Positive and sharp biphasic extracellular waveforms correspond to dendritic and axonal spikes

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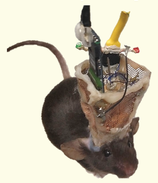
Introduction

1. In-silico models suggest that extracellular spike waveforms differ between neuronal compartments

2. Experimental reports suggest that both positive and biphasic waveforms correspond to axonal potentials

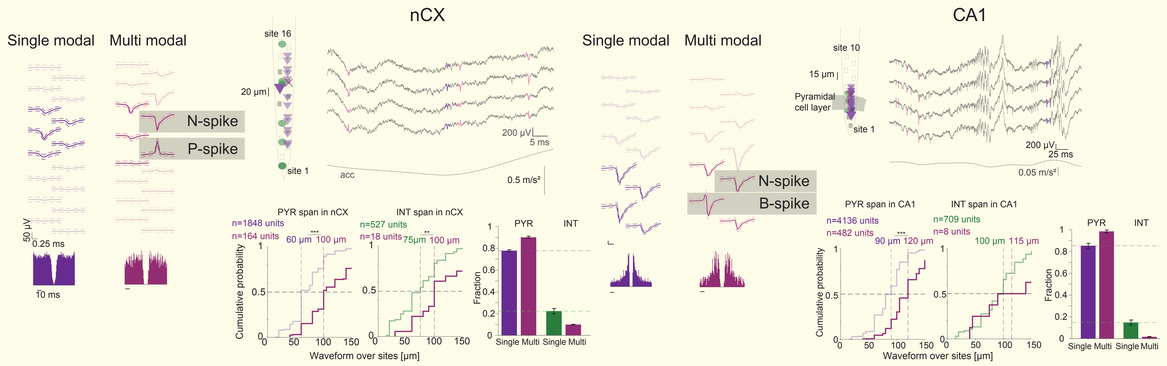
3. Prior work employed relatively small datasets or anesthetized preparations, and did not monitor simultaneously multiple waveforms of the same unit

Extracellular data from 17 freely moving mice

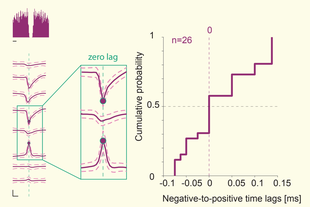


Using high-density silicon probes

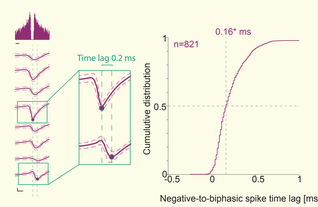
High-density extracellular recordings exhibit multiple spike waveforms of the same neuron



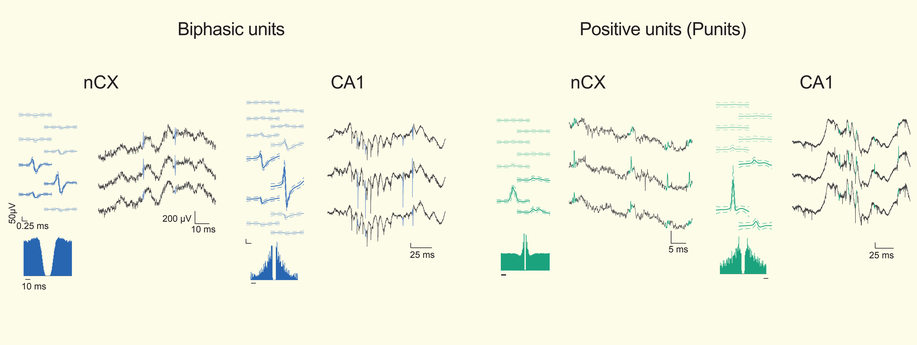
P-spikes are synchronized with N-spikes, suggesting return currents

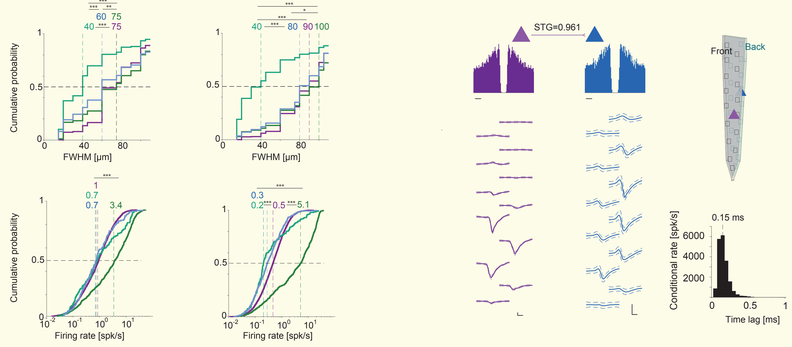


B-spikes follow N-spikes, suggesting axonal propagation



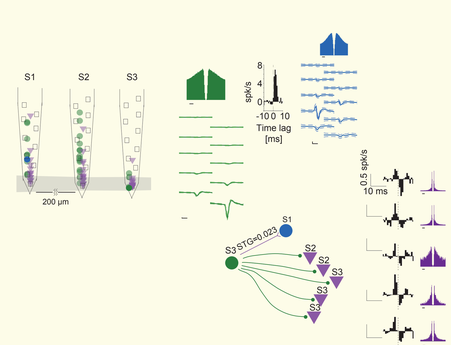
In some units, only biphasic or positive extracellular spike waveforms are recorded



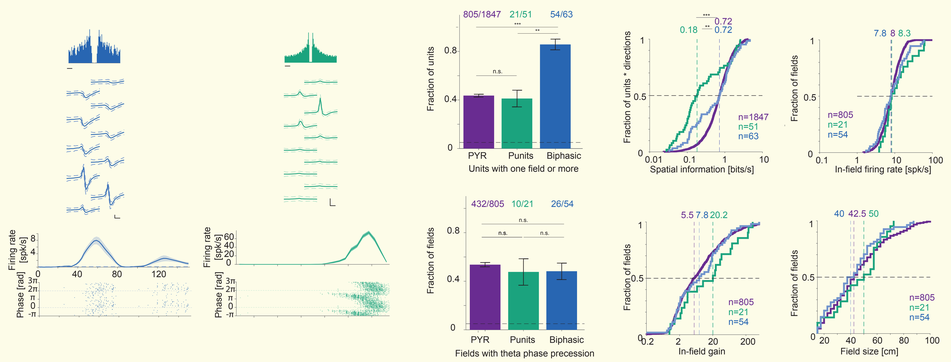


PYR to biphasic spike transmission shows short lag and jitter, suggesting axonal potentials

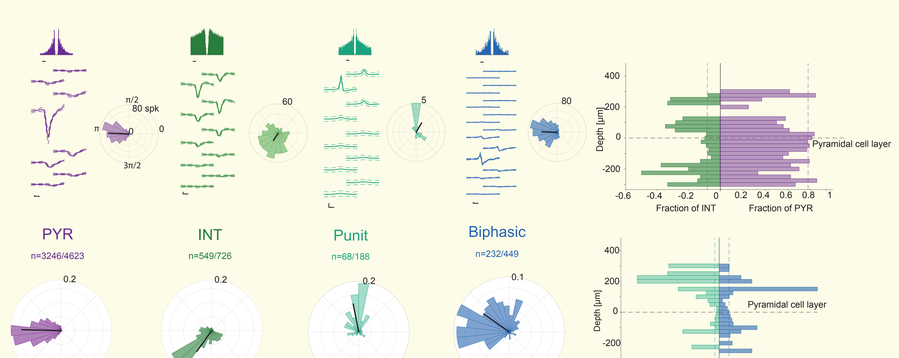
Biphasic units may contradict Dale's law, suggesting axonal potentials

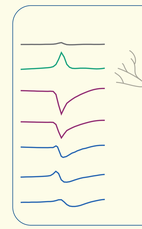


Punits and biphasic units can function as place cells



Punits and biphasic units precede PYR in ripple lock in CA1





Conclusions

1. P-spikes represent the extracellular signature of dendritic return currents

2. B-spikes correspond to axonal potentials

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