The 9th Workshop on
Nilpotent Orbits and Representation Theory

Titles and Abstracts (as of 28 January 2010):

Noriyuki Abe (University of Tokyo)

Title: On extensions between principal series of complex semisimple Lie groups
Abstract: I will talk about extension groups between principal series representations of complex semisimple Lie groups. I will discuss 0-th extension group (a space of homomorphisms) and higher extension groups.

Tomoyuki Arakawa (Nara Women's University)

Title: Nilpotent orbits and Kac-Wakimoto admissible representations of Kac-Moody algebras
Abstract: According to Premet's conjecture proved by Losev, finite W-algeras have a deep connection with the theory of primitive ideals. I will talk about a chiralization (or an affinization) of this fact. Namely we clarify the connection between associated varieties of modules over Kac-Moody algebras and affine W-algebras.

We apply this result to (non-integrable) modular invariant representations of Kac-Moody algebras, called Kac-Wakimoto admissible representations. As a consequence we prove an important finiteness condition, called the C_2 cofinineess condition, for a large family of affine W-algebras, including all (non-principal) exceptional W-algebras recently discovered by Kac-Wakimoto. This gives a huge, new family of rational or logarithmic conformal field theories.

Dan Ciubotaru (University of Utah) and Syu Kato (Kyoto University)

Title: On formal degrees of discrete series of affine Hecke algebras of classical types, I, II
Abstract: We report the exact formula of the formal degree of discrete series of affine Hecke algebras of classical types for arbitrary positive real parameters. Such a formula was previously determined up to rational constants (depending on the discrete series) by the work of Opdam, Delorme, Slooten, Solleveld, and also complements the exceptional group calculation due to Reeder.

Our strategy (presented in [1,2]) is divided into four steps:

1) Determine the eDL parameters corresponding to discrete series;
2) Introduce a new family of affine Hecke algebra representations, which behave well under inductions and parameter specializations;
3) Determine the exact value of the formal degree in the asymptotic case;
4) Use 2) and the Opdam-Solleveld's theorem to show that the constant does not change at certain critical values.

We remark that our new family of representations contains discrete series (in some sense), but its general member is not even tempered.

In the first talk, we present an algorithm which gives 1) after recalling definitions of affine Hecke algebras, the (generic case of) eDL correspondence [3], and the effect of parameter spacializations.

In the second talk, we explain 2)–4) after recalling basics of formal degrees. If time allows, we explain its connection with the Plancherel formula of p-adic groups.

References

[1] Dan Ciubotaru, and Syu Kato, Tempered modules in exotic Deligne-Langlands correspondence, arXiv:0901.3918.
[2] Dan Ciubotaru, and Syu Kato, On formal degrees and W-structure of discrete series of affine Hecke algebras of classical types, in preparation (probably arXiv:1001.xxxx).
[3] Syu Kato, An exotic Deligne-Langlands correspondence for symplectic groups, Duke Math. 148 no.2 305–371 (2009).

Takeshi Hirai (Kyoto University, Professor emeritus)

Title: Projective representations and spin characters of finite and infinite complex reflection groups

Abstract: Let $G(m,p,n)$ be a complex reflection group and $R\big(G(m,p,n)\big)$ one of its representation group, and let $G(m,p,\infty)$ and $R\big(G(m,p,\infty)\big)$ be their inductive limits as $n \to \infty$. We study projective irreducible or factorial representations of $G(m,p,n), 4 \leq n \leq \infty$, and their characters, called *spin*. We talk in particular on the case of generalized symmetric groups $G(m,1,n)$ and also on limiting process as $n \to \infty$.

A representation group $R\big(G(m,1,n)\big)$ is a special kind of central extension of $G(m,1,n)$ by $Z = H^2\big(G(m,1,n), \mathbb{C}^\times\big)$, and so a projective irreducible or factorial representation π of $G(m,1,n)$ has its own spin type, a character χ of Z, such that $\pi(z) = \chi(z)I$. Specifying certain spin types, we would like to go into rather details.

The talk is based on joint works with A. Hora and E. Hirai.

Jing-Song Huang (Hong Kong University of Science and Technology)

Title: Jacquet modules and Dirac cohomology

Abstract: We show that Dirac cohomology of the Jacquet module of a Harish-Chandra module is a Harish-Chandra module for the Levi subgroup. We obtain an explicit formula of Dirac cohomology of the Jacquet module for most of the principal series, based on our determination of Dirac cohomology of irreducible generalized Verma modules with regular infinitesimal characters.

Fanny Kassel (Université Paris-Sud, Orsay)

Title: Deformation of compact quotients of homogeneous spaces

Abstract: Let G/H be a reductive homogeneous space. In all known examples, if G/H admits compact Clifford-Klein forms, then it admits "standard" ones, by uniform lattices of some reductive subgroup L of G acting properly on G/H. In order to obtain more generic Clifford-Klein forms, we prove that for L of real rank 1, if one slightly deforms in G a uniform lattice of L, then its action on G/H remains properly discontinuous. As an application, we obtain compact quotients of $SO(2,2n)/U(1,n)$ by Zariski-dense discrete subgroups of $SO(2,2n)$ acting properly discontinuously.

Sarah Kitchen (University of Utah)

Title: Localization of cohomologically induced modules to partial flag varieties

Abstract: The duality theorem of Hecht, Milicic, Schmidt and Wolf establishes a relationship between Harish-Chandra modules for a real reductive Lie group G that are cohomologically induced from Borels and $\mathcal{D}$-modules on the complex flag variety of G. I will present the corresponding results for partial flag varieties.

Hung Yean Loke (National University of Singapore)

Title: Compact dual pair correspondences for non-linear covers of orthogonal groups

Abstract: Let $M(p,q)$ denote of the universal cover of the connected orthogonal group $SO^0(p,q)$ where $p+q$ is odd. Savin and I studied the smallest representations of $M(p,q)$ that do not factor to $SO^0(p,q)$, based on the earlier papers of A. Knapp and P. Trapa. These representations are unitary representations and they are K-multiplicity free. In this talk, I will consider the compact dual pair $(M(p,a), Spin(b))$ where $a+b=q$, and explain the dual pair correspondences that arise from these smallest representations. In particular, the representations of $M(p,a)$ obtained are isomorphic to the irreducible subquotients of certain cohomological induced modules, generated by the minimal K-types. This is a joint work with Savin.

Hisayosi Matumoto (University of Tokyo)

Title: On a finite W-algebra module structure on the space of continuous Whittaker vectors for an irreducible Harish-Chandra module

Abstract: Let G be a real reductive Lie group. The space of continuous Whittaker vectors for an irreducible Harish-Chandra module has a structure of a module over a finite W-algebra. We have seen such modules are irreducible for groups of type A. We discuss further examples in this talk.

Hiroshi Naruse (Okayama University)

Title: A generalization of hook formula for arbitrary Coxeter group

Abstract: Usual hook formula counts the number of standard tableaux in terms of product of hook length of Young diagram. In this talk I will formulate and prove a generalization of the formula for arbitrary Coxeter group using equivariant cohomology and Schubert calculus techniques.

Kyo Nishiyama (Aoyama Gakuin University)

Title: Orbits on the multiple flag varieties for symmetric pairs

Abstract: Let us consider a symmetric pair (G, K), and consider a product X of partial flag varieties of G and K. In this talk, we establish general principles to study the finiteness of K-orbits on X. As an application we produce many examples of multiple flag varieties which have finitely many K-orbits. In a classical case of type A, we can even classify those multiple flag varieties. If time allows, we will discuss the relation to the theory of spherical varieties and moment maps.

This talk is based on a on-going joint work with Hiroyuki Ochiai (Kyushu University).

Hiroshi Oda (Takushoku University)

Title: Poisson transforms and graded Hecke algebras, I, II

Abstract: Let (G, K) be a Riemannian symmetric pair. The Poisson transform $\mathcal{P}_\lambda$ is a G-map from a spherical principal series representation $\mathcal{B}(G/P; \lambda)$ to $C^\infty(G/K)$. There are many works to construct those systems of differential operators on G/K which characterize $\operatorname{Im} \mathcal{P}_\lambda$. Above all, Johnson gives a unified method applicable to any G, although his systems are not so explicit. We generalize Johnson's method by the notion of single-petaled K-types so that it can produce many concrete systems (e.g. classical Hua operators for bounded symmetric domains). For the graded Hecke algebra $\mathbf{H}$ associated to (G, K), we naturally have analogous versions of Poisson transforms and their image characterization problems. A functorial correspondence of these analogies is also discussed.

Peter E. Trapa (University of Utah)

Title: Enhanced Kazhdan-Lusztig cells

Abstract: A few years ago, S. Kato introduced an exotic nilpotent cone (which may be viewed as a symmetric space version of a related enhanced nilpotent cone). Since then, these varieties have found important applications in the work of many people. This talk will review some of these results, and then turn to progress (joint with Anthony Henderson) on the classification of "enhanced" Kazhdan-Lusztig cells. These cells naturally appear in the geometric setting explained in Nishiyama's talk.

Joseph A. Wolf (University of California, Berkeley)

[Talk I]
Title: Geometry of the discrete series
Abstract: This talk describes the role of discrete series representations in harmonic analysis on real semisimple Lie groups. I'll discuss the underlying Harsh-Chandra theory of distribution characters of representations, tempered series of representations and the Plancherel formula. Then I'll discuss real group orbits on complex flag manifolds and the connection between discrete series representations and homogeneous holomorphic vector bundles over flag domains.

[Talk II]
Title: The Borel – de Siebenthal discrete series
Abstract: The Borel – de Siebenthal discrete series has a number of beautiful geometric properties. I'll describe the relation between the holomorphic normal bundle to a base cycle in the Borel – de Siebenthal flag domain, and the spectrum of a Borel – de Siebenthal discrete series representation along a maximal compact subgroup. I'll also indicate how one can compute explicitly here using the LiE program. Much of this is joint work with Bent Ørsted.