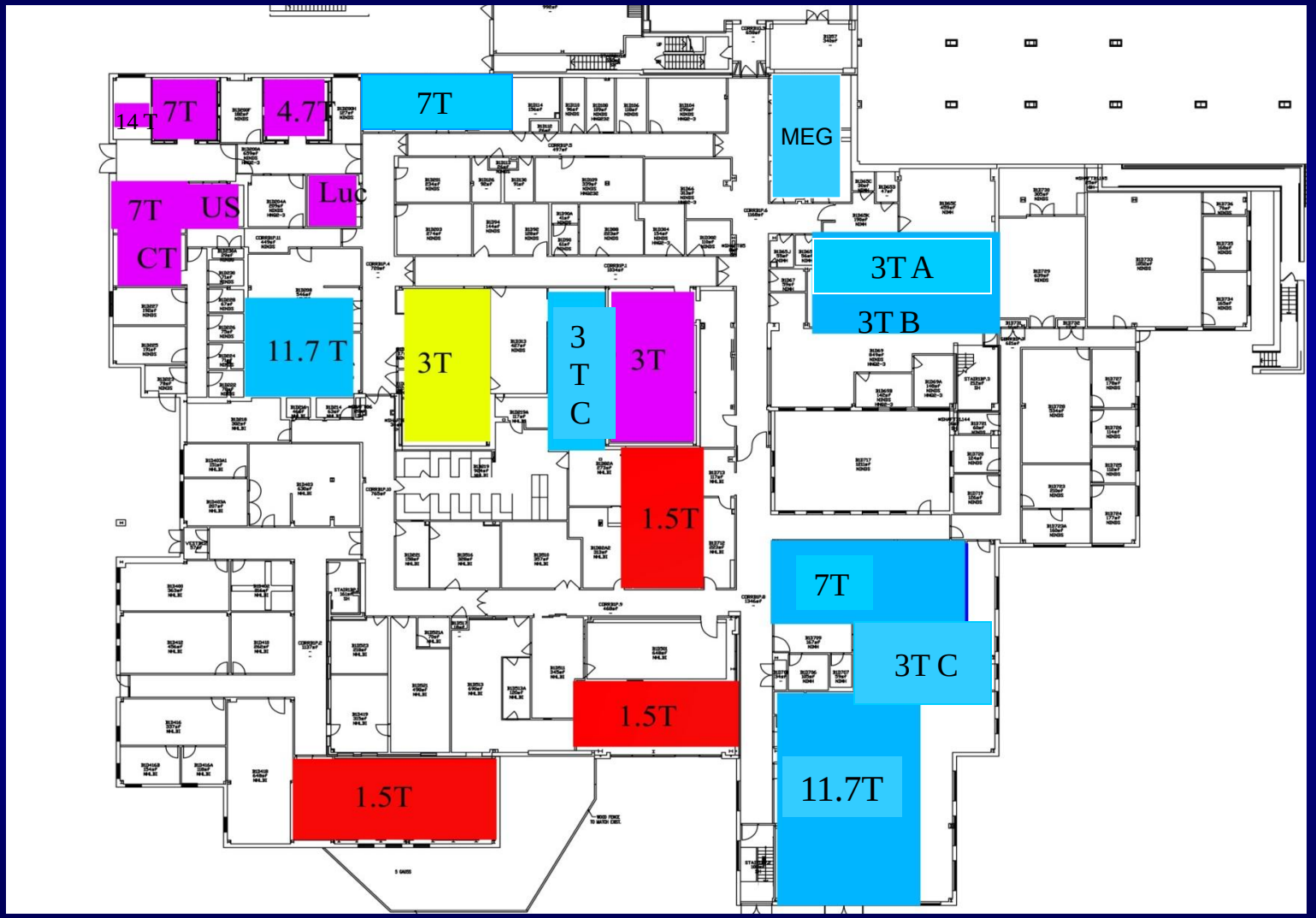
NIH In Vivo NMR Center



High Field MRI at the Intramural Program of the NIH

Advantages of High Field MRI

1) Sensitivity increases with increasing Bo
   - A) Sample noise dominated regime ~Bo
   - B) Detector noise dominated regime ~Bo^2

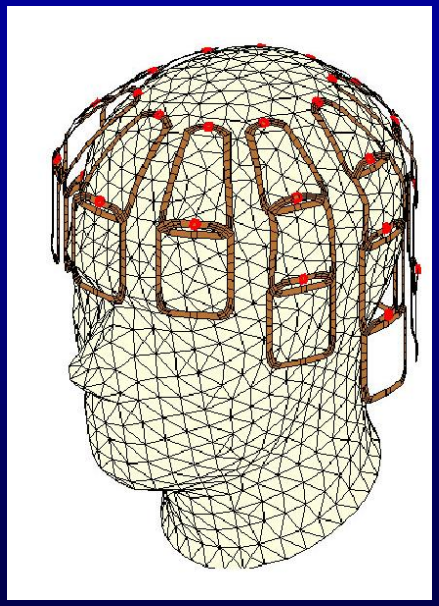
2) Some contrast increases with increasing Bo
   - A) Magnetic Susceptibility weighted contrast
   - B) T_1 based contrast

High Field MRI at the Intramural Program of the NIH

Advantages of High Field MRI

1) Sensitivity increases with increasing Bo
   Detector noise dominated regime is close

32 Element Array



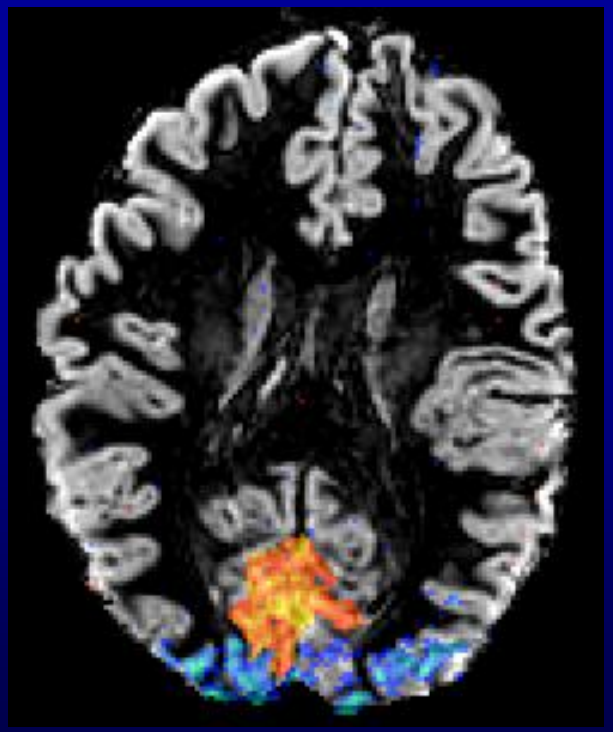
Approximate SNR Gains

	1.5 T	3.0 T	7.0 T
1-channel (Birdcage)	1.0	2.0	4.0
multi-channel (brain center)	1.7	3.5	6.0
multi-channel (cortex)	4.0	8.5	25.0

High Field MRI at the Intramural Program of the NIH

Advantages of High Field MRI

2) Contrast gains with ~Bo



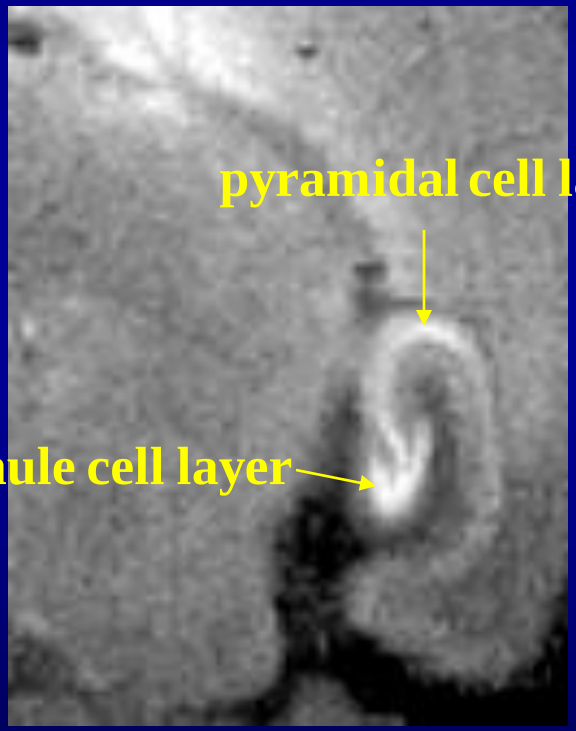
fMRI

History of High Field at NIH

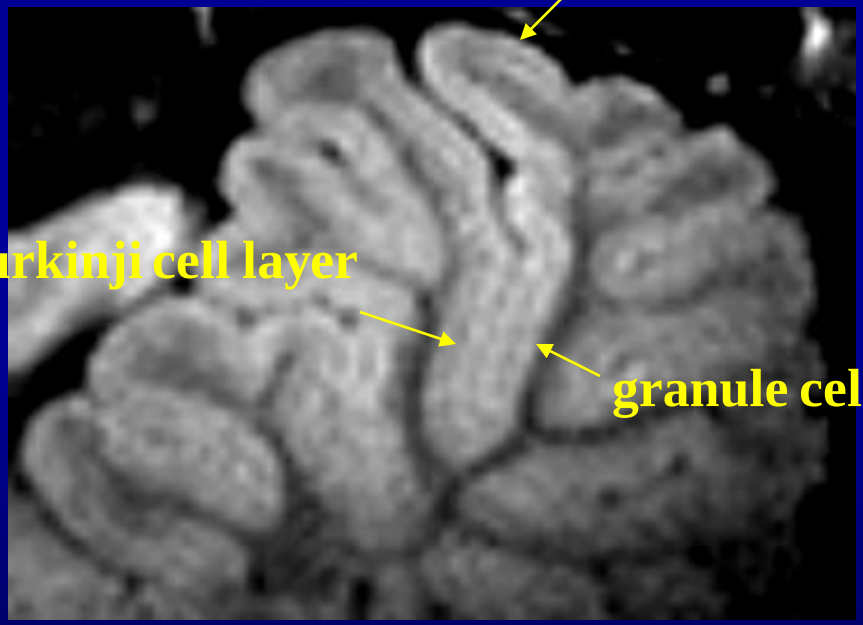
Late 1980's	1.5T human, 4.7T animal (DTI and MTC)
Early 1990's	4T human (fMRI)
Early 2000's	7T (unshielded) 11.7T Animal (SWI, cytoarchitecture, single cells)
Early 2010's	11.7T human head only 17T Animal Actively Shielded 7T human

Neuroarchitecture from Systemic MEMRI

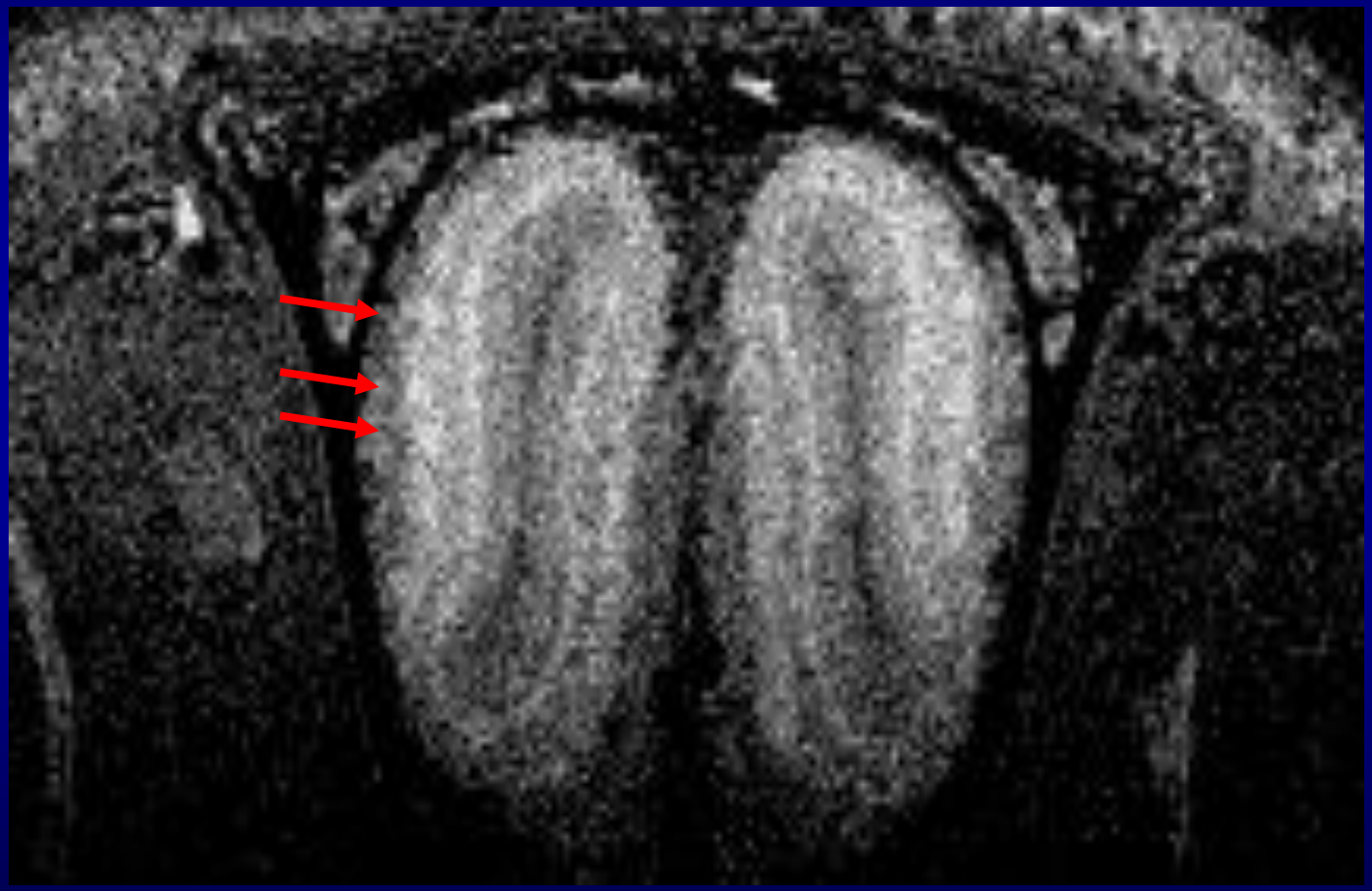
Hippocampus



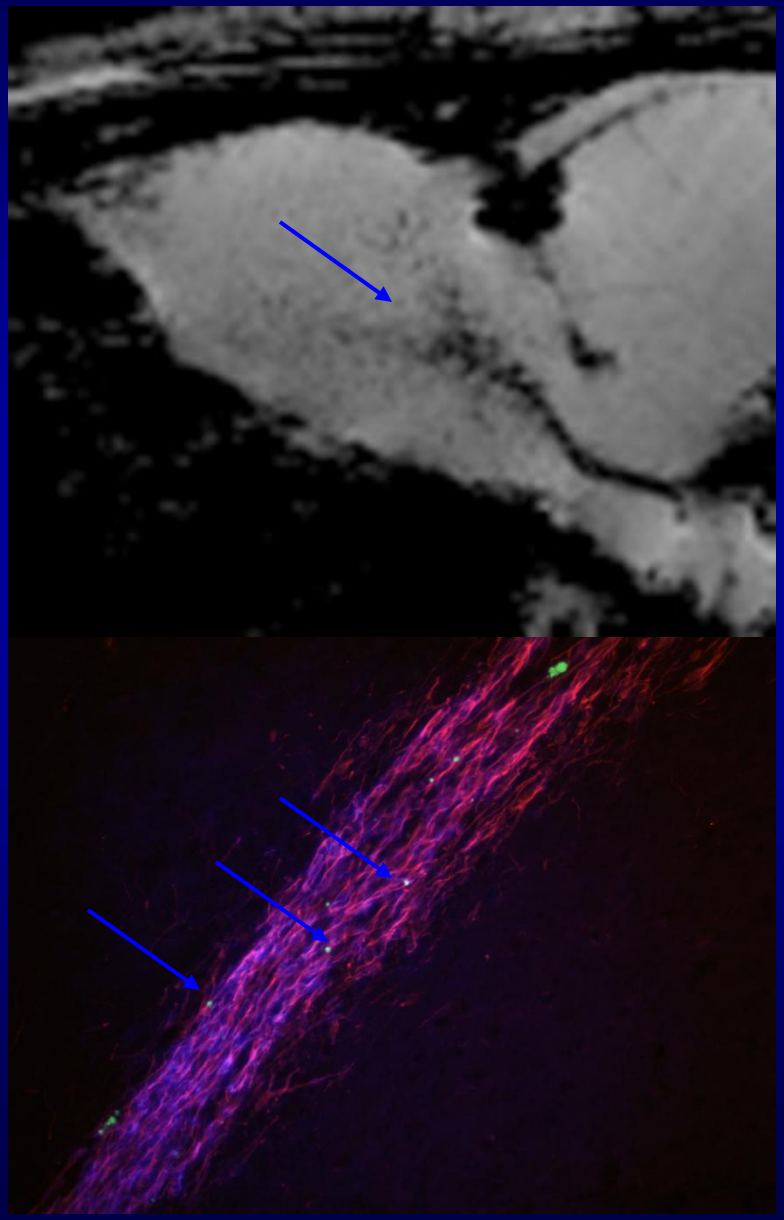
Cerebellum



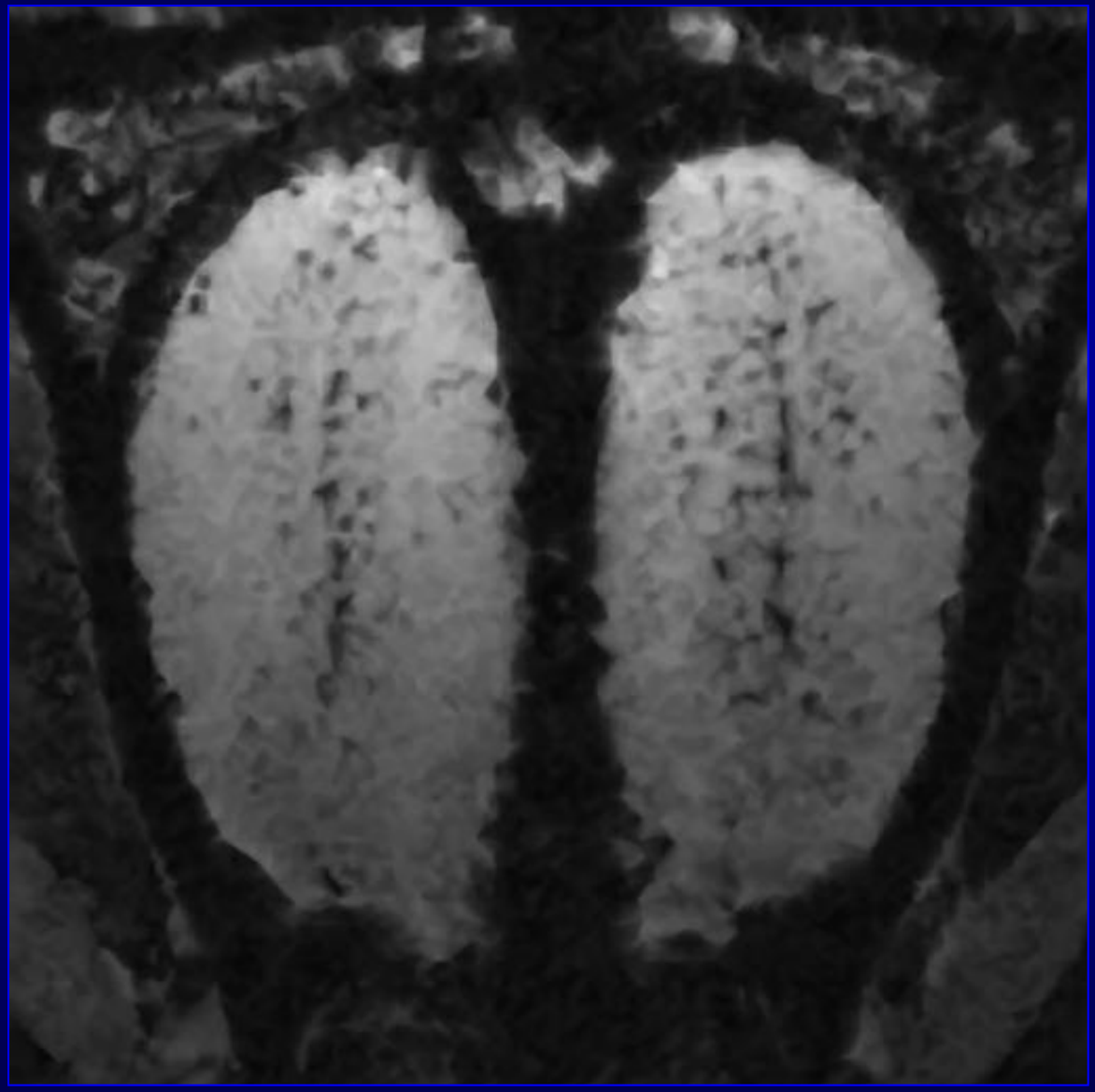
MEMRI of Olfactory Bulb
50 Micron Isotropic Resolution



MRI Tracking of Neuronal Precursors

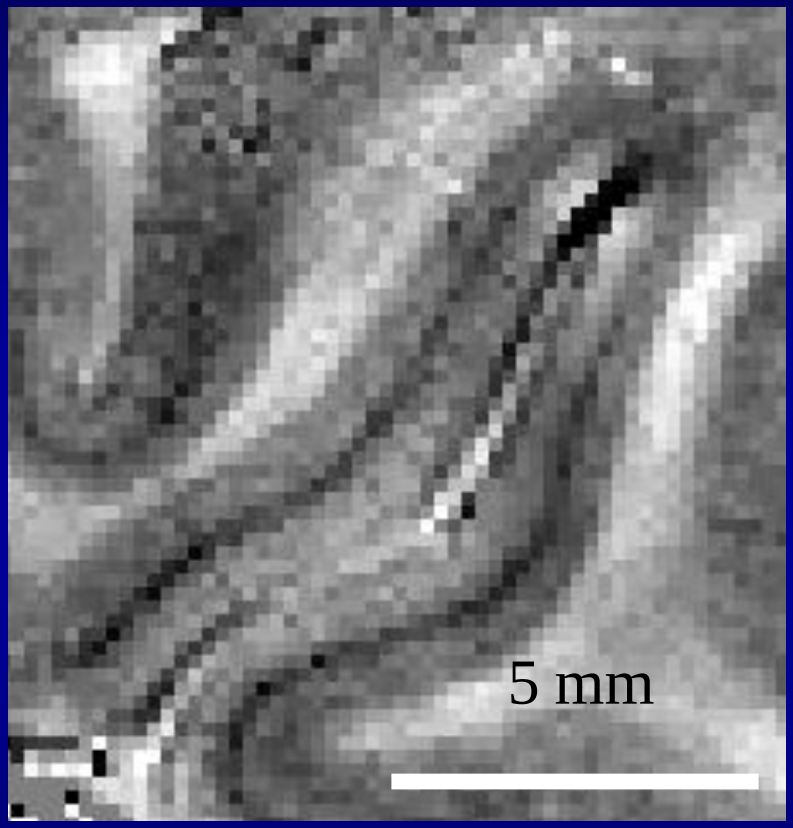


MRI Tracking of Neuronal Precursors

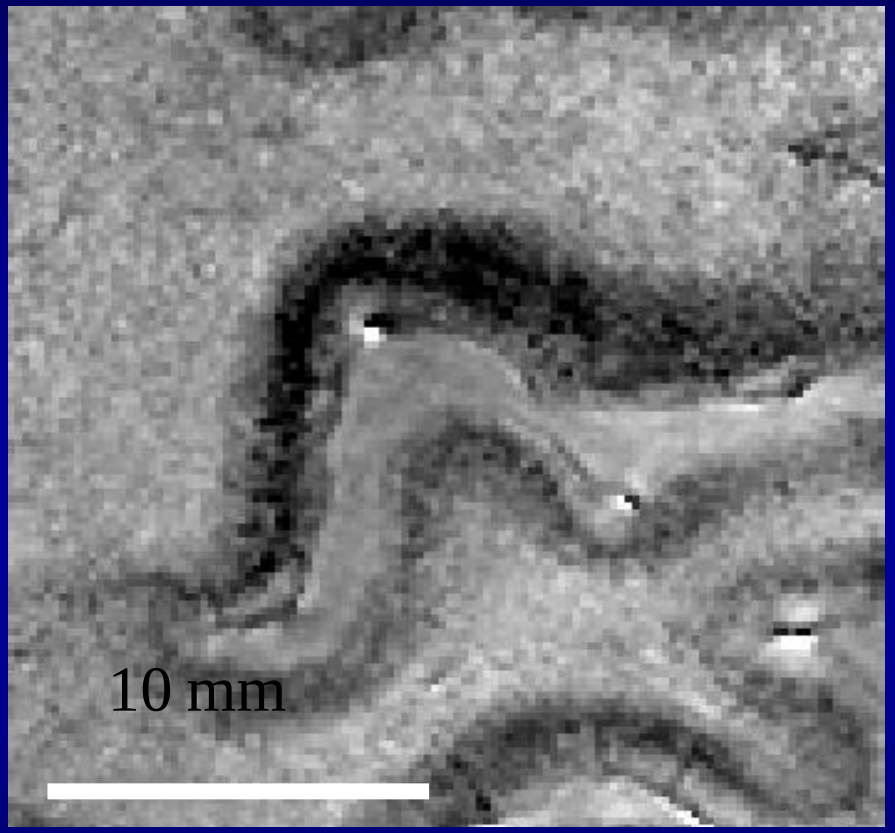


Human Brain MRI at 7T Tesla

Human Brain MRI at 7T Tesla



Visual Cortex



Motor Cortex

High Field MRI at the Intramural Program of the NIH

Conclusions:

1) We like high magnetic fields at NIH.
2) Higher fields and active shielding.
3) Getting prohibitively expensive.
4) Need instrumentation development to get full advantage.
5) Everytime field goes up something interesting happens!