleshoot fMRI paradigms and subject protocols, and for training investigators in fMRI techniques.
Molecular Imaging Program – Huntsman Cancer Institute
Cyclotron Facility
The PET Cyclotron Radiochemistry Laboratory of the Huntsman Cancer Institute is located on the A level of the Institute Building. The facility is 3,850 square feet and includes offices, clean storage, research laboratory, quality control laboratory, synthesis lab, a class 10,000 clean room, two class 100 hoods, shipping room, electronics room, tank room and cyclotron room. The lab became operational in November 2002. The GE ETrace Cyclotron is a negative ion accelerator; 16.5 Mev protons at 70 µA; dual target simultaneous irradiation; proton or deuteron particles. There are six target configuration: F- high yield targets (2, each capable of generating 3 Ci in 60 min, simultaneously), F2 target, O-15 target, N-13 target, C-11 target in a selfshielded configuration.

Radiochemistry laboratory equipment: Exhaust Vent Radioactivity Detection System; Gas Chromatograph System; MCA System; Bioscan MiniScan TLC System; 4 CRC-15-PET single well dose calibrators + printer; CAPRAC Well/Wipe Counter + printer; Minor Emergency Spill Kit; Dose Drawing Station; Shielded Class-100 Hood for Dispensing; Two fume hoods (4 foot and 6 foot), four L-block radiation shields with 8 x 8 x 4" lead glass; Ludlum Radiation Monitoring Equipment (4); Lead bricks and shielding; two Nuclear Interface Dual FDG Synthesizer Systems with Process Control Units; 2 dual mini-cells; Misc Lab equipment: refrigerator/freezer, pyrogen oven, heater block, incubator and glassware. Dedicated research equipment: 400 sq. ft. research radiochemistry laboratory, large 44 X 44 inch research hot cell complete with negative pressure air handling, shielded dose calibrator dropout, and dose delivery dropout drawer, mini-hot cell for 15 O-water and 13 ammonia synthesis modules, and dedicated research fume hood.

Radiochemistry Facility – Huntsman Cancer Institute
We have recently expanded the radiochemistry production facilities by adding additional lead shields minicells) for more radiochemistry synthesis production capabilities. There are a total of 8 mini-cells manufactured by Jaltech to allow for synthesis units to be installed and dedicated to manufacturing a variety of research tracers. In addition a larger shielded module with remote manipulators (Capintec) is also available to allow chemists to perform manual purification of radioactive compounds in high quantities and prepare them for research applications. Commercial 15 O-water and 13 N-ammonia synthesis modules are up and running for research purposes. Additional radiochemistry research equipment includes analytical HPLC with radio and UV detectors, miscellaneous QC equipment, lead bricks, and a radiochemistry development lab with tubing, glassware, connectors, pipettes, valves, vials, electronics, etc... The laboratory has a GE TRACERlab FX/F-N™ general nucleophilic substitution synthesis unit. (http://www.gehealthcare.com/usen/fun_img/radiopharmacy/docs/tracerlabfxfn2.pdf) (http://www.gehealthcare.com/usen/fun_img/radiopharmacy/products/tracerlabfxfn.html).
This is an automated system designed for easy and efficient production of general [18F] Fluoride (nucleophilic) based tracers. The [18F] Fluoride is trapped from the 18O-water allowing one to reuse the water after careful purification if desired. The system releases [18F]Fluoride and transfers it into the organic phase with a phase transfer catalyst when reacted with a substrate. The system enables the chemist to evaporate the reactor and operates in a temperature range between 30 degrees C and 200 degrees C, purifying the integrated preparative HPLC system. To separate the product from the HPLC solvent, the system uses an integrated solid phase extraction system. Finally, the product is formulated and sterile filtered to get an injectable solution. The laboratory has a GE TRACERlab FXC Pro™ automated versatile synthesizer for easy and efficient production of [11C] labeled tracers. It facilitates methylation reactions using methyl iodide or methyl triflate produced from either carbon dioxide or methane. Purification is achieved by a integrated preparative HPLC system. Through the application software, all process steps are easily programmed to produce the required tracers. For more information see: (http://www.gehealthcare.com/usen/fun_img/radiopharmacy/products/tracerlabfxc.html)
The laboratory has purchased the GE FASTlab™ synthesis unit. This system is an automated PET radiochemistry synthesis platform. Beyond delivering the speed, efficiency, economy and regulatory answers required to meet today’s busy PET radiochemistry demands, FASTlab also offers the versatility and flexibility to develop and produce additional fluoride-based tracers such as FLT and numerous other radiopharmaceuticals thus ensuring the capacity to always keep ahead of future molecular imaging applications. For more information see: (http://www.gehealthcare.com/usen/fun_img/radiopharmacy/products/fastlab.html)
The laboratory also has available a BioScan AutoLoop 11C-Methylation System (Mel Plus, Autoloop, and Reformulation) which uses the proprietary “Loop” technique developed and patented by Alan Wilson and
coworkers at the Centre for Addiction and Mental Health (CAMH) and the University of Toronto. This unit uses a standard 11C-methylation reaction carried out in a stainless steel HPLC injection loop with very small amounts of solvent (less than 100µL) and precursor (0.1-1.2mg). Methyl iodide or Methyl triflate is trapped by dissolution in the solvent (trapping efficiencies are >90%), and the reaction proceeds in the closed-off loop at room temperature for 1 to 5 minutes depending on the compound. When the reaction is complete, the contents of the loop are rinsed by the HPLC solvent directly onto a semi-prep column for purification. Included with the systems is P.E.T. Empower software which is a GLP/cGMP compliant software package for Bioscan’s P.E.T. tracer chemistry modules. For the Auto-Loop systems, several key features help speed method development for research chemists. Once developed, methods can be secured and used by technicians for reliable, routine production.

PET Imaging facility of the Huntsman Cancer Institute

GE Advance high-resolution BGO PETscanner: The scanner, installed in Fall 2000, can perform imaging in both 2D and 3D acquisition modes for both clinical and research procedures. The scanner has 12,096 BGO crystals and achieves 4.25mm slice resolution with a maximum scan length of 1589 mm. Transmission imaging for attenuation correction is performed using two 10 mCi Germanium-68 rod sources. Images may be quantitated using image conversion to Standard Uptake Values (SUV). Through a research agreement with GEMS we have complete access to all raw data, calibrations, and normalizations on this system, permitting complete research reconstruction and analysis.

A Siemens fully-3D Biograph LSO PET/CT scanner with 16 slice CT was installed in February 2004. The LSO crystal technology allows very fast imaging at high count-rates, permitting very fast whole-body imaging and high quality imaging of short-lived radiotracers. Through a research agreement with Siemens Medical Systems, we will have complete access to the raw data, including list-mode data access, for research purposes on this system. This scanner will be installed in the Huntsman Cancer Research Hospital imaging facility.

SPECT and Nuclear Medicine

Equipment includes IRIX 3-head gamma-camera with coincidence-detection electronics, and includes all collimators (such as custom research variable-focal length fan-slat collimators etc).

Equipment owned by the Huntsman Cancer Hospital and housed there

Siemens Biograph 16 PET/CT
Siemens 1.5T Avanto MRI
Siemens Sensation 16 CT
Siemens Artis MP multi-purpose angiographic system
Siemens E-Cam gamma camera
Siemens Sirescope SD R&F system
Siemens Novation digital mammography
Siemens Acuson Sequoia ultrasound
Hologic bone densitometer