

Benjamin C. Bromley

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Overview

- Professor of Physics and Astronomy, specializing in theoretical and computational astrophysics (planet formation, galactic dynamics, and relativistic astrophysics).
- 70+ refereed publications; 2900+ citations, h-index=32 (normalized: 20); PI/CoI on 6 grants, ~1M total; Supercomputing allocations of ~6M processor-hours per year.
- Taught over 2000 students; Courses include Intro Physics, Astronomy and grad-level Computational Physics; Advisees: 10 B.S., 4 M.S. and 4 PhD.
- Administrative positions include Department Chair, Associate Chair, Director of Graduate Studies, University Graduate Council, and MS-CES Executive Committee member.

Education

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

Thesis: Wavelet analysis of the large-scale structure of the universe.

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

Thesis: Information theoretical study of quasi-elastic photon scattering.

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

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

Experience

Professor, Department of Physics and Astronomy, *University of Utah*, Salt Lake City, UT
(July, 2006–present; Chair: July 2016–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).

Research Interests

Planet formation: beginning-to-end simulation of planetary systems, including observable planetary debris disks, formation of terrestrial planets, and the origin of the Solar System.

Astrophysical black holes: relativistic accretion flows and binary black hole mergers.

Galactic dynamics: hypervelocity stars and the mass distribution of the Galaxy; galaxy pairs.

Astrophysical cosmology: large-scale structure and galaxy clustering.

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

Honors and Fellowships

University Professor, *University of Utah*, 2005–2006.

NASA GSRP Fellowship, NASA Headquarters, 1991–1993.

Funding Awards

NASA Outer Planets grant (S. Kenyon & B. Bromley), 2011–2016.

NASA Origins of Solar Systems grant (S. Kenyon & B. Bromley), 2010–2013.

NASA Terrestrial Planet Finder grant (S. Kenyon & B. Bromley), 2006–2009.

NASA Astrophysical Theory Program grant (R. Price et al.), 2005–2008.

NASA Astrophysical Theory Program grant (S. Kenyon & B. Bromley), 2002–2005.

NASA Astrophysical Theory Program grant (B. Bromley), 1999–2002.

Teaching and Mentoring

Courses at University of Utah

Foundations of Astronomy (ASTR/PHYS 2500; Fall 2013–2015)

Introduction to Computers in Physics (PHYS 3730/6720; six terms, Fall 1998–2014).

Physics for Scientists & Engineers II (PHYS 2220, E&M; 2001–2004, 2010–2013).

Einstein in the 20th Century & Beyond (PHYS 1905; Fall 2005, 2006)

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

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

Students/postdocs supervised

Served as research mentor to 10 undergraduates (one honors thesis), 3 Master's students, and 4 doctoral students; Supervised 1 post-doc (with R. Price).

Selected Academic Service

Department of Physics and Astronomy

Chair (2016–present); Associate Chair (2015–2016); Astronomy Program Task Force (2010–2016); Space/Facilities (Chair, 2012–2016); Director of Graduate Studies (2010–2012);

University

Graduate Council, Graduate Admissions Committee (2011–2014).

M.S. Computational Engineering & Sciences Executive Committee (2001–2014).

Research community

Reviewer/panelist: NASA (2007–2015); DFG (2011–2016); FGF (2015); NSF Astronomy Division (2010, 2014); CSCS (supercomputing, 2014) DOE (supercomputing, 2011); Canadian Space Agency Mission Concepts (2007).

Ad hoc reviewer: Astron. J., Astrophys. J., Icarus, Parallel & Distributed Computing, Mon. Not. Royal Astron. Soc., Nature, New Astron., Phys. Rev. Letters, Science, Space Sciences Review.

Outreach

Science fair judge/coordinator, Salt Lake County (2000 – present).

Presentations to grade schools in Granite School District, UT (misc. dates since 1998).

In the Media. Astronomy magazine, BBC, CNN, Christian Science Monitor, FoxNews, MSNBC, New York Times, Science News, Scientific American; radio: Public Radio (Australia, Germany, U.S.); TV: U.S. (CBS, NBC and Fox affiliates).

Publications

Refereed articles

- Meisner, A. M., Bromley, B. C., Nugent, P. E., Schegel, D. J., Kenyon, S. J., Schlafly, E. F., Dawson, K. S. 2017, "Searching for Planet Nine with Coadded WISE and NEOWISE-Reactivation Images," *Astronomical Journal*, 153, 65.
- Kenyon, S. J., Najita, J. R., & Bromley, B. C. 2016, "Rocky Planet Formation: Quick and Neat," *Astrophysical Journal*, 831, 8.
- Bromley, B. C., & Kenyon, S. J. 2016, "Making Planet Nine: A Scattered Giant in the Outer Solar System," *Astrophysical Journal*, 826, 46.
- Kenyon, S. J., & Bromley, B. C. 2016, "Making Planet Nine: Pebble Accretion at 250–750 AU in a Gravitationally Unstable Ring," *Astrophysical Journal*, 825, 33.
- Kenyon, S. J., & Bromley, B. C. 2016, "Variations on Debris Disks III. Collisional Cascades and Giant Impacts in the Terrestrial Zones of Solar-type Stars," *Astrophysical Journal*, 817, 51.
- Kenyon, S. J., & Bromley, B. C. 2015, "Collisional Cascade Calculations for Irregular Satellite Swarms in Fomalhaut b," *Astrophysical Journal*, 811, 60.
- Bromley, B. C., & Kenyon, S. J. 2015, "Evolution of a ring around the Pluto-Charon binary," *Astrophysical Journal*, 809, 88.
- Bromley, B. C., & Kenyon, S. J. 2015, "Planet formation around binary stars: Tatooine made easy," *Astrophysical Journal*, 806, 98.
- Kenyon, S. J., & Bromley, B. C. 2015, "Formation of Super-Earth Mass Planets at 125-250 AU from a Solar-type Star," *Astrophysical Journal*, 806, 42.
- Bromley, B. C., & Kenyon, S. J. 2014, "The fate of scattered planets," *Astrophysical Journal*, 796, 141.
- Czaja, B., & Bromley, B. C. 2014, "Distortion of the cosmic microwave background by the Milky Way," *Physical Review D*, 90, 047302.
- Kenyon, S. J., Bromley, B. C., Geller, M. J., & Brown, W. R. 2014, "Predicted space motions for hypervelocity and runaway stars: proper motions and radial velocities for the GAIA era," *Astrophysical Journal*, 793, 122.
- Kenyon, S. J., Currie, T., & Bromley, B. C. 2014, "Fomalhaut b as a cloud of dust: Testing aspects of planet formation theory," *Astrophysical Journal*, 786, 70.
- Kenyon, S. J., & Bromley, B. C. 2014, "Coagulation Calculations of Icy Planet Formation Around 0.1–0.5 M_{\odot} Stars: Super-Earths From Large Planetesimals," *Astrophysical Journal*, 780, 4.
- Kenyon, S. J., & Bromley, B. C. 2014, "The formation of Pluto's low mass satellites," *Astronomical Journal*, 147, 8.
- Bromley, B. C., & Kenyon, S. J. 2013, "Migration of small moons in Saturn's rings," *Astrophysical Journal*, 764, 192.
- Currie, T., Burrows, A., Madhusudhan, N., et al. 2013, "A Combined Very Large Telescope and Gemini Study of the Atmosphere of the Directly Imaged Planet, β Pictoris b," *Astrophys. Journal*, 776, 15
- Bromley, B. C., Kenyon, S. J., Geller, M. J., & Brown, W. R. 2012, "Binary Disruption by Massive Black Holes: Hypervelocity Stars, S Stars, and Tidal Disruption Events," *Astrophys. J. Letters*, 749, L42.
- Kenyon, S. J., & Bromley, B. C. 2012, "Coagulation Calculations of Icy Planet Formation at 15–150 AU: A Correlation between the Maximum Radius and the Slope of the Size Distribution for Transneptunian Objects," *Astronomical Journal*, 143, 63.
- Bromley, B. C. 2011, "Gravitationally focused dark matter around compact stars," *Astrophysical Journal Suppl.*, 197, 37.
- Bromley, B. C., & Kenyon, S. J. 2011, "Migration of planets embedded in a circumstellar disk," *Astrophysical Journal*, 735, 29.
- Bromley, B. C., & Kenyon, S. J. 2011, "A New Hybrid N-Body-Coagulation Code for the Formation of Gas Giant Planets," *Astrophysical Journal*, 731, 101.

Publications

Refereed articles (cont.)

- Kenyon, S. J., & Bromley, B. C. 2010, "Variations on Debris Disks II. Icy Planet Formation as a Function of the Bulk Properties and Initial Sizes of Planetesimals," *Astrophysical Journal Suppl.*, 188, 242.
- Bromley, B. C., Kenyon, S. J., Brown, W. R., & Geller, M. J. 2009, "Runaway Stars, Hypervelocity Stars, and Radial Velocity Surveys," *Astrophysical Journal*, 706, 925.
- Kenyon, S. J., & Bromley, B. C. 2009, "Rapid Formation of Icy Super-Earths and the Cores of Gas Giant Planets," *Astrophysical Journal Letters*, 690, 140.
- Brown, W. R., Geller, M. J., Kenyon, S. J., & Bromley, B. C., 2009, "The Anisotropic Spatial Distribution of Hypervelocity Stars," *Astrophysical Journal Letters*, 690, 69.
- 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," *Astrophysical Journal Supplement Series*, 179, 451.
- Kenyon, S. J., Bromley, B. C., Geller, M. J., & Brown, W. R. 2008, "Hypervelocity Stars: From the Galactic Center to the Halo," *Astrophysical Journal*, 680, 312.
- Kenyon, S. J., Bromley, B. C., O'Brien, D. P., & Davis, D. R. 2008, "Formation and Collisional Evolution of Kuiper Belt Objects," in *The Solar System Beyond Neptune*, Barucci et al. eds. (Tucson: University of Arizona Press), 293.
- 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 η and χ 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 η & χ Persei," *Astrophysical Journal Letters*, 663, 105.
- Kennedy, G. M., Kenyon, S. J., & Bromley, B. C. 2007, "Planet formation around M-dwarfs: the moving snow line and super-Earths," *Astrophysics and Space Science*, 311, 9.
- 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.
- 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.
- 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.
- 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.
- Kenyon, S. J., & Bromley, B. C. 2006, "Terrestrial Planet Formation I. The Transition from Oligarchic to Chaotic Growth," *Astronomical Journal*, 131, 1837.
- 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.
- Kenyon, S. J., & Bromley, B. C. 2004, "Stellar encounters as the origin of distant Solar System objects in highly eccentric orbits," *Nature*, 432, 598.
- Kenyon, S. J., & Bromley, B. C. 2004, "The Size Distribution of Kuiper Belt Objects," *Astronomical Journal*, 128, 1916.

Publications

Refereed articles (cont.)

- 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.
- Kenyon, S. J., & Bromley, B. C. 2004, "Collisional Cascades in Planetesimal Disks II. Embedded Planets," *Astronomical Journal*, 127, 513.
- Kenyon, S. J., & Bromley, B. C. 2002, "Dusty Rings: Signposts of Recent Planet Formation," *Astrophysical Journal Letters*, 577, 35.
- Kenyon, S. J., & Bromley, B. C. 2002, "Collisional Cascades in Planetesimal Disks I. Stellar Flybys," *Astronomical Journal*, 123, 1757.
- Bromley, B. C., Melia, F., & Liu, S. 2001, "Polarimetric Imaging of the Massive Black Hole in the Galactic Center," *Astrophysical Journal Letters*, 555, 83.
- Melia, F., Bromley, B. C., Liu, S., & Walker, C. K. 2001, "Measuring the Black Hole Spin in Sgr A*," *Astrophysical Journal Letters*, 554, 37.
- 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.
- 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.
- Kenyon, S. J., & Bromley, B. C. 2001, "Gravitational Stirring in Planetary Debris Disks," *Astronomical Journal*, 121, 538–551.
- Tegmark, M., & Bromley, B. C. 2000, "Bias is Complicated," *Physica Scripta*, T85, 59.
- Bromley, B. C., & Tegmark, M. 1999, "Is the Cosmic Microwave Background really non-Gaussian?" *Astrophysical Journal Letters*, 542, 79.
- Tegmark, M., & Bromley, B. C. 1999, "Observational Evidence for Stochastic Biasing," *Astrophysical Journal Letters*, 518, 69.
- Barton, E. J., Bromley, B. C., & Geller, M. J. 1999, "Kinematic Effects of Tidal Interaction on Galaxy Rotation Curves," *Astrophysical Journal Letters*, 511, 25.
- 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.
- 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.
- 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.
- Bromley, B. C., Warren, M. S., & Zurek, W. H. 1997, "Estimating Ω 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.
- 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.
- Bromley, B. C. 1996, "Finite-Size Gravitational Microlenses," *Astrophysical Journal*, 476, 537.
- Tegmark, M. & Bromley, B. C. 1995, "Real-Space Cosmic Fields from Redshift-Space Distributions: A Green Function Approach," *Astrophysical Journal*, 453, 533.

Publications

Refereed articles (cont.)

- Bromley, B. C. 1994, "Sampling Functions for Measuring the Cosmic Mass Density," *Astrophysical Journal Letters*, 423, 81.
- Bromley, B. C. 1994, "Correlations in Cosmic Density Fields," *Astrophysical Journal*, 437, 541.
- Bromley, B. C. 1992, "Detecting Faint Echoes in Stellar-Flare Light Curves," *Publication of the Astronomical Society of the Pacific*, 104, 1057.

Selected Conference Proceedings

- 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).
- Kenyon, S. J., & 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, p. 20.
- Bromley, B. C., & Kenyon, S. J. 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. J., & 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.).
- 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).

Selected Invited Talks and Presentations

- Bromley, B. C., & Kenyon, S. J. 2016, "From Disk to Planets: A Theoretical Perspective," *Resolving planet formation in the era of ALMA and extreme AO*, Santiago, Chile.
- Dall'Asén, et al. 2016, "Structural Characterization of carbonaceous meteoritic fragments found in Antarctica by high-resolution Raman spectroscopy and SEM/EDS," *American Physical Society April Meeting Abstracts*, L1.034.
- Zollinger, R., Armstrong, J. C., & Bromley, B. C. 2014, "Tidal Evolution of Exomoons using a Self-Consistent Tidal and Dynamical Model," *American Astronomical Society Meeting Abstracts*, 223, 347.06.
- Bromley, B. C. 2015, "The Revenge of Pluto (and other stories from the outer Solar System)," College of Science *Science at Breakfast* talk to the SLC business community.
- Bromley, B. C., & Kenyon, S. J. 2013, "Satellite formation around Pluto-Charon," American Astronomical Society/DPS Meeting #45, 303.05.
- Bromley, B. C., Brown, W. J., Kenyon, S. J., & Geller, M. J. 2013 "Binary Star Disruptions & the Growth of Massive Black Holes," SnowPAC – Black Hole Fingerprints: Dynamics, Disruptions and Demographics, Snowbird, UT.
- Bromley, B. C., & Kenyon, S. J. 2013, "Brightening up the Infrared Sky: Debris disks and terrestrial planet formation," American Astronomical Society Meeting Abstracts, 221, 325.01.
- Bromley, B. C., & Kenyon, S. J. 2011, "The Diversity of Planetary Systems," The First Kepler Science Conference, NASA/Ames, Moffett Field, CA.
- Bromley, B. C. 2008, "Coagulation theory of planet formation," National Tsing Hua University, Hsinchu, Taiwan.
- Bromley, B. C., & Cranor, M. 2006, "Teaching Einstein: from epicycles to the equivalence principle," April 2006 APS Meeting, Dallas, TX.

For more information, please visit <http://www.physics.utah.edu/~bromley>