

# Jonathan Montaña

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## INTERESTS

Commutative algebra, combinatorics, and algebraic geometry.

## EXPERIENCE

|   |  |                           |
|---|--|---------------------------|
| Assistant Professor   | Arizona State University                 | August 2022-              |
| Research Member   | SLMath(MSRI), Berkeley, CA               | January 2024-April 2024   |
| Assistant Professor*  | New Mexico State University              | August 2018-July 2022     |
| *Granted tenure and promoted to Associate Professor in the spring of 2022 |  |                           |
| Oberwolfach Leibniz Fellow  | MFO, Oberwolfach Res. Inst. for Math.    | Summer 2018               |
| Visiting Assistant Professor  | University of Kansas                     | August 2015-May 2018      |
| Graduate Assistant  | Purdue University                        | August 2009-July 2015     |
| Program Associate   | MSRI, Berkeley, CA                       | August 2012-December 2012 |
| Graduate Assistant  | Universidad Nacional de Colombia, Bogotá | August 2008-August 2009   |

## EDUCATION

### **Purdue University**, West Lafayette, IN

Ph.D. in Mathematics, August 2015

Thesis: *Generalized multiplicities, reductions of ideals, and depth of blowup algebras.*

Advisor: Prof. Bernd Ulrich

M.Sc. in Mathematics, August 2011

### **Universidad Nacional de Colombia**, Bogotá

M.Sc. in Mathematics, August 2009

Thesis: *Idempotents, adjoining an identity, and connectedness.* (in Spanish)

Advisor: Prof. Lorenzo Acosta

B.Sc. in Mathematics, August 2008

Thesis: *Applications of the algorithmic proofs of the Quillen-Suslin theorem in algebraic geometry.* (in Spanish)

Advisor: Prof. José Oswaldo Lezama

## PUBLICATIONS

### **Mathematics:**

25. *Rational powers, invariant ideals, and the summation formula*, with Sankhaneel Bisui, Sudipta Das, and Tàì Huy Hà., [arXiv: 2402.12350](#), **submitted**.
24. *Ladder determinantal varieties and their symbolic blowups*, with Alessandro De Stefani, Luis Núñez-Betancourt, Lisa Seccia, and Matteo Varbaro, [arXiv: 2305.18167](#), **submitted**.
23. *K-polynomials of multiplicity-free varieties*, with Federico Castillo, Yairon Cid-Ruiz, and Fatemeh Mohammadi, [arXiv: 2212.13091](#), **submitted**.
22. *Blowup algebras of determinantal ideals in prime characteristic*, with Alessandro De Stefani and Luis Núñez-Betancourt, [arXiv: 2109.00592](#), **submitted**.
21. *The core of monomial ideals*, with Louiza Fouli, Claudia Polini, and Bernd Ulrich, [arXiv: 2303.10486](#), to appear in **Algebra & Number Theory**.

20. *Computing multiplicity sequences*, with Justin Chen and Youngsu Kim, arXiv: 2103.14175, to appear in **Journal of Software for Algebra and Geometry**.
21. *Double Schubert polynomials do have saturated Newton polytopes*, with Federico Castillo, Yairon Cid-Ruiz, and Fatemeh Mohammadi, **Forum of Mathematics, Sigma** 11 (2023), e100.
18. *Purity of monoids and characteristic-free splittings in semigroup rings*, with Alessandro De Stefani and Luis Núñez-Betancourt, **Mathematische Zeitschrift** 305:31 (2023).
17. *Frobenius methods in combinatorics*, with Alessandro De Stefani and Luis Núñez-Betancourt, **São Paulo Journal of Mathematical Sciences** 17 (2023), 387-429.
16. *Convex bodies and graded families of monomial ideals*, with Yairon Cid-Ruiz, **Revista Matemática Iberoamericana** 38 (2022), 2033-2056.
15. *Mixed multiplicities of graded families of ideals*, with Yairon Cid-Ruiz, **Journal of Algebra** 590 (2022), 394-412.
14. *When are multidegrees positive?*, with Federico Castillo, Yairon Cid-Ruiz, Binglin Li, and Naizhen Zhang, **Advances in Mathematics** 374 (2020), 107382.
13. *Exterior powers and Tor-persistence*, with Justin Lyle and Keri Sather-Wagstaff, **Journal of Pure and Applied Algebra** 226 (2022), 106890.
12. *Analytic spread and integral closure of integrally decomposable modules*, with Carles Bivià-Ausina, **Nagoya Mathematical Journal** 245 (2022), 166-191.
11. *Symbolic analytic spread: upper bounds and applications*, with Hailong Dao, **Journal of the Institute of Mathematics of Jussieu** 20 (2021), 1969-1981.
10. *Extremal growth of Betti numbers and trivial vanishing of (co)homology*, with Justin Lyle, **Transactions of the American Mathematical Society** 373 (2020), 7937-7958.
9. *Splittings and symbolic powers of square-free monomial Ideals*, with Luis Núñez-Betancourt, **International Mathematics Research Notices** 2021 (2021), 2304-2320.
8. *On asymptotic vanishing behavior of local cohomology*, with Hailong Dao, **Mathematische Zeitschrift** 295 (2020), 73-86.
7. *Length of local cohomology of powers of ideals*, with Hailong Dao, **Transactions of the American Mathematical Society** 371 (2019), 3483-3503.
6. *Lower bounds on projective levels of complexes*, with Hannah Altmann, Eloísa Grifo, William Sanders, and Thanh Vu, **Journal of Algebra** 491 (2017), 343-356.
5. *On the growth of deviations*, with Adam Boocher, Alessio D'Alì, Eloísa Grifo, and Alessio Sammartano, **Proceedings of the American Mathematical Society** 144 (2016), 5049-5060.
4. *Edge ideals and DG algebra resolutions*, with Adam Boocher, Alessio D'Alì, Eloísa Grifo, and Alessio Sammartano, **Le Matematiche** 70 (2015), no.1, 215-237.
3. *Artin-Nagata properties, minimal multiplicities, and depth of fiber cones*, **Journal of Algebra** 425 (2015), 423-449.
2. *Multiplicities of classical varieties*, with Jack Jeffries and Matteo Varbaro, **Proceedings of the London Mathematical Society** 110 (2015), 1033-1055.
1. *The  $j$ -multiplicity of monomial ideals*, with Jack Jeffries, **Mathematical Research Letters** 20 (2013), 729-744.

#### Computer Science:

3. *Improving Locality Sensitive Hashing by Efficiently Finding Projected Nearest Neighbors*, with Omid Jafari and Parth Nagarkar, **13<sup>th</sup> International Conference on Similarity Search and Applications (SISAP) 2020**.
2. *mmLSH: A Practical and Efficient Technique for Processing Approximate Nearest Neighbor Queries on Multimedia Data*, with Omid Jafari and Parth Nagarkar, **13<sup>th</sup> International Conference on Similarity Search and Applications (SISAP) 2020**.
1. *Efficient Bitmap-based Indexing and Retrieval of Similarity Search Image Queries*, with Omid Jafari and Parth Nagarkar, **IEEE Southwest Symposium on Image Analysis and Interpretation (SSIAI) 2020**.

## CODES

*MultiplicitySequence* package in Macaulay2, with Justin Chen and Youngsu Kim, **certified by JSAG**.

## FELLOWSHIPS, HONORS, AND GRANTS

|  |  |                        |
|--|--|------------------------|
| Research Member                          | SLMath(MSRI)                             | Spring 2024            |
| AIM SQuaREs Grant                        | AIM                                      | 2023-2025              |
| Natural Sciences DEI Seed Grant          | ASU                                      | 2023                   |
| NSF Conference Grant, DMS #2302498       | SLAM 2023                                | March 2023             |
| Oberwolfach Research Fellow              | MFO, Oberwolfach Res. Inst. for Math.    | November-December 2022 |
| NSF Conference Grant, DMS #2220824       | PASCA 2022                               | June 2022              |
| NSF Standard Grant, DMS #2001645/2303605 | NSF                                      | 2020-2024              |
| Oberwolfach Leibniz Fellow               | MFO, Oberwolfach Res. Inst. for Math.    | Summer 2018            |
| NSF Conference Grant, DMS #1745772       | KUMUNU 2017                              | October 2017           |
| AMS - Simons Travel Grant                | AMS & Simons Foundation                  | July 2017-June 2019    |
| Bilsland Dissertation Fellowship         | Purdue University, College of Science    | June 2014-May 2015     |
| Ross Fellowship                          | Purdue University                        | August 2009-July 2010  |
| Outstanding Graduate Students Fellowship | Universidad Nacional de Colombia, Bogotá | August 2008- July 2009 |
| Second place (nationwide)                | ECAES in Mathematics, Colombia           | 2008                   |

## INVITED TALKS

|   |   |                      |
|---|---|----------------------|
| Latin-American & Caribbean Math. Congress   | João Pessoa, Brazil                     | August 26, 2024      |
| Latin-American Alg. Colloquium (plenary)    | Pont. Univ. Católica, Chile             | July 22, 2024        |
| Bay Area Discrete Math Day                  | Santa Clara University                  | April 20, 2024       |
| Commutative Algebra Seminar                 | SLMath/MSRI                             | March 21, 2024       |
| Algebra Seminar                             | Auburn University                       | October 16, 2023     |
| ICMAM Latin-America, Satellite Conference   | Online                                  | September 27, 2023   |
| Summer CAMP                                 | University of Nebraska-Lincoln          | August 9, 2023       |
| MSRI summer school Colloquium               | University of Notre Dame                | May 26, 2023         |
| Algebra Seminar                             | University of Missouri                  | April 17, 2023       |
| Tulane Mathematics Colloquium               | Tulane University                       | March 30, 2023       |
| XII School of Mathematics                   | Fed. Univ. of Sergipe, Brazil (Online)  | February 14-16, 2023 |
| Algebra&Geometry seminar                    | University of Genova, Italy             | December 21, 2022    |
| Dept. of Mathematical Sciences Colloquium   | University of Texas at El Paso (Online) | November 4, 2022     |
| AMS Sectional Meeting                       | University of Utah                      | October 23, 2022     |
| Comb. and Commalg. Seminar                  | Oklahoma State University (Online)      | April 20, 2022       |
| 2022 JMM                                    | Online                                  | April 7, 2022        |
| AMS Sectional Meeting                       | Online                                  | March 26, 2022       |
| AMS Sectional Meeting                       | Online                                  | March 19, 2022       |
| Southwest Local Alg. Mtg. (SLAM)            | Baylor University                       | February 26, 2022    |
| Sch. Math and Stat. Sc. Colloquium          | Arizona State University                | February 22, 2022    |
| Dept. of Mathematics Millican Colloquium    | University of North Texas               | February 8, 2022     |
| Dept. of Math., Stat., Comp. Sc. Colloquium | University of Illinois Chicago (Online) | December 7, 2021     |
| AG-CA Seminar                               | University of Notre Dame (Online)       | November 16, 2021    |
| Commutative Algebra Seminar                 | U. of Illinois at Chicago (Online)      | November 4, 2021     |
| AMS Sectional Meeting                       | Online                                  | October 23, 2021     |
| Nat. Congress Mexican Math Soc.             | Online                                  | October 21, 2021     |
| Algebra and Alg. Geometry Seminar           | McMaster University, Canada (Online)    | July 19, 2021        |
| Virtual CA seminar                          | IIT Bombay, India (Online)              | July 9, 2021         |
| Fellowship of the Ring                      | MSRI (Online)                           | April 29, 2021       |
| AMS Sectional Meeting                       | Online                                  | April 17, 2021       |
| Dept. of Math. Colloquium                   | New Mexico State University (Online)    | April 9, 2021        |

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| Algebra and Geometry Seminar             | Iowa State University (Online)           | March 16, 2021       |
| Dept. of Math. Colloquium                | U. of California, Riverside (Online)     | February 24, 2021    |
| Combinatorics Seminar                    | University of Kansas (Online)            | November 13, 2020    |
| Dept. of Math. Colloquium                | U. de los Andes, Colombia (Online)       | October 22, 2020     |
| Dept. of Math. Colloquium                | University of New Mexico (Online)        | October 13, 2020     |
| AMS Sectional Meeting                    | Online                                   | October 3, 2020      |
| AG and CA seminar                        | NU/UIC/UofC (Online)                     | July 29, 2020        |
| eCARs conference                         | Online                                   | June 28, 2020        |
| Algebra Seminar                          | U./Neu./Frib./Bern, Switzerland (Online) | May 15, 2020         |
| AMS Sectional Meeting (meeting canceled) | Purdue University                        | April 4, 2020        |
| Algebra and Algebraic Geometry Seminar   | University of Wisconsin, Madison         | February 7, 2020     |
| Commutative Algebra Seminar              | Purdue University                        | April 22, 2019       |
| AMS Sectional Meeting                    | Auburn University                        | March 15, 2019       |
| Frobenius Action in CA Workshop          | Barcelona, Spain                         | January 18, 2019     |
| Algebra Seminar                          | Universitat Pol. València, Spain         | January 15, 2019     |
| Fall School in CA                        | CIMAT, Mexico                            | November 13-17, 2018 |
| Algebra Seminar                          | Georgia State University                 | September 11, 2018   |
| Public Lecture at ECCO 2018              | Barranquilla, Colombia                   | June 7, 2018         |
| Col.-Mex. Math Soc. joint meeting        | Universidad del Norte, Colombia          | May 30, 2018         |
| AMS Sectional Meeting                    | Portland State University                | April 14, 2018       |
| CA-AG Seminar                            | CIMAT, Mexico                            | March 22, 2018       |
| Geometry and Topology Seminar            | San Francisco State University           | March 12, 2018       |
| Commutative Algebra Seminar              | University of Michigan                   | November 2, 2017     |
| Commutative Algebra Seminar              | University of Utah                       | October 19, 2017     |
| PRIMA 2017                               | Oaxaca, Mexico                           | August 14, 2017      |
| Combinatorial and CA Seminar             | Oklahoma State University                | April 20, 2017       |
| Commutative Algebra Seminar              | University of Nebraska-Lincoln           | April 10, 2017       |
| KUMUNU jr 2017                           | University of Nebraska-Lincoln           | April 8, 2017        |
| Algebra Seminar                          | University of Missouri                   | February 27, 2017    |
| Department of Mathematics Colloquium     | New Mexico State University              | February 9, 2017     |
| 2016 CMS Winter Meeting                  | Niagara Falls, Canada                    | December 4, 2016     |
| Algebra & Combinatorics Seminar          | Tulane University                        | November 10, 2016    |
| Commutative Algebra Seminar              | Purdue University                        | October 21, 2016     |
| KUMUNU 2016                              | University of Kansas                     | October 1, 2016      |
| AMS Sectional Meeting                    | North Dakota State University            | April 16, 2016       |
| Algebra Seminar                          | University of Arkansas                   | January 29, 2016     |
| AMS Sectional Meeting                    | Rutgers University                       | November 14, 2015    |
| Combinatorics Seminar                    | University of Kansas                     | November 6, 2015     |
| Commutative Algebra Seminar              | Purdue University                        | October 7, 2015      |
| Midwest Commutative Algebra Meeting      | Purdue University                        | August 5, 2015       |
| CA and related topics 2015               | University of Kansas                     | March 22, 2015       |
| Commutative Algebra Seminar              | Purdue University                        | February 4, 2015     |
| 2015 Joint Mathematics Meeting           | San Antonio, TX                          | January 13, 2015     |
| Commutative Algebra Seminar              | University of Utah                       | November 21, 2014    |
| Commutative Algebra Seminar              | Purdue University                        | November 5, 2014     |
| Algebra Seminar                          | New Mexico State University              | November 3, 2014     |
| AMS Sectional Meeting                    | San Francisco State University           | October 26, 2014     |
| AMS Sectional Meeting                    | Dalhousie University                     | October 19, 2014     |
| AMS Sectional Meeting                    | University of New Mexico                 | April 5, 2014        |
| Commutative Algebra Seminar              | Purdue University                        | February 27, 2014    |
| Commutative Algebra Seminar              | Purdue University                        | October 28, 2013     |
| Commutative Ring Theory Seminar          | University of Illinois at U-C            | October 24, 2013     |

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|---------------------------------|--------------------------------|-------------------|
| Commutative Algebra Seminar     | Purdue University              | October 21, 2013  |
| AMS Sectional Meeting           | University of Louisville       | October 5, 2013   |
| KUMUNU jr 2013                  | University of Nebraska-Lincoln | April 22, 2013    |
| Commutative Ring Theory Seminar | University of Illinois at U-C  | March 7, 2013     |
| AG-CA Seminar                   | University of Notre Dame       | February 26, 2013 |
| Commutative Algebra Seminar     | Purdue University              | February 22, 2013 |

## **ORGANIZATIONAL ACTIVITIES**

|   |   |                       |
|---|---|-----------------------|
| <i>Co-Organizer</i> , Southwest Local Algebra Meeting | Yearly                                  | 2023-                 |
| <i>Co-Organizer</i> , Number Theory&Algebra Seminar   | Arizona State University                | Fall 2022-            |
| <i>Co-Organizer</i> , Algebra Days at Arizona State   | Arizona State University                | November 2023         |
| <i>Co-Organizer</i> , AMS Spe. Ses. on CA and Comb.   | University of Texas, El Paso, TX        | September 2022        |
| <i>Co-Organizer</i> , Pan-American School on CA       | CIMAT, Mexico                           | June 2002             |
| <i>Co-Organizer</i> , AMS Spe. Ses. on CA             | Online                                  | September 2020        |
| <i>Co-Organizer</i> , Algebra Seminar                 | New Mexico State University             | Fall 2019-Fall 2021   |
| <i>Co-Organizer</i> , CAAG Reading Seminar            | New Mexico State University             | Spring 2019-          |
| <i>Co-Organizer</i> , AMS Spe. Ses. on Multiplicities | University of Michigan, Ann Arbor, MI   | October 2018          |
| <i>Co-Organizer</i> , Algebra Seminar                 | University of Kansas                    | Fall 2015-Spring 2018 |
| <i>Co-Organizer</i> , KUMUNU 2017                     | University of Kansas                    | October 2017          |
| <i>Co-Organizer</i> , 2017 SACNAS, Session on CA      | Salt Lake City, UT                      | October 2017          |
| <i>Co-Organizer</i> , AMS Spe. Ses. on CA             | University of North Texas, Denton, TX   | September 2017        |
| <i>Co-Organizer</i> , JMM - MRC Session on CA         | Seattle, WA                             | January 2016          |
| <i>Co-Organizer</i> , AMS Spe. Ses. on CA             | Loyola University, Chicago, IL          | October 2015          |
| <i>Co-Organizer</i> , Student Comm. Alg. Seminar      | Purdue University                       | Fall 2013-Spring 2015 |
| <i>Co-organizer</i> , Student Colloquium              | Dept. of Mathematics, Purdue University | Fall 2013-Spring 2015 |
| <i>Co-organizer</i> , Program Associate Seminar       | MSRI                                    | Fall 2012             |

## **OTHER PROFESSIONAL ACTIVITIES**

*Scientific Committee member*, Colombian Combinatorics Meeting (ECCO), summer 2024  
*Teaching Assistant*, MSRI Summer Graduate School, University of Notre Dame, May 2019  
*Teaching Assistant*, MSRI Summer Graduate School, Okinawa, Japan, May 2017  
*Reviewer*, NSA-AMS Grant  
*Referee*, Communications in Algebra, Contemporary Mathematics, European Journal of Combinatorics, Journal of Algebra, Journal of Algebra and its Applications, Journal of Commutative Algebra, Journal of Pure and Applied Algebra, Mathematical Research Letters, Mathematica Scandinavica, Mathematische Zeitschrift, Nagoya Mathematical Journal, Proceedings of the American Mathematical Society, Rocky Mountain Journal of Mathematics, Transactions of the American Mathematical Society.

## **ADVISING**

### *Ph.D. students:*

Sudipta Das (2020 - )

### *Master's Degree students:*

Emmy Lewis (2019 - 2021) - Currently a PhD Student at Cornell University

### *Undergraduate students:*

Ethan Leventhal (2022 - )

Jacob Cooper (2023 - )

Chris Tapo (2023)

Emmy Lewis (2018 - 2019) - Currently a PhD Student at Cornell University

## **SELECTED OUTREACH ACTIVITIES**

|   |                       |                         |
|---|-----------------------|-------------------------|
| <i>Associate Editor</i> , AMS Blog on Teaching and Learning |                       | August 2020 - July 2021 |
| <i>Associate Editor</i> , Frontiers for Young Minds         |                       | May 2017 - May 2021     |
| <i>Grader</i> , USAMO 2015, 2016                            | Cambridge, MA         | April 2015, 2016        |
| <i>Coordinator (Problem Captain)</i> , IMO 2013             | Santa Marta, Colombia | July 2013               |
| <i>Trainer</i> , AAAS Olympiad Program                      | Washington D.C.       | 2012                    |
| <i>President</i> , Colombian St. Association at Purdue      | Purdue University     | 2011                    |

## **SELECTED AWARDS IN MATHEMATICS AND PROGRAMMING COMPETITIONS**

International Collegiate Programming Contest, South American Final, *first place*, Bogotá, Colombia, 2008.  
Colombian Programming Contest (college level), *first place*, 2008.  
International Mathematics Competition for University Students, *third prize*, Bulgaria, 2008; Ukraine, 2006.  
International Mathematical Olympiad, *bronze medal*, Greece, 2004.  
Colombian Mathematical Olympiad, *gold medal*, 2003.  
Colombian Programming Olympiad, *first place*, 2002, 2001, *third place*, 2003.

## **TEACHING EXPERIENCE**

### **Arizona State University**, August 2022 -

|  |            |             |
|--|------------|-------------|
| Algebraic Geometry and Toric Varieties | Instructor | Fall 2023   |
| Advanced Linear Algebra                | Instructor | Fall 2023   |
| Ring Theory                            | Instructor | Spring 2023 |
| Advanced Linear Algebra                | Instructor | Fall 2022   |

### **New Mexico State University**, August 2018 - July 2022

|   |            |             |
|---|------------|-------------|
| Abstract Algebra I: Groups and Rings            | Instructor | Spring 2022 |
| Calculus and Analytic Geometry II               | Instructor | Spring 2022 |
| Introduction to Modern Algebra                  | Instructor | Fall 2021   |
| Calculus and Analytic Geometry II               | Instructor | Fall 2021   |
| Introduction to Algebraic Statistics            | Instructor | Spring 2021 |
| Introduction to Higher Mathematics              | Instructor | Spring 2021 |
| Advanced Linear Algebra                         | Instructor | Fall 2020   |
| Calculus and Analytic Geometry II               | Instructor | Fall 2020   |
| Introduction to Algebraic Geometry              | Instructor | Spring 2020 |
| Matrix Theory and Applied Linear Algebra        | Instructor | Fall 2019   |
| Calculus and Analytic Geometry III              | Instructor | Fall 2019   |
| Calculus and Analytic Geometry II               | Instructor | Spring 2019 |
| Calculus and Analytic Geometry I (two sections) | Instructor | Fall 2018   |

### **University of Kansas**, August 2015 - May 2018

|                             |            |             |
|-----------------------------|------------|-------------|
| Calculus III (Honors)       | Instructor | Spring 2018 |
| Introductory Modern Algebra | Instructor | Fall 2017   |
| Elementary Linear Algebra   | Instructor | Fall 2017   |
| Linear Algebra              | Instructor | Summer 2017 |
| Linear Algebra              | Instructor | Spring 2017 |
| Elementary Linear Algebra   | Instructor | Fall 2016   |
| Calculus III (Honors)       | Instructor | Fall 2016   |
| Elementary Linear Algebra   | Instructor | Spring 2016 |
| Vector Calculus             | Instructor | Spring 2016 |
| Linear Algebra              | Instructor | Fall 2015   |

**Purdue University**, August 2009 - July 2015

|                          |                       |             |
|--------------------------|-----------------------|-------------|
| Introductory Analysis I  | Instructor            | Spring 2014 |
| Introductory Analysis II | Instructor            | Fall 2013   |
| Calculus I               | Recitation Instructor | Spring 2013 |
| Calculus II              | Recitation Instructor | Spring 2012 |
| Multivariable Calculus   | Recitation Instructor | Fall 2011   |
| Multivariable Calculus   | Recitation Instructor | Fall 2010   |

**Universidad Nacional de Colombia**, Bogotá, August 2008 - August 2009

|                |            |             |
|----------------|------------|-------------|
| Linear Algebra | Instructor | Spring 2009 |
| Calculus I     | Instructor | Fall 2008   |

**LANGUAGES**

English (bilingual proficiency), Spanish (native).

**MEMBERSHIP**

American Mathematical Society, 2010-