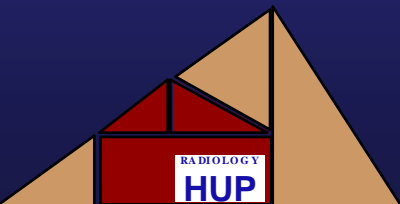


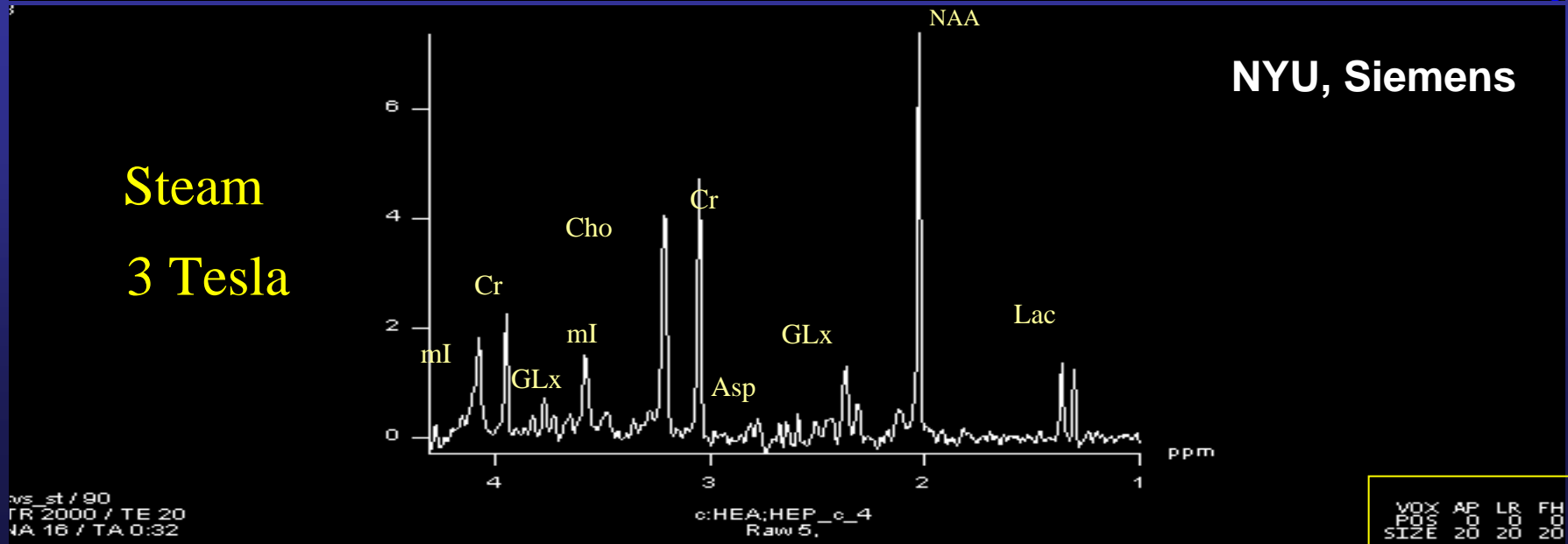
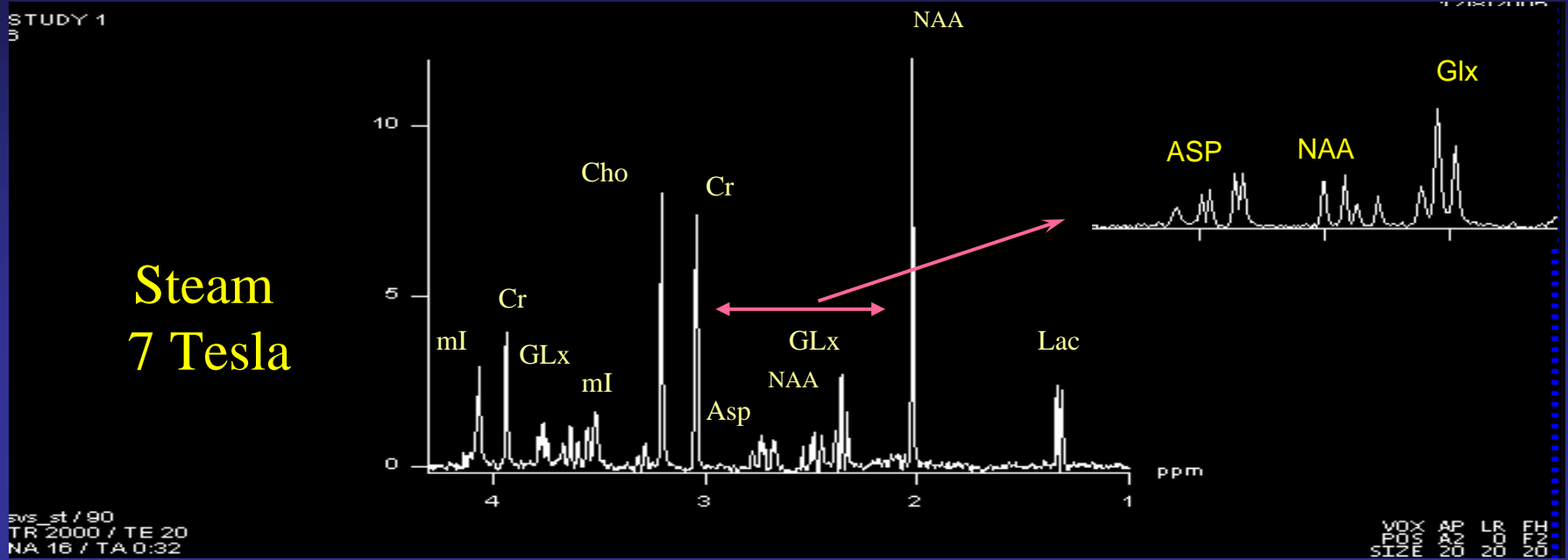
MR Spectroscopy at 7T

Harish Poptani, Ph.D.

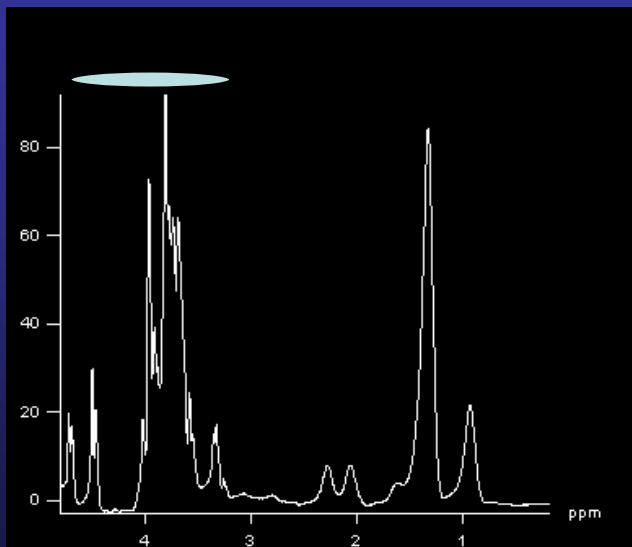
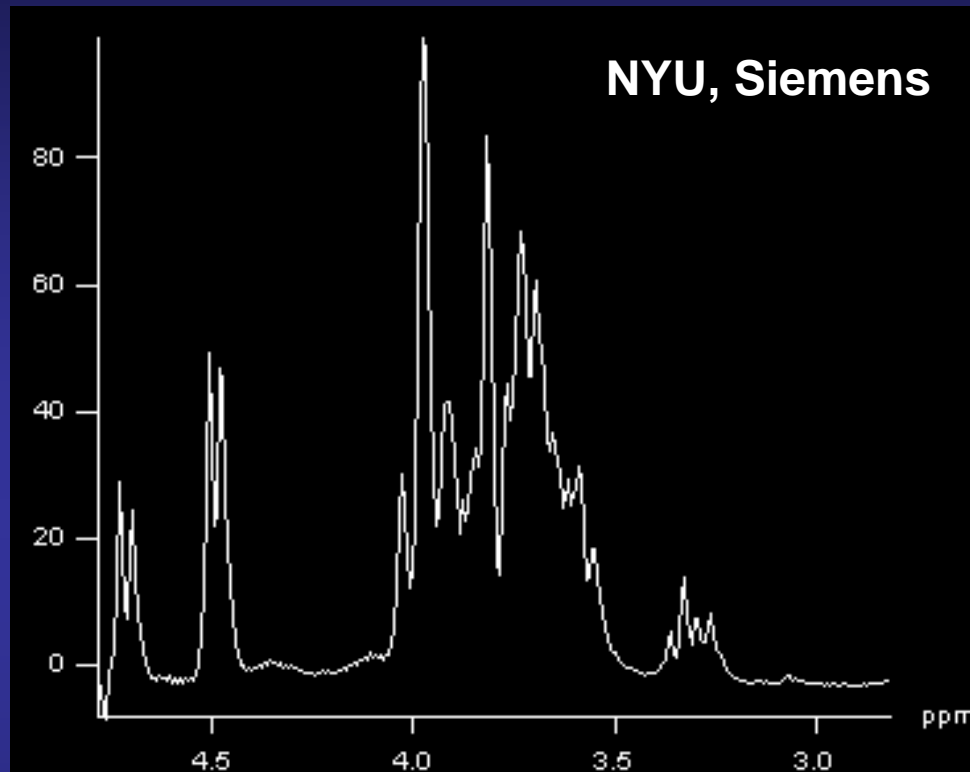
*University of Pennsylvania
Department of Radiology*



Increased chemical shift dispersion

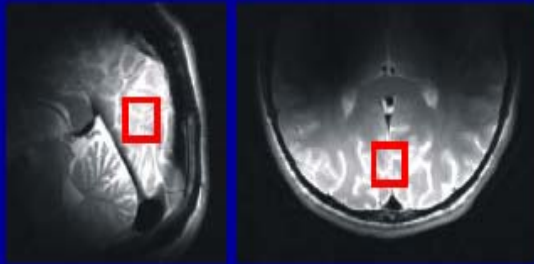


Milk phantom



SVS steam, TE = 30 ms 8 cc voxel, 16 ave TA = 24 sec

Single voxel, one acquisition!



7 T

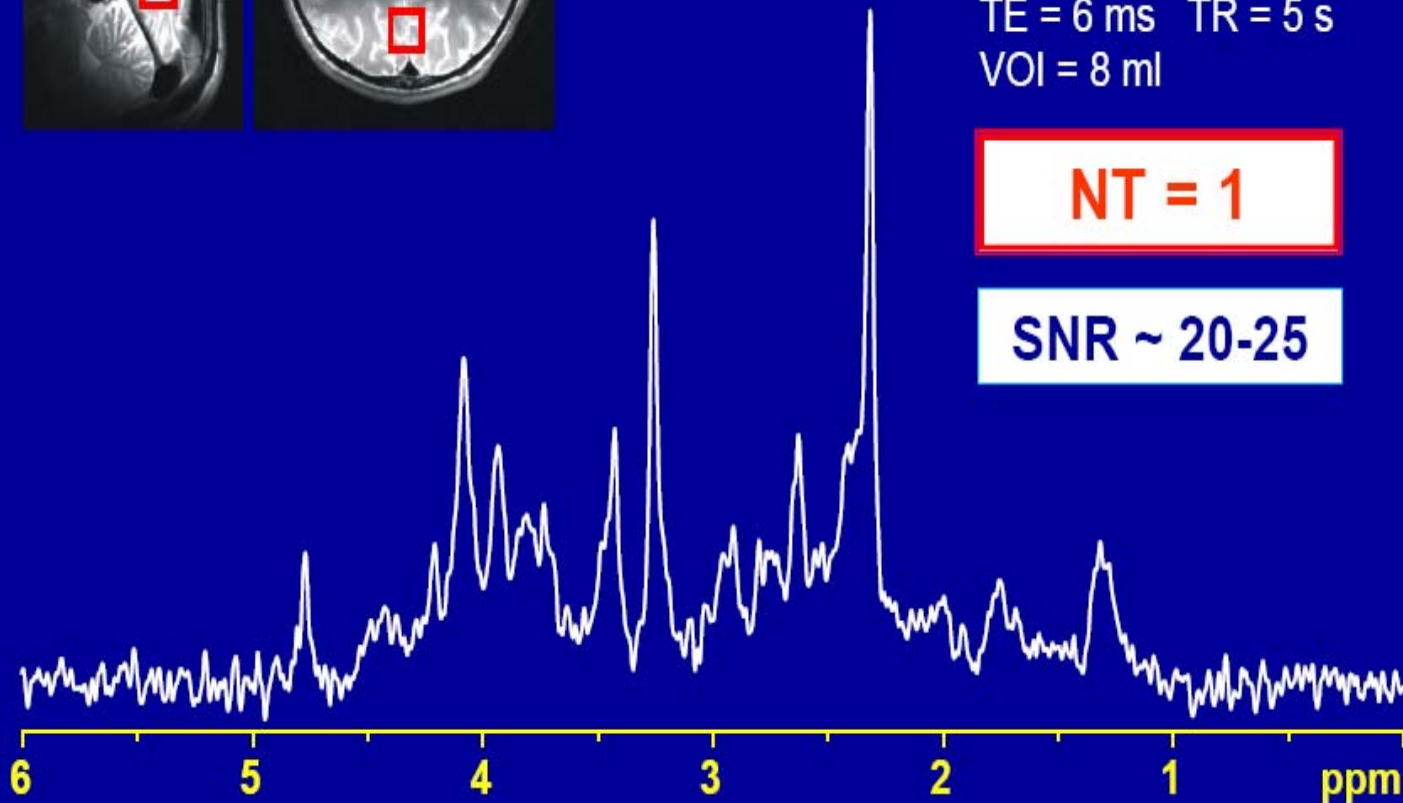
STEAM

TE = 6 ms TR = 5 s

VOI = 8 ml

NT = 1

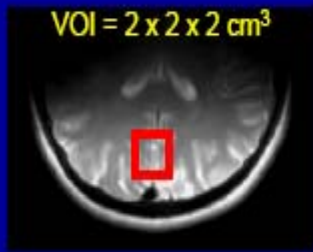
SNR ~ 20-25



Tkac et al, Appl Magn Reson 2005

Increased SNR at 7T

4T



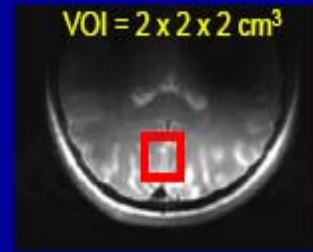
NT = 8

S/N = 35

STEAM
TE = 4 ms



7T



NT = 8

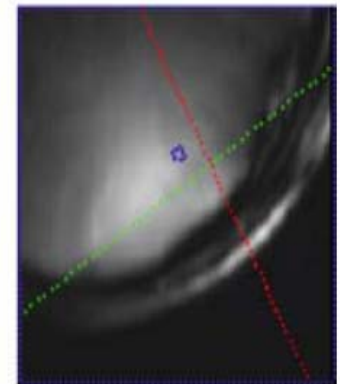
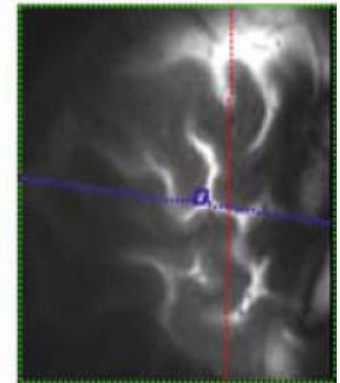
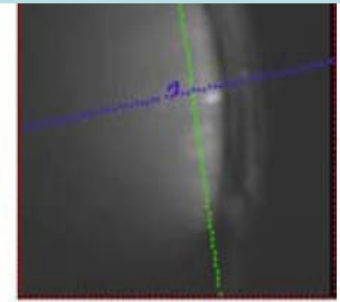
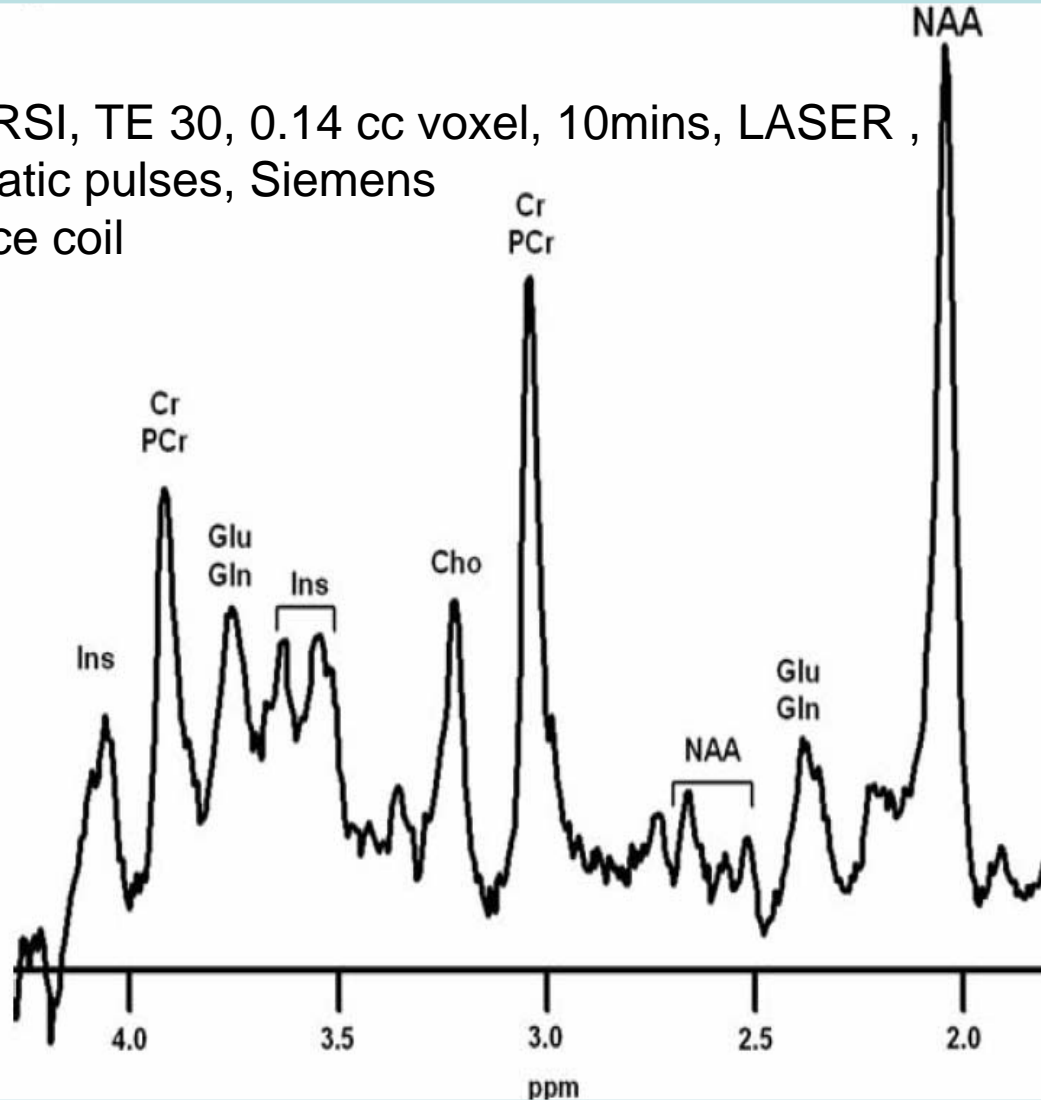
S/N = 65

STEAM
TE = 6 ms

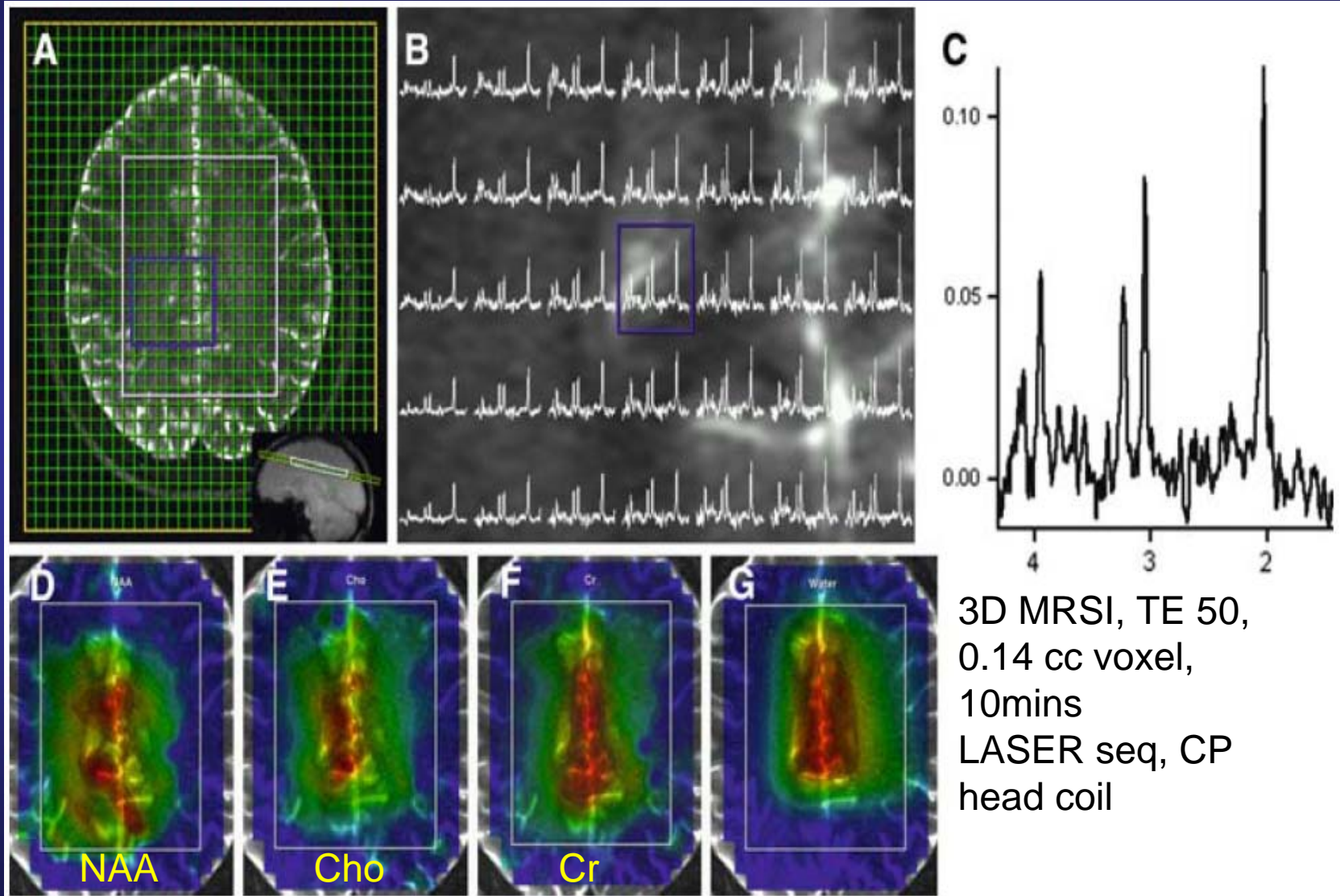


MRSI of much smaller voxels!

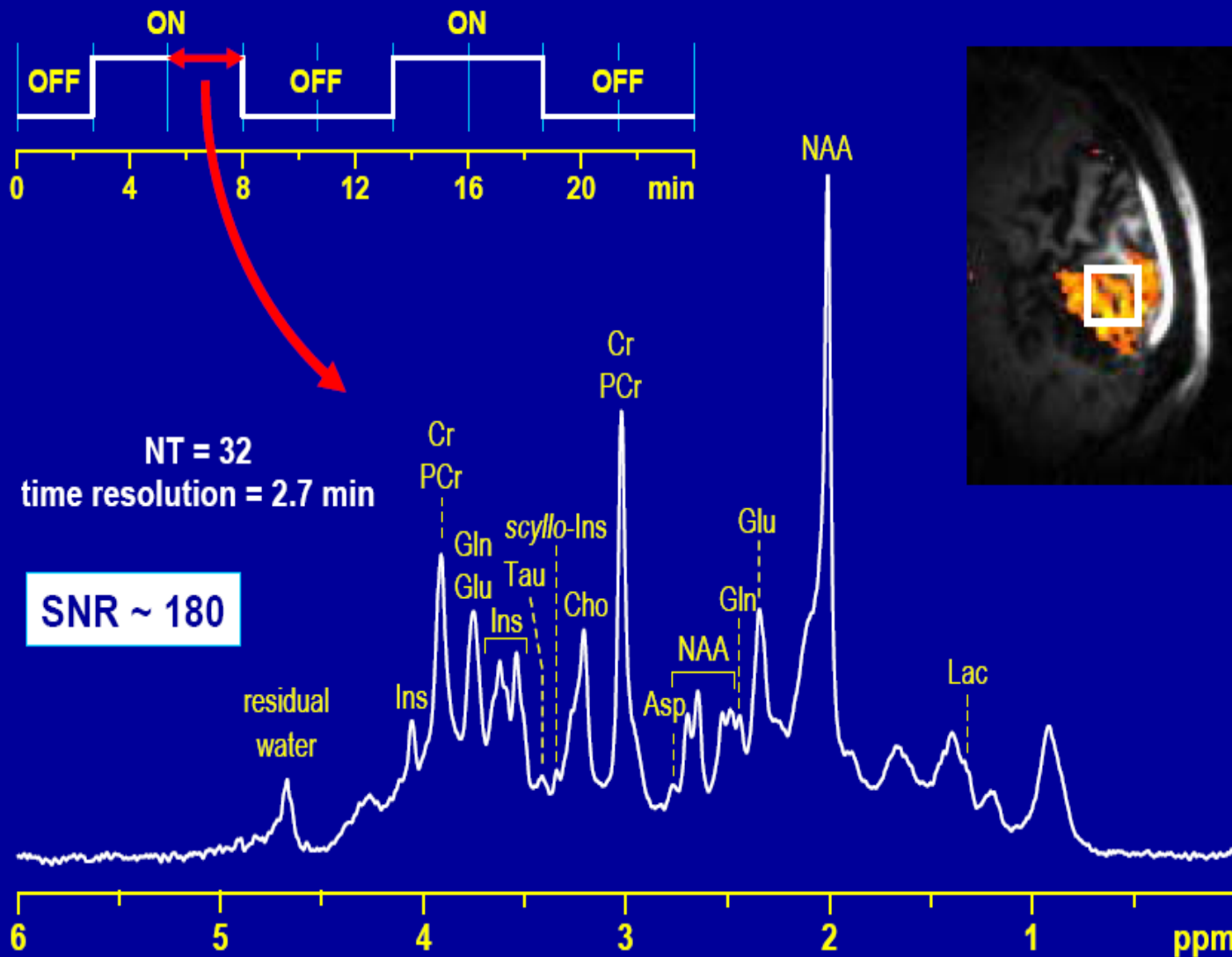
3D MRSI, TE 30, 0.14 cc voxel, 10mins, LASER ,
Adiabatic pulses, Siemens
Surface coil



High resolution metabolite maps

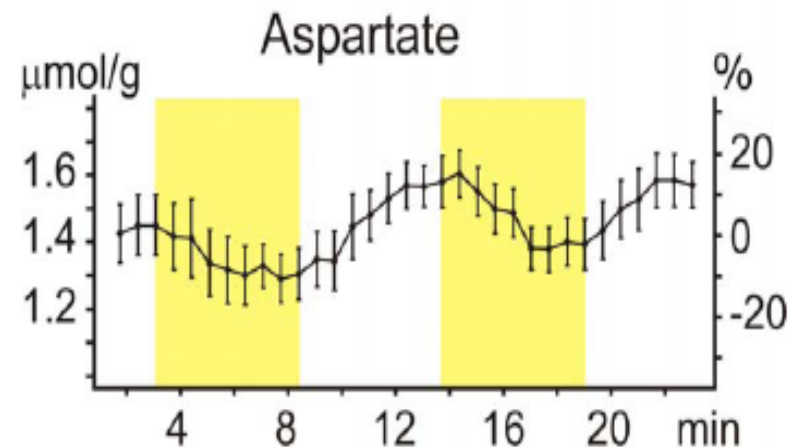
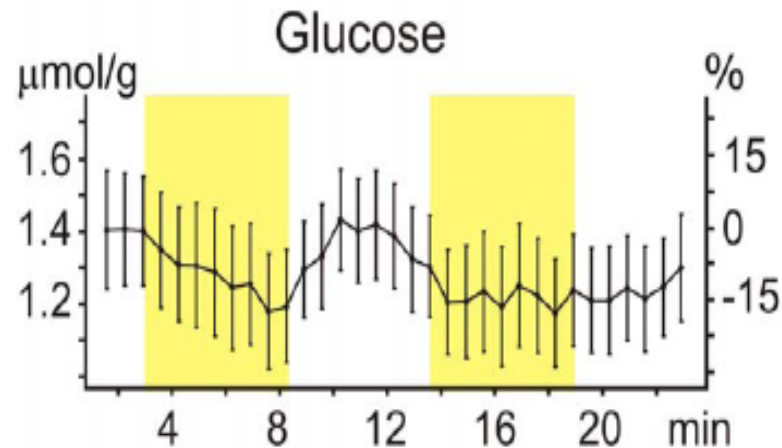
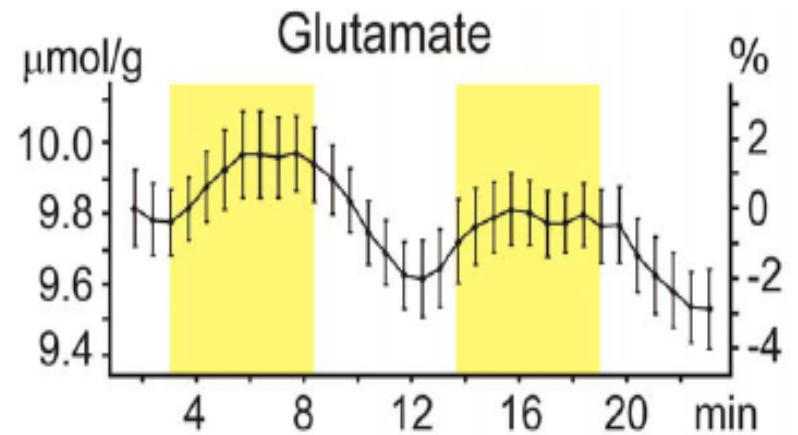
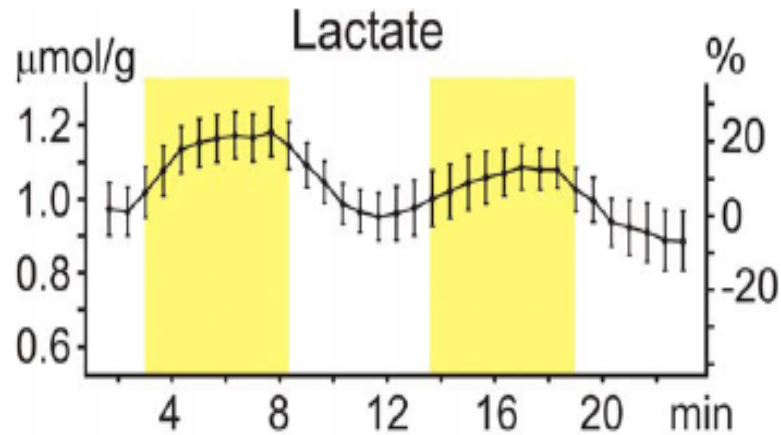


fMRS at 7T

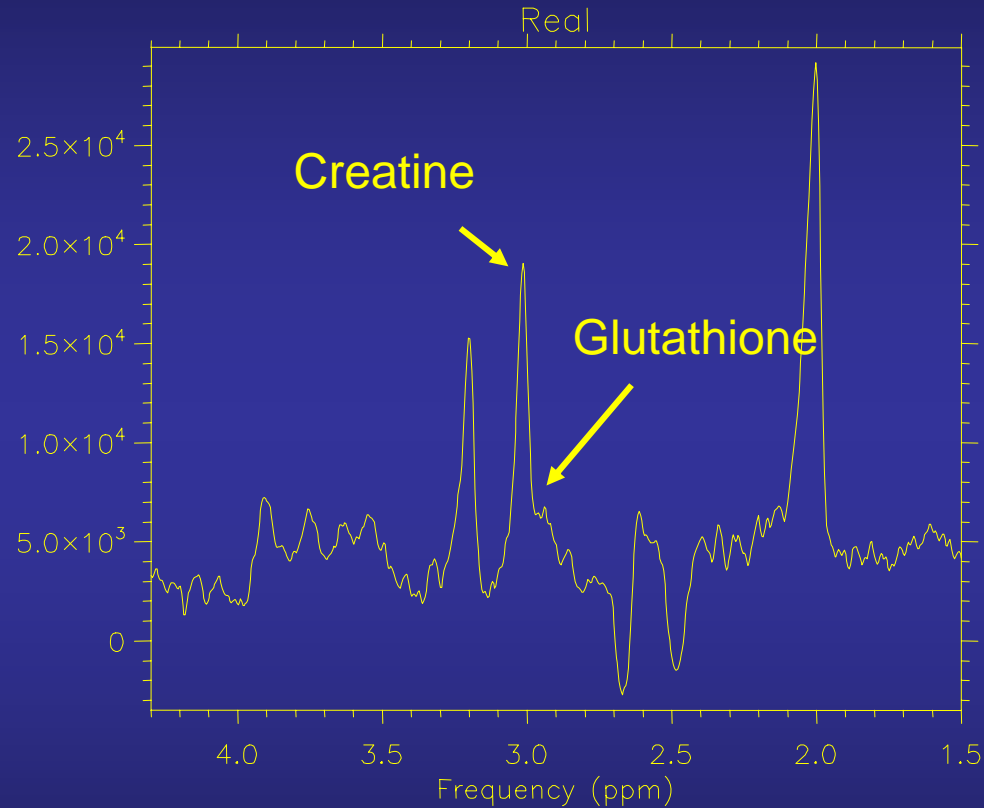


Mangia et al, J Cereb Blood Flow Metab 2007

fMRS

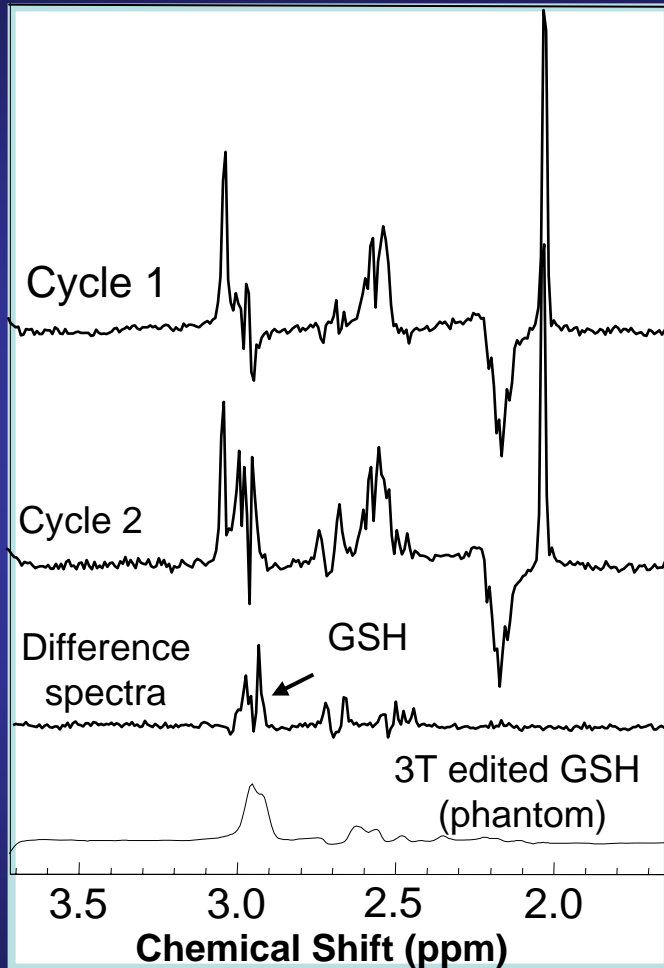


Detecting GSH



Unedited schemes cannot be used for robust detection of Glutathione which is at the shoulder of Creatine.

Glutathione using a spectral editing sequence



A) Spectrum without editing pulse

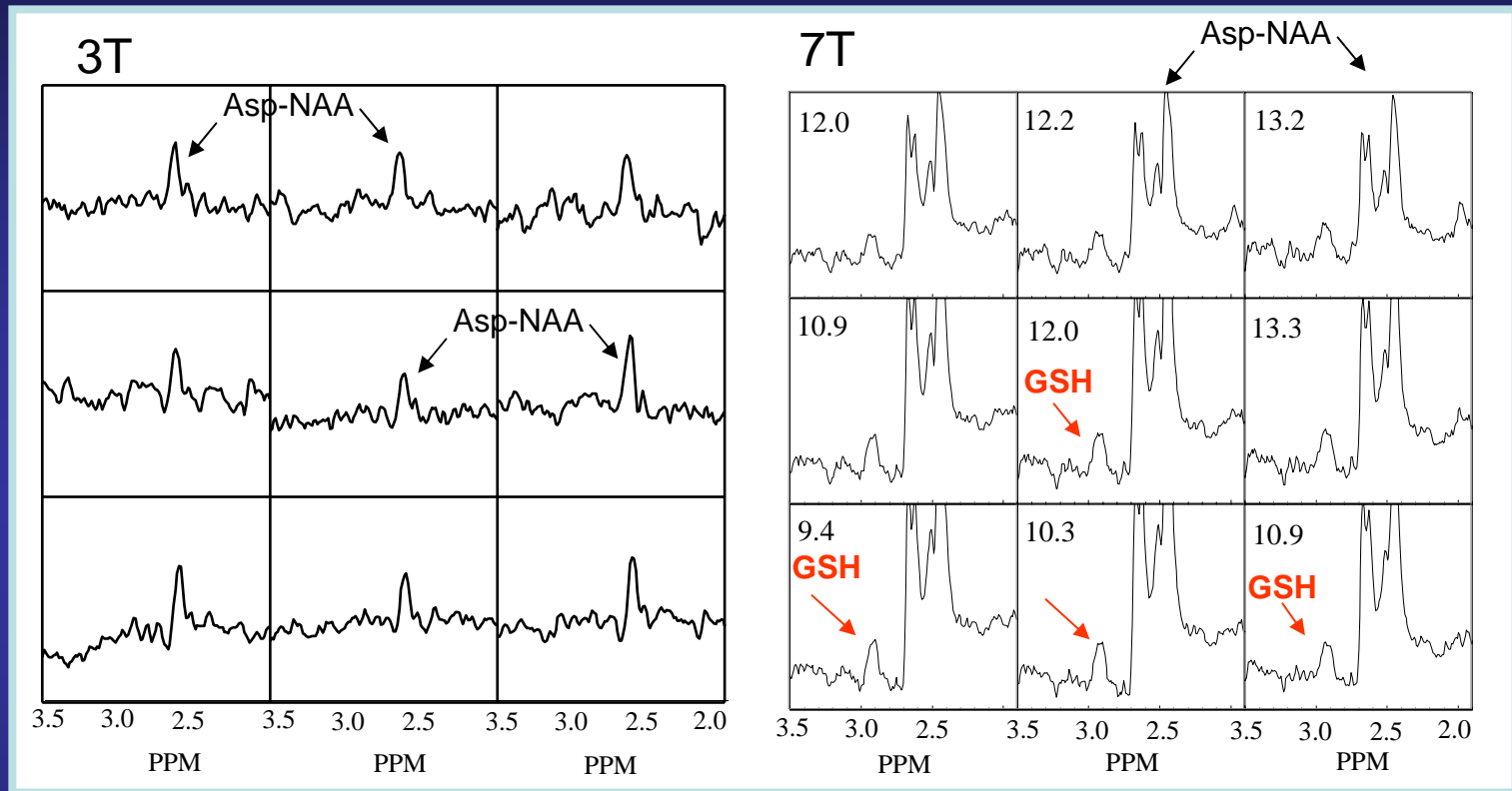
(B) Spectrum with editing pulse

(B-A) Difference spectrum showing GSH at 2.95 ppm.

GSH at 3T

The Aspartyl resonance of NAA (Asp-NAA) co-edits with Glutathione in the difference spectrum

In-vivo detection of GSH at 3T vs 7T



GSH NOT detected at 3T. The only visible peak corresponds to Asp-NAA

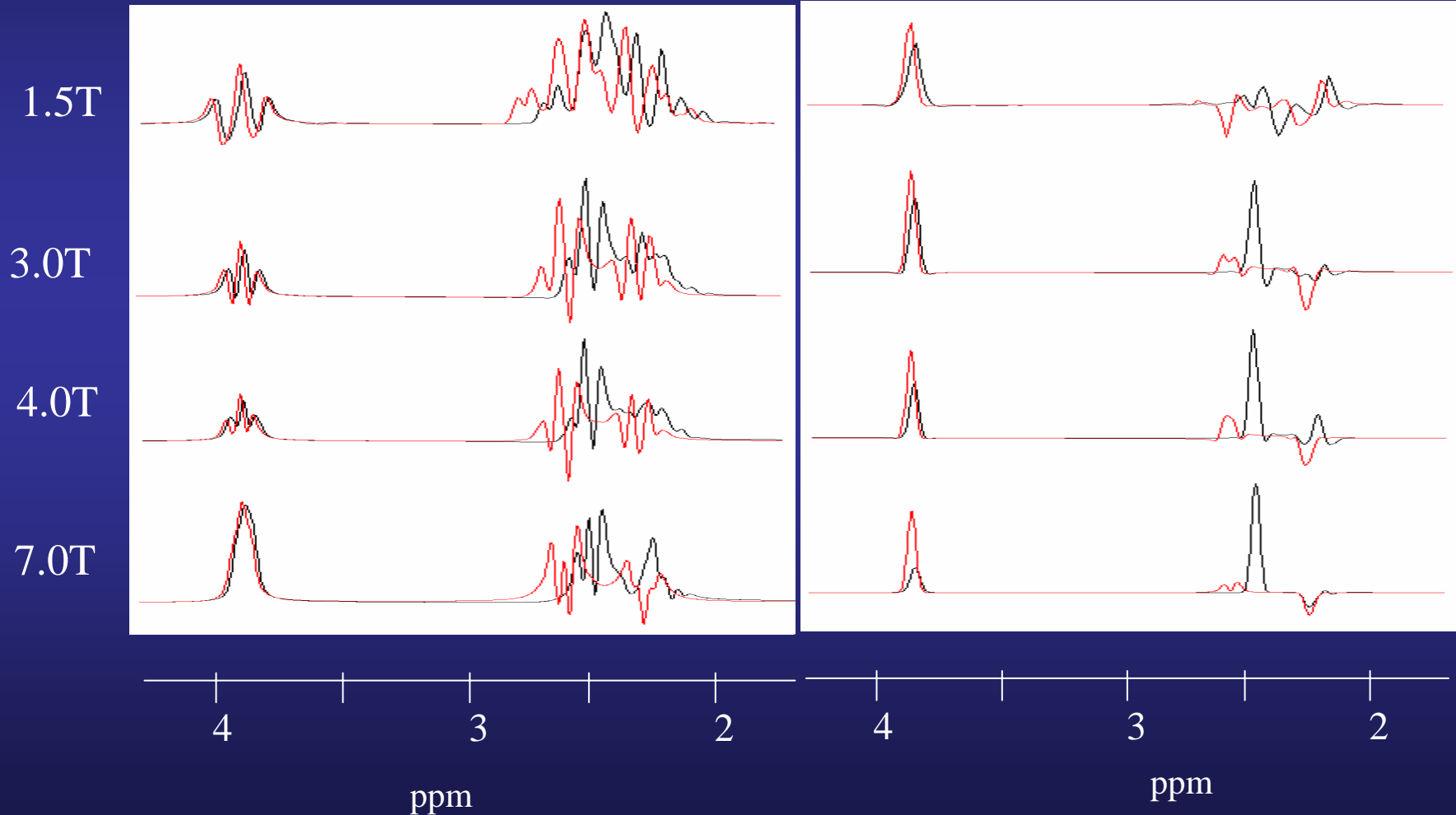
GSH is detected at 7T (red arrows) with the SNR indicated in each voxel.

Glutathione was detected at 7T with the same SNR as Glutamate studies at 3T. This level of detection from a metabolite that is present at half the concentration of Glutamate demonstrates the sensitivity of 7T MRSI.

Glutamate by TE averaged PRESS

Conventional PRESS

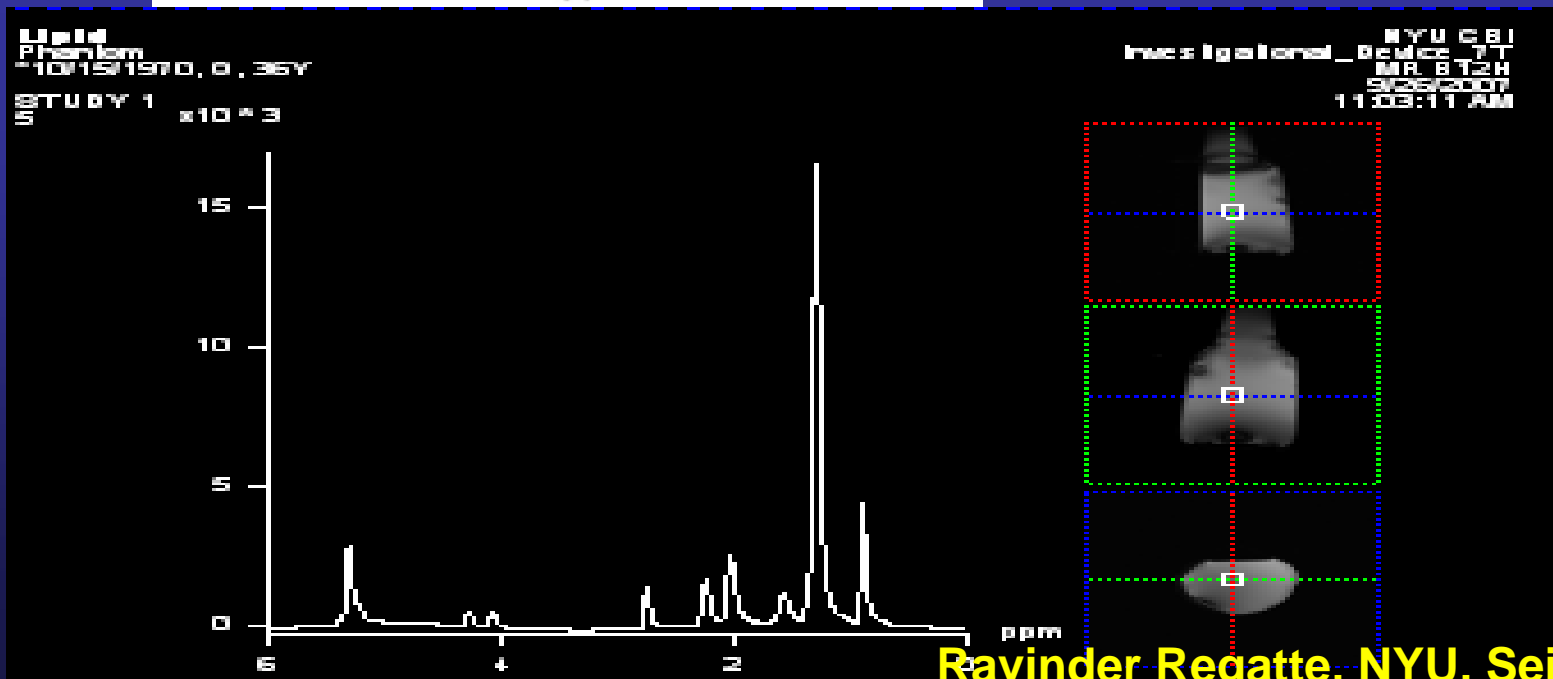
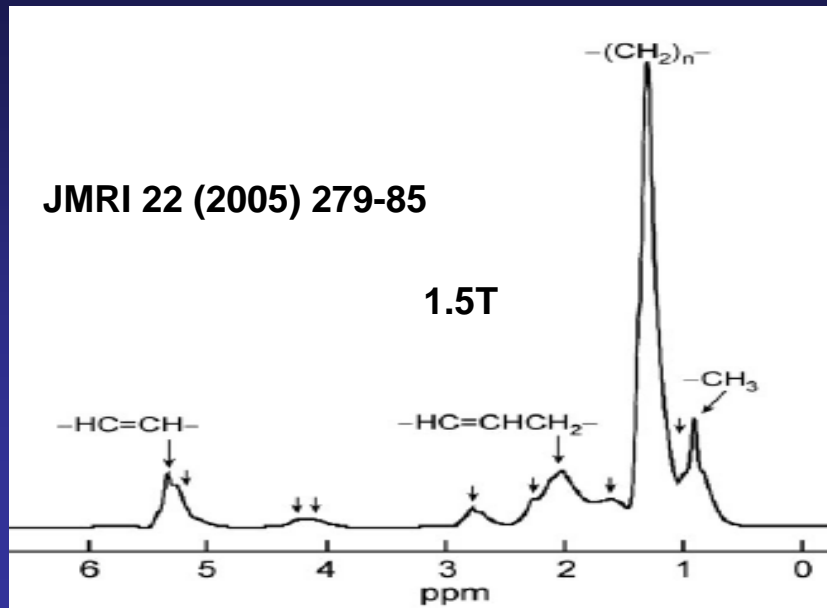
TE Averaged PRESS



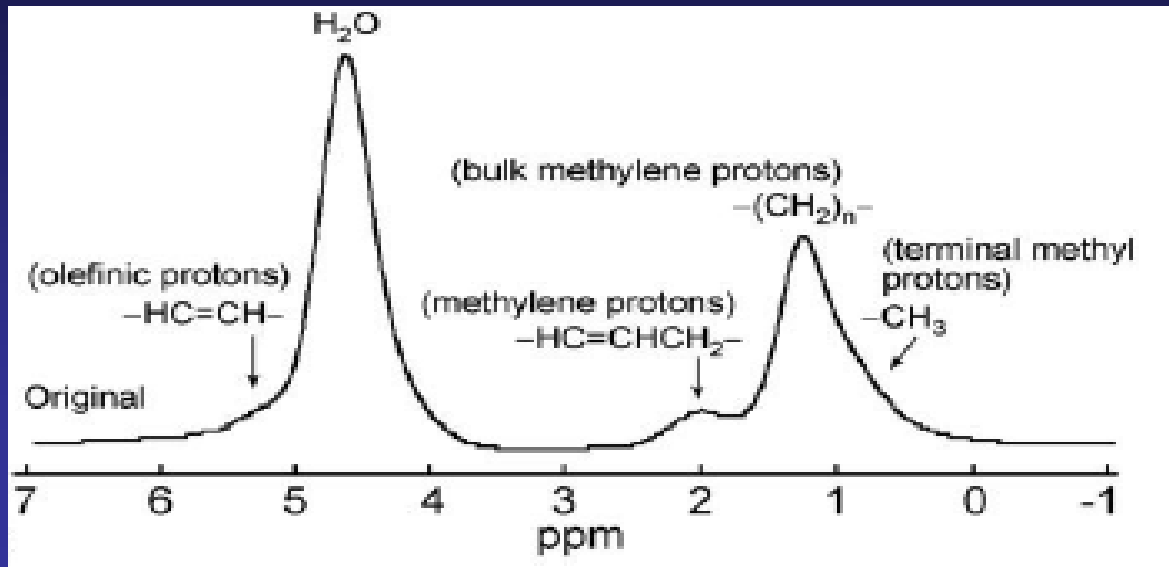
Black: Glutamate Red: Glutamine

Simulation study, Ralph Hurd

Corn Oil-1.5T vs 7T

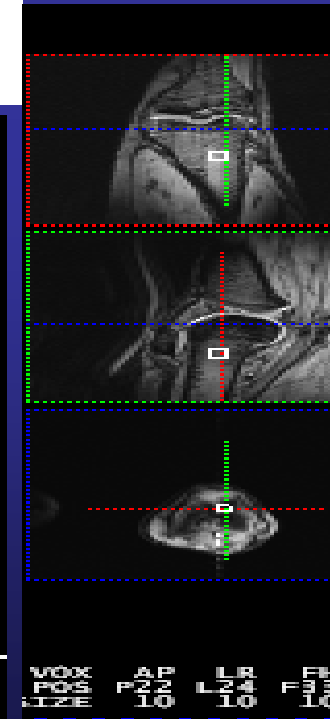
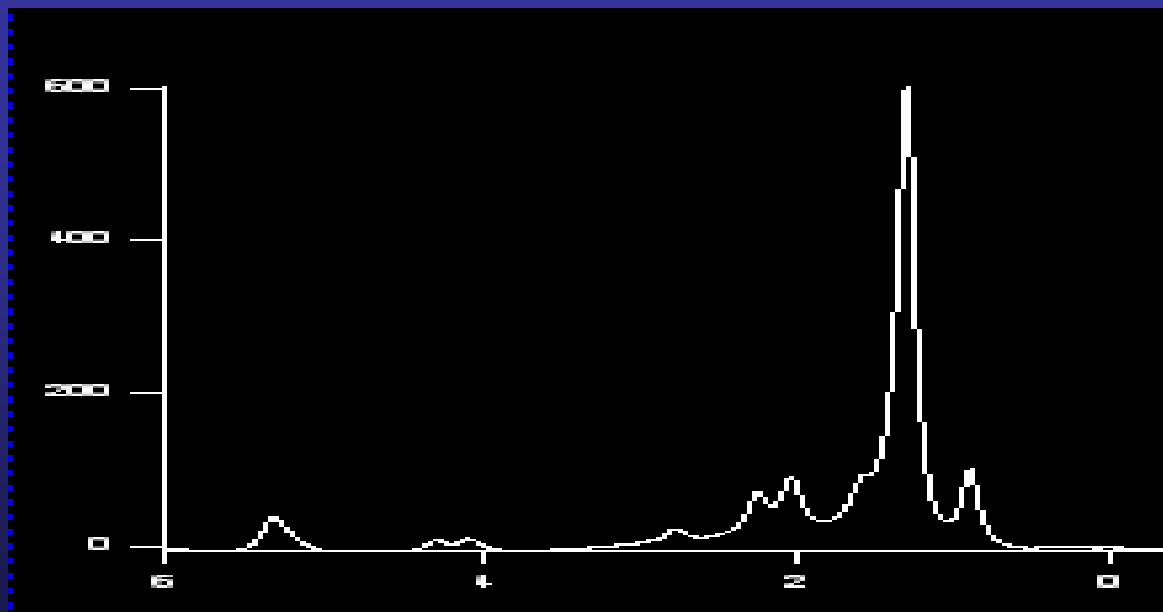


Bone marrow

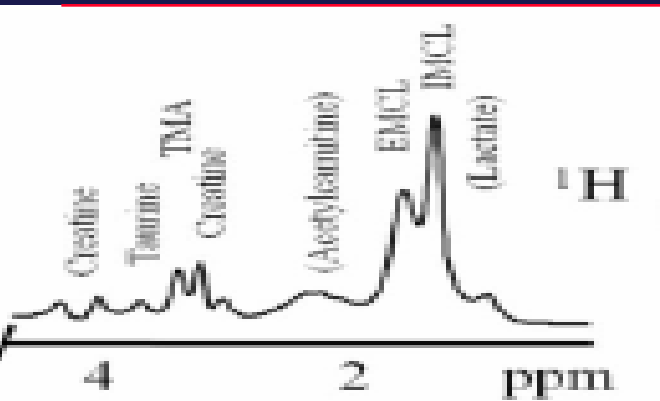


JMRI 22 (2005) 279-85

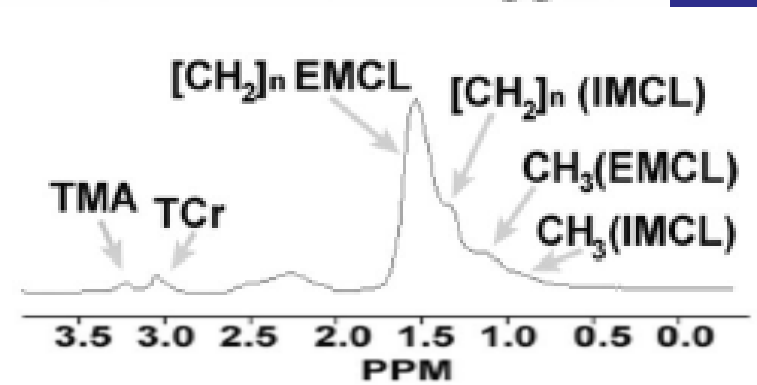
1.5T



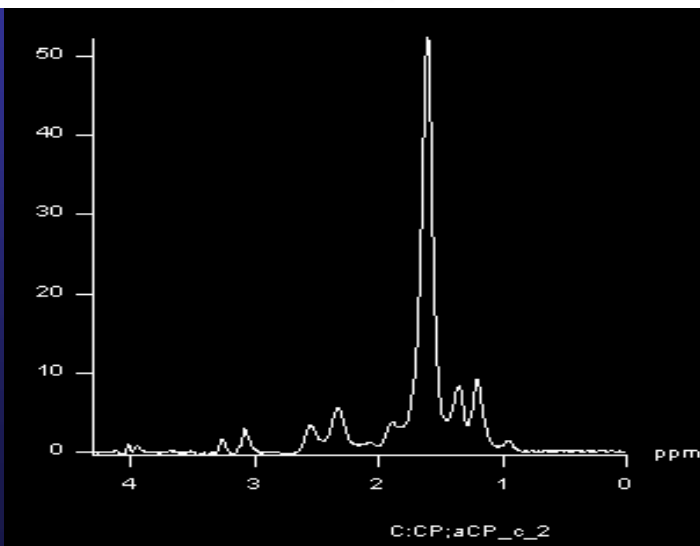
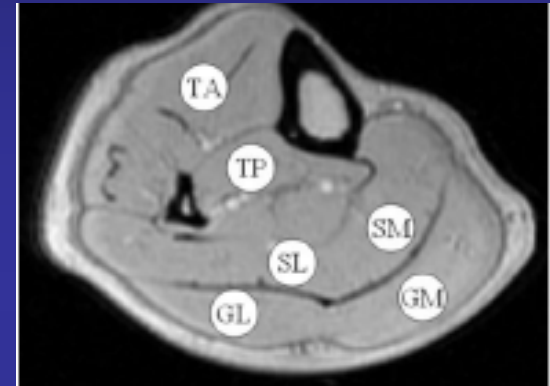
Skeletal Muscle



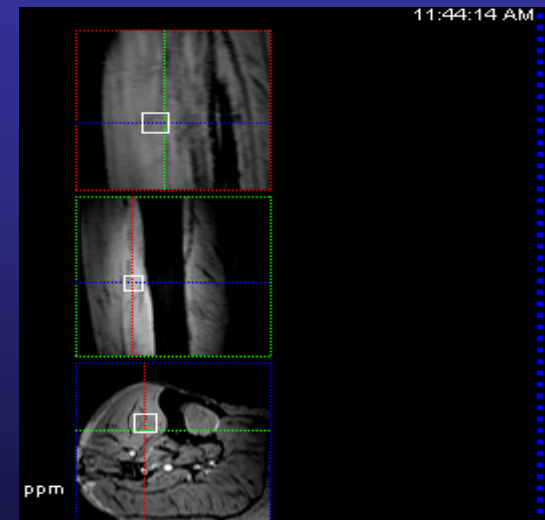
1.5T



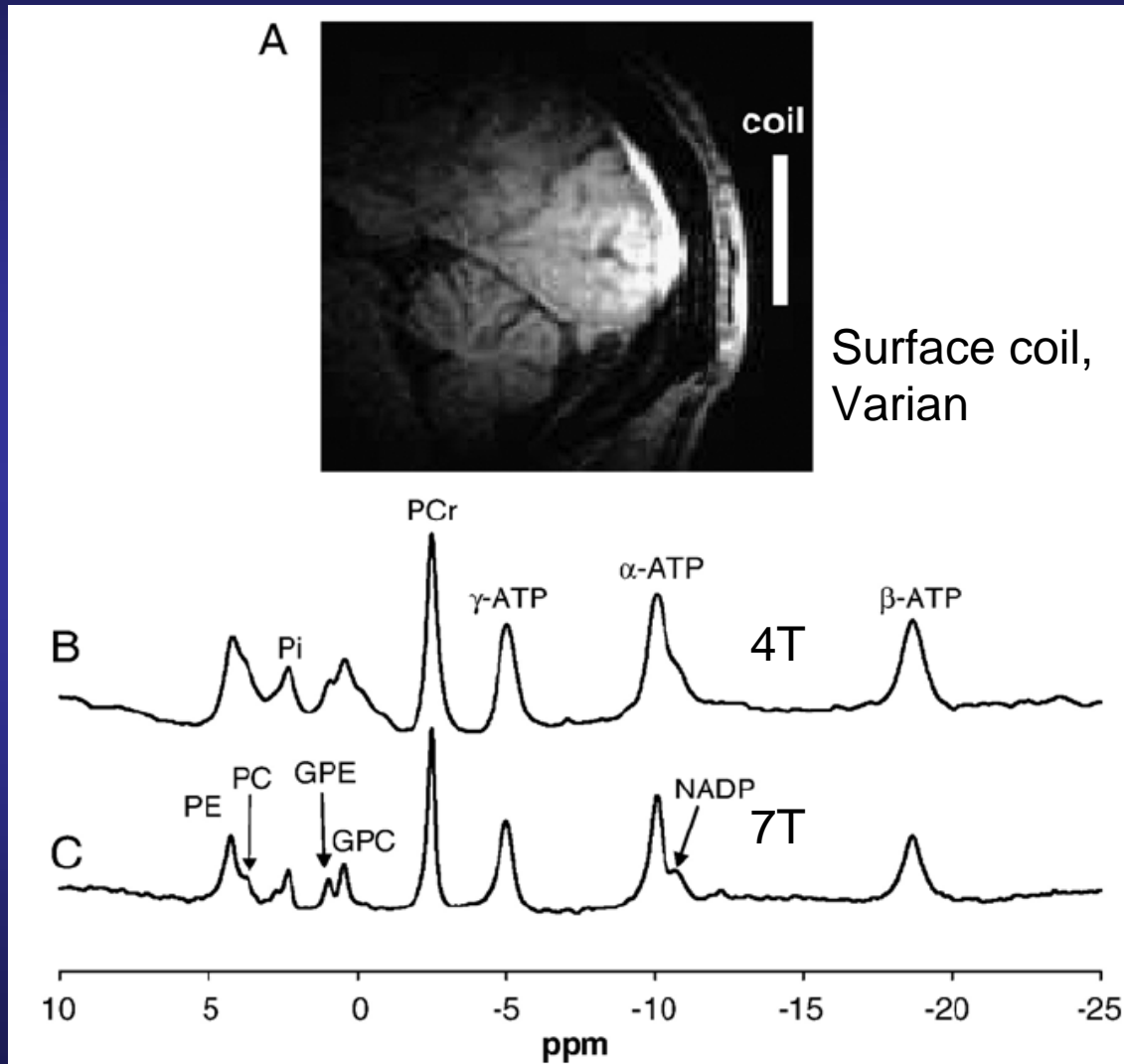
3.0T



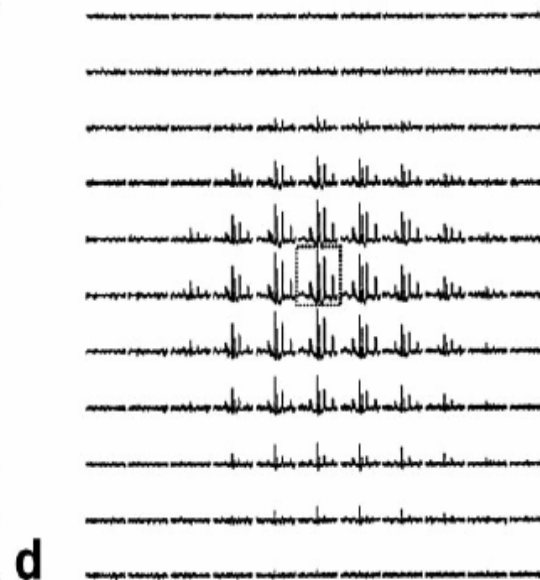
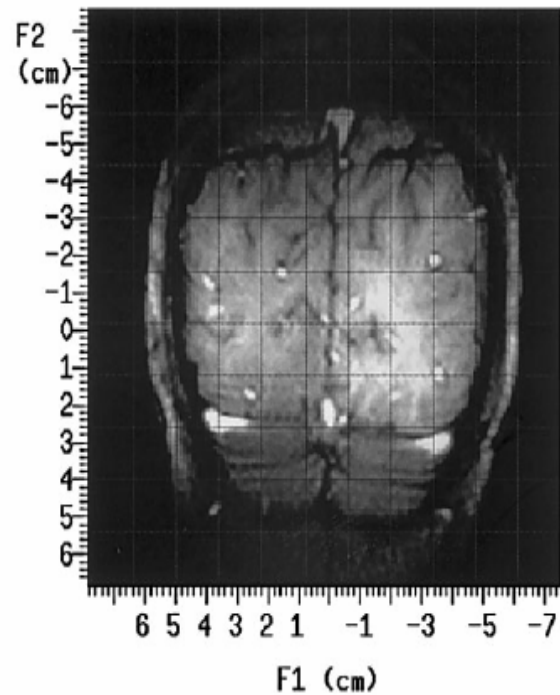
7.0T



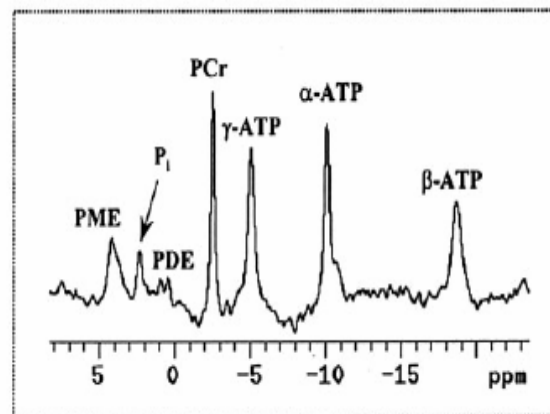
^{31}P MRS of the brain



^{31}P MRS of the brain

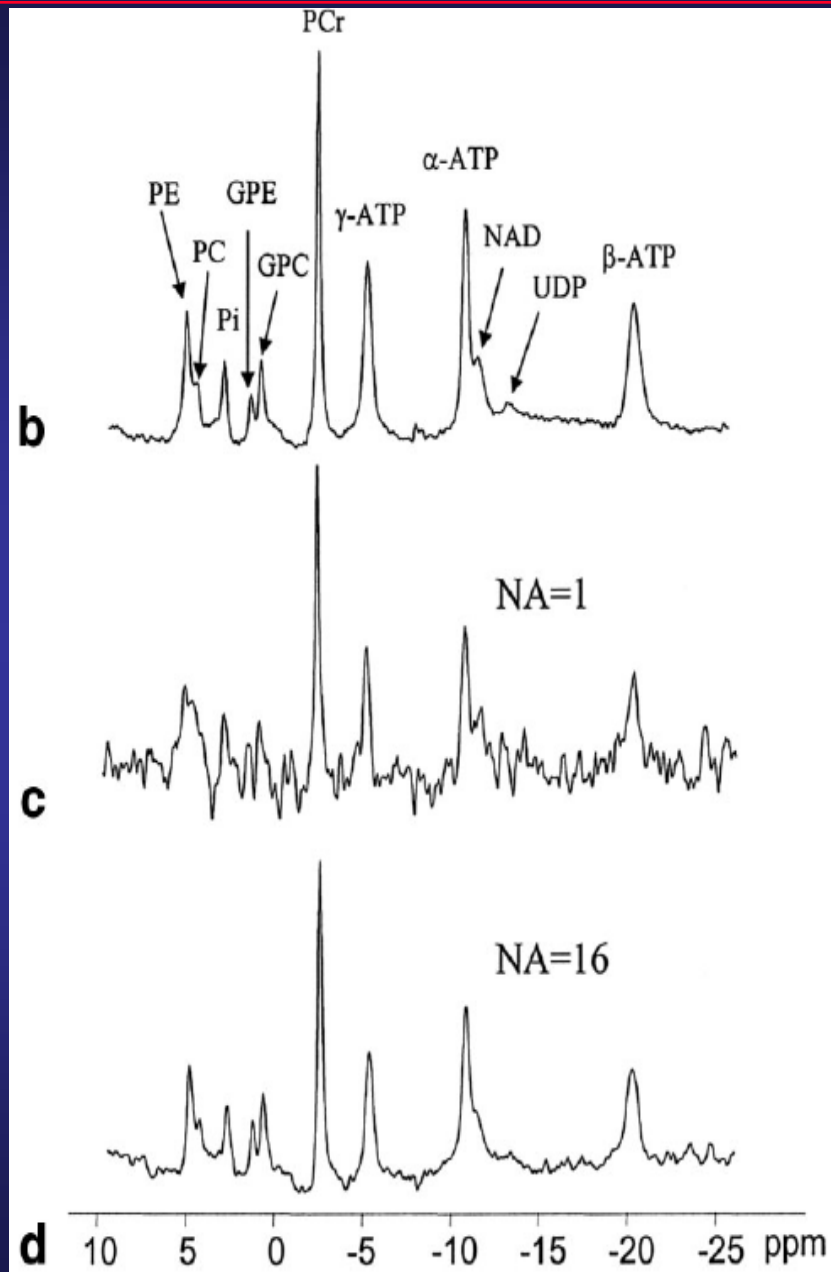


d



e

NOE enhanced
Primary visual cortex
7.5 ml, 8 min
Minnesota, Varian



Disadvantages

- **Static field distortions**
 - Shimming requirements –strong 2nd order shims
- **Chemical shift displacement errors**
 - Increased BW required – higher requirement for achievable peak B1 – adiabatic pulses
- **Less homogenous B1**
 - B1 shimming methods, adiabatic pulses
- **Short T2 – need for shorter TE's**
- **SAR**