Mark C. Neyrinck

Curriculum Vitæ

Dept of Physics and Astronomy
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Born in Colorado; Citizen of USA

Education

Ph.D. Astrophysics, University of Colorado at Boulder (Thomas Award) *Dec 2005*
Ph.D. Thesis: "Illuminating the Tips of Dark-Matter Icebergs"
Advisors: Andrew J. S. Hamilton, Nickolay Y. Gnedin

M.S. Astrophysics, University of Colorado at Boulder (High Pass) *Dec 2002*

B.A. Physics, w/spec. in Astr, University of Chicago (Honors; Lewis Prize) *June 2000*

Mathematics, Part IB, Pembroke College, **Cambridge University** *1998-1999*

International Baccalaureate Diploma *May 1995*
Extended Essay: "Fractionally and Infinitely Iterated Exponentiation"

Selected Awards and Grants

PI, Templeton New Frontiers in Astronomy and Cosmology Award/Grant
Only non-faculty recipient. "Information Flowing and Folding into Complexity" *2012*

Recipient, JHU Digital Media Center Creative Use of Technology Grant, funding a "folding lab" in my "Origami Mathematics and Cosmology" class *2015*

Collaborator, NASA Grants, "Reconstructing Information in Large-Scale Structure via Logarithmic Mapping," "Detecting Dark Energy from WMAP and Pan-STARRS1 Cross-correlations" *2010, 2011*

Richard N. Thomas Award, annual award for outstanding research by a graduating University of Colorado Astrophysics PhD student *2005*

Small Allocations, annual, NCSA/XSEDE *2001-2004, 2012*

Lewis Prize, for the "**best graduating senior in physics," University of Chicago** *2000*

Donnelley Fellowship for one year at Cambridge University, awarded to one undergraduate per year at the University of Chicago *1998*

High-School **Valedictorian**, **National Merit Scholarship** *1995*

Employment

Course Instructor, "Origami Mathematics and Cosmology", JHU *Intersession, Jan 2015*

Asst/Assoc. Research Scientist with PI status, Johns Hopkins *Summer 2011-Present*

W. M. Keck Fellow, Johns Hopkins University *Fall 2008-Summer 2011*

Postdoctoral Researcher, Institute for Astronomy, U. of Hawaii *Fall 2005-Summer 2008*

Course Instructor of Record ("Black Holes"), APS Dept., U. of Colorado *Summer 2005*

Research Assistantship, JILA, Univ. of Colorado *Summer 2000-Fall 2004*

Teaching Assistantship, APS Dept., U. of Colorado *Fall 2000, Fall 2002, Spring 2005*

Teaching Assistantship, Math Dept., U. of Chicago *1997-1998, 1999-2000*

Principal Achievements

- I discovered a simple way to enhance the power of conventional large-scale-structure studies: Gaussianizing transforms. This will lead to a **deeper understanding, and tighter constraints, on cosmic structure formation and the cosmological and galaxy-formation physics** driving it.
- I discovered an engaging **"origami" analogy for structure formation**, which helps to understand information loss in the cosmos, and how angular momentum in a galaxy is related to its environment.
- I pioneered **techniques to detect and analyze cosmic voids** for cosmological constraints. With my premier void-finder ZOBOV, we made the **first detection of the cold imprints of voids** on the **cosmic microwave background**, a **sign of dark energy**.

Popular Media Attention for Work

Interview and segment about the link between origami and cosmology in "The Origami Code," upcoming Franco-German documentary film by director François Vives., 2015

"How to Make an Origami Universe," Battersby, Stephen, *New Scientist*, 20 Dec 2014

"The Origami Cosmic Web of Galaxies," invited blog post, *The Huffington Post,* 11/17/2012

"Dark energy 'imaged' in best detail yet," Merali, Zeeya, *New Scientist,* 19:40 23 May 2008

"Dark Energy's Early Fingerprints," Carlisle, C. M., *Sky & Telescope* online, Aug 6, 2008.

Selected Recent Presentations and Invitations

Talk, "Local Group Astrostatistics" workshop, Ann Arbor, MI *June 2015*

Invited speaker, "Advanced Workshop on Cosmological Structures from Reionization to Galaxies: Combining Efforts from Analytical and Numerical Methods," Trieste, Italy *May 2015*

Invited speaker, National Society of Black Physicists conference, Baltimore, MD *Feb 2015*

Sloan 3 BOSS meeting *Dec 2014*

Invited CITA Seminar *November 2014*

"The Galaxy-Halo Connection Across Cosmic Time" workshop, Aspen Center for Physics *September 2014*

Plenary talk, co-organizer of "Cosmic Voids in the Next Generation of Galaxy Surveys" workshop, Ohio State University *August 2014*

Talk at 6OSME: The 6th International Meeting on Origami in Science, Mathematics, and Education, Tokyo *August 2014*

Seminar, University of Nagoya, Japan *August 2014*

Seminar, Institute for Astronomy, Hawaii *August 2014*

Talk, Santa Fe Cosmology Workshop *July 2014*

Invited talk, Collisionless Fluids Workshop, IAP, Paris *July 2014*

Invited talk, IAU Symposium 308: The Zel'dovich Universe, Tallin, Estonia *June 2014*

LSST Dark Energy Science Collaboration meeting, Philadelphia *June 2014*

Invited talk, IAU Symposium 306: Statistical Challenges in 21st Century Cosmology, Lisbon, Portugal *May 2014*

Invited talk, "Tracing the Cosmic Web," Lorentz Center, Leiden, the Netherlands *Feb 2014*

SDSS BOSS collaboration meeting, Berkeley *Dec 2013*

CASA/JILA Astrophysics Lunch Seminar, U of Colorado, Boulder *Aug 2013*

Ripples in the Cosmos, Durham, UK *Jul 2013*

The Origin of the Hubble Sequence Conference, IAP, Paris *Jun 2013*

Invited Talk, Darklight Workshop, Varenna, Italy *June 2013*

Invited Talk, Cosmic Flows conference, Marseille *June 2013*

Cosmology Seminar, KICP, University of Chicago *Mar 2013*

Invited Seminar, Argonne National Lab *Mar 2013*

Templeton New Frontiers Award Conference, Franklin Institute, Philadelphia *Oct 2012*

Invited talk, Theoretical and Num. Methods in Nonlinear Cosmology Wkshp, CERN *Aug 2012*

Invited talk, 13th Marcel Grossmann Conference, Stockholm *Jul 2012*

Invited Colloquium, Columbia University Astronomy Department *Nov 2011*

Professional and Departmental Service

SOC, "Cosmic Voids in the Next Generation of Galaxy Surveys" workshop, Ohio State University *Aug 2014*

NASA Astrophysics Theory and Data Analysis Program panels (ATP, ADAP) *2011, 2012, 2014*

JHU Cosmology Journal Club (Cosmojo) founding and weekly organization *2009-present*
Head Organizer for IDIES (Institute for Data-Intensive Engineering and Science) *Aug 2009*
Inaugural Symposium/Alex Szalay's 60th Birthday "Szalaybration"
Colloquium Committee, UH Institute for Astronomy *2007-2008*
Colloquium committee, Holiday skit writing and organization, *2001-2004*
APS Dept., U of Colorado

Outreach Activities (hyperlinks in blue)

Involvement in "The Origami Code" documentary: interview and making animations *2015*
JHU Physics & Astronomy Dept Physics Fair contributions and volunteering *2010-2014*
Development of "Fold Your Own Galaxy" origami activity, and *2012-2014*
"Fold Your Own Universe" NASA SpaceApp
USA Science & Engineering Festival (Wash, DC) contributions and volunteering *Oct 2010*
UH Institute for Astronomy Open Houses *2006-2008*
Supervising the "Astronomy" and "Reach for the Stars" events for *2001, 2003, 2004, 2005*
Colorado Science Olympiad (middle and high school) competitions
Running open houses at Boulder's Sommers-Bausch Observatory *2000-2004*

Selected Paper in Preparation

1. **Neyrinck**, Mark C., invited review article to Physics Reports, in prep.
"Optimizing the information extracted from non-Gaussian fields using nonlinear transforms"

Submitted and Accepted Refereed Publications (blue text is linked to ADS abstracts)

2. **Neyrinck**, Mark C. 2015, MNRAS Letters, submitted.
Truthing the stretch: Non-perturbative cosmological realizations with multiscale spherical collapse
3. Alam, Shadab, … **Neyrinck**, Mark C., et al. 2015, submitted to ApJS.
The Eleventh and Twelfth Data Releases of the Sloan Digital Sky Survey: Final Data from SDSS-III
4. Aragon-Calvo, M., **Neyrinck**, Mark C., Silk, J., 2014, MNRAS Letters, submitted
Star Formation Isochrone Surfaces: Clues on Star Formation Quenching in Dense Environments
5. Yang, F. Y., **Neyrinck**, Mark C., … Silk, J., 2014; MNRAS, in press.
Warmth Elevating the Depths: Shallower Voids with Warm Dark Matter
6. **Neyrinck**, Mark C., 2015; MNRAS, in press.
Kolmogorov complexity in the Milky Way and its reduction with warm dark matter
7. **Neyrinck**, Mark C., 2014; accepted after refereeing to Origami^6: Proceedings of the 6th International Meeting on Origami in Science, Mathematics, and Education.
Cosmological Origami: Properties of Cosmic-Web Components when a Non-Stretchy Dark-Matter Sheet Folds
8. Hoffmann, K.; … **Neyrinck**, Mark C., et al. (17 authors), 2014, MNRAS, 442, 1197
Subhaloes gone Notts: subhaloes as tracers of the dark matter halo shape
9. **Neyrinck**, Mark C.; Aragon-Calvo, M. A.; Jeong, D.; Wang, X., 2014, MNRAS, 441, 646
A halo bias function measured deeply into voids without stochasticity
10. Cai, Y-C; **Neyrinck**, Mark C.; et al. (5 authors), 2014, ApJ, 786, 110
A Possible Cold Imprint of Voids on the Microwave Background Radiation
11. Cai, Y-C; ... **Neyrinck**, Mark C.; et al. (5 authors), 2014, MNRAS, 439, 2978
The Integrated Sachs-Wolfe effect in f(R) gravity
12. Achitouv, Ixandra, **Neyrinck**, Mark; Paranjape, Aseem, 2013, MNRAS, submitted
Testing spherical evolution for modelling void abundances
13. Wang, Xin, ... **Neyrinck**, Mark et al. (5 authors), 2014, ApJ, 793, 58
Kinematic Morphology of Large-Scale Structure: Evolution from Potential to Rotational Flow
14. Pujol, A., ..., **Neyrinck**, Mark C., et al., 2014, MNRAS, 438, 3205
Subhaloes gone Notts: the clustering properties of subhaloes
15. Knebe, A., ..., **Neyrinck**, Mark C., et al. (21 of 35 authors), 2013, MNRAS, 435, 1618
Structure finding in cosmological simulations: the state of affairs

16. **Neyrinck**, Mark C. & Yang, L. F., 2013, MNRAS, 433, 1628
Ringing the initial Universe: the response of overdensity and transformed-density power spectra to initial spikes
17. Onions, J., ..., **Neyrinck**, Mark C., et al. (12th of 18 authors), 2013, MNRAS, 429, 2739.
Subhaloes gone Notts: spin across subhaloes and finders
18. Hernandez-Monteagudo, C., ..., **Neyrinck**, Mark C., et al. (7th of 15 authors), MNRAS, 438, 1724.
The SDSS-III Baryonic Oscillation Spectroscopic Survey: Constraints on the Integrated Sachs Wolfe effect
19. McCullagh, N., **Neyrinck**, Mark C., et al. (4 authors), ApJ Letters, 763, 14.
Removing BAO-peak shifts with local density transforms
20. **Neyrinck**, Mark C., 2013, MNRAS, 428, 141
Quantifying distortions of the Lagrangian dark-matter mesh in cosmology
21. **Neyrinck**, Mark C., 2012, MNRAS, 427, 494.
Origami constraints on the initial-conditions arrangement of streams and caustics
22. Onions, J., ... **Neyrinck**, Mark C. et al. (17 authors), 2013, MNRAS, 429, 2739
Subhaloes gone Notts: Spin across subhaloes
23. Falck, B., **Neyrinck**, Mark C., & Szalay, A, 2012, ApJ, 754, 126
ORIGAMI: Delineating haloes using phase-space folds
24. Onions, J., ... **Neyrinck**, Mark C. et al. (17 authors), 2012, MNRAS, 423, 1200
SubHaloes Going Notts: The SubHalo-Finder Comparison Project
25. Carron, J., & **Neyrinck**, Mark C., 2012, ApJ, 750, 28
On the inadequacy of N-point correlation functions to describe nonlinear cosmological fields: Explicit examples and connection to simulations
26. Falck, B., **Neyrinck**, Mark C., Lavaux, G, Aragon-Calvo, M. & Szalay, A, 2012, ApJ, 745, 17.
Straightening the Density-Displacement Relation with a Logarithmic Transform
27. **Neyrinck**, Mark C., 2011, ApJ, 742, 91
Rejuvenating the Matter Power Spectrum III: The Cosmology Sensitivity of Gaussianized Power Spectra
28. **Neyrinck**, Mark C., 2011. ApJ, 736, 8.
Removable Matter-power-spectrum Covariance from Bias Fluctuations
29. Wang, X., **Neyrinck**, Mark C., et al. (8 authors), 2011. ApJ, 735, 32.
Perturbation Theory of the Cosmological Log-density Field
30. Knebe, A., … **Neyrinck**, Mark C., et al. (37 authors), 2011. MNRAS, 415, 2293.
Haloes gone MAD: The Halo-Finder Comparison Project
31. Tian, H.J., **Neyrinck**, Mark C., Budavári, T., & Szalay, A.S., 2011. ApJ, 728, 34.
Redshift-Space Enhancement of Line-of-Sight Baryon Acoustic Oscillations in the SDSS Main-Galaxy Sample
32. **Neyrinck**, Mark C., Szapudi, I., & Szalay, A.S., 2011. ApJ, 731, 116.
Rejuvenating Power Spectra II: the Gaussianized galaxy density field
33. Granett, B. R., Szapudi, I., & **Neyrinck**, Mark C., 2010. ApJ 714, 825.
Galaxy Counts on the Cosmic Microwave Background Cold Spot
34. Granett, B. R., **Neyrinck**, Mark C., & Szapudi, I., 2009. ApJ 701, 414.
A Map of the Integrated Sachs-Wolfe Signal from Luminous Red Galaxies
35. **Neyrinck**, Mark C., Szapudi, I., & Szalay, A. S., 2009. ApJ 698, L90.
Rejuvenating the Matter Power Spectrum: Restoring Information with a Logarithmic Density Mapping
36. Granett, B. R., **Neyrinck**, Mark C., & Szapudi, I., 2008. ApJ 683, L99.
An Imprint of Superstructures on the Microwave Background due to the Integrated Sachs-Wolfe Effect
37. Colberg, J. M., … **Neyrinck** M. C., et al., 2008. MNRAS 387, 933.
The Aspen-Amsterdam void finder comparison project
38. **Neyrinck**, Mark C., 2008. MNRAS 386, 2101.
ZOBOV: a parameter-free void-finding algorithm
39. **Neyrinck**, Mark C. & Szapudi, I., 2008. MNRAS 384, 1221.
Baryon oscillations in galaxy and matter power-spectrum covariance matrices

40. **Neyrinck**, Mark C. & Szapudi, I., 2007. MNRAS 375, L51.
Information content in the halo-model dark-matter power spectrum - II. Multiple cosmological parameters
41. **Neyrinck**, Mark C., Szapudi, I., & Rimes, C. D., 2006. MNRAS 370, L66.
Information content in the halo-model dark-matter power spectrum
42. **Neyrinck**, Mark C., Hamilton, A. J. S., & Gnedin, N. Y., 2005. MNRAS 362, 337.
A galaxy-halo model of large-scale structure
43. **Neyrinck**, Mark C., Gnedin, N. Y., & Hamilton, A. J. S., 2005. MNRAS 356, 1222.
VOBOZ: an almost-parameter-free halo-finding algorithm
44. **Neyrinck**, Mark C., Hamilton, A. J. S., & Gnedin, N. Y., 2004. MNRAS 348, 1.
Understanding the PSCz galaxy power spectrum with N-body simulations
45. Gnedin, N. Y., … **Neyrinck**, M. C., et al., 2003. ApJ 583, 525.
Linear Gas Dynamics in the Expanding Universe

Leniently Refereed Conference Proceedings

43. **Neyrinck**, Mark C., 2014, Proceedings for The Zeldovich Universe: Genesis and Growth of the Cosmic Web", 23-28 June 2014, Tallinn, Estonia.
An Origami Approximation to the Cosmic Web
44. **Neyrinck**, Mark C., 2014, Proceedings for "Statistical Challenges in 21st Century Cosmology," IAU Symposium No. 306, Lisbon, May 2014.
Transformationally decoupling clustering and tracer bias
44. **Neyrinck**, Mark C.; Falck, Bridget L.; Szalay, Alex S., 2015, proceedings of the 13th Marcel Grossmann Meeting, ORIGAMI: Delineating Cosmic Structures with Phase-Space Folds
45. **Neyrinck**, Mark C., & Shandarin, S.F., 2015, proceedings of "The World a Jigsaw: Tessellations in the Sciences."
Tessellating the cosmological dark-matter sheet: origami creases in the universe and how to find them
46. **Neyrinck**, Mark C., 2011. "Statistical Challenges of Modern Astronomy V" conf. proc.
Gaussianization: Enhancing the Statistical Power of the Power Spectrum
47. **Neyrinck**, Mark C., Hamilton, Andrew J. S., & Gnedin, Nickolay Y., 2003. ASSL 281, 203.
The PSCz Galaxy Power Spectrum Compared to N-Body Simulations

Software-Development Accomplishments

Expertise with *N*-body simulations, parallelization and running highly parallel applications
Developed CosmicEmuLog, a Python emulator of the cosmological log-density power spectrum
Developed CosmoPy, a package of Python code for cosmology
Developed the publicly available cosmological halo-finders VOBOZ and ORIGAMI, and the void-finder ZOBOV
Highly proficient in Python, C, FORTRAN, IDL, Java, Mathematica, and HTML
Have also used C++, Perl, Lisp, and Inform

Non-Astronomical Interests

Music composition, piano, creative writing, mathematics, origami

Professional References

1. **Prof. Alexander Szalay**, Department of Physics and Astronomy, Johns Hopkins University, 3400 N. Charles St., Baltimore, MD 21218, szalay@jhu.edu, (410) 516-7217

2. **Prof. Andrew J. S. Hamilton**, JILA and Dept of Astrophysical and Planetary Sciences, University of Colorado; Campus Box 440, Boulder, CO 80309 Andrew.Hamilton@colorado.edu, (303) 492-7833

3. **Prof. István Szapudi**, Institute for Astronomy, University of Hawaii 2680 Woodlawn Drive, Honolulu, HI 96822 szapudi@ifa.hawaii.edu, (808) 956-6196
4. **Prof. Joe Silk**, Department of Physics and Astronomy, Johns Hopkins University, 3400 N. Charles St., Baltimore, MD 21218 jsilk@pha.jhu.edu, (410) 516-2881
5. **Prof. Sergei Shandarin**, Department of Physics and Astronomy, 6070C Malott Hall, 1251 Wescoe Hall Dr., Lawrence, KS 66045, sergei@ku.edu, (785) 864-5274

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