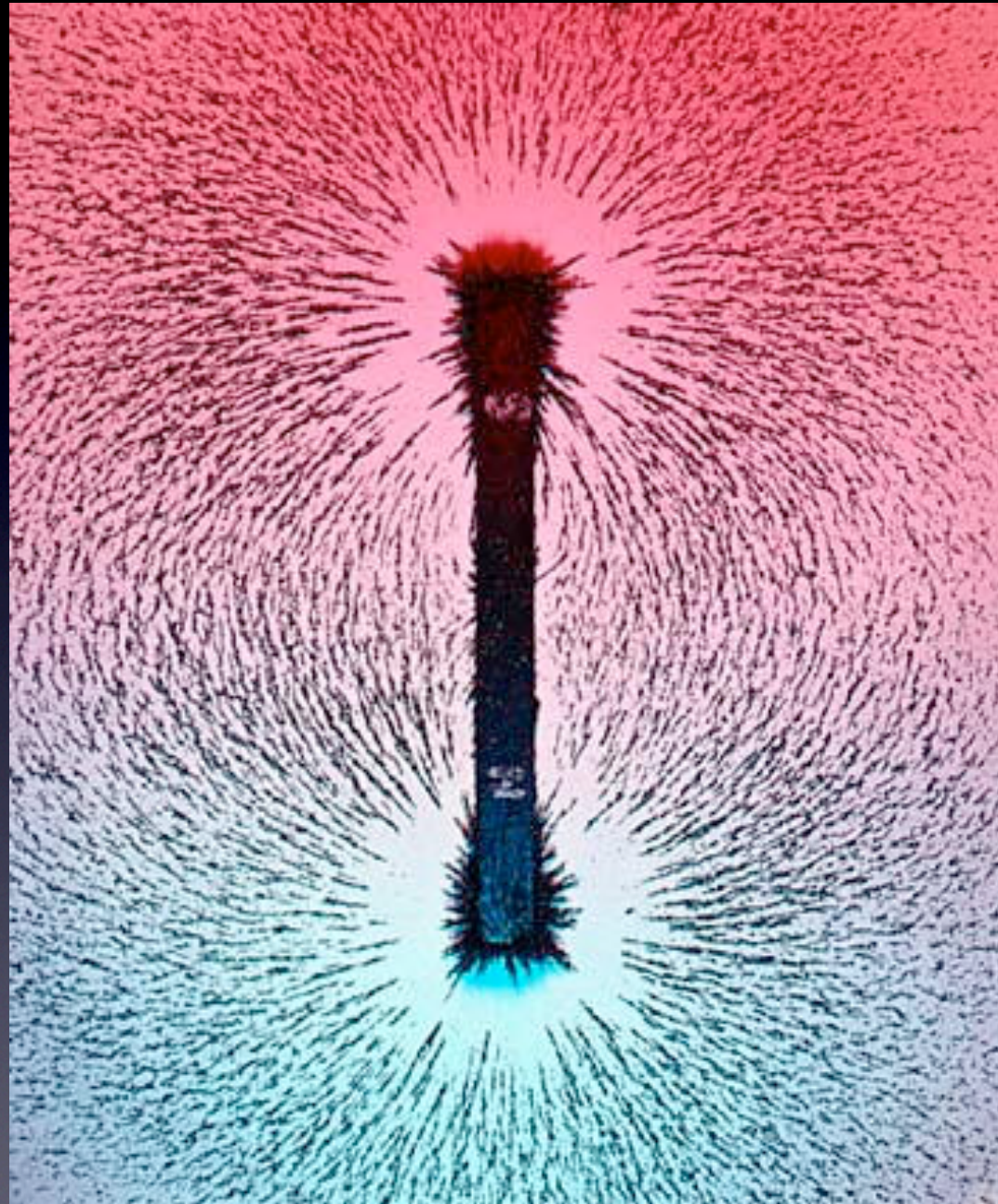


A Non-Physicist's Intro to MRI

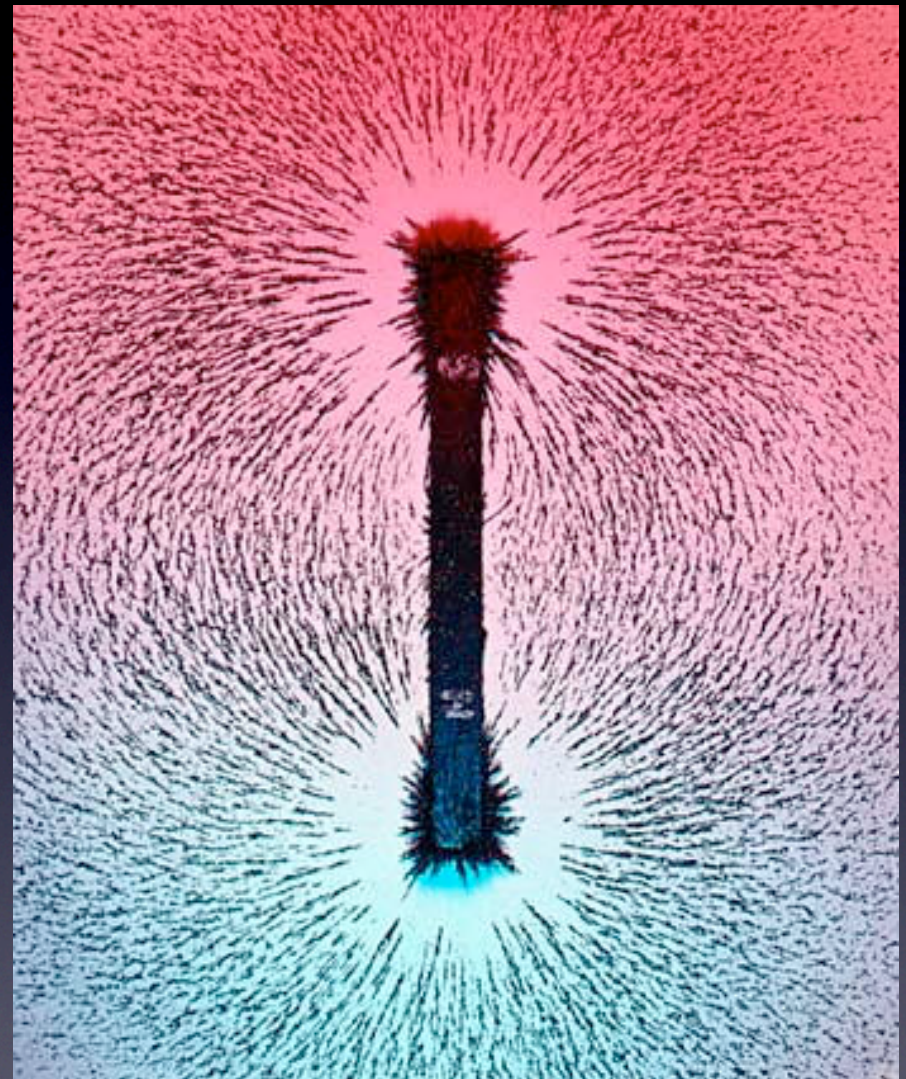
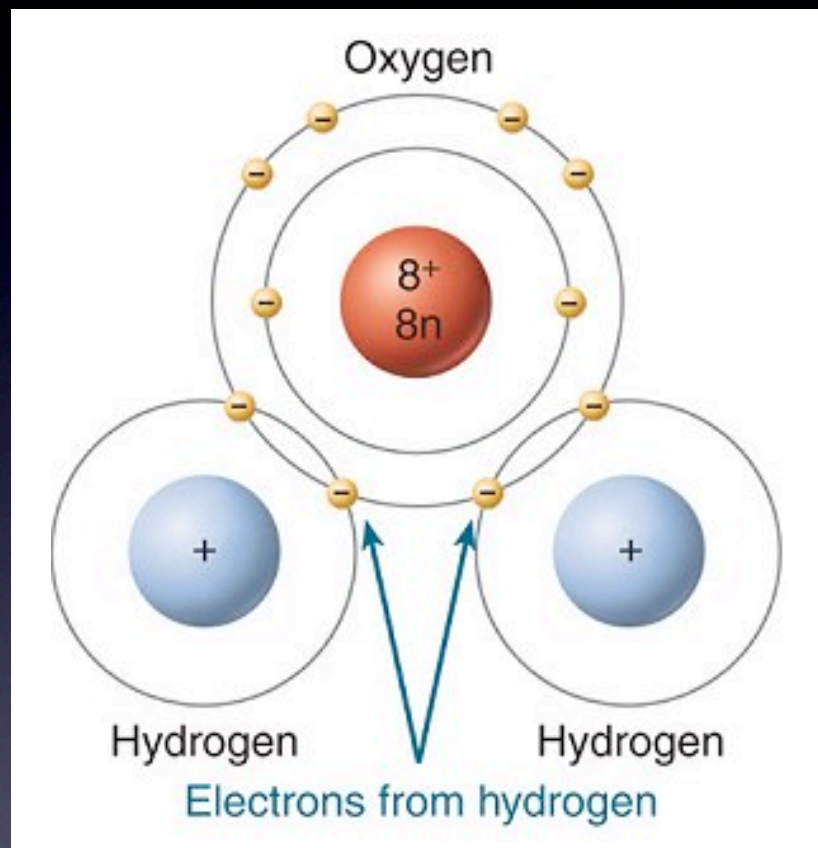
Dylan Tisdall

December 12, 2011





A human head



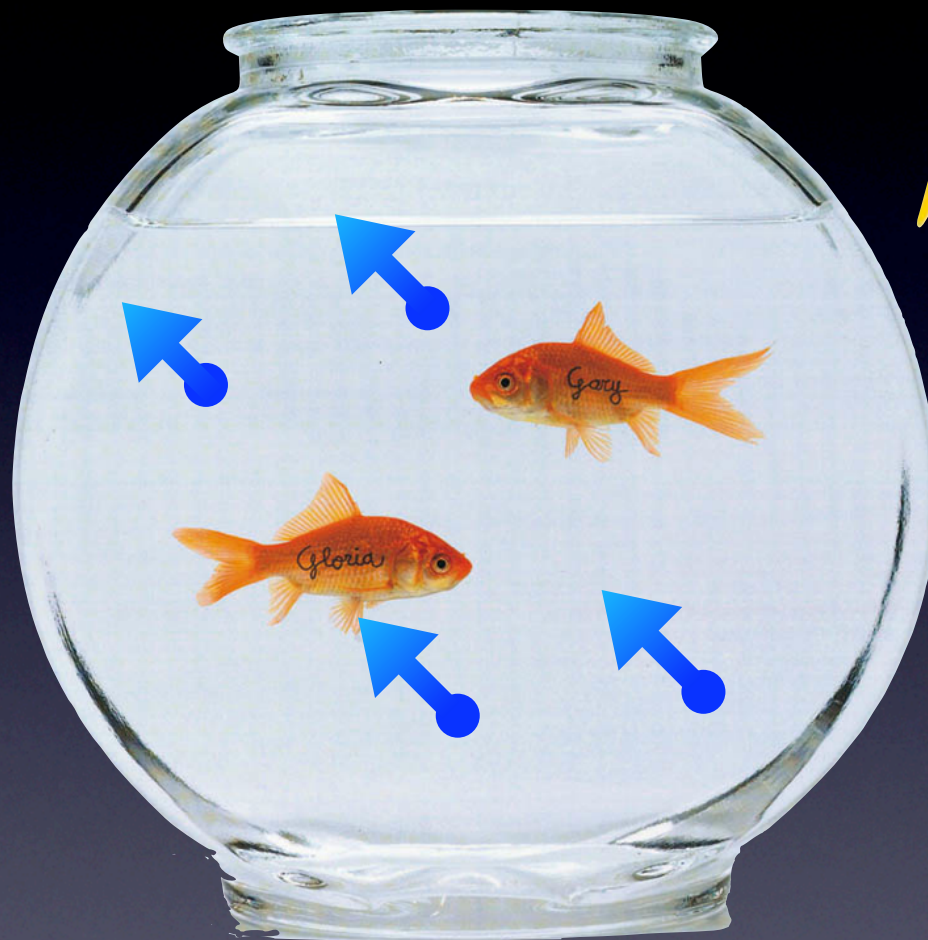


main
magnetic
field





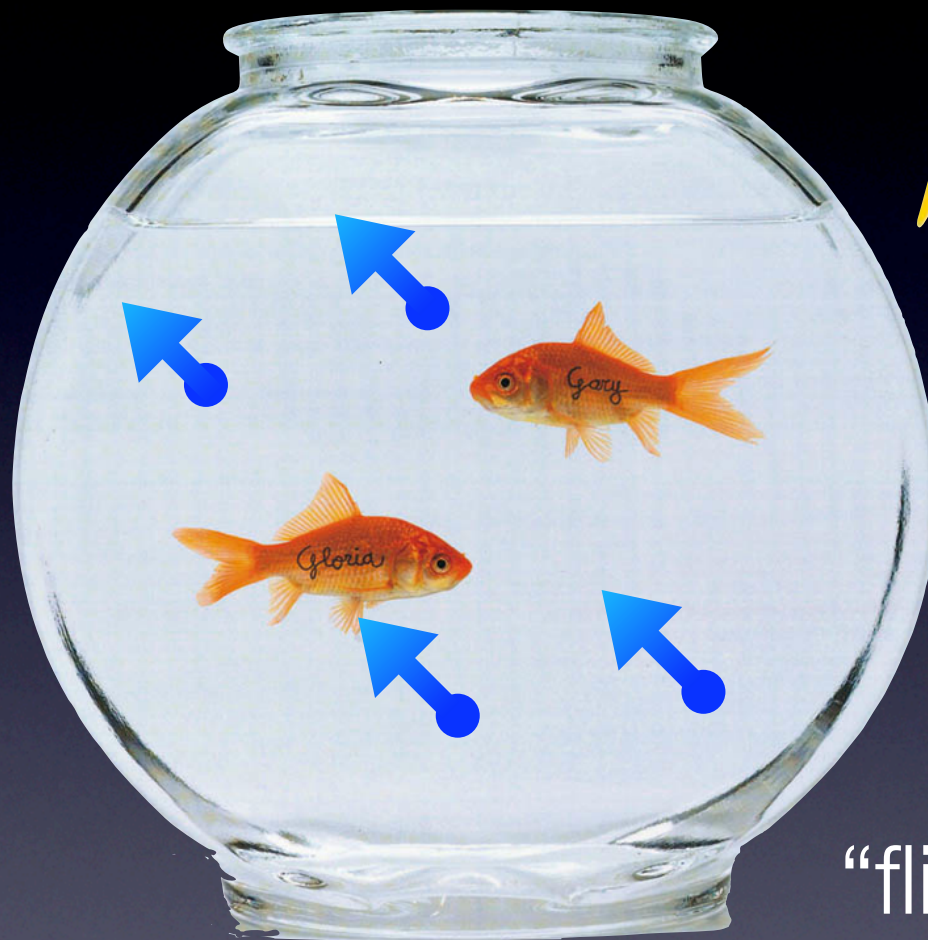
main
magnetic
field



"pulse"

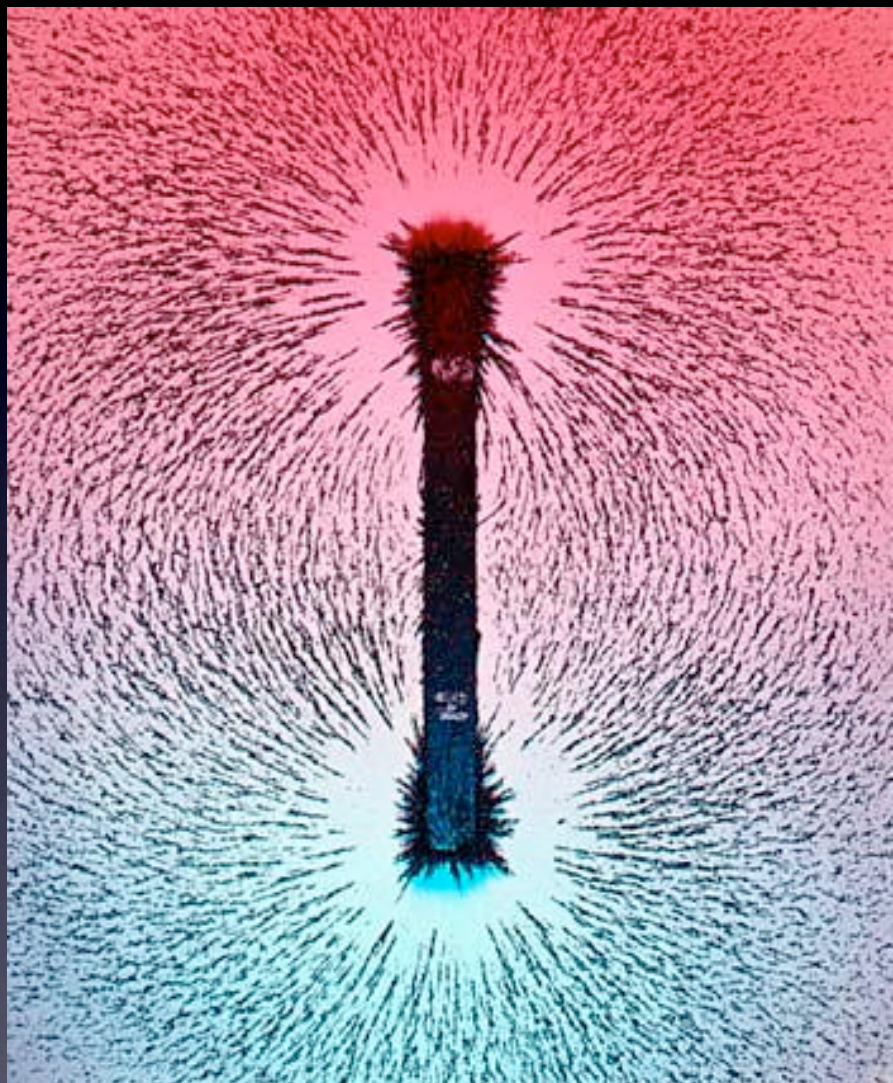


main
magnetic
field

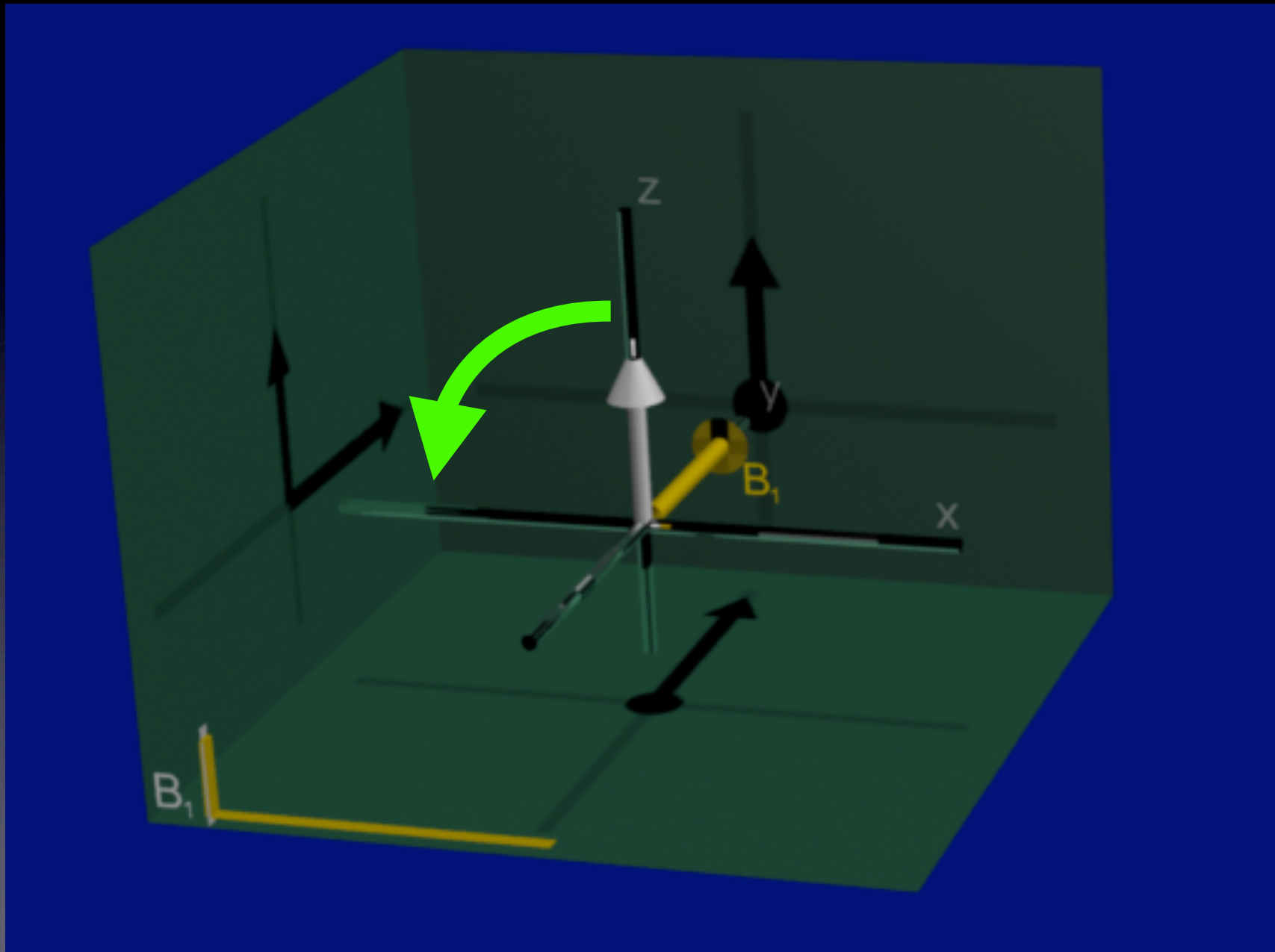


“pulse”

“flip angle”



precession

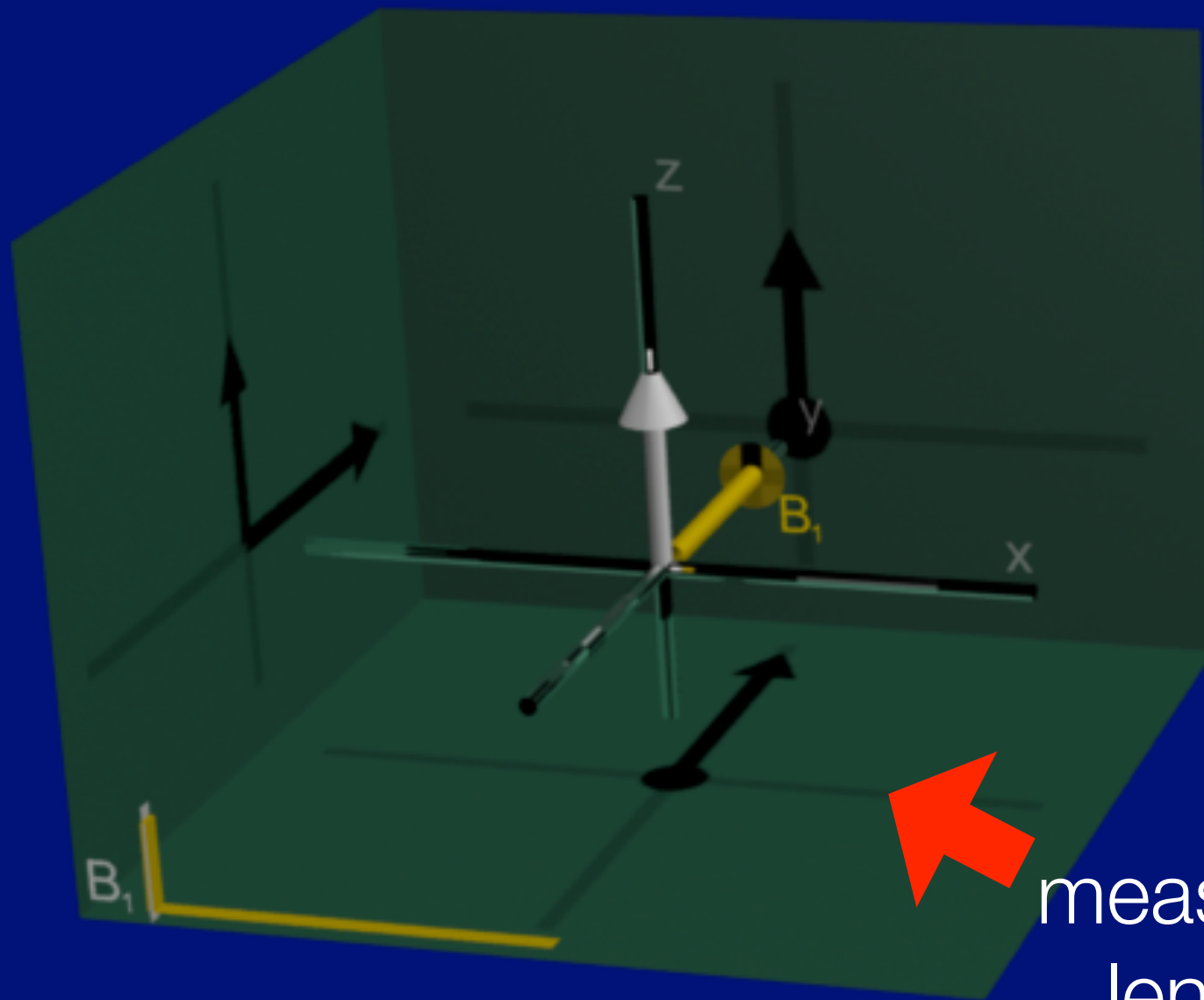


The **rate of precession**
changes **linearly** with the
strength of the **magnetic field**



main
magnetic
field





measured
length

“rotating frame of reference”



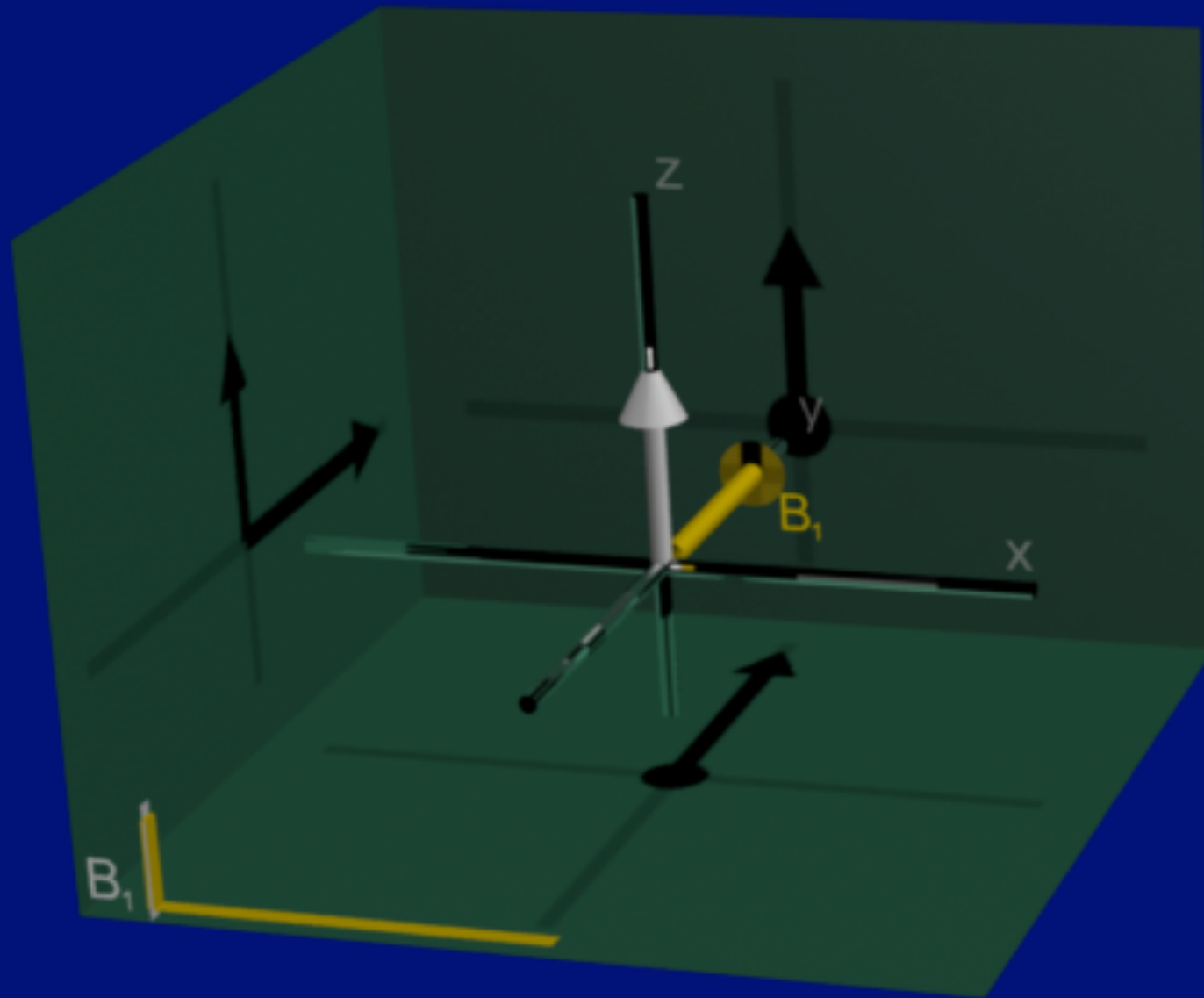
relaxation



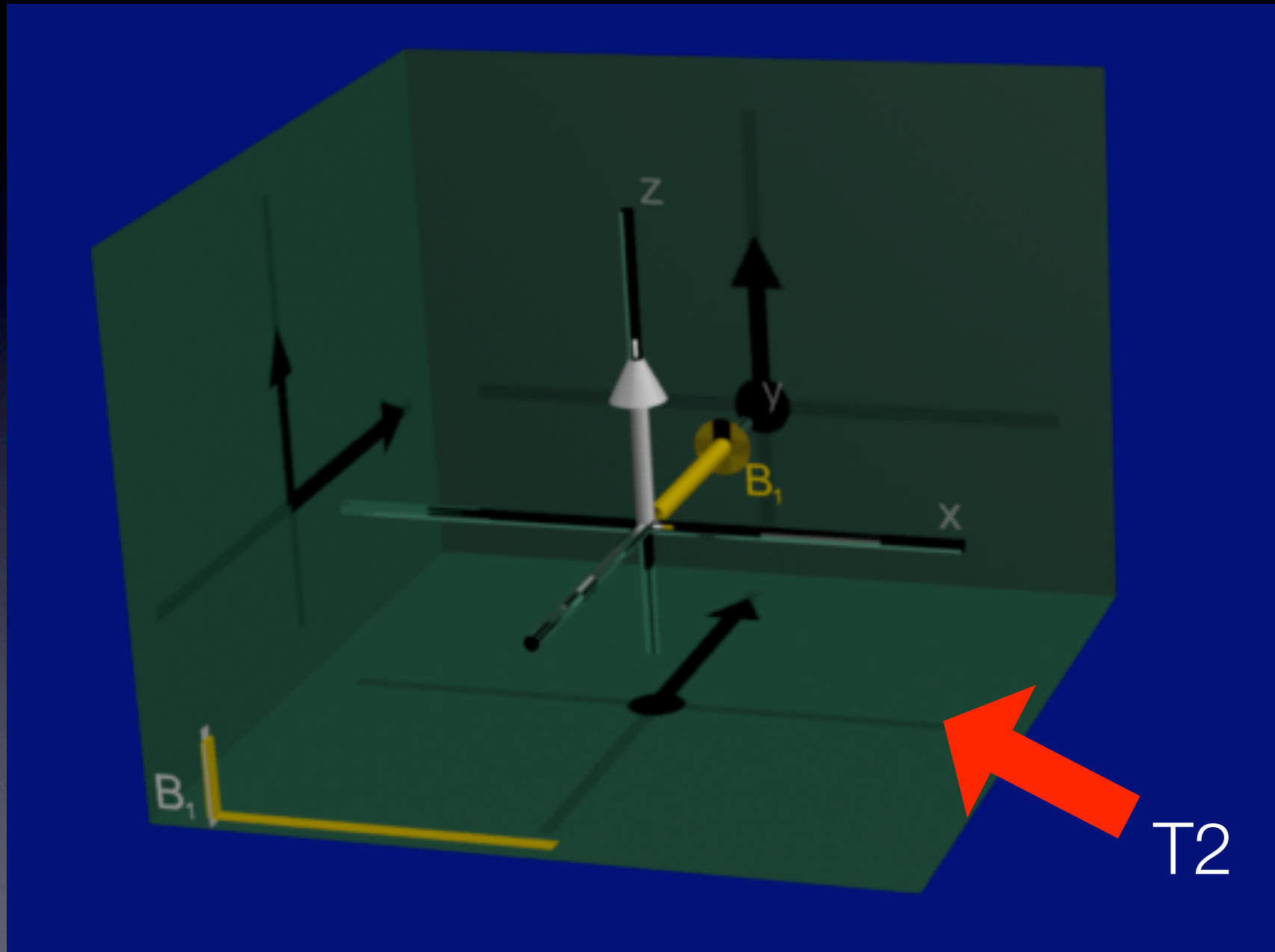
main
magnetic
field



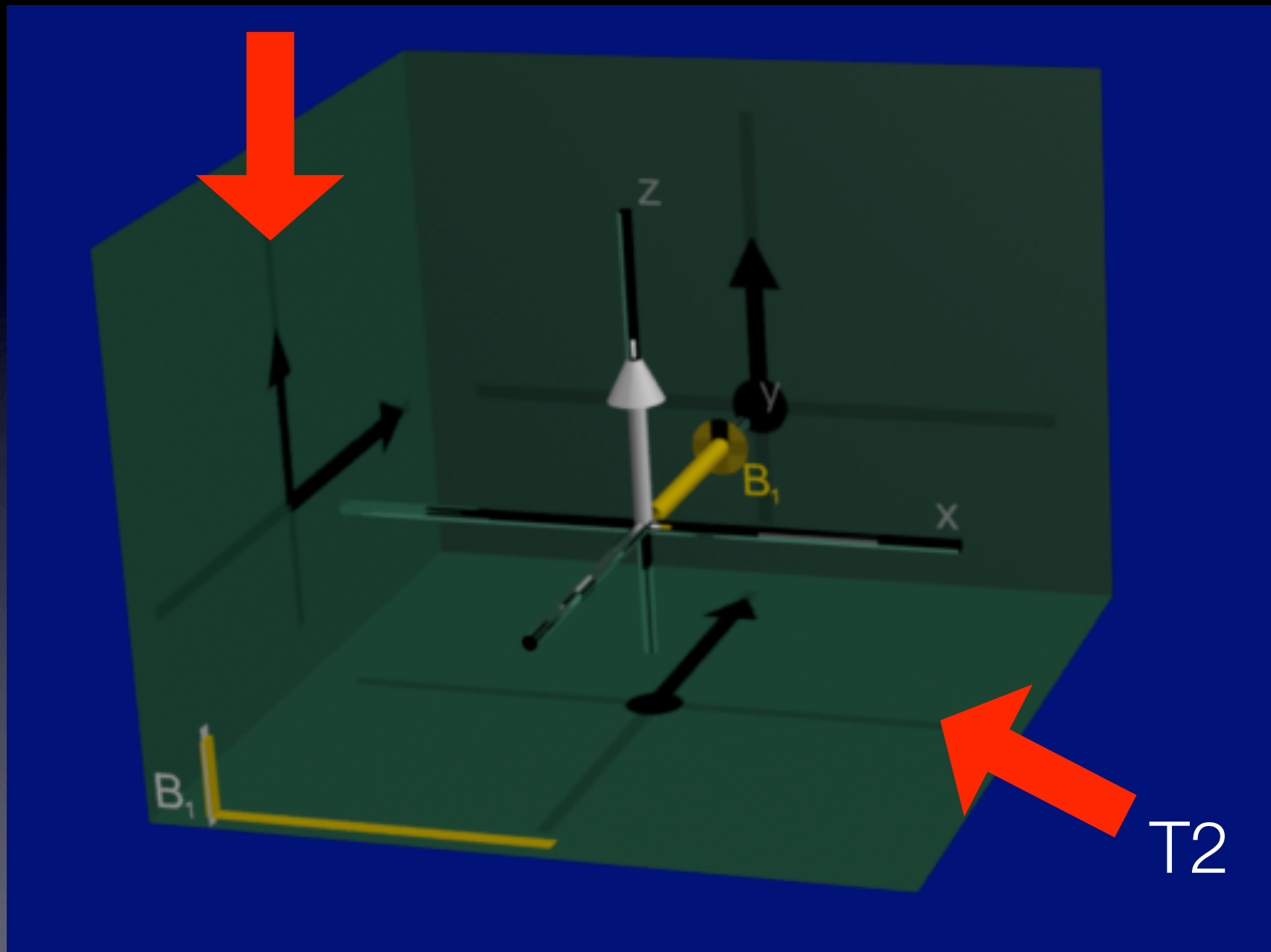
T2 is dephasing



dephasing looks like “less signal”



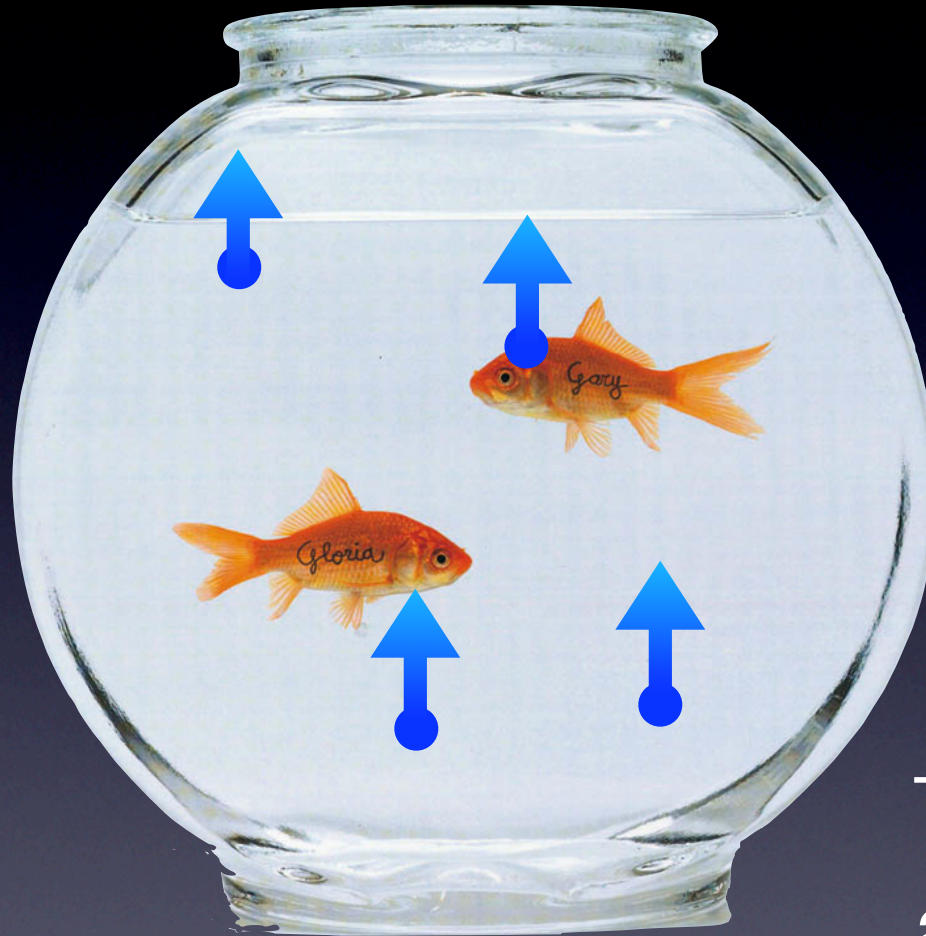
T1



T2

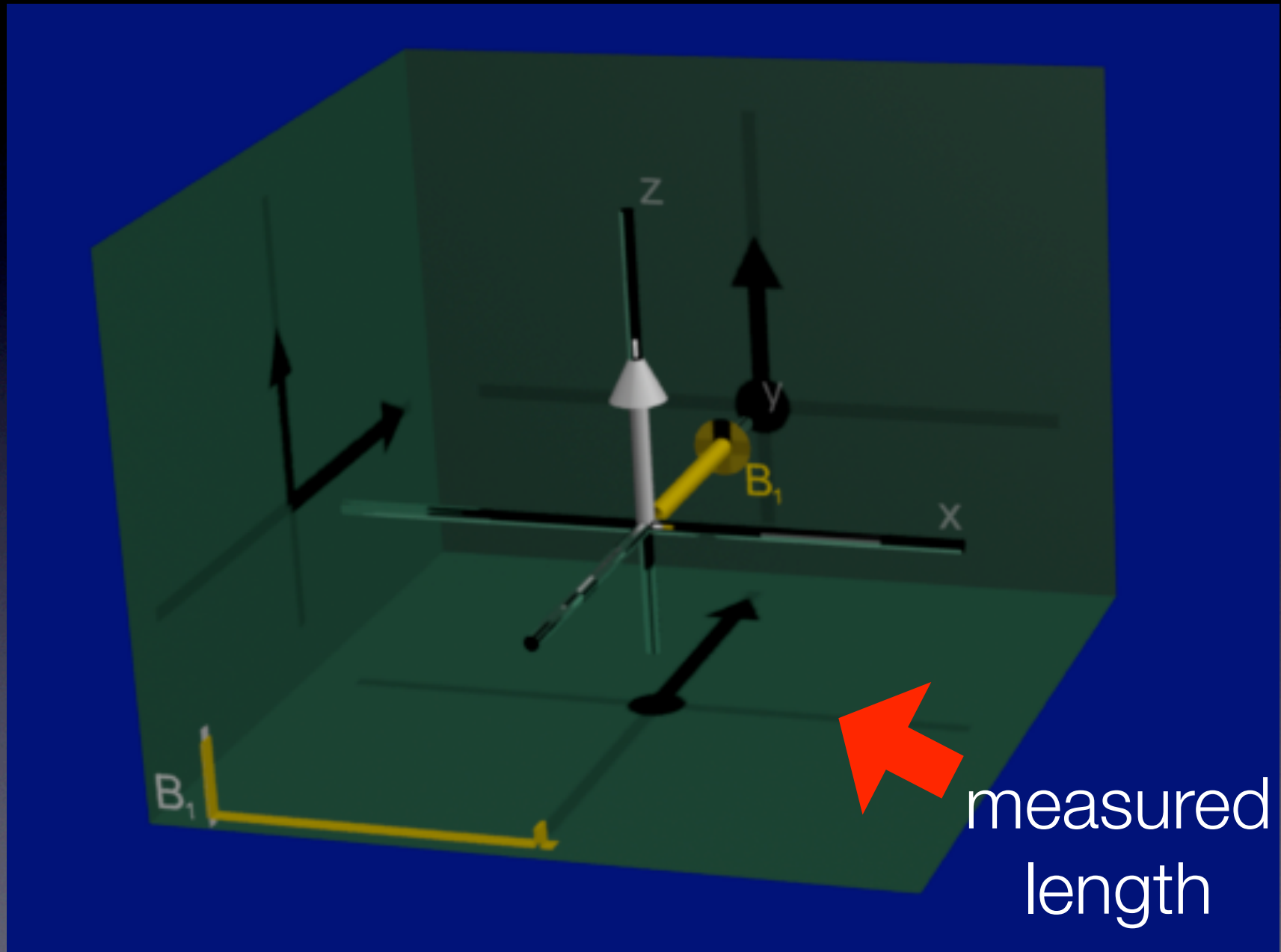


main
magnetic
field



The fish
are what
make it
interesting....

inversion recovery



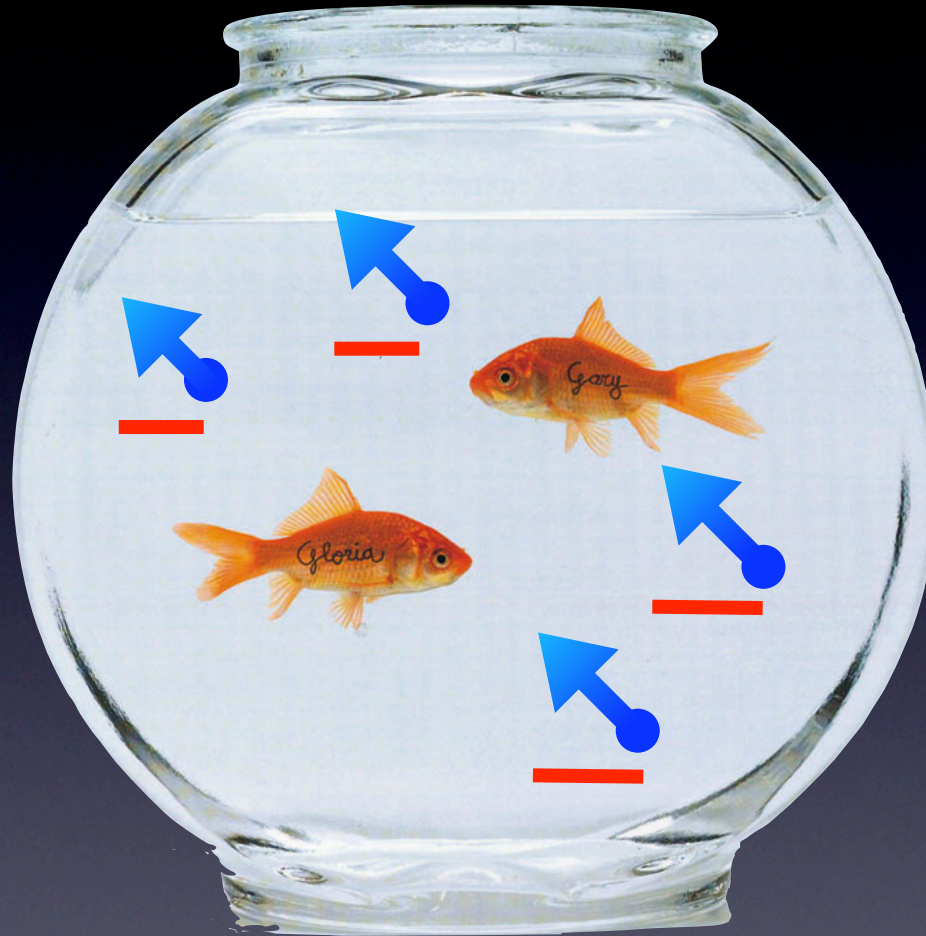
Using **inversion recovery** we
can **weight** our measurements
for tissues with **specific T1**

How do we get
spatial information?

what do we measure?

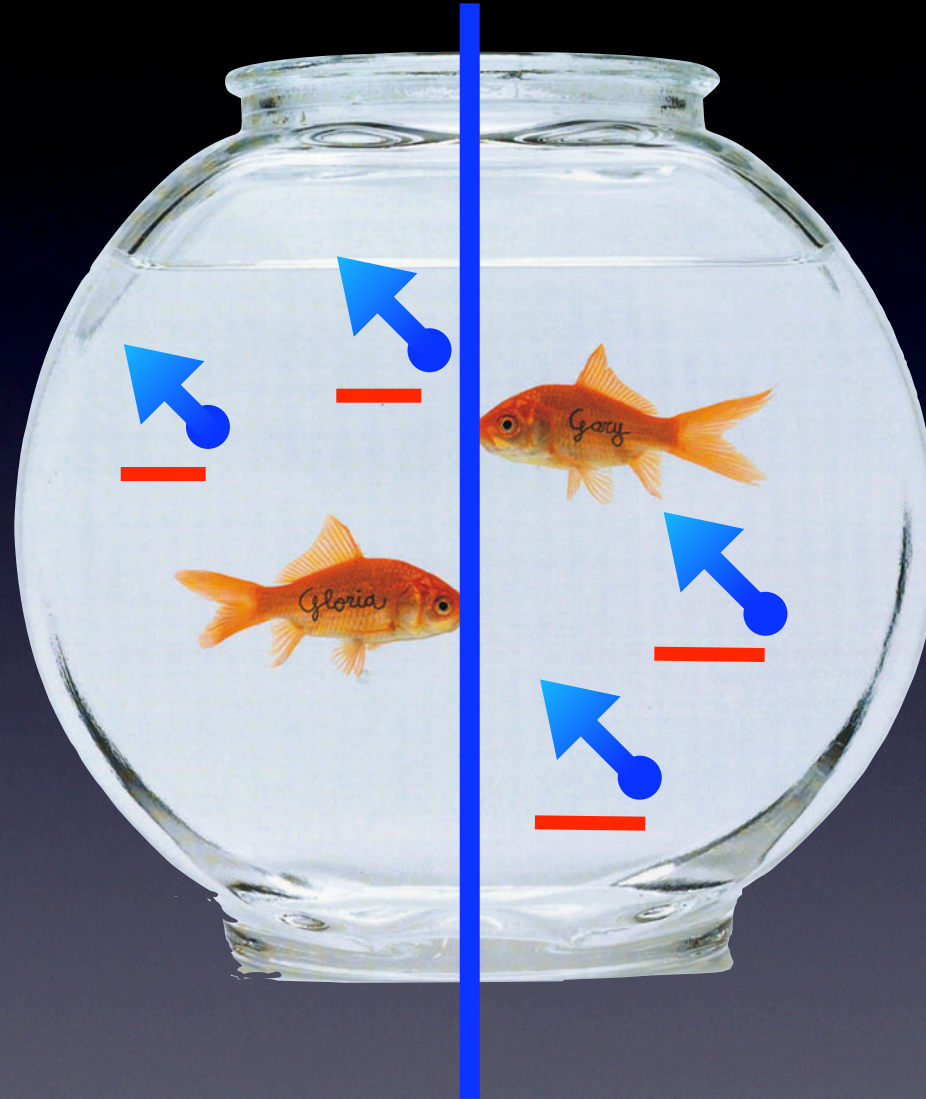


main
magnetic
field



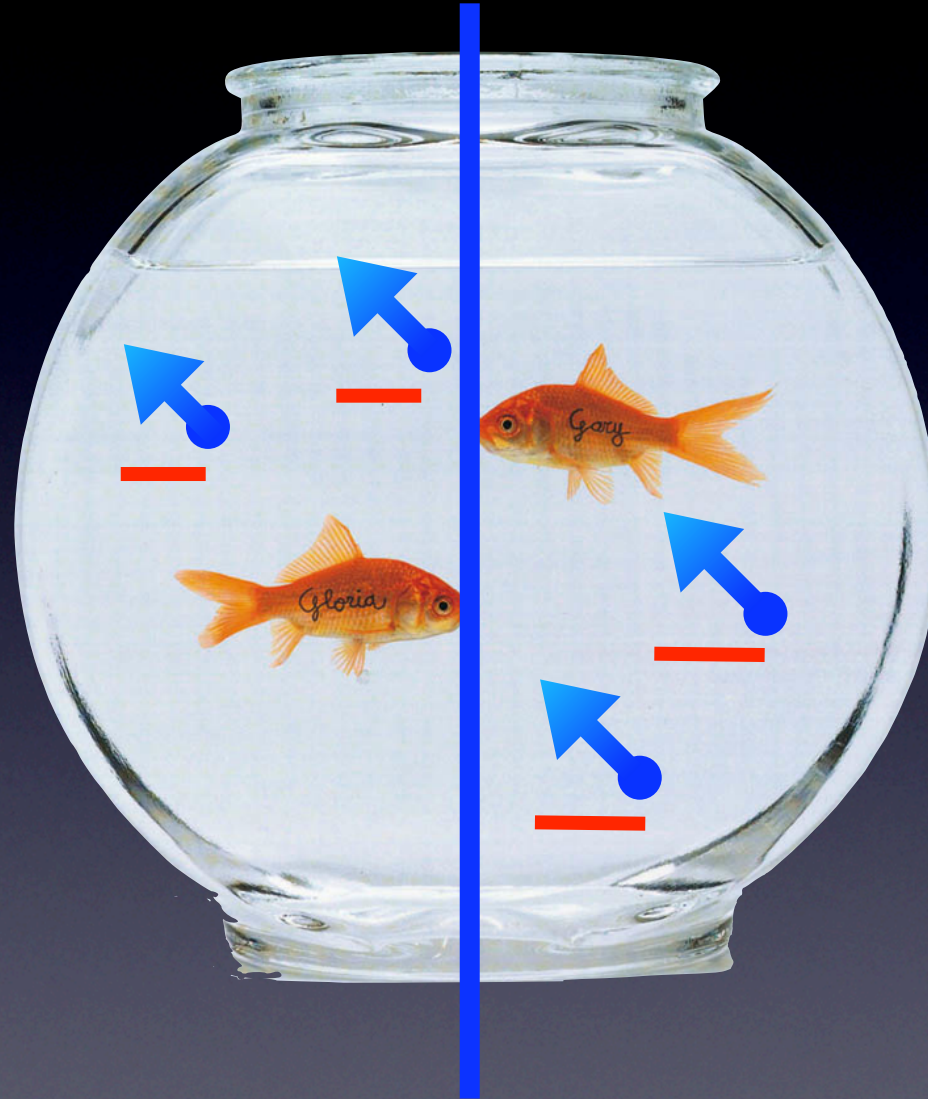
add up the red lines

two voxels (left and right)



take one measurement (sum)

two voxels (left and right)

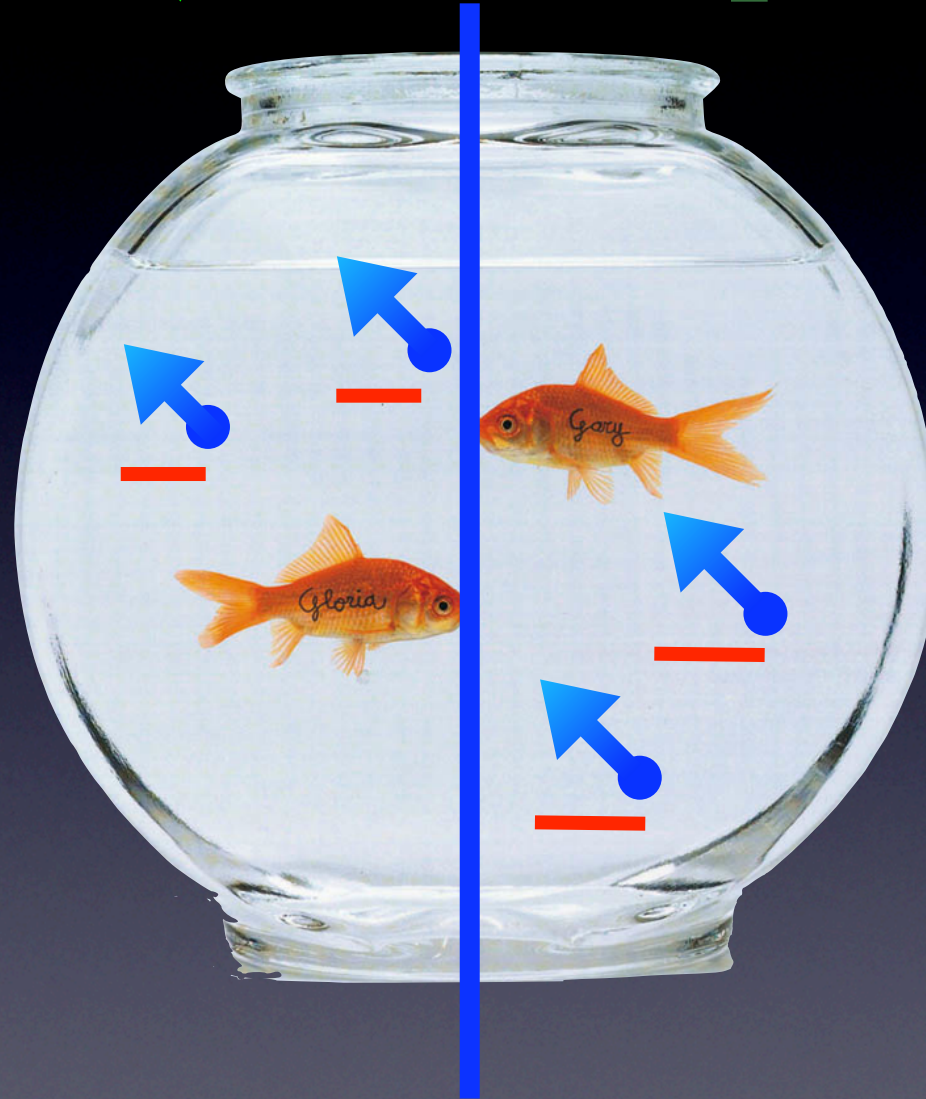


apply a different magnetic field to each half

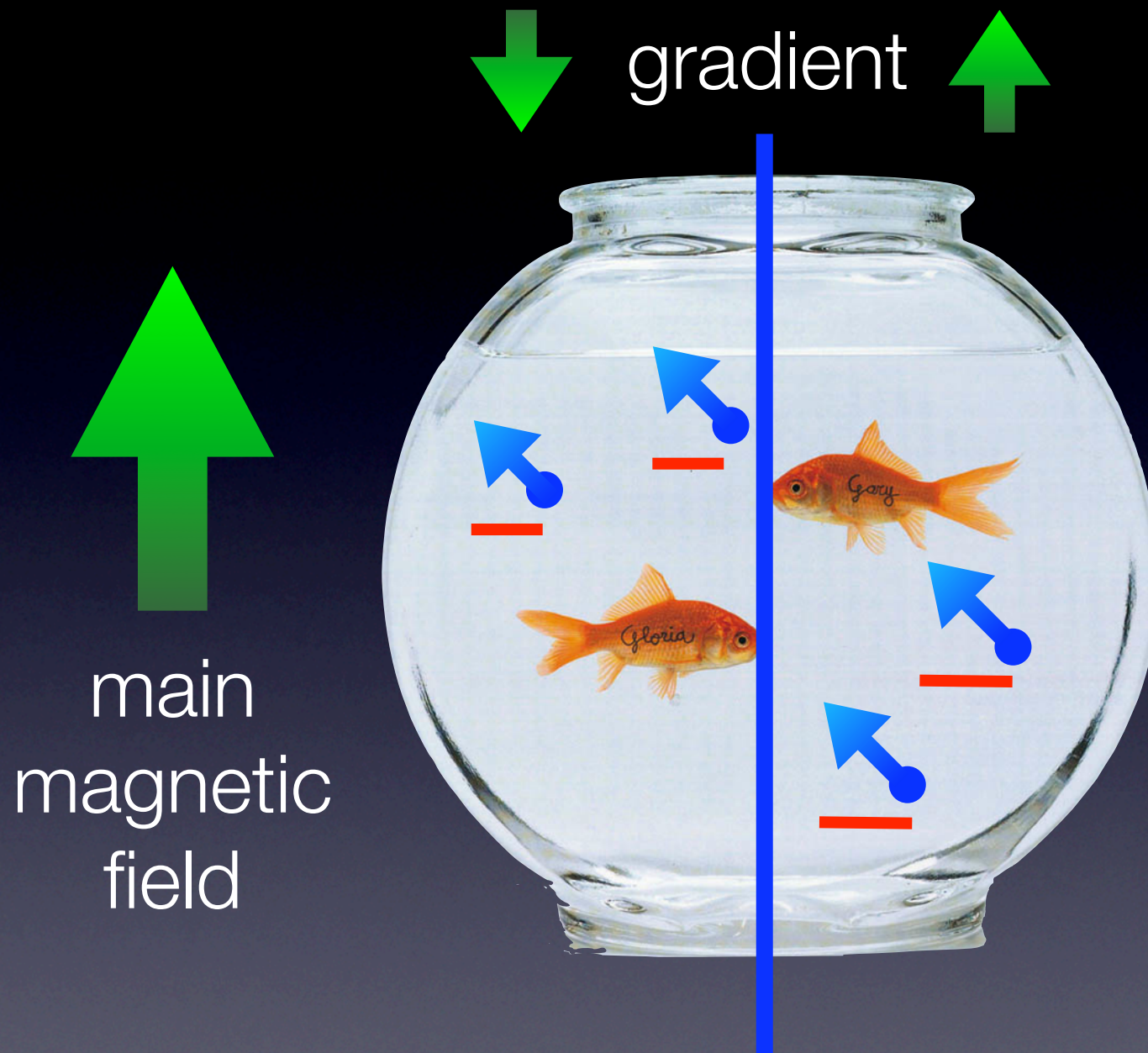
gradient



main
magnetic
field



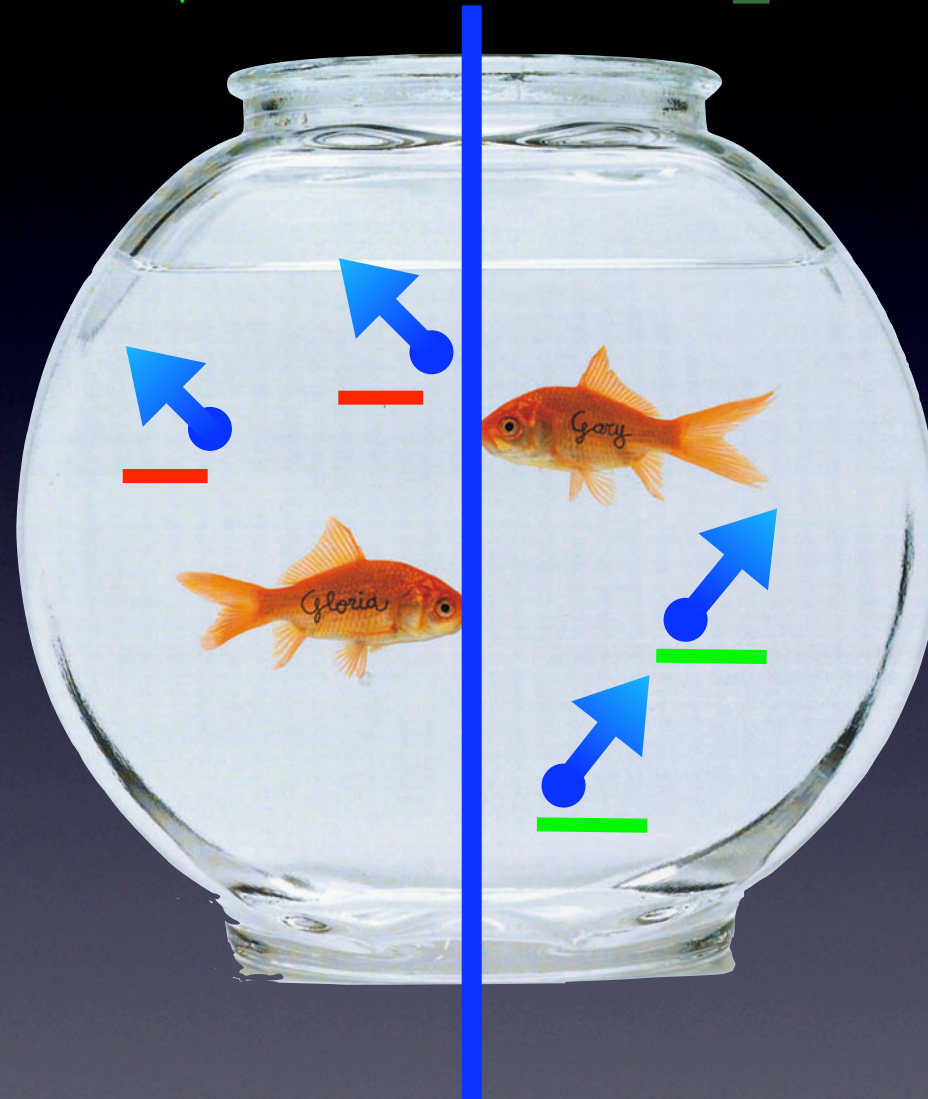
apply a different magnetic field to each half



rate of precession is different in each voxel

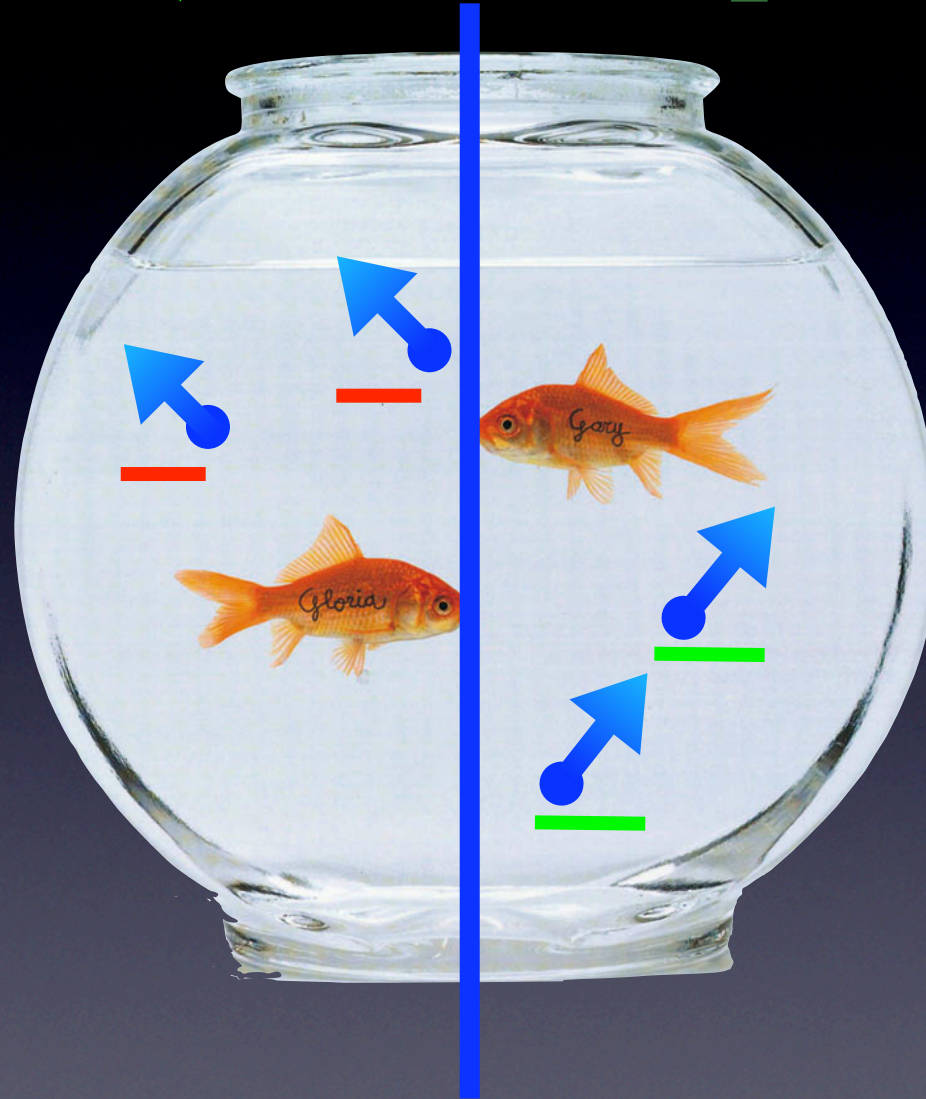


main
magnetic
field



the voxels
are out of
phase

rate of precession is different in each voxel



the voxels
are out of
phase

take second measurement (sum)

1st measurement: left + right

2nd measurement: left - right

add them: 2 x left

1st measurement: left + right

2nd measurement: left - right

subtract them: 2 x right

Real sequences sum together fractional amounts from all the voxels.

The fractions are changed using the x-, y-, or z-gradients.

The voxels are “unmixed” from all the measurements using an Inverse Fourier Transform.

A Pulse Sequence

1. “Prepare” (invert, flip)

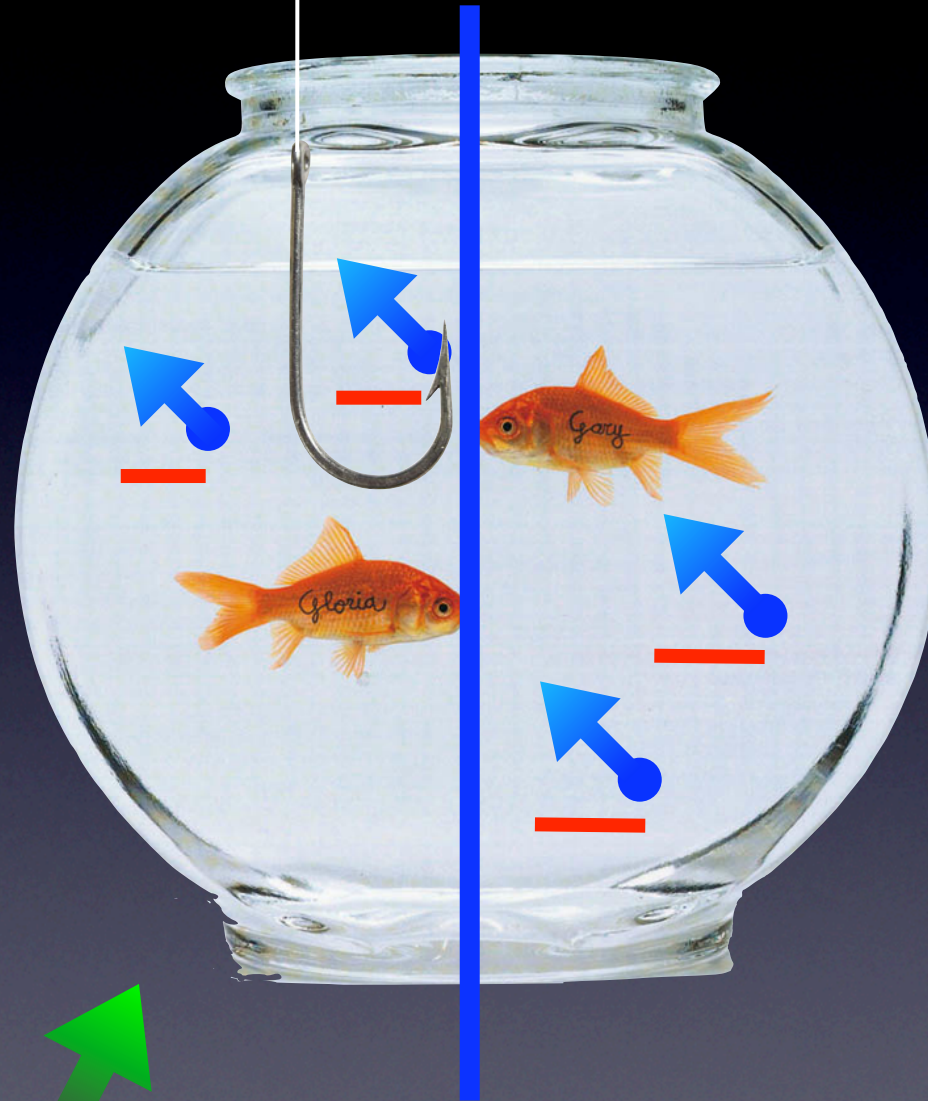
2. Localize (Gradients)

3. Measure repeat

4. Relax

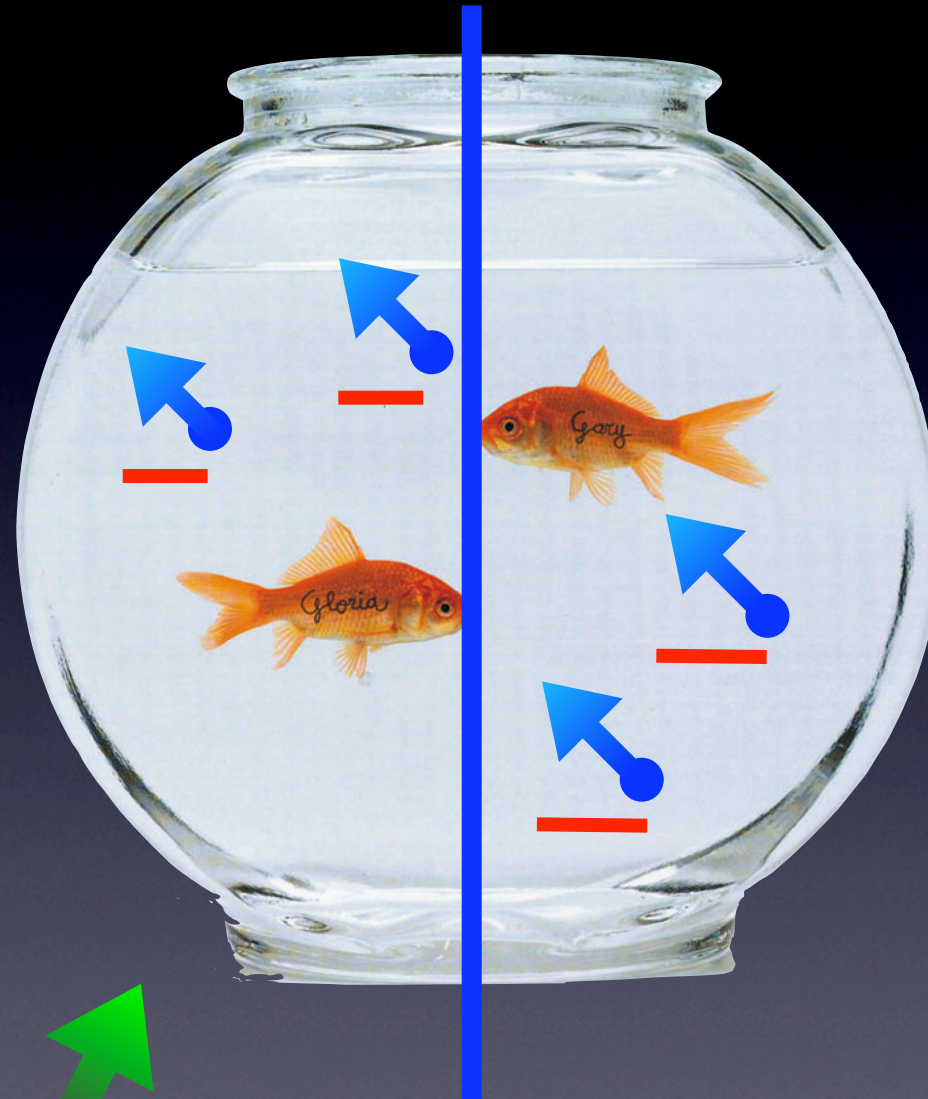
5. Go back to 1.

fMRI (BOLD)



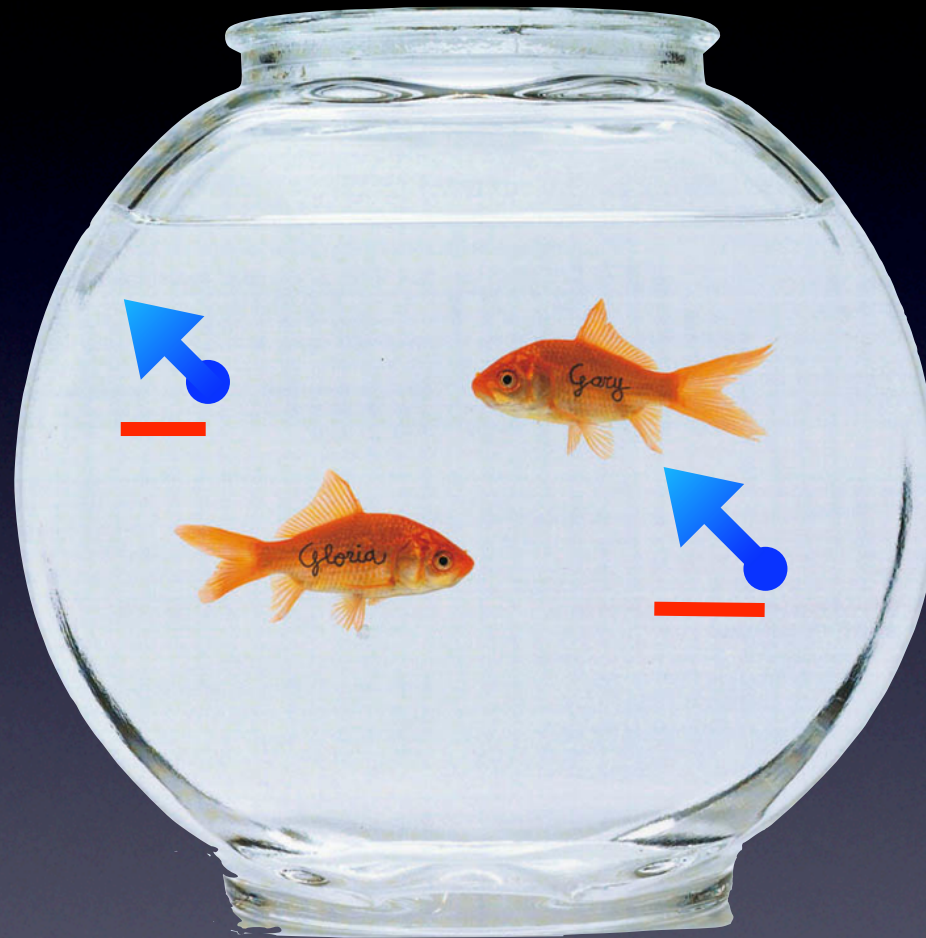
this side dephases faster = less signal

fMRI (BOLD)



this side's T2 returns to normal

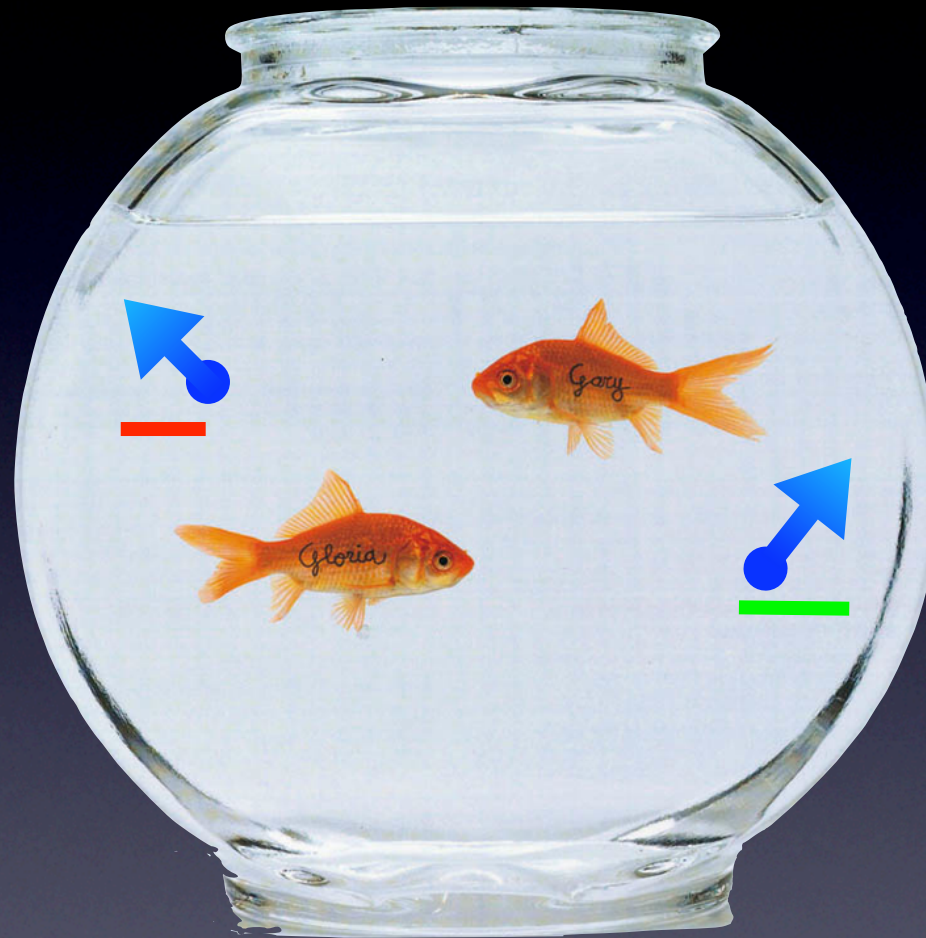
Diffusion



gradient



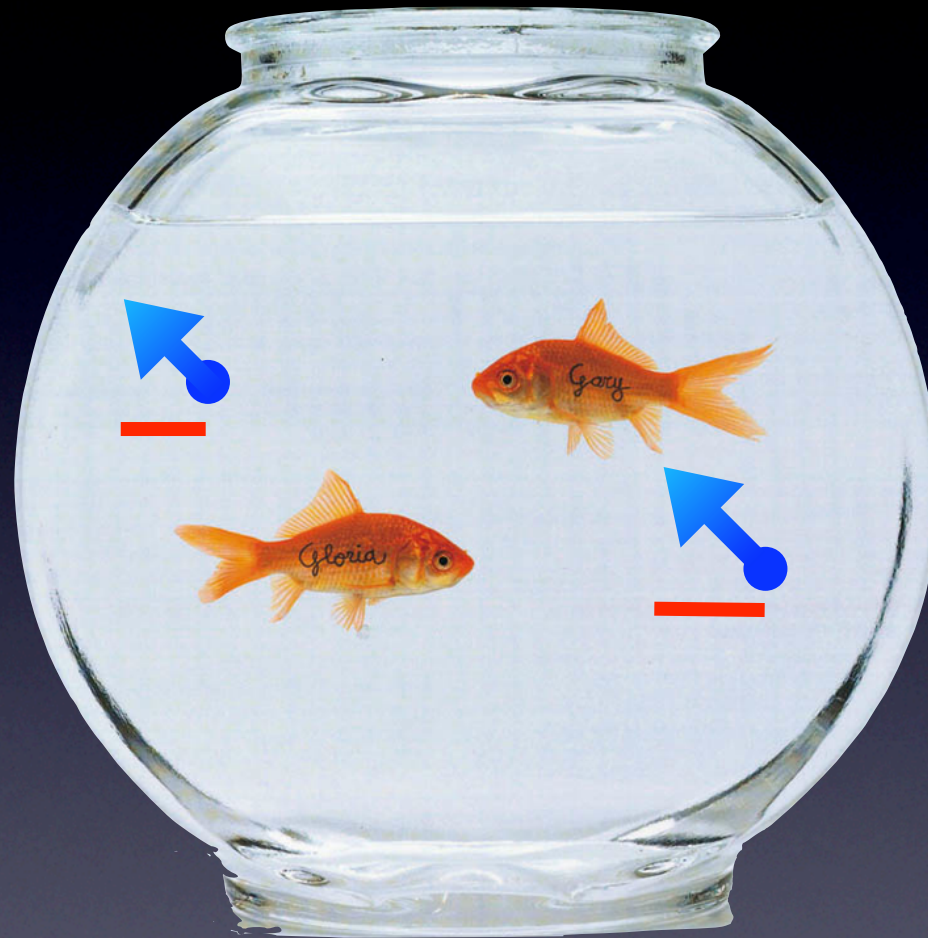
Diffusion



gradient



Diffusion



gradient



Diffusion imaging uses gradients to cancel out signal in water that moves in one direction.

Repeating the experiment, each time using gradient in a different direction, creates a map of how freely water diffuses in each voxel.

questions?

