



Preliminary information to user groups:

MRI at AMI

ADVANCED MAGNETIC IMAGING CENTRE

AALTO UNIVERSITY SCHOOL OF SCIENCE

Toni Auranen
AMI-Centre
O.V. Lounasmaa Laboratory
School of Science, Aalto University

AMI-Centre
July, 2012

AMI-Centre is an infrastructure providing services for its users



Otakaari 5 I (Magnethouse), Espoo



Key personnel:

- Simo Vanni, Scientific Director, vanni@neuro.hut.fi
- Toni Auranen, Technical Director, toni@neuro.hut.fi
- Marita Kattelus, Radiographer, marita.kattelus@aalto.fi
- Ari Laiho, Physicist, ari.laiho@aalto.fi

AMI-Centre maintains the operation of a 3 T MR-device used for MRI and fMRI



3 T GE Signa (2002 – 8/2011)

3 T Siemens Skyra (11/2011 –)

For the needs of research groups at:

- *Aalto University (AU)*
- *University of Helsinki (HY)*
- Hospital district of Helsinki and Uusimaa (HUS)
- Other users (Other academic, industry etc.)

More info?

- Check our webpage: <http://ami.tkk.fi>
- Join AMI mailing list
- Come for a visit

A! Aalto University

Suomeksi Search

Text version

Advanced Magnetic Imaging Centre (AMI Centre)

Home About Current affairs Scanning at AMI Facilities Documents Research Reservations Contact

See also

- ▶ BRU
- ▶ BECS
- ▶ FGSN
- ▶ LTL
- ▶ HUS_BioMag
- ▶ UHJ_Institute of Behavioural Sciences
- ▶ ainoAALTO

Welcome to AMI Centre

AMI Centre maintains a research-dedicated 3T-MRI scanner, develops and maintains the related infrastructure and offers services to multiple research teams. Typical measurements at AMI Centre include functional and structural brain imaging or diffusion tensor imaging. In addition, AMI Centre develops new methods and applications of MRI technology.

AMI-News mailing list

Join AMI-News mailing list by sending e-mail to amicentre@tkk.fi

Events

News

- AMI-keskus hakee fyysikkoja
29.03.2011
- AMI Centre is looking for physicist
29.03.2011

© Aalto University

Last update: 11.03.2011. Page content by: AMI-centre.

RSS + Sitemap Alphabetical index Feedback Print

Standard clinical scanner

- **MR scanner:** whole-body Siemens MAGNETOM Skyra 3T
- **RF-coils:**
 - 32-channel head array
 - 20-channel head-neck array
 - Flex coils (large and small)
 - Body coil (transmitting)

1. *Versatile stimulus- and response systems*
2. *Daytime measurement times available*
3. Quality assurance, assistance & consultation for fMRI
4. Constant development of the environment and knowhow



Overview – topics to be covered

- fMRI data acquisition
- Stimulation systems
- Subject monitoring & Safety
- Quality control
- Future and Summary



Scanning at AMI – requirements



1. Users must have passed the *AMI Centre's Safety Course*
2. Users must read and follow *AMI Centre's Safety and Operations instructions*
3. All studies involving human subjects, must acquire a supporting *ethical statement*
4. Apply a *research permission* from AMI
5. Username/Password for the *reservation calendar* and AMI computer network

Learn to use: Equipment

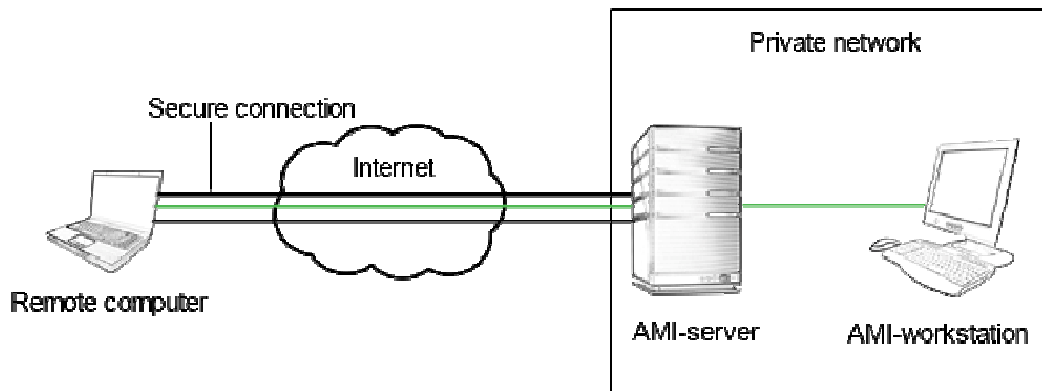
- Magnet and magnet console

- Invisible to users: Electronics, amplifiers, cabinets, signal processing hardware, ...
- What you need: console operation, subject positioning, etc.

- Stimulus systems, accessories

- AMIserver, AMI computer network

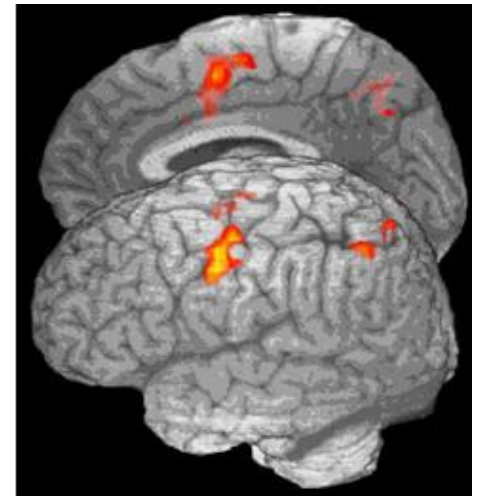
- Data transfer
- Remote use of AMI network
- Data analysis



From: www.siemens.com

Measurements – general

- Reservations
 - Learn the rules and follow them!
 - Changes are informed at AMI-news list
- Keep things where they belong
- Stick to the schedule!
 - Separate preparation area (you can freely use it 30 min. prior and 30 min. after your reserved time)
- One person from the group must be *responsible* for that session
- Radiographer help – *Marita Kattelus*
- *Please, notify AMI personnel immediately if something is missing/broken etc.*



Reservations

USER INFO				Username: toni Laboratory: AMI Account: Admin Date: 12.7.2012			
Add new user		Add/Edit laboratory		Add/Edit ResPer		Add reservations	
Create/cancel reservations		View/cancel reservations		Edit user info		Radiographer requests	
				News scroll		Log out	
						Help	

Week 22 28.5.2012 - 3.6.2012							
	PREV			NEXT			
Time	Monday 28.5.	Tuesday 29.5.	Wednesday 30.5.	Thursday 31.5.	Friday 1.6.	Saturday 2.6.	Sunday 3.6.
09 - 10	SERVICE	Brattico	Ronvall	Salmela	Lalbo	Free	Free
10 - 11	Salmela	Brattico	Ronvall	Salmela	Ronvall	Free	Free
11 - 12	Salmela	Brattico	Ronvall	Shafttan	Vaunt	Tajja	Free
12 - 13	Mononen	Brattico	Shafttan	Shafttan	Ekelund	Tajja	Free
13 - 14	Mononen	Hartnen	Shafttan	Shafttan	Ekelund	Free	Free
14 - 15	Mononen	Hartnen	Shafttan	Iljeström	Vaunt	Free	Free
15 - 16	Mononen	Iljeström	Salmela	Iljeström	Karvonen	Free	Free
16 - 17	Salmela	Iljeström	Salmela	Iljeström	Heikkilä	Free	Free
17 - 18	Salmela	Iljeström	Salmela	Heikkilä	Heikkilä	Free	Free
18 - 19	Heikkilä	Tajja	Heikkilä	Heikkilä	Free	Free	Free
19 - 20	Heikkilä	Tajja	Heikkilä	Free	Free	Free	Free
20 - 21	Free	Free	Free	Free	Free	Free	Free
21 - 22	Free	Free	Free	Free	Free	Free	Free
22 - 23	Free	Free	Free	Free	Free	Free	Free
23 - 24	Free	Free	Free	Free	Free	Free	Free

NOW						
JULY 2012						
week	Mo	Tu	We	Th	Fr	Sa
26	25	26	27	28	29	30
27	2	3	4	5	6	7
28	9	10	11	12	13	14
29	16	17	18	19	20	21
30	23	24	25	26	27	28
31	30	31	1	2	3	4

Your current session will expire in 3610 seconds

- Cancellation policy

- Cancellation *within 48 hours* before the measurement is not acceptable without a force major reason (such as subject falling ill etc.)

- Prereservations are recommended

- These prereservations must be canceled *two weeks before* the measurement if you plan not to use them

- Rush hour rule

- If you reserve more than 7 weekday hours (9-16) within one week, you should announce it in AMI-news list (ami-news@tkk.fi), so that if within 24 hours another research group asks for the same hours, you need to modify your reservation
- If you plan to reserve more than 20 hours per month, please contact AMI scientific director beforehand

- Remember these:

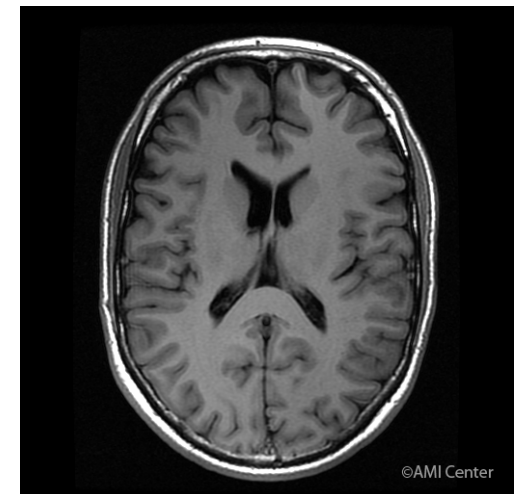
- Free 2 pilot hours for new groups/projects
- You can practise freely with the stimulus computer, eye-movement camera etc. when there are no reservations (if you use the scanner, you must make a valid reservation)

At the console

- In principle, data acquisition is straightforward
 - **Plan well**, imaging parameters, ...
 - Reserve time for **piloting** (phantom & human subject)
 - AMI personnel will help with practicalities and how to use the console
- **Do it yourself** vs. **Use radiographer's assistance**
- Fill in **scanner log** while scanning



From: www.siemens.com

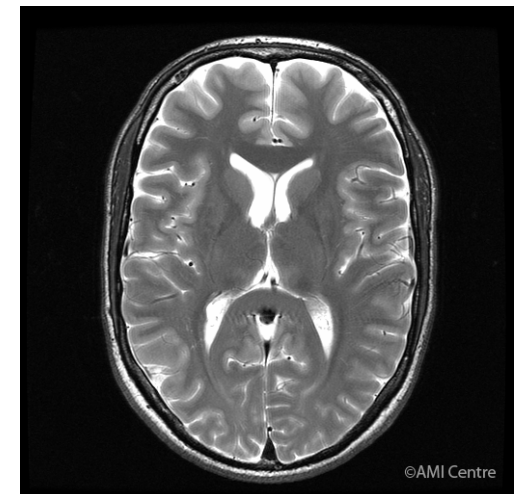


Still at the console

- Create, modify, and save your **research protocol using** the console
 - **Localizer** scan
 - Variable number of **functional and anatomical scans**
- Monitor your subject
- **Check for artefacts** during scanning
- Standard **DICOM images**
 - MOSAIC format
 - Backups are not provided by AMI (2-week grace period)
 - Transfer your data or burn it on CD/DVD



From: www.siemens.com





The most valuable thing – Data

- Data transferred to AMIserver from the console automatically
 - Kept in AMIserver only for two weeks
 - On the console the same or even less
 - Back-up your data as soon as possible!
- Stimulus computer, EEG-computer, and other computers in the console room
 - Not backed-up day-by-day basis...
 - Someone might change or accidentally delete something
 - Copy your logfiles and other data immediately (USB-sticks, portable HDs)

Measurements – general (cont.)

- *Remember to prepare your studies well!*
 - Practice (you will save time)
- Pre-screen your subjects
 - Contraindications for MR, [Safety questionnaire](#) (in the webpages)
- Ask for help if needed, we are happy to assist you!





Differences between GE and Siemens

- Other than the console operations itself, things are roughly the same as before
 - If you knew how to scan with GE, you will with Siemens as well
- AMI Centre has **ready-made protocols** and we will gladly assist you to put together your own protocol
- What are the **minimum requirements** from you:
 - Know your paradigm well, have your stimuli and a working Presentation script
 - Basic parameters: TR, TE, flip angle, # of slices, slice orientations, matrix size etc.
 - We'll help you choose the other parameters (and these as well) if needed!
- Note that if you want to optimize your paradigm, you should do background research on similar studies/paradigms yourself



Differences between GE and Siemens (cont.)

- GRE-EPI, SE-EPI
 - One fMRI trigger pulse per volume (GE: one per slice)
 - Dummies don't send pulses and are not included (GE: you could choose this)
 - *You may want to add more dummies than the scanner does, check your paradigm!*
 - Less time-points with Siemens' SE-EPI (sequence programming required)
- GE – T1 SPGR, BRAVO / Siemens – MPRAGE
 - Current T1 anatomicals work well with e.g. Freesurfer's automatic process flow
- T2 anatomicals
 - No surprises, 3D sequence now possible (SPACE)
- Siemens DTI sequences
 - Current images look good and it is easy to get some nice tracts on the console



Differences between GE and Siemens (cont.)

- FOV, matrix sizes, slice thickness etc.
 - No surprises
 - You should be able to get to at least to the same as before
- DICOM data format / Scanner coordinate system
 - [Siemens Mosaic format](#)
 - Most software recognize these from header information
- Signal-to-noise ratio
 - Siemens 32ch coil at least 1.9 times better than our old 16ch coil with GE
 - Even more so when closer to the surface of the head
- Magnet homogeneity
 - GE was a long bore magnet → more homogeneous

Your options with fMRI

1. Coils

- 32-channel head (A+P or P alone)
- 20-channel head-neck (12ch for head; A+P or P alone)
- Flex coils, body coil (transmitting coil)

2. Other measurement modalities

- EEG, GSR, eye-tracking
- pulse, respiration, ECG, EMG, motion sensors

3. Stimulation

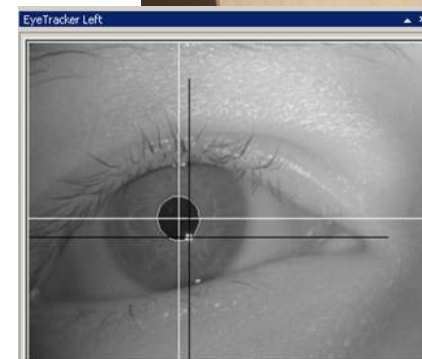
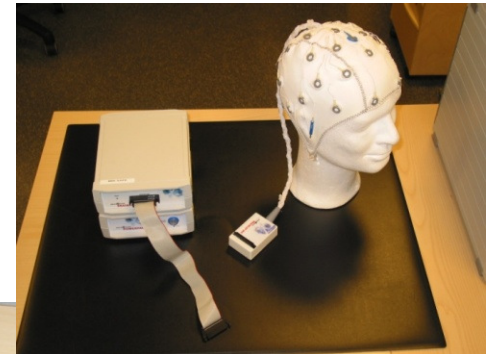
- Visual, auditory, somatosensory (pneumatic, pain/laser)
- Presentation, E-Prime, Psychtoolbox

4. Response devices

- Response buttons, trackball, joystick

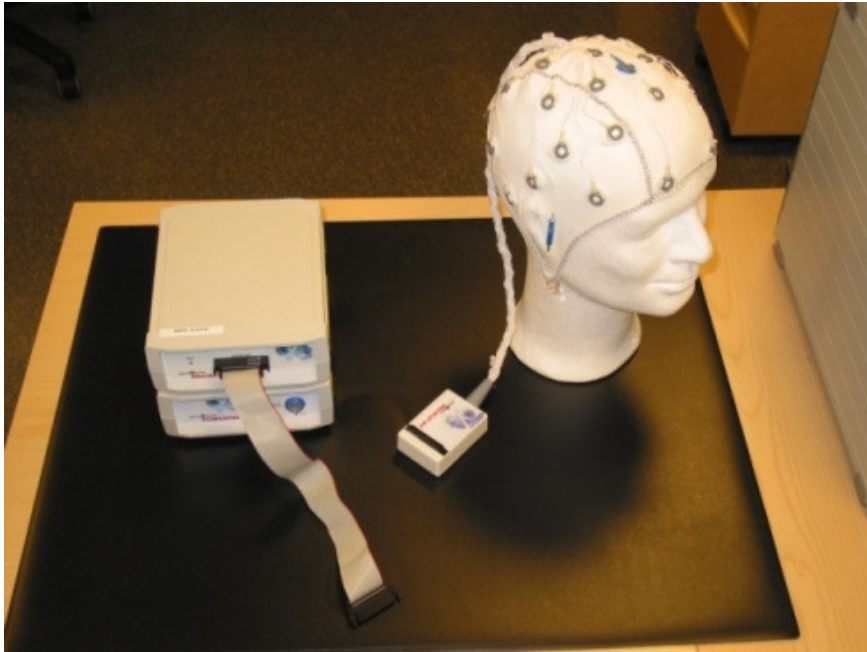
5. Coming soon:

- Insert earphones (already operational)
- Blood pressure (already operational)
- Active-noise cancellation and an optical microphone (in test use)
- Custom-made 30-channel coil (in test use)
- New projector
- (EEG update, grip-force, ...)



Simultaneously with fMRI: EEG, GSR

- Electroencephalography (EEG) / Galvanic skin response (GSR)
 - BrainProducts GmbH
 - Guidance & Instructions available
- EEG only with the 20ch coil
- Limitations with used sequences and measurement times

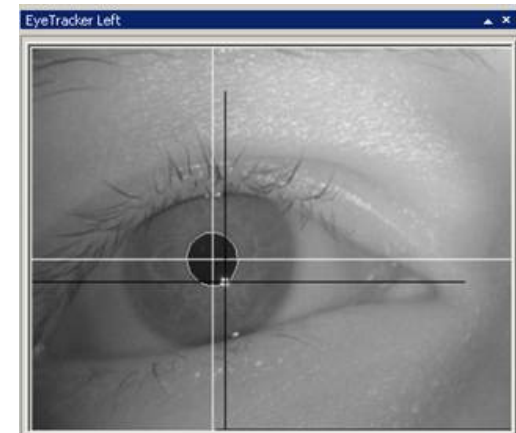


Simultaneously with fMRI: Eye-tracking

- Eye-movement and pupil size
 - SR-Research EyeLink 1000 for fMRI
- Guidance and instructions available
- More robust than our old system
 - Approx. 5 minutes to set up



From: <http://www.sr-research.com>



Simultaneously with fMRI: Biopac

- Electrocardiography (ECG)
- Pulse plethysmography (PPG) x 2
- Respiration signal (RSP)



From: www.biopac.com

- Biopac Systems, Inc.
- Guidance and instructions available
- Other measurements available by adding "blocks" to the system
 - Blood pressure sensor just arrived
 - EDA/GSR possibly in the future, CO₂, ...



Simultaneously with fMRI: Others

- ECG, respiration, and pulse sensors with scanner integrated devices
 - Good for monitoring purposes
- Movement sensors (accelerometers)
 - Custom-made at BRU
- Electromyography (EMG)
- If you need something else, ask us!

Practice makes perfect

- You can and should **practice** your measurements with phantoms
- Especially important if you have difficulty in your paradigm (ECG, EEG, ...)
- Although you need to reserve the scanner, it will pay off in the future
- You can **practice with the other measurements devices for free**
 - Also: 2 hours of free phantom piloting with the scanner for new studies/groups



From: www.phantomlab.com

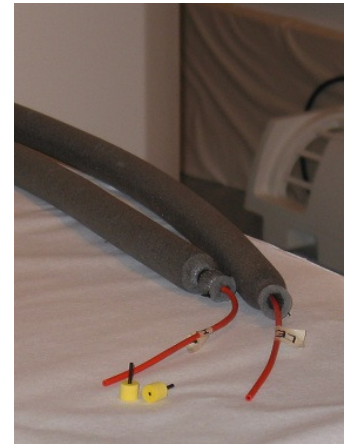


Stimulus delivery & paradigm design

- **Presentation** software (Neurobehavioral Systems)
 - Timing: Scanner pulses sent to Presentation (and other computers)
 - Two computers, one for backup use
 - Newest software versions
- **E-Prime** (and **Psychtoolbox**) can be used as well
- Researcher's own laptops and software can also be used
 - May need some special arrangements
- *You can test the stimulus system when there are no scanner reservations for free!*
 - **AMI Centre does not prepare or implement your paradigm!**

Auditory and Visual stimulation

- External high-quality audio card (E-MU 1616m)
- Waveforms transformed to sounds and relayed via tubing (Unides ADU2a)
- Scanner noise can be further dampened via isolation and padding



- Data projector (Christie Vista X3)
 - Stimuli reflected using surface mirrors
 - Luminance output values measured for calibration
 - Remember to turn off when finished!
- Eye sight correction (MediGoggles)
- New projector system in development



Somatosensory stimulation

- Pneumatic tactile stimulator



- Laser stimulator



- Both rarely used → may require some extra setup-time and checks

Subject response

- Two 4-button optical **response boxes** (Photon control)
- Optical **trackball** with two buttons (Current Designs)
- Optical **joystick** (Current Designs)
- Need any of these? **Sliders, wheels, ...** contact us!



During the scanning

- Two-way **intercom system** for communication
- **Visual contact** to the subject by the person operating the scanner (camera & window)
- **Squeeze ball** for subject emergency
- Heart rate and breathing can easily be monitored
- *Talk to your subject!*



Safety first! – Safety courses are organized several times a year

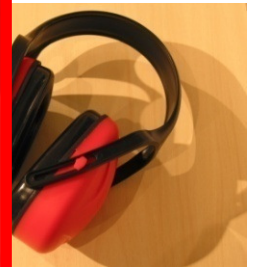


- Superconducting magnet: **always on**
- Attracts **ferromagnetic** objects!
- Danger may be inside subject's body (**implants, pacemaker etc.**)
- RF-power may be **focused, heating**
- **SAR** (specific absorption rate) monitoring
- Acoustic **noise**
- Helium, claustrofobia, contrast agents, ...

● ● ● | ***Safety first!*** – Safety courses are organized several times a year



Provided courtesy of Simply Physics at www.simplyphysics.com



bring

S, ...

● ● ● | Safety precautions

- You are in charge!
- Access limited to the MRI unit
 - Shielded room is strongly restricted
- Safety course must be passed
- Safety questionnaire and screening
- Measurement clothes, metal detector, test magnet, ...
- Double hearing protection for subjects





Safety precautions – there can't be too many

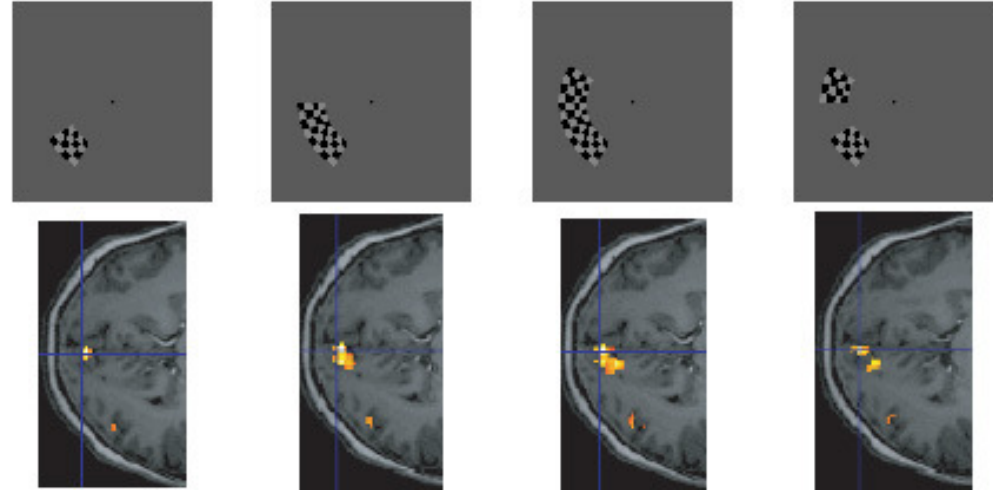
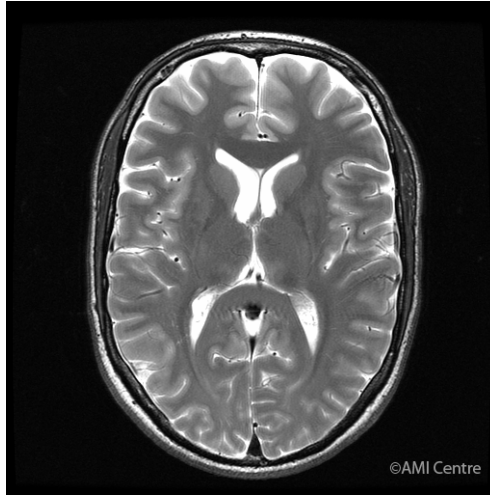
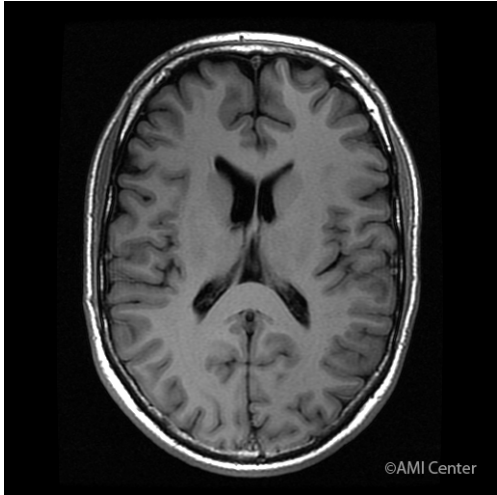
- **Responsible researcher** (or medical doctor) has to make sure that the measurement situation is proper (ethics committee)
- Items that are allowed inside the shielded room are labeled as such – **MRI safe** – all the others are not!
- Oxygen level monitoring, emergency ventilation
- Advanced medical life support equipments and medicines, automatic defibrillator, and oxygen
- All abnormal subject sensations and near accidents must be reported to AMI personnel!



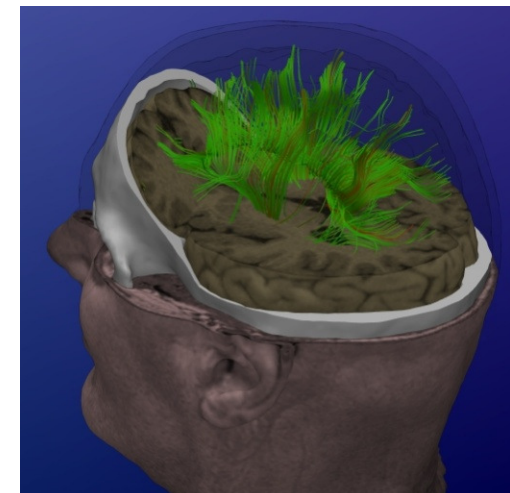
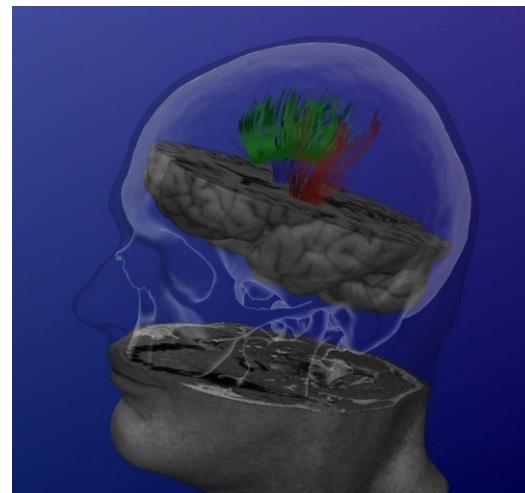
Daily quality routines

- **Stability** of the scanner is checked every morning
- Operation of **squeeze ball** and defibrillator ensured
- All the **equipment checked** for faults or breaking
- Helium level, temperatures, etc. monitored
- Equipment and pharmaceuticals in the first-aid kit checked constantly
- In case of problems with the scanner hardware, **Siemens service** should be notified immediately

What? – Mostly fMRI and anatomical images



- fMRI (& physiological data)
- Different anatomical contrasts
 - T1, T2
- Diffusion tensor imaging (DTI) and tractography
- Other body parts (minor)
- Clinical cases (minor)



Current or recent research topics by different groups measuring @AMI

- Human visual- and auditory-systems
- Somatosensory and motor studies, pain studies
- Attention, memory, language processing
- Anatomical reference images for MEG source localization (and fMRI)
- Decision making, neuroeconomics
- Movies, music, natural stimulation
- Physiological measurements





AMI in near future

- User training, Safety courses
- Constant development of stimulus systems and measurement environment
- Sequence programming
 - 3 people have already been to the Siemens' IDEA/ICE course
- Methods development projects
- There are preliminary plans that a 7T machine would be purchased in 5–7 years time
 - Ultra-high field magnets will most likely be the standard in basic research
 - AMI will be actively involved

Practicalities – am I ready?

- Research idea and funding?
 - Ethical statement?
 - Aalto, HY, HUS, ...
 - AMI permission?
 - Safety course?
- Study the following:
 - *Safety and Operations Instructions*
 - Your favorite MR physics & MR in practice book
 - Reservation calendar account
 - AMI computer network user account

USER INFO Username: toni Laboratory: AMI Account: Admin Date: 3.5.2012

TKK AMI Centre

Navigation: Add new user, Add/Edit laboratory, Add/Edit Res/Pr, Add reservations, Create/cancel reservations, View/cancel reservations, Edit user info, Radiographer requests, News scroll, Log out, Help

Week 19: 7.5.2012 - 13.5.2012

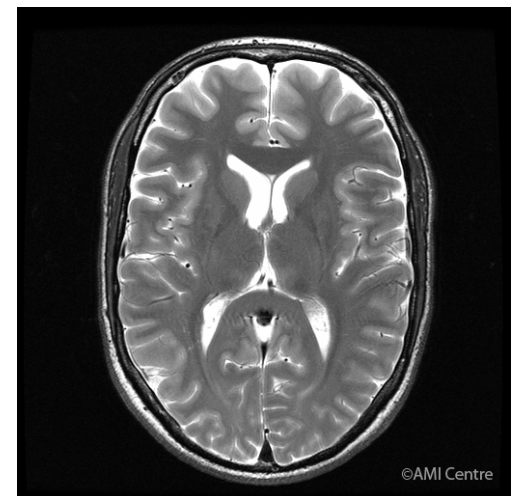
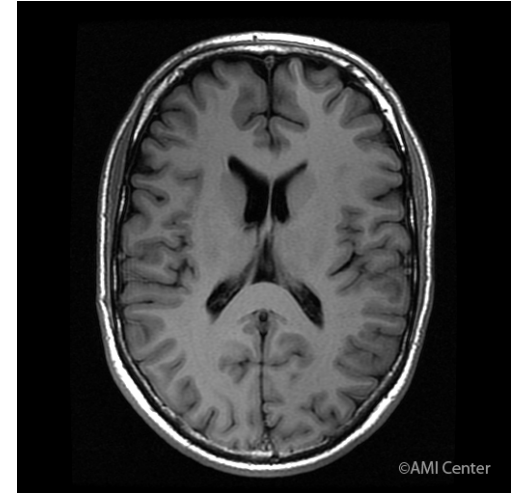
Time	Monday 7.5.	Tuesday 8.5.	Wednesday 9.5.	Thursday 10.5.	Friday 11.5.	Saturday 12.5.	Sunday 13.5.
09-10	SERVICE	Taiva	Brattice	Heikkilä	Lijestrom	Free	Free
10-11	Taiva	Taiva	Brattice	Heikkilä	Lijestrom	Free	Free
11-12	Taiva	Taiva	Brattice	Tikka	Lijestrom	Free	Free
12-13	Taiva	Taiva	Brattice	Sivanto	Free	Free	Free
13-14	Taiva	Free	Brattice	Sivanto	Brattice	Free	Free
14-15	Taiva	Karvonen	Brattice	Sivanto	Brattice	Free	Free
15-16	Taiva	Karvonen	Sharifian	Sivanto	Brattice	Free	Free
16-17	Maanonen	Sharifian	Free	Free	Free	Free	Free
17-18	Maanonen	Sharifian	Sharifian	Free	Free	Free	Free
18-19	Free	Sharifian	Free	Free	Free	Free	Free
19-20	Free	Free	Free	Free	Free	Free	Free
20-21	Free	Free	Free	Free	Free	Free	Free
21-22	Free	Free	Free	Free	Free	Free	Free
22-23	Free	Free	Free	Free	Free	Free	Free
23-24	Free	Free	Free	Free	Free	Free	Free

Small calendar for MAY 2012 showing week 19 (days 7-13).

If you do not see scrolling area's headlines here, your browser is not new enough to support it

Safe and successful fMRI measurements

- Plan and pilot your studies well
- Develop good working practices
- Instruct your MR co-workers
- Select and prepare carefully your patients/subjects
- Follow the instructions and procedures
- Ask, if in doubt!



Questions and answers?



AMI-Centre
O.V. Lounasmaa Laboratory
School of Science, Aalto University
<http://ami.aalto.fi>

