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Session PSTR243 - Computational Neuroscience: Experiment

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PSTR243.07 / XX14 - Brain-wide atlas of electrophysiological properties and associated tools

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Presenter at Poster
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I. IBL[1], K. BOUGROVA[2], J. BOUSSARD[4], J. BHAGAT[5], G. CHAPUIS[6], J. CATARINO[2], S. HOFER[5], P. LAU[5], L. PANINSKI[4], R. PRÔA[4], Y. SHI[7], N. A. STEINMETZ[8], O. WINTER[3], ***H. YU**[4]; [1]Intl. Brain Lab., London, United Kingdom; [3]Neurosci., [2]Champalimaud Ctr. for the Unknown, Lisbon, Portugal; [4]Columbia Univ., New York, NY; [5]Univ. Col. London, London, United Kingdom; [6]Univ. of Geneva, Geneva, Sweden; [7]Princeton Neurosci. Inst., Princeton, NJ; [8]Univ. of Washington, Seattle, WA. Brain-wide atlas of electrophysiological properties and associated tools. Program No. PSTR243.07. 2023 Neuroscience Meeting Planner. Washington, D.C.:

Authors
I. IBL[1], K. BOUGROVA[2], J. BOUSSARD[4], J. BHAGAT[5], G. CHAPUIS[6], J. CATARINO[2], S. HOFER[5], P. LAU[5], L. PANINSKI[4], R. PRÔA[4], Y. SHI[7], N. A. STEINMETZ[8], O. WINTER[3], ***H. YU**[4];
[1]Intl. Brain Lab., London, United Kingdom; [3]Neurosci., [2]Champalimaud Ctr. for the Unknown, Lisbon, Portugal; [4]Columbia Univ., New York, NY; [5]Univ. Col. London, London, United Kingdom; [6]Univ. of Geneva, Geneva, Sweden; [7]Princeton Neurosci. Inst., Princeton, NJ; [8]Univ. of Washington, Seattle, WA

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Abstract
The last decades have seen incredible progress in mapping gene expression, cell types, and connectivity across the entirety of mammalian brains. Yet, to date no attempt has been made to systematically characterize and quantify basic electrophysiological measurements across the brain. Moreover, to make sense of electrophysiological data it is critical to know the location of each recorded neuron. However, precisely localizing electrode channels (and thus recorded neurons) in brain tissue is fraught with uncertainty. Here we use the large dataset acquired at the International Brain Laboratory to build a new brain reference atlas of ephys properties. This dataset comprises the publicly available 354 Neuropixels probe insertions, tiling 194 brain regions of the mouse brain, as well as 551 insertions not yet released.We are developing new methods to compute ephys features (e.g. local field potential (LF) power spectra, spike rate or shape) at such a large scale, and have improved on the pre-processing steps needed to denoise both LF and spike waveforms. We are developing a new website that allows brain-wide exploration of a range of ephys features. Along with this atlas, we are building tools that enable automated localization of recording locations, in any electrophysiology mouse experiment based purely on activity from multi-channel probes (generalizing to many other probe configurations and experiment protocols). Specifically, we are developing decoder algorithms that can predict a brain region label or precise 3D location in the brain based on the ephys signatures (either of a given electrode channel, neuron, or an entire probe; accuracy 64%) - and give a sense for localisation uncertainty. This is the first step towards building on-line tools to be used in real-time experiments.Finally, we build encoding models to construct an electrophysiology atlas of full-brain coverage at high spatial resolution (voxel size 200 um). Specifically, the encoding models use anatomical information (brain region parcellation, spatial coordinates, and gene-expression profiles) as priors, and interpolate the full map from sparse data samples. The encoding models also enable us to explore the link between

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the brain's anatomical structure and ephys features. In particular, we find that the spatial gene expression profiles capture a large fraction of variance of ephys patterns across the brain.This work summarizes a systematical characterization and quantification of ephys features across the mouse brain. This atlas will provide an open, critical resource for neuroscientists to both guide on-line ephys recordings and post hoc interpretation.