CTQM Nielsen Retreat
11-15 October 2009, Sandbjerg Estate
ABSTRACTS

Henning Haahr Andersen

Fusion for tilting modules

The general problem of decomposing tensor products of tilting modules will be discussed both in the modular setting (representations of a reductive algebraic groups over a field of prime characteristic) and for quantum groups at roots of 1.

Jørgen Ellegaard Andersen

The Hermitian structure preserved by the Hitchin connection

The talk will introduce the general setting in which we know the explicit formula for the Hitchin connection. We will then analyse a Toeplitz operator formula for a Hermitian structure and derive sufficient conditions under which the Hitchin connection preserves this Hermitian structure. Finally, we will see that in the moduli space case, this condition is satisfied.

Therese Sby Andersen

Strongly multiplicity free modules

The notion of strongly multiplicity free modules for complex semisimple Lie Algebras and their quantum groups at non-roots of unity will be introduced. It will be discussed how tensor products of such modules decompose in the classical case as well as in the quantum case.

Matthew Bainbridge

Billiards,Teichmller curves, and real multiplication

ATeichmller curve is a finite volume hyperbolic Riemann surface X together with an isometric immersion $X \to M_g$, where M_g is the moduli space of genus g Riemann surfaces, equipped with theTeichmller metric. In this talk, I'll survey the theory of Teichmller curves, including connections with billiards in rational angled polygons and Abelian varieties with real multiplication, infinite families of examples of Teichmller curves due to Veech and Calta-McMullen, and recent results on the classification of Teichmller curves.

Dan Beltoft

Random Partitions in a Rectangular Box

We consider partitions contained in an $n \times m$ rectangle, subject to the probability distribution $P(\lambda) = q^{\text{area}(\lambda)}$ with $0 < q < 1$. Small diagrams have large probabilities, but large diagrams have 'strength in numbers'. Who will win? As n, m grow to inifinity, the rescaled process settles on a compromise with 'maximal entropy', the limit shape. I will go through the asymptotic calculations needed to prove this statement, and also look at the fluctuations of the process.

Johan Dupont

A generalization of Abel's Theorem and the Abel-Jacobi map

We generalize Abel's classical theorem on linear equivalence of divisors on a Riemann surface. For every closed submanifold $M^d \subset X^n$ in a compact orientedRiemannian n–manifold, or more generally for any d–cycle Z relative to a triangulation of X, we define a (simplicial) $(n-d-1)$–gerbe Λ_Z, the Abel gerbe determined by Z, whose vanishing as a Deligne cohomology class generalizes the notion of 'linear equivalence to zero'.
In this setting, Abel's theorem remains valid.
Moreover, we generalize the classical Inversion Theorem for the Abel–Jacobi map, thereby proving that the moduli space of Abel gerbes is isomorphic to the harmonic Deligne cohomology; that is, gerbes with harmonic curvature.

Vladimir Fock

Geometric quantization of cluster varieties

cluster varieties are algebraic varieties glued out of algebraic tori according to a certain combinatorial rule. Typical examples of cluster varieties are simple Lie groups, certain homogeneous and configuration spaces, moduli of local systems on Riemann surfaces and many others.A version of them carry a canonical closed 2-form, while another carries a Poisson structure. We are going to suggest a deformation quantization of the first one - construct a line bundle over it with a canonical connection and explain its relation to the deformation quantization of the second one in a certain sense generalising the Borel-Weil-Bott theorem.

Benjamin Himpel

A splitting formula for spectral flow and the SU(3) Casson invariant for spliced sums

We first introduce and discuss aspects of the SU(3) Casson invariant. This invariant belongs to the field of Chern-Simons gauge theory and counts the number of gauge equivalence classes of flat irreducible SU(3) connections. The SU(3) Casson Invariant does not behave well under spliced sums of homology 3-spheres. However, for splicings of complements of torus knots, Hans Boden and Chris Herald conjectured a formula relating the SU(3) Casson invariant to the SU(2) Casson invariant of the knot complements. The main tool for this is a splitting formula for the su(N) spectral flow of the odd signature operator (basically the Hessian of the Chern-Simons function) for 3-manifolds cut along a torus coupled to a path of SU(N) connections.
This is a project with Hans Boden.

Jane Jamshidi

Introduction to the jungle of administration

Funding is a necessity to produce research. To get funding you need documentation of previous results/publications and furthermore when you /have/ been spending the funds; you need to report back which results you have achieved. For these purposes AU has an excellent system for electronic registration, PURE. More than a registration system PURE can be used to promote your research projects and as a useful tool to convey your research results.

Magnus Roed Lauridsen

The AJ Conjecture from a Gauge Theoretical Viewpoint

The AJ conjecture relates two different knot invariants, namely the colored Jones polynomial and the A-polynomial. The approach we will use will be that of 2+1 dimensional Topological Quantum Field Theory. Indeed, the colored Jones polynomial is constructed in Reshetikhin and Turaev's formulation of a TQFT using quantum groups.
The A-polynomial is defined by a subvariety of the moduli space of flat SL(2,C) connections of a torus. Geometric quantization on this moduli space also gives a TQFT, and the correspondence between these provides a framework where the knot invariants can be compared.
In the talk I will sketch the above constructions and show how we can do explicit calculations for simple knots.
This is work in progress joint with J.E. Andersen.

Thomas Bruun Madsen

Torsion geometry and multi-moment maps

In the first part of the talk I will review the notion of torsion geometry. I will focus in particular on SKT manifolds, and present a recent classification of four-dimensional solvable Lie groups with an invariant SKT structure. On SKT manifolds we have a closed 3-form, and if the action of a Lie group preserves this 3-form, it is possible to construct a map similar to the moment map from symplectic geometry. This so-called multi-moment map will be the subject of the second part of the talk.

Johan Martens

Moduli of parabolic Higgs bundles and Atiyah algebroids

I will review the basic facts about Higgs bundles and their moduli spaces, focusing on their structure as an integrable system through the Hitchin map. After discussing Grothendieck-Springer resolutions for Lie algebras I'll introduce parabolic Higgs bundles, and show how their moduli spaces are naturally Poisson, equipped with an integrable system that combines features of the Hitchin map and the Grothendieck-Springer resolution. This is joint work with M. Logares.

Cristina Martnez

Calabi-Yau fibrations that are derived equivalent

I will report on joint work with A. N. Todorov, in which given a Calabi-Yau fibration by abelian varieties, we construct a dual fibration and we prove that both fibrations are derived equivalent, relating the result to SYZ mirror conjecture. I will discuss also Calabi-Yau fibrations by K3 surfaces, describing their categorical derived equivalent fibrations.

Nuno Miguel Romo

Moduli spaces of vortices and Grassmann manifolds

Vortices are configurations of fields for certain gauge theories in vector bundles over a Riemman surface S. For line bundles, the moduli spaces of these objects are modelled on the space of effective divisors on S with a fixed degree, but for more complicated targets (typical fibres) the situation becomes considerably more intricate. In my talk, I shall explain joint work with Indranil Biswas where we use Quot schemes to give a description of the moduli spaces of vortices with target $\mathrm{Mat}(rxn, C)$, for $n >= r$ and S closed. We show that the moduli spaces embed into Grassmannians and this gives rise to interesting geometrical questions. In the "local case" n=r, there is a neat description of the moduli spaces using Hecke modifications, which I will also explain if time permits.

Gor Sarkissiian

Canonical quantization of the WZW model with defects and Chern-Simons theory

I peform canonical quantization of the WZW model with defects and establish symplectomorphism between phase space of WZW model with N defects on cylinder and phase space of Chern-Simons theory on annulus times time-line R with N time-like Wilson lines.

Dezhen Xu

Graph configurations and the master equation

The "master equation package" of Sullivan is an algebraic structure where homotopy equivalences can be defined. We will give an example of the "master equation package" in the setting of configuration spaces.