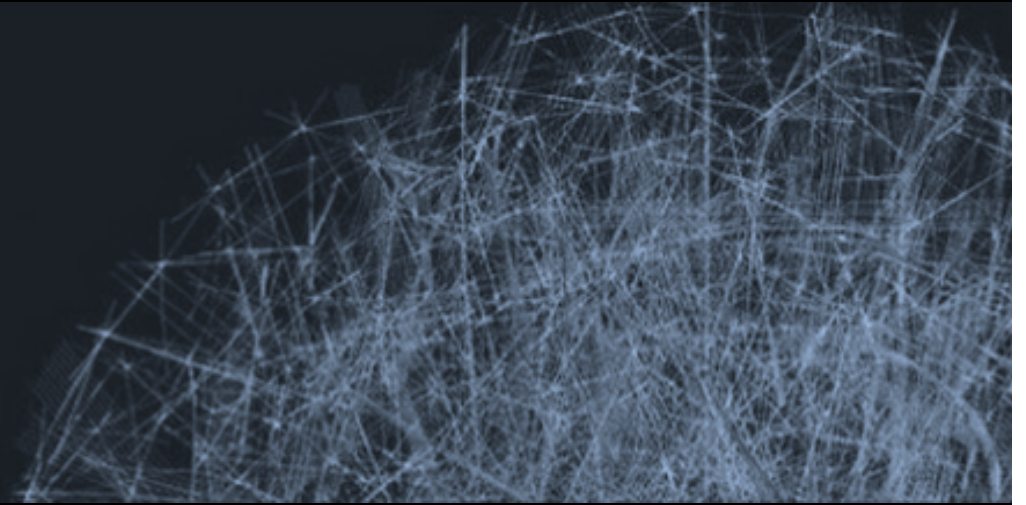


# NeuroMat



## Functional Magnetic Resonance Imaging and Diffusion Tensor Imaging

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*Laboratório de Neurobiologia II*

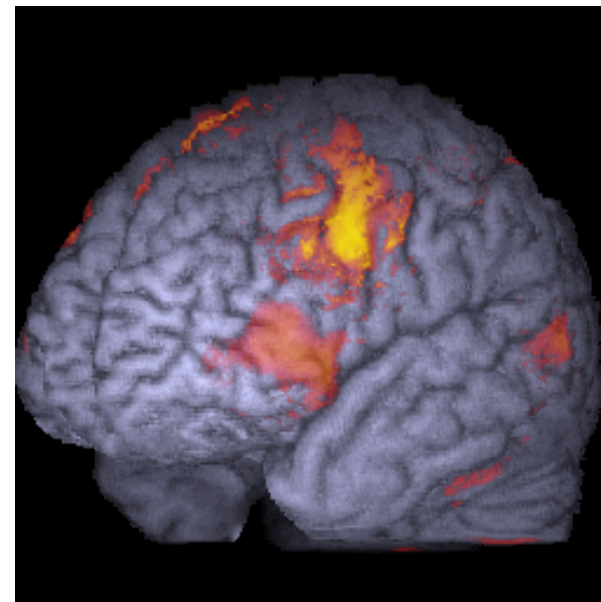
*Núcleo de Pesquisa em Neurociências e Reabilitação*

*Laboratório Integrado de Pesquisa em Estresse*

*Universidade Federal do Rio de Janeiro*

# What is Functional Magnetic Ressonance Imaging?

- *Functional Magnetic Ressonance Imging* - Technic for the study of the **activity** of the brain. It detects changes in blood oxygen level due to changes in the activity of neurons.



# Magnetic field

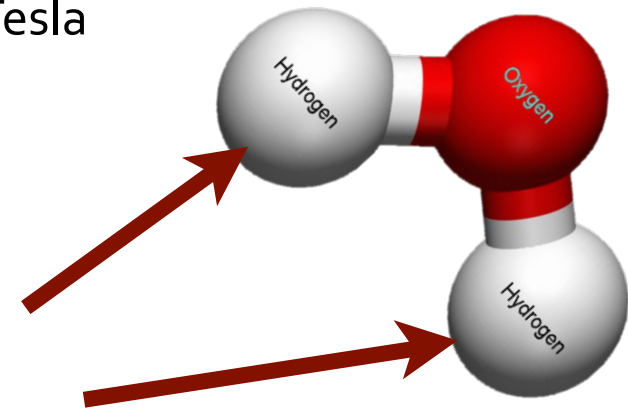


1 Tesla = 20.000 X earth's magnetic field

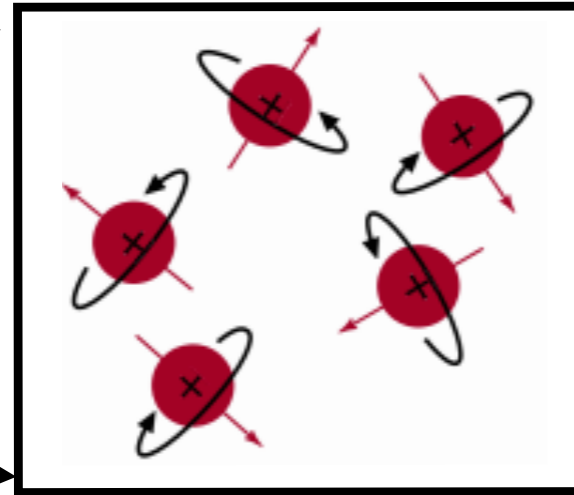
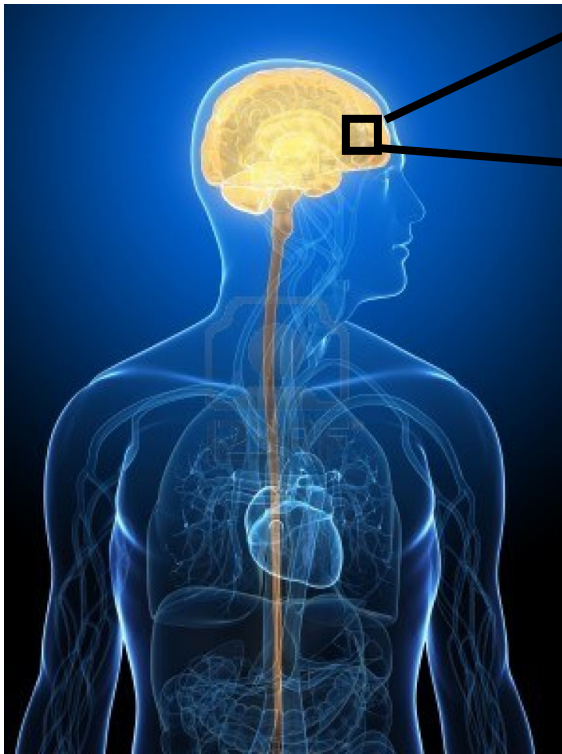


$B_0$

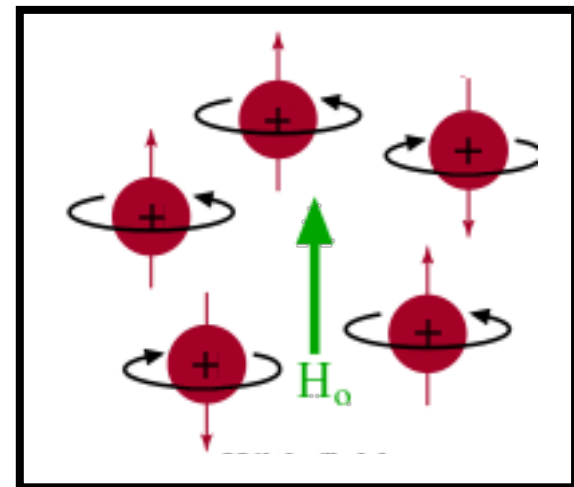
1.5 - 7 Tesla



# H<sup>+</sup> spins alignment with the magnetic field



*Inside the scanner*



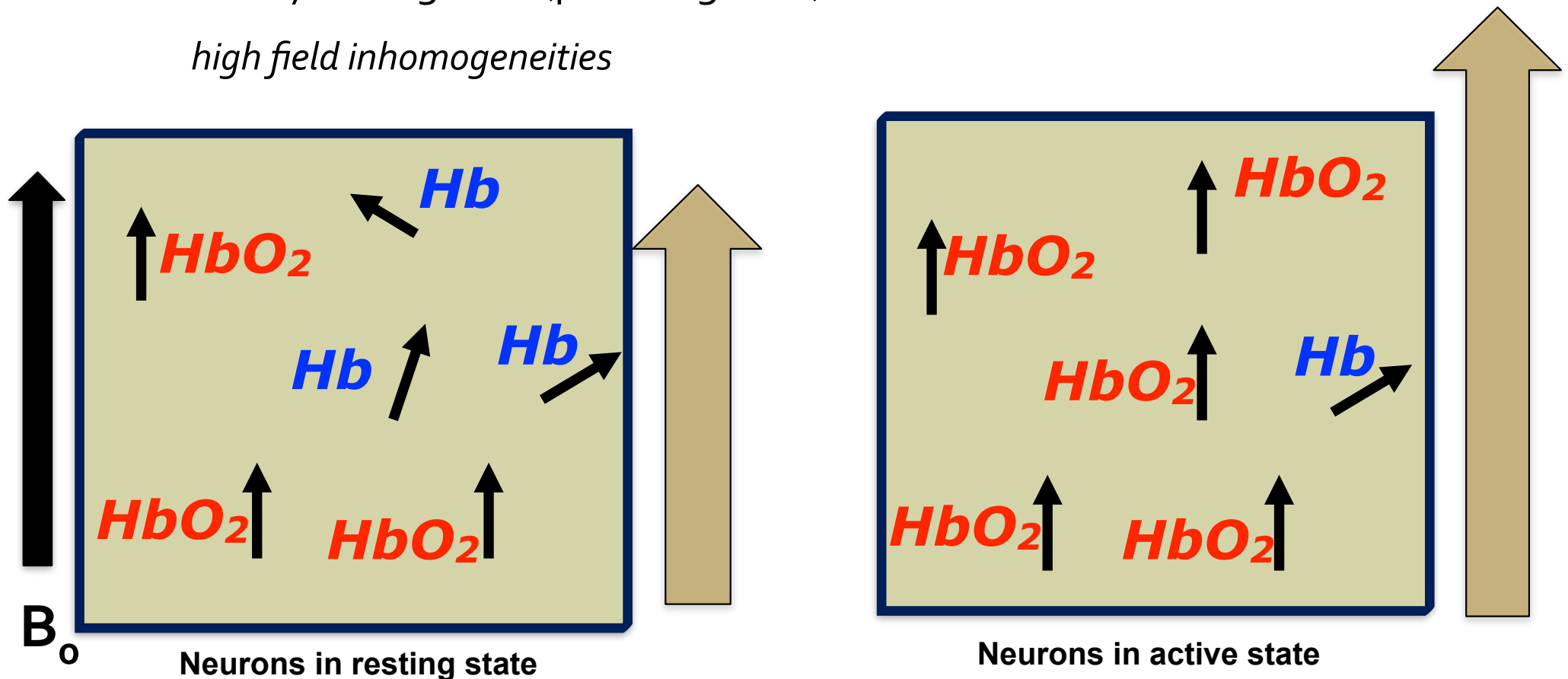
# BOLD signal increases with neuron activity

**HbO<sub>2</sub>** Oxyhemoglobin (diamagnetic)

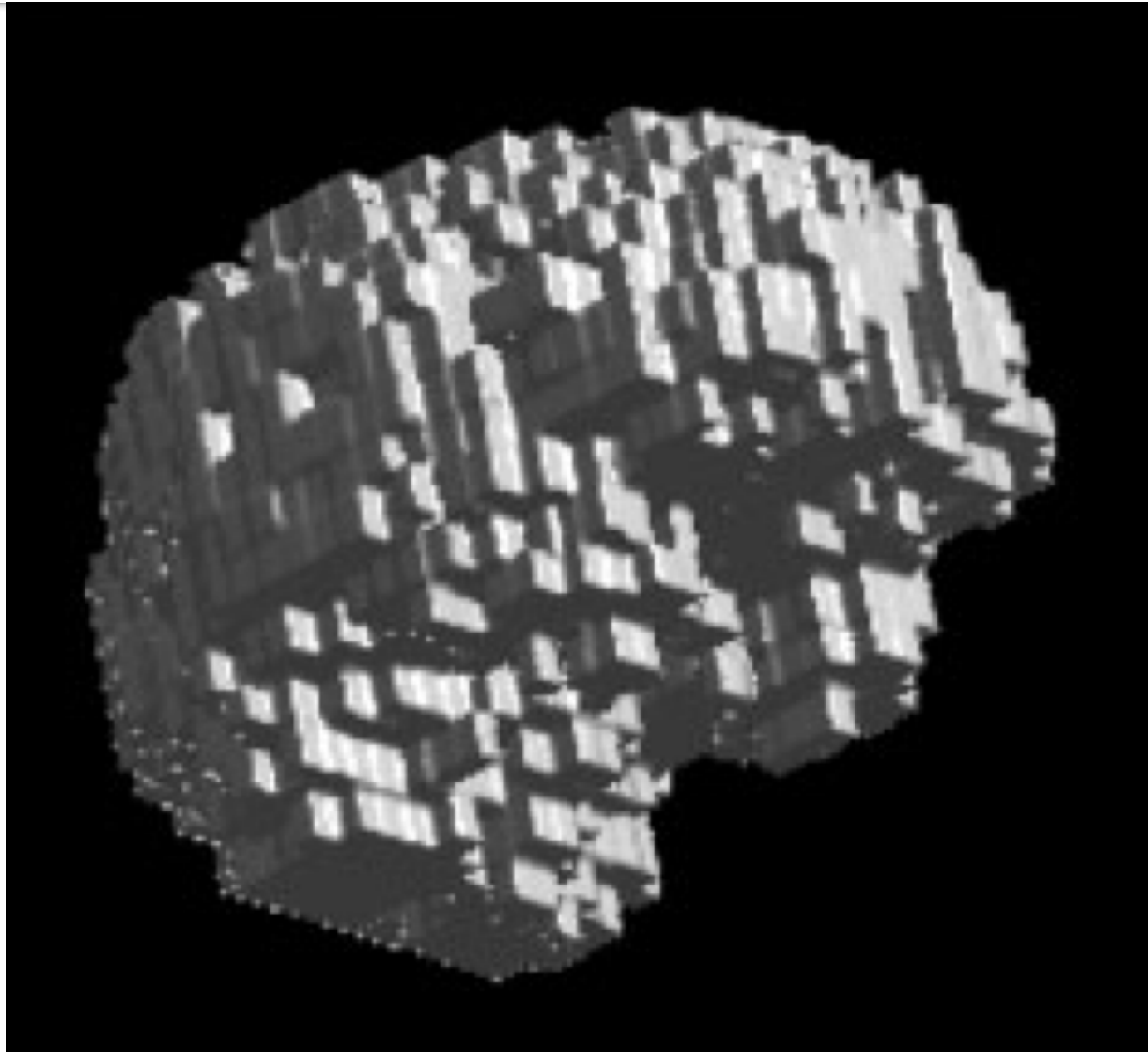
*low field inhomogeneities*

**Hb** Deoxyhemoglobin (paramagnetic)

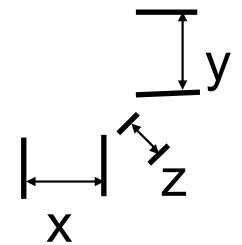
*high field inhomogeneities*



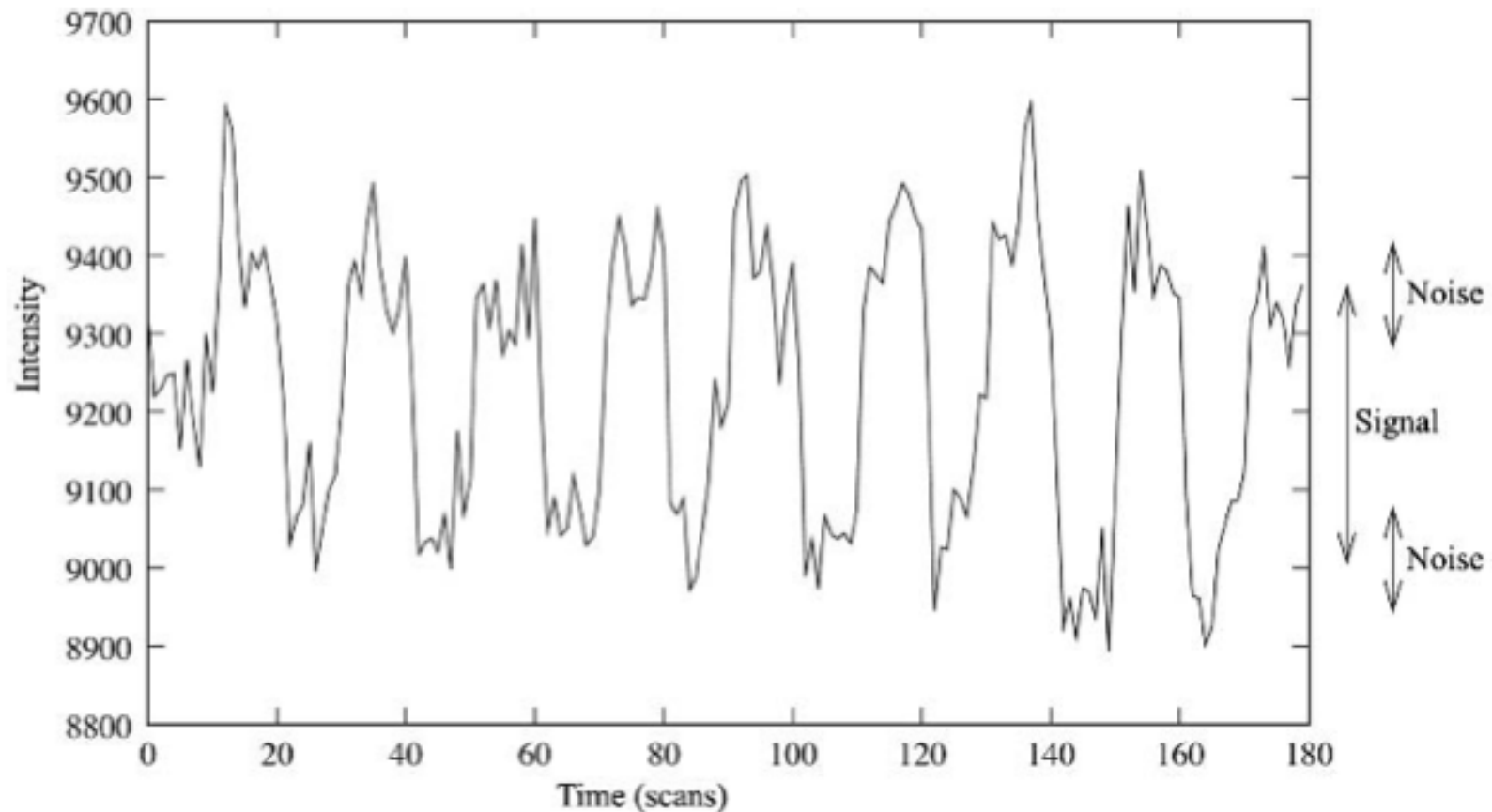
# What is a voxel?



voxel



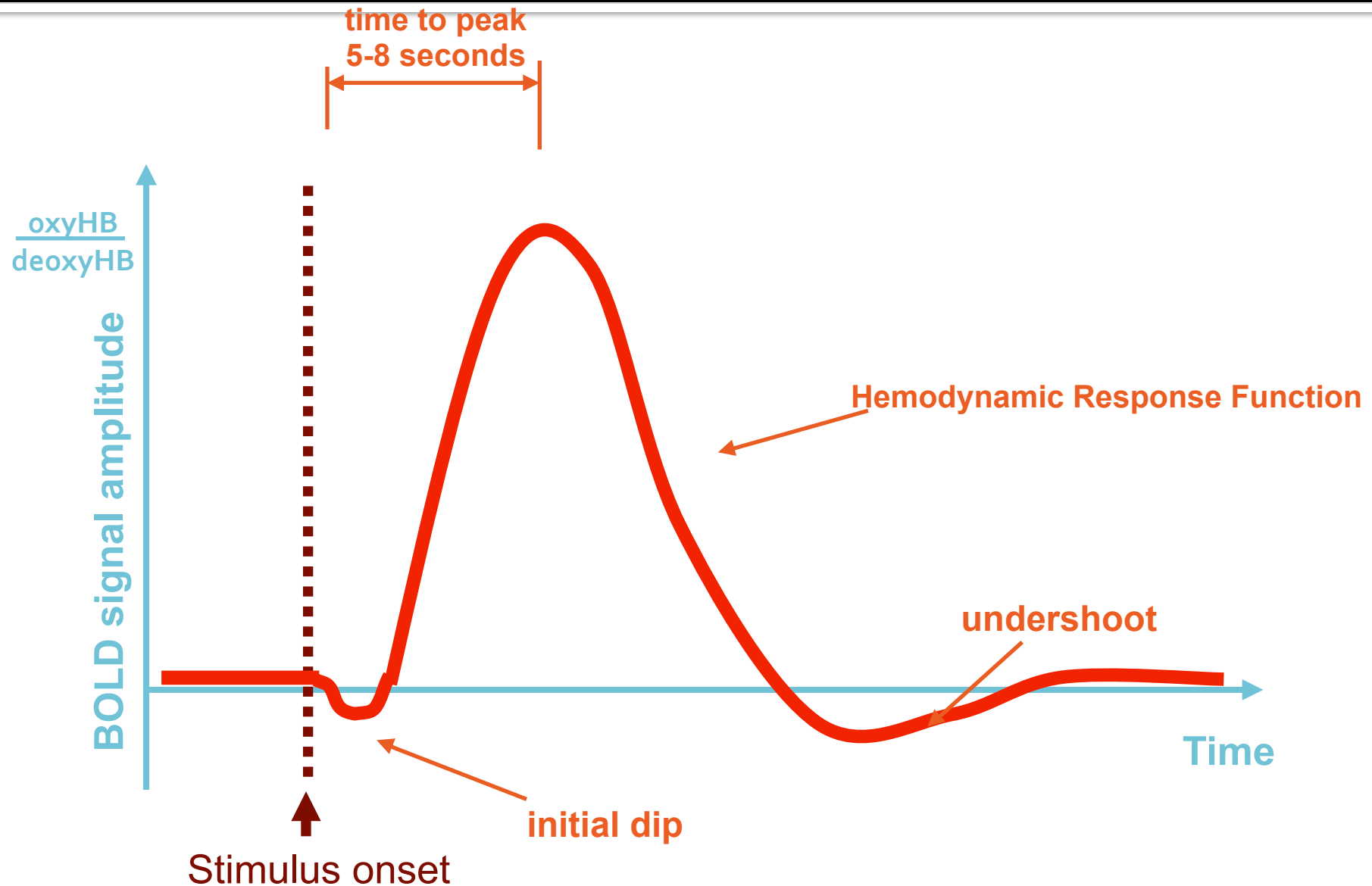
# Signal to noise ratio



- Magnitude of signal change: 0.5 – 3% at 1.5T

# Temporal resolution

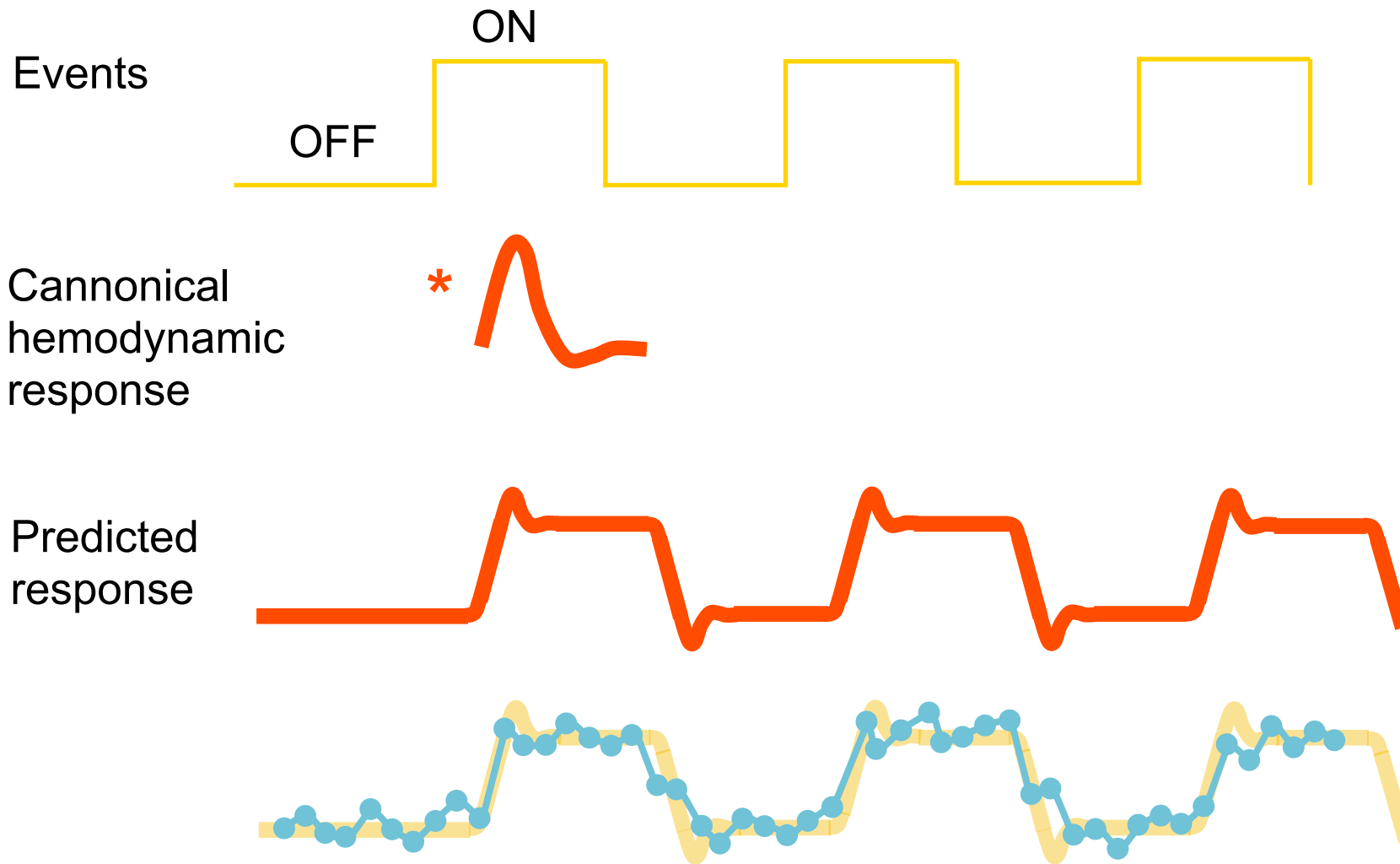
# Temporal resolution



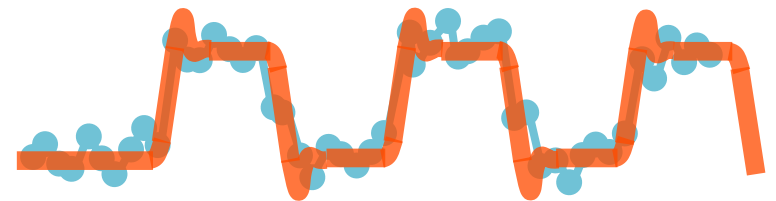
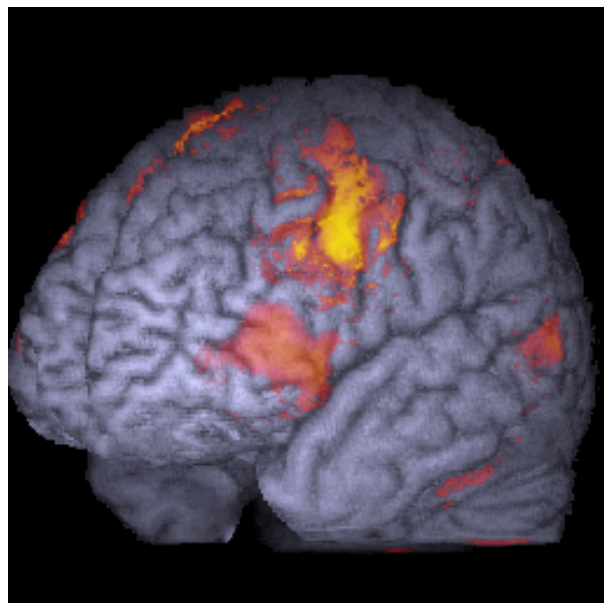
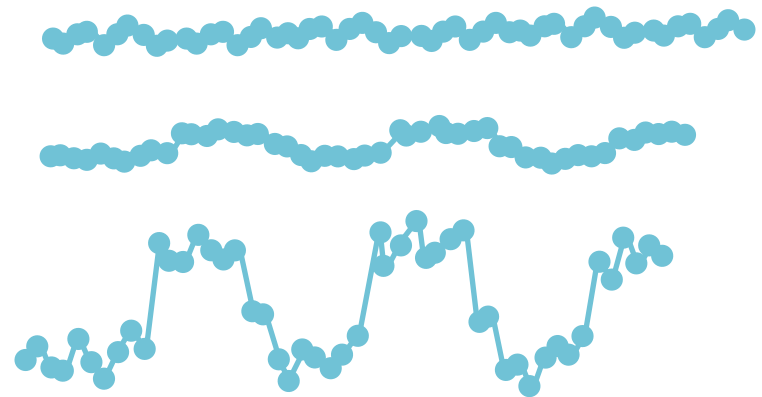
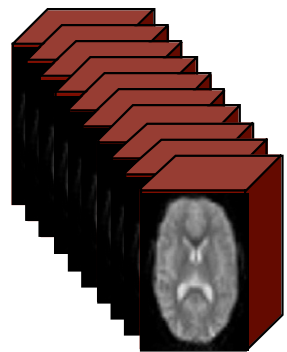
# Spatial resolution

- 2-3 mm - voxel size
- Higher spatial resolution - decrease signal strength
- Higher magnetic field - higher spatial resolution - better signal to noise ratio

# Data Analysis



# Data Analysis



# Data analysis - *General Linear Model*

$$\text{observed value on dependent variable} = \text{effect of } \underline{\text{constant}} \text{ factors} + \text{sum of effects of } \underline{\text{allowed-for}} \text{ factors} + \text{randomly varying } \underline{\text{other}} \text{ factors}$$

$$Y_i = \beta_0 X_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \dots \beta_p X_p + \varepsilon_i$$

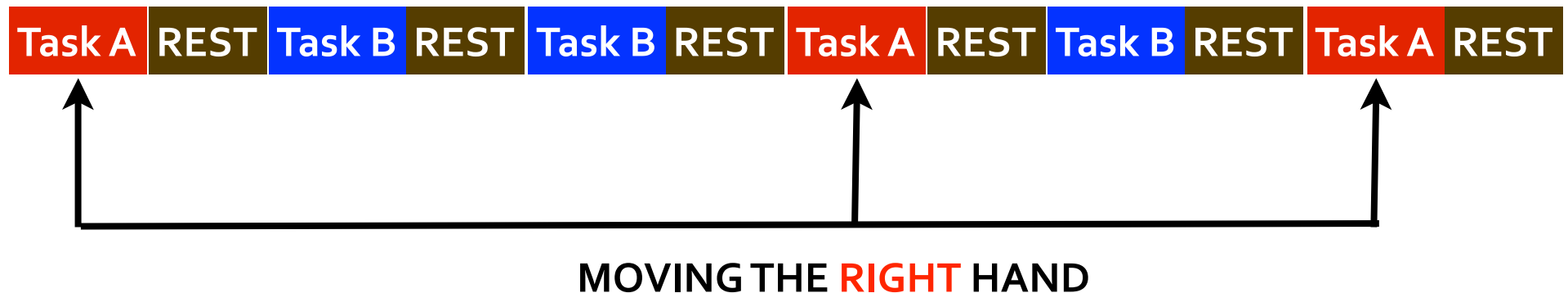
$X_0$  is usually 1

$\beta_0$  is usually the mean

$\mathcal{E}$  is the error (residual): unexplained variation

# Experimental design

- Blocked design



Task duration: 16 s - 1 minute

# Experimental design

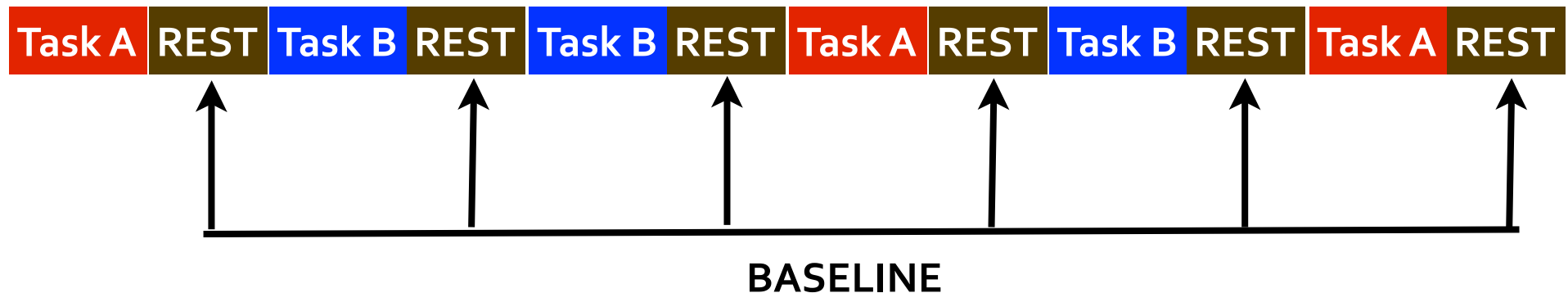
- Blocked design



Task duration: 16 s - 1 minute

# Experimental design

- Blocked design



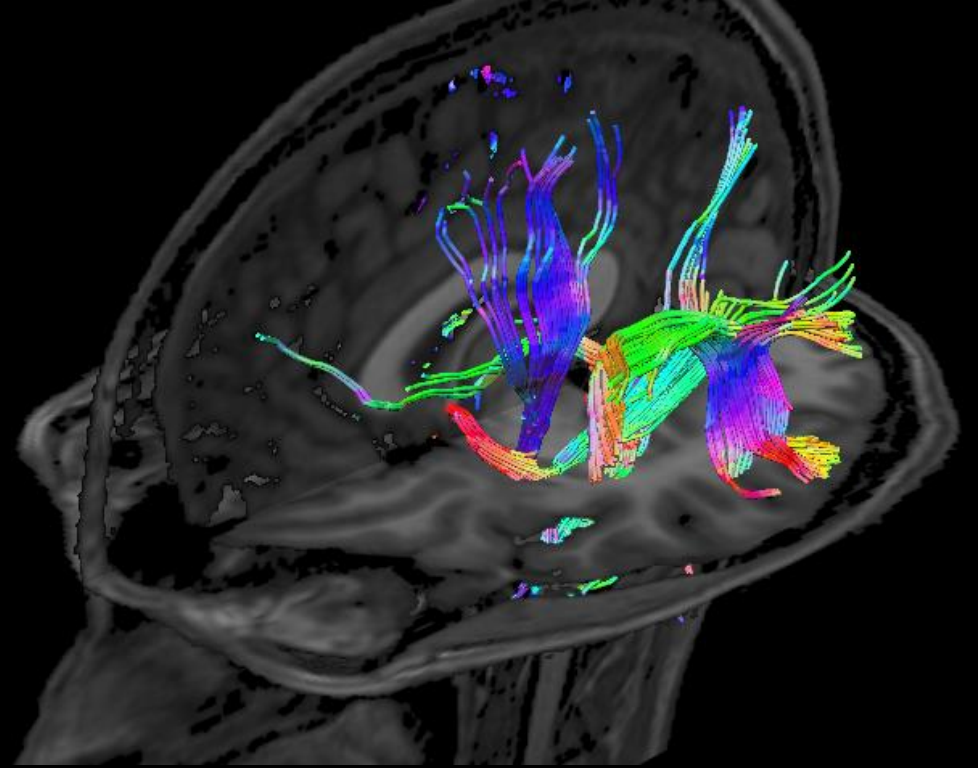
Task duration: 16 s - 1 minute

# Experimental design

- Blocked design
- Event-related design
  - Slow event-related
  - Fast event-related

# Experimental design

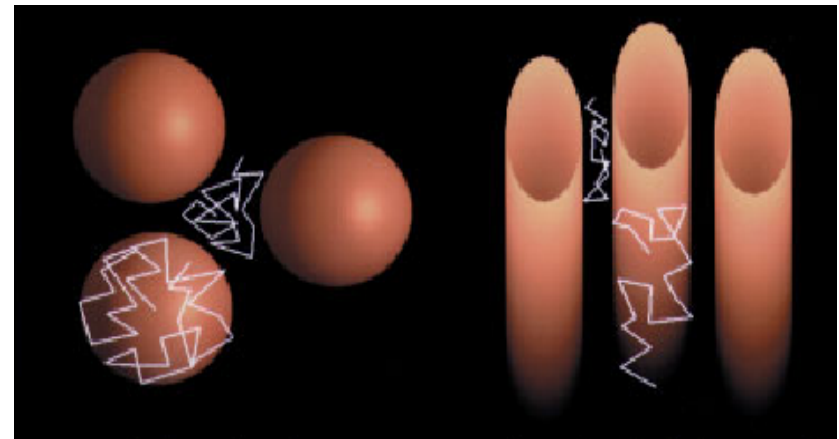
- Blocked design
- Event-related design
  - Slow event-related
  - Fast event-related
- Resting state



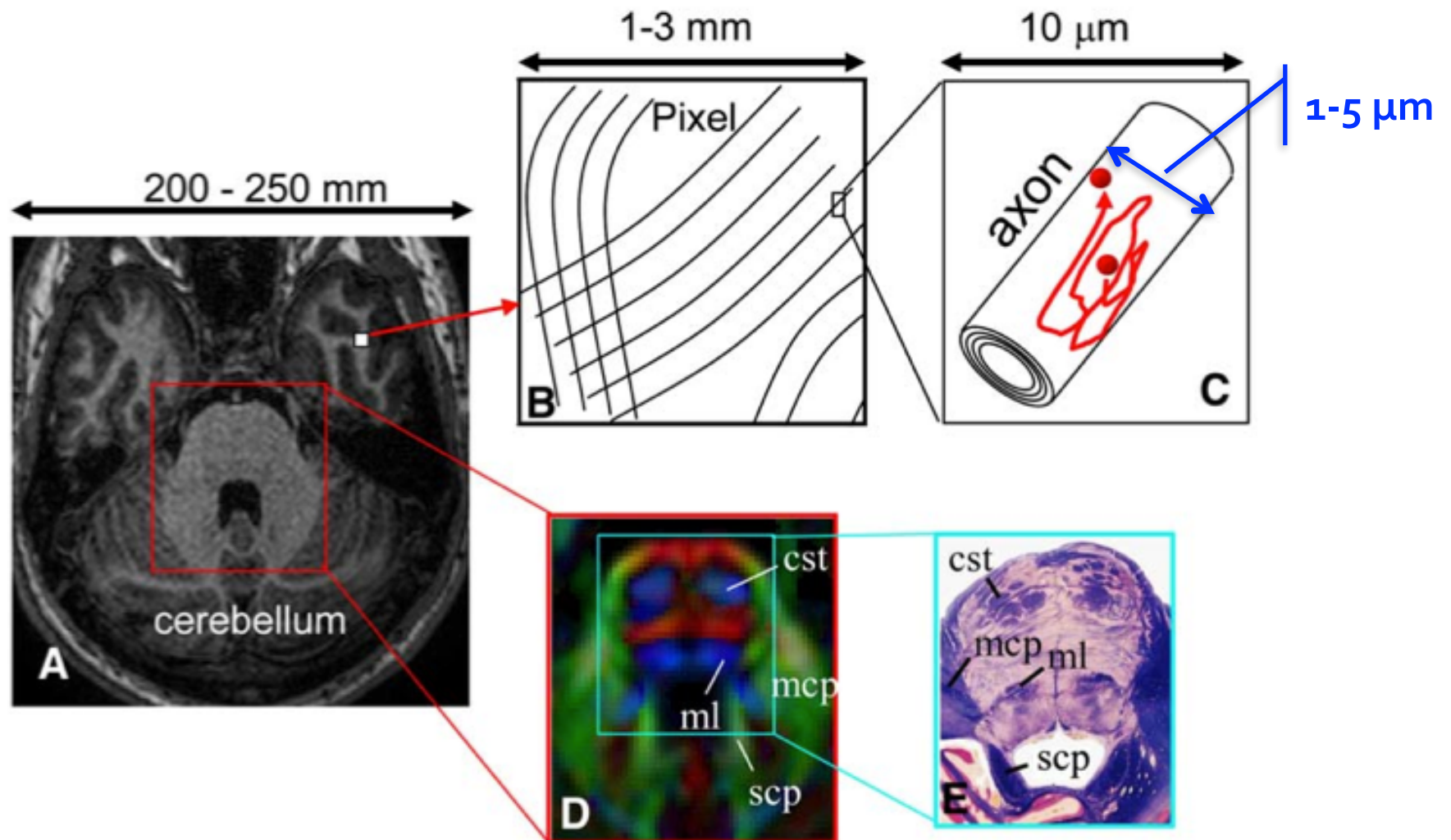
# Diffusion Tensor Imaging

# Diffusion Tensor Imaging

- Uses water molecules motion to infer static neuroanatomy – it is not influenced by physiology.



# Anisotropic movement of water molecules



**Thank you!**