

William J. Cunningham

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Summary

I have worked on projects in high performance computational physics for six years. After working in Lattice QCD during my undergraduate education, I moved to the field of Network Science, concentrating on the statistical physics of random graphs and Causal Set Quantum Gravity. During this period, I developed novel random graph construction algorithms while studying information routing through hyperbolic and Lorentzian networks. I also studied computer architecture and design during my Ph.D. education, leading to several new highly efficient algorithms used in causal set theory. I am continuing my work in computational quantum gravity as a Postdoctoral Research Fellow at Perimeter Institute for Theoretical Physics starting in September 2018.

Education

Northeastern University	BOSTON, MA, UNITED STATES
Ph.D. in Physics	2015 – 2018
Dissertation: High Performance Algorithms for Quantum Gravity and Cosmology	
Advisor: Dmitri Krioukov, Associate Professor of Physics	
M.S. in Physics	2013 – 2015
Concentration: Complex Systems and Network Science	
Rensselaer Polytechnic Institute	TROY, NY, UNITED STATES
B.S. in Physics	2009 – 2013
Concentration: Lattice Quantum Chromodynamics	
Minor in Astrophysics	

Employment

Perimeter Institute for Theoretical Physics	WATERLOO, ON, CANADA
Postdoctoral Research Fellow	2018 – 2021

Publications

Peer Reviewed Articles

- [1] W. J. Cunningham & D. Krioukov, Causal Set Generator and Action Computer. *Comput. Phys. Commun.* in press (2018).
- [2] W. J. Cunningham, Inference of Boundaries in Causal Sets. *Class. Quantum Grav.* **35**, 094002 (2018).
- [3] W. J. Cunningham, D. Rideout, J. Halverson & D. Krioukov, Exact Geodesic Distances in FLRW Spacetimes. *Phys. Rev. D* **96**, 103538 (2017).
- [4] W. Cunningham, K. Zuev & D. Krioukov, Navigability of Random Geometric Graphs in the Universe and Other Spacetimes. *Sci. Rep.* **7**, 8699 (2017).
- [5] W. Cunningham & J. Giedt, Eguchi-Kawai Reduction with One Flavor of Adjoint Möbius Fermion. *Phys. Rev. D* **93**, 045006 (2016).

Submitted for Publication

- [1] J. Carifio, W. J. Cunningham, J. Halverson, D. Krioukov, C. Long & B. Nelson, Vacuum Selection from Cosmology on Networks of String Geometries. *Submitted to Phys. Rev. Lett.* arXiv:1711.06685 (2017).

In Preparation

- [1] M. Boguñá, W. J. Cunningham & D. Krioukov, Discrete Cosmology, Inflation, and the Emergence of Geometry. *In preparation* (2017).

Open-Source Code

- [1] W. J. Cunningham, Causal Set Generator. [Bitbucket: CausalSetGenerator](#) (2017).
- [2] W. J. Cunningham, FastMath Library. [Bitbucket: 2015_code_fastmath](#) (2015).

Awards and Affiliations

Member of Sigma Pi Sigma National Physics Honor Society, United States	2013
Member of Phi Sigma Kappa Gamma Tetarton Chapter, United States	2010
Recipient of the Rensselaer Medal Undergraduate Merit Scholarship of USD \$100,000	2009 – 2013

Conferences and Meetings

Invited Talks

Inference of Boundaries in Causal Sets	UNIVERSITÄT HEIDELBERG (<i>Jun. 2018</i>)
Deep Learning in Quantum Gravity Quantum Gravity on the Computer	NORDITA (<i>Mar. 2018</i>)
Vacuum Selection from Cosmology Using Networks of String Geometries	RENSSELAER POLYTECHNIC INSTITUTE (<i>Jan. 2018</i>)
The Big Data Approach to Quantum Gravity	PERIMETER INSTITUTE (<i>Dec. 2017</i>)
Network Science: Data and Algorithms 2017 Workshop on Data Science and String Theory	NORTHEASTERN UNIVERSITY (<i>Nov. 2017</i>)
Timelike Boundaries in Directed Acyclic Graphs Working Meeting on Causal Sets	RAMAN RESEARCH INSTITUTE (<i>Dec. 2016</i>)
Boundary Terms in Causal Sets Working Meeting on the Quantum Measure and Causal Sets	RAMAN RESEARCH INSTITUTE (<i>Jan. 2016</i>)
Introduction to GPU Programming Working Meeting on the Quantum Measure and Causal Sets	RAMAN RESEARCH INSTITUTE (<i>Jan. 2016</i>)

Contributed Talks

Inference of Boundaries in Causal Sets International School and Conference on Network Science	PARIS (<i>Jun. 2018</i>)
Recovering the Einstein-Hilbert Action from Causal Sets International School and Conference on Network Science	SEOUL (<i>Jun. 2016</i>)

Attended

Working Meeting on Causal Sets	PERIMETER INSTITUTE (<i>Sept. 2017</i>)
Making Quantum Gravity Computable	PERIMETER INSTITUTE (<i>Jun. 2017</i>)
2016 ACM/IEEE Supercomputing Conference	SALT LAKE CITY (<i>Nov. 2016</i>)
XXVI IUPAP Conference on Computational Physics	BOSTON UNIVERSITY (<i>Aug. 2014</i>)
International School and Conference on Network Science	U.C. BERKELEY (<i>Jun. 2014</i>)

Academic Service

Journal Reviews

Classical and Quantum Gravity	2017 – 2018
Astrophysics and Space Science	2017
EPJ Data Science	2017

Proposal Reviews

National Science Foundation IIS: Big Data Science & Engineering	2016
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Departmental Seminars

High Performance Algorithms for Quantum Gravity and Cosmology	May 2018
Recovering the Einstein-Hilbert Action from Causal Sets	Apr. 2016
Navigability and Dark Energy in Causal Set Networks	Feb. 2015

Technical Skills

Expert

C, CUDA (GPU Programming), Intel SSE/AVX, MPI, OpenMP, Bash, RedHat/Centos Linux, LSF and SLURM, Mathematica, L^AT_EX

Proficient

C++, Python, C#, Gentoo Linux, Ubuntu/Debian Linux, Git, Systems Administration

Working Knowledge

Intel x64 Assembly, TensorFlow, MATLAB, OpenCL, POSIX Threading, Adobe Photoshop/Illustrator, Java

Limited Experience

Fortran 77, Perl, PHP, MySQL, HTML, Regular Expressions, Xeon Phi Programming, Intel MKL, Arch Linux

Teaching

Teaching Assistant

Northeastern University

2013 – 2014

Assistant for Introduction to Network Science

Laboratory Assistant for Physics 1 and 2

Rensselaer Polytechnic Institute

Fall 2011

Laboratory Assistant for Physics 2

Languages

English (native)

Professional References

Dmitri Krioukov

NORTHEASTERN UNIVERSITY

Associate Professor of Physics, Mathematics, and Electrical & Computer Engineering

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Sumati Surya

RAMAN RESEARCH INSTITUTE

Professor of Physics

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James Halverson

NORTHEASTERN UNIVERSITY

Assistant Professor of Physics

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