## ALEJANDRO URIBE (AHUMADA)

Mathematics Department University of Michigan, Ann Arbor, MI, 48109-1043

## **Education:**

Ph.D. Massachusetts Institute of Technology, 1982. Licenciatura, Universidad Nacional de México, 1978.

#### **Positions Held:**

University of Michigan, Department of Mathematics Professor of Mathematics, 1995 to date. Associate Professor with Tenure, 1989–1995.

Princeton University Assistant Professor, 1984–89. Instructor, 1983–84.

Massachusetts Institute of Technology Visiting Scholar, 1982–83.

## Service Highlights:

MATH 215 Course Coordinator, 2024–2025.
Chair of the Climate Committee, 2019–2021.
Associate Chair for Graduate Studies, 2011–2017.
Associate Chair for Education, 2000–2001 and 2007–2009.
Interim Chair, 2001–2002.
Editorial Board Member, Electronic Research Announcements (ERA).
U. of M. Mathematics Department Executive Committee member, 1991-1992, 1998-2000, 2005-2007, 2018-2020.
MCTP Executive Committee member, 2008-2010.
Member at Large of the Council of the AMS, 2004-2007.
Member of the AMS Committee on Education, 2004-2007.

## Fellowships and Honors:

Professeur Invité, Université Paris-Saclay, June 2024.

Research Professorship, MSRI Sept–Nov 2019.

Fellow of the American Mathematical Society, 2012.

NSF Research Awards (P. I.), 1983 to 2008 and 2009 to 2015.

Member of M.S.R.I, Berkeley, California, Oct-Nov 1988 and Feb 2001.

Invited Professor, École Normale Supérieure, Paris, June 2000.

Excellence in Education Awards, University of Michigan, 1994 and 1997.

NSF Curriculum Development Award, 1995.

Member of the Institute of Advanced Study, Princeton NJ, 1989–90.

## Selected Recent Invited Addresses (in chronological order):

Geometry seminar of the Instituto Superior Técnico, Lisboa, Portugal, January 2012.

Summer school in Kähler Geometry and Quantization, University of Cologne, Germany, July 16-20, 2012.

GEOQUANT, Erwin Schrödinger Institute, Vienna, August 2013.

TIDY Distinguished Lecturer, School of Mathematical Sciences, Tel-Aviv University, May 2014.

Symmetries and Universality in Mesoscopic Systems III at the University of Cologne, May 11-14, 2015.

Special session speaker, joint meeting of the AMS and the European Mathematical Society, Porto June 2015.

Texas Geometry and Topology Conference, TCU, February 2016.

Quantum Mechanics meets Symplectic Topology, Tel Aviv University, May 2016.

Third Congress of the Pacific Rim Mathematical Association, Oaxaca, Mexico August 14–18, 2017.

A Celebration of Symplectic Geometry: 15 Years of JSG, June 5–6, 2017 CMSA, Harvard University.

Conference on Micro-local analysis and Symplectic Geometry, M.I.T. November 10–12 2017.

Workshop Mexican Mathematicians in the World: Perspectives and Recent Contributions, Casa Matemática Oaxaca, June 10 –15 2018.

Workshop *Quantization in Symplectic Geometry*, University of Cologne, July 15–19, 2019.

Colloquium speaker, Instituto de Matemáticas UNAM, Cuernavaca, México January 19, 2022.

Banff International Research Station-CMO Workshop on Spectral Theory, August 15, 2022.

Workshop on Bergman kernels in microlocal analysis and mathematical physics, CIRM, Luminy, November 2022.

Workshop *Quantization in Geometry*, University of Cologne, July 24–28, 2023.

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Analyisis Seminar lecture, Laboratoire de Mathématique d'Orsay, Université Paris-Saclay, June 18, 2024.

Lecture at the joint meeting of the Sociedad Matemática Mexicana and the Real Sociedad Matemática Española, Valencia, Spain July 2024 (virtual).

# Past and Current Postdoctoral Mentees:

Raymond Brummelhuis David Borthwick Razvan Gelca Tatiana Barron (Tatiana Foth) William Kirwin Elizabeth Stanhope Zuoqin Wang Rohan Kadakia David Sher Donato Cianci Ben Bellis Amir Vig Yu-Tung Yau

## **Doctoral Students:**

Mary Sandoval (Trinity College) Mariah Birgen (Wartburg College) Levente Korpas (Private Industry) Brian Jennings (Westfield State University) Gerardo Hernández-Dueñas (Instituto de Matemáticas, UNAM, México) Jenia Rousseva (Private Industry) Reebhu Bhattacharyya (current student)

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#### LIST OF PUBLICATIONS

#### CHROLONOGICAL BY PUBLICATION DATE

- The Averaging Method and Spectral Invariants, Ph.D. Thesis, Massachusetts Institute of Technology, 1982.
- [2] Some spectral properties of a certain class of complex potentials (with V. Guillemin), Trans. Amer. Math. Soc., 279, 759-771, 1983.
- [3] Hardy functions and the inverse spectral method (with V. Guillemin), Comm. Partial Differential Equations, 8, 1455-1474, 1983.
- [4] A symbol calculus for a class of pseudodifferential operators on  $S^n$  and band asymptotics, J. Funct. Analysis, 59, 535-556, 1984.
- [5] Band invariants and closed trajectories on  $S^n$ , Adv. in Math., 58, 285-299, 1985.
- [6] Band asymptotics on line bundles over S<sup>n</sup> (with V. Guillemin), J. Differential Geom., 21, 129-133, 1985.
- [7] Clustering theorems with twisted spectra (with V. Guillemin), Math. Ann., 273, 479-506, 1986.
- [8] The trace formula for vector bundles (with V. Guillemin), Bull. Amer. Math. Soc., 15, 222-224, 1986.
- [9] Band asymptotics with non-smooth potentials, J. Funct. Analysis, 74, 1-9 1987.
- [10] Some spectral properties of periodic potentials (with V. Guillemin), in Pseudodifferential Operators, Springer Lecture Notes No. 1256, 192-213, 1987.
- [11] Reduction, the trace formula, and semiclassical asymptotics (with V. Guillemin), Proc. Nat. Acad. Sci. U.S.A., 84, 7799-7801, 1987.
- [12] The Laplace operator on the n-th tensor power of a line bundle: eigenvalues which are uniformly bounded in n. (with V. Guillemin), Asymptotic Analysis, 1, 105-113, 1988.
- [13] Monodromy in the quantum spherical pendulum (with V. Guillemin), Comm. Math. Phys., 122, 563-574, 1989.
- [14] Circular symmetry and the trace formula (with V. Guillemin), Invent. Math., 96, 385-423, 1989.
- [15] Reduction and the trace formula (with V. Guillemin), J. Differential Geom. 32, 315-347, 1990.
- [16] A semiclassical trace formula for Schrödinger operators (with R. Brummelhuis), Comm. Math. Phys., 136, 567-584, 1991.
- [17] Sur la formule semi-classique de traces (with T. Paul), Comptes Rendus de l'Academie de Sciences, Paris, 313 (Ser. I) 217-222 (1991).
- [18] Semiclassical spectra of gauge fields (with M. Taylor), J. Functional Analysis 110 No.1, 1-46 (1992)
- [19] On the de Haas-van Alphen effect (with V. Guillemin), Asymptotic Analysis 6, 205-217 (1993).
- [20] Spectral statistics on Zoll surfaces, (with S. Zelditch) Commun. Math. Phys. 154, 313-346 (1993).
- [21] A construction of quasi-modes using coherent states (with T. Paul), Ann. Sc. Institut Henri Poincaré Ser. A 59, 357-381 (1993).

- [22] Periodic orbits and quantum mechanics (with T.Paul), Proceedings of the conference "From classical to quantum chaos (1892-1992)" held in Trieste, SISSA, July 1992.
- [23] The semi-classical trace formula and propagation of wave packets (with T. Paul), J. Funct. Analysis 132 No.1, 192-249 (1995).
- [24] Spectral estimates around a critical level (with R. Brummelhuis and T. Paul), Duke Math. J. 78 No.3, 477-530 (1995)
- [25] Legendrian distributions with applications to relative Poincaré series (with D. Borthwick and T. Paul), Inventiones Math. 122, 359-402 (1995).
- [26] On the pointwise behavior of semi-classical measures (with T. Paul), Commun. Math. Phys. 175, 229-258 (1996).
- [27] Almost Complex Structures and Geometric Quantization (with D. Borthwick). Math. Research Letters 3, 845-861 (1996).
- [28] Weighted trace formula near a hyperbolic trajectory and complex orbits (with T. Paul), J. Math. Phys. 39 No. 8, 4009-4015 (1998).
- [29] Weighted Weyl estimates near an elliptic trajectory (with T. Paul), Revista Iberoamericana de Matemáticas 14 No.1 145-165 (1998).
- [30] Semi-classical spectral estimates for Toeplitz operators (with D. Borthwick and T. Paul). Annales de l'Institut Fourier 48 No. 4, 1189-1229 (1998).
- [31] Quantization of symplectic cobordisms (with L. Korpás), Math. Research Letters 6, 1-11 (1999).
- [32] Trace Formulae. In First Summer school in analysis and mathematical physics, Cuernavaca, Mexico. Contemporary Mathematics series **260**, AMS (2000).
- [33] Nearly Kählerian embeddings of symplectic manifolds (with D. Borthwick), Asian J. of Math 4, No. 3, 599-620 (2000).
- [34] The spectral density function for the Laplacian on high tensor powers of a line bundle (with D. Borthwick), Annals Global Analysis and Geom. 21, 269-286 (2002).
- [35] The Weyl quantization and the quantum group quantization of the moduli space of flat SU(2) connections on the torus are the same (with R. Gelca). Comm. Math. Phys. 233, No. 3, 493-512 (2003).
- [36] Dispersionless Toda and Toeplitz operators (with A. Bloch, F. Golse and T. Paul), Duke Math J. 117, No. 1, 157-196 (2003).
- [37] On the pseudospectra of Berezin-Toeplitz operators (with D. Borthwick). Methods Appl. Anal. 10 (2003), no. 1, 31–65.
- [38] The semiclassical structure of low-energy states in the presence of a magnetic field, (with D. Borthwick), Trans. Amer. Math. Soc. 359 (2007), no. 4, 1875–1888.
- [39] The manifold of compatible almost-complex structures and geometric quantization (with T. Foth), Comm. Math. Phys. 274 (2007), no. 2, 357–379.
- [40] Some inverse spectral results for semi-classical Schrödinger operators (with V. Guillemin), Math. Res. Lett. 14 (2007), no. 4, 623–632.
- [41] "Bottom of the well" semi-classical trace invariants (with V. Guillemin and T. Paul), Math. Res. Lett. 14 (2007), no. 4, 711–719.
- [42] Asymptotics of spectral clusters for a perturbation of the hydrogen atom (with C. Villegas-Blas), Comm. Math. Phys. 280 (2008), 123-144.
- [43] Geodesics on weighted projective spaces (with V. Guillemin and Z. Wang), Ann. Global Anal. Geom. 36 (2009), no. 2, 205–220.
- [44] Theta functions on the Kodaira-Thurston manifold (with W. D. Kirwin), Trans. Amer. Math. Soc. 362 (2010), no. 2, 897–932.

- [45] The spectral density function of a toric variety (with D. Burns and V. Guillemin), Pure Appl. Math. Q. 6 (2010), no. 2, 361–382.
- [46] The spectral function of a Riemannian orbifold (With E. Stanhope), Ann. Global Anal. Geom. 40 (2011), no. 1, 47–65.
- [47] Some inverse spectral results for the two-dimensional Schrödinger operator (with V. Guillemin), Advanced Lectures in Mathematics 17, (2011), 319–328. International Press, Sommerville, MA. (Refereed proceedings of the conference "Geometric analysis: Present and Future", Harvard, 2008.)
- [48] Band invariants for perturbations of the harmonic oscillator (with V. Guillemin an Z. Wang), J. Funct. Anal. 263 (2012), no. 5, 1435–1467.
- [49] A brief introduction to semiclassical analysis (with Z. Wang), in Spectral geometry, Proc. Sympos. Pure Math. 84, 73–89. Amer. Math. Soc., Providence, RI, 2012. (Refereed proceedings of the spectral geometry conference held at Dartmouth, 2010).
- [50] A semiclassical heat trace expansion for the perturbed harmonic oscillator (with V. Guillemin and Z. Wang), in *Spectral geometry*, Proc. Sympos. Pure Math. 84, 181–193 Amer. Math. Soc., Providence, RI, 2012. (Refereed proceedings of the spectral geometry conference held at Dartmouth, 2010).
- [51] From classical theta functions to a topological quantum field theory (with R. Gelca). In Contemporary Math. 621, Amer. Math. Soc., Providence, RI (2014).
- [52] Quantum mechanics and non-abelian theta functions for the gauge group SU(2) (with Razvan Gelca). Fund. Math. 228, no. 2, 97–137 (2015).
- [53] An algebra of semicassical pseudodifferental operators associated with Zoll-type domains in cotangent bundles (with G. Hernández-Dueñas). J. Funct. Anal. 268, no. 7, 1755-1807 (2015).
- [54] Canonical forms for perturbations of the harmonic oscillator (with V. Guillemin and Z. Wang). New York J. Math. 21, 163–180, (2015).
- [55] Semiclassical states associated to isotropic submanifolds of phase space (with V. Guillemin and Z. Wang). Lett Math Phys 106, 1695-1728 (2016).
- [56] Spectral properties of semi-classical Toeplitz operators (with V. Guillemin and Z. Wang). In: *Lie groups, geometry, and representation theory*, 185–199, Progr. Math., **326**, Birkhäuser/Springer (2018).
- [57] Szegö limit theorems for singular Berezin-Toeplitz operators, (with Salvador Pérez-Esteva). J. Funct. Anal. 278, no. 1 (2020).
- [58] On the pseudospectra of Schrödinger operators on Zoll manifolds (with D. Sher and C. Villegas). Contemporary Math. 775, AMS (2021).
- [59] Reduction and coherent states (with J. Rousseva). Lett. Math. Phys. 111 (2021), no. 2, 52.
- [60] Integral representations of isotropic semi-classical functions and applications (with V. Guillemin and Z. Wang). J. Spectr. Theory 12 (2022), no. 1, 227258.
- [61] Perturbations of the Landau Hamiltonian: asymptotics of eigenvalue clusters (with G. Hernández-Dueñas, S. Pérez-Esteva and C. Villegas-Blas). Ann. Henri Poincar 23 (2022), no. 2.
- [62] The exponential map of the complexification of the group of analytic Hamiltonian diffeomorphisms (with R. Bhattacharyya, D. Burns and E. Lupercio). Pure Appl. Math. Q. 18 (2022), no. 1, 3370.
- [63] The semiclassical structure of the scattering matrix for a manifold with infinite cylindrical end (with T. Christiansen). Amer. J. of Math., to appear.

## Preprints

- Local boundary conditions for Dirac-type operators (with Nadine Grosse and Hanne van den Bosch). arXiv:2412.17396 (2024).
- Spectral cluster asymptotics of the Dirichlet to Neumann operator on the two-sphere (with Salvador Pérez-Esteva and Carlos Villegas-Blas). arXiv:2412.16652 (2024).

### Books

- (1) Spectral Geometry (Editor; with Alex Barnett, Carolyn Gordon and Peter Perry). Proc. Symposia Pure Math. vol. 84, AMS, 2012.
- (2) Explorations in Analysis, Topology and Dynamics: An Introduction to Abstract Mathematics (with Daniel Visscher). Pure and Applied Undergraduate Texts 44, AMS 2020.