

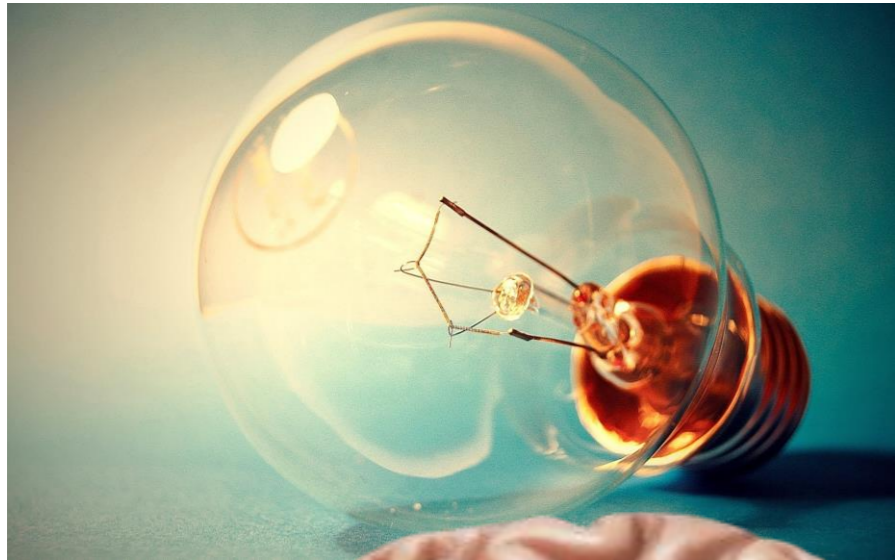
# **Neuroscience beyond neurons**

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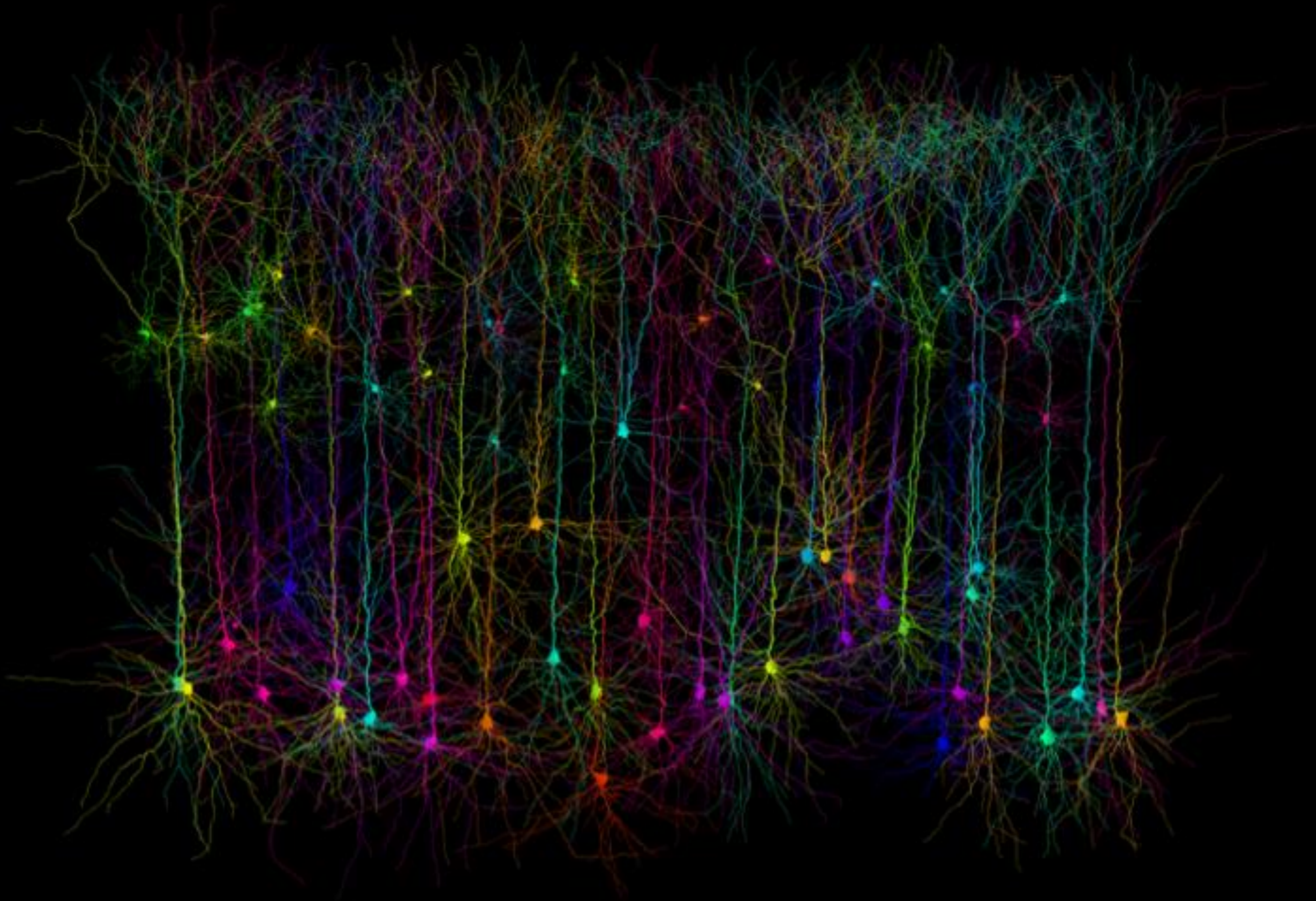
Your brain  
~20 W



iMac  
65 – 240 W

**What's the brain made of?**

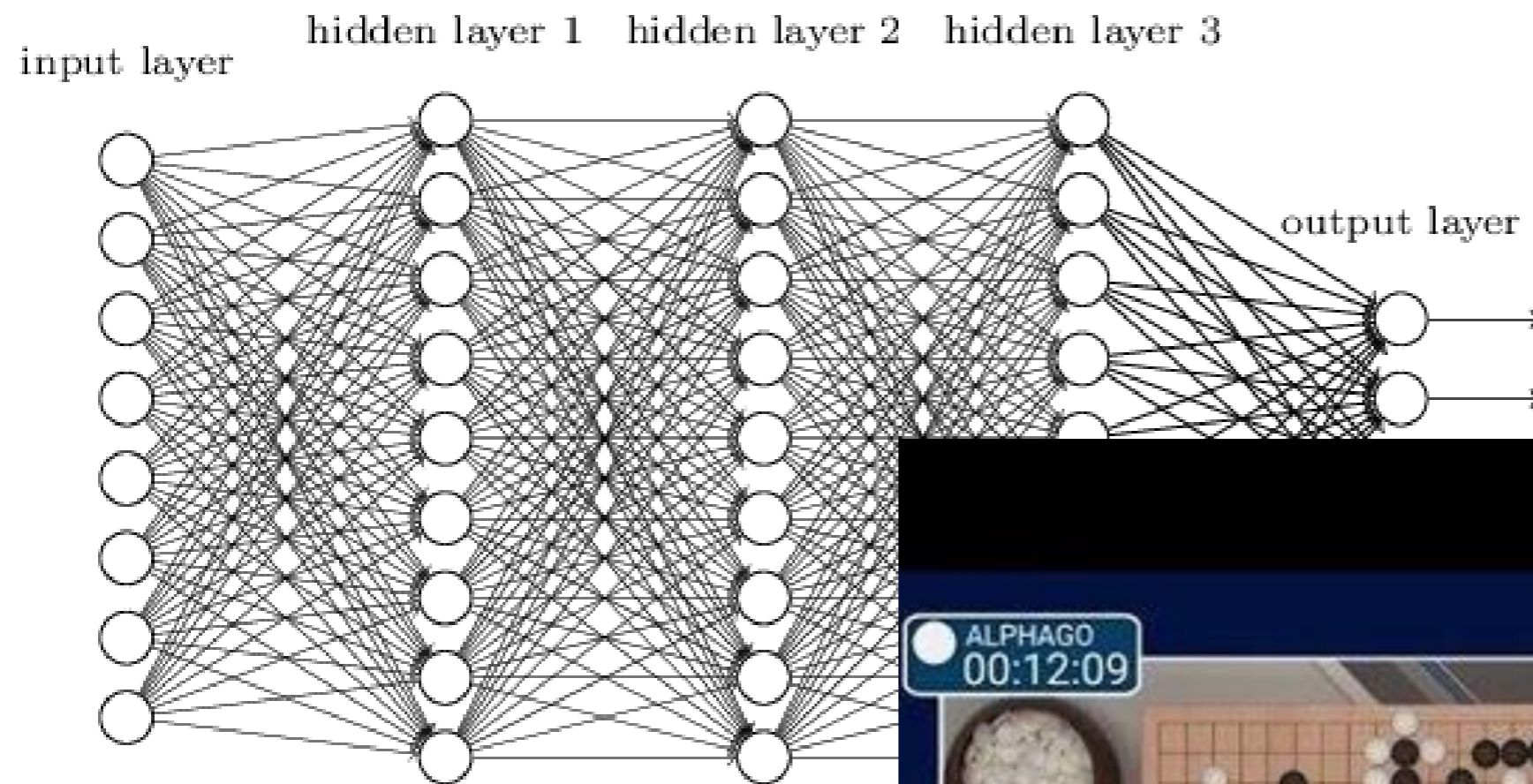




Courtesy of Michael Häusser.



# Artificial neural networks



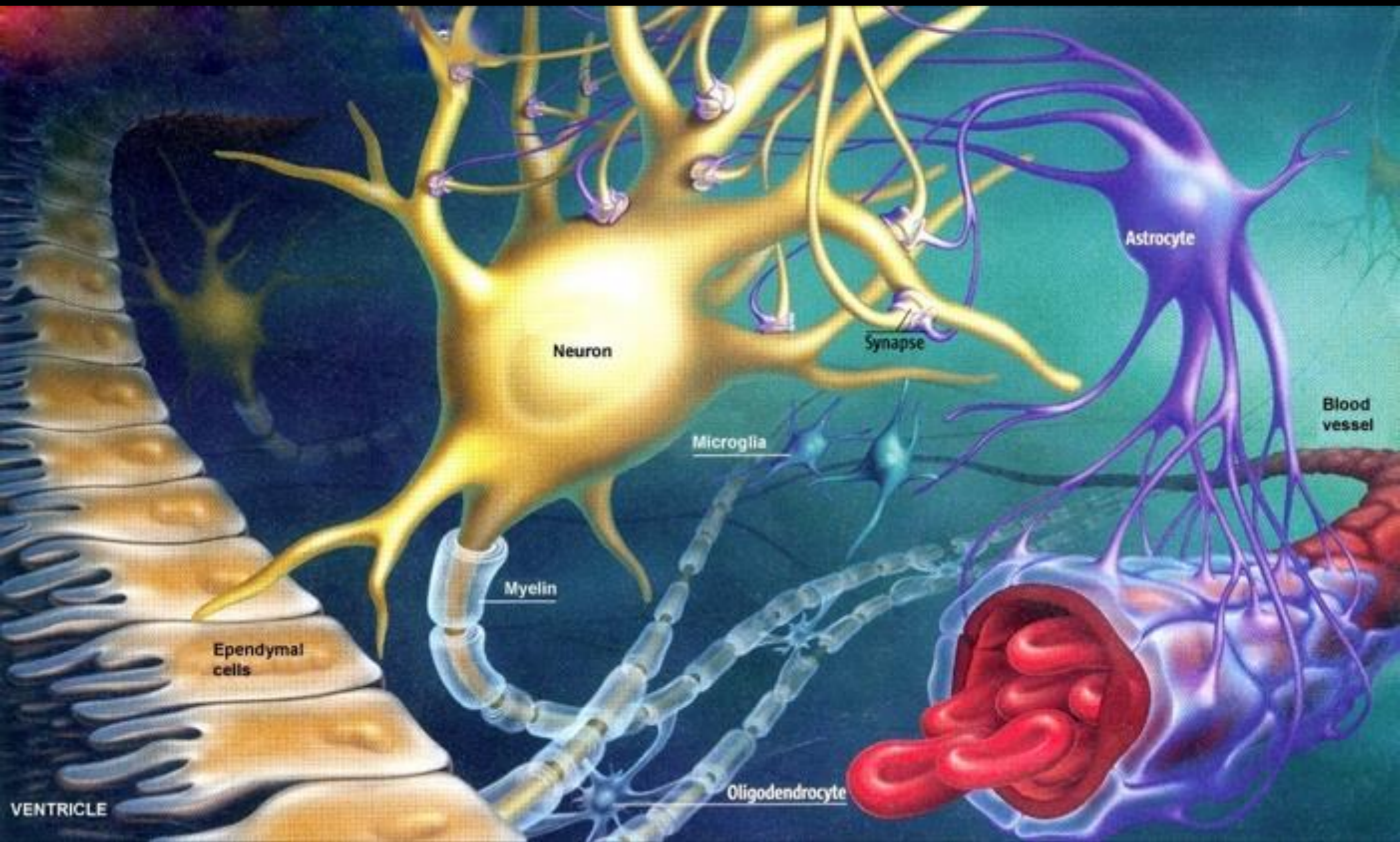


**This view is naive and  
inaccurate!**



**So what's the brain really made of?**





Neuron

Synapse

Astrocyte

Blood vessel

Microglia

Myelin

Ependymal cells

Oligodendrocyte

VENTRICLE



**Whole brain**

1508.91 ± 299.14 g  
170.68 ± 13.86 B cells

86.06 ± 8.12 B neurons  
84.61 ± 9.83 B non-neur  
0.99 non-neur/neurons

**Cerebral cortex (GM+WM)**

1232.93 ± 233.68 g  
77.18 ± 7.72 B cells

16.34 ± 2.17 B neurons  
60.84 ± 7.02 B non-neur  
3.76 non-neur/neurons

81.8% of brain mass  
19.0% of brain neurons

7.8% of brain mass

0.8% of brain neurons

10.3% of brain mass

80.2% of brain neurons

**Cerebellum**

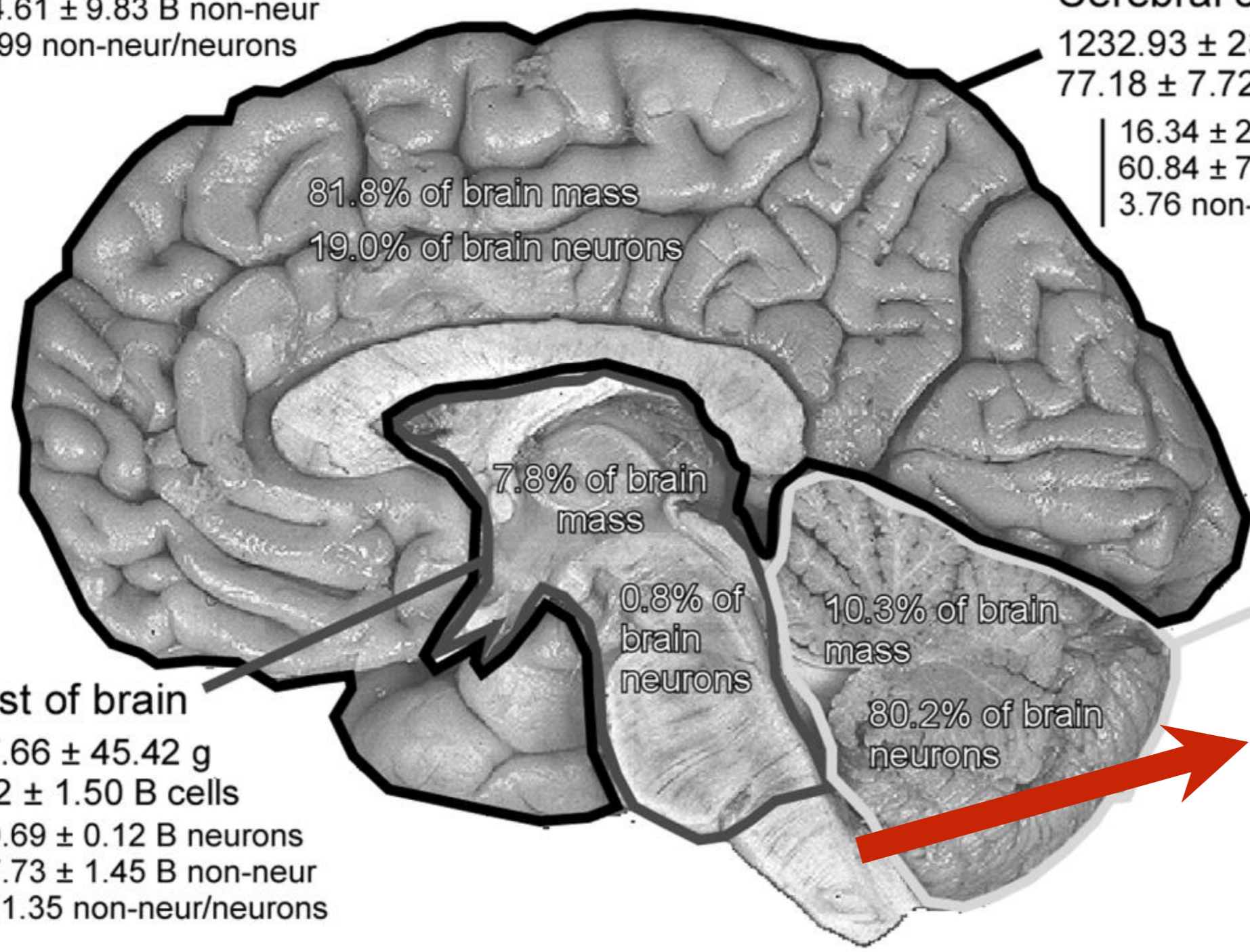
154.02 ± 19.29 g  
85.08 ± 6.92 B cells

69.03 ± 6.65 B neurons  
16.04 ± 2.17 B non-neur  
0.23 non-neur/neurons

**Rest of brain**

117.66 ± 45.42 g  
8.42 ± 1.50 B cells

0.69 ± 0.12 B neurons  
7.73 ± 1.45 B non-neur  
11.35 non-neur/neurons



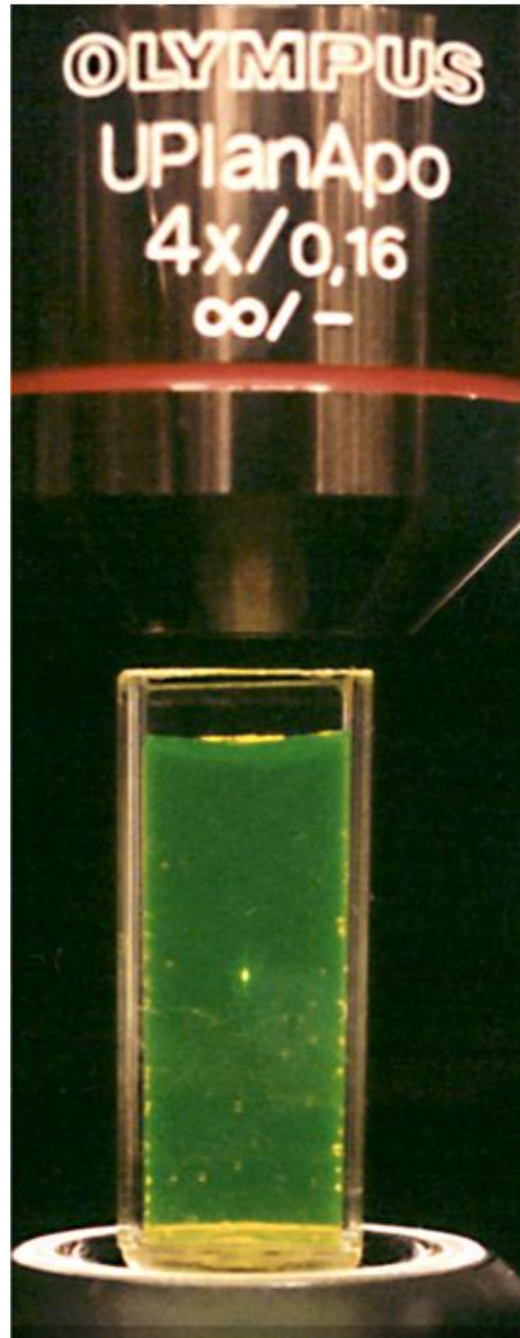


**Do these cells matter?**

**Today we can measure/image activity in almost all types of  
brain cells using two-photon microscopy.**



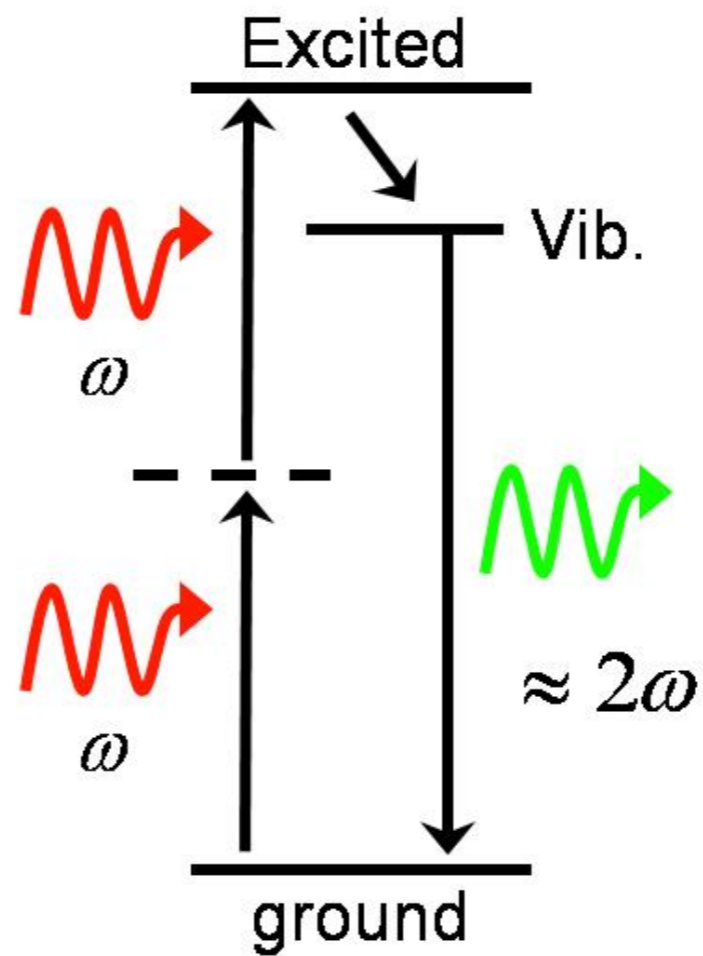
# Two-photon microscopy



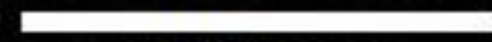
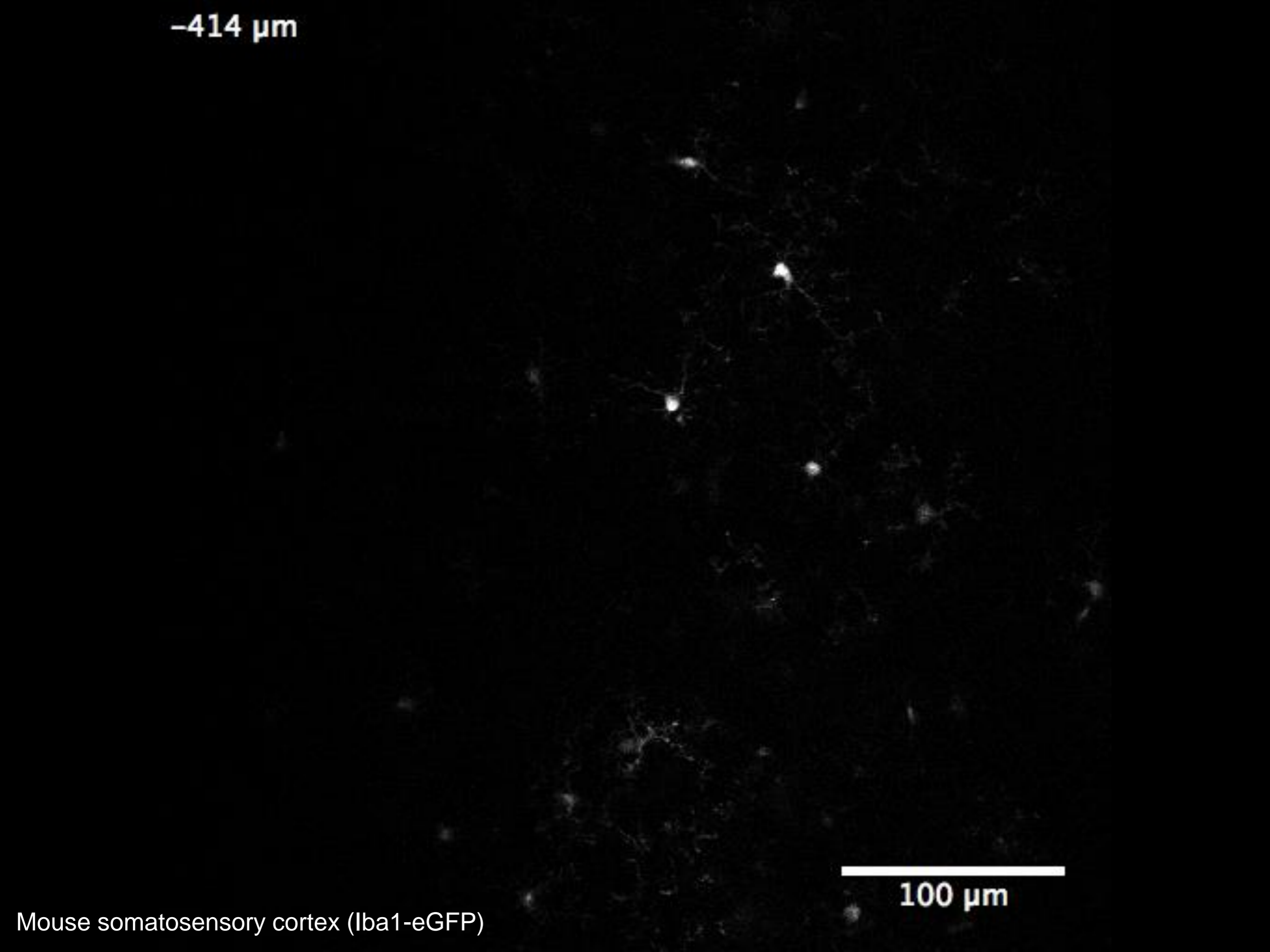
900 nm pulsed excitation

Two-photon  
fluorescence

$$\text{Signal} \propto I^2$$



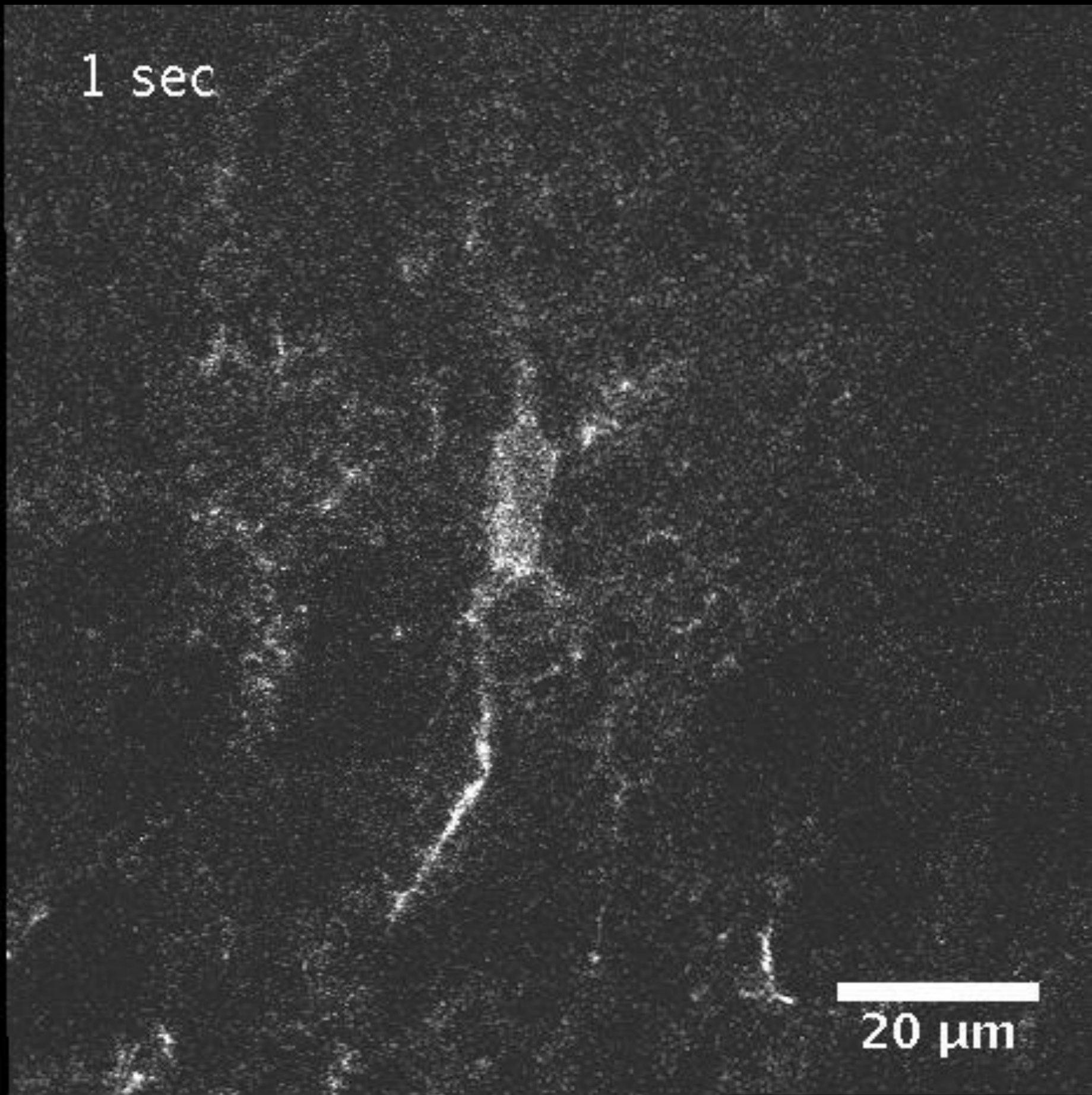
-414  $\mu\text{m}$

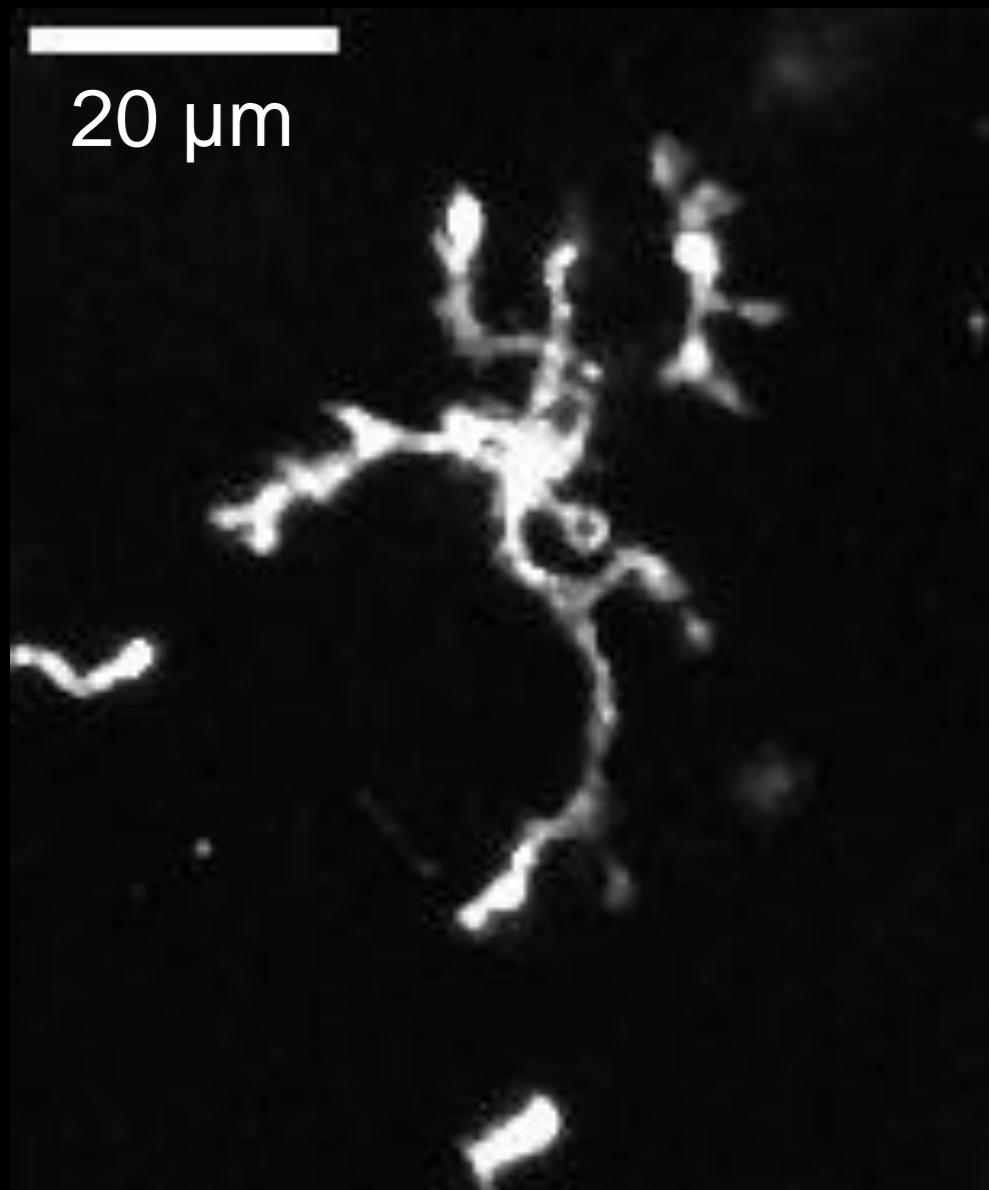


100  $\mu\text{m}$

Mouse somatosensory cortex (Iba1-eGFP)







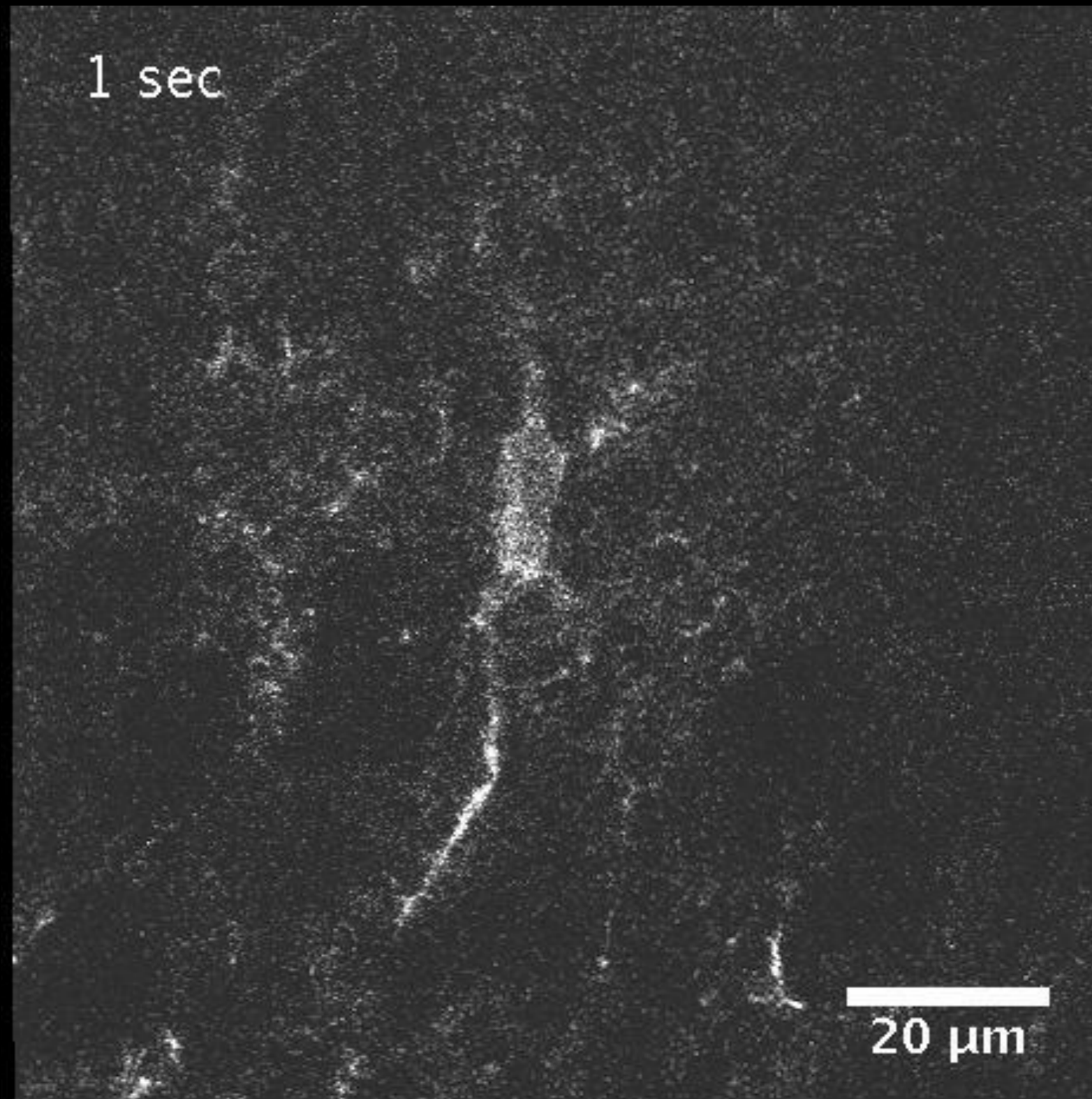
(30 min loop)

**Today we can measure/image *activity* in almost all types of brain cells using two-photon microscopy.**



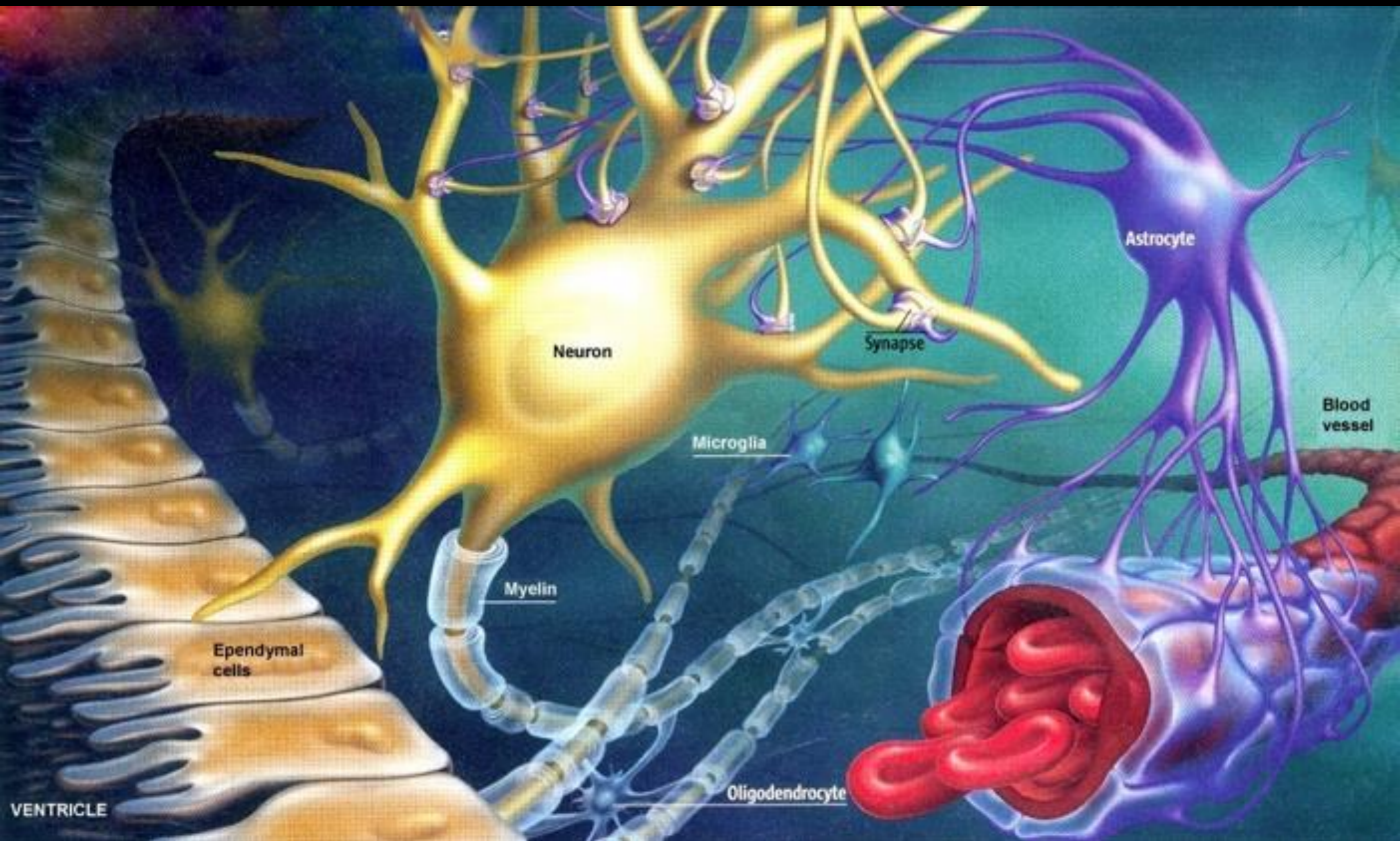
**Challenge #1: Handle vast amounts of imaging data.**

## Challenge #2: Segment and analyse imaging data





# Challenge #3: Develop the framework to address how different cell types interact with each other





**Thank you for your attention!**