

# Evan McDonough

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## Research Interests

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Connections between high energy theoretical physics and cosmology, astrophysics, gravitational waves, dark matter, and dark energy.

## Academic Appointments

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2020 - :	University of Chicago <a href="#">Kavli Fellow</a> , <a href="#">Enrico Fermi Fellow</a> Faculty contact: Wayne Hu, Rocky Kolb
2020:	Massachusetts Institute of Technology <a href="#">Banting Fellow</a> Faculty contact: Alan Guth, David Kaiser
2017-2020:	Brown University Post-Doctoral Research Associate, <a href="#">Presidential Scholar</a> Post-doctoral Researcher Faculty contact: Stephon Alexander, Jim Gates

## Education

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2012-2017:	McGill University Ph.D. Physics
2008-2012:	McGill University Hon. B.Sc. Physics

## Publications

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Summary statistics:  $h$ -index:16, 734 total citations, 27 published papers, 30 papers & preprints.

Student collaborators under my supervision are underlined>.

### 2020:

30. S. Alexander, E. McDonough, and David N. Spergel, *Strongly-Interacting Ultralight Millicharged Particle (STUMP) Neutron Stars as Dark Matter Halos*. Preprint available at [[arXiv:2011.06589](https://arxiv.org/abs/2011.06589)].
29. S. Alexander, L. Jenks and E. McDonough, *Higher Spin Dark Matter*. Preprint available at [[arXiv:2010.15125](https://arxiv.org/abs/2010.15125)].
28. E. McDonough, A. H. Guth, D. I. Kaiser, *Nonminimal Couplings and the Forgotten Field of Axion Inflation*. Preprint available at [[arXiv:2010.04179](https://arxiv.org/abs/2010.04179)].
27. M. M. Ivanov, E. McDonough, J. C. Hill, M. Simonović, M. W. Toomey, S. Alexander, and M. Zaldarriaga, *Constraining Early Dark Energy with Large-Scale Structure*. Phys. Rev. D 102 (2020) 103502 . [[arXiv:2006.11235](https://arxiv.org/abs/2006.11235)].
26. J. C. Hill, E. McDonough, M. W. Toomey and S. Alexander, *Early Dark Energy Does Not Restore Cosmological Concordance*. Editors suggestion, Phys. Rev. D 102 (2020) 4, 043507 . [[arXiv:2003.07355](https://arxiv.org/abs/2003.07355)].
25. S. Alexander, G. Herczeg, J. Liu and E. McDonough, *Chiral Symmetry and the Cosmological Constant*. Phys. Rev. D 102 (2020) 8, 083526. [[arXiv:2003.08416](https://arxiv.org/abs/2003.08416)].
24. E. McDonough, *The Cosmological Heavy Ion Collider: Fast Thermalization after Cosmic Inflation*. Phys. Lett. B 809 (2020) 135755. [[arXiv:2001.03633](https://arxiv.org/abs/2001.03633)].

### 2019:

23. S. Alexander, E. McDonough, A. Pullen and B. Shapiro, *Physics Beyond The Standard Model with Circular Polarization in the CMB and CMB-21cm Cross-Correlation*. JCAP **2001**, no. 01, 032 (2020) [[arXiv:1911.01418](https://arxiv.org/abs/1911.01418)].
22. S. Alexander, S. Gleyzer, E. McDonough, M. W. Toomey and E. Usai, *Deep Learning the Morphology of Dark Matter Substructure*. Ap. J. **15 893** (2020) [[arXiv:1909.07346](https://arxiv.org/abs/1909.07346)].
21. S. Alexander, S. J. Gates Jr. , L. Jenks, K. Koutrolikos, and E. McDonough, *Higher Spin Supersymmetry at the Cosmological Collider: Sculpting SUSY Rilles in the CMB*. JHEP **1910**, 156 (2019) [[arXiv:1907.05829](https://arxiv.org/abs/1907.05829)].
20. S. Alexander and E. McDonough, *Axion-Dilaton Destabilization and the Hubble Tension*. Phys. Lett. B **797** (2019) [[arXiv:1904.08912](https://arxiv.org/abs/1904.08912)].

19. R. Kallosh, A. Linde, E. McDonough, and M. Scalisi, *dS vacua and the Swampland*. JHEP 1903 (2019) 134 [[arXiv:1901.02022](#)].
18. S. Alexander, J. Bramberger, and E. McDonough, *Dark Disk Substructure and Superfluid Dark Matter*. Phys. Lett. B797 (2019) [[arXiv:1901.03694](#)].

**2018:**

17. S. Alexander and E. McDonough, *Primordial Circular Polarization in the Cosmic Microwave Background*. Phys. Lett. B 0370 (2018) 2693 [[arXiv:1811.05953](#)].
16. R. Kallosh, A. Linde, E. McDonough and M. Scalisi, *4d models of dS uplift in KKLT*. Phys.Rev. D99 (2019) no.4, 046006 [[arXiv:1809.09018](#)].
15. S. Alexander, E. McDonough, R. Sims and N. Yunes, *Hidden-Sector Modifications to Gravitational Waves From Binary Inspirals*, Class. Quant. Grav. 35, no. 23, 235012 (2018) [[arXiv:1808.05286](#)].
14. R. Kallosh, A. Linde, E. McDonough and M. Scalisi, *de Sitter Vacua with a Nilpotent Superfield*. Fortschr. Phys. 2018, 1800068 [[arXiv:1808.09428](#)].
13. K. Dasgupta, M. Emelin, E. McDonough, and R. Tatar, *Quantum Corrections and the de Sitter Swampland Conjecture*. JHEP **1901**, 145 (2019) [[arXiv:1808.07498](#)].
12. S. Alexander and E. McDonough, *Observable Chiral Gravitational Waves from Inflation in String Theory*. JCAP 1811, no. 11, 030 (2018) [[arXiv:1806.05684](#)].
11. S. Alexander, E. McDonough, and D. N. Spergel, *Chiral Gravitational Waves and Baryon Superfluid Dark Matter*, JCAP 1805, no. 05, 003 (2018) [[arXiv:1801.07255](#)].

**2013-2017:**

10. H. Bazrafshan Moghaddam, E. McDonough, R. Namba, and R. H. Brandenberger, *Inflationary magneto-(non)genesis, increasing kinetic couplings, and the strong coupling problem*, Class. Quant. Grav. 35, no. 10, 105015 (2018) [[arXiv:1707.05820](#)].
9. S. Alexander, E. McDonough, and R. Sims, *V-mode Polarization in Axion Inflation and Preheating*, Phys. Rev. D 96, no. 6, 063506 (2017) [[arXiv:1704.00838](#)].
8. E. McDonough and M. Scalisi, *Inflation from Nilpotent Kähler Corrections*, JCAP 1611, no. 11, 028 (2016) [[arXiv:1609.00364](#)].
7. K. Dasgupta, M. Emelin, and E. McDonough, *Fermions on the Anti-Brane: Higher Order Interactions and Spontaneously Broken Supersymmetry*, Phys. Rev. D 95, 026003 [[arXiv:1601.03409](#)].
6. E. McDonough, H. B. Moghaddam, and R. H. Brandenberger, *Preheating and Entropy Perturbations in Axion Monodromy Inflation*, JCAP 1605 (2016) 012 [[arXiv:1601.07749](#)].
5. K. Dasgupta, M. Emelin, and E. McDonough, *Non-Kähler Resolved Conifold, Localized Fluxes in M-Theory and Supersymmetry*, JHEP 1502 (2015) 179 [[arXiv:1412.3123](#)].

4. L. P. Levasseur and E. McDonough, *Backreaction and Stochastic Effects in Single Field Inflation*, Phys.Rev. D91 (2015) 063513 [[arXiv:1409.7399](#)].
3. K. Dasgupta, R. Gwyn, E. McDonough, M. Mia, and R. Tatar. *de Sitter Vacua in Type IIB String Theory: Classical Solutions and Quantum Corrections*, JHEP 1407, 054 (2014) [[arXiv:1402.5112](#)].
2. Y. -F. Cai, E. McDonough, F. Duplessis and R. H. Brandenberger, *Two Field Matter Bounce Cosmology*, JCAP 1310, 024 (2013) [[arXiv:1305.5259](#)].
1. E. McDonough and R. H. Brandenberger, *Searching for Signatures of Cosmic String Wakes in 21cm Redshift Surveys using Minkowski Functionals*, JCAP 1302, 045 (2013) [[arXiv:1109.2627](#)].

## Student Mentoring and Research Supervision

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### Density Perturbations Group, MIT

Mentor and research supervisor to five (5) undergraduate students in the Density Perturbations Group (DPG) at the MIT, led by Alan Guth and David Kaiser.

### Presidential Scholars Program, Brown University

Mentor, tutor, and advisor to undergraduate [Presidential Scholars](#) at Brown University.

### Graduate Research Supervision:

8. Jinglong Lui, 2019-2020.  
Master's research, *Baryogenesis and The Cosmological Constant Problem*.
7. Shuangpeng Lin, 2019-2020.  
Master's research, *Higher-Spin Fermions at the Cosmological Collider*.
6. Michael Toomey, 2018 - 2019.  
Master's research thesis, *Machine Learning Dark Matter Substructure*. Accepted to Brown University PhD program. Published paper under my supervision.
5. Bradley Shapiro, 2017 - 2019.  
Master's research thesis, *The Circular Polarization of the Cosmic Microwave Background*. Accepted to Dartmouth College PhD program. Published paper under my supervision.
4. Leah Jenks, 2017-  
Doctoral research, *Cosmological Collider Physics*. Published paper under my supervision.
3. Robert Sims, 2017-2018.  
Doctoral research, *New Probes of Dark Matter*. Published two papers under my supervision.
2. Athira Sanal, 2017-2019 .  
Master's research, *On Superfluid Cores Of Dark Matter Halos*. Research presented at APS April meeting 2019. Accepted to Dartmouth College PhD program.

1. Xiao Zhou, 2018 - 2019.  
Master's research, *An Ultra-Light Dark Disk Universe*. Accepted to Northwestern University PhD program.

#### Undergraduate Research Supervision:

7. **MIT Density Perturbations Group:** Vedang Lad, Michelle Xu, Kiriakos Hilbert, Sami Kaya, Ellen Lee. Undergraduate research, *Primordial Black Holes from First Principles*
6. Kaushik Srinivasan Harith, 2020.  
Undergraduate research project, *Tensions in CMB Data*.
5. Sarah Bawabe, 2019.  
Undergraduate research project, *Reheating in Orbital Inflation*. Research presented at the MIT Eighth Annual Undergraduate Cosmology Workshop.
4. Griffin Edwards, 2019.  
Undergraduate research project, *Reheating in Orbital Inflation*. Research presented at the MIT Eighth Annual Undergraduate Cosmology Workshop.
3. Dante Sanchez, 2019.  
Undergraduate research project, *Numerical Simulations of Fuzzy Dark Matter Solitons*.
2. Kairy Herrera, 2018.  
Undergraduate research thesis, *Investigations on Superfluid Dark Matter*.
1. Stellen Bechtel, 2019.  
Summer reading course, *Early Universe Cosmology*.

## Selected Awards and Honours

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Selected awards and prizes totaling \$311,000 .

Banting Fellowship, Government of Canada.

2020. \$140,000. *National Prize Postdoctoral Fellowship*

Post-Doctoral Fellowship (PDF), Natural Sciences and Engineering Research Council (NSERC)

2017-2019, \$90,000. *National Award*.

P. R. Wallace Thesis Prize, Canadian Association of Physicists,

2019. *National award for best Doctoral thesis*.

Prix Meilleur Etudiant, Centre de Recherches Mathematiques (CRM)

2017, \$1,000. *National award for Doctoral research*.

Post-Graduate Scholar Doctoral fellowship (PGS D), Natural Sciences and Engineering Research Council (NSERC).

2014-2017, \$63,000. *National award.*

Lorne Trottier Science Accelerator Fellowship, McGill University

2014, \$5,000. *Award from McGill University.*

Wolfe Fellowship in Scientific and Technological Literacy, McGill University

1/2015 - 4/1015, \$12,000. *Award funded from the WOCO foundation (and administered by McGill University), awarded on the basis of high academic standing, community involvement, and athletic activities.*

## Teaching

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### **Guest Lecturer**

PHYS 0150: The Jazz of Physics

Fall 2017, Fall 2018, Fall 2019. Brown University

Enrollment: 40 students.

*Designed and gave 6 lectures per term.*

### **Course Co-Instructor**

PHYS 743: Very Early Universe

Fall 2016, McGill University

Enrollment: 11 students.

*Designed and organized the course, gave four lectures, and assessed student performance. Utilized the 'just in time' teaching method.*

### **Course Organizer**

PHYS 731: Mathematical Methods of High Energy Physics (Special Topics Course)

Winter 2013, McGill University

Enrollment: 4 students.

*Organized and led a reading course on mathematical aspects of higher energy physics, for graduate students at McGill University.*

### **Lecturer:**

Summer Lectures on Topological Defects and Cosmology

May-June 2012, McGill University.

*Lecture series (8 lectures) on topological defects (e.g. cosmic strings, monopoles) and their observational signatures to undergraduate and graduate students at McGill University.*

### **Tutoring:**

*Volunteer physics tutor, Medlife McGill fundraiser for children in developing nations (Fall 2012). Calculus tutor for MATH 140-141 (May-June 2012). Physics tutor for McGill Physics Helpdesk (Fall 2011 - Winter 2012).*

## Professional Service and Activities

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**Diversity and Inclusion Committee:** Serving member and post-doc representative on the Departmental Diversity and Inclusion Action Plan (DDIAP) committee, Brown University Physics department.

**Referee for journals:** Referee for *Physical Review Letters*, *Journal of High Energy Physics*, *Physical Review D*, and *European Physics Journal C*.

**Conference Co-organizer:** *String Theory and Cosmology*, June 15 - 16, 2019. Gordon Research Seminar, Barcelona, Spain.

**Workshop Co-organizer:** *Northeast Cosmology Workshop*, March 16-18, 2018. Workshop at McGill University.

**Seminar Series Organizer:** *Brown Physics Post-Doc Journal Club*, 2018-2019, Brown University.

**Session Chair:** "Quantum Gravity and Gravitational Waves", *Theory Canada 13* June 7-10, 2018. National conference at St. Francis-Xavier University.

**Seminar Series Organizer:** *High Energy Theory Journal Club*, 2015-2017, McGill University.

**Webmaster for the High Energy Physics Seminars Listing Website:** Fall 2015 - 2017.

## Seminars and Invited Talks

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31. Invited talk at the Massachusetts Institute of Technology, Joint MIT/Tufts cosmology seminar, *Constraining Early Dark Energy with Large Scale Structure*. Oct. 20, 2020.
30. Invited talk at MPA Garching, *Constraining Early Dark Energy with Large Scale Structure*. Oct. 20, 2020.
29. Invited talk at PACMAN (Particle Astro/Cosmo Meeting Around NYC) seminar, *Ultra-light Fermionic Dark Matter: Halo Cores as Dark Neutron Stars*. Oct. 13, 2020.
28. Invited talk at Copernicus Webinar Series, *Constraining Early Dark Energy with Large Scale Structure*. July 23, 2020.
27. Invited talk at the Theoretical Cosmology, Gravity and Fields Workshop, Dartmouth College. *Constraining Early Dark Energy with Large Scale Structure*. July 21, 2020.
26. Invited talk at University of Illinois Urbana-Champaign, *Gravitational Lamp Posts for Dark Matter Physics*. Dec. 6, 2019.
25. Invited talk at Northeastern University, *The Chirality of Primordial Gravitational Waves*. Sept. 30, 2019.

24. Invited talk at Theory Canada 14, *New (Old) Gravitational Probes of Dark Matter*. May 31, 2019.
23. Invited Lecture at Atlantic General Relativity 2019, *Primordial Cosmology and High Energy Physics*. May 27, 2019.
22. Seminar at the Flatiron Institute, Center for Computational Astrophysics, *Strong Gravity Probes of Dark Matter*. May 1, 2019
21. Seminar at the ETH Zurich, *The Chirality of Primordial Gravitational Waves*. March 22, 2019
20. Seminar at the Max Planck Institute for Astrophysics (MPA) Garching, *The Chirality of Primordial Gravitational Waves*. March 19, 2019
19. Seminar at the Syracuse University, *The Chirality of Primordial Gravitational Waves*, Dec 11, 2018.
18. Seminar at the Massachusetts Institute of Technology, *The Chirality of Primordial Gravitational Waves*, Dec 11, 2018.
17. Invited Speaker at [Canadian Association of Physicists \(CAP\) Congress 2018](#), June 11-15, 2018. Dalhousie University, Halifax, Nova Scotia.
16. Session Chair and contributed talk at the [Theory Canada 13](#), June 7-9, 2018. St. Francis Xavier University, Antigonish, Nova Scotia.
15. Invited speaker at conference [New England Cosmology Workshop](#), October 13-14, 2018. Massachusetts Institute of Technology.
14. Seminar at the Dartmouth College, *Chiral Gravitational Waves and Baryon Superfluid Dark Matter*, May 2, 2018.
13. Seminar at the University of Pennsylvania, *Chiral Gravitational Waves and Baryon Superfluid Dark Matter*, April 26, 2018.
12. Seminar at the New York University, *Chiral Gravitational Waves and Baryon Superfluid Dark Matter*, April 17, 2018.
11. Seminar at the Institute for Advance Study, Princeton, *Chiral Gravitational Waves and Baryon Superfluid Dark Matter*, March 12, 2018.
10. Seminar at Harvard University, Dvorkin-Finkbeiner-Kovacs journal club, *Chiral Gravitational Waves and Baryon Superfluid Dark Matter*, February 20, 2018.
9. Seminar at Tufts University, *Anti-Brane Induced Inflation*, November 14, 2017.
8. Invited speaker at conference [String Theory and Cosmology: Cosmic Origin and Cosmic Fate, From Big Bang to Dark Energy](#) May 27-28, 2017, Italy.
7. Seminar at Brown University, *Primordial Black Holes and Preheating in Axion Inflation*, April 26, 2016.



6. Contributed talk, *Fermions on the Antibrane*, at the workshop [Northeast Gravity Workshop](#), April 22-24, 2016, hosted by UMass Amherst.
5. Seminar at the Massachusetts Institute of Technology, *Preheating in Axion Inflation Models*, April 12, 2016.
4. Seminar at the University of California at Berkeley, *Fermions on the Anti-Brane: Higher Order Interactions and Spontaneously Broken Supersymmetry*, March 1, 2016.
3. Seminar at the University of Chicago, *de Sitter in String Theory: A story of branes, planes, and quantum corrections*, June 12, 2014.
2. Seminar at Ecole Physique Les Houches, *Pour some SUGRA on me: Supergravity and Superconformal Gauge Theory*, while attending summer school *Post-Planck Cosmology*, July 3 - August 3, 2013.
1. Contributed talk, *Two Field Matter Bounce Cosmology*, at the conference [Theory Canada 8](#), May 24-26, 2013, hosted by Bishop's University.