





BRENDAN HARRIS


Postdoctoral Research Associate

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SUMMARY

Postdoctoral Research Associate in the Complex Systems Group at the School of Physics, The University of Sydney. Interested in understanding the dynamical mechanisms of computation and communication in the brain, especially for visual processing. Use new analytic tools, dynamical systems theory, large-scale data, and biophysical neural-circuit models for a multi-level understanding of brain function.

RESEARCH INTERESTS

Circuit- and systems-level neuroscience

Spiking neural circuits; mean-field models; hierarchical processing; oscillations and traveling waves; visual system.

Bridging statistical physics and neural dynamics

Time-series analysis; stochastic processes; criticality; cross-scale dynamics; dimensionality reduction; open software.

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Education

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EDUCATION

2022	Physics PhD Candidate (Submitted) <i>Cross-scale dynamics in the working regime of the visual cortex</i>	The University of Sydney
2021	Physics Honours, Class I and the University Medal <i>Inferring parametric variation across non-stationary time series</i>	The University of Sydney
2018 – 2020	Bachelor of Science/Bachelor of Advanced Studies (Dalyell Scholar) Majored in Physics and Neuroscience	The University of Sydney

PUBLICATIONS AND PREPRINTS

2026	<i>Nested spatiotemporal theta–gamma waves organize hierarchical processing across the mouse visual cortex</i>   Brendan Harris and Pulin Gong	Nature Communications
2026	<i>Anomalous dynamics in the working regime of the visual cortex</i> Brendan Harris and Pulin Gong	In preparation
Jul 2025	<i>Canonical time-series features for characterizing biologically informative dynamical patterns in fMRI</i>   Imran Alam, Brendan Harris , Patrick Cahill, Oliver Cliff, Marija Markicevic, Valerio Zerbi, and Ben D. Fulcher	Aperture Neuro vol. 5, pp.
Aug 2024	<i>Tracking the Distance to Criticality in Systems with Unknown Noise</i>   Brendan Harris , Leonardo L. Gollo, and Ben D. Fulcher	Physical Review X vol. 14, pp. 031021


May 2024	<i>Distributed and dynamical communication: a mechanism for flexible cortico-cortical interactions and its functional roles in visual attention</i>  Shencong Ni, Brendan Harris , and Pulin Gong	Communications Biology vol. 7, pp. 550
Jul 2021	<i>Approximate Modal Cut-Off Wavelengths and the V-Parameter for M-type Optical Fibers and Its Novel Applications</i> Deepak Jain, Mark A George, Brendan Harris , and Simon Fleming	Journal of Lightwave Technology vol. 39, pp. 4478–4488

CONFERENCES


Jun 2025	OHBM 2025  Brisbane, QLD, Australia <i>2072: Nested spatiotemporal dynamics organize hierarchical processing in the mouse visual cortex</i> Brendan Harris and Pulin Gong	Poster
Jun 2025	EPC/APCV 2025 The University of New South Wales <i>Spatiotemporal theta–gamma waves organize hierarchical processing in the mouse visual cortex</i> Brendan Harris and Pulin Gong	Talk
Mar 2025	COSYNE 2025  Montreal, QC, Canada <i>1–117: Tracking the distance to criticality across the mouse visual hierarchy</i> Brendan Harris , Leonardo Gollo, and Ben Fulcher	Poster
Feb 2025	NeuroEng 2025 The University of Melbourne <i>Nested spatiotemporal theta–gamma waves organize hierarchical visual processing</i> Brendan Harris and Pulin Gong	Talk
Jul 2024	2024 46th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC) <i>1–4: Default Mode Network Detection using EEG in Real-time</i> Navin Cooray, Chetan Gohil, Brendan Harris , Shaun Frost, and Cameron Higgins	Conference paper
Oct 2023	IBRO Neuroscience Reports (IBRO World Congress 2023) Granada, Spain <i>S783: Nested and non-stationary oscillatory bursts underlie flexible inter-areal neural communication</i> Brendan Harris and Pulin Gong	Poster
Jul 2022	31st Annual Computational Neuroscience Meeting: CNS*2022 Melbourne, Australia <i>P36: Summarizing non-stationarity in spatio-temporal neural data</i> Brendan Harris and Ben Fulcher	Poster
Jun 2022	28th Annual Meeting of the Organization for Human Brain Mapping <i>Summarizing non-stationarity in spatio-temporal neural data</i> Brendan Harris and Ben Fulcher	Virtual Poster
Sep 2020	Frontiers in Optics / Laser Science (2020) <i>FM4D.2: Approximate normalized frequency (V-parameter) and modal cut-off wavelengths of M-type optical fibers</i> Deepak Jain, Mark George, Brendan Harris , and Simon Fleming	Oral presentation


WORKSHOPS AND TALKS

Apr 2026	Maths in the Brain  <i>Anomalous dynamics in the working regime of the visual cortex</i> Prize: "Best ECR talk"	Talk
May 2025	Center for Neuroscience Imaging Research (CNIR), IBS, Republic of Korea <i>Nested spatiotemporal θ-γ waves organize hierarchical visual processing</i> Invited to give a talk on my PhD research	Talk
Mar 2025	Pre-Cosyne BrainHack 2025 Montreal, QC, Canada Workshop on open science and open-source tools for computational and systems neuroscience.	Workshop attendee
Aug 2024	Strong Compute Chess AI Hackathon Sydney, NSW, Australia Hackathon on transformer models and distributed GPU training for chess	Workshop attendee
Aug 2024	Emerging Aspirations in Complex Systems The University of Sydney <i>Spatiotemporal θ-γ waves in the mouse visual cortex</i> Centre for Complex Systems, The University of Sydney	Workshop talk
May 2024	School of Physics HDR symposium The University of Sydney <i>Spatiotemporal θ-γ waves in the mouse visual cortex</i> School of Physics, The University of Sydney	Workshop talk
Oct 2023	MIP:Lab, Geneva Biotech Campus Geneva, Switzerland <i>Burst-based inter-areal neural communication</i> Presented my PhD work to the MIP:Lab, hosted by Dr. Enrico Amico.	Talk
Jul 2023	Cognitive Neuroscience Hub, The University of Melbourne Melbourne University <i>Burst-based inter-areal neural communication</i> Presented my PhD work, hosted by Dr. Jacob Paul.	Talk
Jul 2023	tLab Monash University <i>Burst-based inter-areal neural communication</i> Presented my PhD work to the lab of Professor Nao Tsuchiya.	Talk
Jan 2023	Complexity, Criticality and Computation Symposium: C3-2023 Heron Island <i>Burst-based inter-areal neural communication</i> Symposium held by the Centre for Complex Systems (The University of Sydney).	Workshop talk
Nov 2022	BrainHack Australia 2022 The University of Sydney <i>Brainharmonic</i> Contributed to a project aiming to synthesize music from neural signals using deep neural networks.	Workshop attendee
Oct 2022	OpenScope NeuroDataReHack Hackathon Seattle, WA, USA Workshop on re-analyzing open-source neural data, hosted by the Allen Institute	Workshop attendee

Oct 2022	Yale Medical School <i>Feature-based analysis of neural time series</i> Invited by Dr. Evelyn Lake to present the results of my projects involving time-series features to a journal club.	Talk
Aug 2022	Emerging Aspirations in Complex Systems The University of Sydney <i>Inferring parametric variation across non-stationary neural time series</i>	Workshop talk
Jul 2022	31st Annual Computational Neuroscience Meeting: CNS*2022 Melbourne, Australia <i>Inferring parametric variation across non-stationary neural time series</i> In workshop 'Highly comparative analysis of neural dynamics'.	Workshop talk
Dec 2021	Neuromatch 4.0  <i>Summarizing non-stationarity in spatio-temporal neural data</i>	Flash talk

RESEARCH EXPERIENCE

2022	Cross-scale dynamics in the working regime of the visual cortex <i>Dr. Pulin Gong, Complex Systems Group, The University of Sydney</i> In my PhD work, I aimed to understand the principles of computation in spatiotemporal neural systems and their role in transforming complex stimuli into flexible behavior. Specifically, I focus on analyzing spatiotemporal patterns, criticality, cross-scale dynamics, and nonlocal diffusion in mouse electrophysiology data, spiking neural circuits and their mean-field reductions, as well gaze trajectories.	PhD research
Mar – Nov 2021	Inferring parametric variation across non-stationary time series <i>Dr. Ben Fulcher, Complex Systems Group, The University of Sydney</i> Developed a method to summarize non-stationary dynamics using time-series features and dimensionality reduction, along with a new approach to dimensionality reduction that uses baseline datasets to account for redundant measurements. I applied this method to both simulated data and mouse electrophysiology recordings.	Honours research
Aug – Nov 2020	Relating BOLD dynamics, interneuron densities, and DREADD activation <i>Dr. Ben Fulcher, Complex Systems Group, The University of Sydney</i> Explored links between BOLD dynamics, neuronal excitability, and cell densities by combining fMRI, DREADD activation, and neuron-count data with time-series features (<i>hctsa</i>) and machine-learning classifiers.	Dalyell project
Jan – Mar 2020	Quantum Control Laboratory <i>Dr. Cornelius Hempel, School of Physics, The University of Sydney</i> Completed lab projects in optics, instrumentation, and Python/Julia/C++ programming, including building an interferometer for ion trap vibration measurements, testing signal generator stability, and developing Arduino-based sensors.	Denison project
Aug – Nov 2019	Classifying the stability of near-critical systems  <i>Dr. Ben Fulcher, Complex Systems Group, The University of Sydney</i> Used machine-learning algorithms and time-series features to classify time series from monostable and bistable regions of dynamical systems.	Undergraduate project

Jul – Aug 2019	<p>Interneuron densities and intrinsic timescales in the mouse brain <i>Dr. Ben Fulcher, Complex Systems Group, The University of Sydney</i> Investigated the relationship between interneuron subtypes and brain dynamics by analysing fMRI time-series features (<i>hctsa</i>) and interneuron density datasets in Matlab and Python.</p>	Casual lab assistant
Mar – Jun 2019	<p>Numerical analysis of M-type optical fibers <i>Dr. Deepak Jain, School of Physics, The University of Sydney</i> Modelled M-type optical fibres in COMSOL and formulated expressions describing their unique properties, cut-off wavelengths, anticrossings, and mode profiles.</p>	Undergraduate project
Aug 2018 – Aug 2021	<p>Tracking the distance to criticality in systems with unknown noise  <i>Dr. Ben Fulcher, Complex Systems Group, The University of Sydney</i> Searched for time-series features that best predict the distance to criticality in noisy dynamical systems; this involved numerical simulation and time-series analysis (<i>hctsa</i>) in Matlab and with the School of Physics HPC cluster.</p>	Undergraduate project

SUPERVISION

Mar – Nov 2025	<p>Aiden Sloots <i>The University of Sydney</i> Physics Honours student</p>	Secondary
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TEACHING

Jul – Nov 2024	<p>Computational optics <i>The University of Sydney</i> Tutored a computational optics lab</p>	Tutor
Feb – Mar 2023	<p>3rd-year Statistical Mechanics <i>The University of Sydney</i> Tutored a combined lecture and tutorial class on statistical mechanics, covering topics such as the Einstein solids, the Ising model, Peierls argument, Monte-Carlo sampling, phase transitions, criticality, and the renormalization group.</p>	Tutor
Aug 2022 – Mar 2023	<p>3rd-year Interdisciplinary Physics computational lab <i>The University of Sydney</i> Tutored the Matlab computational labs of PHYS3888, a course on the physics of complex systems that introduces third year physics students to networks, linear and nonlinear dynamical systems, criticality, and machine learning/neural networks.</p>	Tutor
Mar – Nov 2022	<p>Second-year physics Matlab course <i>The University of Sydney</i></p>	Tutor
Aug – Nov 2018	<p>Science Dalzell Showcase <i>The University of Sydney</i></p>	Mentor

INDUSTRY

Mar – Dec 2023 **Resonait Medical Technologies** **Software developer**
Dr. Cameron Higgins
Worked on a casual basis writing Matlab code to interface with EEG headsets, infer the activation of brain networks, and implement neurofeedback for the monitoring and treatment of depression

AWARDS

2025 **Postgraduate Research Support Scheme** **Scholarship**
The University of Sydney
To fund travel and accommodation for the COSYNE 2025 conference (Montreal, Canada)

2025 **Cosyne Presenters Travel Grant** **Scholarship**
COSYNE
To fund travel and accommodation for the COSYNE 2025 conference (Montreal, Canada)

2023 **Postgraduate Research Support Scheme** **Scholarship**
The University of Sydney
To fund travel and accommodation for the IBRO2023 conference (Granada, Spain)

2022 **Dean's List of Excellence in Academic Performance** **Recognition**
The University of Sydney
For academic performance during my Honours year

2022 **Honours Class I and the University Medal** **Recognition**
The University of Sydney
For academic and research performance during my Honours year

2022 **Research Training Program (fee offset and stipend)** **Scholarship**
The University of Sydney
To fund my PhD studies

2022 **Emerging Aspirations in Complex Systems Award** **Scholarship**
The University of Sydney
To fund accommodation for the C3 symposium

2021 **The University of Sydney Physics Foundation Scholarship No III** **Scholarship**
The University of Sydney
For academic performance in 3rd year undergraduate Physics

2021 **University of Sydney Academic Merit Prize** **Scholarship**
The University of Sydney
For academic performance during my Honours year

2019 **Denison Research Scholarship and Denison Relocation Scholarship** **Scholarship**
The University of Sydney
To fund a 6-week summer research project with the Quantum Control Laboratory

2018	Dean's List of Excellence in Academic Performance <i>The University of Sydney</i> For academic performance in my 1st year of undergraduate study	Recognition
2017	Sydney Scholars Award <i>The University of Sydney</i> For academic results in the higher school certificate	Scholarship

REFEREES

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