

# Rekha Biswal

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## Postdoctoral Affiliation

*Postdoctoral Fellow* (Nov 2016 - present)

Université Laval, Québec City, Canada.

Mentored by Michael Lau

*Visiting Scholar* (Aug - Oct, 2016)

Tata Institute of Fundamental Research (TIFR), Mumbai, India.

Mentored by C. S. Rajan

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## Doctoral Thesis

Title *Demazure Flags, Chebyshev Polynomials and Mock Theta Functions*

Advisor Sankaran Viswanath

Summary The  $\mathfrak{g}[t]$ -stable Demazure modules are of a lot of interest because of their connections to the representation theory of quantum affine algebras. These modules are indexed by a pair  $(\ell, \lambda)$  where  $\ell$  is a positive integer and  $\lambda$  is a dominant integral weight of  $\mathfrak{g}$  and are denoted as  $D(\ell, \lambda)$ . Naoi proves that for  $\ell \geq m$ ,  $D(\ell, \lambda)$  admits a level  $m$  Demazure flag for an arbitrary simple Lie algebra  $\mathfrak{g}$ . We discuss the level  $m$  Demazure flag of  $D(\ell, \lambda)$  for the current algebra associated to  $\mathfrak{sl}_2$ , and give a direct and constructive proof of Naoi's theorem in the case of  $\mathfrak{sl}_2$ . We also see how the generating series of numerical multiplicities of Demazure modules in the Demazure flag of local Weyl modules relates to Chebyshev polynomials and how the generating series of graded multiplicities of Demazure modules in local Weyl modules relates to Ramanujan's fifth order mock theta functions (surprisingly) in certain special cases.

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## Research Interests

Representation Theory of Lie Algebras, Number Theory, Combinatorics.

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## Education

2011-2016 **PhD in Mathematics**, *The Institute of Mathematical Sciences*, Chennai, India.

2006-2010 **Bachelor of Science and Bachelor of Education**, *Regional Institute of Education*, Bhubaneswar, India.

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## Awards and Fellowships

### Postdoctoral Fellowships.

- (In collaboration with CRM) Université Laval (2016), Québec City, Canada.
- Dean of Faculty Fellowship (2016), Weizmann Institute of Science, Rehovot, Israel (declined).
- Harishchandra Research Institute (HRI) (2016), Allahabad, India (declined).

### Other Awards.

- Selected for UGC-CSIR Junior Research Fellowship, July 2013.
- National Board of Higher Mathematics (NBHM) Ph.D Fellowship, 2011.
- National Board of Higher Mathematics (NBHM) M.Sc Fellowship, 2010.

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## Publications

### Published.

- Rekha Biswal and Ghislain Fourier; *Minuscule Schubert Varieties: Poset Polytopes, PBW-degenerated Demazure Modules, and Kogan Faces*, Algebras and Representation Theory, **18**, (2015), Issue 6, pages 1481-1503. (<https://arxiv.org/abs/1410.1126>)
- Rekha Biswal, Vyjayanthi Chari, Lisa Schneider and Sankaran Viswanath; *Demazure Flags, Chebyshev Polynomials, Partial and Mock Theta functions*, Journal of Combinatorial Theory, Series A, **140**, (2016), pages 38-75. (<https://arxiv.org/abs/1502.05322>)

### Submitted/In Preparation.

- Rekha Biswal, Vyjayanthi Chari and Deniz Kus; *Demazure Flags,  $q$ -Fibonacci Polynomials and Hypergeometric Series* (accepted for publication in Research in the Mathematical Sciences). (<https://arxiv.org/abs/1607.01069>)
- Rekha Biswal, Vyjayanthi Chari, Peri Shereen and Jeffrey Wand; *Demazure Flags for  $A_n^{(1)}$  case and Cone Theta functions* (in preparation).
- Rekha Biswal, Abdelkarim Chakhar and Xiao He; *Classification of rank two Lie conformal algebras*(in preparation).
- Rekha Biswal and Deniz Kus; *Schur functions, Dyck path statistics and graded multiplicities in Demazure flags*(in preparation).
- Rekha Biswal and Kailash C. Misra; *Limits of multiplicities in Excellent filtrations and tensor product decompositions for  $\mathfrak{sl}_n$* (in preparation).

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## Teaching Experience

May 25-29, 2016	Taught a short course on Topology to masters students and college teachers in the summer school at the Institute of Mathematical Sciences, Chennai, India
Winter 2013	Teaching assistant for Lie Algebra course at the Institute of Mathematical Sciences, Chennai, India
Summer 2013	Teaching assistant for Algebra course at the Institute of Mathematical Sciences, Chennai, India
Winter 2012	Tutor for Representation Theory course in Annual Foundation School at Chennai Mathematical Institute, Chennai, India
Apr-May, 2009	Worked as a teaching intern at DM School, Bhubaneswar where I taught Physics and Mathematics to students of Std. IX.

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## Academic Visits and Conferences Attended

### Academic Visits

- Visited North Carolina State University, Raleigh, USA for research collaboration with Prof. Kailash C. Misra. May 29 - June 11, 2017
- Visited University of California, Riverside for research collaboration with Prof. Vyjayanthi Chari. April 11 - June 11, 2016.
- Visited University of Cologne, Germany to work with the research group of Prof. Kathrin Bringmann and Prof. Peter Littelmann. June 22 - July 10, 2015.
- Visited University of California, Riverside for research collaboration with Prof. Vyjayanthi Chari. Jan 21 - March 22, 2015.

- Visited The Centre de recherches mathématiques (CRM), Montreal Canada. Apr 19 - May 19, 2014.

## Conferences

- *School and Workshop on Equivariant Combinatorics*, Centre de recherches mathématiques (CRM), Montreal, Canada, June 12-23, 2017
- *The 2017 Midwest Combinatorics Conference*, University of Minnesota, Minneapolis, USA, May 23-25, 2017.
- Workshop on *Mid-Atlantic Algebra, Geometry, and Combinatorics (MAAGC)*, Drexel University, Philadelphia, USA. May 5-6, 2017.
- Conference on *Texas-Oklahoma Representations and Automorphic forms VIII*, Oklahoma State University, Stillwater, Oklahoma, USA. March 31-April 2, 2017.
- Conference on *Combinatorial Algebra meets Algebraic Combinatorics*, Université du Québec à Montréal, Montréal, Québec, Canada, January 27-29, 2017.
- Conference on *Texas-Oklahoma Representations and Automorphic forms VII*, University of North Texas, Denton, TX, USA. April 8-10, 2016.
- *International Conference on Number Theory*, SASTRA University, Thanjavur, TN, India. Dec 21-22, 2015.
- Workshop on *Lie Groups, Lie Algebras and their Representations*, University of California, Riverside, USA. Feb 14-15, 2015.
- Workshop on *Combinatorial Representation Theory*, The Centre de recherches mathématiques (CRM) in Montréal, Canada. April 21-25, 2014.
- Workshop on *Hall and Cluster Algebras*, The Centre de recherches mathématiques (CRM) in Montréal, Canada. May 8-12, 2014.
- Lecture series on *Modular representations of algebraic groups* by Professor Peter Fiebig at The Institute of Mathematical Sciences, Chennai, India. October 6-19, 2013.
- Advanced Instructional School on *Chevalley Groups*, Indian Institute of Science Education and Research (IISER), Pune, India. July 2013.
- Lecture series on *Cohomological finite generation* by Professor Wilberd van der Kallen at The Institute of Mathematical Sciences, Chennai, India. June-Aug, 2013.
- Advanced Instructional School on *Commutative algebra*, Indian Institute of Technology (IIT) Madras, India. May 2013.
- Annual Foundation School III, Harish-Chandra Research Institute (HRI), Allahabad, India. July 2012.
- Lecture series on *Infinite dimensional Lie algebras* by Professor Vyjayanthi Chari at The Institute of Mathematical Sciences, Chennai, India. August 16-30, 2011.
- Annual Foundation School II, Panjab University, Chandigarh, India. July 2011.

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## Talks

### Conference Talks

- *Texas-Oklahoma Representations and Automorphic forms VII* (April 2016), University of North Texas, Denton, TX, USA.
- *International Conference on Number Theory* (December 2015), SASTRA University, Thanjavur, TN, India.

### Seminar Talks

- *Representation theory seminar*(2018), Ohio State University, Columbus, Ohio.

- *CAGE seminar*(Nov 16, 2017), University of Pennsylvania, Philadelphia, USA.
- *Combinatorics seminar*(Nov 3, 2017), Université du Québec à Montréal, Canada.
- *Algebra seminar*(Oct 11, 2017), University of Waterloo, Canada.
- *Algebra and Combinatorics seminar*(June 5, 2017), North Carolina State University, Raleigh, USA.
- *Algebra seminar* (October 2016), Temple University, Philadelphia, PA, USA.

## Other Contributions and Activities

- Participated in the Indian Women and Mathematics Symposium at The Institute of Mathematical Sciences, Chennai, India (Jan 8-10, 2012).
- Participated in the Indian Women and Mathematics Symposium at Indian Institute of Science Education and Research, Pune, India (July 26-28, 2013).
- Participated in Sage Days 60 at The Institute of Mathematical Sciences, Chennai, India (August 14-17, 2014).

## References

- Sankaran Viswanath
- Vyjayanthi Chari
- Kathrin Bringmann
- Michael Lau
- Kailash C. Misra