

## Benjamin C. Bromley

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### Education

Ph.D. Physics, *Dartmouth College*, Hanover, NH, 1994.

*Thesis:* Clustering analysis of cosmic density fields.

M.S. Physics, *University of Vermont*, Burlington, VT, 1987.

*Thesis:* Information theoretical analysis of photon correlation data.

B.A. Physics/Chemistry (Honors), *Middlebury College*, Middlebury, VT, 1982.

*Thesis:* X-ray spectroscopy of supernova remnant Puppis A.

### Experience

Professor, Department of Physics, *University of Utah*, Salt Lake City, UT  
(July, 2006–present).

Associate Professor, Department of Physics, *University of Utah*, Salt Lake City, UT  
(July, 2003–June, 2006).

Assistant Professor, Department of Physics, *University of Utah*, Salt Lake City, UT  
(August, 1998–June, 2003).

Postdoctoral Fellow, Department of Physics, *Harvard University*, Cambridge MA  
(September, 1996–July, 1998).

Postdoctoral Research Fellow, Theoretical Astrophysics, *Los Alamos National Laboratory*,  
Los Alamos, NM (June, 1994–September, 1996).

### Recent Grants

*NASA* Terrestrial Planet Finder grant (S. Kenyon [PI] & B. Bromley), 2006-2008.

*NASA* Astrophysical Theory Program grant (R. Price [PI] et al.), 2004-2006.

### Honors and Awards

University Professorship, *University of Utah*, 2005-2006.

*NASA* GSRP Fellowship, *NASA* Headquarters, 1991–1993.

*NASA* Space Science Grant Award, *Dartmouth College*, 1991.

### Research Interests

Planet formation: evolution of planetary debris disks, formation of terrestrial planets, origin of the solar system.

Astrophysical black holes: binary black hole mergers & gravity waves; accretion flows onto supermassive black holes.

Parallel computation: parallel algorithm design with message passing models (C++ with MPI).

## Publications

*Refereed Articles*

Kenyon, S. J., Bromley, B. C., Geller, M. J., & Brown, W. R. 2008, “Hypervelocity Stars: From the Galactic Center to the Halo”, accepted in the *Astrophysical Journal* (arXiv:0801.3479 [astro-ph]).

Kenyon, S. J., & Bromley, B. C. 2008, “Variations on Debris Disks: Icy Planet Formation at 30–150 AU around 1–3 Solar Mass Main Sequence Stars”, accepted in *Astrophysical Journal Supplement Series*.

Kenyon, S. J., Bromley, B. C., O’Brien, D. P., & Davis, D. R. 2008, “Formation and Collisional Evolution of Kuiper Belt Objects”, in ‘Transneptunian Objects’, Barucci et al. eds. (Tucson: University of Arizona Press; arXiv:0704.0259 [astro-ph]).

Currie, T., Kenyon, S. J., Rieke, G., Balog, Z., Bragg, A., & Bromley, B. C., 2008, “The Rise and Fall of Debris Disks: MIPS Observations of  $\eta$  and  $\chi$  Persei and the Evolution of Mid-IR Emission from Planet Formation”, *Astrophysical Journal*, 672, 558.

Brown, W. R., Geller, M. J., Kenyon, S. J., Kurtz, M. J., & Bromley, B. C. 2007, “Hypervelocity Stars III: The Space Density and Ejection History of Main Sequence Stars from the Galactic Center”, *Astrophysical Journal*, 671, 1708.

Beetle, C., Bromley, B., Hernández, N., & Price, R. H. 2007, “Periodic standing-wave approximation: Post-Minkowski computations” *Physical Review D*, 76, 084016.

Currie, T., Kenyon, S. J., Rieke, G., Balog, Z., & Bromley, B. C., 2007, “Terrestrial Zone Debris Disk Candidates in  $\eta$  &  $\chi$  Persei,” *Astrophysical Journal Letters*, 663, 105.

Brown, W. R., Geller, M. J., Kenyon, S. J., Kurtz, M. J., & Bromley, B. C. 2007, “Hypervelocity Stars II: The Bound Population,” *Astrophysical Journal*, 660, 331.

Nagasawa, M., Thommes, E. W., Kenyon, S. J., Bromley, B. C., & Lin, D. N. C. 2007, “The Diverse Origins of Terrestrial Planet Systems,” in *Planets and Protoplanets V* (Tucson: University of Arizona Press).

Bromley, B. C., Kenyon, S. J., Geller, M. J., Barcikowski, E., Brown, W. R., & Kurtz, M. J. 2006, “Hypervelocity Stars: Predicting the Spectrum of Ejection Velocities,” *Astrophysical Journal*, 653, 1194.

Kennedy, G. M., Kenyon, S. J., & Bromley, B. C. 2006, “Planet formation around low mass stars: the moving snow line and super-Earths,” *Astrophysical Journal Letters*, 650, 139–142.

Yoshida, S., Bromley, B. C., Read, J. S., Uryu, K., Friedman, J. L. 2006, “Models of Helically Symmetric Binary Systems,” in *Classical and Quantum Gravity*, 23, 599–613.

Beetle, C., Bromley, B. C., Price, R. H. 2006, “Eigenspectral computations for linear gravity and nonlinear toy models,” *Physical Review D*, 74, 024013.

Bromley, B. C. & Kenyon, S. J., 2006, “A Hybrid  $N$ -body–Coagulation Code for Planet Formation” *Astronomical Journal*, 131, 2737–2748.

## Publications

*Refereed Articles (cont.)*

- Kenyon, S. J., & Bromley, B. C. 2006, "Terrestrial Planet Formation I. The Transition from Oligarchic to Chaotic Growth," *Astronomical Journal*, 131, 1837–1850.
- Bromley, B. C., Owen, R., & Price, R. H. 2005, "Periodic standing-wave approximation: Nonlinear scalar fields, adapted coordinates, and the eigenspectral method," *Physical Review D* 71, 105017.
- Kenyon, S. J., & Bromley, B. C. 2005, "Prospects for Detection of Catastrophic Collisions in Debris Disks," *Astronomical Journal* 130, 269–279.
- Kenyon, S. J., & Bromley, B. C. 2004, "Stellar encounters as the origin of distant Solar System objects in highly eccentric orbits," *Nature*, 432, 598–602.
- Kenyon, S. J., & Bromley, B. C. 2004, "The Size Distribution of Kuiper Belt Objects," *Astronomical Journal*, 128, 1916.
- Andrade, Z., Beetle, C., Blinov, A., Bromley, B. C., Burko, L. M., Cranor, M., Owen, R., & Price, R. H. 2004, "The Periodic Standing-Wave Approximation: Overview and Three Dimensional Scalar Models," *Physical Review D*, 70, 064001.
- Kenyon, S. J., & Bromley, B. C. 2004, "Detecting the Dusty Debris of Terrestrial Planet Formation," *Astrophysical Journal Letters*, 602, 133–136.
- Kenyon, S. J., & Bromley, B. C. 2004, "Collisional Cascades in Planetesimal Disks II. Embedded Planets," *Astronomical Journal*, 127, 513–530.
- Kenyon, S. J., & Bromley, B. C. 2002, "Dusty Rings: Signposts of Recent Planet Formation," *Astrophysical Journal Letters*, 577, 35–38.
- Kenyon, S. J., & Bromley, B. C. 2002, "Collisional Cascades in Planetesimal Disks I. Stellar Flybys," *Astronomical Journal*, 123, 1757–1775.
- Bromley, B. C., Melia, F., & Liu, S. 2001, "Polarimetric Imaging of the Massive Black Hole in the Galactic Center," *Astrophysical Journal Letters*, 555, 83–86.
- Melia, F., Bromley, B. C., Liu, S., & Walker, C. K. 2001, "Measuring the Black Hole Spin in Sgr A\*," *Astrophysical Journal Letters*, 554, 37–40.
- Pariev, V. I., Bromley, B. C., & Miller, W. A. 2001, "On the Estimation of Relativistic Accretion Disk Parameters from Iron Emission Lines," *Astrophysical Journal*, 547, 649–666.
- Barton, E. J., Geller, M. J., Bromley, B. C., van Zee, L., & Kenyon, S. J. 2001, "The Tully-Fisher Relation as a Measure of Luminosity Evolution: A Low Redshift Baseline for Evolving Galaxies," *Astronomical Journal*, 121, 625–648.
- Kenyon, S. J., & Bromley, B. C. 2001, "Gravitational Stirring in Planetary Debris Disks," *Astronomical Journal*, 121, 538–551.

## Publications

*Refereed Articles (cont.)*

- Bromley, B. C., & Tegmark, M. 1999, "Is the Cosmic Microwave Background really non-Gaussian?" *Astrophysical Journal Letters*, 542, 79–82.
- Tegmark, M., & Bromley, B. C. 1999, "Observational Evidence for Stochastic Biasing," *Astrophysical Journal Letters*, 518, 69–72.
- Barton, E. J., Bromley, B. C., & Geller, M. J. 1999, "Kinematic Effects of Tidal Interaction on Galaxy Rotation Curves," *Astrophysical Journal Letters*, 511, 25–28.
- Pariev, V. I., & Bromley, B. C. 1998, "Line emission from an Accretion Disk around a Black Hole: Effects of Disk Structure," *Astrophysical Journal*, 508, 590–600.
- Bromley, B. C., Press, W. H., Lin, H., & Kirshner, R. P. 1998, "Spectral Classification and Luminosity Function of Galaxies in the Las Campanas Redshift Survey," *Astrophysical Journal*, 505, 25–36.
- Bromley, B. C., Miller, W. A., & Pariev, V. I. 1998, "The inner radius of the accretion disk around a supermassive black hole," *Nature*, 391, 54–56.
- Bromley, B. C., Warren, M. S., & Zurek, W. H. 1997, "Estimating  $\Omega$  from Galaxy Redshifts: Linear Flow Distortions and Nonlinear Clustering," *Astrophysical Journal*, 475, 414.
- Bromley, B. C., Chen, K., & Miller, W. A. 1997, "Line Emission from an Accretion Disk Around a Rotating Black Hole: Toward a Measurement of Frame Dragging," *Astrophysical Journal* 475, 57.
- Bromley, B. C. 1996, "Quasirandom Number Generators for Parallel Monte Carlo Algorithms," *Journal of Parallel and Distributed Computing*, 38, 101–104.
- Brainerd, T. G., Bromley, B. C., Warren, M. S., & Zurek, W. H. 1996, "Velocity Dispersion and the Redshift Space Power Spectrum," *Astrophysical Journal Letters*, 464, 103–106.
- Bromley, B. C. 1996, "Finite-Size Gravitational Microlenses," *Astrophysical Journal*, 476, 537–540.
- Tegmark, M. & Bromley, B. C. 1995, "Real-Space Cosmic Fields from Redshift-Space Distributions: A Green Function Approach," *Astrophysical Journal*, 453, 533–541.
- Bromley, B. C. 1994, "Sampling Functions for Measuring the Cosmic Mass Density," *Astrophysical Journal Letters*, 423, 81–84.
- Bromley, B. C. 1994, "Correlations in Cosmic Density Fields," *Astrophysical Journal*, 437, 541–594.
- Bromley, B. C. 1992, "Detecting Faint Echoes in Stellar-Flare Light Curves," *Publication of the Astronomical Society of the Pacific*, 104, pp. 1057–61.

## Publications

### *Selected Conference Proceedings*

- Kenyon, S. K., & Bromley, B. C. 2005, "Formation of planets and debris disks in the terrestrial zone" in *Star Formation in the Era of Three Great Observatories*, Cambridge, MA [cxc.harvard.edu/stars05/agenda/program.html](http://cxc.harvard.edu/stars05/agenda/program.html), p. 20.
- Bromley, B. C., & Kenyon, S. K. 2004, "Numerical calculations of terrestrial planet formation," in *The Second TPF/Darwin International Conference*, San Diego, CA (<http://planetquest1.jpl.nasa.gov/TPFDarwinConf/confProceedings.cfm>).
- Kenyon, S. K., & Bromley, B. C. 2002, "Evolution of planetesimals in planetary debris disks," in *Astrophysical Supercomputing using Particle Simulations: Proceedings of IAU Symposium 208 in Tokyo*, eds. J. Makino & P. Hut (San Francisco: A. S. P.).
- Pariev, V. I., Bromley, B. C., & Miller, W. A., 2001, "Estimation of Relativistic Accretion Disk Parameters from Iron Line Emission," in *20th Texas Symposium on relativistic astrophysics, Austin, Texas, 10-15 December 2000*, eds. J. C. Wheeler & H. Martel (New York: AIP).
- Barton, E. J., Bromley, B. C., & Geller, M. J. 1998, "Kinematic Effects of Tidal Interaction on Galaxy Rotation Curves," in *Galaxy Dynamics, proceedings of a conference held at Rutgers University, 8-12 Aug 1998*. eds. D. Merritt, M. Valluri, & J. Sellwood (San Francisco: A. S. P. Conf. Ser.).
- Rybicki, G. B., & Bromley, B. C. 1998, "Spectral signatures of a relativistic accretion disk," in *Accretion Processes in Astrophysical Systems: Proceedings of the 8th Annual Astrophysics Conference in Maryland*, eds. S. Holt & T. Kallman (New York: AIP).
- Bromley, B. C., Miller, W. A., & Pariev, V. I. 1998, "Bounds on the inner radius of emission around supermassive black holes," in *Accretion Processes in Astrophysical Systems: Proceedings of the 8th Annual Astrophysics Conference in Maryland*, eds. S. Holt & T. Kallman (New York: AIP).
- Pariev, V. I., & Bromley, B. C. 1998, "Line emission from an accretion disk around a black hole: effects of disk structure," in *Accretion Processes in Astrophysical Systems: Proceedings of the 8th Annual Astrophysics Conference in Maryland*, eds. S. Holt & T. Kallman, (New York: AIP).
- Bromley, B. C., Brainerd, T. G., Warren, M. S., & Zurek, W. H. 1996, "Cosmic Structure on Small Scales: Results on Cluster Cores and Redshift-Space Power Spectra," in *Mapping, Measuring and Modeling the Universe, Valencia Proceedings*, ed. P. Coles (San Francisco: A. S. P. Conf. Ser.).
- Bromley, B. C., Brainerd, T. G., Warren, M. S., Zurek, W. H., & Quinn, P. J. 1995, "On Cluster Cores and Power Spectra" in *Clustering in the Universe, Proceedings of the XXX<sup>th</sup> Moriond Meeting*.
- Brainerd, T. G., Bromley, B. C., Warren, M. S., & Zurek, W. H. 1995, "Testing Theories of Structure Formation," in *Clusters, Lensing & the Future of the Universe, Proceedings of the 1995 Meeting of the Astronomical Society of the Pacific*, eds. V. Trimble & A. Reisenegger (San Francisco: A. S. P. Conf. Ser.).

### Selected Invited Talks and Presentations

Bromley, B. C., Beetle, C., Hernandez, N. G., & Price, R. H. 2007, "Adapted coordinates and the eigenspectral method for solving the periodic standing wave problem," April 2007 APS Meeting, Jacksonville, FL.

Bromley, B. C., & Cranor, M. 2006, "Teaching Einstein: from epicycles to the equivalence principle," April 2006 APS Meeting, Dallas, TX.

Bromley, B. C., & Kenyon, S. J. 2004, "Signatures of Terrestrial Planet Formation," Weber State University, Weber, UT.

Bromley, B. C., 1999, "A Lightweight Review of Middleweight Black Holes," *Matters of Gravity*, Newsletter of the Topical Group on Gravitation of the American Physical Society, <http://gravity.phys.psu.edu/mog/mog14/mog14.html>.

### Teaching Record

#### *Courses at University of Utah*

Einstein in the 20<sup>th</sup> Century & Beyond (PHYS 1905, Fall 2005, 2006)

Introduction to Computers in Physics (PHYS 3730/6720; Fall 1998 – 2000, 2006).

Physics for Scientists and Engineers II (introductory E&M) (PHYS 2220; Fall 2001 – 2004).

Case Studies in Computational Engineering and Science (MATH 6790; Spring 2001).

Computational Physics I (PHYS 6730; Spring 1999 – 2001).

#### *Advisees*

Post-doctoral: Walter Landry (with R. Price; 2000 – 2001).

Ph.D.: Jun Hidaka (2003), Akiko Soemori, Eric Twarog, Tamara Young.

M.S.: Elliott Barcikowski, Eric Bulson (2001), Rachel Costello (2003), Jinyong Yoon (2005).

Undergrad: Cameron Soelberg (Honors project, with R. Price; 2000), Denise Spangler (2002).

### Selected Academic Service

#### *Department of Physics*

Policy Board/Executive Committee (2004-2006).

Director of Graduate Studies (2003 – 2006).

Graduate Admissions Committee (2004 – 2006).

Futures Committee (2004–2005).

#### *University*

Master's in Computational Engineering and Sciences Steering Committee (2001 – present).

College of Science's "Science for Breakfast" lecture (to the SLC business community; 2004).

School of Computing Internal Review Committee (2003).

College of Science Admissions Standards and Degree Committee (1999–2003).

Undergraduate Studies Course Review Committee for Social & Behavioral Sciences (2000 – 2002).

*Research community*

Ad hoc reviewer, *Astron. J.*, *Astrophys. J.*, *Journal of Parallel and Distributed Computing*, *Monthly Notices of the Royal Astronomical Society*, *Nature*, *Physical Review Letters*.

Review panelist NASA Astrophysical Theory Program (chair, 2002), Origins of the Solar System (2004–2006).

Review panelist, NSF Astronomy Division (2001, 2007).

*Public outreach*

Utah Education Network Sci-Fi podcast (Dec. 2006).

Science fair judge/coordinator, Granite School District (2000 – present).

Invited talks to the Salt Lake Astronomical Society (2000, 2002, 2004).

Recent interviews: KCPW/KPCW (public radio), KDXU-AM, KSL-TV, KUER-FM, NBC-Australia.

Press coverage: Astronomy magazine, CNN, Deseret News, MS-NBC, New York Times, Salt Lake Tribune, Science News, Scientific American.