David M. Goldberg

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DEGREES:

August, 2000
- Ph.D. Princeton University, Astrophysics
- Dissertation Topic: Using Perturbative Least Action to Run Simulations "Backwards in Time"
- Dr. David N. Spergel, adviser

June, 1998
- M.A. Princeton University, Astrophysics

June, 1996
- B.A. Boston University, Astronomy and Physics
- Minors in Mathematics and Religion
- Summa cum Laude with Distinction

POSITIONS HELD:

Drexel University College of Arts and Sciences, Philadelphia, PA.,
- Interim Associate Dean of Graduate Education and Research (September, 2008-September, 2009)

Drexel University Physics Dept., Philadelphia, PA.,
- Professor (September, 2012 -)
- Associate Professor (September, 2007 - August, 2011)
- Assistant Professor (September, 2001 - September, 2007)

Yale University Astronomy Dept., New Haven, CT.,
- Gibbs Lecturer in Astronomy (August, 2000 - September, 2001)

DREXEL HONORS AND AWARDS:

- Rothwarf Award for Teaching Excellence (2005)
- 10^6 Club for grants totalling $1 Million/year. (2003-2004)

SPONSORED RESEARCH:

Current Funding:

1. "Where is the Information in Cluster Lensing?" Funded by NSF Astronomy and Astrophysics. (2009-2013). Total Award: $150,000. PI.

Past Awards:

1. "BASIN: Beowulf Analysis Symbolic INterface." (2007-2009) Time allocation of 30,000 processing hours by the National Center for Supercomputing Applications, CyberInfrastructure Partnership. Co-I.
2. "Galaxy Flexion-Gravitational Lensing to Second Order." Funded by NASA Astrophysics Theory Program. (2005-2009). Total Award: $274,127. PI.
3. "Urban Astronomy in Philadelphia: Hands-On Student Observing and Teacher Enrichment ." Funded by NASA Education/Public Outreach supplemental program. (2005-2008). Total Award: $45K. PI.
4. "ITR: Beowulf Analysis Symbolic INterface." Funded by the NSF Information Technology Research program. (2003-2008). Total Award: $1.4M. Co-I.
5. "Measuring Gravitational Flexion in ACS Clusters." Funded by the HST archival program. (2005-2008). Total award: $68,555. PI.

6. "Measuring the Arciness in Arcs." Funded by the NSF Extragalactic program for FY 2003. Total Award: $25K. PI.
7. "Precision Observing in an Urban Observatory." Funded by the American Astronomical Society Small Research Grant program. $1.5K. PI.

RESEARCH INTERESTS:

Analysis of weak and strong gravitational lensing fields, with particular emphasis on higher order moments and the mass reconstruction of clusters of galaxies. The physics of the early universe. Determination of properties of galaxies in cosmological voids. Worked extensively on parameter estimation from observations, including measurement of cosmic baryon density from the galaxy power spectrum and determination of cosmological parameters from the Cosmic Microwave Background three-point correlation function.

A list of publications is attached.

RELATED ACTIVITIES:

- Reviewer/Referee
  - ◇ Invited panel to review content of Physics B (Algebra-based) AP Exam (2012)
  - ◇ INCITE review panel - helped to distribute 1.3 Billion computing hours for government supercomputing facilities (October, 2009).
  - ◇ Astrophysical Journal (2001-)
  - ◇ Astrophysical Journal Letters (2007-)
  - ◇ Monthly Notices of the Royal Astronomical Society (2008-)
  - ◇ Physical Review Letters (2007-)
  - ◇ Physical Review D (2002-)
  - ◇ NASA Education/Public Outreach Program (2007)
  - ◇ Selection Committee for Drexel University Rothwarf Award (2006-2008)
  - ◇ NASA Astrophysics Theory Program (2006)
  - ◇ Member of Pennsylvania Hospital Institutional Review Board (2002-2008)
  - ◇ Invited Reviewer for "Astronomy Today" (Chaisson & McMillan; Prentice Hall)
  - ◇ Invited Reviewer for "Matter and Interaction" (Chabay & Sherwood; Wiley)
- Public Outreach, including Several books/articles in popular science, both as author and editor (See publications and invited talks sections).
- Service
  - ◇ Member of the UAC Committee on Tenure Appeals (2010-2013)
  - ◇ Interim Associate Dean of Graduate Education and Research (2008-2009)
  - ◇ Physics Department Director of Undergraduate Studies (2007-)
  - ◇ Drexel University Faculty Senate (2007-2010)

TEACHING ACTIVITIES:

- Drexel Coursework
  - ◇ Taught courses in introductory/intermediate astronomy, introductory physics, graduate Electromagnetism, and graduate level galactic astrophysics, cosmology, Quantum Field Theory, and General Relativity.
- Drexel Committee Work
  - ◇ University Appeals Committee (2010-2013)
  - ◇ Chair of Search Committee for History and Politics Department Head (2010-2011).
  - ◇ Middlestates Student Enrollment and Support Steering Committee/Working Group (2010-2011)
  - ◇ College of Arts and Sciences Graduate Curriculum Committee (Chair; 2008-2009)
  - ◇ University Undergraduate Research Task Force (2008-2009)
  - ◇ Serve on Physics Dept. Curriculum committee (2001-; Chair 2007-)
  - ◇ Runs undergraduate advising program within the department. (2001-)

- ◇ Served on College of Arts and Sciences undergraduate curriculum committee. (2001-2002).

- Received NASA E/PO outreach grant to bring Philadelphia public school students to the Drexel Observatory. (2005-2008).
- Significant Activities Prior to Drexel
  - ◇ Gibbs Lectureship in Astronomy, Yale University. Co-instructed one-year introductory level course on observational astronomy. Also, directory of the student observatory. (2000-2001)
  - ◇ Founding faculty adviser of Yale Undergraduate Astronomical Society, "STARRY", (2000-2001).
  - ◇ Initiated and ran monthly public observing nights at Princeton University.

RESEARCH SUPERVISION

Supervised Postdoctoral Work:

1. Dr. Otonyo Mangete (co-supervised with Prof. Steve McMillan) (2007-2008).
2. Dr. Enrico Vesperini (co-supervised with Prof. Steve McMillan) (2004-2008)

Supervised Ph.D. Research

1. Sanghamitra Deb (2010). "Cluster Mass Reconstruction using Particle Based Lensing."
2. Austen Groener (2010-).
3. Justin Bird (2012-).

Supervised Graduate Student Research

1. Nicole DiGironimo (2003).
2. Tim Jones (2004).
3. Adrienne Leonard (2003-2005). Master's thesis.

Supervised Undergraduate Research

1. Sajjan Mehta (2011-2012). Senior thesis.
2. Will Giang (2011). STAR Scholar
3. Nick Sifroudis (2011). Undergraduate Summer Researcher.
4. Wendy Harris (2009-2011). STAR Scholar and co-op.
5. Mary Chessey (2009). STAR Scholar.
6. Alyssa Wilson (2008). Co-op and research Student.
7. Max Soloff (2007-2009). Co-op student and senior thesis.
8. Vede Ramdass (2007). Co-op student.
9. Doug Jones (2006-2008). Co-op student and part time researcher.
10. Jason Haaga (2006). Co-op student.
11. Anthony Dyszel (2005-2007). Co-op, part time research, and senior thesis.
12. Kara Blaine (2004). STAR Scholar.
13. Jaclyn Marcel (2003). Senior thesis.
14. Henry Winterbottom (2003). Senior thesis.
15. Pinkesh Patel (2003-2005). Co-op and research student.
16. Ernest Mamikonyan (2002). Co-op student.
17. Greg McIvor (2002-2003). Co-op and part time research.

Ph.D. Committees (non-supervising)

1. Ernest Mamikonyan (2012, planned). Title TBD.
2. Sean Lynch (2012, planned). Title TBD.
3. Runcong Liu (2012, planned). Title TBD.

4. Tim Jones (2012). "New Dynamical Insights on the Global Behavior of Chaotic Attractors."
5. Danny Pan (2011). "Ultraviolet Star Formation Rates of Dwarf Void Galaxies."
6. John Parejko (2010). "Hosts and Environments of Low Luminosity Active Galaxies in the Local Universe: The Care and Feeding of Weak AGN."
7. Jairzinho Ramos Medina. (2006). "Gravito Electromagnetism (GEM): A Group Theoretical Approach."
8. Jimin Gao. (2005). "A Numerical Study of an Asymmetric Breakout Model for CME Initiation."

MEMBERSHIPS:

- American Astronomical Society (1996-)
- Phi Beta Kappa (1995-)
- Sigma Xi (2007-2009)
- American Association of Physics Teachers (2012-)

COLLEGE AND GRADUATE SCHOOL HONORS:

- National Science Foundation Fellow, 1996
- College Awards in Astronomy and Physics, 1996
- Phi Beta Kappa, inducted 1995
- Case Scholarship for Academic Achievement, Boston University, 1995
- Trustee Scholarship, Boston University (Full Tuition Merit-Based)

BOOKS AND CHAPTERS

1. **Goldberg, Dave**. *The Universe in the Rearview Mirror: How Hidden Symmetries ShapeReality.* New York, Dutton (2013).
2. **Goldberg, Dave** & Blomquist, Jeff. *A User's Guide to the Universe: Surviving the Perils of Black Holes, Time Paradoxes, and Quantum Uncertainty.* Hoboken, Wiley (2010). Rated 4.4/5 stars on amazon.com, with very positive reviews by Publisher's Weekly and the Christian Science Monitor. Sales over 7,000 copies in hardcover, 1,000 copies in electronic editions.
3. S. Hawking, *The Dreams that Stuff Is Made Of: The Most Astounding Papers of Quantum Physics-And How they Shook the World.*, edited by **D. Goldberg** & J. Kasius. 2011. Running Press. Selected all works for inclusion in this anthology.
4. S. Hawking, *A Stubbornly Persistent Illusion: The Essential Works of Albert Einstein.*, 2007. Running Press. Ghostwrote section introductions attributed to Hawking, and credited as "Editor."

POPULAR SCIENCE AND MAGAZINE ARTICLES

1. **Dr. Dave Goldberg**, "Ask a Physicst," a bi-weekly column of questions posted by readers on io9.com. April 23, 2010-. Typical columns have between 10,000-100,000 readers, and elicit comments in the hundreds. Dozens of questions are submitted each week.
2. **Dave Goldberg**, "Space, Time, and the Viability of Wormholes," May 7, 2010. LA Times op-ed (syndicated in over a dozen local dailies).
3. **Dr. Dave Goldberg**, "To the Writers and Director of 'Hot Tub Time Machine,' from a Physics Professor," io9.com. A humorous take on the time travel in the movies.
4. **Dave Goldberg**, "Time Traveling for Dummies: A Physicist Looks at the Time Traveler's Wife" August 13, 2009. Slate.com magazine (syndicated in print in the Toronto Sun and elsewhere).

PUBLICATIONS AND INVITED TALKS

Refereed Journals:

Current h-index: 13

1. Deb, S., Morandi, A., Pedersen, K, Riemer-Sorensen, S., **Goldberg, D.M.**, & Dahle, H, 2012, Mass Reconstruction using Particle Based Lensing II: Quantifying substructure with Strong+Weak lensing and X-rays, Submitted to Astrophys. J.
2. Leonard, A., King, L.J. & **Goldberg, D.M.**, 2011, New Constraints on the Complex Mass Substructure in Abell 1689 from Gravitational Flexion. MNRAS, 413, 789-804.
3. Kratzer, R. M., Richards, G.T., **Goldberg, D.M.**, Oguri, M., Inada, N., Becker, R.H., Hodge, J.A. & Kochanek, C.S., 2011, Analyzing the Flux Anomalies of the Large-Separation Lensed Quasar SDSS J1029+2623, Astrophys. J. Lett., 728, L18.
4. Deb, S., **Goldberg, D.M.**, Heymans, C. & Morandi, A., 2010, Measuring dark matter ellipticity of Abell 901/902 using Particle-Based Lensing, Astrophys. J., 721, 124.
5. **Goldberg, D.M.**, Chessey, M.K., Harris, W.B., & Richards, G.T., 2010, Fold Lens Flux Anomalies: A Geometric Approach, Astrophys. J., 715, 793
6. Vesperini, E., **Goldberg, D.M.**, McMillan, S., Dura, J. & Jones, D., 2008, Beowulf Analysis Symbolic INterface (BASIN): Interactive Parallel Data Analysis for Everyone, in Computing in Science and Engineering. vol. 11, no. 2. pp 45-51.
7. Deb, S., **Goldberg, D.M.**, 2008, Reconstruction f Cluster Masses Using Particle-Based Lensing (PBL). Astrophys. J., 687, 39.
8. Massey, R. & **Goldberg, D.M.**, 2008, Weak lensing ellipticities in a strong lensing regime, Astrophys. J. Lett., 673, 111.
9. Leonard, A., **Goldberg D.M.**, Haaga, J. & Massey, R., 2007, Gravitational Shear, Flexion, and Strong Lensing in Abell 1689, Astrophys. J., 666, 51
10. **Goldberg, D.M.** & Leonard, A., 2007, Measuring Flexion. Astrophys. J. 660, 1003
11. **Goldberg, D.M.** & Gott, J.R., 2007, Large-Scale Distortions in Map Projections, Cartographica, Vol. 42, N. 4, preprint at: http://xxx.lanl.gov/abs/astro-ph/0608501

12. Bacon, D.J., **Goldberg, D.M.**, Rowe, B.T., & Taylor, A., 2006, Weak Gravitational Flexion. Monthly Not. Royal Astron. Soc., 365,414-428
13. **Goldberg, D.M.**, Jones, T.D., Hoyle, F., Rojas, R.R., Vogeley, M.S. & Blanton, M.R., 2005, The Mass Function of Void Galaxies in the Sloan Digital Sky Survey Data Release 2. Astrophys. J. 621, 643-650.
14. **Goldberg, D.M.** & Bacon, D.J. 2005, Galaxy-Galaxy Flexion: Weak Lensing to Second Order. Astrophys. J. 619, 741-748.
15. **Goldberg, D.M.** & Vogeley, M.S., 2004, Simulating Voids, Astrophys. J., 605, 1-6.
16. **Goldberg, D.M.** & Natarajan, P., 2002, The Galaxy Octopole Moment as a Probe of the Weak Lensing Shear Field, Astrophys. J., 564, 65-72.
17. **Goldberg, D.M.**, 2001, Using Perturbative Least Action to Reconstruct Redshift-Space Distortions, Astrophys. J. 552, 413-426.
18. **Goldberg, D.M.**, 2001, Using Perturbative Least Action to Simulate the Local Group, Astrophys. J. 550, 87-93.
19. **Goldberg, D.M.** & Spergel, D.N., 2000, Using Perturbative Least Action to Recover Cosmological Initial Conditions, Astrophys. J. 544, 21-29.
20. Spergel, D.N. & **Goldberg, D.M.**, 1999, The Microwave Background Bispectrum, Paper I: Basic Formalism, Phys. Rev. D., 59, 103001.
21. **Goldberg, D.M.** & Spergel, D.N., 1999, The Microwave Background Bispectrum, Paper II: A Probe of the Low Redshift Universe, Phys. Rev. D., 59, 103002.
22. Brainerd, T.G., Wright, C.O., **Goldberg, D.M.**, & Villumsen, J.V., 1999, A Comparison of Simple Mass Estimators for Galaxy Clusters, Astrophys. J. 524, 9.
23. Brainerd, T.G., **Goldberg, D.M.**, & Villumsen, J.V., 1998, High-Resolution Simulations of Cluster Formation, Astrophys. J., 502, 505
24. **Goldberg, D.M.** & Wozniak, P.M., 1998, Astrometric Shifts in the OGLE-1 Microlensing Events, Acta Astronomica, 48, 19
25. **Goldberg, D.M.**, 1998, Using Astrometry to Deblend Microlensing Events, Astrophys. J., 498, 156
26. **Goldberg, D.M.** & Strauss, M.A., 1998, Determination of the Baryon Density from Large-Scale Galaxy Redshift Surveys, Astrophys. J. 495, 29
27. Breuer, K., **Goldberg, D.M.**, Smith, K.E., Greenblatt, M. & McCarroll, W., 1995. Resonant Photoemission Study of the Electronic Structure of $K_{0.3}MoO_3$. Solid State Comm. 94, 601.

Conference Proceedings:

1. Deb, S., Nakajima, R., Mandelbaum, R., Bernstein, G. & **Goldberg, D.M.**, 2011, Quantifying substructure in Galaxy Clusters with X-ray and Gravitational Lensing Measurements., Bull. American Astron. Soc., 217, #227.01.
2. Kratzer, R., Richards, G.T., **Goldberg, D.M.**, Oguri, M., Kochanek, C.S., Hodge, J.A., Becker, R.H., & Inada, N. 2011, Analyzing the Flux Anomalies of the Large-separation Lensed Quasar SDSS J1029+2623., Bull. American Astron. Soc., 217, #347.04.
3. Harris, W.B., Chessey, M.K, **Goldberg, D.M.**, & Richards, G.T., 2010, Fold Lens Flux Anomalies: A Geometric Approach., Bull. American Astron. Soc., 215, #406.02.
4. Deb, S., **Goldberg, D.M.** & Wilson, A, 2009, What More Can We Learn from Galaxy Cluster Lensing?, Bull. American Astron. Soc., 213, #322.02.
5. Deb, S., Ramdass, V.J. & **Goldberg, D.M.**, 2007, Where is the Information in Cluster Lensing?, Bull. American Astron. Soc., 211, #96.19
6. Leonard, A., Deb, S. & **Goldberg, D.M.**, 2006, Weak Gravitational Flexion, Bull. American Astron. Soc.
7. Vogeley, M.S., Hoyle, F., Rojas, R.R., & **Goldberg, D.M.**, 2004, The Void Spectrum and Properties of Void Galaxies in the SDSS. Bull. American Astron. Soc., 205, #94.04.
8. Vogeley, M.S., Hoyle, F., Rojas, R.R., & **Goldberg, D.M.**, 2004, Mapping the cosmic web with the Sloan Digital Sky Survey. IAU Colloquium #195, 5-11.
9. **Goldberg, D.M.**, McMillan, S., Char, B., MacNeice, P., & Vogeley, M.S., 2003. Beowulf Analysis Symbolic INterface (BASIN). Bull. American Astron. Soc., 203, #4.11.

10. **Goldberg, D.M.** & Natarajan, P., 2002. Finding the arciness in arclets - exploring the octopole moments of lensed galaxies. The Shapes of Galaxies and Their Halos. ed. Priya Natarajan.
11. Mamikonyan, E.N., & **Goldberg, D.M.**, 2001, Building a Supercomputer for Cheap! Cheap! Cheap!, Bull. American Astron. Soc., 199, #157.01
12. **Goldberg, D.M.**, 2001, Introducing Showfits: A Web-Based Image Manipulation and Analysis Tool, Bull. American Astron. Soc., 198, #15.12
13. **Goldberg, D.M.**, & Spergel, D. N. 2000, Using Perturbative Least Action to Run N Body Simulations Back in Time. Cosmic Flows: Toward an Understanding of Large Scale Structure, eds. Stephane Courteau, Michael Strauss, & Jeffrey Willick.
14. **Goldberg, D.M.**, Wozniak, P., & Paczynski, B. 1998, Deblending Microlensing Events Using Astrometric Shifts. Bull. American Astron. Soc. 191, #83.07.
15. Brainerd, T.G., **Goldberg, D.M.**, & Villumsen, J. V. 1997, High Resolution Rich Cluster Simulations. HST and the High-Redshift Universe: Proceedings of the 37th Hersmonceux Conference, eds. N. Tanvir, A. Aragon-Salamanca, & J. Wall.
16. **Goldberg, D.M.**, Brainerd, T. G., & Villumsen, J. V. 1995, Self-Consistent High-Resolution Simulations of Cluster Formation, Bull. American Astron. Soc., 187, #52.06
17. Smith, K.E., Breuer, K., **Goldberg, D.M.**, Greenblatt, M., McCarroll, W. & Hulbert, S.L., 1995, Defects in Quasi-One Dimensional Oxide Conductors: $K_{0.3}MoO_3$. Materials Research Society Proceedings, Vol. 375, 133.

Colloquia, Invited and Contributed Talks and Seminars

1. Mapping Galaxy Clusters. Colloquium. Villanova University. April 7, 2011.
2. Where is the Information in Cluster Lenses? Institute for the Physics and Math of the Universe; University of Tokyo. Kashiwa, Japan. August, 2008.
3. Where is the information in Cluster Lenses? Ohio State University. Columbus, OH. Contributed talk in "Great Lakes Cosmology Workshop," June, 2007.
4. Galaxy-Galaxy Flexion. Widener University. September 2006.
5. Weak Gravitational Flexion. Lorentz Center of Physics. Leiden, NL. Contributed talk in "Gravitational Lensing," August, 2006.
6. Weak Gravitational Flexion. Institute for Advanced Study Seminar. Princeton, NJ. March, 2006.
7. Weak Gravitational Flexion. Aspen Center for Physics. Contributed talk in "Cosmological Probes of Baryons and Dark Matter." Aspen, CO. January, 2006.
8. Weak Lensing and Flexion. Invited talk in,"Probing the distant universe with gravitational waves." Johnson City, TN. November, 2005.
9. Galaxy Flexion and the 'Banananess' of Lensed Galaxies. Drexel University, Philadelphia, PA. June, 2005.
10. Galaxy Flexion and the 'Banananess' of Lensed Galaxies. Royal Observatory, Edinburgh Scotland. March 2005.
11. Galaxy Flexion: Gravitational Lensing to Second Order. The Ohio State University. Columbus, Ohio. Workshop on "Gravitational Lensing, Dark Matter, and Dark Energy." Jan, 2005.
12. Galaxy Flexion: Gravitational Lensing to Second Order. Boston University. Boston, MA. September 2004.
13. Weak Lensing and Cosmology. Delaware Valley Amateur Astronomical Society, Philadelphia, PA, October, 2002
14. Rewinding the Universe. Drexel University, Philadelphia, PA, March, 2001
15. Weak Lensing and Cosmology. Union College, Schenectady, NY, February, 2001
16. Rewinding the Universe. University of Massachusetts, Amherst, MA, February, 2001
17. Using Perturbative Least Action to Run Simulations "Backwards in Time." Yale University, New Haven, CT, March, 2000
18. Running Observations Back in Time Using Perturbative Least Action. Fermilab, Batavia, IL, January, 2000
19. Using Perturbative Least Action to Recover Cosmological Initial Conditions. AAS Dissertation Talk, Atlanta, GA, December, 1999

20. Running Observations Back in Time Using Perturbative Least Action. CITA, Toronto, Ontario, December, 1999
21. The Cosmic Microwave Bispectrum. Tufts/CfA/MIT Cosmology Seminar, Cambridge, MA, February, 1999

Popular Talks and Interviews

1. The Higgs Boson. Interview on "Day 6 with Brent Bambury," CBC 1. Broadcast July 7, 2012.
2. 'What is the Universe Expanding into?' and other perfectly reasonable questions. Speaker at Princeton Plasma Lab's "Science on Saturday" program. Approximate audience of 450. January 14, 2012.
3. 'What is the Universe Expanding into?' and other perfectly reasonable questions. Keynote speaker at "Starfest 30." Ayton, Ontario, Canada. August 27, 2011.
4. Our Uncertain Universe. Field Family Teen Author Series. Selected by the Philadelphia Free Library as one of ten speakers to talk to approximately 120 high school students about our work. April 27, 2011.
5. How (not) to build a time machine. Philly NerdNite. A talk given to approximately 100 at the Field House in Philadelphia. January 13, 2011.
6. The Dark Side of the Universe. Talk to the Rittenhouse Astronomical Society. Franklin Institute, Philadelphia. December 8, 2010.
7. Cosmology and Crackpots. Talk to Philadelphia Association for Critical Thinking (PHACT). November 11, 2010.
8. Popular Science. A talk to about 40 high school students at Philadelphia's Science Leadership Academy. May 28, 2010.
9. A User's Guide to the Universe. Talk, Q&A and book signing at Widener University. April 28, 2010.
10. A User's Guide to the Universe. Presentation at the Philadelphia Free Library Book Festival. April 17, 2010.
11. Interview on "The Space Show with David Livingston." Recorded April 2, 2010.
12. The Physics of Time Travel. Presentation at the "Meta Institute for Computational Astrophysics." March 13, 2010.
13. The Physics of Time Travel. The Franklin Institute, Philadelphia. March 11, 2010.
14. A User's Guide to the Universe. Book signing and talk at Barnes and Noble in Center City Philadelphia. March 8, 2010.
15. Time Travel and other Digressions. Drexel College of Arts and Sciences "Dean's Seminar." February 24, 2010.
16. How to build a time machine. Presentation at "Philcon: The Philadelphia sci-fi convention." November 20, 2009.
17. Time Travel. Interview on "Studio 360 with Kurt Anderson," recorded in front of a live audience, and broadcast from WNYC and nationally. Recorded November 17, 2009. Broadcast, December 31, 2009.
18. Telescopes from Galileo to the LSST. Drexel University Alumni Event. The Franklin Institute. Philadelphia, PA. August, 2009.
19. The Mysteries of Dark Matter. The Franklin Institute. Philadelphia, PA. May, 2009.