#6: Data Acquisition at CBU MEG Lab

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The main points

- Apologies
- Experimental design: MEG != fMRI
- Practicalities: the BB is watching you
- Subject preparation
- Data acquisition *per se*

Triggers

- fMRI: stimuli presented, while scan times are logged, OR, stimuli triggered by the scan
- MEG/EEG: the opposite

MEG Triggers

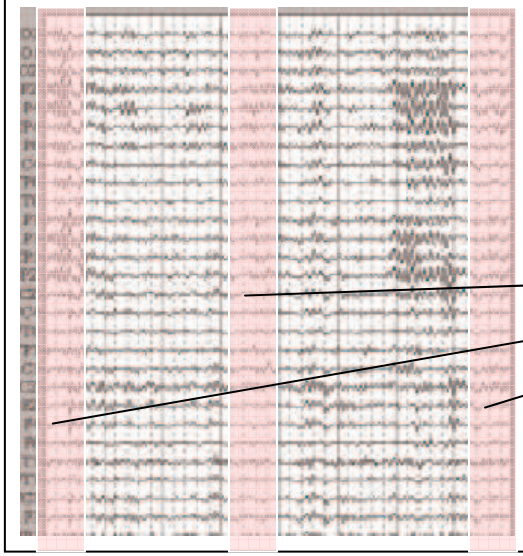
- Data are recorded *continuously* (1kHz sampling rate = a snapshot of 306 channels every 1 ms)
- Triggers must be presented with you stimuli
- Triggers are recorded with the MEG data
- Response triggers are also fed back to the recorder
- Activity is later assessed in relation to the pre-recorded triggers

Recording data and triggers

activity of the brain recorded on outside

data processing after (during) the recording

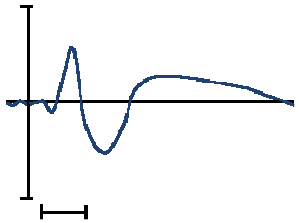
Signal amplified and recorded digitally



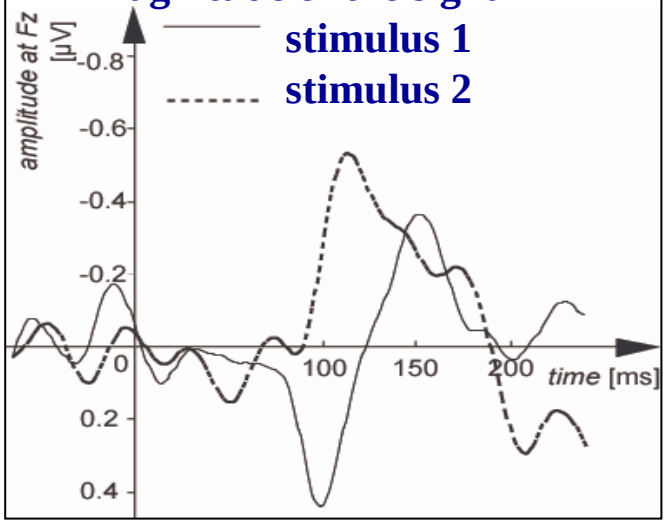
S1 S2 S3 S1 S5 S3 S2 S1

Timing of stimulation/responses locked to MEG/EEG signal

Portions of the signal corresponding to stimuli of the same type are extracted grouped together and (usually) averaged (10s-100s of them are needed)



Basic analysis:
- **Timing of the signal**
- **Magnitude of the signal**



Event-related potentials (ERP)/event-related fields (ERFs)

‘Trigger-free’ MEG

- Spontaneous data
- E.g. record for 2 min with eyes closed, and for two minutes with eyes open, look at the oscillations in different frequency bands

Exp design

- Think of your stimuli/triggers beforehand
- Better have over- than under-specified stimulation protocol: you can always collapse across a few stim types, but the opposite is more difficult:

1 1 1 1 1 1 1 1 1 2 1 1 2 1 1 1 1 2 1 1 1

1 1 1 1 1 1 1 1 1 2 3 1 2 1 1 1 1 2 3 1 1

Exp design

- Not limited by TR, etc.
- No noise!
- Flexible SOA, length, etc.
- >50 trials for averaging for ER designs (>100 desirable)
- >100 trials for oscillations
- Overall recording time: <2 hrs (ideally ~1h) – the subject has to stay still!

Exp design: conditions

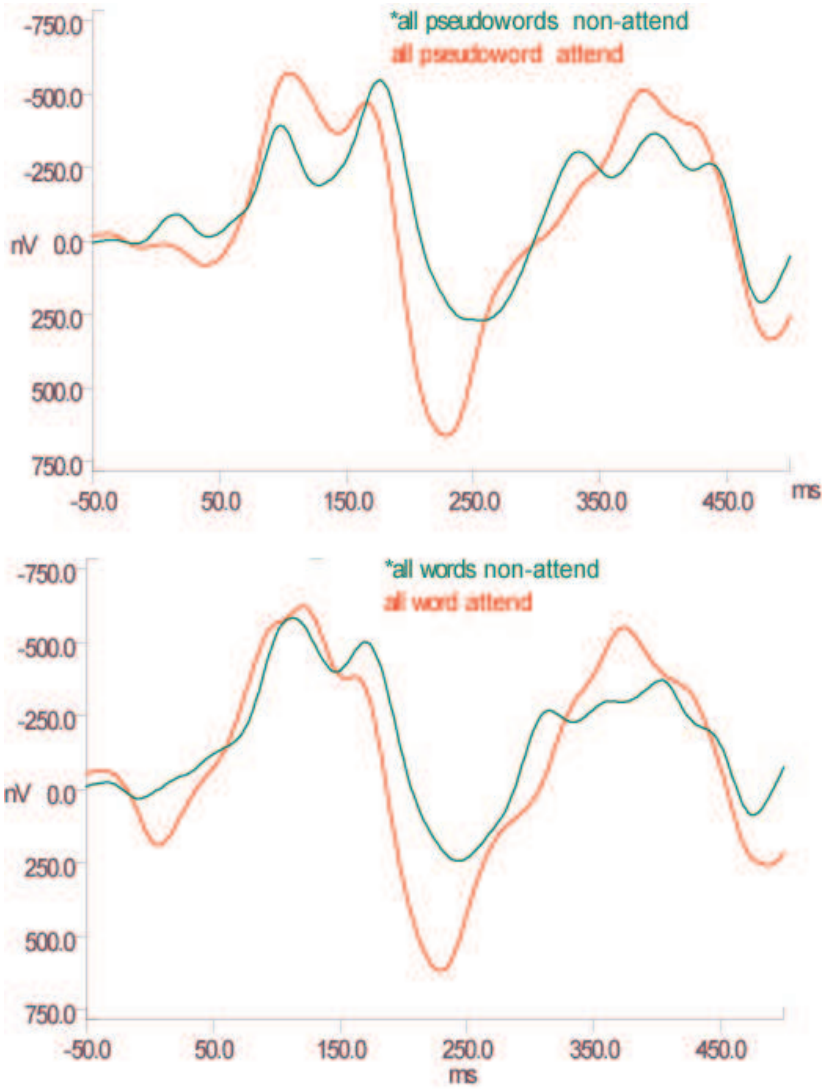
- Layers of subtractions… well… maybe not in MEG
- Orthogonal conditions: thinking the ANOVA way

Exp design: conditions

- Orthogonal conditions, an example
- 2x2 design:
  - words attended -words unattended
  - nonwords attended -nonwords unattended

- Data extracted in numerical form from each condition for all individual subject
- ANOVA with two factors: attention X lexicality (plus any additional – e.g. activation locus)

Exp design: conditions



- Data extracted in numerical form from each condition for all individual subject
- ANOVA with two factors: attention X lexicality (plus any additional – e.g. activation locus)
- SPM5 talk by Rik on Jan 29
- dSPM, etc.

Exp design: stimulus presentation

- Auditory (tubes), visual (projection), somatosensory (electric) readily-available
- Software: same stim PC as in the fMRI scanner (E-Prime etc), anything else connectable
- Button-press responses: two four-digit button boxes available

Exp preparation: further considerations

- Baseline: quiet interval before/after stim usually desired
- Subject position: supine vs upright

Wanna do fancy source localisation stuff?

- Get subject with good structural MR images
- Consider recording EEG+MEG

Practical bits

- Get your ethics sorted
- Get your IMC approval
- Follow SOPs
- Obey your MEG operator
- Get the right volunteers

Practical bits

Health and safety issues:

- Liquid Helium
- Working with volunteers

Practical bits

- Liquid Helium: ~-270C
- Evaporation
- Frost bites
- Asphyxia

Practical bits

Working with volunteers:

- Same basic rules as anywhere, but –
- You will attach things to volunteer skin (coils, electrodes)
- Screen, inform
- Wear gloves, be careful

Practical bits

MEG access:

- Authorised/certified staff
- Only qualified operators can run acquisition
- Other researchers can only be in the MEG lab if accompanied by a qualified operator
- Full de-metallisation on entry

Practical bits

Entrance to the shielded room:

- No metal objects: mobile phones, keys, coins, belts, etc.
- No shoes
- Subjects to be screened

Data acquisition: subject preparation

- Prepare your forms, coils, electrodes, etc. in advance
- De-metallise yourself and your volunteer
- Leave your phone in your office or turn it off
- Brief the subject about the experiment, do the consent, etc.

Data acquisition: subject preparation

- EEG electrodes (1-128, cap)
- EOG (2+2)
- Ground
- HPI coils

Data acquisition: preparation

- Empty room measurement
- ‘Unwired’ subject measurement (esp. for complex set-ups)

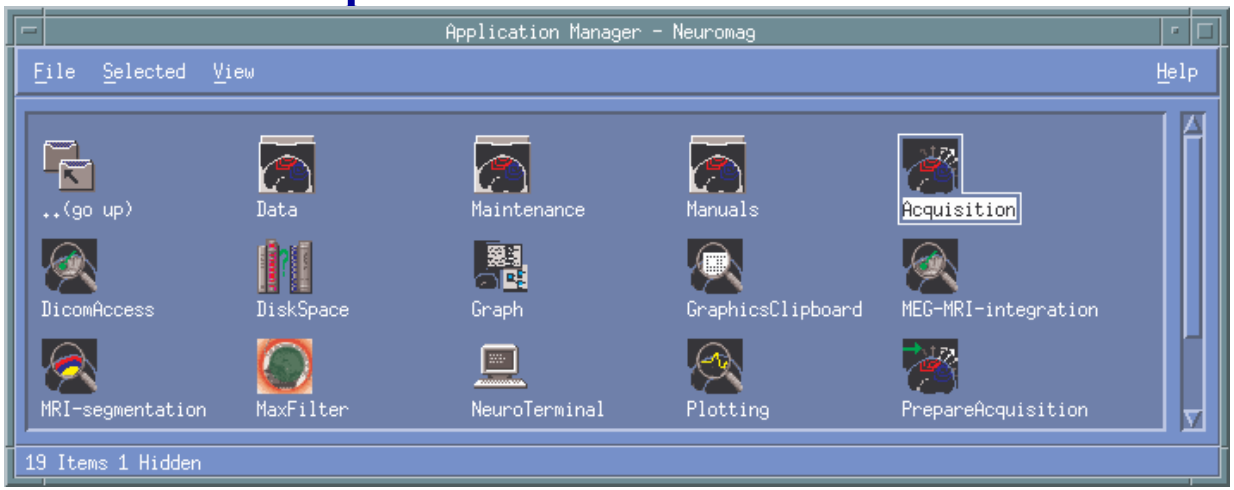
Data acquisition: subject preparation

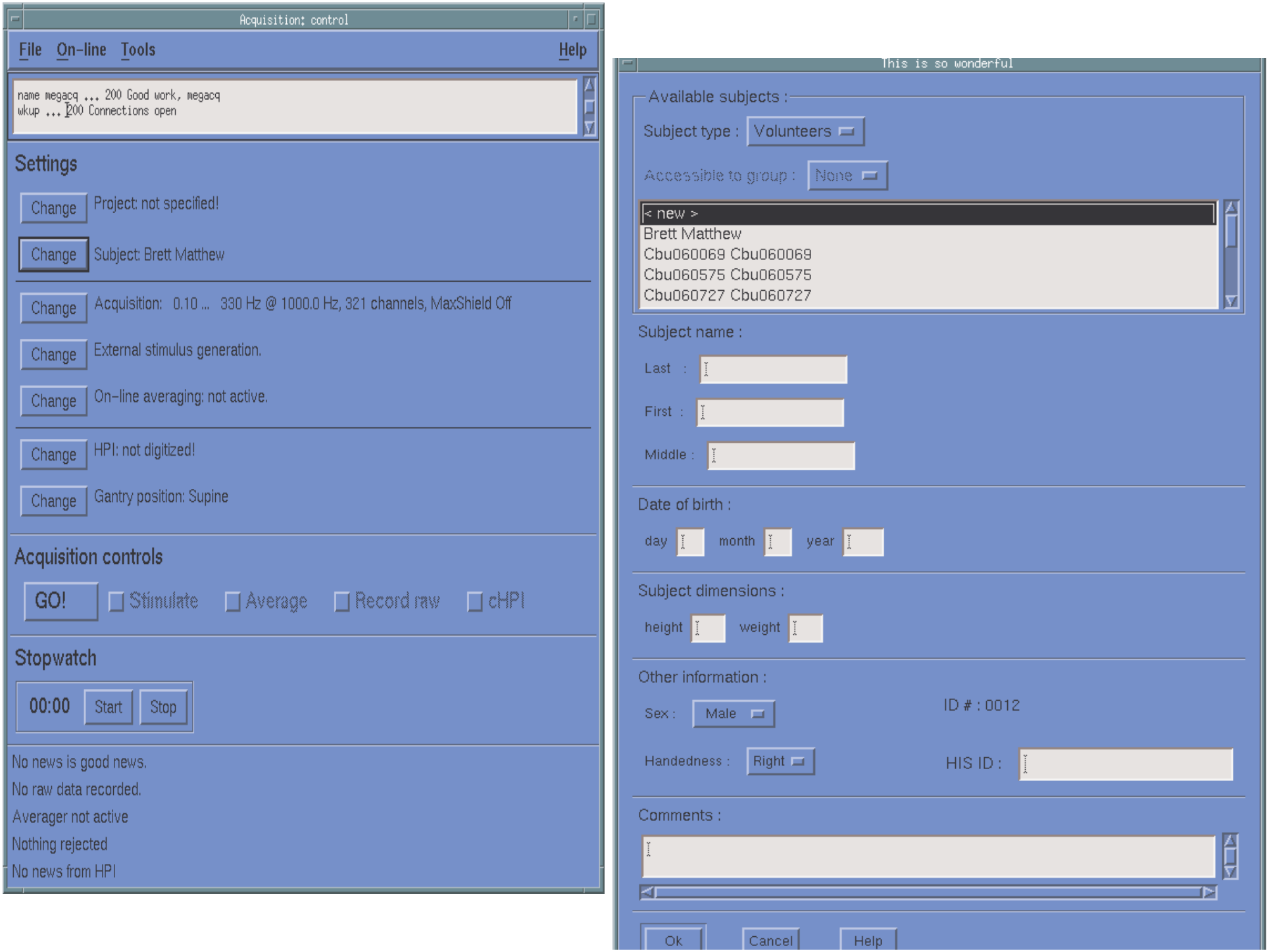
- HPI coils:

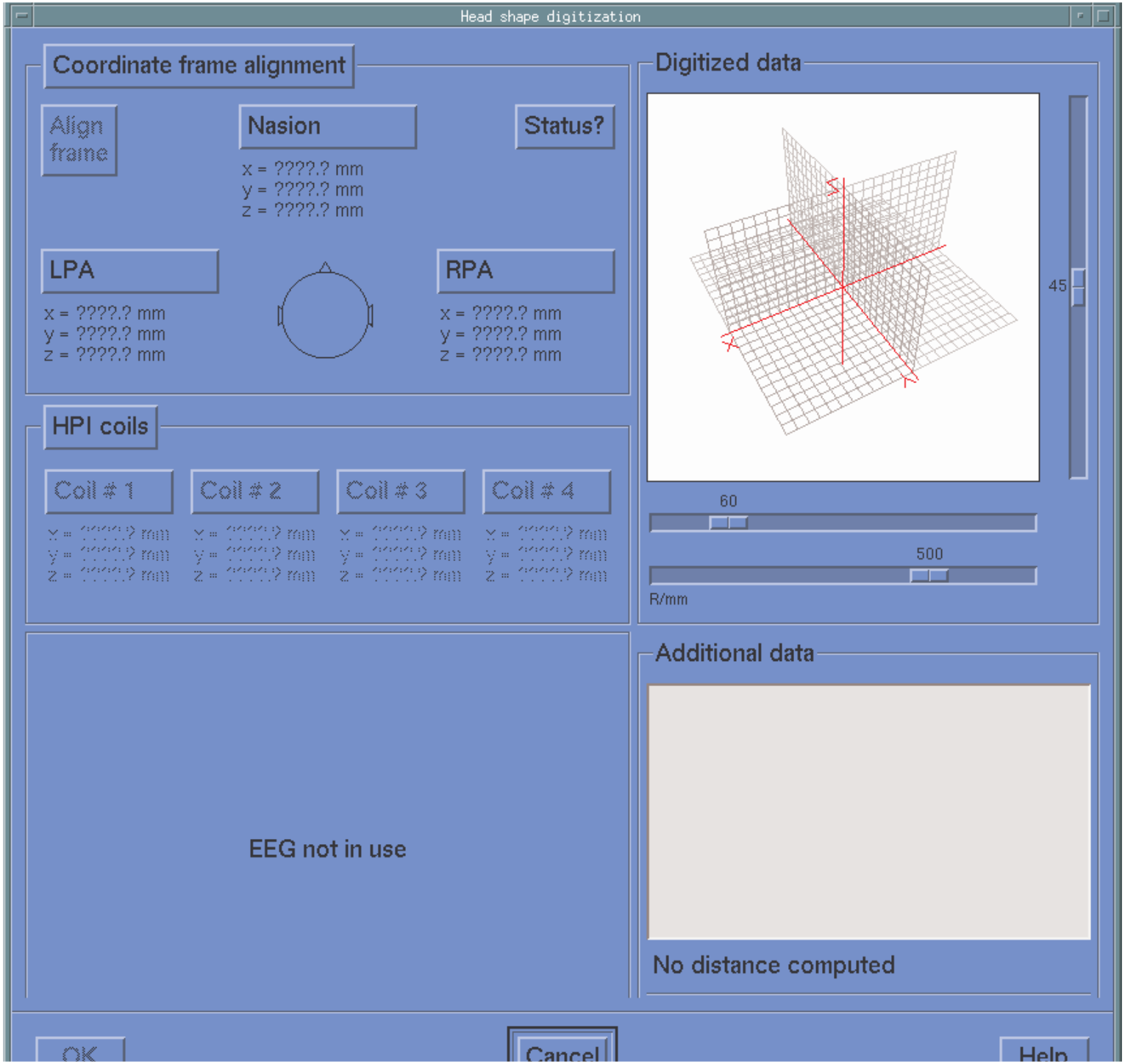
4 HPI coils should be placed to maximize distance between them: two on each side of the forehead (right below the hairline) and one behind and above each ear, ensuring that, once the subject is in the machine, all coils will be inside the dewar and not below it. The coils require no paste, and should be affixed using both double-sided sticky rings and tape.

Data acquisition: subject preparation

- Enter subject details in the database (no name, use volunteer ID for name/surname)
- Choose project settings
- Digitise HPI (head position indicator) coils and landmarks
- Digitise additional point/electrodes




Acquisition: control
File
On-line
Tools
Help
name megacq ... 200 Good work, megacq
wkup ... 200 Connections open
Settings
Change
Project: not specified!
Change
Subject: Brett Matthew
Change
Acquisition: 0.10 ... 330 Hz @ 1000.0 Hz, 321 channels, MaxShield Off
Change
External stimulus generation.
Change
On-line averaging: not active.
Change
HPI: not digitized!
Change
Gantry position: Supine
Acquisition controls
GO!
Stimulate
Average
Record raw
cHPI
Stopwatch
00:00
Start
Stop
No news is good news.
No raw data recorded.
Averager not active
Nothing rejected
No news from HPI
This is so wonderful
Available subjects :
Subject type :
Volunteers
Accessible to group :
None
< new >
Brett Matthew
Cbu060069 Cbu060069
Cbu060575 Cbu060575
Cbu060727 Cbu060727
Subject name :
Last :
First :
Middle :
Date of birth :
day
month
year
Subject dimensions :
height
weight
Other information :
Sex :
Male
ID # : 0012
Handedness :
Right
HIS ID :
Comments :
Ok
Cancel
Help


Head shape digitization
Coordinate frame alignment
Align frame
Nasion
Status?
x = ????.? mm
y = ????.? mm
z = ????.? mm
LPA
x = ????.? mm
y = ????.? mm
z = ????.? mm
RPA
x = ????.? mm
y = ????.? mm
z = ????.? mm
HPI coils
Coil # 1
Coil # 2
Coil # 3
Coil # 4
EEG not in use
Digitized data
45
60
500
R/mm
Additional data
No distance computed
OK
Cancel
Help

Digitization

- Have the subject sit in the wooden chair
- Move all objects with large metal components away from the chair and polhemus
- Turn on the polhemus
- Position the goggles on the subject's head, being careful not to cover up any electrodes or HPIs. It is critical that the goggles are tight and do not move once digitization has begun.
- At the top of the screen, hit the "Coordinate frame alignment" button; you are now ready to begin digitization
- digitize the three cardinal landmarks by pointing to each and simultaneously clicking the button on the stylus (electronic pen)
- Check that the two ear points are within a maximum 5 (3?)mm
- Digitise coils
- EEG electrodes, additional points, head shape

Digitization

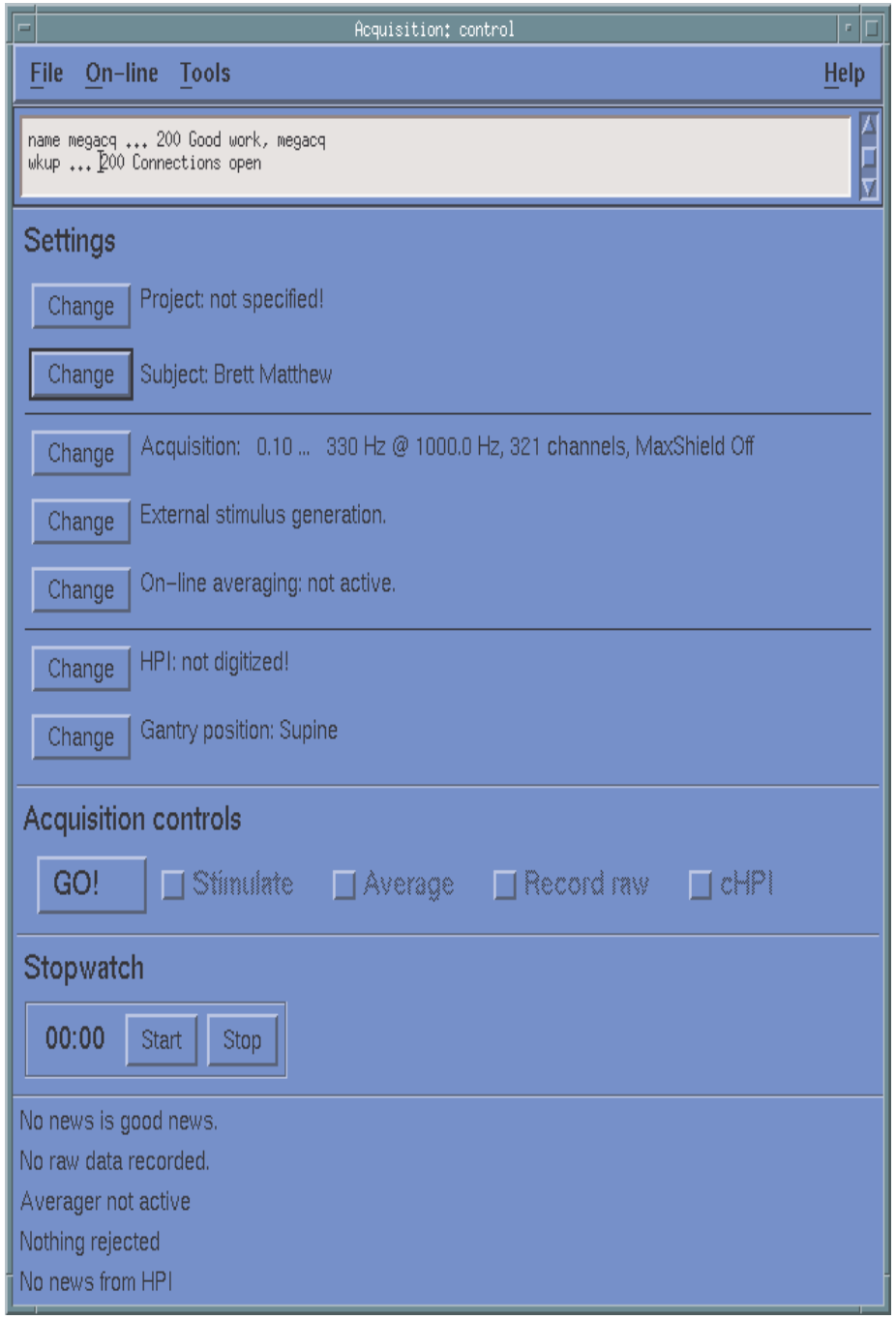
- Make sure you know the locations!
- Essential for coregistering with MRI images

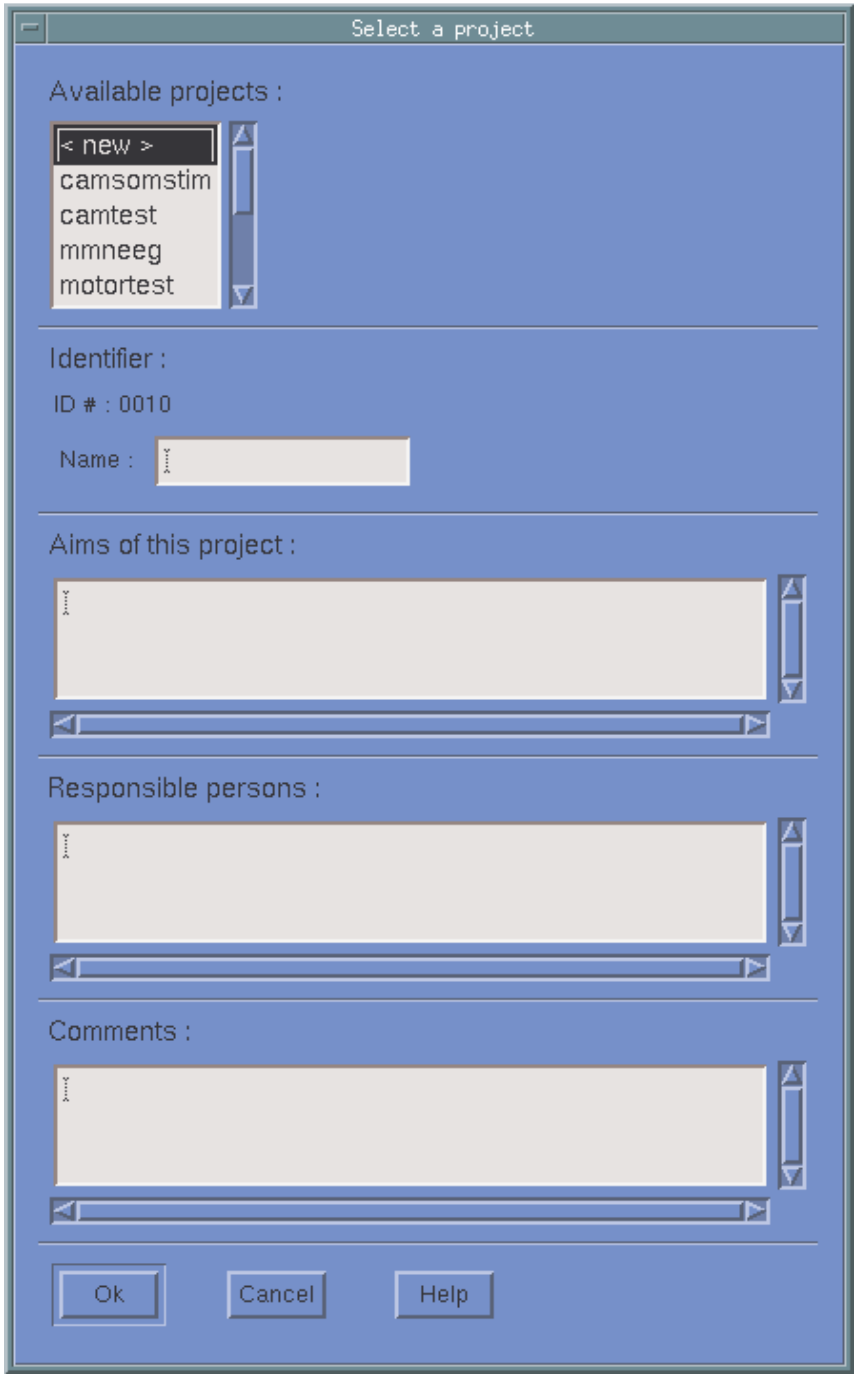

zero


08-01-07 09:57

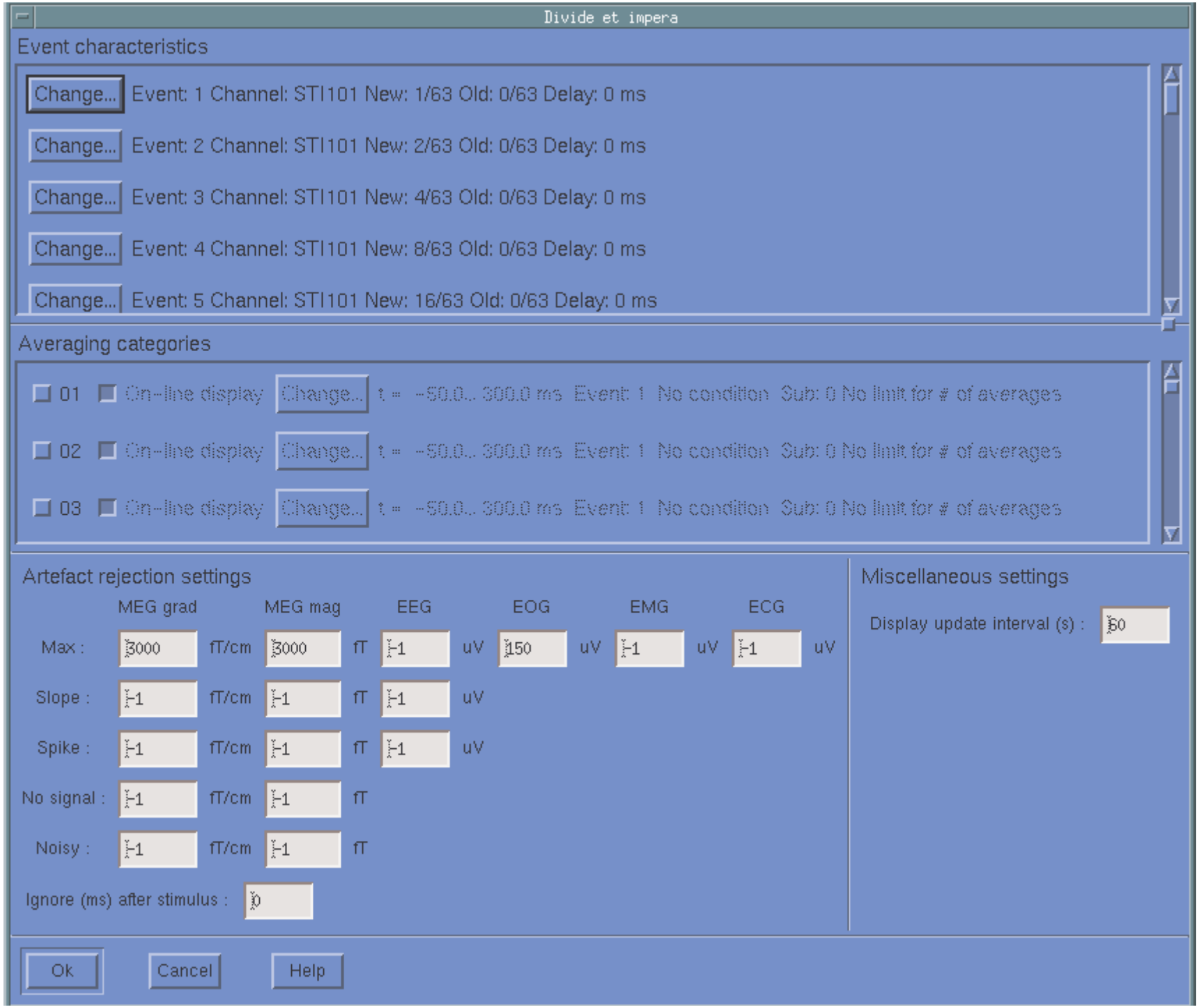
Data recording

- Done by qualified operators with researcher present all the time
- Recording settings are researcher’s responsibility


Acquisition: control
File
On-line
Tools
Help
name megacq ... 200 Good work, megacq
wkup ... 200 Connections open
Settings
Change
Project: not specified!
Change
Subject: Brett Matthew
Change
Acquisition: 0.10 ... 330 Hz @ 1000.0 Hz, 321 channels, MaxShield Off
Change
External stimulus generation.
Change
On-line averaging: not active.
Change
HPI: not digitized!
Change
Gantry position: Supine
Acquisition controls
GO!
Stimulate
Average
Record raw
cHPI
Stopwatch
00:00
Start
Stop
No news is good news.
No raw data recorded.
Averager not active
Nothing rejected
No news from HPI


Select a project
Available projects :
< new >
camsomstim
camtest
mmneeg
motortest
Identifier :
ID # : 0010
Name :
Aims of this project :
Responsible persons :
Comments :
Ok
Cancel
Help


How to acquire?
Channel selection :
MEG 0113 MEG 0112 MEG 0111 MEG 0122 MEG 0123 MEG 0121 MEG 0132 MEG 0133 MEG 0131 MEG 0143 MEG 0142 MEG 0141 MEG 0213 MEG 0212 MEG
MEG 0313 MEG 0312 MEG 0311 MEG 0322 MEG 0323 MEG 0321 MEG 0333 MEG 0332 MEG 0331 MEG 0343 MEG 0342 MEG 0341 MEG 0413 MEG 0412 MEG
MEG 0513 MEG 0512 MEG 0511 MEG 0523 MEG 0522 MEG 0521 MEG 0532 MEG 0533 MEG 0531 MEG 0542 MEG 0543 MEG 0541 MEG 0613 MEG 0612 MEG
MEG 0713 MEG 0712 MEG 0711 MEG 0723 MEG 0722 MEG 0721 MEG 0733 MEG 0732 MEG 0731 MEG 0743 MEG 0742 MEG 0741 MEG 0813 MEG 0812 MEG
MEG 0932 MEG 0933 MEG 0931 MEG 0942 MEG 0943 MEG 0941 MEG 1013 MEG 1012 MEG 1011 MEG 1023 MEG 1022 MEG 1021 MEG 1032 MEG 1033 MEG
MEG 1133 MEG 1132 MEG 1131 MEG 1142 MEG 1143 MEG 1141 MEG 1213 MEG 1212 MEG 1211 MEG 1223 MEG 1222 MEG 1221 MEG 1232 MEG 1233 MEG
MEG 1333 MEG 1332 MEG 1331 MEG 1342 MEG 1343 MEG 1341 MEG 1412 MEG 1413 MEG 1411 MEG 1423 MEG 1422 MEG 1421 MEG 1433 MEG 1432 MEG
MEG 1533 MEG 1532 MEG 1531 MEG 1543 MEG 1542 MEG 1541 MEG 1613 MEG 1612 MEG 1611 MEG 1622 MEG 1623 MEG 1621 MEG 1632 MEG 1633 MEG
MEG 1732 MEG 1733 MEG 1731 MEG 1743 MEG 1742 MEG 1741 MEG 1813 MEG 1812 MEG 1811 MEG 1822 MEG 1823 MEG 1821 MEG 1832 MEG 1833 MEG
MEG 1932 MEG 1933 MEG 1931 MEG 1943 MEG 1942 MEG 1941 MEG 2013 MEG 2012 MEG 2011 MEG 2023 MEG 2022 MEG 2021 MEG 2032 MEG 2033 MEG
MEG 2133 MEG 2132 MEG 2131 MEG 2143 MEG 2142 MEG 2141 MEG 2212 MEG 2213 MEG 2211 MEG 2223 MEG 2222 MEG 2221 MEG 2233 MEG 2232 MEG
MEG 2332 MEG 2333 MEG 2331 MEG 2343 MEG 2342 MEG 2341 MEG 2412 MEG 2413 MEG 2411 MEG 2423 MEG 2422 MEG 2421 MEG 2433 MEG 2432 MEG
MEG 2533 MEG 2532 MEG 2531 MEG 2543 MEG 2542 MEG 2541 MEG 2612 MEG 2613 MEG 2611 MEG 2623 MEG 2622 MEG 2621 MEG 2633 MEG 2632 MEG
STI 7 STI 8 STI 9 STI 10 STI 11 STI 12 STI 13 STI 14 STI 15 STI 16 EEG 1 EEG 2 EEG 3 EEG 4 EEG
EEG 15 EEG 16 EEG 17 EEG 18 EEG 19 EEG 20 EEG 21 EEG 22 EEG 23 EEG 24 EEG 25 EEG 26 EEG 27 EEG 28 EEG
EEG 39 EEG 40 EEG 41 EEG 42 EEG 43 EEG 44 EEG 45 EEG 46 EEG 47 EEG 48 EEG 49 EEG 50 EEG 51 EEG 52 EEG
EEG 63 EEG 64 EEG 65 EEG 66 EEG 67 EEG 68 EEG 69 EEG 70 EEG 71 EEG 72 EEG 73 EEG 74 EEG 75 EEG 76 EEG
EEG 87 EEG 88 EEG 89 EEG 90 EEG 91 EEG 92 EEG 93 EEG 94 EEG 95 EEG 96 EEG 97 EEG 98 EEG 99 EEG 100 EEG
EEG 111 EEG 112 EEG 113 EEG 114 EEG 115 EEG 116 EEG 117 EEG 118 EEG 119 EEG 120 EEG 121 EEG 122 EEG 123 EEG 124 EEG
MISC 7 MISC 8 MISC 9 MISC 10 MISC 11 MISC 12 MISC 13 MISC 14 MISC 15 MISC 16 STI 101 STI 102 STI 201 STI 301 MISC
MISC 205 MISC 206 MISC 301 MISC 302 MISC 303 MISC 304 MISC 305 MISC 306
Number of channels = 321
OK
Cancel
Help


Divide et impera
Event characteristics
Change... Event: 1 Channel: STI101 New: 1/63 Old: 0/63 Delay: 0 ms
Change... Event: 2 Channel: STI101 New: 2/63 Old: 0/63 Delay: 0 ms
Change... Event: 3 Channel: STI101 New: 4/63 Old: 0/63 Delay: 0 ms
Change... Event: 4 Channel: STI101 New: 8/63 Old: 0/63 Delay: 0 ms
Change... Event: 5 Channel: STI101 New: 16/63 Old: 0/63 Delay: 0 ms
Averaging categories
01 On-line display Change... t = -50.0... 300.0 ms Event: 1 No condition Sub: 0 No limit for # of averages
02 On-line display Change... t = -50.0... 300.0 ms Event: 1 No condition Sub: 0 No limit for # of averages
03 On-line display Change... t = -50.0... 300.0 ms Event: 1 No condition Sub: 0 No limit for # of averages
Artefact rejection settings
MEG grad MEG mag EEG EOG EMG ECG
Max : 3000 fT/cm 3000 fT -1 uV 150 uV -1 uV -1 uV
Slope : -1 fT/cm -1 fT -1 uV
Spike : -1 fT/cm -1 fT -1 uV
No signal : -1 fT/cm -1 fT
Noisy : -1 fT/cm -1 fT
Ignore (ms) after stimulus : 0
Miscellaneous settings
Display update interval (s) : 50
Ok
Cancel
Help

Data recording

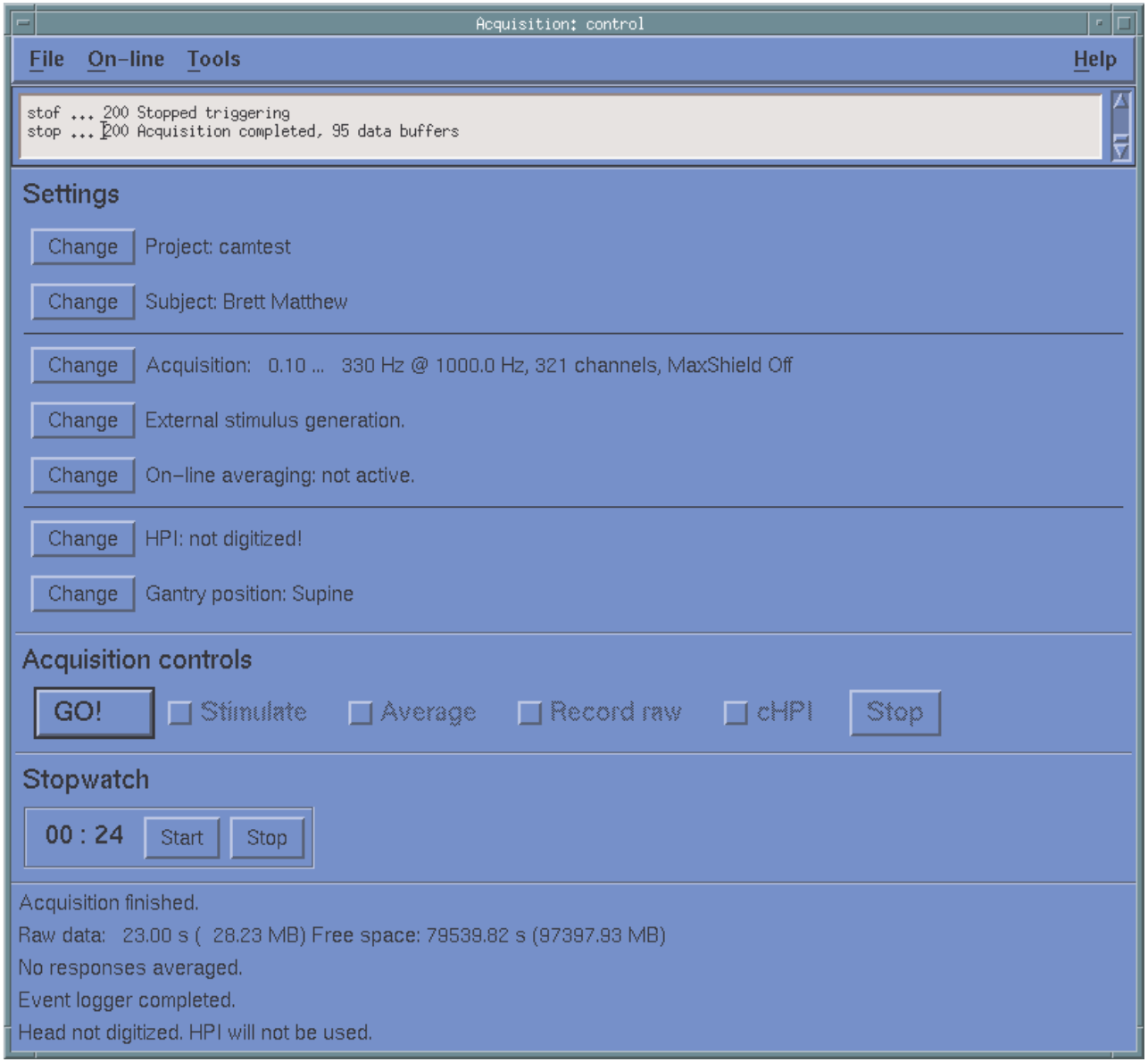
- Record raw/online averaging only
- Set-up stim categories for online averaging
  - Stim types
  - Epoch length
  - Baseline
  - Subaverages
  - Artifact rejection

Data recording

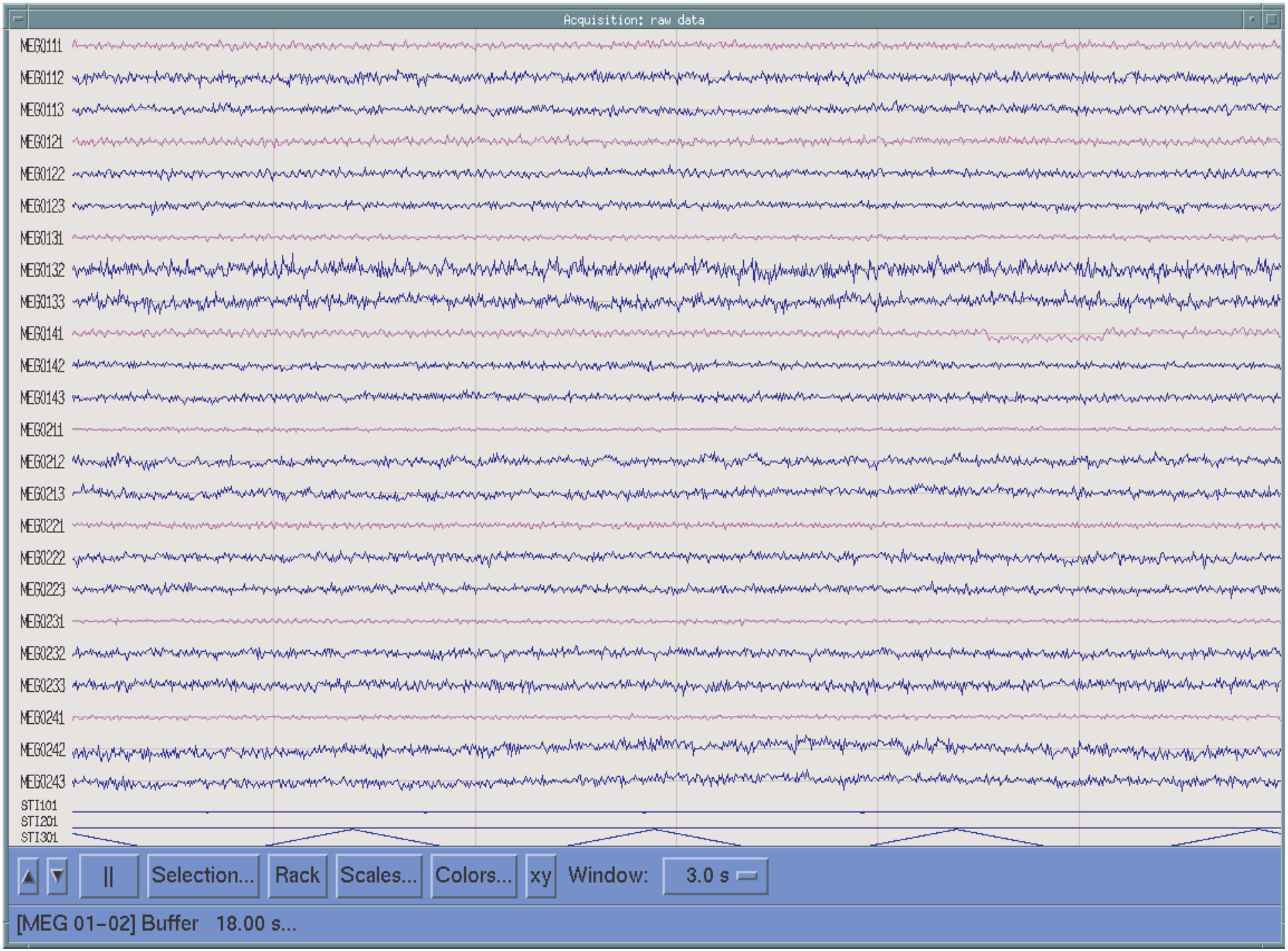
- Record raw/online averaging only
- Set-up stim categories for online averaging
- Sampling rate (1kHz)
- Bandpass
- Channels (EEG, EOG, stim, misc)
- Maxshield
- Continuous HPI recording
- Save settings – you can load them later (more than 1 possible)

Data recording: all ready

- De-metallise
- Take the subject in
- Connect EEG, EOG, ground, HPI coils
- Ear pieces/button boxes/video etc (check in advance)
- Move the subject up as close to the helmet and possible, make sure they are comfortable
- Intercom/camera
- Lock’em up and start the show!



- **Go!**
- **Instruct the subject to stay still**
- **Measure HPI**
- **Select Average and/or Recard Raw**
- **cHPI**


Acquisition: raw data
MEG0111
MEG0112
MEG0113
MEG0121
MEG0122
MEG0123
MEG0131
MEG0132
MEG0133
MEG0141
MEG0142
MEG0143
MEG0211
MEG0212
MEG0213
MEG0221
MEG0222
MEG0223
MEG0231
MEG0232
MEG0233
MEG0241
MEG0242
MEG0243
STI101
STI201
STI301
||
Selection...
Rack
Scales...
Colors...
xy
Window:
3.0 s
[MEG 01-02] Buffer 18.00 s...

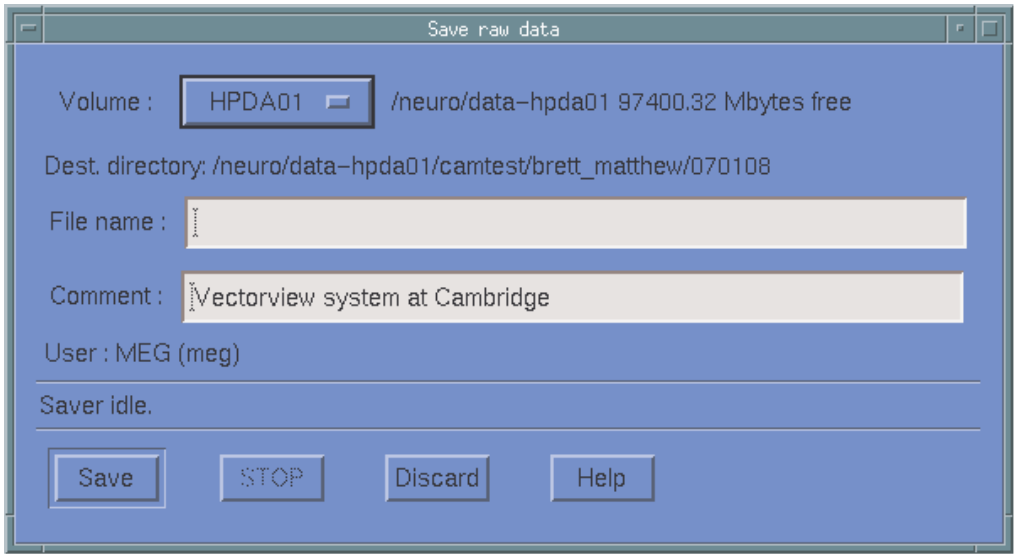
The end

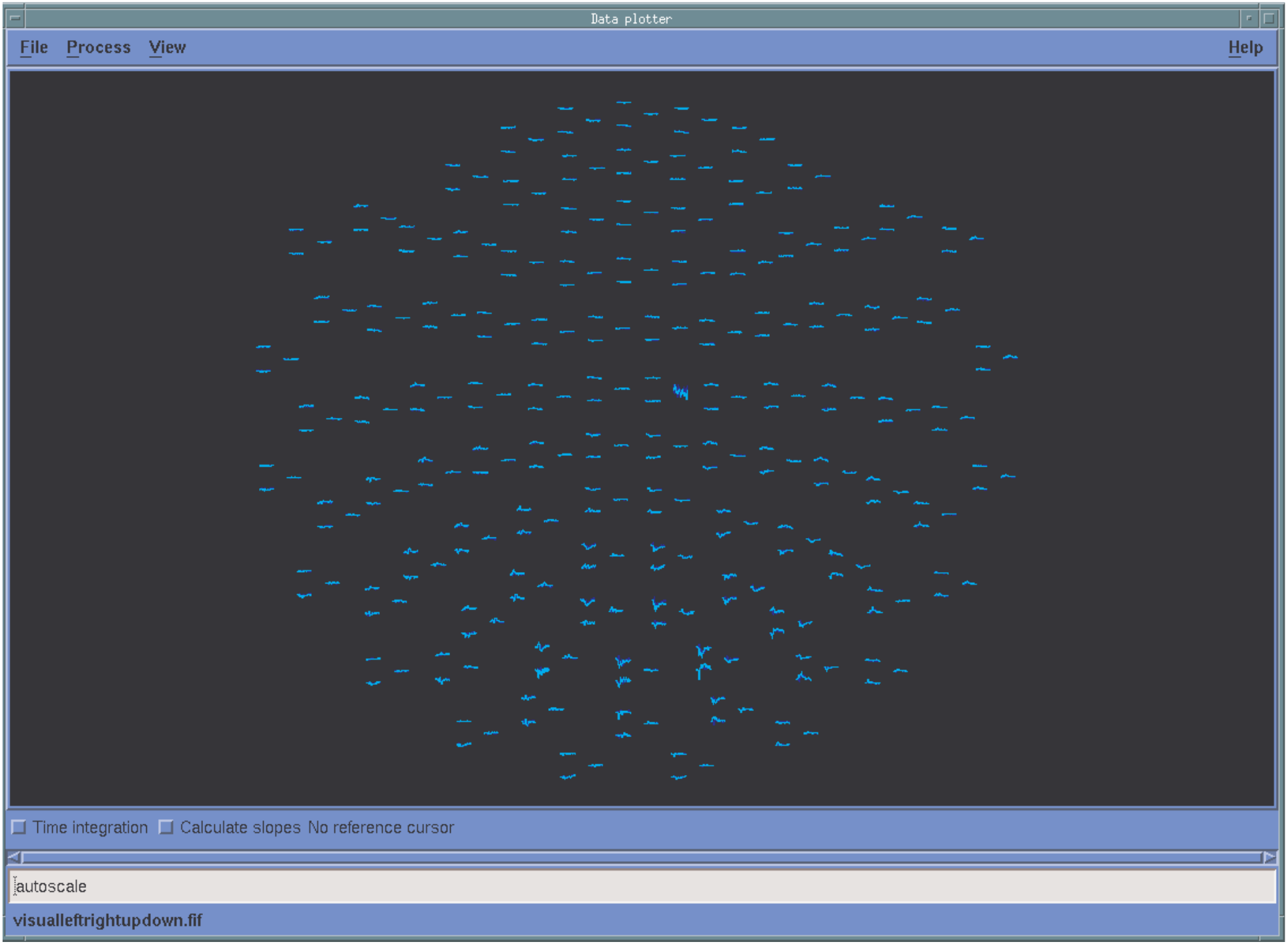
- Monitor channels
- Monitor rejections
- Monitor averages
- Monitor subject
- Give them breaks, talk to them
- Stop – save averages

AND raw data

- Repeat for each block

(15-20 min)



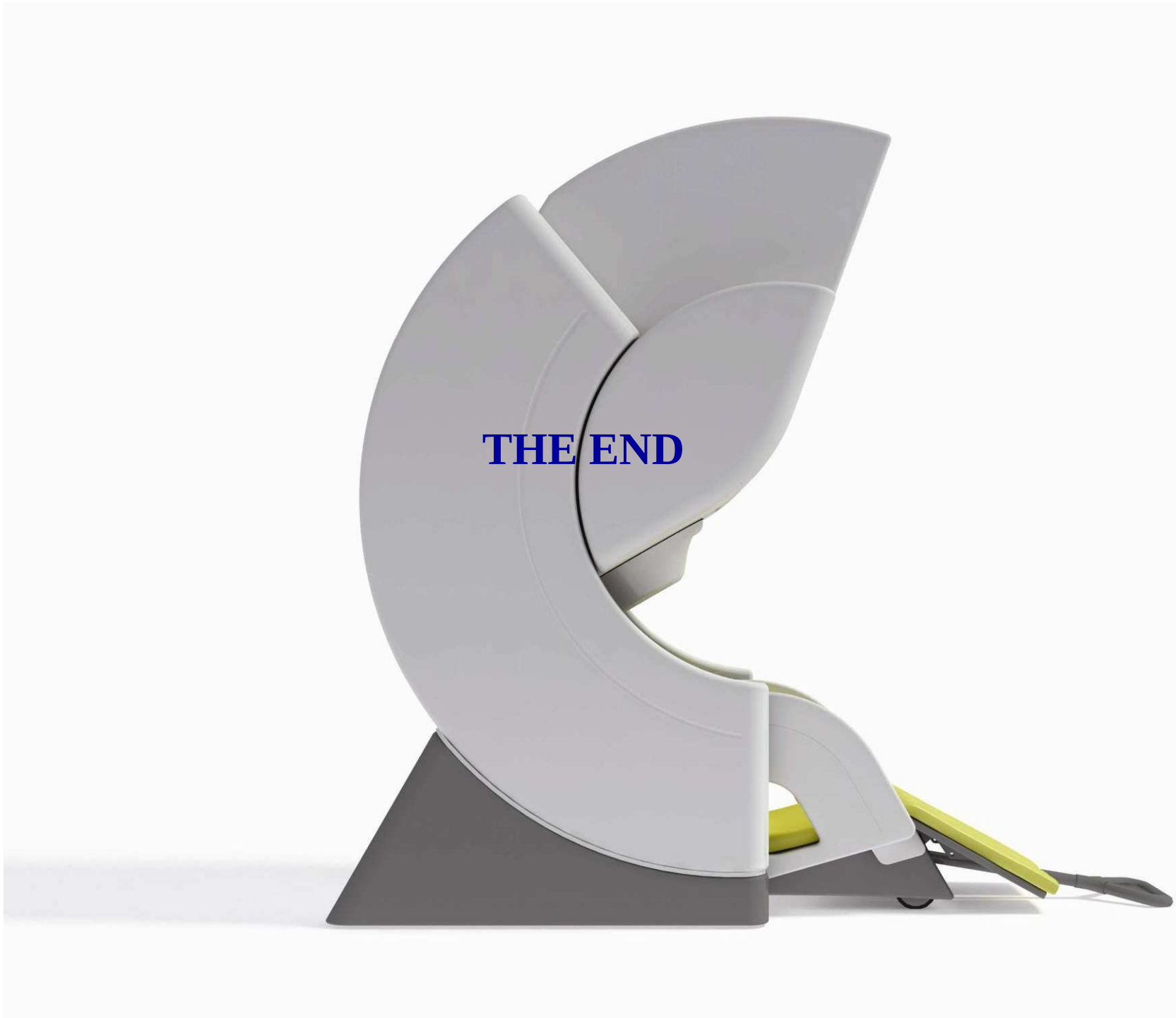

Data plotter
File
Process
View
Help
Time integration
Calculate slopes
No reference cursor
autoscale
visualleftrightupdown.fif

Next week

Lecture 7:

From signals to event-related fields and dipoles: an introduction using Elekta-Neuromag software

15.1.2007


THE END