QGM Retreat 2010
the Sandbjerg Estate 10-14 October
Programme

Sunday 10 October

15:00 Departure from QGM. We meet in the parking lot in front of bldg. 1530

17:15 Arrival at Sandbjerg

18:00 Dinner - (each evening at the same time)

Monday 11 October

08:00-09:00 Breakfast – (each morning same time)

09:45-10:45 **Vladimir Fock**: TBA

11:15-12:15 **Mario Garcia Fernandez**: Solutions of the strominger system via stable bundles on Calabi-Yau treefolds

12:15-13:00 Lunch

13:15-14:15 **Johan Martens**: Moduli of parabolic Higgs bundles and Atiyah algebroids

19:00-20:00 **Rasmus Villemoes**: A Brief Concept Dictionary

Tuesday 12 October

09:45-10:45 **Sergey Arkhipov**: Braid group action on the category of twisted D-modules on the flag variety

11:15-12:15 **Troels Agerholm**: Classification of categorifications and group actions on *A*-mod

12:15-13:15 Lunch

13:15-14:15 **Yusuke Kuno**: The Lie algebra of oriented chord diagrams

14.45-15.30 **Jane Jamshidi**: Administrative requirements for QGMs

18:00 Special Dinner

Wednesday 13 October

11:15-12:15 **Douglas LaFountain**: Convex surfaces and contact structures

12:15-13:00 Lunch

13:15-14:15 **Nuno Miguel Romão**: Vortices and Jacobian varieties

14:45-15:45 **Reza Rezazadegan**: The affine Grassmannian and link invariants

Thursday 14 October

09:45-10:45 **Benjamin Himpel**: An introduction to Reidemeister torsion and the Rho invariant with a view towards Chern-Simons theory

11:15-12:15 **Kim Frøyshov**: Instanton Floer homology

12:15-13:00 Lunch

13:15-14:15 **Hans-Christian Herbig**: TBA

14:30 ***- Departure -***

Mario Garcia Fernandez
Solutions of the strominger system via stable bundles on Calabi-Yau threefolds

We find solutions of a system of coupled non-linear differential equations, known as the Strominger system, which occur as consistency conditions in heterotic string theory. From a mathematical point of view, this system can be considered as a generalize-tion of the Kähler Ricci-flat equation for the case of non-Kähler Calabi-Yau manifolds. We prove that a given Calabi-Yau threefold with a stable holomorphic vector bundle can be perturbed to a solution of the Strominger system provided that the second Chern class of the vector bundle is equal to the second Chern class of the tangent bundle. If the Calabi-Yau threefold has strict *SU*(3) holonomy then the equations of motion derived from the heterotic string effective action are also satisfied by the solutions we obtain. This is joint work with Bjorn Andreas.

Johan Martens
Compactifications of reductive groups and moduli of framed bundles

Given a (complex) connected reductive group G, I will introduce a class of moduli problems for framed principal bundles on chains of projective lines. The corresponding moduli spaces provide compactifica-tions of the group, which in the case of G being a torus cover all toric orbifolds, and for G an adjoint group give its wonderful compactification. A side benefit of this approach is that it provides an orbifold wonderful compactification to any semi-simple group. This is joint work with Michael Thaddeus.

Rasmus Villemoes
A Brief Concept Dictionary

In this somewhat informal talk we will introduce and describe some of the basic objects studied at QGM and how these objects interact: Representation varieties, moduli spaces, holonomy functions, mapping class groups, and Dehn twists. Towards the end of the talk, we will give a simple example of how one may do actual computations with these concepts.

Sergey Arkhipov
Braid group action on the category of twisted D-modules on the flag variety

We recall the geometry of the Springer variety and of the Grothendieck variety for a simple algebraic group G. We show that universal twisted differential operators on the flag variety of G provide a quantization for the ring of functions on the Grothendieck variety. We recall the braid group action on the category of coherent sheaves on the Grothendieck variety due to Bezrukavnikov and Riche. Then we quantize the construction and define a braid group action on the category of universal twisted D-modules on the flag variety. We explain the notion of invariants for a categorical Braid group action and show that the category of U(g)-modules can be realized as the braid group invariants in the category of universal twisted D-modules on the flag variety. Finally we propose a conjecture for a similar construction in the case of the quantum group at a root of unity.

Yusuke Kuno
The Lie algebra of oriented chord diagrams

We introduce a bracket for two labeled chord diagrams on the circle as a formal sum of the diagrams created by the given two in a certain way, and show that this definition yields a well defined Lie algebra. I would like to start from some background, namely, the Goldman Lie algebra and Kontsevich's associative Lie algebra. These motivate us to study the center of our Lie algebra, which we can determine by a diagrammatic way. If time permits, I would like to mention an application for a computation of the center of the Goldman Lie algebra of a surface of infinite genus. This talk is based on a joint work with Nariya Kawazumi (the University of Tokyo).

Troels Agerholm
Classification of categorifications and group actions on *A*-mod.

Douglas LaFountain
Convex surfaces and contact structures

Convex surface theory is a natural and powerful tool used to study contact structures on 3-manifolds. In this talk we will first discuss definitions and properties of both contact structures and convex surfaces. We will then indicate how convex surfaces can be used to address classification problems in low-dimensional contact topology.

Nuno Romao
Vortices and Jacobian varieties

My talk will be concerned with the geometry of the moduli spaces of N vortices on a closed Riemann surface S of genus g > 1, for 1 =< N < g. I will start with an elementary account of the underlying gauge theory, focusing on the situation where the area of the surface is just large enough to accommodate N vortices, which I like to call the dissolving limit. The main theme of the talk is a beautiful relation between the geometry of the moduli spaces and the complex geometry of the Jacobian variety Jac(S) in this limiting situation. For N = 1, the metric on the moduli space converges to a natural Bergman metric on S. When N > 1, the vortex metrics typically degenerate as the dissolving limit is approached, and the degeneration occurs precisely at the critical locus of the Abel-Jacobi map of S at degree N; consequences of this phenome-non from the point of view of multivortex dynamics will be discussed. The basis for this talk is a joint paper with Nick Manton (arXiv:1010.0644) which has been written for a rather broad audience.

Reza Rezazadegan
The affine Grassmannian and link invariants

The topic of this talk is a method proposed by Kamnitzer for categoirifying the quantum link invariants which uses the affine Grassmannian. I will also talk about a possible way of implementing it.

Benjamin Himpel
An introduction to Reidemeister torsion and the Rho invariant with a view towards Chern-Simons theory

Reidemeister torsion and the Rho invariant are topological invariants for manifolds, which have an analytic definition equivalent to the original topological definition. We will discuss this and mention the relevance to Chern-Simons theory

Kim Frøyshov
Instanton Floer homology

After reviewing the classical definition of SO(3)-instanton Floer homology and some of its main properties, including some recent results of Kronheimer and Mrowka, I will go on to discuss my own ongoing work on applications to intersection forms of 4-manifolds with boundary.