

Algebraic Lie Theory and Representation Theory

Date

2022年5月23日（月）から27日（金）まで

Schedule

	5/23	5/24	5/25	5/26	5/27
9:30–10:30	Scrimshaw	杉本	中塚	金久保	no talk
11:00–12:00	武中	浅井	王	林	no talk
13:30–14:30	板東	大谷	小原	森脇	和田
15:00–16:00	波多野	名古屋	McDowell	名古屋	中島

Program

5月23日（月）

Free discussion

9:25 Opening

（AM 座長：藤田直樹）

9:30–10:30 Travis Scrimshaw（大阪公立大学）

Crystal Invariant Theory

11:00–12:00 武中亮 Ryo Takenaka（大阪公立大学）

アフィンリー環のフェルミ型指標公式

Lunch break and Free discussion

（PM 座長：疋田辰之）

13:30–14:30 板東克之 Katsuyuki Bando（東京大学）

Geometric Satake equivalence in mixed characteristic and Springer correspondence

15:00–16:00 波多野幸平 Kohei Hatano（北海道大学）

Cohomology of conical symplectic resolutions

Free discussion

5月24日(火)

Free discussion

(AM 座長：内藤聡)

9:30–10:30 杉本祥馬 Shoma Sugimoto (九州大学)

Simplicity of higher rank triplet VOAs

11:00–12:00 浅井聡太 Sota Asai (大阪大学)

Non-rigid regions of real Grothendieck groups

Lunch break and Free discussion

(PM 座長：山内博)

13:30–14:30 大谷拓己 Takumi Otani (大阪大学)

A Frobenius manifold for ℓ -Kronecker quiver

15:00–16:00 名古屋創 Hajime Nagoya (金沢大学)

Special lecture 1: Irregular conformal blocks and Painlevé tau functions

Free discussion

5月25日(水)

Free discussion

(AM 座長：和田堅太郎)

9:30–10:30 中塚成徳 Shigenori Nakatsuka (University of Alberta)

Correspondence of hook-type W -superalgebras through relative semi-infinite cohomology functor

11:00–12:00 王起 Qi Wang (Yau Mathematical Sciences Center, Tsinghua University)

A symmetry of two-term silting quivers

Lunch break and Free discussion

(PM 座長：大矢浩徳)

13:30–14:30 小原和馬 Kazuma Ohara (東京大学)

On the formal degree conjecture for non-singular supercuspidal representations

15:00–16:00 Eoghan McDowell (Okinawa Institute of Science and Technology)

Determination of characters by their values on p' -classes

Free discussion

5月26日(木)

Free discussion

(AM 座長：柳田伸太郎)

9:30–10:30 金久保有輝 Yuki Kanakubo (筑波大学)

An algorithm for Berenstein-Kazhdan decoration functions on classical groups

11:00–12:00 林拓磨 Takuma Hayashi (大阪大学)

Sheaves of twisted differential operators over schemes

Lunch break and Free discussion

(PM 座長：廣惠一希)

13:30–14:30 森脇湧登 Yuto Moriwaki (理化学研究所)

A method for constructing conformal field theories using quantum groups

15:00–16:00 名古屋創 Hajime Nagoya (金沢大学)

Special lecture 2: Irregular conformal blocks and Painlevé tau functions

Free discussion

5月27日(金)

Free discussion

(PM 座長：阿部紀行)

13:30–14:30 和田堅太郎 Kentaro Wada (信州大学)

Schur-Weyl duality for shifted quantum affine algebras and Ariki-Koike algebras

15:00–16:00 中島俊樹 Toshiki Nakashima (上智大学)

Crystal structure on localized quantum coordinate rings

Free discussion

Abstracts

- 名古屋

In 2012, Gamayun, Iorgov, Lisovyy discovered a remarkable relation that the tau function of the sixth Painlevé equation is expressed as a series expansion in terms of a 4-point Virasoro conformal block with the central charge $c = 1$. It is natural to ask whether the other Painlevé tau functions enjoy similar property. We introduce irregular conformal blocks for the Virasoro algebra. They are defined as expectation values of irregular vertex operators. When $c = 1$, we give conjectures 1) a combinatorial expression of irregular conformal blocks of type (001), 2) tau functions of PV, PIV, PIII, PII are expressed in terms of irregular conformal blocks, and 3) classical conformal blocks ($c \rightarrow \infty$) exist. Finally, we also introduce irregular vertex operators for a super Virasoro algebra (Neveu-Schwarz-Ramond algebra).

- Scrimshaw

Crystal bases were introduced by Kashiwara and allows combinatorial methods to describe the structure of Lie algebra representations. Many of these descriptions can be described by piecewise-linear operators acting on an integer lattice. This can be lifted to rational actions on algebraic varieties, where they become the geometric crystals first given by Berenstein and Kazhdan. The Robinson-Schensted-Knuth (RSK) map can be considered as a map describing the decomposition imposed by Howe duality and yielding the Cauchy identity and has been lifted to an isomorphism of two different algebraic varieties that have natural geometric crystal structures. In this talk, we will show the geometric RSK is a $(GL_n \times GL_m)$ -geometric crystal isomorphism, which is a rational lifting of Howe duality. As a consequence, we can define a natural set of invariants under (subgroups of) the geometric crystal actions and discuss some properties about the corresponding rings. In particular, we see that the geometric R-matrices give a birational symmetric group action. This is based on joint work with Ben Brubaker, Gabriel Frieden, and Pavlo Pylyavskyy.

- 武中

$\tilde{\mathfrak{g}}$ を単純リー環 \mathfrak{g} に付随する $X_l^{(r)}$ 型のアフィンリー環とする. このとき, 可積分最高ウェイト $\tilde{\mathfrak{g}}$ -加群は頂点代数およびその加群によって実現される. L を \mathfrak{g} のルート格子, ν をディンキン図形の自己同型から誘導される L の自己同型とする. 特に L が偶格子であるとき, 可積分最高ウェイト加群 $L(k\Lambda_0)$ はそれぞれ格子頂点代数 V_L ($r = 1$) または ν -twisted 加群 V_L^T ($r > 1$) を用いて実現できる. 講演では, この構成法により twisted アフィンリー環に対する $L(k\Lambda_0)$, およびその主部分空間 $W(k\Lambda_0)$ の組合せ論的基底が得られることを説明する. また, 応用として $L(k\Lambda_0), W(k\Lambda_0)$ のフェルミ型指標公式が計算できることを紹介する.

- 板東

The geometric Satake correspondence is an equivalence between the category of equivariant perverse sheaves on the affine Grassmannian and the category of representations of the Langlands dual group. It is known that there is a mixed characteristic version of the geometric Satake correspondence. The Springer correspondence is a correspondence between the category of equivariant perverse sheaves on the nilpotent cone and the category of representation of the Weyl group. In this talk, we will explain some relation between these two correspondences, including the mixed characteristic case.

- 波多野

In this talk, I will introduce conical symplectic resolutions and symplectic dual. In 2015, Hikita conjectured that the cohomology of the conical symplectic resolution is isomorphic to the coordinate ring of the \mathbb{C}^* -fixed points of the affinization of the symplectic dual. Finally, I will explain Hikita's conjecture in the case of the framed moduli space.

- 杉本

The Triplet VOA is one of the most famous non semi-simple VOAs, defined as a subVOA of the lattice VOA associated with the rescaled A_1 root lattice. However, its ADE generalization (higher rank triplet VOA) has not been studied as much as the A_1 -type case, because the algebraic approach is not applicable due to its complexity. In this talk, I will explain that various fundamental properties of the higher rank triplet VOAs can be proved by using the geometric construction by Feigin-Tipunin.

- 浅井

This talk is partially based on joint work with Osamu Iyama. Let A be a finite dimensional algebra over a field. Then, the real Grothendieck group $K_0(\text{proj } A)_{\mathbb{R}}$ of the category of finitely generated projective modules can be identified with an Euclidean space. This Grothendieck group is useful in the study of silting theory. We can associate the presilting cone $C^+(U)$ for each basic 2-term presilting complex U in $\text{K}^b(\text{proj } A)$ by using the g -vectors of indecomposable direct summands of U . These presilting cones do not cover the real Grothendieck group in general, so we define the non-rigid region as the region where the presilting cones do not exist. The non-rigid region can be quite complicated, but we found that it can be described in terms of the basic 2-term presilting complexes and a certain closed set called the purely non-rigid region in our joint work (arXiv:2112.14908). Also, I determined the purely non-rigid region in the case that A is a special biserial algebra in my sole work (arXiv:2201.09543). I will talk about these two results.

- 大谷

有限型ルート系に対して、Weyl 群不変式論による Frobenius 多様体（平坦構造）の構成は古くから知られている。現在では、この構成が affine 型や楕円型のルート系、複素鏡映群の場合などに拡張されている。一方で、Frobenius 多様体は複素幾何やシンプレクティック幾何など様々な分野で登場する。これらの分野と表現論との対応を考える上で、不変式論による Frobenius 多様体の構成をより一般のルート系に拡張することが望まれている。本講演では、 ℓ -Kronecker 箴が定めるルート系に対して、Frobenius 多様体の構成を紹介する。本講演は、池田氏、白石氏、高橋氏との共同研究に基づく。

- 中塚

The hook-type W -superalgebras are interesting family of W -superalgebras whose maximal affine cosets enjoy the triality phenomenon and especially the Feigin-Frenkel type duality. In my talk, I will explain a reconstruction type theorem for hook-type W -superalgebras in the duality relation and some applications to their representation theory. This talk is based on my joint works with Thomas Creutzig, Andrew Linshaw and Ryo Sato.

- 王

Let Λ be a finite-dimensional algebra over an algebraically closed field and \mathcal{K}_Λ the perfect derived category of Λ . The silting quiver of Λ is a quiver whose vertices are (basic) silting objects in \mathcal{K}_Λ and arrows $T \rightarrow U$ are drawn whenever U is an irreducible left mutation of T ; it coincides with the Hasse quiver of the poset $\text{silt } \Lambda$ of silting objects in \mathcal{K}_Λ . In this talk, we explain a kind of symmetry on the silting quiver of Λ , which is induced by an algebra isomorphism $\sigma : \Lambda^{\text{op}} \rightarrow \Lambda$. In particular, put $(-)^* = \text{Hom}_\Lambda(-, \Lambda)$, we find that if $\sigma(e^*) = e$ for a primitive idempotent e of Λ , then the two-term silting quiver (\simeq the support τ -tilting quiver) of Λ has a bisection. This is joint work with Takuma Aihara.

- 小原

We prove the formal degree conjecture for non-singular supercuspidal representations based on Schwein's work proving the formal degree conjecture for regular supercuspidal representations. The main difference between our work and Schwein's work is that in non-singular case, the Deligne–Lusztig representations can be reducible, and the S -groups are not necessarily abelian. Therefore, we have to compare the dimensions of irreducible constituents of the Deligne–Lusztig representations and the dimensions of irreducible representations of S -groups.

- McDowell

Does knowing its values on p' -classes suffice to identify an ordinary irreducible character of a group? Here, a p' -class means a conjugacy class of elements of order not divisible by a prime p . In this talk I will discuss my recent work on this question for the alternating group A_n . I show, for $p \neq 3$, that all characters of A_n are uniquely determined by their values on the p' -classes, except for the pairs labelled by self-conjugate partitions with a diagonal hook length divisible by p . This implies that the rows of the p -modular decomposition matrix are distinct except for the rows labelled by the specified pairs. I show similar results for the double covers of the symmetric and alternating groups. I also demonstrate that the claim does not hold when $p = 3$ by exhibiting many additional pairs of characters which agree on $3'$ -classes.

- 金久保

Let G be a simply connected connected simple algebraic group and \mathfrak{g} be its Lie algebra. Fixing a reduced word \mathbf{i} of the longest element w_0 of Weyl group, one can define an embedding of crystals $\Psi_{\mathbf{i}}: B(\infty) \hookrightarrow \mathbb{Z}^{l(w_0)}$. The image of this embedding $\text{Im}(\Psi_{\mathbf{i}})$ ($\cong B(\infty)$) is called a polyhedral realization, which coincides with the set of integer points of a polyhedral convex cone called a string cone as a set. As a natural problem, we would like to find an explicit form of linear inequalities defining this cone. For this problem, we consider a regular function Φ_{BK}^h on G called a Berenstein-Kazhdan half decoration, which was introduced in the context of geometric crystals. There exists a morphism $\theta_{\mathbf{i}}$ from a split torus to G and $\Phi_{BK}^h \circ \theta_{\mathbf{i}}$ becomes a Laurent polynomial. It is known that computing $\Phi_{BK}^h \circ \theta_{\mathbf{i}}$ explicitly, we immediately obtain an explicit form of linear inequalities defining the cone. In this talk, we give an algorithm to compute $\Phi_{BK}^h \circ \theta_{\mathbf{i}}$ explicitly in the case \mathfrak{g} is a classical Lie algebra.

- 林

The theory of sheaves of twisted differential operators (tdos) and twisted D-modules on smooth algebraic varieties over fields of characteristic zero was introduced by Kashiwara and Beilinson–Bernstein. I and Januszewski established the theory of tdos and twisted D-modules on smooth schemes over general base schemes to construct arithmetic models of certain Harish-Chandra modules. In this talk, I review the classical theory of tdos on smooth algebraic varieties over fields of characteristic zero briefly. Then I explain the theory of tdos on smooth schemes over arbitrary schemes, based on a joint work with Fabian Januszewski.

- 森脇

There are various mathematical formulations of conformal field theory (physical theory). In this talk, we will introduce an algebra called a full vertex algebra, which describes an algebraic aspect of conformal field theory. As an example, we will also discuss a construction of full vertex algebras using quantum groups.

- 和田

A cyclotomic q -Schur algebra is a quasi-hereditary cover of an Ariki-Koike algebra (cyclotomic Hecke algebra associated with a complex reflection group of type $G(r, 1, n)$). In the case of classical q -Schur algebra which is a quasi-hereditary cover of an Iwahori-Hecke algebra associated with a symmetric group, it is known that the q -Schur algebra appears in the quantum Schur-Weyl duality for a quantum group and an Iwahori Hecke algebra. In this talk, we establish a Schur-Weyl duality for a shifted quantum affine algebra and an Ariki-Koike algebra. This duality is obtained from the quantum affine Schur-Weyl duality by taking a certain shift and a quotient. Then the cyclotomic q -Schur algebra appears in this duality.

- 中島

We will define a crystal structure on localized quantum coordinate ring for an arbitrary simple Lie algebra, which is obtained by the categorification for quiver Hecke algebras. We will also show that it is isomorphic to so-called "cellular crystal" associated with the longest Weyl group element.