YANAGIDA, Shintaro Associate Professor

NO PORTRAIT

Office: Rm 441 in Sci. Bldg. A
Phone: +81 (0)52−789−5595 (ext. 5595)
Email: yanagida@math.nagoya-u.ac.jp
Web-site: http://www.math.nagoya-u.ac.jp/~yanagida/index.html

Membership of Academic Societies:
The Mathematical Society of Japan

Research Interest:

- Representation Theory
- Algebraic Geometry
- Mathematical Physics

Research Summary:

My research areas are algebraic geometry and representation theory, in particular the topics related to mathematical physics.

My interest in algebraic geometry is mainly on the derived category of sheaves on algebraic varieties. Two keywords may be named: Fourier-Mukai transforms and Bridgeland stability conditions. On these topics, I have co-authored papers [1] and [2].

My interest in representation theory is mainly on quantum algebras, in particular quantum groups, Hall algebras and vertex algebras. In [3], we investigated the quantum integrable system associated to Macdonald symmetric functions using representation theory of $\mathfrak{gl}_1$ quantum toroidal algebra (also called the Ding-Iohara-Miki algebra).

Since then, I have been studying the Macdonald polynomials, the family of orthogonal polynomials associated to each affine root system. In a recent collaboration [4] with the doctor student Kohei Yamaguchi-san, we studied the parameter specialization of Koornwinder polynomials, the Macdonald polynomials associated to $C^\vee C$ affine root system, and gave some classification and applications.

I am also interested in Hall algebras, which has an intimate relation with quantum toroidal algebras. In [5], I proved that Bridgeland's Hall algebra of complexes is in general the Drinfeld double of the corresponding Ringel-Hall algebra. In [6], together with the former master student Ryosuke Shimoji-san, we studied Toën's derived Hall algebra for the Jordan quiver, and showed that it has an infinite number of q-Heisenberg algebras as subalgebras.

As an intersection of algebraic geometry and representation theory, I have been studying geometric aspects of vertex algebras. In [7], I introduced the gluing construction of vertex algebras of class S in the derived setting, using the derived symplectic/Poisson geometry. In the recent preprint [8], I introduced an analogue of the canonical Li filtration of a vertex algebra for an arbitrary SUSY vertex algebra, and relate the representation theory of superconformal vertex algebras to the Poisson geometry of the associated superschemes.

Let me also mention a recent collaboration [9] with Professor Masahito Hayashi in this department and Professor Akihito Hora in Hokkaido University. This work has various aspects including

quantum information theory, asymptotic representation theory and the theory of hypergeometric orthogonal polynomials. My contribution lies in the last one, showing that a certain discrete probability arising from the classical SU(2)-S_n Schur-Weyl duality can be described by the Racah hypergeometric orthogonal polynomials.

Major Publications:

[1] S. Yanagida, K. Yoshioka, *Semi-homogeneous sheaves, Fourier-Mukai transforms and moduli of stable sheaves on abelian surfaces*, J. Reine Angew. Math. **684** (2013), 31–86.

[2] H. Minamide, S. Yanagida, K. Yoshioka, *The wall-crossing behavior for Bridgeland's stability conditions on abelian and K3 surfaces*, J. Reine Angew. Math. **735** (2018), 1–107.

[3] B. Feigin, K. Hashizume, A. Hoshino, J. Shiraishi, S. Yanagida, *A commutative algebra on degenerate CP^1 and Macdonald polynomials*, J. Math. Phys. **50** (2009), no. 9, 095215, 42 pp.

[4] S. Yanagida, K. Yamaguchi, *Specializing Koornwinder polynomials to Macdonald polynomials of type B, C, D and BC*, preprint (2021), arXiv:2105.00936.

[5] S. Yanagida, *A note on Bridgeland's Hall algebra of two-periodic complexes*, Math. Z. **282** (2016), Issue 3, 973–991.

[6] R. Shimoji, S. Yanagida, *A study of symmetric functions via derived Hall algebra*, Comm. Algebra **49** (2021), Issue 3, 979–1005

[7] S. Yanagida, *Derived gluing construction of chiral algebras*, Lett. Math. Phys. **111** (2021), Article no. 51.

[8] S. Yanagida, *Li filtrations of SUSY vertex algebras*, preprint (2021), arXiv:2111.05734.

[9] M. Hayashi, A. Hora, S. Yanagida, *Asymmetry of tensor product of asymmetric and invariant vectors arising from Schur-Weyl duality based on hypergeometric orthogonal polynomial*, preprint (2021), arXiv:2104.12635.

Education and Appointments:

2012	Ph.D. Mathematics at Kobe University
2012	JSPS PD at RIMS, Kyoto University
2012	Assistant Professor, RIMS, Kyoto University
2016	Associate Professor, Nagoya University

Message to Prospective Students:

Undergraduate students interested in algebraic geometry or (algebraic) representation theory will be welcomed. The reading seminar will be on standard texts such as the textbooks 1 and 4.

I also welcome graduate students who are willing to study Bridgeland stability conditions and related topics, or geometric representation theory of quantum algebras. For examples of particular topics, please see the books 2, 3 and 5 below.

1. R. Hartshorne, *Algebraic Geometry*, Graduate Texts in Mathematics **52**, Springer (1977).
2. D. Huybrechts, *Fourier-Mukai transforms in algebraic geometry*, Oxford University Press (2006).
3. D. Huybrechts, M. Lehn, *The geometry of moduli spaces of sheaves*, Cambridge University Press (2010).
4. T. Tanisaki, *Lie algebras and quantum groups* (in Japanese), Kyoritsu-syuppan (2002).
5. E. Frenkel, D. Ben-Zvi, *Vertex algebras and algebraic curves*, 2nd edition, Mathematical Surveys and Monographs **88**, American Mathematical Society (2004).