

Efficient simulation platform for the cerebral cortex



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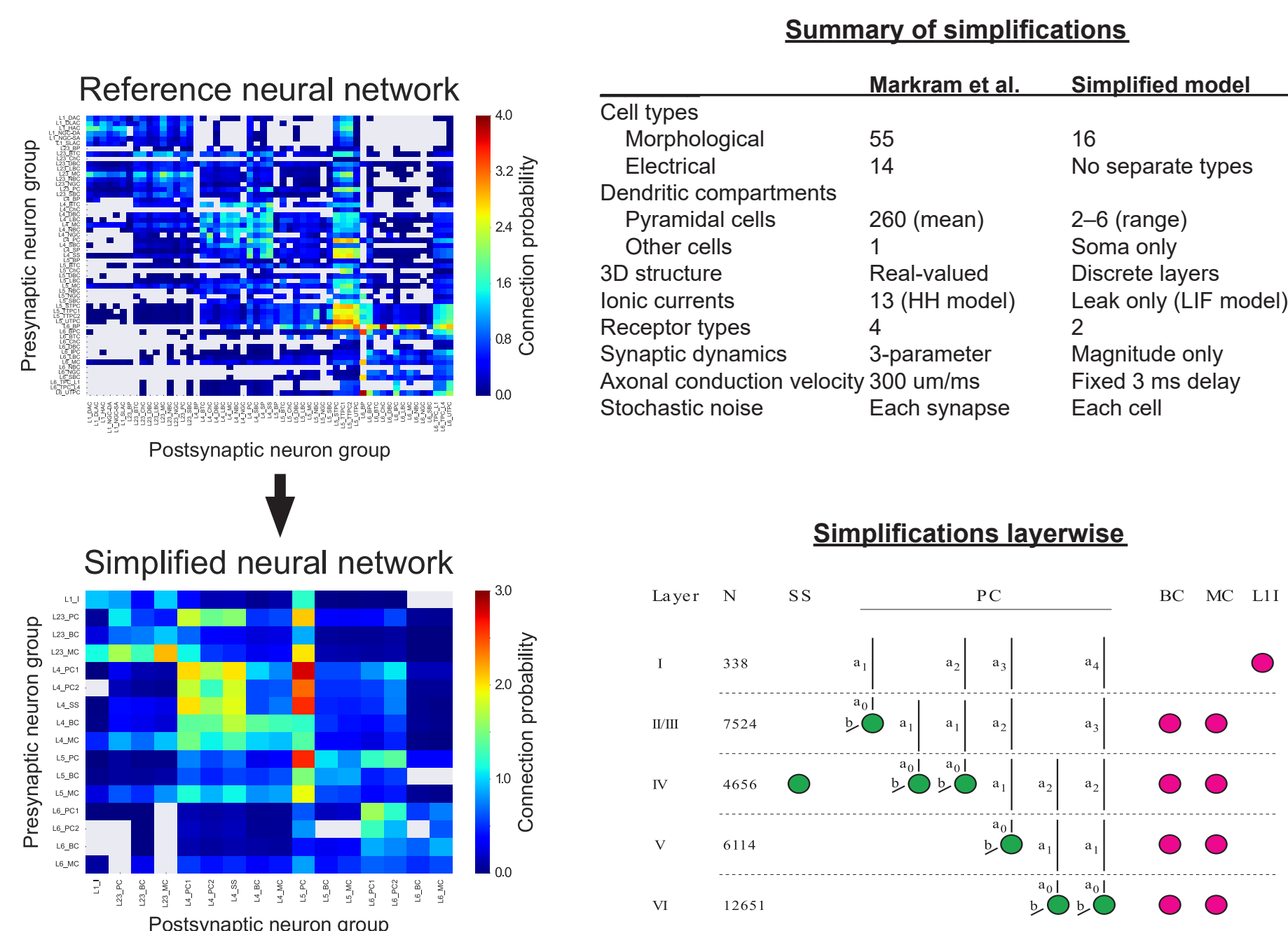
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Introduction

- Markram et al. (2015) provided a comprehensive model of 0.21 mm radius patch of rat somatosensory cortex
- Model reproduced *in vitro* phenomena such as the shift to synchronous activity with high levels of extracellular calcium
- Unfortunately scaling or teaching the Markram model would result in high computational costs
- **We created the CxSystem platform for agile experimentation on biomimetic spiking neural networks**

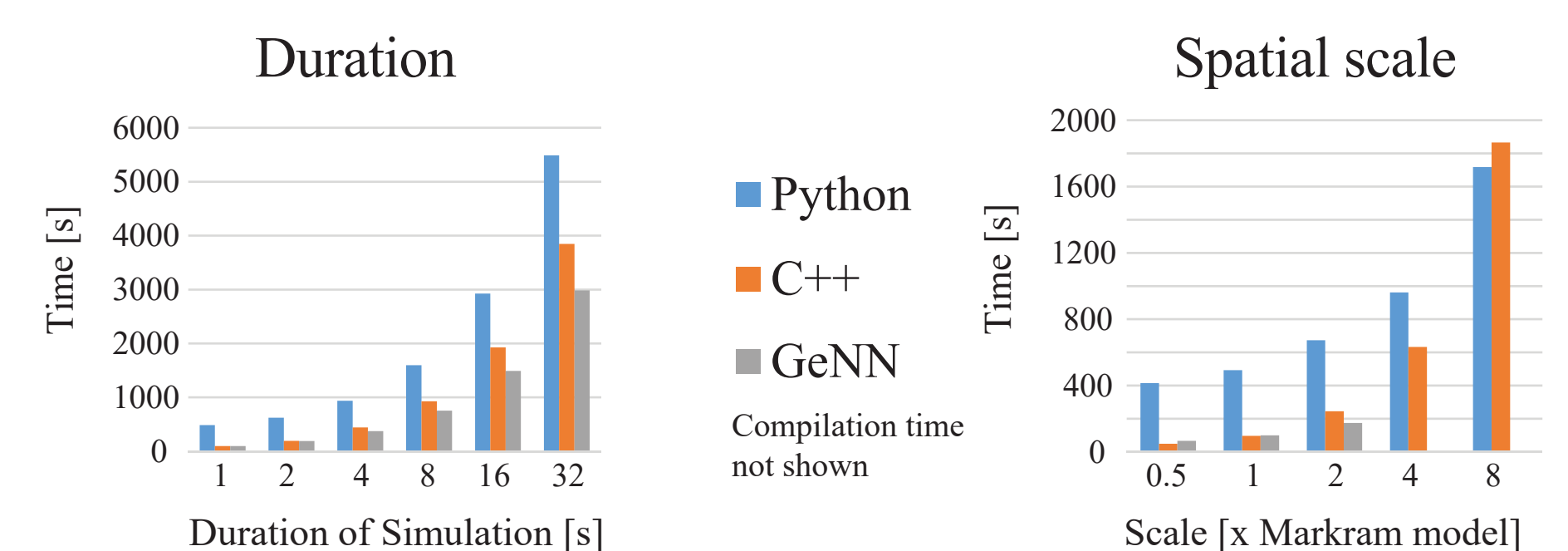
Methods

- The CxSystem runs on BRIAN2² which supports GPU acceleration via GeNN³
- 55 cell types in the Markram model mapped to 16 cell types
- 1941 connection types in Markram model mapped to 239 connection types
- Change in Ca^{2+} modelled as a shift in synaptic transmission (E/I balance)⁴

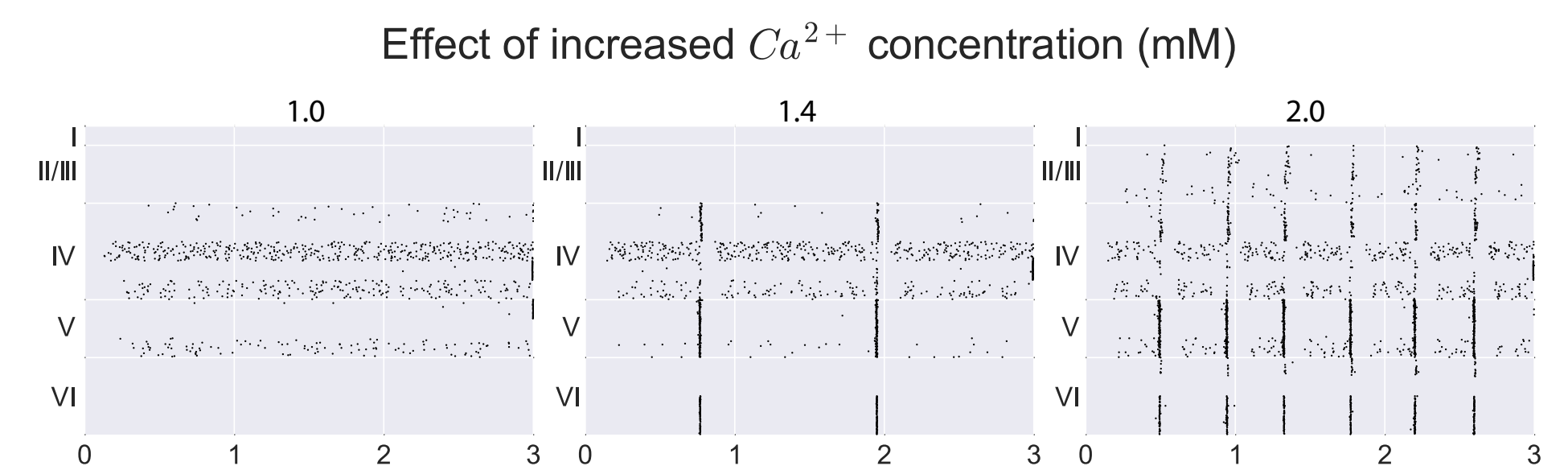


Results

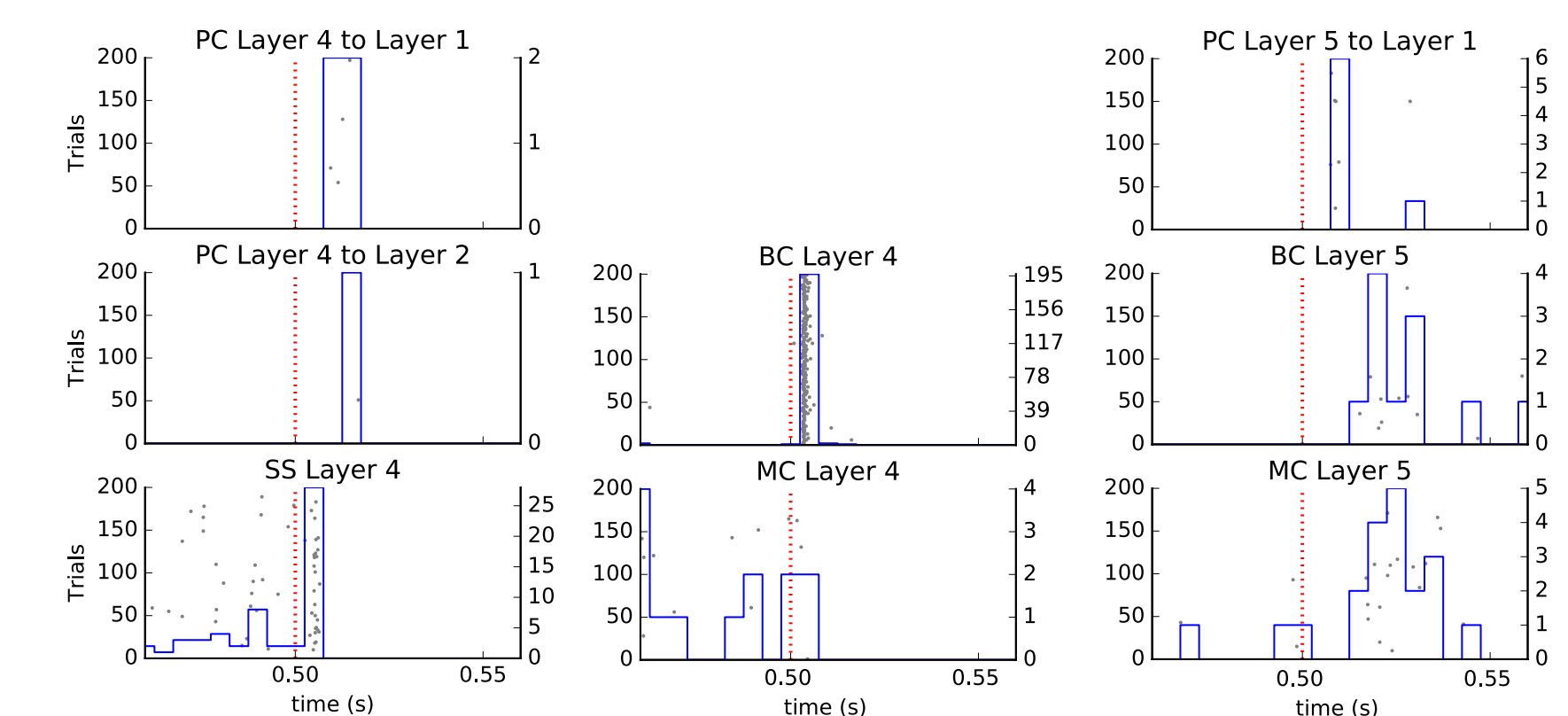
- The CxSystem allows scaling of the original model up to eight-fold on a workstation



- Replication of E/I dynamics



- Responses to thalamic stimulus



Conclusions

- CxSystem supports simulation of cortical networks without supercomputers
- CxSystem benefits from GPU acceleration for long simulations on small networks
- The simplified model can replicate network dynamics of the Markram model

References

1. Markram, H. et al. Cell 163, 456–492 (2015).
2. Goodman, D. & Brette, R. Front. Neurosci. 3, 26 (2009)
3. Yavuz, E. et al. Sci. Rep. 6, 18854 (2016).
4. Rozov A. et al. J. Physiol. 531, 807–826 (2001).

