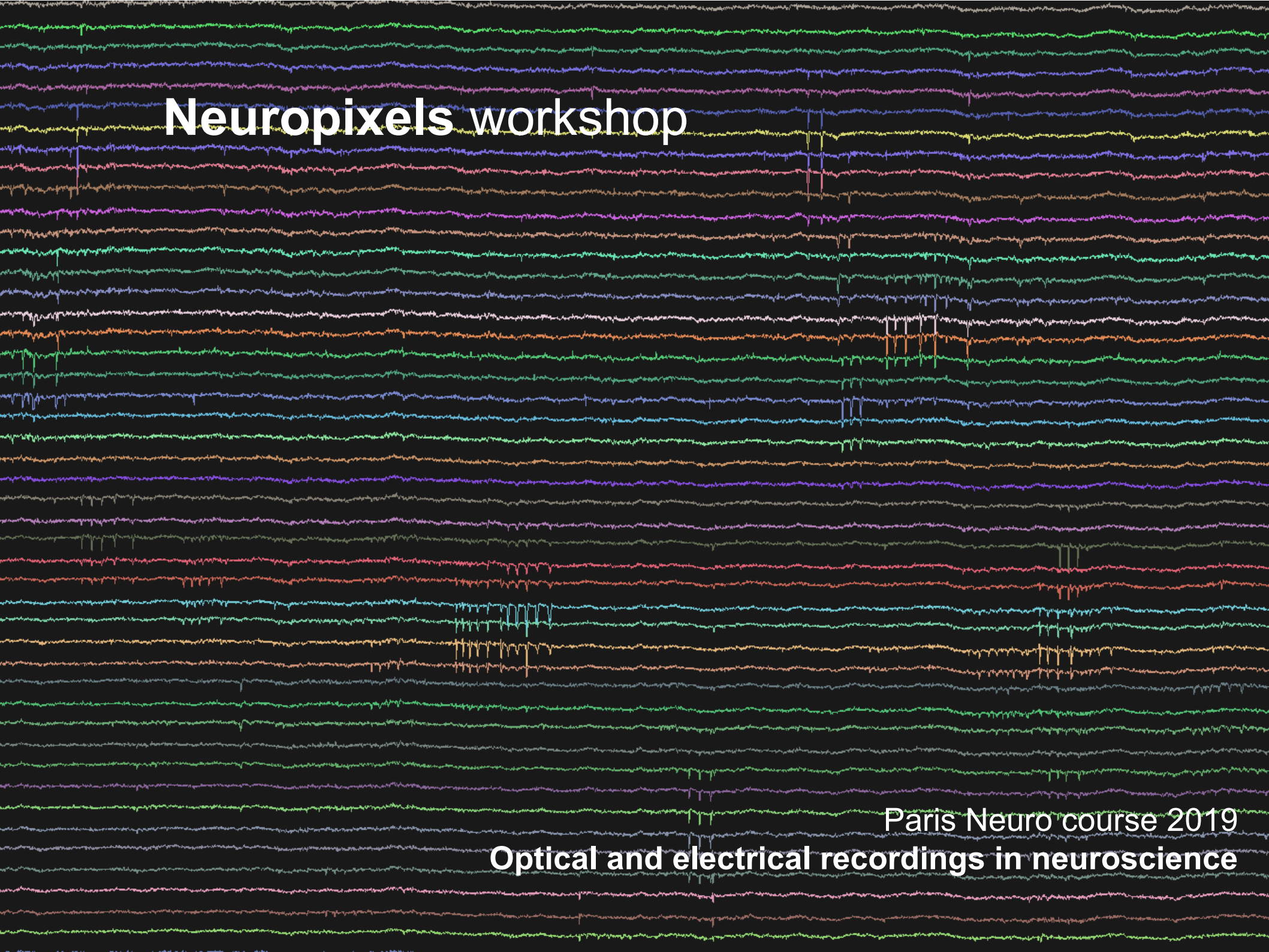
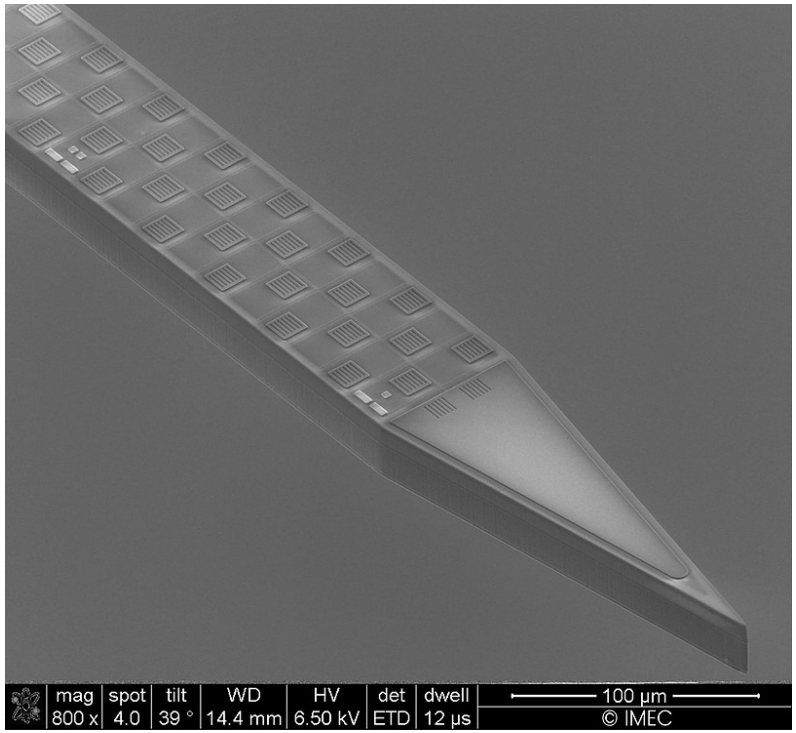


Neuropixels workshop

Paris Neuro course 2019

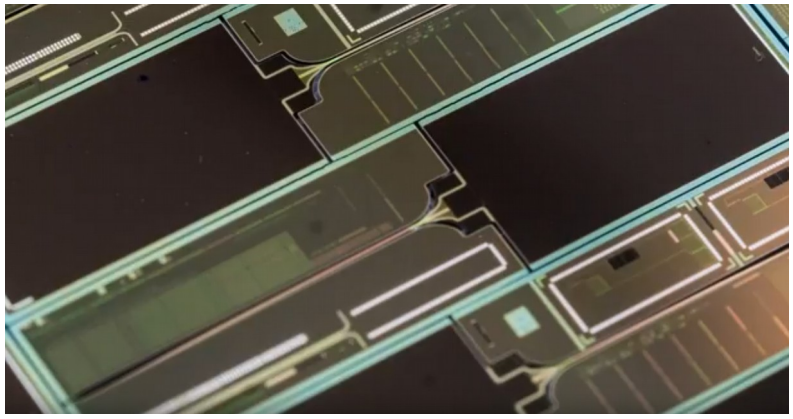
Optical and electrical recordings in neuroscience

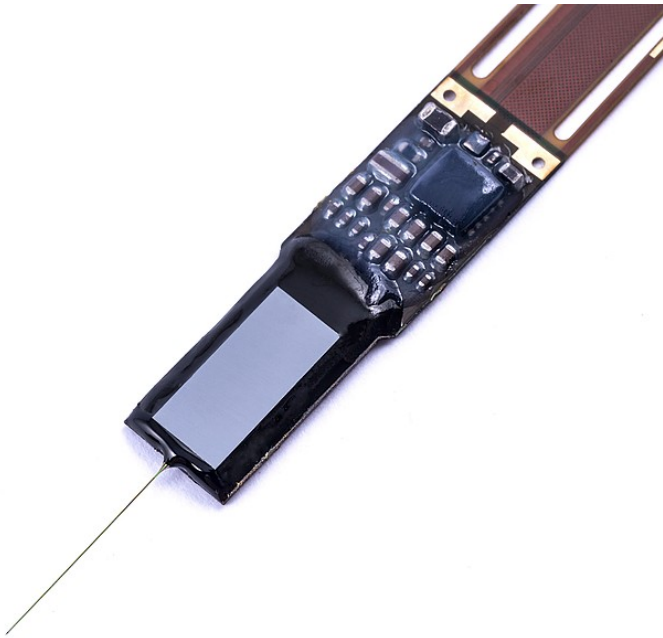
Neuropixels 1.0



IMEC - SEM image of a probe tip and electrodes

IMEC – large scale manufacture





Resources:

Get probes and more
https://www.neuropixels.org/

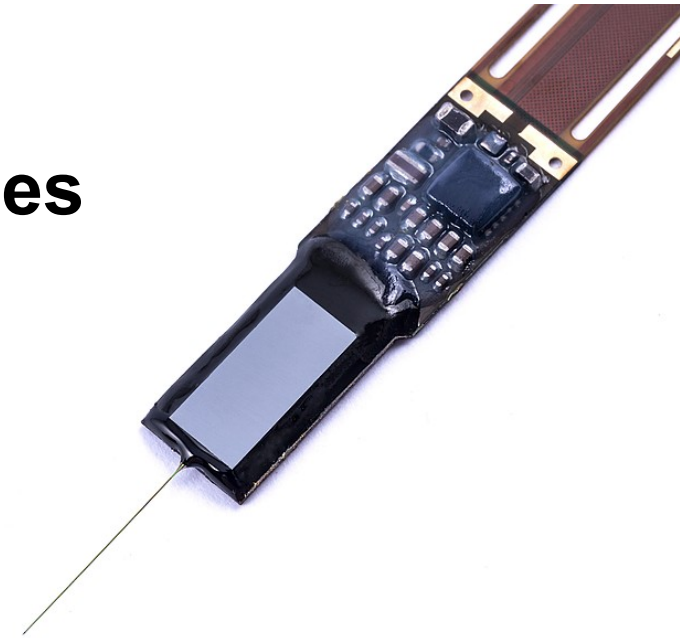
Wiki
https://github.com/cortex-lab/neuropixels/wiki

Slack channel
https://neuropixelsgroup.slack.com

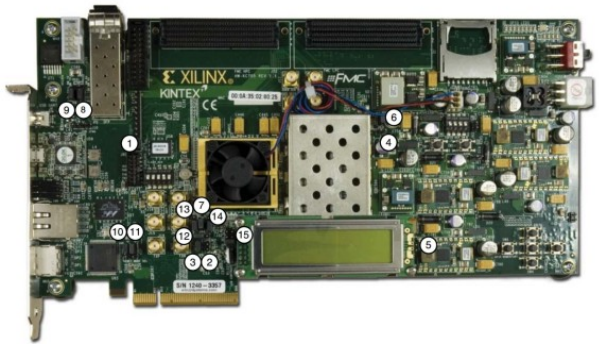
UCL course slides
https://www.ucl.ac.uk/neuropixels/courses/2019-course

How to videos:
https://billkarsh.github.io/SpikeGLX/#how-to-videos

Recording with neuropixels 1.0 probes

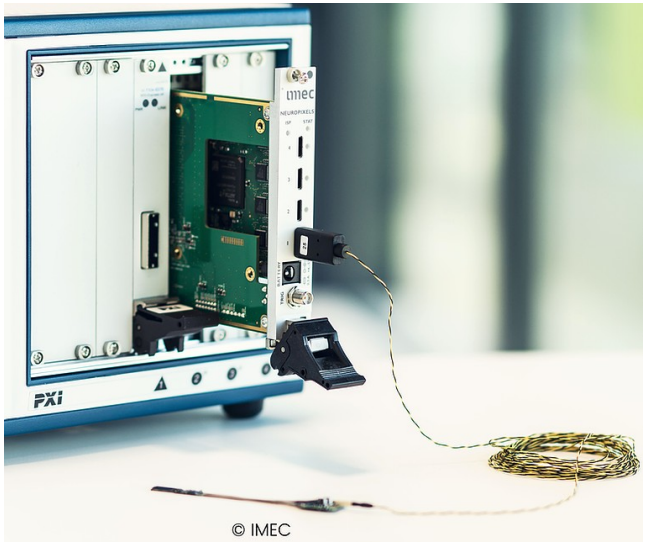


Xilinx

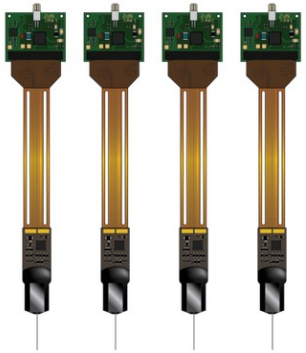


1 probe per system;
ethernet connection

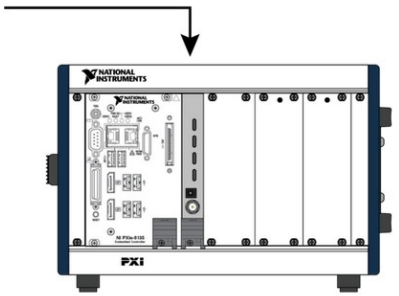
PXI



4 probes per module; up to 16 per PXI



Neuropixels probes

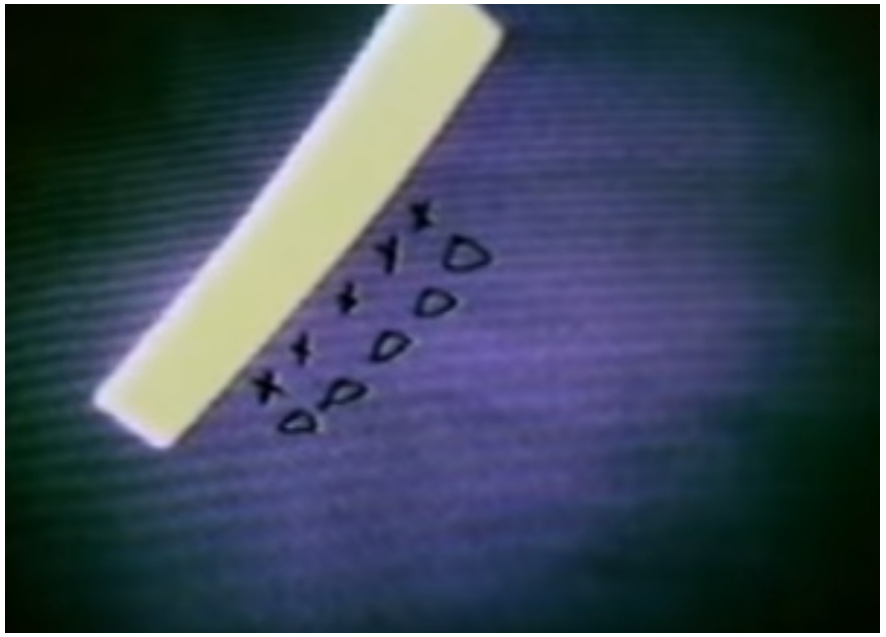


Standard PXIe hardware
+
Neuropixels module

Image from: http://www.open-ephys.org/neuropixels

Planning a recording – stimuli

https://www.youtube.com/watch?v=8VdFf3egwfg



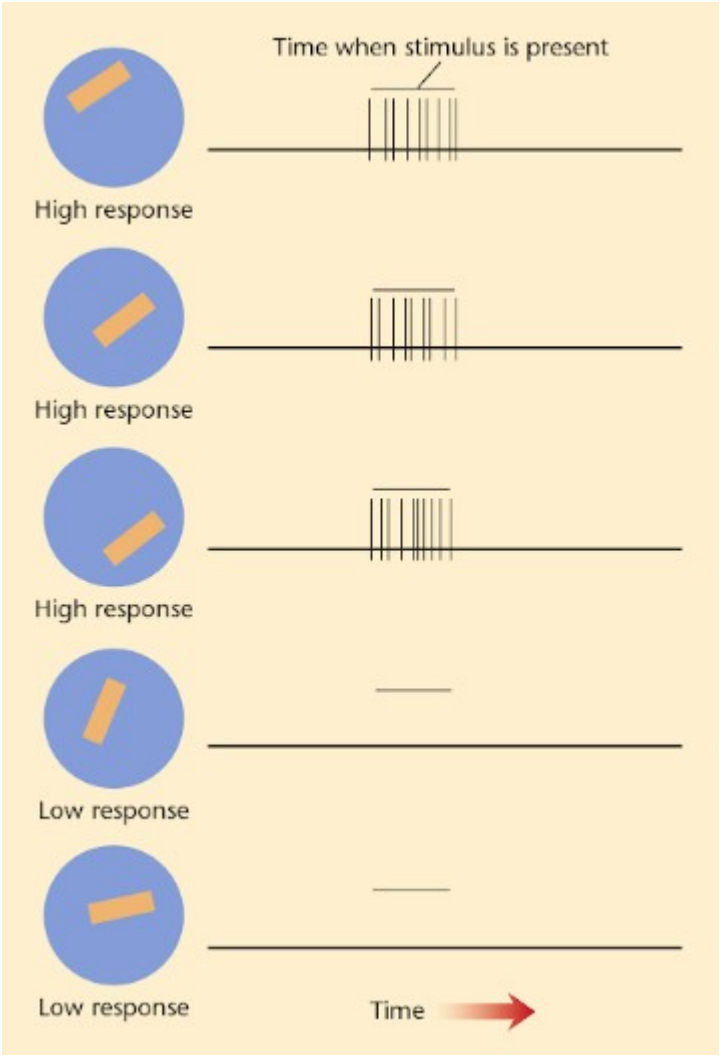
J. Physiol. (1959) 148, 574–591

RECEPTIVE FIELDS OF SINGLE NEURONES IN THE CAT'S STRIATE CORTEX

By D. H. HUBEL* and T. N. WIESEL*

From the Wilmer Institute, The Johns Hopkins Hospital and University, Baltimore, Maryland, U.S.A.

(*Received* 22 *April* 1959)

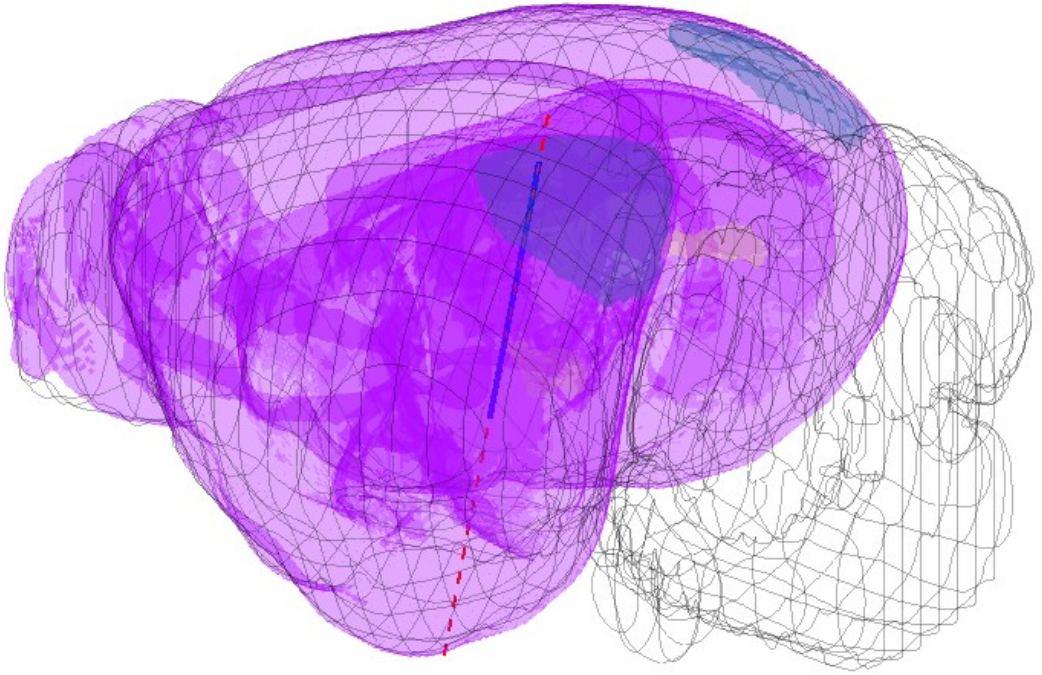


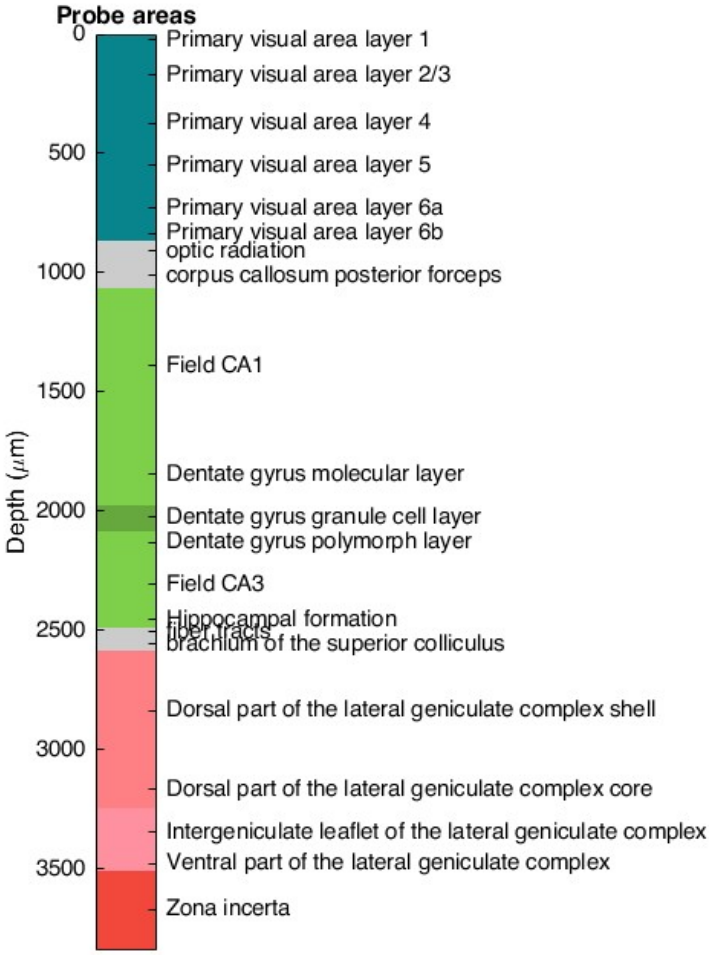
Planning a recording – simultaneous V1 and dLGN

Using the Allen Common Coordinate Framework
Andy Peters https://github.com/cortex-lab/allenCCF

`allen_ccf_npx`

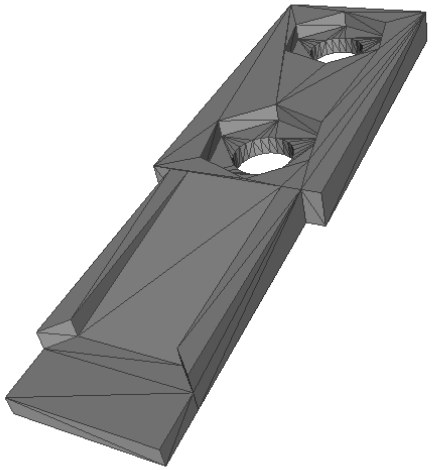
Probe insertion: -3187 AP, -2400 ML, Angle: 78 deg horizontal

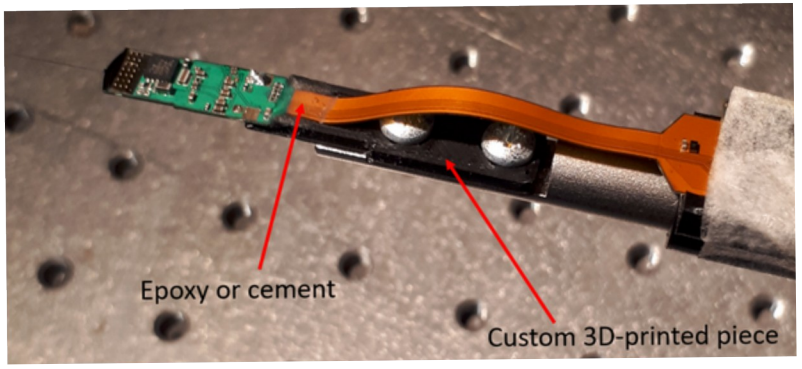




Neuropixels 1.0 – probe holders

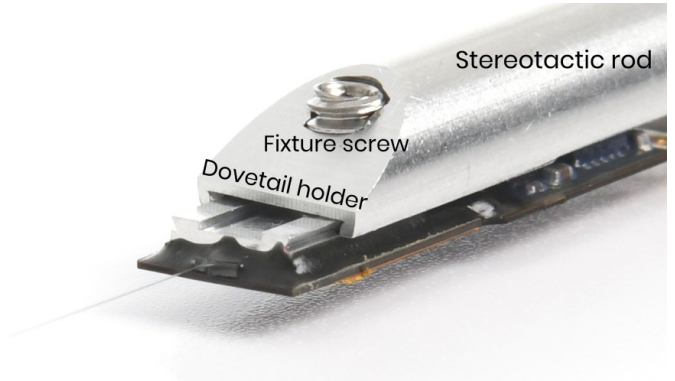
3D printed holder





Nick Steinmetz
https://github.com/cortex-lab/neuropixels/wiki/Probe_handling

Dovetail holder



HHMI Janelia
https://flintbox.com/public/project/52167/

Spike sorting - installation

Hardware:

CUDA capable graphics card (4Gb memory)
> 16Gb memory (¼ of the max recording file recomended)
Fast disk - SSD

Software:

CUDA toolkit (depends on matlab version)
Visual Studio Community (on Windows)
Matlab (>R2016)
Toolboxes (check documentation):
- Signal Processing
- Parallel computing
- Statistics and Machine learning

Matlab version	CUDA toolkit
R2019a	10.0
R2018b	9.1
R2018a	9.0
R2017b	8.0
R2017a	8.0
R2016	7.5

Kilosort2 - https://github.com/MouseLand/Kilosort2

Download: `git clone https://github.com/MouseLand/Kilosort2.git`

Matlab install:
```
cd CUDA % in the kilosort2 folder
mexGPUall
```

JRClust - https://github.com/JaneliaSciComp/JRCLUST

Download: `git clone https://github.com/JaneliaSciComp/JRCLUST.git`

Matlab install:
```
addpath('/path/to/JRCLUST')
jrclust.CUDA.compileCUDA();
```

Spike sorting – running

Kilosort2 - https://github.com/MouseLand/Kilosort2

With the GUI: `kilosort2` **https://github.com/MouseLand/Kilosort2/wiki/1.-The-GUI**

Through the command line:
1) **Create a channelmap**: look at *\configFiles\createChannelMap.m*
2) **Copy** the *master_kilosort.m* and *configFiles\StandardConfig_MOVEME.m* to another folder (e.g. data folder).
3) StandardConfig.m: **Set the paths** *ops.fbinary*, *ops.fproc*, *ops.chanMap* and *ops.root*, the **sampling frequency –** *ops.fs*, and the **number of channels** in the file – *ops.NchanTOT.*
4) master_file.m: Set the paths to the config file and the repositories.

Run the master_file.

JRClust - https://jrclust.readthedocs.io/en/latest/usage/index.html

Create a config file: `jrc bootstrap`

Display traces: `jrc traces <configfile.prm>`

Do the sorting: `jrc detect-sort <configfile.prm>`

Manual sorting GUI: `jrc manual <configfile.prm>`

Spike sorting – manual curation kilosort2

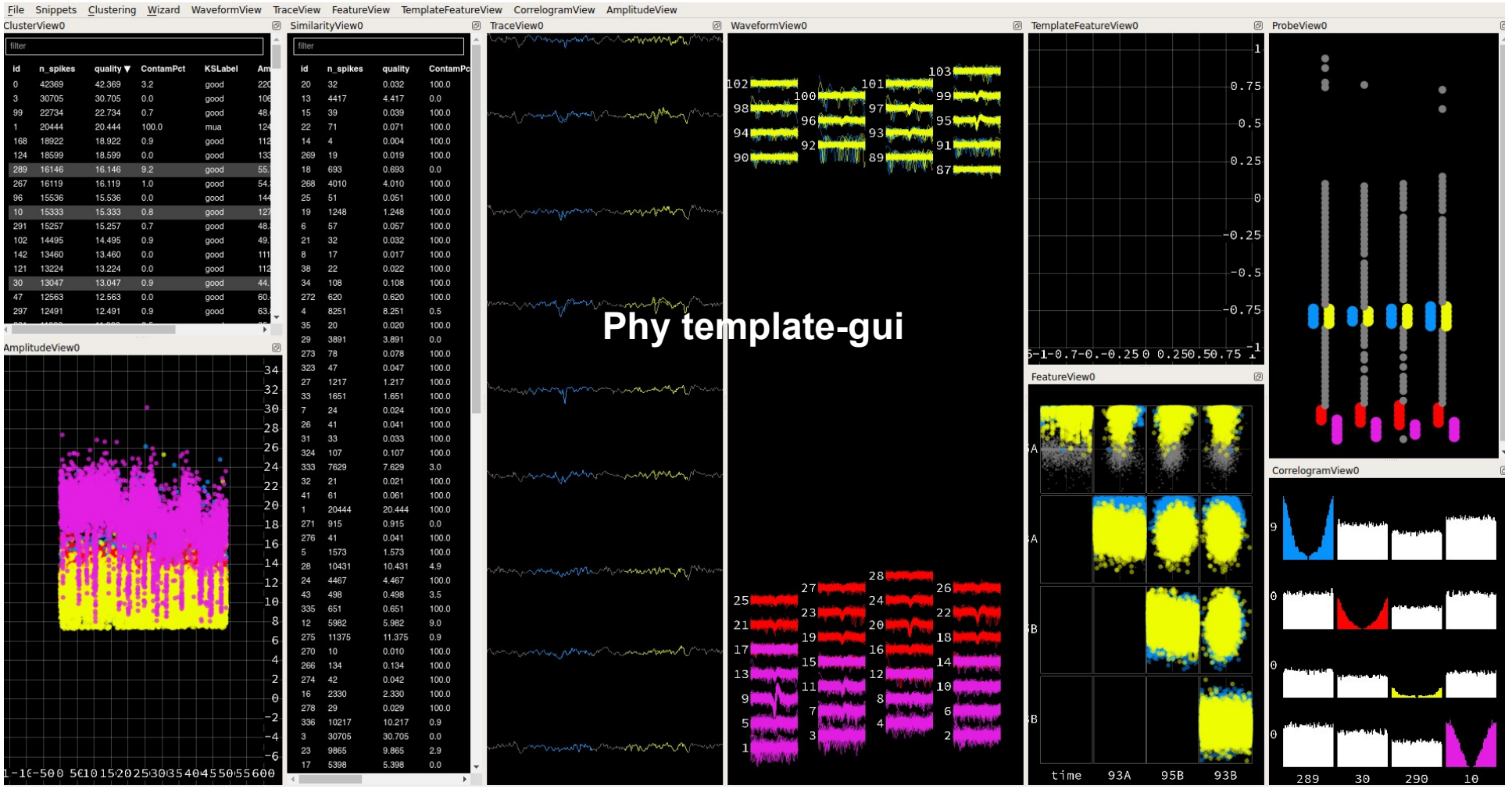
Installation:

Install dependencies using conda: https://github.com/kwikteam/phy

```
pip install git+https://github.com/kwikteam/phy git+https://github.com/kwikteam/phy-contrib --upgrade
```

Documentation:

https://phy-contrib.readthedocs.io/en/latest/template-gui/ - **Important! Has also decision criteria.**

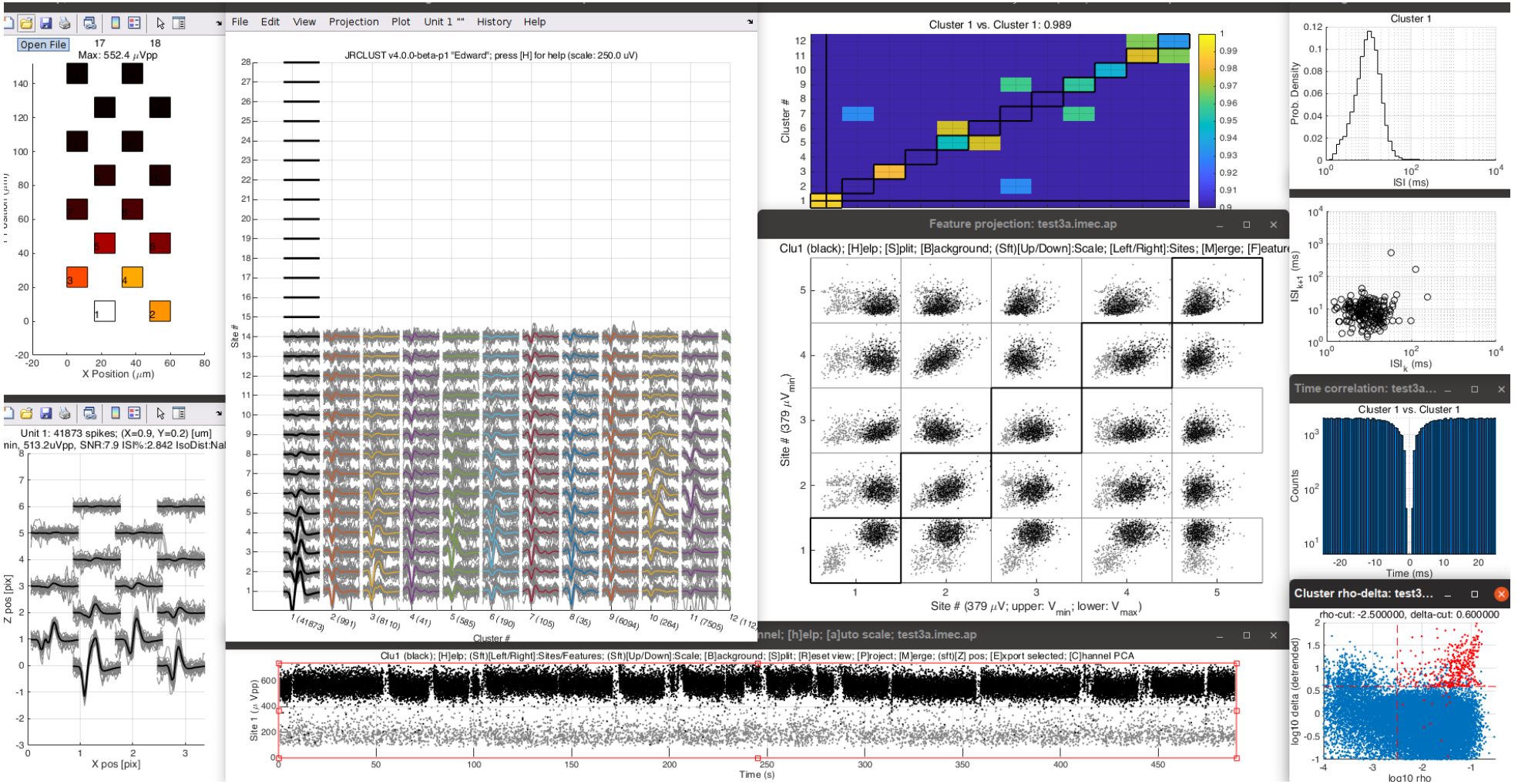


Spike sorting – manual curation JRClust

```
jrc manual <configfile.prm>
```

Documentation:

https://jrclust.readthedocs.io/en/latest/pipeline/curate/index.html#the-waveform-view-figwav



Spike sorting – manual curation

Documentation:
https://phy-contrib.readthedocs.io/en/latest/template-gui/#a-typical-approach-to-manual-clustering

Small waveforms?

Yes: label as MUA; move to the next.
No: compare with most similar waveforms.

Are the clusters in different channels?

Yes: Move to the next comparison.
No: inspect cross-correlograms.

Are the autocorrelograms different and there is no refractory period on the cross-correlogram?

Yes: Not the same neuron
No: Check amplitude stability and overlap in feature space

Units drift continuously in time and don't overlap?

Yes: Probably the same unit, merge.
No: Move to the next comparison.

Clear refractory period and all reasonable comparisons made?

Yes: Classify as "good"
No: Classify as "multi-unit activity" (MUA)

Neuropixels 3A – xilinx and basestation