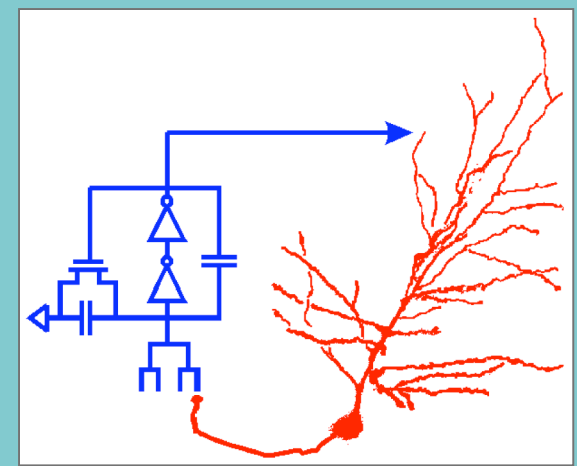


# Revealing Hidden Neural Processes

## Signal Processing with MEG in the Human Brain

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### Introduction

#### Magnetoencephalography (MEG)

- Noninvasive brain imaging technique
- Great temporal resolution and no distortion

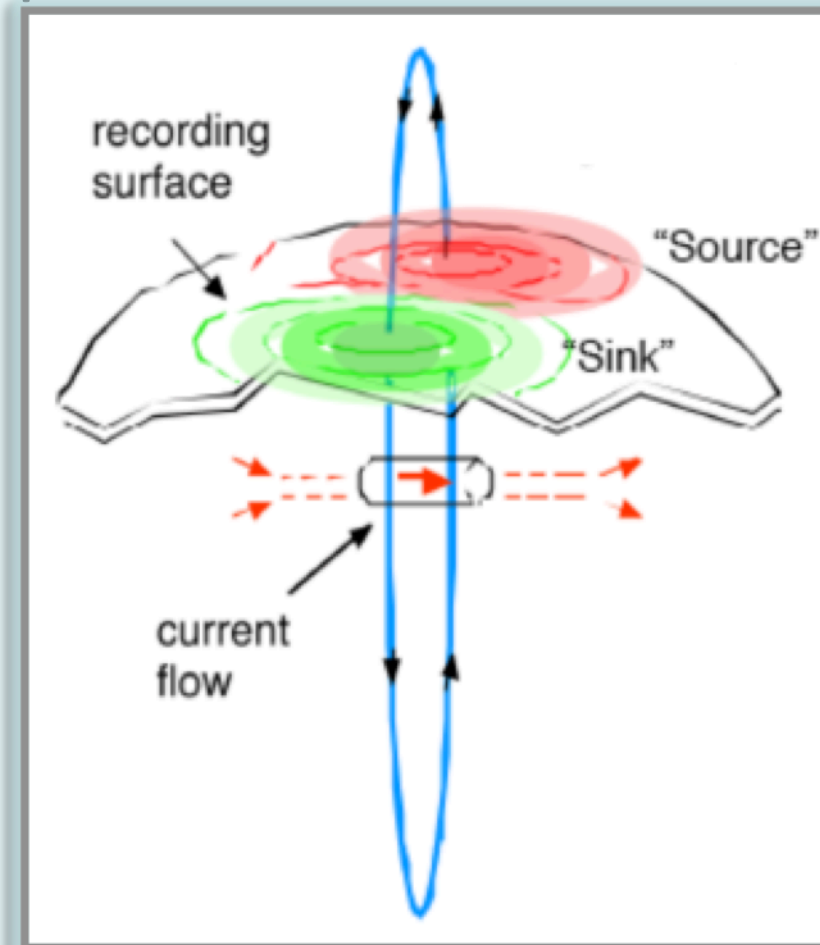


Figure 1. Magnetic Dipole from Neural Current  
MEG Usage Ex.: Transient Auditory Response

- Evoked response about 100 ms after a beep

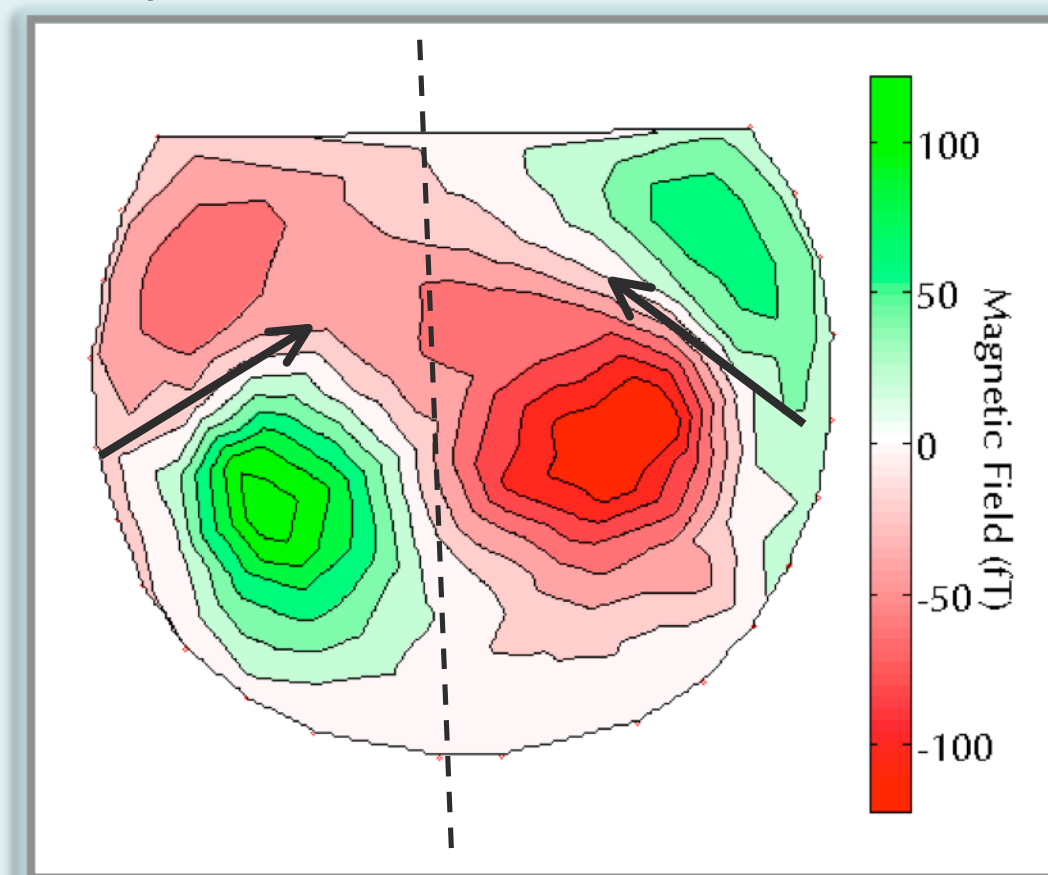


Figure 2. Magnetic Field over Head of M100 Response

- Evoked (phase locked) response seen by averaging field over trials
- Induced (not phase locked) responses cannot be seen this way

### Motivation and Focus

- Develop techniques to discern neural activity from MEG data
- Identify induced neural activity through dipoles
  - Verify dipole, localize dipole, clean signal

### Data

- Previously collected 70 trials of response to different stimuli (noise, sentences, amplitude modulated noise) in two subjects

### Analysis

#### Possible Magnetic Dipole

- 2 peaks in power averaged over trials
- Power averaged over trials = induced response
- Consistent for all stimuli and both subjects

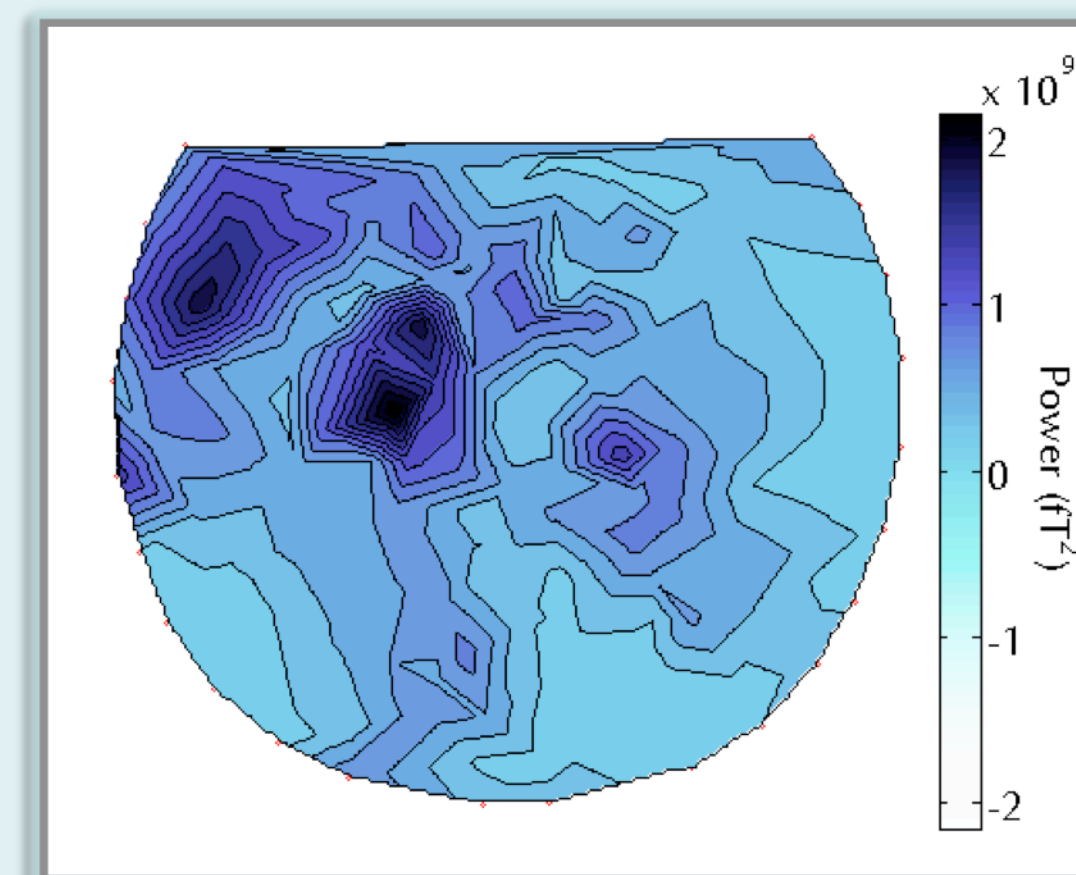


Figure 3. Head Map of Power at 7 Hz

#### Dipole Verification

- Examine phase differences and coherences within trials
- Use power threshold to avoid displaying noisy correlations

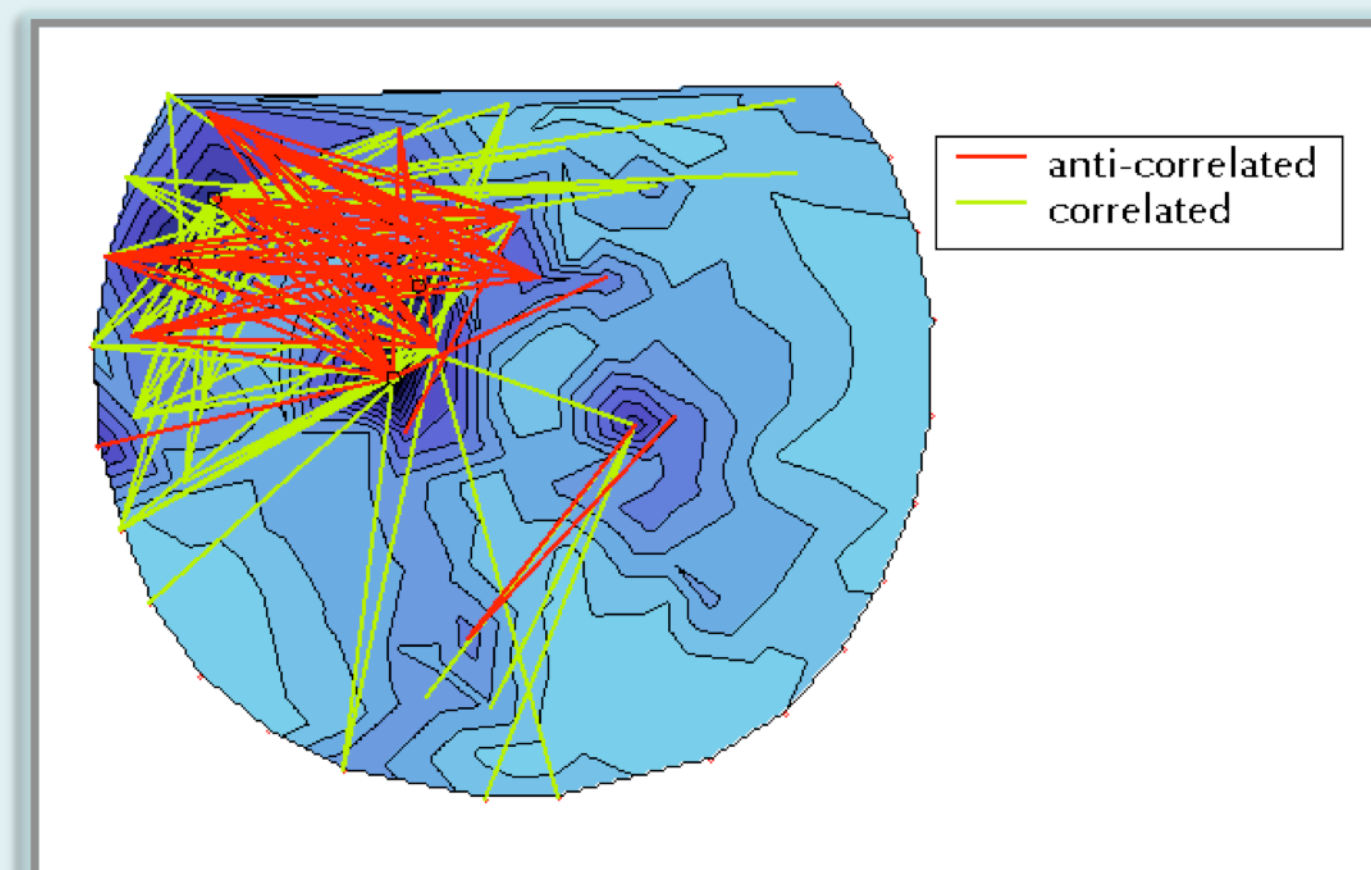


Figure 4. Channel Correlations Imposed on Head Map

### Signal Compression

- Need single magnetic field head map
- Weight each time instance based on sign and power of the response

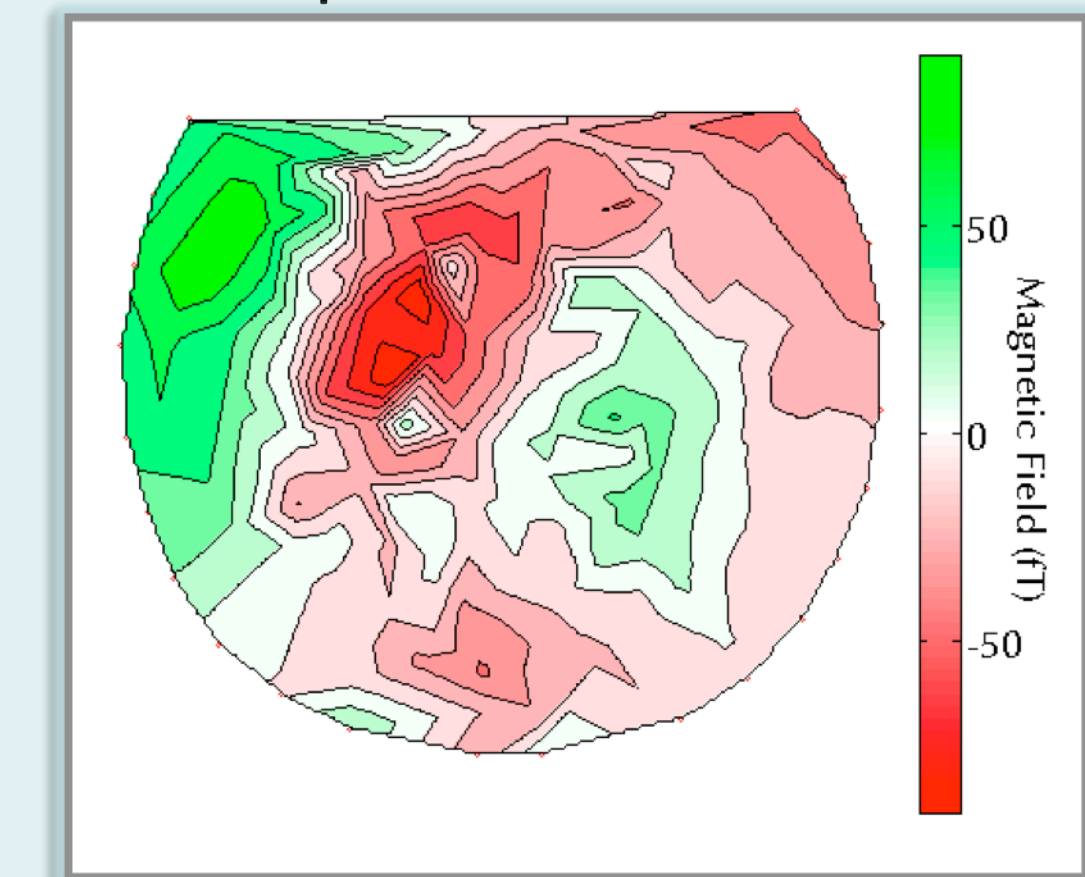


Figure 5. Magnetic Field over Head after Weighting  
Dipole Localization

- Use Figure 5 with localization algorithm

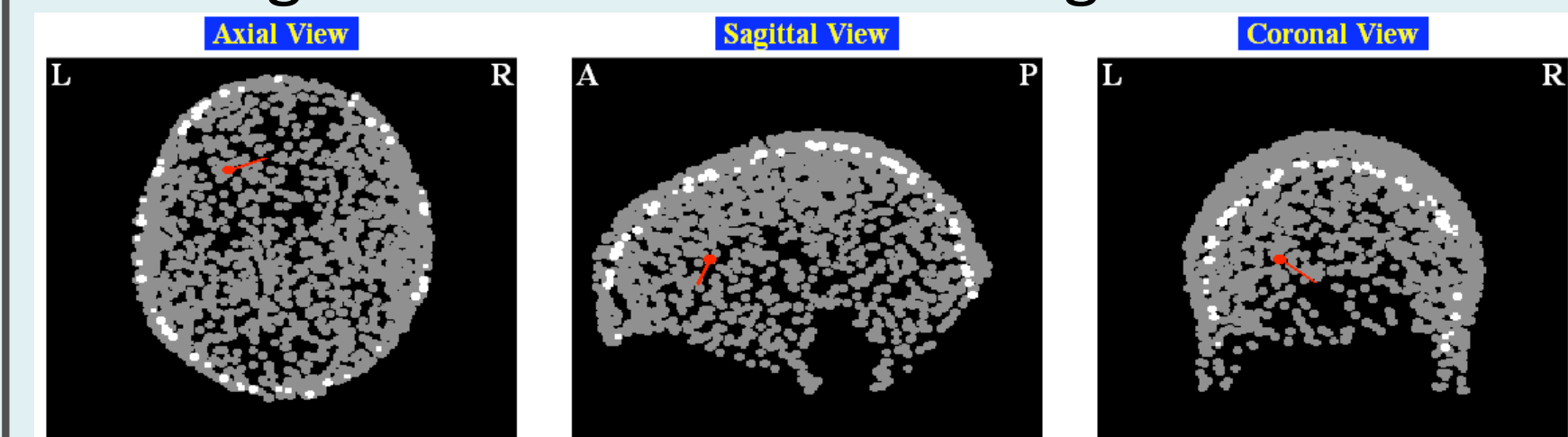


Figure 6. Neural Source Found from Localization

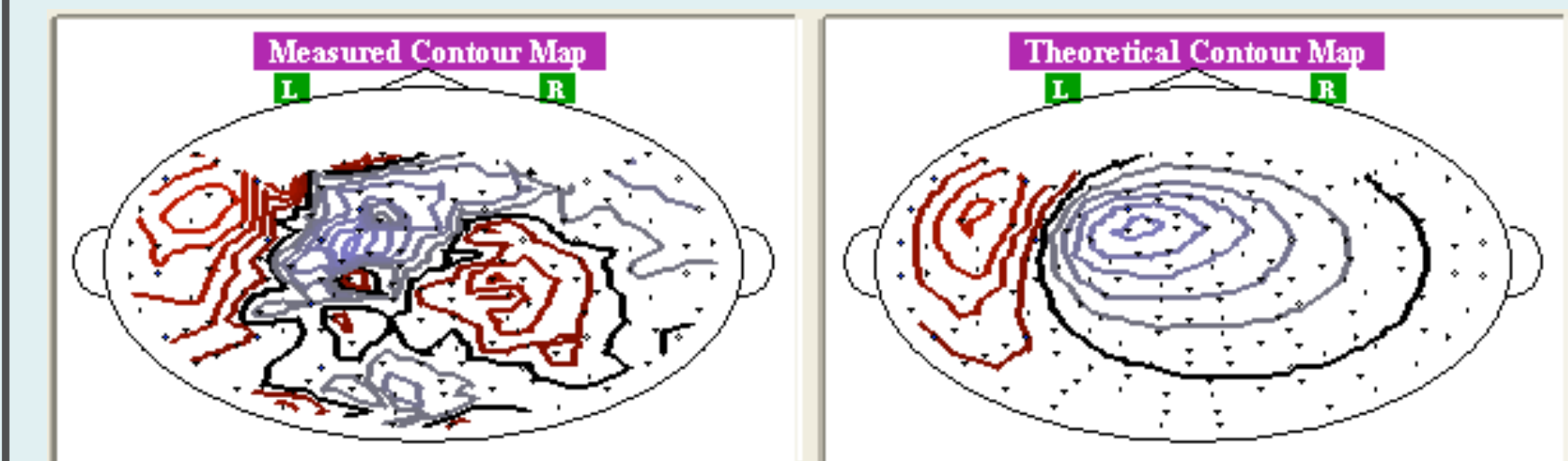


Figure 7. Original Head Map vs. Reconstructed Head Map

### Conclusions and Future Work

- Induced power peaks correlate with a dipole
- Localized to left hemisphere in frontal lobe
- Cleaner signal/better weighting needed
- Physiological source of dipole undetermined

### References

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- [2] Luo, H., and Poeppel, D. Phase Patterns of Neuronal Responses Reliably Discriminate Speech in Human Auditory Cortex. *Neuron* 54, 1001-10 (2007).
- [3] Roberts, T.P.L., Ferrari, P., Stufflebeam S.M., and Poeppel D. Latency of the Auditory Evoked Neuromagnetic Field Components: Stimulus Dependence and Insights Toward Perception. *J. Clin. Neurophysiol.* Vol. 17, No.2, (2000).