

# Singapore-Hong Kong Glorious Sun Symposium on Representation Theory

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# Abstracts

## **Ext-groups of representations of $p$ -adic reductive groups**

Kei Yuen Chan

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One of the modern perspectives of the (categorical) Langlands program is to understand the whole category of smooth representations of  $p$ -adic reductive groups. The Ext-group is one basic invariant in understanding a non-semisimple category. In this talk, I will review some classical results in this subject such as Ext-vanishing theorems for discrete series and standard modules. Then I will report some recent results and applications of Ext-groups such as irreducibility of some parabolically induced modules and branching laws.

The talk is based on some separate joint/on-going work with Simeng Huang and Daniel Kayue Wong.

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## **A suggestion of a dimension equation**

Dmitry Gourevitch

*Weizmann Institute of Science, Israel*

We propose a “rule of a thumb” to determine whether a given period integral of an automorphic representation has a number-theoretic meaning, e.g. is Eulerian. Our rule is based on our recent works on multiplicities of small representations of real reductive groups in functions on non-spherical spaces, and on the formulas suggested by Friedberg and Ginzburg.

This is an ongoing project with Eitan Sayag.

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## On a braided monoidal Hall 2-category

Quoc Ho

*Hong Kong University of Science and Technology, Hong Kong SAR*

Appearing in various forms and flavors, Hall algebras play a crucial role in representation theory. In this talk, I will describe a new version of the Hall algebra construction whose output is a (braided) monoidal 2-category. This construction can be thought of as a twice-categorified version of the usual Hall algebra story. The resulting object is interesting and rich already when the input category is the category of finite-dimensional vector spaces over a finite field. Focusing on this example, I will explain why such an object is desirable from the point of view of categorified representation theory and low-dimensional topology. This is joint work in progress with Jonte Goedicke, Walker Stern, and Hu Yang.

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## Desiderata and uniqueness of local Langlands correspondence

Chi-Heng Lo

*Purdue University, USA*

The local Langlands conjecture predicts a "canonical" bijection between the set of smooth irreducible representations of a  $p$ -adic reductive algebraic group  $G$  and the set of enhanced  $L$ -parameter of  $G$ , known as the local Langlands correspondence (LLC). There are several constructions of LLC in the literature, either on specific types of groups or on special classes of representations. The comparison between different constructions of LLC is a non-trivial problem.

In this talk, I will introduce a list of desiderata of LLC for general quasi-split  $p$ -adic group  $G$ . Then, I will show that when  $p$  is sufficiently large, the LLC that satisfies these desiderata is unique (if it exists).

This is a joint work with Tasho Kaletha and Cheng-Chiang Tsai.

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## Extensions of Harish-Chandra modules and A-packets

Arvind Nair

*Tata Institute of Fundamental Research, India*

I will present some computations of Ext groups in the category of Harish-Chandra modules for representations which belong to Arthur packets.

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# Character theory at torsion elements of compact connected Lie groups

Dipendra Prasad

*Indian Institute of Technology, Mumbai, India*

The Weyl character formula, in principle, tells everything about characters of compact connected Lie groups. However, in practice, this is often not easy. In particular, character values at specific torsion elements have not been calculated, such as at elements of order 2, or at other torsion elements, or at other special elements, which sometimes have a beautiful structure. The lecture will discuss some of these matters.

This is joint work with Santosh Nadimpalli and Santosh Pattanayak.

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## Gluing cluster structures

Gus Schrader

*Northwestern University, USA*

Many interesting algebraic varieties appearing in representation theory (for example various kinds of surface character varieties, or subvarieties of simple Lie groups or their flag manifolds) are known to admit cluster Poisson structures. Given a geometrically defined birational map between two such varieties, it is natural to ask whether it respects the corresponding cluster structures in a suitable sense. I will explain a kind of 'gluing procedure' for certain special kinds of cluster structures, which leads to a positive answer to the question above for morphisms of character varieties associated to cutting a surface along a simple closed curve, and leads to a proof of the existence of a cluster structure on the BFN Coulomb branches for some quiver gauge theories.

Based on joint work with Alexander Shapiro.

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# **Braid group symmetries on Poisson algebras arising from quantum symmetric pairs**

Jinfeng Song

*National University of Singapore, Singapore*

Let  $U$  be a Drinfeld-Jimbo quantum group. De Concini-Kac-Procesi showed that  $U$  admits a remarkable integral form invariant under the Lusztig braid group action, whose semiclassical limit is isomorphic to the coordinate algebra of the dual Poisson Lie group. A quantum symmetric pair  $(U, U^i)$  consists of the quantum group  $U$ , and a coideal subalgebra  $U^i$ , called an i-quantum group, which vastly generalizes quantum groups.

In this talk, we show that the i-quantum group admits a remarkable integral form, invariant under the (relative) braid group action constructed by Wang-Zhang. Its semiclassical limit is isomorphic to the coordinate algebra of a Poisson homogeneous space. We further establish a PBW-basis for this integral form. After specialization, we obtain a family of polynomial Poisson algebras, equipped with braid group symmetries, including the celebrated Dubrovin-Ugaglia Poisson brackets. If time permits, we will discuss the connections with cluster algebras and quantum algebras at roots of unity.

This is based on joint work with Weinan Zhang (HKU).

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## **Real groups and Hodge theory**

Kari Vilonen

*The University of Melbourne, Australia*

I will explain how Hodge theory can be used in representation theory of real groups.

This is largely joint work with Dougal Davis.

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## **Level-rank dualities from d-Harish-Chandra series**

Ting Xue

*The University of Melbourne, Australia*

We explain a conjectural generalisation of Uglov's level-rank (Koszul) duality that arises from d-Harish-Chandra series introduced by Broué-Malle-Michel. We discuss connections with character sheaves for graded Lie algebras and Oblomkov-Yun's construction of rational Cherednik algebra modules using affine Springer fibres.

This is based on joint work with Minh-Tam Trinh.

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