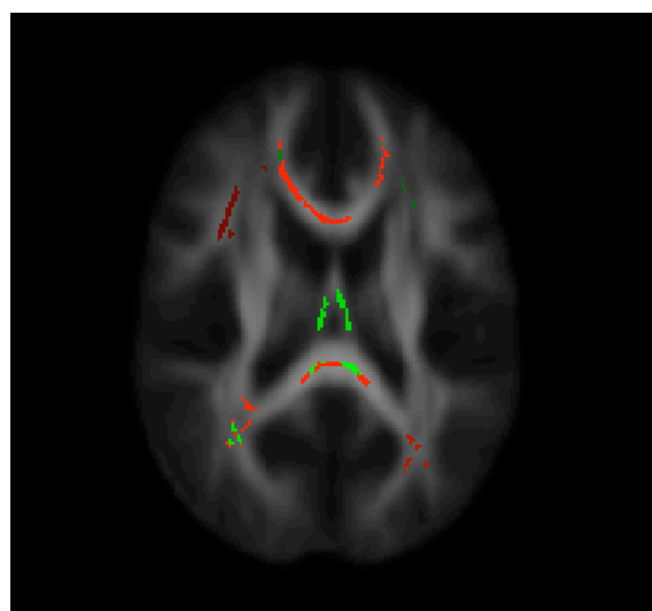
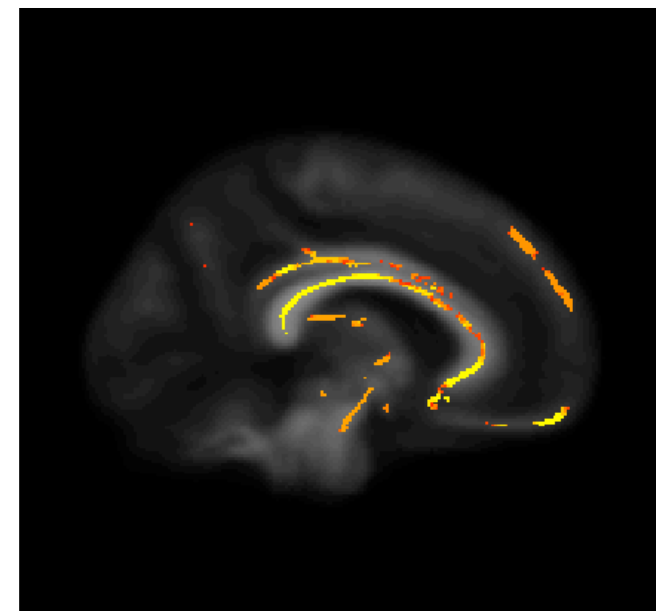
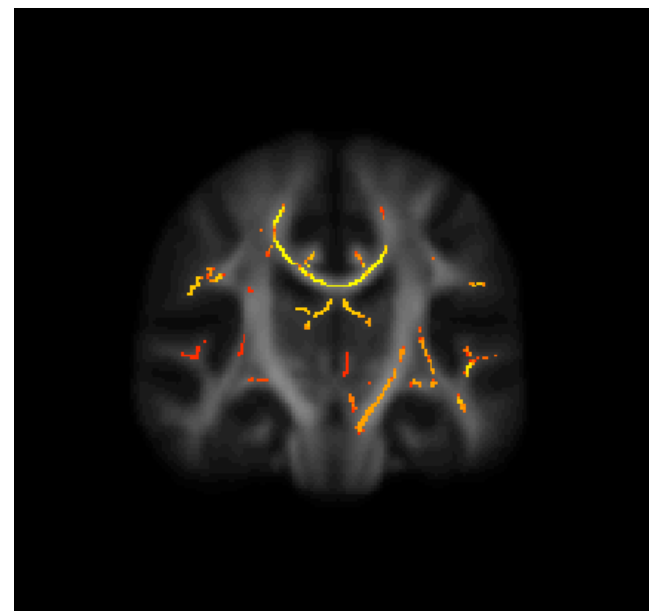
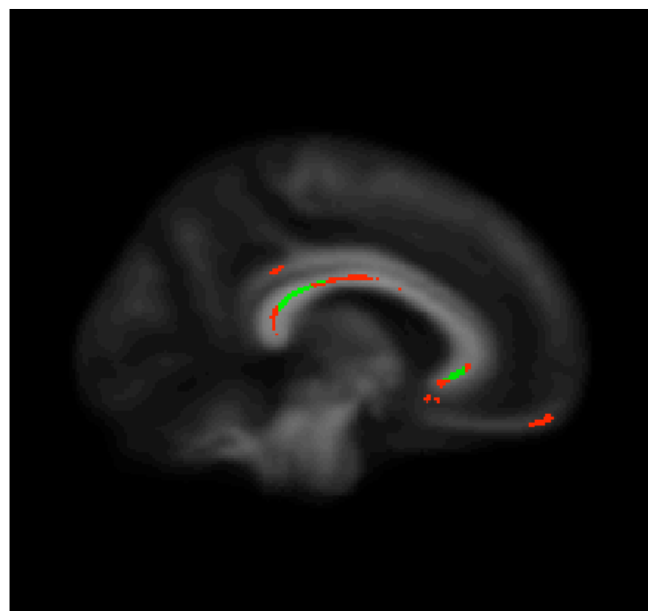
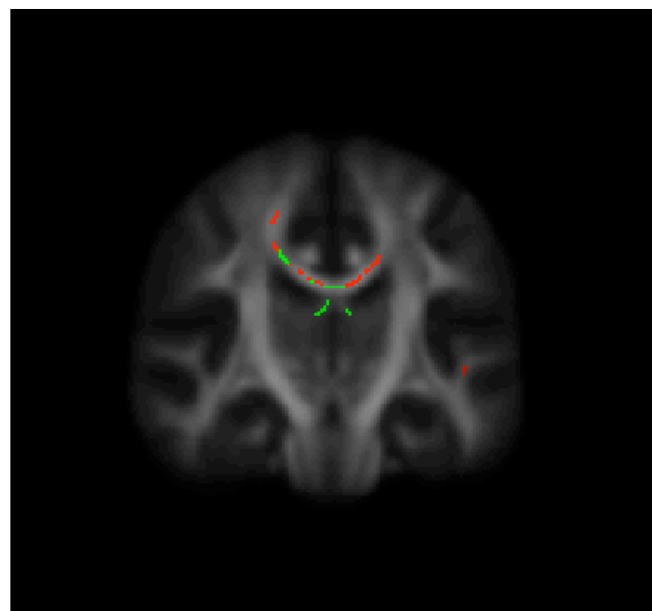




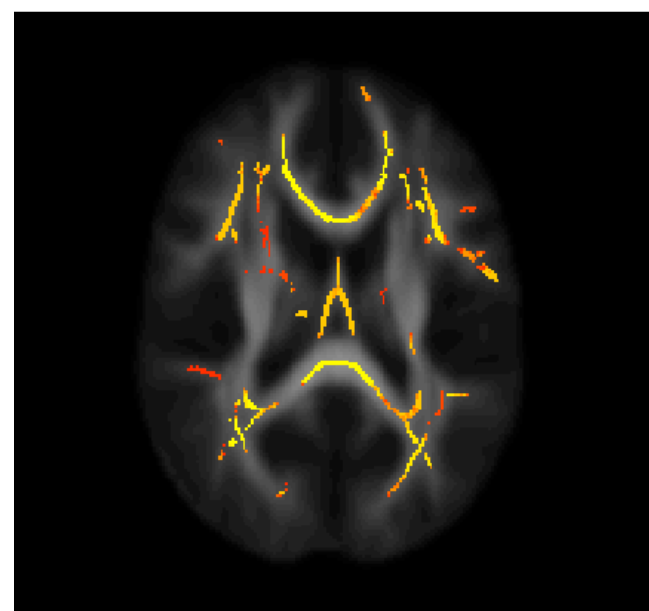
TFCE for TBSS

controls > schizophrenics

$p < 0.05$ corrected for multiple comparisons across space,
using randomise



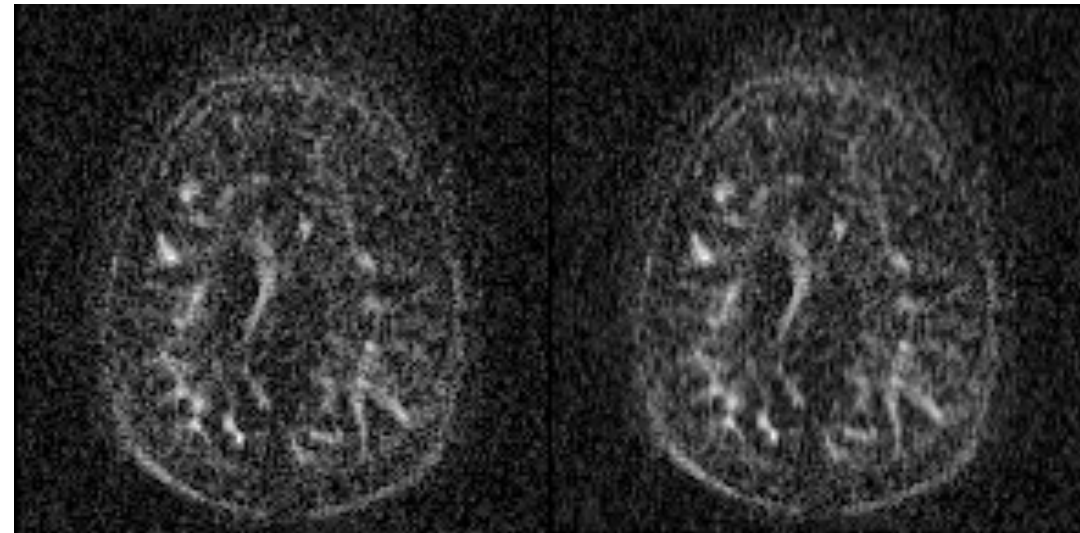
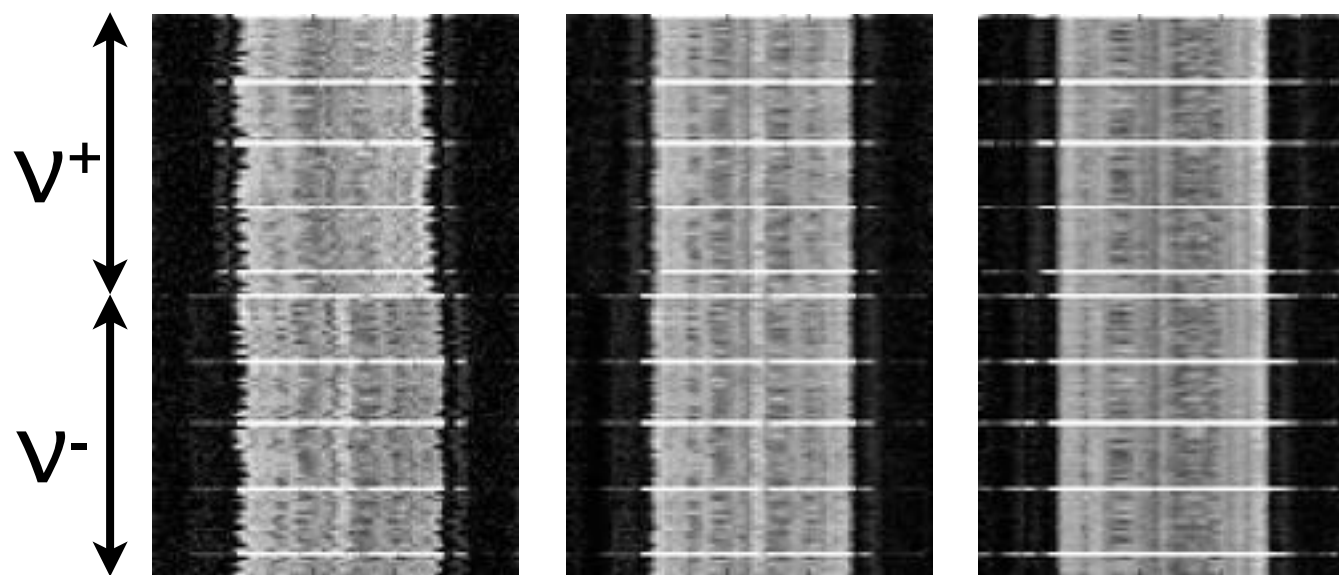
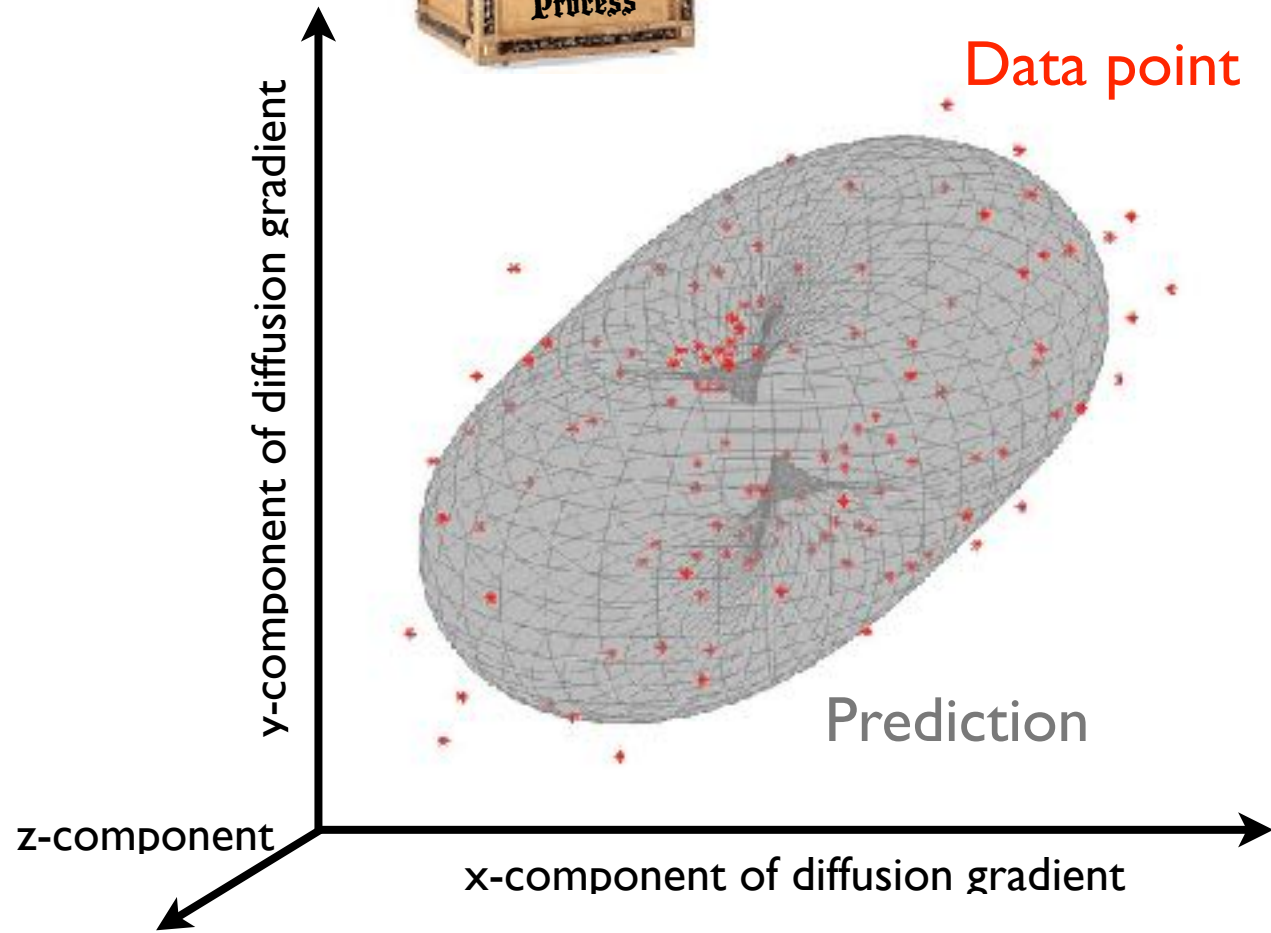
cluster-based:
cluster-forming
threshold =
2 or **3**



TFCE



eddy and topup - tools for processing of diffusion data





Outline of the talk

- What is the problem with diffusion data?
- Off-resonance field
 - How does it cause distortions?
 - Where does it come from?
- Registering diffusion data
 - How topup works
 - How eddy works
- Practicalities
- Some results
- Quality control
- “Advanced” eddy features

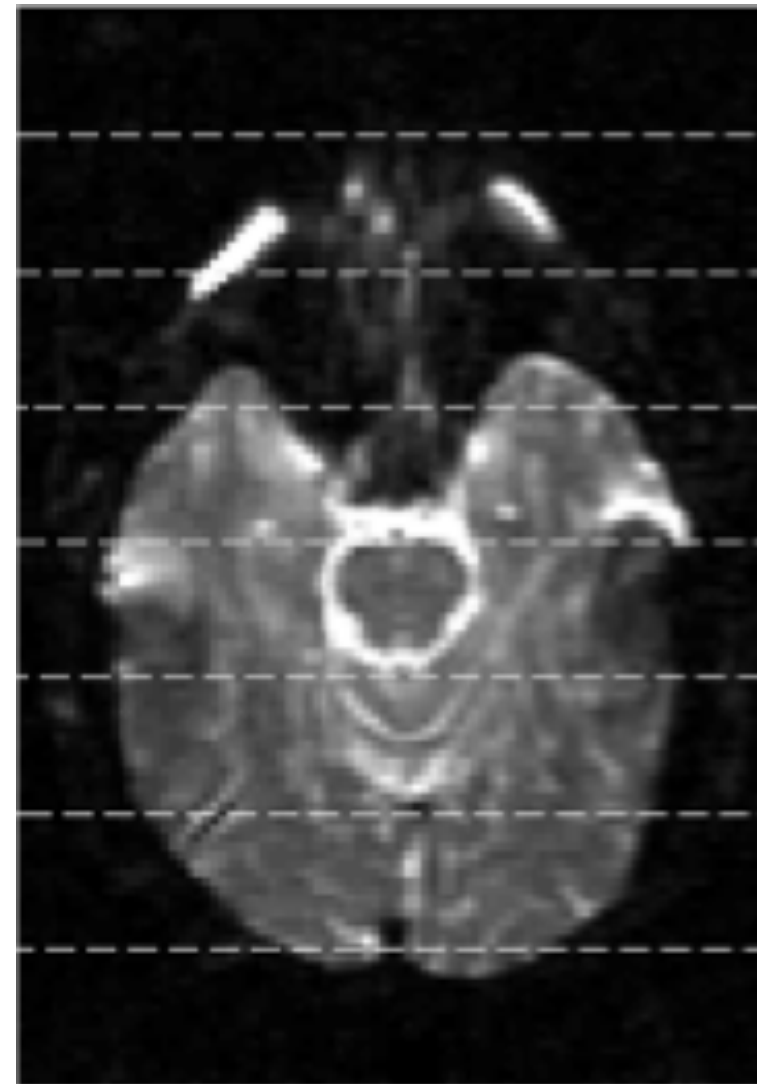
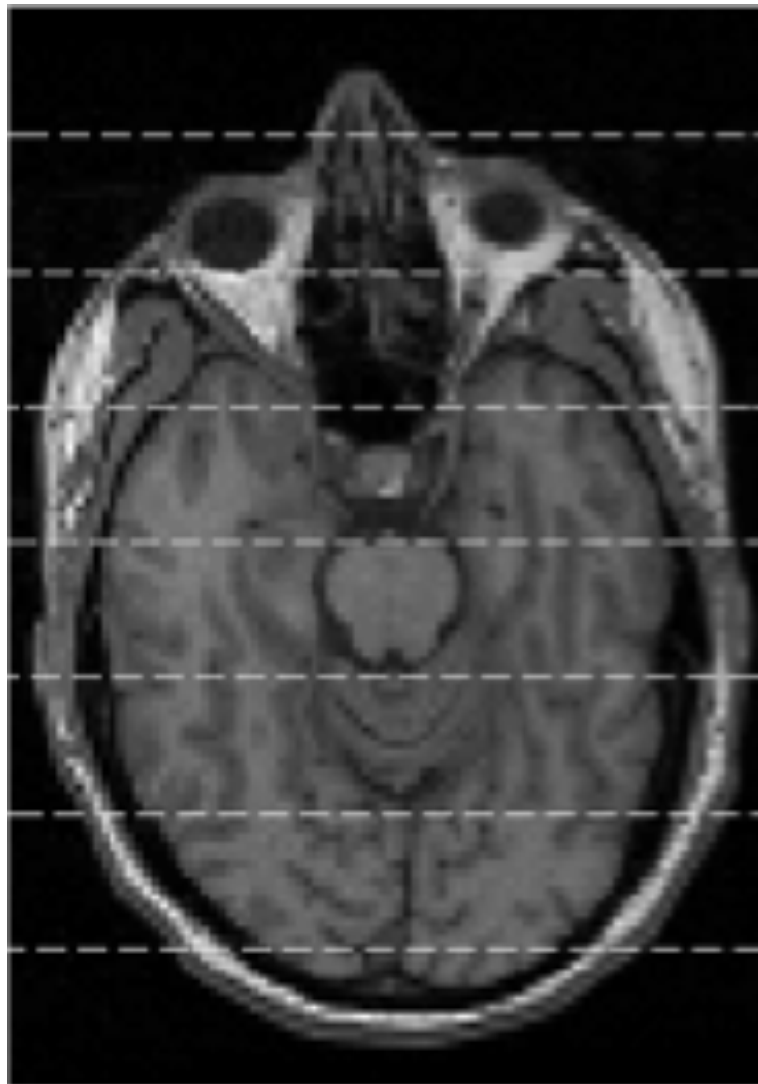


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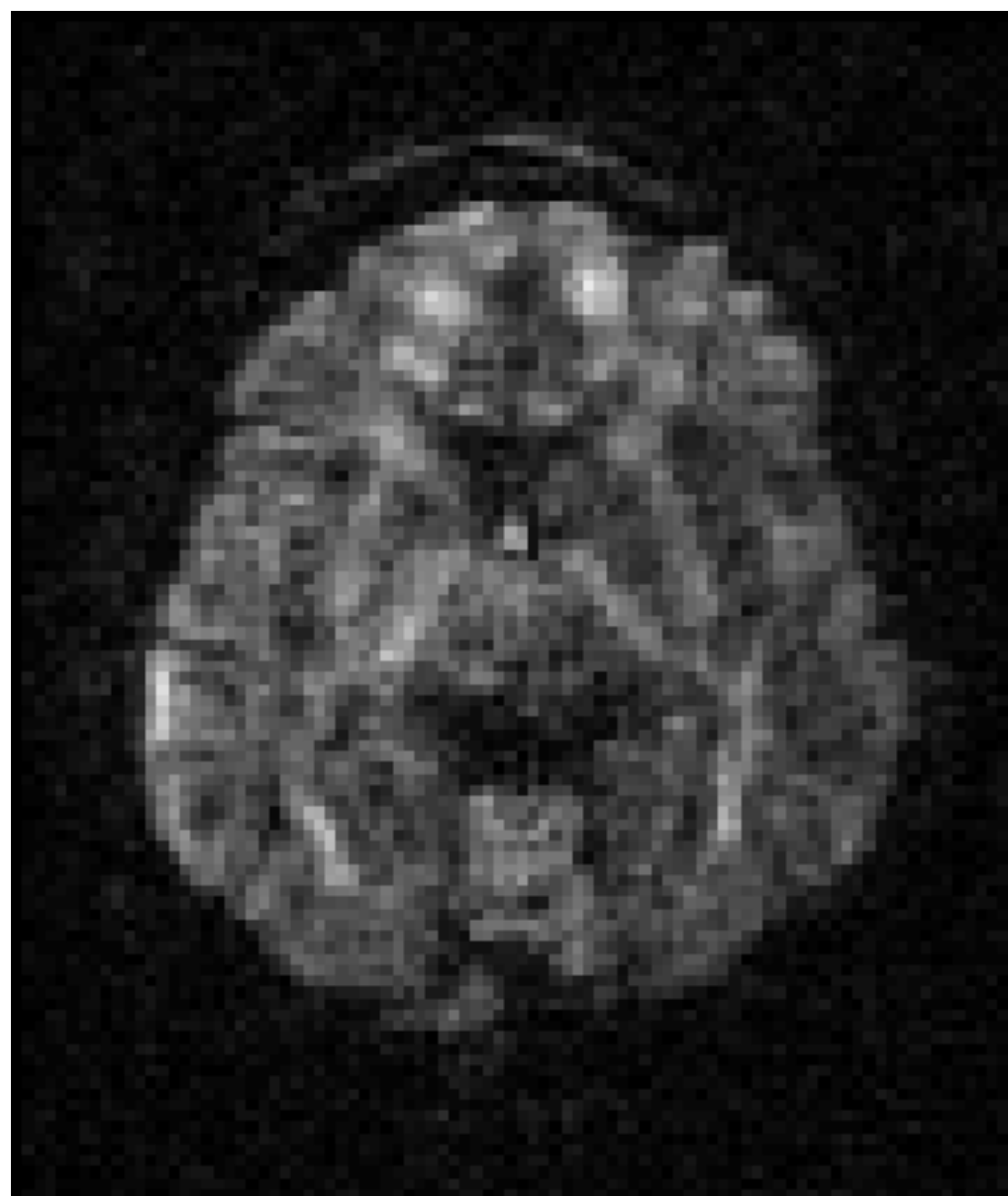
What is the problem with diffusion data?



Well, it isn't very anatomically faithful



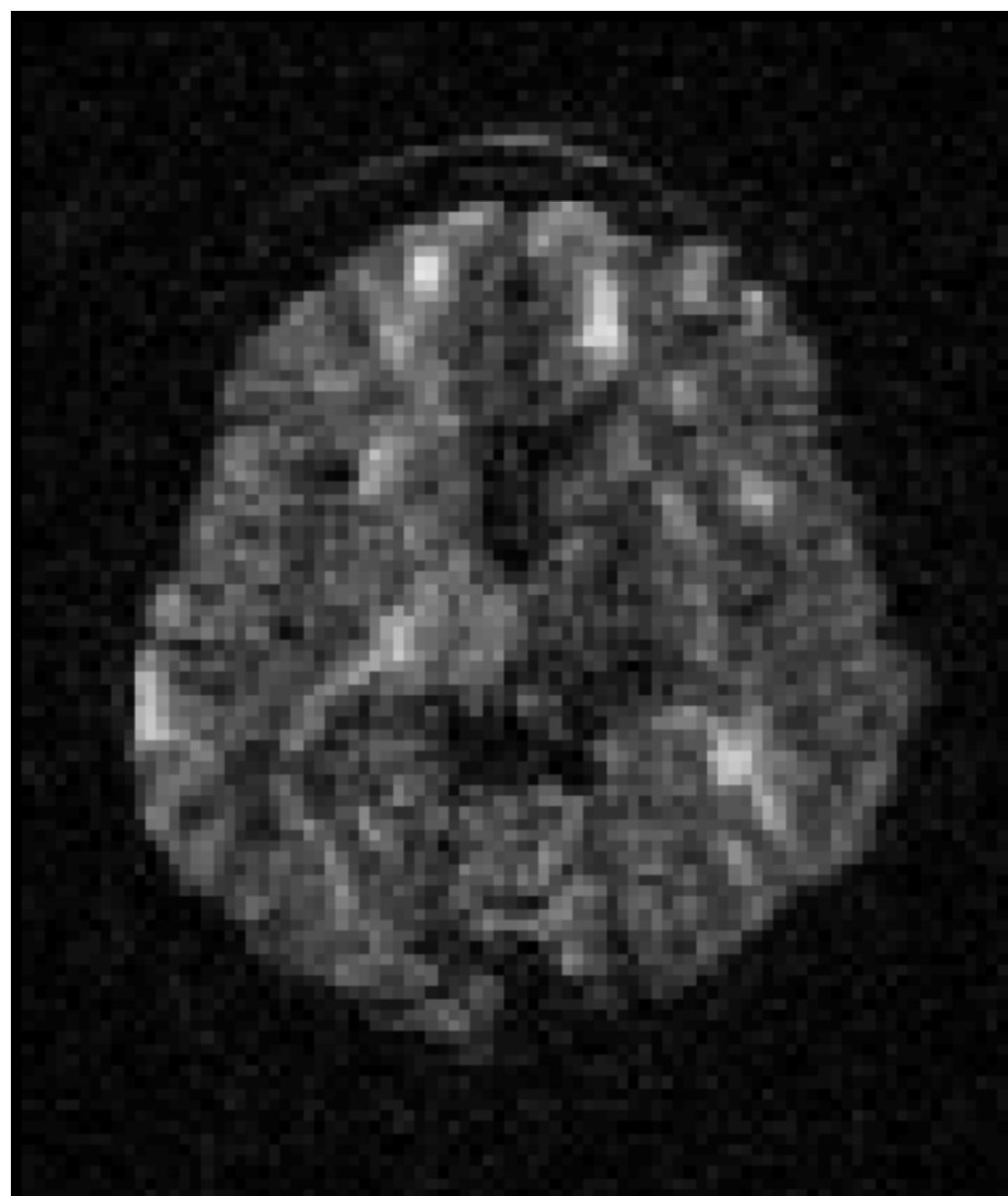
What is the problem with diffusion data?



In fact, it isn't even internally consistent



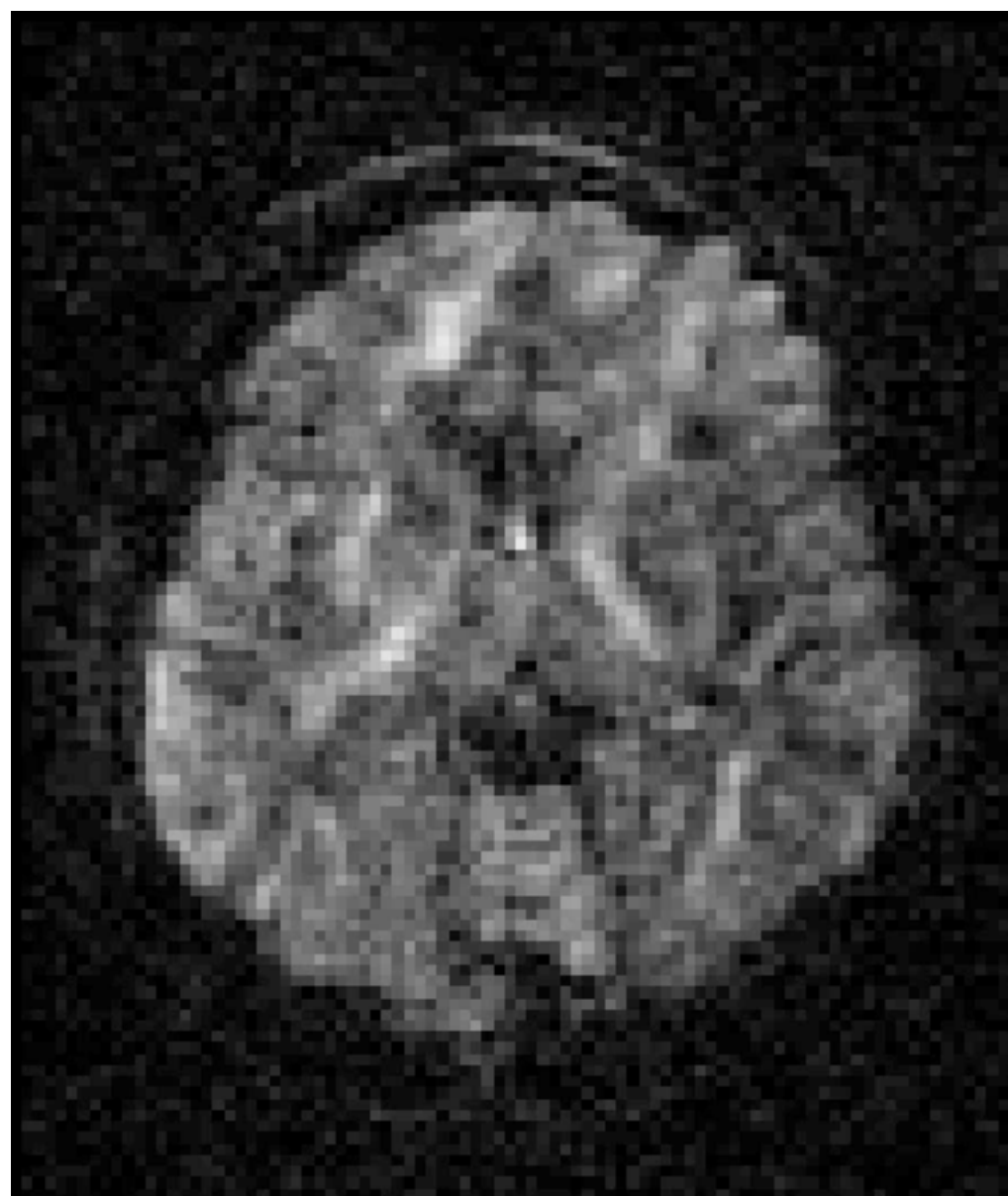
What is the problem with diffusion data?



In fact, it isn't even internally consistent



What is the problem with diffusion data?



In fact, it isn't even internally consistent



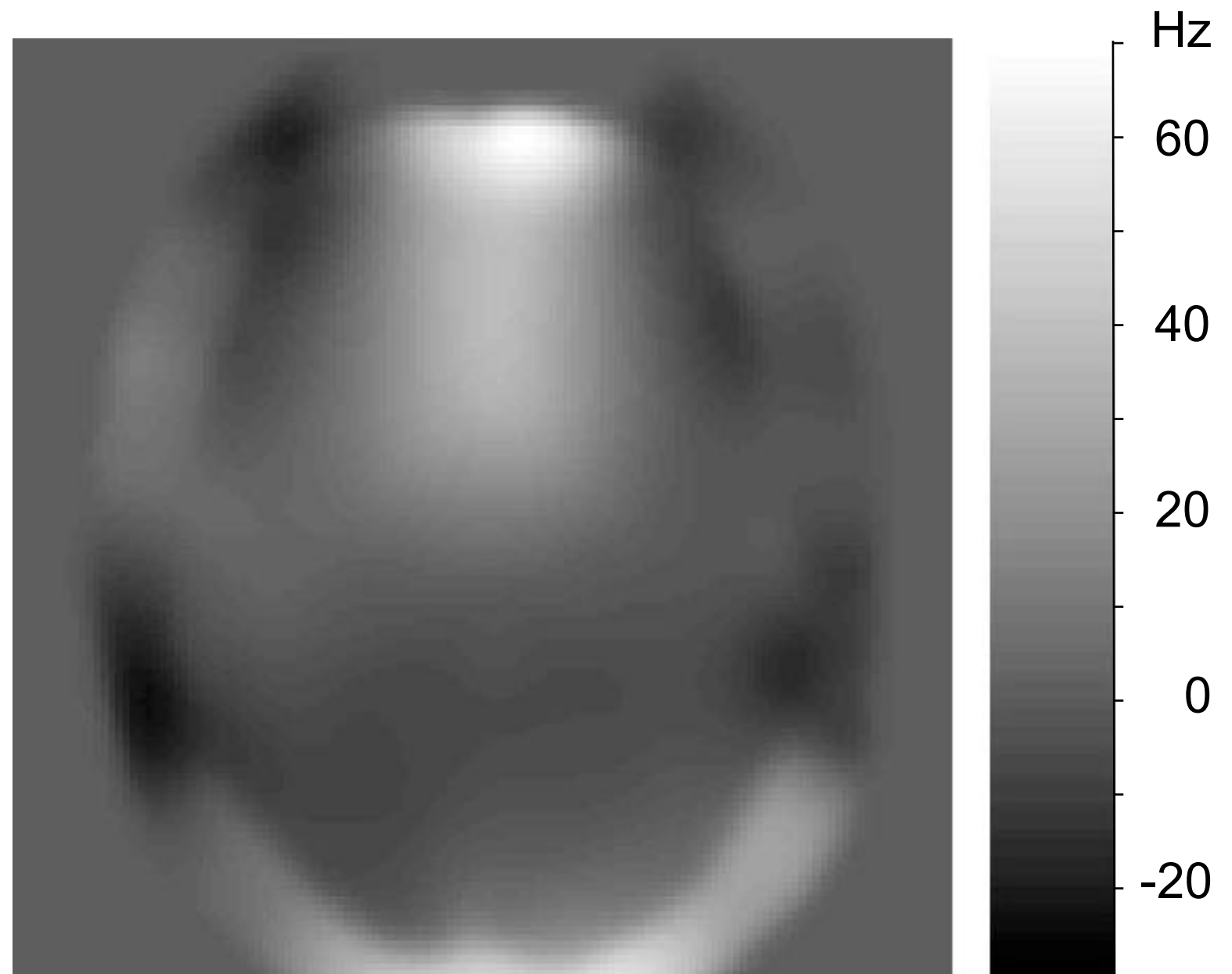
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Off-resonance field $\Rightarrow$ Distortions

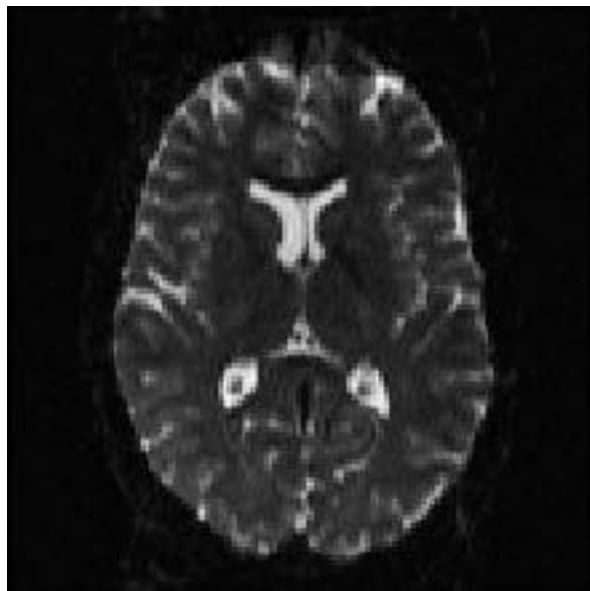
An “off-resonance” field is a map of the difference between what we think the field is and what it really is.



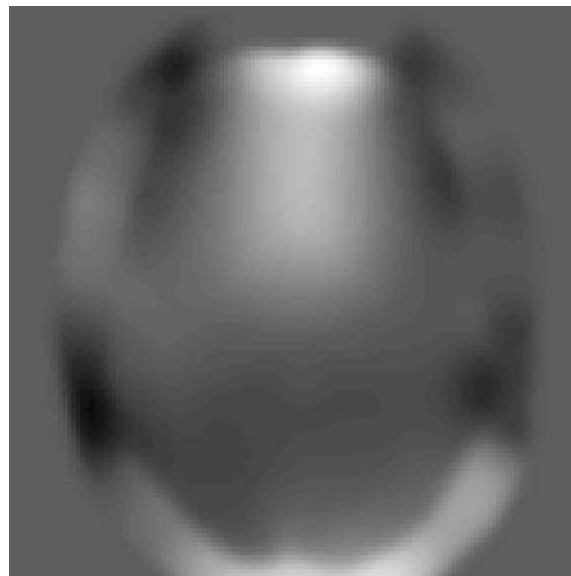
It is all caused by an “off-resonance” field



Off-resonance field $\Rightarrow$ Distortions



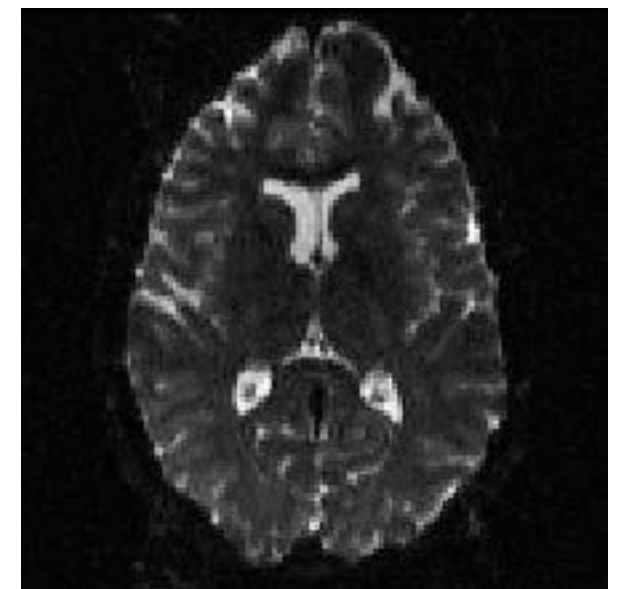
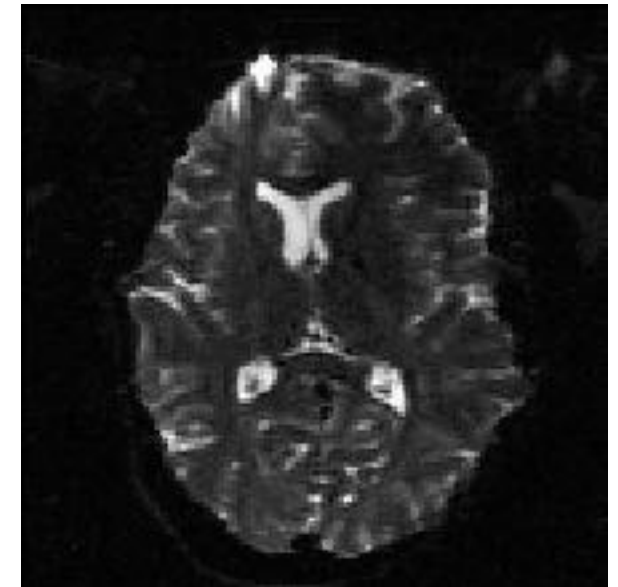
But this object



scanned in
this field

or this

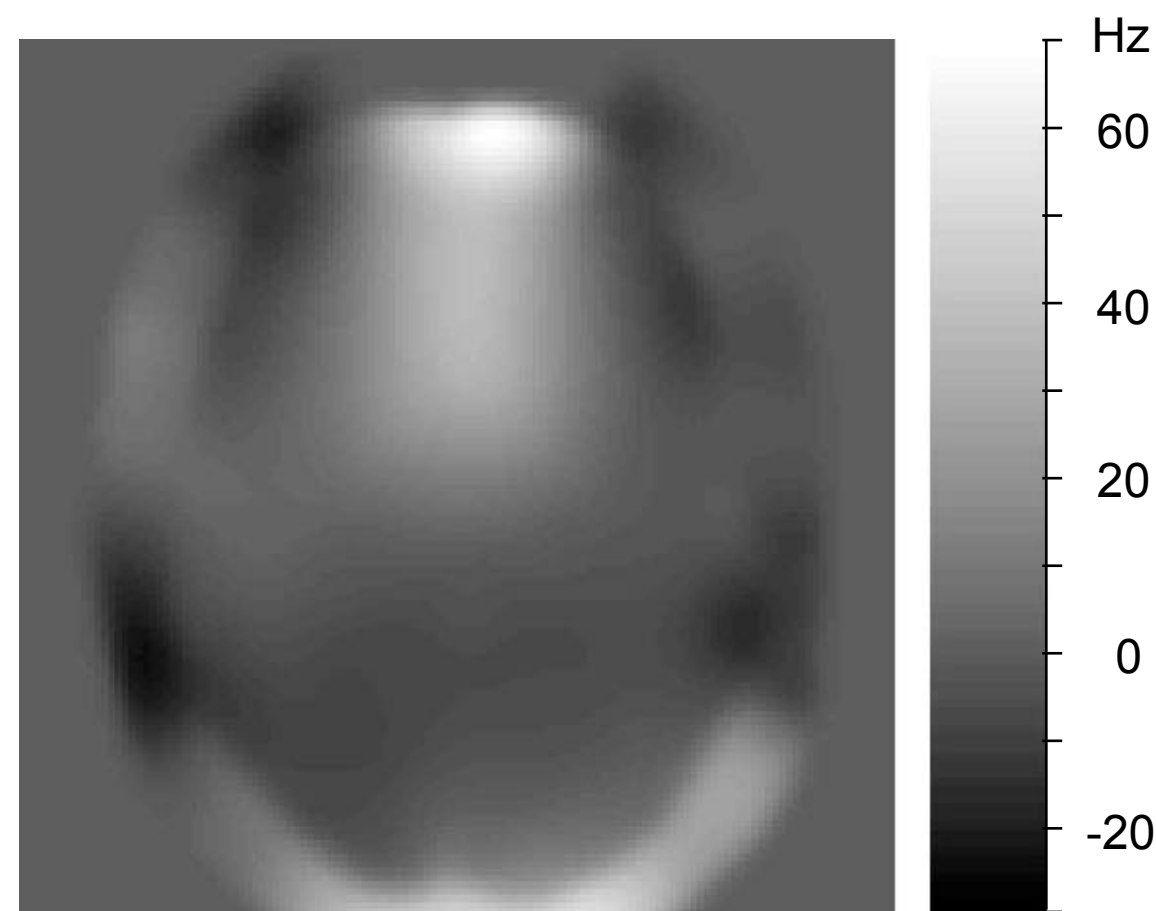
Can yield this



So there is clearly more to this story...



Off-resonance field $\Rightarrow$ Distortions

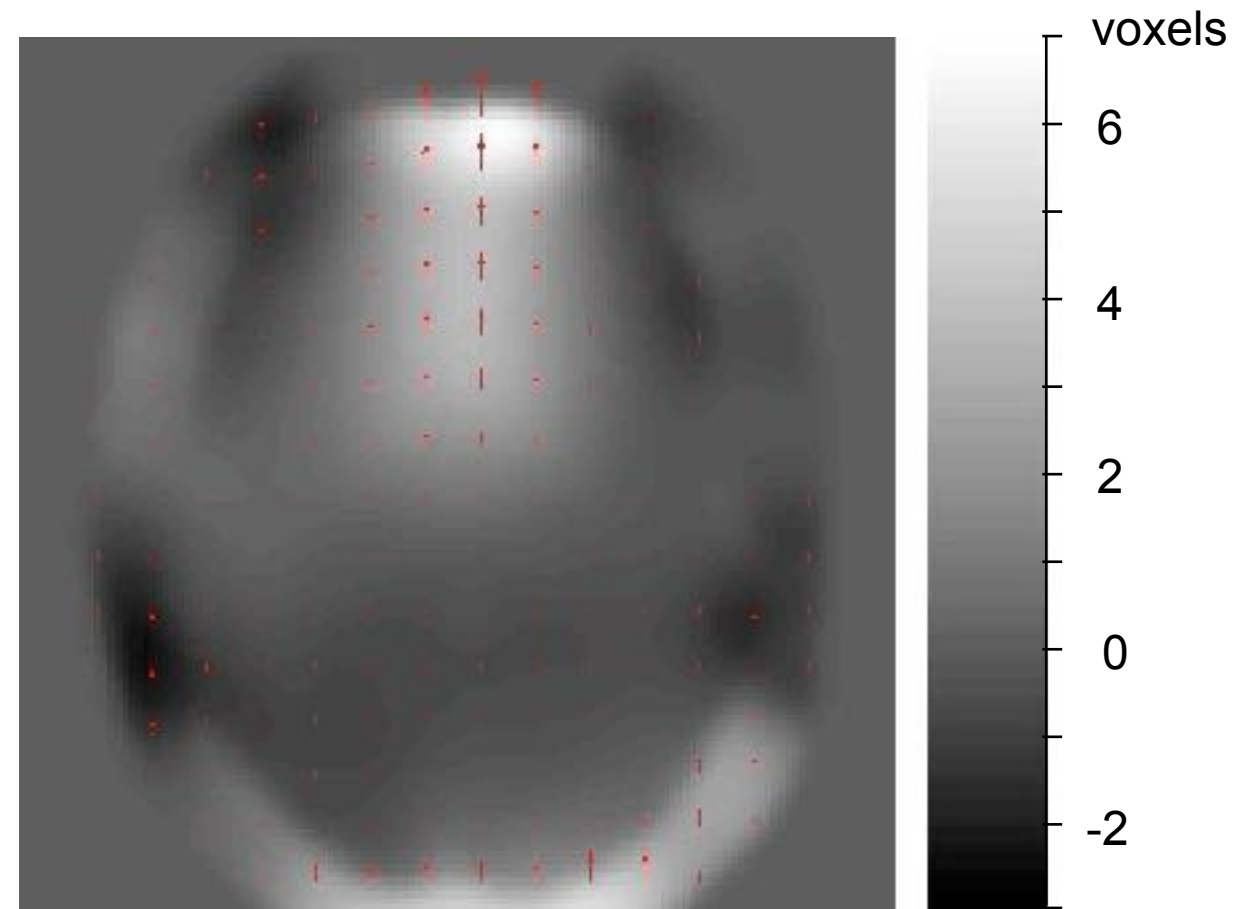
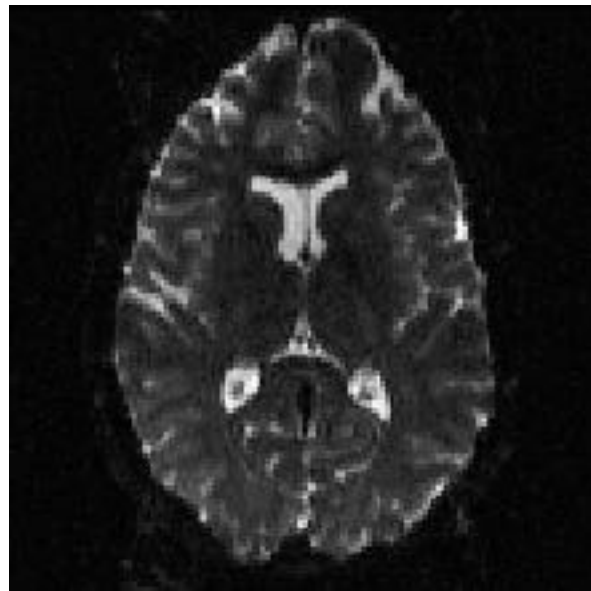


An off-resonance field is effectively a scaled voxel-displacement map.

If we know the imaging parameters we can do the translation.



Off-resonance field $\Rightarrow$ Distortions



And know what to expect

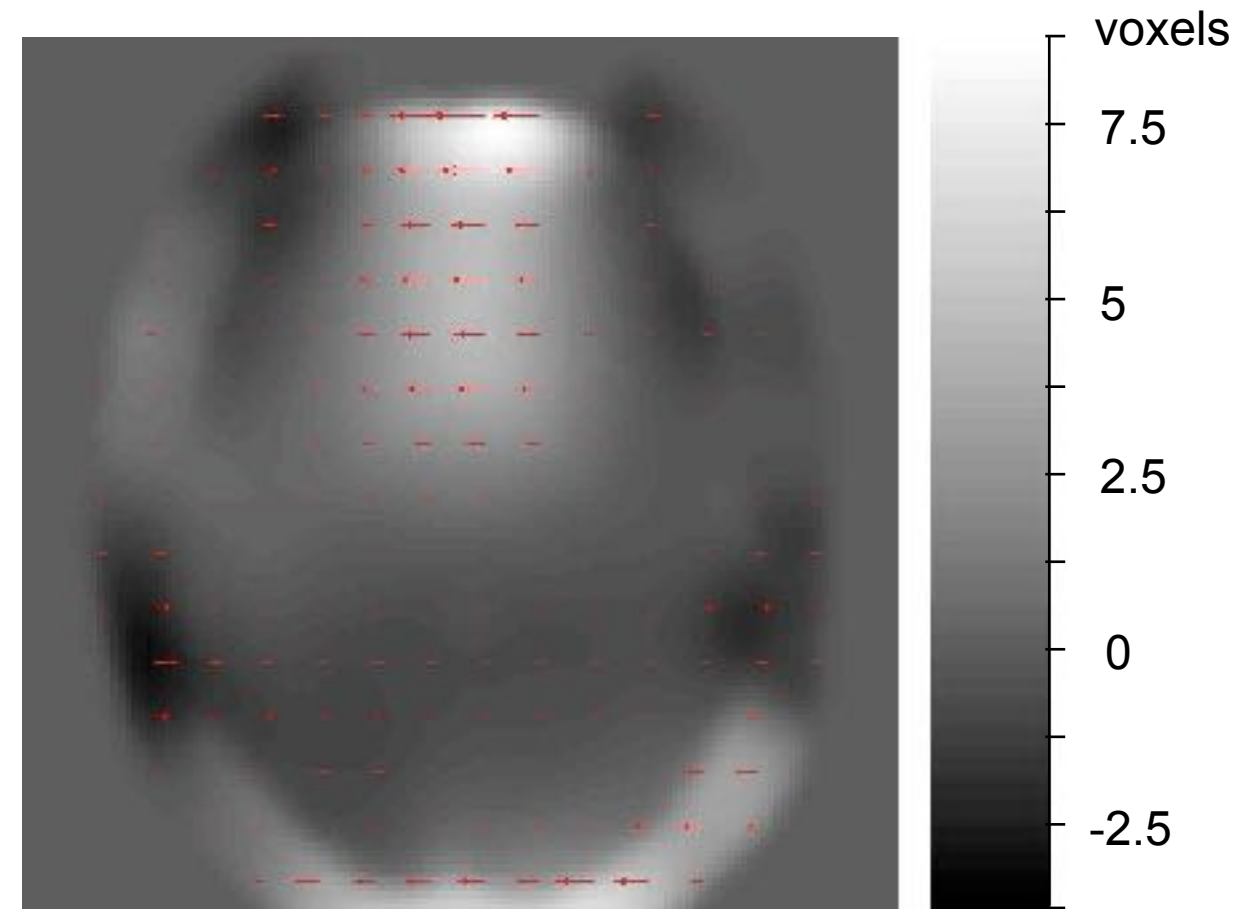
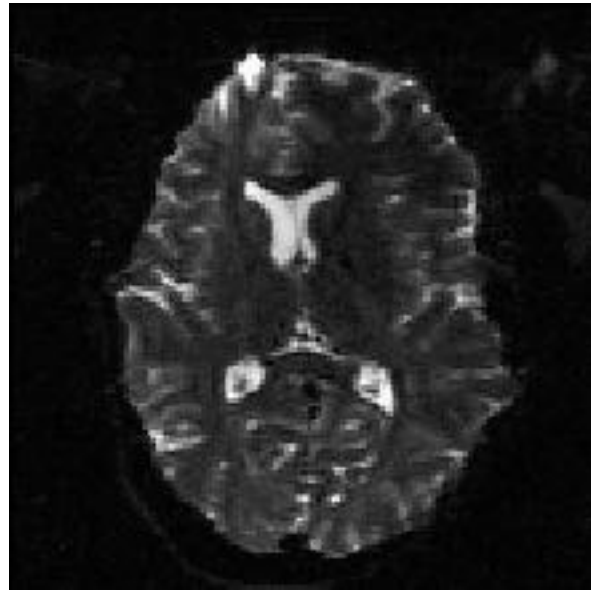
An off-resonance field is effectively a scaled voxel-displacement map.

If we know the imaging parameters we can do the translation.

$$BW/\text{voxel} = 10\text{Hz}, \mathbf{p} = [0 \ 1 \ 0]$$



Off-resonance field $\Rightarrow$ Distortions



And know what to expect

So, an off-resonance field is effectively a scaled voxel-displacement map.

And if we know the imaging parameters we can do the translation.

$$BW/\text{voxel} = 8\text{Hz}, \mathbf{p} = [-1 \ 0 \ 0]$$



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Where does the off-resonance field come from?

- There are two sources
- The first is the object (head) itself.

(CT of) Human head

$B_0 \odot$



Resulting field

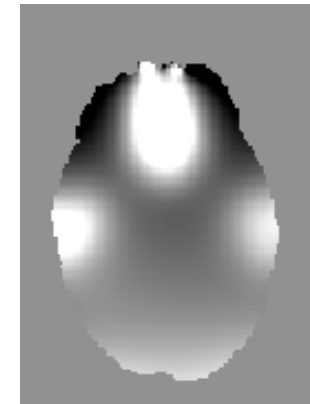


PPMs

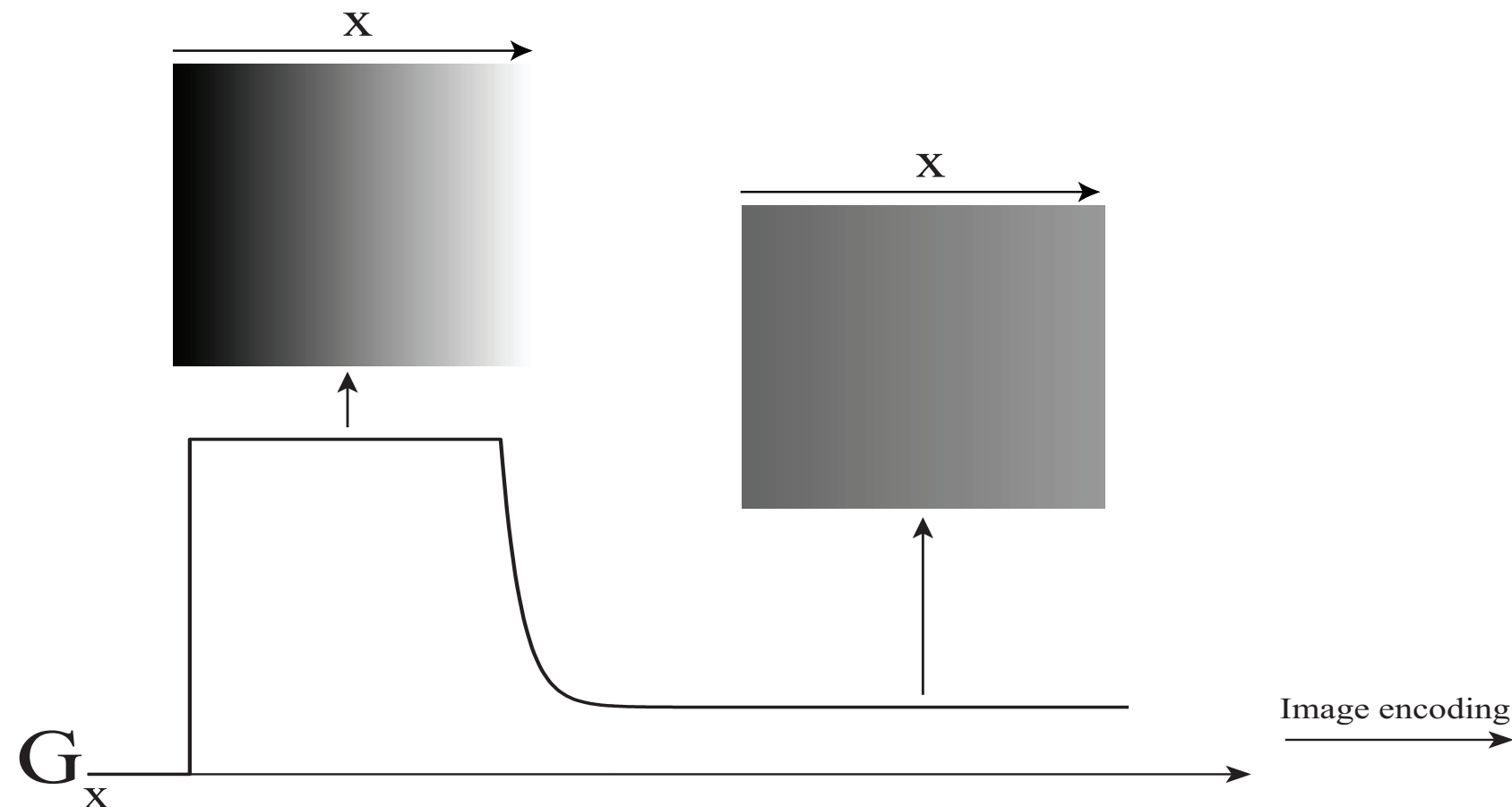
Must fulfil $\begin{cases} \nabla \times \mathbf{H} = 0 \\ \nabla \cdot \mathbf{B} = 0 \end{cases}$ (still)

Where does the off-resonance field come from?

- There are two sources
- The first is the object (head) itself.



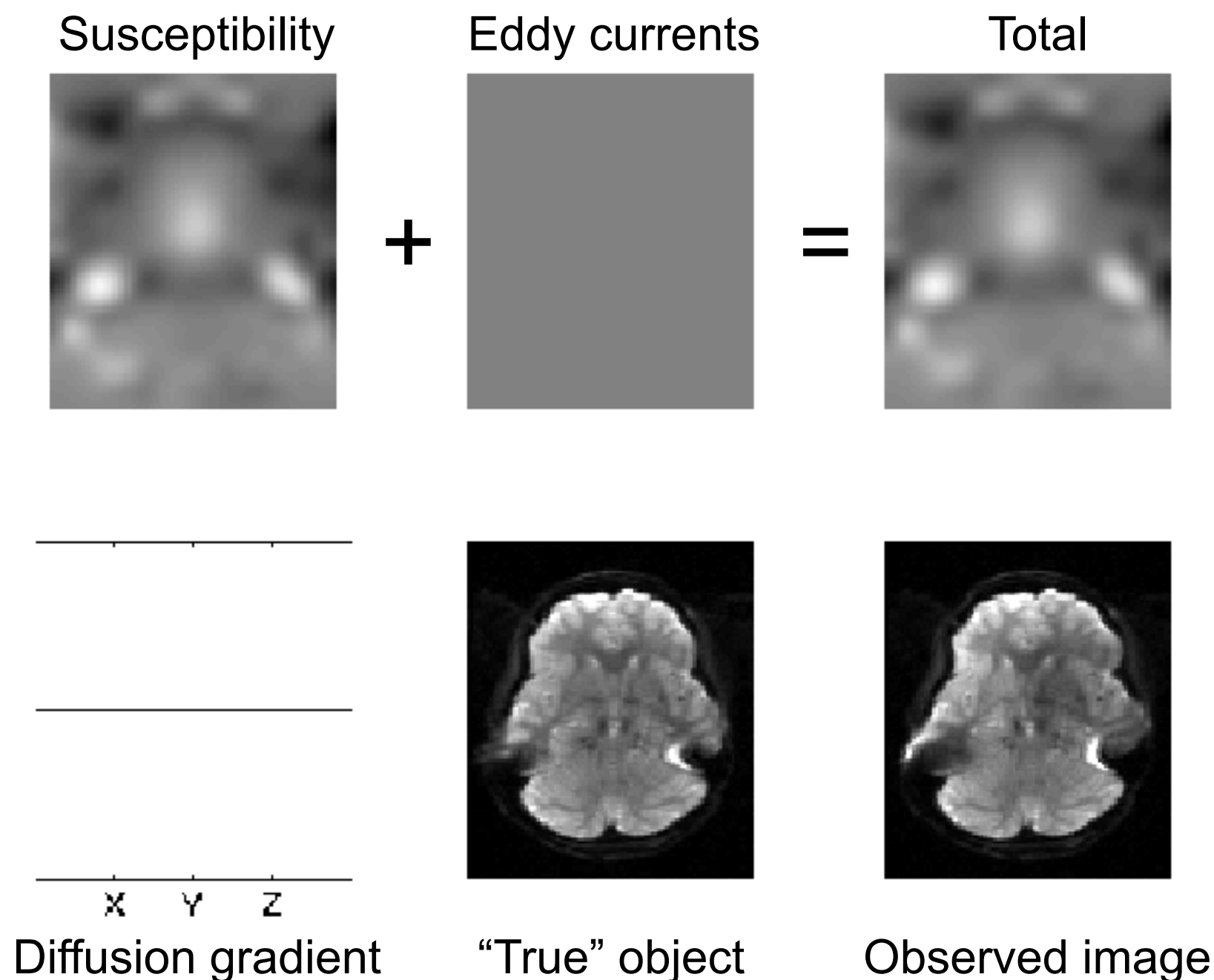
- The second is caused by the diffusion gradient





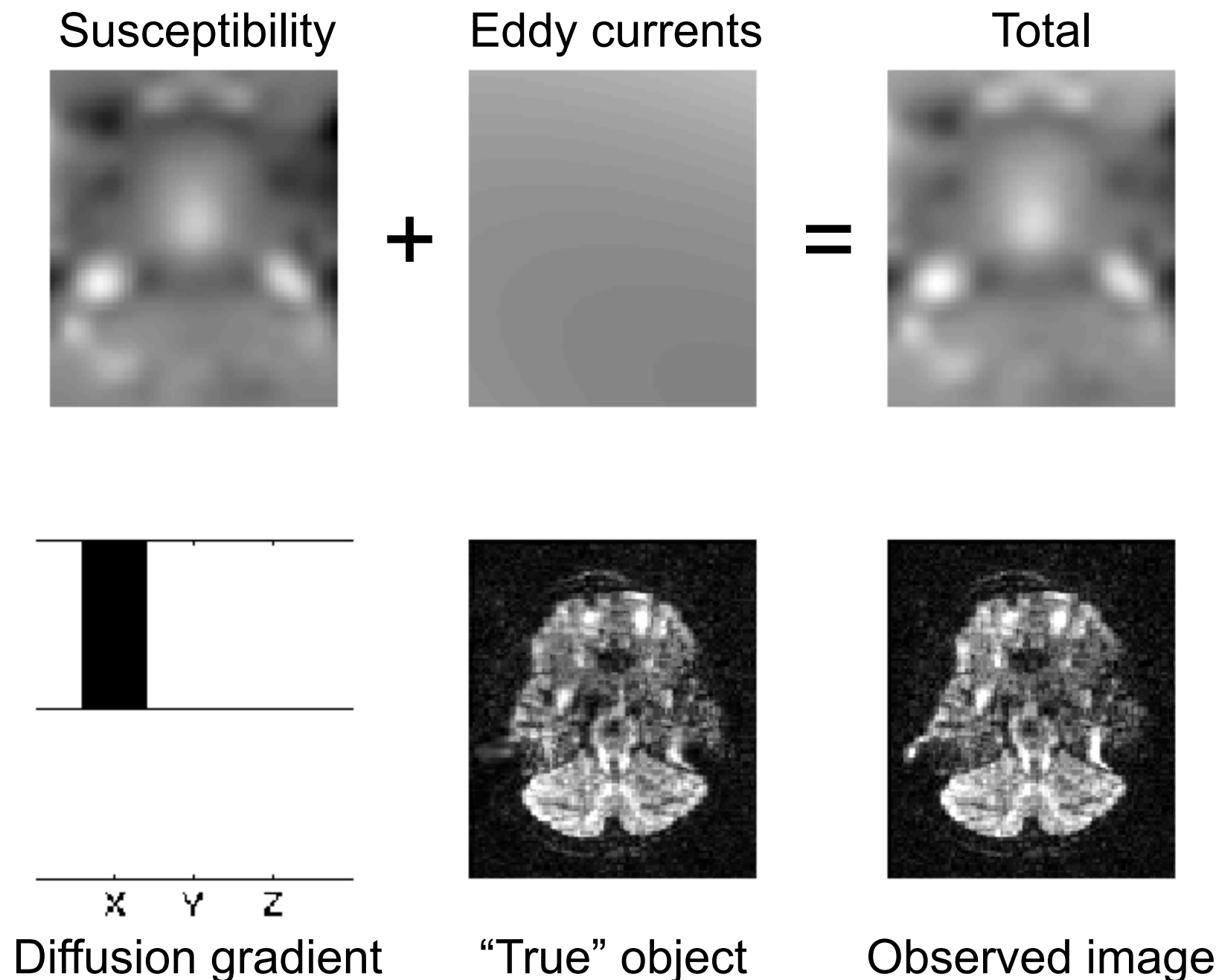
Where does the off-resonance field come from?

So for any diffusion weighted volume the off-resonance field is the sum of these two contributions



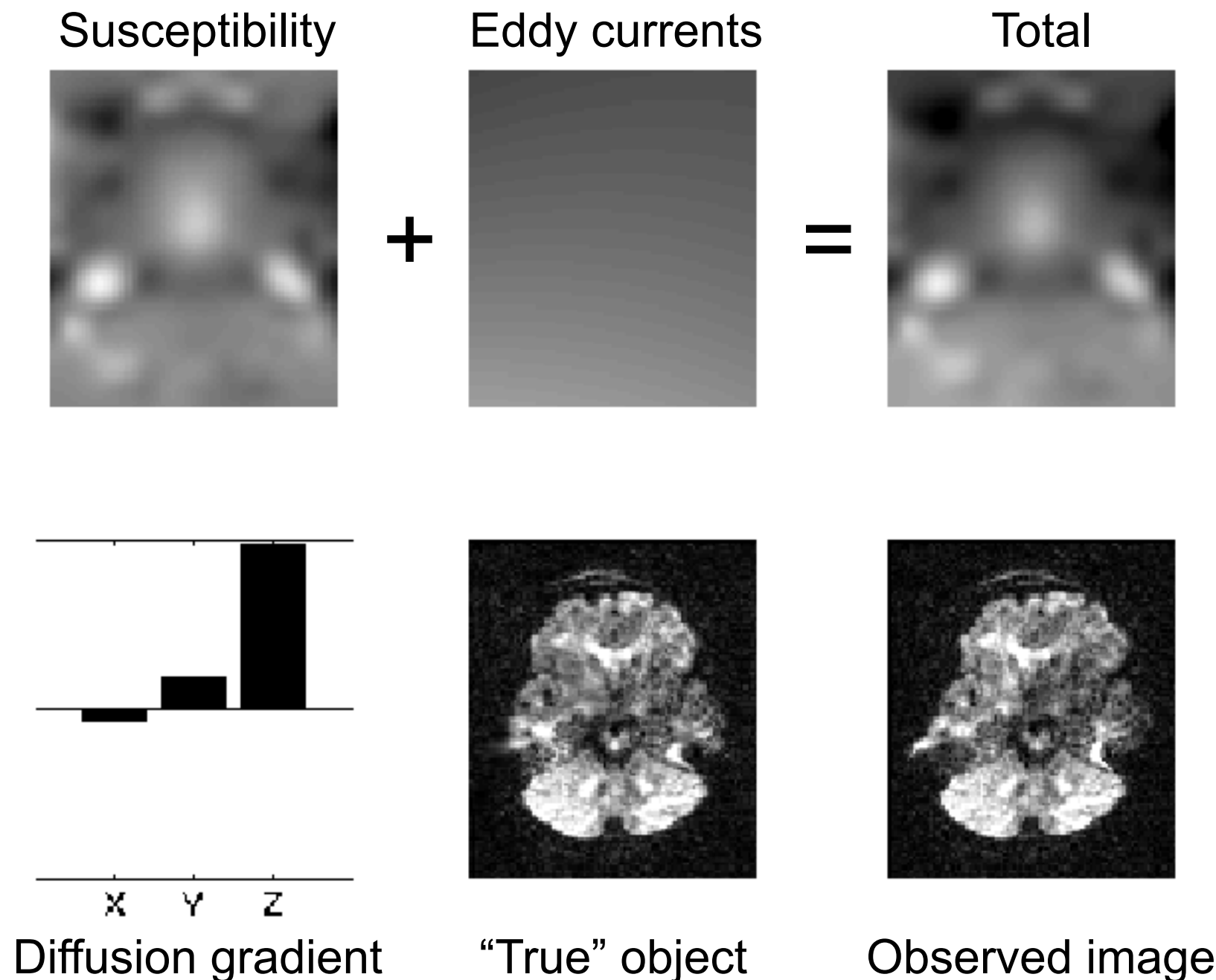
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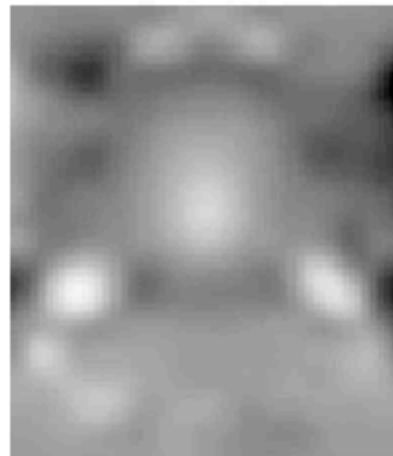
So for any diffusion weighted volume the off-resonance field is the sum of these two contributions



Where does the off-resonance field come from?

So for any diffusion weighted volume the off-resonance field is the sum of these two contributions

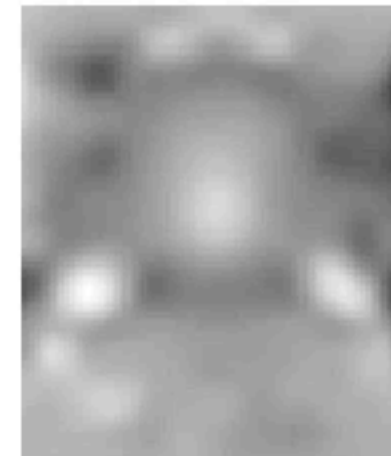
Susceptibility



Eddy currents



Total

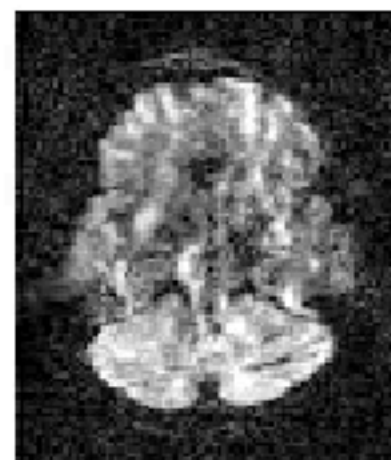


+

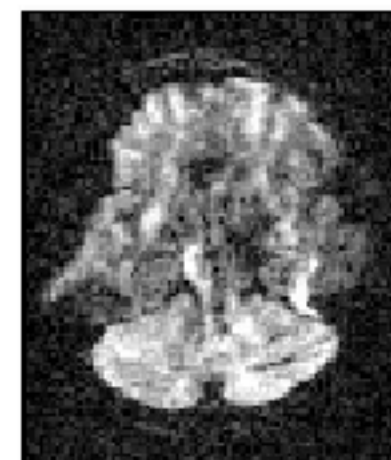
=



Diffusion gradient



"True" object



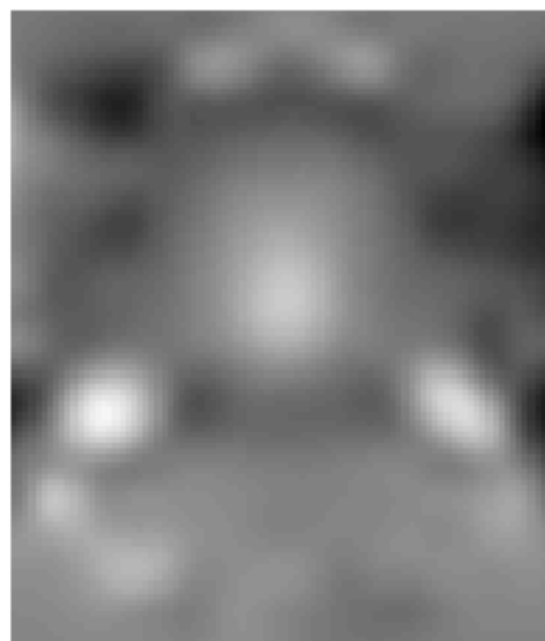
Observed image



Separate estimation of susceptibility- and eddy current-fields

So, what we need to estimate is

One of these per
subject



One of these per
volume



FSL-tools:

topup

eddy