

# Functional MRI Facility

# Core Facility Staff:

Peter Bandettini, Ph.D.	– Director
Sean Marrett, Ph.D.	– Staff Scientist
Jerzy Bodurka, Ph.D.	– Staff Scientist
Wen-Ming Luh, Ph.D.	– Staff Scientist
Adam Thomas	– Computer Administrator
Kay Kuhns	– Program Assistant
Karen Bove-Bettis	– Technologist
Janet Ebron	– Technologist
Alda Ottley	– Technologist
Ellen Condon	– Technologist
Sahra Omar	– Technologist

# Scanners:

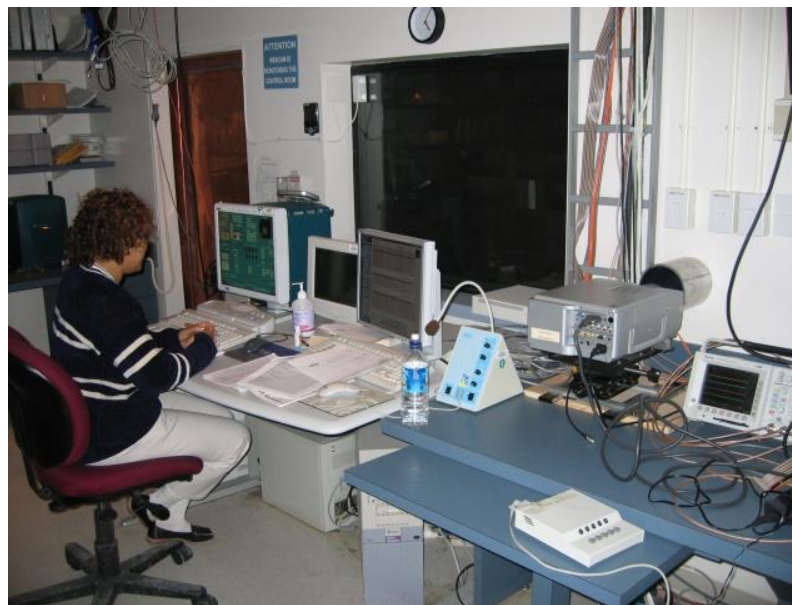
“3T-1” GE 3T (June 2000)  
“3T-2” GE 3T (Nov 2002)  
“FMRIF 1.5T” GE 1.5T (Sept 2004)  
Currently being Cited GE 3T (Aug 2003)



1.5T



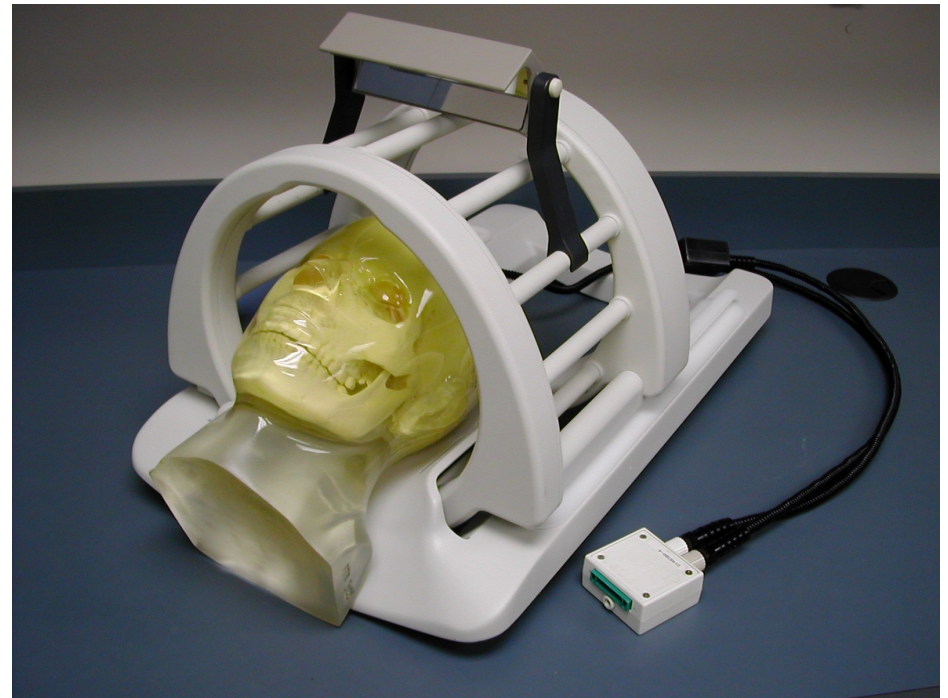
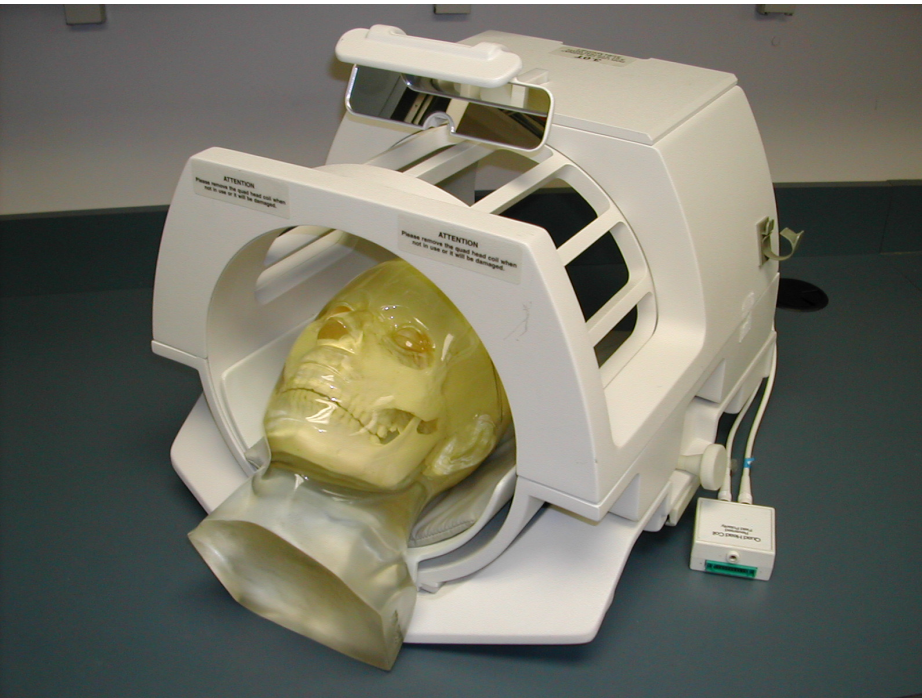
3T-1



3T-2

# Radiofrequency Coils

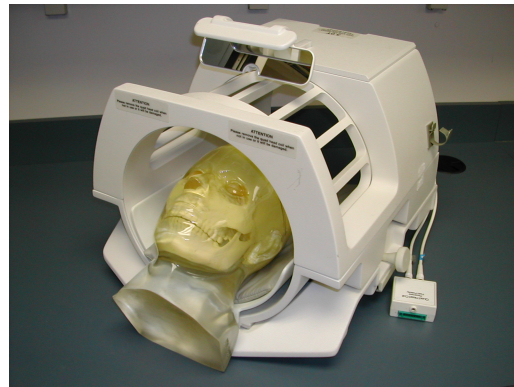
## Head “Bird-cage” coils



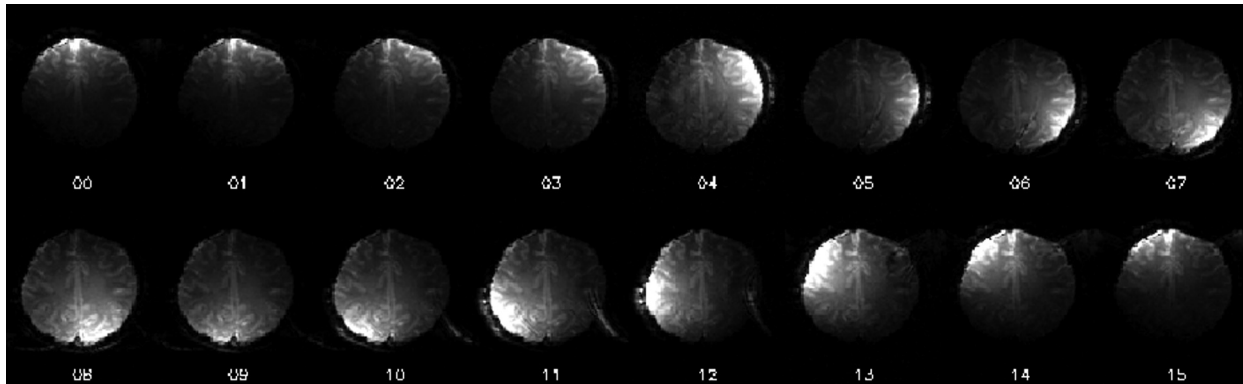




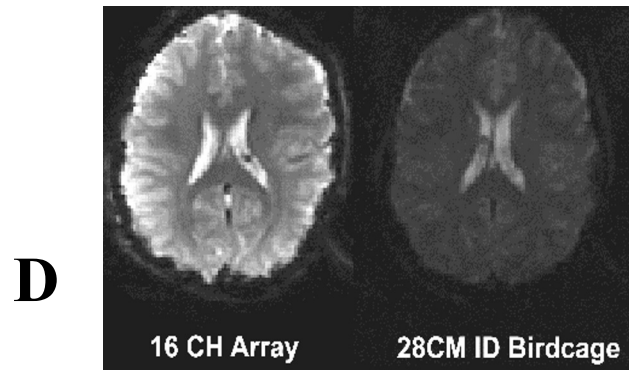
**A**



**B**



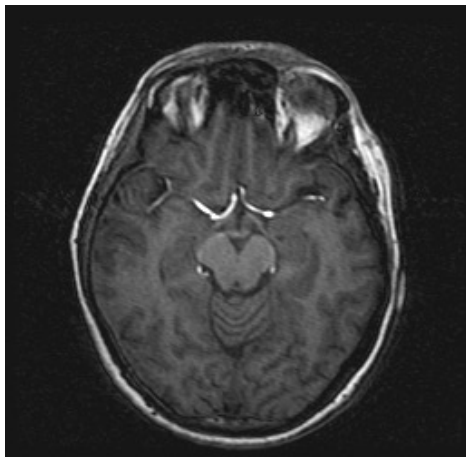
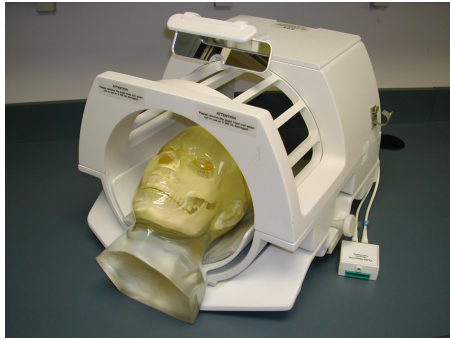
**C**



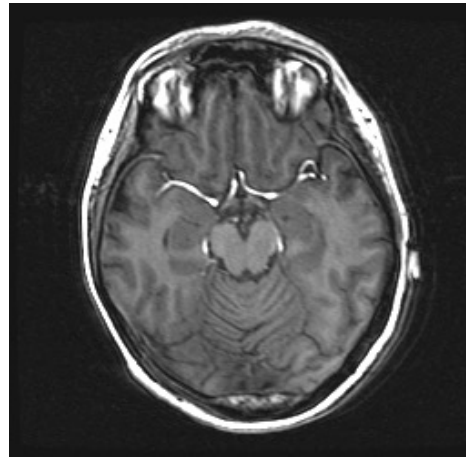
**D**

# Radiofrequency Coils

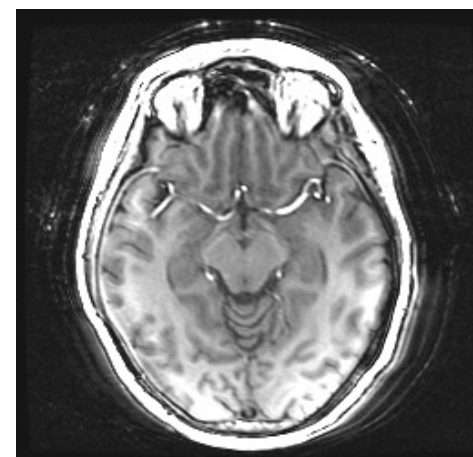
## *8-channel acquisition:*



GE birdcage



GE 8 channel coil



Nova 8 channel coil



## ***Stimulus presentation equipment***

- Back projection screen 48X36in (DaLite Polacoat 100) mounted on an aluminum stand.
- Sharp LCD projectors with Buhl lens
- Avotec Silent Vision fiber-optic glasses for visual stimulus with integrated eye-tracking system
- SMI iView system with long-range lens for video-camera based eye-tracking
- Avotec Silent Scan earphones
- Phone-Or Dual Channel Noise-canceling Microphone

## ***Software and response devices***

- Presentation software
- e-prime (biological)
- Psychophysics Toolbox
- SuperLab
- Custom designed button response units and physiological interfaces RSB

## ***New Devices (acquired in the last year)***

- EEG
- Custom DLP projection (higher temporal resolution)
- DLP Backprojection
- Fiber-optic response systems
- MRI compatible power-injector
- Drug infusion pump



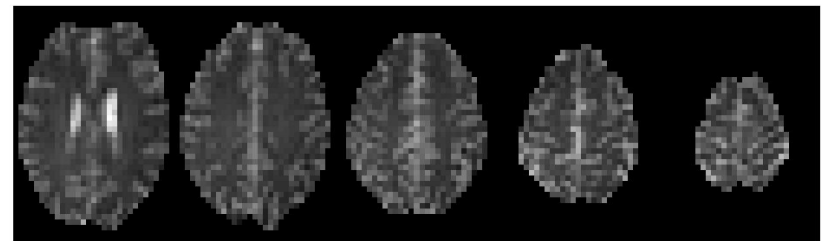
# Pulse Sequences

## BOLD imaging:

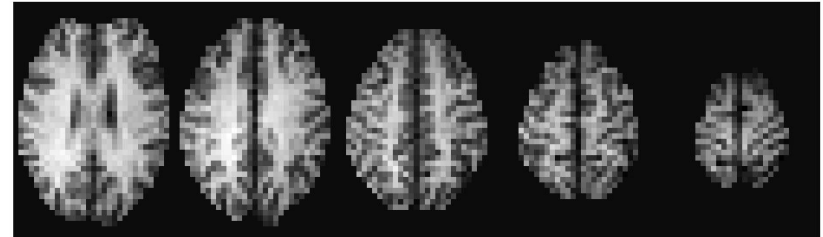
- **EPI-RT** : General purpose BOLD imaging with real time display
- **epi3, epi4** : NIH EPI sequences, epi4 for use with 16 channel system
- **SPEP**: Simultaneous perfusion and BOLD -spiral/EPI sequence with perfusion and diffusion modules and multi-echo and combined SE and GE capability
- **Clustered volume EPI-RT**: (for auditory studies)
- **NIH-EPI** (for use with 16 channel receiver system)

## Anatomical Imaging:

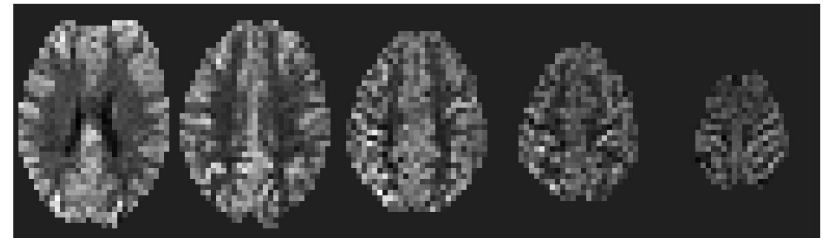
- **MP-RAGE**: T1 weighted sequence with excellent Gray/White matter contrast
- standard product multi-shot sequences like: SPGR, SE, FSE etc.



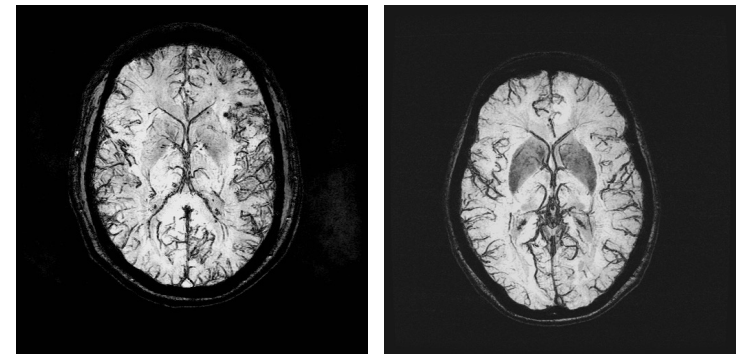
EPI



IR-EPI



Pulsed ASL (QUIPSS II)



High-resolution venogram

# “Real – Time” fMRI

AFNI 2.55d: Data/RT2/rt.#001+orig & rt.#001@1+orig

x = 5.156 mm [L]  
y = 73.906 mm [P]  
z = -7.500 mm [I]

Color: green  
Gap: 5  
Index: 0

Original View  
AC-PC Aligned  
Talairach View

Define Markers  
See Markers

Define Function  
See Function

Define Datamode

Switch Session  
Switch Anatomy  
Switch Function  
Control Surface

Options  
Anat underlay  
Func underlay

Anat # 0 #0  
Func #0 Fit Coef  
Thr #1 Correlation

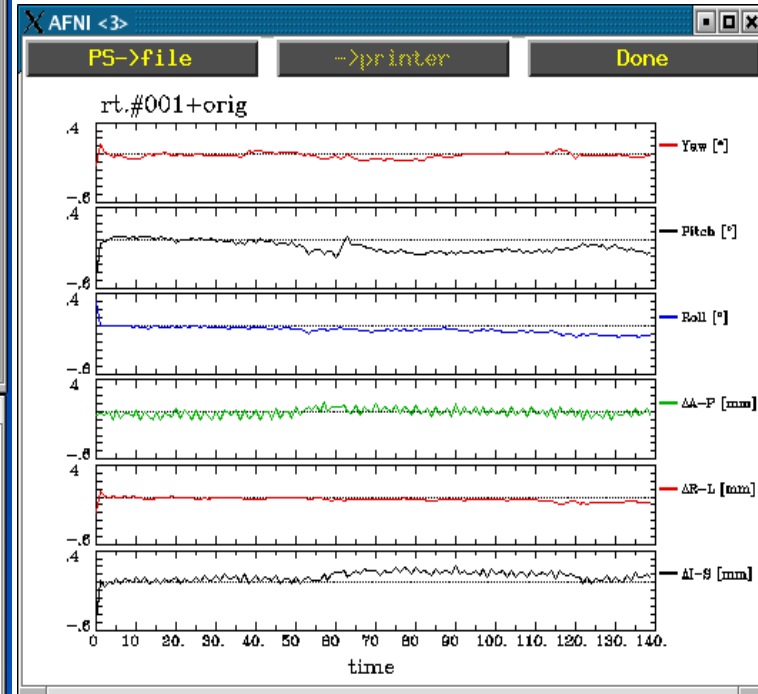
Anat 0: 7450  
Func -0.252845; 0.417904  
Thr -0.5232; 0.9005

autoRange: 0.417904

10000 Rota

See TT Atlas Regions

1.1-6 # \*\* Anat = 2937  
\*\* 0 Func = 0.181984  
Pos? Thr = 0.9005



AFNI 2.55d: Data/RT2/rt.#001+orig & rt.#001@1+orig <3>

Color: Swap Norm

1609 [+158]

1451

AXIAL X: 33 index=0 value=2937 at 0.299999  
Y: 53 Grid: 20 Scale: 2 datum/pix  
Z: 3 Num: 140 Base: separate

AFNI FIM Opt

Detailed description: This figure shows a motion tracking plot for the same subject. The x-axis represents time from 0 to 140 seconds. The y-axis represents motion in degrees or millimeters. The plot shows several time-series traces. A yellow box highlights a region of high motion between approximately 60 and 100 seconds. The plot includes a color scale on the left and various control buttons at the bottom.

motion tracking

Website:

FMRI.NIMH.NIH.GOV

**FMRI**  
fmrif.nimh.nih.gov

welcome news search sitemap  
\* pab my folder my preferences edit users log out mailing list banner undo phone setup php/pg  
you are here: home

site navigation

**public resources:**  
About  
Research  
Investigators  
Staff  
Education  
Volunteer  
Directions

**internal resources**  
Help!  
scanner docs  
tools/software  
scanner room  
forums  
mailing lists  
faqs  
scheduling

folder contents view edit publishing gui edit

**Welcome to the fMRI Facility at NIH**

GE:  $I_s=100\mu A$ ,  $I_e=150\mu A$  SE:  $I_s=100\mu A$ ,  $I_e=150\mu A$

L 10 = 10 = R  
T value  
4  
3  
2  
1  
0

Click on images to view recent research using the fMRI.

**news**  
fMRI Poster at NIMH Retreat 09/22/2003  
Severe Weather Info 09/17/2003

**NIH** National Institute of Mental Health  
**NIAAA**  
NATIONAL INSTITUTES OF HEALTH

# 3T-1

	Wednesday 03/09/05	Thursday 03/10/05	Friday 03/11/05	Saturday 03/12/05	Sunday 03/13/05	Monday 03/14/05	Tuesday 03/15/05
8am	CBDB (smarenco)	CBDB (Berman)	LBC (friedman-hill)	NMRF	CBDB (Berman)	training	CBDB (vmattay)
9am	CBDB (jcallicott)	CBDB (Berman)	LBC (friedman-hill)	NMRF	CBDB (Berman)	training	CBDB (vmattay)
10am	CBDB (jcallicott)	CBDB (Berman)	LBC (friedman-hill)	NMRF	CBDB (Berman)	CBDB (smarenco)	CBDB
11am	CBDB (jcallicott)	CBDB (vmattay)	LBC (friedman-hill)	NMRF	LBC	CBDB (vmattay)	NINDS
Noon	NMRF	CBDB (vmattay)	LBC (friedman-hill)	NINDS	LBC	CBDB (vmattay)	NINDS
1pm	NMRF	CBDB (jcallicott)	LBC (friedman-hill)	NINDS	LBC	CBDB (vmattay)	NINDS
2pm	NMRF	CBDB (jcallicott)	CBDB (Berman)	NINDS	LBC	NINDS	NINDS
3pm	NMRF	FIM (dknight)	CBDB (Berman)	NINDS	LBC	NINDS	NINDS
4pm	NIAA	FIM (dknight)	CBDB	NINDS	LBC	NINDS	NINDS
5pm	NIAA	FIM (dknight)	CBDB (smarenco)	NINDS	LBC	NINDS	NINDS
6pm	NIAA	FIM (dknight)	CBDB (vmattay)	NINDS	LBC	NINDS	NINDS
7pm	NIAA	FIM (rbirn)	CBDB (vmattay)	NINDS	LBC	NINDS	NINDS
8pm	DEV	FIM (rbirn)	CBDB (vmattay)	NINDS	LBC	GE	DEV
9pm	DEV	FIM (rbirn)	CBDB (vmattay)	NINDS	LBC	GE	DEV
10pm	DEV	FIM (rbirn)	CBDB (vmattay)	NINDS	LBC	GE	DEV

Department	Weekday		Weekend	
	Day	Eve	Day	Eve
Geriatric Psychiatric Branch				
training				
NIAA - National Inst. of Alcohol and Alcoholism				
DEV - Scanner Development				
FIM - Functional Imaging Methods				
GE Maintenance Time				
MAP - Mood and Anxieties Program				
NINDS - Neurological Disorders and Stroke				
CBDB - Clinical Brain Disorders Branch				
LBC - Laboratory of Brain and Cognition				
NMRF - NIH Magnetic Resonance Facility				
David Rubinow				
Posted				

# 3T-2

	Wednesday 03/09/05	Thursday 03/10/05	Friday 03/11/05	Saturday 03/12/05	Sunday 03/13/05	Monday 03/14/05	Tuesday 03/15/05
8am	MAP	NINDS	NINDS	MAP	DR	DR	DR
9am	MAP	NINDS	NINDS	MAP	LBC	training	CBDB
10am	MAP	NINDS	NINDS	MAP	LBC	training	CBDB
11am	MAP	NINDS	NINDS	MAP	LBC	MAP	CBDB
Noon	MAP	NINDS	NINDS	MAP	LBC	MAP	GPB
1pm	MAP	NINDS	NINDS	MAP	FIM	LBC (imukai)	GPB
2pm	MAP	NMRF	NINDS	MAP	FIM	LBC (imukai)	GPB
3pm	MAP	NMRF	NINDS	MAP	NINDS	LBC (imukai)	GPB
4pm	MAP	NMRF	NINDS	MAP	NINDS	LBC (imukai)	MAP
5pm	MAP	NMRF	NINDS	MAP	NINDS	LBC (imukai)	MAP
6pm	MAP	NMRF	NINDS	MAP	NINDS	LBC (imukai)	MAP
7pm	MAP	NMRF	NINDS	MAP	NINDS	NMRF	MAP
8pm	DEV	DEV	NINDS	GPB	NINDS	NMRF	GE
9pm	DEV	DEV	NINDS	GPB	NINDS	NMRF	GE
10pm	DEV	DEV	NINDS	GPB	NINDS	NMRF	GE

Department	Weekday		Weekend	
	Day	Eve	Day	Eve
Geriatric Psychiatric Branch				
training				
NIAA - National Inst. of Alcohol and Alcoholism				
DEV - Scanner Development				
FIM - Functional Imaging Methods				
GE Maintenance Time				
MAP - Mood and Anxieties Program				
NINDS - Neurological Disorders and Stroke				
CBDB - Clinical Brain Disorders Branch				
LBC - Laboratory of Brain and Cognition				
NMRF - NIH Magnetic Resonance Facility				
David Rubinow				
Posted				

# Education / Support:

- Weekly fMRI discussions (Fridays, 1pm, 10/4N230)
- Bi-Monthly user meetings (First Monday every other month, 3pm, 10/4N230)
- Bi-Monthly steering committee meetings (First Monday every other month, 3pm, 10/4N230)
- Meetings with each PI to address needs and concerns & guide purchases
- Training in scanner operation and use of subject interface devices
- Consulting on paradigm design



# PI Research:

## **NIMH:**

Peter Bandettini, Ph.D.  
Karen Berman, M.D.  
James Blair, Ph.D.  
Robert Cohen, M.D., Ph.D.  
Christian Grillon, Ph.D.  
Wayne Drevets, M.D.  
Ellen Liebenluft, M.D.  
Daniel Pine, M.D.  
Jun Shen, Ph.D.  
Leslie Ungerleider, Ph.D.  
Daniel Weinberger, M.D.

## **NINDS:**

Leonardo Cohen, M.D.  
Jeff Duyn, Ph.D.  
Jordan Grafman, Ph.D.  
Mark Hallett, Ph.D.  
Alan Koretsky, Ph.D.  
Chrsity Ludlow, Ph.D.

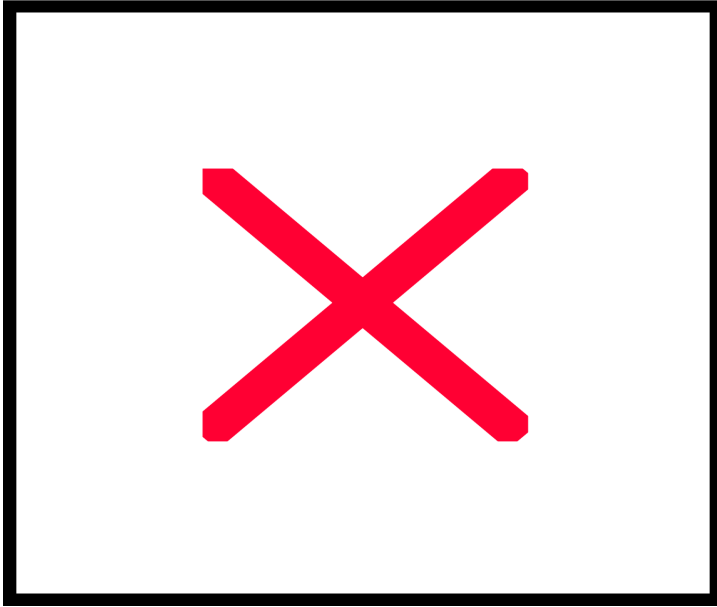
## **NIAAA:**

Daniel Hommer, M.D.

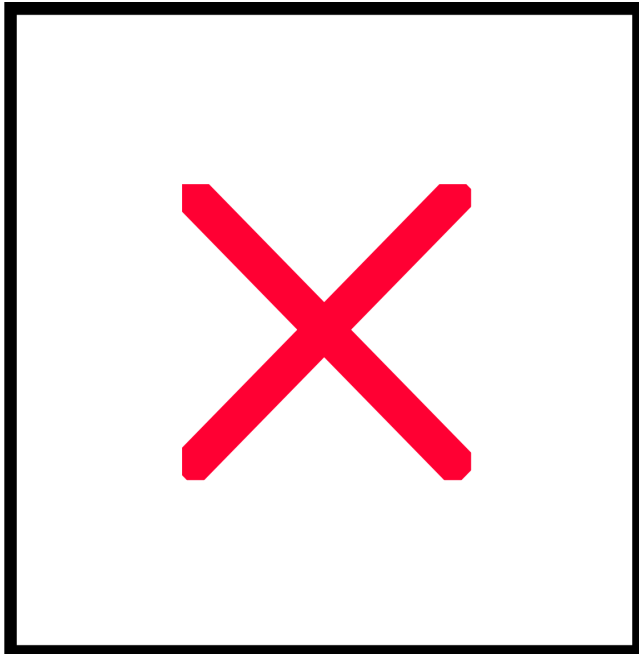
## **NICHD:**

Peter Basser, Ph.D.  
Allen Braun, M.D.

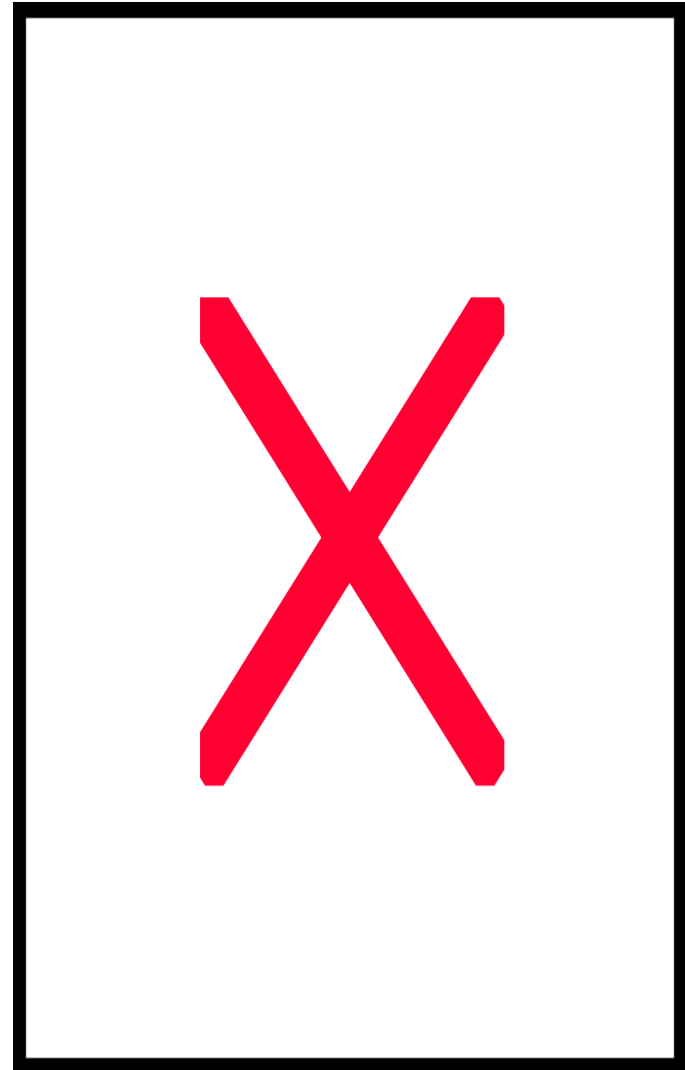
# Research Protocols on fMRI Scanners



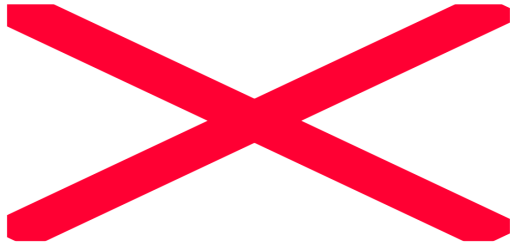
17



20



32



**2003:**

**Up days:**

**3T-1: 303**

**3T-2: 280**

**Total budget (including salaries):**

**\$1,746 000.00**

**Cost per usage hour (only counting  
up days x 10 hrs day): \$309**

**Cost per Gigabyte: \$2.35**



# **Functional MRI**

## **Papers Published at the NIH:**

**2000: 20**

**2001: 11**

**2002: 24**

**2003: 26**

**2004: 31**

**2005: 5**

# Ongoing Projects and Directions

- **More routine access to advanced subject interface devices (eye tracking, skin conductance).**
- **Better dissemination of methods information to and across groups.**
- **Simultaneous EEG/fMRI.**
- **Higher resolution single shot fMRI (1.5 mm<sup>3</sup>).**
- **More routine access to perfusion imaging methods and processing.**
- **Better shimming techniques (to image base of brain more effectively).**



# Schedule so far

Feb 17: Peter Bandettini: Introduction, overview

March 3: (3:00 PM) Steven Schiff from the Krasnow Institute

March 10: Joelle Sarlls from the University of Arizona. "Radial Data Acquisitions in Diffusion-weighted MRI"

March 17: Danny Pine, Mood and Affective Disorders Program

March 24: Niko Kriegeskorte (discussion: multivariate analysis and pattern classification)

March 31:

April 14: David Leopold

April 21: Adam Thomas (discussion: slice orientation tradeoffs)

April 28: Rasmus Birn

May 19: Sean Marrett (discussion: fMRI of processes associated with perceptual decision making)

May 26: Kyle Simmons, Laboratory of Brain and Cognition (discussion: voxel-wise uniqueness and variability of activation patterns)

June 23:

June 30

July 7

July 21

July 28

# Potential topics/issues...

**Signal dropout**

**Multivariate analysis**

**Pooling across scanners**

**Slice orientation**

**DTI and fMRI integration**

**Connectivity assessment methods**

**High field strength issues**

**Simultaneous measures (EEG, SCR, eye tracking, physiology)**

**FMR-Adaptation**

**Behavior prediction**

**Neuronal-hemodynamic coupling**

**Voxel based morphometry**

**High resolution issues**

**Perfusion imaging**

**...?**

