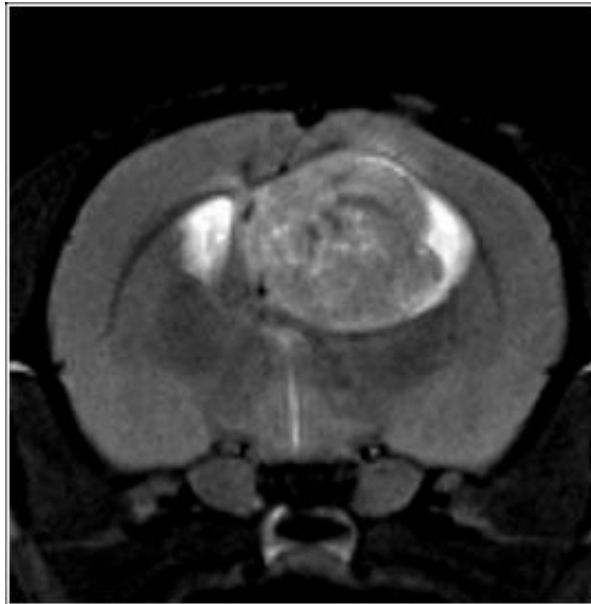


QUESTIONS THAT NEED TO BE ANSWERED DURING SESSION ON SMALL ANIMAL IMAGING



1. Who can use the MRI scanner?
2. How do I book time on the MRI scanner?
3. What do I need to know before entering the MRI room? Are there any dangers associated with being near high magnetic field?
4. What is MRI?
5. What are the main parts of an MRI system?
6. What equipment do I need to turn on before the scan?
7. I see a red button in the scanning room. Is this button for turning off the magnet?
8. What are RF resonators (coils) used for?
9. Why do you have so many RF resonators? How do I decide which one to use?
10. Why do you have so many animal beds? How do I decide which one to use?
11. How do I position the animal in the scanner?
12. How do I administer the anesthesia to the animal during the scan?
13. How do I keep the animal warm during the scan?
14. How do I set up equipment for animal monitoring (respiration, temperature, ECG)?
15. The animal was breathing nicely and regularly but suddenly the breathing stopped during a scan. What shall I do?
16. How do I get an account on the computer that runs the scans?
17. What is the program that controls the scanner?
18. How do I start the first scan?
19. How should I name the patient/registration/study/scan?
20. What are all these ParaVision windows for?
21. What is a Tri-Pilot?

22. What are all these adjustments before the first scan starts?
23. What if I get no signal/image after running the Tri-Pilot?
24. What if the scan does not start?
25. What is the high sound coming from the scanner during scanning? Does it influence the animal?
26. How do I view the finished scan(s)?
27. I see an image on the screen but not of the part of the body I am interested in. What shall I do?
28. How do I load a new scan?
29. What are protocols? How do I create my own protocol and save it in my own folder on the system?
30. What does it mean to clone scan/clone reco?
31. What is the difference between undoing and deleting scan/reco?
32. How do I adjust the geometry of the scan?
33. How do I adjust the basic scan parameters like FOV (field-of-view), resolution, matrix size, TE (echo time), TR (repetition time), etc...
34. There are so many protocols available on the scanner. How do I decide which one is right for my application?
35. What methods exist in PV5.1 for looking at the anatomy?
36. What methods exist in PV5.1 for measuring function?
37. My image looks strange. There are some imaging artifacts present. What shall I do?
38. I thought I knew/understood how to scan, but now I cannot remember some important details. Is there a manual that I can refer to?
39. My project requires some special adjustments to the existing sequences that I cannot do myself. Who can help me?
40. What kind of analysis can I do in ParaVision 5.1?
41. What other software can I use for data analysis?
42. How do I transfer data to my computer?
43. What do I need to do when I am done scanning?
44. Which equipment do I need to turn off when I am done scanning?
45. There is a log book here... what shall I write in it?
46. How do I clean the animal bed and the table?
47. Where do I store my equipment (isoflurane, syringes, catheters)?
48. I would like to learn more about NMR/MRI. Where do I start?

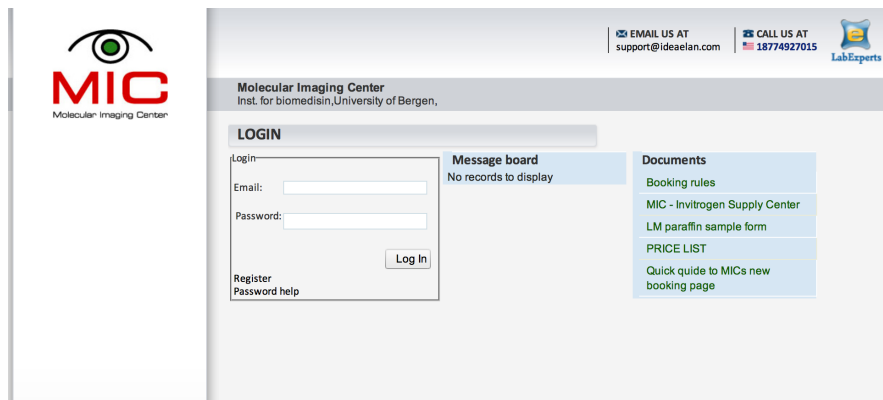
1. Who can use the MRI scanner?

- Internal (UiB) and external (national, international) researchers which:
 - Have either been [trained by MIC](#) personal to use the scanner or have demonstrated competence in MRI
 - Have [completed animal handling course](#) (if scanning animals) and are certified FELASA category C Researchers in Laboratory Animal Science (exception applies if not scanning animals)
 - Have [no medical condition](#) (such as metallic implants, pacemakers, etc) that would prohibit them from being in the high-field environment
 - Have [registered](#) with and obtained a user account at MIC (Molecular Imaging Center at UiB)

2. How do I book time on the MRI scanner?

- Go to <http://elabexperts.com/bergen/Public/FacilityLogin.aspx>
- Register
 - For help on registering see: https://wikihost.uib.no/mriwiki/images/6/61/Quick_guide_to_MICs_new_booking_page.pdf
- We will approve you as a user:
 - After you have been trained by [MIC personnel](#) in MRI safety and informed about our Policies and Regulations.
- Log into the booking site using your email and password you have chosen
- Book the time slots in the booking calendar
- Familiarize yourself with user and booking rules

2. How do I book time on the MRI scanner?



The screenshot shows the Molecular Imaging Center (MIC) website. The header includes the MIC logo (an eye icon) and the text "Molecular Imaging Center". To the right, there are contact details: "EMAIL US AT support@ideaelan.com" and "CALL US AT 18774927015", along with a "LabExperts" logo. The main content area is titled "LOGIN" and features a login form with fields for "Email:" and "Password:", a "Log In" button, and links for "Register" and "Password help". To the right of the login form is a "Message board" section with the text "No records to display". Further right is a "Documents" section with a list of links: "Booking rules", "MIC - Invitrogen Supply Center", "LM paraffin sample form", "PRICE LIST", and "Quick guide to MICs new booking page".

3. What do I need to know before entering the MRI room?

- Safety rules regarding potential risk and dangers of being in a high-field environment
- Safety procedures in case of accident or damage to the equipment

A wealth of information and videos on MRI safety can be found here

✓ <http://www.imrser.org/genpg.asp?pgname=VideoList>

and on YOUTUBE:

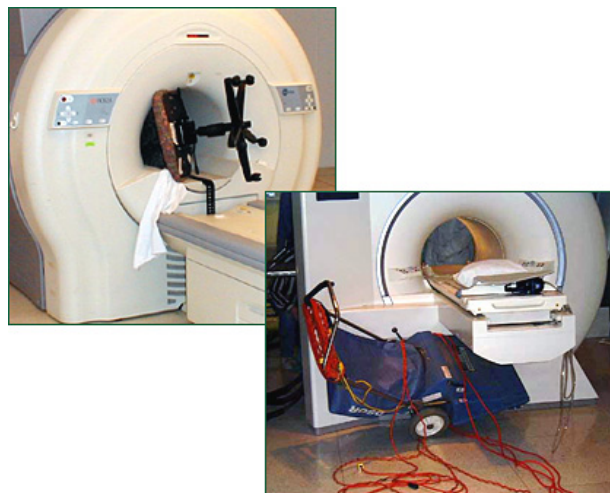
✓ http://www.youtube.com/watch?v=HufSI_rfHLA

✓ <http://www.youtube.com/watch?v=IEJ2notNLo0>

3. Safety Cont: Projectile or missile effect

- **DANGER:** Metallic object become magnetized near a strong magnetic field and therefore attracted to the center of the magnet. Since the magnetic field is always ON, this long-distance magnetic force is ALWAYS present. If metallic object project into bore of the magnet, they can damage RF equipment and/or injure the animal.
- **EXAMPLE:** Animal surgical tools, animal ear clippers, mechanical tools such as screwdrivers, wrenches, etc...
- **SOLUTION:** No metallic objects are allowed into the MR room. Use titanium and plastic tools when needed.

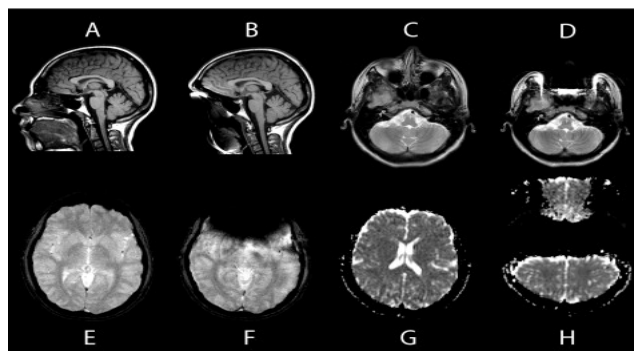
3. Safety Cont: Projectile or missile effect



3. Safety Cont: Implants and Foreign Bodies

- **DANGER:** Implants and foreign bodies can be ferromagnetic or metallic, which means that they interact with the magnetic and RF fields and can lead to:
 - Trauma caused due to movement of the object in the magnetic field
 - Thermal injury from radio-frequency inductive heating of the object
 - Failure of the implanted device
- **EXAMPLE:** pacemakers, vagus nerve stimulators, defibrillators, insulin pumps, deep brain stimulators, surgical prostheses, aneurysm and surgical clips, shell fragments.
- **SOLUTION:** Do not enter the MR room if you have any implants or foreign bodies.
- **NOTE:** This potential danger applies also to your animals. Make sure your animal does not have any metallic surgical clips or non MR-compatible labeling chips implanted under the skin.

3. Safety Cont: Implants and Foreign Bodies



Distortion caused by stainless steel brackets detected by the 4 MRI sequences: A , Essix trays, sagittal T1-weighted image; B , stainless steel brackets, sagittal T1-weighted image; C , Essix trays, axial T2; D , stainless steel brackets, axial T...

J. Matthew Elison , V. Leroy Leggitt , Matthew Thomson , Udo Oyoyo , N. Dan Wycliffe

Influence of common orthodontic appliances on the diagnostic quality of cranial magnetic resonance images

American Journal of Orthodontics and Dentofacial Orthopedics Volume 134, Issue 4 2008 563 - 572

<http://dx.doi.org/10.1016/j.ajodo.2006.10.038>

3. Safety Cont: Cryogenics

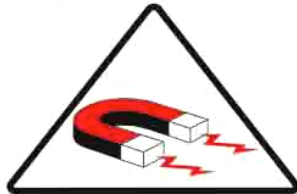
- **DANGER:** A superconducting magnet can *quench*. This can occur spontaneously (although rarely) and it involves a rapid boiling of liquid He from the magnet. As liquid He is converted into gas at room temperature, it expands rapidly through the quench pipe and also into the MR room, where it displaces oxygen and presents a risk of asphyxiation.
- **SOLUTION:** In case of a quench, leave the MR room immediately and shut the door behind you.

3. Safety Cont: Cryogenics



Always Remember....

DANGER!
Restricted Area



**Powerful Magnet
 Always On**



ICD's (Implant Cardioverter Defibrillators) and Cardiac Pace Makers are NOT ALLOWED.
 Individuals with implants, devices or objects of a metallic, electronic, magnetic or mechanical nature are not permitted into this area. Injury or death may result.
 If you are unsure if this pertains to you **DO NOT ENTER**, consult a radiologist or MRI Technologist.



No loose ferrous (metal) items allowed.
 Injury, death or property damage may occur. Cell phones, hearing aids, PDA's and other electronic items may be damaged.



• **NO CARDIAC PACEMAKERS OR IMPLANTABLE CARDIOVERTER DEFIBRILLATORS (ICDs)**

Persons with certain metallic, electronic, magnetic, or mechanical implants, devices, or objects may not enter this area. **Serious injury may result.**

Do not enter this area if you have any question regarding an implant, device, or object. Consult the MRI Technologist or Radiologist.



• **NO LOOSE METAL OBJECTS**

Objects made from ferrous materials must not be taken into this area. **Serious injury or property damage may result.** Electronic objects such as hearing aids, cell phones, and beepers may also be damaged.

4. What is MRI?

MRI is an imaging technique (based on **nuclear magnetic resonance**) for visualizing detailed structures and to some extend function in the body

You will find a nice condensed description of MRI on Wikipedia:

✓ <http://en.wikipedia.org/wiki/Mri>

and on YOUTUBE:

✓ http://www.youtube.com/watch?v=6_2D3Lh1v74&NR=1

5. What are the main parts of an MRI system?

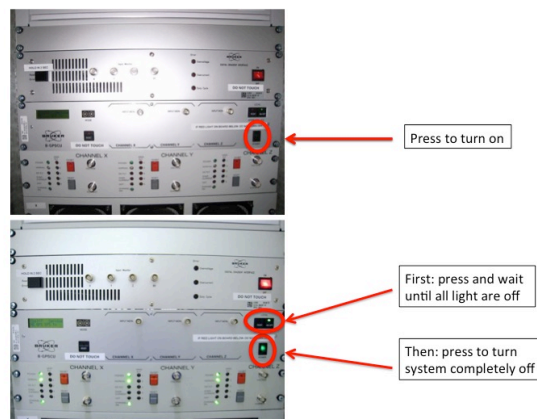
Major components of an MRI scanner are:

1. main magnet, which polarizes the sample
2. shim coils for correcting inhomogeneities in the main magnetic field
3. gradient system, which is used to localize the MR signal
4. RF system, which excites the sample and detects the resulting NMR signal
5. One or more computers which control the entire system



6. What equipment do I need to turn on before the scan?

- Main power switch in the first cabinet in the electronics room (this cabinet contains high-power electronics which should be turned off after use)



6. What equipment do I need to turn on before the scan?

- Water heater and circulation for keeping the animal warm during the scan (REMEMBER: always connect the heating blanket before turning on the water circulation unit, otherwise the water might leak out at the end of the water tube near the scanner!)



6. What equipment do I need to turn on before the scan?

- Animal monitoring and gating PC for reading the temperature and respiration rate of the animal during the scan, as well as while positioning and stabilizing the animal on the bed before the scan.



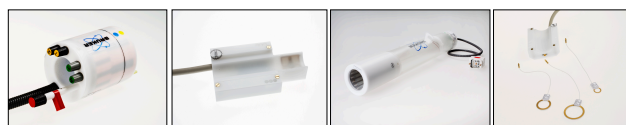
SA Instruments, Monitoring and Gating System

7. I see a red button in the scanning room. Is this button for turning off the magnet?



- No! The magnet is always on!
- The red button turns off the main power to the MR room, the green button turns it back on.
- You should press the red button if:
 - The scanner is transmitting RF power (i.e., pulsing) non-stop and you are not able to terminate it within Paravision
- You should press the green button if:
 - The electronics (see previous slide) does not power up when you turn it on. This can occur once each month after the main power in Vivarium is re-set.

8. What are RF resonators (coils) used for?



- They are used for MR signal transmission and reception
- Our system uses a single-coil configuration, which means that the same coil is used for transmission and reception.

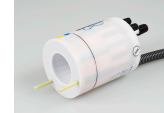
ASIDE:

- More sophisticated systems use a dual-coil configuration, where each coil is optimized for either transmission or reception. Dual-coil systems in general require tuning and matching procedure to be performed before each scan.
- Our RF coils are pre-tuned and pre-matched:
 - GOOD in that the system is simple and easy to use
 - BAD in that that the RF resonators are optimized for particular loads (typical mouse and rat), so they are not optimal for other applications

9. Why do you have so many RF resonators? How do I decide which one to use?

We have 6 types of RF resonators/coils:

1. Rat body (volume, quadrature)
2. Rat head/mouse body (volume, quadrature)
3. Rat brain (surface, phased array)
4. Mouse head (volume, quadrature)
5. Mouse brain (surface, phased array)
6. Loop Coils (10-, 20-, 30 mm)



10. Why do you have so many animal beds? How do I decide which one to use?

We have several types of animal beds to be used with the RF coils.

The beds consist of a rat/mouse bed base + a bed tip which is RF coil specific (exception is bed for rat body which has no tip):

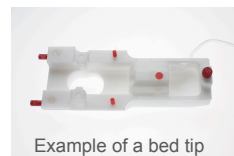
1. Bed for rat body → used with rat body RF coil
2. Rat bed base + Bed tip for rat head volume coil
3. Rat bed base + Bed tip for rat brain surface coil
4. Mouse bed base + Bed tip for mouse body volume coil
5. Mouse bed base + Bed tip for mouse head volume coil
6. Mouse bed base + Bed tip for mouse brain surface coil



Bed for rat body imaging



Rat/mouse bed base

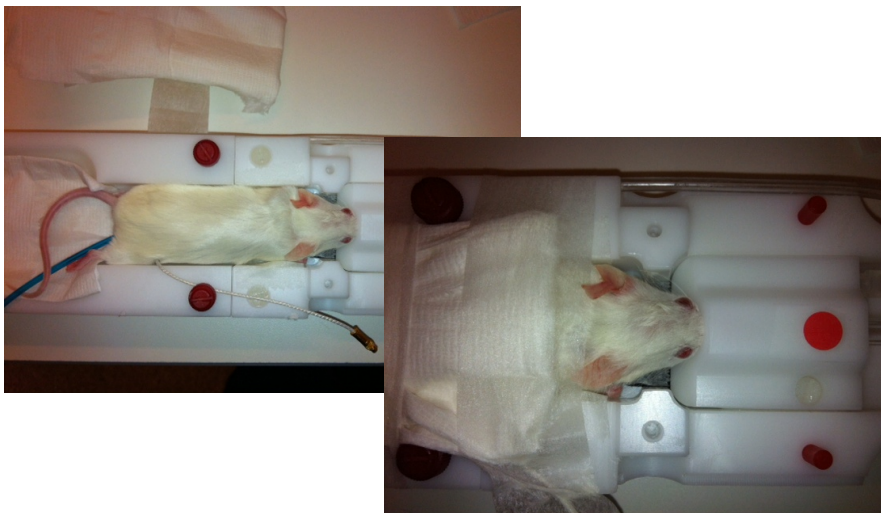


Example of a bed tip

11. How do I position the animal in the scanner?

- Position the animal onto the appropriate animal bed, belly down (i.e., in a prone position)
- Hook the animal teeth around the plastic mouth piece
- Pull the animal into the mask and tighten the screw of the rod
- Attach animal monitoring and gating equipment
- Tape the animal down to minimize motion due to respiration
- Cover the animal with a heating blanket
- Slide the animal bed into the magnet
- TriPilot scan will tell you if you are in the right position within the scanner. If needed, push/pull the bed in/out of the scanner.
- If doing a study, mark the correct position on the white tape which is glued to the animal bed slider

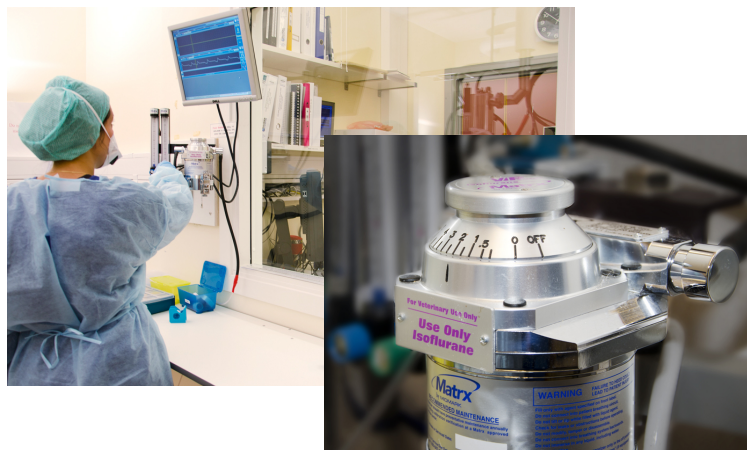
11. How do I position the animal in the scanner?



12. How do I administer the anesthesia to the animal during the scan?

- We use gas anesthesia, which consists of:
 - Isoflurane (1.5%-2% in volume)
 - N₂O (laughing gas) and O₂ as carrier gases:
 - For rat use: 400 ml/min N₂O and 400 ml/min O₂
 - For mouse use: 50 ml/min N₂O and 200 ml/min O₂
- Make sure the vaporizer is filled with isoflurane before you start scanning
- Start the gas flow and turn on the isoflurane a few minutes before you begin to scan to fill the dead space in the tube
- Position the animal (see previous slide) and pull the animal's nose into the anesthesia mask. Be careful not to overextend the neck—it might obstruct the respiratory pathway and cause animal to suffocate
- Monitor animal's respiration (and temperature) throughout the scan

12. How do I administer the anesthesia to the animal during the scan?



13. How do I keep the animal warm during the scan?

- Using warm recirculation water system connected to a “heating blanket” or to the animal bed base directly.
 - Note: The mouse bed base does not provide sufficient heating for imaging of mice body, so use heating blanket.
- The heating blanket should conform to the animal body:
 - For rats use the big blue blanket, positioned either on the bottom or on the top of the animal
 - For mice use small, home-made blanket (tubing), positioned on the top of the animal
- Make sure to cover the tail of the animal. Mice lose a lot of heat through the tail.
- If you are doing a head-scan, you can cover the animal with some cloth to keep it warm; if you are doing a body-scan, you will have limited space for the blanket.

14. How do I set up equipment for animal monitoring?

1. RESPIRATION MONITORING
 - Connect the pillow (pressure sensor) to the respiration module of the animal monitoring and gating system
 - Position the pillow on the side of the animal, in the abdominal region (pay attention to the placement of paws – they should be placed away from the pillow)
2. CARDIAC (ECG) MONITORING
 - Remove a small portion of skin from the paws of the animal
 - Attach the ECG leads to the paws
 - Twist the ECG cables around each other
 - Connect the ECG cables to the temperature/ECG module
3. TEMPERATURE MONITORING
 - Connect the temperature probe to the battery
 - Insert the temperature probe into the rectum of the animal
 - It is best to tape the temperature probe onto the bed (rather than the animal's tail) to keep it in place during the scan

15. The animal was breathing nicely and regularly but suddenly the breathing stopped during a scan. What shall I do?

- You can wait 20 sec to see if the breathing resumes, but this is rarely beneficial since:
 - You risk to lose the animal
 - You will most likely have artifacts in the image
- Interrupt the scan by pressing the STOP button
- Take the animal out of the scanner
- Disconnect the animal from anesthesia
- If the animal does not start breathing on its own, start resuscitation of the animal (clear the airway passage, use black air pump to force the air into the lungs, tap the heart)

16. How do I get an account on the computer that runs the scans?

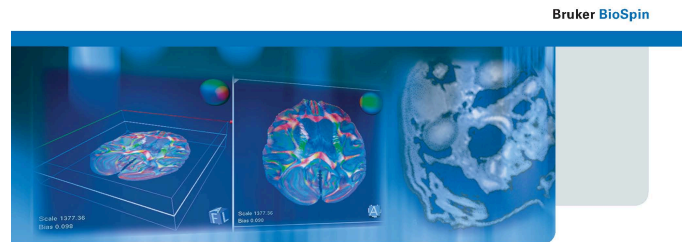
You can request an account if:

1. You are trained as a user on the MRI scanner and
2. You have registered with MIC

email tina.pavlin@biomed.uib.no or kai.brandt@cih.uib.no

17. What is the program that controls the scanner?

- PV 5.1 (Paravision 5.1)



- **ParaVision 5.1**
Users Manual

18. How do I start the first scan?

There are several ways, but the following is probably the easiest:

- Create a new patient by clicking on the “New Patient” icon
- A window pops up → Fill in the patient name and registration, press OK
- A window pops up → Fill in the name of the study and select the location of the folder where your scanning protocols are stored, press OK
- A window pops up → Load a TriPilot (**TriPilot must always be the first scan you do!**)
- Press the traffic light

19. How should I name the patient/ registration/study/scan?

This is what we recommend:

1. PATIENT:

- LoginName_InitialsOfPersonScanning_rat/mouseID
- NOTE: the patient name does not appear in the file structure of the raw data (only the DICOM data), so you will not be able to distinguish raw data folders based on the patient name

2. REGISTRATION

- YYMMDD_rat/mouseID
- NOTE: the registration number is unique and linked to each patient, it appears as the name of the raw data folder in location /Datadisk/data/user/nmr/, as well as the beginning part of the name of the DICOM folder.

19. How should I name the patient/ registration/study/scan?

3. STUDY

- There are many choices for study name, but some examples are:
 - PRE and POST treatment
 - WEEK1, WEEK2, WEEK3, etc, if you are following disease progression or effect of treatment/drug over time
 - CONTROLS and TREATED animals (but note that in this case the two studies will be associated with two different patients)

A GENERAL COMMENT: Although the naming of the patient/registration/study should be a “no-brainer”, it is one thing that is causing problems and confusion to a lot of users. We advise you the following:

- Try to stick to the our convention for naming patient/registration/study
- Keep a good logbook of the scans you did so that you can refer to it when searching for the data on the system

20. What are all these ParaVision windows for?

Most of the time you will be using the following windows:

- SYSTEM CONTROL
 - This is the main window which allows you to access all other tool (windows) as well as to properly exit Paravision
- SCAN CONTROL
 - For creating new and loading existing patient/studies/scans
 - For accessing image geometry and scan parameters (EDIT SCAN)
 - For starting/stopping the scan
- IMAGE DISPLAY & PROCESSING
 - For displaying and processing images
- ACQ/RECO DISPLAY
 - Shows real time acq data (i.e. echoes) and reconstruction of the data
 - Useful particularly when monitoring the initial adjustments (f_0 , shim, gains)

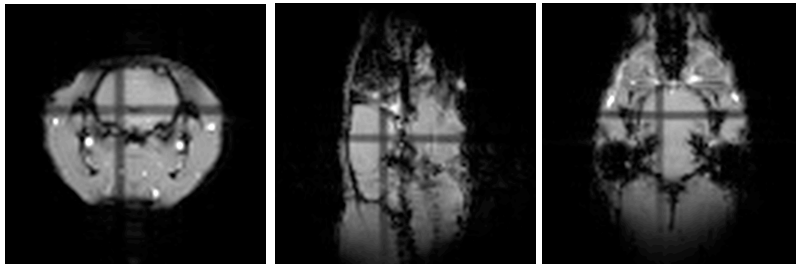
20. What are all these ParaVision windows for?

In addition, you will often need the following:

- DATA MANAGER
 - For converting data to DICOM format
 - For sftp-ing data
 - For deleting data
- MACRO MANAGER
 - For accessing macros (automated tasks from Bruker and the individual user)

21. What is a Tri-Pilot?

- A TriPilot is a fast scan that collects three slices (axial, coronal, sagittal) in the iso-center of the magnet to facilitate slice positioning using geometry editor



22. What are all these adjustments before the first scan starts?

- Whenever a new patient OR a new study is created, the scanner performs the following automatic adjustments:
 - Central frequency: O1 (i.e., finding the correct Larmor frequency)
 - Shimming (adjusting the magnetic field homogeneity)
 - Transmit gain: TX0 and TX1 (adjusting the strength of the 90 degree pulse)
 - Receiver gain (adjusting the gain/amplification of the receiver)
- You can force these adjustments to execute any time by pressing SHIFT + TRAFFIC LIGHT
- In addition, the RG adjustment is performed each time you press the TRAFFIC LIGHT, **unless** you run the scan in the GOP MODE (this is useful when you want to run a series of scans with absolutely the same settings)
- You should repeat the adjustments every time you reposition the animal

23. What if I get no signal/image after running the Tri-Pilot?

Perform the following steps in the order below:

1. Check that the animal/phantom is in the right position
2. Check if the RF resonator is connected to the preamplifier at the back of the magnet
3. Turn off and then back on the main power on the spectrometer
4. Restart the computer running Paravision
5. Call Tina or Kai

24. What if the scan does not start?

- Check that the sequence you are using does not have the TRIGGER module activated in the PREPARATION section of the EDIT METHOD tool. If so:
 - If the imaging protocol DOES NOT require you to trigger, then de-select the triggering module
 - If the imaging module DOES require you to trigger, then connect the triggering equipment

25. What is the high sound coming from the scanner during scanning?

- The sound is due to the current expanding and contracting gradient coils.



26. How do I view the finished scan(s)?

- To view and analyze the finished scans you need to load the completed scans into the IMAGE DISPLAY AND PROCESSING WINDOW. There are several ways of doing this:
 1. To view only the middle frame (e.g., slice): select the scan, press the middle mouse button, drag the scan to a viewing window, release the middle button
 2. To view all frames of the completed scan:
 - a) same as above + press ALL in the bottom of the IMAGE DISPLAY AND PROCESSING WINDOW
 - b) Press SHIFT + middle mouse button, drag the scan to a viewing window, release

27. I see an image on the screen but not of the part of the body I am interested in. What shall I do?

- You need to reposition the animal:
 - If the anatomy of interest is too low on the screen on the coronal scan, you need to push the animal bed into the magnet
 - If the anatomy of interest is too high on the screen on the coronal scan, you need to pull the animal bed out of the magnet
- You can determine the exact distance by which you need to move the animal using the RULER tool in IMAGE DISPLAY AND PROCESSING tool:
 - Click on the RULER tool
 - Left-click on the part of the image which you would like to have in the center of the screen and drag the pointer to the center
 - Press OK (top right corner of the window)
 - Read the distance next to the ruler line

28. How do I load a new scan?

- Most straightforward way
 1. Press NEW SCAN icon in the SCAN CONTROL tool, click on the location window and choose the folder where you have stored the protocol, click on the protocol, press ACCEPT. This is particularly useful when running an animal study and all the necessary protocols have been finalized and stored in the user's folder
- Other possibilities
 1. Right click on the last completed scan and select CLONE SCAN. This will clone all the scan parameters. If you want to change any of the parameters, select EDIT SCAN tool. This is particularly useful when you are optimizing scan parameters, one at a time
 2. If you have a READY/NEW scan on the list and you would like to load a different/new scan protocol: right click on the scan and select LOAD SCAN PROTOCOL

29. What are protocols?

How do I create my own protocol and save it in my own folder on the system?

- **Scan protocol is a collection of scans (measuring methods with particular parameter values) which were created for a particular study (e.g., tumor characterization in rat brain, perfusion in mice, etc..)**
- After you have optimized a pulse sequence:
 - Right click on a completed scan and choose EDIT SCAN
 - A new window appears, click on STORE
 - A new window appears, click in the LOCATION field
 - A new window appears. If creating a new location: right-click anywhere inside the window, chose NEW, and type the Name of the NEW-LOCATION (something that is easy for you to remember). If storing in an existing location: double-click on an existing location
 - Choose the NAME for the pulse sequence. It is useful to label the sequences with a number denoting their order in a protocol (e.g., 1_TriPilot, 2_FLASH_axial, 3_DTI, etc.) so that they appear in an ordered list when you are loading them during a scan



30. What does it mean to clone scan/clone reco?

- **CLONE SCAN:** When cloning a scan (either READY or COMPLETED), a new ready scan is generated with exactly the same acquisition parameters as the old scan. The new scan is a clone of the old scan and appears in the scan list in the *READY* mode
- **CLONE RECO:** When cloning a reconstruction (only from a COMPLETED scan), raw data will be cloned/copied, but not reconstructed .
- To clone a scan/clone a reco:
 - Right click on the scan you want to clone
 - Select CLONE SCAN/CLONE RECO


31. What is the difference between undoing and deleting scan/reco?

- **UNDO SCAN** = delete the acquired data, but leave the scan in the READY mode for a new acquisition
- **DELETE SCAN** = delete the scan completely from the computer memory and therefore from the scan overview list
- **UNDO RECO** = delete reconstruction, but not the acquired raw data (can be useful when a reconstruction fails). Scan will appear as NOT RECONSTRUCTED in the scan list.
- **DELETE RECO** = used only if you have generated additional reconstruction of data (e.g., 1:5:2) where number 2 denotes second reconstruction

32. How do I adjust the geometry of the scan?

- Click on  in scan control tool. A GEOMETRY EDITOR opens.
- **LOAD REFERENCE**: This tool allows you to load a previous scan as the reference image for the new scan.
- **IMPORT GEOMETRY**: Use this option if you would like to import geometry from a previous scan (very useful when you need to collect an image with different pulse sequences, but same geometry)
- Click on  in the GEOMETRY EDITOR to adjust the slice position, slice angle, slice thickness, interslice distance, FOV and various offsets
- Confirm your selection by clicking ACCEPT in all windows
- You can read more about *GEOMETRY EDITOR* in *OPERATION MANUAL*, Chapter 5 (O-5)

33. How do I adjust the basic scan parameters like FOV (field-of-view), resolution, matrix size, TE (echo time), TR (repetition time)?

- Click on EDIT SCAN  in the scan control tool
- Under EDIT SCAN you have the following submenus:
 - **Standard:** here you can access parameters which are varied most often
 - **Geometry:** here you access geometry parameters such as FOV, matrix size, slice orientation, slice thickness, inter-slice distance, number of slices...
 - **Contrast:** here you can access parameters that determine contrast in the MR image, such as TR, TE, flip angle, fat, motion and flow suppression...
 - **Research:** allows access to EDIT METHOD
- You can read more about *SCAN EDITOR* in *OPERATION MANUAL*, Chapter 3 (O-3)

34. There are so many protocols available on the scanner. How do I decide which one is right for my application?

- There is no easy and straightforward answer to this questions, but here are some suggestions:
 - You can start first with Bruker protocols: either with their templates (Bruker_templates), or with protocols which were optimized for a specific application (e.g., Bruker_cardiac, Bruker_relaxography, Bruker_angio...).
 - MIC has optimized protocols for some basic applications, such as MIC_rathead_tumor, MIC_mousebody_fat, etc.
 - Search literature to see what other researchers are using for a similar application/animal model.
 - Consult with other users of MIC MRI system to see what they are using and if they have designed something that might be useful to you.

35. What methods exist in PV5.1 for looking at the anatomy?

- **B_ANATOMY**
 - Sequences designed for anatomical imaging, especially suited for imaging the brain
 - FLASH, RARE, TurboRARE, MSME, FISP, etc.
 - 2D AND 3D sequences
 - T1 contrast, T2 contrast, PD (proton density) image
- **B_ABDOMEN**
 - Triggered sequences for imaging of the abdomen
 - FLASH, Snap, TurboRARE, Non-triggered IntraGate
 - 2D and 3D
 - T1 contrast, T2 (and T1) contrast
 - Note: All triggered sequences require you to adjust the TR time to respiration cycle (TR \leq respiration time)!
- **B_RELAXOMETRY**
 - Sequences designed for measuring T1, T2 and T2* relaxation times in each voxel (so-called T1, T2, and T2* maps)
 - MGE for T2* map, MSME for T2 map
 - FISP and RARE for T1 + T2 map.

36. What methods exist in PV5.1 for measuring function?

- **B_ANGIOGRAPHY**
 - Sequences designed for imaging blood flow
 - FLASH-3D, FLASH-TOF-2D (without and with flow compensation), PCA-2D (Phase Contrast Angiography), Velocity-map
 - 2D AND 3D sequences
- **B_DIFFUSION**
 - Sequences designed for imaging diffusion of water
 - EPI (Echo Planar Imaging)-diffusion-map, EPI-diffusion-tensor, EPI-diffusion-weight, SE (Spin-echo)-diffusion-weight
 - EPI is a very fast sequence, but known for many artifacts
- **B_PERFUSION**
 - Sequences designed for imaging blood perfusion (note, different from flow)
 - EPI-T2star-FOVsat, FAIR-global, FAIR-selective
 - These sequences are based on Arterial Spin Labeling methods and have not yet been tested on our Pharmascan system

36. What methods exist in PV5.1 for measuring function?

- **B_fmRI**
 - Sequences designed for functional MRI
 - EPI-FID_FOVsat (T2* weighting), EPI-SE-FOVsat (T2 weighting)
- **B_CARDIO**
 - Sequences designed for cardiac imaging using prospective triggering (using ECG signal)
 - FISP-cine, FLASH-cine, FLASH-cine-blackblood, FLASH-cine-tagging, FLASH-multi-slice, Velocity-map (NOTE: cine means movie mode)
- **B_INTRAGATE**
 - Sequences designed for cardiac imaging using retrospective trigger (done in post-processing)
 - IG-FLASH-cine (single slice), IG-FLASH-sat-cine (multi slice, can have blackblood contrast)
- **B_SPECTROSCOPY**
 - Sequences designed for spectroscopy and spectroscopic imaging
 - Sequences for evaluation of linewidths: SINGLEPULSE
 - Shimming protocol: FASTMAP
 - Spectroscopy: PRESS-1H, : PRESS-waterline, STEAM-1H, STEAM-waterline
 - Chemical shift imaging: CSI, RARE-CSI

37. My image looks strange. There are some imaging artifacts present. What shall I do?

- Imaging artifact can have many causes and sometimes are very hard to identify.
- You can read more on imaging artifact here:
 - <http://www.mritutor.org/mritutor/artifact.htm>
 - <http://www.mr-tip.com/serv1.php?type=art>
- You can contact Tina (tina.pavlin@biomed.uib.no) or Frits (frits.thorsen@biomed.uib.no) for help .

38. I thought I knew/understood how to scan, but now I cannot remember some important details. Is there a manual that I can refer to?

- Consult Paravision manual
 - Can find the manual under HELP in Paravision OR
 - Download PV 5.1 manual here <http://vedlegg.uib.no/?id=656c7c2454029d0e883614c291a9fcb9> OR
 - You can consult previous Paravision versions as well. You can find hard copies of PV 3.0 manual in the lab.
- PV manual consists of the following sections:
 - System Manual (only available in hard copy for PV 3.0): System components, hardware, etc.
 - **Operation: A must read for everyone starting to work with PV**
 - Application: Experimental procedure, protocols, explanation of pulse sequences...
 - Advanced: For advanced user

39. My project requires some special adjustments to the existing sequences that I cannot do myself. Who can help me?

- Tina: tina.pavlin@biomed.uib.no
- Frits: frits.thorsen@biomed.uib.no
- Kai: kai.brandt@cih.uib.no
- Other users

40. What kind of analysis can I do in ParaVision 5.1?

- ROI (region-of-interest) analysis
 - Used for computing ROI statistics
 - Examples: Average signal amplitude, average noise, signal-to-noise (SNR) calculations
- ISA (image sequence analysis) tool
 - Used for fitting various functions to a sequence of images
 - Examples: T_1 , T_2 , T_2^* and diffusion coefficient estimations, fitting dynamic scan data
- DTI (diffusion tensor imaging) tool
 - We currently do not have a license for this tool

41. What other software can I use for data analysis?

- ImageJ:
 - <http://rsbweb.nih.gov/ij/>
- OsiriX (for mac):
 - <http://www.osirix-viewer.com>
- OsiriS (for windows):
 - http://www.sim.hcuge.ch/osiris/01_Osiris_Presentation_FR.htm
- More resources:
 - <http://www.medical-image-processing.info/DICOM/index.htm>
 - <http://www.rtstudents.com/pacs/free-dicom-viewers.htm>

42. How do I transfer data to my computer?

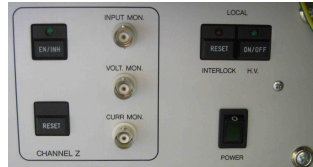
- Two kinds of data:
 - Raw data, stored in /Datadisk/data/username/nmr/
 - DICOM data, stored in /opt/DICOM
 - ✓ DICOM data can be created by using Data Manager, selecting the patient in the list, right clicking on the patient and selecting *Transfer immediately*
- Can use a USB stick or external hard drive for data transfer
- Open two windows:
 - One window showing external hard drive directory
 - One window showing either Raw data or DICOM data directory
- Copy and paste the data from the data directory to the external hard drive directory
- See TransferringMRData document for more details

43. What do I need to do when I am done scanning?

- Log into the blue book in the control room (see 2 slides down)
- Turn off power in the first cabinet with high power electronics and the hot water circulation system (see next slide)
- Turn off/disconnect all anesthesia gases (see below)
- Refill the Isoflurane vaporizer to the point you found it
- Clean the animal bed and table
- Remove and store any equipment that is particular to your experiment (syringes, venflons, tubes, etc...)
- Tidy up behind you
- Switch off the light in the MR room
- Lock the doors behind you

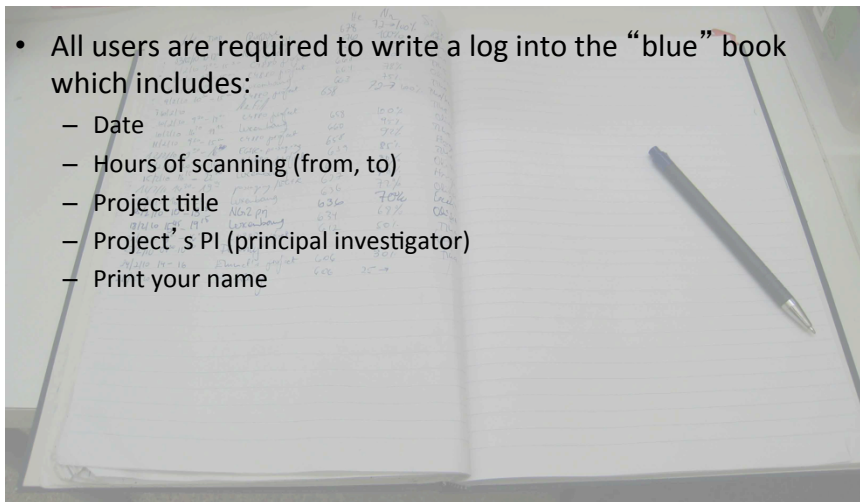
44. Which equipment do I need to turn off when I am done scanning?

- Turn off water circulation system in the magnet room
- Turn off the high power cabinet in the electronics room:
 - FIRST, press the top (on/off) button, under LOCAL (H.V)
 - THEN, switch the system off using the switch above POWER
- Disconnect the anesthesia gas cables (blue and white) in both rooms (magnet room and animal preparation room)
- Turn off isoflurane on the anesthesia vaporizers
- Disconnect the battery from the temperature module and connect it to the charging port on the respiration module



45. There is a log book here... what shall I write in it?

- All users are required to write a log into the “blue” book which includes:
 - Date
 - Hours of scanning (from, to)
 - Project title
 - Project's PI (principal investigator)
 - Print your name



46. How do I clean the animal bed and the table?

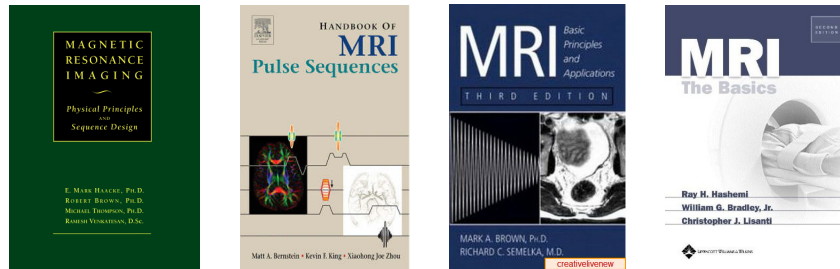
- Clean, by using water in the **BLUE** spraying bottles
- Disinfect, by using the disinfectant in the **RED** spraying bottles (this is a solution of DesiDos and water)
- Spraying bottles are located in the MR room

47. Where do I store my equipment (isoflurane, syringes, catheters)?

- The room next to the animal preparation room contains:
 - Small cabinets (with keys) for storage of animal preparation materials (syringes, catheters, isoflurane, etc...). If you are a regular user you can choose a cabinet for yourself. If all are taken, email kai.brandt@cih.uib.no
 - Refrigerator for storing chemicals (contrast agents, etc...)
- Note: Isoflurane should not be stored in the refrigerator because it loses its potency (effect)

48. I would like to learn more about NMR/ MRI. Where do I start?

- Books you can borrow from our “MRI library”:



- In the MR scanning room you can also find a while folder with some interesting articles related to NMR/MRI

49. I would like to learn more about NMR/ MRI. Where do I start? Continued...

- Useful MRI websites:
 - 1) <http://www.revisemri.com/>, with interactive questions/answers, animated tutorials, learning tools and discussion forum on MRI
 - 2) <http://www.imaios.com/en/e-Courses/e-MRI>, interactive course about MRI physics
 - 3) <http://www.magritek.com/videos.html>, excellent teaching videos
 - 4) <http://www.cis.rit.edu/htbooks/mri/>, book on basic MRI with animations
 - 5) <http://www.mritutor.org/>, with intro to MRI physics
 - 6) <http://www.mrieducation.com/>, MRI courses online
 - 7) http://sunnybrook.ca/research/?page=sri_groups_cmri_mrp_1, Intro to MR physics
 - 8) http://www.ismrm.org/mr_sites.htm, website of the International Society of Magnetic Resonance in Medicine which has resource of various links