THE UNIVERSITY  OF HONG KONG

Institute of Mathematical Research
Department of Mathematics

International Workshop on Geometry and Representation Theory

4 - 6 November, 2013
Room 210, Run Run Shaw Building, HKU

Sunday, 3 November School and Workshop Excursion

Monday, 4 November

10:30 – 11:20 **Xuhua He** (Hong Kong University of Science and Technology and University of Maryland)

Minimal length elements: some applications in geometry and representation theory

Coffee / Tea Break

11:40 – 12:30 **Meng-Kiat Chuah** (National Tsing Hua University, Hsinchu)

Graph painting and Lie theory

School and Workshop Banquet

Tuesday, 5 November

10:30 – 11:20 **Fei Han** (National University of Singapore)

E_8-bundles and rigidity

Coffee / Tea Break

11:40 – 12:30 **José M. Mourão** (Instituto Superior Técnico, Lisboa)

$\mathrm{Diff}_C(S^1)$ in the context of the complexified Hamiltonian flows on T^*S^1 and the annulus semigroup of Segal

Wednesday, 6 November

10:30 - 11:20 **Graeme Wilkin** (National University of Singapore)

Moment map flows and the Hecke correspondence for quivers

Coffee / Tea Break

11:40 – 12:30 **Matthew Young** (The University of Hong Kong)

Hall modules with applications to quantum groups and moduli spaces

Lunch Break

14:00 – 14:50 **Nan-Kuo Ho** (National Tsing Hua University, Hsinchu)

Hitchin's equations over a nonorientable manifold

Organizer: Siye Wu

Abstracts

Meng-Kiat Chuah (National Tsing Hua University, Hsinchu)
Graph painting and Lie theory
Abstract: A painted graph is a graph whose vertices are white or black. We introduce a game based on an algorithm on painted graphs. As applications, we discuss related results in real forms, symmetric spaces and Lie superalgebras.

Fei Han (National University of Singapore)
E_8-bundles and rigidity
Abstract: An elliptic operator is called rigid if on a manifold with Lie group action its equivariant index is constant. Dirac operators coupled with E_8-bundles on spin or spin^c manifolds play a prominent role in string/M-theory. In this talk, I will discuss the rigidity property of these E_8 twisted Dirac operators and the proof by using Jacobi forms. This represents our joint work with Kefeng Liu and Weiping Zhang.

Xuhua He (Hong Kong University of Science and Technology and University of Maryland)
Minimal length elements: some applications in geometry and representation theory
Abstract: I will present some remarkable properties of minimal length elements in affine Weyl groups and their applications to representation theory and arithmetic geometry. Among other things, I will explain the "degree = dimension" theorem, which relates the degree of class polynomials of affine Hecke algebras and the dimension of affine Deligne-Lusztig varieties. As a consequence, we verify a conjecture of Gortz-Haines-Kottwitz-Reuman.

Nan-Kuo Ho (National Tsing Hua University, Hsinchu)
Hitchin's equations over a nonorientable manifold
Abstract: We study Hitchin's equations over a non-orientable manifold whose oriented cover is compact Kähler. Using the involution induced by the deck transformation, we show that the Hitchin's moduli space over a nonorientable manifold is Langrangian/Kähler with respect to the hyper-Kähler structure on Hitchin's moduli space over its orientable cover. We then establish a Donaldson-Corlette type correspondence which implies that the moduli space of flat connections over a nonorientable manifold is Kähler. Finally, we study Hitchin's moduli space via the use of representation varieties. This is a joint work with G. Wilkin and S. Wu.

José M. Mourão (Instituto Superior Técnico, Lisboa)
$\mathrm{Diff}_{\mathbb{C}}(S^1)$ in the context of the complexified Hamiltonian flows on T^*S^1 and the annulus semigroup of Segal
Abstract: In a neighborhood of the zero section of the tangent bundle TM of a real analytic Riemannian manifold (M, γ) there is a natural adapted Kähler structure. We will define the action of the formal complexification $\mathrm{Diff}_{\mathbb{C}}(M)$ of $\mathrm{Diff}(M)$ on the adapted Kähler structure. For $(M, \gamma) = (S^1, d\theta^2)$ we find explicitly the action of $\mathrm{Diff}_{\mathbb{C}}(S^1)$ and relate the orbit with the annulus semigroup of Segal. Applications to conformal field theory will be discussed.

Graeme Wilkin (National University of Singapore)
Moment map flows and the Hecke correspondence for quivers
Abstract: Narasimhan and Ramanan's Hecke correspondence for bundles over curves relates bundles of different degree via a Hecke modification over a point on the curve. In the 1990s, Nakajima used an analogous correspondence for quiver varieties (Hecke modifications of bundles over an ALE 4-manifold) to give a geometric construction of representations of affine Kač-Moody algebras and quantum affine algebras. In this talk I will give a different construction of the Hecke correspondence using gradient flow lines for the norm-square of a moment map. Similar methods also lead to gradient flow interpretations of Nakajima's Lagrangian subvariety and Kashiwara's operators on crystal bases.

Matthew Young (University of Hong Kong)
Hall modules with applications to quantum groups and moduli spaces
Abstract: I will begin by introducing the Hall module of an exact category with duality. This plays the role of the Hall algebra when objects of the category carry non-degenerate forms. Applied to the category of quiver representations, this construction produces representations of twisted quantum Kač-Moody algebras. I will also explain how Hall modules can be used to study arithmetic aspects of moduli spaces of self-dual quiver representations and principal bundles over curves.