Chun-Ju Lai

Assistant Research Fellow

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Academia Sinica

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Research Interests

Affine Hecke algebras, quantum groups, quantum symmetric pairs, modular representation theory, Springer fibers, quiver varieties, geometric representation theory, and algebraic combinatorics.

Appointments

2010 – 2011	Research Assistant, *National Center of Theoretical Sciences*, Taiwan
	Mentor: Prof. Shun-Jen Cheng
2016 – 2017	Postdoc Fellow, *Max-Planck Institute for Mathematics in Bonn*, Germany
2019	Summer Collaborator Program, *Institute for Advanced Study*
2017 – 2020	Limited Term Assistant Professor, *University of Georgia*
	Research mentor: Prof. Daniel K. Nakano
2020 – now	Assistant Research Fellow, *Academia Sinica*

Professional Preparation

2005 – 2009	B.S. Mathematics; B.S.E. Electrical Engineering, *National Taiwan University*
2011 – 2016	Ph.D. Mathematics, *University of Virginia*
	Advisor: Prof. Weiqiang Wang

Publications

[1] S. Eu, T. Fu, and C. Lai, *On the enumeration of parking functions by leading terms*, Adv. in Appl. Math., **35** (2005), 392–406.

[2] S. Eu, T. Fu and C. Lai. *Cycle lemma, parking functions and related multigraphs*, Graphs Combin., **26** (2010), 345–360.

[3] C. Lai, *On Weyl modules over affine Lie algebras in prime characteristic*, Transform. Groups **21** (2016), 1123–1153.

[4] C. Lai and L. Luo, *An elementary construction of monomial bases of modified quantum affine $\mathfrak{gl}_n$*, J. Lond. Math. Soc. **96** (2017), 15–27.

[5] Z. Fan, C. Lai, Y. Li, L. Luo, and W. Wang, *Affine flag varieties and quantum symmetric pairs*, Mem. Amer. Math. Soc., 265 (2020), no. 1285.

[6] Z. Fan, C. Lai, Y. Li, L. Luo, and W. Wang, *Affine Hecke algebras and quantum symmetric pairs*, Mem. Amer. Math. Soc. (to appear), 75 pages, arXiv:1609.06199v1.

[7] Z. Fan, C. Lai, Y. Li, L. Luo, W. Wang and H. Watanabe, *Quantum Schur duality of affine type C with three parameters*, Math. Res. Letters, 27 (2020) 79–114.

[8] C. Lai and L. Luo, *Schur algebras and quantum symmetric pairs with unequal parameters*, Int. Math. Res. Not. (to appear), 34 pages.

[9] C. Lai, D. K. Nakano and Z. Xiang, *On Schur algebras corresponding to the Hecke algebras of type B*, arXiv: 1902.07682, 32 pages, submitted.

[10] M.S. Im, C. Lai and A. Wilbert, *Irreducible components of two-row Springer fibers and Nakajima quiver varieties*, arXiv: 1910.03010, 37 pages, preprint.

Grant

- **Provost's Affordable Course Materials Grant**, Center of Teaching and Learning, University of Georgia, with Joseph Hoisington.

Teaching Experience

- **Applied Calculus I/II**, three-hour coordinated courses on the essentials of Calculus biased on computational aspects for business/biology/social science students. **WebAssign** is used as an online instructional tool.
  –UVA, Spring 2016, 2015, 2014 for Applied Calculus II; Fall 2013 for Applied Calculus I.
- **Calculus I/II**, four-hour coordinated Calculus courses for science and engineering students. I served as a member in the Final Exam Making Committee two times. **WeBWorK** is used as an online homework system.
  –UGA, Fall 2017, Spring 2019 for Calculus I. UVA, Fall 2015 for Calculus II.
- **Calculus III**, a four-hour course on multivariable Calculus and basic differential geometry for science and math majors.
  –UGA, Fall 2017, Spring 2018.
- **Lie algebras**, a graduate level introduction to the theory of Lie algebras. Topics include the classification theorem, the PBW theorem for the universal enveloping algebras, and the Weyl character formula. Humphreys' GTM textbook is used.
  –UGA, Fall 2019.
- **Quantum groups**, a graduate level topic course. Topics include the (quasi) R-matrices and Yang-Baxter equations, braid group actions and the PBW theorem, tensor product rule for crystal bases, canonical bases and categorification. We used textbooks of Jantzen, Hong-Kang and Lusztig.
  –UGA, Fall 2018.

Professional Development

- *Oral Academic Communications*, University of Virginia.
- *Classroom Communications*, University of Virginia.
- *Diversity in Mathematics and Inclusivity in the Classroom*, University of Georgia.
- *Small Teaching, Big Impact*, University of Georgia.
- *Equity and Inclusivity in the Classroom*, University of Georgia.
- *Non-Discrimination and Anti-Harassment Training Session*, University of Georgia.

Training and Service

- **Journal manuscript reviewer** for the *European Journal of Combinatorics*, the *International Mathematics Research Notices*, the *Journal of Algebra*, the *Journal of Algebra and its Applications*, the *Journal of Pure and Applied Algebra*, the *Nagoya Mathematical Journal*, the *Pure and Applied Mathematics Quarterly*, and the *Symmetry*. I'm also a reviewer for *Zentralblatt MATH (zbMATH)* and *Math Reviews*.
- **Secondary thesis advisor** to Dr. Ziqing Xiang, whose primary advisor is Prof. Daniel K. Nakano at the University of Georgia.
- **Panel member** for the discussion session "Organization and Workflow: How to stay organized as an academic" in the 2018 summer professional development workshop, University of Georgia.
- **Lecturing Seminar**
  –at 2017 reading course on *Affine Hecke algebras and their appearance in mathematics* run by Prof. Catharina Stroppel at the Max Planck Institute.

–at 2019 summer reading course for graduate students on *Perverse Sheaves and Applications to Representation Theory* run by Prof. Laura Rider at the University of Georgia.

–at *Street Math and Related Topics (SMART)* Seminar, University of Georgia, Nov 2019. This is a student-organized seminar. The goal is to fill gaps in knowledge with necessary research topics that are not always covered in a course.

- **Science fair judge** of the Georgia Science and Engineering Fair (GSEF), 2018 – 2020. This is a regional competition for researchers in grades 6–12.
- **Judge** of the 2020 Shing-Tung Yau High School Mathematics Award. This is a science fair competition for Taiwanese high school students.
- **Science communicator** for the *Academia Sinica Newsletter*, 2020, regarding representation theory.

Conference Organizations

- **Southeast Lie Theory Conference XI**, University of Georgia, Jun 10–12, 2018.
- **Algebra Seminar at the University of Georgia**, Aug 2018 – May 2020.
- (canceled due to COVID-19) **AMS Special Session** on *Representation Theory of Algebraic Groups and Quantum Groups: A Tribute to the Work of Cline, Parshall and Scott (CPS)*, University of Virginia, Mar 13–15, 2020.
- **AMS Special Session**, University of Virginia, Mar 11–13, 2022.

Conference Talks

2007	Jun	Cross-strait Conference on Graph Theory and Combinatorics, National Taiwan University, Taiwan, *The triple-labeled algorithm in parking functions*
2014	May	Southeastern Lie Theory Workshop, University of Georgia, *Quantum Schur-type dualities of affine type B*
2015	Jul	Workshop on Lie Theory and Representation Theory, East China Normal University, China, *An elementary approach to monomial bases of quantum affine $\mathfrak{gl}_n$*
	Oct	Southeastern Lie Theory Workshop, North Carolina State University, *Schur duality, canonical bases, and quantum symmetric pairs of affine type*
2016	May	Workshop on Hecke Algebras and Lie Theory, University of Ottawa, Canada, *Affine Hecke algebras and quantum symmetric pairs*
	May	Southeastern Lie Theory Workshop, University of Virginia, *Affine Hecke algebras and quantum symmetric pairs*
2017	Jul	Taipei Workshop on Representation Theory of Lie Superalgebras and Related Topics, Academia Sinica, Taiwan, *RTT Formalism, Schur Algebras and Quantum Supergroups*
2018	Oct	Representation Theory, Combinatorics, and Geometry, University of Virginia, *Schur algebras and quantum symmetric pairs with unequal parameters*
2019	May	Southeastern Lie Theory Workshop, Louisana State University, *A coordinate coalgebra realization of q-Schur duality of type B*
2020	Aug	Taipei workshop on representation theory and related topics (invited), *The power of folding in representation theory* Academia Sinica, Taiwan
	Dec	TMS Annual Meeting (invited), Fu-Jen Catholic University, Taiwan

Expository Talks

2014	Jul	5 lectures, *Minicourse on Representation Theory of Lie Algebras*, Taiwan Normal University, Taiwan
	Dec	4 lectures, *Minicourse on Representation Theory of Lie Algebras*, Central University, Taiwan
2016	Jul	3 lectures, *Minicourse on Quantum Groups*, Taiwan Normal University, Taiwan
2020	Oct	10 lectures, *Minicourse on Springer Fibers and Quiver Varieties*, National Center of Theoretical Science (Taipei Office), Taiwan

Seminar Talks / AMS Special Sessions

2010	Nov	Combinatorics Seminar, University of Kaohsiung, Taiwan
2013	Sep	Algebra seminar, University of Virginia
2013	Nov	Graduate seminar, University of Virginia
2014	May	Algebra seminar, University of Virginia
	Dec	Seminar, National Central University
	Dec	Seminar, Academia Sinica, Taiwan
2015	Mar	AMS special session on *Quantum Algebras, Representations, and Categorifications*, Georgetown University, D.C.
	Nov	Algebra seminar, University of Virginia
	Dec	Lie Group/Representation Theory Seminar, University of Maryland
2016	Sep	Algebra Seminar, University at Buffalo (SUNY)
2016	Oct	Emmy Noether Seminar, FAU Erlangen-Nürnberg, Germany
	Nov	Algebra Seminar, Newcastle University, UK
	Dec	Oberseminar, Max Planck Institute for Mathematics in Bonn, Germany
	Dec	Algebra Seminar, Universität Bonn, Germany
2017	Feb	Algebra Seminar, Université Clermont Auvergne, France
	Apr	Algebra Seminar, Universität Bielefeld, Germany
	Aug	Algebra Seminar, University of Georgia
	Aug	Oberseminar, University of Georgia
	Sep	Algebra Seminar, University of Georgia
	Sep	AMS special session on *Recent Advancements in Representation Theory*, University at Buffalo, New York
	Dec	Algebra Seminar, Institut de mathématiques de Jussieu-Paris Rive Gauche, France
2018	Apr	Algebra Seminar, University of Georgia
	Sep	Algebra Seminar, University of Georgia
	Dec	Combinatorics Seminar, Academia Sinica, Taiwan
2019	Jan	Algebra Seminar, University of Georgia
	Mar	AMS special session on *Representations of Lie algebras, algebraic groups, and quantum groups*, Auburn University, Alabama
	Sep	Algebra Seminar, University of Georgia
	Nov	AMS special session on *Geometric Methods in Representation Theory*, University of California, Riverside
	Nov	AMS special session on *Geometry and Representation Theory of Quantum Algebras and Related Topics* , University of California, Riverside
	Dec	Combinatorics Seminar, National Sun Yat-Sen University, Taiwan
	Dec	Combinatorics Seminar, Academia Sinica, Taiwan
	Dec	Colloquium, National Tsing Hua University, Taiwan
2020	Feb	Algebra Seminar, National Taiwan University, Taiwan